BIOECONOMY IRELAND WEEK

OCTOBER 17-23 2022

An Roinn Talmhaíochta, Bia agus Mara
Department of Agriculture, Food and the Marine

Bioeconomy Research Symposium Poster Booklet

Department of Agriculture Food & the Marine
Backweston Laboratory Campus, Celbridge, Co. Kildare
Monday 17th October 2022

CONNECTING IRELAND'S BIOECONOMY

Acronyms

AFBI	Agri-Food and Biosciences Institute
ATU	Atlantic Technological University
DAERA	Department of Agriculture, Environment and Rural Affairs
DAFM	Department of Agriculture Food and the Marine
EIP	European Innovation Partnership
EPA	Environmental Protection Agency
ERA-Nets	European Research Area Networks
EU	European Union
GHG	Greenhouse Gas
IrBEA	Irish Bioenergy Association
MTU	Munster Technological University
QUB	Queen's University Belfast
RDP	Rural Development Programme
RPO	Research Performing Organisation
SEAI	Sustainable Energy Authority of Ireland
TCD	Trinity College Dublin
TUDublin	Technological University Dublin
TUS	Technological University Shannon
UCC	University College Cork
UCD	University College Dublin
UL	University of Limerick

Order	Projects
1	**Land-Use, Agriculture and Bioenergy Measures for the Abatement of Climate Change and inclusion in Marginal Abatement Cost Curve analyses (LABMACC).** This project aims to quantify a range of feedstocks for AD, optimise nutrient recovery, refine GHG emissions from digestate and investigate carbon sequestration from digestate use. **Lead RPO:** Teagasc. **RPO Partners:** AFBI, UCD, NUIG & QUB. **Funder:** DAFM & DAERA. **Timeframe:** 2021-2026 (5-year duration). **Funding award:** €2,198,002. **Project ID:** 2021R550. **Principal Coordinator:** Karl.Richards@teagasc.ie
2	**Assuring the Chemical and Microbial Safety of Organic Waste Spread on Land in Ireland (SAFEWASTE).** This project aims to provide data on the concentration of veterinary drug residues, biocide residues, and metals (cadmium, chromium, copper, iron, mercury, molybdenum, nickel, lead, antimony, selenium, tin, and zinc) in animal waste and wastewater treatment sludge used for land spreading in Ireland. **Lead RPO:** Teagasc. **RPO Partners:** UCD, TUDublin & NUIG. **Funder:** DAFM. **Timeframe**: 2021-2025 (4-year duration). **Funding award**: €1,234,349. **Project ID:** 2021R453. **Principal Coordinator:** Declan.Bolton@teagasc.ie
3	**Duckweed as a novel, sustainable source of protein for Ireland (Duck-Feed)**. This project aims to develop improved small scale outdoor cultivation systems, to develop Lemna growth using on farm waste-streams, to optimise protein extraction technology, assess feed quality, economic and environmental viability, and public acceptance of duckweed as a native, protein-rich feedstock. **Lead RPO:** UCC. **RPO Partners:** Teagasc & TuDublin. **Funder:** DAFM. **Timeframe**: 2022-2026 (4-year duration). **Funding award**: €937,717. **Project ID:** 2021R487. **Principal Coordinator:** M.Jansen@ucc.ie
4	**Rapid demonstration model of a sustainable food systems approach in Horticulture** (**RapidHort).** This project is a circular demonstration model based on Irish grown microgreens that will enhance the economic and environmental sustainability of horticultural food production. Using a food systems approach, RAPIDHOT aims to characterise the impact of variation and interactions within the model on nutritional, microbial, sensory, growing and processing properties of the microgreens. **Lead RPO:** UCD. **RPO Partners:** Teagasc. **Funder:** DAFM. **Timeframe**: 2021-2025 (4-year duration). **Funding award**: €522,085. **Project ID:** 2021R523. **Principal Coordinator:** Niamh.Harbourne@ucd.ie
5	**Seaweed Bioactives supplemented animal feeds (SeAFEED).** This project will investigate seaweed bioactive compounds as an alternative to zinc in pig feed. SeAFEED will investigate non-GMO methods to enhance the concentration of bioactive compounds in seaweed biomass at growth, in farmed seaweeds. It will also investigate the overall environmental impact of using seaweeds in the animal feed industry and the green credentials of the drying and separation processes. **Lead RPO:** UL. **RPO Partners:** ATU-Sligo & QUB. **Funder:** DAFM & DAERA. **Timeframe:** 2022-2026 (4-year duration). **Funding award**: €1,198.940. **Project ID:** 2021R647. **Principal Coordinator:** gavin.walker@ul.ie
6	**Valorisation of Digestate using Photocatalysis and Hydrodynamic Cavitation** (**ValiD).** This project focuses on developing science and technology needed for valorising AD digestate and thereby transforming the waste into a resource the project will develop optimal pre-treatment of primary digestate to enhance biogas. **Lead RPO:** UL. **RPO Partners:** QUB & ATU-Donegal **Funder:** DAFM & DAERA. **Timeframe:** 2022-2025 (3-year duration). **Funding award**: €1,028,684. **Project ID:** 2021R475. **Principal Coordinator:** Viverk.Ranade@ul.ie

Order	Projects
7	**Sustainable construction and Assessment Of the full Lifecycle impact of Irish harvested Wood products** (**SAOLWooD).** This project is for the sustainable construction and assessment of the full lifecycle impact of Irish harvested Wood products. This project addresses the challenge of minimising the carbon footprint of construction projects, promoting greater use of sustainable timber solutions in place of high embodied carbon materials. **Lead RPO:** NUIG. **RPO Partners:** UL & TUDublin. **Funder:** DAFM. **Timeframe:** 2022-2026 (4-year duration). **Funding award**: €997,259. **Project ID:** 2021R543. **Principal Coordinator:** Patrick.McGetrick@nuigalway.ie
8	**Utilising organic bio-resources and novel technologies to develop specifically designed and sustainable peat replacements for professional horticultural crop production** (**Beyond Peat).** This project aims to utilising organic bio-resources and novel technologies to develop specifically designed and sustainable peat replacements for professional horticultural crop production. **Lead RPO:** Teagasc. **RPO Partners:** TUS-Athlone, UL, UCD, AFBI & UCC. **Funder:** DAFM & DAERA. **Timeframe:** 2021-2026 (5-year duration). **Funding award**: €1,692,446. **Project ID:** 2021R499. **Principal Coordinator:** Michael.Gaffney@teagasc.ie
9	**INtegrated Framework fOR Mapping, Modelling and Monitoring Ireland's BIOeconomy (INFORMBIO).** This project sets out to deliver a Bioeconomy Foresight Analysis providing a clear roadmap towards a sustainable bioeconomy for Ireland, along with the tools to rigorously measure progress towards this objective. INFORMBIO will develop a prototype national bioeconomy monitoring system, enabling stakeholders to track the development and progress of the national bioeconomy against key bioeconomy indicators. One of the project partners includes the Central Statistics Office. **Lead RPO:** MTU. **RPO Partners:** Teagasc, UL & NUIG. **Funder:** DAFM. **Timeframe:** 2022-2027 (4-year duration). **Funding award**: €996,430. **Project ID:** 2021R423. **Principal Coordinator:** James.Gaffey@mtu.ie.
10	**Biostimulants and Biopesticides for Crop production** (**BioCrop).** This is a project examining new and testing existing biobased fertilisers and biopesticides for growers in the face if EU regulations on fertiliser use and the loss of plant protection products. **Lead RPO:** UCD. **RPO Partners:** Teagasc, NUIG & TCD. **Funder:** DAFM. **Timeframe:** 2020-2025 (5-year duration). **Funding award**: €1,999,570. **Project ID:** 2019PROG705. **Principal Coordinator:** Dr Angela.Feechan@ucd.ie
11	**Seaweeds and seaweed-ingredients to reduce enteric methane emissions from pasture-based sheep, cattle and dairy cows** (**SeaSolutions).** This project's aim is to evaluate effects of seaweeds on total methane gas production using different in vitro rumen fluid models and animal trials. **Lead RPO:** Teagasc. **Irish RPO Partners:** ATU-Sligo. **Funder:** DAFM via European Era-Net Co-Fund. **Timeframe:** 2020-2023 (3-year duration). **Funding award**: €300,844. **Project ID:** 2019EN207. **Principal Coordinator:** Maria.Hayes@teagasc.ie
12	**Innovative Design for the Future - Use and Reuse of Wood (Building) Components** (**InFutUReWood).** This project seeks to develop a method for ensuring the future possibility of circulation of timber products with true consideration of the whole lifecycle, and practical industry issues at design, construction and deconstruction phases. Approaches to the primary design of buildings to facilitate deconstruction rather than demolition will be developed, while considering issues such as the use of chemical treatments, adhesives and other synthetic materials. **Lead Irish RPO:** NUIG. **Irish RPO Partners:** UCD. **Funder:** DAFM via European Era-Net Co-Fund. **Timeframe:** 2019-2022 (3-year, 4 months duration). **Funding award**: €294,552. **Project ID:** 18RDFORESTVALUE1. **Principal Coordinator:** Annette.Harte@nuigalway.ie

Order	Projects
13	**Unlocking the potential of microalgae for the valorisation of brewery waste products into omega-3 rich animal feed and fertilisers (AlgaeBrew).** This project sets out to use microalgal biotechnology to convert brewing wastes (nutrient rich wastewater and spent grain) into useful products, thereby creating new revenue streams for breweries, decreasing their environmental impacts and promoting a circular bioeconomy. **Lead Irish RPO:** UCD. **Funder:** DAFM via European Era-Net Co-Fund. **Timeframe:** 2022-2025 (3-year). **Funding award**: €324,815. **Project ID:** 2021SUSFOODFOSCEN101. **Principal Coordinator:** Ronald.Halim@ucd.ie
14	**Strategies for Circular Agriculture to reduce GHG emissions within and between farming systems across an agro-ecological gradient** (**CircAgric-GHG).** This project represents a consortium of 17 world-leading researchers from 8 countries with expertise in livestock, cropping systems, farm and landscape modelling, lifecycle assessment, and ecosystem services evaluation. The consortium draws upon state-of-the-art knowledge, research methods and models to assess how circular practices can deliver sustainable food systems. **Lead Irish RPO:** NUIG. **Irish RPO Partner:** Teagasc. **Funder:** DAFM & Teagasc (96K-Own contribution) via European Era-Net Co-Fund. **Timeframe:** 2022-2025 (3-year). **Funding award**: €246,186. **Project ID:** 2021EN902. **Principal Coordinator:** David.Styles@nuigalway.ie
15	**Multi-criteria assessment, decision support and management tools for sustainable circular mixed farming systems for dairy production** (**DairyMix).** This project aims to increase sustainability and reinforce climate friendly mixed crop and dairy production systems. DairyMix will be a major step forward in achieving GHG mitigation and circularity between cropping systems and dairy production systems. **Lead Irish RPO:** Teagasc. **Irish RPO Partner:** UCD. **Funder:** DAFM & Teagasc (96K-Own contribution) via European Era-Net Co-Fund. **Timeframe:** 2022-2025 (3-year). **Funding award**: €249,241. **Project ID:** 2021EN904. **Principal Coordinator:** Dominika.Krol@teagasc.ie
16	**Converting urban waste streams into value-added products** (**CircBioCityWaste)**. This project is developing a first-of-a-kind cascading biorefinery concept to produce new value chains and transform urban biological wastes such as municipal sludge, dairy processing sludge and black bin waste into sustainable bio-based fertilizers and biochemicals for agriculture, food, cosmetic and pharmaceutical sectors. **Lead RPO:** MTU. **RPO Partners:** UL & TUDublin. **Funder:** EPA & DAFM. **Timeframe:** 2022-2026 (4-year). **Funding award**: €493,670. **Project ID:** 2021-GCE-1040**. Principal Coordinator:** Gaurav.Rajauria@mtu.ie
17	**Sustainable, biodegradable, compostable and recyclable plastics for packaging and end of life management** (**BioPost).** The aim of this project is to develop sustainable environmentally friendly plastics to address the real-world problems of current plastics.. This project is also partnered by Cré. **Lead RPO:** TCD. **RPO Partners:** UCD. **Funder:** EPA & DAFM. **Timeframe:** 2020-2023 (3-year). **Funding award**: €497,784. **Project ID:** 2019-RE-LS-4. **Principal Coordinator:** ramesh.babu@tcd.ie
18	**Scenarios Quantifying land Use & Emissions Transitions towards Equilibrium with Removals** (**SeQUEsTER)**. This is a transdisciplinary project involving a wide range of stakeholders contributing to model development via workshops and through consultation. SeQUEsTER combines bioeconomic modelling and lifecycle assessment to identify promising pathways towards net zero GHG emissions in Ireland's agriculture, forestry and other land use sector. **Lead RPO:** UL. **Irish RPO Partner:** Teagasc & NUIG. **Funder:** EPA & DAFM. **Timeframe:** 2019-2022 (3 years). **Funding award**: €348,934. **Project ID:** 2018-CCRP-MS.57. **Principal Coordinator:** David.Styles@nuigalway.ie

