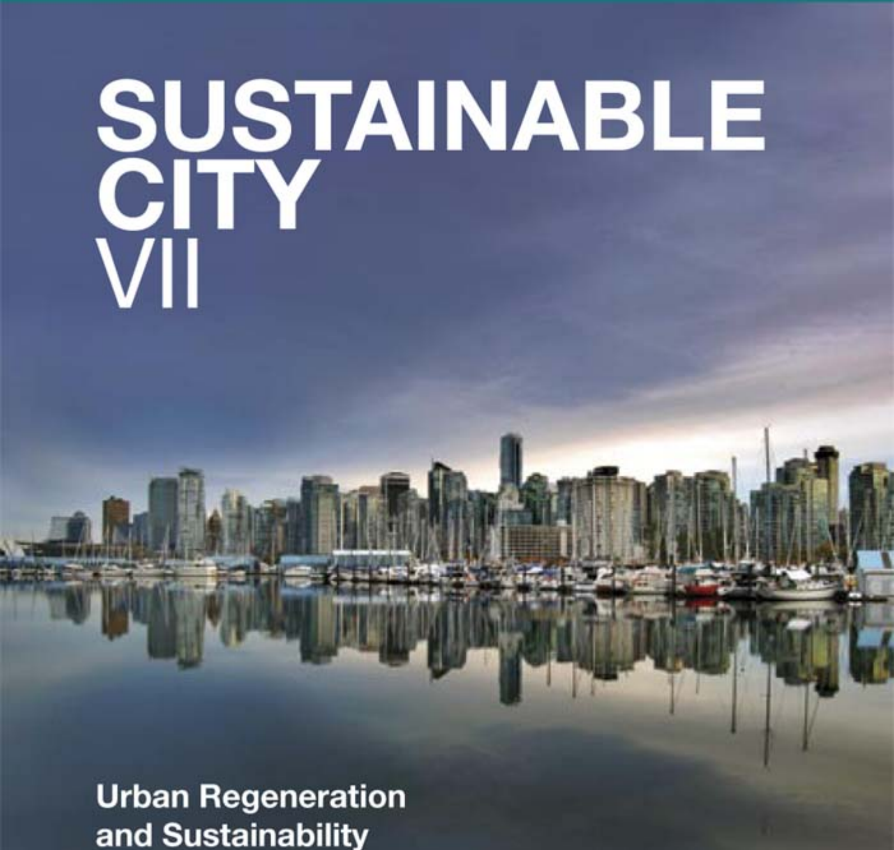

SUSTAINABLE CITY VII

Urban Regeneration and Sustainability

WIT PRESS

Editors
M. Pacetti,
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The Sustainable City VII

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URBAN REGENERATION AND SUSTAINABILITY

THE SUSTAINABLE CITY VII

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Preface

This book contains a reviewed selection of papers presented at the International Conference on Urban Regeneration and Sustainability (The Sustainable City), which is the seventh in a series of successful meetings previously held in Rio (2000), Segovia (2002), Siena (2004), Tallinn (2006), Skiathos (2008) and A Coruña (2010). To date, more than fifty percent of the Earth population lives in cities. The process of urbanization made this percentage increase from a small value at the beginning of the nineteenth century to about thirty percent in the fifties. After that, this figure has linearly increased so that, at the end of last decade the urban population was more than half of that of the Earth. This process has generated many problems deriving from the drift of population towards cities. On the other hand, cities represent the most efficient habitat and increasing the number and the size of big cities is the most promising way to save resources without damaging our lifestyle. As a matter of fact, gathering within relatively small neighbourhoods increases efficiency of services which, in turn, leads to a higher quality and standards of life. Nevertheless big cities face a number of major challenges to maintain such standards and develop further. Losses in efficiency lead to a waste of resources, which in turn means poorer quality of life. Cities run on a razor's edge: a city doing well rapidly improves the quality of life and attracts people while a city doing badly declines even more quickly, losing population, resources and high life standards.

