Leveraging AI and NLP to Evaluate Sustainability in the Curriculum.

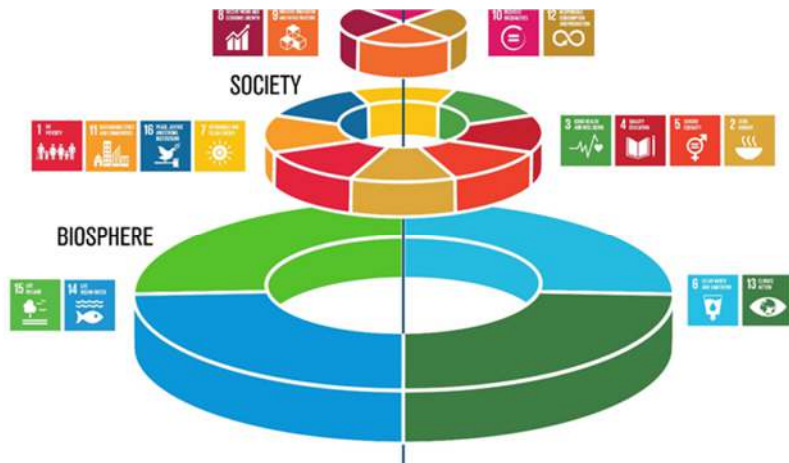**DigitalEd**

17th May 2023

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TU Dublin is a registered charity **RCN 2020475**

OLLSCOIL TEICNEOLAÍOCHTA
BHAILE ÁTHA CLIATH

TU DUBLIN

TECHNOLOGICAL
UNIVERSITY DUBLIN

Reflective Mapping Tools

- UCC – **SDG Toolkit**
- DeMontford – **SDG Planning Toolkits**

TU's Strategic Intent

Developing Responsible Global Citizens

We are co...

All programmes will have sustainability as a learning outcome and every learner will engage in practice-based research

Sustainable Development

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

- **Gro Harlem Brundtland**
  Prime Minister of Norway (1981, 1986–89, and 1990–96) and Director-General of the World Health Organization from 1998 to 2003

Value Driven ....

GETTING STARTED WITH
THE SDGS IN UNIVERSITIES

A GUIDE FOR UNIVERSITIES, HIGHER EDUCATION, AND THE ACADEMIC SECTOR

Education for
Sustainable Development Goals
Learning Objectives

Education 2030

GreenComp

The European sustainability competence framework

THE GLOBAL GOALS
For Sustainable Development

1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE AND JUSTICE STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS

AdvanceHE   QAA

Education for Sustainable Development
in Higher Education Practice Guides

Accreditation Criteria Overview

Programme Outcomes

PO1	Knowledge and Understanding
PO2	Problem Analysis
PO3	Design
PO4	Investigation
PO5	Professional and Ethical Responsibilities
PO6	Teamwork and Lifelong Learning
PO7	Communication
PO8	Engineering Management

Programme Areas

PA1	Science and Mathematics
PA2	Discipline-specific Technology
PA3	Software and Information Systems
PA4	Creativity and Innovation
PA5	Societal and Business Context
PA6	Engineering Practice
PA7	Sustainability

Programme Management

PM1	Entry Standards, Transfer and Mobility
PM2	Duration and Structure
PM3	Objectives, Resourcing and Viability
PM4	Assessment of Student Performance
PM5	Programme Development and Quality Assurance

PA7. Sustainability

The engineering profession has a critical role to play in sustainability and climate change mitigation and adaptation. Students need to be familiar with the impact of their work on the three pillars of sustainability (environmental impact, social impact and economic impact) and should aspire to be leaders in engineering climate action. Students should be introduced to specific sustainability concepts such as net zero carbon, resource efficiency, circular economy and whole-life cost. Engineers also need to be aware of the global and multi-cultural context of their work.

Students should be exposed to, for example, the UN Sustainable Development Goals the 'blueprint to achieve a better and more sustainable future for all', consisting of 17 goals to be achieved by 2030. The SDGs and targets will be updated and not every programme can be expected to cover each SDG in depth, the relevance of certain SDGs varies by branch of engineering.

