
Maximising Sustainability Outcomes by Amalgamating Dimensions of Sustainability

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Abstract

There is no single way for a university to become an organisation where sustainability is a basis of all activities. Rather, there must be many threads that together weave a culture of sustainability: threads that come from many parts of the organisation, have diverse approaches, and engage many people over an extended period. Although these need to have a range of sources, skills, and people, clear goals need to be shared and communicated so that all efforts are aligned and so that each initiative reinforces all others. This paper explores how one large, research-intensive university is working toward a more sustainable future through combining dimensions of sustainability, including teaching, campus operations and research in sustainability initiatives so that each dimension supports the other dimensions for mutual success.

Keywords

Sustainability · Education · Campus operations · Research · Governance

1 Introduction

Becoming a ‘sustainable organisation’ is a process rather than an act, and no single act will achieve the desired goal. Sustainability goals should be determined and shared by the leadership team so that all participants know where they are heading and so that plans can be made and implemented, but these goals must also be

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flexible so that they can respond to changes in conditions and priorities. A university is a community leader and community role model, its research output can influence or even revolutionise practices and, most importantly, its graduates are the researchers, the decision makers, and the business, community and political leaders of the future. Thus it is more important for a university than another organisation of a similar scale and environmental footprint to take actions to ensure that sustainability is part of all aspects of its activities. For a university to become more sustainable there is a need for big picture planning and goal setting, for careful and detailed planning, for identifying the many aspects that need to be considered, planned for and coordinated, and for a need for all parts of the team to have a shared vision of success and a desire to achieve that success.

Much has been written about initiatives for enhancing sustainability in the curriculum or increasing the sustainability of a university campus and much can be learned from the experiences of others. However, it is proposed that for the goal of a sustainable university to be achieved that each dimension needs to be considered both individually and alongside at least two other dimensions. There should be efforts (and funds) directed towards creating opportunities where three or more dimensions of sustainability are brought together and that, in doing so, each dimension will be strengthened more than if addressed only in isolation. This paper will look at how a research intensive university is addressing sustainability, and in particular, it will outline some sustainability initiatives that address multiple dimensions of sustainability and the benefits that are being reaped from this approach.

2 Context

The University of Melbourne is a large research-intensive university situated in the City of Melbourne in Victoria, Australia. It was established in 1853 and the University is ranked number one in Australia and number 34 in the world in the Times Higher Education World University Rankings 2013–2014. In the 2013 *Universitas Indonesia Green Metrics* ranking (see <http://greenmetric.ui.ac.id/>) the university was ranked ninth worldwide for urban campuses and ranked 18 for overall excellence in campus sustainability. The main campus covers 22.5 ha adjacent to Melbourne's central business district and there are also six other campuses, both urban and rural. The university has approximately 45,000 students and approximately 8,000 academic and professional staff.

Since it first established targets in 2008, the University has achieved its sustainability targets. For example, carbon emissions were reduced by 50 % from 2008 to 2010 through a combination of energy reduction projects and the voluntary purchase of green power and abatements. In 2014 the voluntary purchase of green power and energy abatements ceased, and funds (>AUD\$1 m) that previously were used for this are being invested in campus projects, such as voltage optimisation, HVAC improvements, LED lighting and solar PV installations. These projects will

deliver ongoing savings in energy use and emissions that, together with other energy saving and energy generating initiatives, will contribute to achieving 2015 energy and emissions targets and the University's aspirational target of carbon neutrality by 2030.

In 2010 a review of research and research training at the University was undertaken, with the outcome being the report *Research at Melbourne: Ensuring excellence and impact to 2025* (University of Melbourne 2012). From the extensive process in developing this paper came the exposition of three 'Grand Challenges' facing society that universities can contribute to, and that the University would have as centrepieces for its research endeavours in the coming decade. One of these Grand Challenges is 'Supporting sustainability and resilience'. Placing sustainability at the centre of research at this research-intensive university is recognition of previous work and a framework for future research and research training. This report estimated that over 1,300 researchers are working in this area and that around AUD\$218 million annually was being expended in research across energy, water, carbon management and related sustainability domains at the University. This will be boosted by a share in the AUD\$100 million dollars that the University is injecting to work related to the three 'Grand Challenge' areas.

