GREENING UNIVERSITIES TOOLKIT V2.0

TRANSFORMING UNIVERSITIES INTO GREEN AND SUSTAINABLE CAMPUSES : A TOOLKIT FOR IMPLEMENTERS

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ACKNOWLEDGEMENTS

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Finally we would like to acknowledge the substantial contribution of Dr. Paul Osmond from UNSW Australia, the co-author of the previous version of this toolkit, whose work the Greening universities Toolkit V2.0 is developed and expanded upon. We also thank Dr. Lan Ding from UNSW Australia for her generous contribution in case studies and data collection. Thanks also to Emiliano Miranda y Miranda for his design and formatting work in the revised Toolkit.

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- University of British Columbia, Canada
- Princeton University, USA
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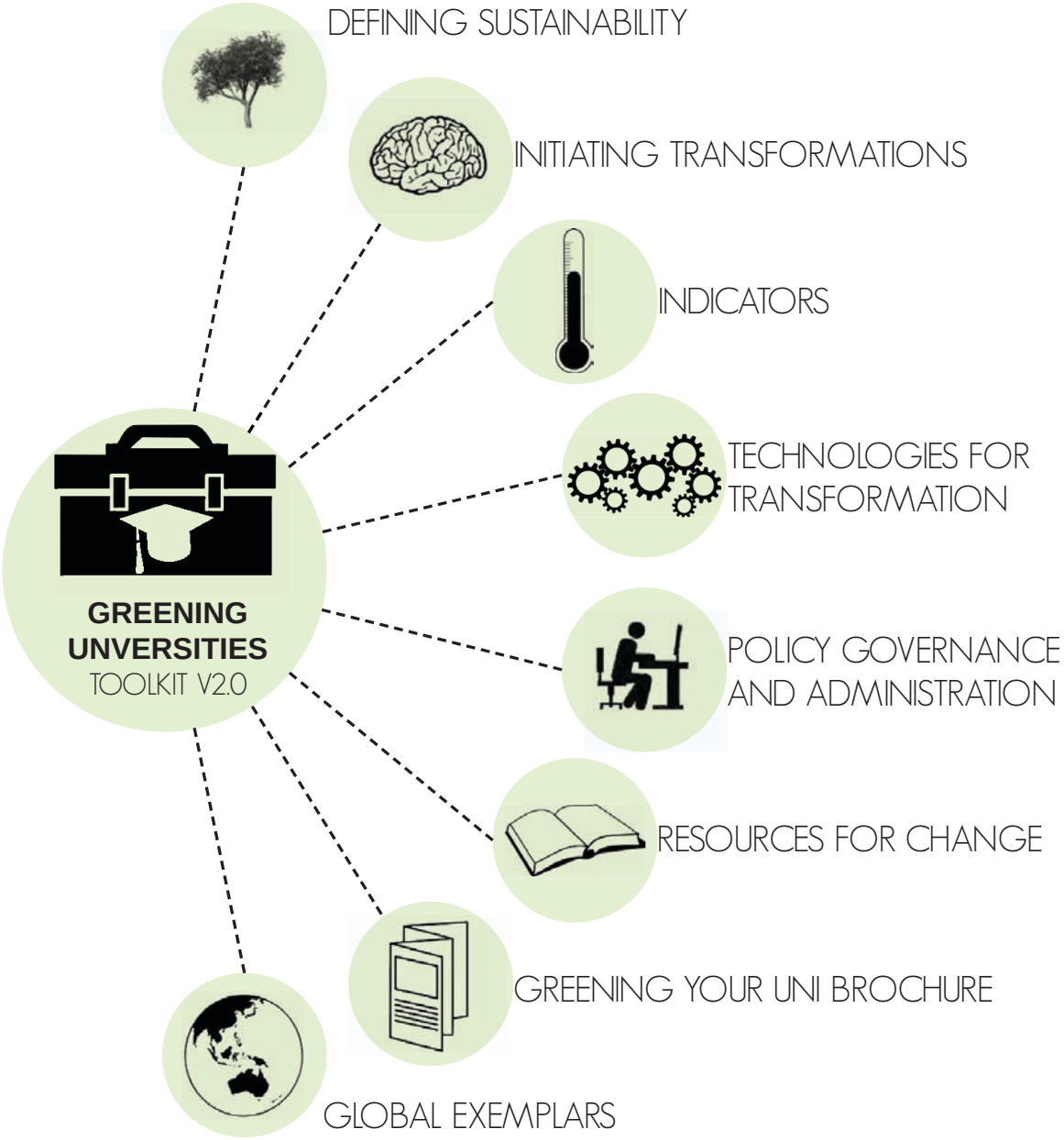
Finally, we would like to point out that this Toolkit aims to be a "living document" that will be updated on a regular basis. For this purpose, we plan to have an electronic online version, were universities are able to incorporate and share their experiences in the greening of university campuses.


DEFINING SUSTAINABILITY
INITIATING TRANSFORMATIONS
INDICATORS
TECHNOLOGIES FOR TRANSFORMATION
POLICY GOVERNANCE AND ADMINISTRATION
RESOURCES FOR CHANGE
GREENING YOUR UNI BROCHURE
GLOBAL EXEMPLARS
GREENING UNVERSITIES
TOOLKIT V2.0

THE DESIGN AND DEVELOPMENT OF THIS TOOLKIT

The Toolkit was conceived in 2011 as part of the Greening Universities Initiative set up by UNEP's Environmental Education and Training Unit (EETU) in partnership with other UN agencies and leading "green universities" experts and researchers, under the umbrella of the Global Universities Partnership for Environment and Sustainability (GUPES). UNEP's approach to this project involves:

- Developing criteria for green/sustainable campuses, including infrastructural, managerial and operational considerations;
- Supporting the development and implementation of strategies for transforming Universities into green/sustainable campuses;
- Advocacy, lobbying and publicity activities for greening Universities;
- Developing and launching a global award scheme for green Universities.

Publication of this Toolkit addresses the first of these four objectives. The University of New South Wales (UNSW) Faculty of the Built Environment was engaged to prepare the draft Toolkit for review by UNEP. This process involved four stages:

- An extensive review of the green University literature, including both academic research and the so-called "grey" literature of reports, websites and operational material produced by individual Universities and international and national associations relevant to University sustainability;
- Two international workshops auspiced by GUPES, held in Santiago, Chile in September 2011 and in Nairobi, Kenya in February 2012, which reviewed and discussed work in progress and provided input and direction to the final document;
- Collection of a substantial body of best practice case studies from Universities worldwide both to inform the content of the Toolkit overall and to include as a standalone Chapter on global exemplars; and
- Final review by the EETU to ensure currency, consistency and alignment with the objectives of the UNEP Greening Universities Initiative.

OBJECTIVES AND EXPECTED OUTCOME OF THIS TOOLKIT

The objective of this Toolkit is to inspire, encourage and support universities to develop and implement their own transformative strategies for establishing green, resource-efficient and low carbon campuses. It will provide an opportunity to build stakeholder capacity to deliver systemic, institution-wide integration of sustainability principles into all aspects of university business. This initiative is intended to improve the sustainability performance of universities globally and to provide support to other stakeholders embarking on their own sustainability journeys. Further, it will enhance the practical relevance of universities to sustainable development and by extension, the new paradigm of the "green economy". In short, the aim is to encourage and promote the contribution of universities to the overall sustainability of the planet. We cannot have a sustainable world where universities promote unsustainability [1] – conversely, the sustainable university can help catalyse a more sustainable world.

USING THIS TOOLKIT

This Greening Universities Toolkit is designed to provide universities with the basic strategies and tactics necessary to transform themselves into green, low carbon institutions with the capacity to address climate change, increase resource efficiency, enhance ecosystem management and minimise waste and pollution. To effectively support this journey and other transformative processes in Universities, the Toolkit is structured in such a way that the focus is on the sustainable planning, design, development and management of the university campus. This is linked to the core business of teaching, research and outreach, which are the subject of a separate initiative by UNEP's Environmental Education and Training Unit (EETU)[Higher Education Guidelines for Curriculum Review and Reorientation Towards Sustainable Development], Aspects of teaching, research and outreach are addressed here only insofar as they intersect/interact with the fabric and operations of the campus.

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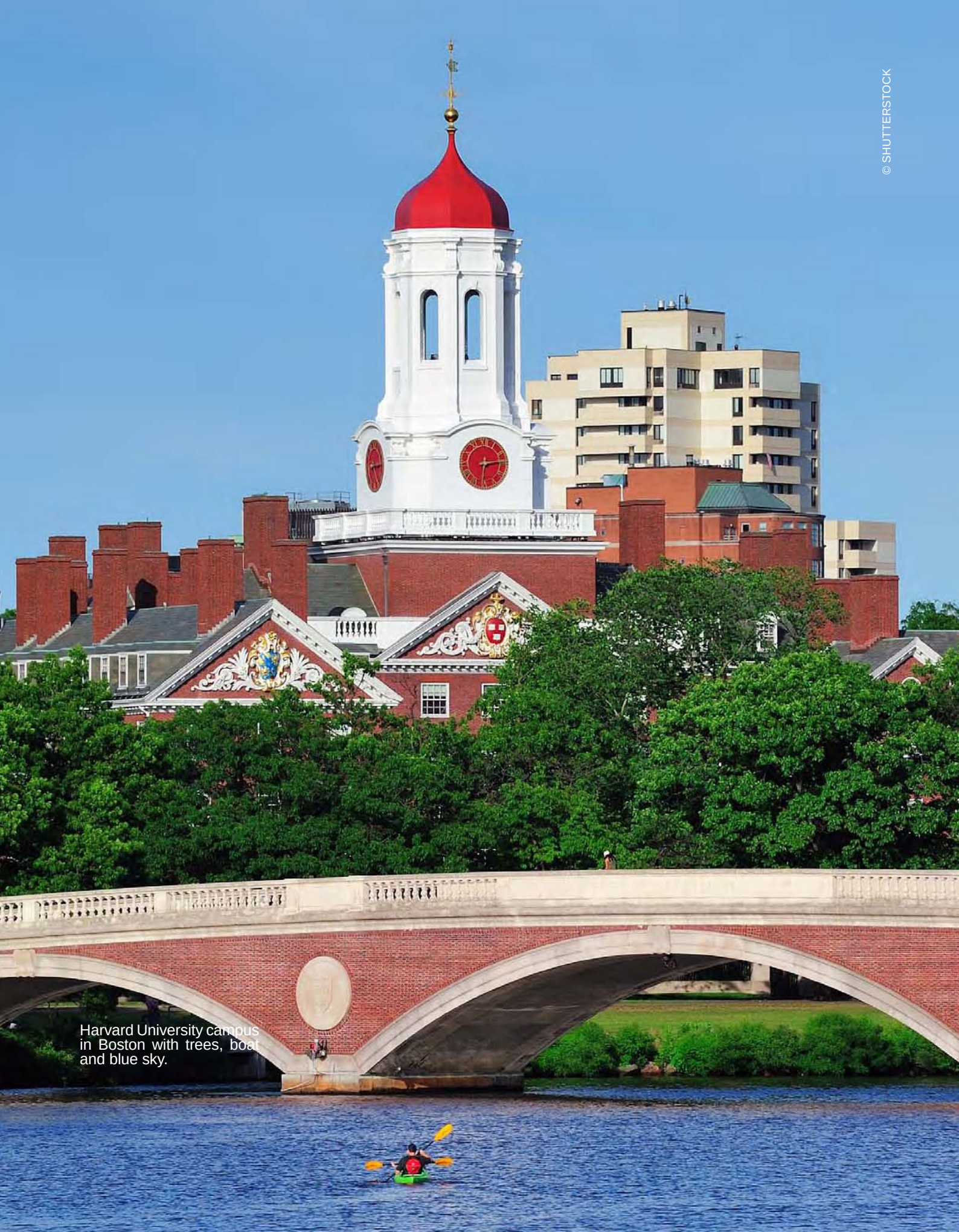

Harvard University campus in Boston with trees, boat and blue sky.

EXECUTIVE SUMMARY FOR ACADEMICS

The focus of this Toolkit is to help address that gap – to provide University staff and students with a selection of strategies, tools and resources, gleaned from the literature, from global case studies and from practice which are intended to inspire, encourage and support Universities to develop and implement their own transformative strategies for establishing green, resource-efficient and low carbon campuses. In turn, it is hoped the "green campus" will help inform the "green curriculum", and extending beyond institutional boundaries, help to catalyse more sustainable communities.

- **CHAPTER 1** establishes the context with a brief introduction to sustainability and sustainable development, the elements expected of a sustainable university, and brief cost-benefit analyses for greening university campuses.
- **CHAPTER 2** addresses the strategic infrastructural, managerial, operational and cultural issues to be considered in setting up a framework for sustainability planning and management.
- **CHAPTER 3** defines key performance indicators and examples to measure sustainable campus.
- **CHAPTER 4** sets out generic guidance measuring key performance of university campuses and also suggest key strategies to improve the performance.
- **CHAPTER 5** outlines a methodology and potential criteria for a global award scheme to facilitate continual improvement in university sustainability performance.
- **CHAPTER 6** lists a variety of books, journals, associations and websites which can provide further information and guidance on university sustainability topics.
- **CHAPTER 7** is an introductory brochure which presents a brief outline of the overall project and a concise summary of the outcomes.
- **CHAPTER 8** presents a series of best practice case studies from universities around the world.
- Finally, a reference list is included which sets out the full list of references drawn on and the methods and calculations used to inform the development of the Toolkit.

Each Chapter has been prepared as a stand-alone document which can be read and used on its own, or be combined with the other Chapters to constitute the full Toolkit. The emphasis is on practical guidance, drawn from mainstream, proven systems, techniques and tools and illustrated by examples of what works, and why.

EXECUTIVE SUMMARY FOR FACILITIES MANAGERS

Sustainability management programs or action plans are the engine room for a green university campus. Although each university will have its own targets and its own prioritised strategies, the structure developed for this Toolkit integrates models from many individual universities, university associations and other organisations reported in the literature, and practical experience in preparing and implementing environmental / sustainability action plans. It is designed to address: the core biophysical strategies on energy, carbon and climate change; water consumption; waste generation; and biodiversity protection and enhancement – which are pertinent to the great majority of the university's operations and activities; and the main activity-specific strategies on campus planning, design and development, procurement of goods and services, sustainability of offices, laboratories and IT services, and transport (university related and commuter). This toolkit maps four of the five sustainability themes – energy/climate, water, land and materials – against the portfolio of management programs / action strategies.

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EXECUTIVE SUMMARY FOR ADMINISTRATORS

This toolkit introduces the notion of top-down, bottom-up and combined strategies. In all cases, genuine engagement of academics, administrative / operational staff and students in the early stages is crucial to the successful initiation of the sustainability agenda. Indeed the organised participation of students and staff in every aspect of the sustainability transition is essential to success. The strategies presented in this toolkit can be employed to support and reinforce any of the practical sustainability initiatives and interventions at any stage of the journey, involving different people at different stages.

The policy ("where do we want to be?") and the initial review ("where are we now?") informs the planning phase ("how do we get from where we are to where we want to be?"). This includes identification of appropriate performance indicators, objectives and targets and sustainability action plans.

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Public-garden of the Warsaw University Library in Poland

INTRODUCTION

Universities have long been agents of change – catalysts for social and political action as well as centres of learning. Universities not only educate most of the world's leaders, decision-makers and teachers and advance the boundaries of knowledge, but as major employers and consumers of goods and services they play a significant economic role nationally and globally.

Given the ascribed role of Universities in society, and the prevailing environmental and sustainability challenges, Universities are coming under increasing pressure to engage with and respond to climate change and other sustainable development issues and the associated risks and opportunities. They are expected to be the engines and innovation centres for sustainable development through teaching and learning, research and knowledge transfer. Critically, universities' educational role does not end with undergraduate and postgraduate learning; it extends to the plethora of activities which support and extend the teaching and research core: campus management and operations; campus planning, design, construction and renovation; purchasing; transport; and engagement with the wider community. Awareness is also growing in the higher education sector that universities can teach and demonstrate the theory and practice of sustainability through taking action to understand and reduce the unsustainable impacts of their own activities. Linkage of curricula and campus operations under the aegis of sustainability can create a powerful "shadow curriculum" which emphasises the nexus between theory and practice [2-5].

Evidence, however, shows that many universities are struggling with the concept and agenda of university "greening"; achievements to date have been scattered and unsystematic. Completion of a showcase green building is not the same as embracing a university-wide commitment to ensure all future buildings are built green – the former is a project success, the latter a systemic transformation [6], which is more desirable for sustainability. However, sustainability needs not be considered only from perspectives extrinsic to universities, but also from more intrinsic perspectives. These should motivate universities to adopt sustainable/green university strategies which should demonstrate sustainability principles.

Education has been described as humanity's best hope and most effective means in the quest to achieve sustainable development [7]. In this context, universities have a special responsibility to help define and also to exemplify best practice.

The steady growth of higher education in both the developed and the developing world has created a surge of competing priorities, of which sustainability is one of the more recent. The most successful green campus initiatives are those which acknowledge these shifting priorities and welcome the emerging opportunities which growth and development can generate [6]. While some noteworthy exemplars of university sustainability initiatives exist around the world, there is a need to maximise the potential benefits by encouraging their replication in as many universities as possible globally.

CHAPTER 1

UNIVERSITIES AND SUSTAINABILITY: DEFINITIONS, ISSUES, RISKS AND CHALLENGES

1.1 WHAT DO WE MEAN BY "SUSTAINABILITY"?

The World Conservation Strategy was launched in 1980 by the IUCN (International Union for Conservation of Nature and Natural Resources), UNEP (United Nations Environment Programme) and WWF (the World Wildlife Fund) and introduced not only the concept of sustainable development but also the term "sustainable" in relation to human use of the biosphere. However, the antecedents of the sustainability debate are evident in the discussions of 'limits to growth' in the early 1970s, whilst the concept itself was developed at the United Nations Conference on the Environment in Stockholm in 1972 [8].

The World Conservation Strategy was significant for stressing that rather than conservation and development being mutually exclusive activities, as had generally been argued up to that time, they are interdependent. The WCS stressed that development requires the conservation of the living resource base on which it ultimately depends; in the longer term development will not be able to take place unless we conserve our living resources. Likewise conservation will not occur unless at least minimal standards of development are met, i.e. basic needs of food, shelter and clean water [9].

Subsequent definitions of "sustainability" and "sustainable development" run into the hundreds and reflect a wide range of perspectives. Despite lack of agreement on an unequivocal interpretation of the concept, there is general agreement that it involves simultaneous satisfaction of economic, environmental and social goals. Meeting environmental criteria in a society which fails to meet economic and social goals concerning justice and equity does not make for sustainability.

The most emblematic definition of sustainable development is that set out in Our Common Future, the 1987 "Brundtland Report" of the World Commission on Environment and Development [10], which states:

> Humanity has the ability to make development sustainable – to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs.

The WCED go on to say (p 8):

> The concept of sustainable development does imply limits – not absolute limits but limitations imposed by the present state of technology and social organization on environmental resources and by the ability of the biosphere to absorb the effects of human activities. But technology and social organization can both be managed and improved to make way for a new era of economic growth.

And (p 46):

> In essence, sustainable development is a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are all in harmony and enhance both the current and future potential to meet human needs and aspirations.

This statement of sustainable development is one which we would probably all endorse. It captures the key temporal prerequisite of sustainability – persistence into the long-term future – through its explicit reference to intergenerational equity. On the other hand, the Brundtland formulation can be seen as enigmatic as well as emblematic – by expressing a qualified consensus reached by a UN Commission charged with reconciling the goals of environmental protection and economic growth it epitomises the contestability of the territory. The price of consensus commonly is ambiguity; the positive aspect is that ambiguity can encourage discussion and debate, an essential part of the practical process of working towards sustainability [11].

1.2 SUSTAINABILITY AND SUSTAINABLE DEVELOPMENT

The terms "sustainability" and "sustainable development" have been used interchangeably above – but is this appropriate? The following distinction [12] offers a useful guide:

> Sustainability is the ultimate goal or destination. Exactly what defines the state of being, of what is sustainable (whether it be a society, logging, fishing, etc.), is informed by science but ultimately depends on personal values and world views.
>
> To achieve a state of environmental sustainability, a framework or process is needed. Certain conditions have to be met and steps in the process toward 'sustainability' have to be made. The framework of sustainable development is the means for achieving sustainability.
>
> So, in brief, "sustainability" refers to the goal and "sustainable development" is the path or framework to achieve it. As with the term "sustainability", what is considered as a necessary path and time frame will vary amongst individuals.

Further, it must be emphasised that development is not synonymous with growth. Growth is about becoming quantitatively bigger; development on the other hand is about becoming qualitatively better [13].

Sustainable development, then, may be defined as the intentional means whereby humans strive towards sustainability, the co-evolution of human and natural systems to enable adaptation to change indefinitely, which:

- Is based on qualitative development/ improvement, not quantitative growth;
- Conserves and enhances natural capital stocks, which cannot sustainably be substituted by other forms of capital;
- Combines social equity in improving present quality of life with intergenerational equity in meeting the needs of the future; and
- Acknowledges cultural development and cultural diversity (as with biodiversity) as central to the adaptive process of realising sustainability.

1.3 THE FOUR CAPITALS AND THE FOUR BOTTOM LINES

Ecological economists generally recognise four distinct "capitals" [14-16] which are necessary to support the real, human welfare producing economy:

- Natural (the land, sea, air and ecosystems from which the human economy derives its materials and energy and to which it ultimately returns its wastes);
- Built (buildings and cities, the physical infrastructure which produces economic outputs and the human artifacts thus obtained);
- Human (the health, skills, knowledge and values of the human population); and
- Social (the web of formal and informal interpersonal connections and institutional arrangements which facilitate human interactions).

This taxonomy provides a useful model to help articulate the structures, processes and relationships which are fundamental to the transition to sustainability.

The expectation of tripartite satisfaction of economic, environmental and social goals referred to above can also be expressed in terms familiar to the business world; the triple bottom line refers to satisfaction of not just the acknowledged bottom line of meeting economic goals (profits) but also the need to now simultaneously meet environmental and social goals (or "bottom lines") in carrying out their business. This also provides a practical framework for the development of policies and strategies to drive institutional change. When the objective is transformation rather than mere observation, the rationale for including governance as a fourth bottom line is reinforced (Figure 1.1). Governance is defined in the present context to include both the formal regulatory, business, administrative and political processes of the university which determine or influence decision-making and action, and the informal networks, traditions and cultural and behavioural norms which act as enablers or disablers of sustainable development.

FIGURE 1.1: THE QUADRUPLE BOTTOM LINE.

1.4 WHAT DOES A "SUSTAINABLE UNIVERSITY" LOOK LIKE?

It seems pretty clear that there can be no sustainable world where universities promote unsustainability [1]. Moreover, "...no institutions in modern society are better situated and more obliged to facilitate the transition to a sustainable future than colleges and universities" [17].

A "fully mature" approach to university sustainability may be summarised as "one in which the activities of a university are ecologically sound, socially and culturally just and economically viable" [18]. How the transition towards sustainability is expressed in a particular university must inevitably reflect the social, cultural, economic and ecological circumstances of the nation and region in which that university is situated. Nevertheless, although they can be expressed in different ways, there are well-defined foundational principles which characterise university sustainability [18-22].

In general terms, a university consciously choosing the path of sustainable development would exemplify the following principles:

- Clear articulation and integration of social, ethical and environmental responsibility in the institution's vision, mission and governance;
- Integration of social, economic and environmental sustainability across the curriculum, commitment to critical systems thinking and interdisciplinarity, sustainability literacy expressed as a universal graduate attribute;
- Dedicated research on sustainability topics and consideration of "quadruple bottom line" sustainability aspects in all other research;
- Outreach and service to the wider community, including partnerships with schools, government, non-governmental organisations and industry;
- Campus planning, design and development structured and managed to achieve and surpass zero net carbon/water/waste, to become a regenerative organisation within the context of the local bioregion;
- Physical operations and maintenance focused on supporting and enabling "beyond zero" environmental goals, including effective monitoring, reporting and continual improvement;
- Policies and practices which foster equity, diversity and quality of life for students, staff, and the broader community within which the university is based;
- The campus as "living laboratory" – student involvement in environmental learning to transform the learning environment;
- Celebration of cultural diversity and application of cultural inclusivity; and
- Frameworks to support cooperation among universities both nationally and globally.

Universities by definition have accepted the challenge of leadership and aspiration to best practice, in the creation and dissemination of knowledge. The transition to sustainability opens up new challenges, but also tremendous opportunities. Governments, businesses, NGOs and individuals – and a growing number of universities – have already made significant progress, and the road ahead is well illuminated in terms of tested and evidenced strategies. The following Section of the Toolkit introduces those strategies which have shown the greatest capacity to enable systematic institutional transformation, and are also internationally recognised and readily available. These include the International Organization for Standardization (ISO) environmental management standards and social responsibility guidelines, the Global Reporting Initiative framework and university-specific resources which have been developed by several international sustainable campus associations and intergovernmental organisations (see also Section 5, Resources for change).

SCOPE OF HEI RESPONSIBILITY

AS ORGANISATION

- Personal well-being - Personal development - Health & safety - Human rights - Social & cultural diversity - Employability...	- Waste and pollution - Natural resource preservation - Energy - Climate change - Biodiversity preservation...	- Financial transparency - Short & long-term financial sustainability - Value creation - Community development - Anti-corruption - Organizational governance...

- Contribution to the implementation of SD in the sector

AS INSTITUTION OF EDUCATION AND RESEARCH

- Socially responsible issues in the behavior and in managerial decisions made by graduates - Personal and professional well-being of graduates...	- Inclusion of environmental sustainability issues in managerial decisions made by graduates and partners...	- Long-term vision of graduates and partners - Participation of graduates in the economic and ethical development of society and of companies...

LEVERS OF ACTION

IN THE ORGANISATION

- Working and learning conditions, - diversity policy, equal opportunities plans - Access to knowledge, - Intellectual development, - Social dialogue...	- Transportation policy, - Energy policy (sobriety, efficiency and renewable energy) - Building solutions, - Management of GHG emissions, waste... - Biodiversity plans...	- International strategy, - Community involvement and development - Investment and remuneration policy, - Quality and efficiency management - Risk management...

Fair operating practices, sustainable purchasing and user behaviors, exemplary behavior, lobbying in the sector, sharing with peers, Stakeholders engagement, sustainable performance indicators...

IN PROGRAMS & RESEARCH

Pedagogical approach, curriculum content, learning by doing, research themes, transversal research, exemplary behaviour, evolving information sources, provident of standards...

Sources : *KEDGE Business School*
Practical guide to the UN Global Compact for HEI - RIO 2012
Greening universities toolkit UNEP 2013
Revised in 2014 by Kedge Business School

1.5. SUSTAINABILITY ISSUES, RISKS AND ASSOCIATED CHALLENGES IN UNIVERSITIES

Universities are complex, multi-faceted entities with diverse organisational subcultures, traditions and concerns [6], and the transitory nature of university life for the bulk of the campus community can mean the real impacts of the institution remain unacknowledged [23]. There may be individual high quality initiatives aimed at addressing these impacts, but where these are restricted to one or a handful of organisational units they inevitably end up ad hoc and uncoordinated. In addition, limited funding and multiple calls on capital budgets favour short-term fixes over green investments with long-term paybacks.

Staff and students have heavy workloads; limited time and multiple expectations as to how that time is used can make it problematic to initiate, maintain, complete and evaluate projects, and compound natural resistance to change. Moreover, universities generally lack the incentive structures necessary to promote changes at the individual level [24].

Universities are located in a sea of competing and interacting social processes whereby decisions on growth and direction are often made outside the immediate institutional community [25]. Structural change in response to new research priorities and societal educational demands combined with the loss of corporate memory through staff turnover and the transience of the student population can mean mistakes are repeated, previous high performing initiatives are not emulated and it becomes difficult to build on progress or initiate continual improvement cycles. Sometimes failure to develop appropriate performance measures limits direct feedback on the benefits of sustainability actions – the environmental, social and financial value of achievements is not understood or promoted [26-28].

Two common denominators across all of these well-recognised risks and challenges are lack of commitment by university leadership, and lack of awareness and engagement of staff and students.

However, some of the same characteristics of universities which tend to hinder progress towards sustainability – for example the tradition of decentralisation and autonomy – have a dual nature, and can equally act as enablers of change. In particular, the university has historically provided a safe haven for the innovator and the activist. Early-adopter sustainability champions, whatever their substantive role in the organisation, can be critical change agents. And where cross-campus interdisciplinary networks already exist, they can contribute to the critical mass for the dissemination of new ideas. There are also important external drivers, for example pressure from peer institutions, particularly those which have already made worthwhile progress towards sustainability; and pressure from society at large – community aspirations for a cleaner, greener world, and corporations and government bodies keen to support sustainability-focused research, or to hire graduates with the relevant skills [24].

In discussing the issues, risks and challenges of university sustainability it is helpful to separately review the "triple bottom line" dimensions of environment, economy and society / culture, recognising both their inter-relationships, and the crucial role of the fourth "bottom line" – governance – across these three dimensions.

1.5.1 ENVIRONMENTAL

Universities embody the environmental issues, risks and challenges of the wider communities in which they are situated, but also express their own unique characteristics. On one level, a university may be likened to a small town, with all the associated issues of spatial planning, management of physical growth and development, maintenance of buildings and open spaces, supply of electricity, water and other utilities, and often provision of residential accommodation and ancillary services. In addition, there are the typically corporate functions of finance, procurement, human resources, etc.

However, the distinguishing feature of a university is its core purpose of teaching, research and community outreach. This generates a plethora of distinctive environmental issues on top of those typical of the small town or the corporate office, which often include significant (indeed semi-industrial) levels of resource consumption, carbon emissions, waste and pollution. Risks here include the reputational and financial – linked to legal compliance – which on their own are enough to motivate some institutions towards sustainable development. The broader challenge is to minimise the legally compliant but environmentally unsustainable impacts of the university's activities while maintaining and extending its teaching / research / outreach core.

To meet this challenge requires an understanding of the particularities of the university's activities as well as its

environmental impacts, in other words, the key areas for intervention: in relation to environmental parameters such as energy, carbon and climate change, water, waste, and biodiversity; and management parameters such as the planning, design and development of the campus; and the "greening" of specific operational activities such as offices, laboratories, information technology, transport and procurement. Both sets of parameters are addressed in Section 3, Tools for delivering transformation.

1.5.2 ECONOMIC

Universities are major employers, major investors and major purchasers of goods and services. There are opportunities across all these areas for intervention, in terms of direct and indirect support for local jobs, ethical/sustainable investment and "green" procurement strategies which can help integrate sustainability along the supply chain (for example by specifying standards of environmental performance in tender documentation).

One challenge common across many nations is a declining level of public funding. Cost is a significant factor in most sustainability investment, and in some cases may appear insurmountable. However, even in situations where natural disaster or difficult economic conditions limit university budgets to the minimum necessary to keep their doors open, options to address sustainability imperatives are available. Typically these will involve the capture of savings around management of the key flows (inputs and outputs) of energy, water and materials, which can provide a buffer for future capital and operational investment in sustainability initiatives.

The risk is that senior management may welcome the savings, but be reluctant to channel any (let alone all) into new greening endeavours, thereby relinquishing the opportunity for continual improvement. The key here is management buy-in – which means a shift from a "command and control" mentality to a shared vision [29], discussed in Section 2, Strategies for initiating transformation.

Nevertheless, universities in different parts of the world, and at different stages of their life cycles, are not directly comparable – there is no "one size fits all" approach to addressing the economic dimension of sustainability. The intent of this Toolkit is to provide a conceptual framework which allows participating universities to take from it what is appropriate to their circumstances, from effectively zero cost behaviour change "housekeeping" measures to reduce energy consumption to development of institution-wide sustainable investment and procurement strategies. Indeed for any university, whatever its circumstances, logic supports a step by step approach which starts with initiatives able to generate immediate monetary savings (and gain staff, student and management support) before tackling more complex, costly or contentious matters. These opportunities are discussed in some detail in Section 3.

PROMOTING RESPONSIBLE INVESTMENT BY CANADIAN UNIVERSITIES

The Coalition of Universities for Responsible Investing was founded in 2009 to identify constructive, new approaches to bring environmental, social and governance concerns into the management of university endowments and pension funds. Focusing on Canadian universities, CURI aims to help resolve the responsible investment gap by:

- Providing multi-stakeholder solutions for investment policy development and the proactive management of beneficiary interests, through the provision of best practices, sample policies and other relevant guidance material;
- Serving as a forum where relevant stakeholders – including industry experts, students, alumni, trustees and academics – are invited to participate in innovative and collaborative initiatives including conferences, web-based discussions, outreach campaigns and networks; and
- Supporting curriculum development to advance knowledge and expertise in the field of responsible investing.
- CURI is also committed to building an international movement to connect dispersed efforts to incorporate responsible investment in universities, for example through facilitating collaboration between universities and investor coalition groups such as the Social Investment Organization, the UN Principles for Responsible Investing, and the Responsible Endowments Coalition.

http://www.curi.ca/

1.5.3 SOCIO-CULTURAL

The socio-cultural dimension of sustainability needs to be considered at two levels: internally with respect to the university's own formal and informal organisational structures;

and externally with respect to the university's relationships with the wider community. Regarding the former, the key issue is gaining support and commitment from students, academic staff, operational staff and senior management, groups whose motivations, priorities and ways of thinking and doing may be on some issues not just unaligned, but diametrically opposed.

Section 2 provides a detailed explanation of stakeholder engagement strategies to promote cross-university participation in sustainability action – and in particular, commitment from senior management. Absence of top management support precludes long-term gains. Similarly, if the university's leadership is not "walking the talk", then employees will disregard any change initiative as just "talk" [29].

Some remarks on avoiding greenwash are pertinent at this point. Greenwash refers to the not uncommon situation where an organisation makes serious claims to "green" credentials but does little or nothing to act on them. Even before making a formal commitment to sustainable development, there must be a sufficient level of organisational maturity to give confidence to the university community that decisions will be followed through. In particular:

- Is there evidence that the university has the resources to commit to implementation of sustainability programme (budget, people, time, knowledge and skills)?
- Is there a history of following up internal and external engagement with action on the issues raised?
- Does the university have efficient and effective governance and administration systems (finance, facility management, human resources, teaching and research management)?
- Are there effective, day-to-day internal and external communications channels (newsletters, websites)?
- Is the university open and transparent in its dealings with staff, students and the wider community?
- A university is by definition a teaching organisation, but is it also a learning organisation (staff development programs, internal and external benchmarking and quality systems)?

Answers to these questions may provide a useful checklist of the capacity of the institution to deliver on its promises. A lot of negative answers would suggest there are more deep-seated management issues to be addressed before taking on the additional challenge of sustainable development.

1.6. COST-BENEFITS OF GREENING

World Green Building Council reviewed evidence pertaining to cost-benefits of green buildings and listed out all possible benefits that a green building can bring to us [30]. First and foremost, building green does not necessarily need to cost more, particularly when cost strategies, program management and environmental strategies are integrated into the development process right from the start. While there can be an additional costs associated with building green as compared to a conventional building, the costs can to different extent be paid back in a building's life cycle. Specifically, green building has two major cost-benefits:

- Operating Costs: Green buildings have been shown to save money through reduced energy and water use and lower long-term operations and maintenance costs. Energy savings in green buildings typically exceed any design and construction cost premiums within a reasonable payback period.
- Workplace Productivity and Health: Research shows that the green design attributes of buildings and indoor environments can improve worker productivity and occupant health and well-being, resulting in bottom line benefits for businesses. Investing in better indoor environments can lead to better returns on one of every institute's greatest assets - its employees.

In a report by Capital E Group in U.S., it is found that health and productivity would be the most significant benefit for building green [31]. However, there is a lack of cost-benefit evidence for university campuses.

Table 1.1 summarizes university cost-benefit information from our case studies collected in this report. See more about these case studies in Chapter 8. Most of them are about energy systems through renewable energy such as PVs, and the results show that these investments in university campuses are very cost-effective.

Table 1.2 shows payback periods for each green strategies according to different case studies or reports through a web search. It shows that most green strategies can pay back less than 10 years through energy cost savings.

TABLE 1.1 EXAMPLES OF COST-BENEFITS OF GREENING IN UNIVERSITY CAMPUSES

GREEN BUILDING	INVESTMENT/COST	BENEFIT	SOURCES
GREEN CAMPUS OF TONGJI UNIVERSITY (Tongji University, Shanghai, China)	- 630kWp BIPV Systems, sewage source heat pumps, wtaer recycling projects, ect. - Campus Energy Managemengt System -Intelligent card faucets in bathhouse and dormitories	- 5.6% reduced in per capita energy use and 14.8 % reduced in per capita water use - 32.29% (Reduce energy budget about 30 M-RMB (4.8 M$) in 2011) -Reduction of 40% of electric power consumption and 30% of water consumption	-Greening University Toolkit -Slide page 14 http://www.international-sustainable-campus-network.org/view-document/256-2012-iscn-award-campus-tongji.html -Tongji University Green Campus Construction Energy saving through management approach http://www.tongji.edu.cn/sc/index.php?classid=6086
FUDAN UNIVERSITY (Shanghai, China)	-Water meters, campus e-cards (used in student and boiling rooms) -Air conditioning systems (Guanghua Building) -Elevator System (Guanghua Building	-Hot water saved by 50% -Energy saved by 18% -Energy saved by 19%	-Fudan University
SHANGHAI UNIVERSITY OF ELECTRIC POWER	- Campus energy management system (CEMS) - Micro-grid energy system - Monitoring and managing of water use	- Reduced more than20% of total energy consumptions - Save more than 20% of water	- Information provided by Dr. Yongwen YANG from Shanghai University of Electric Power,based on Acceptance report of constructing conservation campus on Ministry of Housing and Urban and Rural Development (MOHURD);
UNIVERSITY OF BRITISH COLUMBIA (UBC) Centre for Interactive Research on Sustainability (CIRS)Vancouver Campus, Vancouver, Canada)	- PV (a 25KW PV array) - Energy from the ground and scavenges heat from neighbouring buildings - Material (Constructed primarily of certified wood and beetle-killed wood) - Harvest water from the rain	- Campus energy consumption reduced 275 Mega Watt-Hours each year. -CO2 Emissions sequestered in structure 600 Tons, -Water demand supplied by rain 100%	- http://sustain.ubc.ca/research/signature-research-projects/centre-interactive-research-sustainability-cirs -http://www.greenbuildconsult.com/pdfs/case-study_CIRS.pdf

GREEN BUILDING	INVESTMENT/COST	BENEFIT	SOURCES
UNIVERSITY OF NAIROBI (Nairobi, Kenya)	-Developing and Sustaining an environmental management systems (EMS)		-http://sustainabledevelopment.un.org/index.php?page=view&type=1006&menu=1348&nr=176
PRINCETON UNIVERSITY (Princeton, USA)	- University's Energy Master Plan (established in 2008) - PV systems (5.3-megawatt solar arry online in fall 2012) -Princeton's cogeneration plant	-Annual energy savings of approximately $5.5 -Annual CO2 reductions by more than 25,000 metric tons -For the remainder of the 2013 fiscal year, provided approximately 4.5% of campus electricity, avoiding 2,250 metric tons of CO2 - 4% reduction in annual campus water usage in 2012, and 22% reduction since 2006.	- 2013 Sustainability Report Highlights http://sustainability.princeton.edu/sites/sustainability/files/450156%20Sustainability%20Highlights%20Brochure_pageview_0.pdf
BOND UNIVERSITY'S MIRVAC SCHOOL OF SUSTAINABLE DEVELOPMENT (Australia)	- Energy demand reduction systems. - PV systems.	- 40% reduction in peak demand on electricity infrastructure. - Produce around 13,500 kilowatt-hours per year	- Jim Smith and Gorge Earl - Australia's first 6-star green education building: Design and Performance, -Bond University ePublications @ Bond -http://epublications.bond.edu.au/cgi/viewcontent.cgi?article=1034&context=sustainable_development
HARVARD UNIVERSITY (Cambridge, Massachusetts, USA)	- Over 1,300 energy conservation measures (FY06-March 2014) -Renewable energy sources -Innovative water conservation technology - Integrating room scheduling with building management systems	- Save an estimated $8-9million annually - 17% electricity from renewable energy sources - 23% reduction in water use (FY06-FY13) - Decrease in energy use resulting annual savings of over $33,000	- Harvard University Sustainability Progress Report FY2013 - http://report.green.harvard.edu/sites/report.green.harvard.edu/files/Sustainability%20Progress%20Report.pdf - http://green.harvard.edu/tools-resources/case-study/integrating-room-scheduling-building-management-systems

GREEN BUILDING	INVESTMENT/COST	BENEFIT	SOURCES
	- Unified computing systems	- (500virtual guest results in) save for over $250,000, and $2.5m in capital expense avoidance for physical servers	- http://green.harvard.edu/tools-resources/case-study/unified-computing-system-implementation
UNIVERSITY OF TEXAS Student Services Building (Dallas, Texas, USA)	- Energy efficiency systems	- Energy efficiency performs 41% over ASHRAE, offering $60,000 annual electrical savings - 40% reduction in water consumption	- http://www.utdallas.edu/sustainability/ssb/ - http://www.aashe.org/files/resources/student-research/2009/supplemental_materials.pdf

TABLE 1.2 PAYBACK PERIODS FOR GREEN STRATEGIES

GREEN DESIGN		PAYBACK PERIODS	SOURCES
Green roofs		10 years	http://www.greenandsave.com/cooling/c/green_roofs.html
White roof		6.7 years	http://www.greenandsave.com/cooling/c/smart_roofs.html
Cool roof		2-3years	http://www.poplarnetwork.com/news/cost-green-roofs-what-payback-period
Photovoltaics	- Multicrystalline-silicon PV modules - Thin film modules	- 4 years - 3 years	http://www.nrel.gov/docs/fy04osti/35489.pdf
- High performance HVAC System		- 1-3 years	- http://www.distributedenergy.com/DE/Articles/HVAC_Payback_14945.aspx
- Windows	- Smart windows (RavenBrick, LLC) -ENERGY STAR® qualified 'Low-E' windows - Sun tubes	- 5-8 years - 2-3 years -6-7 years	- http://www.greensolutionsmag.com/?p=2040 - http://www.greenandsave.com/finishes/windows/windows.html - http://www.greenandsave.com/finishes/windows/sun_tubes.html
- Insulation	- Insulated walls -Insulated basement walls -Insulated double walls -Insulated ducts -Insulate attics and ceilings	-2.5 years -2.5 years -7.5 years -2.5 years -5 years	-http://www.greenandsave.com/finishes/walls/insulated_walls.html -http://www.greenandsave.com/remodeling/basements/insulated_basement_walls.html -http://www.greenandsave.com/finishes/walls/insulated_double_walls.html -http://www.greenandsave.com/remodeling/basements/insulated_ducts.html -http://www.greenandsave.com/green_remodel.html

GREEN DESIGN		PAYBACK PERIODS	SOURCES
-Floors	-Bamboo floors -Cork floors -Radiant floor -Thermal mass floors	-5years -5 years -7.3 years -7.5 years	-http://www.greenandsave.com/green_remodel.html -http://www.greenandsave.com/heating/radiant/radiant_floors.html http://www.greenandsave.com/finishes/flooring/thermal_mass_floors.html
-Rain water collection	-Rain water harvesting system (residential system) -Rain water harvesting system (commercial System)	-6 years -7.8 - 12.5 years - 3 years	-http://www.greenandsave.com/green_remodel.html -http://www.harvesth2o.com/Is_RWH_a_good_investment.shtml#.VA-cbPmSyV4 -http://www.thegreenhome.co.uk/heating-renewables/rainwater-harvesting/what-is-the-payback-period-for-rainwater-harvesting-system/
-Solar-hot water systems	-Solar-hot water system -Solar-hot water system	-8..9 years -5 years	-http://www.greenandsave.com/utilitysavings/gas/solar_hot_water.html -http://solarhotwater.siliconsolar.com/solar-hot-water-payback-periods.html
-Energy star-labeled appliances		-2 years	-http://www.greenbuildingadvisor.com/blogs/dept/green-communities/are-energy-efficient-appliances-worth-it
-Building Energy Management Systems		-Less than two years	-http://www.green-buildings.com/content/781986-building-energy-management-system-us-energy

Beautiful classic ivy clad halls
on a University Campus

CHAPTER 2

STRATEGIES FOR INITIATING TRANSFORMATION

Having established the destination, the next step is to decide how to get there. Fortunately, there is no need to "reinvent the wheel" – given the intent of this Toolkit as a resource relevant to universities worldwide, strategies and frameworks with evidenced global applicability are adopted where possible, and adapted where necessary. The focus of this Section is on the high level strategies needed to initiate a university's transition to sustainability – understanding barriers and drivers, making the commitment, establishing a vision and engaging with the university and external communities to bring it to fruition. The sources drawn on for this Section include the International Organization for Standardization, the UNEP Practitioner's Handbook on Stakeholder Engagement [33] and work done over the past two decades by organisations such as the University Leaders for a Sustainable Future (ULSF), International Sustainable Campus Network (ISCN), and Association for the Advancement of Sustainability in Higher Education (AASHE). Details for these and other similar international organisations are provided in Section 5, Resources for change.

It is stating the obvious that the transition to global sustainability requires conscious, long-term, directed effort, but the message bears repeating. It will not happen through wishful thinking. The time scale for such transformational change is frequently cited as 40-50 years, or between one and two generations. If, for instance, worldwide CO_2 emissions were halved by 2050 compared to 1990 (suggesting a reduction of at least 80% by developed countries), there is a high probability that global warming could be stabilised below two degrees [34]. The strategies introduced in this Chapter reflect this long-term perspective.

2.1 WHERE TO BEGIN?

Strategies for organisational change are often characterised as top down (management driven) or bottom up (staff driven). The best strategies usually involve a combination of both approaches; for example, adoption of a high level vision statement or policy, and initiation of low cost, high impact project(s) at a grass roots level. Improving energy efficiency is a typical example of such "low hanging fruit".

Experience worldwide has demonstrated time and again that leadership from university management at the highest level is essential to integrate sustainability into mainstream practice. Bottom-up action by staff and students is necessary, but is not in itself sufficient to bring about inclusion of sustainability in the university's core business. For development to be sustainable, it must be rooted in cultural values [35] – the bottom-up approach alone is unlikely to achieve the cultural shift which is a precondition for institutional sustainability transformation [36].

