HKUST 2020 Sustainability Challenge

Sustainability Education at HKUST

Sustainability Course Evaluation Report

September 2019
Report developed by the Sustainable Education Advisory Group (SEAG)

Executive Summary

As part of the HKUST 2020 Sustainability Challenge, the University included a commitment to ensuring that all students gain a solid understanding of sustainability concepts and graduate with the capacity and commitment to solve problems locally and globally.

This report documents the on-going efforts of the Sustainability Education Advisory Group (SEAG) to achieve this goal, based on the previous report that was completed in June 2018, for assessing the breadth and depth of sustainability education across the curriculum at HKUST. This report includes:

1. *Updated results of a preliminary evaluation of sustainability coverage across the 2017-19 UG course catalogue;*
2. *Updated results from a faculty self-assessment exercise; and,*
3. *Key findings and recommendations for moving forward.*

Highlights from the report:

- *Overall, Sustainability Focused or Related courses represent roughly 6% of the overall UG course catalogue.*
- *In 2018-19, Sustainability Focused or Related courses represented roughly 14% of the approved new courses.*
- *By distribution, all schools and all departments include at least one listed course. SENG has the largest overall number of listed courses among schools, and ENVR, CIVL, and SOSC having the highest number of listed courses among departments.*
- *In terms of exposure to sustainability concepts, we note that 57% of recent graduates are leaving with a ''strong'' exposure (completing two or more Sustainability Focused courses); only 6% of students graduated with no course exposure to sustainability.*

Introduction and Definition of Terms

In June 2016, a sustainability master plan for HKUST (called the HKUST 2020 Sustainability Challenge) was approved by University Council, setting in motion activities intended to raise our sustainability performance and profile. One of the goals of the Challenge is to ensure that *all students gain a solid understanding of sustainability concepts and graduate with the capacity and commitment to solve problems locally and globally*.

We feel quite confident that *some* of our students meet the Sustainability Foundation goal. The "challenge" is to reach *all* of our students.

One way to achieve this objective is to make sure that sustainability is largely distributed across all Schools and disciplines so that regardless of major, concentration, or academic pathway, all students will come in contact with sustainability principles, ideas, and content through their coursework.

What is Sustainability Education?

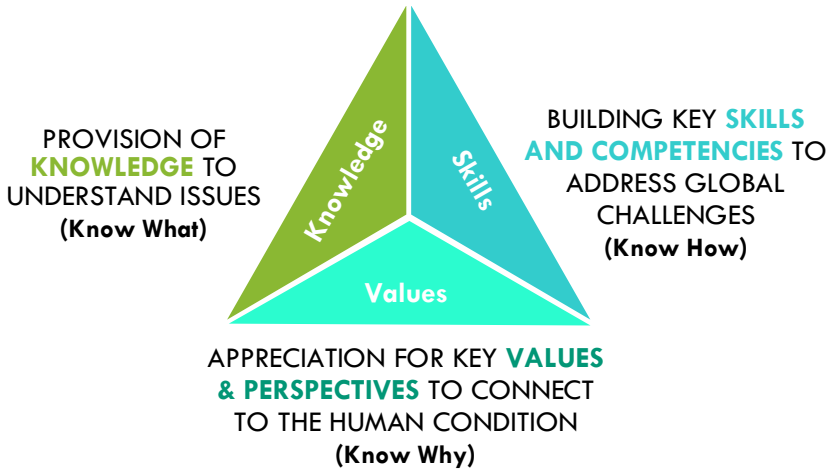
SEAG Members were asked to share their views on the character of sustainability education. The discussion stressed several key themes and key words:

- inter-disciplinary
- inclusive
- multigenerational
- thinking across time and space
- building a common language of values
- identifying and solving problems

There was broad agreement that sustainability education is the foundation for preparing students to meet the challenge of *creating the conditions for human thriving over time within planetary boundaries*. To achieve this, the SEAG agreed that sustainability education is built through the interplay of:

- Relevant **knowledge and understanding** of the issues, supported by…
- An appreciation for **values and perspectives**, creating the foundation to build…
- The **skills and competencies** necessary to address the challenge of a sustainable future

Figure 1: Sustainability Education Framework



The three domains reinforce each other to build a comprehensive sustainability education framework that allows students to see the connections between *what* issues need to be addressed, the values that influence *why* we should act, and the skills that provide the insights on *how* to act.

