Integrating Sustainability into the Curriculum at HKUST

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Climate change has brought the world to a historical inflection point. The global community knows it must transform its energy systems and the broader mismanagement that exacerbates climate change and degrades our life systems. Globally, sustainable development has been adopted to bring about systemic change to ensure present and future generations can enjoy the benefits of a healthy environment. At its core are changes in social behaviour, not crudely restricting consumption or changing lifestyles, but learning how to live with environmental parameters with an improved quality of life, and developing the technologies and economic incentives to bring about those changes. Importantly, political will is required to initiate the research, policies and markets that will create the framework for sustainable development.

Belatedly universities are becoming part of the sustainable development movement. As large institutions with thousands of employees, students and facilities, they have huge environmental impacts. Moreover, as institutions of higher education and research—and producer of society's leaders—our responsibilities are clear and pressing. The critical role of universities play in cultivating environmental awareness and leadership among students is a central focus of the agreements among that hundreds of universities have signed agreements to take action on environmental issues (see Talloires and Copernicus Charters in annex). The common theme that runs through these agreements is that universities must actively develop the programs and faculty capacities that will produce students with a high level of environmental literacy and the ability to deal with environmental issues on a disciplinary and transdisciplinary basis. This multi-pronged approach provides an understanding of the main environmental issues, how sustainable development meets the environmental challenge with a systemic approach, and the tools to put sustainability into practice. If we do not respond to this challenge we will be failing our students and our community. Moreover, we will fall behind our peers in the US and Europe which are racing forward in commitment, action and innovation.

1. A FRAMEWORK FOR A SUSTAINABILITY CURRICULUM

In this paper, we provide a framework view of approaches taken at other universities. We present the sustainable curriculum as an interdisciplinary and multidisciplinary approach that involves a mix of five areas and compare these approaches to the current situation at HKUST. Drawing on this review, we present a brief analysis of the integration of sustainability into the curriculum and then discuss the promotion, organization, and management of a sustainability

curriculum, within the sustainability goals of a university and the university's strategic development. We focus on the need for awareness raising, consensus building, and buy-in for the development of an integrated sustainability curriculum and discuss means to take the university forward.

1.1 Sustainability and Trans-disciplinary Environmental Programs

Sustainability or environmental programs are established as explicitly transdiscplinary in nature in order to foster wholistic approaches to dealing with human-environmental issues. These programs provide a university with depth of knowledge, resources and expertise, and provide reference points for other courses and activities. These programs offer undergraduate, MA/MSc, and PhD degrees that bridge the natural sciences, engineering, and social sciences to enable students to understand the interrelations of environmental issues with human activities in a comprehensive and integrated manner. For example, students learn the environmental impacts of a business activity or public policy, the regulatory and social conditions governing it, and the interrelations among the technological, economic, policy, behavioural and managerial options available for mitigation. Designed to produce leaders that can deal with these interrelations, the programs have many origins and forms. Science, engineering and law schools have, for example, incorporated economics, planning, anthropology and other perspectives to improve the real world applicability of their environmental thrusts. Standalone programs with their own dedicated faculty and staff have been developed, more common are programs that draw in faculty and resources from several disciplines. Brown University's Center for Environmental Studies lists about two hundred of these programs, in North America (envstudies.brown.edu/dept/espgm.htm) and a similar number are in European universities. Program outlines for Arizona and Columbia are available in the annex.

To date HKUST's lone environmental program has been a successful taught MSc in Environmental Science and Engineering. With the new program in Environmental Science and Technology, however, HKUST is initiating its first undergraduate program in sustainability. The program will serve as the flagship program for the Institute for the Environment and will be one of the new signature programs at the university. Although based in the schools of engineering and sciences, it will enjoy the active support of the schools of Humanities and Social Science and the School of Business Management, and will be a broad interdisciplinary education in science, engineering, socio-economics, environmental law and management, and policy. The program will be attractive because of its academic breadth, and it will allow students more time to decide what they would like to focus on, compared to the traditional specialized UG programs. With the interdisciplinary background obtained after the 4-year program, some students may want to obtain more specialization by taking additional engineering courses during a fifth year that could lead to accreditation in engineering, or taking an MSc in Environmental Science or Engineering, an MBA, etc.

1.2 Environmental Literacy

The implication of each individual in environmental damage and remediation requires that students understand the interactions of human and ecological systems, that they are instilled with the willingness to change personal behaviour and the capacity to make workplace and institutional decisions that will contribute to fashioning sustainable development in different institutional or spatial contexts. When introduced early, environmental literacy sustainable

development can shape student perspectives on approaches taken in their majors and other courses. In the US, the National Project for Excellence in EE proposes a framework of branches of environmental literacy: "Personal and civic responsibility; knowledge of environmental processes and systems; skills for understanding and addressing environmental issues; questioning and analysis skills" (EETAP.org).

