Stage 1 Talks:

Sustainable Systems Engineering

Bachelor of Engineering (BE) programme

Presented by

1. Dr Rajat Nag
Assistant Professor, Biological Engineering,
(Programme director, stage 4 coordinator)

1. Dr Tamíris da Costa
Assistant Professor, Sustainable Biosystems Engineering
(stage 2 coordinator)

3. Associate Professor Junli Xu (Lily)
(stage 3 coordinator)

On 23rd October 2025

UCD School of Biosystems & Food Engineering

Welcome to the School of Biosystems and Food Engineering

- Made up of over **300** students, including 65 research students
- Circa **€5 million** research funding awarded annually
- Four **Highly Cited Researchers** in our academic team: Prof Paula Bourke, Prof Da-Wen Sun, Prof Colm O Donnell & Prof Enda Cummins

Professor Paula Bourke
Head of School

Highly Cited Researcher
2018-2024
Clarivate

UCD School of Biosystems & Food Engineering
Scoil na hInnealtóireachta Bithchórais agus na hInnealtóireachta Bia UCD

OUR STAFF

As of 2024, New faculty members have recently joined.

Professor Paula Bourke
Head of School
*Highly Cited Researcher

Professor Enda Cummins
Deputy Head of School
Head of Teaching & Learning
Programme Director
*Highly Cited Researcher

Professor Colm O'Donnell
BE PhD CEng FIAE
Full Professor
Head of Subject - Biosystems & Food Engineering
*Highly Cited Researcher

Professor Nick Holden
BSc MSc MEngSc PhD
Head of Research, Impact & Innovation
Head of Subject - Agricultural Systems Technology

Professor Aoife Gowen
College VP for Research Impact & Innovation

Dr Dimitrios Argyropoulos
Lecturer/Assistant Professor
Programme Director - MSc Digital Technology for Sustainable Agriculture

Dr Fionnuala Murphy
Lecturer/Assistant Professor
Programme Director - Bioeconomy with Business
School EDI Champion

Professor Kevin McDonnell
Programme Director - MSc Sustainable Energy and Green Technologies

Assoc Professor Tom Curran
College VP for Internationalisation
Programme Director - MSc Environmental Technology

Professor Shane Ward
Full Professor

Professor DaWen Sun
MRIA, MAE, MPAN, FIAFoST, FiAABE, FIAR, FIAgrE
Full Professor
*Highly Cited Researcher

Dr Anna Molter
Lecturer/Assistant Professor

Dr Joseph Sweeney
Lecturer/Assistant Professor

Dr Sharon O'Rourke
Lecturer/Assistant Professor
UCD Ad Astra Fellow
School Research Integrity Champion

Professor Francis Butler
Professor

Assoc Professor Pat Grace
College Timetabling Coordinator

Dr Ronald Halim
BE PhD MIChemE
Lecturer/Assistant Professor
Head of Graduate Studies

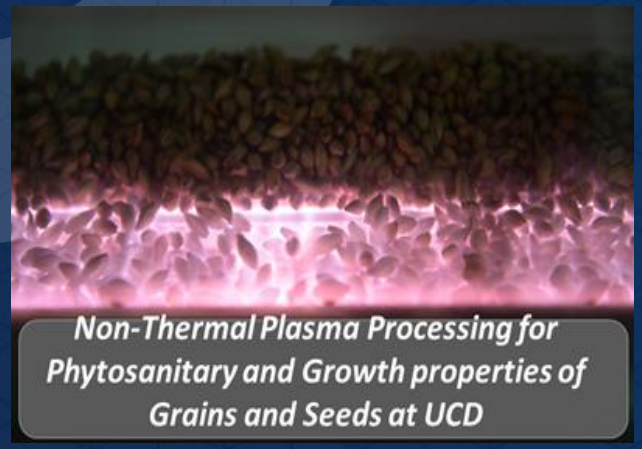
Dr Junli Xu
Lecturer/Assistant Professor
UCD Ad Astra Fellow

Dr Tamíris Da Costa
Lecturer/Assistant Professor

Dr Rajat Nag
MSc PhD CEng MIEI
Lecturer/Assistant Professor

We celebrate our success and EDI

Research & Teaching Infrastructure



- Food and Bioprocess Engineering Suite
- Biosystems Analysis and Modelling Suite
- Digital Agriculture and Environmental Technology

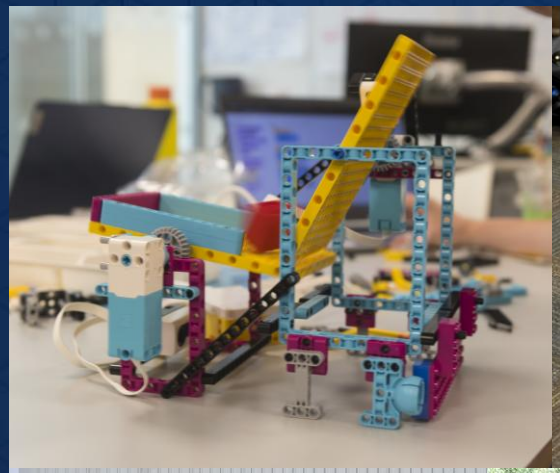
ICP-MS (Spectrometer)

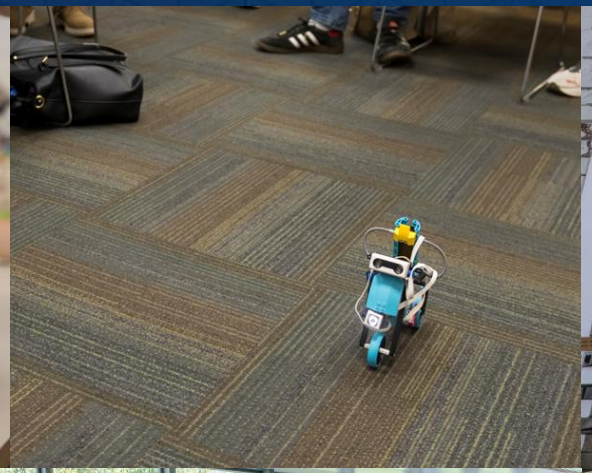
CN-analyser

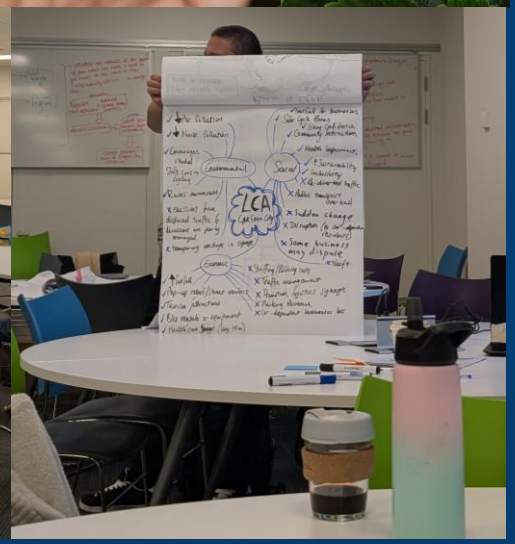
Py-GC-MS

Spectral Imaging Research Group (SIRG)