Course Criteria

As stated in the previous report, the SEAG has undertook several exercises to define the terms relating to sustainability, sustainability education, and sustainability courses. As a result, the SEAG has agreed upon that sustainability education is built through the interplay of:

- Relevant **knowledge and understanding** of the issues, supported by…
- An appreciation for **values and perspectives**, creating the foundation to build…
- The **skills and competencies** necessary to address the challenge of a sustainable future

The SEAG also further developed a sub-list of criteria to help in evaluating core areas that are associated with sustainability education. The list of criteria is further broken down into key concepts, as detailed in Appendix A.

Values	Knowledge and Understanding	Skills and Competencies
1. Human responsibility within the environment 2. Human responsibility within society 3. Human behaviour	4. Natural limits 5. Business and economics 6. Science and technology 7. Planning and design 8. Governance	9. Systems thinking 10. Collaboration & communication 11. Futures thinking 12. Critical thinking & complex problem solving

Preliminary Evaluation

With these previously defined sustainability criteria, we reviewed the UG catalogue again, focusing on any newly offered course in the 2018-2019 academic year. The preliminary review includes identifying any keywords or concepts included in the course descriptions which suggest the course may cover sustainability concepts throughout its delivery. Apart from courses that had keywords in their description which overlap with the pre-defined sustainability course criteria, courses which has no overlap in wordings but the descriptions itself suggested that it may be sustainability related were also shortlisted for further investigation.

As a result, ***a total of 99 newly offered courses were reviewed and an addition of 14 courses were identified as potentially relevant to sustainability education, representing 14% of the newly offered courses.***

To further evaluate the existing courses in the catalogue – and to help identify gaps and areas of opportunity– the SEAG decided to break the courses into two categories: "sustainability focused," and "sustainability related."

1. Sustainability focused courses – these courses may be broad and cover a wide breadth of sustainability concepts, content, issues, and contemporary thinking, or they may be narrowly focused and address one or more sustainability issues or concepts in depth. In both cases, the course is primarily focused on sustainability.
    - ✓ A focused course must concentrate on sustainability in **at least 75%** of class time, and incorporate elements of sustainability criteria within the course material (readings, discussions, and assignments).
2. Sustainability related courses – these courses are focused on a topic other than sustainability, but have sustainability ideas, principles, or content embedded within specific parts of the curriculum.
    - ✓ A sustainability related course spends **at least 25%** of class time covering one or more of the sustainability criteria within the course material (readings, discussions, and assignments).

Faculty Self-Assessment Exercise

In order to further investigate and assess the shortlisted courses at a more in-depth level to ensure they are designated to "sustainability focused" or "sustainability related" courses accurately. We have previously developed a survey tool which was distributed to faculty members who teach the courses that are potentially relevant to sustainability education.

The survey tool was developed based on the previously defined sustainability criteria, asking the faculty to provide detail information of which sustainability criteria their course would cover.

In addition to the previously 76 course surveys that were returned, we received 13 more surveys, which bring us to a total of 89 course surveys returned (76% of identified courses) of which four were cross listed.

Based on the previous report, the results after Self-assessment results were as follows:

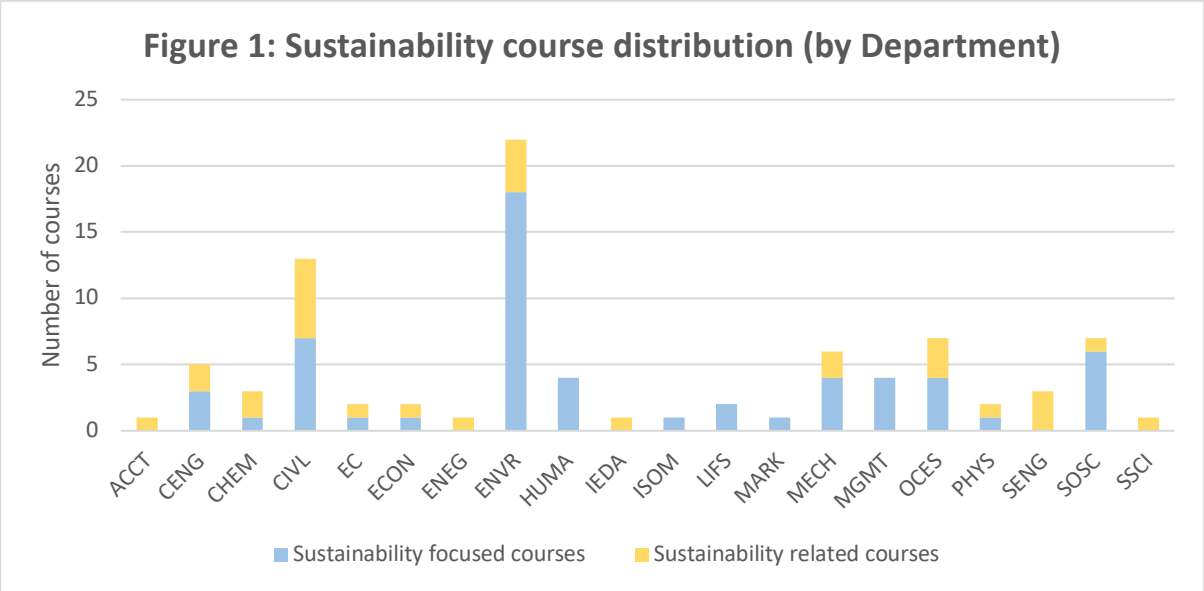
- Sustainability focused courses: 49 existing, plus 6 new in 2018-19 (55 total)