Students should also develop competences for achieving the SDGs. The Curriculum Framework for the Sustainable Development Goals (2017) outlines five core competences for achieving the SDGs (which have been attributed to the above Programme Outcomes):

- Critical thinking and reflection (Problem Analysis) – learning to question our current belief systems and to recognise the assumptions underlying our knowledge, perspectives and opinions.
- Envisioning (Design) – being able to imagine a better future, establishing a link between long-term goals and immediate actions, and to motivate people to take action by harnessing their deep aspirations.
- Systemic thinking (Knowledge & Understanding, Investigation) – acknowledging complexities and looking for links and synergies when trying to find solutions to problems.
- Building partnerships (Teamwork, Communication) – promoting dialogue and neg... together, so as to strengthen ownership of and commitment to sustainable action... learning.
- Participation in decision making (Professional & Ethical Responsibilities, Enginee... empowering oneself and others, being involved and involving people in joint analy... local decisions.

ENGINEERS IRELAND

GreenComp

The European sustainability competence framework

PRI — Principles for Responsible Investment

PRME — Principles for Responsible Management Education

CHARTERED ACCOUNTANTS IRELAND

RIAI

GRI — Global Reporting Initiative

SOCIETY OF CHARTERED SURVEYORS IRELAND

ENGINEERS IRELAND

European Degree System

Programmes

- 3 – 4 years Undergradaute
- 1 – 2 Years Post Gradaute
- Semester – 2 per year
- Module – 6 per semester
- ECTS – 5 or 10 per module
- Programme Level Outcomes
- NQF Level

Module

- Codes, ECTS, NQF Level
- Intended Learning Outcomes
- Indicative Syllabus
- Learning and Teaching MEthods
- Assessments
- Learning Resources

Example: Corporate Strategy & Governance

Learning Outcomes

Upon successful completion of this module the learner will be able to

#	
MLO1	Evaluate key strategic environmental factors
MLO2	Critically assess key organizational strategic capabilities
MLO3	Formulate business-level and corporate-level strategic decisions
MLO4	Explain the strategic importance of business and marketing ethics and corporate social resposbility for contemporary organisations
MLO5	Comprehend theories of ethics and social responsibility and apply critical reasoning within business context
MLO6	Evaluate ethical and corporate governance issues in relation to managerial decision-making

Requisites

Requisite Type	Module Title	Type
No requisites exist.		

Module Details

Module Code:	BPOL H1001
Module Long Title:	Corporate Strategy & Governance APPROVED
Banner Title:	
Version:	3
Indicative NFQ level:	Level 8
Valid From:	Sept 2018 (September 2018)
Language of Instruction:	English
ECTS Credits::	5
ISCED Code:	0414 - Marketing and advertising

Module Type
No Module study modes listed

Current Coordinator::	Joyce Byrne-Walsh
Module Coordinators:	Joyce Byrne-Walsh (01 September 2018 to ---)
School Responsible:	Tallaght Campus (TA)
Campus:	Tallaght
Module Overview	This module aims to provide students with a comprehensive understanding of the process of determining strategic position, making strategic choices and putting strategy into action. More here from Ciara ....

Indicative Syllabus
1. Introduction
1.1) Introducing corporate strategy and governance
2. The Strategic Position
2.1) The environment, strategic capability, expectations and purposes
3. Strategic Choices
3.1) Business-level strategy, corporate-level strategy strategy
4. Theories of Ethics & Corporate Social Responsibility
4.1) Main Ethical Approaches: Virtue-based; Deontological; Teleological; Ethical Learning & Growth
5. Organisational Responses to Ethical Issues
5.1) Corporate Responsibility, Corporate Citizenship & Corporate Governance; Sustainability; Ethical Confirmance: Codes, Standards, Culture, Leadership & Citizen Power
6. Contemporary Issues
6.1) Contemporary Issues relating to Corporate Strategy & Governance

Module Content & Assessment

Assessment Breakdown	%
Formal Examination	50.00%
Other Assessment(s)	50.00%

Assessments

Formal Examination

Assessment Type	Written Examination	% of Total Mark for Module	50
Indicative Week	End-of-Semester (Inactive)	Learning Outcomes	1,2,3
Semester	Not Yet Determined	Assessment Threshold:	
Assessment Role		Assessment Authenticity	
Pass/Fail	No		

Assessment Description
End-of-Semester Final Examination

Other Assessment(s)

Assessment Type	To Be Confirmed	% of Total Mark for Module	35
Indicative Week	n/a (Inactive)	Learning Outcomes	1,2,3,4,5,6
Semester	Not Yet Determined	Assessment Threshold:	
Assessment Role		Assessment Authenticity	
Pass/Fail	No		

Assessment Description
The continuous assessment may take the form of a group project which researches, analyses and documents the corporate, governance and ethical strategies of a listed public company, involving a report and presentation.

