Circular Australia

ENGINEERS AUSTRALIA

Engineering for Australia's Circular Economy:

A National Strategy

Circular Engineering White Paper

NOVEMBER 2025

THE UNIVERSITY OF SYDNEY

About this White Paper

This white paper is authored by Circular Australia's Chief Circular Engineer, a national role established to provide engineering leadership in advancing Australia's transition to a circular economy. Appointed by Circular Australia, the Chief Circular Engineer represents the engineering, systems, and infrastructure dimensions of circular transformation – connecting policy vision with technical delivery. This publication is the inaugural instalment of the Chief Circular Engineer White Paper Series, which will offer sector-focused, implementation-ready strategies to embed circularity into Australia's most material-intensive and high-impact systems. This 2025 edition focuses on waste and construction – sectors at the heart of Australia's built environment and responsible for a significant share of emissions, resource use, and economic opportunity.

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Acknowledgement of Aboriginal people

We acknowledge the traditional custodians of Country throughout Australia and pay our respects to Elders past and present, and to all First Nations peoples. We recognise our economic activities are on Aboriginal and Torres Strait Islander lands and waters and commit to inclusive, respectful and thoughtful collaboration to undertake sustainable economic practices.

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2. Foreword

Lisa McLean
Chief Executive Officer
Managing Director
Circular Australia

Circular Australia is pleased to release the 2025 inaugural *Chief Circular Engineer White Paper,* an important contribution to Australia's transition to a resilient and regenerative circular economy.

As Australia faces accelerating pressures on materials, waste systems, supply chains and biodiversity, and growing expectations for climate action - making circularity core business practice is not negotiable.

Circular Australia's mission is to accelerate the shift to a circular, climate-safe and prosperous Australia by 2035. Central to this mission is enabling the redesign of our systems, infrastructure and industries so materials are kept in use, waste is designed out, and natural systems are restored. This white paper aligns strongly with our priorities to embed circularity across the economy, activating circular precincts and infrastructure, new markets and value chains for critical materials, job creation, and systems innovation.

The appointment of Australia's first *Chief Circular Engineer*, a role initiated by Circular Australia, signalled our commitment to marrying systems-level vision with technical capability. This paper demonstrates why the role is essential. By outlining the design principles, standards, digital tools and engineering practices needed to operationalise circularity, the paper offers a clear pathway for implementation across the waste and construction sectors, two of the most material and emissions intensive parts of the Australian economy.

This work also reinforces that achieving a circular economy requires collaboration across policy, industry, research and community. Circularity is not a recycling agenda, it is a systems agenda demanding new business models, skills, governance structures, and a cultural shift in how we design, procure, operate and retire assets. We hope this practical blueprint helps engineers convert circular economy ambition into measurable outcomes.

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Chief Executive Officer
Engineers Australia

This paper arrives at a pivotal moment for our nation. As the peak body representing more than 140,000 engineers, Engineers Australia has consistently led the development and integration of circular principles in our economy.

In our advocacy to the government, we reinforce the urgency of engineering-led approaches, harmonised standards, and whole-of-system thinking as essential to lift Australia's circular material use rate and improve our national resilience. The appointment of Australia's first Chief Circular Engineer by Circular Australia and this inaugural white paper provides an important opportunity for national coordination, capability-building and implementation.

We are proud to support this white paper, which advances practical, evidence-based pathways to embed circularity across design, procurement, operation, and end-of-life decision-making. The paper reflects the values, direction and mission of Engineers Australia to shape a sustainable society through engineering excellence, supporting Australia's transition to a circular economy by 2035.

What distinguishes this white paper is its focus on engineering as the enabler of circularity, translating policy ambition into technical practices, standards, tools and professional capabilities urgently needed for engineers. This paper speaks to our profession's responsibility to lead cultural change - to design differently, collaborate across sectors, and treat materials and assets as long-term value streams. It asks engineers to apply systems thinking, identifying connections across energy, water, materials, mobility and industry and adopt the mindset of stewards, not just builders.

Engineers Australia welcomes this work and looks forward to collaborating with industry, government, academia and the broader engineering community to deliver the circular, sustainable and prosperous future outlined in these pages

3. Executive Summary

"This inaugural 2025 Circular Engineering White Paper sets forth a national engineering-led strategy to transition Australia's waste and construction systems to full circularity by 2040."

Prof. Ali Abbas
Chief Circular Engineer, Circular Australia

Australia stands at the threshold of a profound transformation in how it designs, uses, and recovers materials. Traditional 'take–make–dispose' models are failing in the face of growing waste volumes, resource constraints, and rising emissions. The construction sector alone generates ~29 million tonnes of waste annually[1] and consumes approximately 23% of Australia's raw materials. Cement and steel production account for up to 20% of industrial emissions. Yet only ~60% of total waste is recovered nationally, and circularity rates remain low.

At the same time, there is mounting pressure to address housing shortages, cost blowouts in construction, and critical material security, making circularity not only an environmental necessity but an economic imperative. This will require coordinated engineering innovation and policy reform, informed by both Australian priorities and global best practice. This paper calls for *Australia's waste and built environment systems* to *operate in closed loops, construction projects to design for disassembly, materials to be digitally tracked for transparent reuse, new circular engineering metrics,* and *'Materials productivity' to be core engineering and economic outcomes.* This engineering-led circular transition is supported by international benchmarks, and a comprehensive set of policy, infrastructure, cultural and innovation enablers.

This paper supports key targets set out in Australia's Circular Economy Framework to double Australia's circularity rate[2], the National Waste Policy of 80% average resource recovery by 2030,[3] state circular strategies, and the Circular Economy Ministerial Advisory Group (CEMAG) recommendations[4] for harmonised regulation, consistent data, investment in innovation, and a new Circular Economy Act.

This white paper puts forward a 2040 vision for circular engineering to drive Australia's economic resilience, innovation, and social well-being. To realise the vision, there are five key pillars:

1. Circular Design and Construction
2. Resource Recovery and Remanufacturing Systems
3. Policy and Standards
4. Culture, Skills and Capacity
5. Innovation and Digital Tools

This transition will create over 50,000 new jobs, increase the national resource recovery rate to 90%, cut embodied carbon in construction by 50%, reduce virgin material use by half, and position Australia as a global exporter of high-quality recycled materials and circular products. Indigenous communities will play a central role in stewardship and regional innovation

Engineers will lead this transformation. With design foresight, data intelligence, and cross-sector coordination, circularity can be embedded into the DNA of Australia's infrastructure and economy. This paper focuses on the technical and implementation roadmap in the construction and waste sectors, particularly the engineering systems, infrastructure development, standards adoption, and workforce transformation required to operationalise that agenda.

Leading economies are moving fast to adopt a circular economy through ecodesign and packaging regulations; targets (in the Netherlands) to halve primary raw materials use;[5] and circular development requirements at project inception.[6]

Australia can learn from and leapfrog these models by tapping our unique national strengths, from rich mineral resources fuelling a materials re-manufacturing boom, to Indigenous knowledge systems long embodied in circular principles of custodianship and sustainability.

4. Vision

2040 Circular Engineering Strategy:

A prosperous Australia where waste is eliminated, materials circulate indefinitely, and our built environment regenerates the natural environment.

The 2040 Circular Engineering Strategy vision is to deliver practical engineering solutions driving economic resilience, innovation, and social well-being. The strategy sets targets for a fully circular waste and construction system in Australia by 2040 with:

- **90% resources recovered**
- **95% construction & demolition (C&D) waste diverted from landfill**
- **30% reduction in virgin material use**
- **50% GHG reduction associated with C&D waste**
- **50,000 new jobs created, including regional areas**
- **0% organics to landfill**

These detailed targets are supported by key actions across five pillars, designed to deliver the outcomes below, including nearly all construction materials and products are reused or recycled at end-of-life, landfill is minimal, new buildings are conceived as "material banks" for the future, waste management has evolved into resource stewardship.

This vision aligns with and stretches Australia's commitments to the UN Sustainable Development Goals and the Paris climate targets, recognising that circular economy strategies are essential to achieving carbon-neutral and sustainable growth. The vision addresses the findings of the Productivity Commission's (PC), *Australia's Circular Economy Framework* and the *Circular Economy Ministerial Advisory Group* (CEMAG)'s *Circular Advantage* recommendations. It does this by proposing sector-specific engineering standards, digital material passports, and ISO 59020-aligned performance measurement, including embedding PC recommended metrics into infrastructure delivery.[7]

Targets by 2040

90%	95%	30%	50%	50,000	0%
Resource Recovery rate	C&D waste diverted from landfill	Reduction in virgin material	GHG reduction associated C&D	New jobs (incl. regional area)	Organics going to landfill

Pillars

1 Circular Design & Construction

- Design for disassembly, modular & prefabrication.
- Material passports & prioritise adaptive reuse.
- Minimise construction waste and use low impact materials.

2 Resource Recovery & Remanufacturing

- Invest in domestic infrastructure.
- Strengthen resource recovery & circular collection.
- Support innovation and localised solution.

3 Policies & Standards

- National CE framework, targets, & CE Act.
- Harmonised definitions & standards across states, EPR & public procurement.
- Circular KPIs, green economic incentives.

4 Skills, Education, & Culture

- Embed CE in engineering/trades education & CPD.
- Integrate Indigenous knowledge; promote public awareness.
- Foster innovation & community business.

5 Innovation & Digitalisation

- National CE data platform, AI, digital marketplaces.
- Pilot projects, living labs, and new circular business models.

Outcomes

- C&D waste reduction
- Materials banks from C&D for future usage
- New industry: Circular design consultants, deconstruction contractors, and reuse certification

- Demolition material increase in value
- Local recycling boost regional economy
- Australia become a net importer of waste by 2040

- Strategy embedded in the economy
- Uniform rules across states
- Boost investor confidences and international collaboration

- Trained circular economy workforce
- Community demand for CE, zero waste trend emerge
- Long term cultural shift and mindset across society

- Digital tools in material flow
- Marketplace for new business
- Continuous and future proof CE strategies

5. Achieving Australia's Circular Targets to 2035

This strategy directly aligns with the national direction set by the Circular Advantage report, authored by CEMAG. Where Circular Advantage outlines whole-of-economy priorities and cross-sectoral opportunities, this white paper provides a targeted, engineering-led implementation framework for waste, construction, and infrastructure transitions. The relationship between the two is one of complementarity - as outlined below: *strategy and vision on one hand* and *systems delivery and engineering action on the other.*

Achieving the Commonwealth Government's targets to double Australia's circularity rate by 2035 - will take strong collaboration and leadership from industry and governments. This strategy lays out a detailed plan to begin the essential reforms required to build a productive, sustainable economy for future generations, reducing carbon, protecting natural assets and creating the jobs and industries of the future. We invite you to provide feedback and join Circular Australia and Engineers Australia in this essential transition.