However, the top-down approach by itself is also insufficient. The decentralised and semi-autonomous nature of university entities such as departments, schools and research centres tends to encourage responsibility to the unit rather than the university, so initiatives driven solely from the top may be seen as an imposition and will be difficult to implement successfully [37].

There are three distinct constituencies in any university – students; academic staff; and administrative / operational staff. Any sustainability program which aims to achieve widespread participation must take account of the varying roles, experiences and expectations of these separate subcultures as the starting point. The evidence suggests the greatest leverage in achieving institutional change occurs when all three groups share a vision and a perception that they are working to the same end [6]. Further, once an idea has been accepted and incorporated into the system's culture and day-to-day operations it becomes difficult to dislodge, even with a change of top management [38].

Another way to manage change is to think of a university as a complex ecosystem composed of interdependent components which must be considered in their totality, together with their web of connections. This "whole systems" approach implies a condition of dynamic equilibrium in which goals, objectives, and activities are adjusted and fine-tuned in the organisation and day-to-day practical delivery of campus sustainability programs [25]. This model is the hallmark of a learning organisation.

In summary, experience worldwide confirms that a combination of top management commitment and staff and student engagement offers the best opportunity both for successful initiation and long-term performance of university sustainability programs. Table 2.1 shows some practical strategies to bring this about, addressing the substantive "tactical" aspects of making it happen, broadly in line with the ISO 14001 Environmental Management System standard as adapted for the higher education context.

TABLE 2.1 PROCESS OVERVIEW

ACTIVITY	COMMENTS
Making the commitment	This commonly includes developing a sustainability vision and/or mission statement, and/or signing a third party declaration or charter on university sustainability.
Engaging the university and wider community	Includes strategies and tactics for engaging with and securing the participation of university stakeholders (academic and operational staff and students) as well as the wider community of alumni, industry partners, government agencies, local schools and residents, etc.
Developing a sustainability policy	The university's sustainability policy is the high level driver for its short- and long-term sustainability goals.
Establishing a sustainability committee	The committee, representing staff and students and chaired by a member of senior management, is responsible for input to and review of the university's sustainability policy, objectives, targets and action plans, for final management approval.
Setting up the sustainability team	Top management should appoint a sustainability manager with sufficient authority, resources and freedom to act, who may head a professional sustainability unit and/or coordinate a team of staff and student volunteers, depending on the size and resources of the particular university.
Determining the baseline: initial environmental / sustainability reviews	This provides the starting point for prioritising issues for action (for example through application of risk assessment methods) and setting objectives and targets.
Selecting and defining indicators	Indicators enable tracking of progress towards achievement of objectives and targets. Suggested indicator themes are: energy, carbon and climate change; water use; land use; material flows; sustainability in research; education for sustainability; governance and administration; and community outreach.
Setting objectives and targets	Objectives are overall goals arising from the university's sustainability policy; targets are detailed performance requirements set to achieve the objectives. Targets should be "challenging but achievable", and should reflect the university's commitment to sustainable development and the ultimate achievement of a sustainable university.
Developing and implementing sustainability action plans	Sustainability management programs or action plans are the engine room for change. Plans are time-bound, and developed and reviewed on a regular basis in line with the sustainability targets. The plans set out in this Toolkit address the following substantive areas: Energy, Carbon and Climate Change; Water; Waste; Biodiversity and ecosystem services; Planning, Design & Development; Procurement; Green office; Green lab; Green IT; Transport
Awareness and training	Awareness building and training opportunities need to be built into every sustainability action plan.
Communications and documentation	Each sustainability action plan will need to incorporate a communications strategy to facilitate engagement of the university community and maximise the chances of success. Documentation of all aspects of the system minimises the loss of "corporate memory".
Closing the loop: monitoring, evaluating and communicating progress	This system requirement includes establishment of internal audit and management review cycles, annual sustainability reporting, and marketing promotion and celebration of successes.

2.2 MAKING THE COMMITMENT – VISIONS, MISSIONS, VALUES AND DECLARATIONS

Terms such as "vision" and "mission" may be dismissed as management jargon, and sustainability is not advanced through uncritical adherence to textbook prescriptions. Fundamentally, universities should define their own concept and definition of what a sustainable university is about [39]. However, all universities have strategic planning processes, which commonly include some kind of vision of what the university leadership (in most cases), or the university community more generally, want to see their institution become. Typically this will be some version of "the best" [40].

Envisioning exercises are sometimes conducted by local governments, universities still rely predominantly on more traditional and hierarchical methods [19] whereby vision statements are generally handed down from above. A more robust process, and certainly one which encourages ownership of the outcome, is to involve the university community through seminars, workshops, surveys etc. in the same way as local residents may be engaged in the process of developing a vision for their city's future.

ENVISIONING THE SUSTAINABLE UNIVERSITY

Universities are increasingly aspiring to be both models and catalysts of change, leading the world to a more sustainable future. Yet complex and ineffective governance, traditional disciplinary boundaries, and the lack of a shared vision often hinder progress towards this goal.

In 2007, the University of Vermont in Burlington, USA initiated an envisioning process to develop a plan to transform the university into a leader in whole systems thinking and sustainable design. The process involved 1,500 participants from the campus and the Burlington community. Participants' visions of a sustainable and desirable university were gathered through two community events and three online surveys. Analysis of the results led to the formation of a vision narrative, a sustainability charter, and guided the creation of a range of initiatives. The results suggest that when provided with sufficient and well-structured opportunities, university community members will become active participants in initiatives aimed at fostering institutional change.

By focusing on shared values and long-term goals, envisioning exercises can achieve a surprising amount of consensus while avoiding the divisiveness and polarization that often plague open-ended discussions and university governance.

Pollock, N., Horn, N, E., Costanza, R. & Sayre, M. (2009). Envisioning helps promote sustainability in academia: A case study at the University of Vermont. International Journal of Sustainability in Higher Education, 10, 343-353.

While a vision statement represents a commitment to the future rather than a decision to do something now, it provides a good starting point for policy development and a motivational focus for the university community, if the staff and students have been actively involved from the start. They must own it. A strong strategic vision helps focus attention on opportunities which support that vision [41] – beginning with the end in mind and working to achieve it step by step.

A vision statement should by definition be future oriented and ambitious [22], but it also needs to be specific enough that it is not simply a promise to be "the best". It should reflect the organisation's values and culture, and also its activities and context. Where is the university located? Is it big or small, primarily a research institution or mainly teaching focused? What are its particular teaching/research strengths? Is the campus part of a heavily built-up urban area, or spread out across a "greenfields" site? Is it a centuries old university, steeped in tradition, or was it founded in the past decade? What are its relationships with the wider community? All these present-day issues (and more) can contextualise and inform where and how the university sees itself positioned in terms of an envisioned sustainable future.

DEVELOPING A VISION STATEMENT – UNIVERSITY OF MARIBORDEVELOPING A VISION STATEMENT – UNIVERSITY OF MARIBOR

The University of Maribor in Slovenia is leading the nation's universities in introducing sustainability principles into its everyday performance, guided by its institutional vision.

The number of tertiary students in Slovenia more than doubled between 1995 and 2005, coinciding with its evolution as an independent country and admission to the European Union. In 2006 the University of Maribor established a Sustainability Council, including representatives from most departments, in response to growing interest from the university community. The Council adopted a combination of top-down and bottom-up approaches to promote the sustainability agenda, and in June 2006 proposed the following vision statement:

"To become an institution that integrates sustainable development principles into everyday activities, from achieving research and educational excellence (ranking within the first third of European universities) and to foster local, regional, and international cooperation, and spread cultural awareness and values."

The University adopted the Plan-Do-Check-Act continual improvement "Deming cycle" [42] to drive its sustainability initiatives. The Sustainability Council continues to bring together stakeholders from across the University to coordinate and foster sustainability projects.

Lukman, R. & Glavi , P. (2007). What are the key elements of a sustainable university? Clean Technologies and Environmental Policy, 9: 103-114.

VISION, MISSION AND VALUES

With more than 300 member, the Environmental Association for Universities and Colleges (EAUC) www.eauc.org.uk strives to lead the way in bringing sustainability to the business management and curriculum of institutions across the UK and further afield. As well as its vision and mission, the EAUC website sets out the Association's foundational values:

Our Vision
Our vision is a tertiary education sector where the principles and values of environmental, economic and social sustainability are embedded

Our Mission
The EAUC will lead, inspire and support Members and stakeholders with a shared vision, knowledge and the tools they need to embed sustainability and facilitate whole institution change through the involvement of everyone in the institution.

Our Values
Leadership and Service for Sustainability
Leading, as a role model, we inspire change and challenge unsustainable practice

Partnership and Independence
Benefiting from our independent position we value collaborative networks and partnerships

Commitment and Creativity
As one team, we bring a potent mix of optimism, determination, innovation and dynamism to solving problems

Listening, Understanding and Learning
We continually learn, account for and improve our organisation through the knowledge and initiative of our members, staff, trustees and other stakeholders

Many organisations, including many universities, adopt a mission statement as well as (or instead of) a statement of their vision for the future. A mission statement helps explain the motivation for the vision; it should answer (in general terms) the questions who, what, and why, and lay the foundation for future action [36]. A mission is more pragmatic than a vision. It is about what the organisation plans to do rather than what it wants to be. It uses "doing words" (lead, educate, plan, develop...) to identify actions, and defines those areas in which action will be taken (curriculum, research, fabric and operations...).

Since the launch of the Talloires Declaration in 1990 [20], regional and international conferences, higher education associations and intergovernmental organisations such as UNESCO have developed a variety of agreements, declarations and charters on university sustainability. These represent another strategic tool available to universities choosing the path of sustainable development. As at 2011 there were more than 30 such international agreements, signed by more than 1400 universities globally [43].

Similar to a vision or mission statement, a sustainability declaration represents a high level commitment to achieving a sustainable future; as such it can offer general guidance, but is not designed to provide specific direction. Institutions pledge to implement broadly defined actions around core issues such as environmental literacy, institutional culture change, interdisciplinary collaboration and stakeholder participation. These actions may be staged for ease of implementation, for example the International Sustainable Campus Network – Global University Leaders Forum Sustainable Campus Charter [44] structures commitments into a nested hierarchy encompassing individual buildings, campus-wide planning and target setting, and integration of research, teaching, outreach and facilities for sustainability.

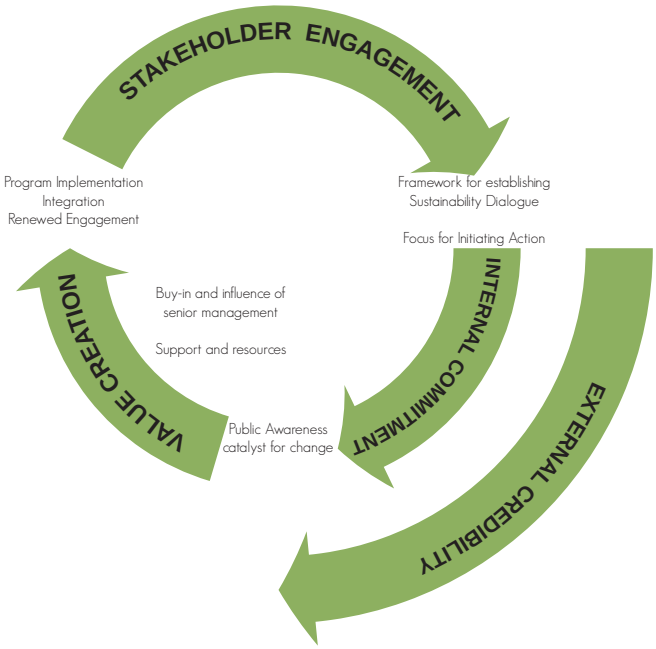
Of course signing a declaration does not of itself guarantee implementation of its commitments. Voluntary agreements by definition provide no mechanisms to enforce accountability. On the other hand, commitment to an external agreement can provide the basis for a university to develop its own internal sustainability vision and policy. Arguably, international declarations and charters have also helped to shape the growing consensus on the role of universities in sustainable development, and even national legislation [43].

2.3 ENGAGING THE UNIVERSITY (AND WIDER) COMMUNITIES

Section 2.2 above introduced the notion of top-down, bottom-up and combined strategies. In all cases, genuine engagement of academics, administrative / operational staff and students in the early stages is crucial to the successful initiation of the sustainability agenda. Indeed the organised participation of students and staff in every aspect of the sustainability transition is essential to success. Hence the strategies presented below can be employed to support and reinforce any of the practical sustainability initiatives and interventions at any stage of the journey, involving different people at different stages.

The topic of community engagement and participation is an important focus for research and teaching, and an issue for practical application in governance and the corporate sector, but universities can sometimes be reticent about practicing what they teach. But as with other aspects of greening the university, tested and effective strategies exist for motivating, informing and engaging the involvement of the university and wider communities, discussed below.

FIGURE 2.1: THE "VIRTUOUS CYCLE" OF STAKEHOLDER ENGAGEMENT. MODIFIED FROM THE GUIDE TO PRACTITIONERS' PERSPECTIVES ON STAKEHOLDER ENGAGEMENT [42]



It should be emphasised that the present discussion is about engagement to inform and promote institutional sustainability, not what is referred to as "civic engagement" or "outreach" whereby the university is promoting sustainability beyond its own institutional boundaries. The latter interpretation is outside the scope of this toolkit – although the strategies for accomplishing it are much the same as for the former.

"Engagement" describes the full scope of an organisation's efforts to understand and involve stakeholders in its activities and decisions. It includes basic communication strategies consultation exercises and deeper levels of dialogue and collaboration [45]. Stakeholder engagement in the wider world is progressing from simple informing to discussing to partnering. A similar progression is necessary in the higher education sector to drive sustainable development.

Engagement of staff and students in creating a sustainability vision or mission or around signing a declaration or developing a policy provides both a framework for dialogue and a focus to initiate action. This in turn generates credibility, encourages commitment and ultimately facilitates the integration of sustainability into institutional culture – a "virtuous cycle" (Figure 2.1).

INTERNATIONAL CAMPUS NETWORK DISCUSSES COMMUNITY ENGAGEMENT

The International Sustainable Campus Network Symposium Better Campus, Better City: Learning for a Sustainable Future took place in Shanghai during the World Expo 2010. The conference session on "Green buildings and beyond" prompted some insightful discussion on the effective integration of sustainable buildings, technologies and design elements on campuses. First and foremost, stakeholder engagement was identified as critical. Frequently difficult and complex choices must be made which impact stakeholders right across a campus. For example, at the National University of Singapore, a decision was made to air-condition common spaces and classrooms but not the dormitory rooms. As an energy saving measure, the benefits of this decision were clear; however, students needed to understand why the choice was made. Sometimes the impacts of campus development spread well beyond the physical boundaries. For example when campus transportation and mobility options are developed, the neighbourhoods around the campus will be affected, necessitating honest dialogue with local residents.

ISCN (2010). "Better Campus, Better City: Learning for a Sustainable Future", International Sustainable Campus Network Symposium, Shanghai, July 27-28.

2.3.1 INITIATING ENGAGEMENT FOR SUSTAINABLE DEVELOPMENT

The primary stakeholders are the staff and students, but within these constituencies there are of course particular groups and individuals whose involvement is critical [46]:

- University leadership – the office of the President / Vice Chancellor and the governing Council or Board, academic and operational executives;
- Key operational departments – facilities management, purchasing, IT, marketing and media, student housing, etc.;
- Academic experts in various aspects of sustainability;
- Academic and operational staff associations;
- The student association and student clubs.

In addition, the web of groups and individuals who affect, or are affected by the university and its activities [33] extends well beyond the immediate university community to include:

- Alumni, who may be scattered across the world;
- Public and private sector funding bodies, which have their own agendas and objectives;
- Government and corporate research partners, as above;
- National and international associations to which the university may belong;
- External suppliers of goods and services, for whom the university may represent a major economic development opportunity;
- School students and their families, as prospective university students; and
- The local community within which the university is situated.

The precise composition of the wider "secondary community" of university stakeholders will vary from place to place, and will certainly include members not specifically identified above. It is worth noting too that usually it is better to cast the net more widely than is absolutely necessary rather than inadvertently exclude an important group. However, it is also necessary to define and adhere to the time and resources available for the task. How extensive the engagement process needs to be will be determined by its purpose and scope – initiation of an institutional sustainability vision or policy, or the launch of an individual program or project. So a stakeholder "mapping" exercise represents a good starting point. Aspects to consider are:

- Who needs to be involved?
- Why do they need to be involved?
- How should they be involved?

Equally, who from the university is managing the engagement process – if it is initiated by staff and/or students (bottom-up), has senior management been invited to the table? And if initiated by management, has it been organised so that staff (or students) do not see it as an imposition on their already busy schedules? In either case, clear objectives are essential, and also a clear explanation of the baseline position (whether with respect to overall policy, or to a specific project, depending on the purpose of the engagement) from which it is intended to progress. Those who are being asked to get involved need to be adequately briefed.

Finally, in relation to capacity, community engagement requires resources too. Those being asked to contribute their time and energy will respond to the time and energy put into the participatory process. Whether engaging with internal or external stakeholders, those involved need to be both good listeners and good advocates. It can often be a useful strategy to utilise the services of an independent specialist facilitator where the issues are complex and often poorly defined [33], as is the case with sustainable development.

2.3.2 LEVELS AND METHODS OF ENGAGEMENT

The stakeholder engagement spectrum ranges from informing through to empowering. The table below is adapted to the university context from The Practitioner's Handbook on Stakeholder Engagement, published by UNEP, AccountAbility and Stakeholder Research Associates to promote the use of stakeholder engagement worldwide as a way of advancing sustainable development goals [30]. While the focus of the Handbook is on the corporate sector and external engagement, strategies are easily modifiable to suit other types of organisations. (Table 2.2)

TABLE 2.2: LEVELS AND METHODS OF STAKEHOLDER ENGAGEMENT, MODIFIED FROM THE PRACTITIONER'S HANDBOOK ON STAKEHOLDER ENGAGEMENT [33].

LEVEL	GOAL	COMMUNICATION	RELATIONSHIP	TYPICAL METHODS
Inform	Inform or educate stakeholders.	One-way.	"We will keep you informed."	Newsletters, brochures, displays, websites, presentations.
Consult	Gain information and feedback from stakeholders to inform decisions made by management.	Limited two-way – views solicited and provided.	"We will keep you informed, listen to your concerns, consider your insights, and provide feedback on our decision."	Surveys, focus groups, workshops, "toolbox" meetings, standing advisory committee, online feedback and discussion.
Involve	Work directly with stakeholders to ensure their views are understood and considered in decision making.	Two-way, learning takes place on both sides.	"We will work with you to ensure that your views are understood, to explore options and provide feedback about how stakeholders' views influenced the decision making process."	Multi-stakeholder forums, advisory panels, consensus building processes, participatory decision making processes.
Collaborate	Partner with or convene a network of stakeholders to develop mutually agreed solutions and joint plan of action.	Two-way, or multi-way between the university and stakeholders. Learning, negotiation, and decision making on both sides. Stakeholders work together to take action	"We will look to you for direct advice and participation in finding and implementing solutions to shared challenges."	Joint projects, voluntary two-party or multi-stakeholder initiatives, partnerships. In the university context this may involve partnerships with student or staff associations, local NGOs, etc.
Empower	Delegate decision making on a particular issue to stakeholders.	New organisational forms of accountability: stakeholders have formal role in governance or decisions are delegated to stakeholders.	"We will implement what you decide."	Integration of stakeholders into governance structure (note that many universities already include staff and student representatives in governing bodies, but their influence may be nominal).

Higher level engagement makes for greater opportunities for transformation. In practice, the three lower levels – Inform, Consult and Involve, and their associated methods – are most appropriately applied during the early stages of consolidating commitment, articulating a vision and formulating a policy. The two higher levels – Collaborate and Empower – are more relevant to the implementation of a comprehensive sustainability program. In particular empowerment necessitates governance structures of a distinctly new type, appropriate for an organisation well advanced along the transition to sustainability.

Table 2.2 demonstrates that methods of engagement should reflect the intended objectives [33]. They must also take into account local circumstances, and acknowledge that each method has both strengths and weaknesses.

For example web or email based feedback or discussion facilities may be convenient for engaging with staff and students, but online approaches may exclude members of the external community without internet access. Surveys (verbal, written or online) are very helpful to establish a baseline and identify issues of concern. However, they are essentially a one-way means of communication and must be well designed and the results carefully analysed if they are to elicit useful information. Focus groups are effective for in-depth investigation of a particular topic but may favour expertise over representativeness, while larger public meetings can encompass a variety of issues but may feel intimidating for some participants. A useful "hybrid" method is the single-issue forum, which enables a wider group of participants to focus on more tractable subsets of a complex whole.

Once the university's sustainability commitment and vision have been defined, a SWOT analysis may be used to identify institutional strengths, weaknesses, opportunities and threats which can help or hinder progress towards achievement [46]. Advisory panels or committees are particularly valuable during the practical implementation stage.

These methods are best understood as complementary – they are designed to achieve different outcomes and are applicable at different stages, but appropriately combined can present a comprehensive and transformative approach.

The Association of University Leaders for a Sustainable Future (ULSF) has developed a university Sustainability Assessment Questionnaire [47], which is discussed further in Chapter 4 in relation to the development of a performance "scorecard". The issues raised in the questionnaire can also serve as helpful prompts during the early stages of establishing a commitment and vision, to initiate engagement around what constitutes best practice. Table 2.3 summarises the main sustainability criteria targeted by the ULSF.

One of the most perceptive questions / prompts is:

> "What do you see when you walk around campus that tells you this is an institution committed to sustainability?" [47].

Equally it could be asked: "What do you see when you walk around campus that suggests opportunities for improvement and action?" A guided campus walk is simple and instructive engagement strategy for observing and assessing (at a very general level) what is, as a guide to considering what could and should be.

2.4 INITIATIVES AND NETWORKS

2.4.1 INTERNATIONAL SUSTAINABLE CAMPUS NETWORK

The International Sustainable Campus Network (ISCN) provides a global forum to support leading colleges, universities, and corporate campuses in the exchange of information, ideas, and best practices for achieving sustainable campus operations and integrating sustainability in research and teaching. The ISCN is managed by the network's Secretariat, operated by Sustainserv Inc., and its strategic development is guided by a Steering Committee including representatives of the five schools who generously host the ISCN: EPF Lausanne, ETH Zurich, Nanyang Technological University, National University of Singapore, The University of Hong Kong.

The ISCN promotes continuous improvement through learning and innovation on all aspects of sustainability on campus. Key goals in this respect are summarized in the ISCN-GULF Sustainable Campus Charter, which is complemented by a detailed Charter Guidelines document. The Charter was developed to support universities in setting targets and reporting on sustainable campus development goals and performance. The Sustainable Campus Charter is disseminated in collaboration between the International Sustainable Campus

TABLE 2.3: UNIVERSITY SUSTAINABILITY PROMPTS FOR COMMUNITY ENGAGEMENT, ADAPTED FROM ULSF SUSTAINABILITY ASSESSMENT QUESTIONNAIRE [47].

DIMENSION	TOPIC FOR DISCUSSION
Curriculum	Courses which address topics related to sustainability Integration of sustainability into traditional disciplines Learning about the campus as a socio-environmental system
Research and scholarship	Staff and student research and scholarship relating to sustainability Interdisciplinary structures for sustainability research, education and policy development
Fabric and operations	Building construction and renovation Energy and water conservation Waste minimisation Sustainable food programs Sustainable landscaping Sustainable transportation Green purchasing Minimisation of toxic materials Environmental / sustainability auditing Integration of operational practices with learning and teaching
Staff development and rewards	Sustainability criteria for hiring and promotion Staff development opportunities
Outreach and service	Sustainable community development at regional, national and international levels Partnerships with schools, local government and local business
Student opportunities	Orientation on sustainability for students Student environmental centre Student groups with sustainability focus Career counselling focused on sustainability Student involvement in campus sustainability initiatives
Administration, mission and planning	Commitments to sustainability in terms of reference for university organisational units Positions and committees dedicated to sustainability issues Staff orientation programs Socially responsible investment practices Regular environmental audits Sustainability related events

Network (ISCN) and the Global University Leader Forum (GULF) convened by the World Economic Forum, which provides universities and corporations a common framework to formalize their commitments and goals on campus sustainability, and a platform to publicly share achievements within a group of peer and leading organizations around the globe..

To address sustainability holistically, the Charter structures campus commitments about sustainability into a nested hierarchy encompassing individual buildings, campus-wide planning and target setting, and integration of research, teaching, outreach and facilities for sustainability. Three corresponding principles, each with supporting explanatory texts, are at the core of the Charter. Charter Reports will be made public via the ISCN website and are expected to be submitted to the ISCN-GULF Sustainable Campus Secretariat annually, unless there is a compelling reason for a different reporting frequency by the organization in question. The Charter Report should begin with a brief introduction including a description of the signatory institution, its mission, key characteristics, and governance structure. Including, for example, Name, Location and regions/markets served,

Key activities/services, Size, Operational and governance structure, Ownership/funding basis, etc. There are three basic pprinciples for the report: Principle 1: To demonstrate respect for nature and society, sustainability considerations should be an integral part of planning, construction, renovation, and operation of buildings on campus; Principle 2: To ensure long-term sustainable campus development, campus-wide master planning and target setting should include environmental and social goals; Principle 3: To align the organization's core mission with sustainable development, facilities, research, and education should be linked to create a "living laboratory" for sustainability. For more information about the ISCN and its Charter, please refer to: http://www.international-sustainable-campus-network.org/.

2.4.2 CHINA GREEN CAMPUS NETWORK

To strengthen the communication and cooperation in the construction of green campus in China, to establish a platform for sharing and complementation of experience and source, and to lead and promote the sustainable development of the construction of green campus, the China Green Campus Network (CGUN) was established and held by Tongji University and the participation of more than 10 members including Zhejiang University, South China University of Technology, Jiangnan University, Tianjin University, Chongqing University, Shandong Jianzhu University, The Hong Kong Polytechnic University, China Architecture Design and Research Group and Shenzhen institution of Building Research. After a serious discussion, all the organizations reached the agreement to establish the CGUN so as to enhance exchanges, integrate resources, provide suggestions for governmental policy decision and promote the green campus construction of Chinese universities. The purpose of CGUN is to reinforce communication, integrate resources and enjoy the experience. Thus, our network can provide support for government policy decision, serve the whole society, deepen the construction of green campus and promote the development of green campus in China.

The primary missions of CGUN are to deepen the collaboration and communication among universities in the construction of green campus, to offer advice for government's policy decision in energy consumption management, to promote the innovation, collaborative research and popularization of green architecture, to cultivate advanced talents in green campus construction and green architecture energy consumption management, to provide practice and demonstration base to develop the green campus culture, to guide the development of green campus culture and construction. The president position of the network practices a rotation system, which is held by the president or vice president of universities. Supported by Tongji University and Energy Foundation, the network secretariat is located in Tongji University. The network consists of 11 subcommittees, which are in charge of promoting work of different aspects. Figure 2. 2 shows the members of the CGUN. Since its establishment, the scale of CGUN has been expanding quickly. The first batch of members of the network in 2011 consisted of 10 units, including 8 universities and 2 research institutes. After 2 years' development, the current members of the network has grown to 30 units, including science and engineering, comprehensive, normal and other types of colleges and universities throughout China's major climatic regions. According to the Alliance membership requirements, all members must get the acceptance of energy-saving regulatory platform, and are in the forefront of green campus construction field.

2.4.3 AFRICA GREEN CAMPUS INITIATIVE

Green Campus Initiative (GCI), is an organisation within the University of Cape Town (UCT), aiming to make UCT a sustainable and environmentally friendly institution. The initiative has its origins in the Botany Department, where Susan's work was based, but the organisation quickly grew to a campus-wide initiative. The vision of the GCI is to shift UCT towards a carbon neutral, environmentally conscious institution through the volunteer efforts of staff and students. It also aims to become a vehicle to create, support and implement green projects driven by the university community that will reduce UCT's carbon footprint and increase its use of sustainable practices.The first projects included the implementation of campus-wide recycling; the organisation of UCT's first Green Week; the Building-to-Building Roadshow initiative and the promotion and implementation of carpooling.

The project of Ridelink seeks to reduce carbon emissions by the UCT community by promoting carpooling, bicycle use and public transport. A key component is the Campus Carpooling system – an online database that matches interested students up with others who live in their area. Campus Carpooling offers

students an opportunity to save money on petrol, find parking more easily, and make new friends. The Residence Project is aimed at residents that are one of the biggest producers of waste and consumers of energy at UCT. As they are home to thousands of students, they have a significant environmental impact. The GCI has helped set up recycling in catering and self-catering residences. Kitchens in the catering residences separate dry and wet waste, while there are separate bins in self-catering residences for recyclable and non-recyclable goods. Recycling is very important at UCT – it produces up to 8 tonnes of waste on a daily basis. The GCI has been very involved with Properties and Services (management at UCT) in creating and implementing a recycling system on campus. All bins on Upper and Middle Campus have been grouped into stations and people are expected to throw their waste into the right bin. Waste is collected and taken to a sorting facility and UCT receives some of the revenue from recycled goods. Not only is recycling necessary for the open areas on UCT's campus, but within the buildings as well. The Building-to-Building campaign aims to target buildings one by one by raising awareness of environmental challenges among staff, making suggestions on how to 'green' the building (such as setting up an in-house recycling system), decreasing water and electricity consumption, and encouraging carpooling.

GCI organises events for the benefit of students on sustainable development. Such events include screenings of environmental documentary films, tree-planting days, talks and lectures by professionals in the environment field, and social events for the purpose of contact-building. This includes participation with several schools around Cape Town. See more about this initiative at: http://www.greening.uct.ac.za/.

FIGURE 2.2: MEMBERS OF CHINA GREEN CAMPUS NETWORK

Heinz Chapel on the Campus of the University of Pittsburgh in Pennsylvania

CHAPTER 3

INDICATORS

3.1 SELECTING AND DEFINING INDICATORS

What gets measured gets managed. Measurement of progress against agreed performance indicators enables a university to benchmark against others, but more importantly, against the sustainability targets it sets for itself [48].

Indicators provide the mileposts on the journey to sustainability. As such, they need to fulfill certain criteria. The World Health Organisation [49] points out that the criteria used to select a particular indicator depend on the purpose of that indicator. Indicator selection is thus both a technical and a normative decision; linking the two provides an opportunity to facilitate dialogue and learning, which "provides the foundation for developing shared meanings of sustainability, the role of indicators, and how they will function" [50].

Sustainability indicators need to incorporate, but go beyond, considerations of "eco-efficiency" (or environmental performance). An eco-efficiency energy indicator, for example, would measure energy conservation – a sustainability indicator would record total greenhouse gas emissions against a goal of zero. The difference is between incremental and systemic change; eco-efficiency ends with the incremental, sustainability integrates both [48].

Indicators may also be grouped and weighted to form indices of environment or sustainability performance. Ecological footprint analysis (the amount of land necessary to provide the necessary resources and assimilate the wastes and pollutants generated by a population [51]) is a well-known index which has been extended from its original role in comparing national and regional impacts to include application to public and private sector organisations, households and the comparison of consumer products. It has also been adapted to focus on specific criteria of environmental concern, for example carbon and water footprints.

The advantage of the ecological footprint lies in the comprehensibility and educative value of the measure; the disadvantage is that despite extensive data collection and analysis requirements, the end result is a metric which enables comparability between places, but not a high degree of accuracy. It is not discussed further here – a wide range of online and other resources is available for those wishing to explore and apply footprint analysis in their institutions.

The development of an indicator set typically proceeds from the general to the particular: from the overall concepts to the main themes, to the specific, measurable indicators. The themes serve to organise and contextualise the indicators. More detail on the process of indicator selection, which as suggested above, should involve a participatory dialogue with the university community – is given in the Technical Appendix.

The biophysical aspects of university sustainability can be condensed into four key themes, as noted above: energy use, water use, land use and material flows. Although climate change crosses multiple themes, for ease of data collection and reporting it is included here with energy, to create a theme of "Energy, carbon and climate change". In addition to the themes where physical outcomes are directly measureable, there are a further four themes which relate to more qualitative (but indirectly measurable) aspects of change: research, learning and teaching (education for sustainability), governance and administration and community outreach (Table 3.1). The "range of variables" column indicates potential areas for the definition of quantitative or qualitative indicators (Table 3.2).

The focus of this Toolkit is on the sustainable planning, design, development and management of the university campus as distinct from the core business of teaching, research and outreach, which is the subject of a separate initiative by UNEP's Environmental Education and Training Unit (Higher Education Guidelines for Curriculum Review and Reorientation towards Sustainability). Hence the indicators proposed here will be restricted to the four themes which encompass the physical aspects of university sustainability, together with the critical enabler – governance and administration.

Every university has its individual goals and priorities, and every university exists in a national and regional context, as has been emphasised throughout the Toolkit. Hence

TABLE 3.1: SUSTAINABILITY ASPECTS AND IMPACTS, SIGNIFICANCE AND POTENTIAL MANAGEMENT RESPONSES IN RELATION TO THE MAINTENANCE OF CAMPUS GROUNDS.

ACTIVITY	ASPECT	IMPACT	SIGNIFICANCE	MANAGEMENT
Grounds Maintenance	Water Use	Resource depletions	Depends on climate and geography- will be of major significance for some sites.	-Use recycled water and/or captured rainwater -Select low water requirement plants.
	Fuel use	Resouce depletion GHG emissions Air pollution	Depends on extent of mechanised maintenance, impacts likely to be moderate.	-Substitute biofuels for fossil fuels -Purchase fuel-efficient equipment -Reduce use of mechanical equipment -Improve equipment maintenance, training.
	Fertiliser use	- Resource depletion -Damage to soil structure -Runoff / eutrophication	-Impacts generally moderate, but may be more significant where a university is located near sensitive natural ecosystems	-Replace artificial fertilisers with organic products
	Herbicide / pesticide use	- Resource depletion - Effects on non-target species - Runoff / water pollution - Spillage	- Generally as above; however the impact of a spill may represent a major risk	- Reduce chemical use - Substitute non-persistent for persistent chemicals - Improve chemical safety – storage, handling, training
	Biodiversity and ecosystem services	Biodiversity and ecosystem services may be maintained, enhanced or reduced, depending on maintenance regime	Positive or negative impacts range from relatively low to high, depending on location (urbanised vs. natural ecosystems)	- Specify local native species - Preserve significant vegetation during building works - Avoid monocultures - Avoid environmental weeds
	Soil disturbance	- Erosion - Compaction - Dust	-Generally low, but may be moderate, again depending on location	- Apply mulch - Use no-till methods
	Garden organics (green waste)	-Reduction of landfill space -GHG emissions -Impacts of transport to landfill -Land and aquifer contamination -Production / use of compost	-Moderate negative impacts from landfill, but these will increase as landfill space runs out in many regions -Moderate positive impact of composting	- Process garden organics to generate mulch and compost
	Campus amenity	-Impact on work/study environment, productivity, quality of life	-Moderate positive impacts	-Continually improve maintenance standards, training
	Local employment	-Impact on local economy	-Range from low to relatively high, depending on location	-Hire grounds staff from local area

TABLE 3.2: POTENTIAL THEMES AND INDICATIVE MEASUREABLE VARIABLES RELATING TO UNIVERSITY SUSTAINABILITY.

THEME	INDICATIVE RANGE OF VARIABLES
Sustainability in research	Grant funding, publications, conferences and seminars, commercialisation
Education for sustainability	Cross-disciplinary courses, sustainability literacy, curriculum integration
Governance and administration	Sustainability policies, environmental management plans and systems, environmental auditing, recruitment and staff development, ethical investment, local economic development, student access and equity
Community outreach	Service learning, collaboration with other institutions, community development projects
Energy, carbon and climate change	Operational energy, embodied energy, transport energy, greenhouse gas emissions
Water use	Potable water, water reuse, rainwater collection
Land use	Green buildings, space planning, ecosystem services, biodiversity
Material flows	Contract specification and evaluation, supply chain management, life cycle assessment, waste minimisation, air and water pollution

to suggest a "one size fits all" indicator set would be inappropriate and unworkable. However, there are clearly a number of core indicators – such as carbon emissions – which are relevant to all universities. Each university can supplement these core indicators with additional metrics which measure particular attributes which the university community deems are worth tracking on its journey towards sustainability.

Table 3.3 lists a recommended core set of indicators of environmental performance, which are identified as relevant and applicable to almost all universities, irrespective of size or location (one minor exception include use of natural gas, which will be irrelevant to some). The task of collecting the initial baseline data should be used to develop an effective procedure for regular data collection to inform action planning and target setting – annually for most indicators, and typically monthly for energy, water and waste.

In addition to these biophysical metrics, the following management indicators are recommended as a basic core on which individual universities can build. These are adapted from the University Leaders for a Sustainable Future Sustainability Assessment Questionnaire for Colleges and Universities [47].

- Existence of a university Sustainability Policy
- Existence of a Sustainability Management Plan
- Existence of a Sustainability Steering Committee or equivalent institution-wide strategic body
- Responsibility for oversight of sustainability matters allocated to member of senior management
- Appointment of a Sustainability Manager or equivalent position
- Orientation programs on sustainability for academic and operational staff
- Existence of socially responsible purchasing and investment practices and policies
- Regularly conducted environmental audit.s.

A new initiative that was launched at the Rio + 20 Conference, the Higher Education Sustainability Initiative, sets out similar core criteria with respect to teaching and research, campus greening, community outreach and also sharing knowledge through international frameworks such as the UN's education and training structures. (http://www.uncsd2012.org/rio20/index.php?page=view&nr=341&type=12&menu=35)

3.2 EXAMPLES OF INDICATORS

Javier Benyas defined indicators and sustainability assessment in Spanish and Latin American universities [52]. It covers three areas: leadership and governance, teaching and research, and states and operation. In the area of leadership and governance, there are three major indicators: politics and sustainability assessment, engagement and awareness of the university community, and social responsibility, relationships/engagement towards society. In the area of teaching and research, the two major indicators are teaching and research and transfer of technologies. In the area of states and operation, there are seven major indicators: urban planning and biodiversity, energy, water, mobility, waste, green purchase and impact assessment. Under each major indicators, there are hundreds of sub-indicators. See more at http://www.slideshare.net/ISCN_Secretariat/javier-benayas-metrics.

TABLE 3.3: RECCOMENDED CORE UNIVERSITY ENVIRONMENTAL PERFORMANCE INDICATOR SET.

ELEMENT	METRIC	UNITS*	COMMENTS
Energy, carbon and climate change	Scope 1 and 2 greenhouse gas emissions	tCO2e/capita	Measurement of Scope 1 & 2 emissions disaggregated to source is regarded as the minimum requirement. Best practice will include Scope 3.
	Electricity consumption	kWh/m2 floor space kWh/capita	In most cases, this will be the largest contributor to a university's GHG emissions. Proportion of electricity derived from onsite and/or renewable sources should be separately recorded.
	Natural gas consumption	GJ/m2 floor space GJ/capita	Any natural gas used in cogeneration and trigeneration should be separately recorded.
	Transport energy consumption	kL fuels Passenger kilometres	Minimum requirement for measurement is the university vehicle fleet. Best practice will include air travel and commuter travel modal split.
Water use	Potable and non-potable water consumption	kL/m2 floor space kL/capita	Should include consumption of collected rainwater and any other sources of water reuse.
	Wastewater production	kL/capita	Volume of greywater and blackwater which is reused is captured by the previous indicator
Land use	Proportion of certified green buildings by floor area	m2/m2	This indicator is assumed to integrate the workplace health, environmental and productivity benefits of green buildings.
	Proportion of pervious / impervious surfaces	m2/m2	Proxy metric for anthropogenic impact on hydrological cycles and urban microclimate.
	Vegetation cover	m2/m2	Proxy estimate of vegetation ecosystem services. May be supplemented by measurement of leaf area index (LAI) which enables a more refined estimate (see Technical Appendix).
Material flows	Solid waste disposal	kg/capita	Can be disaggregated into categories, e.g. municipal solid waste, construction and demolition, hazardous, e-waste, etc.
	Solid waste recovery	kg/kg (diversion rate)	Can be disaggregated into material types where required.
	Material use	kg/capita	Typically one or a few representative materials such as paper will be selected. Best practice will require a more comprehensive material balance.

*Given as SI units here, actual units employed will depend on country. Note that "per capita" refers to the total population of the university (staff + students).

The Sustainability Tracking, Assessment & Rating System (STARS) is another important example of green campus indicators. It is a voluntary, self-reporting framework for recognizing and gauging relative progress toward sustainability for colleges and universities. It is designed to provide a framework for understanding sustainability in all sectors of higher education; to enable meaningful comparisons over time and across institutions using a common set of measurements developed with broad participation from the campus sustainability community; to create incentives for continual improvement toward sustainability; to facilitate information sharing about higher education sustainability practices and performance; and to build a stronger, more diverse campus sustainability community. STARS encompasses long-term sustainability goals for already high-achieving institutions as well as entry points of recognition for institutions that are taking first steps toward sustainability [53]. There are three major categories in STARS: Education and Research, Operations, Administration, Planning and Engagement. Under each category, there are many indicators and sub-indicators. For further using these indicators, please refer to https://stars.aashe.org/.

UI GreenMetric World University Ranking bases on a broad philosophy that encompasses the three Es: Environment, Economics and Equity. The selected criteria are generally thought to be of importance by universities concerned with sustainability. These include the collection of a basic profile of the size of the university and its zoning profile, whether urban, suburban, rural.

The next category of information concerns electricity consumption because of its link to our carbon footprint. Then the ranking also wants to know about transport, water usage, waste management and so on. Beyond these indicators, the ranking gets a picture about how the university is responding to or dealing with the issue of sustainability through policies, actions, and communication. Scores are simple counts of things, or responses on a scale of some sort. Each of the criteria are categorized in a general class of information and when the results are processed, the raw scores will be weighted to give a final calculation. Basically, there are six criteria: Setting and Infrastructure, Energy and Climate Change, Waste, Water, Transportation and Education. Under each criterion, there are many indicators. The whole list of the indicators can be found at: http://greenmetric.ui.ac.id/.

There are some important indicator systems that dedicate to rating large-scale infrastructure and can be used to rate university facilities. For example, IS Rating Tool that is a scheme for infrastructure is developed and administered by the Infrastructure Sustainability Council of Australia (ISCA). IS is Australia's only comprehensive rating system for evaluating sustainability across design, onstruction and operation of infrastructure. The IS rating tool uses a framework consisting of 15 categories within 6 broad themes. This framework was developed through industry engagement and working groups. In addition to seeking formal ratings, this framework is being used to develop project sustainability plans. More information can be found at http://www.isca.org.au/is-rating-scheme/is-overview/is-rating-tool.

3.3 HOW TO USE INDICATORS

In general, an optimal indicator set can be described in terms of several desirable characteristics (for example the five characteristics comprising the well-known "SMART" model (Simple, Measurable, Accessible, Relevant and Timely). A more detailed consideration of indicator selection is given in the Bellagio Principles concerning selection of sustainability indicators [54]. Table 3.4 outlines a set of five characteristics of an optimal indicator set derived from a synthesis of the SMART test and the Bellagio Principles, together with the detailed criteria which define these characteristics.

Multi-criteria analysis has proved to be a useful method to achieve broad agreement around a suitable indicator set. A typical definition of multi-criteria analysis is "a decision-making tool developed for complex multi-criteria problems that include qualitative and/or quantitative aspects of the problem in the decision-making process" [55] or simply, a tool for comparative assessment of options, accounting for several criteria simultaneously. The key advantages of MCA are that it directly involves stakeholders in decision making, obliges users to think holistically as well as within their discipline, and enables consideration of a large number of criteria.

The characteristics of a good indicator are not necessarily equally important, hence each is given a percentage weight to indicate its relative importance – i.e. the higher the weighting, the more significant the particular characteristic in helping to select an optimal indicator set. The combined weights must add up to 100%, and the first task of the indicator selection team is to identify the relative (weighted) importance of each characteristic. Note that in MCA these characteristics are often referred to as categories.

These characteristics/categories tend to be multi-dimensional, therefore each is best described in terms of a number of specific criteria which together provide a full explanation of the given category. So the next stage is to score each potential indicator against the individual criteria associated with each category. This involves the application of a numerical rating from 1 to 5, where the higher the score, the more closely the indicator aligns with the given criterion.

The MCA method proposed here is a simplified weighted sum model which assigns a numerical value to each indicator based on multiplying the category weights by the sum of the scores for each of the criteria. The weighted category values are then summed to give a final numerical value for the indicator:

$$V(q) = \sum_i \left(W_i(q) \sum_i S_i(q) \right)$$

where V(q) is the numerical value for indicator q, W(q) is the category weight and S(q) is the criterion score for each indicator.

When these calculations have been completed for all indicators, the final stage of the process is to rank the indicators from highest to lowest priority according to their numerical values. A cut-off point may then be applied, with indicators falling below this point being discarded. Note that the calculated numerical values are relative (i.e. to enable ranking), not absolute.

TABLE 3.4: CHARACTERISTICS AND CRITERIA TO INFORM SELECTION OF SUSTAINABILITY INDICATORS.

CHARACTERISTICS OF AN OPTIMAL INDICATOR SET	CRITERIA WHICH QUALIFY AND EXPLAIN THE CATEGORIES	UNITS*
Purposefulness	-Focused -Implementable -Meaningful	-Guided by and contributes to a clear vision of "triple bottom line" sustainability -Can be linked to discrete objectives and targets -Able to provide pertinent feedback to decision makers
Efficiency	-Simple -Accessible -Practical	-Easily interpreted and monitored -Data are already collected or institutional capacity exists for easy collection -Measurement is standardised to facilitate comparison
Effectiveness	-Measureable -Relevant -Timely	-Statistically verifiable, reproducible and shows trends -Directly addresses agreed issues of concern -Able to capture change at the relevant timescale to determine trends
Communicability	-Clear -Transparent -Explicit	-The information conveyed can be understood by a wide range of users -Data collection and analysis methods are readily comprehensible -Uncertainties in data and interpretation can be made apparent and minimised
Responsiveness	-Adaptable -Scalable -Replicable	-Responds to change and uncertainty -Aggregated city scale data are valid at State and national scale -Data collection and analysis methods can be repeated across different urban jurisdictions

This toolkit notes that what gets measured, gets managed. Energy, water, materials and ecosystem services represent four critical dimensions of sustainability which are amenable to measurement – in the last-mentioned case, through "proxy" metrics such as vegetation coverage or leaf area index (defined as the leaf area of a plant divided by the projected canopy area). Some straightforward methods for setting and quantifying indicators, objectives and targets to support the transition towards sustainability across these four areas are discussed below.