Assessment Type	Journal/Reflective Journal	% of Total Mark for Module	15
Indicative Week	n/a (Inactive)	Learning Outcomes	4,6
Semester	Not Yet Determined	Assessment Threshold:	
Assessment Role		Assessment Authenticity	
Pass/Fail	No		

Assessment Description
Students may be required to prepare a reflective journal indicating what they have learned from their assignment and their study of this module.

Reassessment Requirement	
A repeat examination	
Reassessment of this module will consist of a repeat examination. It is possible that there will also be a requirement to be reassessed in a coursework element.

Recommended Reading List

Recommended Book Resources

Johnson, G., Scholes, K., Whittington, R.. (2017), Exploring Corporate Strategy. Text & Cases, 11th edition. Prentice Hall.
Colin Fisher, Alan Lovell. (2012), Business ethics and values, 4th. FT Prentice Hall, [ISBN: 9780273716167].

This module does not have any journal article/paper resources

Other Resources

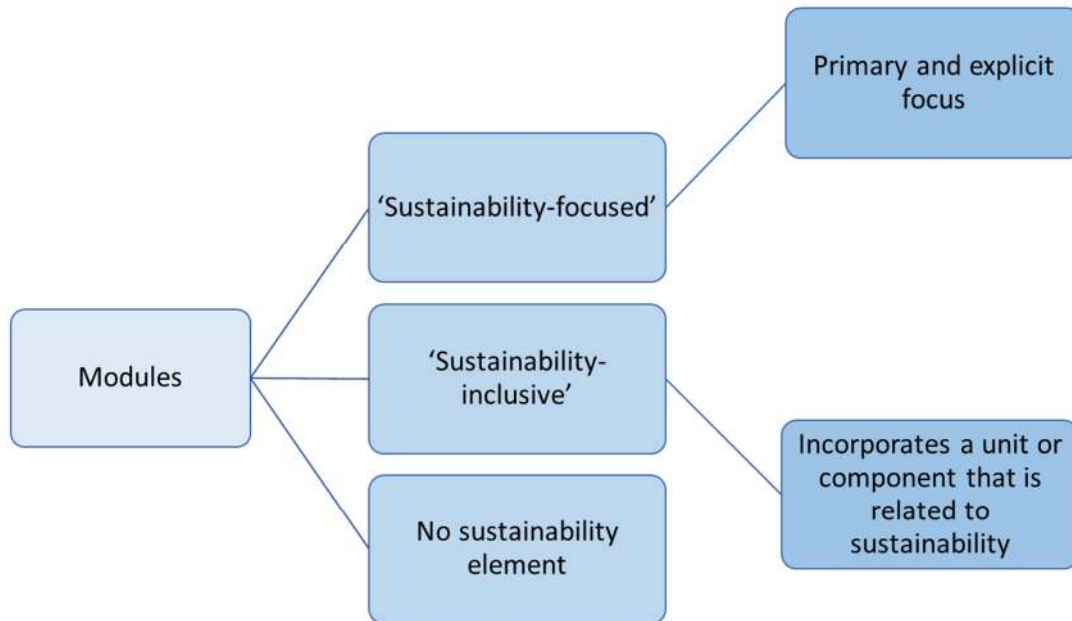Various, Video and Case Studies.

Essential Reading List	

Two key questions …...