Order	Projects
19	**Agri Bio Circular Economy** (**ABC Economy)**. This project has engaged with key stakeholders through project partner, Cré, and project collaborators, Tipperary County Council and Monaghan County Council, to develop sustainable value chains based on the bioresources available in each region. **Lead RPO:** UCD. **Funder:** SEAI & DAFM. **Timeframe:** 2019-2022 (2 years). **Funding award**: €228,213. **Project ID:** 18/RDD/365. **Principal Coordinator:** Fionnuala.Murphy@ucd.ie
20	**Enhancing and Assessing the Impact of Novel Circular Economy Sectors in the bioeconomy** (**BioCIRCLE)**. This project sets out to assess the impact of novel circular economy sectors within the Irish biomass bioeconomy and issues in relation to scale-up. BioCIRCLE will undertake several analytical tasks for a number of different Case Studies and identify market opportunities for relevant sectors. **Lead RPO:** NUIG. **Funder:** SEAI & DAFM. **Timeframe:** 2019-2022 (2 years). **Funding award**: €185,720. **Project ID:** 19/RDD/235. **Principal Coordinator:** Cathal.ODonoughue@nuigalway.ie
21	**Circular Bioeconomy Outlook Study 2030-2050 (CBI).** This is a desk-based study to support policymaking for a sustainable and circular bioeconomy in Ireland, providing an Evidence Review. A 'snapshot' of the current knowledge base available, to provide the foundation for an innovation outlook up to 2050. The review would highlight key policy choices that need to be considered regarding the sustainable use of biological resources. CBI was also partnered by EUR Digital Village. **Lead RPO:** UCD, **Irish RPO Partner:** MTU & TCD. **Funder:** EPA & DAFM. **Timeframe:** 2021-2022 (6 months). **Funding award**: €50,000. **Project ID:** 2021-GCE-2021. **Principal Coordinator:** Kevin.OConnor@ucd.ie
22	**Biorefinery Glas Small-scale Farmer-led Green Biorefineries.** Is a first demonstration of small-scale biorefinery in Ireland, supporting development of new business models and farmer diversification into the circular bioeconomy. **RPO Led** by the MTU. **Partners** include the Barryroe Co-operative, the Carbery Group, GRASSA B.V. and UCD. **Funded** by DAFM and the EU as a EIP for Agriculture Productivity and Sustainability (Agri) Operational Group under RDP 2014-2020. **Timeframe:** 2019-2020. **Funding award**: €940,498. **Project ID/Geographical location:** IE 053 South-West Region. **Principal Coordinator:** James.Gaffey@mtu.ie
23	**Biomass to Biochar for Farm Bioeconomy (BBFB).** This project aims to demonstrate how unwanted or underutilized agricultural biomass such as rushes, gorse, bracken and hazel, can be used to produce biochar through a lifecycle approach for current management practices and farm vegetative control. In doing so, BBFB seeks to make direct use of this biochar to sustain a circular bioeconomy from the farm, as well as providing a downstream ecosystem service. **Lead** by Biomass to Biochar Ltd (BTBL). **Funded** by DAFM and the EU as a EIP Agri Operational Group under the RDP 2014-2020. **Timeframe:** 2018-2021. **Funding award**: €988,377. **Project ID/Geographical location:** IE 051 Mid-West Region. **Principal Coordinator:** Bernard Carey biomasstobiochar@gmail.com
24	**Small Biogas Demonstration Programme** (**SBDP).** This project aims to stimulate the deployment of innovative on-farm small-scale biogas production by providing support and a capital contribution to three demonstration projects. Research will assist in understanding how biogas can drive sustainability improvements at farm level. **Lead** by IrBEA. **Partners** include Teagasc, Laois Partnership and Tipperary Cheese. **Funded** by DAFM and the EU as an EIP Agri Operational Group under the RDP 2014-2020. **Timeframe:** 2019-2022. **Funding award**: €994,273. **Project ID/Geographical location:** IE 063 Midlands & IE Mid-West Region. **Principal Coordinator:** Sean.Finan@irbea.org

Land-Use, Agriculture and Bioenergy Measures for the Abatement of Climate Change and inclusion in Marginal Abatement Cost Curve analyses (LABMACC)

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INTRODUCTION

The Climate Action Plan envisages a 51% reduction in national Greenhouse Gas (GHG) emissions by 2030, with a goal of agriculture achieving Climate Neutrality by 2050 at a national, all-Island and EU level.

OBJECTIVE

LABMACC will investigate a wide range of new agricultural measures to reduce GHG and ammonia emissions from Irish farms. Optimise manure management and nutrient recovery systems that promote a circular farm nutrient cycling and energy recovery thus supporting bioeceonomy.

The new measures will be included in a new Marginal Abatement Cost Curve (MACC) for Irish farmers to achieve climate neutrality and the new emission factors incorporated into the national inventory.

NEW MITIGATION MEASURES FOR REDUCING NITROUS OXIDE AND AMMONIA EMISSIONS

OBJECTIVES

- Evaluate and refine the emission factor for a range of compound fertilisers
- Quantify GHG emissions from slurry and digestate spread using low emission techniques

MEASURES TO ENHANCE CARBON SEQUESTRATION

OBJECTIVE

Investigate carbon emissions and sequestration associated with liming, basalt application and digestate addition and impacts of alternative land-use on soil organic carbon

THE APPLICATION AND ASSESSMENT OF INTEGRATED MANURE MANAGEMENT AND NUTRIENT RECOVERY TECHNOLOGIES AT FARM-SCALE

OBJECTIVE

Assess the impact of nutrient inputs from treated slurries, digestates, and processed fractions, on nutrients recycling and organic matter accumulation in agricultural grasslands

Acknowledgements

This research is financially supported under the National Development Plan, Research Stimulus Fund, Department of Agriculture, Food and the Marine Grant number 2021R550.

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Teagasc
Agriculture and Food Development Authority

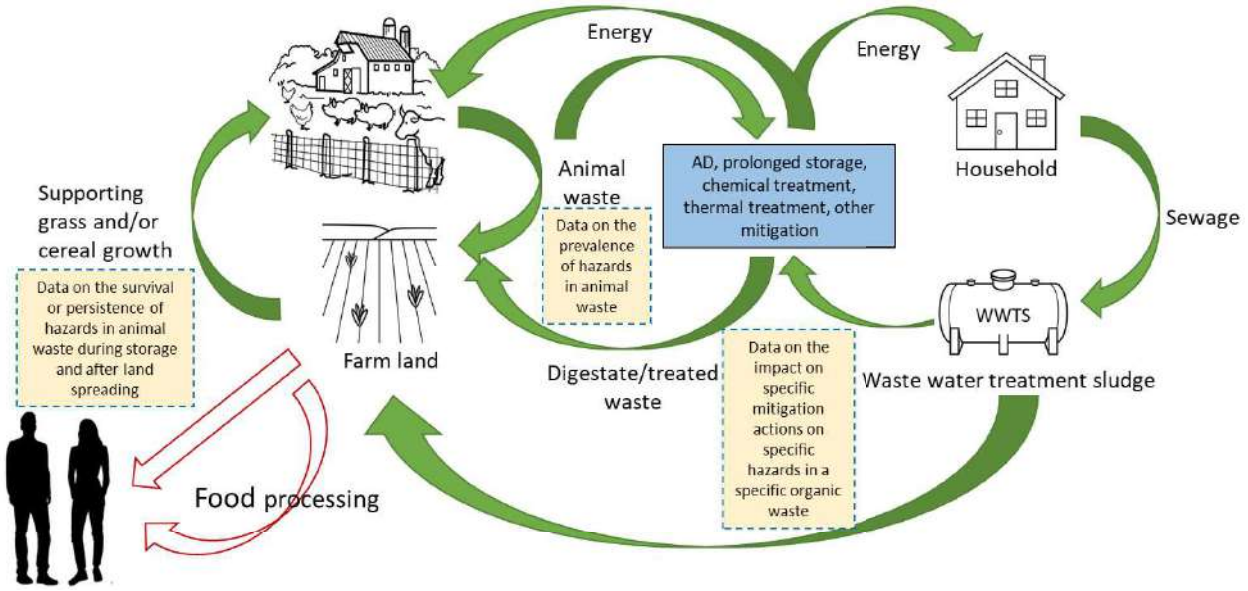
Assuring the Chemical and Microbial Safety of Organic Waste Spread on Land in Ireland (SAFEWASTE-2021R453)

This project will provide data on the concentration of veterinary drug residues, biocide residues, and metals (cadmium, chromium, copper, iron, mercury, molybdenum, nickel, lead, antimony, selenium, tin and zinc) in animal waste and wastewater treatment sludge used for land spreading in Ireland.

The numbers, prevalence and survival of *Salmonella* spp., STEC/*E. coli* O157, *Listeria monocytogenes*, *Campylobacter* spp., *Clostridium* spp., *Cryptosporidium* and norovirus will also be investigated.

A risk ranking exercise will inform targeted mitigation by identifying the most relevant waste-hazard combinations requiring control. Mitigation studies on the most relevant hazards will then be undertaken, including storage, anaerobic digestion (AD), composting, thermal and chemical treatments.

The outputs will inform farmers, AD operators, regulators and other relevant stakeholders about the chemical and biological hazards in organic wastes intended for land spreading in Ireland as well as best practice and policy for their control.



Ollscoil Teicneolaíochta Bhaile Átha Cliath
TU DUBLIN
Technological University Dublin

Ollscoil na Gaillimhe
University of Galway

UCD DUBLIN

An Roinn Talmhaíochta, Bia agus Mara
Department of Agriculture, Food and the Marine

This study is funded by the Department of Agriculture, Food and Marine (Project 2021R453).

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An Roinn Talmhaíochta, Bia agus Mara
Department of Agriculture, Food and the Marine

Duckweed as a Sustainable Source of Protein for Ireland

Marcel A.K. Jansen, Edmond Byrne, Niall O'Leary, Anushree Priyadarshini, Uma Tiwari, Brijesh K. Tiwari, Mick O'Connell

Duck-Feed
Sustainable protein from duckweed

@PLANTS_UCC

INTRODUCTION

The overarching aim of the project is to develop duckweed as a novel protein source for Ireland, with cultivation based on the principles of the circular economy, whereby waste is a novel resource.

Lemnaceae (duckweed) are fast growing aquatic plants that have received ample attention because of their;

- ability to phytoremediate surface waters, including the removal of plant nutrients such as nitrogen and phosphorus
- high protein content with a desirable amino acid profile, which makes the biomass suitable for use in food (e.g. USA) as well as feed. In the latter role it can replace soymeal as a source of protein.

Several duckweed species are native in Ireland, making duckweed a promising candidate as a novel, native protein source for Ireland.

