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# Considering the importance of a systems approach to integrating ESD with campus operations

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## Abstract:

Society faces an unprecedented global education challenge to equip professionals with the knowledge and skills to address emerging 21<sup>st</sup> Century challenges, spanning climate change mitigation through to adaptation measures to deal with issues such as temperature and sea level rise, and diminishing fresh water and fossil fuel reserves. This paper discusses the potential for systemic and synergistic integration of curriculum with campus operations to accelerate curriculum renewal towards ESD, drawing on the authors' experiences within engineering education. The paper begins by providing a brief overview of the need for timely curriculum renewal towards ESD in tertiary education. The paper then highlights some examples of academic barriers that need to be overcome for integration efforts to be successful, and opportunities for promoting the benefits of such integration. The paper concludes by discussing the rationale for planning green campus initiatives within a larger system of curriculum renewal considerations, including awareness raising and developing a common understanding, identifying and mapping graduate attributes, curriculum auditing, content development and strategic renewal, and bridging and outreach.

**Key Words:** model for rapid curriculum renewal, systems approach, education for sustainable development

## 1. Introduction

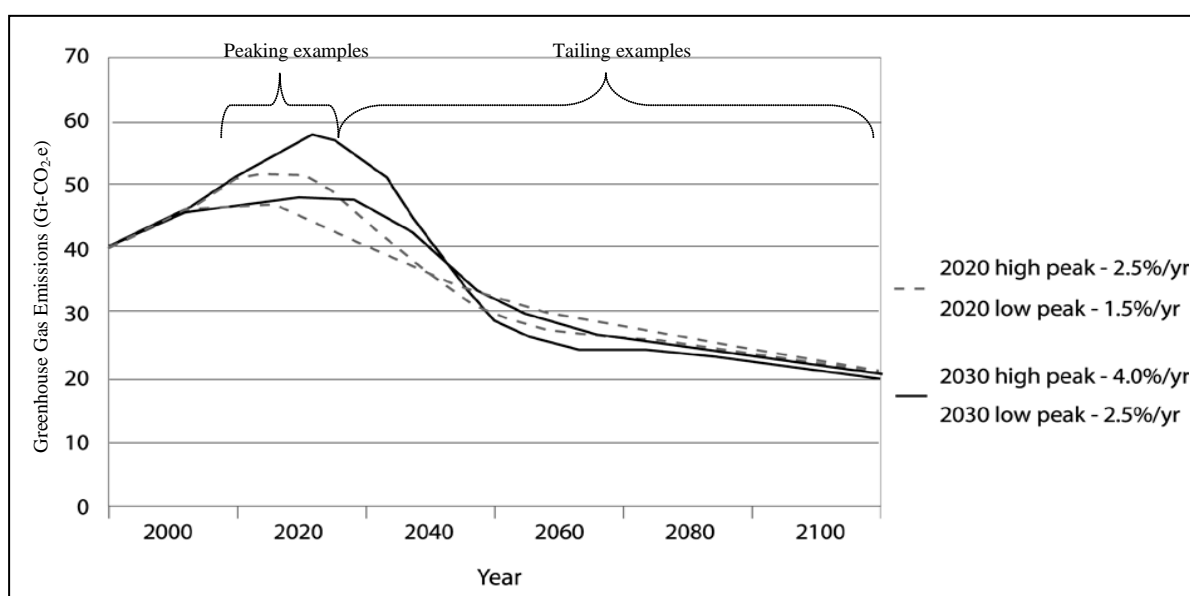
### 1.1. The need for ESD in higher education

David Orr, one of the world's leading environmental proponents, has argued for many years that the planetary crisis we face is actually a crisis of education (Orr 1994), where a lack of understanding about the impact of human activity on the environment has resulted in numerous global challenges. Today, tertiary educators (i.e. including universities and vocational education institutions) around the world still grapple with how to equip professionals with knowledge and skills in a range of critical areas, to address both mitigation challenges such as greenhouse gas emissions and biodiversity losses, and adaptation challenges such as temperature rise, sea level rise, and diminishing water and fossil fuel resources. This education dilemma spans primary through tertiary education and professional development, across industry, government and society, in both developed and developing countries (Desha & Hargroves 2009a). Indeed, the extent of this challenge was foreseen more

than two decades ago by the World Commission on Environment and Development (i.e. the 'Brundtland Report'), which advocated all types of education to reach out to as wide a group of individuals as possible, given that environmental issues and knowledge systems can '*now change radically in the space of a lifetime*' (WCED 1987, p113).