- To what extent is sustainability embedded?
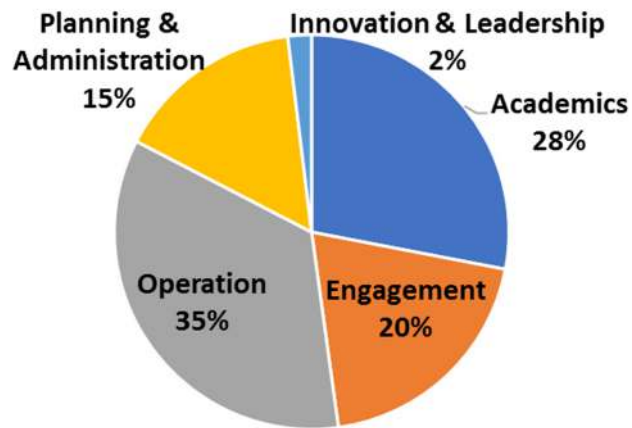
- How do we map modules to specific SDGs?
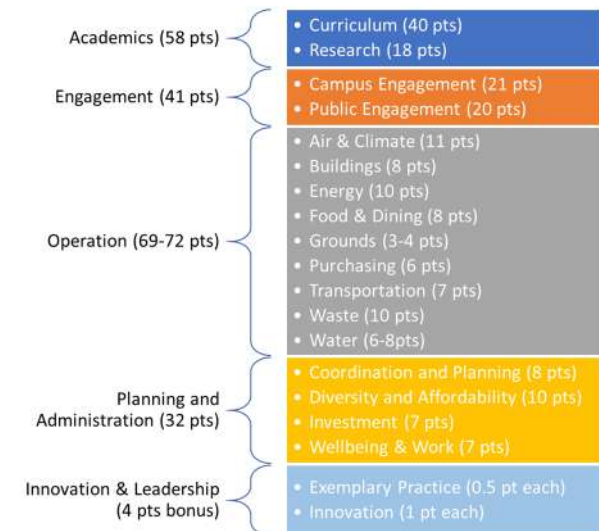
STARS Categorisation of Courses/Modules

The course will examine the health impacts of environmental degradation and pollution, with a focus on the concept of environmental justice.
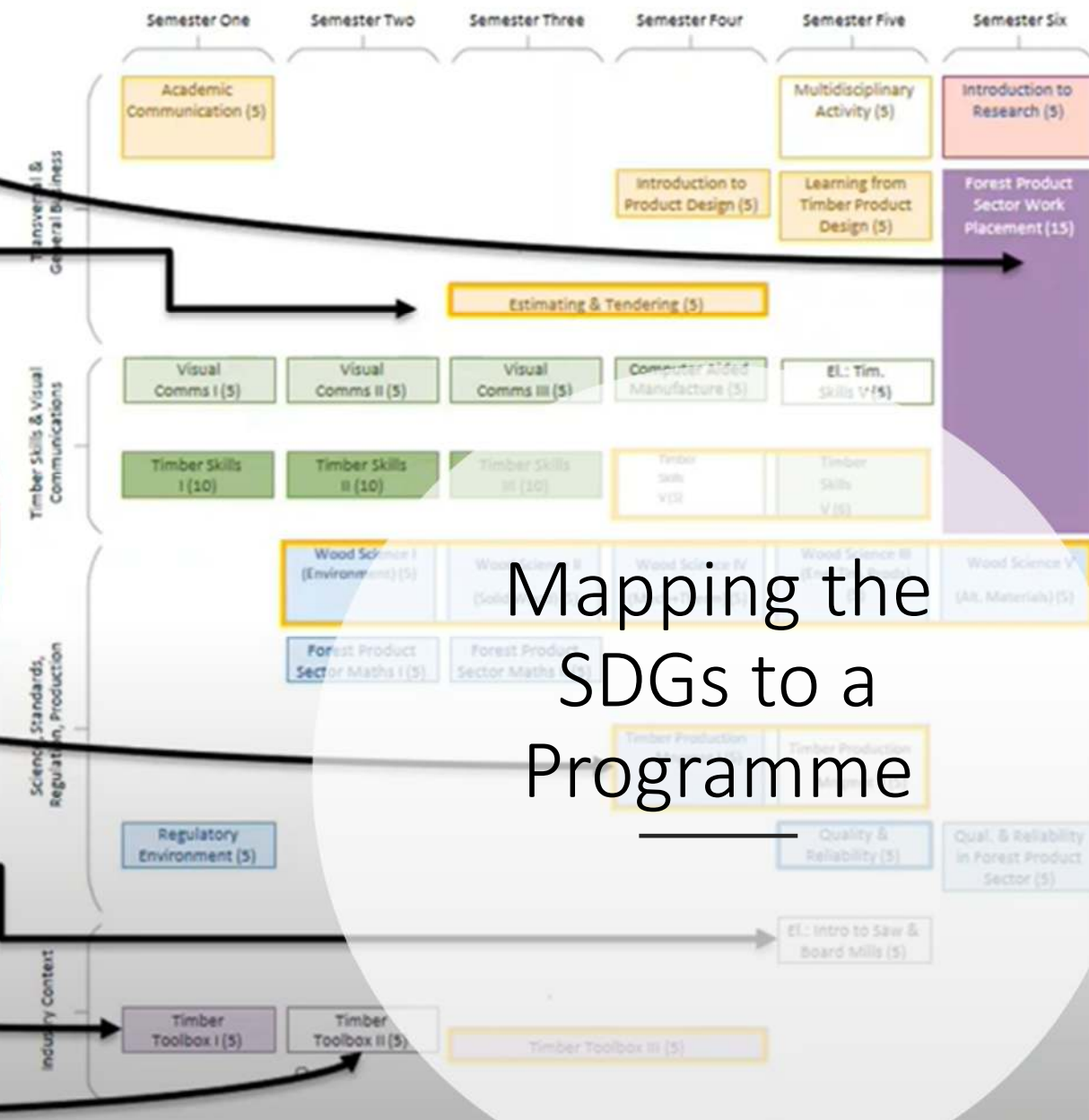
The course includes a module on "ESG (environmental, social and governance) Criteria" that addresses corporate social and environmental responsibility in a global context.