3 Aspects of Sustainability

The seven key dimensions of university sustainability functions are defined by Calder and Clugston (2003) as:

- Curriculum
- Research and Scholarship
- Operations
- Faculty and Staff Hiring, Development and Rewards
- Outreach and Service
- Student Opportunities
- Institutional Mission, Structure and Planning

There are thus many aspects of sustainability that need to be planned for and addressed as part of a university's journey to becoming more sustainable. Each aspect needs to be considered both as a specific area for planning and action, and also in conjunction with all others, so that each initiative supports and reinforces each of the others. This paper will look at how one large research intensive university has addressed these aspects of sustainability, and in particular, ways that the University has strengthened its performance and outcomes in sustainability through initiatives that address a number of sustainability dimensions, so that one is reinforcing the other. This collectively and slowly contributes to cultural change to a culture where sustainability is one of the considerations in the decision-making process at all levels, which continues to be sought and worked towards.

4 Leadership and Governance: Setting the Goals and Funding

For any organisation to attain long term goals there needs to be commitment from the senior leadership, and this commitment needs to be instantiated in policies, commitments, and structures. The commitment to sustainability is needed in policy documents and accountabilities, as otherwise a change in staffing could mean that priorities can shift in unintended ways.

The latest *Environmental Policy* (approved April 2013) extended on earlier policies and includes the following Principles:

- 1.1. The University has extensive environmental impacts in its role as an international teaching and research based University and a large organisation.
- 1.2. The University is committed to improving its environmental performance through teaching, research, engagement, operations and providing community leadership.
- 1.3. The University influences the environment beyond its local boundaries, and embraces social justice through its respect for limited resources globally.
- 1.4. Heads of academic budget divisions are responsible for ensuring that education for sustainability is embedded in all curricula.
- 1.5. Heads of budget divisions are responsible for ensuring all staff, students and stakeholders are engaged, encouraged and supported in achieving a sustainable campus.

(University of Melbourne 2013)

Flowing from this policy commitment and from a 2012 Sustainability Survey, which found that the University needed more collective and senior Sustainability leadership, the University's *Sustainability Executive* was established in early 2013 to complement the broader *Sustainability Forum*, which had been established in December 2009. The *Sustainability Executive* is composed of high level senior managers of the University and provides collective leadership that consolidates and integrates environmental, social and economic aspects of sustainability in the University.

The *Environment Policy* and consequent activities are in addition to public commitments that the University of Melbourne has made to becoming more sustainable and there are many external and internal drivers toward this outcome. These include public commitments that the University has made about its graduates and their understanding of sustainability, national and international agreements to which the University is a signatory, the Australian National Action Plan for Education (EfS) for Sustainability (DEWHA 2009) that has as an objective that EfS is to be integrated into all university courses/subject areas, and other international drivers.

Recently the Vice Chancellor, in an opinion piece for the national newspaper (Davis 2014) and an email to all staff, stated that: "Sustainability is a core graduate attribute" and this is backed up by a recent revision of the University's *Graduate Attributes* which, under the Active Citizenship section, includes that graduates will:

- have a high regard for human rights, social inclusion, ethics and the environment;
- lead change through advocacy and innovation for a sustainable future. Setting clear University goals, having accountability for goals at a senior level, and putting sustainability on the agenda of each of the University’s business units is a necessary foundation for the other dimensions of sustainability to be built upon. That is, if the university leadership is explicitly committed to a sustainable future and campus operations are working towards increasing sustainability in more and less visible ways, then the message that the university, through its hidden curriculum (Orr 1992), is sending to its staff, its students and the wider community is that it values sustainability. This is not to diminish the importance of the other dimensions of sustainability, as each one contributes to the overall culture of sustainability of a university, and each can reinforce the other.

5 Campus Operations: Making Things Happen

Campus operations as a unit has led the way in sustainability at the University of Melbourne, and this includes working toward the ambitious target of carbon neutrality by 2030, which is on track to be achieved, impressive water savings and remarkable achievements across all aspects of operations, some of which are outlined in Table 1 and others that will be components of case studies later in this paper. The team at campus operations has been proactive, creative, and energetic in looking at campus operations and seeing how things can be done in a more sustainable way, and have not constrained themselves to purely operational matters, which has led to some exemplary projects that will be outlined below.