PROJECT PARTNERS

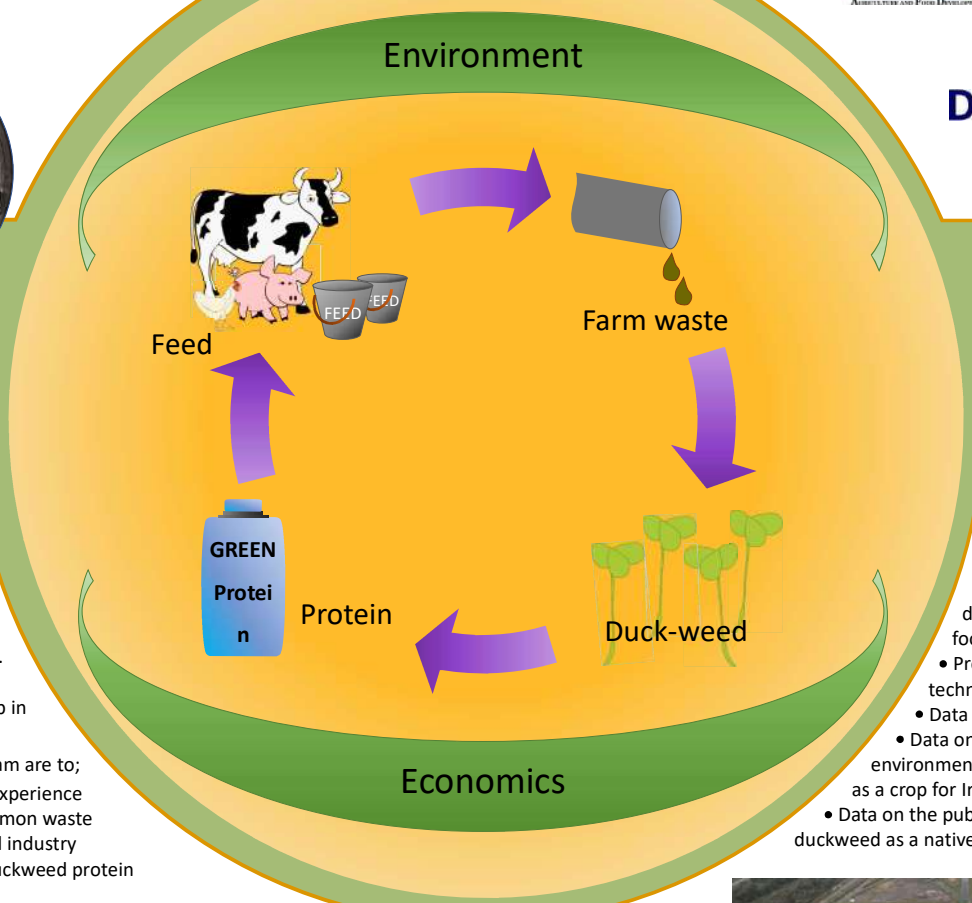
UCC - University College Cork
TUD - Technological University Dublin
TEAGASC - Agriculture and Food Development Authority
Devenish - quality animal feeds

UCC University College Cork, Ireland Coláiste na hOllscoile Corcaigh

TUD Ollscoil Teicneolaíochta Bhaile Átha Cliath Technological University Dublin

Teagasc Agriculture and Food Development Authority

DEVENISH



AIMS & VISION

The project team has recently achieved yields of 30 tonne dry matter at the Bord Iascaigh Mhara-funded Mt Lucas (Offaly) experimental farm. This demonstrates that duckweed is a realistic crop in the Irish climate.

The **aims** of the project team are to;

- develop expertise and experience to grow duckweed on common waste streams from the agri-food industry
- explore and optimise duckweed protein extraction technology
- Show-case the use of duckweed in composite pig and/or fowl feeds
- Quantify the economic and environmental benefits of the use of duckweed as a novel protein source

The **vision** of the project team is to;

- facilitate a roll-out of Duckweed cultivation in Ireland, in close collaboration with farmers and agri-industry.
- support the transition to a sustainable circular farming economy by recycling plant nutrients
- reduce a reliance on imported feed-stocks and improve the competitiveness of a sustainable, green, Irish agriculture

DELIVERABLES

- Robust medium scale outdoor cultivation systems,
- Protocols for growing duckweed on various agri-food waste streams,
- Protein extraction technology,
- Data on feed quality,
- Data on the economic and environmental viability of duckweed as a crop for Ireland,
- Data on the public acceptance of duckweed as a native, protein-rich feedstock.

Duckweed production on Mt Lucas (Offaly)

Websites: https://www.ucc.ie/en/plantstress/ https://www.ucc.ie/en/brainwaves/

UCC University College Cork, Ireland Coláiste na hOllscoile Corcaigh

Environmental Research Institute

BRAINWAVES Agri Prospecting Archwilio Amaethyddol Taiscéalaíocht Talmhaíochta

BIM Ireland's Seafood Development Agency

UCD Institute of Food and Health

RapidHort - Rapid demonstration model of a Sustainable food systems approach in **Hort**iculture

N. Harbourne, D. Hurley, JC Jacquier, M. Harty, C. Elliott-Kingston, E. Crofton, E. Feeney, J. Lyng, B. Dereje Olika (PhD student), S. Dubey (PhD student)

About the project

RapidHort is a circular demonstration model based on Irish-grown microgreens that will enhance the economic and environmental sustainability of horticultural food production.

The goal of RapidHort is to provide growers and processors with tools to develop and deliver horticultural products with increased competitiveness, nutritional value, and sustainability.

Why microgreens?

- Seedlings of herbs or vegetables with a short growing cycle (7–21 days) and short shelf-life
- Can be grown all year round requiring limited space
- High nutritional value
- Opportunity to reconnect public imagination with food production

Project overview

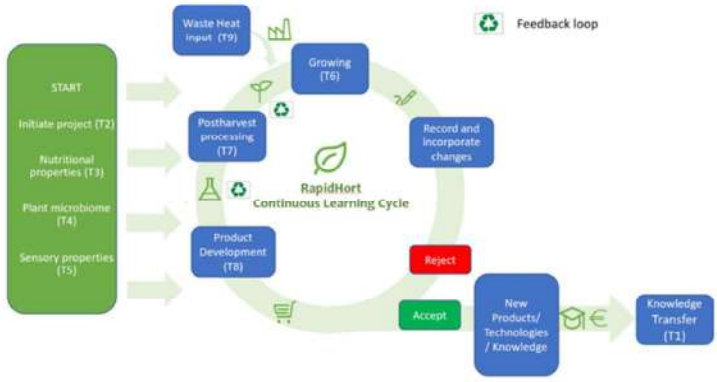


Figure 1. Graphical overview of the RapidHort project

Microgreens display both rapid growth and deterioration which compounds challenges faced in commercial horticulture. This project brings together key stakeholders including academics, consumers, growers, and processors. Using a food systems approach, RapidHort aims to characterise the impact of variation and interactions within the model on growing, microbial, nutritional, processing, and sensory properties of microgreens. In addition, it will explore the potential of using waste heat from data centres to power vertical farming for microgreen production to reduce waste and achieve greater environmental sustainability.

Impact on the bioeconomy

- **Holistic demonstration model for sustainable horticultural food production:** inform more sustainable practices for fresh produce growing, handling, and product development.
- **Reuse model for industrial waste energy as an input for food production:** proof of concept for food production with zero waste by recycling heat energy produced by a data centre to power a vertical farm production facility.
- **Proposed design for 21st Century sustainable urban food production in Dublin region:** incorporation of food production into the future design of the city will enable co-location of people and food production reconnecting the public with the "where" and "how" food is produced. The public have become removed from how their food is produced and this distance is reducing value placed on food and increasing food waste. By reintegrating food production into urban areas, RapidHort aims to improve consumer linkage with food production, recycle waste energy, and provide a ready source of locally grown, healthy, plant-based foods with a low carbon footprint.

New value-added bio-products

- **Sustainable production of novel food ingredients to extend shelf-life and reduce waste associated with fresh horticultural products:** provide the Irish food industry with new, ground-breaking ingredients with health and functional properties.
- **Prototype food products containing sustainably produced clean-label plant-based ingredients:** successful development of innovative food products will lead to new production facilities in Ireland and boost export sales.

Policy and regulation advice

Our research acknowledges UN Sustainable Development Goals and results generated will be used to inform policy change in the areas of Sustainable Production and Waste Reduction.

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UNIVERSITY OF LIMERICK
OLLSCOIL LUIMNIGH
Bernal Institute

SeAFEED Seaweed Bioactives supplemented animal feeds

Project Lead: Gavin Walker (UL)

Project Overviews

After beef and dairy, pig farming is Ireland's third-largest livestock industry. In place of zinc in pig feed, the SeAFEED research will look into the beneficial chemicals found in seaweed. Until now, post-weaning diarrhea and other animal diseases were treated with zinc oxide as a therapeutic addition to piglet diets. Ireland is known for its rich marine biodiversity and currently has more species of seaweeds than other EU countries. Yet, the development and commercialisation of this sector, particularly in terms of seaweed aquaculture/farming, is still significantly underdeveloped. Both the ROI and NI (agree-food sector) have significant capacity to farm/harvest seaweeds that is currently underutilised. Zinc oxide, on the other hand, is banned beginning this year for a variety of reasons, including zinc toxicity and environmental contamination. The study will investigate non-GMO techniques for increasing the concentration of beneficial chemicals in farmed seaweed biomass during growth. It will look into greener drying processes for seaweeds as well as greener separation ways to produce an enriched fraction from seaweeds with antimicrobial characteristics that may be used as a feed additive. It will also look into the overall environmental impact of employing seaweeds in animal feed, as well as the sustainability of the drying and separation procedures. The General Objective is to enable and accelerate the transition from traditional animal feed value chains to a carbon neutral.

Zinc oxide – Banned, EU 2022

Side effects

- Toxic
- Heavy metal contamination in soil
- Environmental concerns
- Nutritional interactions

Natural Alternative

Bioactive properties
Antioxidant
Antimicrobial agent

Environmental friendly
Economical
Less toxicity

Seaweed

SeaFEED

1. Inducing compounds of interest at growth in seaweed biomass
2. Greener dying methods for seaweed Biomass
3. Removal of non-digestible fibres using green chemistry to produce feed ingredient additives to produce a zinc replacement
4. LCA of processes

Project Aims

The four main areas of this research will be:

- Increase concentration of bioactivates in seaweed
- The development of a phlorotannin-enriched feed ingredient.
- The optimisation and scale-up of drying and palletization processes.
- The production of feed pellets that will meet the bioavailability and nutritional needs of pigs while improving gut health in an eco-friendly and sustainable manner.

Expected Impacts

- SeAFEED will strive to increase public knowledge of biodiversity/ecosystems and improve public awareness of the impact of the commercialisation of seaweeds on such systems.
- Train & develop expertise in seaweed biotechnology.
- The improvement of drying technologies used in the seaweed industries such as reducing variability in the dying process, while preserving the bioactive ingredients in seaweed biomass that have commercial value.
- To improve efficiencies and reduce the carbon footprint of the process.
- Currently, drying seaweed biomass accounts for the majority of the processing costs which hikes the prices of seaweed feedstocks making them less attractive to the end users, i.e. feed and food sectors. The development of such technologies has significant benefit not just in this project but across the seaweed industry both locally, nationally and internationally.