Relationship between CEMAG recommendations & Circular Engineering Strategy

	Circular Economy Ministerial Advisory Group (CEMAG) Recommendations	**Circular Engineering Strategy**
Framework	Whole-of-economy transformation	Engineering
Themes	Industry, Built Environment, Resources, Food & Agriculture	Construction & housing engineering roadmap, design standards, material recovery metrics
Contribution	Legislation, regulation, policy and harmonisation, Innovation, infrastructure and regional development funding	Engineering-led implementation pathway starting with construction and materials
Delivery	Implementing Circular Advantage recommendations & Australia's Circular Economy Framework	National Circular Engineering Strategy Delivery Guidance
Audience	Policymakers, ministers, industry	Engineers, project leaders, industry and regulators

6. The Context

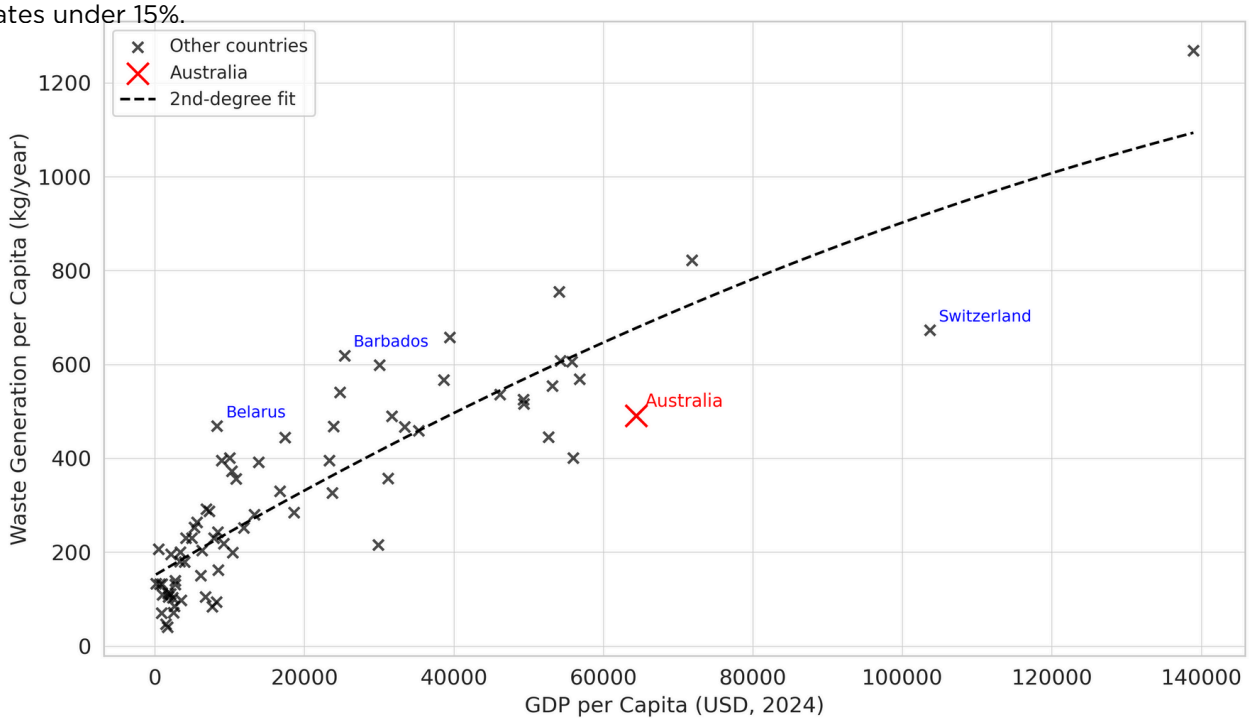
Our current linear economic model, where resources are extracted, turned into products, used, and disposed of, is unsustainable.

Australians are consuming resources at one of the highest rates in the world per capita, and waste volumes have steadily increased over the past decades, as the graph below shows. Landfill space is finite, and communities face the impacts of pollution and lost value. At the same time, global supply chains for key materials, from metals to timber, are under strain, exposing Australia to supply risks.

Engineers and policymakers are confronting the triple planetary crisis of climate change, biodiversity loss, and pollution, all of which are exacerbated by the linear economy. In this context, shifting to circular economic models is not optional; it is imperative. As of 2024, Australia reported over 75 million tonnes of waste annually, with the construction and demolition (C&D) sector alone accounting for ~45% of that volume (excluding mining). While overall recovery rates have improved to ~66%, large disparities remain between states and material streams. C&D materials are recovered at high rates in some jurisdictions (exceeding 80%), yet plastics, textiles, and complex composites continue to lag significantly, many with recycling rates under 15%.[1]

Circular practices such as modular design, digital material tracking, and reuse marketplaces remain nascent and largely uncoordinated. Although some policy momentum has emerged, currently no national legislative framework, harmonised metrics, or institutional owner is driving circular transitions across sectors. Australia's material circularity rate is now measured at 4.3% 2024[8] - well below national averages, reinforcing the need for urgent systemic intervention.

The PC inquiry into Australia's circular economy provides a complementary whole-of-economy perspective on policy, regulation, and market settings. The PC's interim findings[9] emphasise the need for nationally consistent targets, enhanced material flow data, and clearer definitions of key metrics such as circular material use rate (CMUR) and recovery rates. While the PC frames these as economy-wide imperatives, the engineering sector and particularly the waste and construction domains, will be essential in operationalising these metrics through improved materials tracking, reporting systems, and life-cycle design approaches.



Correlation between GDP per capita and Waste generation per capita (kg/year) for selected countries, highlighting Australia's position. There's a clear correlation between GDP per capita and waste generation per capita – and Australia is high on both measures. This tells us that high prosperity currently means high waste. Our collective mission is to break that link – to decouple growth from waste generation. That's where engineering-led solutions come in. *Source:* Compiled from World Bank and National Waste Report 2024 data.

7. Why Construction & Housing?

The construction and housing sectors sit at the heart of Australia's resource, environmental, and socio-economic challenges and present some of the most immediate and scalable opportunities for circular transformation.

Waste management, as the back-end of our economic system, reveals the full consequences of linear consumption. In 2022–23, Australia generated approximately 75.6 million tonnes of waste, of which 29 million tonnes came from the construction and demolition (C&D) sector,[1] making it the largest single waste stream. **While ~82% of C&D waste is currently recovered, most is downcycled into low-value uses like road base, and significant volumes still go to landfill, as the diagram below illustrates.**

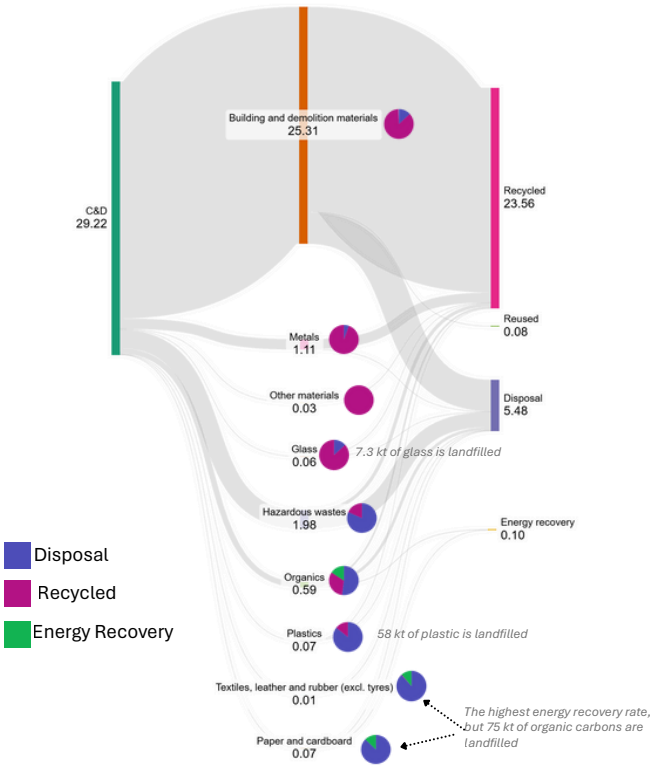
Improving recovery, reuse, and recycling rates offers immediate environmental returns, reduced pollution, lower landfill demand, and avoided embodied emissions. Meanwhile, the construction sector consumes approximately 23% of Australia's raw materials, including concrete, steel, aluminium, glass, timber, and aggregates.[10] Cement and steel production alone contribute up to 15–20% of[11] Australia's industrial emissions, making material circularity central to decarbonisation.

These pressures coincide with acute national priorities: a housing shortage exceeding 175,000 dwellings,[12] sharp rises in building costs (up over 30% since 2020 in some regions),[13] and supply chain vulnerabilities for imported materials like engineered timber, steel products, and plasterboard. Embedding circularity into construction – through adaptive reuse, modular and prefabricated systems, design for disassembly, and high-recycled-content materials – can reduce environmental burdens, enhance material efficiency, and offer cost and time savings.

Construction has both the highest waste generation and one of the highest recycling rates, suggesting there is already momentum and proven methods but to advance further, the focus must shift to waste avoidance and higher-order reuse by reducing over-ordering, reusing materials on-site, and designing buildings that generate less waste at end-of-life are next frontiers.

Critically, these are domains where engineers have direct agency: from structural and civil engineers optimising circular design, to materials and systems engineers scaling remanufacturing and local reuse networks. A circular approach to waste and construction not only aligns with climate goals and net zero targets, but also supports housing affordability, reduces dependency on global supply chains, and builds sovereign capability in critical materials and infrastructure delivery, placing circular engineering at the centre of solving Australia's most pressing infrastructure and social needs.

Sankey diagram of Australia's Construction and Demolition (C&D) waste generated in 2022–23, showing material-specific flows (in million tonnes) and their corresponding fates, accompanied by pie charts of fate distribution for each material (%)[1]



8. Challenges

Australia faces unique challenges in transitioning to a circular economy, but also distinct opportunities. Together, the factors below highlight that achieving circular economy engineering in construction and housing requires systemic change; stronger economic incentives, regulatory reform, design innovation, industry education, and infrastructure investment. Without addressing these interlinked challenges, Australia risks continued waste growth, lost economic value, and environmental degradation, missing the opportunity to create a resilient, low-carbon, resource-efficient built environment.

Rising waste generation, environmental impacts, economic barriers, regulatory constraints, and operational limitations collectively hinder circular practices. Total waste generation reached 75.6 million tonnes in 2022–23, a 20% increase over 15 years, with construction and demolition (C&D) waste surging 73%.[1]

Recycling rates have plateaued at around 60%, while disposal volumes continue to grow. This places considerable strain on recycling infrastructure, material recovery facilities, and local governments, highlighting the urgency of systemic circular interventions.[1]

The built environment is a major driver of resource use and emissions, accounting for one-third of Australia's resource consumption and nearly 40% of energy-related emissions when operational and embodied carbon are combined. Production of materials such as cement, steel, aggregates, and timber is resource-intensive and emissions-heavy, while C&D waste contributes roughly 38% of landfill inputs.[1] Addressing these impacts requires improved material efficiency, low-carbon alternatives, and reuse, yet technical, commercial, and cultural barriers remain. Landfill scarcity further exacerbates these challenges.

Community opposition to new sites and capacity limits in several jurisdictions increases reliance on effective recovery, while poor disposal contributes to methane emissions, leachate contamination, and landscape pollution. Export restrictions on unprocessed waste intensify domestic recovery demands, but infrastructure investment and coordinated policy support remain insufficient.