- Sustainability related courses: 13 existing, plus 5 new in 2018-19 (29 total)

The courses are distributed somewhat evenly by level (Table 1).

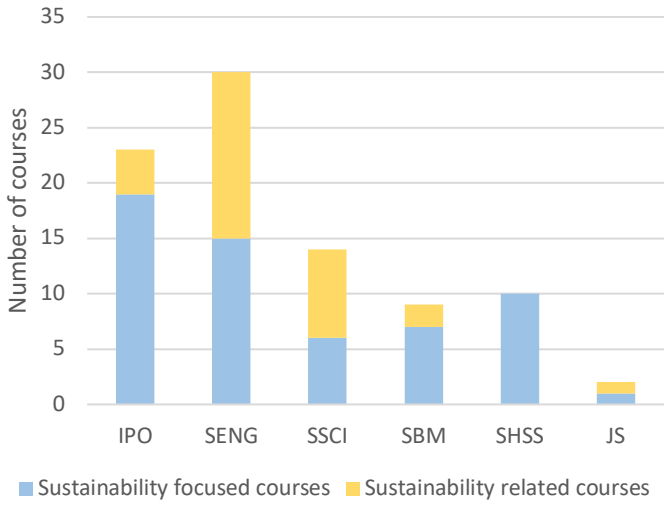
Table 1: Updated Sustainability Course Designations (distribution by level)

	Sustainability Focused	Sustainability Related
1000 level	18	7
2000 level	15	4
3000 level	13	7
4000 level	9	11
TOTAL	55	29



Out of the 1,322 UG courses that were offered from 2017-2019 summer, 84 (6% of total UG courses) have been identified as courses that are relevant to sustainability education. By department, ENVR and CIVL offer most courses that are relevant to sustainability education (both "focused" and "related" courses). Some department offers only "focused" courses and some offers "related" courses with no significant correlation.

Figure 2: Sustainability course distribution (by School)



By school, it is apparent that SENG offers the most courses that are relevant to sustainability education. However, according to Figure 1, we should note that most of the sustainability courses are offered by CIVL, CBE and MAE, which means the exposure of sustainability education to engineering students may be more limited to those that are studying the aforementioned discipline only. The previous report also stated that around 30% of the departments offer no sustainability courses, and therefore it will depend on the individual students to make decision on their study pathway in order to gain knowledge of concepts related to sustainability.

Evaluation of Sustainability Exposure

As an attempt to analyse student exposure to sustainability education, we retrieved the enrolment data for recent graduates from ARO (any students who graduated from 2017 fall to 2019 summer) and mapped it against the 84 identified "sustainability focused" and "sustainability related" courses. This will allow us to evaluate how many students graduated with an exposure to sustainability concepts throughout their undergraduate studies. It will also allow us to determine whether the students are graduating with an elementary or substantial understand of sustainability.

We will separate the graduates into the following two groups for comparison

- ***2017/18 academic year*** *(students who graduated from 2017 fall to 2018 summer)*
- ***2018/19 academic year*** *(students who graduated from 2018 fall to 2019 summer)*

In 2017/18 academic year, 2204 graduates (95%) enrolled in at least 1 sustainability course. Of those, 779 graduates (33%) completed only 1 sustainability course.