Partnership & Collaborations

Academic Partnership:

- **University of Limerick:** Prof Gavin Walkers (Chemical Engineer), Dr Patrick Cronin.
- **Atlantic Technological University Sligo:** Dr Thomas Smyth & Dr Owen Kennedy (Natural Product Chemists)
- **Queen's University Belfast:** Dr Pamela Walsh & Dr Beatrice Smyth (Mechanical Engineers), Prof Jaimie Dick (Ecologist), Dr Louise Kregting (Marine Biologist) and Dr Andy Marr (Chemist – green chemistry)

Industrial Partnership

The Seaweed Company
SeaLac
Artisan Finnebrogue
DEVENISH
jmw farms

Funders
Agriculture, Environment and Rural Affairs
Agriculture, Food and the Marine

BIOECONOMY IRELAND WEEK OCTOBER 17-23 2022

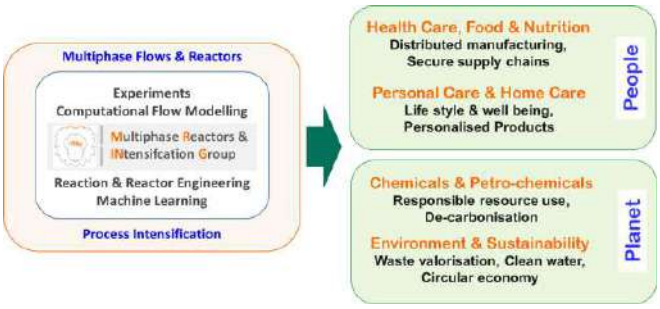
Novel Pre-treatment for Valorising Waste Biomass

Insights, Innovations & Intensification for Circular Bio-economy

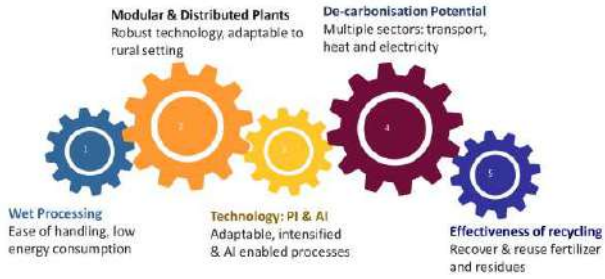
Vivek V. Ranade (Vivek.Ranade@ul.ie)
Multiphase Reactors & Intensification group, Bernal Institute
University of Limerick, Limerick, Ireland

An Roinn Talmhaíochta, Bia agus Mara
Department of Agriculture, Food and the Marine

Enhanced Productivity, Sustainable Processes, Smart Manufacturing



Key Drivers for Valorisation of Waste Biomass



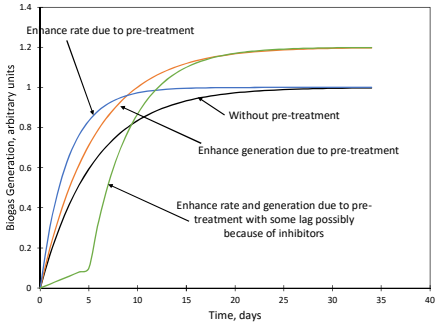
Bio-chemical, particularly biogas route is quite attractive, considering potential for realisation of circular economy and inclusive growth via decentralised – modular plants

Valorisation of Waste Biomass via Anaerobic Digestion

- Reasonably robust; uses consortium of microbes
- Decarbonise a variety of sectors – transportation, heat and power
- Wet processing of waste feedstock
- Potential to recover fertiliser and other valuable materials/ energy from digestate → circular economy
- Potential to create and expand local industry & jobs – inclusive economic growth

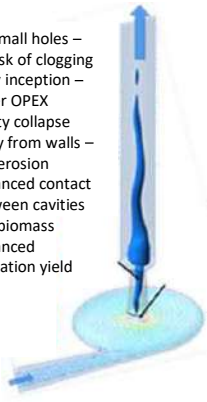
Slower processes - large footprint
Low carbon conversion
Difficult digestate management

Develop pre-treatment solutions to intensify AD performance



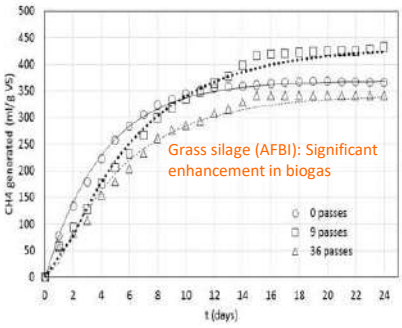
Goal is to minimise formation of inhibitors and maximise rate & extent of digestion

- No small holes – no risk of clogging
- Early inception – lower OPEX
- Cavity collapse away from walls – less erosion
- Enhanced contact between cavities and biomass
- Enhanced cavitation yield

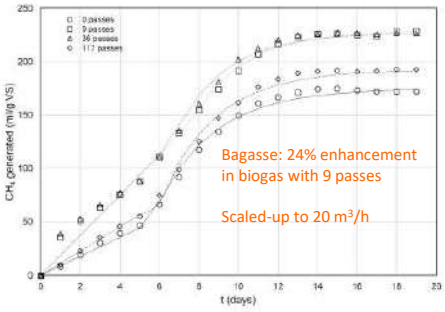


US9422952, I & EC Research 2019

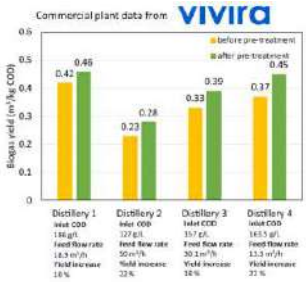
Used novel vortex based hydrodynamic cavitation devices for enhancing biogas yield of variety of AD feed stocks



Developed and optimised pre-treatment for a variety of ligno-cellulosic biomass & sludges

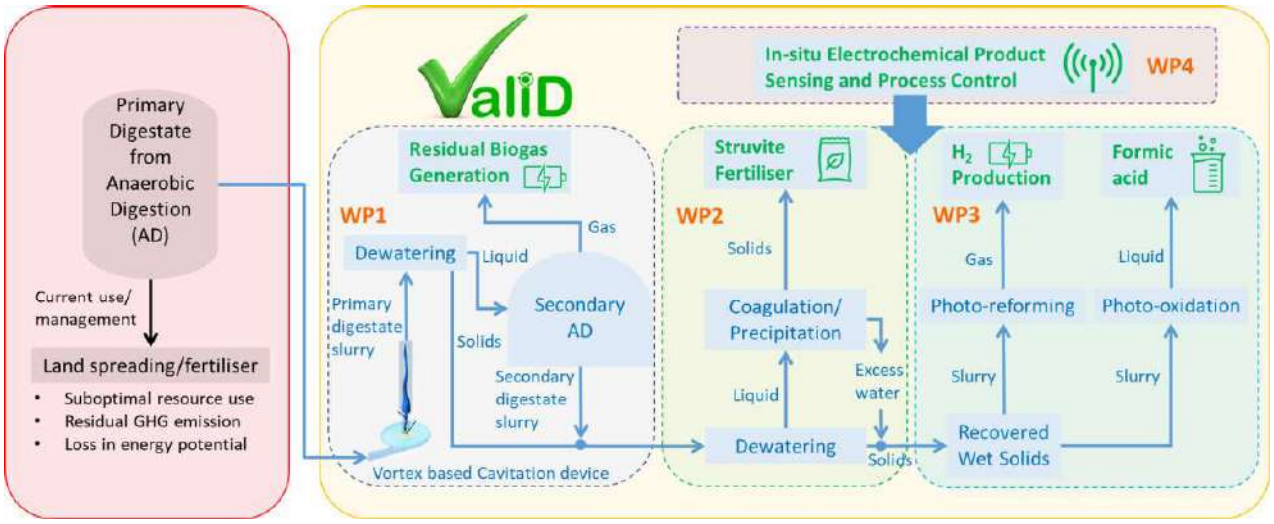


Developed AD models and scaled-up pre-treatment up to 50 m³/h nominal capacity



Plant data from four digesters (single pass through cavitation device)

New DAFM funded project lead by University of Limerick on Valorisation of Digestate using Photo-catalysis and Cavitation



UNIVERSITY OF LIMERICK OLLSCOIL LUIMNIGH Bernal Institute
QUEEN'S UNIVERSITY BELFAST
ATU
GREEN GENERATION
BIOCORE
United Renewables

Summary and Outlook

Established sound basis and experimental data confirming enhancement in biogas yield using vortex based cavitation devices; A suite of computational models provides useful insights and facilitates optimisation of pre-treatment devices as well as design and operation of AD systems

Significant opportunities for enhancing biogas yield in the existing and new AD plants

SAOLWood: Sustainable construction and Assessment Of the full Lifecycle impact of Irish harvested Wood products

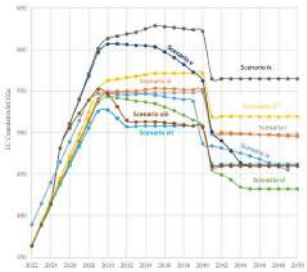
BIOECONOMY IRELAND WEEK OCTOBER 17-23 2022

S. Ge, P.J. McGetrick, C. O'Ceallaigh, A.M. Harte, C. O'Donoghue, D. Styles, A. Byrne, M. Quilligan, M. de Freine

Introduction: This project aims to minimise the carbon footprint of construction projects by promoting greater use of sustainable timber solutions in place of high embodied carbon materials and delivering a comprehensive database for improved whole lifecycle assessment (LCA) of the impacts of utilising locally sourced Irish wood products in the built environment. This supports growth of the circular bioeconomy and creation of sustainable employment. For the first time, construction demand and land-use for forestry will be linked in the LCA of harvested wood products in order to optimise returns to forest owners and identify novel cascading uses of wood.

Review Gaps and Barriers

Review Irish construction practices and policy on monitoring and tracking the environmental performance of materials used in construction (e.g. Fig. 1). Identify current gaps and barriers based on the overview and provide corresponding solutions.



Scenario	Average % Timber Builds	Timber apartments (% of total no. apartments)	EC	CS (-)	Net
			Mt CO_2e		
i	24	4,178 (2.9%)	14.6	5.8	8.8
ii	20	6,820 (2.9%)	15.1	5.6	9.6
iii	36	16,930 (7.1%)	14.7	6,1	8.6
iv	42	41,471 (17%)	14.3	6.4	7.8
v	50	82,883 (35%)	15.0	7.6	7.5
vi	50	82,883 (35%)	13.8	6.9	6.9
vii	45	99,971 (42%)	13.8	6.9	6.9
viii	57	141,117 (59%)	14.0	8.6	5.5
ix	42	11,790 (4.9%)	16.4	6.4	10

Figure 1. Embodied Carbon (EC) emissions and carbon storage (CS) for different housing scenarios between 2022 and 2050 in Ireland. Cumulative totals shown in table; potential savings of up to ~40% in CO2e. (*Gil-Moreno et al* 2022, *CERI Conference*).

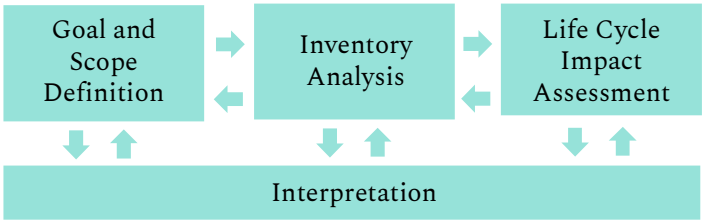


Figure 2. LCA framework based on ISO 14040

New National Database

Create a new national database of lifecycle data for Irish harvested wood products promoting the circular bioeconomy, material passport creation and sustainable building certification.

Lifecycle Assessment

Rigorous holistic life cycle assessment to quantify the environmental sustainability of harvested wood product use in buildings and try to reduce the impacts during construction and deconstruction.

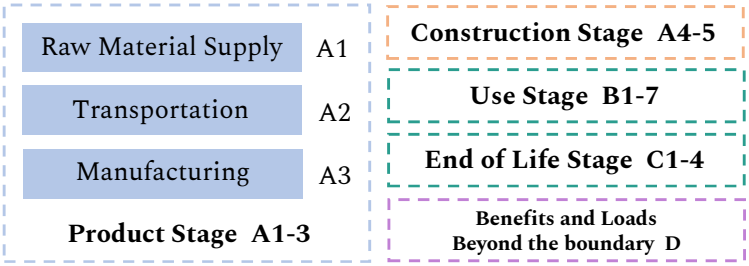


Figure 3. The system boundary of buildings' lifecycle assessment (defined in EN 15978)

Bioeconomic modelling and Impact Assessment

Assess the economic, social, spatial and environmental impacts of locally-sourced Irish timber products and associated value chains to support informed decisions by building designers, contractors, planners, developers and policy-makers

Building modelling and performance validation

Modelling, detailing and structural testing of Irish timber building solutions and components for which test data is limited or non-existent. Investigation of an integrated BIM-based LCA approach, and design for deconstruction and reuse to minimise waste.