Environmental literacy is stipulated as a core need by the Talloires and Copernicus charters, but few universities have established systematic means to ensure students are exposed to sustainability education while in university. This lacunae exists despite many universities are stipulating a set of core courses or general education courses. Environmental or sustainability courses are not specified but can, however, be taken within such frameworks and some schools proactively support students in their search for such courses. Eindhoven University of Technology does ensure that most of its students follow an introductory course in sustainable development in preparations for a curriculum in which it is emphasized (see course outline in annex). Carnegie Mellon's Steinbrenner Institute for Environmental Education and Research offers an online guide to connect students in a particular field with appropriate courses related to sustainability where-ever they are located in other disciplines. Harvard's Green Campus Initiative offers something akin to a core environmental course through the university's extension program.

HKUST does not have a course or courses that are designed as a broad introduction to sustainability or the environmental issues confronting human activities at the undergraduate level. It does have several general education courses in Biology, Social Science and Engineering that deal with environmental issues and accessible to non-specialists. The university, however, does not have any coordinating mechanism or personnel familiar with these courses and able to guide a student in creating a portfolio of courses on the environment.

1.3 Sub-disciplines and Disciplinary Sustainability Courses

Many disciplines are developing sub-disciplines focused on sustainability issues and that also provide a wholistic view of how sustainability can be integrated into the discipline. Environmental engineering, environmental science, environmental law and politics, environmental sociology, business and the environment, environmental accounting are a few of the sub-disciplines that have programs with a number of courses or are represented in departments by courses that have become accepted components of disciplinary training. These sub-disciplines identify key environmental issues (e.g. climate change; biodiversity loss; human health), relate them to the theories and practices of the discipline and also adapt key environmental theories and practices to the discipline (e.g. carrying capacity; environmental impact assessment; life-cycle analysis; polluter pays principle). Outlines of sub-discipline elements for business are attached in annex.

HKUST's strongest suite of environmentally related courses can be found in engineering where a student can take several specialized topics directly related to environmental issues and also courses that relate environmental engineering to its social-political contexts, such as: Environmental Planning and Management and Environmental Impact Assessment and Monitoring. Other schools and departments have much smaller or non-existent sustainability course offerings. However, many faculty, for example in Social Science or biological sciences, utilize concepts and trans-disciplinary approaches that students can utilize to develop a sustainability thrust to their studies. There is much greater environmental course

selection at the graduate level.

1.4 Integration into Courses

As sustainability cannot be achieved either by specialists from sustainability programs or from sub-disciplines, sustainability concepts and practices need to be incorporated into the mix of a discipline's courses as appropriate. That at least is the view of academic and practical analysis, and is expressed by the Talloires and Copernicus charters. Certainly, many courses are discussing sustainability or environmental issues as pressing topics; however, this is done primarily on an ad hoc basis and with little reference to the theories and practices of sustainability science. The critical factor is likely the lack of knowledge, time or incentives on the part of instructors to build these concepts into their course materials. There is also an indifference or marginalization of environmental concerns in dominant textbooks. Increasingly, these barriers are being overcome by the use of approaches such as prepared case studies and field-based case studies (Steiner and Laws 2006), modules developed for specific disciplines (Paten and Palousis 2005), and trans-disciplinary team teaching (Caviglia-Harris and Hatley 2004). These approaches incorporate sustainability theory and practice and teach students to work in a trans-disciplinary perspective.

HKUST is no better than the majority of universities in integrating sustainability concerns or concepts into courses that are focused on their specializations. Anecdotal examples of the few courses that do are the exceptions that prove the rule.

1.5 University and Community Experience

One of the strongest thrusts of sustainability teaching is to use the university facilities and services or the community as venues for students to put sustainable development into practice. Experiential approaches, for example internships and interviews (Domask 2007) or a planning class bringing sustainability concepts to the community (Conroy 2004; Thomas et al. 2005) are being used to integrate course work with fieldwork. The Sustainable Toronto project is an exemplar of a practice oriented curriculum development, integrating: a sustainability course and sustainability material added to new courses; theses on sustainability; field experiences, job placements, etc.; guest speakers; and use of campus practices and procedures (Savan and Bell 2002). Predominately, however, student experiences with sustainable development are organized by campus sustainability or EHS offices, or by the students themselves. As an exemplar UBC's Social, Economic, Ecological and Development Studies program (SEEDS) was established by the Sustainability office to bring faculty, staff, and students together in projects that have saved the university thousands of dollars and involved over a thousand students (see annex for description). Harvard's Green Campus Initiative has provided critical knowledge and support to a large number of faculty, operations and student sustainability programs.