The United Nations has adopted the term 'Education for Sustainable Development' (ESD, also known as 'Education for Sustainability', or 'EfS') which is defined as education that encourages '*changes in behaviour that will create a more sustainable future in terms of environmental integrity, economic viability, and a just society for present and future generations*' (UN General Assembly 2002). Indeed, ESD goes further in advocating education as a tool to achieve sustainability. This is in contrast to 'education about sustainable development' which is limited to an awareness lesson or theoretical discussion, such as acknowledging climate change as an issue and provide learning opportunities about the context and/or science of such phenomena. Thus, ESD is about increasing the capacity of individuals, groups or organisations to contribute to sustainable development, through empowering them with the necessary knowledge and skills.

Within this context, universities are seen as key players in providing ESD across the spectrum of disciplines offered. As Griffith University Vice Chancellor Ian O'Connor stated at the Green Cross International 2006 Earth Dialogues forum, '*The urgent challenge for higher education now is to include ecological literacy as a core competency for all graduates, whether they are in law, engineering or business*' (O'Connor 2006). However, the challenge is complex, as described by the 2006 *Stern Review* (Stern, 2006) and in the 2007 report by the Intergovernmental Panel on Climate Change (IPCC 2007). For example, strategic opportunities to stabilise greenhouse gas concentrations in the atmosphere include both short term actions to stop increasing the emission of pollution such as greenhouse gases (i.e. 'peaking'), followed by sustained reduction in levels of pollution over the longer term (i.e. 'tailing'). Figure 1 illustrates a variety of such peaking and tailing opportunities to stabilise concentrations of carbon dioxide equivalent (CO<sub>2</sub>e); in this example at 550 parts per million.



**Figure 1-1. Illustrative emissions pathways to stabilise greenhouse gas emissions, highlighting the complexity of possible solutions**

Source: Adapted from Stern (2006)

Smith et al (2010) refer to implementing these strategies while maintaining or improving economic performance as ‘decoupling economic growth from environmental pressure’. Ideally, negative environmental impacts would be completely – or ‘absolutely’ – decoupled from economic performance, eventually being eliminated. Furthermore, positive environmental impacts (for example reforestation, aquifer recharge etc) would be ‘recoupled’ to economic performance so that as development proceeds, environmental systems are restored. This perspective on addressing 21<sup>st</sup> Century challenges is shared by leaders in the sustainable development field such as Brundtland, MacNeill, Pachauri, Sachs and Ruffing in their forewords to the publication *Cents and Sustainability* (Smith et al 2010). In developing strategies to address complex challenges, numerous innovations are being created across all sectors of society, as depicted in the ‘wave of innovation’ diagram in Figure 2. Clearly there is a need to embed knowledge and skills associated with these innovations within tertiary education, to empower future practitioners and decision makers.