All stakeholders need to appreciate the importance of cities and their role in the ecology of the entire planet. Metropolises would then lose their character of huge, massively polluting entities and unwelcome places to live in. Well organized cities are posed to become wonderful places to live in. The turning point for this process was the sharp abatement of pollution achieved in the last part of the twentieth century by moving energy generation outside cities and by improving mass transportation infrastructures and systems. In fact, in the first stages of their development, most cities, to avoid decline and to keep developing, consumed – and often wasted two vital resources: space and energy. At a certain point metropolitan areas hastily moved towards the neighboring countryside, creating suburbs in a kind of centrifugal development which turned city centers almost wastelands. At the same time energy consumption rose sharply together with average-house square meters and distance to work places. The improvement of citizens' lifestyle was almost completely based upon high consumption of goods and energy. Those processes led to an abrupt decline of environmental standards, i.e. pollution of air soil and water, accumulation of waste within the urban areas and a general reduction of quality of life with the related social problems. Everyone is now aware that the next development step had to aim at healing cities rather than letting them grow indefinitely. This turning point was the first step towards Urban Regeneration and Sustainability.

Today, after decades of studies, most issues regarding the improvement of quality of life in major cities have been addressed but new challenges arose and several more are just around the corner. The urban heat island effect has been exacerbated by Global Warming while municipal solid waste disposal had to be rethought almost from scratch. In the near past, city improvements came from a range of step-by-step "classical" upgrades and every progress usually meant an increase of energy consumption. Now we are all more aware that a tool, device, or even living entities become more difficult to manage, to repair or to heal as soon as they grow in size and become more complex. In this regard, big cities are probably the most complex mechanisms to manage. However, despite such complexity, cities still represent a fertile ground for architects, engineers, and other key professionals able to conceive new ideas and tune them according to available technology and human requirements. Such new ideas in the past were the underground train system or the skyscraper for instance. We can also cite concepts such as the second skin of buildings, the low-energy building, and the concept of limited access areas. Today, green facades, passive buildings, distributed production of energy and fuel are examples of key ideas within reach.

Each conference on Urban Regeneration and Sustainability aims at sharing such ideas and related case studies. The diversity of topics, concepts, and papers are all indicators of the wide scope and complexity of the Sustainable City.

The Editors wish to express gratitude to all the authors and the members of Scientific Advisory Committee of The Sustainable City 2012 conference. They are grateful to the authors for sharing their expertise and to the reviewers for managing manuscripts with competence to assure high standards.

The Editors
Ancona, 2012

PRIGOGINE MEDAL 2012

University of La Marche, Ancona, Italy

The 2012 Prigogine Gold Medal Ceremony took place at the University of La Marche on the occasion of the 7th International Conference on Urban Regeneration and Sustainability (Sustainable City 2012).

The Medal was established by the University of Siena and the Wessex Institute of Technology to honour the memory of Professor Ilya Prigogine, Nobel Prize Winner for Chemistry.

Ilya Prigogine

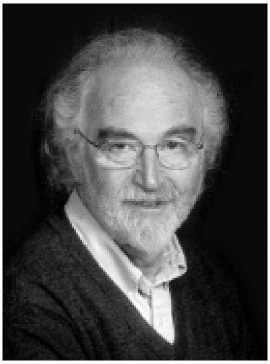
Ilya Prigogine was born in Moscow in 1917, and obtained his undergraduate and graduate education in chemistry at the Free University in Brussels. He was awarded the Nobel Prize for his contribution to non-equilibrium thermodynamics, particularly the theory of dissipative structures. The main theme of his scientific work was the role of time in the physical sciences and biology. He contributed significantly to the understanding of irreversible processes, particularly in systems far from equilibrium. The results of his work have had profound consequences for understanding biological and ecological systems.

Prigogine's ideas established the basis for ecological systems research. The Prigogine Medal to honour his memory is awarded annually to a leading scientist in the field of ecological systems. All recipients have been deeply influenced by the work of Prigogine.

Previous Prigogine Gold Medal winners were:

2004 Sven Jorgensen, Denmark
2005 Enzo Tiezzi, Italy
2006 Bernard Patten, USA
2007 Robert Ulanowicz, USA
2008 Ioannis Antoniou, Greece
2009 Emilio del Giudice, Italy
2010 Felix Müller, Germany
2011 Larissa Brizhik, Ukraine

Gerald Pollack



The recipient of the 2012 Award was Gerald Pollack, Professor of Bioengineering at the University of Washington, USA.