HKUST's Health, Safety and Environment Office, with the support of Facilities Management and Student Affairs, has been the most proactive force trying to draw students into environmental activities on campus: encouraging and supporting student initiatives; staff-student collaborations; fostering activities such as organic farming; introducing market principles into paper and air-conditioning use. There is however no system for faculty and students to transform university services or facilities into student or faculty projects. Some graduate classes send their students out to conceptualize sustainable development activities in the field, but as yet there are no courses asking students to put sustainability into practice.

2. HKUST'S CURRICULUM IN COMPARISON

Although the university has substantial environmental research and teaching expertise, it is only beginning to be coordinated to provide education for the environment. The new Environmental Science and Technology program will be a bold step in that direction and provide a base for the development of courses on sustainability, a magnet for students for other disciplines that wish to integrate sustainability into their education, and an origin for the diffusion of sustainability concepts and pedagogy. The university is in need of accessible 1st and 2nd year courses on sustainability and related issues, and perhaps a core course on sustainable development. Engineering and Science have the basis of sub-disciplines and strong course offerings, but the same can not be said of Humanities or Business which are bereft of environmental courses. In compensation, Social Science offers Environment and Business and Society and Environment, but a reasonable course offering would include Environmental Economics; Environmental Law and Politics; Planning; Physical Geography.

Integration of sustainability concepts into courses appears to be another weak point for the university. Anecdotal evidence suggest that introduction of environmental issues is occurring, but not in a systematic manner and not incorporating sustainability concepts and practices. Sustainability and environment are being used for experiential teaching practices, for example final year projects in Global Business and Engineering, but thus far no indication of job placements, internships etc. HSEO, FMO, and SAO have made significant efforts to use the campus as a venue for students to experience sustainability, but these efforts have not been matched by faculty involvement or administration directives for faculty to get involved.

In summary it can be said that HKUST has a reasonable palette of environmental courses in the science and engineering streams, courses in other disciplines, environmental literacy, and practical experience need development. Overcoming these weaknesses will require some effort on the part of instructors to gain understanding of the relationship of sustainability to their specialties and the encouragement and support of administration. Before discussing how this may be done, it is worth noting the advice of a leader in the field of sustainable curriculum.

Lesson 1: Sustainability is not necessarily a subject, rather the teaching of a wholistic way of thinking and acting on human-environment issues.
Lesson 2: Sustainability is no-one's domain.
Lesson 3: There are flexible approaches to teaching sustainability.
Lesson 4: Sustainability needs to be practical.
Lesson 5: Curricula need to be changed if universities are going to succeed in promoting sustainability.
Lesson 6: Anyone can do it, indeed everyone can incorporate sustainability concepts and specialists are the best ones to do it in their own field.
Walter Leal Filho (Filho 2002)

3. OVERCOMING OBSTACLES—BUY-IN FOR A SUSTAINABLE CURRICULUM

There are many challenges to introducing sustainability into the university curriculum. Sustainability is a topic that is both local and global; is a technical, social and economic problem; and is interdisciplinary in nature. Solutions for sustainable issues such as climate change require integration of science, engineering, political science and business. Given the meta-curricular nature of sustainability how can the university develop sustainability across

the curriculum? What breadth and depth of sustainability might be introduced into the curriculum? What factors will influence the adoption of sustainability? In this section we consider the institutional situation of sustainability at HKUST, and consider issues that will influence integration.

In this section we will first describe several possible curriculum scenarios, and then discuss the most significant factors that will influence the development of a sustainability curriculum. We conclude with several recommendations.

	Low Student and Faculty Acceptance	**High Student and Faculty Acceptance**
Low Leadership Involvement	• Few discipline-specific courses • Little to no coordination across curriculum • No systematic development	• Student and faculty led development • Many discipline-specific courses • Little coordination across disciplines • No systematic development
High Leadership Involvement	• Discipline specific courses • Few cross-disciplinary programs • Limited coordination across disciplines • Some systematic development	• Breadth and depth within and across disciplines • Interdisciplinary coordination • Systematic development

A distinguishing feature of sustainability is its meta-curricular nature, above a single discipline. A coherent curriculum for sustainability involves all disciplines, and requires coordination above and across disciplines. In doing so we must consider two key dimensions that will influence the development of a university-wide sustainability curriculum: faculty and student receptiveness, and leadership. We follow a fundamental principle that the most effective implementation of sustainability will consider the existing norms and work practices of the institution. This requires a realistic assessment of the nature of the institution and recognizing the costs of imposing solutions that run counter to the existing work practices.