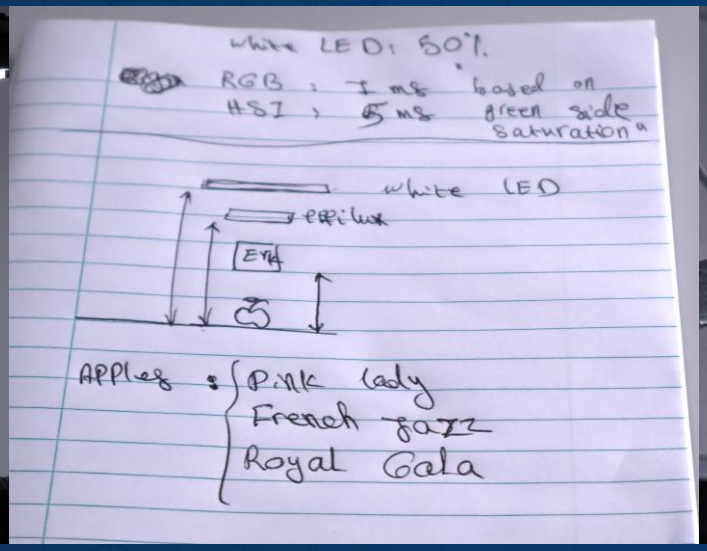
Problem-based learning and teamwork

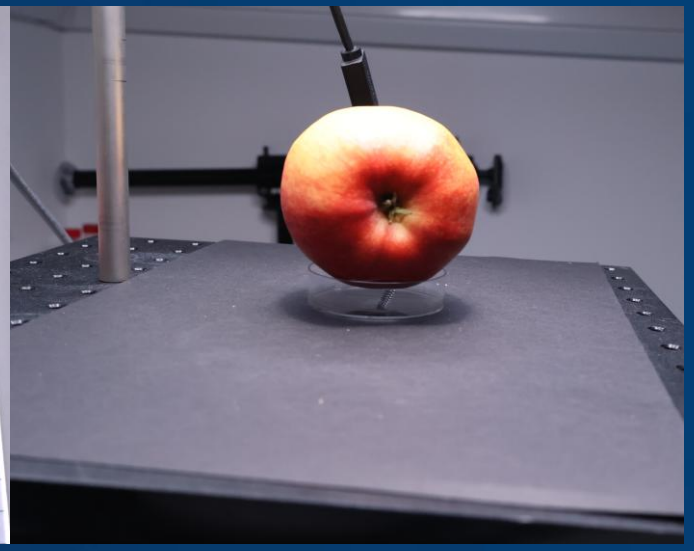


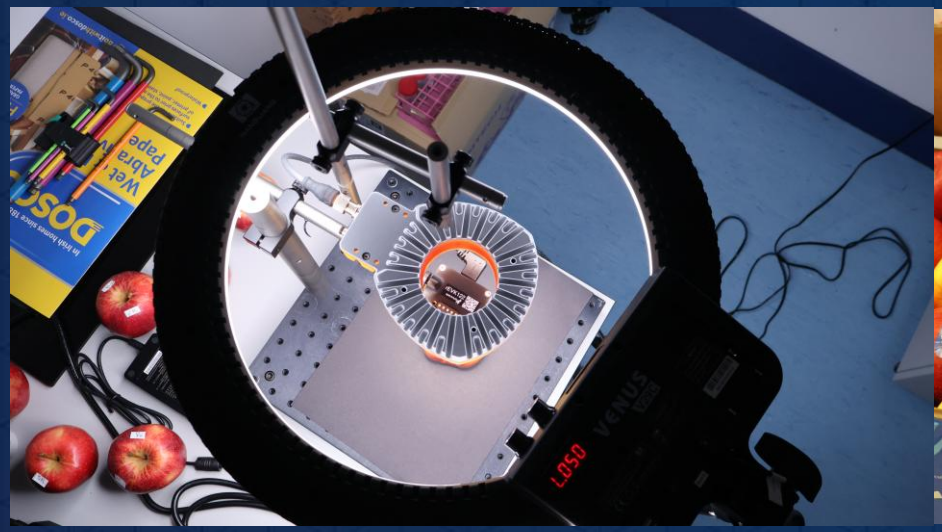


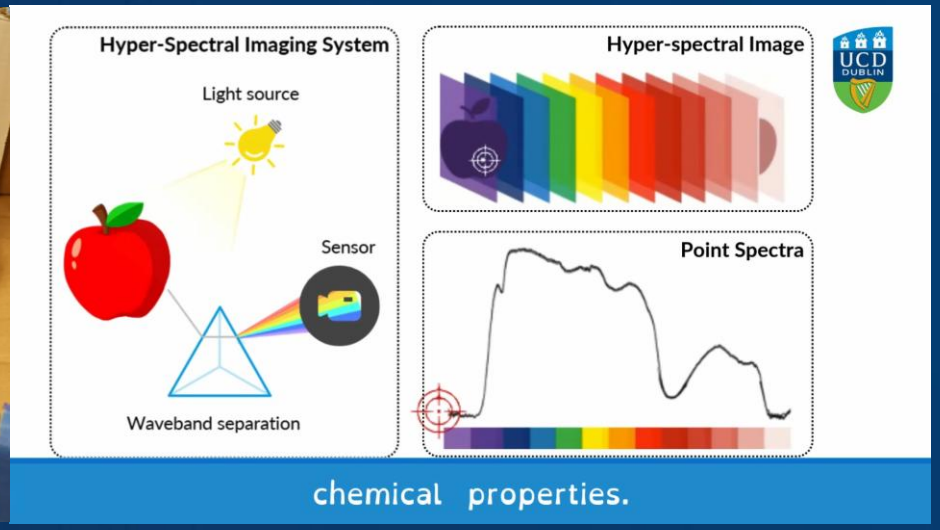


Hyperspectral imaging technique







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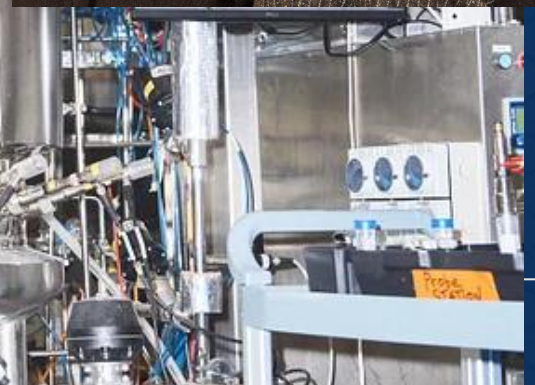
SIMBA



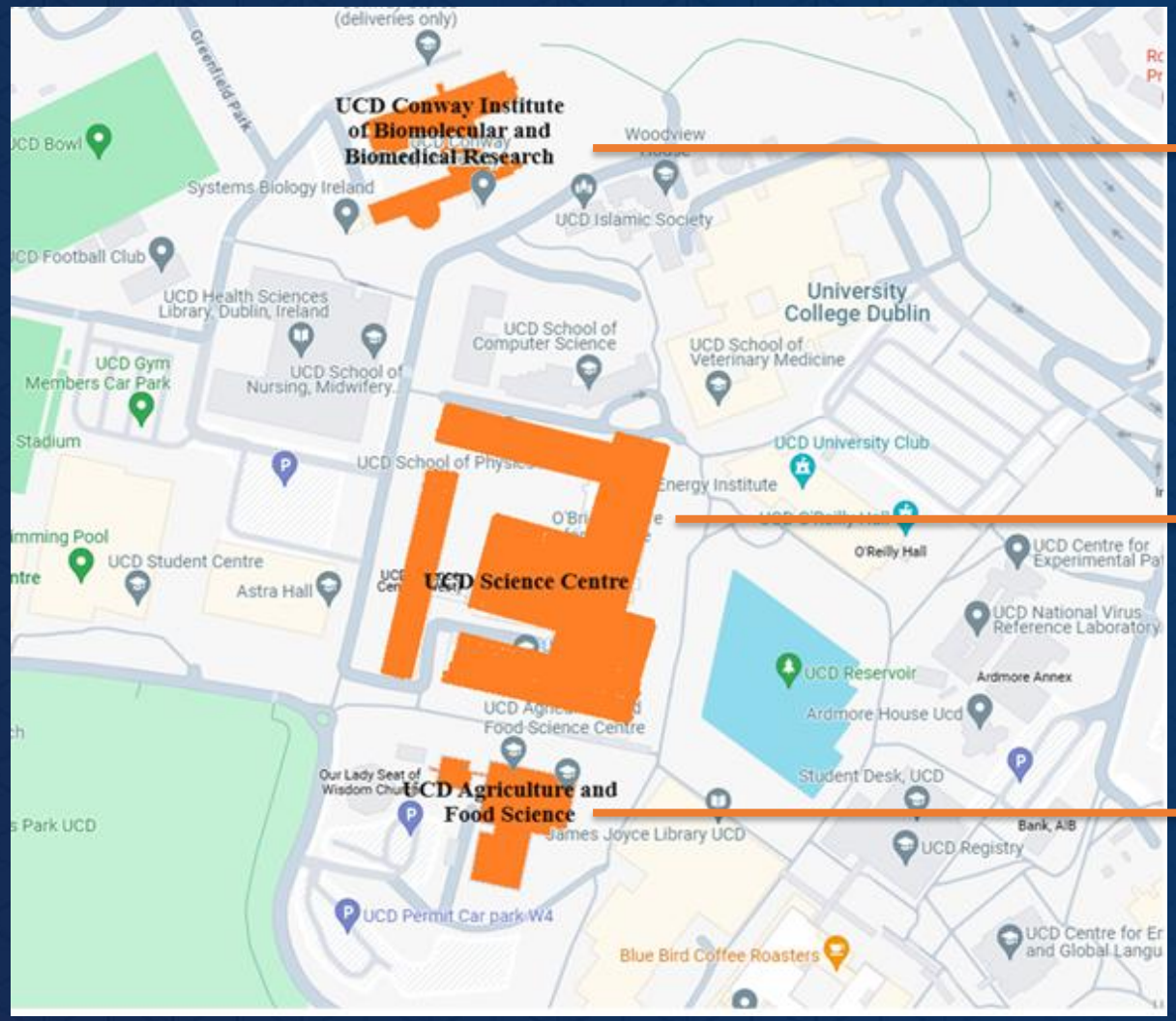
Where can you go with a degree in Sustainable Systems Engineering?