Gerald received his PhD in biomedical engineering from the University of Pennsylvania and since then has carried out outstanding research in a wide variety of fields, ranging from biological motion and cell biology to the interaction of biological surfaces with aqueous solutions. He has published numerous papers in leading scientific journals and is author of several books, including one on the underlying principle of biological motion and another on cells and gels as the engines of life.

He has received many awards and is member of prestigious national and international organisations. Gerald is Founding Fellow of the American Institute of Medical and Biological Engineering and a Fellow of both American Heart Association and the Biomedical Engineering Society.

Gerald Pollack's Prigogine Lecture was entitled "The Secret Life of Water"

For further information about the Prigogine Awards, please contact Professor Carlos Brebbia at the Wessex Institute of Technology or see www.wessex.ac.uk/prigogine2012.

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Vertical vegetation design decisions and their impact on energy consumption in subtropical cities

Y. Stav & G. Lawson
Queensland University of Technology, Australia

Abstract

Vertical vegetation is vegetation growing on, or adjacent to, the unused sunlit exterior surfaces of buildings in cities. Vertical vegetation can improve the energy efficiency of the building on which it is installed mainly by insulating, shading and transpiring moisture from foliage and substrate. Several design parameters may affect the extent of the vertical vegetation's improvement of energy performance. Examples are choice of vegetation, growing medium geometry, north/south aspect and others. The purpose of this study is to quantitatively map out the contribution of several parameters to energy savings in a subtropical setting. The method is thermal simulation based on EnergyPlus configured to reflect the special characteristics of vertical vegetation. Thermal simulation results show that yearly cooling energy savings can reach 25% with realistic design choices in subtropical environments. The most important parameter is the aspect of walls covered by vegetation. Vertical vegetation covering walls facing north (south for the northern hemisphere) will result in the highest energy savings. In making plant selections, the most significant parameter is Leaf Area Index (LAI). Plants with larger LAI, preferably LAI>4, contribute to greater savings whereas LAI<2 can actually consume energy. Change of growing medium thickness from 6cm to 8cm causes a dramatic increase in energy savings from 2% to 18%. It is best to use a growing material with high water retention, due to the importance of evapotranspiration for cooling. Similarly, for increased savings in cooling energy, sufficient irrigation is required. To conclude, the choice of design parameters for vertical vegetation is crucial in making sure that it contributes to energy savings rather than energy

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consumption. Optimal design decisions can create a dramatic sustainability enhancement for the built environment in subtropical climates.
Keywords: vertical vegetation, living walls, thermal simulation, energy consumption, sustainable design.

1 Introduction

1.1 Vertical vegetation for sustainable built environment

In recent years it has been suggested that integration of vegetation within the building envelope is a sustainable design strategy for the built environment. One of the expected contributions of vegetation in terms of sustainability is the improved thermal behaviour of buildings when covered with vegetation layers. While green roof implementation is becoming more prevalent, and the research for green roofs' energy efficiency accumulates into a significant body of knowledge, the implementation and research of vertical vegetation technologies is still sparse. In addition, vertical vegetation systems are typically very expensive (e.g. living wall panel systems) or very slow to mature (e.g. climbing vines on trellises) or both. Therefore, when vertical vegetation project is considered, it is beneficial to be able to make informative design decisions at an early stage. Another incentive to focus on vertical vegetation is its potential to cover large surface areas of building walls that are otherwise not used. In the urban context most vertical surfaces are merely a maintenance challenge whereas if "greened" these surfaces can serve as cooling engines, air purifiers, carbon sinks and be pleasing to the eye at the same time.

1.2 Vertical vegetation design parameters

Vertical vegetation can be designed in various ways. The first design decision for a living wall project is choosing the vertical vegetation system. The primary classification of vertical vegetation, as suggested by other authors [1, 2], differentiates between green façades and living walls. Green façades refer to vines and climbers that grow from the ground or from large containers at various locations around the building. The climbers are supported either by the wall itself (the traditional green façade) or by a supporting trellis/mesh. Living walls, on the other hand, consist of plants that grow from a vertical layer of growing medium. Within the living wall category, some of the systems are based on plants growing hydroponically, typically planted in layers of synthetic felt, while others are based on panels or pockets filled with a more traditional growing medium (e.g. potting mix). These were categorised by Kontoleon and Eumorfopoulou [3] as vegetated mat and modular living wall respectively (see Fig. 1).