To what extent does the university community accept sustainable development as a necessary topic for inclusion in the curriculum? For instance, while climate change may be a global crisis, to what extent are faculty able and willing to teach issues related to climate change? Climate change may be one of the defining issues of our time engaging all disciplines, but as university scholarship is increasingly specialized, it is increasingly difficult for even a global crisis to penetrate a culture of specialism.

We have some anecdotal and limited evidence to suggest that there is already some support for sustainability at HKUST. Sixty-six faculty have interests in environmental or sustainable research, and ninety-three courses are offered across the university. The largest number of courses fall within civil and chemical engineering with the notable absence of business.

Environmental Courses		
Atmospheric, Marine and Coastal Environment Program	8	12%
Bioengineering Postgraduate Program	1	2%
Biology	7	11%
Chemical Engineering	14	21%
Chemistry	1	2%
Civil Engineering	33	50%
Economics	2	3%
Graduate Diploma and Msc in Env. Eng. and Env. Sci.	11	17%
High Tech Entrepreneur Project	1	2%
Mathematics	2	3%
Mechanical Engineering	4	6%
Physics	1	2%
School of Social Science	8	12%
Total	93	100%

These courses are a positive indication of discipline-specific engagement of sustainability issues. Could a meta-curriculum emerge out of a single discipline? It is possible, but unlikely given the discipline-specific structure and incentives. A set of available discipline-specific courses is a good start but, in order to fully engage an issue such as climate change, students need to have a more discipline specific courses, a greater breadth of courses across schools and programs, interdisciplinary courses and programs, and some harmonization of sustainability across programs and schools. These developments are unlikely to emerge from one or two disciplines. Their development requires a higher level of coordination.

Incorporating sustainability across the university curriculum is a large organizational change. We need to consider the receptiveness of the community to issues of sustainability. Using climate change as a proxy for a highly relevant sustainability issue, we consider a recent survey by HSBC on global attitudes towards climate change. Characterizing Hong Kong citizens as "committed confident" the survey found Hong Kong as "only moderately engaged with the issue of climate change: relatively confident and optimistic, with a clear sense that any further action would need to be government-led." (HSBC) While generalization of this study to the university community is limited, the findings suggest that students may have some interest in learning about climate change in courses, and faculty may have some interest in including material on climate change. However, given that most respondents consider climate change a government issue, it argues against sustainability as a student or faculty led movement. Students and faculty may not see sustainability as a priority and argue against allocation of time and resources for sustainability. As there are more courses in some disciplines than others, we would expect to find that receptiveness to sustainability will be higher in disciplines offering the most courses. This variability across the university would suggest that university leadership will be critical in developing a sustainability curriculum.

A faculty member has great discretion to choose the elements of their courses, how the topics are taught, and the depth to which a topic is investigated. In general, faculty see themselves as experts in their disciplines, and they have strong professional incentives to pursue teaching and research within the boundaries of their disciplines. Over time each discipline develops a strong set of institutional structures that include acceptable topics, methods and work practices that define the discipline. Topics enter the classroom through validation, exploration, and the slow development of community consensus on concepts and teaching

practices. External imposition of a curriculum change upon disciplines and their faculty run counters to this institutional process. This suggests that in the context of sustainability, introduction of new additions to the curriculum should involve the discretion of faculty, as well as follow the discipline norms.

In disciplines that already are engaged in sustainability there will be greater receptiveness to initiatives that assist development of curriculum that are consistent with discipline practices. To the extent that introduction of new initiatives are synergistic with existing practices, introduction of new topics and methods will have the least resistance in these disciplines. Program level initiatives that respect discipline practices are likely to be most effective.

For disciplines that are not currently engaged in teaching sustainable development, introduction is more difficult. There are, in general, three ways in which sustainable development might enter the curriculum. The first is through a groundswell of interest on the part of faculty. As noted, this depends upon faculty being willing and able to teach sustainability. At the most superficial level, faculty might introduce the concepts of their field using general information about sustainability. For instance, teaching a marketing strategy case that happens to be on a company that is engaging issues of climate change. The principles are from marketing, the illustration is about sustainability. This requires little expertise about climate change on the part of the faculty. At a deeper level, faculty might teach concepts of sustainable development in the language of their discipline. This would require disciplines to engage sustainability through discipline specific norms of publication, funding and tenure. This is a slow process, thus the creation of independent entities such as climate change centers, such as those at Columbia and Stanford, as mechanisms for developing a distinct community and providing incentives for sustainability research and teaching.