Ollscoil na Gaillimhe University of Galway · University of Limerick Ollscoil Luimnigh · Technological University Dublin Ollscoil Teicneolaíochta Bhaile Átha Cliath · An Roinn Talmhaíochta, Bia agus Mara Department of Agriculture, Food and the Marine

The SAOLWood Project is funded by the Department of Agriculture, Food and the Marine's Competitive Research Funding Programmes. Project Ref: 2021R543

TERG Timber Engineering Research Group @TERG_UniGalway

COILLTE · GLENNON · IGBC · ITFMA · MEDITE SMARTPLY · PUNCH consulting engineers · SISK · URBAN AGENCY

Beyond Peat

Beyond Peat

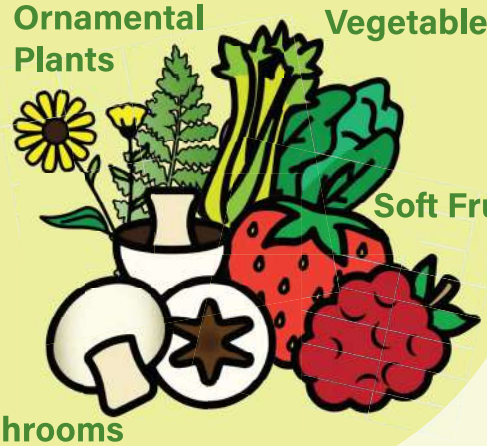
BIOECONOMY IRELAND WEEK OCTOBER 17-23 2022

Utilising organic bio-resources and novel technologies to develop specifically designed and sustainable peat replacements for professional horticultural crop production

[1]Gaffney, M.T., [1]Walsh, L., [1]Grogan, H., [1]Corbett, E., [2]Schmidt, O., [2]Tracy, S., [3]Kilpatrick, M., [4]Devine, D., [4]Chen, Y., [5]Jansen, M, [5]Lettice, E., [6]Prasad, M., [6]Leahy, J.J.

[1]Teagasc, Horticulture Development Department, Ashtown, Dublin 15; [2]School of Agriculture and Food Science, UCD, Dublin 4; [3]Agri-Food and Biosciences Institute, Loughgall, Armagh BT618JA; [4]Materials Research Institute, Technological University of the Shannon, Athlone, Westmeath N37HD68; [5]School of Biological, Earth and Environmental Sciences, UCC, T23N73K; [6]Faculty of Science and Engineering, University of Limerick, V94T9PX

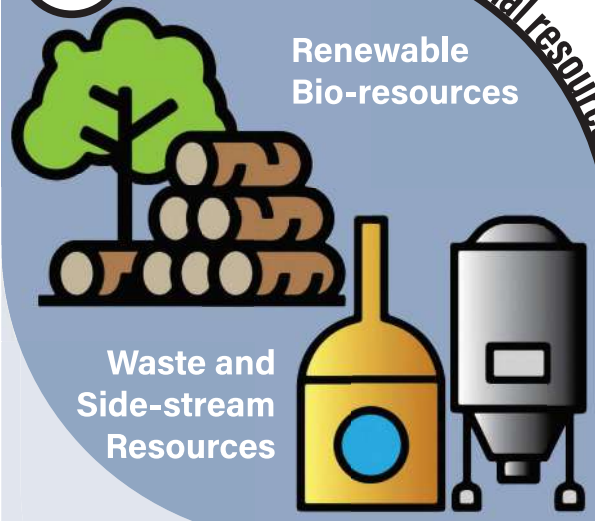
Key Horticultural Sectors



Horticulture is the 4th largest agricultural sector, valued at €467m (DAFM; 2020)

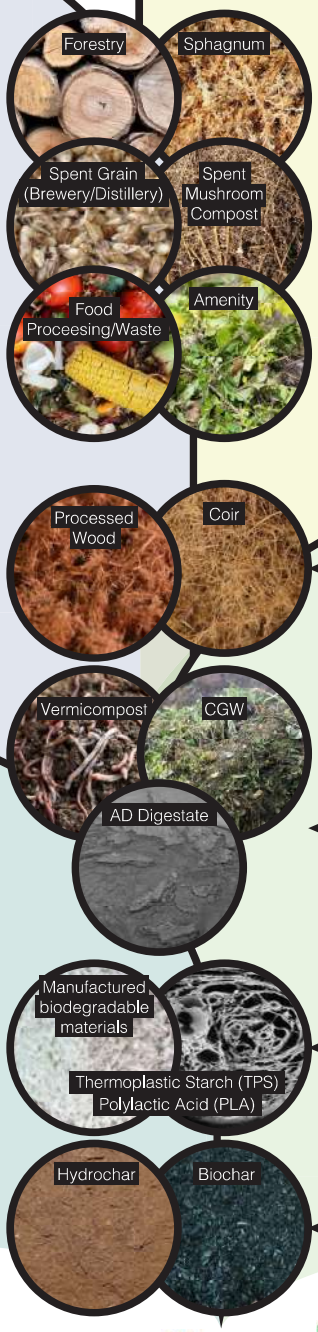
Approximately 60% of the value of Irish Horticulture is dependent on peat (Working group final report; 2021)

WP 2 Inventory for raw-material resources



Growth Media Requirements

Professional Horticulture - 380,000 m³ annually
Retail Horticulture - 470,000 m³ annually
Horticulture within N. Ireland - 150,000 m³ annually



Processes, Transformation, Manufacturing

WP 3 Material Characterisation
Mechanical Processing, Milling, Shredding

WP 4 Optimising Biological Processes
Composting, co-composting, vermicomposting, microbial digestion

WP 7 Manufacturing Solutions
Solutions based approach, combining organic and inorganic materials

WP 8 Thermal Transformation
Pyrolysis, Hydro thermal carbonisation

Growth Media Evaluation

Demonstration - Commercial-like crop trials **WP 5**

Development- Agronomic testing of novel growth media **WP 9**

Sustainability - Life Cycle Analysis of viable alternatives
Economic - Appraisal of cost and scalbility **WP 10**

The Beyond Peat consortium would like to acknowledge that the project is funded by the Department of Agriculture, Food and the Marine's Competitive Research Funding Programme (2021R499) and through the Department of Agriculture, Environment and Rural Affairs in Northern Ireland.

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Department of Agriculture, Food and the Marine

Department of Agriculture, Environment and Rural Affairs

afbi Agri-Food & Biosciences Institute

TUS

University of Limerick Ollscoil Luimnigh

UCC University College Cork, Ireland

UCD Dublin

Teagasc Agriculture and Food Development Authority

MTU Ollscoil Teicneolaíochta na Mumhan Munster Technological University

Ollscoil na Gaillimhe University of Galway

Teagasc Agriculture and Food Development Authority

An Phríomh-Oifig Staidrimh Central Statistics Office

InformBio

Integrated Framework for Mapping, Modelling and Monitoring Ireland's Bioeconomy

InformBio is a DAFM funded project that positions Ireland as a front-runner among EU member states, by developing a **prototype national bioeconomy monitoring system**, enabling Ireland to track the development and progress of the bioeconomy against key bioeconomy indicators.

The project will deliver a **Bioeconomy Foresight Analysis** providing a roadmap for Ireland towards a sustainable bioeconomy, along with the tools to rigorously measure progress towards this objective.

InformBio combines datadriven research, **analysis** and **modelling** with input from expert **thematic groups**, ensuring robust and informed outcomes for industry, policy makers and other relevant groups.

1 Biological raw material mapping

Quantifying the regional distribution of biological raw materials taking into account accessibility constraints (temporal availability, existing uses, economic and environmental constraints) using a **bioresource modelling tool**.

2 Bio-based value chain catalogue

Developing a **catalogue of feedstock-specific biobased value chain opportunities** for Ireland's bioeconomy, and screening them with stakeholder input to identify highest potential value chain opportunities.

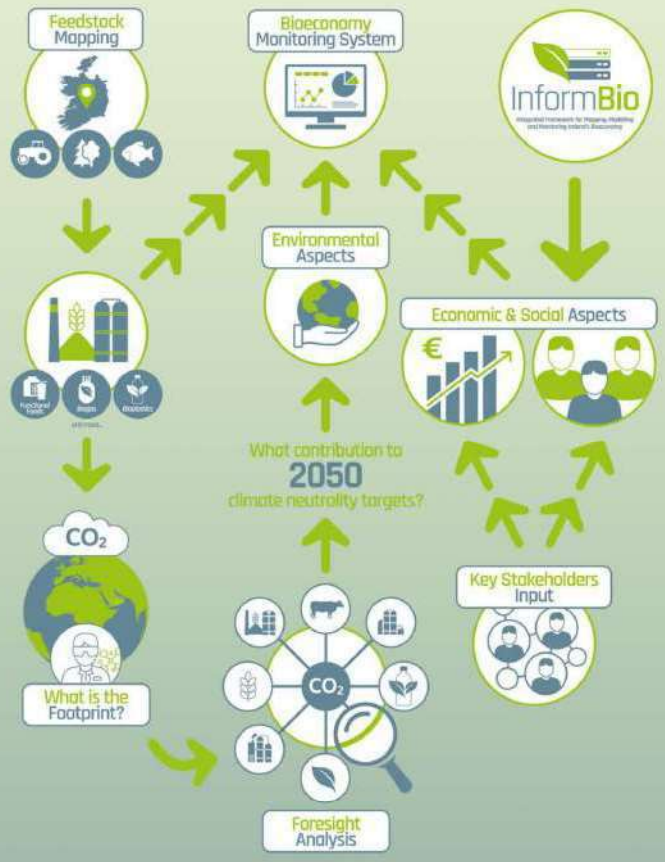
3 Feasibility study

Analyzing the feasibility of prioritized value chains through stakeholder mapping, techno-economic assessment and market analysis.

4 National mitigation potential quantification

Using attributional and **consequential LCA** approaches to assess the environmental impact of prioritized value chains, including impacts on land use management and to conduct quantitative scenario modelling, using a backcasting approach, to understand the scenarios with highest potential to support Ireland in meeting its climate, environmental and sustainable development targets.

What is InformBio?



5 Foresight Analysis

Detailed insight into the environmental sustainability of bio-based value chains at **product, inter-system and national scales** will be synthesized within a foresight analysis.

6 Bioeconomy monitoring systems assessment

Mapping existing relevant national data to bioeconomy indicators within the bioeconomy monitoring system.

7 Prototype bioeconomy monitoring system design and building

Designing a prototype bioeconomy monitoring system for **measuring and analyzing** progress in Ireland's bioeconomy and creating a **dashboard** to allow users to access and visualize bioeconomy data.

8 GAP analysis

Conducting a GAP analysis, alongside the CSO, to understand additional data requirements and providing recommendations towards a more comprehensive bioeconomy monitoring system.

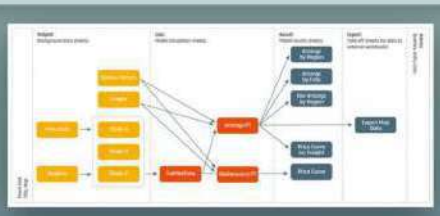
9 Bioeconomy monitoring system dashboard

Exploiting the bioeconomy monitoring system, foresight analysis and other project outputs, through intensive engagement activities with key thematic network stakeholders.

InformBio Tools to help deliver a bioeconomy observatory for Ireland

Bioresource Mapping Tool

The bioresource mapping tool is a recognised tool to support the mapping and modelling of biological raw materials for new value chain development



GOBLIN Model

The General Overview for a Back-casting approach of the Livestock Intensification (GOBLIN) model is a first version of a python-code-based bio-physical national model of the Agriculture, Forest and Other Land-Use (AFOLU) sector in Ireland.

Bioeconomy Monitoring Framework

A prototype bioeconomy monitoring dashboard will be constructed to share data collected for measuring and analysing different aspects of Ireland's bioeconomy. Building on previous EU work (EU Bioeconomy Monitoring System) and similar efforts, this prototype will support the monitoring and assessment of Ireland's bioeconomy.

BIOECONOMY IRELAND WEEK OCTOBER 17-23 2022

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Department of Agriculture, Food and the Marine

https://informbioproject.ie/

School of Agriculture and Food Science

BioCrop: Biostimulants and Biopesticides for Crop Production

BIOECONOMY IRELAND WEEK OCTOBER 17-23 2022

Mariluz del Pino-de Elias, Conor Blunt, Rainer Melzer, Angela Feechan, Saoirse Tracy, Olga Lastovetsky

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Email maria.delpino-deelias@ucdconnect.ie

@BioCropIRL

Crop production is dependent on manufactured fertilisers and pesticides/fungicides. Biocrop is exploring biostimulants and biopesticides as viable alternatives while addressing the sustainability of these. Biocrop aims to produce new algal and fungal derived biopesticides and biostimulants while engaging with industry and collaborators to test existing biofertilisers (algal and bacterial based) and biostimulants (endophytes) for efficacy.

The existing products are being compared to fossil fertiliser applications and their ability to control disease (e.g. Ramularia Leaf Spot, RLS) in Barley in field trials is under investigation. Life-cycle analysis will consider impacts across the full life cycle to avoid 'burden shifting' from one environmental impact to another. This analysis will assess the use of biobased products in an integrated management approach. Furthermore, BioCrop will undertake economic modelling to assess the impact of these biobased fertilsers and pesticides on production costs and the profitability for Irish growers.