Other design decisions include choosing the walls to be covered with vegetation, and the extent to which they are covered. The vegetation may only cover the bottom floors, or only strips between windows. It may cover the entire wall or leave the windows clear for uninterrupted view and light.

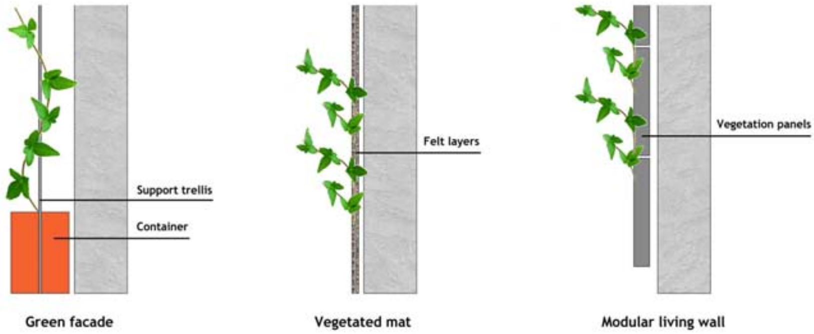

Figure 1: Schematic diagram of vertical vegetation types.

Decisions about plant selection have many impacts. It is important not only to make sure that the plants are suitable for the conditions, but also that they match their properties to the expectations of the people who use the building, maintenance plans, environmental considerations and the thermal behaviour required. Another important decision is the irrigation system: The living wall can survive with only local rainfall, but it is usually irrigated automatically (both in hydroponic systems and the modular systems) and it should be decided whether the water can be recycled, or whether grey water can be used. Energy modelling can assess how these design decisions influence energy consumption.

2 Previous work

Vertical vegetation, in addition to green roofs, can cool buildings in tropical and subtropical climates through their impact on shading the building, adding to exterior wall insulation, evaporating moisture from the growing substrate and transpiring moisture from leaf surfaces. The thermal impact of eight different vertical greenery systems in a Singapore study [4] found that vertical vegetation can reduce the surface temperature of building facades in a tropical climate by up to 11.58°C. In subtropical Hong Kong [5], vegetated cladding was found to reduce interior temperatures by up to 14.5°C and delay the transfer of solar heat. A model for estimating heat flux transmission of vertical vegetation system was developed and tested in Hong Kong [6]. It showed that a south facing vertical vegetation wall absorbs large amounts of heat flux due to evapotranspiration. Green façades, on the other hand [7], were shown to create a micro climate between the wall and the vegetation slightly lower temperatures and higher relative humidity (up to 7% more) in Mediterranean climate. Probably the first simulation-based study for vertical vegetation was a model of double-skin façade with plants [8] using measurements of real plants in a test facility and incorporating these properties in the model. The results demonstrated up to 19% savings in cooling energy consumption due to the shading effect of the vegetation.

Only a couple of studies have investigated specific parameters of vertical vegetation and their affect on the cooling impact: A simulation of energy transfer, as well as Urban Heat Island (UHI) reduction of vertical vegetation [9] in a tropical climate, showed that full coverage of a building with vertical vegetation can significantly reduce the thermal transfer value of the building envelope. The efficiency depends heavily on the Leaf Area Index (LAI) of the vegetation. Another study [3] investigated the influence of orientation and covering percentage of vertical vegetation coverage in a Mediterranean climate. The conclusions were that the adequate incorporation of a plant-covered wall in a building envelope improved the building's energy efficiency, with a more pronounced effect on the east and west facing walls.

Thus it is recognised that vertical vegetation has a significant impact on decreasing the energy consumption of buildings. However little is as yet known about how design characteristics of plants and the vertical vegetation system itself (variables of wall aspect, extent of wall coverage, plant species selection, growing medium material and geometry, water availability) can be modified to influence the degree of impact.