Identify current operational stationary energy use Eo including both conventional (Ec) and renewable energy (Er):

Eo = Er + Ec

Identify year to achieve 100% renewable energy goal (zero net operational greenhouse emissions):

Eo = Er

Set intermediate percentage targets (annual, biannual etc) for the proportion of energy derived from renewable sources towards the final goal of 100%, where:

$$T = \frac{E_r}{(E_r + E_c)}$$

$$\lim_{T \to 1} f(T) = E_o$$

entify current operational stationary energy use Eo including both conventional (Ec) and renewable energy (Er):

WATER USE

Identify current operating water use Wo including external potable supply We and any recycled/reused water Wr (i.e. captured rainwater, greywater and blackwater)

Wo = We + Wr

Water sustainability is most appropriately assessed at the watershed (catchment) level, so the next step is to identify the catchment in which the university is located, determine its spatial extent and human population, and the average precipitation rate (which controls the basic rate of supply) [56]. Sustainable use may be defined as staying within the sustainable yield of the catchment Ys such that

Ys ≤ R

where R = recharge rate for the watershed (precipitation minus evapotranspiration).

For a given catchment the amount available for non-residential usage N is:

N = R – CP

where C = adequate minimum standard of per capita water use, and P = population.

Several different amounts have been proposed to meet the basic needs for drinking, sanitation, bathing and cooking, ranging from 50 litres per person per day [57] to 100 L/p/d [58]. Users of this toolkit should enter a value appropriate to the location and context of their university.

As disaggregated data for non-residential water uses (agricultural, industrial, etc) are frequently unavailable, land area may be used as a proxy for non-residential water allocation. Thus the external sustainable water allocation Ws for a university may be calculated based on the land area occupied by the university Au minus the area occupied by university housing Ah, divided by the total non-residential land area of the catchment An:

$$W_s = \frac{(A_u - A_h)}{A_n} N + CL$$

Where L represents the number of students living on campus.

The final step is to identify the year to achieve sustainable operational water use such that:

Wo ≤ Ws + Wr

As this goal can be achieved by a combination of reducing consumption of externally sourced water and increasing the proportion of internally reused/recycled water, intermediate targets may be set for either or both of Ws/We and Wr/Wo as per the methodology outlined above for operational energy.

MATERIAL FLOWS

A university's use of materials may be defined in terms of inputs (procurement of equipment, consumables, building materials etc), stocks (the existing inventory of such items) and outputs (solid waste and recyclables). Inputs and outputs are collectively regarded as material flows.

Material flow analysis (MFA) is "the systematic assessment of the flows and stocks of materials within a system defined in space and time" [59] to help quantify the environmental impacts of human activities. It developed out of mass balance (input-output) methods traditionally used in chemical and process engineering. MFA is predicated on the conservation of matter when subjected to physical or chemical transformative processes:

$$\sum_{k_I} m_I = \sum_{k_O} m_O + m_S$$

where m represents mass, k represents the number of flows, I refers to input, O to output, and S to storage (accumulation or depletion of materials).

A bulk MFA typically requires collection of an extensive materials inventory. On the other hand, a "streamlined" MFA, restricted to quantification of the stocks and flows of selected, representative goods (defined as substances of positive or negative economic value), can supply sufficient data to enable an initial estimate of environmental impact [60], and support the development of targets to reduce that impact.

Applying MFA to built form, stocks equate to the total mass of construction materials, which may be disaggregated by material type – concrete, steel, glass etc. This may be quantified in relation to building volume, gross floor area, number of occupants, activities etc for a given time period. Inputs include raw materials and prefabricated or manufactured components, and outputs include wastes and pollutants, some of which may be recycled (Figure 3.5).

The building life cycle can thus be characterised as a set of mass balance equations [60]:

For the construction phase:

$$\sum_{j=1}^{n} S_j = \sum_{j=1}^{n} I_j - \left(\sum_{j=1}^{n} Rcon_j + \sum_{j=1}^{n} Wcon_j \right)$$

where stocks = inputs minus outputs; S_j represents the stock of material j in the building fabric, I_j is the input of j to the new building project, $Rcon_j$ is the output of j as construction waste which is recovered, and $Wcon_j$ is the output of j as construction waste to landfill.

For the demolition phase,

$$\sum_{j=1}^{n} S_j = \sum_{j=1}^{n} Rdem_j + \sum_{j=1}^{n} Wdemj$$

where stocks = outputs; $Rdem_j$ and $Wdem_j$ refer to demolition waste which is recycled and landfilled respectively.

The construction and demolition (C&D) recycling rate Rr_j (i.e. the mass of material j recovered as a proportion of total waste) is given by:

$$\sum_{j=1}^{n} Rr_j = \sum_{j=1}^{n} \left(R_j \big/ R_j + W_j \right) = \sum_{j=1}^{n} R_j \big/ S_j$$

where R_j represents the mass of the combined C&D recycling stream and W_j represents the combined mass of C&D waste to landfill.

Finally, the composition of the C&D recycling stream Cr_j is estimated by multiplying the percentage recovery of specific building materials by their proportionate contribution to the overall mass of the given building type:

$$Cr_j = R_j S_j \sum_{j=1}^{n} S_j \Big/ S_j \sum_{j=1}^{n} S_j \sum_{j=1}^{n} R_j = R_j \Big/ \sum_{j=1}^{n} R_j$$

For each of the above equations, material densities per square metre of floor space are obtained by dividing by the gross floor area (GFA) for a given building or for the totality of buildings on the site. Where multiple buildings are selected this assumes a linear mathematical relationship, which holds only where the buildings are of similar surface area to volume ratio and share similar construction characteristics.

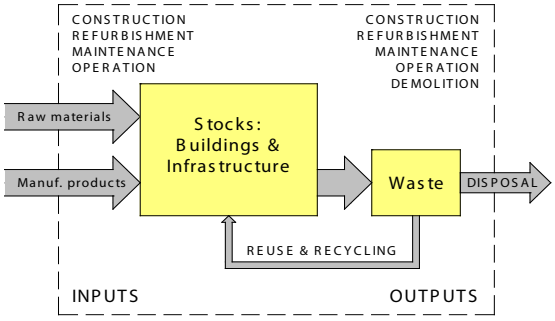


FIGURE 3.5: SIMPLIFIED MODEL FOR THE MATERIAL FLOWS AND STOCKS RELATING TO BUILT FORM. THE SYSTEM BOUNDARY (DASHED LINE) IS THE "CAMPUS ECONOMY".

Application of these equations enables calculation of the volume or mass of selected materials embodied in campus buildings, the average annual addition to and subtraction (via demolition) of materials from the existing stock of buildings, C&D recycling and landfill disposal rates and the proportional composition of the waste stream. The construction/demolition cycle also provides useful information on the durability or persistence of campus built form. Knowing the annual addition to and subtraction from the building stock enables calculation of the percentage turnover each year, and hence the average service life of the campus buildings. The material intensity of built form may be measured against the relevant services provided by campus buildings [61]. "Units of service" may be defined in terms of student numbers, degrees awarded, research income etc. In other words, how much concrete, steel, glass, aluminium, etc is required to support the core business of the university?

Given that concrete and steel have been estimated to be responsible for about two-thirds of the life cycle environmental impacts of buildings [62, 63], a "streamlined" approach limited to these two materials offers a relatively straightforward way to establish performance indicators and set objectives and targets in relation to material intensity per unit of service, average building service life and C&D waste management. The analysis is based on basic building science and on readily obtainable information on building typology, floor area and construction and demolition dates. A corollary to this form of analysis is that the role of the building as intermediary in delivering a given service becomes the focus of attention, raising the obvious questions: can the service be delivered

without the mediation of any building at all? And if not, what is the minimum material intensity necessary to do the job? For example, to what extent can a combination of online learning, improved space utilisation/scheduling, use of outdoor spaces and small group teaching in preference to large lecture theatres help to "dematerialise" the university campus [60]?

ECOSYSTEM SERVICES

The positive impacts of urban vegetation, of which campus vegetation may be considered a subset, covers the full spectrum of environmental, economic, social and cultural benefits, or ecosystem services. The amount of vegetation in a given space has typically been measured in terms of canopy coverage. Boon Lay Ong of Melbourne University in Australia has proposed a new architectural and planning metric for urban greenery, which is well suited to application on university campuses. The green plot ratio (GPR) is based on leaf area index (LAI): the GPR is simply the average LAI of the greenery on site and can be presented as a ratio similar to the building plot ratio (BPR) currently in use in many cities to control maximum allowable built-up floor area in a development [64]. LAI is an indicator of vegetation primary productivity [65], hence a more meaningful measure of the ecosystem services provided by vegetation than simple canopy coverage.

The LAI values recommended in this Toolkit, as with those proposed by Ong, are based on global LAI data compiled from field measurement over a period of nearly 70 years [66]. But whereas Ong sets his measures at 1:1 for grass, 3:1 for shrubs and 6:1 for trees, the metrics recommended here are expressed as decimal numbers rather than ratios, include paved surfaces (LAI = 0) and introduce a distinction between shrubs (LAI = 2) and small trees (LAI = 4). This gives five potential values for LAI.

The GPR method may be applied to a university campus as a whole, or to defined sites within the campus. The LAI value for each site LAIS is calculated from the formula:

$$LAI_S = \sum A(LAI_i) \times (LAI_i) \Big/ A(S)$$

i = {0, 1, 2, 4, 6}outreach

where LAIS = average LAI for the given site, A(LAIi) = area covered by elements of leaf area index i, and A(S) = total area of the site.

In similar manner to the other metrics examined in this Chapter of the Toolkit, the green plot ratio method may be used to define performance indicators for campus green space, and to set quantified objectives and targets for the step-by-step greening of the campus.

The Clock Tower on the Campus of the University of British Columbia in Vancouver, Canada

CHAPTER 4

STRATEGIES AND TECHNOLOGIES

Sustainability management programs or action plans are the engine room for change. Plans are time-bound, and developed and reviewed on a regular basis in line with the sustainability targets and corresponding strategies. Each university will have its own targets and its own prioritised strategies. The structure developed for this Toolkit integrates models from many individual universities, university associations and other organisations reported in the literature, and practical experience in preparing and implementing environmental / sustainability action plans. It is designed to address:

The core biophysical strategies on energy, carbon and climate change; water consumption; waste generation; and biodiversity protection and enhancement – which are pertinent to the great majority of the university's operations and activities;

The main activity-specific strategies on campus planning, design and development, procurement of goods and services, sustainability of offices, laboratories and IT services, and transport (university related and commuter).

Table 4.1 maps four of the five sustainability themes – energy/climate, water, land and materials – against the portfolio of management programs / action strategies. The depth of the shading indicates the strength of the connection between the theme and the plan, in other words the extent to which each plan addresses the objectives and targets set under each theme. The fifth theme – governance and administration – is implicit across all plans. Action plans for learning, teaching and research and community engagement are outside the scope of this Toolkit.

4.1 ENERGY, CARBON AND CLIMATE CHANGE

The challenge of climate change can serve as a fulcrum for institutional transformation. The ultimate necessity for carbon neutrality anticipates myriad opportunities for organisational learning across all aspects of higher education [67].

As noted above in Selecting and defining indicators, measurement of Scope 1 and 2 emissions disaggregated to source is regarded as the minimum requirement to support climate change action planning. Best practice will address at least some Scope 3 emissions1.

Development of a climate action plan – assuming the necessary policy, governance and administrative structures are in place will commence with the development of a GHG inventory. Where the focus is limited to Scope 1 and 2, this will include reference to utility billing data, and measurement or modelling of fugitive emissions of minor greenhouse gases such as refrigerants used in air-conditioning

TABLE 4.1 SUSTAINABILITY THEMES MAPPED ONTO MANAGEMENT PROGRAMS.

MANAGEMENT PROGRAMS	SUSTAINABILITY THEMES			
	ENERGY & CLIMATE CHANGE	WATER	LAND	MATERIALS
Energy, Carbon and Climate Change				
Water				
Waste				
Biodiversity and ecosystem services				
Planning, Design & Development				
Procurement				
Green Office				
Green Lab				
Green IT				
Transport				
Learning, Teaching and Research				
Community Engagement				

systems and methane produced by any farm animals on campus (information on minor GHGs is available from the Intergovernmental Panel on Climate Change website). Emission offsets such as tree planting and renewable energy credits also need to be included in the inventory. Inclusion of Scope 3 emissions will require significantly more detailed data collection – and rather than attempting to evaluate the emissions from all goods and services procured by the university, it is more practicable to start with one or a small number of high visibility examples, such as paper.

A climate action plan limited to Scopes 1 and 2 will focus mainly on energy use; inclusion of Scope 3 will extend the system boundary to include solid waste management, transport (air travel, commuting) and procurement. The Cool Campus climate planning guide [46] produced by the Association for the Advancement of Sustainability in Higher Education (AASHE) describes suitable methods for collecting and calculating Scope 3 emissions, and another NGO, Clean Air-Cool Planet, has produced a free downloadable campus carbon calculator.

The major source of campus emissions in most cases will be purchased energy, hence the primary focus of a university climate action plan will generally be on energy management. Energy management can be split into three discrete categories, which provide the framework for the energy-related elements of the climate action plan:

- Energy conservation – policy interventions and behaviour change programs;
- Energy efficiency opportunities – maintenance and capital works;
- Renewable and alternative energy solutions.

The specific detail of the actions identified under each of these headings will of course depend on the context of the individual university. Table 4.2 outlines some significant opportunities under the headings listed above, adapted from the Cool Campus climate planning guide [46] and practical experience. Note also that there will be some overlap with other action plans.

TABLE 4.2 CLIMATE ACTION PLANNING- SOME COMMON ENERGY-RELATED ACTIONS.

CATEGORY	ACTION
Energy conservation (policy and behaviour change)	Employment of Energy Manager.
	Energy efficiency standards for new construction and refurbishments.
	Energy efficiency purchasing standards.
	Staff energy conservation training.
	Improved space utilisation to avoid new construction or heating/cooling of underutilised space.
	Thermal comfort policy (e.g. widening heating/cooling temperature settings).
	Financial strategies to assign energy costs incurred – and savings achieved – to the responsible cost centres.
	Energy / climate change awareness programs – posters, stickers, events and competitions, websites, awards and incentives for switching off, reporting waste etc.
	Establishment of "energy champions" network across campus buildings.
Energy efficiency (maintenance and capital works)	Detailed energy audit to identify priority areas.
	Periodic recommissioning and building tuning to optimise energy efficiency.
	Building retrofitting – installation of external shading devices, sealing, insulation, double glazing, low emissivity window film, light coloured paint.
	Lighting – delamping, installation of high efficiency lighting fixtures, use of task lighting, lighting controls (timers/sensors).
	Heating, ventilation and air-conditioning (HVAC) – high efficiency chillers, boilers, motors, pumps and air handling units, variable speed drives, variable air volume fan systems, recommissioning, tuning and regular maintenance, heat recovery systems.
	Laboratory ventilation and fume hoods – ventilated storage cabinets for storage, variable air volume and low-flow hoods.
	Installation of building management and control systems (BMCS) and sub-metering for major building energy uses, energy use displays.
Renewable and alternative energy	Purchase of certified "green power".
	Installation of photovoltaic, wind, biomass, etc. systems.
	Installation of cogeneration and trigeneration.
	Fuel switching – conversion of electric space or water heating to natural gas.
	University managed revegetation program to offset greenhouse emissions.

1 Scope 1 refers to direct emissions, e.g. CO_2 released by burning fossil fuels on site or in university vehicles, and fugitive emissions of minor greenhouse gases; Scope 2 refers to indirect GHG emissions, resulting from purchased electricity, heat or steam; and Scope 3 refers to indirect emissions other than those covered by Scope 2, such as emissions associated with the production of goods and services purchased by the university, waste-related emissions and emissions from business travel or employee commuting in vehicles not owned or controlled by the university.

University energy management probably offers the best opportunities for achieving the "little victories" necessary to enable "systemic transformation" [6]. An important consideration here is developing a business case which itemises costs and savings. Many energy actions (like switching off lights and equipment when not in use) are effectively cost free. Others will involve upfront cost which are paid back over time – and payback calculations should take account of energy price inflation, project life span and other monetary and non monetary savings such as reduced maintenance, impacts on health or comfort and pedagogic value (life cycle cost analysis) [46].

One useful method is to establish a revolving loan fund, whereby savings accruing from energy conservation and efficiency actions (and other sustainability initiatives) are placed in an account to fund other projects.

Other potential actions to save energy and reduce greenhouse emissions can include outreach programs such as collaboration with schools, local government and community organisations; service learning activities for students; engagement in the public policy process; and programs to support students and staff to reduce their own residential energy consumption [46].

The above recommendations focus on reducing emissions from stationary energy – electricity and gas. Universities may wish to combine a suite of emission-reducing actions around transport, waste, building design, procurement, office and laboratory practices and IT into a single climate action plan, or include them in separate action plans around the abovementioned issues (which is the format given here). Either option is entirely valid.

DISTANCE LEARNING AND GREENHOUSE EMISSIONS

In the UK, distance learning requires 87% less energy and generates 85% fewer CO_2 emissions than full-time courses on campus, and part-time campus-based courses reduce energy and CO_2 emissions by 65 and 61% respectively compared with full-time [68]. The lower impacts of part-time and distance learning is due mainly to a reduction in student travel, elimination of significant energy consumption from students' housing and more efficient campus site utilisation.

E-learning appears to offer only relatively small energy and emission reductions (20 and 12% respectively) compared with mainly print-based distance learning courses, mainly because online learning requires more energy for computing and paper for printing.

The most striking finding from this project was that distance learning can dramatically reduce the energy and emissions involved in studying to only 13-15% of those arising from an equivalent full-time, face-to-face campus-based course [68]. While these outcomes are specific to a particular time and place, they suggest that university sustainability programs should be extended beyond addressing campus site impacts and greening the curriculum, and that the role of distance education should be further evaluated as a potential sustainability initiative.

4.2 WATER

Depending on location and climate, availability and conservation of adequate supplies of clean drinking water may be the most critical sustainability issue for a university. As well as conservation (policy and behaviour change) and efficiency measures (maintenance and capital works), water management for sustainability generally includes actions to reuse and recycle potable water for potable or non-potable purposes. Table 4.3 outlines some typical opportunities for managing campus water use, adapted from the University of New South Wales Water Savings Action Plan [69].

4.3 WASTE

The central objective of a university solid waste action plan is to maximise resource recovery (i.e. the proportion of solid waste stream recovered for high resource value use), with the corollary that this minimises waste disposal to landfill. The main strategy is to apply the "waste hierarchy" – avoid purchasing products which will end up as waste, repair and reuse, then recycle, and finally if there are no other options, dispose. This also recognises that environmentally preferred procurement is a major factor in avoiding waste in the first place.

Since the environmental impact of responsible waste

management is inherently beneficial, continually improving the delivery of the service itself represents a positive sustainability action. Waste management is data intensive – but unlike energy and water, there are no "waste meters" to track performance. Hence regular data collection and audits are necessary. The first step will usually be a full waste characterisation study to describe the waste stream, evaluate existing waste management practices and identify gaps, with the aim of informing the development of additional systems for avoidance, reuse and recovery.

Engagement with the university community requires a focus on best practice, accountability and transparency. Waste management systems must be more convenient to use than the alternative of throwing things away – because there is no "away". So adequate information is crucial to progressing "towards zero waste", and where dedicated off-site processing is available, it will reduce the need for user-unfriendly source separation systems on site.

The university solid waste stream is usually extremely diverse, ranging from food organics to electronic waste and laboratory glassware, and actions to deal with these varied components need to be prioritised according to impact. Table 4.4 lists some common elements of a waste management action plan.

TABLE 4.3 ACTIONS FOR WATER CONSERVATION, EFFICIENCY, REUSE AND RECYCLING.

CATEGORY	ACTION
Water conservation (policy and behaviour change)	Employment of Water Manager (can be combined Energy / Water Manager position).
	Water efficiency standards for new construction and refurbishments.
	Water efficiency purchasing standards.
	Staff water conservation training (can combine with energy conservation training).
	Financial strategies to assign water costs incurred – and savings achieved – to the responsible cost centres.
	Water conservation awareness programs – posters, stickers, events and competitions, websites, awards and incentives.
	Extension of "energy champions" network to incorporate water conservation.
Water efficiency (maintenance and capital works)	Detailed water audit and campus water balance to identify priority areas.
	Active maintenance program of early detection and repair of faulty plant, equipment and fixtures.
	Retrofitting of water saving devices – timed flow taps, waterless urinals, dual flush cisterns, eater efficient shower heads.
	Underground pipework leak detection and repair.
	Use of pervious paving.
	Specification of low water use species for campus grounds.
	Laboratory water use – mechanical vacuum infrastructure to replace use of aspirators, closed loop cooling water systems, water efficient reverse osmosis plant.
	Installation of building management and control systems (BMCS) and sub-metering for major building water uses, water use displays.
Water reuse and recycling	Capture and reuse of rainwater from roofs and other hard surfaces for non-potable uses (irrigation, laboratories, toilet flushing, cooling towers, construction works, swimming pools, etc.) – may also be treated to potable standard.
	Substitution of borewater for non-potable uses, when combined with managed aquifer recharge to ensure more water is returned to the aquifer than extracted (see also Section 7 of the Toolkit, Global exemplars).
	Installation of greywater recycling system for treatment of kitchen, laundry and shower water for non-potable uses.
	Composting toilets and urine recovery for fertiliser.
	Installation of blackwater recycling system to treat sewage for non-potable uses.
	Recovery and reuse of fire system test water, vehicle washdown water, etc.

UNIVERSITY OF VIRGINIA FOOD COMPOSTING PROGRAM

March 3, 2010 – The University of Virginia plans to expand its pioneering food composting program to two more dining halls.

Food waste from the Observatory Hill Dining Hall has been composted since November 2008. A student-run operation hauls about 2.5 tons of organic waste from the dining hall to Earlysville's Panorama Farms each week, where it is composted and sold locally as a fertilizer and soil amendment.

"We've reduced Observatory Hill's trash service by half," said Bruce "Sonny" Beale, recycling superintendent for the University. "We were picking up six to 10 tons a week. Now we are getting six to eight tons every two weeks."

A second food pulper has been installed in Newcomb Dining Hall. The pulp is placed in special 30-gallon containers, which the recycling office hauls to Panorama Farms.

"This takes landfill material and turns it into a useful product," said Jeff Sitler, environmental compliance manager at the Office of Environmental Health and Safety. "And it reduces greenhouse gases because food waste in a landfill generates methane gas. When you compost it is broken down by different microbes and does not produce methane."

He also noted that the material is composted locally and used locally in growing food and flowers. "This is a student-initiated learning tool," Sitler said. "They collect the data and write all the reports."

Report edited from http://www.virginia.edu/uvatoday/newsRelease.php?id=11152, accessed 25/3/2012

TABLE 4.4 ACTIONS TO MAXIMISE RESOURCE RECOVERY AND MINIMISE WASTE TO LANDFIL.

CATEGORY	ACTION
Policy and behaviour change	Employment of Waste Manager.
	Sustainable procurement standards which address longevity, durability, repairability recyclability and recycled content.
	Financial strategies to assign waste costs incurred – and savings achieved – to the responsible cost centres.
	Waste management awareness programs – posters, stickers, events and competitions, websites, awards and incentives.
	Programs targeting teaching and research to minimise generation of hazardous wastes.
Waste management	Waste characterisation study to identify waste stream components and prioritise response.
	Individual staged and prioritised programs for waste minimisation which address each component of the university waste stream according to environmental impact.
	Performance-based waste management contracts to specify resource recovery targets.
	In-house collection of recyclables (e.g. paper / cardboard) where practicable, to support local job creation.
	Provision of adequate storage spaces for waste and recyclables.
	Secure storage spaces for hazardous wastes to minimise risk of spillage / leakage.
Closing the loop	Campus based exchange and reuse programs – e.g. office furniture, stationery, lab equipment, computers and office equipment.
	On-site composting of food and garden organics for reuse on campus grounds.
	Campus based programs to process collected recyclables – e.g. shredding of food-contaminated paper, broken furniture, etc. for compost and mulch.

4.4 BIODIVERSITY AND ECOSYSTEM SERVICES

University campuses are located in practically every bioregion on the planet. Even in the most urbanised setting, a campus usually contains some greenery – trees, lawns and garden beds.

Costanza et al identify 17 major categories of services provided by natural ecosystems, from climate regulation to pollination and recreation [70]. They estimate these services (via economic valuation methods, which they stress are hedged by uncertainties) as worth at least $US33 trillion annually worldwide. Their valuation was in 1994 US dollars, equivalent to at least $50 trillion in today's money. Greater biodiversity enhances the resilience and productivity of these ecosystem services.

Urban spaces in particular import ecosystem services from vast areas; "Eventually, human services in urbanized areas decline as ecosystem services locally and globally are reduced by the increasing pressure posed by urbanization" [71].

Objectives for the design and management of campus green space should therefore address three distinct aspects: extending the area of vegetation where possible (which may include, for example, the installation of green roofs; increase the density of vegetation, e.g. as measured by leaf area index, i.e. available photosynthetic surface; and enhance the diversity of vegetation. Targets can be set for all three aspects. "Ecologically engineered" green infrastructure systems [72] (of which green roofs and walls are two examples) provide a means of addressing these aspects simultaneously. Similarly, development of productive landscape systems to provide food, fibre and/or timber (e.g. through permaculture design) can address the economic, social and environmental bottom lines of sustainability at the same time.

Finally, the specifically human element cannot be ignored – the design of the campus landscape should acknowledge the restorative effect of green spaces, and incorporate opportunities for quiet contemplation and relaxation, community interaction and more active recreation, to enhance health and wellbeing in an environment which can often be intense and stressful.

In relation to green infrastructure management, the key is to design in such a way as to minimise the ongoing impacts of maintenance (material and energy inputs and waste outputs). Table 4.5 outlines some potential action plan responses relating to biodiversity and ecosystem services policy, design and development.

TABLE 4.5 ACTIONS TO PRESERVE AND ENHANCE CAMPUS BIODIVERSITY AND ECOSYSTEM SERVICES.

CATEGORY	ACTION
Policy, design and development	Survey and evaluation of campus biodiversity and ecosystem services.
	Extension of campus green space (consolidation / intensification of campus buildings over time, installation of green roofs / walls).
	Increase density of campus vegetation, e.g. through additional tree planting.
	Enhance diversity of campus vegetation.
	Green infrastructure / ecological engineering projects (green roofs / walls, designed wetlands for wastewater treatment, phytoremediation of contaminated land, indoor landscapes for biofiltration / indoor environmental quality).
	Development of productive landscape systems (permaculture, aquaponics) to provide food / fibre / timber.
	Restorative and enabling landscapes for contemplation, recreation and wellbeing.
	Campus grounds and green infrastructure used in teaching and research.
Management and maintenance	Refer to Table 3.1 for typical management and maintenance actions. Note that specialised green infrastructure (green roofs, designed wetlands, etc.) require specialised maintenance, which can both provide opportunities for local job creation and valuable student learning experiences.

4.5 PLANNING, DESIGN AND DEVELOPMENT

Sustainability action plans relating to the planning, design and development of the university campus provide the greatest opportunity to support the transition to sustainability over the longer term. Campus planning enables consideration of the effective campus-wide use of space to optimise the efficiency of built form, climate-appropriate location and orientation of new buildings, the extent and overall configuration of campus green space, interaction between the campus and the wider community, and many other criteria central to sustainable development. The design of individual buildings and infrastructure offers the chance to implement and showcase best practice principles and technologies and address the university's largest single source of greenhouse emissions and other environmental impacts. Although not of the same scale, the construction process itself is a significant generator of emissions, wastes and other adverse impacts, which can be minimised through appropriate actions.

The physical, climatic and other attributes of university campuses vary enormously, but while recognising site specificity it is equally important, in facilitating implementation, not to "reinvent the wheel". So the starting point – especially for buildings – is to design and construct to the relevant "green building" rating system which applies in the given jurisdiction. The pertinent term here is "starting point". With every new university building or major refurbishment the aim should be to include at least one feature which goes beyond the requirements of the rating system, ideally drawing on the expertise of the university itself, and thereby serving to extend the definition of a "green building" within the built environment industry.

Table 4.6 sets out some generic actions for planning, design and development; detailed actions will be site-specific. Note that actions relating to biodiversity and ecosystem services may be equally appropriately included in an overall planning, design and development action plan, or treated separately – the main criterion should be efficiency of implementation in the given context.

TABLE 4.6 ACTIONS TO SUPPORT SUSTAINABLE CAMPUS PLANNING, DESIGN AND DEVELOPMENT.

CATEGORY	ACTION
Campus planning	Campus-specific sustainability objectives included in all campus planning instruments (i.e. considering climate and weather patterns, topography, geology/soils, hydrology, urban design context).
	Space planning at campus, precinct and building scale to optimise flexibility, adaptability, diversity and multifunctionality of spaces.
	Investigation of non-building solutions to accommodate university growth.
	Physical accessibility of the campus to the external community, different age groups and people with a disability.
Campus building design	Design to the appropriate green building rating system as the minimum starting point.
	Each new building / major refurbishment to incorporate at least one innovative sustainability feature beyond the requirements of the green building rating system.
Campus construction management	Construction contractors certified to ISO 14001.
	Contractor staff inducted to the university's sustainability management system.
	Management of campus construction/demolition to minimise on- and off-site impacts.

4.6 PROCUREMENT

Sustainable procurement is a major driver for sustainable development. It also makes good business sense and is good risk management. Strategic procurement aligns supply contracts with the university's strategic aims, thus embedding sustainability into procurement embeds it into the university's core business.

Sustainable procurement specifications may be performance based (e.g. incorporating an outcome driven target for reducing energy use) or technical (e.g. requirement for a particular certification or eco-label). In practice, specifications for goods or services frequently combine both approaches. In summary, sustainable procurement is about preference for purchased goods and services which minimise life cycle environmental impacts, meet ethical and OHS criteria and provide value for money.

GLOBAL ECOLABELLING NETWORK

The Global Ecolabelling Network (GEN) applies the Voluntary Environmental Performance Labelling ISO (1420 – 1425) definitions to a range of goods and services:

TYPE I: a voluntary, multiple-criteria based, third party program that awards a license that authorizes the use of environmental labels on products indicating overall environmental preferability of a product within a particular product category based on life cycle considerations

TYPE II: informative environmental self-declaration claims

TYPE III: voluntary programs that provide quantified environmental data of a product, under pre-set categories of parameters set by a qualified third party and based on life cycle assessment, and verified by that or another qualified third party.

Reproduced from the Global Ecolabelling network, http://www.globalecolabelling.net/whatis-ecolabelling/ accessed 25/3/2012

The procurement process can usefully be divided into three main stages: the initial tendering process (specification writing), tender evaluation; and contract management. Sustainability criteria need to be addressed in all three stages. Specifications for provision of goods or services will necessarily include details specific to the product or service in question. Tender evaluation in addition will usually seek to identify more general sustainability information. Best practice contract management will often utilise target-driven "service level agreements" which provide incentives for improved performance and disincentives for poor performance.

Standard sustainability criteria for tender evaluation include:

- Internal sustainability management practices – ISO 14001(environmental) / 9000 (quality) certification; existence of signed sustainability policy; any actions or findings against the supplier in past 2 years.
- Fair employment practice – initiatives promoting women and/or minorities to senior roles; any employment related convictions or actions in past 2 years, including OH&S.
- Public reporting – corporate social responsibility / Global reporting Initiative / greenhouse gas and energy reporting, including activities, strategies, plans.
- Sustainability strategies and plans – must include objectives, targets, actions and timeframes); examples of achievements; waste, water, energy, transport reduction strategies and action plans.
- Services / goods sustainability attributes – certification to a robust environmental label; providers who offer eco-design /eco-manufacture in the use of recycled content, tight management of GHG emissions, , design for disassembly and recycling, best practice e-waste management, product / packaging take-back, recyclable packaging.

Table 4.7 lists the "framework" actions necessary for a sustainable procurement action plan –actions relating to individual goods and services will fit within these frameworks.

TABLE 4.7 CORE ELEMENTS OF SUSTAINABLE PROCUREMENT ACTION PLANNING.

CATEGORY	ACTION
Developing specifications	Evaluation of university contracts for procurement of goods and services on the basis of cost, complexity and actual/ potential sustainability impacts to determine priorities.
	Staged development of sustainable procurement standards / specifications based on identified priorities.
	Inclusion of sustainability criteria in tender specifications for procurement of goods and services.
Tender evaluation	Inclusion of sustainability criteria in tender evaluation procedures.
Contract management	Inclusion of sustainability objectives and targets in contract management documentation, and regular monitoring of progress.
	"Second party" audits of providers to drive continual improvement through the supply chain.

4.7 GREEN OFFICE

Universities are largely office-based institutions, and Green Office programs / action plans deal with the sustainability transformation of office practices. The Green Office "mandate" or terms of reference cross over into energy, water, waste, procurement and IT services. The focus is typically on education, training and awareness; the methods may include seminars and online discussion groups, websites, social media, newsletters and other promotion material, events and competitions.

Specific actions – switching off appliances when not in use, turning off lights in vacant rooms, default double-siding for printing and copying, etc, when implemented university-wide may represent considerable monetary savings as well as a significant cumulative reduction in environmental impacts.

Table 4.8 lists some generic Green Office actions around policy and behaviour change and improvements to office practices.

4.8 GREEN LABORATORIES

Laboratories are complex environments which may stock hundreds or thousands of chemicals, compressed gases, biological agents, radioactive materials, fume hoods, biosafety cabinets, centrifuges, autoclaves, vacuum systems, lasers, sophisticated electrical equipment and any number of other research items [73]. University labs commonly cater for researchers who are independently funded through external grants. These labs must continually accommodate new equipment and procedures; constant change makes it difficult for occupational health and safety, energy efficiency and other sustainability issues to be adequately and routinely addressed.

Laboratory planning and design represents a key opportunity to minimise environmental impacts, particularly those relating to energy consumption – labs typically consume 4-5 times more energy than similarly-sized commercial spaces [73]. The Laboratories for the 21st Century (Labs21) program provides extensive guidance on the design and management of high

TABLE 4.8 ACTIONS TO REDUCE THE IMPACTS OF OFFICE WORK.

CATEGORY	ACTION
Policy and behaviour change	Employment of Green Office Manager.
	Sustainable procurement standards for office equipment and consumables.
	Education, training and awareness programs – induction of new staff, seminars and discussion groups, posters, stickers, events, websites, social media.
	Establishment of "Green Office champions" network across campus buildings as the vehicle for the energy and water conservation network proposed in Sections 3.5.1 and 3.5.2.
Office practices	Campus- wide audit of office practices disaggregated to department level – paper use, energy consumption, deployment and use of office equipment, procurement of consumables, office waste management.
	Establishment of department-specific targets for (e.g.) paper use, office waste, equipment left on overnight, etc.; monitoring of progress; and competitions between departments to drive continual improvement, including awards and incentives.

performance labs. Strategies include using life-cycle costing to identify energy efficiency opportunities, separating energy intensive processes and spaces from those which are less intensive to optimise mechanical and electrical design, "right-sizing" equipment and installing energy monitoring, control and recovery systems.

Fume hoods are the primary means by which lab personnel minimise their chemical exposure. A typical fume hood in a research lab runs 24 hours a day, 365 days a year and uses 3.5 times more energy than the average (western) house [73]. Careful planning for the number, size, location, and type of fume hoods is critical to efficient laboratory performance. Water use is another major concern – a useful principle to adopt is that no potable water be used "once-through" for any laboratory equipment, unless it is required as direct contact process water. Best practice also demands that universities develop systems to track the inputs and outputs of hazardous materials, and establish procedures to eliminate, minimise, substitute, recycle and safely dispose of these materials [74].

Table 4.9 describes some typical Green Lab actions relating to the three main areas of policy and behaviour changes, laboratory practice and maintenance and capital works. Note that some actions also are listed in the Energy and climate change, Water and Waste action plans.

4.9 GREEN IT

Information technology (IT) or more broadly, information and communication technology (ICT) is a pervasive element of most universities. IT integrates a spectrum of sustainability aspects – energy use, procurement, waste management, and even campus development (consideration of computer heat loads in building design). Actions to address the impacts of information technology may thus be spread across a number of action plans, or conversely, recognising the common management context, they may be amalgamated into a separate "Green IT" plan.

The growing energy demand associated with the proliferation of IT services has prompted the development of a number of national and globally recognised standards and assessment tools (see box in next page).

LABORATORY GREENING ONLINE

Behaviour change opportunities abound in the university laboratory setting [73]. The Green Lab Program at the University of New South Wales in Sydney, Australia was one of the first of a growing number of specialist initiatives focusing on higher education labs. The program provides mandatory online environmental compliance training for research staff and students, covering environmental best practice behaviour as well as legal obligations. Researchers learn to prepare a comprehensive risk assessment before initiating new experiments, manage hazardous materials and wastes and conserve energy and water. This may involve the redesign of experiments to reduce material and energy use and toxic byproducts, utilise safer solvents and allow for greater reuse and recycling, for example through application of the principles of green chemistry.

TABLE 4.9 ACTIONS TO SUPPORT LABORATORY "GREENING"..

CATEGORY	ACTION
Policy and behaviour change	Employment of a Green Lab manager.
	Development of a "green chemistry" program.
	Sustainable procurement standards for lab equipment and consumables.
	Green Lab online and face-to-face training.
Laboratory practice	Campus wide audit of university laboratories – energy, water, input and output of chemicals, hazardous waste management.
	Establishment of lab-specific prioritised targets for improvement.
	Development of online tracking system for chemical management (inputs, processes and outputs).
	Establish lab equipment / consumables exchange program to minimise waste.
Maintenance and capital works	Development of green laboratory design standards, e.g. referencing Labs21.
	Laboratory ventilation and fume hoods – ventilated storage cabinets for storage, variable air volume and low-flow hoods.
	Laboratory water use – mechanical vacuum infrastructure to replace use of aspirators, closed loop cooling water systems, water efficient reverse osmosis plant.
	Secure storage spaces for hazardous wastes to minimise risk of spillage / leakage.

STANDARDS AND ASSESSMENT TOOLS

The IEEE 1680-2009 Standard for Environmental Assessment of Electronic Products [75] establishes environmental performance criteria for the design of electronic products and provides a valuable tool for developing contract specifications. The Electronic Product Environmental Assessment Tool (EPEAT®) offers a rating system for suppliers and a global registry to help purchasers identify greener electronic products [76]. It combines comprehensive criteria for design, production, energy use and recycling with ongoing independent verification of manufacturer claims. The Electronics Environmental Benefits Calculator (EEBC) was developed to help organisations assess the environmental benefits of greening their purchase, use and disposal of electronics [77]. The EEBC estimates the environmental and economic benefits of purchasing EPEAT registered products and improving equipment operation and end-of-life management practices.

Actions around green IT can be conveniently grouped into two categories – policy and behaviour change and IT management and capital works. Table 4.10 lists some generic suggestions.

4.10 TRANSPORT

Sustainability action planning around transport will probably involve the greatest variation between universities based on location, existing public transport infrastructure and the extent to which residential and other services are provided on campus for students (and in some cases for staff).

The two main areas are commuter travel and travel on university business (air or land-based). In relation to the former, the most effective action is to increase the proportion of student housing and related services provided on campus, to eliminate the need to commute to the university each day. In relation to the latter, the increasing availability and sophistication of video conferencing facilities can be utilised to substitute "virtual" for physical travel in many cases – and enable considerable savings on escalating travel costs. Table 4.11 outlines some generic actions to reduce greenhouse emissions and other environmental impacts of transport.

4.11 CLOSING THE LOOP: MONITORING, EVALUATING AND COMMUNICATING PROGRESS

Regular monitoring, evaluation and communication of progress are integral aspects of mainstream business culture, and thus should be integral to sustainability as a mainstream university activity. Audits provide a way of tracking progress towards achievement of objectives and targets and – through implementation of audit recommendations – driving continual improvement. Management review enables update of policies and objectives to align with changing circumstances, and the effectiveness of the system overall. Sustainability reporting informs the university and wider community of what has been achieved, and equally, what remains to be achieved [78]. Figure 3.2 illustrates the functions of auditing, review and reporting in the overall context of the sustainability management system.

TABLE 4.10 ACTIONS TO SUPPORT THE "GREENING" OF UNIVERSITY INFORMATION TECHNOLOGY .

CATEGORY	ACTION
IT policy and behaviour change	Adoption and implementation of IT purchasing standards (e.g. IEEE, EPEAT, etc.).
	"Switch off when not in use" awareness programs – posters, stickers, events and competitions, websites, awards and incentives.
	Standard operating environments (hardware and software).
IT management and capital works)	Reduce frequency of computer replacement programs – substitute software upgrades for hardware upgrades where possible.
	Centralised / dedicated server space(s) to avoid dispersing server heat loads across multiple buildings.
	Computer reuse program, e.g. donation to community groups / schools.
	E-waste program.
	Ensure energy saving features are enabled.

TABLE 4.11 ACTIONS TO REDUCE IMPACTS OF COMMUTER AND BUSINESS TRAVEL

CATEGORY	ACTION
General	Employment of Transport Manager.
	Development of university transport policy.
Commuter transport	Student housing and services on or close to campus.
	Awareness and promotion of alternatives to private transport – posters, stickers, events and competitions, websites, awards and incentives.
	Regular liaison with public transport providers to optimise services to the campus.
	Incentives for staff committing to forego use of private commuter transport.
	Secure, undercover bike racks, and shower facilities, lockers and bike repair workshop for cyclists.
	Car pooling programs.
	Reduction of car parking spaces and provision of dedicated spaces for car pool vehicles and electric vehicles (and also charging points).
	Establishment of shuttle bus service where the university has multiple campuses.
	Acknowledgement that for reasons of social equity, disability, etc. some staff and students will still need to use private vehicles to access the campus.
	Pedestrian-friendly campus to minimise internal motor vehicle trips.
Travel on university business	Acquisition and promotion of video conferencing technology to staff and students.
	University managed revegetation program to offset emissions for air travel, and/or commitment to "third party" carbon credit / carbon offset program.
	Purchase of fuel efficient vehicles for university fleet.
	Regular maintenance to optimise motor vehicle fleet fuel efficiency.

4.11.1 INTERNAL AUDIT

ISO 14001 Environmental management systems – Specification with guidance for use requires organisations to conduct internal audits at planned intervals to objectively verify the adequacy and effectiveness of the EMS. These are system audits which are aimed at continual improvement in the performance of the system, hence only indirectly address continual improvement in the objective sustainability performance of the university. Best practice suggests combining internal system audits with periodic evaluation of the university's sustainability performance as required to inform production of the sustainability report. This is effectively a repeat of the initial review conducted to determine the institution's baseline performance, and matters to consider will include:

Standard sustainability criteria for tender evaluation include:

- Measurement of performance against agreed sustainability indicators (see for example the list of recommended core indicators in Table 3.3);
- Extent of achievement of detailed sustainability targets.
- Any changes in relation to sustainability impacts and their significance, as a result of changes in internal or external circumstances since the last audit (for example a new research project which requires storage, use and disposal of hazardous materials).
- Any changes to the university's fabric or operations which may affect overall sustainability performance (for example increase in greenhouse emissions resulting from the construction of a new building).
- Any organisational changes which may affect overall sustainability performance.

System documentation should include procedures for internal audits which cover the audit scope, frequency and methodology, as well as the responsibilities for implementation and reporting results. Internal auditors must demonstrate objectivity and impartiality, ideally by being independent of the organisational unit responsible for the establishment and day-to-day management of the system

being audited.

Table 4.12 Shows an internal audit checklist which covers the common system attributes of a sustainability management system. The heading "Corrective and preventive action" refers to system issues; potential environmental incidents are addressed under the heading "Emergency preparedness and response" (noting of course that system nonconformities may give rise to environmental incidents).

Each university will have its own individual system attributes which require checking; similarly, the combination of indicators, targets, significant impacts etc will be unique to every university, so the content of an internal sustainability audit will invariably be unique to the given institution.

TABLE 4.12 A BASIC SUSTAINABILITY MANAGEMENT SYSTEM AUDIT CHECKLIST.

SYSTEM ELEMENT	THE AUDITOR IS LOOKING FOR EVIDENCE THAT…
Sustainability policy	There is top management commitment; the policy is distributed internally; the policy is available to the public
Organisational structure	Management responsibility is assigned; specific roles / responsibilities are defined at each level / function; roles / responsibilities are understood and communicated
Training and awareness	Training needs are identified; appropriate training is conducted at each level / function; competence is determined; training records are kept
Sustainability aspects / impacts	Sustainability aspects / impacts are identified; significance is determined; procedures exist to update information
Legal requirements	Legal and regulatory requirements are identified; this information is accessible; procedures exist to update information
Objectives and targets	Appropriate objectives and targets are set at each level / function; objectives and targets are regularly reviewed; views of the university community are considered in setting objectives and targets
Sustainability action plans	Responsibilities are designated at each level / function; appropriate resources are allocated and time frames are set; plans are reviewed and updated
Documentation and document control	Core system documentation exists, is up to date and controlled; documentation is cross-referenced; documentation is reviewed and approved; documents are available where needed; procedures exist for creation and modification of documents
Communication and reporting	Procedures exist for communicating internally and externally; there are records of internal and external communications
Emergency preparedness and response	There are documented emergency procedures; capability exists for emergency response and mitigation; procedures are tested and reviewed
Corrective and preventive action	There are procedures for preventing, recording, handling and investigating nonconformities and preventing recurrence; effectiveness of corrective and preventative actions is reviewed; changes are made to documented procedures arising from corrective/preventive actions; roles, responsibilities and authorities are established for handling nonconformities
Internal audit	There is an internal audit program and audit procedures; internal audit responsibilities are set and understood; audit reports exist and recommendations are followed up; internal auditors demonstrate objectivity and impartiality
Management review	Management review is occurring; follow-up actions from management review are implemented; recommendations from management reviews are incorporated into the system

4.11.2 MANAGEMENT REVIEW

In addition to regular internal audits (usually annual, or otherwise aligned with the frequency of publication of the sustainability report), the university's senior management is expected to implement a high level review of the sustainability management system at defined intervals. A four or five yearly cycle should generally be adequate. The intent is that core elements of the system such as the university's sustainability policy, objectives, resourcing arrangements and so on are reviewed at the level of management which defined these elements in the first place.