Economic incentives for circular practices are weak. Billions of dollars of recoverable materials are lost annually. Recycled aggregates can reduce road base costs by up to 83%, yet uptake is low. Landfill levies vary and are sometimes too low to incentivise reuse. Virgin materials often remain cheaper than recycled alternatives, particularly when externalities like carbon emissions or resource depletion are not priced. Analyses indicate that a circular economy could contribute up to $210 billion to GDP by 2048, but market,[15] regulatory, and procurement barriers prevent full value recovery.

Resource security is another concern. Australia relies on stable supplies of raw and critical materials. Circular strategies can reduce dependence on imports and enhance resilience, but domestic reprocessing of metals, glass, plastics, and engineered timber is uneven and under-scaled. Demand-side measures like reuse, repair, and recycling are essential but still developing in the construction sector.

Operational and cultural factors further impede circularity. Many builders, especially SMEs, are unaware of circular practices or perceive them as risky or costly. Logistics challenges, such as limited space on sites and mixed waste streams, reduce recovery efficiency. Regulatory and standards barriers create uncertainty over using high recycled content or reused components. Most buildings are not designed for disassembly, limiting reuse to downcycling, and regional or remote areas often lack recycling infrastructure, making local solutions necessary but logistically complex.

9. Opportunities

Australia's Unique Strengths

Australia brings distinctive strengths to the circular challenge. We have abundant mineral and metal resources, which, if coupled with world-class recycling technology, could position us as a global hub for secondary raw materials. For example, recycling lithium from batteries or recovering rare earths from electronics. We possess strong research institutions and an innovative engineering sector capable of developing new circular technologies, such as advanced material sorting or low-carbon concrete.

Moreover, Indigenous Australians hold 60,000+ years of knowledge in sustainable resource management – their principles of taking only what is needed, maximising use of resources, and regenerating the land align closely with circular economy ideals. Integrating Indigenous knowledge and partnering with First Nations communities can lead to place-based circular solutions and ensure the transition is culturally inclusive and just. According to Engineers Australia's submission to the Productivity Commission (Nov 2024), engineers are "essential enablers" in designing and governing circular systems and have called for the creation of a Chief Engineer role at the national level to lead this transformation formally.[14] Below the Bradfield City Centre the NSW Government embeds circular design and delivery, building a new circular future.

Policy Momentum

Governments in Australia have begun to lay the groundwork for circular economy. The National Waste Policy (2018 and Action Plan 2019) set targets like 80% average resource recovery by 2030 and reducing total waste generation per capita. Several states have circular economy or waste strategies. For example, the New South Wales (NSW) Government's *Circular Economy Policy Statement*, Victoria's *Recycling Victoria* strategy.

The federal government convened the *Circular Economy Ministerial Advisory Group* (CEMAG) in 2023–24. Its final report *The Circular Advantage*[4] outlines core recommendations and sectoral opportunities. The first key recommendation has been adopted with the release in 2024 of *Australia's Circular Economy Framework*.[2] It includes strong targets to double Australia's circularity rate by shrinking the per capita material footprint by 10%; lifting material productivity by 30% and safely recovering 80% of our resources. Other key recommendations to be adopted include a *Circular Economy Act*, harmonised cross-state rules, and investments in circular innovation are also essential to achieving This white paper builds on that momentum, providing the engineering detail and implementation pathways to operationalise such recommendations.

Bradfield City Centre by NSW Government designed and built as a circular city

10. Findings

Australia's current waste and construction profile presents both a warning and an opportunity. The warning is that trends of increasing consumption and waste will overwhelm our environment and nullify climate gains if left unchecked. The opportunity is that we have a robust foundation (e.g. high C&D recycling, proven policies in some states, emerging technologies) to build upon.

This national circular engineering strategy directly responds to the data, challenges and opportunities outlined on previous pages. Using the findings below, it charts a course to drastically improve outcomes with strategic objectives and actions to move from 63% recovery,[1] high-waste society to an 80-90% recovery, low-waste circular society in two decades, focusing on where it matters most, waste and construction.

High volumes, high stakes: Improving the national recovery rate from ~63% to 70% would keep an additional ~5 million tonnes of material out of landfills each year, equivalent to the weight of ~30 Sydney Harbour Bridges in materials.

Construction as low-hanging fruit: Construction has both the highest waste generation and one of the highest recycling rates, suggesting two things:

1. There is already momentum and proven methods in this sector to build upon (crushing, recycling, etc.)
2. To advance further, the focus must shift to waste avoidance and higher-order reuse. Reducing over-ordering, reusing materials on-site, and designing buildings that generate less waste at end-of-life

Policy works: States with sustained policy interventions (SA, ACT) perform far better. The data validates measures like landfill levies, container deposit schemes, organics diversion programs, and strong recycling targets. It indicates that a National Circular Framework, as recommended by CEMAG, could elevate lagging regions by sharing best practices and establishing minimum standards.[1]

Critical weak links: Plastics recycling is a glaring weak point in the system - important to address, especially given plastics' pollution impacts, with a majority of the C&D's plastic is disposed of. While not directly a construction waste issue (except plastic packaging and some construction plastics), it is part of the broader waste system context. Solutions like improved sorting, advanced recycling, and packaging product stewardship are essential.

Regional disparities: In remote and regional areas, recycling options for construction materials can be limited. Transporting heavy materials like rubble hundreds of kilometres may be uneconomical, so local reuse solutions are needed (like using crushed rubble in local roadwork). The Norfolk Island example shows that even remote communities can succeed. A new recycling facility there has led to an estimated recycling rate above the national average, but it required infrastructure and government support.

Regulatory and Standards Barriers: Some codes and standards do not explicitly allow or account for high levels of recycled content or reuse, which can make engineers and certifiers hesitant. While structurally, recycled materials can often perform as well, getting approval can be bureaucratic. For example, reusing steel beams from a building requires assurance of their properties (which might need standardised testing protocols).

Lack of Design for Reuse: Historically, buildings were not designed to be taken apart; they are difficult to deconstruct without damage (e.g. concrete is poured monolithically, and mechanical connections are not used). This makes actual component reuse low, most recycling is downcycling (crushing, melting) rather than reusing whole components, which would be more resource-efficient. Changing this requires design changes for benefits realised decades later, which is a hard sell without policy mandates or visionary clients.

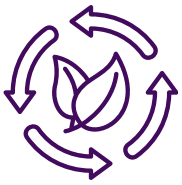
Data and Measurement: The process of compiling this baseline also highlights data gaps. We rely on the National Waste Report (which is biennial) and various state reports. Improved real-time data (potentially via digital tracking) will be needed to measure progress. Additionally, metrics like a *"circular material use rate"* have only recently started to be measured. Setting targets for these metrics will be essential to drive the transition.

11. Targets by 2040

The following targets measure progress toward the 2040 Circular Engineering Strategy:

Resource Recovery Rate

Increase the national resource recovery rate to 80% by 2030 (from ~63% in 2020–21) and to 90% by 2040. This implies a corresponding reduction of waste to landfill to under 10% of total waste by 2040. Interim targets include 70% by 2027 (which matches the National Waste Policy target for core waste excluding ash) and 85% by 2035.

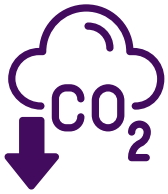


Virgin Material Reduction

Achieve a 30% reduction in the virgin raw material use in construction by 2030, and a 50% reduction by 2040 (relative to a 2025 baseline), through substitution with recycled content and extending the life of existing assets. This aligns with international benchmarks (Netherlands 50% by 2030 goal) and ensures Australia stays competitive in efficient material use.

Construction Demolition Waste

By 2030, ensure 95% of C&D waste is diverted from landfill (essentially zero avoidable C&D waste to landfill), up from ~84% today. By 2040, move beyond diversion to ensure at least 30% of recovered C&D materials are directly reused (not just downcycled) in new construction. This shift to reuse will be a key indicator of circular maturity. Eliminate the landfilling of organics (food and garden waste) by 2030



Greenhouse Impact

By 2040, cut the embodied carbon emissions of construction projects by 50% (vs 2020 levels), via circular practices and material innovation. This complements operational decarbonisation and is crucial for Australia's net-zero by 2050 pledge.

Public Sector Leadership

By 2030, 100% of Australian government (federal, state, local) procurement of construction and infrastructure will include circular economy criteria (such as minimum recycled content, design for disassembly requirements, and take-back provisions). Governments as major clients will drive market change through these demands.

Productivity and Jobs

Create over 50,000 new jobs in circular economy sectors by 2040 (e.g. recycling, remanufacturing, repair, circular design services). Many of these will be in regional areas, supporting a just transition.

12. Circular Engineering Pillars

The national Circular Engineering Strategy is structured around five key pillars to be implemented to 2040. They are outlined below:

Circular Design & Construction

Embed design for disassembly, modularity, material passports, and adaptive reuse into all major construction projects.

Resource Recovery & Remanufacturing Systems

Expand and modernise recycling infrastructure, especially for construction materials, organics, plastics, and e-waste, and scale up domestic remanufacturing.

Culture, Skills & Capacity

Equip engineers, workers, and communities with circular economy skills through education, CPD programs, and Indigenous knowledge integration.

Policy & Standards

Introduce a Circular Economy Act, harmonise landfill levies and definitions across states, and mandate green procurement and extended producer responsibility (EPR) schemes.

Innovation & Digital Tools

Leverage AI, data platforms, digital marketplaces, and material passports to optimise circular flows and enable real-time policy calibration.

12. CIRCULAR ENGINEERING PILLAR 1:

Circular Design & Construction

OBJECTIVE

Transform design and construction practices so that new buildings and infrastructure generate minimal waste throughout their life cycle and are easily deconstructed and repurposed at end-of-life. Move from linear design to circular design as the norm in the built environment.

Implement "Design for Disassembly" Standards: By 2026, develop guidelines and standards (through Standards Australia in collaboration with industry) for designing buildings and infrastructure that can be disassembled. This includes standardized connections (bolts, clips instead of welds or glues where feasible), using materials that can be separated (avoid composite materials that are inseparable), and planning for future adaptability. By 2027, incorporate these into the National Construction Code (NCC) or state building codes as best-practice requirements for large projects. For instance, mandate that any government-funded building above a certain size must submit a "circular design plan" demonstrating how major components (steel, facades, etc.) could be recovered at end-of-life.

Material Passports for Buildings: Encourage (and by 2030, require for large projects) the use of digital material passports for buildings and infrastructure. A material passport is a digital record that lists all key materials and components in a structure, along with their properties, quantity, and disassembly instructions. This facilitates future reuse or recycling. Through a digital platform (possibly an expansion of existing BIM – Building Information Modelling – systems), the passport can be updated through renovations and accessed during demolition to guide salvage. Pilot programs between 2026–2027 can refine the approach (e.g. a partnership with a major developer to create passports for a new commercial building and an infrastructure project like a bridge).