3 Methodology

3.1 Set of energy simulations

In order to address the knowledge gap described above, a set of energy simulations were created, using a parametric study of the various vertical vegetation parameters in subtropical Brisbane, Australia. The energy simulation tool used was EnergyPlus, developed by the US Department of Energy. EnergyPlus is a whole building energy simulation program with a built-in module for green roofs [10] that was developed as a tool to inform green roof design decisions. The green roof module took into account the growing media characteristics, irrigation and vegetation characteristics, and accounts for shading and insulation effects as well as evapotranspiration from the substrate and plants. This module was validated with real experiments of green roofs including live vegetation. In this study, the simulations included "green roof" surfaces that were both horizontal and vertical in order to simulate green roof as well as green walls, i.e. vertical vegetation.

For this study, a simple building model was created, consisting of a single story rectangular area with two double pane windows, light walls and roofs typical to the subtropical buildings commonly used in Brisbane (wood, fibreglass and plasterboard). The air system assumed infinite cooling/heating regimes. The vertical vegetation model was schematic and consisted of a layer of growing medium, and a layer of vegetation. The vegetation covered the entire roof and walls, excluding the windows (see fig. 2). The weather file used was yearly Brisbane weather data created in 2006 based on data from 1967–2004.

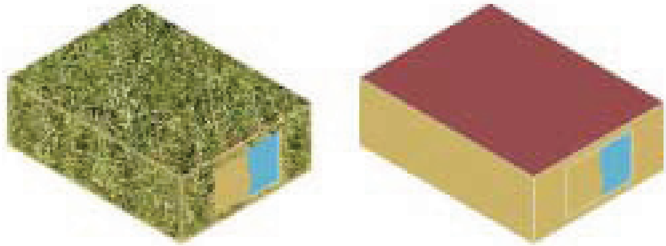

Figure 2: Schematic building with and without vegetation coverage.

Each simulation measured the amount of energy required for heating and cooling during an entire year, with a different set of parameter values. Yearly energy consumption for each simulation was then compared to the scenario with a bare building (without vegetation cover) (see fig. 2) in order to estimate the energy impact of the vegetation.

3.2 Parametric study

A baseline scenario was defined for comparison when studying the various parameters. The values of the baseline scenario parameters were picked so that this scenario was reasonable. The list of parameters and their values appears in Table 1. The table shows for each parameter the baseline value, as well as the minimum and maximum values used during the simulations. Some of the parameters are discussed below:

1. Height of Plants. The baseline value used was 0.3 metre since the estimated height for living walls was 0.1–0.5 metre.
2. Leaf Area Index. In various green roof studies, the LAI was assumed to be around 3 – typical for green roofs with grass [11] and for ivy cover [12]. This was chosen as the baseline value for the LAI of plants in this study.
3. Thickness of Growing Medium. Green roofs have thicker growing media such as 15cm or even 30cm for intensive green roofs. However vertical vegetation can have no growing media at all (in the case of green façades) and typically has a slim growing medium of 5–10cm. The baseline value was therefore chosen as 8cm.
4. Irrigation was set for two hours each morning, and the irrigation rate used two different values, one for summer and the other for winter.

4 Analysis

4.1 Heating energy vs. cooling energy

When using the baseline parameter values with the Brisbane weather file, the results showed that most of the energy required for maintaining thermal comfort during the daytime (8:00–18:00) was cooling energy. In this scenario the

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Table 1: List of vertical vegetation parameters studied.

	Parameter Name (in EnergyPlus)	Baseline value	Min	Max	Comments
Vegetation	Height of Plants {m}	0.3	0.01	1	0.1-0.5 are reasonable for living walls
	Leaf Area Index {dimensionless}	3.0	0.001	5	
	Leaf Reflectivity {dimensionless}	0.22	0.1	0.4	Typically 0.18-0.25
	Leaf Emissivity	0.95	0.8	1	Default=0.95
	Minimum Stomatal Resistance {s/m}	180	50	300	
Growing Medium	Roughness	Medium Smooth			6 values from VerySmooth to VeryRough
	Thickness {m}	0.08	0.05	0.5	0.15 and 0.30 are common for green roofs. Living walls are slimmer
	Conductivity of Dry Soil {W/m-K}	0.4	0.2	1	Typically 0.3-0.5 for green roof substrate
	Density of Dry Soil {kg/m3}	641	300	2000	Typically 400-1000
	Specific Heat of Dry Soil {J/kg-K}	1100	501	2000	Default=1000
	Thermal Absorptance	0.95	0.81	1	Typically 0.90-0.98
	Solar Absorptance	0.8	0.4	0.9	Typically 0.6-0.85
	Visible Absorptance	0.7	0.51	1	
Moisture in Growing Media	Saturation Volumetric Moisture Content of Soil Layer	0.4	0.11	1	Typically less than 0.5
	Residual Volumetric Moisture Content of Soil Layer	0.01	0.01	0.1	
	Initial Volumetric Moisture Content of Soil Layer	0.2	0.11	1	
	Irrigation Daily Rate {cm/hr}	0.2, 0.1	0	0.3	The values represent rates for summer and winter, set for 2 hours every morning
HVAC Thermostat	Thermostat Set-Points {ºC}	20-24			Tested with 19-25ºC and 21-23ºC
	Thermostat Schedule	Always			Tested with daily schedule 8:00-18:00
	Living Wall Aspects	All aspects			North, South, East, West and combinations