In 2018/19 academic year, 1887 graduates (94%) enrolled in at least 1 sustainability course. Of those, 682 (34%) completed only 1 sustainability course.

From this preliminary result, we can assume that at least 33% and 34% of graduates are gaining an elementary understanding of sustainability for 2017/18 and 2018/19 academic year respectively, while 62% and 60% are potentially gaining a medium to substantial exposure of sustainability concepts. And 5% and 6% of students are potentially receiving little to no understanding or exposure to sustainability upon graduating for both year.

We will now break the statistics down into more detail to look at the level of exposure the graduates are receiving and whether there is any correlation to which school the graduates are from.

Any courses that are listed as "sustainability focused" implies that over 75% of class time is dedicated on covering sustainability concepts, while "sustainability related" courses implies over 25% (and no more than 75%) of class time is spent on sustainability related concepts.

For student to gain a strong exposure of sustainability concepts, we believe the student should complete at least 2 "sustainability focused" courses. While students who only enrolled in "sustainability related" courses can be considered as having a elementary to medium exposure to sustainability.

In 2017/18 academic year, *1367 graduates (59%) enrolled in at least 2 sustainability focused courses. 837 graduates (36%) completed only 1 sustainability focused course and sustainability related courses. Of those, 147 (6%) completed sustainability related courses only.*

In 2018/19 academic year, *1143 graduates (57%) enrolled in at least 2 sustainability focused courses. 744 graduates (37%) completed only 1 sustainability focused course and sustainability related courses. Of those, 136 (7%) completed sustainability related courses only.*

From this, we can determine that for 2017/18 and 2018/2019 academic year, 59% and 57% of the graduates had a substantial exposure to sustainability education upon graduation. While 30% of the graduates for both year received a medium exposure to sustainability concept during their study at HKUST.

Figure 3. Level of exposure to sustainability education of graduates by school (2017/2018 academic year)

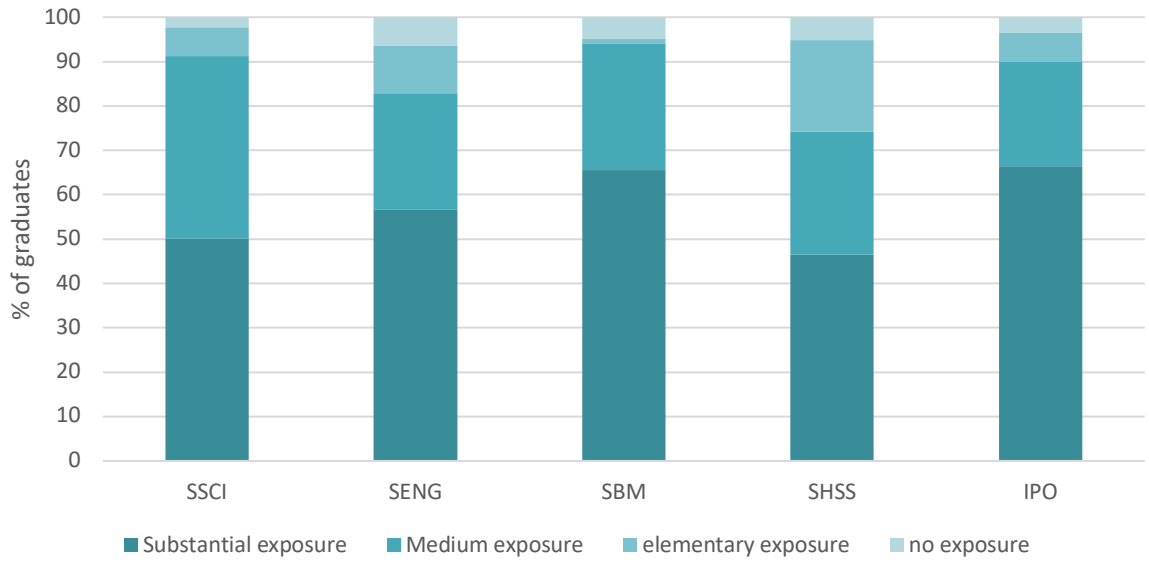


Figure 4. Level of exposure to sustainability education of graduates by school (2018/2019 academic year)