aashe
The Association for the Advancement
of Sustainability in Higher Education

Modules
- 'Sustainability-focused' → Primary and explicit focus
- 'Sustainability-inclusive' → Incorporates a unit or component that is related to sustainability
- No sustainability element

The STARS Credit System for a University

Mapping the SDGs to a Programme

Automated SDG Alignment Mapping Tool

- Identify root keywords (RK)

- Attribute a Sustainability Importance (SI) Score to each RK

- Determine the likely SDGs from the presence of RKs

- Calculate a SI for each module and programme

- Categorise using AASHE-STARS each module based on its SI Score

Calculating Sustainability Importance (SI) Score

$$RK_{SI} = \frac{No.\ of\ times\ the\ RK\ appears\ in\ the\ targets\ and\ indicators}{No.\ of\ SDGs\ in\ which\ the\ RK\ appears}$$

Examples of Root Key Words (RKs)

recycl	1	green	3	vehicle	5
relig	1	economic	3	ventilat	5
renewable	1	environmental	3	waste	5
resilient	1	social	3	wastewater	5
resistant	1	good governance	3	water	5
resource	1	Biodiesel	4	wells	5
restore	1	Carbon Dioxide	4	all-natural	6
rights	1	Carbon Emissions	4	alternative	6
road	1	Carbon Footprint	4	balanced	6
safe	1	Carbon Offsets	4	beneficial	6
sanitation	1	Climate Change	4	biobased	6
		Composting	4	biodegradable	6
				biodynamic	6
				chemical-free	6

SDG Automated Tool Outputs

- Sustainability Focused
- Sustainability in Mind
- No Sustainability Elements

- Most Likely SDGs
- Other Possible SDGs

Example – Academic Communications module

Root Keywords detected in the Module Description

support,enviro,academ,

DESCRIPTION

Academic Communications -This module is delivered in two parts. The first part introduces the learner to the key academic tasks of researching, synopsizing, paraphrasing the works of others. It further sets out to give the learner the skills to assimilate the gathered information into a coherent, structured, referenced document suitable for submission as coursework using standard computer applications. The second part develops the learner's interpersonal communication, problem solving. This supports a greater understanding of why and how to communicate effectively in an increasingly diverse work and social environment.

Example – Academic Communications module

Module Content

The nature & value of research;Assess the quality of information available when carrying out research;Primary and secondary sources of information;Measured, calculated and simulated information;Appraising source of information for use in research;Academic writing (ethics, avoiding plagiarism).Structuring an academic paper.Structured referencing.The use of web browsing, word processing & spreadsheet software for research & academic report production.Storage and retrieval of information. Definition of communication; barriers to communication; the listening cycle and active listening.Assertive communication – the visual, vocal and belief aspects of passive, aggressive and assertive behaviour. The assertive communication model.Team planning exercises (e.g. Hollow and Broken Square).Time Management (Eisenhower Grid, Pareto's Law, Prioritisation Grid, Micro Tips, 7 Habits of Highly Effective People, Time Wasters questionnaire).Team Work – The Group Process.Leadership Styles and Skills.Decision Making.Transactional Analysis.Managing Meetings.Conflict Resolution Presentation styles (incl. Pecha Kucha)Direct positive impacts on certain targets of SDG #4:(Quality Education) and SDG #5 (Gender Equality) and SDG #9 (Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation). They are explored as sustainable development goals that directly relate to education, teamwork, diversity, communication, research and thereby innovation . Indirect positive impacts on certain targets of SDG #10 (Reduce inequality within and among countries) and SDG #8 (Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all).