Modular and Prefabrication Push: Support the shift toward modular construction and off-site prefabrication, which tends to be more precise and generate less waste. Prefab components (like wall panels, bathroom pods) are built in factories where offcuts are easier to recycle and quality control reduces mistakes. Modular designs also lend themselves to being taken apart and reused. The strategy will provide incentives such as R&D tax credits or grants for modular construction techniques, and government projects should consider prefab options. By 2030, aim for 20% of new building projects (by value) to utilise significant prefabrication or modular methods.

Adaptive Reuse Prioritisation: It is often said, "the greenest building is one that already exists." Establish policies that favour retrofit and adaptive reuse of existing structures over new builds. Planning and zoning regulations can be tweaked to make it easier to repurpose old buildings (e.g. flexible zoning for mixed-use conversions, waivers on certain code requirements if safety is not compromised, etc.). Introduce a requirement that any proposal for demolition of a major building must include an adaptive reuse feasibility assessment. By 2028, target that at least 30% of major building works in cities are refurbishments/adaptive reuses rather than demolish-and-new-build, climbing to 50% by 2040. This extends building lifespans and avoids waste.

12. CIRCULAR ENGINEERING PILLAR 1:

Circular Design & Construction cont.

Construction Waste Minimisation Plans: Expand on existing waste management plan requirements for construction projects. All building and infrastructure projects above a threshold (currently $7.5 million under the Environmentally Sustainable Procurement Policy[16]) should prepare a Circular Construction Plan before starting. This would detail how the project will minimise waste (accurate ordering, modular sizing to reduce offcuts), segregate and recycle waste generated, and what recycled materials will be used in construction. Many government tenders already ask for waste management plans – this would bolster them to include more circular elements (e.g. committing to send unused materials to material exchanges or charities rather than landfill). Monitor compliance and outcomes from these plans, and feed results into best practice guides.

Encourage Use of Secondary and Low-Impact Materials: Promote materials that are renewable, recycled, or have lower embodied energy. Examples: use cross-laminated timber (CLT) or sustainably sourced timber in place of steel or concrete where feasible (since timber has lower embodied carbon and can be part of a regenerative forestry loop), use recycled aggregates in concrete and pavement, use reclaimed timber and bricks from old buildings in new projects (some state heritage grants encourage this for character). By 2030, set targets such as: All concrete used in government projects must contain at least 30% supplementary cementitious material (fly ash, slag, etc.) and 20% recycled aggregate; Asphalt for roadworks must contain at least 30% recycled material (reclaimed asphalt pavement, rubber, plastic); At least 10% of materials in new public buildings by value should be reclaimed or recycled content. These percentages can be tightened for 2040 as markets develop.

PILLAR 1:
Directly builds on CEMAG's recommendations to embed circularity into the built environment, offering a structured implementation pathway for standard-setting, materials tracking, and modular design. This paper deepens that vision with applied engineering tools such as digital material passports and disassembly-ready designs.

12. CIRCULAR ENGINEERING PILLAR 1:

Circular Design & Construction cont.

PILLAR 1 OUTCOMES:
if a building constructed in 2030 following these principles and reaches end-of-life in 2070, it might be completely dismantled and its steel, glazing, fixtures directly reused in other projects, with minimal actual waste. This future scenario is what Pillar 1 is engineering toward.

Expected Outcomes of Pillar 1: New construction will inherently produce less waste (through efficient design and prefab – likely reducing construction waste by 50% per project). Buildings will become material banks for the future, as their components can be identified and retrieved. By 2040, demolitions should be more aptly described as deconstructions – systematic harvesting of materials – rather than smash-and-dispose. The uptake of circular design will also create demand for new services: design consultancies specialising in circular architecture, deconstruction contractors (instead of demolition only), and certification services for reused components. Ultimately, this pillar aims to eliminate the concept of "construction waste" – what was waste becomes inputs for something else, enabled by thoughtful design.

Circular Design Playbooks for Priority Asset Classes: To accelerate sector-wide adoption of circular practices, targeted Circular Design Playbooks should be developed for priority asset classes. These playbooks will provide engineers, architects, and asset owners with practical guidance on design principles, material selection, specification updates, and end-of-life recovery strategies. Each playbook will be developed in consultation with industry and standards bodies to ensure technical viability, compliance, and scalability.

These playbooks can form a national resource for circular engineering in the built environment, serving as reference material for project design, procurement, and certification processes. By aligning with ISO 59004 principles and ISO 59020 measurement frameworks, the playbooks will also support consistent reporting and benchmarking of circularity performance across projects and jurisdictions.

Table 1: Summary of Priority Asset Class Playbooks

Asset Class	Circular Design Strategies
Schools / Hospitals	Modular, prefabricated construction systems; reversible connections; adaptable layouts enabling repurposing; design for flexible services and upgradeability.
Roads	Incorporation of recycled asphalt pavement; concrete aggregates from C&D waste; crumb rubber; polymer-modified binders from recycled plastics; lifecycle performance monitoring.
Bridges	High scrap-content structural steel; supplementary cementitious materials (SCMs) in concrete; bolted and demountable structural joints; corrosion protection to extend service life.
Commercial Buildings	Façade systems with replaceable panels; standardised floor grids; modular interior fit-outs; integrated material passports for major building components.

12. CIRCULAR ENGINEERING PILLAR 2:

Resource Recovery & Remanufacturing Systems

OBJECTIVE

Greatly expand and innovate Australia's capacity to collect, sort, and remanufacture materials, so that nearly all waste generated (especially construction and hazardous wastes) is efficiently captured and reprocessed into new materials or products. In essence, build a world-class circular economy infrastructure that underpins the material loops.

Invest in Advanced Recycling Infrastructure: With a combination of public funding, private investment, green bonds, substantially increase recycling and reprocessing facilities by 2030. Priorities include:

- **Construction Material Recycling Hubs:** Establish specialist regional hubs in each state for processing C&D waste to high-quality outputs. Hubs feature advanced sorting lines (to separate wood, metal, aggregates, plastics from mixed debris), crushers for concrete, and innovation such as automated de-nailing of timber or cleaning of brick for reuse. Co-locate in industrial areas where outputs (metals, aggregates) can feed local industries. By 2030, a min of one major hub operational in each state (in addition to existing facilities), with capacity to cater for construction sites 200 km from a recycling facility (to keep transport feasible).
- **Plastics and Chemical Recycling:** Ensure sufficient plastic reprocessing capacity onshore for all major polymers by 2025 (this is underway due to waste export bans). Introduce one or more chemical recycling or plastic-to-feedstock plants by 2030 to handle hard-to-recycle mixed plastics, complementing mechanical recycling.
- **Organics Treatment:** Every metro area to have large-scale composting or anaerobic digestion by 2026 (many already do), and expansion to smaller towns by 2030, enabling full coverage of food and garden organics processing. Compost is for agriculture and land rehabilitation, closing loops.
- **E-waste and Others:** Specialised facilities for electronics, batteries, solar panels, etc., to cater growing volumes. For example, support the establishment of battery recycling plants (Lithium-ion) by 2026 (some exist, like Envirostream in Vic) and scale up as EV uptake grows.
- **Waste-to-Energy (WtE) for Residuals:** Consider limited WtE for truly non-recyclable residual waste, ensuring it meets strict emissions and efficiency criteria. By 2030, a few plants might take remaining municipal waste that cannot be recycled, reducing landfill of that fraction. However, the strategy emphasises material recovery first and foremost.

Develop Domestic Remanufacturing Markets: Recycling only closes the loop if there's uptake of the recycled outputs in manufacturing new products. Coordinate with industry to integrate recycled materials into supply chains. Examples:

- Encourage cement and concrete producers to use more recycled aggregate and industrial byproduct through standards allowances and procurement.
- Work with plastic product manufacturers to incorporate locally recycled resins (the ReMade in Australia campaign by the government)
- Expand remanufacturing industries: e.g., facilities taking used construction equipment or building fixtures (doors, windows, fittings), refurbish them to like-new condition for resale. Government could procure remanufactured office furniture. Also, encourage automotive parts remanufacture and machinery (like a circular industrial park focusing on remanufacturing mining or agricultural equipment, which Australia's regional areas could host, adding jobs).
- Textile recycling for insulation or rags is part of a whole-systems approach

Support via incentives: e.g., reduced payroll tax or grants for companies that set up plants to make products from recycled feedstock. By 2040, aim for a diverse remanufacturing sector that has significantly reduced reliance on raw material imports (for example, producing construction materials like composite lumber from plastic waste, or insulation boards from textile waste).

12. CIRCULAR ENGINEERING PILLAR 2:

Resource Recovery & Remanufacturing Systems cont.

Strengthen Resource Recovery Regulations: Ensure that regulatory settings push materials towards recycling rather than landfill. Increase landfill levies progressively where needed (with safeguards for illegal dumping) to make recycling the financially obvious choice for businesses. Also, implement bans on landfilling particular materials that have strong recycling markets. For instance, many jurisdictions have or plan bans on landfilling whole tyres, e-waste, and large batteries – extend that. By 2030, consider bans on unprocessed C&D waste landfilled (i.e. require it to be sent to a C&D recycler first) and landfill bans on organics (like EU nations). These measures force development of alternatives. Work with industry to ensure bans are timed with available recycling capacity.

Circular Collection Systems: Redesign collection systems to better segregate waste at source, reducing contamination and enhancing recycling yields. For municipal waste: implement FOGO (Food Organics, Garden Organics) bins universally by 2025 so food waste is collected separately. Introduce options for kerbside collection of separated construction materials during renovations (e.g. council hard waste services that recover metal, e-waste). For construction sites: promote on-site separation (like separate skips for timber, metal, rubble) through education and possibly regulation for large projects. Alternatively, support third-party services that offer "bins with benefits" – they drop off multi-compartment bins and handle sorting off-site. By 2026, update waste contractor licensing to encourage or require a minimum recovery rate from mixed C&D waste (e.g. a facility must achieve at least 75% recycling from what it collects, or face penalties/higher fees).

Support Innovation in Resource Recovery: Not all materials have easy recycling solutions yet. This strategy allocates funds for R&D in tricky waste streams such as composites, ceramics, plasterboard, hazardous construction wastes, asbestos or drywall. Innovators (startups, universities) can pilot methods like using crushed glass and plastic in new composites, or extracting rare metals from electronic scrap more efficiently. Through challenges or grants (like a "Circular Innovation Fund"), develop at least 5 novel recycling technologies by 2030 and scale the promising ones by 2040. One example: research into recovering textiles and plastics from old carpet underlays or insulation materials – potentially turning them into new insulating products, thereby solving waste while producing useful goods.

Remote and Regional Solutions: Recognising geography, deploy special strategies for remote areas. This could include mobile recycling units (for example, a mobile crushing unit that can travel to a remote town after a building demolition to crush and grade material on-site for local reuse). Or create regional aggregation points where, periodically, materials are bulk-transported to main centres for processing. Provide financial support (grants) for local councils in remote Australia to set up small-scale resource recovery (like balers for recyclables, small composters, etc.).

Emphasise training and employing local Indigenous communities in these operations. As recommended by CEMAG, allocate grant funding specifically to support circularity in remote and very remote Australia (e.g. funding waste collection and reprocessing initiatives). By 2030, even remote communities should see a significant improvement – no community, however small, should be simply dumping all waste – there should be at least a baseline recycling/composting service available. Insights from Circular Australia's Productivity Commission submission[17] into circularity highlight the importance of embedding circular practices in remote and regional precincts through targeted infrastructure support and policy incentives. This reinforces the need for dedicated programs within this strategy to address regional circular equity.