Our alumni progress to a wide range of careers, taking up positions shortly after graduation in posts:

- Environmental Engineer
- Renewable Energy Engineer
- Sustainability Consultant
- Water and Waste Management
- Food Innovation roles
- Medical and Pharmaceuticals
- PhD (UCD, MSU etc.)

International

School of Biosystems and Food Engineering - Locations

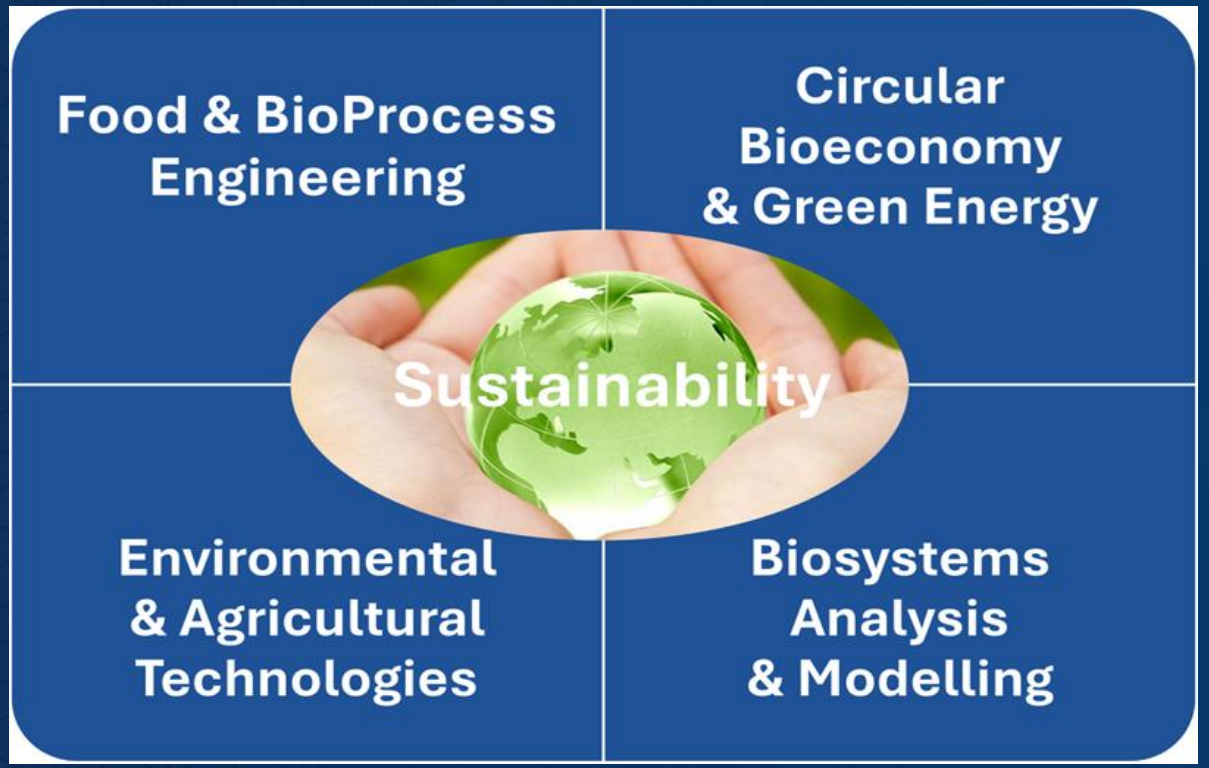


UCD Conway Institute

UCD Science Centre

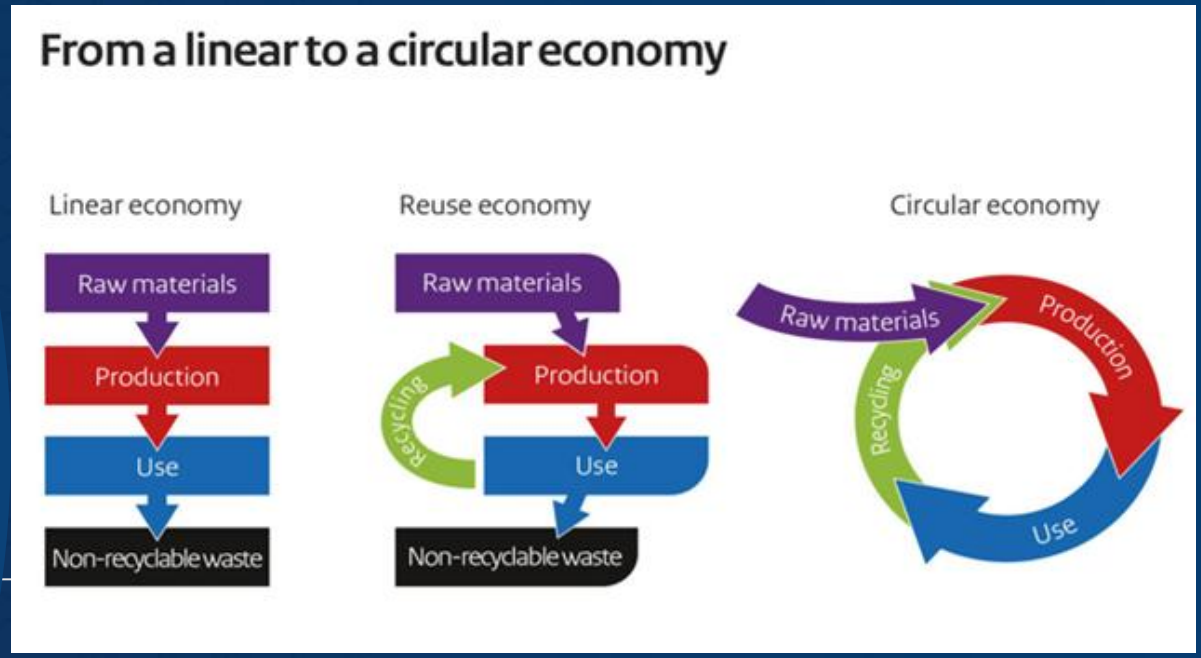
UCD Agriculture and Food Science Centre (Primary Location)

Sustainability and Green Technologies are Core SBFE Business across Research, Education and Innovation



Why study Sustainable Systems Engineering?

- The World's population is projected at **9.6 billion** in **2050**, which requires sustainable systems for food, water, energy, and goods.
- Transition to a circular economy (figure below)
- Climate change, with a systems and technology solutions emphasis



Finding Solutions and solving problems for Sustainable Life and Planetary Health

What is sustainability?