vegetation saved 690,530 kJ per year for cooling and only 4,417kJ per year for heating (See Table 2).

The results showed that for the subtropical Brisbane, heating energy savings were negligible and therefore in the rest of the work only cooling energy was considered in further scenarios.

Table 2: Yearly heating and cooling energy savings.

	Cooling		Heating	
	Total [kJ]	Energy Savings	Total [kJ]	Energy Savings
Bare Building	3,895,287	--	9,506	--
Building w Green Roof & Vertical Vegetation	3,204,757	690530	5,089	4417

4.2 Layout selection

A set of simulations examined the impact of the direction of the vertical vegetation. Different simulations of the building were used with only one or two of the walls covered with vegetation. The results can be seen in table 3.

Table 3: Cooling energy savings of wall-facing aspects.

	Living wall cover	Total [kJ]	Energy Savings
Bare Building	NA	3,895,287	
Building with green roof only	NA	3,299,674	15%
Building with green roof and living wall/s	all aspects	3,204,757	18%
	north	2,973,047	24%
	east	3,230,621	17%
	south	3,467,318	11%
	west	3,154,473	19%
	north west	2,918,924	25%
	north east	2,942,613	24%

Although covering the entire wall envelope of the building with vegetation improved energy savings by only 3% over the 15% improvement achieved by green roof alone, covering only the north facing wall with vegetation supplied an additional 9% in energy savings adding to the 24% total savings. On the other hand, covering only the south facing wall brought the total savings down to only 11%, making it an energy burden. The best configuration was having a green roof and living walls facing the north and west aspects of the building, reaching 25% total energy savings.

4.3 Plant selection

Some parameters of the vegetation itself were found to be significant for energy consumption. The most important parameter was LAI (Leaf Area Index). LAI dramatically changed savings on cooling energy since it indirectly measured both the size of the plant as well as the relative size of its leaves. Using small values for LAI, it was shown that vertical vegetation with tiny leafed plants or no plants at all caused warming and therefore required even more cooling energy than the bare building scenario. Mycrophyll plant species have a lower ability to shed heat. This stressed the importance of vertical vegetation not just as an additional layer of matter, but also as an active vegetation layer that allowed evapotranspiration processes to occur. The optimal LAI values that were tested were 4 or 5, but even LAI=3 created a significant energy savings impact.

Other vegetation parameters also influenced the effectiveness of cooling by the vertical vegetation. This included the following:

1. Minimum stomatal resistance (MSR) indicated the leaves' stomatal behaviour with regards to evaporating water. Minimal and maximal values of MSR from 50 to 300 resulted in energy savings range of 15-22%.
2. Vegetation Height increases resulted in small linear increases in energy savings (see fig. 3).
3. Leaf Reflectivity increases resulted in increases in cooling savings ranging from 11% to 22%.
4. Leaf Emissivity increases resulted in some increases in cooling savings ranging from 15% to 19%.

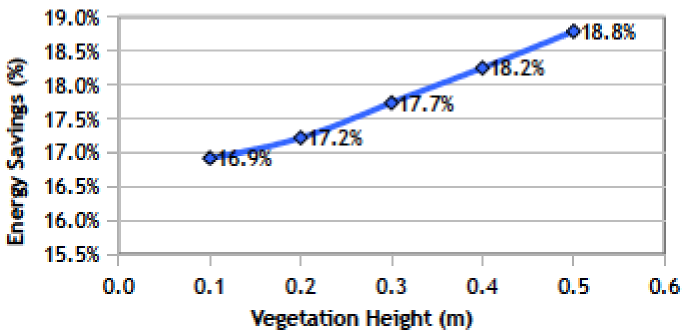

Figure 3: Cooling energy savings vs. vegetation height.