Organizations also change through crisis, which loosens up institutional practices. For instance, issues of sustainability might enter the university curriculum because of a universal acknowledgement of an impending crisis. A highly visible climate change crisis might free up the wheels, mobilize stakeholders, and increase willingness to change existing pedagogical practices. While many feel there is a climate change crisis happening outside the university, institutional persistence makes it business as usual inside the university curriculum. Climate change may be an organizational crisis, but it is a very slow one, which makes rapid short term change unlikely without powerful external pressure.

Third, organizations change when subject to a powerful external force. If international bodies or government impose draconian measures or some powerful incentive such as funding to muscle research and teaching onto the university agenda, this would result in rapid change. While this may happen in the longer term, in the short term this situation does not appear to exist and seems an unlikely change mechanism.

To summarize the discussion so far: 1) There is evidence of faculty and student interest in the current curriculum but little interdisciplinary coordination, 2) There is moderate interest in issues related to sustainability, but expectation of government led action, and 3) Strong discipline-based norms of teaching and research. Given these observations, what is the best approach for the university? It would seem that the most effective mechanism to introduce sustainable development into the curriculum would be to appeal to faculty in a fashion that is appropriate for their disciplines and their level of interest. Incentives may be offered to faculty that will encourage the development of research and teaching materials that are

discipline specific and at the same time contributes to the portfolio of topics for the university. To reduce the costs of course development within disciplines, common cross-discipline resources can be offered that might be adapted for discipline-specific purposes. These might include shared information, teaching resources, inter-university resources, government databases, funding, etc. This is consistent with creating an interdisciplinary program that draws upon discipline-specific expertise. This is an approach that recognizes the faculty-led nature of teaching and research, and the level of acceptance of sustainability by the community.

Sustainable development is a meta-curricular issue, its intellectual home is scattered across disciplines. While environmental issues have a very long history in education, many of the concepts in sustainable development did not emerge from academic pursuits but through public policy discourse that was later drawn into academic disciplines. For curriculum development we find that there are multiple views of sustainability, as disciplines take ownership of aspects of sustainability they develop their own specialized perspectives. To develop programs that coordinate across disciplines, it is necessary to establish a meta-curricular language that enables shared understandings.

As an example of the difficulty of introducing a meta-curricular topic, ethics in business is often raised as an urgent issue for students of management. Highly visible failures in business ethics, such as Enron, raised awareness of ethical issues. The topic of ethics touches upon all aspects of business, across all management fields. The business school accreditation authority, AACSB required teaching of ethics in management education. While, in its most general form, ethics is a concept accessible to all faculty and could be taught in every management course, most faculty and their home disciplines either choose not to teach ethics, or feel unqualified to teach ethics. Business ethics is most often relegated to a single course, covering the minimum requirement for certification.

As demand for education in sustainability grows, there will be an incentive to coordinate across disciplines in order to provide graduates that are conversant in sustainability but trained in engineering, sciences, social sciences and business. Development of a shared understanding of sustainability across disciplines is necessary to provide an umbrella for a curriculum in sustainability. This is necessary for establishing coherency within the university but also for establishing partnerships between the university and the external community that are engaged in finding solutions for problems of sustainability.

The leadership of the university is crucial for integrating sustainability into the curriculum. First, leadership can develop greater awareness of sustainability across faculty and students, developing acceptance for a sustainability curriculum. Second, leadership can guide a meta-curricular discussion of sustainability that develops a shared understanding and some common language for a sustainability curriculum. Third, leadership can guide funding and incentives to support discipline specific curriculum development while encouraging inter- and multi-disciplinary coordination. Fourth, university leadership can provide the interface between disciplines and the larger external community.

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ANNEX 1

THE TALLOIRES DECLARATION

We, the presidents, rectors, and vice chancellors of universities from all regions of the world are deeply concerned about the unprecedented scale and speed of environmental pollution and degradation, and the depletion of natural resources.

Local, regional, and global air and water pollution; accumulation and distribution of toxic wastes; destruction and depletion of forests, soil, and water; depletion of the ozone layer and emission of "green house" gases threaten the survival of humans and thousands of other living species, the integrity of the earth and its biodiversity, the security of nations, and the heritage of future generations. These environmental changes are caused by inequitable and unsustainable production and consumption patterns that aggravate poverty in many regions of the world.

We believe that urgent actions are needed to address these fundamental problems and reverse the trends. Stabilization of human population, adoption of environmentally sound industrial and agricultural technologies, reforestation, and ecological restoration are crucial elements in creating an equitable and sustainable future for all humankind in harmony with nature.