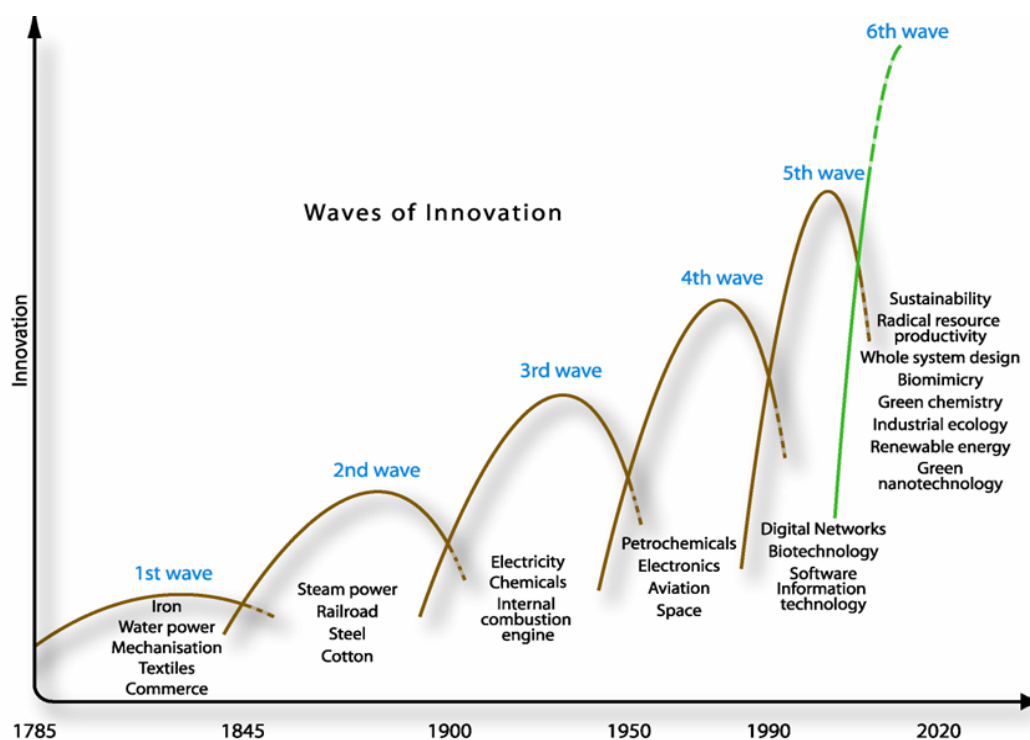


Figure 2. Waves of Innovation Diagram, showing the latest sustainable development wave

Source: Hargroves et al (2005, p17)

## 1.2. The need for rapid curriculum renewal

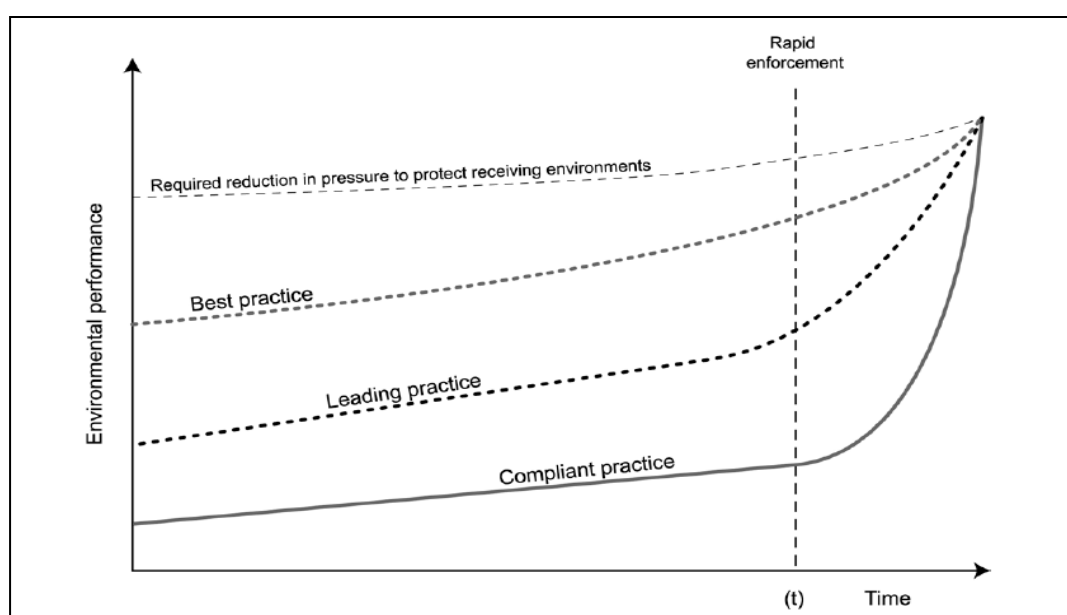
Despite awareness of the need for curriculum renewal towards ESD for more than 20 years, there has been a distinct lack of action within tertiary education to achieve ESD. For example, within engineering education the results of a variety of surveys investigating the state of ‘engineering ESD’ (EESD) in universities worldwide suggest that in general the curriculum renewal process to-date has been slow and *ad hoc* (Desha 2010). This conclusion is supported by the findings of researchers in the field such as Ferrer-Balas et al (2005) Lozano et al (2006), and Mulder et al (2008) and numerous other authors writing for conference proceedings from key engineering education research events and conferences around the world over the last decade. Furthermore, internationally there are a number of publications arriving at similar conclusions by the American National Academy of Engineering (NAE 2005), UNESCO (Marjoram 2006), the UK Royal Academy of Engineering (RAE 2007) and the Higher Education funding Council for England (HEFCE 2007).