Therefore, BioCrop will develop new and test existing biofertilsers and biopesticides for Barley production providing alternatives for growers in the face of EU regulations on fertiliser use and the loss of plant protection products

Spring barley treated with biostimulants

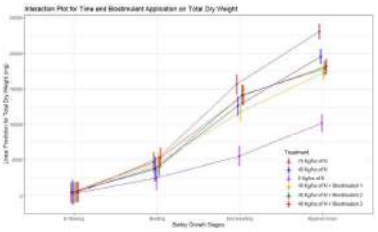
Barley was fertilized with different rates of nitrogen and biostimulants were applied via foliar spray.

N_2O emissions were analyzed via cavity ring-down spectroscopy. High-through put technology was utilized for phenotyping and barley grain quality was investigated.

Figure 1. (**a**) Rosemount Environmental Station, UCD (**b**) Heading (**c**) Ripened grain (**d**) Fitting chambers to plant pots for capturing GHG emissions **(e)** PhotosynQ device tracking photosynthetic efficiency (**f**) ImageJ software calculating leaf area of barley.

Growth of barley treated with biostimulants.

Barley was grown and harvested at key physiological growth stages to investigate the effect of biostimulants on development. Photosynthetic performance and stress indices were recorded. Preliminary data suggests biostimulants improve early barley development.



Biostimulants tested

- **Barramar:** *Ascophyllum nodosum extracts ;* Brandon Bioscience
- **Aqua Clean Foliar – Soil Remediation Plus (ACF-SR)** : Organic certified formula of plant growth promoting bacteria (PGPB); Nova-Q
- **HESGP** : *Hydrolysed yeast product made from brewery waste*; University of Seville

Figure 2 . Above-ground dry weight accumulation of spring barley with different rates of nitrogen and treated with biostimulants in the glasshouse.

Antifungals from endophyte fungi control the barley pathogen which causes Ramularia Leaf Spot

Endophytes were grown in liquid culture and the filtrate was collected after 7 days. *R. collo-cygni* was cultivated on PDA supplemented with 16% filtrate for 7 days.

Growth inhibition was observed in the presence of all endophyte filtrates (Fig. X). The strongest inhibition was observed with *Penicillium sp.* isolates 20, 21, 23, 24, 29, 30, 31, 42, 44, 54.

Figure 3 . (a) Ramularia Leaf Spot symptoms **(b)** Growth of *R. collo-cygni* in the presence of endophytes filtrates. Each plate is marked by a code corresponding to a different endophyte, control is dH_2O.

Winter barley under reduced nitrogen with biostimulants, UCD Lyons Farm

First-Year Field Trial Layout '21

Variety	Treatm	Nº Plot	Variety	Treatm	Nº Plot	Variety	Treatm	Nº Plot
TREATED								
Valerie	8T	1	Cassia	2T	2	Valerie	5T	3
Cassia	8T	6	Valerie	2T	5	Cassia	5T	4
Cassia	1T	7	Valerie	9T	8	Valerie	4T	9
Valerie	1T	12	Cassia	9T	11	Cassia	4T	10
Valerie	3T	13	Valerie	6T	14	Valerie	9T	15
Cassia	3T	18	Cassia	6T	17	Cassia	9T	16
Valerie	8T	19	Cassia	5T	20	Valerie	7T	21
Cassia	8T	24	Valerie	5T	23	Cassia	7T	22
Valerie	3T	25	Valerie	4T	26	Cassia	1T	27
Cassia	3T	30	Cassia	4T	29	Valerie	1T	28
Cassia	2T	31	Cassia	7T	32	Cassia	6T	33
Valerie	2T	36	Valerie	7T	35	Valerie	6T	34
Cassia	4T	37	Cassia	1T	38	Cassia	8T	39
Valerie	4T	42	Valerie	1T	41	Valerie	8T	40
Cassia	2T	43	Valerie	3T	44	Valerie	9T	45
Valerie	2T	48	Cassia	3T	47	Cassia	9T	46
Valerie	7T	49	Cassia	4T	50	Valerie	6T	51
Cassia	7T	54	Valerie	4T	53	Cassia	6T	52
Cassia	9T	55	Cassia	5T	56	Valerie	3T	57
Valerie	9T	60	Valerie	5T	59	Cassia	3T	58
Cassia	6T	61	Valerie	7T	62	Valerie	8T	63
Valerie	6T	66	Cassia	7T	65	Cassia	8T	64
Valerie	1T	67	Valerie	2T	68	Cassia	5T	69
Cassia	1T	72	Cassia	2T	71	Valerie	5T	70
UNTREATED								
Cassia	3U	73	Cassia	8U	74	Cassia	7U	75
Valerie	3U	78	Valerie	8U	77	Valerie	7U	76
Cassia	6U	79	Valerie	1U	80	Valerie	2U	81
Valerie	6U	84	Cassia	1U	83	Cassia	2U	82
Valerie	9U	85	Cassia	3U	86	Valerie	8U	87
Cassia	9U	90	Valerie	3U	89	Cassia	8U	88
Cassia	4U	91	Valerie	2U	92	Cassia	5U	93
Valerie	4U	96	Cassia	2U	95	Valerie	5U	94
Cassia	5U	97	Cassia	9U	98	Cassia	4U	99
Valerie	5U	102	Valerie	9U	101	Valerie	4U	100
Cassia	7U	103	Valerie	6U	104	Valerie	1U	105
Valerie	7U	108	Cassia	6U	107	Cassia	1U	106
Cassia	8U	109	Valerie	5U	110	Valerie	3U	111
Valerie	8U	114	Cassia	5U	113	Cassia	3U	112
Valerie	7U	115	Valerie	6U	116	Valerie	4U	117
Cassia	7U	120	Cassia	6U	119	Cassia	4U	118
Valerie	1U	121	Cassia	3U	122	Cassia	9U	123
Cassia	1U	126	Valerie	3U	125	Valerie	9U	124
Valerie	4U	127	Valerie	2U	128	Cassia	7U	129
Cassia	4U	132	Cassia	2U	131	Valerie	7U	130
Valerie	9U	133	Cassia	8U	134	Cassia	6U	135
Cassia	9U	138	Valerie	8U	137	Valerie	6U	136
Valerie	2U	139	Valerie	5U	140	Cassia	1U	141
Cassia	2U	144	Cassia	5U	143	Valerie	1U	142

Nº Treatment	Rate of Nitrogen	Biostimulant	Pesticide (T/U)	
1	100%	N/A	Treated	Untreated
2	50%	Barramar	Treated	Untreated
3	50%	ACFSR+	Treated	Untreated
4	50%	HESGP	Treated	Untreated
5	50%	Water	Treated	Untreated
6	25%	Barramar	Treated	Untreated
7	25%	ACFSR+	Treated	Untreated
8	25%	HESGP	Treated	Untreated
9	25%	Water	Treated	Untreated

Figure 4. Layout and description of treatments

Field trial conducted on winter barley (KWS Cassia, and Valerie) grown under reduced Nitrogen application to investigate biostimulants impact on plant growth. The optimal time for nitrogen fertiliser was according to Teagasc guidelines. 3 bio-based products were sprayed at accurate timing to enhance nitrogen use efficiency. Therefore, 3 foliar applications were carried out at seedling, tillering, and stem elongation stage by field plot sprayer. Plots are split into untreated and fungicide treated.

Treatments are assessed for impact on development, quality.

Figure 5. Equipment used to fertilise with Nitrogen and spray biostimulants.

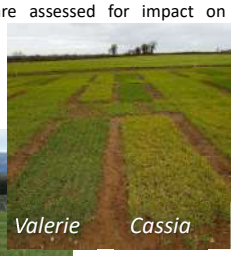


Figure 6. Plots of 1.5x4m of *Valerie* and *Cassia*

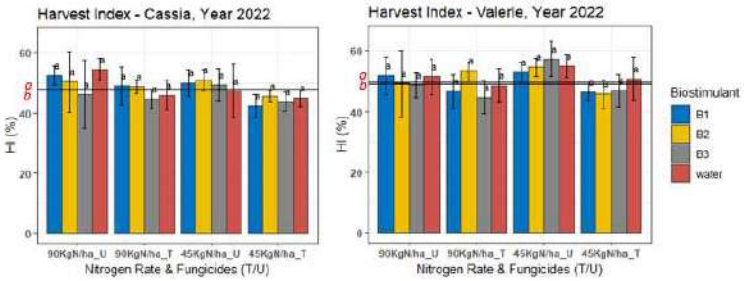


Figure 6. *Harvest Index(%) on winter barley with different rates of nitrogen, treated/untreated with fungicides and spraying biostimulants. (a) Reference's line of plots treated with fossil fertiliser (180KgN/ha) and fungicides; (b) Reference's line of plots treated with fossil fertiliser (180KgN/ha) and no fungicides. B1: Seaweed extract, B2: PGPB, B3: Protein hydrolysates.*

Conclusions:

- **Antifungals from endophytes can inhibit growth of *Ramularia collo-cygni***
- **Preliminary data suggests biostimulants may improve early barley development**
- **Analysis of the impact of biostimulants on nitrogen use efficiency and disease is being investigated**

An Roinn Talmhaíochta, Bia agus Mara
Department of Agriculture, Food and the Marine

Teagasc

NUI Galway OÉ Gaillimh

UCD Dublin

University College Dublin Ireland's Global University

Trinity College Dublin Coláiste na Tríonóide, Baile Átha Cliath The University of Dublin

Brandon Bioscience

glanbia

eseed

NOVA Q

Project Partners: UCD (Angela Feechan, Saoirse Tracy, Rainer Melzer, Fiona Doohan, Grace Cott, Carl Ng, Paul McCabe, Michael Wallace, Fionnuala Murphy), Teagasc (Steven Kildea, Louise McNamara, Fiona Thorne), Trinity College Dublin (Trevor Hodkinson), NUI Galway (Zoe Popper).

Seaweeds & seaweed-ingredients to reduce enteric methane emissions from pasture-based sheep, cattle and dairy cows

SEASOLUTIONS CONSORTIUM, led by Teagasc, Food Research Centre, Ashtown, Dublin 15, Ireland

SEASOLUTIONS PROJECT

An Roinn Talmhaíochta, Bia agus Mara
Department of Agriculture, Food and the Marine

Teagasc
Agriculture and Food Development Authority

Introduction

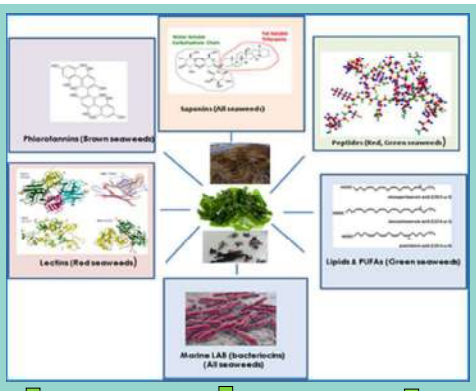
The Seasolutions project is comprehensively screening and testing the efficacy of seaweeds and seaweed extracts in reducing methane (CH_4) emissions from cows, cattle and sheep. It aims to provide answers to the following practical issues regarding the development of seaweed feed for CH_4 emissions reduction including research gaps:

(1) Nutrition: Seasolutions will provide formulations that are palatable, bioactive and dose specific and will enhance precision feeding approaches that will be adapted by farmers

(2) Delivery: Seasolutions will answer issues concerning delivery of supplements/additives to pasture fed animals.