Universities have a major role in the education, research, policy formation, and information exchange necessary to make these goals possible. Thus, university leaders must initiate and support mobilization of internal and external resources so that their institutions respond to this urgent challenge.

We, therefore, agree to take the following actions:

1. Increase Awareness of Environmentally Sustainable Development

Use every opportunity to raise public, government, industry, foundation, and university awareness by openly addressing the urgent need to move toward an environmentally sustainable future.

2. Create an Institutional Culture of Sustainability

Encourage all universities to engage in education, research, policy formation, and information exchange on population, environment, and development to move toward global sustainability.

3. Educate for Environmentally Responsible Citizenship

Establish programs to produce expertise in environmental management, sustainable economic development, population, and related fields to ensure that all university graduates are environmentally literate and have the awareness and understanding to be ecologically responsible citizens.

4. Foster Environmental Literacy for All

Create programs to develop the capability of university faculty to teach environmental

literacy to all undergraduate, graduate, and professional students.

5. Practice Institutional Ecology

Set an example of environmental responsibility by establishing institutional ecology policies and practices of resource conservation, recycling, waste reduction, and environmentally sound operations.

6. Involve All Stakeholders

Encourage involvement of government, foundations, and industry in supporting interdisciplinary research, education, policy formation, and information exchange in environmentally sustainable development. Expand work with community and non-governmental organizations to assist in finding solutions to environmental problems.

7. Collaborate for Interdisciplinary Approaches

Convene university faculty and administrators with environmental practitioners to develop interdisciplinary approaches to curricula, research initiatives, operations, and outreach activities that support an environmentally sustainable future.

8. Enhance Capacity of Primary and Secondary Schools

Establish partnerships with primary and secondary schools to help develop the capacity for interdisciplinary teaching about population, environment, and sustainable development.

9. Broaden Service and Outreach Nationally and Internationally

Work with national and international organizations to promote a worldwide university effort toward a sustainable future.

10. Maintain the Movement

Establish a Secretariat and a steering committee to continue this momentum, and to inform and support each other's efforts in carrying out this declaration.

COPERNICUS CHARTER OF EUROPEAN UNIVERSITIES

Preamble

Man's exploitation of the biosphere is now threatening its very existence and delicate balance. Over the last few decades, the pressures on the global environment have become self-evident, leading to a common outcry for sustainable development. In the words of the Brundtland report, we must learn to care for the needs of the present without compromising the ability of future generations everywhere to meet their own needs. The awareness is there. What is required is a comprehensive strategy for building a sustainable future which is equitable for all human beings, as highlighted by the Rio Conference (UNCED) in 1992. This requires a new frame of mind and new sets of values. Education is critical for promoting such values and improving people's capacity to address environment and

development issues. Education at all levels, especially university education for the training of decision-makers and teachers, should be oriented towards sustainable development and foster environmentally aware attitudes, skills and behavior patterns, as well as a sense of ethical responsibility. Education must become environmental education in the fullest sense of the term.

The role of universities

Universities and equivalent institutions of higher education train the coming generations of citizens and have expertise in all fields of research, both in technology as well as in the natural, human and social sciences. It is consequently their duty to propagate environmental literacy and to promote the practice of environmental ethics in society, in accordance with the principles set out in the Magna Chart of European Universities and subsequent university declarations, and along the lines of the UNCED recommendations for environment and development education. Indeed, universities are increasingly called upon to play a leading role in developing a multidisciplinary and ethically-oriented form of education in order to devise solutions for the problems linked to sustainable development. They must therefore commit themselves to an on-going process of informing, educating and mobilizing all the relevant parts of society concerning the consequences of ecological degradation, including its impact on global development and the conditions needed to ensure a sustainable and just world. To achieve these aims and fulfill their basic mission, universities are urged to make every effort to subscribe to and implement the ten principles of actions set out below.

Principles of action

1. Institutional commitment: Universities shall demonstrate real commitment to the principle and practice of environmental protection and sustainable development within the academic milieu.
2. Environmental ethics: Universities shall promote among teaching staff, students and the public at large sustainable consumption patterns and an ecological lifestyle, while fostering programmes to develop the capacities of the academic staff to teach environmental literacy.
3. Education of university employees: Universities shall provide education, training and encouragement to their employees on environmental issues, so that they can pursue their work in an environmentally responsible manner.
4. Programmes in environmental education: Universities shall incorporate an environmental perspective in all their work and set up environmental education programmes involving both teachers and researchers as well as students - all of whom should be exposed to the global challenges of environment and development, irrespective of their field of study.
5. Interdisciplinarity: Universities shall encourage interdisciplinary and collaborative education and research programmes related to sustainable development as part of the institution’s central mission. Universities shall also seek to overcome competitive instincts between disciplines and departments.
6. Dissemination of knowledge: Universities shall support efforts to fill in the gaps in the present literature available for students, professionals, decision-makers and the general public by preparing information didactic material, organizing public lectures, and establishing training programmes. They should also be prepared to participate in environmental audits.
7. Networking: Universities shall promote interdisciplinary networks of environmental experts at the local, national, regional and international levels, with the aim of

collaborating on common environmental projects in both research and education. For this, the mobility of students and scholars should be encouraged.