Pillar 2:
This pillar operationalises CEMAG's call to build domestic remanufacturing capacity and regional reprocessing capabilities.

12. CIRCULAR ENGINEERING PILLAR 2:

Resource Recovery & Remanufacturing Systems cont.

PILLAR 2 OUTCOMES:
By bolstering resource recovery systems, Australia will ensure that once materials enter the economy, they remain in circulation much longer or indefinitely.

Expected Outcomes of Pillar 2: Landfill tonnages will plummet (helping hit the <10% to landfill goal). The value retention of materials will increase – for instance, rather than paying to bury demolition concrete, companies can sell it to recyclers; rather than incurring disposal costs for old steel beams, they might sell them for reuse. The expanded recycling sector will also contribute to regional diversification – recycling plants can often be set up in regional towns (near material sources or ports), contributing to those economies. By 2040, Australia should aim to be a net importer of waste for recycling – meaning our facilities are so developed that we can even take certain material streams from other countries (as a business opportunity and to ensure full utilisation of capacity). This flips the script from 2010s when we exported waste to Asia; by 2040, we could be the recycler of the Pacific, signalling true leadership.

Photo from Veolia ANZ

12. CIRCULAR ENGINEERING PILLAR 3:

Policy & Standards

OBJECTIVE

Establish a strong national policy framework, regulatory incentives, and standards that collectively drive the circular transition. This pillar provides the "rules of the game" that reward circular practices and remove barriers.

The PC's interim report underscores the economic and productivity benefits of harmonised regulation and target-setting. It recommends national-level targets for recovery, reuse, and circular material use rates, alongside reforms to remove regulatory barriers to secondary materials markets. This strategy adopts and extends these recommendations with an engineering lens – translating targets into project-level performance requirements, standardised tender specifications, and adaptive regulatory sandboxes for emerging recovery technologies.

Implement the CEMAG Recommendations outlined in Circularity Advantage Report including:

- Integrate circular economy principles into Australia's net zero decarbonisation transition in Australia's 2035 targets and sector plans
- Deliver innovation and research funding for circularity using a challenge-based approaches.
- Ensure policy settings recognise contributions of sector-based approaches to circularity beyond the Built Environment, including Retail & Consumer Goods, Food & Agriculture, Resources and Water.
- Make circular economy a Regional Development Australia priority supporting place-based circular economy transition brokers; funding for precinct innovation, advancing regeneration and restorative practices reflecting First Nations expertise.
- **Introduce a Circular Economy Act:** Introduce a Circular Economy Act that provides an overarching, integrated regulatory framework for the circular economy. Provide adequate resources at Commonwealth level for product stewardship and managing the circular economy. Consider mandating extended producer responsibility (EPR) and empowering regulators to enforce take-back, reuse and product stewardship. Consider establishing a dedicated authority or commissioner to provide long-term, bipartisan stability similar to climate legislation models.

Harmonise Definitions and Standards Across States: Coordinate across the Australian Building Codes Board (ABCB), Standards Australia and procurement councils to:

- Align national definitions (e.g. "waste", "recycled content", "product").
- Create consistent end-of-waste criteria to unlock secondary materials markets.
- Align landfill levies via a national levy floor to eliminate perverse interstate flows.
- Update material standards (concrete, steel, asphalt, glass) to allow specified recycled content.
- Develop national QA/QC protocols and recycled-content specifications for procurement.

The PC calls for nationally consistent definitions, minimum landfill levy floors, and standardised recycled-content specifications to stimulate investment in secondary materials markets. This aligns directly with the engineering requirements for predictable input quality, risk-managed procurement, and long-term infrastructure planning. This white paper builds on those recommendations by specifying engineering-relevant implementation steps, including updates to Australian Standards for concrete, steel, asphalt, and glass; harmonised QA/QC testing protocols; and procurement templates embedding recycled-content verification.

Economic Incentives and Signals: Strengthen economic signals through harmonised levies, targeted tax incentives for circular businesses, R&D credits for circular innovation, and sustainable finance mechanisms. Encourage banks to integrate circularity into green loan frameworks by 2025.

12. CIRCULAR ENGINEERING PILLAR 3:

Policy & Standards cont.

Strengthen EPR and Product Stewardship: Expand EPR schemes, which make manufacturers/importers responsible for end-of-life management of their products. Australia has some (e.g. for electronics through the National Television and Computer Recycling Scheme, for packaging via APCO, for tyres via Tyre Stewardship). Strengthen and broaden these:

- Make the Packaging Covenant targets legally binding by 2025 if voluntary progress falters.
- Introduce EPR for building products that are problematic: for instance, carpet tiles (some companies already take them back for recycling abroad; formalise that), photovoltaic panels and batteries (a scheme is in development).
- Ensure EPR schemes incentivise circular design – perhaps by modulating fees based on how recyclable a product is. For packaging, this is being attempted (eco-modulation of fees).
- Use EPR funds to subsidise collection and recycling infrastructure (e.g. paint industry has a scheme where a small levy on paint funds Paintback, a program that collects old paint for proper disposal/recycling).
- Expand EPR for major waste streams.
- Make packaging targets binding if voluntary progress stalls.
- Require EPR for problematic building products, PV panels, batteries, carpets and textiles.
- Adopt eco-modulated fees to reward recyclable design and use EPR funds to support collection and reprocessing infrastructure.

By 2030, any product category that significantly contributes to waste should have a stewardship scheme in place.

Expand Circular Procurement: Leverage the buying power of governments to create markets for circular products. By 2026, update procurement rules at federal and state levels to prioritise circular outcomes beyond recycling. For example:

- Harmonise procurement rules relating to circularity across Federal and State governments that support holistic, evidence-based improvement without unintended consequences
- Require tenderers for infrastructure projects to demonstrate circular economy integration (waste reduction, recycled materials), weight in scoring.
- Expand minimum recycled content requirements to include more items, including commonly purchased items (paper, construction materials for vehicles, etc.). The US and EU have such "recycled content laws" for public procurement.
- Prioritise higher order circular economy outcomes, e.g. suppliers offering product stewardship (companies that will take it back for refurbishing).
- Track and publish the outcome. e.g. "X tonnes of virgin materials saved, X tonnes of recycled material procured by the government this year" to show leadership. Aim for 100% of relevant contracts having CE criteria by 2030.

Introduce Circular KPIs in Governance: Integrate circular metrics (via ISO 59020) into corporate ESG reporting and government agency accountability. Require large organisations to report circularity indicators and departments to track waste, reuse and end-of-life asset management KPIs.

PILLAR 3: Detailed pathway to harmonise circular regulations, in line with CEMAG recommendations, using instruments such as a Circular Economy Act and ISO 59000 adoption.

Expected Outcomes of Pillar 3: By 2030, a clear directional shift should be evident: it will make economic sense for companies to design for circularity and to invest in recycling, because policies (like procurement and EPR) reward that behaviour. Australian businesses will operate under uniform rules across the country, reducing compliance burden and encouraging cross-state solutions.

The Circular Economy Act and national strategy will give confidence to investors and stakeholders that Australia is committed for the long haul, encouraging them to back long-term projects (some recycling facilities take years to pay off). Internationally, this will bolster Australia's reputation and allow us to collaborate as equals with EU and others on circular initiatives. Essentially, Pillar 3 creates the "level playing field" and pushes all actors towards circular choices by default.

PILLAR 3 OUTCOMES:
A robust policy environment will ensure that the circular strategy doesn't rely on voluntary goodwill alone, but becomes embedded in the operating fabric of the economy.

12. CIRCULAR ENGINEERING PILLAR 4:

Culture, Skills & Capacity

OBJECTIVE

Equip Australia's workforce, educational institutions, and communities with the knowledge and skills to drive and sustain circular economy practices. This pillar recognizes that technology and policy alone don't guarantee success – people do. It aims to foster a culture that values resource stewardship and to develop the human capital needed for new circular industries.

Engineering Education Curriculum: Update university and TAFE curricula to integrate circular economy principles into engineering and architecture programs. By 2025, every civil engineering, environmental engineering, and architecture degree in Australia should include coursework on sustainable design, materials life-cycle assessment, and circular economy strategies. Case studies on circular construction, waste reduction techniques, and regenerative design should be part of core courses. Collaboration can be done via Engineers Australia accrediting programs and working with universities. Develop vocational training modules for construction trades on waste-wise construction, material separation, etc.

Continuing Professional Development (CPD): Engineers Australia's CPD series "Circular Economy for Engineers" in 2025 should be expanded and made available widely (possibly a mandatory CPD topic over a certain period). Courses will provide practical insights, e.g. how to conduct a material circularity audit of a project, how to implement ISO 59010 strategies in a business. The CPD can be in partnership with Circular Australia, CSIRO, and international experts (to bring global best practice). By 2030, aim for thousands of engineers and built environment professionals to have undergone such training, seeding expertise across industry.

Community and Business Networks: Work with Circular Australia to build circular engineering networks, where practitioners share knowledge, host an annual Circular Engineering Economy Summit to bring together engineers, policymakers, community leaders to exchange practices and recognise achievements (awards for circular design etc.). Peer learning is powerful: a local council may be more open to implementing a circular program if they hear directly from another council that succeeded. By formalising these exchanges, knowledge spreads faster.

Trades and Workers Training: Aside from professionals, the thousands of workers on construction sites, in waste management, and manufacturing need skills to operate in a circular economy. Develop micro-credentials or short courses for:

- Construction site managers on waste minimisation and deconstruction techniques.
- Machine operators on new recycling technologies.
- Council waste managers on community recycling engagement.

The strategy could fund a Circular Skills Program that provides subsidised training for workers transitioning from declining industries (like fossil fuels) into recycling and remanufacturing roles – aligning with a Just Transition agenda.

Indigenous Knowledge Integration: Create partnerships with Indigenous communities to learn from and integrate traditional ecological knowledge and land management practices that align with circular principles. For instance, Indigenous rangers could lead initiatives in organic waste composting to regenerate soils (tying to traditional practices of returning nutrients to land). Support First Nations enterprises that apply circular approaches – such as businesses turning local waste into handicrafts or building materials. Include Indigenous representatives in the design of circular programs, acknowledging the stewardship role and perspectives that have existed for millennia. Possibly establish a "First Nations Circular Knowledge Hub" to formalise this exchange, ensuring respect for Indigenous intellectual property.

12. CIRCULAR ENGINEERING PILLAR 4:

Culture, Skills & Capacity cont.

Public Awareness Campaigns: Achieving a circular economy requires broad public participation – from diligent recycling to acceptance of refurbished goods to new consumption habits (like product-as-service models). Launch nationwide awareness campaigns by 2026 akin to past successful Australian campaigns (e.g. water conservation "Every drop counts" or anti-littering). Under a banner like "Circular Australia: Value What Matters", the campaign can use social media, community events, and school programs to emphasise:

- The value of resources ("don't treat it as waste, it's material for new things").
- Proper recycling behaviours (reducing contamination etc.).
- Promotion of repair and sharing (e.g. highlight the growth of repair cafes, tool libraries).
- Showcase positive stories: for instance, profiles of innovative Australian circular businesses or councils achieving high recycling.