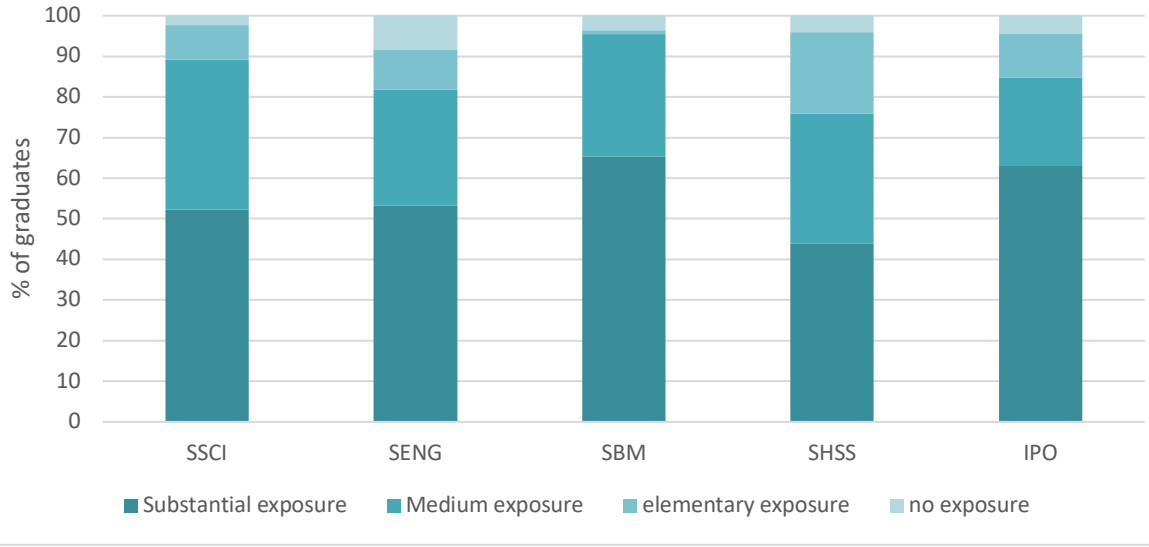


Figure 3 and 4 shows the exposure level of the graduates to sustainability education by school for 2017/2018 and 2018/2019 academic year respectively.

It is apparent that IPO and SBM have higher % of graduate with strong exposure to sustainability educations than the other school. (66%, 65.5% for 2017/18 and 63%, 65% for 2018/19 academic year respectively). Graduates from SBM also have the least % of graduate with elementary exposure (1% for both year), meaning a higher proportion of SBM graduates gained medium or substantial exposure of sustainability education during their study.

Out of all the school, graduates from SHSS have the least % of graduate with substantial exposure for both academic year (46.5% and 44%), while they have the highest % of graduates with only elementary exposure for both academic year (20.6% and 20%).

For both academic year group, graduates from SENG have the highest % of graduates with no exposure (6.4% and 8.2% respectively), while graduates from SSCI have the lowest % of graduates with no exposure (2.3% and 2.3% respectively)

The overall result shows that this is short of the University's 2020 education goal of ensuring that *all students gain a solid understanding of sustainability concepts*. The result suggested a high percentage of graduates are receiving medium to substantial exposure to Sustainability concepts, however, our next target is to reach all the students.

It is also important to note that the level of exposure to sustainability education of the graduate is quite similar for the 2 different academic year group. This in terms suggest that the exposure level of student rely on their discipline heavily. Further study of mapping the sustainability course list against major requirement for different school would allow us to identify more accurately how many majors do not have required sustainability courses.

Conclusion and recommendation

As suggested in the previous report, the assessment result demonstrates that sustainability ideas and concepts are permeating across all schools and in many departments. According to the comparison between the graduates in 2017/2018 and 2018/2019, it is also suggested the level of sustainability education exposure to student depends heavily on their major or which school they are in.

In additional to the previous report, this shows that it is clear work is still needed to ensure that *all students* graduate with a solid understanding of sustainability concepts.

In order to meet the university's 2020 education goal, we would recommend the following two initiative for reaching a higher level of sustainability literacy.

1. Develop a branding system for easily identifying sustainability coursework and require all students to take at least one sustainability branded common core course.

By developing a branding scheme for distinguishing the sustainability-focused in the course catalogue, we can enable the students to identify sustainability easily and quickly for designing their own sustainability learning pathway.

A branding scheme would also act as an incentive for faculty to (a) complete the self-assessment, and (b) adjust their course materials in order to qualify for a designation, thus contributing to the university education goal.

2. Develop and implement a Sustainability Minor for interested students to supplement their studies with a more structured framework for understanding sustainability within the context of skills, values, and knowledge.