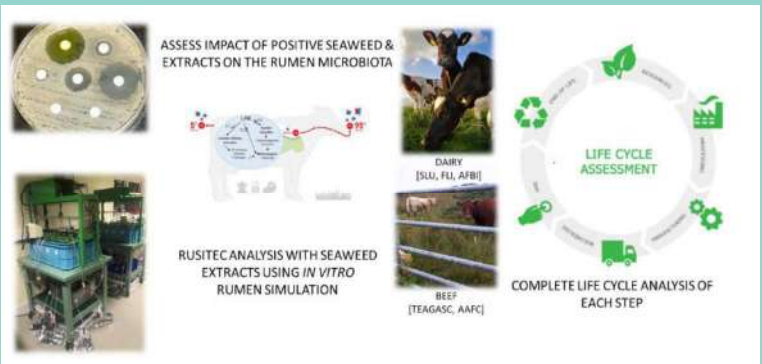
Study area & methodology

- To harvest and preserve native, sustainable seaweeds in sufficient quantities (600 kg-1000 kg dry weight) for use as an ingredient/raw material for animal feed development through implementation of drying, ensiling and novel technologies (high pressure processing, accelerated solvent extraction).
- To characterise and selective native seaweeds for in vitro and animal trials based on their bioactive and safety profiles. The constituent composition of selected seaweeds will be quantified in terms of tannins, peptides, lipids using MS and NMR.
- To evaluate effects of seaweeds on total CH_4 gas production using different in vitro rumen fluid models and animal trials.
- To examine the positive nutritional contributions of algae in the diet of sheep, cattle and dairy cows and the impact on meat, milk and CH_4 emissions.



Dairy, beef and sheep trials

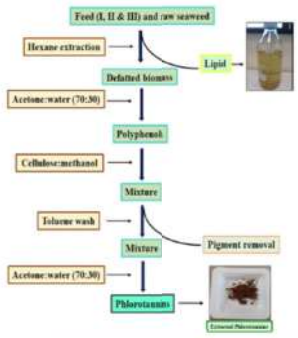
Methodology (cont.)



Results to date

- 72 seaweeds and extracts characterised to date.
- Two seaweed extracts developed with potential to reduce CH_4 emissions from sheep by greater than 10 %.
- Two sheep feeding trials completed using seaweeds and extracts in Teagasc Athenry and NIBIO Norway.
- One dairy trial completed with seaweed at FLI, Germany,
- One beef trial completed at Teagasc Grange.
- Two dairy trials ongoing with seaweed extracts and seaweeds in AFBI and SLU, Sweden.
- One beef trial completed at AAFC Canada using selected seaweed extracts generated at Teagasc.
- LCA analysis underway.
- Methane (CH_4) inhibitors from seaweed extracts identified using well diffusion and growth curves at Ashtown.

- A number of potential seaweed and seaweed extracts identified for future *in vivo* studies using RUSITEC analysis.



FEED FORMULATION

Conclusions and Future work

Several seaweed and seaweed extracts were identified to date that reduced CH_4 *in vitro* and *in vivo*. Dairy trials are on-going and food and feeds are being analysed for bromoform, iodine and TPC/tannin content.

Acknowledgements

Seasolutions is funded by the European Research Area on Sustainable Animal Production (ERA-NET) SUSAN and ICT-AGRI-2, 2018, Joint call on Novel Technologies, solutions and systems to reduce GHGs in animal production systems. The project receives funding from the EU Horizon 2020 Research and Innovation programme under grant agreement 696231. Contact: Maria.Hayes@Teagasc.ie

Sligo SINTEF SLU NIBIO Agriculture and Agri-Food Canada IGFS Teagasc FLI

InFutUReWood: Innovative Design for the Future – Use and Reuse of Wood Building Components

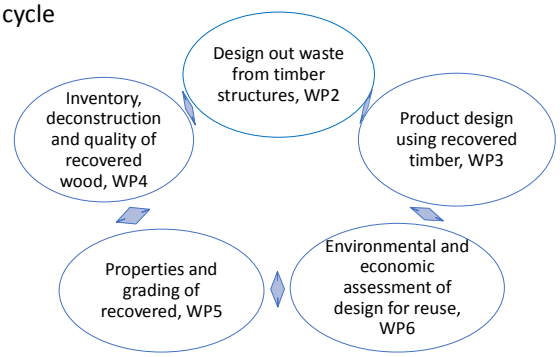
BIOECONOMY IRELAND WEEK OCTOBER 17-23 2022

A.M. Harte, C. Uí Chúláin, D. Gil-Moreno, P.J. McGetrick, E. Shotton, S.J. Walsh

Introduction: The construction sector is the largest consumer of raw materials and generator of waste in the EU. New circular economy principles are driving greater resource efficiency. The InFutUReWood project develops methods to maximise the reuse potential of timber products and systems at the end of building life to unlock the significant economic value of the material, minimise waste and reduce the carbon footprint. The aim is to close both the material loop and the knowledge loop.

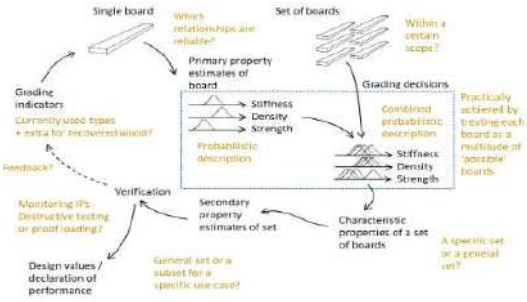
Objectives:

- Develop a method for ensuring the future possibility of circulation of timber products over whole life cycle
- Plan primary design to facilitate deconstruction rather than demolition
- Optimize the primary design to enhance resource efficiency and reduce environmental impacts
- Allow grading for quality of recovered wood in a way that is compatible with grading of new timber
- Identify potential new construction products using recovered timber.
- Examine the economic and environmental factors over a building's life cycle



Results:

New grading approach for recovered timber



Summary report available at https://www.Infuturewood.info

Project consortium:
22 partners – 7 countries
Ireland, Finland, Germany, Slovenia, Spain, Sweden, UK
Total project budget: €2.36 M
Project completion: 28/02/2022

Results:

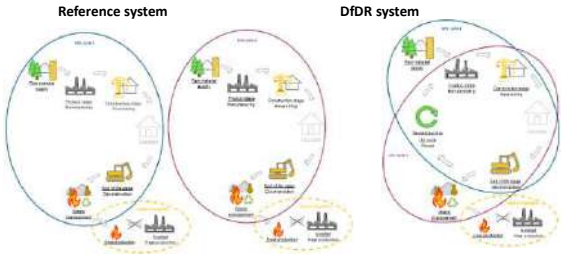
Designing out Waste

Design buildings specifically to facilitate disassembly rather than demolition. Increase the **efficiency** of material use by optimize the primary design.

Mass timber products from recovered timber

Utilize material from existing buildings in new wood products.

Environmental and economic assessment



Impacts:

- **New design solutions** -industry, researchers, designers, standardisation
- **First version of deconstruction plans** - industry, policy makers
- **Grading approach for quality of reused timber**- standardisation, researchers
- **Stock and flow model to predict quantity of timber in built environment**
- -policy makers, researchers
- **Timber reuse in engineered wood products** -industry, researchers

The InFutUReWood Project is funded by the Department of Agriculture, Food and the Marine's Competitive Research Funding Programmes – Proj. Ref. 18RDFORESTVALUE1. It is supported under the umbrella of ERA-NET Cofund ForestValue. ForestValue has received funding from the EU's Horizon 2020 research and innovation programme under grant agreement N° 773324.

TERG @TERG_UniGalway

An Roinn Talmhaíochta, Bia agus Mara Department of Agriculture, Food and the Marine · Ollscoil na Gaillimhe University of Galway · UCD Dublin · ForestValue · Connaught Timber · Hegarty Demolition · SIP Energy

Unlocking the Potential of Microalgae for the Valorisation of Brewery Waste Products into Omega-3 Rich Animal Feed and Fertiliser

Qinge Ma[1,2], Felix J. Brooke[1,2], Mohammadhosein Rahimi[1,2], Hossein Kiani[1,2], Ronald Halim[1,2,*]

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2. UCD Conway Institute of Biomolecular & Biomedical Research, Dublin 4, Ireland

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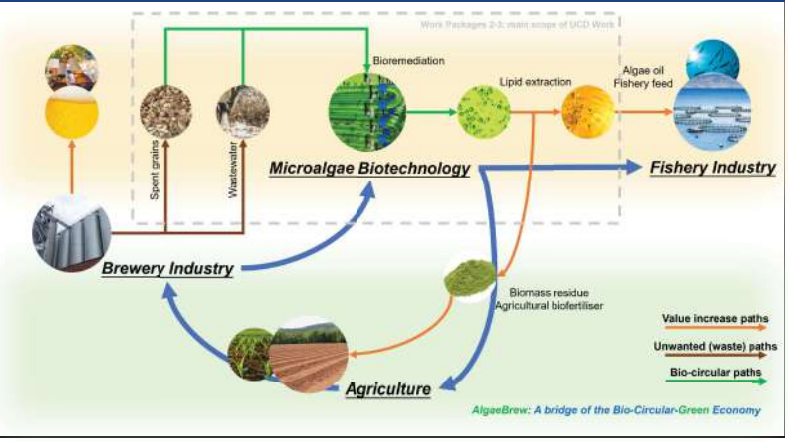
BIOECONOMY IRELAND WEEK OCTOBER 17-23 2022

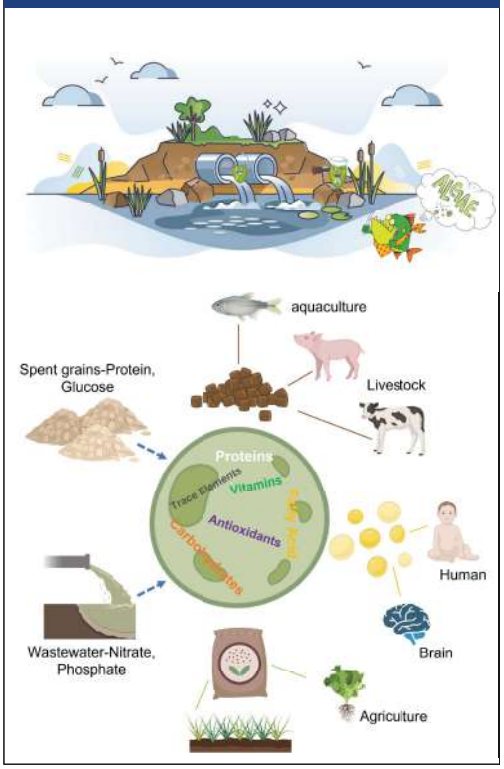
An Roinn Talmhaíochta, Bia agus Mara
Department of Agriculture, Food and the Marine

Abstract

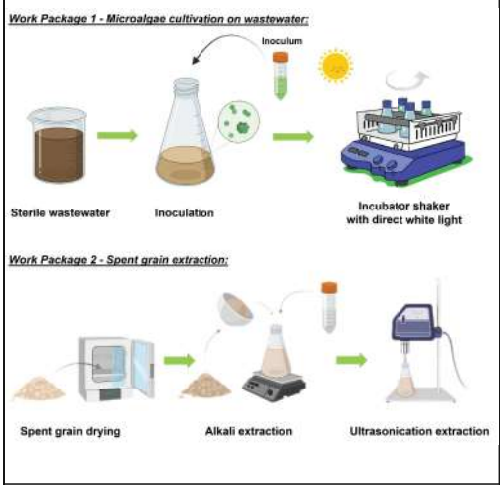
AlgaeBrew aims to develop sustainable solutions for the valorisation of brewery by-products using microalgae. ***Nannochloropsis Oceanica*** is a marine microalga well known for its ability to assimilate nutrients from wastewater and accumulate high levels of omega-3 polyunsaturated fatty acids (ω-3 PUFAs). The project aims to simultaneously utilise nutrients from two brewery by-product streams (nitrogen and phosphorus from brewery wastewater, and protein from Brewer's Spent Grain) to support *Nannochloropsis* production. A biorefinery approach will then be developed for the recovery of ω-3 PUFAs as aquaculture feed, and the application of microalgae biomass residue as bio-fertiliser. The project is coordinated by the **UCD Algae Group** and involves five research institutions and two industrial partners from seven countries.