4.4 Growing medium selection

Changing of the parameters that characterise the growing medium (called here substrate for short) influences energy consumption for both heating and cooling. The important parameters are substrate thickness and substrate conductivity.

Thickness of the growing medium is a significant parameter for both heating and cooling, indicating that this layer serves as an insulation layer. Change of a couple of centimetres in substrate thickness from 6cm to 8cm causes dramatic energy consumption changes from 2% to 18%.

4.5 Irrigation

Most parameters related to irrigation and moisture significantly change the capacity of the vertical vegetation to cool the building: Higher water retention by the growing medium improves cooling – indicating the importance of evaporation from the growing medium to the cooling effect of the substrate (for example, see fig. 4).

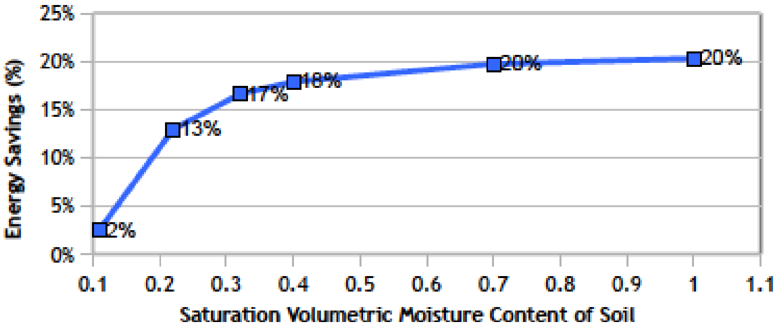

Figure 4: Cooling energy vs. saturation moisture content of substrate.

Sufficient irrigation is also important for cooling of the vertical vegetation. If the irrigation is missing then vertical vegetation will increase the energy required to cool the building. If irrigation is sufficient (around 1mm/hr for 2 hours a day in the case of this simulation) then the vertical vegetation will reduce energy consumption, whereas if the amount is higher than 2mm/hr, and keeps the growing medium and vegetation moist, then cooling energy reduction can go up to 20% (see fig. 5).

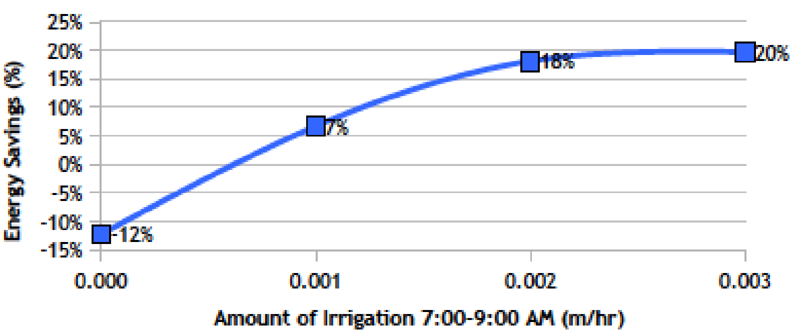

Figure 5: Cooling energy vs. irrigation amounts.

Thus it is shown that irrigation and moisture behaviour in the vertical vegetation system are very important to cooling due to evapotranspiration.

5 Discussion and conclusions

It was shown by earlier studies that vertical vegetation can save cooling/heating energy of buildings [13–15]. Since there is a wide selection of vertical vegetation systems and various ways to implement them and plant them, it is important to use informed design decisions for designers/architects to establish vertical vegetation projects that contribute to energy efficiency of buildings.

This research was focused on green roofs and vertical vegetation in subtropical Brisbane and used energy simulation software that took into account various thermal processes related to vertical vegetation including evaporative cooling by leaves and substrate, shading, insulation and wind. The simulation method, via parameter study, allowed testing of a range of values for various parameters of vertical vegetation, resulting in data that was equivalent to testing dozens of different vertical vegetation projects.