In Australia, a national report on addressing the supply and quality of engineering graduates for the 21<sup>st</sup> Century (King 2008) highlighted a lack of progress since the 1997 report, *Changing the Culture* (Institute of Engineers Australia 1996) which had raised concerns with regard to curriculum change and graduate attributes. The report identified that although there is willingness among leading engineering educators to address emerging issues, there are too few examples of a systematic, ‘top-down’ educational design and/or review process where learning experiences and assessment measures are rigorously mapped and tracked against the specification of graduate outcomes for a particular program.

With this historic lack of action and within the complex and rapidly changing context described above, the tertiary sector is increasingly being questioned by a variety of stakeholders including future employers (government and industry), future customers (i.e. students) and the broader community, whether they are actively building capacity to deliver sustainable solutions.

For example current practitioners and decision makers need new knowledge and skills to make decisions about immediate issues such as peaking greenhouse gas emissions, stopping deforestation, and increasing efficiencies in the supply of goods and services. Such education needs to begin immediately. There is also a need to embed knowledge and skills within undergraduate programs, to build capacity for addressing longer term issues. For example, beyond the next decade, future practitioners and decision makers need to be equipped with a fundamentally different mindset to provide society with goods and services in a changed climate, and in a way that will not diminish environmental or human well-being. Given the 10 year timeframe for first year undergraduates to graduate and begin contributing substantially in the workplace, their education also needs to begin immediately.

Desha (2010) discusses this educational challenge from a risk management perspective, as represented in Figure 3. Across all sectors of society, at some point in the near future (i.e. time ‘t’), there are likely to be abrupt market, regulatory and institutional shifts responding to sustainability challenges, which will require professional graduates to be equipped with a range of new knowledge and skills. Depending on where in Figure 3 the institution is positioned, this transition to produce such graduates, competing with other institutions, may be difficult unless pre-emptive steps are taken to renew the curriculum before time ‘t’ occurs.



**Figure 3. Levels of Commitment to Reducing Pressure over Time**

Source: Smith et al (2010, p69)

## 2. Connecting sustainability in campus and curriculum

We now discuss the reality of the state of interaction between campus greening and curriculum renewal initiatives and a number of barriers associated with curriculum renewal. We then discuss the potential for win-win situations as students and staff members engage in sustainable development learning while achieving real change on campus.

### 2.1. The state of interaction between curriculum renewal and campus greening

Tertiary education providers operate within a broader community and so contribute to the sustainability of these communities. Within this context, as large consumers of water, energy and resources, they are increasingly being expected to ‘walk the talk’ with regard to ESD in campus operations. The good news is that there are significant existing campus greening initiatives underway, primarily driven by a realisation of the cost-saving potential in reducing energy and water consumption. Numerous institutions - in Australia and overseas - are designing, constructing and retrofitting buildings that emulate green building principles of water, materials and energy efficiency.