8. Partnerships: Universities shall take the initiative in forging partnerships with other concerned sectors of society, in order to design and implement coordinated approaches, strategies and action plans.
9. Continuing education programmes: Universities shall devise environmental educational programmes on these issues for different target groups: e.g. business, governmental agencies, non-governmental organizations, the media.
10. Technology transfer: Universities shall contribute to educational programmes designed to transfer educationally sound and innovative technologies and advanced management methods.

This document is a follow-up to a number of university initiatives concerned with environmental awareness and responsibility, recent examples of which include:

* The Magna Charta of European Universities,
  Bologna, September 1988
* University Presidents for a Sustainable Future,
  the Talloires Declaration, October 1990
* Urgent Appeal from the CRE, the association of European universities, presented to the Preparatory Committee for the United Nations Conference on Environment and Development (UNCED),
  Geneva, August 1991
* Creating a Common Future: An Action Plan for Universities,
  Halifax, December 1991

Endorsing the Charter

The COPERNICUS Secretariat invites university rectors to endorse the Charter on behalf of their institutions. Their signature will constitute a commitment to secure the support of their university, teachers and students alike, in adopting and implementing environmental guidelines which are consistent with the Charter. The principles of action listed above are general and open-ended. It is left to each individual institution and its students and staff to give them substance compatible with local circumstances. Expressed in terms of specific guidelines, they should form a key element in the mission statement of the university concerned.

CRE

The Association of European Universities has over 520 universities or equivalent institutions of higher education in 41 countries. It provides a forum for discussion on academic policy, contributes to the institutional development of universities, and reflects on their role within European society. As a non-governmental organization, it represents the universities' point of view in governmental and non-governmental circles concerned with higher education in Europe. CRE organizes bi-annual conferences, training seminars for new university heads, and other meetings on issues of interest to its members. It also runs a number of interuniversity cooperation programmes.

ANNEX 2

SUSTAINABILITY PROGRAMS

School of Sustainability, Arizona State University

Bachelor of Arts in Sustainability

The B.A. program introduces students to the concept of sustainability in the context of real-world problems, exploring the interaction of environmental, economic, and social systems. The B.A. in Sustainability (vs. the B.S.) is best suited to students inclined towards social sciences, planning, and related fields.

Learning Outcomes

B.A. students will gain a general understanding of sustainability issues. They will be adaptable, capable of both communicating and learning across a number of disciplines, and have a strong orientation towards problem solving and quantitative methods. In addition to the common learning outcomes, B.A. students will be able to:

* Understand the concepts and methods of environmental economics, sociology, anthropology, environmental politics, ethics, design, and human geography relevant to the sustainability of environmental resources and social institutions.
* Apply these concepts and methods to developing sustainable institutions for water, land, air, and urban management at the local to global level.
* Evaluate the sustainability of environmental institutions, legal frameworks, property rights, and culture.

Bachelor of Science in Sustainability

The B.S. program introduces students to the concept of sustainability in the context of real-world problems, exploring the interaction of environmental, economic, and social systems. The B.S. in Sustainability (vs. the B.A.) is best suited to those inclined towards natural sciences or engineering.

Learning Outcomes

B.S. students will gain a general understanding of sustainability issues. They will be adaptable, capable of both communicating and learning across a number of disciplines, and have a strong orientation towards problem solving and quantitative methods. In addition to the common learning outcomes, B.S. students will be able to:

* Understand the concepts and methods of environmental economics, ecology, environmental biology, hydrology, environmental chemistry, engineering, earth-systems management, and other disciplines relevant to the sustainable use of environmental resources.
* Apply these concepts and methods to developing sustainable strategies for water, land, air, and urban management at the local to global level.
* Evaluate the sustainability of technology, the built environment, and their environmental regulations and policy.