Table 1 Some achievements of campus operations at the University of Melbourne in achieving sustainability goals

Energy and emissions	• Net emissions reduced by 43 %, after green energy and abatements
Water	• Potable water consumption reduced by 30 %
Waste	• 41 % of solid waste is recycled
Campus buildings	• New buildings built to 5-Star-Green-Star design rating, with the newest building on track to gain 6-Star-Green-Star rating • Major building upgrades built to 4-Star-Green-Star rating
Transportation	• Fleet reduced by 25 vehicles • Fleet emissions offset through Greenfleet since 2008 • Increased bicycle parking on campus
Sustainable IT	• Energy considerations of configuration and usage of all IT-related equipment, particularly computer labs and workstations
Sustainable purchasing	• Inclusion of sustainability elements in locally negotiated product and service contracts, i.e. sustainable products, reduced/recyclable packaging, take-back schemes for electronic equipment, catering

6 Campus as a Laboratory: Sustainability Dimensions Supporting Each Other

This section will focus on some case studies where the broad concept of ‘Campus as a Laboratory’ has been applied. The idea of integrating aspects of sustainability with each other is not new or unique, and McMillin and Dyball (2009) of the Australian National University have outlined benefits of integrating sustainability into many aspects of the university, and Mike Shriberg of the University of Michigan (Shriberg and Harris 2012; Shriberg et al. 2013) has also done extensive work looking at the connections of sustainability and curriculum. The case studies presented here will not focus on curriculum connections, as McMillan and Dyball and Shriberg have done, but rather on connections between campus operations (underpinned by governance), research and research training, and the engagement and education of staff, students and the wider community.

7 Case Study 1: Recycling at the University of Melbourne: Operations, Research and Engagement

A shining example of breaking down boundaries between dimensions of sustainability is recycling. Typically recycling and waste are seen as an operational activity, with staff and student engagement and education provided only as necessary. In 2010 the University developed a Waste Management Plan, set a 2015 target of 50 % of waste to be recycled (from a baseline of 16 % recycled in 2009) and appointed a Waste and Recycling Coordinator to drive the changes necessary to achieve the ambitious target. The person appointed to this role came to the position not only with waste management experience, but also 30 years of experience in environmental education.

Some of the early actions to achieve 50 % of waste being recycled that engaged all staff was a shift from a waste bin in each office to a approximately 1 L desktop container for waste and a larger bin for recyclable materials. Education of staff accompanied the staged roll out of the office bin system. The size of the bins was a clear indication of the expectations of the amounts of landfill waste and recyclables that staff would produce. This connection between operations and staff engagement is not particularly remarkable, but a later stage in the process of achieving the University goal took the much less usual path of combining campus operations with research. A study, entitled *Build It and They Will Recycle: The critical importance of infrastructure in changing recycling behaviour* (Gilmour et al. 2013) used the campus as the site of investigation and the staff and students as the actors on the campus, whose behaviours were influenced through the arrangements of landfill and recycling bins provided at different locations and whose behaviours were measured through the data collected about the amounts and proportions of landfill and recyclable materials that ended up in the bins.

The Waste and Recycling Coordinator, who initiated and was coordinating investigator of the study, worked with a researcher from the Department of Infrastructure Engineering and a postgraduate student from the Faculty of Science. The study was funded by the *Melbourne Institute for a Sustainable Society*, a multi-disciplinary research institute of the University of Melbourne. The study focussed on people—staff and students with waste to dispose of and cleaning staff who are responsible for correct disposal of waste—and on infrastructure—the availability and placement of appropriate bins.

The study commenced with a review of literature to inform the later stages, with the key findings of this stage being that effective systems need to be easy to use and infrastructure needs to be conveniently located. Bins were audited using a methodology that was developed for the study to determine the composition of waste within individual bins using digital photographs and counting items using a superimposed grid. The data from bin audits enable an understanding how location, labelling, and distance to the nearest recycling/landfill bin was influencing the behaviour of people disposing of waste.

Findings include:

- Inside buildings the absence of a recycling bin led to a landfill waste bin containing an average of 38 % recyclable material (by weight).
- If a recycling bin was visible, but more than 5 m away, then there was no significant difference in the amount of recyclable material in the landfill bin.
- If the recycling bin was visible and 1–4 m away, then the amount of recyclables in the landfill waste bin dropped to an average of 17 %.
- If the two bins were placed adjacent to each other then this dropped to 14 %.

This provides evidence of the critical importance of co-locating landfill and recycling bins and, while perhaps unsurprising, demonstrates that the provision of suitable infrastructure can lead to dramatic improvements in rates of recycling and less recyclable materials going to landfill. An outcome of the study, and associated works, has led to an increase in recycling rates across the University from 16 to 41 %, which is well on the way to achieving the 2015 goal of 50 %.