By normalising these concepts, the culture shifts to one where throwing away usable materials is seen as odd or undesirable.

Innovation and Entrepreneurship: Encourage a startup culture around circular economy. Expand incubators and grants for entrepreneurs focusing on circular solutions (like apps for sharing surplus materials, or new products made from waste). By 2030, host challenge competitions (e.g. a Circular Economy Hackathon series) that engage young people in creating solutions for specific problems (like how to reuse coffee cups, or how to design waste-free festivals). This not only generates ideas but builds a community of innovators who see circular economy as an exciting frontier. The government can also provide seed funding (through CSIRO's ON program or others, including the emerging 'Deep Tech Innovation House' model by Scimita Group, co-founded by Prof. Abbas) to commercialise promising technologies developed in research (e.g. novel bio-materials, recycling methods and technologies).

PILLAR 4:
Aligns with CEMAG's skills roadmap, extending it specifically to the engineering and technical professions. Engineers Australia has launched a national continuing professional development (CPD) program titled "Circular Economy for Engineers" (2025) [39], delivered in collaboration with Circular Australia, aimed at upskilling engineers across all disciplines in circular principles, material efficiency, and ISO 59000 frameworks.

Expected Outcomes of Pillar 4: By equipping people with skills and awareness, the circular economy becomes self-propelling. Engineers entering the workforce by 2030 will inherently think in circular terms – leading to better designs and innovative solutions without needing external pressure. Construction crews will treat waste management as part of their craft, not an afterthought.

Consumers will increasingly demand circular options (e.g. products with recycled content, rental services, etc.), which in turn pushes businesses further. The cultural shift might manifest in trends like the popularity of second-hand building materials markets, or pride in communities that achieve "zero waste" certification. Importantly, new industries like remanufacturing and repair create employment that can absorb workers from sectors like mining as they automate or downscale, ensuring a just transition socially.

PILLAR 4 OUTCOMES:
Pillar 4 is a long-term play – culture and skills take time to build – but signs of progress should appear early: e.g. by 2025, seeing university design projects centred on circular economy, by 2030, having mainstream media celebrate circular successes (like how today tech startups are celebrated), and by 2040, an entire generation for whom circular is the default mindset.

12. CIRCULAR ENGINEERING PILLAR 5:

Innovation & Digital Tools

OBJECTIVE

Harness cutting-edge technology, data analytics, and innovative business models to optimise and accelerate the circular transition. Pillar 5 ensures that we are using the best tools available and continually improving the system through feedback and innovation.

National Circular Data Platform: Develop a digital platform (perhaps government-hosted in partnership with industry) that compiles and shares data on material flows, waste, and recycling in real-time. This could involve IoT sensors on bins, weighbridge data from facilities, etc., feeding into a central dashboard. Such a platform increases transparency – e.g. companies can see where excess materials exist, or recyclers can signal available capacity. A "material flow map" updated regularly can help identify bottlenecks or opportunities. By 2027, aim to have a live public dashboard of key metrics (recycling rates, landfill volumes, CMUR, LEF, SIS and MLI, etc, by region), which can engage citizens and researchers, and an analytical backend for planners to do scenario analysis (e.g. what if we build another MRF here, how will flows change?).

Digital Marketplaces for Secondary Materials: Support the creation and scaling of e-commerce style platforms for buying/selling secondary materials. Whether it's leftover construction materials, recovered components, or recyclate like pellets and aggregates, these platforms connect supply with demand. Some exist (Gumtree and Facebook marketplace informally, and specialised ones for construction in certain states). Government can help by endorsing them, listing its own surplus materials for sale (leading by example), or even mandating that publicly funded projects first check these marketplaces before buying new. The goal is that by 2030, whenever a project manager needs a certain material, they check the "reuse marketplace" as routinely as they check hardware suppliers, because it's known that you might find what you need at a lower cost and environmental impact.

AI and Smart Collection: Encourage waste management firms and local governments to deploy smart bins and AI sorting to improve efficiency. Smart sensors can signal when collection is needed (optimising routes, saving fuel). AI-equipped robots in recycling facilities (already emerging) can pick contaminants or sort materials faster. By 2030, all new recycling facilities above a certain size should incorporate advanced automation to maximise recovery (with support via grants if needed). Also, explore AI in demolition – e.g. using drones or scanning tech to quickly inventory materials in a building slated for deconstruction, tying into the material passport concept.

Monitoring and Adaptive Management: Use the wealth of data and experience from above to adapt strategy over time. Establish a formal feedback mechanism: for instance, a biennial "State of Circular Economy" report (beyond just waste) analysing progress, obstacles, and emerging trends. Use scenario modelling tools (drawing on the national data platform) to test if current actions are sufficient for targets, and adjust accordingly. For example, if by 2028 the data shows plastics still lagging badly, perhaps it triggers a policy update or a tech investment in that area. This dynamic management ensures the strategy remains on track amid changing circumstances (economic growth, new tech, etc.).

PILLAR 5:

CEMAG identifies data and digital infrastructure as enablers; this pillar goes further by proposing digital material passports, AI-enabled tracking, and national interoperability standards.

12. CIRCULAR ENGINEERING PILLAR 5:

Innovation & Digital Tools cont.

Innovation Pilots and Living Labs: Dedicate funding to pilot innovative circular solutions in real-world settings (living labs). For example:
A precinct-scale material loop: pilot a "circular precinct" in a city or eco-industrial park where multiple buildings and businesses share resources (one's waste heat warms another, a shared logistics centre handles all waste and recycling with high tech, industrial ecology resource integrations).
Circular Economy Technology Hubs (Place-based piloting facilities) to support startups, SMEs and corporates working on circular products and process technologies. These hubs leverage partnerships with research organisations. An example is the Clean Tech Sandbox concept by Prof. Abbas (Chief Circular Engineer), proposed for regional NSW for scaling up innovations.
3D printing using recycled materials: support projects that use construction waste (plastic, glass, concrete) as feedstock for 3D-printed street furniture or even building components.
Blockchain for material traceability: pilot using blockchain to track a batch of recycled plastic from collection through to new product to verify recycled content claims, improving trust in recycled materials. A National Digital Traceability Stack will integrate global product identifiers (e.g., GS1) with machine-readable material attributes such as grade, recycled content, embodied carbon, and service life. These identifiers will feed into material passports for buildings and infrastructure assets, enabling ISO 59020-compliant reporting and residual value assessment for recovered components. 5-10 key pilots by 2028 allow experimentation and showcase possibilities. Successful pilots can be scaled up or replicated commercially.

Support New Circular Business Models: Beyond technology, innovation in business models is crucial. Promote models like:
Product-as-a-Service (PaaS): e.g. lighting as a service (where a company retains ownership of lighting equipment and ensures it's upgraded and recycled), construction equipment sharing (instead of each contractor owning a full fleet), or "building services" instead of selling materials (some companies exploring leasing facades or elevators).
Sharing and Peer-to-Peer: support community initiatives (with small grants or platform development) for the sharing economy in areas like tools, appliances, even space (e.g. platform for sharing vacant building space as suggested in Swedish context).
Reverse logistics services: startups that handle take-back of materials from end-users back to recyclers (like integrating with e-commerce for product returns to recycling).

Potentially use challenge grants: e.g. an annual Circular Economy Innovation Challenge where winners get funding to develop their business concept. This will inject dynamism and attract entrepreneurs to the circular economy field. We want to see circular startups scale up and become mainstream companies by 2040.

PILLAR 5:
CEMAG identifies data and digital infrastructure as enablers; this pillar goes further by proposing digital material passports, AI-enabled tracking, and national interoperability standards.

PILLAR 5 OUTCOMES:
Technology and innovation will amplify the impact of all other pillars.

Expected Outcomes of Pillar 5: Efficiency gains from digitalisation can reduce costs – important for circular practices to become economically favourable. For instance, smart routing can cut waste collection costs, making recycling services cheaper. Marketplaces will reduce waste by finding uses for materials that would be skipped. New business models may significantly shift consumption patterns – e.g. if product-as-a-service takes off, manufacturers have incentive to make products last and be recyclable, solving multiple issues at once.

By 2040, one can imagine highly optimised circular flows: AI systems managing waste in cities like an "urban mine," plucking materials for reuse or recycling with minimal human intervention, guided by the data in material passports and market demand. Innovation also future-proofs the strategy – as new challenges arise (like novel materials or consumption habits), the culture of innovation will meet them with new solutions rather than letting them become problems.

13. Metrics

How do we gauge if we're catching up with global leaders? Setting measurable targets is essential for tracking circular economy transitions. Globally, governments and institutions are increasingly adopting a common suite of indicators to benchmark performance. These include:

Resource productivity: GDP per unit of domestic material consumption. This metric reflects how efficiently an economy uses materials to generate value. The EU has nearly doubled its resource productivity since 2000 - Japan and South Korea also report strong gains. Comparatively, Australia is material-intensive, highlighting the need to decouple growth from resource throughput.

Recycling rates of key waste streams: The EU municipal waste recycling average sits at ~50%, with Germany exceeding 67%. Australia's national municipal recycling rate is slightly higher at ~55% but varies widely by jurisdiction and waste type. Many EU countries recycle >85% of Construction and demolition (C&D) waste, and this is where Australia performs relatively well – some states (e.g. South Australia, ACT) report >80% C&D waste recovery, approaching EU leader benchmarks.

Landfill dependency: Countries like the Netherlands, Germany, and Sweden send <1% of waste to landfill, enabled by high recycling rates and waste-to-energy capacity. In contrast, Australia still landfills nearly 40% of core waste, with over 500 landfills nationally – a legacy of dispersed infrastructure and historically low landfill levies.

Circular material use rate (CMU): This metric tracks the share of total material inputs that come from recycled materials. The EU reports a CMU of 12.8% (2020)[18], with the Netherlands approaching 30%. Australia has just begun measuring CMU rates which are well under the EU rate of ~12%. Australia's CMU rate is particularly low in construction, metals, and plastics. Improving this figure is critical for sovereign supply resilience and emissions reduction, particularly for resource-intensive sectors like construction. International data shows a positive correlation between GDP per capita and waste generation per capita, with Australia performing above the global trendline.

Circular economy business activity: A growing number of countries are monitoring the share of business revenues from circular products and services – such as repair, refurbishment, leasing, or resale. In the Netherlands, over 20% of SMEs report offering circular business models. This metric signals whether circularity is becoming economically embedded, beyond compliance.

Benchmarking against these metrics enables Australia to calibrate its ambition and chart a credible path to circular leadership. For example, national targets such as an 80% total recycling rate by 2030 (already achieved in South Australia for certain streams), a >90% C&D waste recycling rate by 2040, and a 50% reduction in virgin material use in construction by 2040 would align Australia with leaders like the Netherlands and Finland.

Critically, these metrics also connect to broader engineering and industrial systems, enabling engineers, policymakers, and businesses to track transformation in material flows, infrastructure performance, and economic value creation. With these metrics, it's possible to embed and track circularity to break the link between economic prosperity and waste output.