In the curriculum literature, the need for holistic consideration of campus and curriculum has been discussed for a number of years. As a 2005 *National Review of Environmental Education and its Contribution to Sustainability in Australia* (Tilbury and Cooke, 2005) concluded, ‘*Change towards sustainability in the further and higher education sector requires more than just rethinking education plans or curriculum. Ultimately, learning for sustainability has implications for the core of the institutional culture, influencing the decisions, management procedures and research actions of the further and higher education sector*’. In a 2006 UNESCO publication, Thomas describes the need for a systemic approach to connecting curriculum to greening campus operations, which includes improving the environmental management of campus operations; embedding education for sustainable development, developing partnerships with other organisations for mutual benefits, and either through focused research centres or the efforts of individual researchers, exploring the dimensions of sustainable development and its achievement (Thomas, 2006). More recently in the Australian Government’s National Action Plan for Education for Sustainability (DEWHA, 2009), the government has committed to the Australian education sector linking campus operations to research, curriculum and administrative practice, so that sustainability can be embedded across every aspect of institutional operations in a synergistic way.

However the literature suggests that to date, efforts to integrate campus operations with curriculum appear to be limited (i.e. as case study examples rather than mainstreamed), *ad hoc* (i.e. driven by individual champions rather embedded within institutional structures) and often initiated by students engaging with facilities operators, rather than staff. For example, students have undertaken water and energy audits of buildings, designing solar photovoltaic options for campus buildings, designing green buildings and retrofits and exploring institutional consumption and procurement of goods such as electronic equipment, paper and furniture. Even in institutions such as Harvard where world leading greening campus initiatives have been underway for the last decade, there appears to be limited connectivity with Faculty in engaging students in these initiatives through the curriculum.

While facility managers are beginning to see Faculty (or staff) and student engagement as opportunities to engage in cost effective campus improvement projects, anecdotal evidence from previous ACTS conferences suggests a high level of resistance from the academic community in engaging in curriculum renewal activities to connect with greening campus initiatives. This is in contrast to primary and secondary schools in Australia, which are much more likely to be engaging with campus sustainability projects in the classroom.

This situation may be partly due to the greater focus given to sustainability in primary and secondary education over the last decade. In Australia for example, national initiatives such as the Australian Sustainable Schools Initiative (AuSSI), the Sustainable Living Challenge led by UNSW, and state initiatives such as the Queensland Environmentally Sustainable Schools Initiative (QESSI) and the state's sustainable schools policy have built significant momentum in school based action that is grounded in the curriculum. This includes portal access for teachers to upload (i.e. share) and download lesson templates, case studies and assessment items, professional development opportunities in action-research to renew their curriculum, and informal and formal peer mentoring initiatives.

Within tertiary education, university and vocational education providers have been undertaking campus greening projects in relative isolation, with the Australian Campuses Towards Sustainability (ACTS) network being the main forum for sharing ideas and innovations in the Australasian region. Within this forum 2010 saw the first major conference focus on connecting curriculum and campus operations. Internationally, the US has progressed much further in connecting campus and curriculum, supported by the American Association for Sustainability in Higher Education (AASHE) network and the US Partnership for Education for Sustainable Development, and significant online resources provided by both organisations. The UK has also used the Higher Education Academy (HEA) to encourage both campus greening and curriculum renewal towards ESD, in particular through the Subject Centres. More recently it has placed ESD as a core priority, which has stimulated a number of initiatives that are just getting underway.

## **2.2. Addressing barriers to curriculum and campus connectivity**

In seeking to understand this lack of connectivity between campus operations and curriculum, it is perhaps helpful to explore the academic perception of potential barriers and benefits to such connection. In 2009 the authors of this paper undertook research for the National Framework on Energy Efficiency (NFEE), on barriers and benefits to embedding the topic of energy efficiency within engineering curriculum (Desha & Hargroves 2009b). While the content findings are discipline specific, it is proposed that the pedagogical findings could apply beyond this specific case. In the study, 10 options (or tools) for curriculum renewal were identified by a network of engineering educators from around the country, as follows (in descending order of priority):

1. Include a case study on energy efficiency
2. Offer supervised research topics on energy efficiency themes
3. Include a guest lecturer to teach a sub-topic
4. Include tutorials that align with the energy efficiency theme in the course
5. Offer energy efficiency as a topic in a problem-based learning course
6. Include assessment that aligns with the energy efficiency theme within the course
7. Overhaul the course to embed energy efficiency
8. Include a field trip related to energy efficiency
9. Include one workshop (i.e. experiments) on energy efficiency in the course
10. Develop a new course on energy efficiency

Research into these options uncovered a wide range of barriers and benefits facing lecturers considering curriculum renewal for energy efficiency, as shown in Table 1. The table also highlights the impact of some barriers across a number of potential initiatives.