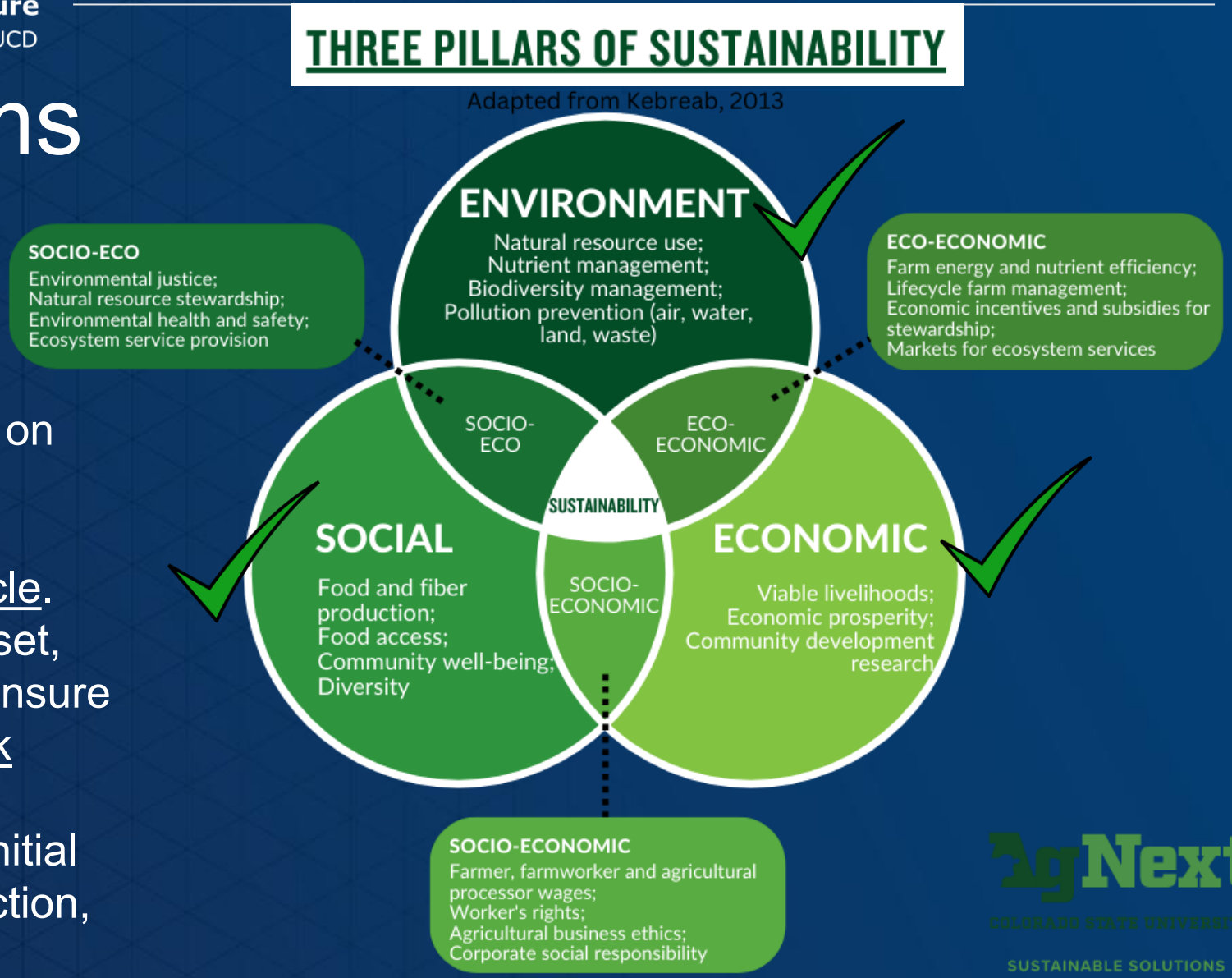
"...development that meets the needs of the present without compromising the ability of future generations to meet their own needs“ – United Nations

Key components of the UN's view of sustainability

- **Future Generations**: Care for the future.
- **Three Pillars**: economic growth, social inclusion, and environmental protection.
- **Global Goals**: Utilises the 17 Sustainable Development Goals (SDGs): Vision 2030.
- **Inclusivity**: "no one is left behind".

What is systems engineering?

- Systems engineering is an interdisciplinary field focused on designing, developing, and managing complex systems throughout their entire life cycle.
- It applies an integrative mindset, using a holistic approach to ensure that all parts of a system work together seamlessly.
- Meet customer needs, from initial concept and design to production, operation, and maintenance.



AgNext
COLORADO STATE UNIVERSITY
SUSTAINABLE SOLUTIONS FOR ANIMAL AGRICULTURE

BE Sustainable Systems Engineering

Programme Overview

- An interdisciplinary programme enabling graduates to address global challenges across food and biosystems, energy and the environment.
- The course integrates engineering and sustainability principles to develop knowledge and skills for circular and bio-economies, sustainable food systems, bioresource management, and renewable energy.

What are the graduate attributes?

- Engineering skills aligned with UN SDGs
- Integrating digital tech in sustainable engineering sectors
- Quantitative analysis for sustainability assessment
- Systems thinking and life cycle design focus
- Prepared to lead climate-resilient, resource-efficient systems.

How will I learn?

Design challenges	problem-based learning	laboratory practicals & field experiments
lectures	Industry placement & study abroad/ Erasmus opportunities	Independent research project with world-class professors.

Programme Outcomes (POs) - summary

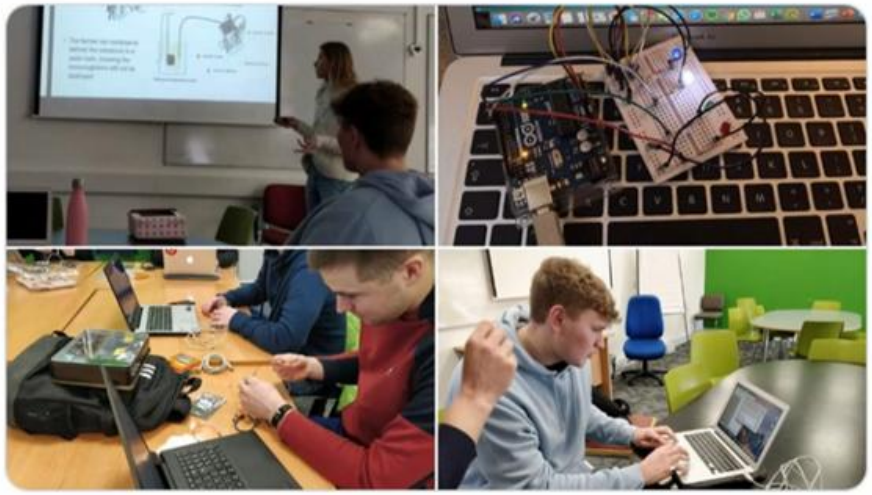
1. Advanced knowledge in food, bioresources, and energy technologies
2. Analyse sustainability challenges using systems thinking
3. Quantitatively assess the environmental performance of systems
4. Apply ethics, responsibility, and compliance in engineering
5. Work effectively in diverse, multidisciplinary teams
6. Communicate complex concepts to varied audiences

Employer needs and skills developed, and their transferability to other domains in engineering and science, and management

Professional Work Experience

- Professional Work Experience (3 months) is incorporated during the summer between stages 3 and 4 and can be based in Ireland or internationally with industry, research institutes, or government agencies (internship).

designing and developing their own Arduino microcontrollers for agricultural application



International Study Opportunities

- In the 3rd year: one or two trimesters studying abroad at a partner University.
- Studying in countries: Belgium, France, Australia, New Zealand, Canada, the USA, Singapore, Germany, and Switzerland is an option.
- Can go for 4+2 option. MSc Sustainability Engineering Leadership (year 1: Northeastern University, Boston, USA; year 2: UCD)

Career & Graduate Study Opportunities

- Graduates of this programme will drive innovation in sustainable energy, bioresource and environmental management, and food engineering.
- Opportunities in renewable energy, water and waste management, and sustainable food production, focusing on food safety, low-carbon technologies, and circular economy solutions.
- Careers include climate adaptation, consulting, and food innovation, with options for **ME and PhD** study.

SECTOR SPOTLIGHT

ICT

Ireland is the ICT hub for European operations

MED TECH

The medical technology sector in Ireland is recognised as one of the five global emerging hubs

ENGINEERING

The engineering industry in Ireland is strong and vibrant.

FOOD AND AGRICULTURE

The manufacture of food and drink is Ireland's most important indigenous industry.

PHARMA

Ireland is a world-leading centre of excellence for the manufacture of pharmaceutical and fine chemical products

FINANCIAL SERVICES

Ireland is the 5th largest exporter of financial services in Europe

Programme structure in detail (stage-wise)

Stage 1

Major/Minor or exit/entry/pathway programme Title:	Stage	Level	Credits	Trimester
Core				
CHEM10030 Chemistry for Engineers	1	1	5	Autumn
CHEN10040 Intro. to Eng. Computing	1	1	5	Autumn
CVEN10040 Creativity in Design	1	1	5	Autumn
EEEN10010 Electronic and Electrical Engineering I	1	1	5	Autumn
MATH10250 Introduction to Calculus for Engineers	1	1	5	Autumn
PHYC10150 Physics for Engineers I	1	1	5	Autumn
MATH10260 Linear Algebra for Engineers	1	1	5	Spring
MEEN10030 Mechanics for Engineers	1	1	5	Spring
MEEN10050 Energy Engineering	1	1	5	Spring
PHYC10160 Physics for Engineers II	1	1	5	Spring
Option Module x 1			5	Spring
Elective Module/ Additional Option x 1	1	1	5	Spring
Total			**60**	
Stage 1 Recommended Option Module				
BSEN10010 Biosys Eng Design Challenge	1	1	5	Spring
BSEN10020/ DSCY10190 How Sustainable is my Food?	1	1	5	Spring
Stage 1 Recommended Elective Modules				
COMP10060 Computer Sci for Engineers I	1	1	5	Spring
DSCY10060 Energy, Climate Change & Policy	1	1	5	Spring
XXXXX Language courses	1	1	5	Spring
DSCY10070 Materials in Society	1	1	5	Spring
DSCY10150 Hope	1	1	5	Spring