As described earlier, a study of the various wall directions and coverage was performed for a Mediterranean climate context and showed that west and east facing walls were most important [3]. In our Brisbane study, the impact of the direction of the vertical vegetation showed that significant reductions in energy consumption were possible with only the north facing wall covered with vegetation. This study also showed that it was best to use growing substrate that was thicker than 8cm, with dense vegetation (LAI>2) and adequate irrigation.

Thus vertical vegetation systems that have not used well-considered design parameters are unlikely to result in expected energy saving outcomes. Vertical vegetation may actually increase the amount of energy required to cool a building. The results yielded a set of design characteristics that can be useful for vertical vegetation designers in order to create a more sustainable city.

6 Future work

These simulation parameters remain theoretical and were based on a simple building representation. This simulation model was not sophisticated enough to simulate various family houses or commercial buildings in Brisbane. Running this simulation with a larger building type of greater thermal mass would be expected to decrease the influence of the vegetation and substrate as simply an insulation layer. In addition, the simulation does not take into account internal gains (people and equipment inside the building). Similar simulations should be conducted with larger, more complex buildings, preferably those appropriate to the Brisbane Central Business District where the greatest heat island effect is experienced. The simulated building should include other parameters such as thermal zones, shading devices and internal gains (heating generated by people and equipment).

The simulation model itself has a few technical drawbacks. It was based on a green roof module and was not planned as a vertical surface. One of the challenges here was that the vertical vegetation use approximate wind and moisture calculations. A few improvements to the simulation code should be performed in order to increase accuracy.

Being theoretical, this study ignored the botanical/horticultural aspect, as it was assumed that there would be plants found with specified characteristics to suit the use on vertical surfaces. It was assumed that they would thrive within the given conditions of light, wind and irrigation. It would also be preferable to use real plant species or combination of species, with their corresponding parameters (mainly LAI), to allow simulation of realistic choices of vegetation. Soil materials should also be modelled using real materials suitable as living wall substrates (i.e. rockwool, synthetic felt, hydrocell etc). The real physical properties of these materials, such as their thermal conductivity and water retention, should be used within the simulation. Much work has yet to be done in refining this simulation approach.

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Defence Sites

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Edited by: ***C. CLARK*** *and* ***C.A. BREBBIA****, Wessex Institute of Technology, UK*

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In the Wake of a Local Government Initiative

Küçükçekmece: Ayazma-Tepeüstü Urban Regeneration Project

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In the Wake of a Local Government Initiative: Küçükçekmece: Ayazma-Tepeüstü Urban Regeneration Project is the first and so far only publication to elaborate on all the stages of one of the many "Urban Regeneration" projects implemented in Turkey in recent years. In this publication the authors detail the operation and management processes of the municipality where the initiative is taking place, in addition to the actors involved and the duties they have taken over. The book not only examines the "Küçükçekmece Ayazma-Tepeüstü Urban Regeneration" project, but it also gives a clear account of the positive and negative aspects of the process.

To date, especially in the western world, a large number of scientifically significant books have been released on some such initiatives (mainly in the UK), yet there has been no widely disseminated volume on Turkey's approach and project-building methodologies. Unlike in the Western world, urban regeneration in Turkey is a means to overcome the challenges created by the growth of unauthorised housing. In the case of Turkey this publication will serve as a step in developing more publications, as well as present the reader with an example for comparison.

The authors prepared the book in order to bring to light the "Küçükçekmece Ayazma-Tepeüstü Urban Regeneration Project" and all its associated dynamics. The project has been under way since 2004 and is the first redevelopment project in Turkey with well adjusted social projects implemented in parallel. The Ayazma-Tepeüstü region is historically a location of unplanned/illegal settlements. Unlike a standard project, this initiative was embarked upon with a genuine academic enthusiasm and an investigative perspective, making it valuable to share publicly all phases, timelines and current achievements.

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Wind Power Generation and Wind Turbine Design

Edited by: ***W. TONG****, Kollmorgen Corporation, USA*

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Along with the rising energy demand in the 21st century and the growing recognition of global warming and environmental pollution, energy supply has become an integral and cross-cutting element of every country's economy. In recent years, more and more countries have prioritised sustainable, renewable, and clean energy sources such as wind, solar, hydropower, biomass, etc., as the replacements for fossil fuels.

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