In addition to the demonstrable success of the project in achieving its goal of increased rates of recycling on the campus, the project is a rare example of campus operations being a lead player in university research and working directly with university researchers and gaining funding from a research institute of the University. The divide between the roles of academic and professional (that is, non-academic) university staff is generally fairly impermeable at research-intensive universities, but this project demonstrates that these barriers not only can be overcome, but that major benefits can occur when this happens. This blurring of boundaries between academic and professional staff is explored as an emerging trend in universities in the UK and Australia by Whitchurch (2008).

Although the project and its outcomes do not impact directly on the taught curriculum of the university, the change in bins on the campus, such that bins are now all paired and labelled, not only increases recycling rates, but also sends a clear

message to staff, students, and community members who walk through the University. The priorities of the University are evident from the bins and this is one more strand that builds the cultural shift to one where sustainability is a priority.

8 Case Study 2: Green Roofs: Research, Teaching, Community Engagement and Education and Operations

Not far from the main campus of the University of Melbourne is a smaller campus, known as Burnley because of the suburb it is located in, that has been the site of horticulture education for over 100 years and of environmental horticulture for over 30 years. The campus is the site of the heritage-listed 8.2 ha Burnley Gardens. This campus is a component of the Melbourne School of Land and Environment (MSLE), which is located at a number of campuses, including the main campus. The Burnley Gardens are open to the public and sells seeds and plants, as well as exchanging seeds and plants with other botanic gardens and research institutions.

Research is being undertaken at the Burnley campus into the efficacy of green walls and green roofs as an emergent technology to adapt urban centres to climate change and to improve urban environmental quality (Melbourne School of Land and Environment 2011). This site is one that plays a leading role in community education as well as research leadership. This community engagement includes annual open days and a 'Friends of Burnley Gardens' community volunteer group. Weekly seminars held at Burnley are open to the public and it is a place where connections between the University and its community are very strong.

The Green Infrastructure Research Group (see <http://thegirg.org/>) of the MSLE is undertaking wide ranging research, including into green roofs and walls. As part of this research a number of green roofs and walls have been constructed at the Burnley campus, where they are used for research, teaching, and community engagement and education. Much of the research into green roofs has been undertaken in cooler and wetter climates, and so research in Australian conditions is needed. A small research green roof was established in 2008, which demonstrated a 48 % reduction in energy use during summer for cooling the building.

The *Burnley Green Roofs* were completed in 2012 and are Australia's first dedicated green roof demonstration, training, and research facility. This suite of green roofs comprises a demonstration roof of 166 m², a research green roof of 80 m², and a biodiversity green roof of 52 m². The demonstration roof is on the roof of the heritage-listed Burnley Campus Hall and has been designed so that there is access across the entire roof and it shows how different substrates and different depths of substrates function, as well as demonstrating different uses and plants. The roof has 14 planting zones and the design of the roof, with access via a connecting curving walkway, facilitates small group teaching. Over 200 plant taxa are represented on the roof, with over 3,000 individual plants. The plantings are designed to demonstrate the range and variability of plants that can be used

successfully on a green roof. The demonstration roof has gained much publicity in the community through open days and through the media.

The research roof is on the Main Building staff room and is based around four quadrants; three green roofs with different depths of substrate and one quadrant without a green roof. Climate and hydrology data are captured with automated instrumentation. Research is underway to seek to quantify the hydrology and energy benefits of different substrate depths and plant combinations. The biodiversity green roof was designed to attract and to provide habitats for lizards, insects, and birds. This roof features indigenous plants that are representative of Victoria's endangered grasslands, it has a small ephemeral pond and shallow creek bed that flows during rain events using stormwater from an adjacent roof. Different substrates have been used to provide a range of habitats for invertebrates and specific habitat features, such as logs and sand for insect burrowing, hollow twigs for nests of native bees, and hard surfaces for lizards and insects to bask on.

These green roofs are exemplary in bringing together many dimensions of sustainability at the University—they are a site for research and they are used for formal teaching and for community engagement and education. Research into green roofs is being undertaken both by University researchers and postgraduate research students, classes are held on the demonstration roof, and a *Specialist Certificate in Green Roofs and Walls* is a new postgraduate coursework qualification that is now being offered by the University. The course is targeted at professionals in the built environment and landscape sectors, and will enable them to undertake such projects for their clients in the community. This intensive will be held on the main campus and sites to be developed as part of this course are being chosen on the campus for both physical suitability and also for social benefits. This will extend the impacts of green roofs to the main campus of the University.

Thus, this undertaking brings together research, teaching, the hidden curriculum, and community engagement and education in a way that has captured the imagination of the community, as well as the energy savings and benefits to campus operations that assist the University in meeting energy saving targets.