14. Recommendations

Australia's transition to a circular economy by 2040 requires coordinated action across design, materials, policy, skills, culture, technology, and innovation. The recommendations that follow are designed to be actionable, ambitious and internationally aligned, while firmly grounded in Australia's economic, social, environmental, and legislative context.

The recommendations are not final blueprints, but national conversation starters. Through broad engagement and iterative refinement, the recommendations can evolve into a coherent national action plan positioning Australia as a world leader in circular economy and enabling implementation by 2040.

The recommendations are intentionally framed to initiate broad dialogue and collaborative refinement across all sectors: *government (federal, state and local), industry leaders, the engineering profession, the construction sector, manufacturers, waste and recycling organisations, educators, regional and remote communities, the technology and innovation ecosystem, and First Nations partners* whose custodianship knowledge is essential to a regenerative circular transition. Collectively, the recommendations aim to translate vision into on-the-ground outcomes: high-value jobs, strengthened domestic manufacturing, thriving regions, innovation-led industries, reduced waste, and the regenerative use of resources.

1. Circular Design & Construction

Recommendation 1.1
Adopt National Circular Design Standards. Launch national circular design guidelines and standards for all major construction projects, covering measures like design for disassembly, modular construction, material passports, and use of reclaimed components. By 2027, integrate these requirements into the National Construction Code and relevant infrastructure standards, including targets for minimum reused or recycled content in new projects.

Benchmark
Leading economies are moving in this direction – the EU is introducing new circular design regulations, and international standards (ISO 59000 series) now provide common frameworks for circular design and terminology. Aligning with these global standards will ensure Australia's designs meet world's best practice.

Recommendation 1.2
Mandate Circular Economy Plans in Building Projects. Require major developments to include a "Circular Economy Implementation Plan" (e.g. a Circular Economy Statement as part of planning approvals) demonstrating how the project will minimise waste, enable future disassembly, and use secondary materials. This should be mandated for all large construction projects and as a criterion for public infrastructure funding by 2025.

Benchmark:
London already requires Circular Economy Statements for large developments, embedding circularity from project inception. Adopting similar requirements nationally will drive designers and engineers to consider end-of-life reuse and recovery from the start, making buildings into material banks for the future.

14. RECOMMENDATIONS

2. Resource Recovery & Remanufacturing Systems

Recommendation 2.1
Invest in Advanced Recycling and Remanufacturing Infrastructure. Establish a dedicated "Recycling and Remanufacturing Fund" to significantly expand Australia's resource recovery infrastructure. This fund (leveraging public and private co-investment) should support new high-tech recycling facilities and re-manufacturing plants, targeting key waste streams like construction & demolition debris, plastics, organics, and e-waste. For example, co-fund at least one advanced C&D waste recycling facility in each state by 2027, and deploy organics processing facilities or composters in every major regional town by 2030. Upgraded transport and logistics (rail, ports) may be needed to efficiently move recovered materials.

Benchmark
Similar large-scale investments are seen internationally – the EU and UK have poured funding into modernising recycling infrastructure as part of their circular economy action plans. Expanding Australia's Recycling Modernisation Fund in this way will build domestic reprocessing capacity and reduce reliance on virgin imports or waste exports.

Recommendation 2.2
Support Regional and Remote Circular Solutions. Provide dedicated support for circular economy initiatives in regional and remote communities, ensuring the benefits of circularity are nation-wide. This includes grant programs and technical assistance for remote and Indigenous communities to establish small-scale recycling and reuse systems. For example, fund local councils to acquire modular recycling equipment (small crushers, balers, plastic reprocessors) and set up regional "circular hubs" – facilities that serve as repair cafés, second-hand material depots, and training centres for circular skills. Partner with First Nations communities to integrate traditional knowledge of stewardship and create local green jobs as these programs roll out.

Benchmark:
Even isolated communities can excel with the right support – for instance, Norfolk Island's new recycling facility lifted its recycling rate above the national average. By investing in tailored regional solutions, Australia can dramatically increase resource recovery outside the major cities, while respecting local cultural and environmental contexts.

14. RECOMMENDATIONS

3. Policy & Standards

Recommendation 3.1
Establish a Circular Engineering Taskforce (2026) to deliver a National Circular Engineering Strategy. The taskforce, comprising engineering, architecture and design leaders, to co-design will: consult and confirm Australia's Circular Engineering Strategy, including clear goals, targets and outcomes for 2030 and 2040; guide sector-specific engineering pathways to ensure circularity is integrated into national transition planning; and align with the CEMAG Circularity Advantage Report to:

1. Integrate circularity into Australia's circular transition, embedding circular design and resource efficiency into 2035 sector plans,
2. Deliver challenge-based innovation and research funding to accelerate circular engineering solutions and support commercialisation of circular technologies
3. Ensure policy settings recognise circular engineering contributions beyond the built environment, including retail and consumer goods, food and agriculture, resources, and water systems
4. Support Regional Development Australia to lead place-based circular transitions, including precinct innovation funding, circular transition brokers, and regenerative practices grounded in First Nations knowledge.

This Strategy and Taskforce will create a coordinated national engineering-led pathway for circularity, ensuring alignment with existing government actions while providing the technical backbone needed to translate policy ambition into measurable systems change.

Benchmark
Countries leading in circular economy transition, such as the Netherlands, Finland and Japan, have established national circular taskforces and engineering-led advisory bodies to coordinate targets, align sector pathways, and connect policy with technical implementation. Establishing a Circular Engineering Strategy and Taskforce positions Australia alongside these global leaders, ensuring the transition is technically robust and nationally coherent.

Recommendation 3.2
Enact a Circular Economy Act by 2026 (National Legislation). Draft and pass a dedicated Circular Economy Act to solidify Australia's commitment and provide the regulatory backbone for circular economy measures. The Act should include design standards, binding national targets (for waste reduction, recycling rates, use of recycled content, etc.) include mandating product stewardship schemes, set minimum recycled-content standards, harmonise key definitions and landfill levies across states, and embed circular principles into procurement and planning laws.

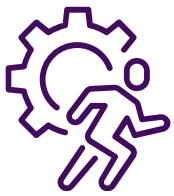
Benchmark
Such legislation aligns with moves overseas – the EU's Circular Economy Package and the UK's Environment Act 2021 provide models for comprehensive circular economy law. Enacting a Circular Economy Act would put Australia on par with global best practice, ensuring consistency nationwide and enabling long-term policy certainty for businesses and communities.

Recommendation 3.3
Mandate Extended Producer Responsibility (EPR) Schemes for Key Products. Introduce mandatory EPR programs by 2027–2028 for high-priority products: *packaging* (with enforceable recycled content targets)*, electronics* (e-waste take-back schemes)*, solar panels and batteries, textiles, and select construction materials*. If voluntary industry-led schemes exist, transition to regulated schemes with clear obligations/ outcomes. Strengthen the federal Product Stewardship Act, allowing quick listing of new products & empower ministers to set requirements if industry fails to act.

Benchmark
EPR is a cornerstone of international circular economy policy. The EU, for instance, updated its Packaging Directive to require all Member States to establish EPR schemes for packaging by 2024, and has long-standing EPR for electronics (WEEE) and vehicles. Japan pioneered EPR through laws that make manufacturers responsible for end-of-life home appliances and vehicles. By mandating EPR in Australia, producers will be incentivised to design products for recyclability and take responsibility for their products' end-of-life, aligning with what's already standard practice in Europe and Japan.

14. RECOMMENDATIONS

4. Culture, Skills & Capacity



Recommendation 4.1
Launch a National Circular Economy Awareness & Behaviour-Change Campaign. Initiate a long-term, nationwide public awareness campaign (from 2026 onward) to foster a culture of waste avoidance and resourcefulness. This campaign should be collaboratively funded by government and industry and delivered through popular media, community programs, and partnerships with influencers and First Nations leaders. It would highlight positive case studies of circular economy in action (e.g. successful reuse, repair, and recycling initiatives) and promote messaging such as "Waste is a resource – let's not waste it!". The campaign should encourage practical behaviours among citizens – repairing products, buying recycled, participating in sharing or product-as-a-service schemes, and celebrate Indigenous practices of custodianship and sustainability as inspiration. By 2030, the aim is to measurably increase public awareness and participation (e.g. raise the percentage of Australians who are familiar with the circular economy concept to >80%, from a lower base).

Benchmark
Many countries recognise the importance of public engagement – Japan, for example, has national 3R (Reduce, Reuse, Recycle) campaigns, and the EU holds annual circular economy conferences and awareness events. A sustained Australian campaign will ensure that policy and industry efforts are matched by broad public support and action on the ground.

Recommendation 4.2
Integrate Circular Economy into Education and Training. Embed circular economy principles across Australia's education and professional training systems. By 2025, update university and TAFE curricula for engineering, architecture, and planning programs to include core modules on circular design, materials efficiency, and sustainability. Encourage accreditation bodies to make circular economy knowledge a requirement for relevant degrees. In parallel, expand continuing professional development (CPD): support Engineers Australia, TAFEs, and universities to deliver, in partnership with peak bodies like Circular Australia, new "circular engineering" CPD courses, aiming to train at least 5,000 existing professionals by 2030. Establish a national-level Circular Economy Centre of Excellence (knowledge hub) by 2027 to share best practices and research outcomes across industry and communities.

Benchmark
Education systems globally are beginning to incorporate circular economy skills – for example, several European universities now offer specialised degrees in Circular Engineering and design for sustainability. By integrating these concepts into Australian education and training, we cultivate a future workforce and citizenry equipped to implement and normalise circular economy solutions.