Please select modules from our School to know more about sustainability

BSEN10010 Biosys Eng Design Challenge

Student's challenge-based group project – some recent examples

Lab environment: Design in progress

The winning team that designed a solar cooker

Another example: A puppet show frame

Stage 2

Major/Minor or exit/entry/pathway programme Title:	Stage	Level	Credits	Trimester
Core/Option				
BSEN20060 Food Physics	2	2	5	Autumn
BSEN20170 Applied Programming for Ag Systems	2	2	5	Autumn
CHEN 20030 Thermodynamics & Kinetics	2	2	5	Autumn
CVEN20130 Hydraulics I	2	2	5	Autumn
MATH20290 Multivariable Calculus for Eng	2	2	5	Autumn
CVEN20120 Construction Practice	2	2	5	Spring
BSEN20190 Intro to Carbon and Energy Footprinting	2	2	5	Spring
STAT20060 Statistics & Probability	2	2	5	Spring
BSEN20040 Sustainability Eng Res Trends	2	2	5	Spring
BSEN20210 Sustainable Systems Design	2	2	5	Spring
Elective Module/ Additional Option x 1	2	2	5	Autumn
Elective Module/ Additional Option x 1	2	2	5	Spring
Total			**60**	
Stage 2 Recommended Elective Modules				
BSEN20180 Intro to Env Footprinting	2	2	5	Autumn
CVEN20030 Environmental Eng Fundamentals	2	2	5	Autumn
IA20010 Creativity and Innovation	2	2	5	Autumn + Spring
PLAN20040 Urban & Regional Economics	2	2	5	Spring
BSEN20200 Alternative Protein Foods	2	2	5	Spring

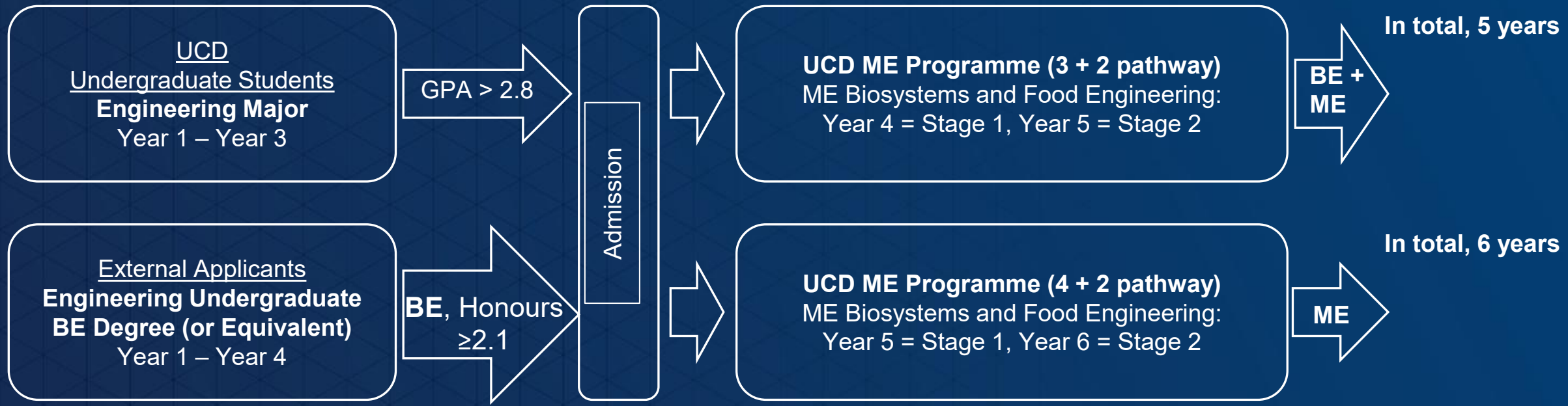
Stage 3

Major/Minor or exit/entry/pathway programme Title:	Stage	Level	Credits	Trimester
Core/Option				
BSEN30280 Water and Wastewater Engineering	3	3	5	Autumn
BSEN30310 The Bioeconomy; A strategy for sustainable fuel, material and chemical production	3	3	5	Autumn
BSEN30360 Life Cycle Assessment	3	3	5	Autumn
BSEN30590 MATLAB and R for beginners	3	3	5	Autumn
BSEN30010 Bioprocess Engineering Principles	3	3	5	Autumn
BSEN40350 Renewable Energy Systems Analysis	3	4	5	Spring
EEEN30150 Modelling and Simulation	3	3	5	Spring
CHEN30130 Heat Transfer & Fluid Mech	3	3	5	Spring
BSEN30630 Practical Applications ArcGIS	3	3	5	Spring
BSEN30610 Sustainability Design Challenge	3	3	5	Autumn + Spring
BSEN30660 BE Professional Work Experience	4	4	10	Summer
Total			**60**	

Two pathways for progression (important)

Progression Requirements

At the end of year 3, students can choose either to pursue a 4-year BE or a 5-year integrated ME degree pathway, subject to meeting grade requirements.