9 Case Study 3: Shallow Geothermal

Shallow geothermal (or ground source heat pump) installations make use of the constant temperature below ground (gained from solar radiation) to heat spaces in winter and cool them in summer. This technology is not common in Australia, despite being extensively used in other regions, and research is needed to investigate its efficacy in Australian conditions. A wider understanding of the technology in the Australian community is beneficial, as, once installed, the energy used to run the heating and cooling systems are approximately 20 % of that using traditional energy sources. In Victoria, the state where the University is sited, the primary source of electricity production is brown coal, which is the most polluting of all coals, and so reduction in electricity use is of particular benefit in Victoria.

Initially a small experimental shallow geothermal system was installed to heat and cool a weights room in the University gymnasium. This 14 kW system consisted of four 30 m deep bores with associated above ground heat pumps. This demonstration unit had some small operational benefits through energy savings and had some, though limited, visibility to staff, students and the wider community [For a technical description of the projects see Johnston et al. (2014)].

As a second stage a larger (25 kW) shallow geothermal system was installed at the newly developed *Campus Sustainability Centre*, which is centrally located on the main campus of the University and was established to showcase sustainability-related research being undertaken across our campuses and to inform and engage on all aspects of sustainability at the University. This shallow geothermal system has five 50 m deep boreholes and heats and cools the ground floor of the building where the *Campus Sustainability Centre* is housed. The project was completed in 2013 and academic staff and students from the Department of Infrastructure Engineering were involved, working with staff from campus operations and industry partners. This gave valuable experience for both staff and students in this technology. The system has now been functional for a year and contributes to the University meeting energy targets.

This demonstration unit is part of a larger research project of staff of the Department of Infrastructure Engineering that is funded by the government Department of Primary Industries, and the installation of this unit was a significant achievement and an important first step of the overall project. The on-going monitoring of the system's operations will contribute towards local design and installation guidelines and the system will contribute to raising awareness of this technology, which is little known in Australia. This geothermal project is also a component of a research student's Ph.D. studies. This student worked with several contractors to design and install the system, which will inform his research into design techniques and guidelines. The installed system will allow field experiments to be performed and incorporate local heating/cooling loads and local geological characteristics in his research.

Knowledge gained is being used to inform larger scale shallow geothermal systems being designed for major construction work elsewhere on campus, in particular a 90 kW system now being installed at the *Bio21 Science Sub-school* (see <http://www.sciencesubschool.bio21.unimelb.edu.au>). This science sub-school is planned to be a leading centre for science education for secondary school students and teachers and is the fruition of a partnership between the University of Melbourne, led by the Bio21 Institute, and the Melbourne Graduate School of Education, the Victorian Government (Department of Education and Early Childhood Development) and two local secondary schools. Its year 11 and 12 students will have a lived experience of the technology and will be able to use the building as a living experiment in their studies with direct access to the data generated.

The demonstration shallow geothermal installations thus brings together campus operations, through lower energy usage and informing the design for new buildings, research and research training, through the work of academic researchers and research students, as well as the engagement and educational opportunities for staff, students and the wider community.

10 Conclusions

Although there have been successes at the University of Melbourne, there is still a long way to go in achieving sustainability goals. Some of the more visible targets, such as energy use and waste production, which are in the realm of campus operations, are well on track; governance and leadership in the area has led to good policies being in place; and specific areas of research are world class. However, and despite the case studies presented here that demonstrate successes, there is still much work to be done in bringing together the various dimensions of sustainability so that even more can be achieved in the future. The goal that each decision being considered through a sustainability lens, as well as the more usual lenses of University decision-making, is still not usual practice, and there is thus much cultural change needed. However, it is proposed that one effective way to work toward this desired approach is to look for, and to fund, opportunities that enable a number of the dimensions of sustainability to become entwined and for each to strengthen the other. This approach of designing sustainability initiatives to address three or more of the dimensions of university sustainability is one that has delivered great results and it shows much promise as a way forward for universities to work at becoming more sustainable.

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Dianne completed her Ph.D. in 1990 in the field of forest ecology, looking at the changes in soil that promote growth of mountain ash (*Eucalyptus regnans*) after a bushfire, before moving into teacher education. Dianne has been involved in a number of multimedia projects that support learning in teacher education and has won a number of awards for her teaching, including the inaugural *Award for Excellence in Teaching* from the Melbourne Graduate School of Education at the University of Melbourne and a *Universitas 21 Fellowship*.

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