Number of RK found	RK detected
18	waste,sustainab,resilient,promote, production,natur,innov,infrastruct,i nequality,industrial,inclusive,growt h,equal,employ,educ,econom,deve lopment,academ,

Methodology Now Published

Caturing this Information in Future Module Descriptor

Module Code	Pre-requisite Module codes	Co-Requisite Modules code(s)	ISCED Code	Subject Code	ECTS Credits	NFQ Level (CPD)#	SDGs	Sustainability Category
TTEC 2203		TTEC 2202			10	8	8,12	Sust in Mind
Module Title	**Timber skills IV**							

Example of a Programme Analysis

CKEY	SUBJ	CRSE	Title	Number of Unique RKs Found	Unique RKs Found	Sustainability Importance (SI) Score	AASHE Categorisation	Most Likely SDG Associations	Other possible SDGs to consider?		DESCRIPTION.Overview
MECH	H4023	MEC H4023	Design Project II	3	sensor,industrial,energ	8.8	No Sustainbility Included	9	7,9		The aim of this final year design projec... substantive individual or teamwork ba... intended to develop and nurture their... and implement design solutions to sp... potential mechatronic solutions.
MECH	H4022	H4022	Industrial Networks & Distributed Systems	4	industrial,employ,secur,$safety	9.6	No Sustainbility Included	9	11,2,8,9		To provide learners with the underlyin... employed in modern industrial networ... automation systems.
MECH	H4020	H4020	Mechanics and Materials 4	9	material,treat,reduc,life,harm,enviro,econom,development,chemi	21.6	Sustainability in Mind	12	1,11,12,14,17,3,5,8,9		The aims of this module include: • To f... of common engineering materials, fro... alloys, ceramics and polymers. To intr... Index and its application in the selecti... applications. • To provide the learner... theoretical instruction in fatigue failur... student's ability to solve complex mac... this analysis. • To provide the learner... fundamental theory of mechanical vib... and damped free vibrations of a single... and un-damped and damped forced... freedom system.
MECH	H4019	MEC4 H4019	Sustainable Energy Systems.	26	renewable,energ,econom,consumption,sustainab,solar,society,resourc,reduc,production,power,polic,ocean,marine,infrastruct,hydro,heat,fuel cell,fuel,enviro,emission,dem...	78.4	Sustainability Focused	7	1,11,12,13,14,15,17,3,6,7,8,9		This module will familiarize the learner... energy technologies currently in use... also give the learner an appreciation... economic, surrounding energy gener... consumption in Ireland and worldwide... technologies in it.

Rewriting Module Descriptors for Sustainability

Learning Outcomes (LO): (to be numbered)
For a 5ECTS module a range of 4-10 LOs is recommended
On Completion of this module, the learner will be able to

1	Explain the chemical properties, functions and sustainability factors of the main food components: water, fat, carbohydrates, proteins, colourants, food additives, vitamins
2	Describe the chemical aspects of brewing and distilling and its environmental impact
3	Discuss the principles of food analysis, including use of validated methods, sampling and sample preparation as well as use of greener technologies
4	Detail the basic terminology and applications of chemical analysis to food and beverages
5	Demonstrate a critical understanding of the applications of instrumental techniques in food and beverage analysis with emphasis on efficiency and reduction in the use of environmentally harmful reagents.
6	Outline applications of various techniques particularly related to brewing and distilling
7	Recognize food fraud in the context of food chemistry and analysis and the resulting food loss and waste
8	Develop enhanced laboratory skills to perform high quality food analyses for a range of food constituents
9	Develop enhanced research and scientific writing skills to report on food analysis experiments
10	Show enhanced numeracy skills to perform analytical calculations and recognise sources of error

Indicative Syllabus:

Indicative syllabus covered in the module and / or in its discrete elements

Describe the chemical properties and functions of the main food components:
Water and water activity in food and its role in food spoilage.
Fat in foods: physical and chemical properties. Oxidation of fats and preventative measures to reduce food waste. Emulsions and emulsifiers. Importance of RSPO (roundtable on sustainable palm oil) labelling.
Protein in foods; structure and stability. Main functions and contributions to food. Case studies for meat, flour, cheese. The use of protein-related waste products to add value and reduce environmental impact.
Carbohydrates in foods: types and functions. Dietary fibre and its role in human gut health. Low calorie sweeteners to reduce metabolic disease burden. Inversion of sugars and uses in industry. Maillard chemistry. Natural pigments and artificial food colourants. Flavour compounds; properties and categories. Food additives; categories and functions. Vitamins; stability, sources, structure.