Matters to be considered in a management review will include:

- The continuing relevance of the sustainability policy, and sections which may need to be updated in the light of changing internal or external circumstances (for example new teaching or research priorities or government greenhouse legislation);
- The overall performance of the system, and in particular the extent to which objectives and targets have been met;
- Establishment of new, high level objectives and targets (the setting of more detailed and specific targets is addressed in the development of sustainability action plans rather than at senior management level);
- The status of corrective and preventative actions relating to any environmental incidents or regulatory non-compliances which may have occurred;
- Relevant communications from external stakeholders (government bodies, industry, the local community etc);
- TheAny follow-up actions from previous management reviews;
- Any other recommendations for improvement.

4.11.3 PREPARING A SUSTAINABILITY REPORT

Sustainability reporting has been defined as "the practice of measuring, disclosing, and being accountable to internal and external stakeholders for organizational performance towards the goal of sustainable development… A sustainability report should provide a balanced and reasonable representation of the sustainability performance of a reporting organization – including both positive and negative contributions." [79].

The Global Reporting Initiative (GRI) is an independent international foundation based in The Netherlands. It has developed a comprehensive sustainability reporting framework, based around a set of principles and performance indicators which organisations can use to measure and report their economic, environmental, and social performance.

The GRI promotes a standardised approach to sustainability reporting which has been used by thousands of organisations worldwide. All GRI Reporting Framework documents are developed using a process that seeks consensus through dialogue between stakeholders from business, the investor community, labour, civil society, accounting, academia and others [79].

The GRI Framework consists of the Sustainability Reporting Guidelines, Sector Supplements and the Technical Protocol - Applying the Report Content Principles. The Guidelines set out Performance Indicators and Management Disclosures which organisations can adopt voluntarily, flexibly and incrementally, enabling them to be transparent about their performance in critical sustainability areas. Sector Supplements address sector-specific issues, and the Technical Protocol provides process guidance on preparing a sustainability report and how to define the content.

A university sustainability report should reflect both the institution's mission and activities, and the expectations of the university community and other stakeholders. Thus the context – if not the content – is consistent with accepted global practice such as represented by the GRI. The GRI Guidelines are intended to be applicable to most organisations irrespective of size, type, sector or location. However, while many indicators are relevant to universities others are not, and the core university mission of teaching, research and outreach is not addressed.

The GRI defines the base content which should appear in a sustainability report ("standard disclosures") as follows [79]:

- "Strategy and Profile: Disclosures that set the overall context for understanding organizational performance such as its strategy, profile, and governance.
- "Management Approach: Disclosures that cover how an organization addresses a given set of topics in order to provide context for understanding performance in a specific area.
- "Performance Indicators: Indicators that elicit comparable information on the economic, environmental, and social performance of the organization."

Sustainability Report accessed 24/3/2011 at http://cms.bsu.edu/Academics/CentersandInstitutes/COTE/Sustainability/GRI.aspx

Table 4.13 Illustrates a generic table of contents for a university sustainability report based on the above criteria.

INTRODUCTION TO BALL STATE UNIVERSITY SUSTAINABILITY REPORT 2010

At Ball State University, we have a long history of identifying and implementing methods to protect and enhance our environment. We are proud to maintain this forward momentum by our active use of the Sustainability Tracking, Assessment and Rating System1 (STARS); a reporting tool now in use by some 675 campuses throughout North America. In fact, we are on schedule to file our first full STARS Report by the close of this calendar year.

As a compliment to this nation-wide collaboration to report on campus sustainability, we have been working through our Ball State University Building Better Communities (BBC) Fellows Program to explore the use of an additional assessment tool: the Global Reporting Initiative2 (GRI). Like STARS, this tool provides a framework for reporting sustainability performance and it is in use today by some 1500 organizations in over 60 countries.

An interdisciplinary team of students working within our BBC Fellows program, under the direction of Dr. Gwen White, Associate Professor in the Miller College of Business, was instrumental in gathering the information necessary to construct this first GRI Sustainability Report for BSU. Through this experience they have become versed in environmental, social and economic sustainability, developed leadership skills, and worked in a collaborative environment. Their efforts contribute to our actions to protect and enhance our environment.

With the country's largest geothermal project underway on our campus, our biennial Greening of the Campus Conference Series and our very active campus-wide Council on the Environment, we maintain a substantial investment in achieving campus sustainability. The use of STARS and GRI for annual Sustainability Reporting extends that work as a valuable resource for our full academic community: our students, faculty, staff and administrators.

Jo Ann Gora
President
Ball State University

Sustainability Report accessed 24/3/2011 at http://cms.bsu.edu/Academics/CentersandInstitutes/COTE/Sustainability/GRI.aspx,

TABLE 4.13: TABLE OF CONTENTS FOR A UNIVERSITY SUSTAINABILITY REPORT CONSISTENT WITH GRI

TABLE OF CONTENTS	DESCRIPTION OF CONTENTS
Foreword	Signed statement from the University Vice-Chancellor / President.
Organisational profile and governance	Brief description, background, mission and explanation of the governance structure of the University.
Strategy and analysis	Strategic summary of how the University is addressing the challenges of sustainable development (e.g. vision, policy, sustainability management system).
Reporting parameters	Scope, system boundary and methodology of the report.
Environment	The substantive subject matter of the report. These sections (divided into subsections which reflect the detailed content of the University's sustainability management system) will report on movements in the indicators, achievement of objectives and targets and progress in implementation of action plans. They will generally contain a combination of narrative and quantitative material (including graphics).
Society	
Economy	
Conclusions	Summary of the report and its findings. This section can usefully include a gap analysis (what was planned but not achieved, and what opportunities have emerged during the reporting period which can inform the next round of sustainability action planning).

Other key principles embraced by the GRI, and which are relevant to university sustainability reporting, are:

- Materiality – defined as "the threshold at which topics or Indicators become sufficiently important that they should be reported";
- Stakeholder inclusiveness – or how the reporting organisation has responded to the reasonable expectations and interests of its stakeholders;
- Sustainability context – the report should present the organisation's performance in the wider context of sustainability;
- Completeness – coverage should be sufficient to reflect significant economic, environmental and social impacts and enable stakeholders to assess the reporting organisation's performance for the reporting period.

4.11.4 MARKETING, PROMOTION AND CELEBRATING SUCCESS

This Section does not aim to provide guidance on how to market and promote the university's sustainability initiatives or celebrate successes. There are probably as many ways of doing this as there are universities engaging with sustainable development. The Section is simply intended to reinforce the importance of these factors.

Especially at the outset, the transition to sustainability can seem a daunting prospect. Sustainable development in many instances is still seen as outside the mainstream, unconnected to the teaching / research mission, perhaps an optional extra to be "appended" to core business but not core university business in and of itself. Reality imparts a harsher message; sustainability is not "optional", it is not an "extra", it is an imperative we neglect to the detriment of our environments, our societies and ultimately our economies.

That said, presentation of "doom and gloom" scenarios may help to initiate transformation, but cannot sustain it. Sustained transformation requires motivated champions. Motivation requires hope for the future. Strategies for transformation demand affirmation and reinforcement of motivation at every stage. Knowledge helps drive motivation, and in this universities are ideally placed.

Moreover, champions are necessary, but insufficient on their own. The great bulk of the university community must be engaged in the transition to sustainability for there to be any chance of success. Collective celebration of victories big or small reinforce the sense of community, that together we can transform our institutions – and ourselves – one step at a time. Finally, universities do not exist in a vacuum, they are part of an environment, a society, an economy. So for example the transient nature of the bulk of the university community – the student body – is at once a weakness and a strength. While sustainability strategies and campaigns must continually be reinvented to cope with the regular changeover of the campus population, graduating students each year bring all that they have learnt to the wider world of work, citizenship and new responsibilities.

As emphasised in the Introduction to this toolkit, "The sustainable university can help catalyse a more sustainable world".

THE PLATFORM FOR SUSTAINABILITY PERFORMANCE IN EDUCATION

The Platform for Sustainability Performance in Education brings together organisations which have created sustainability assessment tools designed to support universities and colleges around the world.

The purpose of this Platform is to promote sustainability assessment in education. By coming together it is our goal that more universities and colleges learn about the value of sustainability assessment tools to improve the sustainability performance across the whole of their institution.

The Platform is also designed to assist commitments of Higher Education Sustainable Initiative (HESI) signatories, by providing a range of tools and options in assessing and improving their sustainability performance. It can also support complimentary Rio+20 initiatives such as the People's

Sustainability Treaty on Higher Education.
http://www.eauc.org.uk/theplatform/home

CHAPTER 5

POLICY GOVERNANCE AND ADMINISTRATION

This Chapter of the Toolkit sets out step by step guidance for universities seeking to translate their commitment to, and vision of sustainable development into reality. The format follows the familiar Plan-Do-Check-Act "Deming cycle" of continual improvement [42] which reflects the globally acknowledged management system models developed by the International Organization for Standardization (ISO) [80-83]; the Global Reporting Initiative guidelines [79]; and a range of best practice initiatives drawn both from practical experience and from the literature.

An important "bridging" stage between initial commitment as an institution to take the sustainable development path and the development of detailed policies and strategies to effect delivery is to adopt a time scale for the transition to sustainability. Definition and adoption of a time scale which is both challenging and appropriate to a particular university requires serious engagement with the members of that university.

It is arguable that objective reality is defining the time scale for us. Over the past few decades it has become obvious that anthropogenic environmental impacts are global in scope [84, 85]. The landmark Millennium Ecosystem Assessment [86] revealed that some 60% of ecosystem services which provide the basis for life on Earth have been degraded or are being used unsustainably, and emphasised that humans have changed ecosystems more rapidly and extensively in the past 50 years than at any other period. Increasing evidence of global warming, predicted "peaking" of oil, phosphorus and other natural resources and an extinction rate which rivals the great extinctions of the deep geological past [87] reinforce the need to take action now.

Universities have been described as microcosms of the environmental problems which face society as whole [88], from greenhouse emissions to noise pollution. The previous sections of this Toolkit have emphasised that achievement of a sustainable campus represents a paradigm shift in institutional thinking and practice. While as noted in Chapter 2, "little victories" can pave the way for "systemic transformation" [6], it is necessary to keep the destination in mind. From that perspective, setting long term stretch goals can provide a framework for necessary action.

Campus sustainability integrates the cultural/institutional and the biophysical, and different strategies – and stretch goals – are required in each case. In relation to the quantitative, there are four broad categories for which both long and short-term targets can be defined and presented:

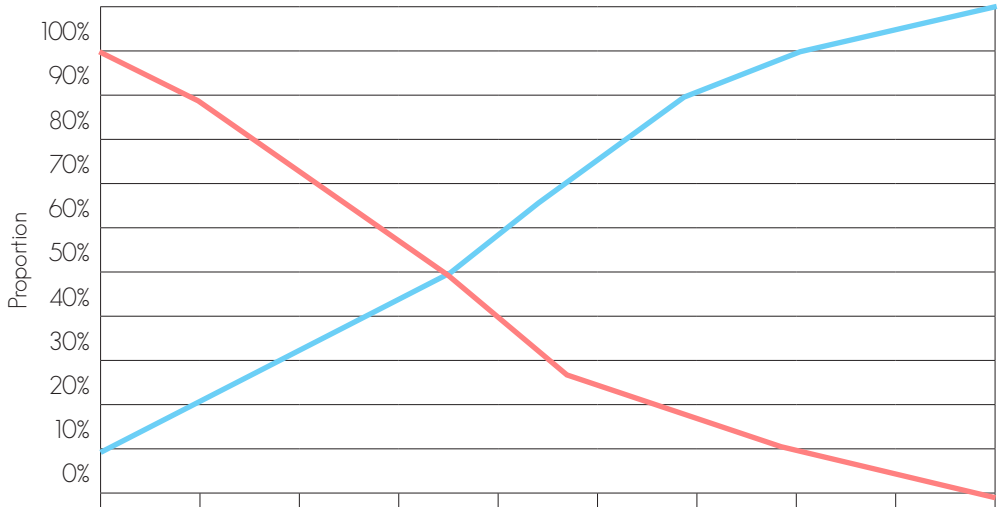
- Energy, carbon and climate change;
- Water consumption;
- Suse of land- campus ecology, planning design and development; and
- Material flows- procurement, toxicity, air pollution, waste disposal and recovery.

Taking energy consumption as an example, the proportion of energy derived from renewable sources (hydro, wind, solar, geothermal, biofuels) globally was approximately 8% in 2010 [89]. A university which is genuinely sustainable in terms of its energy consumption is one which derives 100% of its energy needs for heating, cooling and transport from renewable sources. The difference between 100% and 8% (or perhaps a higher baseline, if the university is already using more than 8% renewable energy) represents the "sustainability gap" for energy which the university can close by setting an ultimate target date and meeting a step-by-step schedule of intermediate targets until the final goal is achieved (Figure 5.1). The Technical Appendix describes a mathematical model for deriving these targets from baseline energy consumption.

Similar transitional strategies can be defined for water consumption (not exceeding the sustainable yield of the catchment within which the university is located), land use (campus planning and development), and management of material flows (zero net waste). For present purposes, the primary issue is to establish agreed stretch goals and target dates.

Energy, water, land and materials are defined in terms of direct biophysical outcomes. Other aspects of sustainable university practice are characterised by their social and cultural

FIGURE 5.1 TRANSITION TO RENEWABLE ENERGY



	2010	2015	2020	2025	2030	2035	2040	2045	2050
Renewable Energy	10%	20%	35%	50%	65%	80%	90%	95%	100%
Conventional Energy	90%	80%	65%	50%	35%	20%	10%	5%	0%

outcomes. The biophysical impact of embedding sustainability in research and teaching, governance and administration and community outreach is long term and indirect. Suitable stretch goals in these areas may be qualitative or quantitative, and will be more closely linked to management decisions – 100% of goods and services procured by the university to meet some sustainability accreditation target, 100% of students to have completed an introductory sustainability course, and so on.

The question of a sustainability policy has not been discussed to this point. Policy development represents the first stage of implementing the university's vision. While still articulated at the "overview" level (for example, referencing the stretch goals mentioned above) an organisation's policy should be the driver for setting intermediate objectives and targets, and giving the context for action plans around the issues identified through community engagement. Policies in general apply to the medium term, and are subject to regular review.

Figure 5.2 maps the structure of the continual improvement cycle, synthesised from a variety of sources [79-83, 90-92] and including a set of management programs (ISO 14001 terminology) or action plans specific to this toolkit. In summary:

- The university's sustainability policy drives the cycle. Also discussed in this Chapter are the structures necessary to ensure delivery: a cross-campus sustainability committee and the dedicated personnel assigned the task of managing implementation – the sustainability team.
- An initial environmental review ((ISO 14001 terminology) or sustainability review determines the baseline conditions and enables issues to be prioritised for action.

- The policy ("where do we want to be?") and the initial review ("where are we now?") informs the planning phase ("how do we get from where we are to where we want to be?"). This includes identification of appropriate performance indicators, objectives and targets and sustainability action plans. Planning as per ISO14001 also includes awareness and training, communications and documentation and emergency preparedness and response.

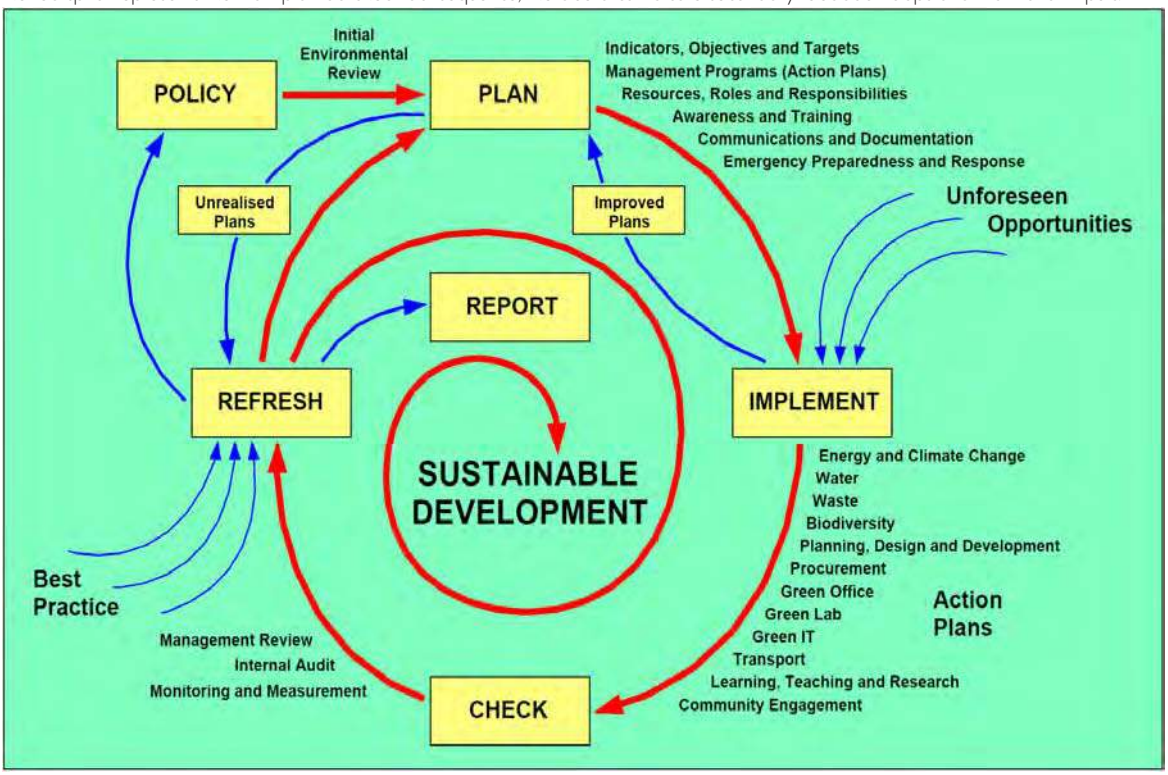
- The implementation phase refers to the "doing" element of the plan-do-check-act cycle. This entails carrying out the context-specific action plans prepared during the previous phase of the cycle, and also taking advantage of any unforeseen opportunities which may have emerged [92] since the original plans were prepared. In addition, defects in existing plans can be identified in implementation, and this information fed back into the planning process.

- The checking phase represents the closing of the loop: monitoring and measurement of progress, internal audits and management review enables rejuvenation of the entire cycle. Outcomes from benchmarking against best practice and any planned actions which have not been achieved inform the next round of planning; the policy is re-assessed for relevance and currency; and the progress to date is documented in the university's sustainability report.

Trencher et al. conducted a large-scale international survey focusing on university partnerships for urban sustainability in industrialised Europe, Asia and North America to 1) determine defining features such as focus areas, geographical scales, mechanisms, actors and motivations, and 2) identify commonly encountered drivers, barriers and potential impacts [93]. Results indicate that partnerships most typically target energy, buildings, governance and social systems, unfold at local or city-scales, and involve collaborations with local

FIGURE 5.2 THE UNIVERSITY SUSTAINABILITY CONTINUAL IMPROVEMENT CYCLE. [79.83,90-92].

The red spiral represents the main plan-do-check-act sequence, the blue arcs indicate secondary feedback loops and information inputs.



or regional government. Our analysis shows that potential outcomes of university initiatives to co-design and co-produce urban sustainability are not limited to knowledge and policy. They encompass new technological prototypes, business and new socio-technical systems, in addition to transformations of the built and natural environment. Findings also suggest that individual partnerships are making strong social, environmental and sustainability impacts, with less evidence of economic contributions. Strategies are required to enhance project management and ensure that projects address contrasting priorities and time horizons in academia and local government. Implications for policy include findings that targeted funding programmes can play a key role in fostering partnerships. Measures are also required to challenge academic norms and incentive structures that, in some cases, hinder university efforts to engage in place-based initiatives to co-design and co-produce urban sustainability.

5.1 SUSTAINABILITY POLICY, GOVERNANCE AND ADMINISTRATION

ISO 14001 specifies environmental management system elements applicable to all types and sizes of organisations under diverse geographical, cultural and social conditions. Success depends on commitment from all levels of the organisation. There must be demonstrated dedication to establishing and assessing the effectiveness of environmental policy, objectives and procedures, and to achieving conformance and demonstrating it to others. Thus the aim of ISO 14001 is to support environmental protection in balance with socio-economic needs. It should be emphasised that ISO 14001 does not establish absolute requirements for environmental performance beyond commitment to compliance with applicable legislation and regulations and to continual improvement. ISO 14001 also does not address the broader social, economic or cultural issues pertinent to a holistic approach to university sustainability; these aspects, however, may be incorporated into the relevant sections of the EMS Standard (policy, objectives and targets, action plans, training etc) with only minor adjustments required to facilitate implementation.

An organisation's sustainability policy is the essential tool for setting short- and long-term sustainability goals against which all subsequent actions will be judged. ISO 14001 requires an organisation's environmental policy to:

- Be developed by top management and cover the scope of the EMS (in the university context, "top management" refers to the President / Vice-Chancellor and those senior executives who report directly to him/her);
- Be appropriate to the nature, scale and environmental impacts of the organisation's activities, products and services (i.e. linked to the overall mission of the university);
- Include a commitment to continual improvement and prevention of pollution;
- Commit to compliance with applicable legal requirements and with other requirements to which the organisation subscribes which relate to its environmental aspects;
- Provide the framework for setting and reviewing environmental objectives and targets;
- Be documented, implemented and maintained;
- Be communicated to all persons working for or on behalf of the organisation (which includes contractors, temporary staff etc – and in the case of universities, students);
- Be available to the public.

Adaptation of the above points to address a university's sustainability policy (i.e. to explicitly include social, economic and cultural elements) will not substantially change the structure of the policy statement, although it will obviously affect the content.

Apart from these broad criteria, the contents of a university's sustainability policy can include any matters which the institution wishes to emphasise and address. Policies are "high level" documents; hence they should deal with the general rather than the specific ("The University of XYZ will minimise energy consumption" rather than "The University of XYZ will replace its incandescent lamps with compact fluorescents"). As noted in ISO 14001, the policy provides a framework for setting objectives and targets, it is not itself a list of objectives and targets. As high level documents, university sustainability policies should also be brief and to the point.

UNIVERSITY OF NAIROBI ENVIRONMENTAL POLICY STATEMENT

The University of Nairobi is firmly committed to protection of the environment as an integral part of good institutional practice. To enable us to do this, we shall develop and sustain an Environmental Management System that will lead to sustainable development and will advance positive effects on both human health and the environment for the university community and our neighbours.

Believing this goal to be fully achievable, at the University of Nairobi:

We are totally dedicated to preventing pollution by minimizing waste generation through enhanced adoption of Cleaner Production methods and development and implementation of effective programs and practices
We are committed to reducing our energy consumption, implementing energy conservation programmes and promoting energy efficiency

We are committed to increasing water use efficiency in our campuses and reducing the quantity of waste water released to the environment

We are committed to improving indoor and outdoor air quality by implementing effective programmes where appropriate to mitigate negative effects, use of materials in building construction and renovation that protect and improve indoor air quality and minimizing greenhouse gas emissions from University-related activities.

We will examine the operations of University-owned vehicles and identify and implement alternatives that will reduce environmental impacts

We are committed to maintaining all noise within national guidelines

We will ensure that we comply with, and where possible exceed, applicable environmental laws and regulations.

We will review our environmental objectives and targets from time to time in order to minimize resource consumption and improve our environmental performance

We will review and revise this Policy, if necessary, every two years to ensure that our activities, products and services are appropriate and have no adverse effects on human health and the environment

We will ensure through education and training that each employee and student is aware of our environmental objectives and can fulfill them

We will communicate our Environmental Policy to all our stakeholders

Prof. G.A.O Magoha
VICE-CHANCELLOR
01 October 2009

5.2 THE SUSTAINABILITY COMMITTEE

It has been stressed throughout this Toolkit that top management commitment is a prerequisite for the transition to a sustainable university. An objective assessment of the budgetary implications of waste disposal and energy consumption, and the potential financial risks associated with environmental accidents or legislative non-compliance seems to be a useful exercise for convincing senior managers of most organisations. Most importantly, ISO 14001 requires management not just to commit, but to ensure the availability of resources to develop and implement a sustainability management system.

While not a requirement of the EMS standard, creation of a sustainability steering committee with representation (in the case of a university) from students, academic and operational staff is for all practical purposes essential. The steering committee may also include representation from external stakeholders – for example the local community, government bodies and/or significant local employers of the university's graduates.

The actual title of this group is of course a matter for the particular institution; the main issue is its function. The terms of reference for the steering committee should include as a minimum, responsibility for input to and review of the policy, objectives and targets and sustainability action plans, for final approval by senior management. Depending on the level of stakeholder engagement practiced by the university, the committee may play a formal role in the university's governance structure, with delegated powers to approve policy and related high level documentation. Irrespective of the extent of delegated powers, the committee should be chaired by a member of senior management, with the person directly accountable for implementation of the sustainability management system in an executive role. In addition, the committee should act as a conduit from the university community to senior management in relation to overall sustainability issues.

5.3 THE SUSTAINABILITY TEAM

A member of the university's top management group should maintain overall oversight of the sustainability "portfolio", and top management should assign responsibility for the overall implementation and effectiveness of the system to a competent senior person with sufficient authority, resources and freedom to act. This person – the "management representative" in the language of ISO 14001 (or in other words, sustainability manager) – should be accountable for:

- Ensuring that environmental management system requirements are established, implemented and maintained in accordance with the standard, and any additional social / economic / cultural sustainability aspects adopted by the university are also addressed within the overall management framework provided by the system;
- Reporting on the performance of the system to top management for review and as a basis for continual improvement.

The sustainability manager – depending on the size and resources of the university – may head a professional sustainability unit and/or coordinate a team of staff and student volunteers.

In many universities the environment or sustainability manager / team is organisationally located in a major operational area such as the Estates / Facilities Management unit; less commonly, the role is embedded in an academic unit. An operational location provides direct access to the university's day-to-day campus management and administrative activities – on the other hand, an academic role can facilitate the nexus between education for sustainability and practical campus sustainability. In either case, the key criterion is the position's level of authority, accountability and ability to deliver on approved sustainability policies and plans. While this is certainly linked to the adequacy of budgetary and other resources, it is fundamentally an organisational rather than financial issue. Ideally, the sustainability manager will report directly to a member of the top management group, a situation which is still quite rare, but is characteristic of those universities which take the transition to sustainability seriously.

OFFICE OF THE PRO VICE-CHANCELLOR (SUSTAINABILITY)
LA TROBE UNIVERSITY, AUSTRALIA

In 2010 the University announced the creation of the Office of the Pro Vice-Chancellor (Sustainability) headed by Professor Carol Adams. Replacing the Sustainability Taskforce that had existed in 2009, the Office is the driver behind La Trobe's determination to make sustainability central to everything we do.

Climate Change, unsustainable resource use and increasingly inequitable access to the benefits of economic development are some of the major challenges that have to be tackled on a global scale.

Issues of Sustainability and social responsibility will affect everyone's career in the future. La Trobe and the Office of the PVC (Sustainability) will make a difference.
Reproduced from http://www.latrobe.edu.au/sustainability/governance

A sustainability team's workload may be structured on the basis of particular impact areas (energy and climate change, water, biodiversity, transport etc), university functional areas (green office, green lab, procurement, IT etc) or some combination of the two – there is no "right way" or "wrong way", it is a question of ensuring alignment with the way the particular university is governed, its vision and mission.

Economic sustainability is conventionally a matter for the university's Finance Department, and the function of sustainable procurement may either sit there, or with the sustainability team. The objective is to ensure integration of triple bottom line criteria in the university's financial management, which can be tackled organisationally in a variety of ways. Similarly, universities frequently address social and cultural aspects of sustainability through policies and personnel involved in student services, human resources, equal opportunity and the like. Again, it is critical to ensure appropriate alignment and communication between those charged with delivering outcomes across the different facets of sustainable development, whether these have been explicitly identified as "sustainable" or simply as part of good management practice.

5.4 DETERMINING THE BASELINE: INITIAL ENVIRONMENTAL/ SUSTAINABILITY REVIEWS

The ISO 14001 EMS standard offers flexibility to organisations to develop their own means of identifying the significant environmental impacts of their activities. ISO 141001 does not stipulate the method to be used, only that it has to be applied systematically. Standards Australia's HB [Handbook] 206 Initial Environmental Review (IER) provides structured guidance to organisations seeking to determine their current baseline environmental status [94], and may be adapted to include additional sustainability aspects beyond the specifically environmental. The results of the review can be used to assist the organisation in developing or improving its environmental policy, setting the scope of its environmental / sustainability management system, establishing its sustainability objectives and targets, and determining the effectiveness of its approach to maintaining compliance with applicable legal and other requirements. Less formally, an initial review will answer the question "Where are we now and what do we have to do to get where we want to be"?

The review is intended to provide sufficient information for a preliminary identification of the significant environmental (and other sustainability) aspects and impacts associated with the activities of, and services provided by, the university. "Environmental aspects" are identified as elements of an organisation's activities, products or services which can interact with the environment, for example energy consumption or waste generation. An impact, on the other hand, is any change to the environment (positive or negative) resulting from this interaction. In addition, the review identifies how these aspects are currently being managed, including legal compliance and emergency response, and can also reveal opportunities for improvement.

A systematic initial sustainability review of a university will entail five phases:

- Planning – setting the scope and objectives, schedule, resources and personnel;
- Review of existing information (i.e. documentation review) – organisational, physical (site) and functional (detail of activities, including teaching, research and operations);
- Confirmation of existing information and collection of new information – site inspections, questionnaires, interviews, discussions;
- Evaluation of the information, for example in relation to potential environmental risks, compliance with legal requirements and adequacy of existing policies, procedures and management practices (gap analysis);
- Reporting and recommendations – summary of the methods and findings and presentation of opportunities for improvement (how to get from "where we are" to "where we want to be").

The review can be conducted using checklists, process flowcharts, interviews, direct inspection, past and current measurements, and where available, the results of previous audits or reviews. An initial review does not involve site contamination audits, direct sampling and analysis of environmental media (soil, water, air) or detailed life cycle assessment of products or services. However, if a need for any such investigations is identified, it should be flagged in the recommendations.

Not all environmental or sustainability aspects and impacts are equally important – determination of their significance is necessary to enable prioritisation of responses, for example through sustainability action plans. Qualitative evaluation of the significance of environmental aspects and impacts is commonly achieved through application of risk assessment techniques, which identify the consequences of a particular impact (severity, spatial and temporal scale), and the probability (likelihood) of it occurring, to determine the overall risk (Figure 5.3). The particular criteria used to define the consequences may include effects on people, property and ecosystems, monetary value and reputation.

In the case of readily quantifiable aspects such as energy and water consumption, waste production and procurement of high volume goods such as paper or construction materials, the significance of the associated environmental impacts may be ascertained more directly. Typical methods include calculation of operational greenhouse gas emissions, embodied energy and material balances for particular goods (e.g. the amounts of paper purchased, used, recycled and disposed of to landfill). These figures can also be used to generate sustainability indicators, particularly when coupled with appropriate denominators (e.g. tonnes CO2 per square metre of floor space, or per student).

Given the wide range of universities at which this Toolkit is aimed, it is impossible to set out a checklist of activities, aspects, impacts, management responses and levels of significance relevant to all; the methodology is the critical factor here. The matrix format can provide a useful template to assess the vast variety of activities relevant to any given university, which may encompass anything from student housing to research on genetically modified organisms.

FIGURE5.3: PROBABILITY/ CONSEQUENCES MATRIX, INDICATING EXTREME, HIGH, MEDIUM AND LOW RISK

LIKEHOOD	CONSEQUENCES				
	Insignificant	Minor	Moderate	Major	Severe
Almost Certain	M	H	H	E	E
Likely	M	M	H	H	E
Possible	L	M	M	H	E
Unlikely	L	M	M	M	H
Rare	L	L	M	M	H

5.5 SETTING OBJECTIVES AND TARGETS

ISO 14001 defines an environmental objective as an overall goal, arising from the environmental policy, which an organisation sets itself to achieve and which is quantified where practicable. An environmental target is defined as a detailed performance requirement, quantified where practicable, applicable to the organisation or parts thereof, which arises from the environmental objectives and which needs to be set and met (annually, five yearly etc) in order to achieve these objectives. Similar criteria will apply to objectives and targets which address the economic, social and cultural dimensions of sustainability.

Objectives and targets are typically linked to indicators, to enable tracking of progress. Targets should be "challenging but achievable", and should reflect the university's commitment to sustainable development and the ultimate achievement of a sustainable university. The introduction to this Chapter proposes a combination of stretch goals (e.g. zero net imported energy and water, zero net waste) and staged transitional strategies to achieve them – see for example Figure 5.1. To support the implementation of sustainability action

plans, objectives and targets should be set and regularly reviewed for each relevant function and level of the university; for example an overall objective to reduce energy use may be disaggregated to include individual annual targets for specific buildings or services such as lighting or HVAC.

Objectives and targets must be relevant to the university's significant environmental / sustainability aspects and impacts, discussed above. Priorities will vary according to the economic, social, geographic, etc circumstances for each university, although it is clear that carbon emissions and climate change will represent a common priority for the great majority of institutions. ISO 14001 also requires organisations to consider legal, financial, operational and business requirements in setting its objectives and targets, and the views of "interested parties". In the university context, the interested parties are students, staff and the wider community, who should be purposely engaged in the target setting process.

5.6 AWARENESS AND TRAINING

Awareness building and training opportunities need to be build into every sustainability action plan. Staff at all levels and new students should be introduced to sustainability awareness training as part of regular induction procedures, explaining the university's sustainability policy and action plans, the impacts of the university's activities (particularly around priority areas such as climate change) and the importance of compliance with relevant legislation and regulations.

5.6.1 STUDENT AND STAFF DEVELOPMENT

ISO 14001 requires organisations to identify training needs associated with their environmental aspects for all persons performing tasks for or on behalf of the organisation, i.e. contractors, subcontractors, agency staff, etc as well as the permanent workforce. As with all aspects of the EMS, training details and competence levels must be clearly documented, and documentation kept up to date. While training for (e.g.) office staff may be covered by the "general awareness" discussed above, it is essential that staff performing tasks with the potential to cause (or prevent) significant environmental impacts are appropriately trained and examined with respect to the appropriate competencies.

Personnel performing specialised environmental management functions must have appropriate education, competence, experience and training. It is important that such personnel are exposed to the most recent technology and knowledge base relevant to the organisation's significant environmental impacts. This includes those staff with responsibilities for delivering particular tasks associated with actions specified in the university's sustainability action plans. Development plans which address these issues should be incorporated into the university's human resources policies and procedures (e.g. in relation to recruitment, performance review, promotion, etc).

Training and development opportunities should also be provided for students working as volunteers or interns on environmental or other sustainability projects. This may be integrated with, or managed separately from, the university's usual curriculum, and may be run as an incentive scheme (e.g. fee-free) to encourage participation. University student associations are often well-placed to offer training and development, which can help to reinforce their stake in sustainable campus development.

5.6.2 THE CAMPUS AS LIVING LABORATORY

The Introduction to the Toolkit notes that "universities can teach and demonstrate the theory and practice of sustainability through taking action to understand and reduce the unsustainable impacts of their own activities. Historically, the demands of teaching and research resulted in the structural separation of academic staff from campus management. This has led to the view that focusing on campus issues is a distraction from the core mission of the university. In fact, the campus itself can become a feedback mechanism for the teaching and research practice to "achieve mission alignment between teaching, research and campus operations, harnessing the vast collective learning process that is currently underway within its walls, to benefit its own systems" [6].

Such projects broadly reflect the philosophy of experiential learning. Kolb [95] offers a concise summation: "Learning is the process whereby knowledge is created through the transformation of experience". This definition emphasises process as distinct from content or outcomes, and importantly, the transformative nature of that process, in both an objective and a subjective sense. Within this experiential framework, environmental learning is best served by an approach which is both context-based, responsive to social context and setting [96]; and problem-based, characterised by the use of "real world" problems as the context for students to learn critical thinking and problem-solving skills [97].

The literature and many university websites offer a substantial and growing inventory of examples of the university campus as living laboratory (and lecture theatre) for applied sustainability interventions. Examples include projects from first year to PhD level, and include all aspects of sustainability – environmental, social, economic and cultural. For universities embarking on the transition to sustainability,

logical opportunities to pursue include determination of the university's baseline environmental / sustainability performance through an initial environmental or sustainability review, preparation of a sustainability report, or conducting a carbon footprint analysis, as assessable components of an environmental science or engineering program. Generally these tasks would be class based; individual or small team based studies could include post-occupancy evaluation of a specific campus building, energy, water or waste audits of particular activities, life cycle assessment of goods or services procured by the university or life cycle costing of proposed sustainability actions.

Even this brief summary indicates the potential to involve different disciplines individually and collectively in campus based projects. Sociologists and historians can explore the background to university sustainability management with a view to informing current policy; law students can research the applicability of environmental legislation to campus operations; medical students can address issues of public health; psychologists can investigate opportunities and barriers to organisational change and the adoption of sustainable behaviours – and this is just a partial list.

There are several different models for implementing "living laboratory" initiatives:

- Student internships, paid or unpaid, with the sustainability team. These would include an appropriate level of academic credit awarded for successfully completed projects.

UNIVERSITY OF SONORA CERTIFIED SUSTAINABILITY MANAGEMENT SYSTEM

One of the most successful efforts in Latin America to transform a higher education institution into a more sustainable organisation has come from the University of Sonora in Mexico.

Sustainable practice at the University of Sonora is inspired by the institutional vision and mission and reflected in the sustainability policy which fosters a culture of protecting natural resources and preventing, reducing and/or eliminating environmental and occupational risks.

The University's sustainability initiatives address the full scope of its activities – teaching, research, outreach and partnership and campus greening. A Sustainability Management System (SMS) provides the framework for greening campus operations. The SMS achieved ISO 14001 certification in 2008, enabling the University of Sonora to become one of the few higher education institutions in the world with this certification, and the first in Latin America.

The SMS is not only directed at sustainable operations, but also strives to enhance Engineering College students' education through practical apprenticeships with an integrated triple bottom line focus. From the start, the system has been linked to the substantive functions of teaching and research in order to transform the campus into a living laboratory for continual learning. Areas of attention include efficient use of water and energy, laboratory safety and hazardous materials management as well as the reduction, reuse, and recycling of non-hazardous materials such as paper, plastic and organic waste.

A quarterly report provides the basis for review and evaluation of the SMS to ensure its effectiveness. Strong emphasis is put on continuous improvement and overall performance shown by sustainability indicators. The appropriateness of the sustainability policy is also reviewed, as well as achievement of the objectives and targets, regulatory compliance, corrective and preventive actions and the findings of internal audits.

Text adapted from Velázquez, L., Munguía, N., Esquer, J. and Zavala, A., 2011. "Sustainable Good Practices in the University of Sonora, Mexico", Global University Network for Innovation http://www.guni-rmies.net/news/detail.php?id=1750; Image from Universidad de Sonora/University of Sonora website http://www.uson.mx/noticias/default.php?id=6511, accessed 21/08/2011.

- Inclusion of teaching and assessment material on campus sustainability in an existing course.
- A specific course focused on campus sustainability. Ideally this would be cross-disciplinary, and open to students from different fields of study.
- Integration of teaching and assessment material on campus sustainability across a number of courses, covering a range of disciplines and coordinated with implementation of the university's sustainability action plans. This is the preferred model to support the university's ongoing transition to sustainability, and will likely require several iterations of the sustainability planning cycle to achieve.

The campus can also function as a living laboratory for staff and student research, with similar scope as in learning and teaching. The advantage here is that the outcomes are likely to be more long-lasting, for example involving potentially major innovations affecting the campus fabric and operations, and also providing new resources for learning and teaching into the future. The main criterion – whether in relation to teaching or research – is that living laboratory programs are integral to the university's sustainability management system and action plans.

5.7 COMMUNICATIONS AND DOCUMENTATION

"Communications" in this context refers to internal communications relevant to the development, maintenance and continual improvement of the university's sustainability management system. Strategies for communication with internal stakeholders should consider the range of variables relating to community engagement. Each sustainability action plan will need to incorporate a communications strategy to facilitate engagement of the university community and maximise the chances of success – although in practice some of these may be combined.

ISO 14063: 2006 Environmental management - Environmental communication - Guidelines and examples, one of the International Organization for Standardization "family" of environmental management standards [98], gives guidance to an organisation on general principles, policy, strategy and activities relating to both internal and external environmental communication. For example, communications activities should enhance two-way communication, promote consensus, provide opportunities to address issues in depth and promote education and awareness. ISO 14063 suggests setting targets for communication, for example in terms of stakeholder participation and feedback obtained. Approaches and tools may include minuted meetings (possibly with an independent facilitator where the issues are particularly complex), newsletters, social media, focus groups and workshops, displays and exhibitions.

Responsibilities for communication with the university community around sustainability issues should be defined and allocated, and should also include media / communications staff responsible for other areas of internal university communications. The effectiveness of communication activities should be regularly evaluated to help drive the continual improvement cycle.

"Documentation" – in the context of ISO 14001 – simply refers to the need for all aspects of the university's sustainability management system to be documented, and the records to be centrally maintained and kept up to date. Documentation includes obvious material such as policies, plans, minutes of meetings and training records – but importantly, the EMS standard (and good management practice) requires that system procedures be documented and maintained. This includes procedures for stakeholder engagement, identifying and assessing the significance of environmental impacts, conducting initial reviews and internal audits, setting objectives and targets, and so on.

Section 1.5 points out that "...the loss of corporate memory through staff turnover and the transience of the student population can mean mistakes are repeated, previous high performing initiatives are not emulated and it becomes difficult to build on progress..." Ensuring comprehensive and current documentation minimises this scenario.

5.8 EMERGENCY PREPAREDNESS AND RESPONSE

Universities are not usually associated with environmental emergencies such as spills or inadvertent release of air pollutants. However, the range of hazardous materials stored on many campuses, the variety of teaching and research endeavours in which these materials are used, and also the scope of operational activities, highlights the need to be

prepared for potential emergencies.

ISO 14001 outlines the requirements for emergency preparedness and response for organisations subscribing to an environmental management system, and this advice is relevant to universities which have committed to the path of sustainable development. As a minimum, documented procedures should be established, maintained and periodically reviewed for identifying hazards and risks, responding to accidents and emergency situations and for preventing and mitigating the potential environmental impacts associated with them. Periodic exercise of such procedures should be undertaken where practicable.

Emergency preparedness and response needs to be included in the training provided to those staff (and contractors) responsible for teaching, research or operational areas with the potential to cause significant environmental impacts, and those providing specialised environmental management services for the university.

5.9 RECOGNISING AND REWARDING PROGRESS

Having achieved initial successes in sustainable development it is natural that universities will want to see how they compare with their peers, from both a benchmarking and a marketing perspective. Benchmarking against comparable institutions promotes continual improvement; public recognition can attract funding, students and high quality academic and operational staff. However, the operative word here is comparable. As noted throughout this Toolkit, universities operate in a wide range of circumstances, with huge disparities in geography and climate, resources, curriculum, student and staff numbers, research profiles and so on.

Most benchmarking and award programs are managed through individual national university sustainability associations, although growing international collaboration is beginning to extend the scope of such programs across national boundaries. At present though, the pool of potential award winners is fairly restricted by the selection criteria for the awards. Establishment of a truly global scheme presupposes a level playing field. Clearly conventional quantitative benchmarking – the "scorecard" model – is inappropriate in this context.

The alternative is a "continual improvement" model, which rewards universities based not on absolute performance but on measured improvement against self-identified objectives, incorporating evaluation of creativity and innovation and normalised against economic, social and climatic factors. This model will need further research and considerable discussion between national and international university sustainability organisations to bring to fruition.

The most widely recognised existing award programs are briefly summarised below.

The International Sustainable Campus Network (ISCN) established the International Sustainable Campus Excellence Awards in 2009. These awards recognise projects which demonstrate leadership, creativity, effectiveness and outstanding performance in the areas of Building, Campus, Integration and Student Initiatives.

The Green Gown Awards now in their 9th year, recognise exceptional initiatives being taken by universities and colleges across the UK to become more sustainable. Now run by the UK's Environmental Association for Universities and Colleges (EAUC), the Awards were created to recognise and reward those institutions making a positive impact towards sustainability within the education sector. In 2012 there were 13 Award categories, including continuous improvement, student initiatives and campaigns, social responsibility, carbon reduction and courses. Building on this success and keen to embrace international collaboration, Australasian Campuses Towards Sustainability (ACTS) formally launched the Green Gown Awards Australasia in 2010. The categories cover continuous improvement, learning and teaching, student campaigns, Technical and Further Education (TAFE) colleges and smaller institutions, and the ACTS Award of Excellence.

In 2012 the Green Gown Awards launched the International Green Gown Awards. This initially incorporates the winning entries from the UK and Australasia going head to head on 3 categories to gain an International Green Gown Awards. The Green Gown Awards will also be delivered in France in 2014 and will be included in the International Green Gown Awards.

The Association for the Advancement of Sustainability in Higher Education (AASHE) presents two Campus Sustainability Case Study Awards, one Faculty Sustainability Leadership Award, one Innovation in Green Building Award, one Student Sustainability Leadership Award, and one Student Research on Campus Sustainability Award annually. The awards are presented at AASHE's annual conference. The Association comprises member institutions across 18 countries.

CHAPTER 6

RESOURCES FOR CHANGE

The emergence and diffusion of individual campus greening initiatives in the late 1980s soon led to existing university coalitions and associations adding sustainability criteria to their terms of reference, establishment of new organisations, convening of conferences, adoption of high level declarations and charters and the publication of a rising tide of print and online resources. This Chapter of the Toolkit brings together and summarises the material: associations; international commitments; online tools; books and journals; and sustainability award programs. The list does not attempt to be all-inclusive – this is a rapidly expanding field – but includes the most widely recognised, readily available and relevant resources for university senior management, academic and operational staff and students to support the transition towards sustainability.

6.1 INTERNATIONAL AND ASSOCIATIONS

This list includes only those bodies which are international in scope – i.e. with member universities across several countries. Many nations have their own university sustainability organisations, and many generalist university organisations include sustainability interest groups or activity streams.