As the previous report concluded, the result of the assessment exercise indicated that there was sufficient breadth and depth of coursework to support an academic minor that is cross-disciplinary. By developing a sustainability minor, we can provide a more structured framework for the interested students to make appropriate decision for a learning pathway that is most suitable for them. It can also be an incentive for students that they can pursue their interest in sustainability for a minor as a recognition.

Appendix A: Sustainability Criteria

	Criteria	Key Concepts
VALUES	**Human responsibility within the environment** *Exploring the morality underlying how humans interact with natural surroundings, particularly through the lens of fairness and responsibility for future generations*	• Environment-related Sustainable Development Goals • Environmental justice • Valuing eco-system services for future generations • Ecological citizenship in terms of protection of the public environmental good • Appreciation, empathy, and nurturing of environmental values
	Human responsibility within society *Exploring the social factors that limit human thriving and global quality of life*	• Social justice and responsibility • Social-focused Sustainable Development Goals • Universal Declaration of Human Rights • Poverty reduction • Equity (e.g., income distribution, Gini coefficient) • Gender equality • Actions that degrade human well-being
	Human behaviour *Exploring how culture, social networks, and personal identity can shape human behaviours in ways that impact our ability to act in sustainable ways*	• Institutional theory and dynamics of social change • Behaviour economics • Change management • Strategies for pro-environmental behaviors (e.g., Community-Based Social Marketing) • Environmental psychology • Reflecting upon diverse perspectives (e.g., moral relativism, social norms, identities)
KNOWLEDGE	**Natural limits** *Exploring the finite capacity of natural ecosystems (including the global ecosystem) and their ability to support human needs*	• The Anthropocene • The biosphere, ecological risks, biodiversity • Understanding of planetary systems (air, water, or soil) • Food systems • Demographic trends • Natural capital and limits to growth
	Business and economics *Exploring the market conditions that create ''market failures'' with respect to the environment or society, and examining business and economic strategies that can better maintain the integrity of ecosystems*	• The circular economy • Sustainability business strategies (e.g., auditing, reporting, green finance) • Tragedy of the commons, externalities, or other market failures • Global patterns of production and consumption
	Science and technology *Exploring the role of basic science and technology (broad and individual technologies) specifically in mitigating harmful impacts to humans and the natural world*	• Transitions to renewable, zero-carbon energy • Green technologies to preserve oceans, forests, and agriculture • Technologies to generate efficiency, conservation, and productivity • Mitigating pollution, waste, and effluence • Smart cities strategies
	Planning and design *Exploring concepts from local and regional planning, infrastructure development, and product design to mitigate harmful impacts to humans and the natural world*	• Sustainable urban environments • Green building design • Product design for sustainability outcomes • Urban infrastructure (e.g. transport, waste management)

	Governance *Exploring how legal frameworks and government policies impact society and the natural world*	• Political and economic organisations • Policy for sustainability (e.g., codes, standards, and regulations) • Governing for public good (e.g., public investment, incentives, public relations campaigns) • Legal frameworks (e.g., property rights, trade agreements)
SKILLS	**Systems thinking** *Building a holistic perspective, recognising interconnectedness and interdependence across multiple scales*	• Resilience and robustness • System dynamics (e.g., feedback loops, tipping points) • Unanticipated consequences and trade-offs • Qualitative / quantitative systems analysis • Life-cycle thinking and whole-life cost analysis
	Collaboration & communication *Building interdisciplinary thinking and a capacity to work with others to resolve sustainability problems*	• Communicating for sustainability outcomes • Negotiation, mediation, or conflict resolution • Team-building for sustainability causes • On/off-site experiential learning • Stakeholder engagement
	Futures thinking *Building an orientation to the long-term, with the ability to anticipate future challenges, risks, and opportunities*	• Assessing sustainability-related risks • Forecasting / backcasting • Scenario planning • Simulation modelling • Strategic planning • Adaptation and mitigation strategies
	Critical thinking and complex problem-solving *Building a foundation for evaluating the credibility of data and ideas, and the capacity to develop and implement meaningful solutions*	• Analysis of news cycles and media depictions of events • Objective development of judgements and persuasive arguments • Principled reasoning • Multi-criteria assessment models • Impact assessment methods • Creativity and innovation • Critical data analysis and interpretation