**Table 1. Barriers to curriculum renewal (Adapted from Desha et al 2009)**

Key Issues for Implementation	Shortlisted Options for Curriculum Renewal									
	1. Case Study	2. Guest Lecturer	3. Supervised Research	4. PBL Topic	5. Include Assessment	6. Tutorials	7. Course Overhaul	8. Workshop	9. Field Trip	10. New Course
<b>Common Barriers</b>										
Lack of available information	●	●		●	●	●	●		●	●
Lack of time for preparation	●	●		●	●	●		●		●
Prohibitive cost	●		●	●	●	●		●	●	●
Lack of knowledge	●	●	●	●	●		●		●	●
An overcrowded curriculum	●		●	●		●			●	●
Lack of value attached	●		●			●				
Lack of industry contacts		●	●					●		
Administrative coordination							●	●		●
Lecturer apathy		●					●			
Resistance to top-down directive			●				●			
Students' prior learning habits					●				●	
<b>Common Benefits</b>										
Improved marketability	●	●					●	●		●
Improved pedagogy – PBL*				●	●	●			●	
Improved pedagogy – skills				●	●	●			●	
Cross-functionality of content	●						●			●
Networking for students		●	●					●		
Networking for lecturers		●	●					●		
Research opportunities		●								●
Lecturer prof. development		●				●				
Experience in renewal			●				●			
Addressing the time-lag issue			●				●			

\* Problem based learning

Despite the lack of literature and scarcity of precedents on tools and strategies to encourage curriculum renewal through reducing such barriers and increasing such benefits, a number of strategic components were highlighted in the literature, which could be of use to departments considering how to undertake curriculum renewal. These include:

- Including in desired graduate attribute list
- Committing senior management support
- Recruiting staff with expertise
- Providing training
- Hosting topical event/s
- Understanding 'Hot Topic' areas
- Providing access to web-based courses
- Fostering interdisciplinary networks
- Providing financial assistance
- Creating a Working Party
- Setting future targets
- Creating a clear timeline
- Permitting workload discussions
- Providing seed funds for new research
- Providing seed funds for teaching research
- Harnessing other institutional overhauls
- Identifying and using modular content
- Investigating graduate career options
- Directly involving potential employers
- Engaging external support for advice



In addition to opportunities at the level of the lecturer and engineering department, the authors also identified key roles for accreditation agencies, professional bodies and government, which could help to catalyse timely curriculum renewal. In particular the literature identified a role for accreditation bodies to include ESD requirements. The literature also identified a key role for professional bodies in content and professional development support for educators. Finally the role of government was highlighted as essential in providing clear signals, and supporting initiatives by departments, accreditation agencies and professional bodies.

From this research into engineering education and embedding energy efficiency knowledge and skills, it is suggested that any engagement with academics around curriculum renewal needs to be strategic and well targeted, to overcome the above-mentioned barriers. Furthermore, the operational activities of most universities are very different to the academic systems surrounding teaching and research, from accounts through to management committees, often only having common reporting structures at the level of university senior executive (i.e. through pro vice-chancellors to the vice-chancellor or president). With these considerations regarding the complexity of sustainability knowledge and skills, and the nature of barriers to curriculum renewal in mind, the following section discusses the opportunity for systemic curriculum engagement with campus operations that can also assist the institution in rapidly renewing the curriculum towards ESD.

### 3. Campus greening and rapid curriculum renewal

We now discuss the potential for a win-win opportunity in addressing the need for rapid curriculum renewal toward ESD, and the desire to engage academics and students in greening campus operations. Figure 4 presents a model previously developed by the authors, whereby a transition to ESD could be completed within an accelerated timeframe. This model includes campus integration as one of six key elements to implement, within a larger process that involves timeframe catalysts, institutional leadership and strategic staging. As discussed in the following paragraphs, facilities managers or academics could use this model to demonstrate understanding of the broader ESD challenge, and the potential for connecting campus and curriculum to have synergistic benefits across facilities management and academia.