As discussed earlier, evidence based study is essential in avoiding greenwash. The following case studies, therefore, clearly list any specific targets of greening initiatives and specify any evidence of measured improvements in the project's environmental performance.

This list of global exemplars is expected to grow over time as more and more examples of campus greening initiatives are implemented and accurate information is made available for inclusion in this toolkit.

INTERNATIONAL SUSTAINABLE CAMPUS NETWORK

The International Sustainable Campus Network (ISCN) provides a global forum to support leading colleges, universities, and corporate campuses in the exchange of information, ideas, and best practices for achieving sustainable campus operations and integrating sustainability in research and teaching. The ISCN is managed by the network's Secretariat, operated by Sustainserv Inc., and its strategic development is guided by a Steering Committee including representatives of the five schools who generously host the ISCN: EPF Lausanne, ETH Zurich, Nanyang Technological University, National University of Singapore, The University of Hong Kong.

GLOBAL HIGHER EDUCATION FOR SUSTAINABILITY PARTNERSHIP (GHESP)

"Four international organisations with a strong commitment to making sustainability a major focus of higher education have formed the Global Higher Education for Sustainability Partnership (GHESP). The four founding partners of the initiative – the International Association of Universities, the University Leaders for a Sustainable Future, Copernicus Campus and UNESCO – combine forces in a unique effort to mobilise universities and higher education institutions to support sustainable development in response to Chapter 36 of Agenda 21."

HIGHER EDUCATION SUSTAINABILITY INITIATIVE

The Higher Education Sustainability Initiative (HESI) for Rio+20 was initiated in 2012 by a group of UN partners (the Executive Coordinator of Rio+20, UN DESA, UNEP, UNESCO, UN Global Compact, UN Global Compact's Principles for Responsible Management Education (PRME) and UNU) as an unprompted initiative for Higher Education Institutions (HEI) in the run-up

to the Rio+20 Conference. Since HEIs educate current and future decision makers, they play a key role in building more sustainable societies and creating new paradigms. A total of 272 organizations in 47 countries have made commitments to the HESI as of June 2013. These commitments represent organizations from a diverse range of countries including both public and private HEIs from all six UN regions. Many of these organizations are also affiliated to other UN initiatives, such as the Global Universities Partnership on Environment and Sustainability (GUPES) and around two-thirds of the organizations are signatories to the UN Global Compact or PRME.

AMFORT (OR WAPTT, THE WORLD ASSOCIATION FOR PROFESSIONAL TOURISM TRAINING)

Amfort (or WAPTT,the World Association for Professional Tourism Training) was created at Nice in 1969, as part of the same movement which created WTO. Its aim was » to define, develop, promote and adapt world tourism training to the needs and evolution of the tourism industry. Every second year, its world congress brought together the representatives of the three categories of institution and people that can shape the future of tourism education and training

ASSOCIATION OF INTERNATIONAL EDUCATION ADMINISTRATORS (AIEA)

Association of International Education Administrators (AIEA) works by bringing international education leaders into dialogue with each other, their counterparts around the world, umbrella organizations that promote international education, and organizations concerned with the shaping and management of higher education. http://www.aieaworld.org

CEEMAN

CEEMANis an international management development association established in 1993 with the aim of accelerating the growth in quality of management development in central and eastern Europe. CEEMAN is a global network of management development institutions focusing on the quality of education and innovations within the field, as well as in the broad area of subjects related to change. CEEMAN has more than 200 institutional and individual members from 51 countries in Europe, North America, Latin America and Asia.Learn more about CEEMAN http://www.ceeman.org

CNRD

CNRD is an international university network on research and education related to the Millennium Development Goal 7 (MDG 7). Currently the network consists of 11 partner universities in Latin America, Africa, the Middle East, Asia, and Europe. CNRD is funded by the German Federal Ministry for Economic Cooperation and Development and managed by the German Academic Exchange Service (DAAD). Its focal point is Cologne University of Applied Sciences.

EFMD

EFMD is an international membership organization, based in Brussels, Belgium. With more than 760 member organizations from academia, business, public service and consultancy in 82 countries, EFMD provides a unique forum for information, research, networking and debate on innovation and best practice in management development. EFMD runs the EQUIS, EPAS, CEL & CLIP accreditation systems as well as the Deans Across Frontiers business school mentoring programme (DAF) and is one of the key reference points for management education worldwide. Since its inception EFMD has been pioneering initiatives related to responsible management .

GRLI

GRLI: The Globally Responsible Leadership Initiative is a worldwide partnership of companies and business schools/learning organisations working together in a laboratory of change to develop a next generation of globally responsible leaders. The GRLI engages in thought leadership, advocacy and projects to achieve measurable impact. Founded in 2004 by the European Foundation for Management Development and the UN Global Compact, today it comprises 70 partner (member) organisations who are committed to transforming leadership development. It is a member organization, a foundation, an advanced laboratory and a movement. www.grli.org

MEDIES (MEDITERANEAN REGION): MEDITERANEAN EDUCATION INITIATIVE FOR ENVIRONMENT AND SUSTAINABILITY

MEDIES (Mediteranean Region): Mediteranean Education Initiative for Environment and Sustainability aims to support the educational community in its efforts to contribute to the implementation of Agenda 21, the Millennium Development Goals (MDGs), as well as the UN Decade of Education for Sustainable Development (2005-2014), through the successful application of innovative educational programmes in all countries around the Mediterranean basin. http://www.medies.net/main1.asp

PROSPER.NET (PROMOTION OF SUSTAINABILITY IN POSTGRADUATE EDUCATION AND RESEARCH NETWORK)

ProSPER.Net (Promotion of Sustainability in Postgraduate Education and Research Network)is an alliance of higher education institutions launched in June 2008, formed by leading universities in the Asia-Pacific region. ProSPER.Net was created in recognition of the need to advance and disseminate knowledge and research for sustainable development within a systematic and collaborative platform. By engaging with other members within this framework, opportunities for synergies and collaboration in terms of building upon members' strengths, exchanging good practices and expertise in joint projects are enhanced. Collaborative projects in various fields have been carried out since the network was founded, comprising design and delivery of an e-learning programme on sustainable development practice in public policy, integration of sustainability issues in business school and engineering and built environment curricula, faculty training module and resource materials for sustainability, researchers' school in sustainable development, research on innovative pedagogies applied in regional poverty reduction programmes and alternative university appraisal project, that aims to reflect and create tools for universities' evaluation as regards their activities in ESD.For more information, please visit: www.ias.unu.edu/efsd/prospernet

SENAI

SENAI has been based on meeting the needs of the industrial production process, with courses and programs for vocational education, aiming at high levels of professional qualification of workers, as well as the formation of creative and enterprising citizens. We reinforce our goal of promoting education for a generation of workers and managers capable of promoting sustainability today and over the long term. Our pedagogical practice will be guided by the goal of forming autonomous learners, who have initiative, pro-activity and ability to solve problems. Thus, educating professionals capable of conducting self-training and improvement as well as the resources and environment sustainability.

THE ASSOCIATION OF AFRICAN UNIVERSITIES (AAU)

The Association of African Universities (AAU) is an international non-governmental organisation founded in Rabat, Morocco in November 1967 having its headquarters in Accra, Ghana. The Association draws its membership from all five sub-regions of Africa and operates in three official languages, namely English, French and Arabic. Over the years, membership has grown from an initial 34 to 265 members from 46 African countries. It is accorded observer status by the African Union (AU), the United Nations Educational, Scientific and Cultural Organisation (UNESCO) and the United Nations University (UNU). A major development in recent years is that the AAU has been designated the lead implementing agency for the higher education component of the Action Plan for the Second Decade of Education of the African Union.http://www.aau.org

THE ASSOCIATION OF MBAS

The Association of MBAs is the international impartial authority on postgraduate business education. Established in 1967, it sets the global standard for accrediting MBA, DBA and MBM programmes. The Association currently accredits MBA provisions in 189 schools in more than 75 countries. It is also a professional membership association connecting MBA students and graduates, accredited business schools and MBA employers. The Association of MBAs is committed to the advancement of responsible management through postgraduate business education. http://www.mbaworld.com

THE ASSOCIATION OF UNIVERSITY LEADERS FOR A SUSTAINABLE FUTURE (ULSF)

The Association of University Leaders for a Sustainable Future (ULSF) is the Secretariat for signatories of the Talloires Declaration (1990), which has been signed by over 400 college and university presidents and chancellors worldwide. ULSF provides resources and support for sustainability as a critical focus of teaching, research, operations and outreach in higher education through publications, research, and assessment. www.ulsf.org

THE COPERNICUS ALLIANCE

The COPERNICUS Alliance is a European network of Universities and partners which promotes transformative learning and change for sustainability across the higher education sector. The COPERNICUS Alliance promotes learning through dialogue and exchange opportunities; encourages the development of publications and resources; collects and shares best practice; provides opportunities for collaborative research; and reviews assessment tools to assist organisations in their journeys towards sustainability.

THE INTERNATIONAL ASSOCIATION OF UNIVERSITIES (IAU)

The International Association of Universities (IAU), founded in 1950, is a UNESCO-based worldwide association of higher education institutions. The Association brings together HEIs and higher education organizations and associations from some 120 countries from around the world for reflection and action on common concerns. Its services are available on a priority basis to Members but also to organizations, institutions and authorities concerned with higher education, as well as to individual policy and decision-makers, specialists, administrators, teachers, researchers and students. The three overarching clusters the Association works on are: I. Internationalisation, globalisation, cross-border higher education, and intercultural learning and dialogue; II. Access to higher

education, including growing demand for enrolment and decreased funding, use of ICTs, distance education and the opportunities brought on by innovations such as the Open Content movement; III. Higher education and society (including higher education for sustainable development, the role of higher education in meeting the UN Education for All programme goals, etc.). www.iau-aiu.net

UNITWIN

UNITWIN: The University Twinning and Networking Programme, established in 1992, seeks to advance research, training and programme development in all of UNESCO's fields of competence by building university networks and encouraging inter-university cooperation through the transfer of knowledge across borders. http://www.unesco.org/en/unitwin/university-twinning-and-networking/

WORLD BUSINESS SCHOOL COUNCIL FOR SUSTAINABLE BUSINESS (WBSCSB)

World Business School Council for Sustainable Business (WBSCSB): WBSCSB is a sustainability think-tank and platform of action for business schools to contribute making business sustainable through their research, education and engagement. Founded at the 2010 annual conference of the Academy of Management in Montreal, a small group of concerned deans and professors took a first step to create the World Business School Council for Sustainable Business (WBSCSB). Core areas of activities

include: leading research addressing pressing sustainability issues and education embracing sustainability as a function of business. www.wbscsb.com

UNIVERSITY LEADERS FOR A SUSTAINABLE FUTURE (ULSF)

"The mission of the Association of University Leaders for a Sustainable Future (ULSF) is to support sustainability as a critical focus of teaching, research, operations and outreach at colleges and universities worldwide through publications, research, and assessment."

ASSOCIATION FOR THE ADVANCEMENT OF SUSTAINABILITY IN HIGHER EDUCATION (AASHE)

"AASHE is helping to create a brighter future of opportunity for all by advancing sustainability in higher education. By creating a diverse community engaged in sharing ideas and promising practices, AASHE provides administrators, faculty, staff and students, as well as the business that serve them, with: thought leadership and essential knowledge resources; outstanding opportunities for professional development; and a unique framework for demonstrating the value and competitive edge created by sustainability initiatives."

GLOBAL UNIVERSITY NETWORK FOR INNOVATION (GUNI)

"The Global University Network for Innovation - GUNI is composed of the UNESCO Chairs in Higher Education, higher education institutions, research centers and networks related to innovation and the social commitment of higher education. 179 institutions from 68 countries are GUNI members."

INTERNATIONAL ALLIANCE OF RESEARCH UNIVERSITIES (IARU)

"The International Alliance of Research Universities (IARU) is a collaboration between ten of the world's leading research-intensive universities who share similar visions for higher education, in particular the education of future leaders... The Alliance has identified sustainable solutions on climate change as one of its key initiatives. As a demonstration of its commitment to promote sustainability, IARU has sought to lead by example through the establishment of the Campus Sustainability Programs aimed at reducing the environmental impact of our campus activities."

ALIANZA DE REDES IBEROAMERICANAS DE UNIVERSIDADES POR LA SUSTENTABILIDAD Y EL AMBIENTE - ARIUSA

"ARIUSA is a network of environmental university created in Bogota October 26, 2007 by a group of University Networks in Environment and Sustainability (RUAS), collected during the "Fourth International Congress University and Environment", organized by the Colombian Network of Education environmental (RCFA).The basic purpose or mission is to promote and support ARIUSA coordination of actions in the field of environmental education superior, and the scientific and academic cooperation between University Networks for Environment and Sustainability".

AFRICA

ANSTI

The African Network of Scientific and Technological Institutions was established in 1980 and its mission is to facilitate the active collaboration among African scientific institutions for the purpose of training and research in science, engineering and technology. http://www.ansti.org/

Association of African Business Schools (AABS)

Association of African Business Schools (AABS) is an association of leading business schools throughout the African Continent. AABS promotes excellence in business and management education through capacity building, collaboration and

quality improvement. http://www.aabschools.com

REGIONAL UNIVERSITIES FORUM FOR CAPACITY BUILDING IN AGRICULTURE

Mainstreaming environment and sustainability in the 29 member universities in Eastern, Central and Southern Africa which are in the consortium of RUFORUM- Building capacity of universities to access opportunities for mainstreaming sustainability in higher education- – Greening of university training, research and outreach programs - Engaging with university management and policy processes to ensure visibility and contribution of universities in sustainable development

EUROPE

CONFÉRENCE DES GRANDES ECOLES (CGE)

CGE (France): The Conférence des Grandes Ecoles is a non-profit organization dedicated to support higher education institutions through joint activities, accreditation of educational programs and promotional activities in France and abroad. CGE members are mainly engineering, management and other specialized schools (215), plus companies (16) and non-profit organizations (46). www.cge.asso.fr

CAMPUS RESPONSABLES (SUSTAINABLE CAMPUS)

Campus Responsables (Sustainable Campus) (France) : It was launched in 2006 to encourage students and estates/administration staff of French colleges and universities to embed the sustainability into the campus management and curriculum. The Network counts 40 campus members in January 2012. Campus Responsables support the campuses by giving them the tools to share good practices, to innovate on tackling new green challenges, to communicate on their commitment especially through the Sustainable Campus Guide we publish regularly. Our website : www.campusresponsables.com

CONFERENCE OF UNIVERSITY PRESIDENTS (CPU)

The Conference of University Presidents (CPU - France), as defined in the « Freedoms and responsibilities of the universities » Act of August 10, 2007, is an association with recognized public benefit (117 members). It represents the common interests of institutions of higher learning. French universities have set up a Sustainable Development Committee within the framework of the CPU, in order to identify shared needs, to find answers through partnerships with the socio-economic world, and to share initiatives and tools. www.cpu.fr

ENVIRONMENTAL ASSOCIATION FOR UNIVERSITIES AND COLLEGES (EAUC)

The Environmental Association for Universities and Colleges (EAUC) is a not-for-profit charity with a membership of over 300 universities and colleges, supporting sustainability within the UK tertiary education sector. The EAUC is THE sustainability champion for universities and colleges in the UK. Run by members, for its members, the EAUC seeks to drive sustainability to the heart of further and higher education. With a Membership of over 320 colleges and universities from across the UK, the EAUC is now the recognised hub of sustainability best practice in the sector. The EAUC provides

strong alliance of Further and Higher Education Institutions, sector bodies and commercial organisations, working together both in the UK and internationally. With links to similar bodies in North America, Australasia, Spain and South Korea amongst others, the EAUC is working on a global scale to raise the profile of sustainability in the tertiary education sector. Find out more at www.eauc.org.uk

ASIA AND PACIFIC

ASPUNIVNET

ASPUnivNet is a network of universities that support activities at UNESCO Associated Schools as their partners. It was established in 2008 jointly by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) and the Japanese National Commission for UNESCO (JNCU). http://www.nara-edu.ac.jp/ADMIN/SOUMU/panfe.pdf

ECOLEAD

EcoLeaD (Japan): Environmental Consortium for Leadership Development (EcoLeaD) is an academia-industry-government-NGO/NPO consortium with 24 international partners in Asia Pacific. It was launched by the Ministry of the Environment, Japan as part of the Environmental Leadership Initiatives for Asian Sustainability (ELIAS) in 2009. EcoLeaD works as a multi-stakeholder platform to run projects in four major areas: (1) developing environmental education program guidelines and certification systems for higher education and industry; (2) holding seminars and symposia to introduce and discuss innovative approaches in environmental education and environmental business; (3) building information infrastructure including a database of environmental education programs in higher education; and (4) promoting international cooperation for constructing sustainable society.www.eco-lead.jp

GUNI-AP

The Global University Network for Innovation in Asia and the Pacific aims to improve higher education in that region through the application of the UNESCO decisions on higher education taken at the World Conference on Higher Education in 1998. http://www.guni-ap.org

THE AUSTRALASIAN CAMPUSES TOWARDS SUSTAINABILITY

The Australasian Campuses Towards Sustainability is a non-profit member based organisation representing higher and further education institutions within Australia and New Zealand. ACTS aims to inspire, promote and support change towards best practice sustainability within the operations, curriculum and research of the tertiary education sector. ACTS seeks to build community and business partnerships at the local, regional and international level, in order to bring together a network of people for positive engagement, capacity building and change." http://www.acts.asn.au/

THE CENTRE FOR ENVIRONMENT EDUCATION (CEE)

The Centre for Environment Education (CEE) is a Centre of Excellence in Environmental Education and Education for Sustainable Development (ESD) supported by the Ministry of Environment and Forest, Government of India. CEE is the nodal agency for implementation of Decade of Education for Sustainable Development in India and has been engaged in ESD with a variety of higher education institutions within and outside India, for over two decades. CEE also co-ordinates six Regional Centres of Expertise (RCE) under the Global RCE initiative of the UNU-IAS. CEE is the Secretariat of the South Asia Youth Environment Network (SAYEN) supported by the UNEP Regional Office, Asia and the Pacific which engages youth in the environmental activities.

THE HIMALAYAN UNIVERSITY CONSORTIUM (HUC)

The Himalayan University Consortium (HUC) is a membership network for education and research for sustainable mountain development of the Hindu Kush-Himalayan (HKH) region, which covers many large, vulnerable, and fragile ecosystems in Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan. More at http://www.icimod.org/?q=146

UNIVERSITIES AUSTRALIA

Universities Australia (Australia): Universities Australia is the peak body representing Australia's universities. Its broad commitment is to ensure Australia's reputation as a highly innovative and educated nation. Universities Australia's role is to promote the social, economic, environmental and cultural value of higher education through its relationships with governments, industry, the professions and the wider community, both nationally and internationally. Universities Australia is an active player in the determination and formulation of public policy, advocating on behalf of Australia's universities. www.universitiesaustralia.edu.au

NORTH AMERICA

AMERICAN COLLEGE & UNIVERSITY PRESIDENTS' CLIMATE COMMITMENT (ACUPCC)

The American College & University Presidents' Climate Commitment (ACUPCC) is a high-visibility effort to address global climate disruption undertaken by a network of colleges and universities that have made institutional commitments to eliminate net greenhouse gas emissions from specified campus operations, and to promote the research and educational efforts of higher education to equip society to re-stabilize the earth's climate. Its mission is to accelerate progress towards climate neutrality and sustainability by empowering the higher education sector to educate students, create solutions, and provide leadership-by-example for the rest of society.http://www.presidentsclimatecommitment.org

AACC

AACC (US): The American Association of Community Colleges is the leading national organization representing close to 1,200 community, junior and technical colleges and their more than 13 million students. Headquartered in Washington, D.C., AACC advocates for the colleges and their interests in Congress, with federal agencies and the White House, and with a broad array of businesses, organizations and the news media. AACC's sustainability efforts are largely focused through its Sustainability, Education and Economic Development initiative, which supports the colleges in their efforts to expand green job training opportunities and innovation. www.aacc.nche.edu

AASHE

AASHE is helping to create a brighter future of opportunity for all by advancing sustainability in higher education. By creating a diverse community engaged in sharing ideas and promising practices, AASHE provides administrators, faculty, staff and students, as well as the business that serve them, with: thought leadership and essential knowledge resources; outstanding opportunities for professional development; and a unique framework for demonstrating the value and competitive edge created by sustainability

AGB

AGB (US): The Association of Governing Boards of Universities and Colleges is the only national association that serves the interests and needs of academic governing boards, boards of institutionally related foundations, campus CEOs and other senior-level campus administrators on issues related to higher education governance and leadership. Its mission is to strengthen, protect, and advocate on behalf of citizen trusteeship that supports and advances higher education. www.agb.org

HACU

HACU (US) : The Hispanic Association of Colleges and Universities was established in 1986 with a founding membership of 18 institutions. Today, HACU represents more than 400 colleges and universities committed to Hispanic higher education success in the U.S., Puerto Rico, Latin America, Spain and Portugal. HACU is an association representing existing and emerging Hispanic-Serving Institutions. Information is available at www.hacu.net

LATIN AMERICA AND THE CARIBBEAN

INNOVEMOS

INNOVEMOS (Latin America & Caribbean): Network of Educational Innovation for Latin America and the Caribbean is an interactive space and a permanent forum for reflection, production, exchange and dissemination of knowledge and practices about innovations and educational change. www.redinnovemos.org

STUDENT ORGANIZATIONS

FSNSD (FRENCH STUDENT NETWORK FOR SUSTAINABLE DEVELOPMENT)

FSNSD (French Student Network for Sustainable Development): Created in 2007. In 2012, 90 students associations (situated in universities, business and engineering schools) are members of the network, that is to say 4500 students from all over the French territory working towards sustainable development in their campuses. More information : www.refedd.org. For an example of our work, you can have a look at the report "10 000 young people to imagine a more sustainable higher".

OIKOS

Oikos is the international student organisation for sustainable economics and management and a leading reference point for the promotion of sustainability change agents. http://www.oikos-international.org/

SENSD

SENSD, the Students' European Network for Sustainable Development, is a network that aims to gather European students together to promote sustainable development, by exchanging knowledge and information. By networking European students concerned with sustainable development, SENSD promotes a new generation of students aimed at constructing a cooperative, fair and environmentally friendly Europe.

THE WORLD STUDENT COMMUNITY FOR SUSTAINABLE DEVELOPMENT (WSCSD)

The World Student Community for Sustainable Development (WSCSD) is a non-profit international student organization committed to addressing the issues of sustainable development. WSCSD is comprised of students and organizations within universities in more than 100 countries from all the 5 continents. Since its inception in 2002, WSCSD has provided a platform for multidisciplinary and cross-border student collaboration on research and community development projects.

6.2 INTERNATIONAL AGREEMENTS AND DECLARATIONS

Since the formulation of the Talloires Declaration in 1990, regional and international university conferences have generated a range of agreements, declarations and charters on university sustainability. As at 2011 universities and intergovernmental institutions had developed some 30 university sustainability declarations, and more than 1400 universities worldwide had signed such a document [43]. A declaration represents a high level statement of commitment to a sustainable future; as such it can offer general guidance, but is not designed to provide specific direction. The most widely adopted examples are listed below.

TALLOIRES DECLARATION

"Composed in 1990 at an international conference in Talloires, France, this is the first official statement made by university presidents, chancellors, and rectors of a commitment to environmental sustainability in higher education. The Talloires Declaration (TD) is a ten-point action plan for incorporating sustainability and environmental literacy in teaching, research, operations and outreach at colleges and universities. It has been signed by over 400 university leaders in over 50 countries."

Copernicus Charter

The University Charter for Sustainable Development is an instrument created by Copernicus, an inter-university co-operation programme on the environment, established by the Association of European Universities. The Charter expresses a collective commitment on behalf of a large number of universities. It represents an effort to mobilize the resources of institutions of higher education to further concept and objective or sustainable development.

HALIFAX DECLARATION

"Over the period 8-11 December 1991, the presidents and senior representatives of 33 universities from 10 countries on 5 continents met in Halifax, Canada to take stock of the role of universities regarding the environment and development. They were joined by a number of senior representatives from business, the banking community, governments, and non-governmental organizations. The meetings were sponsored by the International Association of Universities, the United Nations University, the Association of Universities and Colleges Canada and Dalhousie University, Canada." Creating a Common Future: The Halifax Declaration and Action Plan was released at the end of the conference.

SWANSEA DECLARATION

"At Swansea, Wales, in August 1993, participants in the Association of Commonwealth Universities (ACU) 15th Quinquennial Congress drawn from over 400 universities in 47 different countries met to address the challenge of 'People and the Environment - Preserving the Balance'. They engaged in a quest for the ways by which the universities of the ACU, their leaders, scholars and students might engage and deploy their unique common traditions and comity to respond appropriately to this challenge."

KYOTO DECLARATION

"The Kyoto Declaration on Sustainable Development was issued following the Ninth International Association of Universities Round Table in 1993. Linked to Agenda 21 and the outcomes of the United Nations Commission on Environment and Development Conference in Rio de Janeiro, the Declaration called for universities to seek, establish and disseminate a clearer understanding of sustainable development."

THE AMERICAN COLLEGE & UNIVERSITY PRESIDENTS' CLIMATE COMMITMENT (ACUPCC)

"The ACUPCC is a high-visibility effort to address global climate disruption undertaken by a network of colleges and universities that have made institutional commitments to eliminate net greenhouse gas emissions from specified campus operations, and to promote the research and educational efforts of higher education to equip society to re-stabilize the earth's climate. Its mission is to accelerate progress towards climate neutrality and sustainability by empowering the higher education sector to educate students, create solutions, and provide leadership-by-example for the rest of society".

THE SCOTTISH UNIVERSITIES AND COLLEGES CLIMATE CHANGE COMMITMENT FOR SCOTLAND

"Scotland's universities and colleges have publicly declared their intention to address the challenges of climate change and reduce their carbon footprints by signing the Universities and Colleges Climate Commitment for Scotland (UCCCfS) - this programme is delivered by the EAUC and funded by the Scottish Funding Council. Signatories produce and publish a 5-year Climate Change Action Plan (CCAP) which will be incorporated into established improvement processes, with the aim to achieve a significant reduction in emissions".

6.3 ONLINE TOOLS AND RESOURCES

There is a growing list of online resources designed to help universities to develop sustainably. These include self-assessment reporting frameworks and questionnaires, guidelines and case study databanks. Most national sustainable campus associations provide at least some best practice case studies and checklists for reference. The list below includes the more widely known and internationally relevant examples.

CHARTER AND GUIDELINES (ISCN)

"The ISCN promotes continuous improvement through learning and innovation on all aspects of sustainability on campus. Key goals in this respect are summarized in the ISCN-GULF Sustainable Campus Charter, which is complemented by a detailed Charter Report Guidelines document. The Charter was developed to support universities in setting targets and reporting on sustainable campus development goals and performance."

SUSTAINABILITY TRACKING AND RATING SYSTEM (STARS) (AASHE)

"The Sustainability Tracking, Assessment & Rating System™ (STARS) is a transparent, self-reporting framework for colleges and universities to measure their sustainability performance. STARS® was developed by AASHE with broad participation from the higher education community... The STARS framework is intended to engage and recognize the full spectrum of colleges and universities in the United States and Canada – from community colleges to research universities, and from institutions just starting their sustainability programs to long-time campus sustainability leaders."

SUSTAINABILITY ASSESSMENT QUESTIONNAIRE (ULSF)

"The Sustainability Assessment Questionnaire (SAQ) is designed to assist you in assessing the extent to which your college or university is sustainable in its teaching, research, operations and outreach. "Sustainability" implies that the major activities on your campus are ecologically sound, socially just, economically viable and humane, and that they will continue to be so for future generations."

SUSTAINABLE DEVELOPMENT ON CAMPUS: TOOLS FOR CAMPUS DECISION MAKERS (IISD)

"The International Institute for Sustainable Development (IISD) is a Canadian-based, public policy research institute that has a long history of conducting cutting-edge research into sustainable development. IISD's Sustainable Development on Campus Tool Kit has been compiled in support of a Memorandum of Understanding between IISD, the International Association of Universities (IAU), and the Earth Council, in which the Association of Canadian Community Colleges (ACCC) has also participated, to assist institutions of higher education to meet the challenges of the Kyoto Declaration."

INTERNATIONAL ALLIANCE OF RESEARCH UNIVERSITIES CAMPUS SUSTAINABILITY TOOLKIT (IARU)

"The six-point toolkit includes strategies to address the following elements: mapping current situation and developing a governance structure; measuring environmental impacts; integrating campus activities; determining goals and a strategy for the process; establishing strategies to create a sustainable campus; and education and awareness. Accompanying the online toolkit are resources, strategies, and case studies on sustainability efforts by IARU members." IARU is an alliance of ten of the world's leading research-intensive universities.

LEARNING IN FUTURE ENVIRONMENTS (LIFE) (UK AND AUSTRALASIA)

"Learning in Future Environments (LiFE) is a comprehensive performance improvement and benchmarking system developed specifically to help colleges and universities to manage, measure, improve and promote their social responsibility and sustainability performance... The system reflects not only the specific nature of the Further and Higher Education Sector but

also the uniqueness of each institutional, their context and their individual approaches to embedding sustainability and social responsibility… LiFE is developed and delivered by the Environmental Association for Universities and Colleges in partnership with Australasian Campuses Towards Sustainability.

AUSTRALASIAN CAMPUSES TOWARDS SUSTAINABILITY HTTP://WWW.ACTS.ASN.AU/

ACTS is a non-profit member based organisation representing higher and further education institutions within Australia and New Zealand. ACTS aims to inspire, promote and support change towards best practice sustainability within the operations, curriculum and research of the tertiary education sector. ACTS seeks to build community and business partnerships at the local, regional and international level, in order to bring together a network of people for positive engagement, capacity building and change.

SECOND NATURE (USA)

"Second Nature's mission is to accelerate movement toward a sustainable future by serving and supporting senior college and university leaders in making healthy, just, and sustainable living the foundation of all learning and practice in higher education. Second Nature is a Commonwealth of Massachusetts nonprofit public benefit corporation, and a tax-exempt charitable organization as described in section 501(c)(3) of the United States Internal Revenue Code."

HIGHER EDUCATION ASSOCIATIONS SUSTAINABILITY CONSORTIUM (USA)

"HEASC is an informal network of higher education associations (HEAs) with a commitment to advancing sustainability within their constituencies and within the system of higher education itself. The current member associations that make up HEASC see the need for developing in-depth capability to address sustainability issues through their associations and have decided to work together in this effort. HEASC hopes to involve all higher education associations to get the broadest perspectives and produce the greatest effectiveness and synergy in our efforts."

HEALTHY UNIVERSITIES TOOLKIT (UK)

"A Healthy University aspires to create a learning environment and organisational culture that enhances the health, wellbeing and sustainability of its community and enables people to achieve their full potential…This toolkit comprises a collection of resources created by the Developing Leadership and Governance for Healthy Universities Project and is designed to support Higher Education Institutions (HEIs) that wish to adopt and/or embed a whole system Healthy University approach."

GOOD CAMPUS (UK)

"We provide guidance (e.g. cases, guides, white papers), networking and tools on sustainability - and especially energy and resource efficiency - in knowledge-intensive organisations. We began, and retain a strong presence, in universities but now also work in health, hitech, pharma and similar areas."

SUSTAINABLE UNIVERSITY 21 ONE-STOP SHOP (ASITHA JAYAWARDENA, UK)

"This website is a one-stop shop for resources for initiatives in sustainability in higher education in the UK and outside. And it strives to promote the Sustainable University concept around the world – within and outside universities."

SUSTAINABLE PROCUREMENT CENTRE OF EXCELLENCE FOR HIGHER EDUCATION (UK)

"The Sustainable Procurement Centre of Excellence for Higher Education (SPCE) is a 4 year project funded by the Higher Education Funding Council for England (HEFCE). The project began in October 2009 and intends to make demonstrable changes to the ways Higher Education Institutions (HEIs) embed sustainable procurement into their standard procedures, practices and policies."

ENVIRONMENTAL ASSOCIATION FOR UNIVERSITIES AND COLLEGES RESOURCE BANK (UK)

"Built up by the sector for the sector, the Resource Bank is a hugely important and useful long-term resource. The Bank is comprised of 11 key sector areas, in each you will find a growing collection of sector generated resources plus related case studies, forthcoming events and current news."

SUSTAINABLE DEVELOPMENT ON CAMPUS – TOOLS FOR CAMPUS DECISION MAKERS (INTERNATIONAL INSTITUTE FOR SUSTAINABLE DEVELOPMENT, CANADA)

"These tools will help you to learn more about sustainable development and its relevance to you and your institution. There are learning modules, case studies, action plans, environmental policies, resources, forums and contacts - all designed to help you, as part of the administration, as a student, or a member of faculty, implement sustainable development on your campus."

VIRTUAL SUSTAINABILITY PLATFORM IN UNIVERSITIES (WWW.PROJETOSUSTENTABILIDADE.SC.USP.BR)

(Consortium: University of São Paulo, Brasil; Autonomous University of Madrid (Spain) and the Pontifical Catholic University of Rio Grande do Sul (Brazil))

The Virtual Sustainability Platform is a digital space created to stimulate the participation of the university community in evaluating and learning about sustainability in the campus. In it, users register and share personal, group and institutional initiatives concerning sustainability. The platform has also a sustainability test, which poses questions to the reader about his/her university related to institutional commitment, management (waste, energy, water, mobility, buildings, green purchasing, green areas), curriculum greening and participation in decision making. After each block of questions the user receives information of the situation in his/her campus, previously prepared by the staffs of the universities involved. The results are shared and discussed with managers and directors to improve activities, projects and programs towards sustainability.

The Platform for Sustainability Performance in Education was launched at UNEP In February 2013. It brings together organisations which have created sustainability assessment tools designed to support universities and colleges around the world.

The purpose of this Platform is to promote sustainability assessment in education. By coming together it is our goal that more universities and colleges learn about the value of sustainability assessment tools to improve the sustainability performance across the whole of their institution.

6.4 BOOKS AND JOURNALS

From a base of virtually no published material 20 years ago, accumulating practical experience and theoretical reflection on university sustainability has generated a lively and expanding literature which includes a small shelf of books, a dedicated, peer-reviewed journal and hundreds of specialist papers published in education, environmental, policy and other publications. The key published sources of information are listed below. The explanatory text is taken from the relevant websites.

Regenerative Sustainable Development of Universities and Cities: The Role of Living Laboratories

'This book's case studies from North America, Europe and Asia highlight an enormous, but as yet untapped, potential for achieving social and technological change in cities worldwide. The authors show how university campuses around the world can be "living laboratories" to investigate and demonstrate the practicality of "regenerative sustainability", which looks beyond environmental damage control to a vision of urban development that actually improves environmental quality and human welfare. If these ideas catch on, they could literally change the world.'

INTERNATIONAL JOURNAL OF SUSTAINABILITY IN HIGHER EDUCATION (IJSHE)

"The IJSHE is the first fully refereed academic journal for the analysis of environmental and sustainability programs and initiatives at colleges and universities worldwide... The journal will be of special interest to higher education institutions and to those working on them."

JOURNAL OF CLEANER PRODUCTION

Cleaner production is a concept that goes beyond simple pollution control. It involves active research and development into new structures, systems, processes, materials and products that are more resource and energy efficient, whilst engaging and empowering people. Such approaches have become necessary for businesses, institutions, governments, and civil society to ensure ecologically, socially,and economically sustainable, consumption production and service strategies. These involve educational, training, management, and technical assistance programs, which are needed to accelerate the adoption of cleaner production and sustainability by industries, governments and universities.

SOLUTIONS

"Solutions is an online and hard-copy journal and magazine providing substantive discussion on the integrated design and analysis of human social and economic systems, ecological systems, urban environments and building and all other components of the earth system to achieve a desirable and sustainable human future. Solutions is a ULSF partner."

HIGHER EDUCATION QUARTERLY

"Higher Education Quarterly publishes articles concerned with policy, strategic management and ideas in higher education. A substantial part of its contents is concerned with reporting research findings in ways that bring out their relevance to senior managers and policy makers at institutional and national levels, and to academics who are not necessarily specialists in the academic study of higher education."

JOURNAL OF EDUCATION FOR SUSTAINABLE DEVELOPMENT (JESD)

"The Journal of Education for Sustainable Development (JESD) is a forum for academics and practitioners to share and critique innovations in thinking and practice in the emerging field of Education for Sustainable Development (ESD). A peer-reviewed international journal, JESD aims at global readership and is published twice a year."

PERSPECTIVES: POLICY & PRACTICE IN HIGHER EDUCATION

"Perspectives: Policy & Practice in Higher Education provides higher education managers and administrators with innovative material which analyses and informs their practice of management."

CAMPUS ECOLOGY, BY APRIL SMITH AND THE STUDENT ENVIRONMENTAL ACTION COALITION (1993)

"This book is designed to take the environmental issues and principles currently being studied in the classroom and move them outside the classroom doors into the campus community and the larger world. By making environmental knowledge part and parcel of campus environmental practice, students, faculty, and administrators have an extraordinary opportunity to act as agents of environmental education and change."

ECODEMIA: CAMPUS ENVIRONMENTAL STEWARDSHIP AT THE TURN OF THE 21ST CENTURY, BY JULIAN KENIRY (1995)

"At campuses around the country, staff, administrators, faculty, and students are redesigning the basic principles on which their institutions operate from day to day. The winners in this transformation are the global environment, local communities, campus morale, and the institutions' fiscal bottom-line. Now, the [US] National Wildlife Federation's Campus Ecology Program has documented these management innovations in a comprehensive new book based on extensive interviews with the people behind the green practices."

GREENING THE IVORY TOWER, BY SARAH HAMMOND CREIGHTON (1998)

"Universities can teach and demonstrate environmental principles and stewardship by taking action to understand and reduce the environmental impacts of their own activities. Greening the Ivory Tower, a motivational and how-to guide for staff, faculty, and students, offers detailed "greening" strategies for those who may have little experience with institutional change or with the latest environmentally friendly technologies."

SUSTAINABILITY AND UNIVERSITY LIFE, EDITED BY WALTER LEAL FILHO (1999)

"Sustainability and University Life, as the title implies, identifies various ways by which sustainability may be brought closer to a university´s routine. By means of critical analyses, case studies and examples from North American, European and African universities, the book not only discusses the problems faced with the promotion of sustainability at institutional level, but also shows how sustainability is being put into practice by a number of higher education institutions."

Planet U: Sustaining the World, Reinventing the University, by Michael M'Gonigle & Justine Starke (2006)

"Planet U places the university at the forefront of the sustainability movement. Questioning the university's ability to equip society to deal with today's serious challenges such as economic growth, democratic citizenship and planetary survival, it calls for a new social movement to take a lead in reforming the university - the world's largest industry."

DEGREES THAT MATTER, BY ANN RAPPAPORT AND SARAH HAMMOND CREIGHTON (2007)

"Universities and colleges are in a unique position to take a leadership role on global warming. As communities, they can strategize and organize effective action. As laboratories for learning and centers of research, they can reduce their own emissions of greenhouse gases, educate students about global warming, and direct scholarly attention to issues related to climate change and energy. Degrees That Matter offers practical guidance for those who want to harness the power of universities and other institutions, and provides perspectives on how to motivate change and inspire action within complex organizations."

REINVENTING HIGHER EDUCATION: TOWARD PARTICIPATORY AND SUSTAINABLE DEVELOPMENT (UNESCO, 2007)

In 2007, the Asia-Pacific Programme of Educational Innovation for Development (APEID), UNESCO Bangkok, convened the 11th UNESCO-APEID Conference entitled "Reinventing Higher Education: Toward Participatory and Sustainable Development." This volume contains selected papers from that conference, held in Bangkok from 12 to 14 December 2007.

FINANCING SUSTAINABILITY ON CAMPUS, BY BEN BARLOW AND ANDREA PUTMAN (2009)

"In Financing Sustainability on Campus, Ben Barlow, with guidance from Andrea Putman, provides higher education leaders with a comprehensive handbook to financing sustainability with real world examples, creative strategies, and clear explanations of a wide variety of financial tools and programs."

Universiti Sains Islam Malaysia

CHAPTER 7

GREENING YOUR UNIVERSITY BROCHURE

GREENING UNIVERSITIES TOOLKIT V2.0

CASE STUDY: SYDNEY, AUSTRALIA

INITIATIVE:

Tri-generation – A tri-generation plant is installed not only to service the TETB but also to export both electricity and chilled water to surrounding buildings. In addition tit is also furnished with 1,000sqm of photo-voltaic panels which will produce up to 150KW of electrical energy.

EVIDENCE:

'6 Star Green Star Design' rating (World Leadership) for an Education facility by the Green Building Council of Australia.

MORE INFO AT :

UNIVERSITY OF NEW SOUTH WALES. Tyree Energy Technologies Building http://www.keyprojects.unsw.edu.au/project/tyree-energy-technologies-building

CASE STUDY: NAIROBI, KENYA

INITIATIVE

The University developed its environmental policy in 2009; and a maintenance policy for all assets owned by the University in 2010 mainstreaming environmental considerations. All units of the university, as well as students, have embraced sustainable practices.

EVIDENCE:

Only university in Kenya to conduct an environmental audit of its products and services.

MORE INFO AT :

UNIVERSITY OF NAIROBI

Introduction http://www.uonbi.ac.ke/about

STEP BY STEP

STEP 1 Making The Commitment - Vision, Missions, Values And Declarations

STEP 2 Engaging The University And Wider Communities

STEP 3 Initiating Engagement For Sustainable Development

STEP 4 Establishing Sustainability Policy, Governance And Administration.

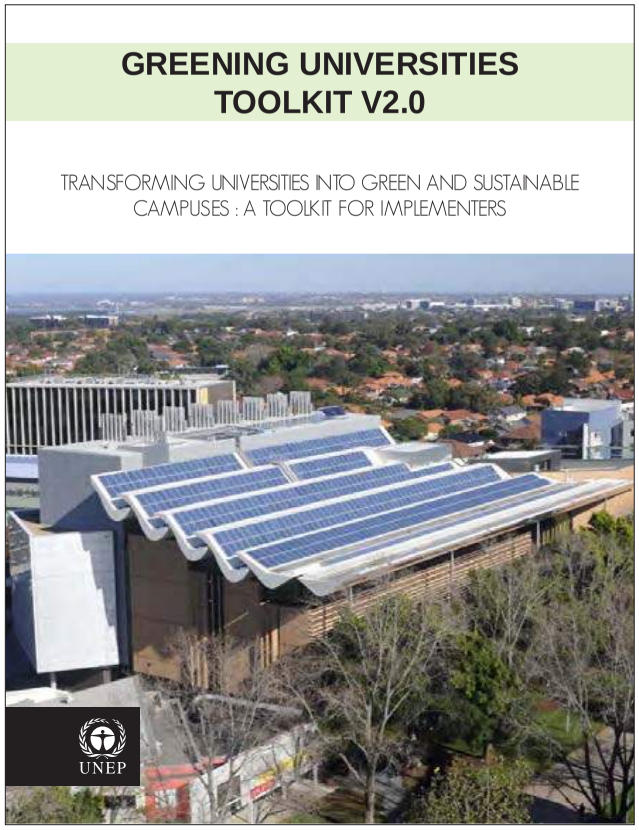
STEP 5 Determining The Baseline: Initial Environmental/ Sustainability Reviews

STEP 6 Selecting And Defining Indicators

STEP 7 Setting Objectives And Targets

STEP 8 Developing And Implementing Sustainability Action Plans

STEP 9 Closing The Loop: Monitoring, Evaluating And Communicating Progress



GREENING UNIVERSITIES TOOLKIT V2.0

LOW CARBON LIVING CRC

UNEP

eye on earth

GREENING UNIVERSITIES TOOLKIT V2.0

MISSION STATEMENT/ CONTEXT/ PURPOSE

The objective of this Toolkit is to inspire, encourage and support universities to develop and implement their own transformative strategies for establishing green, resource-efficient and low carbon campuses. It will provide an opportunity to build stakeholder capacity to deliver systemic, institution-wide integration of sustainability principles into all aspects of university business.

DEVELOPMENT OF THE TOOLKIT

The process involved four stages:

- An extensive review of the green University literature.
- Two workshops auspiced by GUPES which reviewed and discussed work in progress and provided input and direction to the final document.
- Collection of a substantial body of best practice case studies from Universities worldwide.
- Final review by the EETU to ensure currency, consistency and alignment with the objectives of the UNEP Greening Universities Initiative.

WHO IS GOING TO USE IT

This Greening Universities Toolkit is designed to provide universities with the basic strategies and tactics necessary to transform themselves into green, low carbon institutions with the capacity to address climate change, increase resource efficiency, enhance ecosystem management and minimise waste and pollution.

HOW / WHEN CAN YOU USE IT ?

The focus of this Toolkit is to provide University staff and students with a selection of strategies, tools and resources, gleaned from the literature, from global case studies and from practice which are intended to inspire, encourage and support Universities to develop and implement their own transformative strategies for establishing green, resource-efficient and low carbon campuses. In turn, it is hoped the "green campus" will help inform the "green curriculum", and extending beyond institutional boundaries, help to catalyse more sustainable communities.

OVERVIEW OF THE TOOLKIT (CONTENTS)

UNIVERSITIES AND SUSTAINABILITY

Establishes the context with a brief introduction to sustainability and sustainable development, and the elements expected of a sustainable university.

INITIATING TRANSFORMATION

Strategic infrastructural, managerial, operational and cultural issues to be considered in setting up a framework for sustainability planning and management.

INDICATORS

Defines key performance indicators and examples to measure sustainable campus.

TECHNOLOGIES FOR TRANSFORMATION

Sets out generic guidance measuring key performance of university campuses and also suggest key strategies to improve the performance.

POLICY GOVERNANCE AND ADMIN.

Outlines a methodology and potential criteria for a global award scheme to facilitate continual improvement in university sustainability performance.

RESOURCES FOR CHANGE

Lists a variety of books, journals, associations and websites which can provide further information and guidance on university sustainability topics.

GREENING YOUR UNI BROCHURE

Is an introductory brochure which presents a brief outline of the overall project and a concise summary of the outcomes.

GLOBAL EXEMPLARS

Presents a series of best practice case studies from universities around the world.