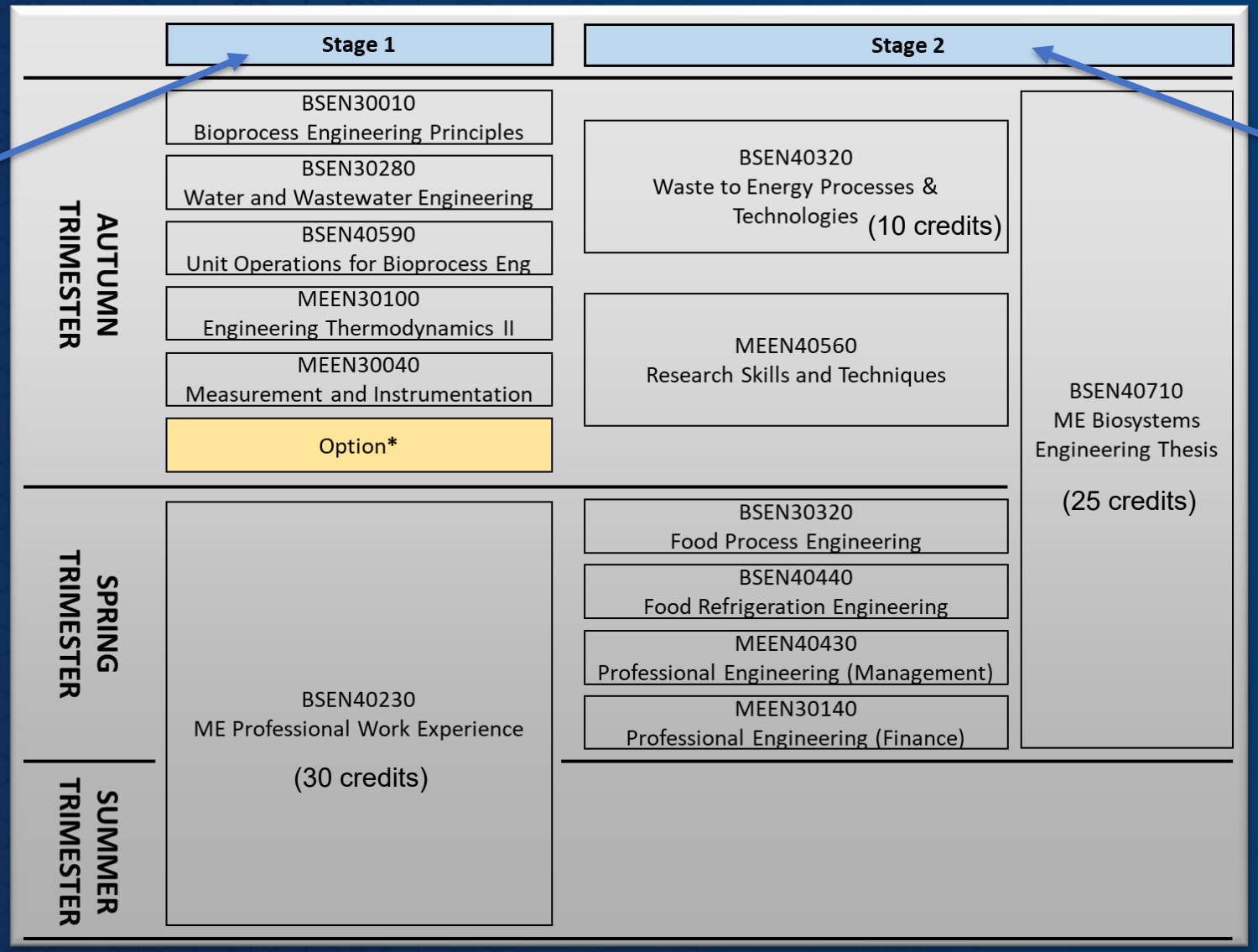


Stage 4

Major/Minor or exit/entry/pathway programme Title:	Stage	Level	Credits	Trimester
Core/Option				
BSEN40410 Food Chain Integrity	4	4	5	Autumn
BSEN40590 Unit Ops for Bioprocess Eng	4	4	5	Autumn
BSEN40500 Hyperspectral imaging	4	4	5	Autumn
BSEN40320 Waste to Energy Processes & Technologies	4	4	10	Autumn
BSEN30320 Food Process Engineering	4	3	5	Spring
MEEN40430 Professional Engineering (Mgt)	4	4	5	Spring
MEEN30140 Professional Engineering (Finance)	4	3	5	Spring
BSEN41000 Capstone Research Project	4	4	10	Spring
Option x 1	3	3	5	Autumn
Option x 1	3	3	5	Spring
Total			**60**	
Stage 4 Recommended Optional Modules				
BSEN30190 Agricultural Mechanisation: Hydraulics and components	3	3	5	Autumn
CHEN30010 Chemical & Bioprocess Reaction Engineering	3	3	5	Autumn
BSEN30210 Precision Agriculture	3	3	5	Spring
BSEN30520 Sensors and Sensing Systems	3	3	5	Spring
BSEN30060 Quantitative Risk Assessment for Human and Animal Health	3	3	5	Spring
BSEN30030 Air Pollution	3	3	5	Spring
BSEN30560 Measures to Mitigate Climate C	3	3	5	Spring

Stage 5 for (3+2 programme) ME students

Year 4 of
(3 + 2 pathway)



Year 5 of
(3 + 2 pathway)

Master of Engineering (ME) in Biosystems and Food Engineering

Two Year Full Time (September start)

Programme Director
Dr. Ronald Halim
Ronald.halim@ucd.ie

- The masters provides engineering graduates with the opportunity to deepen their knowledge in the design and application of **sustainable biological systems** for the bioeconomy, particularly in novel food process engineering, waste and wastewater management, and bioenergy.
- The masters offers 6-8 months **professional work experience** with one of our industry partners.
- Our graduates have secured graduate employment in relevant industries (e.g. Glanbia, Sanofi, Royal Oak Distillery, Guinness, Abbott, and Rowan) or full PhD Scholarships in Ireland/EU.

Industry Partner Testimonial

"We regularly hire UCD graduates into our environmental consultancy and sustainability teams. I have been **impressed by their excellence, professional maturity, capacity to learn and ability to communicate**."

Tom Rowan,
Rowan Managing Director

Student Testimonial

"During the ME programme, I completed a **placement at Teagasc Food Research Centre**, published a journal paper, and secured a **full Scholarship to pursue a PhD at UCD** in the valorisation of dairy side streams using microalgae."

Dr Yuchen Li,
ME 2018-2020,
PhD complete 2025 (UCD)

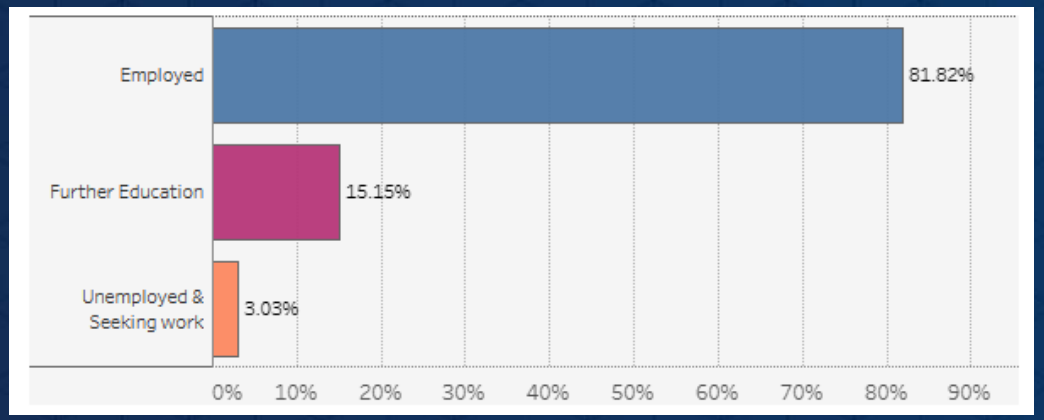
Student Testimonial

"I chose to study at UCD's School of Biosystems and Food Engineering for its **blend of science, engineering, and practical learning**. The **Unit Operations for Bioprocess Engineering** module inspired my interest in environmental bioprocessing. During my **8-month placement at Teagasc**, I worked on seaweed pre-treatment for biorefineries, which shaped my research skills and led to my current PhD on microalgae-based extraction for sustainable biofuel and protein production."

Yiting Han,
ME 2022-24
PhD Sought (UCD)

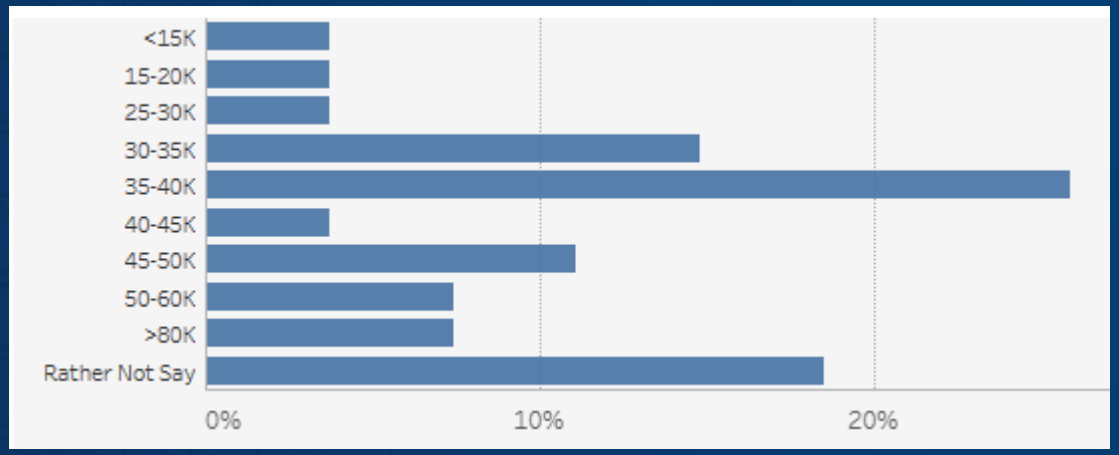
Career Opportunities

Employment status 9 months after graduation (2021/22 academic year*)



*Graduate Outcomes Survey | Tableau Public

Annual salary or scholarship stipend (2021/22 academic year*)



Rahul
ME graduate (2021 – 2023)
Current Position: Maintenance Systems Coordinator, Royal Oak Distillery