Describe the chemical aspects of brewing and distilling:
Composition of ingredients and products, chemistry of processing of beer, wine and spirits. Spent grains produced from brewing and distilling and their valorisation.

Describe the principles of food analysis, including use of validated methods, sampling and sample preparation:
Steps involved in method validation. Data evaluation. Rejection of data. Explanation of sampling and sampling plans, risks. Main sample preparation techniques, solvent as well as use of novel greener technologies for
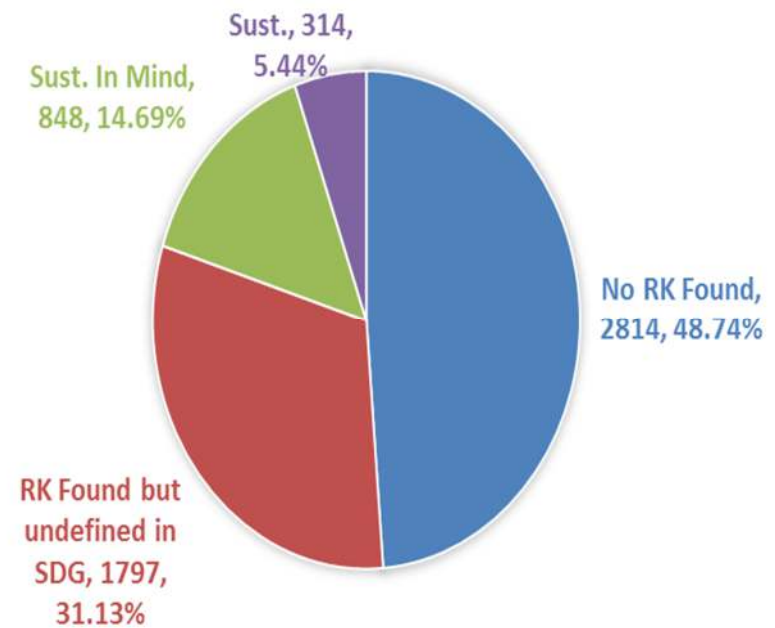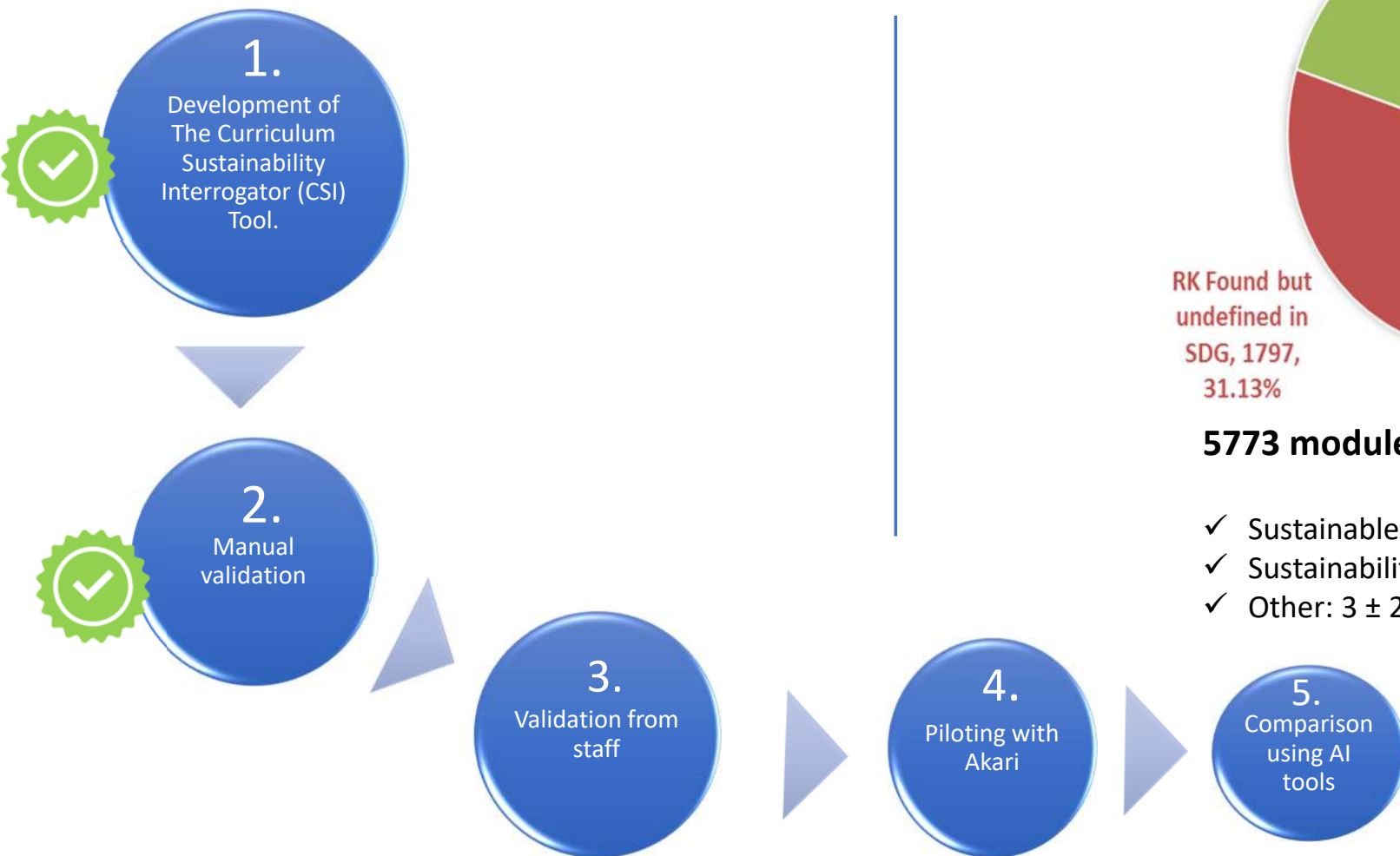
Marketing our **Curriculum** through the **Sustainable Development Goals**