ADDITIONAL RESOURCES

-UNIVERSITY LEADERS FOR A SUSTAINABLE FUTURE (ULSF)
-http://www.ulsf.org/

-ASSOCIATION FOR THE ADVANCEMENT OF SUSTAINABILITY IN HIGHER EDUCATION (AASHE)
-http://www.aashe.org/

-GLOBAL UNIVERSITY NETWORK FOR INNOVATION (GUNI)
-http://www.guni-rmies.net/

-INTERNATIONAL SUSTAINABLE CAMPUS NETWORK (ISCN)
-http://www.international-sustainable-campus-network.org/

-INTERNATIONAL ALLIANCE OF RESEARCH UNIVERSITIES (IARU)
http://www.iaruni.org/

-COPERNICUS ALLIANCE
http://www2.leuphana.de/copernicus/

CONTACT

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Tel: (+254 20) 762 3381/ 4101
Fax: (+254 20) 762 3917
E-mail: env.edu@unep.org

DOWNLOAD THE TOOLKIT V2.0 FROM:

-http://www.unep.org/training/docs/Greening_University_Toolkit.pdf

Law School Library in
University of Michigan

CHAPTER 8

GLOBAL EXEMPLARS

As part of this toolkit's goal to provide information that can assist those universities that are beginning their journey of campus greening, this Chapter provides a compilation of various case studies of exemplary campus greening initiatives from around the world.

The objective of this Chapter is,

- To inspire encourage and faciltate learning through real-world examples.
- To acknowledge different physical, socio-economic and environmental contexts.
- To document different ways and aspects of greening:
  - Issues and opportunities
  - Strategies and initiatives
  - Benchmarks and performance indicators

The information on each case study is presented in a concise and standard format, which has three broad sections. The first one presents a general background or context to the project, lists target beneficiaries, and outlines UNEP thematic priority area as well as the area of the greening. The second section outlines various issues identified, initiatives implemented and outcomes achieved or expected. The third section presents quick facts of the project: evidence of measured improvement; size, cost and year of implementation; funding; and finally information source for this case study.

As discussed earlier, evidence based study is essential in avoiding greenwash. The following case studies, therefore, clearly list any specific targets of greening initiatives and specify any evidence of measured improvements in the project's environmental performance.

This list of global exemplars is expected to grow over time as more and more examples of campus greening initiatives are implemented and accurate information is made available for inclusion in this toolkit.

The Old Yard at Harvard University in autumn

EGYPT:
THE AMERICAN UNIVERSITY IN CAIRO

GENERAL DESCRIPTION:

- Founded in 1919, the American University in Cairo (AUC), an independent, not-for-profit institution, is one of the oldest and most established American universities abroad. It has 6,500 undergraduate and graduate students, 500 faculty and more than 2,500 staff.
- AUC's commitment to leadership in the fields of sustainable energy management and climate change is exemplified by Our Carbon Footprint 2.0 (The American University in Cairo, November 2013, www.aucegypt.edu/about/sustainability) the first carbon footprint study of a higher education institution in the Arab world.
- In September 2008, AUC moved the bulk of its operations from 9 acres of campuses centered on Tahrir Square in central Cairo to an all-new, state-of-the art 260-acre campus in the desert satellite city of New Cairo. The university's built space jumped from 68,000 to 203,000 square meters, and its operating budget more than doubled.
- By the fall of 2011, AUC was faced with persistent budget deficits aggravated by rapidly rising energy consumption and costs. To meet these challenges, the Office of Sustainability formed an internal energy task force consisting of facilities managers, architects and engineers, budget officers and faculty from the School of Sciences and Engineering. After a thorough review of energy consumption data from the first 3 years of operations at the new campus, the task force set a goal of reducing energy consumption university-wide by at least 1/3 within 3 years.

TARGET BENEFICIARIES:

Community largely at university and regional level, but also at global level.

UNEP THEMATIC PRIORITY AREA:

Climate change; Resource efficiency (sustainable consumption and production).

IDENTIFIED ISSUES:

By fiscal 2011 (the year prior to commencement of the 3-year energy saving program and the year used as the base year

for future comparisons) AUC-wide energy consumption had reached a peak of 103.5 million kilowatt hours (kwhr) annually for heating, ventilation and air conditioning (HVAC), lighting and other electrical equipment. Nearly 70% of all energy consumed at AUC was being used for HVAC (50% for air conditioning, 20% for heating). 30,000 lights in public and common areas burned night and day. Electricity consumption had risen nearly 20% in the aggregate over the preceding 2 years, and the university had concluded an agreement with the operator of its on-site power plant to install a fourth, larger electricity generator to meet the steadily growing demand.

OUTCOMES:

AUC's energy task force devised a two-pronged strategy to drastically reduce consumption:

(1) Retro-Commissioning. All components of HVAC and lighting systems throughout the university were inspected to determine if they had been installed properly and were being operated in accordance with manufacturer's instructions for maximizing energy efficiency. Numerous adjustments were made to correct deficiencies.

(2) Demand Management.

- (a) HVAC. Operating parameters for the HVAC system, in particular air conditioning, were completely overhauled. Thermostat settings were raised and lowered (in some cases by nearly 3 degrees Celsius) to eliminate over-cooling and over-heating. Hours of service were significantly curtailed to eliminate cooling and heating of empty rooms. Large spaces like auditoriums and big lecture halls, which require outsize inputs of energy for cooling and heating, were serviced only upon advanced reservation and then only when actually in use. Classroom assignments for summer school (which operates when the air conditioning need is greatest) were reorganized to allow shutting down as much of the air conditioning system as possible during the summer.
- (b) Lighting. The university's Lutron (timed lighting) system was completely reprogrammed, building-by-building, so that 15,000 of the 30,000 lights in public and common areas will never be turned on again. Of the remaining 15,000, the vast majority will be turned on only during evening working hours and will be turned off during the day and overnight. Additionally, sensors were installed to turn off lights in classrooms, laboratories, lecture halls and meeting rooms when not in use, and students, faculty and staff were encouraged to use natural light instead of artificial light ("day lighting") whenever possible.

EVIDENCE / ASSESSMENT / RATING:

After 3 years of implementing the 2-pronged strategy, AUC's total energy consumption has been reduced by more than 35% (37 million kwhr) university-wide, and electricity consumption has been reduced 25%. Energy costs have been reduced by $2-2.5 million (US) annually. The results of the 3rd year of the program (just concluded) suggest that AUC is close to achieving its stabilized energy demand; the university is actively negotiating with the operator of its on-site power plant to remove the fourth generator because it is no longer needed.

In January 2014 AUC was ranked 25th for energy and climate change programs (out of 301 universities surveyed) in Indonesia University's fourth annual GreenMetric World University Ranking.

SIZE OF IMPLEMENTATION:

AUC's 3-year energy saving initiative has targeted the university as a whole, more than 203,000 square meters of facilities.

COST OF IMPLEMENTATION (US $):

Approximately $65,000 (US) was spent initially to buy and install energy meters, in order to fill gaps in the university's metering program. An additional $40,000 (US) was spent to upgrade software for the Lutron system that manages the university's public and common area lighting.

All costs of the 3-year program have been internal, e.g. staff time devoted to rewiring HVAC system components and lighting, and to reprogramming AUC's computerized building management (BMS) and Lutron systems.

YEAR OF IMPLEMENTATION:

February 2011 - Ongoing

FUNDING PARTNERS:

Not Available

SOURCE:

Our Carbon Footprint 2.0 (The American University in Cairo, November 2013, www.aucegypt.edu/about/sustainability).

KENYA:
UNIVERSITY OF NAIROBI

GENERAL DESCRIPTION:

- The University of Nairobi, the only institution of higher learning in Kenya, has so far offered academic programs and specialisation in approximately 200 diversified programs on its seven campuses in the capital city.

- The University recognizes that it has a responsibility to manage its activities in a way that reduces the negative environmental impacts and enhances positive impacts.

- Inspired by the above, the key aspects of its greening include: Strategic planning and implementation; Education and Awareness; Safety and Health; Monitoring and Reporting; Communication; Purchasing Policy and; Environmental Management System.

- The University is committed to developing and sustaining an Environmental Management System (EMS) based on the International Standard ISO 14001. The EMS, together with the ISO 9001 - 2000 Standard, have been adopted for achieving the University's Environmental Policy, including compliance with legislative requirements and the measurement of continual improvement targets and outcomes. An environmental audit was carried out in 2008 as per the requirements of the Environmental Management and Coordination Act 1999, and the Environmental Impact Assessment and Audit Regulations 2003.

- The audited areas include Waste management; Energy management; Water management and economy of use; Noise evaluation and control; Indoor air quality; Emergency prevention and preparedness; Staff/student environmental awareness and training; environmental management system, and a University Environmental Policy.

TARGET BENEFICIARIES:

The University and local communities as well as the global community.

UNEP THEMATIC PRIORITY AREA:

Climate change; environmental governance; harmful substances and hazardous waste; and Resource efficiency (sustainable consumption and production).

PROJECT / INNOVATION AREA:

- Greening of University infrastructure/facilities/operations
- Community collaboration
- University management
- Student participation/engagement

IDENTIFIED ISSUES:

The environmental audit highlighted that:

- The University does not have an Environmental Policy to guide its operations.
- The measurement culture at the University is weak as far as resource use and waste generation are concerned.
- Although there is a procurement policy which is informed by the Government Act, environmental considerations do not seem to be important in the procurement of goods and services for the different University units.
- The University does not have an asbestos management plan despite having buildings with asbestos roofing.
- No recycling takes place at the University.
- There has been no air quality or noise monitoring at any site in the University.
- There is need for staff awareness and training in environmental matters.

OUTCOMES:

- The University developed its environmental policy in 2009; and a maintenance policy for all assets owned by the University in 2010 mainstreaming environmental considerations.
- Following the initiative, top management in the University are now aware, supportive and committed to improving the environmental performance of the University.
- All units of the university, as well as to some degree the students, have embraced environmentally sustainable practices.
- The University intends to appoint a Standing Environmental Policy Steering Committee and allocate budgets for environmental management as stated in the Environmental Policy.

EVIDENCE / ASSESSMENT / RATING:

Only university in Kenya to conduct an environmental audit of its products and services.

SIZE OF IMPLEMENTATION:

Not Available

COST OF IMPLEMENTATION (US$):

Not Available

FUNDING PARTNERS:

Not Available

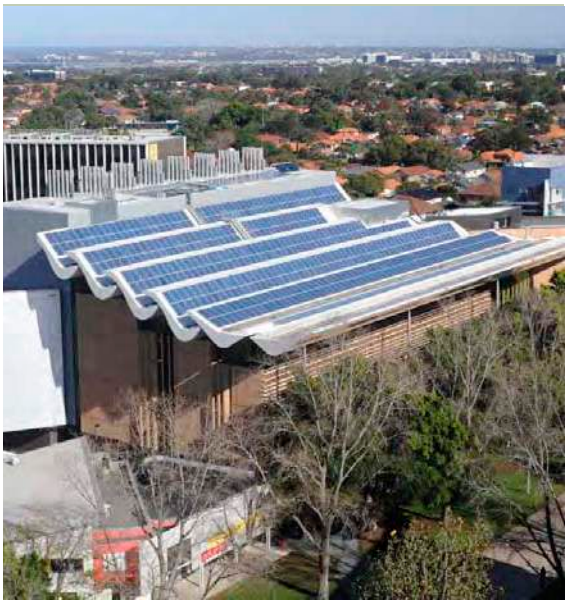
SOURCE:

UNITED NATIONS ENVIRONMENT PROGRAMME (UNEP) 2011. Innovations and Best Practices on Education for Sustainable Development and Sustainability in Universities – Success Stories from Around the World.

UNIVERSITY OF NAIROBI. 2011. Introduction [Online]. Available: http://www.uonbi.ac.ke/about
[Accessed 24 March 2012]

UNIVERSITY OF NAIROBI. 2010. Annual Report 2010 [Online]. Available: http://www.uonbi.ac.ke/sites/default/files/UON%20AR%202010%20WEB.pdf
[Accessed 24 March 2012].

AUSTRALIA:
UNIVERSITY OF NEW SOUTH WALES
Tyree Energy Technologies Building (TEBT)



GENERAL DESCRIPTION:

- The University of New South Wales (UNSW) each year educates more than 50,000 students from over 120 countries in eight faculties.
- The Tyree Energy Technologies Building (TETB) is located on the university's main campus on a 38-hectare site in Kensington.
- The six storey building of the TETB, which is used largely by the Faculty of Engineering, features teaching and learning spaces, workshops and display spaces, research spaces including wet and dry labs and a cafe.
- The TETB's laboratories will support the ongoing research of UNSW researchers in world record-breaking solar photovoltaic technologies, sustainable clean fuels, smart grids, energy storage, energy economics and policy analysis.
- The TETB is also an educational hub for undergraduate and postgraduate students, providing an optimal learning environment for expert engineers and analysts.

TARGET BENEFICIARIES:

Community largely at university and regional level, but also at global level.

UNEP THEMATIC PRIORITY AREA:

Climate change; Resource efficiency (sustainable consumption and production).

PROJECT / INNOVATION AREA:

- Research & Development
- Greening of University infrastructure/facilities/operations
- Community collaboration
- University management
- Student participation/engagement

IDENTIFIED ISSUES:

Indoor environmental quality; energy consumption; water conservation; and carbon emission

OUTCOMES:

- Environmental Management – The head Contractor, Brookfield Multiplex, is ISO 14001 certified ensuring that sound environmental practices are involved in all decision making processes associated with the design and construction of the building
- Waste Management – The construction waste management plan and agreements with waste contractors ensured over 80% of the construction waste being recycled or re-used.
- Indoor Environment Quality – Furniture and finishes have been carefully selected to reduce off-gassing of Volatile Organic Compounds and Formaldehyde, and improve air quality.
- Tri-generation – A tri-generation plant is installed not only to service the TETB but also to export both electricity and chilled water to surrounding buildings. This ensures that the tri-generation system operates for longer hours and maximises the benefit of the reduced carbon emissions provided by this method of power and chilled water production.
- Energy Efficiency – Air conditioning load is reduced by linking the air conditioning controls to motion sensors and carbon dioxide sensors in all spaces. An underground labyrinth and borewater is also used to pre-cool/warm incoming outside air.
- Energy Production – In addition to the tri-generation system it is also furnished with 1,000sqm of photo-voltaic panels which will produce up to 150KW of electrical energy.
- Water re-use – An existing bore feeds into a storage tank which also collects rainwater from the roof. This systems feeds into the campus borewater system which is then treated and returned to buildings as non-potable water. This is used in TETB for toilet flushing, laboratory water and makeup to the evaporative cooling systems. Fire system testing water and run-off from hardstand area is also returned to the aquifer through the percolation chamber.
- Water efficiency – Water efficient fixtures are used throughout the building, including waterless urinals. The cooling of the tri-generation system is provided by a hybrid Muller 3C cooling tower which only uses water for evaporation when ambient conditions are extreme and loads are high. This is fed by non-potable, treated borewater and rainwater.

EVIDENCE / ASSESSMENT / RATING:

'6 Star Green Star Design' rating (World Leadership) for an Education facility by the Green Building Council of Australia.

SIZE OF IMPLEMENTATION:

Approx. 15,000 sqm facility

COST OF IMPLEMENTATION (US $):

Approx. $81.6 million

YEAR OF IMPLEMENTATION:

February 2010 – February 2012

FUNDING PARTNERS:

Education Investment Fund Initiative of the Australian Government ($75 million),

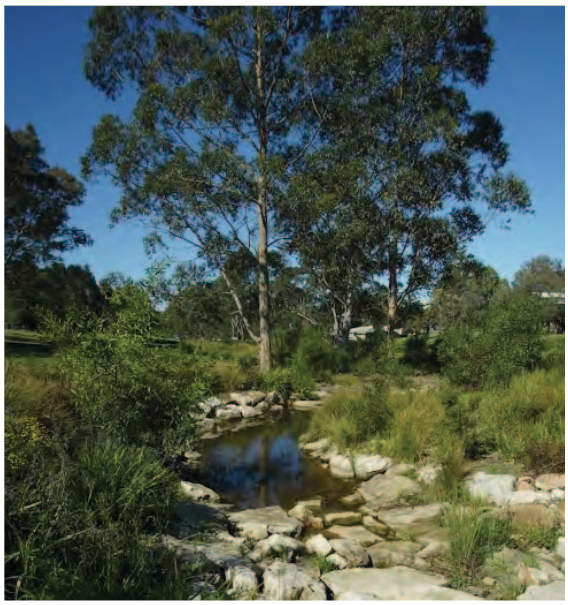
Sir William Tyree, who donated $1 million and pledged a further bequest of $10 million

SOURCE:

UNIVERSITY OF NEW SOUTH WALES. n.d. Key Projects: Tyree Energy Technologies Building [Online]. Available: http://www.keyprojects.unsw.edu.au/project/tyree-energy-technologies-building [Accessed 18 March 2012].

UNITED NATIONS ENVIRONMENT PROGRAMME (UNEP) 2011. Innovations and Best Practices on Education for Sustainable Development and Sustainability in Universities – Success Stories from Around the World.

AUSTRALIA:
MACQUIRIE UNIVERSITY



GENERAL DESCRIPTION:

Founded in 1964, Macquarie University is a 126 hectare (311 acre) campus

In 2013, 38,753 students from 116 countries were enrolled at Macquarie University

MARS CREEK

Mars Creek is an urban watercourse that runs through the University's North Ryde Campus. Two projects have contributed to its overall rehabilitation – Wetlands (a major intervention) and Bushcare@MQ (community intervention)

The Biodiversity Committee (a multi-disiplinary, voluntary group made up of staff and students) initally identified the upper most reach of Mars Creek as a priority for rehabilitation and storm water improvement works in 2008 – the same year the Bushcare@MQ group launched

To protect creek habitats locally and downstream, storm water pollution flowing into the campus is now captured through a series of pollution traps and wetland features

As part of the campus 'living laboratory' concept, the Wetlands project's ecological values are being captured by students who undertake core environmental units of study. Measurements commenced prior to the works and will continue each year, with field measurements capturing changes over time

The Bushcare@MQ group comprises of staff, students and local community members who meet at various Mars Creek sites, twice per month. The group works to restore and regenerate biodiversity through supervised weeding activites and the planting of native shrubs, trees and ground covers

TARGET BENEFICIARIES:

The University and local communities as well as the global community

UNEP THEMATIC PRIORITY AREA:

Climate change; Disasters and conflicts; Environmental governance; Harmful substances and hazardous waste; Ecosystems management.

PROJECT / INNOVATION AREA:

- Research & Development
- Greening of University infrastructure/facilities/operations
- Community collaboration
- University management
- Student participation/engagement

IDENTIFIED ISSUES:

The inlet reach of Mars Creek within Macquarie University was a highly engineered and incised channel. It followed a straight, rather than natural course. The surrounding land had been cleared of native vegetation for many decades.

Prior to the project, flow from the 22 hectare catchment upstream of the campus was untreated. Sources of potential urban pollution into the catchment include a major road, a rehabilitated landfill site, a service station/carwash complex, and the street and drain network. The University sought to exceed its own compliance requirements and improve the quality of these inflows. Additionally, prior to restoration Mars Creek was actively eroding. A consequence was sedimentation of the downstream pond and other creek reaches extending into Lane Cove National Park, an adjacent nationally protected parcel of natural bushland.

OUTCOMES:

- The rehabilitated channel delivered immediate mitigation against further sediment pollution of the downstream creek system
- Improved flood capacity was integrated holistically into all major features of the rehabilitation. The system reflects an adaptive approach to greater flow variability anticipated under the effects of climate change
- A marked flattening of the flow peaks from intense storm runoff was observed upon completion of the realignment
- Up to 24 hours of temporary detention is provided in the wetland, reducing the Summer extremes between peak flow and base flow in the main creek channel that affect this creek
- Sediment, litter and nutrient associated with storms are routed through the gross pollutant trap
- The reed beds of the wetland provide a secondary filtration stage
- The target treatment level is: 95% reduction of gross pollutants, 70% reduction of suspended solids and 30% reduction of total Phosphorus. Removal of further fine sediment and nutrient pollution is achieved through the reed bed system's filtration function
- As it matures, the newly established vegetation progressively adds shade, bank stability, organic carbon and micro-scale habitat diversity to the water course
- Design supports the long term recovery of resilient aquatic ecosystems within the creek reach
- Endangered ecological communities are provided with connection to and embellished surrounding remnant vegetation

EVIDENCE / ASSESSMENT / RATING:

The Mars Creek Catchment Environmental Plan was conferred a 2012 Merit Award of Excellence in the category of Strategic/ Master Planning by Stormwater NSW

SIZE OF IMPLEMENTATION:

Approx. 22 hectares

COST OF IMPLEMENTATION (US$):

Mars Creek The project's total capital cost, incorporating design inspection services during construction, was (US$) 620,500 GST inclusive.

Bush Care The project is primarily carried out by volunteers supported with catering, contractors, recruitment activities and equipment (US$) 45,000 to date.

YEAR OF IMPLEMENTATION:

2009 - ongoing

FUNDING PARTNERS:

City of Ryde; National Parks and Wildlife Service; Storm Consulting (design consultants); Total Earth Care (Contractors)

SOURCE:

MACQUARIE UNIVERSITY Sustainability Annual Report 2013. Available at: http://www.mq.edu.au/business_and_community/property_and_facilities/ese_ecologically_sustainable_development/what_else_we_do/report/sustainability_annual_report/ [Accessed 8/10/14]

MACQUARIE UNIVERSITY Annual Report 2013: Available at: http://mq.edu.au/about/how_mq_works/reports.html [Accessed 8/10/14]

AUSTRALIA:
SBRC WOLLONGONG UNIVERSITY

GENERAL DESCRIPTION:

- The University of Wollongong (UOW) educates over 30,000 students in five major faculties, is ranked as one of the top ten research universities in Australia, and is placed in the top 2% of Universities worldwide.
- The Sustainable Buildings Research Centre (SBRC) building is located at the UOW Innovation Campus, a world-class, award-winning research and commercial precinct.
- The SBRC facility is designed to house over fifty research staff and students.
- The SBRC is a multi-disciplinary centre that hosts a wide range of research and industry collaborations to address the challenges of making buildings sustainable.
- The SBRC also delivers education and training programs designed to upskill students, industry and the community in energy efficiency and sustainability solutions for the built environment.
- The SBRC has a wide range of research and testing facilities to support the development and implementation of sustainable building technologies and systems, particularly those focussed on enhancement of the performance of existing buildings.

TARGET BENEFICIARIES:

Community at all levels, industry, students, universities, regional and global.

UNEP THEMATIC PRIORITY AREA:

Climate change; Resource efficiency (sustainable consumption and production).

IDENTIFIED ISSUES:

Neither the University nor the Illawarra Region had a world class sustainable building prior to the SBRC; the Australian residential building stock often has poor energy efficiency and thermal comfort qualities – leading to the need for a research facility focussed on upgrading existing building stock; a perceived community need to reduce resource consumption and keep user costs down; a national need for development of a facility for testing of new building technologies, especially for retrofitting.

OUTCOMES:

- The building houses research professionals, staff and students from various engineering, science and social science disciplines under one roof and links to other sustainability focused faculties and divisions.
- A primary focus of research at the SBRC is the reduction of resource consumption in our built environment with a special focus on retrofitting existing building stock.
- The net zero energy and water SBRC building is a regional leader and an inspirational example of how to achieve a low energy, healthy and beautiful space.
- Energy targets are extremely low with electricity consumption targets of 65kWh/m2/yr (including research equipment) through a 'natural ventilation preferred', mixed-mode, low energy, in-slab hydronic HVAC system driven by ground source heat pumps, and a low energy thin-client IT system.
- A grid-connected 160kWp photovoltaic system provides the bulk of the onsite renewable energy generation through the building's research micro-grid.
- The SBRC focusses on applied research outcomes and works closely with industry to develop and test products and technologies that are underdevelopment or new to market.
- The Centre has developed a comprehensive Living Laboratory program researching retrofitting of external buildings within the community as well as using the building as a research tool itself.
- Activities at the Centre continue to influence the broader University campus and facilities with new energy efficiency and renewable energy programs ongoing.

EVIDENCE / ASSESSMENT / RATING:

The building is targeted to be the first Living Building in Australia certified under the Living Building Challenge program and has also been designed to achieve a 6 Star Green Star Design rating (equivalent to LEED Platinum).

The building is aiming to be ultra low energy with a target consumption of 65kwh/m2/yr (including research equipment) and hopes to achieve net zero energy and water use in an annual cycle.

SIZE OF IMPLEMENTATION:

Building Size = 3,500 m2 including roof-top testing areas

Outdoor breakout spaces/decks/green roof = 780 m2

Associated precinct landscape – 7,600 m2

COST OF IMPLEMENTATION (US $):

Cost of Building Works (including breakout spaces and green roof) = $19.8M

Cost of precinct landscape works = $1.2M

YEAR OF IMPLEMENTATION:

August 2010 – July 2014

FUNDING PARTNERS:

The building was funded under the Education Investment Fund initiative of the Australian Commonwealth Government

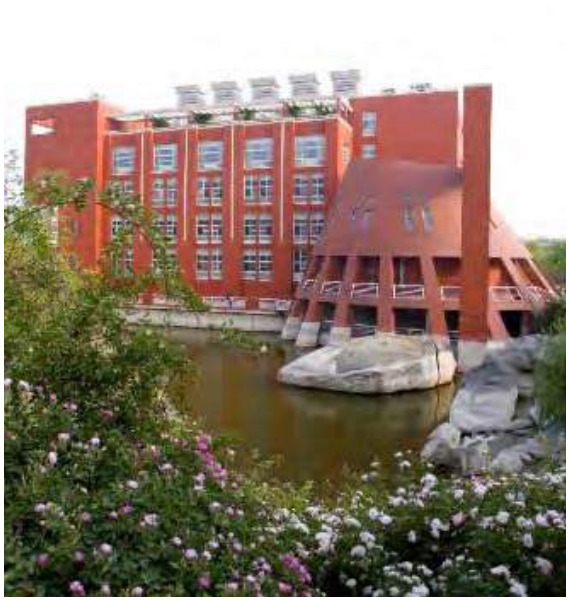
New South Wales Trade and Investment

University of Wollongong

SOURCE:

UNIVERSITY OF WOLLONGONG. Sustainable Buildings Research Centre [Online]. Available: http:// http://sbrc.uow.edu.au/ [Accessed 10th September 2014].

CHINA:
SHANDONG JIAOTONG UNIVERSITY, JINAN CITY



GENERAL DESCRIPTION:

- Building involved in the program: Wuyingshan Library of Shandong Jiaotong University
- Number of Staff : 1,300
- Number of Students: 1.9x104

TARGET BENEFICIARIES:

- Shandong Jiaotong University
- The Students and staff
- The surrounding residents

UNEP THEMATIC PRIORITY AREA:

- Climate change
- Resource efficiency
- Disasters and conflicts
- Harmful substances and hazardous waste
- Ecosystems management

PROJECT / INNOVATION AREA:

Strengths of the project: We achieved comfort through common technology at low cost for a typical building and environment designing according to the local conditions. We also achieved different ways of ventilation, natural ventilation :tunnel ventilation, chimney ventilation and solar ventilation.

Weaknesses of the project: Adapting innovative tochnology into the building such as an efficient air conditioning design.

IDENTIFIED ISSUES:

It had a short deadline. And the local site was full of stones and sand because of a weathering rock. It was full of rubbish after taking away the sand. Some cleaning methods were not understood by many people and there was not enough money to finish the building.

OUTCOMES:

- Climate change: the campus climate was changed by planning buildings and planting trees .Such as forming local wind and increasing humidity etc.

- Resource efficiency: the Terence is higher around and lower in the middle. The lowest place is in the south which is a pit dug sands. Remained the original terrain and the pit. Collect rainwater from the site and create a water system of Chinese small scale landscape with the lake and pool and steam. Buried a tube underground and raise the collected water into the higher place using a pump, then the water in the high place goes down into the lake again and being as water source to cool the air and form the landscape etc.
- Disasters and conflicts: the concept about plain style and luxurious style was different.
- Environmental governance: wrote the instructions for the Green Library Building.
- Harmful substances and hazardous waste: local stones in the original site were used as material such as pave ground, landscape stone etc.
- Ecosystems management: with the water system, collect rainwater and irrigating plant and cool temperature etc. the water system is pured by flowing water and plants around.

EVIDENCE / ASSESSMENT / RATING:

- In 2007, The University received a national award of annual demonstration project of building energy conservation in China.
- In 2008, it received the 1st prize of the Progress Award in Science and Technology issued by the Ministry of Education in China - Demonstration and Integration of Technologies in Sustainable Campus Construction.
- Per capita energy and water use has been reduced by 5.6% and 14.8% respectively between 2010 and 2011.
- The BIPV system on the ADRI building covers 6600 m2 of the roof area, generates 535MWh of electricity every year and provides an annual reduction in CO2 emission by about 566 tons.

SIZE OF IMPLEMENTATION:

16000 m2.

COST OF IMPLEMENTATION (RMB):

25 000 000

YEAR OF IMPLEMENTATION:

2000-2003

FUNDING PARTNERS:

Shandong Jiaotong University Jing Yin Jin-xing Feng Yu-gang Lu

Qinghua University: Bin Yuan; Bo-rong Lin; Yingjie Lu

SOURCE:

- http://www.sdjtu.edu.cn/articles/ch01410/201406/d63ad326-cc45-40d3-81e0-9706b7a31878.shtml
- http://www.sdjtu.edu.cn/articles/ch01402/201306/ccc772f2-3888-4662-a630-2d8a79fc70cc.shtml
- http://d.g.wanfangdata.com.cn/Periodical_ft201114070.aspx
- Studies on the Ecology Building Practice of the Shandong Jiaotong University Library, 2008 http://www.shangxueba.com/lunwen/view/19/54362.htm
- http://www.cnki.com.cn/Article/CJFDTOTAL-GYJZ200811036.htm
- http://www.lunwentianxia.com/qikan_detail_gis/211703/
- http://www.cnki.com.cn/Article/CJFDTOTAL-KJJS200706005.htm

CHINA:
TONGJI UNIVERSITY, SHANGHAI

GENERAL DESCRIPTION:

- Tongji University has four campuses, with the total area of 1,501,281 m2, and 420 buildings where around 39,000 students study every year in 29 faculties.
- The University recognizes that it has a responsibility to manage its activities in a way that reduces the negative environmental impacts and promotes sustainability.
- Tongji University established a Management Committee, an Expert Committee and a Management Office to share the responsibilities of the sustainable campus construction, and identifies three priority areas for sustainable campus construction, namely energy conservation in research, management, and education.
- Tongji University initiated the setting up of the China Green University Network (CGUN), which consists of 8 core universities and 2 research institutes and Tongji University acts as the first chairmanship. CGUN is leading the construction of sustainable campuses in China and its influence is growing fast in the world.

TARGET BENEFICIARIES:

Community largely at university and regional level, but also at global level.

UNEP THEMATIC PRIORITY AREA:

Climate change; Resource efficiency (sustainable consumption and production).

PROJECT / INNOVATION AREA:

- Research & Development
- Greening of University infrastructure/facilities/operations
- Community collaboration
- University management
- Student participation/engagementconservation in research, management, and education.

IDENTIFIED ISSUES:

The need to take responsibility as a major research university to contribute to shaping of the national sustainable campus

agenda. The need to promote sustainability on its campuses in terms of energy use, research, education, student engagement, and social service.

OUTCOMES:

- Campus energy management system (CEMS) is established to monitor and report energy use of the whole university, and 182 buildings have online monitoring.
- Commissioned by Chinese government, Tongji University composed five national technical guidelines for the construction and operation of CEMS, which are implemented in 120 universities.
- In total 91 course have been developed that include sustainability in their curricula.
- Various initiatives on sustainability have effectively stimulated students' interest in sustainable design; they have successfully designed a bamboo solar house and a container solar house showing good sustainable concepts in Solar Decathlon in 2010 and 2011.
- Building retrofit of total area of 296,647 m2 is on progress since 2009, which includes the use of sewage source heat pumps, water recycling projects, vertical and roof greening, etc. in addition to energy and water efficiency measures.
- One of the retrofit projects included renovation of an existing abandoned car parking building, which was originally planned to be demolished, into an office building of five stories and 68,000 m2. The building, for Architectural Design & Research Institute (ADRI), is now a demonstration building with a 630KWp BIPV system and a centre of education on energy conservation and renewable energy technologies.
- The University intends to publish an annual report on sustainable campus innovations implemented that year.

EVIDENCE / ASSESSMENT / RATING:

- In 2007, The University received a national award of annual demonstration project of building energy conservation in China.
- In 2008, it received the 1st prize of the Progress Award in Science and Technology issued by the Ministry of Education in China - Demonstration and Integration of Technologies in Sustainable Campus Construction.
- Per capita energy and water use has been reduced by 5.6% and 14.8% respectively between 2010 and 2011.
- The BIPV system on the ADRI building covers 6600 m2 of the roof area, generates 535MWh of electricity every year and provides an annual reduction in CO2 emission by about 566 tons.

SIZE OF IMPLEMENTATION:

Campus energy management system in approx. 1.16 million m2 in 182 buildings; Total floor area of building retrofits of about 296,647 m2. Adaptive reuse of the existing car parking building into an office building of 68,000 m2 for ADRI.

COST OF IMPLEMENTATION (US $):

$1.3 million for the establishment of Campus energy management system; $7.62 million for building retrofit projects; $16 million ADRI.

YEAR OF IMPLEMENTATION:

Overall campus initiatives: 2003 – Ongoing; ADRI: 2009 – 2010

FUNDING PARTNERS:

Ministry of Housing and Urban and Rural Development (MOHURD); World Bank Loan Program; and Shanghai Government.

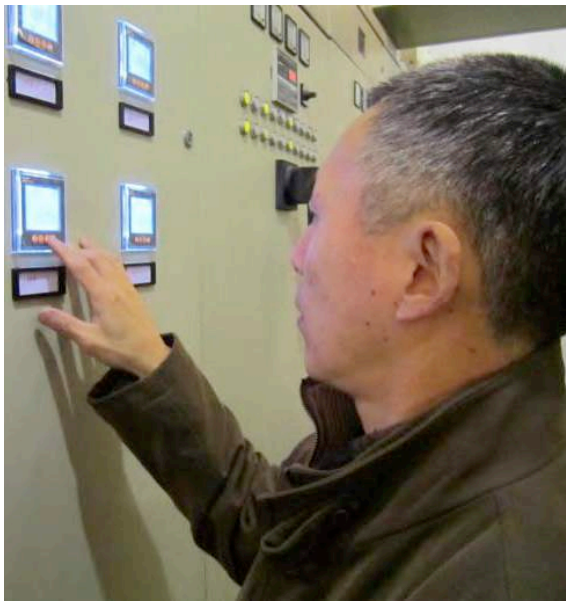
SOURCE:

Information provided by Dr. Shuqin Chen from Tongji University, based on

Acceptance report on Demonstration Project of Solar PV Buildings for Ministry of Finance and Ministry of Housing and Urban and Rural Development (MOHURD); and

Annual Report of Sustainable Campus Innovation of Tongji University, 2011.

CHINA:
FUDAN UNIVERSITY, SHANGHAI



GENERAL DESCRIPTION:

- Fudan University has four campuses (Handan, Zhangjiang, Jiangwan and Fenglin), consisting of 438 buildings on 2,443,200 square meters in area. Our green campus project covers all the four campuses and 420 buildings;
- The university has 2,700 faculty members in 28 departments/schools and offers 70 undergraduate majors. There are 28,900 students in total, with 14,100 undergraduates, 14,800 graduate students, and 3,000 international students. Our green campus project involves all departments/schools of the university;
- Our greening campus is managed by the Energy Saving Management Office, and involves the Property Deparment, the Infrastructure Management Department, the Logistics Management Company, the Management Committee of all campuses, the Student Affair Department, and all the departments/schools.

TARGET BENEFICIARIES:

Community largely at the university and the regional level.

UNEP THEMATIC PRIORITY AREA:

Resource efficiency (sustainable consumption of electricity, water and gas).

PROJECT / INNOVATION AREA:

- Research & Development
- Greening of University infrastructure/facilities/operations
- Community collaboration
- University management
- Student participation/engagement

IDENTIFIED ISSUES:

Responsibility as a major research university to contribute to shaping the national sustainability agenda, to promote the development of sustainability on its campus, and to prepare its students.

OUTCOMES:

- All campuses were transformed to use energy saving lights;
- Smart meters were installed in students' dormitories;
- Student bath rooms and boiling rooms were transformed to use our campus e-cards, leading to hot water saving by 50%;
- The water-supply network was closely examined for leakage issues, and 16 leakage points were found and fixed to avoid water waste;
- In Zhangjiang Campus, the fountain water-supply system by the Scenery Avenue was transformed;
- The water in Zhangjiang Campus was recycled for water saving;
- Heat pumps was employed in Jiangwan campus, leading to more effective energy use;
- New institutions were established: << Provisional Regulations of Fudan University on Energy (Electricity, Gas, and Water) Use Management >>, <<Fudan University Campus Pipe Base Management System >>, <<Reward Regulations of Fudan University on Energy Saving>>, <<Detailed Rules of Fudan Univrsity for Water and Electricity Payment>>, etc.;
- Water Saving Week and Energy Saving Week were held every year;
- Water saving campuses were constructed: all four campuses have been entitled as Water Saving Campuses of Shanghai;
- Window heat insulation film transformation: applied window heat insulation films developed by our Material Department to the School of Management, library, the Guanghua Building, the Zhengda Stadium, resulting in heat insulation and warm preservation. Tests show that after the application of heat insulation window films, the temperature (Summer) is 3-5 degrees lower than before;
- Room energy use was monitored for student's dormitories with the first and second level smart meters installed in all campuses, based on which functions such as inquiry, comparison, and statistics analysis were provided;
- All the inquiry of the use of the smart meters, energy use of all buildings, information of energy consumption, and alerting information were automatically sent to the mobile phones of the relevant personnel;
- In 2012, a remote online management of campus energy use was implemented, based on which we have started to implement the quota management of the electricity bill
- After the Guanghua Building was transformed for energy saving, energy saved from the Air Conditioning system was by 18% or so, and energy saved from the elevator system was by 19% or so. The energy saving light transformation paid its on way in a year.

EVIDENCE / ASSESSMENT / RATING:

Overall, the green campus project is evaluated based on <<Management and Technical Guides for the Construction of Energy Conserving University Campuses>>.

SIZE OF IMPLEMENTATION:

- All four campuses and all 420 buildings were covered;
- 11406 smart electricity meters and 253 smart water meters were installed;
- Since April 2012 when the system started to run, we got over 38.8GB of data stored in our database, with about 0.6 billion records of water and electricity use.

COST OF IMPLEMENTATION (RMB):

10,730,000

YEAR OF IMPLEMENTATION:

2010-2013 (system has been running since April 2012)

FUNDING PARTNERS:

Ministry of Housing and Urban and Rural Development Ministry of Housing and Ministry of Finance allocated 4,000,000 RMB for the Construction of Energy Saving Monitoring and Management Platform for Energy Saving Campus; Fudan supported 6,730,000 RMB.

SOURCE:

Fudan University. www.fudan.edu.cn (Accessed in April 2014)

Reports from the General Services of Fudan University (Internal Use only)

<<Management and Technical Guides for the Construction of Energy Conserving University Campuses>>

The energy monitoring and management platform. http://218.193.130.178/

CHINA:
SHANGHAI UNIVERSITY OF ELECTRIC POWER, SHANGHAI

GENERAL DESCRIPTION:

Shanghai University of Electric Power SUEP is a full-time institute of higher learning jointly set up by the Central Government and Shanghai Municipal Government and mainly under the administration of Shanghai Municipal Government. Pingliang Campus, the main campus of the university, lies near Yangpu Bridge in the eastern urban district of Shanghai, overlooking Pudong from the other side of Huangpu River. The other campuses are respectively in Nanhui Science and Education Park and Changyang Road.

At present, the whole covering area of the university is nearly 1,000 Chinese mu(about 667,000 m2), with over 1,000 faculty members and more than 10,000 full-time students, as well as a certain number of postgraduate students and international students. A large number of graduates are working on the mainstay posts of production, operation, and management in the electric power systems of China.

Shanghai University of Electric Power established an energy-saving management system of three levels, which includes the SUEP energy-saving leading group, the energy-saving office and the energy-saving management offices of each faculty (department), reducing the consumption of energy from three aspects.

Shanghai University of Electric Power has joined the CGUN, the China Green University Network, initiated by Tongji University.

TARGET BENEFICIARIES:

Community largely at university, but also at regional.

UNEP THEMATIC PRIORITY AREA:

Resource efficiency (sustainable consumption and production).

PROJECT / INNOVATION AREA:

- Research & Development
- Greening of University infrastructure/facilities/operations
- Community collaboration
- University management
- Student participation/engagement

IDENTIFIED ISSUES:

The need to take responsibility as a university in the energy field to advocate green power and promote sustainability on its campuses in terms of energy use, research, education, student engagement, and social service.

OUTCOMES:

- .Campus energy management system (CEMS) is established to monitor and report energy use of the whole university, and 89 buildings have online monitoring;
- The campus energy management system works as a course teaching platform of energy-saving for students , which is proved to be effective.
- Energy saving reconstruction of buildings of 124000 m2, including heat supply andillumination from renewable energy sources and the intelligent management of split-type air conditioners, which reduced more than 20% of total energy consumptions of 2012 by 2013.
- A micro-grid energy system, with a total capacity of more than 500kW has been built, which includes wind power, solar photovoltaic generation, solar-thermal power generation and gas distributed energy system.
- By means of monitoring and managing of water use, we reduces the waste of water effectively, and saves more than 20% of it.
- As a university in the energy field, SUEP advocates green power and tak

EVIDENCE / ASSESSMENT / RATING:

The construction of conservation campus has passed the quality acceptance of the national Ministry of Housing and Urban-Rural Development (MOHURD) in 2013. The experiences and methods in saving energy will be used in the construction of the new green campus.

SIZE OF IMPLEMENTATION:

Campus energy management system in approx. 343,957 m2 in 92 buildings; Total floor area of building retrofits of about 124,000 m2.

COST OF IMPLEMENTATION:

$0.8 million for Campus energy management system; $2.4 million for building retrofit projects; $5 million for the micro-grid energy system.

YEAR OF IMPLEMENTATION:

- Campus energy management system:2010-2012
- Building retrofit projects:2012-ongoing
- The micro-grid energy system:2011-2014

FUNDING PARTNERS:

Ministry of Housing and Urban and Rural Development (MOHURD); and Shanghai Government

SOURCE:

Information provided by Dr. Yongwen YANG from Shanghai University of Electric Power,based on Acceptance report of constructing conservation campus on Ministry of Housing and Urban and Rural Development (MOHURD);

INDIA:
CALICUT UNIVERSITY

GENERAL DESCRIPTION:

The University recognises its responsibility in developing a sustainable ecosystem and manage its activities to reduce the negative environmental impacts and enhance positive impacts. The Calicut University is working towards becoming India's greenest campus.

The University of Calicut is committed to developing and sustaining an Environmental Management System (EMS), which is keen to lead the society into the habit of sustainable use of the natural resources. The EMS is designed for achieving the University's Environmental targets and outcomes, and ensures compliance with legislative requirements.

As an initial step we did an audit of our 'Environment Friendliness'. The audited areas include Waste management; Energy management; Water management and the economy in water usage; Staff/student environmental awareness and training; environmental management system, and a University Environmental Policy.

TARGET BENEFICIARIES:

- Staff and students of the University campus and the 450 affiliated colleges
- Local community and at large National and International individuals and organisations
- Local and National administration

UNEP THEMATIC PRIORITY AREA:

- Climate change
- Resource efficiency (sustainable consumption and production)
- Disasters and conflicts
- Environmental governance
- Harmful substances and hazardous waste;
- Ecosystems management

PROJECT / INNOVATION AREA:

- Strategic planning and implementation
- Education and Awareness
- Safety and Health

- Monitoring and Reporting
- Communication
- Environmental Management System and
- Community partnership

IDENTIFIED ISSUES:

- The University lacks an Environmental Policy to guide its operations;
- There is no measurement of the resource utilisation and waste generation;
- Environmental considerations do not seem to be important in the procurement of goods and services for the different University units;
- The University is not having an asbestos management plan though many buildings in the campus have asbestos roofing;
- No recycling, even for paper takes place at the University;
- There is need for staff awareness and training in environmental matters.

OUTCOMES:

The campus is located in an area mainly covered with laterite rock. The possibility of natural vegetative growth is very low. Because of that we had to introduce suitable plants.

We planted various fruit and flower bearing plants and shade plants in various areas with considerable amount of loose soil for rooting. In areas with laterite rock we planted mango trees which are known to have a root system able to penetrate the laterite rock.

The mango plants as members of pioneer community will help the breaking of the laterite rock and provide soil and enough vegetative materials in the soil for the growth of successive vegetation.

Before greening the atmospheric temperature was quite high during summer. Hot wind in summer was a serious issue for the inhabitants of the campus.

Now we have campus covered with greenery which has a soothing effect in summer heat. Within a few years we will start harvesting the fruits from the mango trees and the other fruit trees that we planted in this 'green campus' program.

Water dropping from the leaves of the Malabar plum tree keeps the air cool during hot summer.

EVIDENCE / ASSESSMENT / RATING:

Effect of the 'Green Campus' project was monitored by measuring the plant abundance. This was measured by measuring the plant cover.

Before the start of the project the average cover of the campus was less than 10%. After one year it had increased to 20%. By the end of third year we estimate it to increase to 30%. After five years we aim to have a plant cover of 50% of the campus.

We could also see the fact that the use of umbrellas to escape from the scorching heat of the sun by the campus peoples is reduced as most areas of the foot path are covered by shades of plants.

We started measuring the underground water levels in the surrounding areas. We were already told by the inhabitants of the area around the campus about the observed rise in water level in the wells used for getting drinking water. These reports are qualitative, but we are planning to have a quantitative measure of the changing underground water level. For this we will use physical measurements and the data collected/provided by the villagers.

SIZE OF IMPLEMENTATION:

500 Acres campus

COST OF IMPLEMENTATION (US $):

4 million US

YEAR OF IMPLEMENTATION:

2012 -2017

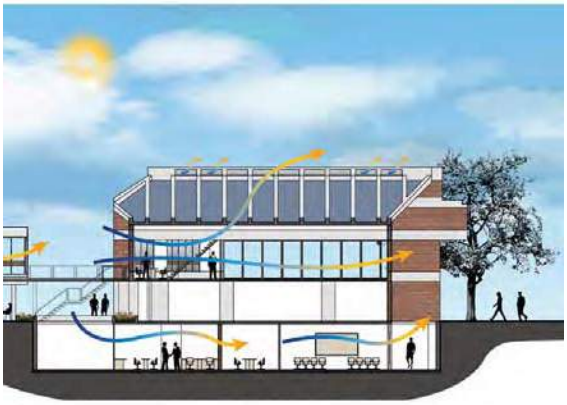
FUNDING PARTNERS:

Government of India, Government of Kerala, RUSA, University Grants Commission, Kerala State Higher Education Council, Kerala State Council for Science, Technology and Environment.