14. RECOMMENDATIONS

5. Innovation & Digital Skills

Recommendation 5.1

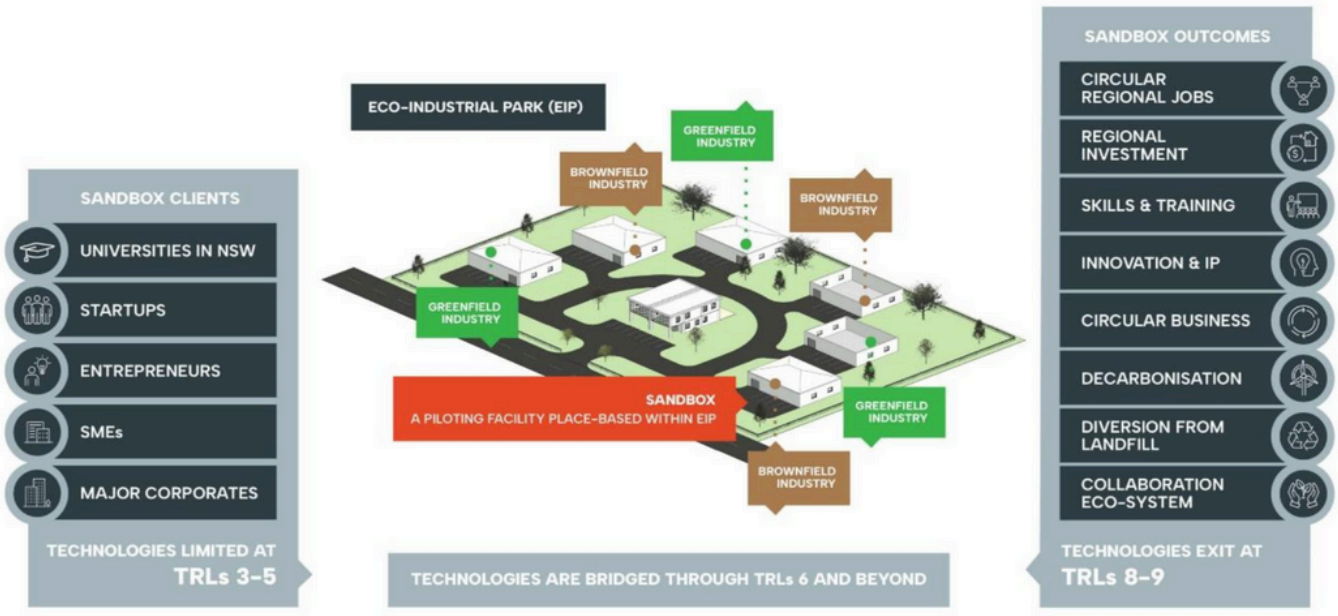
Foster Circular Innovation through Challenges and Hubs. Establish programs to incubate and reward circular economy innovation. Launch a national "Circular Innovation Challenge" series – regular competitions that invite engineers, startups, and communities to solve specific circular economy problems, with winning solutions receiving funding or pilot opportunities (e.g. design a 100% recyclable building façade, develop an app for sharing or reusing products). In addition, create Circular Economy Technology Hubs in each state (physical or virtual incubators) to support startups and SMEs working on circular products, process technologies and services. These hubs should provide mentorship, seed funding, and collaboration space to help scale up new ideas (leveraging partnerships with CSIRO, universities, and state innovation programs). An example is the Clean Tech Sandbox concept by Prof. Abbas (Chief Circular Engineer), proposed for regional NSW for scaling up innovations.

Benchmark

This approach mirrors international best practices – for instance, the EU and Netherlands fund circular innovation challenges and living labs, and Japan incentivises technology developers to pursue recycling and remanufacturing breakthroughs. By seeding innovation, Australia can generate home-grown circular solutions and even export them to the world.

The Clean Tech Sandbox can serve as a vital bridge between the development phase and commercial deployment of new technologies, particularly at TRL 6 and higher. At these stages, technologies are beyond the proof of concept in a controlled environment and enter a phase where prototype pilots are tested in operational environments. This progression allows for the demonstration of their practicality and effectiveness and real-world setting

The Clean Tech Sandbox[19] can serve as a vital bridge between the development phase and commercial deployment of new technologies, particularly at TRL 6 and higher. At these stages, technologies are beyond the proof of concept in a controlled environment and enter a phase where prototype pilots are tested in operational environments. This progression allows for the demonstration of their practicality and effectiveness and real-world settings.



14. RECOMMENDATIONS

5. Innovation & Digital Skills cont.

Recommendation 5.2
Leverage Digital Technology for Circular Resource Management. Deploy cutting-edge digital tools to track and optimise material flows across the economy. This includes implementing Digital Product/Material Passports for key products and building materials – i.e. electronic records that travel with a product and list its material composition, repair history, and recycling instructions. By 2027, require digital passports (or QR codes linking to databases) for priority products to facilitate take-back and recycling (the EU is already making digital passports mandatory for all new batteries by 2027). Develop national online marketplaces for secondary materials to connect suppliers of recycled materials or reclaimed components with buyers (e.g. an Australian platform for trading used construction materials or recycled plastic feedstock). Additionally, utilise AI and IoT technologies for smarter resource management – for example, AI-driven sorting robots to improve recycling efficiency, and sensor networks to monitor waste bins and optimise collection routes.

Benchmark
Leveraging technology is a key enabler worldwide – Europe is investing in digital platforms and standards for circularity, and cities like Amsterdam use material passport systems to catalogue building components for future reuse. By embracing digitalisation and data analytics, Australia can dramatically increase the efficiency and transparency of its circular economy, ensuring valuable materials are tracked and looped back into use rather than lost.

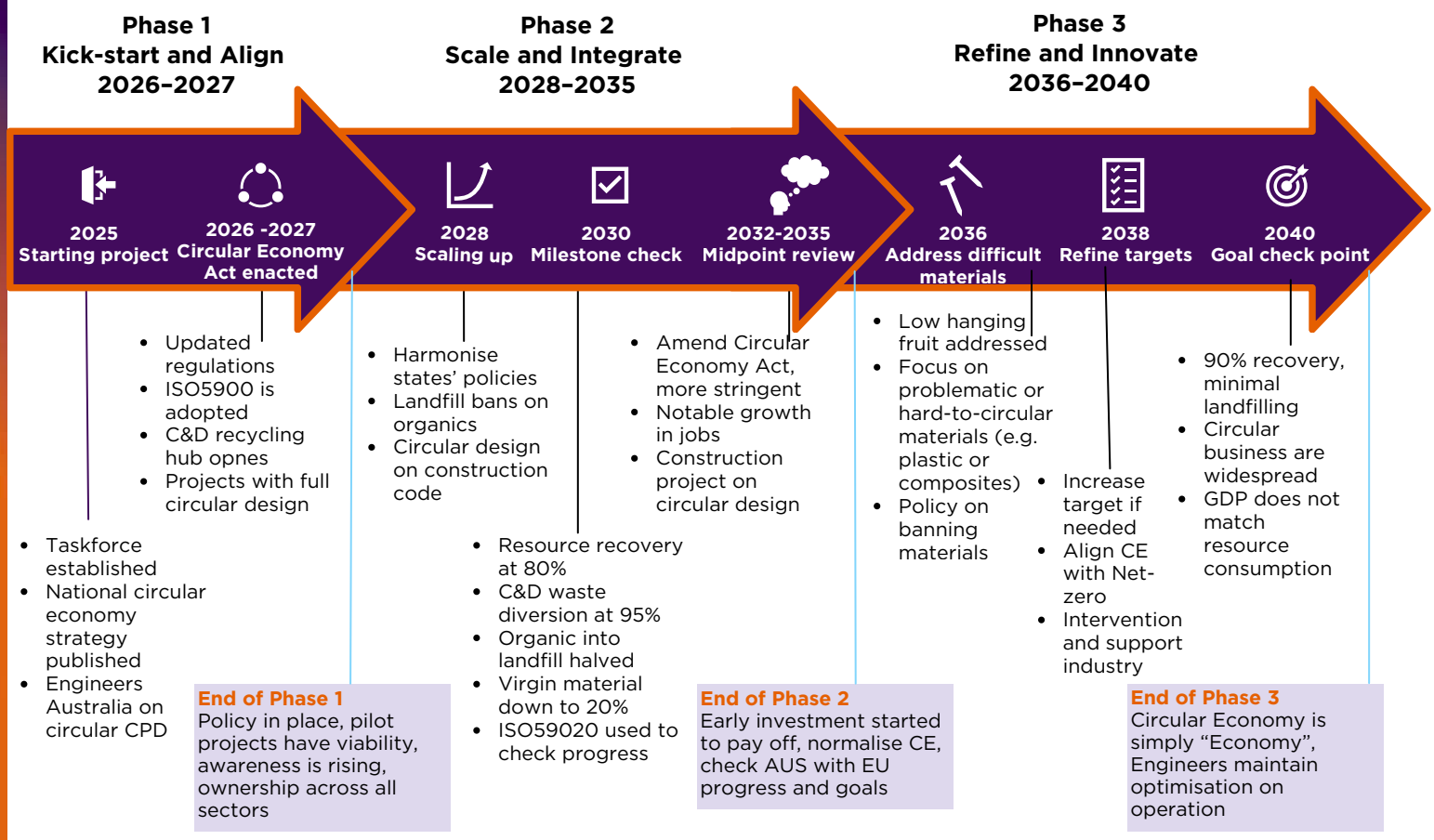
Recommendation 5.3
Develop a National Circular Economy Data & Monitoring Framework. By 2026, implement a unified national framework to measure and track circular economy progress, aligning with global standards (ISO 59020 for circularity indicators). This involves building robust data infrastructure: for example, unify and digitise waste data reporting across all jurisdictions (require large waste and recycling facilities to report electronically), and start publishing an Annual Circular Economy Progress Report through the ABS. Define and monitor key metrics such as the Circular Material Use Rate, recycling/reuse rates by material, resource productivity, and landfill reduction, using the ISO 59020 indicators as benchmarks. Consider legislating mandatory disclosure of material flows by large companies (analogous to energy/emissions reporting).

Benchmark
The EU already operates a Circular Economy Monitoring Framework with indicators to gauge progress (the EU's circular material use rate is around 12% and rising). Adopting a similar evidence-based dashboard in Australia will allow real-time policy adjustments and ensure accountability toward 2030/2040 targets. In short, what gets measured gets managed – this framework will give engineers and decision-makers the data needed to optimise circular initiatives.

15. Implementation Roadmap

This indicative roadmap provides key milestones to be considered in the timeline from 2025 to 2040 including: national taskforce and strategy (2025), Circular Economy Act (2026), ISO 59000 adoption (2026), EPR expansion (2027–2030), and circular economy targets review (2032 and 2038).

By 2040, resource recovery is targeted to reach 90%, construction waste to landfill virtually eliminated, and circular business models normalised. As shown in Figure 1, the 2025–2040 roadmap highlights five strategic pillars supported by policy, innovation, and skills initiatives.



16. Conclusion

"Australia's engineering-led circular economy transition is a grand undertaking, but as this white paper has outlined, it is both necessary and achievable. The benefits of economic resilience, innovation, environmental restoration, and intergenerational equity, far outweigh the efforts required." Prof. Ali Abbas

This inaugural Chief Circular Engineer white paper has charted the vision, strategy, and path forward. The immediate next steps are clear:

1. **Establish the Circular Engineering Taskforce with engineering and design leaders**
2. **Consult and confirm the Circular Engineering Strategy Goal, Targets and Outcomes**
3. **Set the roadmap for implementation of priority actions**

Engineers and built environment professionals have a pivotal role as the designers and stewards of material flows. It is upon the engineering community to take these recommendations and embed them in every project, every design brief, and every innovation session. By doing so, and working in concert with policymakers, businesses, and communities, we will transform Australia's waste and construction sectors from a linear model of extraction and disposal to a circular model of continual regeneration.

In Aboriginal Australian wisdom, we talk about "Caring for Country", managing the land and its resources in a way that ensures their abundance for future generations. The circular economy is a modern expression of that ancient principle. As we implement this blueprint, we honour both cutting-edge knowledge and traditional knowledge, driving a transition that is not just technical, but deeply cultural.

By 2040, when Australians look around their cities and towns, they will see tangible outcomes of this strategy: *cleaner environments, innovative circular businesses, buildings that are beautiful repositories of reusable materials, and landfills that are relics of a bygone era.* Achieving this will affirm Australia as a global leader in sustainable engineering and circular economy – a legacy of ingenuity and responsibility for future generations.

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