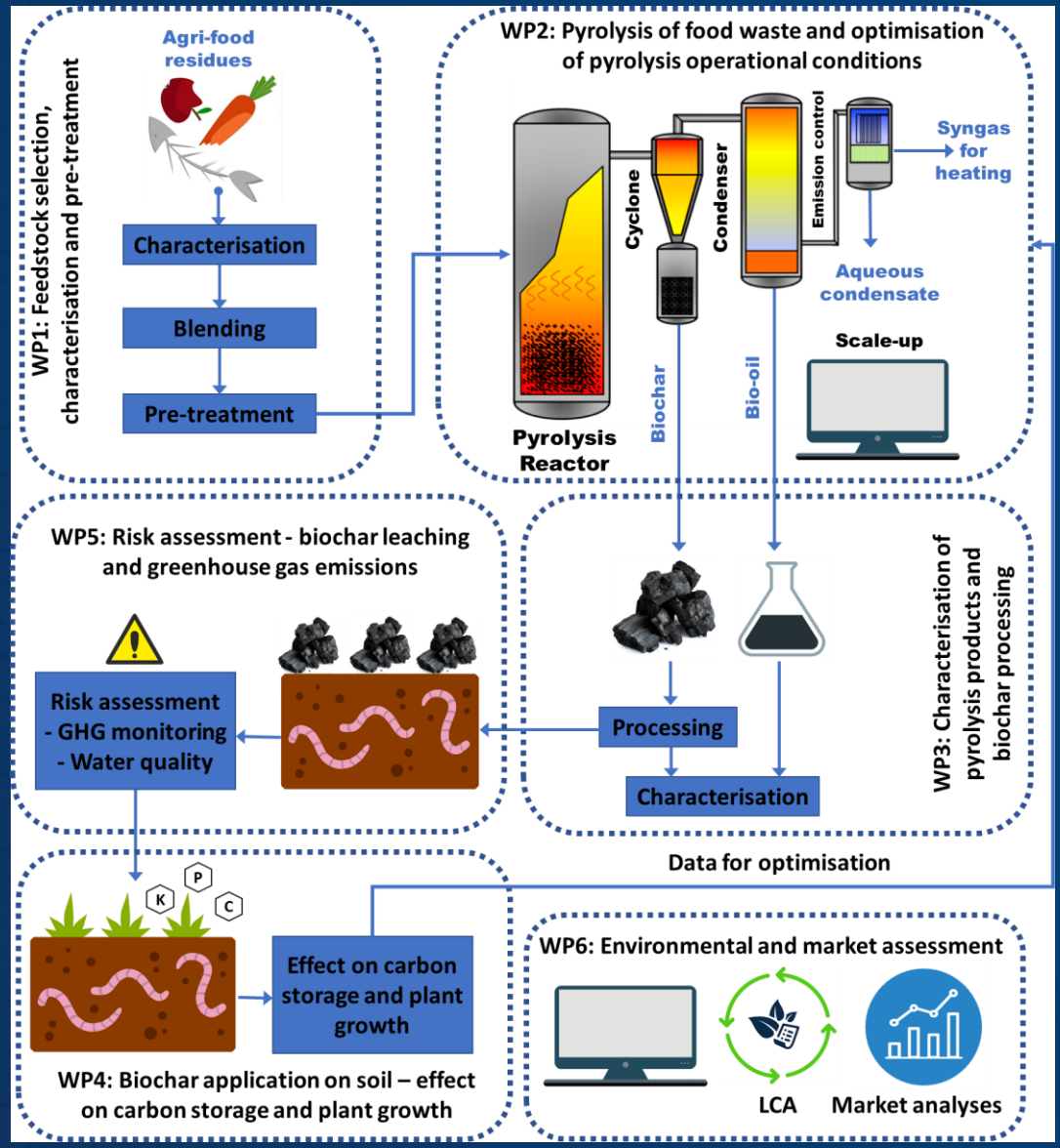
"The ME Biosystems and Food Engineering programme at UCD was highly influential in the trajectory of my career - it helped me approach engineering principles from a practical viewpoint…. I completed a 6-month internship at the Royal Oak Distillery, mainly working towards compliance engineering, quality and safety. I was then offered a graduate position immediately upon the completion of my degree"

Research at UCD School of Biosystems and Food Engineering

seai
SUSTAINABLE ENERGY AUTHORITY OF IRELAND

BIOPYROC

High-value BIO-based products from residual agri-food biomass via PYROlysis: A dual approach for Carbon sequestration and residues valorisation



Horizon Europe

watson

A holistic frameWork with Anticounterfeit and inTelligence-based technologieS that will assist food chain stakehOlders in rapidly identifying and preveNting the spread of fraudulent practices.

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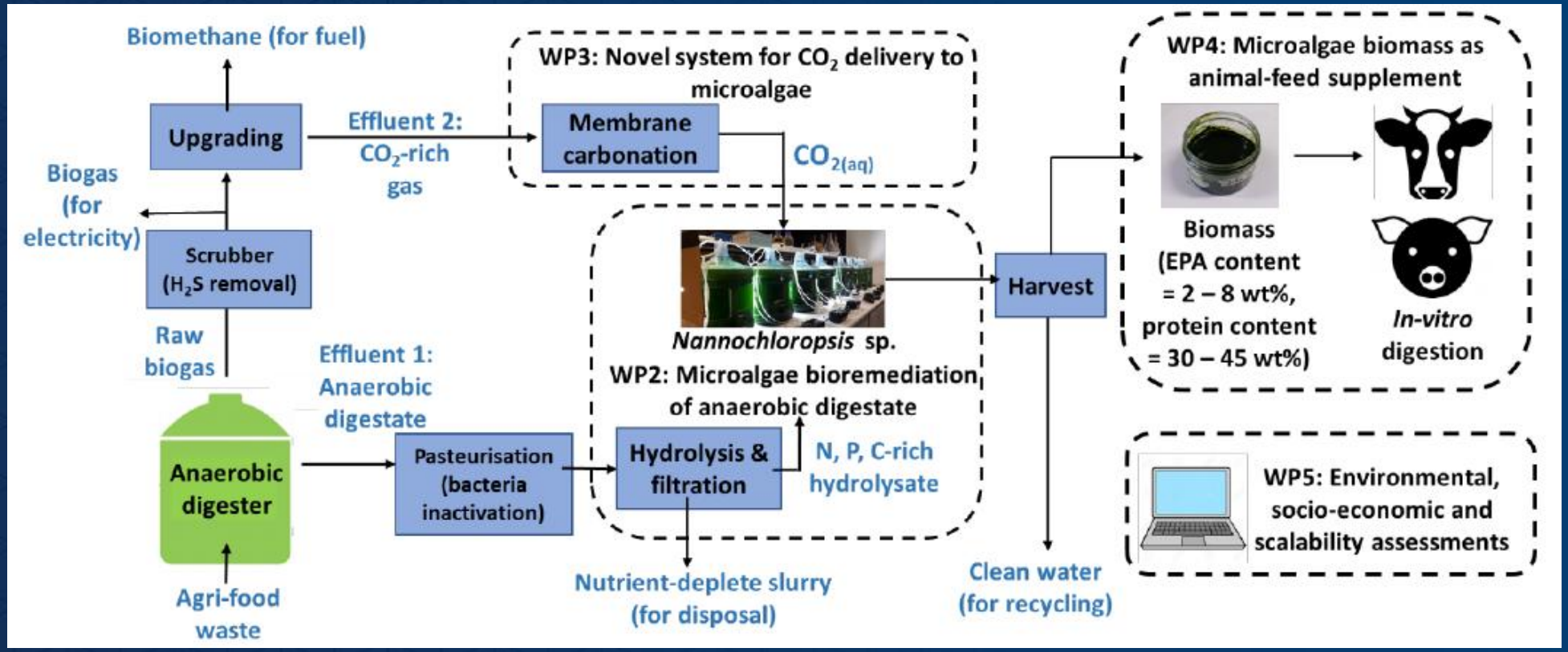
SUSTAINABLE ENERGY AUTHORITY OF IRELAND

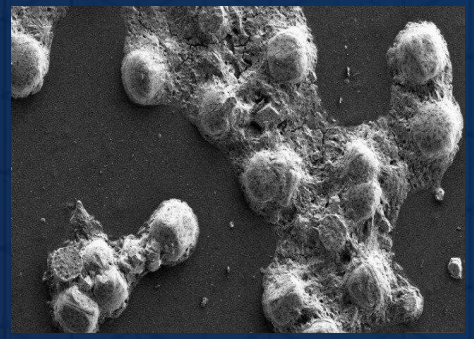


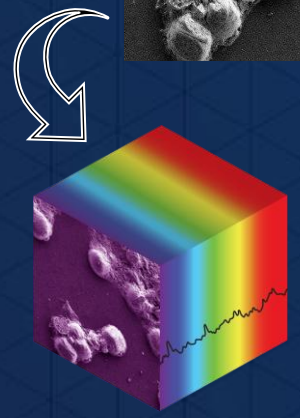
Unlocking the potential of microalgae for the valorisation of brewery waste products into omega-3-rich animal feed and fertilisers

Algaebrew

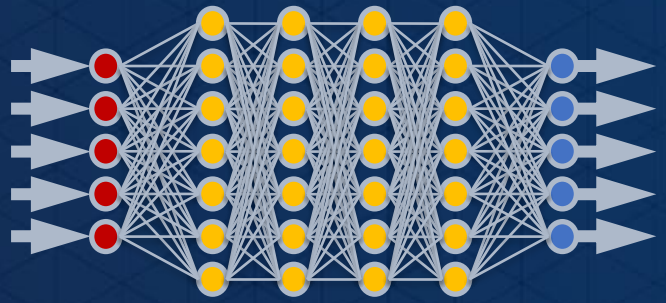
PLASTOX

Micro- and Nanoplastics

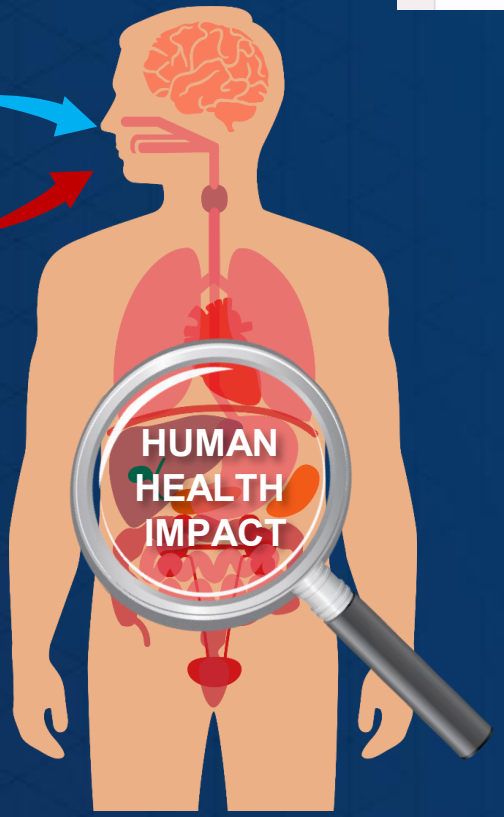




Spectral Imaging



Machine Learning



MICROPLASTIC
RESEARCH GROUP

UCD Microplastic Research Group

Microplastic; Human Health; Enviroment; Artificial Intelligence

"The beautiful thing about learning is no one can take it away from you" - B.B. King