SOURCE:

Dr. Radhakrishna G Pillai, Head, Department of Environmental Science and water management, University of Calicut

INDIA:
CEPT UNIVERSITY



GENERAL DESCRIPTION:

- CEPT University focuses on understanding, designing, planning, constructing and managing human habitats. Its teaching programs build thoughtful professionals and its research programs deepen understanding of human settlements. the University comprises five faculties. The faculty of architecture, faculty of planning, faculty of technology, faculty of design, and faculty of management
- The faculty/departments/buildings involved in the program are : the Faculty of Design, CEPT University,; The Centre for Advanced Research in Building Science and Energy (CARBSE) and the CEPT Research and Development Foundation

CEPT University has seven research centres. CARBSE has more than 13 full-time research students, 03 professors, and 11 research scholars.

TARGET BENEFICIARIES:

Community largely at university level.

UNEP THEMATIC PRIORITY AREA:

Climate change; Resource efficiency (sustainable consumption and production)

PROJECT / INNOVATION AREA:

- Research & Development
- Greening of University infrastructure/facilities/operations
- Community collaboration
- University management
- Student participation/engagement

IDENTIFIED ISSUES:

India has engaged itself in generation of knowledge pertaining to energy efficient built habitat. Profession also have practiced sustainable design with focus on savings of energy over operation of built habitat. Centre for Advanced Research in Building Science and Energy (CARBSE) does provide platform to academia, industry and government to participate in research and development activities which is

contextual to India. A NZEB building where will be housed is an example of 'Living Laboratory'. It is expected to offer opportunity to work in area of building physics, materials and construction leading to energy savings, thermal comfort studies, codes and standards and system integration. Most of these areas are in nascent stage of research in India. This facility is expected to provide platform for CEPT University's research scholars and students to involve ins 'State – of Art' research activities.

OUTCOMES:

- The NZEB will function as a 'Living Laboratory', wherein the building itself will be used to evaluate the performance of various materials, construction technologies and systems. NZEB at CEPT University campus in Ahmedabad, Gujarat, will house the Centre for Advanced Research in Building Science and Energy (CARBSE).
- The building is net-zero energy building (NZEB) where energy consumption has been reduced by 86% compared to business-as-usual buildings in the university through passive and active energy-efficiency measures. The rest of the energy use will be balanced by high efficiency Solar PV system. The building design has only incorporated "market-ready" technologies to demonstrate that the net-zero energy building design can be propagated in the market with proper design and execution.
- Apart from being ultra-efficient, the building design incorporates "mixed-mode" operation where the building operates in natural ventilation mode when outdoor conditions are favourable. Passive features of the building, such as passive ventilation, window locations, and thermal mass of the building, have been optimized based on extensive computational fluid dynamics (CFD) modelling and thermal simulations. Even in harsh climate of Ahmedabad, the building will operate 150 days of the year in natural ventilation mode.
- The ultra-efficient building will also house laboratory testing equipments that will characterize performance of high efficiency components.
- Through extensive daylight simulation, the building has been designed with sufficient openings and light shelves to be completely daylit without glare throughout the day. For late evening and early morning operation hours, the space has been designed with optimum ambient and task light layout, along with occupancy sensors.
- The ceiling concrete in the building contains fly ash contents to minimum embodied energy of the building. Double glazed high-efficiency windows have been installed in the building. The operable windows have been installed near occupant sitting to provide them opportunity to get fresh air as well as to provide them adaptive measures for control.
- The building contains highly-efficient air conditioning system components such as graphite-based radiant ceiling, variable refrigerant flow (VRF) systems, variable flow dedicated outdoor air system with heat recovery wheel, variable speed pumps, and modulating inverter chillers with EC motors.

EVIDENCE / ASSESSMENT / RATING:

NZEB at CARBSE, CEPT University has been recognised as flagship pilot NZEB project by USAID-ECOIII Project.

SIZE OF IMPLEMENTATION:

Net Zero Energy Building at CEPT University is about 800 Sq.mts of floor space on 240 Sq.mts of land area.

COST OF IMPLEMENTATION:

INR 22 million

YEAR OF IMPLEMENTATION:

December 2011 – December 2014

FUNDING PARTNERS:

CEPT University, Ahmedabad, India

Ministry for New and Renewable Energy, Government of India

Gujarat Energy Development Agency, Gandhinagar, India
United States Agency for International Development

Vastu-Shilpa Consultants, VMS Engineering+Architecture, Pankaj Dharkar Associates, ANTECH Consultants, Tripur Builders, Asahi India Glass Ltd, Ownes Corning, SGL Carbon, Pidilite Industry, ASHRAE Western India Chapter, Yogi Engineers, Infinite technologies and SUVEG Electronics.

SOURCE:

www.cept.ac.in

www.carbse.org

INDIA:
TERI UNIVERSITY

GENERAL DESCRIPTION:

- The TERI University was set up in 1998 with a vision of disseminating the vast knowledge created in the realm of energy, environment and sustainable development by The Energy and Resources Institute (TERI). In its 15 years of functioning, TU has achieved significant progress in creating an institution of higher learning with a strong foundation of research and innovation. It is registered with the University Grants Commission (UGC), India and operates at its 'green campus', located at Vasant Kunj, New Delhi. Currently, there are 13 masters' level programs, 2 post-graduate diploma programs and 6 doctoral programs in science, policy and management offered by TERI University. There are about 125 Ph.D. students at TERI University and over 550 students at the masters' level.
- The campus is housed in a green building in New Delhi and is spread over two acres of land, and is one of the first in the country for a university and it further aims to minimize the ecological footprint. A truly green campus, it puts into practice the very principles it teaches in its classrooms. An architectural delight, the campus has been planned to provide a setting that enhances learning, while simultaneously showcasing the concept of modern green buildings.

TARGET BENEFICIARIES:

- TERI University is the role model for green initiatives in other educational institutions.
- TERI University students and employees.
- Residents/Communities residing in the Sector C, Vasant Kunj, New Delhi due to greening in and around the campus.

UNEP THEMATIC PRIORITY AREA:

Environmental resource management, Climate science and policy, Environmental pollution, Policy and planning, Energy and environment and Water resource management

PROJECT / INNOVATION AREA:

- Research & Development
- Greening of University infrastructure/facilities/operations
- Community collaboration

- University management
- Student participation/engagement

IDENTIFIED ISSUES:

With the increasing awareness for environmental sustainability, academic institutions have been recognized worldwide as the crucial platforms for imparting these ideas in young minds. Initially the University was operating from TERI campus located in India Habitat Centre, Lodhi Road, New Delhi. The University moved to the new campus at Vasant Kunj in 2008.

Area in and around the campus was very much rocky except the Delhi ridge area which has got a decent good green cover. Since the university is committed to principles of sustainable development, conscious decision was made to design the building in such a manner that it is sustainable in terms of energy use and low carbon footprints.

On moving to the new campus a pilot project was undertaken to make an assessment of the existing energy usage and waste disposal. The findings of this project prompted to initiate steps that would help in further "greening" the campus.

OUTCOMES:

The first pilot project i.e. initial environmental review (IER) that was carried out to understand the areas of concern in the campus through a questionnaire survey was designed to understand the perceptions of students, faculty members and staff members vis a vis "green" issues. The strengths, weaknesses, opportunities and threats (SWOT) analysis was also carried out to identify the major environmental concerns in the university. This was followed by preparation of environmental policy and plan based on finding of this study. Based on the findings, following changes were made:

- The green cover in and around the campus was increased in order to increase the carbon sink.
- In order to have modal shift from private to public transport, and hence reduce the carbon footprints, initiatives were taken to introduce public transport facility for students and faculty members.
- Initiatives were made to have paperless communication systems with in the campus
- TERI University has planted 3900 trees, 7 green patches and a traffic round-about covering a total area of about 7000 sq ft as shown in Figure 1.
- The sewage treatment plant has been installed for the campus wastewater released from cafeteria and hostel and treated water is used for landscaping purpose.
- Vermicomposting plant has been installed for managing the kitchen waste.

Recently, a project was undertaken by postgraduate students to determine the further scope of improvement in energy efficiency and indoor environment. The findings of this study would be used in further "greening" the campus in terms of energy efficiency and indoor environmental quality and carbon footprints.

EVIDENCE / ASSESSMENT / RATING:

TERI University wins the 'Greenest University and Research Institution' award in a competitive assessment, edging out other prestigious global institutions like Copenhagen University, Denmark, University of Plymouth, UK, Deakin University, Australia, and Unity College, Maine, USA, among others. The award is one amongst ten inaugural Climate Change Awards organized by Responding to Climate Change (RTCC).

SIZE OF IMPLEMENTATION:

3 Acres

COST OF IMPLEMENTATION:

Approx. INR 10 million

YEAR OF IMPLEMENTATION:

2009-2014

FUNDING PARTNERS:

TERI University, New Delhi

Oil and Natural Gas Corporation Ltd. (ONGC), New Delhi

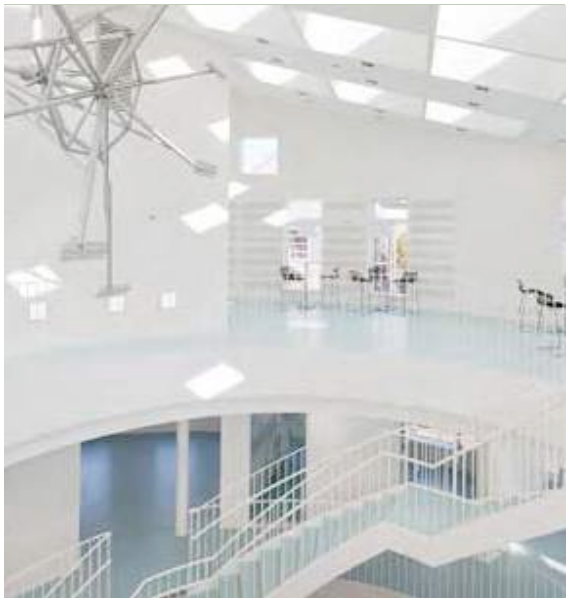
SOURCE:

Jain, S., and Pant, P. 2010. Environmental Management Systems for Educational institutions: A case study of TERI University, New Delhi. International Journal of Sustainability in Higher Education. Volume 11(3), pp. 236-249.

Jain, S., Aggarwal, P., Sharma, N., Sharma, P., 2012. Fostering Sustainability through Education, Research and Practice: A case study of TERI University. Journal of Cleaner Production, 61(15):20-24.

TERI University, http://www.teriuniversity.ac.in/teri-university-campus-map

DENMARK:
UNIVERSITY OF COPENHAGEN



GENERAL DESCRIPTION:

- The University of Copenhagen was founded in 1479.
- The University has about 1,000,000 sqm premises on four campus areas in central Copenhagen. The University consists of 8 faculties and more than 100 departments and research centres. It has more than 7,000 employees and over 37,000 students.
- The University is working towards becoming one of the Europe's most green campus areas.
- The University's Green Lighthouse, Denmark's first carbon-neutral public building, is located at the Faculty of Science. It has been built in less than a year and it houses the Student Service Centre. The Green Lighthouse also hosts The Copenhagen Innovation and Entrepreneurship Lab (CIEL). It is the place of work of 19 people.

TARGET BENEFICIARIES:

Community largely at university and regional level, but also at global level.

UNEP THEMATIC PRIORITY AREA:

Climate change; Resource efficiency (sustainable consumption and production).

PROJECT / INNOVATION AREA:

- Research & Development
- Greening of University infrastructure/facilities/operations
- Community collaboration
- University management
- Student participation/engagement

IDENTIFIED ISSUES:

The university, considering its size and research profile, recognises its 'green responsibility' and wishes to become one of the greenest campuses in Europe.

OUTCOMES:

- The university aims to reduce its energy consumption and greenhouse gas emissions by 20% between 2006 and 2013.
- Ongoing engagement and collaboration with both internal and external partners to achieve more sustainable campus; active involvement of faculties and student organisations.
- Improving thermal performance of existing buildings, energy smart installations in buildings, facilitating energy smart conducts by employees and students, and energy efficient purchases.
- The energy savings projects are expected to result in annual reduction of 1700 tons of CO2 emissions and annual saving of DKK 4.6 million.
- Global collaboration to communicate and share own experiences with the sustainability efforts with other universities such as through International Alliance of Research Universities (IARU) collaboration and International Sustainable Campus Network (ISCN).
- By 2013, at least 75% of all purchases via purchase agreements to require sustainability.
- The University develops an annual Green Campus Action Plan.
- Partnered in creating the Green Lighthouse, Denmark's first carbon-neutral public building, which provides for its total energy needs with 35% of solar energy and 65% of district heating with heat pump. 76m2 of solar cells on the roof power the building's lighting, ventilation and pumps.

EVIDENCE / ASSESSMENT / RATING:

Green Lighthouse is a CO2 neutral building in operation.

SIZE OF IMPLEMENTATION:

1,000,000 sqm for all premises and 950 sqm for Green Lighthouse.

COST OF IMPLEMENTATION (US $):

Approx. $6.6 million (DKK 37 million) for Green Lighthouse; Approx. $1.8 million (DKK 10 million) for energy and climate efforts; Approx. $45,000 (DKK 250,000) for student sustainability initiatives.

YEAR OF IMPLEMENTATION:

2008 –2009 (Green Lighthouse)

FUNDING PARTNERS:

- The Ministry of Science,
- Technology and Innovation (DKK 33 million);
- VELUX,
- VELFAC
- Windowmaster and Faber (DKK 3.5 Million);
- Rockwool, Veksø, Knauf and Danogips (DKK 500,000).

SOURCE:

UNIVERSITY OF COPENHAGEN. n.d. Green Campus [Online]. Available: http://climate.ku.dk/green_campus/ [Accessed 18 March 2012].

VELUX. n.d. Experiment # 2 - Green Lighthouse [Online]. Available: http://www.velux.com/sustainable_living/model_home_2020/green_lighthouse [Accessed 24 March 2012].

ITALY:
CA' FOSCARI UNIVERSITY OF VENICE

GENERAL DESCRIPTION:

- Ca' Foscari University of Venice was founded in 1868 as a Business School (the first in Italy and the second in Europe) oriented to economic subjects with a specific focus on Eastern and Western languages, reflecting Venice's long-standing tradition as crossroads of culture, people and trade.
- The University has 28 sites diffused in the whole city of Venice, educates about 21,200 students among which 1,100 are international students and has more than 1,200 employees.
- 8 departments, 15 Bachelor's Degree programmes, 30 Master's Degree programmes, 39 Professional Master's programmes, 16 PhD programmes.
- Ca' Foscari University of Venice launched in 2010 the program Sustainable Ca' Foscari with the aim to include sustainability in every university's activities, and integrating it into existing processes and involving actively staff, students, community and institutions.
- The Sustainability Commitment Chart is the operative tool which defines the objectives aiming to minimise the university's impact on the environment and on natural resources, to increase social cohesion and reduce inequality within society, and to favour cultural development and sustainable economic growth in the region

TARGET BENEFICIARIES:

Community largely at university and regional level, but also at global level.

UNEP THEMATIC PRIORITY AREA:

Climate change; Resource efficiency (sustainable consumption and production); Environmental governance; Ecosystems management.

PROJECT / INNOVATION AREA:

- Research & Development
- Greening of University infrastructure/facilities/operations
- Community collaboration
- University management
- Student participation/engagement

IDENTIFIED ISSUES:

Ca' Foscari University is placed in a historical and magnificent building built in 1453. Until the 2010 the attention was paid to preserve the artistic value of the building, and the environmental issues were almost totally ignored, both because belonging to a different perspective and because of structural constraints, such as laws forbidding any change in the artistic heritage. The challenge was to implement sustainable strategy enhancing value of artistic building.

OUTCOMES:

- Ca' Foscari is the first Italian sustainable University thanks to the strong commitment in sustainability of the whole organization and the launch of some important projects.
- Sustainable Ca' Foscari worked hard to not focus only on the environmental dimension of sustainability but also on the social one.
- Many are the projects and initiatives that Ca' Foscari has run from 2010 to nowadays, but the main are:
- - the pilot project of Carbon Management to develop effective ways of calculating CO2 emissions for complex structures like Universities, and then to define targets for reducing GHG emissions.
- - The development of a Carbon Footprint Calculator addressed to students, faculty and staff with the aim of building a consciousness and spreading of sustainable behaviours.
- - Ca' Foscari sociale project to boost the university community's cooperation with the local non-profit associations.
- - Launch of "Sustainability competencies", a voluntary based activity for acquiring competencies in sustainability, achievable by all students and entitled 1 extra-curriculum credit
- University aims to reduce CO2 emissions through big interventions to make buildings more efficient and increasing purchases with green and social criterion.
- Ca' Foscari spreads sustainable behaviours among its staff, students and faculty, but also in the local community.
- The University shares sustainable practices among other academic institution, public administrations, companies and other organisations.
- Engagement and collaboration with partners and suppliers to offer spaces and services more sustainable..

EVIDENCE / ASSESSMENT / RATING:

From 2012 Ca' Foscari University Palace is the oldest building certified with LEED EB:O&M.

Ca' Foscari University is the first Italian sustainable university, as reported by UI GreenMetric World University Ranking.

SIZE OF IMPLEMENTATION:

104,723 sqm

COST OF IMPLEMENTATION (US $):

Not available

YEAR OF IMPLEMENTATION:

2010 - ongoing

FUNDING PARTNERS:

- Italian Ministry of the Environment and Protection of Land and Sea

SOURCE:

SUSTAINABLE CA' FOSCARI WEBSITE: http://www.unive.it/nqcontent.cfm?a_id=132906

ANNUAL REPORTS: http://www.unive.it/nqcontent.cfm?a_id=133118

TOWARDS A SUSTAINABLE UNIVERSITY. THE CA' FOSCARI EXPERIENCE, C.Mio, Palgrave Macmillan (ISBN 9781137351920) Link DOI

CATALONIA - SPAIN:
AUTONOMOUS UNIVERSITY OF BARCELONA, CERDANYOLA DEL VALLÈS

GENERAL DESCRIPTION:

- The Universitat Autònoma de Barcelona (UAB) was founded in 1968. The main campus located in Bellaterra (Cerdanyola del Vallès) has an approximate area of 230 ha. The university has 13 faculties, 57 departments and 81 degrees. The university has nearly 40,000 students, 3,800 academic staff and 2,500 administrative staff.
- UAB was the first university in Spain teaching a degree and a doctorate on Environmental Sciences. It was also the first Spanish University that set up an office devoted to the campus environmental management.
- The "Greening Events" experience involves the whole university community and also works at a regional level because many municipalities, NGO's and firms have adopted some of the ideas and initiatives developed in the UAB, to their own celebrations.
- It is agreed that festivals influence communities, alters its normal production, and exert some stress to the environment. Consequently, they should be analysed from a sustainability standpoint in order palliate their negative effects and strengthen their positive ones.

TARGET BENEFICIARIES:

University community, municipalities and, and generally speaking all institutions, firms and NGO's that celebrate events and festivals.

UNEP THEMATIC PRIORITY AREA:

Resource efficiency (sustainable consumption and production).

IDENTIFIED ISSUES:

Since 1986 the UAB has been organising a welcome party to the new academic course which promotes interaction between new and old community members and it gives the opportunity to students and cultural groups to organise activities to raise funds. The party consists in cultural and music performances while students set up their stalls to

sell food and drinks. This one day event lasts for 10 hours approximately, and it gathers about 20,000 people.

Before greening the event neither was a strategy to reduce the amount of waste, nor was a plan to collect this waste separately. Therefore the figures of waste produced rose up to nearly 0.5 kg per person, most of them mixed up being impossible to be recycled.

Moreover, the party was regarded as a student's celebration whose impacts had to be fixed up after it finished. It was an end of pipe strategy, and when the party was over staff had to deal with all the mess, parking, littering, wild peeing and waste produced.

OUTCOMES:

- Only reusable cups are allowed to be used in the party. An average of 3-4 single use plastic cups are avoided for each reusable one during the party. Participants pay a monetary deposit for each reusable cup which is recovered when it is returned back to stalls. The deposit is an incentive to keep the cup during the celebration and prevents littering by participants in the festival area because they will lose money if they do so.
- Reusable cups are kept from one year to another and their waste prevention effect last for years until participants don't return them back to the organization. In the 2013 edition reusable cups avoid an amount around 50,000 single use plastic cups and the littering associated to them.
- The environmental team is formed by a group of 30 students that work to make a greener celebration. They are responsible to provide assistance to students stalls in all the aspects concerning the event greening:
- Providing plastic bags and bins for the collecting of different wastes,
- Cleaning up the reusable cups
- Hiring reusable cups to students stalls
- Auditing the amount of wastes that every stall brings to the recycling station
- Auditing the environmental performance of stalls on site
- Every year there is an award to the most sustainable student stall. The environmental performance of every stall is reported at several times during the celebration.
- All students' stalls have to bring their waste to the temporary party recycling centre, where they can put them separately. This recycling centre is also used by the cleaning services.
- The welcoming party has also extra train and bus services specially deployed for this event.

EVIDENCE / ASSESSMENT / RATING:

After the implementation of the greening strategy, waste per person experienced a reduction between two and three times, being 40% of this waste sorted out in order to ease its recycling.

SIZE OF IMPLEMENTATION:

The event gathers around 20,000 people during the day.

COST OF IMPLEMENTATION (US $):

This undertaking requires an average investment of 0.5 € per attendee which includes the reusable cups purchasing, green team enrolment and their uniform and facilities, purchasing of containers for the waste collection, waste collection costs, prize for the most sustainable students' stall.

YEAR OF IMPLEMENTATION:

1998 - ongoing

FUNDING PARTNERS:

- AGBAR (Water company), ARC (Catalonian Waste Agency), AMB (Barcelona Metropolitan Area), Fundació Territori i Paisatge (Heritage Foundation for the Conservation of Nature) and some small firms which traditionally collaborate in the service greening of the university like vending food service.

SOURCE:

The Environmental Office web page of the UAB has a section devoted to events' greening. Here some of its publications:

Hidalgo, C., M. Rubio & P. Ysern (2010) Guide to organising more sustainable congresses. Guíes d'Educació Ambiental n. 35. Barcelona City Council.

Adell, A.; Ysern, P; Rubio. M.; Muñoz P. (2004). Grans esdeveniments festius: anàlisi i experiències per la sostenibilitat. Documento núm. 9 de la colección "Documents de l'Agenda 21 de Barcelona". Ayuntamiento de Barcelona.

Rubio, M. & P. Muñoz (2001) More sustainable celebrations. Guies d'Educació Ambiental n. 6. Barcelona City Council.

SPAIN:
AUTONOMOUS UNIVERSITY OF MURCIA

GENERAL DESCRIPTION:

- The University of Murcia has as an objective to achieve sustainable development, the University strives to establish objectives that consider social, economic and environmental needs of the community. These policies have been translated into the "Sustainable Campus" environmental strategy.
- "Sustainable Campus" has incorporated the development of strategies on renewable energy, energy efficiency, environmental performance of the facilities, waste management, air and water quality and incentives for the use of alternative ways of transport.
- Total campus area is 1 378 000 sqm, with 79 buildings, and about 20 000 users. The water treatment system named Golftrat is based on processes of elimination of organic pollutants with a capacity of treatment of up to 500 cubic metres.
- The system combines two processes: depuration of residual water through an underground system that leaks over gravel panels plus the generation of green spaces, in addition to this, the construction of artificial wetlands contribute to the elimination of nitrates in treated water.
- After treatment, water is pumped to regulation storage areas and then distributed to water the green spaces throughout the campus.

TARGET BENEFICIARIES:

University community.

UNEP THEMATIC PRIORITY AREA:

Resource efficiency (sustainable consumption and production).

IDENTIFIED ISSUES:

The region of Murcia suffers from water scarcity. From this premise considering the progressive extension of the University of Murcia consuming increasing amounts of water, the introduced system started to be researched. A small scale pilot system was tested through a plant of precast columns. After the trial gave positive outcomes, the residual water treatment system was constructed in 2005.

OUTCOMES:

- The facility opened in april 2007 and has enabled the treatment of residual water throughout the campus, which is then used to garden all green spaces of the University, reducing significantly water consumption.
- The system being underground and generating green spaces on the surface contribute to the aesthetic and embellishment of the campus. Also the wetlands become a decisive factor in the promotion of the zoologic and botanical biodiversity of the area.
- The system attracts researchers and organisations from Murcia interested in sustainable development. Guided visits are offered in different levels of technicality as an environmental education program.

EVIDENCE / ASSESSMENT / RATING:

Faculties of Chemistry and Biology ran a series of tests and determined the treated water reached a quality level appropriate for gardening, the wetlands serve as a media for the recovering of local flora and fauna with diverse species of reptiles, fish, and birds benefitted.

SIZE OF IMPLEMENTATION:

Platform 17 000 m2

Wetland 1464 m2

Green Areas 7023 m2

COST OF IMPLEMENTATION:

685 081.56 Euros

YEAR OF IMPLEMENTATION:

2005 - ongoing

FUNDING PARTNERS:

Financing from : Ministerio de Medio Ambiente and Golftrat in colaboration with the Faculty of Chemistry of the University of Murcia.

SOURCE:

www.campussostenible.um.es

http://www.um.es/eubacteria/depuracion.pdf

SPAIN:
AUTONOMOUS UNIVERSITY OF MADRID

GENERAL DESCRIPTION:

The Centro Integral de la Bicicleta (CibiUAM) represents the commitment of the Universidad Autónoma de Madrid to sustainable mobility.

The function of CibiUAM is to provide students and staff of the university specific alternatives front to car use, which is often the means of transport used. Its aim is to encourage use of bicycles as an everyday means of transportation and sensitize the university community about the need for sustainable mobility.

The center provides the following services: bicycle hire, bicycle hostel, mechanical workshop, documentation center of cycling and sustainable mobility, auto-repair workshop, second hand market of bicycles and accessories, clothing, and educational and awareness workshops.

CibiUAM is located next to the train station to enhance intermodality between public transport and cycling.

The CibiUAM is managed by a cooperative of students. For a number of years, this cooperative carried out the distribution of letters and postal documents by different university buildings using pedal bikes.

The CibiUAM center is an initiative of Ecocampus project, this is the formalization of the UAM's commitment to the Agenda21 and it seeks to achieve two main goals:

To improve the environmental situation of the different UAM campus and facilities.

To raise awareness to all the staff and students to promote participation in the debate and search solutions to the global and local environmental conflicts.

TARGET BENEFICIARIES:

University community: Students, teachers and administrative staff

UNEP THEMATIC PRIORITY AREA:

Climate change

IDENTIFIED ISSUES:

The form of transport used to access the campus is the train (41%), followed by private cars (37%), and lastly the bus (22%). On a weekday enters the campus an average of 10,000 cars daily.

The use of bicycles as transportation was irrelevant.

The UAM detected as a priority to treat excessive role of the private motor vehicle, which has implications for the quality of life and environment. To change this dynamic focused on two main activities: the promotion of public transport and promoting cycling as transportation.

The main objectives UAM arises to promote cycling as a means of transport are a assume leadership role in the implementation of a more efficient model of mobility; and develop actions educational for a change of habit transport within the university community.

OUTCOMES:

- The increased presence of bicycles on campus since opening cibiUAM has been remarkable. It has gone from being a rare vehicle according to the 2007 mobility study, a common internal mobility vehicle on campus. In October 2013, 217 bikes were counted on campus (75-system of loan and the rest are private bikes).
- The occupation of the CibiUAM bicycle parking, as well as other centers and faculties, show us the reality of increased bicycle on campus.

EVIDENCE / ASSESSMENT / RATING:

Some facts: More than 4,750 people have accessed services CibiUAM from creation to December 2013; 626 people currently have service user license bicycle rental (48% are students, teachers and researchers 46% and 6% administrative and other personal services); the number of new ID cards by year: 2009 (141 new members); 2010 (118); 2011 (110); 2012 (45); 2013 (212). These data do not reflect the "pull" effect that generated the CibiUAM because on campus there are many more private bicycles that of the corresponding to the loan service.

SIZE OF IMPLEMENTATION:

Campus wide strategy

COST OF IMPLEMENTATION (US $):

359 535.85 Euros from 2009

YEAR OF IMPLEMENTATION:

2001- ongoing

FUNDING PARTNERS:

- Renfe-Cercanías (Attached to the Ministry of Public Works public company). Address of the Partner: Avenida Ciudad de Barcelona 8, 3º, 28007, Madrid, España. Financial support.
- Fundación Movilidad Ayuntamiento de Madrid (Foundation). Address of the Partner: Calle Albarracín 31, 3º planta, 28037-Madrid. Technical support.
- Consorcio Regional de Transportes de Madrid (Public company of Madrid). Address of the Partner: Calle Diego de Ordás, 3 (Santa Engracia, 120), 28003-Madrid. Technical support.

SOURCE:

The UAM and Renfe inaugurated CibiUAM to promote the use of train and bicycle as a model of sustainable mobility, Europa Press, 8 May 2009, link: http://www.europapress.es/madrid/noticia-uam-renfe-inauguran-cibiuam-promover-uso-cercanias-bicicleta-modelo-movilidad-sostenible-20090508163110.html

Open the use of bicycles Cercanías trains in Madrid, Crónica Norte, 1 June 2011, link: http://www.cronicanorte.es/trenes-cercanias-madrid-bicicleta/14373

CibiUAM, Youtube, author Goodwill, 20 September 2010, link: https://www.youtube.com/watch?v=zEhOhSiZHIs

A trickle of pedaling for sustainable mobility, Daniel Jiménez, Noticias Positivas, 2 March 2011, link: http://www.noticiaspositivas.net/2011/03/02/un-goteo-de-pedaladas-por-la-movilidad-sostenible/

SWEDEN:
CHALMERS UNIVERSITY OF TECHNOLOGY GOTHENBURG

GENERAL DESCRIPTION:

- Chalmers University of Technology is situated in Gothenburg on the Swedish west coast. Research and Education, conducted on a broad front within technology, the natural sciences and architecture, are carried out by Chalmers 17 departments, which integrate and collaborate across disciplines and with the surrounding world through our 8 Areas of Advance, where academia, business and society jointly approach complex societal challenges.
- Chalmers University of Technology is located on two campuses in central Gothenburg, campus Lindholmen and campus Johanneberg. There are 9000 full year students on 42 programs and 3000 employees.
- Our vision, "Chalmers for a sustainable future", highlights the direction of our research and education efforts. Chalmers University of Technology is certificated according to the International environmental standard ISO 140001. The Environmental Management System is fully integrated in the organization and includes education, research and innovation as well as a reduced ecological footprint and campus greening efforts.

TARGET BENEFICIARIES:

Chalmers university of technology with its students and employees are the prime beneficiary. Other beneficiary groups for Chalmers University of Technology are through collaboration in the Regional Clusters in West Sweden where Sustainable development is the joint driving force. But also globally with other Universities and companies world wide.

UNEP THEMATIC PRIORITY AREA:

Climate change; Resource efficiency (sustainable consumption and production); Environmental governance; Harmful substances and hazardous waste; Ecosystems management.

PROJECT / INNOVATION AREA:

- Research & Development
- Greening of University infrastructure/facilities/operations
- Community collaboration
- University management
- Student participation/engagement

IDENTIFIED ISSUES:

Identifying a third method and strategy for achieving change with three important building blocks:

- Create a neutral arena/organization
- Build on individual engagement and involvement (bottom-up)
- Communicate the clear commitment of the management team

OUTCOMES:

- Chalmers became a member of the Alliance for Global Sustainability (AGS) with the aim of pursuing research and development within complex global issues, focusing on environmental science and sustainable development.
- An Environmental coordinator was employed to improve the campus environment and implement an environmental management system (EMS).
- In 2003, the President decided to launch a requirement of the equivalent of five weeks of courses in environment and sustainable development for all students in all bachelor programmes. Furthermore, all students should be able to choose a sustainability-profiled master's programme.
- Project Education for Sustainable Development, ESD, was started in 2006 in order to adopt a comprehensive approach to education for sustainable development.
- Chalmers launched a matrix organisation, with eight Areas of Advance for transition toward sustainability: Energy, Transport, Built Environment, Life Science Engineering, Nanoscience and Nanotechnology, Materials Science, Information and Communication Technology, and Production.
- Five knowledge clusters were launched in the region West Sweden Knowledge clusters: Urban Future, Marine Environment and Maritime Sector, Green Chemistry and Bio-based Products, Sustainable Mobility, and Life Science). These five clusters were identified by leading representatives from academia and the private and public sectors in the region.
- In the Challenge Lab, students become change agents by taking on complex societal challenges together with industry, academia and the public sector (related to the five clusters mentioned above).

EVIDENCE / ASSESSMENT / RATING:

The campuses areas have been developed towards greening in a strategic way, during several years to be welcoming of pedestrians and cyclists and giving less space to motorised traffic. This has led to calmer and inspiring campuses areas with meeting places and room for reflection. This is possible through an active traffic plan where priority is given to the use of public transport, bicycle and walking for work related travelling. The percentage of employees going to work by car has decreased from 34 to 21 per cent between the years 2006 and 2012. A decrease in energy use can also be seen as an effect of the greening projects. Large improvements in the handling of chemicals are a result of the systematic safety work by the EMS.

SIZE OF IMPLEMENTATION:

The greening projects are integrated into the whole university, in Research, Education and Innovation and at both campuses.

YEAR OF IMPLEMENTATION:

1970 – Ongoing

SOURCE:

http://www.chalmers.se/en/about-chalmers/vision-goals-and-strategies/Pages/default.aspx

http://publications.lib.chalmers.se/records/fulltext/164591/local_164591.pdf

U. Lundqvist and M. Svanström, "Inventory of content in basic courses in environment and sustainable development at Chalmers University of Technology in Sweden", European Journal of Engineering Education, 2008

http://unesdoc.unesco.org/images/0014/001484/148466e.pdf

http://www.wwf.se/source.php/1234157/Goteborgsrekommendationerna.pdf

http://www.chalmers.se/en/areas-of-advance/Documents/Areas%20of%20advance%20print.pdf

TURKEY:
MIDDLE EAST TECHNICAL UNIVERSITY

GENERAL DESCRIPTION:

- The Middle East Technical University (METU) is located on a 4500 hectare Campus about 20 km from the centre of Ankara; it includes 3043 hectare of forest area and the Lake Eymir.
- ETU runs about 206 programs serving over 24,500 students including more than 1,700 students from over 85 different countries.
- METU plays a key role in the greening of Ankara through its comprehensive re-forestation program. Preliminary planning for the METU Re-forestation and Landscaping Program began in 1958 in response to two major incentives: First, being that the capital city Ankara, which is surrounded by hills, suffers from heavy air pollution. Second was that, the Turkish law supports for green zone next to Ankara. This law states that forest land cannot be expropriated, thereby encouraging the creation of newly planted woods to limit urban sprawl.
- The Re-forestation Program has led to the successful planting of some ¾ of the campus area. Every year, over 20,000 trees are planted by students, staff and alumni.
- The initiative was further inspired by the fact that 4500 hectares were available for this purpose. The area was formerly a degraded, barren pasture of wheat fields once covered with primal forests. By 1960, the university's department of landscaping had tested tree species that would be appropriate, and in 1961, the re-forestation program commenced.

TARGET BENEFICIARIES:

Community largely at university and the residents of the city of Ankara.

UNEP THEMATIC PRIORITY AREA:

Climate change; Ecosystem management; Environmental governance; Resource efficiency (sustainable consumption and production).

PROJECT / INNOVATION AREA:

- Greening of University infrastructure/facilities/operations
- Community collaboration
- University management
- Student participation/engagement

IDENTIFIED ISSUES:

Disappearance of wilderness, degradation of biodiversity and extinction of species due to urbanisation and other human processes.

OUTCOMES:

- The area with non-irrigational plants now covers 3000 hectares. Plants that require irrigation cover 800 hectares, and are located within the built environment of the Campus where they form a beautiful landscape along the pedestrian network. The remaining 500 hectares consist of lakes and ponds. The flora at METU consists of more than 250 species, some of them native, others from other parts of Turkey.
- The forest area created not only contributes to the quality of campus life for the users, but also to the urban quality of life for the entire Ankara region. Additionally, and more importantly, it provides a broad range of other environmental services.
- The METU green area helps purifying Ankara's air, filters wind and noise, stabilizes the microclimate; i.e. makes the city much more sustainable and livable. In 1995, the Re-forestation Program received the Aga Khan Award for Architecture. The habitats created by the planted area, step and lake-shore areas provide living conditions for many species of mammals, birds, fish and butterflies. A recent research found out that two endemic butterfly species are living on the METU Campus.
- The built environment in METU has been created in line with sustainable design principles and includes the use of local construction materials. One of the buildings under construction is designed to include photovoltaic panels that will provide energy for the operation of the basic equipments within the building.
- The University, with an active participation of students, staff and alumni, organises an annual afforestation festival on the Campus.
- The University has an Afforestation and Landscape Department which provides maintenance and implementation strategy for plants. Decision-making on the sustainable development of the Campus belongs to the Presidency and its related offices. The Commission for University's Spatial Strategy and Development focuses on the preservation of greenery, while responding to the spatial development needs of the Campus.

EVIDENCE / ASSESSMENT / RATING:

Specific research on heat island in and around Ankara has shown beneficial cooling effect around METU campus.

SIZE OF IMPLEMENTATION:

Approx. 4,500 hectare campus

YEAR OF IMPLEMENTATION:

1958 – Ongoing

FUNDING PARTNERS:

- National government's Ministry of Forestry provided trees during the 1960s
- General Directorate of Afforestation and Erosion Control annually provids 20000-25000 tree seedlings
- Business and Industry provides grants for new energy-efficient buildings.

SOURCE:

MIDDLE EAST TECHNICAL UNIVERSITY. n.d. General Information [Online]. Available: http://www.metu.edu.tr/general-information [Accessed 21 March 2012].

UNITED NATIONS ENVIRONMENT PROGRAMME (UNEP) 2011. Innovations and Best Practices on Education for Sustainable Development and Sustainability in Universities – Success Stories from Around the World.

UK:
UNIVERSITY OF GLOUCESTERSHIRE

GENERAL DESCRIPTION:

- Higher Education Institution. Approx. 10,000 FTE students (UG and PG) and 850 staff. 3 town-based campuses in rural county setting. University of Gloucestershire (UoG) gained university status in 2001 following its long history of education provision dating back almost 200 years and embracing its Anglican origins.
- Its reputation is built on high quality, innovative teaching and learning, excelling in Sports, Business, Teacher Training, Applied Sciences, Media and Arts, with a diverse international cohort and active student community.
- UoG has a deeply held commitment to Sustainability through its 'whole of institution' approach, striving to improve its own performance and redefine learning experiences through the curriculum, co-curriculum and its activities in research, outreach and partnerships.

TARGET BENEFICIARIES:

All University departments, both professional and academic, are connected with central Sustainability initiatives, which have an impact on decision-making, planning and strategy, as well as grass-roots innovation and individual inspiration.

Thus students and staff are key beneficiaries of this initiative. Our external stakeholders who come into contact with our staff and students or are involved in university activities are also direct beneficiaries.

UNEP THEMATIC PRIORITY AREA:

Relevant to priority areas: Climate change; Resource efficiency (sustainable consumption and production); Disasters and conflicts; Environmental governance; Harmful substances and hazardous waste; Ecosystems management.

IDENTIFIED ISSUES:

University of Gloucestershire (UoG) has been deeply committed to 'whole of institution' sustainability since 2007 and seeks to be a pace-setter in Education for Sustainability.

It has recently changed gear over the past 5 five years: having been recognised for our structural and policy shifts, we had the plans and frameworks for deep change but not the reach and staff-student 'engagement levels to make it happen. With targeted effort in leadership, practice, curriculum, student participation and outreach, the University took large strides. Equipped with the map, strengthened strategic focus it developed sector-leading projects, new levels of engagement, and a tested ability to adapt and innovate for the future.

OUTCOMES:

Over the past 5 years, UoG has focused intentionally on changes in key areas to achieve the shift of gear and acceleration, which then develops the organisational connectivity and longevity that Sustainability requires:

- Improving how our Leadership team engages with Sustainability as responsible governance, corporate priority and learning agenda.
- Integrating Education for Sustainability principles into the institutional curriculum development systems and its academic strategies:
- Extending Student Engagement with Sustainability in the student experience, professional opportunities and student representation.
- Supporting academic staff development in EfS to achieve critical impact on the curriculum and build capacity for improving student learning.
- Creating more effective Partnerships and Outreach initiatives to collaborate with our community, external organisations and networks.

EVIDENCE / ASSESSMENT / RATING:

Achievements includes meeting a 30% reduction of scope 1 and 2 emissions against 2005 carbon emission baselines and reduction of 5% on scope 3 emissions. As well as lower its footprint the campus is greener, healthy and more accessible and useful to the community. 88% of our students believe that we practice sustainability well on campus and 76% believe that they have had a positive experience of education for sustainability during their time at the University.

SIZE OF IMPLEMENTATION:

Whole-of-institutional. Lead by a cross-institutional team with expertise in academic as well as corporate performance.

COST OF IMPLEMENTATION:

£1.5 million (university investment plus external funding)

YEAR OF IMPLEMENTATION:

2007 –2015

FUNDING PARTNERS:

- Higher Education Funding
- Council of England (HEFCE)
- National Union of Students, UK
- Quality Assurance Agency of the UK
- European Commission – Marie Curie Awards
- Copernicus Alliance
- UNU Regional Centres of Expertise.

SOURCE:

Sustainability Vision: http://insight.glos.ac.uk/sustainability/Pages/default.aspx

Sustainability Education http://insight.glos.ac.uk/sustainability/Education/Pages/default.aspx

Sustainability Performance: http://insight.glos.ac.uk/sustainability/practice/Pages/default.aspx

Sustainability News: http://insight.glos.ac.uk/sustainability/news/Pages/default.aspx

BRAZIL:
FEDERAL UNIVERSITY OF SAO CARLOS

GENERAL DESCRIPTION:

- In 2002, the UFSCar environmental student society called GAIA, supported by the former University Environmental Bureau (substituted by the Secretary of Environmental Management and Sustainability), developed a project for minimizing solid waste which has been known as "The Mugs Project". It is based on the first and most important element of the R-cycle, reduction, aiming at reducing solid waste production by the academic community in the University restaurants (Meira et al., 2007; Cinquetti & Logarezzi, 2007). From 2010 onwards, the Mugs Project became a permanent project in the University Environmental Education Program. In 2011, other two student societies (GIRe3 and EMA-Bio) joined the project as partners. We have around 20 people involved in the organization and implementation of the Project every year. These are 4 members of the University staff and around 15 to 20 student volunteers. In the beginning of each academic year, the organizers plan seminars and environmental awareness raising activities for student and staff newcomers, distributing reusable plastic mugs to be used in the restaurants instead of disposable plastic cups. To enhance student/staff adhesion to the project, disposable plastic cups are only available for guests in the four University restaurants.

TARGET BENEFICIARIES:

Academic community newcomers - undergraduate, graduate students and staff - of all four UFSCar campuses.

UNEP THEMATIC PRIORITY AREA:

Resource efficiency (sustainable consumption and production).

IDENTIFIED ISSUES:

- Before the Mugs Project start, all students who had lunch or dinner at the University restaurants would take (on a daily basis) at least one plastic cup to drink juice.

The volume of waste was far beyond the capacity of the available trash bins. In 2002, the estimated number of plastic cups consumed in the main Campus was about 14.500 per week. By the afternoon, when students would walk back to classrooms, it could be seen plastic cups lying around in the University woods just next to the restaurant, as well as in other unusual locations throughout the Campus.

OUTCOMES:

- After the project was implemented, the volume of solid waste produced in the university had a tremendous decrease and it would no longer be observed plastic cups discarded improperly around the university. In 2014, the number of meals served per week in the main Campus is 25% higher than in 2002. Therefore, the benefits of the Mugs Project in terms of waste reduction are even more significant. Besides, the project has also achieved its goal of building awareness of the importance of preserving the environment and natural resources, as well as provoking critical thinking about consumer habits.

EVIDENCE / ASSESSMENT / RATING:

Since the distribution of plastic cups in the restaurant was ceased, it could rarely be seen any littering related to plastic in the restaurant waste bins and their surroundings (visual perception). Students have effectively engaged in the Project and they are frequently seen carrying their mugs hanging from their backpacks throughout the Campus. An internal research (poll) carried out in 2012 (not published) indicated that the students use their mugs not only in the University restaurants but that they have incorporated them in their daily routine making use of the mugs also in coffee breaks and at parties. The students have also pointed that the Mugs Project helped them to rethink other consumer related habits. However, it was detected that the older students sometimes start to make less use of their mugs on a daily basis. Pointing that the Project needs to reinforce their importance as the students advance in their studies. Some institutional contribution in providing official regulations for the use of disposable plastic cups in snack bars, events and other activities would also be helpful to reinforce the Project.

SIZE OF IMPLEMENTATION:

All 4 UFSCar campuses. Approximately 4.000 people each year.

COST OF IMPLEMENTATION (US $):

R$ 6.730,00 per year (about US$ 3.000,00 per year).

YEAR OF IMPLEMENTATION:

2003- ongoing

FUNDING PARTNERS:

- Funding to this project is provided by UFSCar (ProACE and PROEX)
- Partner organizations:
- GAIA (Grupo Ambiental Ipê Amarelo - Yellow Ipe Environmental Society)
- GIRe3 (Grupo de Incentivo à Redução, Reutilização e Reciclagem - Society of Incentive to Reduction, Reuse and Recycling)
- EMA-Bio (Empresa Júnior da Biologia - Biology Junior Company in UFSCar)
- SGAS (Secretaria de Gestão Ambiental e Sustentabilidade – Secretary of Environmental Management and Sustainability)
- DeAEA (Departamento de Apoio à Educação Ambiental – Environmental Education Support Department))
- DeGR (Departamento de Gestão de Resíduos – Department of Waste Management)

SOURCE:

Cinquetti, H.C.S. & Logarezzi, A. 2007.Consumo e Resíduo: Fundamentos para o trabalho educativo. EdUFSCar. São Carlos, SP. 212pp.