Work in progress…

1. Development of The Curriculum Sustainability Interrogator (CSI) Tool.

2. Manual validation

3. Validation from staff

4. Piloting with Akari

5. Comparison using AI tools

No RK Found, 2814, 48.74%

RK Found but undefined in SDG, 1797, 31.13%

Sust. In Mind, 848, 14.69%

Sust., 314, 5.44%

5773 modules analysed:

- ✓ Sustainable: 16 ± 6 keywords (Max 41)
- ✓ Sustainability In Mind: 9 ± 2 keywords (Max 19)
- ✓ Other: 3 ± 2 keywords (Max 12)

Useful Resources

- Adams, T., Kishore Kumar, S., Goggins, J., and Manton, R. (2020). Embedment of UN Sustainable Development Goals (SDG) Within Engineering Degree Programmes. Civil Engineering Research in Ireland.

- AASHE (2019). Stars R Technical Manual Version 2.2. Philadelphia, PA: American Association for the Advancement of Sustainability in Higher Education.

- Chang, Y. C., and Lien, H. L. (2020). Mapping course sustainability by embedding the SDGS inventory into the university curriculum: a case study from national university of Kaohsiung in Taiwan. Sustainability 12, 4274.

- Pukelis, L., Puig, N. B., Skrynik, M., and Stanciauskas, V. (2020). OSDG– open-source approach to classify text data by UN Sustainable Development Goals (SDGs). arXiv preprint arXiv:2005.14569. doi: 10.48550/arXiv.2005.14569

- Lozano, R., and Peattie, K. J. (2009). "Developing a tool to audit curricula contributions to sustainable development," in Sustainability at Universities - Opportunities, Challenges and Trends, Vol. 31, ed W. Leal Filho, pp. 179–194.

- Rieckmann, M. (2017). Education for Sustainable Development Goals: Learning Objectives. Paris: UNESCO Publishing.

- UNSDSN Asia Pacific (2017). Getting Started With the SDGs in Universities: A Guide for Universities. Higher Education Institutions and the Academic Sector. Available online at: https://resources.unsdsn.org/getting-started-with-the-sdgsin-universities