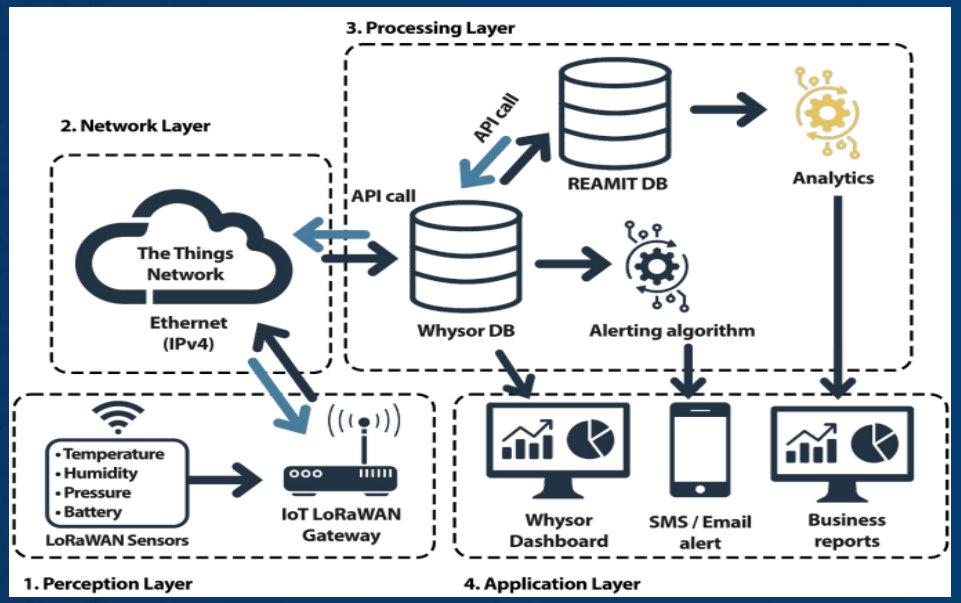
Video break

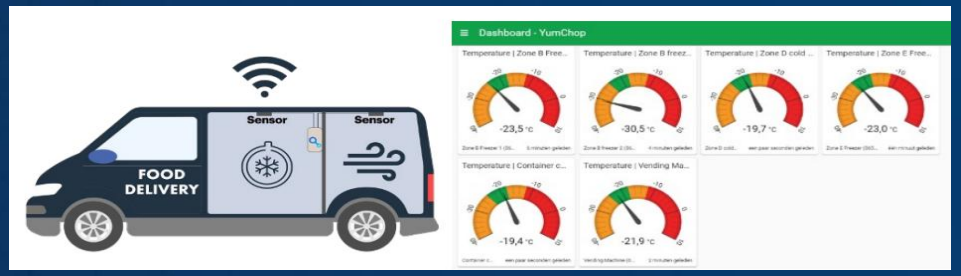
Link to watch the recording of the entire presentation, including the video break session.
https://drive.google.com/file/d/1cfHAIZBthoT4l91AuBHq63xtBwdzdMMS/view?usp=sharing

UCD College of Engineering & Architecture
Coláiste na hInnealtóireachta agus na hAiltireachta UCD

REAMIT - Improving Resource Efficiency of Agribusiness supply chains by Minimising waste using Big Data and Internet of Things sensors

Interreg North-West Europe REAMIT
European Regional Development Fund





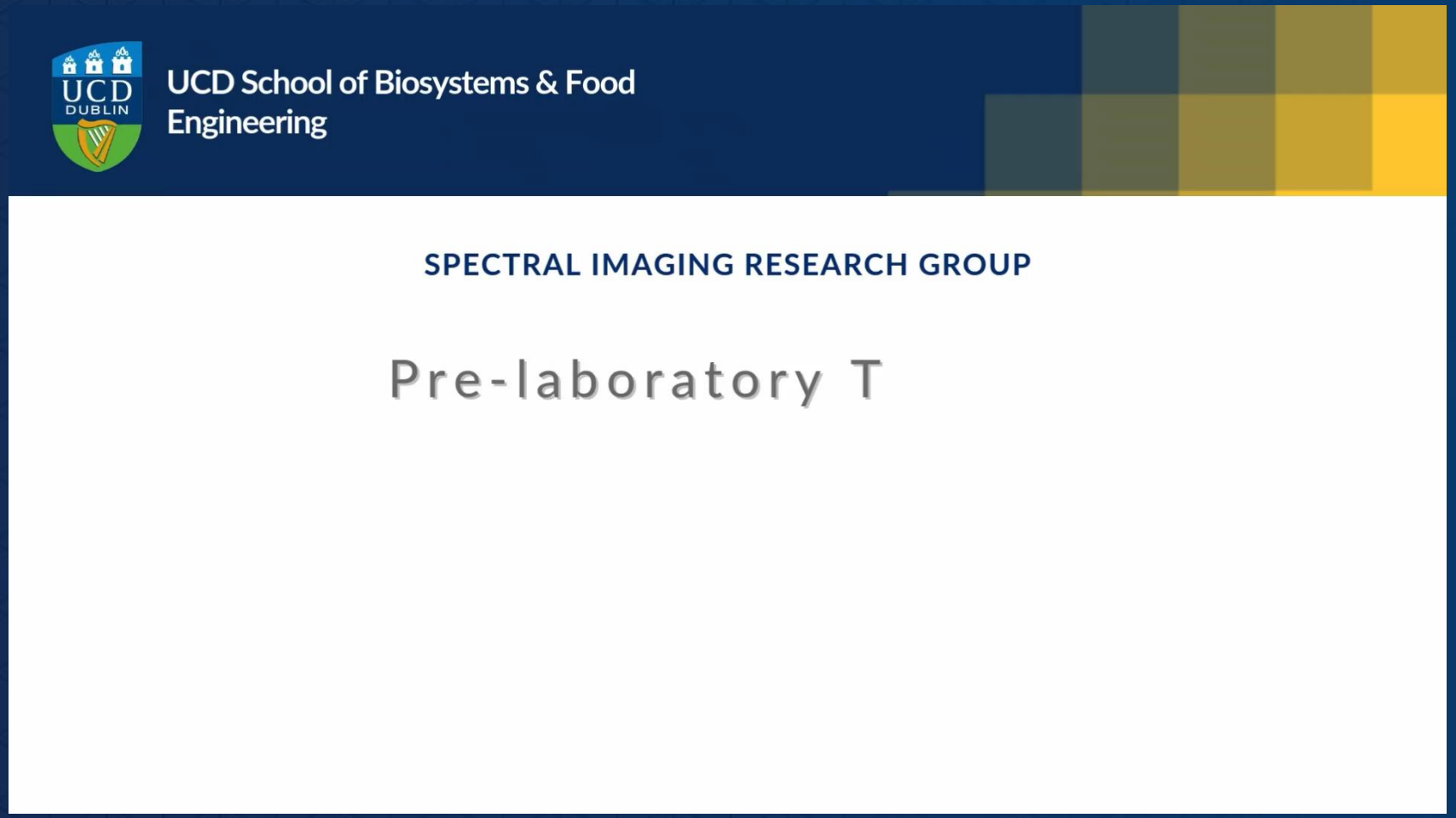
UCD Algae Group

https://youtu.be/dxCzsZeywss

Digital Technology for Sustainable Agriculture – Vertical Food Production

https://www.youtube.com/watch?v=SR-h5H2wmNE

Spectral Imaging Research Group



This multidisciplinary research team is breaking new ground in the application of Spectral imaging to investigate interactions between biomaterials and their surroundings, identification of bacterial colonies of a variety of surfaces and identification of cancer in prostate tissue.

Many thanks for your kind attention! Now questions are invited…

Acknowledgement:
Thank you, the organising committee of UCD College of Engineering and Architecture, for giving us the opportunity to interact with beautiful minds.

Terima kasih
Go raibh maith agat

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