Meira, A.M.; Rosa, A.V., Sudan, D.C., Leme, P.C.S. & Rocha, P.E.D. 2007. Da Pá Virada: Revirando o tema Lixo. USP Inovação. São Carlos. SP. 234pp.

GAIA Website:

http://ipeamarelo.wix.com/gaia

DeAEA Website:

http://www.deaea.ufscar.br/

The video used during the workshop can be found at (in Portuguese): http://www.youtube.com/watch?v=g39IEUbIICU - (Part 1)

http://www.youtube.com/watch?v=Z-91MRtz4ig&feature=relmfu - (Part 2).

BRAZIL:
UNIVERSITY OF SAO PAULO

GENERAL DESCRIPTION:

- Founded in 1934, the University of São Paulo (USP) has 11 campuses in 7 cities and nearly 113,000 people, of which 90,000 students.
- A team of 5 professors, 3 educators, 20 internships and administrative staff works at USP's Environmental Management Office (EMO), coordinating the activities related to sustainability.
- As a major Brazilian higher education and research institution, preparing numerous graduates, masters and PhDs, USP strives to become one of the country's greenest universities.

TARGET BENEFICIARIES:

Campus community, but also at regional and global level.

UNEP THEMATIC PRIORITY AREA:

Environmental governance; resource efficiency (sustainable consumption and production); ecosystems management.

PROJECT / INNOVATION AREA:

- Environmental governance: over 70 environmental "structures" were identified: departments, labs, teaching programs, EE projects, decision-making agencies, research groups, etc. Most of these environmental initiatives were isolated, not evenly distributed among the campuses, and lacked institutional policy with guidelines for environmental management, participation and education.
- Resource efficiency: efforts are made to educate the university community about environmental issues. However, considering the number and the action potential of undergraduate students and non-academic staff, environmental education for these groups was necessary.
- Ecosystems management: with extensive green areas, USP had declared protected only 10.2 of its total 7,630 hectares (in 2012), located in the Biosciences Institute Forest Reserve, in the campus of São Paulo.

Therefore, to ensure long-term conservation, additional legal protection and ecological restoration in some areas were required.

OUTCOMES:

In 2012 the Environmental Management Office (EMO) was created, with the mission of integrating the environmental structures in the university, promoting policies, addressing sustainability in operations and developing Environmental Education programs.

- Environmental governance: 10 work groups were created to develop policies on sustainable buildings, water and sewage, energy, atmospheric emissions, solid waste, sustainability in public administration, green areas and land use, fauna, mobility and environmental education. These groups, formed by professors and administrative staff, must present their final studies and propositions in 2015. During this process, meetings and other activities ensure the participation of the university community.
- Resource efficiency: in 2013 the Environmental Training Program began, based on critical and emancipatory perspectives, aiming at educating employees concerning sustainability and addressing sustainability in university life. To reach all the employees, a group commits to mobilize another in their workplace, with theory and practice courses. The initial group (level 1) is responsible for developing the training plan and mentoring level 2 leaders. The group will then offer courses in their workplaces to level 3 people, who, in turn, will involve other employees (level 4), totalling 17,000 people after 3 years. Currently more than 200 employees are involved, having attended 100 hours of courses.
- Ecosystems management: in 2012, EMO created 63 Ecological Reserves in 6 campuses, totalling over 2,200 ha, almost 30% of USP's total area. Most of these reserves, in rural areas, are fragments of the Atlantic Rainforest and savannas that still present ecological integrity. Besides contributing to biodiversity conservation and ecosystem services, these reserves are useful for generating knowledge, training students and outreach programs.

EVIDENCE / ASSESSMENT / RATING:

In just two years of activities, actions toward sustainability mobilized thousands people in the university. A system of indicators for assessing progress is being developed.

SIZE OF IMPLEMENTATION:

Environmental governance and resource efficiency: all campuses

Ecosystems management: 2,200 ha (approx. 30% of USP's area), distributed in 60 sites in 6 campuses.

COST OF IMPLEMENTATION (US $):

Environmental governance: Information not publicly available

Resource efficiency: Information not publicly available

Ecological reserves: US $ 900.00 per hectare/year for maintenance and recovery of protected areas.

YEAR OF IMPLEMENTATION:

2012-2014

FUNDING PARTNERS:

- The University of São Paulo (USP) is a public institution, maintained by the state of São Paulo's Secretary for Economic Development, Science and Technology. No other partners were involved.

SOURCE:

www.sga.usp.br (only in Portuguese)

Virtual Sustainability at Universities Platform http://www.projetosustentabilidade.sc.usp.br/index.php/eng

CHILE:

UNIVERSITY OF CHILE, SANTIAGO, CHILE

GENERAL DESCRIPTION:

- Founded in 1842, the Universidad de Chile is the main and oldest institution of higher education owned by the State in Chile, with a national and public character. The Universidad de Chile is a research-oriented institution, and it is organized in 14 Faculties. The Faculty of Physical and Mathematical Sciences (FCFM, for its acronym in Spanish), in which this case study is focused, hosts the School of Engineering and Sciences. The FCFM has 222 full-time professors, 1.200 graduate students and 4.900 undergraduate students.
- The Beauchef Campus, where the FCFM is located, comprises 13 Academic Departments - Astronomy, Materials Science, Computer Science, Physics, Geophysics, Geology, Civil Engineering, Mining Engineering, Electrical Engineering, Industrial Engineering, Mathematical Engineering, Mechanical Engineering, and Chemical Engineering and Biotechnology - distributed in 24 buildings, and totalizing 130.000 m2 of construction over a ground surface of 42.000 m2. This includes the new building complex, Beauchef 851, with 50.000 m2.

TARGET BENEFICIARIES:

Community largely at university and regional level, but also at global level.

UNEP THEMATIC PRIORITY AREA:

Climate change; Resource efficiency (sustainable consumption and production).

IDENTIFIED ISSUES:

The area of the new building was previously occupied by an arrangement of small constructions, which were used mainly as classrooms. There was not an architectural harmony among those buildings, as they were built to satisfy immediate

needs without planning.

In addition, the FPSM did not have an office or person in charge of sustainability-related initiatives at the Campus.

OUTCOMES:

- The new building complex Beauchef 851 has been designed and built with high sustainability standards, including technologies such as a grey water recycling system, a solar PV plant of 20 kW, solar thermal for heating, efficient lighting and air conditioning, and a CO2 monitoring system.
- In addition, an Office of Engineering for Sustainable Development (OESD) was created, which is dedicated to foster sustainability in teaching, research, operations, and outreach at the FCFM. This initiative has full support from FCFM authorities, who have granted space, a committee and funding for the OESD.
- Among the projects the OESD Office is currently developing are: a new sustainability minor for undergraduates, promoting the incorporation of sustainability-related contents in undergraduate courses, and the compliance of a Cleaner Production Agreement, signed between the Head of the University and the Chilean government. The OESD also has active collaboration with the Architecture Office of the Campus, consequently most of the retrofit or new buildings are incorporating sustainability concepts. Additional ongoing projects of OESD are a carpooling platform, the carbon footprint measurement and an energy audit. Finally, a recycling system for the entire Campus is being designed and will be launched during the second semester of 2014.

EVIDENCE / ASSESSMENT / RATING:

LEED Gold rating under way (full compliance expected in December 2014).

SIZE OF IMPLEMENTATION:

The new building complex Beauchef 851 has 50.000 m2, while the OESD Office has 40 m2.

COST OF IMPLEMENTATION (US $):

The cost of the LEED certification for Beauchef 851 is US$ 2.100.000; the budget of the OESD Office is US$ 70.000 per year; the carpooling platform had no cost, as it was provided freely by a private company; the carbon footprint certification cost is US$ 5.000; the energy audit has had a cost of US$ 8.000; and finally the recycling system is expected to cost around US$ 120.000.

TIME OF IMPLEMENTATION:

The time of implementation of the Beauchef 851 project has been of 5 years.

SOURCE:

Claudia Mac-Lean (cmaclean@ing.uchile.cl),
Luis Vargas (lvargasd@ing.uchile.cl)

COSTA RICA:
EARTH UNIVERSITY

GENERAL DESCRIPTION:

- EARTH University is a private, international, non-profit university. Located in Costa Rica, and since 1990 has offered classes to the international community. The institution's educational model has prepared students of Latin America and the Caribbean, and other regions, including Africa and Asia, to share our Mission: prepare leaders with ethical values to contribute to the sustainable development of the tropics and to construct a prosperous and just society.
- EARTH University's curriculum is based on four formative areas designed to prepare students with the competencies required to respond to the needs of today's world. These include: technical and scientific knowledge; personal development, attitudes and values; ethical entrepreneurship; and social and environmental awareness and commitment.
- IThe 8,342-acre campus includes classrooms, laboratories, academic farms, sports and recreational facilities, student and faculty residences, a commercial banana plantation, reforested areas and a forest reserve. The university has 421 students and 40 % are women. The students represent 36 countries on four continents. A total of 60 % of the students have a full scholarship and the student retention rate is 84 %. EARTH offers the students a unique, quality learning opportunity. To date, the university has 1829 alumni from 29 countries.
- The university has 428 employees, including 50 faculty members who come from 18 countries. There is only one degree offered at EARTH, an honors degree in agricultural sciences with the title of Agricultural Engineer.

TARGET BENEFICIARIES:

Community largely at university and regional level, but also at global level.

UNEP THEMATIC PRIORITY AREA:

The program deals with integrated solid waste management, carbon neutrality on campus, and efficient management of energy and water resources

PROJECT / INNOVATION AREA:

- Research & Development
- Greening of University infrastructure/facilities/operations
- Community collaboration
- University management
- Student participation/engagement

IDENTIFIED ISSUES:

EARTH was founded as a response to the need to promote appropriate agronomic, animal husbandry, and forestry practices in the field of sustainable development. The realization that the population was growing and inappropriate agronomic, animal husbandry, and forestry practices were being used, motivated a group of people to commit to finding solutions oriented at agricultural development and the efficient administration of the resources of the humid tropics, through education and the training of young leaders who would start and /or accelerate the process of agricultural development in their communities. Along with this, from the beginning, was an emphasis to minimize the effects of agricultural development on the environment.

OUTCOMES:

The indicators of environmental management and the practices applied to achieve environmental sustainability include:

- Solid wastes: the university generates an average of 870 kg of wastes per day. It has a 92 % efficiency of separation of wastes at the source and recovery rate for recyclables of 80 %. The remaining 20 % is adequately managed in a landfill on campus, which is in compliance with the national law for landfills.
- Energy management: 96 % of the campus possesses efficient lighting systems and the energy savings with these systems, since their implementation in 2007, has been a 23 % reduction in the kWh used. As well, with the installation of a biodigester, which produces methane gas, the university has been able to reduce the use of propane gas by the cafeteria, by 27 %
- Water management: since 2007 there has been a 30 % reduction in per capita water use on campus.
- Emissions of gases: on campus, the university has inventoried the emissions of gases which affect climate change four times, each time expanding the scope of the measurements and improving the measurement systems. The university has achieved carbon neutrality of the campus by reducing and offsetting carbon emissions.
- Education: the university has provided training each year to 100 % of the first year students and 97 % of the newly hired employees concerning the environmental management at the institution.
- Automobile Free Days: since 2007, the university has celebrated three days every year, for a total of 21 days, as a day to leave the car at home and walk or bike to work.
- Blue Flag Ecological Program: since 2004, the university has participated in this program and in 2014 has received certification in five categories: non coastal communities, climate neutral community, actions to tackle climate change, promotion of community health and sustainable households.

EVIDENCE / ASSESSMENT / RATING:

In 2009 was the first university in the region to be accredited as an institution which had a center for carbon neutrality certification.

COST OF IMPLEMENTATION (US $):

Approx. $1.74 million

YEAR OF IMPLEMENTATION:

1998 - 2012 ongoing

COLOMBIA:

UNIVERSITY OF APPLIED AND ENVIRONMENTAL SCIENCES

GENERAL DESCRIPTION:

- The U.D.C.A. University was established in 1983, and has actually seven campuses in two cities (Bogotá and Cartagena), with a population made up of almost 5500 people, including students, teachers and administrative staff. The whole university consists of eight faculties that offer academic programs at technical, technological, undergraduate and graduate levels in areas related to health, animal, environmental, sport, and social sciences, as well as engineering, administration, accounting and humanities. The U.D.C.A. is committed to academic excellence, through the transmission, generation, and application of knowledge at the service of sustainable human development.
- The SIGA was officially recognized on April 30 (2014), and it was conceived as a transverse system to all instances of the university, in order to integrate the environmental component as a part of the university life. Therefore, three subunits integrates the SIGA: Academic quality, Environmental quality, and Environmental processes. Each one of these is able to work by itself or in cooperation with another subunit depending on the related subject, as well as other unities of the university.
- The SIGA has a Technical Secretariat (ST-SIGA), which is the unit in charge and responsible for defining guidelines and for developing strategies as well as to coordinate actions that will enable the system to operate within the university. The general coordinator of the ST-SIGA began to work in October 2013, but the group of 5 people was not formed until March 2014.

TARGET BENEFICIARIES:

The university (students, teachers and administrative staff) and local communities as well as regional and global societies.

UNEP THEMATIC PRIORITY AREA:

Climate change; Resource efficiency (sustainable consumption and production); Environmental governance; Harmful substances and hazardous waste; Ecosystems management.

IDENTIFIED ISSUES:

- In the 90's some actions, coming from academic staff, were undertaken in environmental matters over the years. Unfortunately, most of them were not followed continuously over time, and few members of university's community were involved and benefited from them. For Example: Selection of environmental symbol (Spot-flanked Gallinule) for the university, construction of an artificial wetland that acts as a refuge for this Colombian threatened and endemic subspecies, and many initiatives to reforesting and afforesting with native Andean species. In addition, the first attempts for organizing the treatment of the waste generated by the university activity were made. For that time, the wastewater was discharged to a nearby natural wetland.
- As a result, from the above-mentioned actions and the impossibility to define clear environmental goals, the university made the decision to outsource all environmental issues. That became the beginning of a management under ISO 14001 guidelines to improve the environmental performance of the university. This kind of management allowed the university some remarkable aspects such us the construction of wastewater treatment plant, which led to the university to stop contamination of nearby natural wetland. The adjustment of university life to the environmental regulation was also a notorious fact.
- Unfortunately, the time of response under this kind of management was too slow since the outsourcing company only comes once per week. This situation led to some economic penalties to the university.

OUTCOMES:

- Improvement of communication about environmental issues through the ST-SIGA, and the creation of a regularly up-dated Blog. Furthermore, the SIGA and the ST-SIGA now also appears on the institutional web page.
- Establishment of monthly social-ecological meetings named: "Have a coffee with..." to discuss sustainability.
- Establishment of program to use the campuses as living classroom, and tutoring practices of the students of some of the university's faculties.
- Short-term training about identifying and management of waste material disposal. As well as short courses related to recognition of territory as a basis to form cultural capital.
- Establishment of a low-cost management for wastewater treatment plant, and improvements of all wastewater (domestic and industrial) collecting systems.
- Writing of many environmental management plans (ie. Management plan for subterranean water use).
- Advances in formation of stakeholders relations such as schools and companies in neighbourhood.
- Establishment and monitoring environmental indicators to improve environmental performance.

SIZE OF IMPLEMENTATION:

The SIGA covers all instances of university in the seven campuses, which is a size of approximately 180.000 m2

COST OF IMPLEMENTATION (US $):

Technical Secretariat's staff: ≈ U$ 110.000/year

Other annually costs depends on an individually-based project development by ST-SIGA, and are not publicly available.

YEAR OF IMPLEMENTATION:

2013 - Ongoing

FUNDING PARTNERS:

- Universidad de Ciencias Aplicadas y Ambientales -U.D.C.A-.

SOURCE:

http://www.udca.edu.co/es/sistema-integrado.html

http://www.udca.edu.co/es/estatutos-acuerdos.html - Acuerdo 368 - Sistema Integrado de Gestión Ambiental

http://media.wix.com/ugd/c1bd7b_0f5d9002dac4415b7ebb4b910ca3c79.pdf

http://sigaudca.wix.com/st-siga/

http://www.udca.edu.co/es/secretaria-tecnica-st.html

CANADA:
UNIVERSITY OF BRITISH COLUMBIA

GENERAL DESCRIPTION:

- The Vancouver Campus of the UBC educates more than 47,000 students each year in hundreds of academic programs through 12 faculties and 14 schools.
- CIRS will house more than 200 inhabitants from several academic disciplines, including applied science, psychology, geography, forestry and business.
- CIRS is also the home of the UBC Sustainability Initiative (USI), which promotes and integrates UBC's sustainability efforts in teaching, learning, research and campus operations.
- Major features of the four-storey, 60,000 square-foot facility include: a four storey atrium and lobby areas for display and demonstrations, BC Hydro Theatre with advanced visualization and interaction technologies to engage audiences in sustainability and climate change scenarios, Policy Lab, Building Simulation Software Lab, Solar Simulation Daylighting Lab, Sustainability Education Resource Centre, Building Monitoring and Assessment Lab with a building management system that shares building performance in real-time, 450-seat CIRS Lecture Hall, CIRS Inhabitants' space, and the Loop Café that uses no disposable packaging and serves local and organic food.

TARGET BENEFICIARIES:

Community largely at university and regional level, but also at global level.

UNEP THEMATIC PRIORITY AREA:

Climate change; Resource efficiency (sustainable consumption and production).

PROJECT / INNOVATION AREA:

- Research & Development
- Greening of University infrastructure/facilities/operations

- Community collaboration
- University management
- Student participation/engagement

IDENTIFIED ISSUES:

Urban population explosion; unprecedented demand for housing, amenities and necessities in the coming decades; increased consumption of natural resources; although working hard to find and implement solutions, the public, private and not-for-profit sectors are largely working in isolation, not benefiting from each other's discoveries.

OUTCOMES:

- North America's greenest building by being net positive on energy, water self-sufficient, having 100% access to daylight and superior natural ventilation amongst many other sustainability features.
- It will be an international centre for research, partnership and action on sustainability issues, including green building design and operations, environmental policy and community engagement.
- CIRS is used as a platform to test and showcase the technical performance and usability characteristics of the building's technologies and systems, and to generate new knowledge about how to construct and maintain sustainable buildings using building itself as the lab.
- All of the CIRS building systems, as well as the behaviour of its inhabitants, will be the subject of extensive and ongoing research, to study building performance and how people interact with the space over time making it a 'living laboratory'.
- CIRS will be the only place in the world combining three activities – sustainable building design and operations, sustainability-focused partnerships and the development of interactive community engagement processes – under one umbrella.

EVIDENCE / ASSESSMENT / RATING:

LEED Platinum rating. Aims to achieve 'The Living Building Challenge' certification with the help of its various regenerative features that create 'Net Positive' environmental impacts.

SIZE OF IMPLEMENTATION:

Approx. 5,600 sqm (60,000 square-foot) facility

COST OF IMPLEMENTATION (US $):

37 million (less than 10% over equivalent LEED Gold rated building)

YEAR OF IMPLEMENTATION:

March 2009 – August 2011

FUNDING PARTNERS:

Major funding partners include:

- British Columbia Knowledge Development Fund (BCKDF)
- British Columbia Ministry of Advanced Education
- British Columbia Ministry of the Environment
- Canada Foundation for Innovation (CFI)
- Federation of Canadian Municipalities
- Kresge Foundation
- McCall MacBain Foundation
- Metro Vancouver
- National Research Council - Institute for Fuel Cell Innovation
- Natural Resources Canada
- Real Estate Foundation
- Sustainable Development Technology Canada (SDTC), etc.

SOURCE:

THE UNIVERSITY OF BRITISH COLUMBIA. Sustainability [Online]. Available: http://www.sustain.ubc.ca/ [Accessed 15 January 2012].

UNITED STATES OF AMERICA:
PRINCETON UNIVERSITY

GENERAL DESCRIPTION:

- Princeton University was originally established in 1746.
- The university's main campus in Princeton Borough and Princeton Township consists of approximately 180 buildings, spanning more than four centuries, on 500 acres. The university follows a residential college system and 98% of the undergraduate students live on the campus.
- The university's more than 1,100 faculty members educate more than 7,500 students each year in 34 departments and 46 interdisciplinary certificate programs.
- The campus is expected to serve as a model for advanced practices and as a laboratory for students and faculty to test new approaches.
- The Princeton Sustainability Committee consisting of students, faculty, and staff was established in 2002, and the Office of Sustainability was set up in 2006, which prepared a Sustainability Plan in 2008 identifying three priority areas for the campus: Greenhouse Gas Emission Reduction, Resource Conservation, and Research, Education and Civic Management.

TARGET BENEFICIARIES:

Community largely at university and regional level, but also at global level.

UNEP THEMATIC PRIORITY AREA:

Climate change; Resource efficiency (sustainable consumption and production).

PROJECT / INNOVATION AREA:

- Research & Development
- Greening of University infrastructure/facilities/operations
- Community collaboration
- University management

- Student participation/engagement

IDENTIFIED ISSUES:

University's environmental impacts; responsibility as a major research university to contribute to shaping the national sustainability agenda, to promote the development of sustainability on its campus, and to prepare its students.

OUTCOMES:

- The university aims to reduce its greenhouse gas emissions to 1990 levels by 2020, while expanding its campus by 185,000 m2.
- All non-laboratory buildings are expected to be 50% more energy-efficient than required by regulations. Implementation of its Energy Master Plan has resulted in annual savings of $1.7 million in energy costs and 10,000 metric tons of CO2.
- The university will provide incentives to the faculty and students to reduce the number of cars coming to the campus by 10%.
- All residence halls have low-flow water fixtures, which are estimated to have cut water use from 2006 by 30%.
- The university purchased 29% less paper in 2011 than in 2008. A total of 83% of the paper purchased in 2011 was of 100% post-consumer recycled chlorine-free paper.
- Various resource conservation initiatives have increased sustainable food purchases to about 66%, and about 59% of the food served in the dining halls comes from within 250 miles radius.
- In the past one year more than five acres of woodlands were restored with 215 new trees and 197 new shrubs.
- Greening of the curriculum has resulted in over 50 classes having a sustainability component. There has been an increase in the number of students receiving Environmental Studies certificates by 300%.

EVIDENCE / ASSESSMENT / RATING:

Life Cycle Cost Analysis (LCCA), including a CO2 tax, informed decision making process is applied to new construction and major renovations on the campus. It strives for LEED Silver equivalency wherever applicable. About 30 staff members are LEED-Accredited Professionals. The University has signed on to the Sustainability Tracking, Assessment and Rating System (STARS), a transparent, self-reporting framework for colleges and universities to measure their sustainability performance

SIZE OF IMPLEMENTATION:

Approx. 500 acres campus

COST OF IMPLEMENTATION (US $):

$45 million between 2009 and 2017 under its Energy Master Plan initiative. Since 2008 $5.3 million have been invested in energy saving and emission reduction projects.

YEAR OF IMPLEMENTATION:

2008 –2020.

FUNDING PARTNERS:

- High Meadows Foundation

SOURCE:

PRINCETON UNIVERSITY. Sustainability at Princeton [Online]. Available: http://www.princeton.edu/sustainability/ [Accessed 12 February 2012].

THE PRINCETON REVIEW. 2011. Guide to 311 Green Colleges [Online]. The Princeton Review. Available: http://www.princetonreview.com/uploadedfiles/sitemap/homepage/greenguide/princetonreviewgreenguide2011.pdf [Accessed 12 February 2012]

UNITED STATES OF AMERICA:

SUSTAINABLE LIVING CENTRE, MAHARISHI UNIVERSITY OF MANAGEMENT, IOWA

GENERAL DESCRIPTION:

- About MUM: For more than 30 years, Maharishi University of Management (MUM) has pioneered a new approach to learning, called Consciousness-Based Education, which supplies a missing element of education.
- Accredited by the Higher Learning Commission, MUM offers Bachelor's, Master's, and PhD degrees in a variety of traditional fields, including Business, Media and Communications, Art, Literature, Computer Science, and Education. MUM has developed new disciplines as well, including Sustainable Living and Maharishi Vedic Science.
- The Greening University initiative was the design and construction of a "building that teaches" the knowledge and skills covered in the 4-year B.S. in Sustainable Living degree program, which was launched in 2003.
- The resulting Sustainable Living Center is the most environmentally ambitious commercial building on the planet. It is off-grid for water (rooftop rainwater collection) and wastewater treatment, and annually generates about 33% more energy than it consumes in a climate that currently ranges in temperature from -28 to 41 C. It meets 95% of the criteria for LEED Platinum, Living Building Challenge, and Bau Biology, and is fully certified for Maharishi Vedic Architecture. In addition, its roof is supported by whole trees, it features day lighting throughout the building, and it has 250 tons of locally-sourced compact earth blocks in its walls.
- The Sustainable Living Department currently has six faculty (David Fisher, Appachanda Thimmaiah, Travis Cox, Lawrence Gamble, Mark Stimson, and John Collin), and four staff (Geraldine Stood, Mabel Scaroni-Fisher, Diana Kyrstofiak, and Rick Ryerse).
- MUM has 1,400 students, 179 full time and 64 part

time staff, and 125 full time and 45 part time faculty.

- The level of coverage of the activities is primarily the University but also includes interactions with the city of Fairfield.

TARGET BENEFICIARIES:

This building serves primarily the students in the Sustainable Living program by providing classroom and greenhouse teaching space, and offices for faculty and staff. However, classes from other departments also use the building, and it is often the site for public events and meetings.

UNEP THEMATIC PRIORITY AREA:

The Sustainable Living Center is mainly an example of extraordinary resource efficiency in a commercial building, annually producing one third more energy than it uses while maintaining a constant inside temperature of 19-22 C.

IDENTIFIED ISSUES:

Before the Sustainable Living Building was built, students met in a 60's-era Science building that has no windows and contradicts most of the environmental principles that were being taught in the Sustainable Living program.

OUTCOMES:

- The most important outcome of this initiative is that, in contrast to the old Science building, this building fully illustrates the curriculum being taught in the Sustainable Living program. Nevertheless, it was a real challenge to combine so many different environmental features into one commercial building. Thus the strength of the project was that it was so ambitious, but that was also its weakness in that it greatly slowed down construction and complicated the operating systems while increasing the cost. Perhaps our next environmental building will have fewer sustainability features and simpler systems yet still equal the extraordinary performance of this building. For instance, on several days when the temperature was 41 C outside, it was 22 C inside, and the building still generated more energy than it consumed.

- Although the Sustainable Living Center has been occupied since April 2012, we have continued to make adjustments and add features to the building. No one else has attempted to combine in one commercial structure the criteria for four building certifications, to be off grid in all ways (not yet fully accomplished), to provide day lighting to all spaces, to feature a roof supported by whole trees, and to have 250 tons of compact earth blocks for thermal mass. The building is heated by rooftop solar hot water heaters backed up by geothermal, and cooled by air conditioning using electricity from photovotaic panels and a wind generator, which also meet all other electrical needs. Rainwater is collected in a 10,000 gallon cistern and filtered for all uses in the building, including drinking water. Waste water is treated in an off-grid, two stage system that includes filtration though peat moss. As mentioned above, about 95% of the 120 criteria covered in LEED, Living Building Challenge, Bau Biology, and Maharishi Vedic Architecture are also met by this building.

EVIDENCE / ASSESSMENT / RATING:

Green Lighthouse is a CO2 neutral building in operation.

SIZE OF IMPLEMENTATION:

The Sustainable Living Center occupies 650 sq meters

COST OF IMPLEMENTATION (US $):

The cost of the building is $3,000,000.

YEAR OF IMPLEMENTATION:

Construction of the building began in July 2008 and was occupied in April 2012.

FUNDING PARTNERS:

- Funding was provided by a combination of many donations (most notably Eric and Mary Sue Schwartz, Bradford Cooke, and Steve Guich), Bank Loans (Wells Fargo), and Grants (The Kresge Foundation and The Wege Foundation).

SOURCE:

MUM website page on the Sustainable Living Center: http://www.mum.edu/sustainable-living/buildings/sustainable-living-building

Research on the Transcendental Meditation program: http://www.tm.org/research-on-meditation

ADDITIONAL CASE STUDIES:

ENVIRONMENT AGENCY - ABU-DHABI

- http://ameinfo.com/blog/company-news/b/borouge/ead-launches-pilot-phase-sustainable-campus-initiative-across-abu-dhabi-universities/

BOND UNIVERSITY MIRVAC SCHOOL OF SUSTAINABLE DEVELOPMENT, AUSTRALIA:

- http://www.bond.edu.au/faculties-colleges/institute-of-sustainable-development-architecture/about-the-institute/facilities/index.htm

CURTIN UNIVERISTY, AUSTRALIA

- http://greencampus.curtin.edu.au/

GRIFFITH UNIVERISTY, AUSTRALIA

- http://www.griffith.edu.au/about-griffith/campuses/nathan-campus/facilities/sir-samuel-griffith-building

AUSTRALASIAN CAMPUSES TOWARDS SUSTAINABILITY

- http://www.acts.asn.au/initiatives/ggaa/2014-ggaa/

PONTIFICAL CATHOLIC UNIVERSITY OF RIO GRANDE DO SUL, PORTO ALEGRE (CITY), BRAZIL

- http://www.isabelcarvalho.blog.br

AMRITA UNIVERSITY, NEW DELHI, INDIA

- http://www.newindianexpress.com/cities/thiruvananthapuram/Amrita-Universitys-green-campus-initiative/2013/07/27/article1704558.ece

UNIVERSITY OF CAPE TOWN, SOUTH AFRICA

- http://en.wikipedia.org/wiki/Green_Campus_Initiative_(UCT)

UNIVERSITY OF WESTERN CAPE, SOUTH AFRICA

- http://www.greenafricadirectory.org/uwc-wins-africas-greenest-campus-award/

NELSON MANDELA METROPOLITAN UNIVERSITY, SOUTH AFRICA

- http://sru.nmmu.ac.za/sru/media/Store/documents/Publications%20and%20Reports/Currie,-2012--NMMU-George-Campus-Student-Mobilization-Change-Project-Evaluation-Report.pdf
- https://www.gbcsa.org.za/news_post/sa-green-building-first-for-nmmu/

UNIVERSITY OF TEXAS AT DALLAS, USA

- http://www.aashe.org/files/resources/student-research/2009/supplemental_materials.pdf

HARVARD UNIVERSITY, USA

- http://green.harvard.edu/node/899

WASHINGTON UNIVERSITY IN ST. LOUIS, MISSOURI, USA

http://www.aashe.org/resources/case-studies/getting-net-zero-energy-lessons-learned-living-building-challenge

INTERNATIONAL SUSTAINABLE CAMPUS NETWORK

- http://www.international-sustainable-campus-network.org/resources/iscn-sustainable-campus-best-practices.html
- http://www.international-sustainable-campus-network.org/images/stories/Regenerative_flyer.pdf

University of New South Wales, Sydney, Australia.

CHAPTER 9

REFERENCES

1. M'Gonigle, M. and J. Starke, Planet U, sustaining the world, reinventing the university. 2006, Canada: New Society Publishers.

2. Smith, A., Campus Ecology: A Guide to Assessing Environmental Quality and Creating Strategies for Change. 1993, Los Angeles: Living Planet Press.

3. Keniry, J., Ecodemia: Campus Environmental Stewardship at the Turn of the 21st Century. 1995, Washington: National Wildlife Federation.

4. Creighton, S.H., Greening the Ivory Tower. 1998, Cambridge, Massachusetts: MIT Press.

5. Leal Filho, W., ed. Sustainability and University Life. 2nd ed. 2000, Peter Lang: Frankfurt am Main.

6. Sharp, L., Green campuses: the road from little victories to systemic transformation. International Journal of Sustainability in Higher Education, 2002. 3(2): p. 128-145.

7. UNESCO, Educating for a sustainable future: A transdisciplinary vision for concerted action, in Proceedings, International Conference on Environment and Society: Education and Public Awareness for Sustainability1997, United Nations Educational, Scientific and Cultural Organisation: Thessaloniki, Greece.

8. UN, Report on the United Nations Conference on the Human Environment, 1972, United Nations: Stockholm.

9. (IUCN), World Conservation Strategy: Living Resource Conservation for Sustainable Development. 1980, Gland, Switzerland: International Union for the Conservation of Nature.

10. World Commission on Environment and Development (WCED), Our Common Future. 1987, Oxford: Oxford University Press.

11. Diesendorf, M., Sustainability and sustainable development, in Sustainability: The corporate challenge of the 21st century, D. Dunphy, et al., Editors. 2000, Allen & Unwin: Sydney, Australia. p. 19-37.

12. Harding, R., ed. Environmental Decision-making. The roles of scientists, engineers and the public. 1998, Federation Press: Sydney.

13. Daly, H.E., Beyond Growth: The Economics of Sustainable Development. 1996, Boston, Massachusetts: Beacon Press.

14. Meadows, D., Indicators and information systems for sustainable development: A report to the Balaton Group, 1998, The Sustainability Institute: Vermont.

15. Costanza, R., et al., An Introduction to Ecological Economics. 1997, Boca Raton, FL: St Lucie Press.

16. Costanza, R., et al., Quality of life: An approach integrating opportunities, human needs, and subjective well-being. Ecological Economics, 2007. 61(267-276).

17. Orr, D.W., The Nature of Design: Ecology, Culture and Human Intention. 2002, Oxford: Oxford University Press.

18. Bekessy, S., et al., Universities and Sustainability, in TELA: Environment, economy and society, D. Yencken, Editor 2003, Australian Conservation Foundation: Melbourne.

19. Pollock, N., et al., Envisioning helps promote sustainability in academia: A case study at the University of Vermont. International Journal of Sustainability in Higher Education, 2009. 10(4): p. 343-353.

20. ULSF, The Talloires Declaration, 1990, University Leaders for a Sustainable Future: Washington DC.

21. Wright, T., Definitions and frameworks for environmental sustainability in higher education. International Journal of Sustainability in Higher Education, 2002. 3(3): p. 203-220.

22. Lukman, R. and P. Glavi , What are the key elements of a sustainable university? Clean Technologies and Environmental Policy, 2007. 9: p. 103-114.

23. Flint, K., Institutional ecological footprint analysis: A case study of the University of Newcastle, Australia. International Journal of Sustainability in Higher Education, 2001. 2(1): p. 48-62.

24. Ferrer-Balas, D., et al., An international comparative analysis of sustainability transformation across seven universities. International Journal of Sustainability in Higher Educatiob, 2008. 9(3): p. 215-316.

25. Koester, R.J., J. Eflin, and J. Vann, Greening of the campus: a whole-systems approach. Journal of Cleaner Production, 2006. 14: p. 769-779.

26. Levy, J.I. and K.M. Dilwali, Economic incentives for sustainable resource consumption at a large university: Past performance and future considerations. International Journal of Sustainability in Higher Education, 2000. 1(3): p. 252-266.

27. Christensen, P., et al., Sustainable development: Assessing the gap between preaching and practice at Aalborg University. International Journal of Sustainability in Higher Education, 2009. 10(1): p. 4-20.

28. Spellerberg, I.F., G.D. Buchan, and R. Englefield, Need a university adopt a formal environmental management system? Progress without an EMS at a small university. International Journal of Sustainability in Higher Education, 2004. 5(2): p. 125-132.

29. Rauch, J.N. and J. Newman, Institutionalizing a greenhouse gas emission reduction target at Yale. International Journal of Sustainability in Higher Education, 2009. 10(4): p. 390-400.

30. World Green Building Council, The Business Case for Green Building: A review of the costs and benefits for developers, investors and occupants, 2013, World Green Building Council.

31. Capital E, The cost and financial benefits of green buildings, 2003, Capital E Group.

32. Mahlia, T.M.I., H.A. Razak, and M.A. Nursahida, Life cycle cost analysis and payback period of lighting retrofit at the University of Malaya. Renewable and Sustainable Energy Reviews, 2011. 15(2): p. 1125-1132.

33. Krick, T., et al., The Stakeholder Engagement Manual Volume 2: The practitioner's handbook on stakeholder engagement, 2005, AccountAbility, United Nations Environment Programme, Stakeholder Research Associates Canada Inc.: Cobourg, Ontario.

34. Meinshausen, M., et al., Greenhouse-gas emission targets for limiting global warming to 2°C. Nature, 2009. 458: p. 1156-1162.

35. Thaman, K., Shifting sights: The cultural challenge of sustainability. International Journal of Sustainability in Higher Education, 2002. 3(3): p. 233-242.

36. Bekessy, S., K. Samson, and R.E. Clarkson, The failure of non-binding declarations to achieve university sustainability: A need for accountability. International Journal of Sustainability in Higher Education, 2007. 8 (3): p. 301-316.

37. Hunt, C.B. and E.R. Auster, Proactive environmental management: avoiding the toxic trap. Sloan Management Review, 1990. Winter: p. 7-18.

38. Lozano, R., Incorporation and institutionalization of SD into universities: breaking through barriers to change. Journal of Cleaner Production, 2006. 14: p. 787-796.

39. Velazquez, L., et al., Sustainable university: what can be the matter? Journal of Cleaner Production, 2006. 14: p. 810-819.

40. Cramer, W., et al., Comparing global models of terrestrial net primary productivity (NPP): overview and key results. Global Change Biology, 1999. 5 (Suppl. 1): p. 1-15.

41. Moore, J., et al., Recreating the university from within: Collaborative reflections on the University of British Columbia's engagement with sustainability. International Journal of Sustainability in Higher Education, 2005. 6(1): p. 65-80.

42. Deming, W.E., Out of the Crisis. 1986, Cambridge, Massachusetts: MIT Center for Advanced Engineering Study.

43. Grindsted, T.S., Sustainable universities – from declarations on sustainability in higher education to national law. Environmental Economics, 2011. 2(2): p. 29-36.

44. ISCN-GULF, Implementation Guidelines to the ISCN-GULF Sustainable Campus Charter: Suggested reporting contents and format, 2010, International Sustainable Campus Network and Global University Leaders Forum: Boston.

45. Partridge, K., et al., The Stakeholder Engagement Manual Volume 1: The guide to practitioners' perspectives on stakeholder engagement, 2005, Stakeholder Research Associates Canada Inc., United Nations Environment Programme, AccountAbility: Cobourg, Ontario.

46. Simpson, W., Cool Campus! A How-To Guide

for College and University Climate Action Planning, 2009, Association for the Advancement of Sustainability in Higher Education: Lexington, USA.

47. ULSF, Sustainability Assessment Questionnaire (SAQ) for Colleges and Universities, 2009, University Leaders for a Sustainable Future: Wayland, USA.

48. Shriberg, M., Institutional assessment tools for sustainability in higher education: Strengths, weaknesses and implications for practice and theory. International Journal of Sustainability in Higher Education, 2002. 3(3): p. 254-270.

49. Von Schirnding, Y., Health in sustainable development planning: The role of indicators, 2002, World Health Organization: Geneva.

50. McCool, S. and G. Stankey, Indicators of Sustainability: Challenges and Opportunities at the Interface of Science and Policy. Environmental Management 2004. 3(3): p. 294-305.

51. Wackernagel, M. and W.E. Rees, Our Ecological Footprint: Reducing Human Impact on Earth. 1996, Philadelphia: New Society Publishers.

52. Benayas, J., Definition of indicators and sustainability assessment in Spanish and Latin American universities, 2014, ARIUSA Conference.

53. AASHE, The Sustainability Tracking, Assessment & Rating System 2012, Association for the Advancement of Sustainability in Higher Education.

54. Hardi, P. and T. Zdan, Assessing sustainable development: Principles in practice, 1997, International Institute for Sustainable Development: Winnipeg, Canada.

55. Mendoza, G.A., P. Macoun, and R. Prabhu, Guidelines for applying multi-criteria analysis to the assessment of criteria and indicators, 1999, Center for International Forestry Research: Bogor, Indonesia.

56. Graedel, T.E., Quantitative sustainability in a college or university setting. International Journal of Sustainability in Higher Education, 2002. 3(4): p. 346-358.

57. Gleick, P., Basic water requirements for human activities: Meeting basic needs. International Water 1996. 21(2): p. 83-92.

58. Falkenmark, M. and C. Widstrand, Population and water resources: A delicate balance. Population Bulletin 1992. 47(3): p. 1-36.

59. Brunner, P.H. and H. Rechberger, Practical Handbook of Material Flow Analysis. Advanced Methods in Resource and Waste Management. 2003, Boca Raton, Florida: CRC Press/Lewis Publishers.

60. Osmond, P., Application of "streamlined" material accounting to estimate environmental impact. World Academy of Science, Engineering and Technology, 2010. 6(668-678).

61. Schmidt-Bleek, F., MIPS - a universal ecologic measure. Fresenius Environmental Bulletin, 1993. 2(8): p. 407-412.

62. Yau, R. and V. Cheng. Developing life cycle assessment tool for buildings in Hong Kong. in Sustainable Building Conference 2004. 2004. Shanghai: International Council for Research and Innovation in Building and Construction.

63. Asif, M., T. Muneer, and R. Kelley, Life cycle assessment: A case study of a dwelling home in Scotland. Building and Environment, 2007: p. 1391–1394.

64. Ong, B.L., Green plot ratio: an ecological measure for architecture and urban planning. Landscape and Urban Planning, 2003. 63 p. 197–211.

65. Asner, G.P., J.M.O. Scurlock, and J.A. Hicke, Global synthesis of leaf area index observations: implications for ecological and remote sensing studies. Global Ecology and Biogeography, 2003. 12: p. 191-205.

66. Scurlock, J.M.O., G.P. Asner, and S.T. Gower, Global Leaf Area Index Data from Field Measurements, 1932–2000, 2001, University of Colorado: Oak Ridge.

67. White, S.S., Early participation in the American College and University Presidents' Climate Commitment. International Journal of Sustainability in Higher Education, 2009. 10(3): p. 215-227.

68. Roy, R., S. Potter, and K. Yarrow, Designing low carbon higher education systems: Environmental impacts of campus and distance learning systems. International Journal of Sustainability in Higher Education, 2008. 9(2): p. 116-130.

69. UNSW, Water Savings Action Plan, 2006, University of New South Wales: Sydney.

70. Costanza, R., et al., The value of the world's ecosystem services and natural capital. Nature, 1997. 387: p. 253-260.

71. Alberti, M. and J.M. Marzluff, Ecological resilience

in urban ecosystems: Linking urban patterns to human and ecological functions. Urban Ecosystems, 2004. 7: p. 241-265.

72. Mitsch, W.J. and S.E. Jørgensen, Ecological Engineering and Ecosystem Restoration. 2004, New Jersey: John Wiley and Sons.

73. Woolliams, J., M. Lloyd, and J.D. Spengler, The case for sustainable laboratories: first steps at Harvard University. International Journal of Sustainability in Higher Education, 2005. 6(4): p. 363-382.

74. Labs21, Labs21 Environmental Performance Criteria 3.0, 2010, Laboratories for the 21st Century.

75. IEEE Standards Association. 1680-2009 - IEEE Standard for Environmental Assessment of Electronic Products. 2011 04/01/2012]; Available from: http://standards.ieee.org/findstds/standard/1680-2009.html.

76. Green Electronics Council. EPEAT. 2011 04/01/2012]; Available from: http://www.epeat.net/.

77. Federal Electronics Challenge. Electronics Environmental Benefits Calculator. 2011 04/01/2012]; Available from: http://www.federalelectronicschallenge.net/resources/bencalc.htm.

78. Carpenter, D. and B. Meehan, Mainstreaming environmental management: Case studies from Australasian universities. International Journal of Sustainability in Higher Education, 2002. 3(1): p. 19-37.

79. GRI, Sustainability Reporting Guidelines, 2011, Global Reporting Initiative: Amsterdam, The Netherlands.

80. ISO, ISO 14001 Environmental management systems - Requirements with guidance for use, 2004, International Organization for Standardization: Geneva.

81. ISO, ISO 14004 Environmental management systems - General guidelines on principles, systems and support techniques, 2004, International Organization for Standardization: Geneva.

82. ISO, ISO 26000 Guidance on social responsibility, 2010, International Organization for Standardization: Geneva.

83. ISO, ISO 19011 Guidelines for auditing management systems, 2011, International Organization for Standardization: Geneva.

84. Vitousek, P.M., et al., Human domination of earth's ecosystems. Science, 1997. 277: p. 494-499.

85. Palumbi, S.R., Humans as the world's greatest evolutionary force. Science, 2001. 293(5536): p. 1786-1790.

86. World Resources Institute, Millennium Ecosystem Assessment (MA) Synthesis Report, 2005, United Nations Environment Programme: New York.

87. Kingsford, R.T., et al., Major conservation policy issues for biodiversity in Oceania Conservation Biology, 2009. 23(4): p. 834-840.

88. Dahle, M. and E. Neumayer, Overcoming barriers to campus greening. International Journal of Sustainability in Higher Educatiob, 2001. 2(2): p. 139-160.

89. BP, BP Statistical Review of World Energy June 2011, 2011.

90. Fisher, R.M., Applying ISO 14001 as a business tool for campus sustainability: A case study from New Zealand. International Journal of Sustainability in Higher Education, 2003. 4(2): p. 138-150.

91. Comm, C.L. and D.F.X. Mathaisel, A case study in applying lean sustainability concepts to universities. International Journal of Sustainability in Higher Education, 2005. 6(2): p. 134-146.

92. Clarke, A., The campus environmental management system cycle in practice: 15 years of environmental management, education and research at Dalhousie University. International Journal of Sustainability in Higher Education, 2006. 7(4): p. 374-389.

93. Trencher, G., et al., University partnerships for co-designing and co-producing urban sustainability. Global Environmental Change, 2014. 28(0): p. 153-165.

94. Standards Australia, HB 206 Initial Environmental Review (IER), 2004, Standards Australia: Sydney.

95. Kolb, D., Experiential Learning. 1984, New Jersey: Prentice Hall.

96. Hansman, C.A., Context-based Learning, in New Directions for Adult and Continuing Education, S. Merriam, Editor. 2001, Jossey-Bass: San Francisco. p. 43-52.

97. Bould, D. and G. Felletti, eds. The Challenge of Problem-Based Learning. 1991, St. Martin's Press: New York.

98. ISO, ISO 14063 Environmental management -- Environmental communication -- Guidelines and examples, 2006, International Organization for Standardization: Geneva.

UNEP