Appendix B : Updated sustainability courses

SUSTAINABILITY FOCUSED		SUSTAINABILITY RELATED	
CENG4130	Plant Design and Economics	ACCT1010	Accounting, Business and Society
CENG4720	Environmental Impact Assessment and Management Systems	CENG3230	Reaction and Reactor Engineering
CENG4912	Chemical and Environmental Engineering Project	CENG4710	Environmental Control
CHEM1004	Chemistry in Everyday Life	CHEM4310	Environmental Chemistry
CIVL /ENVR1150	Climate Change Impacts and Extreme Weather Events	CHEM4320	Environmental Analytical Chemistry
CIVL1140	Environmental Quality Control and Improvement	CIVL1160	Civil Engineering and Modern Society
CIVL1170	Big History, Sustainability and Climate Change	CIVL2410	Environmental Assessment and Management
CIVL3420	Water and Wastewater Engineering	CIVL3610	Traffic and Transportation Engineering
CIVL3510	Hydrosystems Engineering	CIVL4100H	Water, Energy and Climate Challenges in Smart Cities
CIVL4450	Carbon Footprint Analysis and Reduction	CIVL4440	Environmental Systems Analysis
CIVL4460	Process Design of Environmental Engineering Facilities	CIVL4620	Transportation System Operations
ECON4434	Economic Development and Growth	ECON2310	Introductory Environmental and Health Economics
ENTR3030	Social Innovations & Entrepreneurship	ENEG/MECH3110	Materials for Energy Technologies
ENVR 3010O	Sustainable Urban Development and Responses to Climate Change	ENGG1110	Engineering Solutions to Grand Challenges of the 21st Century
ENVR/SOSC2310	Introductory Environmental and Health Economics	ENGG1130	The Impact and Value of Technology Innovation
ENVR1030	Environment and Health	ENGG2990J	Systems Design Engineering
ENVR1040	The Environment and Society - A Comprehensive Perspective	ENTR 1001	Entrepreneurship 1001: Building Your Own Future
ENVR1050	The Sustainable Citizen	ENVR3220	Energy Resources and Usage
ENVR1070	Thinking Big: Systems Thinking for Environmental Problems	ENVR4000O	Climate Modelling and Risk Assessment
ENVR1080	The Smart Consumer - Uncovering the Hidden Story behind the Product Label	ENVR4320	ESG Management and Reporting
ENVR2002B	Life Cycle Analysis	ENVR4330	Environmental Geographical Information System
ENVR2010	Environmental Science Fundamentals	ENVS3004	Global Climate Change
ENVR2020	Urban Air Pollution	ENVS4001	Environmental Impact and Risk Assessment
ENVR2040	Life Cycle Assessment	ENVS4905	Marine Molecular Biology and Ecology
ENVR3003	Green Buildings and Energy Efficiency	IELM2150	Product Design

ENVR3010G	Sustainability Thinking
ENVR3110	Sustainable Development
ENVR3310	Green Business Strategy
ENVR3410	Economics for Environmental Policy and Management
ENVS2001	Environmental Conservation and Sustainability in Practice
ENVS2004	Introduction to Ocean Science
ENVS4301	Environmental Conservation
HUMA2595	Science, Technology and Modern Life
HUMA2597	Environmental History
HUMA2621	Culture and Environment
HUMA2623	Cultural Sustainability in South China
ISOM1700	Critical Issues in Business Operations
LIFS/OCES2011	A Practicum on Wetland Conservation
LIFS1030	Environmental Science
MARK1220	Marketing and Society
MECH1902	Energy Systems in a Sustainable World
MECH1905	Buildings for Contemporary Living
MECH1906	Mechanical Engineering for Modern Life
MECH4350	Indoor Air Quality in Buildings
MGMT2010	Business Ethics and the Individual
MGMT2130	Business Ethics & Social Responsibility
MGMT3160	Environmental Business Strategies
MGMT3170	Managing CSR (Corporate Social Responsibility)
PHYS1003	Energy and Related Environmental Issues
SOSC1860	Population and Society
SOSC2170	Environment, Sustainability and Business: A Design Approach
SOSC3260	Sustainability Science: Problems and Perspectives
SOSC3540	Psychology of Environmental Sustainability
SOSC4290	China's Sustainable Development
SUST1000	Introduction to Sustainability
MECH3420	Engineering Materials II
PHYS1001	Physics and the Modern Society
SCIE1120	Chemistry and Life
SOSC3880	Social Inequality and Social Mobility