Careers

Graduates will be able to move on to graduate-degree programs or gain employment in areas such as:

* Local, State, and Federal Government
* Industry
* Utilities
* Regulatory Agencies

The Earth Institute, Columbia University

The Earth Institute's overarching goal is to help achieve sustainable development primarily by expanding the world's understanding of Earth as one integrated system. We work toward this goal through scientific research, education and the practical application of research for solving real-world challenges. With 850 scientists, postdoctoral fellows and students working in and across more than 20 Columbia University research centers, The Earth Institute is helping to advance nine interconnected global issues: climate and society, water, energy, poverty, ecosystems, public health, food and nutrition, hazards and urbanization. With Columbia University as its foundation, The Earth Institute draws upon the scientific rigor, technological innovation and academic leadership for which the University is known. The Earth Institute encompasses centers of excellence with an established reputation for groundbreaking research, including the renowned Lamont-Doherty Earth Observatory, home to some of the world's leading scientists pursuing the study of Earth and its systems. The Earth Institute is implementing solutions to global challenges; pioneering research; advising national governments, the United Nations and other international agencies; and educating the next generation of leaders in sustainable development. While Earth is indeed at a critical crossroads, our work reflects the fundamental belief that the world has within its possession the tools needed to effectively mitigate climate change, poverty and other critical issues.

Eindhoven University of Technology's Core Course on Sustainability

The introductory course 'Technology and Sustainability' is a multimedia course. Starting from case studies (e.g. the design of a gasification unit) the basics of sustainability are introduced. This way students experience the direct relation between sustainability issues and their technical specialization. This experience is built upon in a multidisciplinary way and to deal with real day-to-day problems on sustainability. Students are also able to follow over twenty optional courses that are related to environmental issues, to deepen their insight into the relationship between technology and sustainability, and to broaden their view on sustainability.

Business Course Elements according to HE 21

HE 21 (1999): The Higher Education 21 Project, London. http://www.he21.org.uk/publicns.html

Corporate Responsibility	Environmental ethics and values	
	Social ethics and values	
	Corp. environm. & social responsibility / corp. citizenship	
	Individ. environm. & social responsibility / global citizenship	
	Environmental stewardship	
	Stakeholders and stakeholder management	
Systems Thinking and Methods	Systems thinking	
	Environmental systems / natural cycles	
	Limits to growth / carrying capacity	
	Applic. of systems thinking to the search for solutions	
Corporate Strategy and Change	The role of leadership/corporate visions	
	Long termism vs short termism	
	Converting threats into opportunities	
	Contribution of business to sustainable solutions	
	The role of lifelong learning	
	Sustainable economics	
Management Systems, Tools and Techniques	Environmental management systems principles	
	Environm. managem. systems standards (ISO 14001, EMAS)	
	Environmental reporting	
	Environmental impact analysis	
	Life-cycle analysis/input-output analysis	
	Product stewardship	
	Environmental / sustainability indicators	
	Social audit/social reporting	
Managing partnerships and networks	Stakeholder analysis	
	Rationale for external partnerships	
	Managing external partnerships	
	Rationale for inter and intra organisational networks	
	Managing networks	
	Corporate community investments	
Environmental legislation, policy and control	International, European and national environmental policy and law	
	Administration and enforcement	
	Fiscal instruments	
	Economic instruments	
	Integrated pollution control	
	Integrated transport policy	

Additional elements according to HE21

Balance between personal and organisational demands	
Methods of managing change	
Environm. influences on consumer behaviour; implications on marketing strategy	
Consideration of corporate image: marketing / PR	
Role of Quality Management in reducing waste in organisations	
Neg. influence of leisure on environment: overuse of pop. areas, countryside erosion	
Unsustainable tourism	
Planning effects of urban tourism	
Organisational support for learning, e.g. mentoring	
Gaia theory	
Deep ecology	
Rural issues	
Sustainable tourism operations & International Hotel Environment Initiative	
Environmental influence on R&D	
Environmental influence on technological innovation	
Green agenda	
Major threats to planet	
Ecodesign & manufacture	
Energy efficiency	
Waste management and waste minimisation	
Green marketing & purchasing	
Environmental communication & awareness-raising by campaign groups	
Product & process design	
Recycling	
Transport economics	
ISO 14001: due for incorporation in 1999	
Environmental reporting, SMEs and environmental management, individual environmental and social responsibility	
Environmental marketing, environmental communication	
Perspectives on change: incremental, transformational, and a critique of these	

UBC Social, Ecological, Economic Development Studies

Student, staff and faculty working towards sustainability in tandem.

In 2001, UBC launched western Canada's only academic program bringing together students, faculty, and staff in projects that address sustainability issues. To date SEEDS has saved the university hundreds of thousands of dollars and attracted more than 1,000 participants.

Projects include:
* Studying stormwater treatment alternatives.
* Finding innovative ways to market Fair Trade coffee.
* New ways to reduce pesticide use.
* Exploring a sustainable food system for campus.