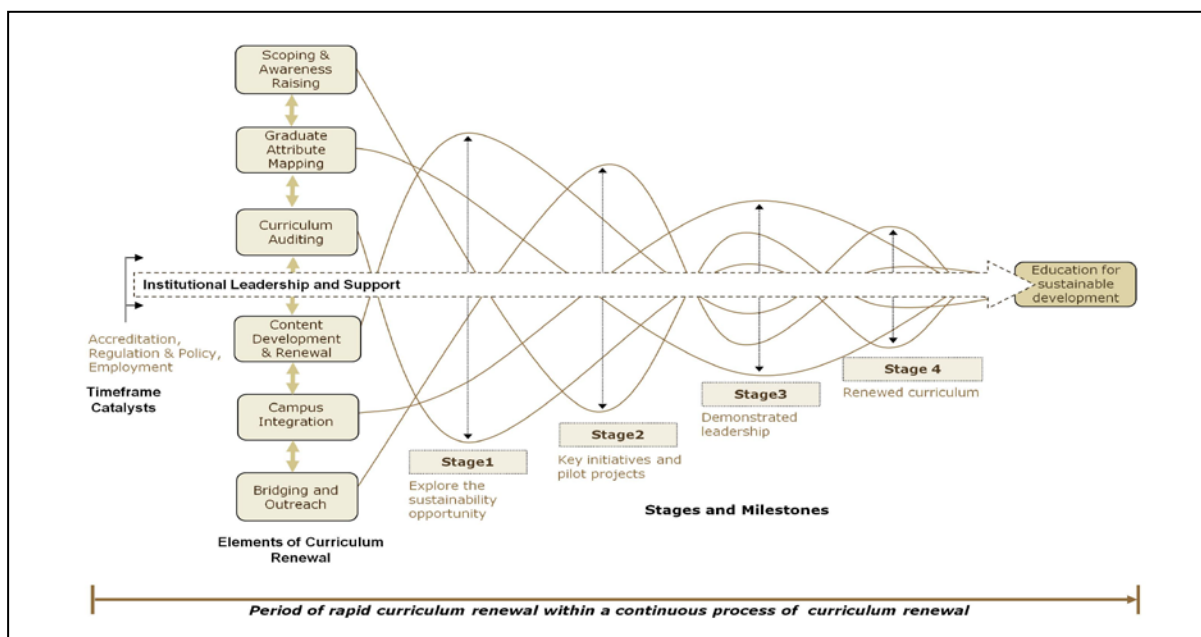


Figure 4. Stylistic representation of a model for rapid curriculum renewal

Source: Desha (2010)

### 3.1. Integrating with the six elements

As shown by the boxes and arrows on the left of the figure, six inter-related elements of curriculum renewal need to be incorporated into the rapid curriculum renewal process:

- Awareness raising and developing a common understanding
- Graduate attribute mapping
- Curriculum auditing
- Content development and renewal
- Bridging and outreach
- Campus Integration

As implied by the model, none of the elements are able to independently stimulate or sustain rapid curriculum renewal, and must be viewed and used as part of a whole system approach (incorporating timeframe catalysts and the other elements).

Integration of campus activities with curriculum could be achieved for example by linking a sustainability curriculum audit process with an assessment of opportunities to undertake campus greening operations; in effect ‘operationalising’ the curriculum. An institution could differentiate itself by the motto: ‘Many are talking about Sustainable Development, but at this university we practise what we teach’. There is much scope for improvement in this regard: beginning with sharing knowledge about both campus operations and areas identified for potential improvement; teaching and research activities that may overlap with regard to potential on-campus projects that might be financially attractive as a cheaper implementation option for facilities management; and an opportunity to involve students from the academic perspective. In engineering education this may include for example opportunities to audit the energy or water consumption of buildings on campus, calculating the potential costs and energy savings of onsite renewable energy options, water saving infrastructure and passive cooling initiatives (such as shading, or painting the roof white or a lighter colour).

With many future leaders spending time on higher education campuses, greening campus efforts that involve students can yield educational dividends for the future, fast-tracking student experiences in real-life applications of the theory that they are being exposed to, and providing a supportive environment to address barriers surrounding dealing with new and emerging technologies. In a professional environment where staff may not have recent industry experience, on-campus initiatives can also provide staff with practical experience in their subject matter. For engineering education, where the majority of staff have not had practical experiences for 10 years or more, such experience can also be important in providing professional development opportunities in their discipline, and also to build off-campus networks with industry, business and government who may also be interested in piloting new technologies on campus.

### 3.2. Collaborating through strategic staging

Rapid curriculum renewal requires an overarching plan, which should result in a process that preserves institutional diversity and innovation. As noted in Figure 4 by the stage boxes, this transition includes tasks that are defined with clear staging and an endpoint whereby the curriculum may be said to have achieved ESD

- In Stage 1 the institution considers options to determine what value ‘EESD’ could bring to its mission and business model.
- In Stage 2 the institution tests the business case for EESD through key initiatives and pilot projects.

- In Stage 3 the institution has made a systemic commitment to ESD through its operation and influence, taking a public leadership role.
- In Stage 4 the institution completes the embedding of ESD within the curriculum, producing its first graduates who can contribute to genuine progress in economic and social development, in the local community and the world at large.

Within this context, the challenge is to compress the timeframe for the three phases of curriculum renewal (i.e. ad hoc, flagship and integration) through strategic staging and milestones, to ensure that the outcome is rapid (i.e. 2 accreditation cycles, or 6-8 years) rather than standard curriculum renewal which can span up to 4 accreditation cycles (i.e. two decades). As highlighted by the interwoven strands, there are variations in what may occur along the way, depending on the organisational context and existing frameworks. Hence, the composition of each stage is not fixed. In addition, departmental activities may change and develop to include new ideas and emerging knowledge and skills.

In this context, campus integration is seen as an element of curriculum renewal carries opportunities to accelerate the process within the larger context of greening campus initiatives, and to also take advantage of momentum created by existing institutional change processes. As for the elements ‘bridging’ and ‘outreach’, campus integration should be included as a minor component of the early stages (i.e. Stage 1 and 2). This ensures that relationship building activities are commenced with campus facilities managers, and that future interaction opportunities are flagged and planned. Such activities may include inviting facilities managers to keynote lectures and staff workshops regarding EESD. Campus integration then becomes a focal point in the later stages (e.g. Stage 3 and 4), once staff begin to plan new content and campus interactions.

### **3.3. Timeframe catalysts and leadership support**

Key timeframe catalysts might comprise program accreditation, regulation and policy, and employment. Moving along the long arrow in the centre of the figure, institutional leadership and support is crucial to enabling the timeframes to be set within the institution, and to ensuring that a process of rapid curriculum renewal is maintained over the set period, ending with a curriculum that has embedded substantial new content.

In addition to taking advantage of those sustainability activities already being undertaken on campus, rapid curriculum renewal for sustainable development may also benefit from utilising other change processes underway within the institution. These may include for example, other teaching-related initiatives that encourage curriculum renewal, other restructuring endeavours which involve reviews and changes to offered courses and programs, and institutional benchmarking initiatives, which may already be investigating how the institution can improve its ranking among other universities. Staff turnover may also be considered an opportunity to review programs for desired candidate strengths. Existing greening campus initiatives could also be offered as catalysts for promoting curriculum renewal, providing academics with precedent to engage in campus oriented projects with students.

## **4. Conclusion**

In conclusion, universities are increasingly recognising the need to renew their curriculum to teach sustainability skills and knowledge, and to reflect this change in curriculum through campus greening initiatives. Moreover, neither ESD nor campus greening by themselves will be sufficient to ‘green the university’. Rather, there is a synergy between these goals, and a model presented here summarises a holistic approach through which rapid curriculum renewal can be aided by, and contribute to, campus greening initiatives.

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