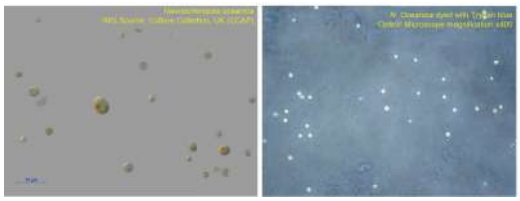
Introduction



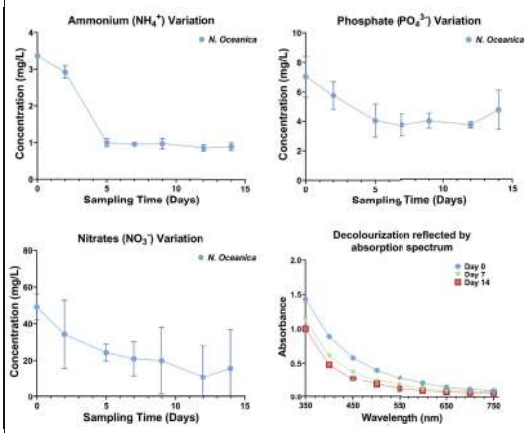
Methodology



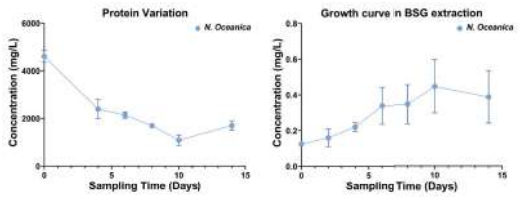
Indicative Outcomes



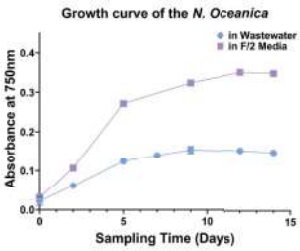
Work Package 1: *Nannochloropsis Oceanica* successfully removed 73% of ammonium, 33% of phosphate and 70% of nitrate from the brewery wastewater within 7 days.



Work Package 2: *Nannochloropsis Oceanica* cultivated on protein-rich extracts from pale brewers' spent grain removed >50% of soluble proteins from the extract within 4 days, indicating the ability of species to assimilate protein.



Progress & Prospects



Microalgae growth in the brewery wastewater is slower than in the standard medium.

In **Work Package 3**, protein-rich spent grain extract is to be added to the brewery wastewater in order to boost microalgae growth and improve the rate of nutrient removal from the wastewater.

Worldwide Collaborators

- University College Dublin
- University of Camerino (UNICAM)
- Bilecik Seyh Edebali University (BU)
- National School of Agriculture in Meknes (ENA)
- Lambers Seghers (LS)
- USAMV Bucuresti (USAMV)
- Swansea University (SU)

Acknowledgement

An Roinn Talmhaíochta, Bia agus Mara
Department of Agriculture, Food and the Marine

FOSC ERA-NET Cofund on Food Systems and Climate

This project has received funding from the European Union's Horizon 2020 research and innovation programme and the Department of Agriculture, Food and the Marine.

CircAgricGHG: Strategies for **Circ**ular **Agric**ulture to reduce **GHG** emissions within and between farming systems across an agro-ecological gradient

David Styles, Marion Sorley, Emma Buckley & James Humphreys

European farms have trended towards specialisation and high per ha yields but have become increasingly dependent on external inputs to compensate for declining recycling of nutrients. Farms in sub-Saharan Africa have low inputs and yields and much higher vulnerability to climate change. More efficient (re)cycling of resources across the agri-food sector and enhanced resilience, is imperative to deliver food security whilst respecting ecological boundaries and rural livelihoods. In Europe, re-coupling of livestock and crop systems could play an important role in more efficient (re)cycling across livestock and crops, and food value chains. In Africa, integrating sustainability and resilience objectives with enhanced food security could avoid some of the trade-offs currently experienced in Europe. CircAgric-GHG represents a consortium of 17 world-leading researchers from 8 countries with expertise in livestock, cropping systems, farm and landscape modelling, LCA and ecosystem services (ES) evaluation. The consortium will draw upon state-of-the-art knowledge, research methods and models to assess how circular practices can deliver sustainable food systems. Using farm typologies as a baseline, the extent of existing circular practice implementation will be evaluated. LCA will be applied to integrate modelling outputs into environmental footprints of food production, developing a novel framework for future projects. Farm-scale modelling will also inform a marginal abatement cost curve and a decision support tool, enabling robust comparison of GHG abatement efficacy of specific circular practices. Meanwhile, stakeholder dialogue via workshops and focus groups will identify systemic lock-ins and levers pertinent to wide scale deployment of circular practices, culminating in a Transition Roadmap. Results will be made available in an open-access database. Project partners will engage their stakeholder networks and outreach organisations to leverage impact through transdisciplinary research, maintaining dialogue via social media, workshops and focus groups, as well as traditional academic channels.

Objectives

- Measure circularity across representative farm typologies farms along an agro-ecological gradient.
- Identify on-farm and between-farm practices to increase circularity across farm typologies and regional case studies.
- Assess the efficacy of circular practices on farm profitability and GHG mitigation at different scales, using country specific MACCs to explore possible trade-offs and win-win combinations.
- Identify and assess ecosystem services related to increased circularity at landscape scale.
- Develop a novel decision support tool (DST) for farmers and policymakers to explore effective circular practices for GHG abatement across case study regions.
- Design a Transition Roadmap based on the identification of lock-ins and levers for the adoption and out-scaling of circular practices identified using ICTs.

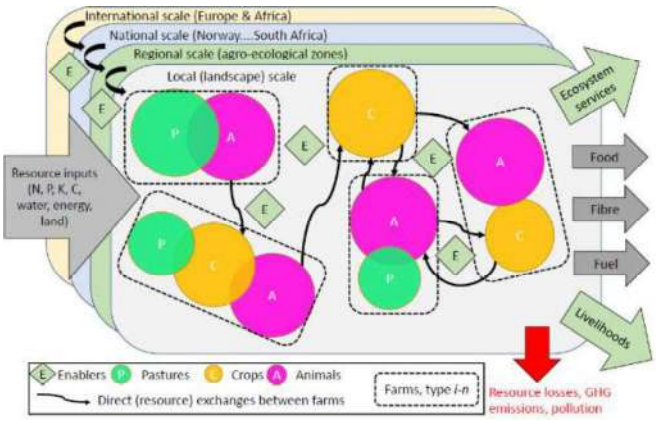


Figure 1. Integrated crop and livestock systems (ICLS) and interactions at local (foreground), regional, national, and international scales. Out-scaling within the project will consider interactions within and across these scales, including with other sectors.

University of Galway will lead landscape- and inter-system scenario modelling, applying consequential LCA and the GOBLIN model to explore how various circular and bio-based innovations could contribute to 2030 Farm-to-Fork targets for agricultural sustainability, as well as the 2050 climate neutrality target and compliance with Planetary Boundaries.

Promising circular practises likely to be explored will include, *inter alia*: maximum use of by-products from food & drink processing for animal feed, via insect conversion where relevant; anaerobic digestion of organic wastes not suitable for animal feed; upgrading slurries and digestates to pellet biofertiliser for efficient (and distributed) end use; integration of nitrogen-fixing protein crops into rotations to replace soybean imports and/or livestock protein in human diets; grass-clover swards to minimise synthetic-N-fertiliser demand for livestock systems; enhanced dairy-beef production to reduce production of higher-impact suckler-beef.

Scenario scaling will consider factors such as feedstock availability and prevalence of relevant farm typologies within relevant radii. Land sparing effects will be translated into carbon offset opportunities in order to identify the contribution of practises that spare land to climate neutrality, at national and European scale.

Methodology

CircAgric-GHG will take a rigorous, scientific approach to define the baseline farm typologies across agro-ecological zones in terms of circularity (flows of nutrients and carbon in feed, nutrients on farm, livestock and bedding) and GHG emission intensity (WP1,3). Then, based on consortium expertise, literature review and stakeholder dialogue, promising (scalable) and innovative circular practices will be shortlisted (WP2,5). State-of-the-art measurements and (inter-)systems modelling (WP3,5) will provide new evidence on the efficacy and cost-effectiveness of shortlisted practices to reduce GHG emissions and other environmental externalities. WP3 will integrate models, LCA and remote sensing to generate farm- and product-level results. WP5 will examine interactions across farm typologies, different scales and different sectors (e.g. competition of food processing co-products or farm residues for feed or bioenergy) (Figure 1 & 2). Results will be synthesised in a decision support tool (DST) for farmers and policymakers, and a Transition Roadmap (WP 4-5). Technical and non-technical barriers and opportunities for adopting circularity-based GHG mitigation strategies will be explored (WP3-4), including systemic lock-ins and levers to adoption and out-scaling (WP4). Causal loop diagrams will be applied to identify feedback mechanisms, whilst socio-economic and ecosystem services will be assessed semi-quantitatively across scenarios. Finally, WP6 will disseminate results and actively engage stakeholders (List 2) throughout the project, harnessing all partner networks.

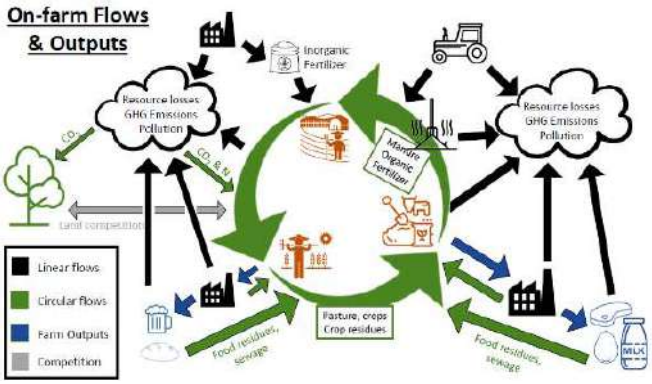


Figure 2. CircAgric-GHG will evaluate circularity and crop-livestock system linkages at multiple scales, from farm to international, and will include food value chain loops and inter-sectoral effects.

Teagasc will provide case study evidence on circular use of nutrients via the Zero Synthetic Nitrogen blueprint farm system pioneered at Solohead Research Farm. In addition to undertaking detailed environmental and economic analyses of milk production at Solohead, a Walsh Scholarship PhD student will survey a network of pro-active dairy farmers who have already adopted grass-clover swards, to evaluate real-world performance on these farms. The environmental footprint of milk produced on these farms will be benchmarked against national average carbon footprints presented in the Teagasc sustainability report.

Early-adopted farmers will be interviewed to identify perceptions around various circular practises, and barriers and opportunities they experienced when converting from high-fertiliser-dependent systems.

BIOECONOMY IRELAND WEEK OCTOBER 17-23 2022
SusCrop – ERA-NET
Cofund on Sustainable Crop Production
FACCEJPI
An Roinn Talmhaíochta, Bia agus Mara
Department of Agriculture, Food and the Marine

DairyMix: Multi-criteria assessment, decision support and management tools for sustainable circular mixed farming systems for dairy production

Mary Brennan[a], Dominika Krol[b], Cathal Buckley[a]

[a] Teagasc Rural Economy Development Programme, Mellows Campus, Athenry, Co.Galway, Ireland

[B] Teagasc Crops, Environment and Land Use, Johnstown Castle, Co. Wexford, Ireland

mary.brennan@teagasc.ie

BIOECONOMY IRELAND WEEK OCTOBER 17-23 2022

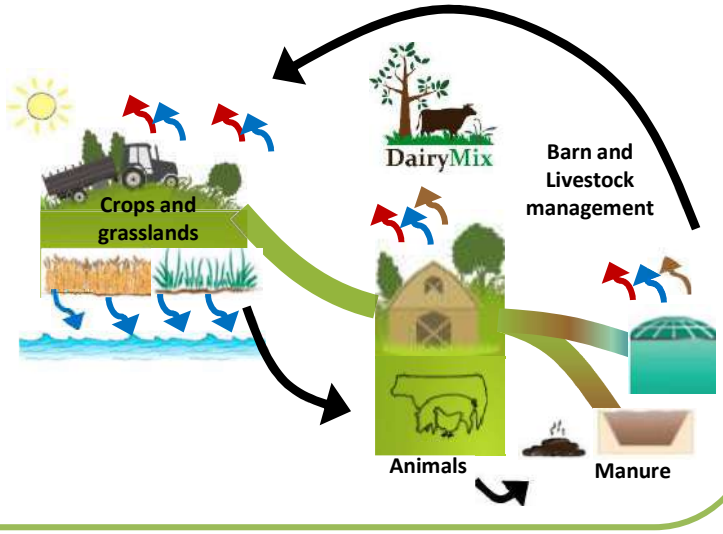
1. Introduction

The DairyMix Project aims to increase sustainability and reinforce climate friendly mixed crop and dairy production systems.

DairyMix will be a major step forward in achieving greenhouse gas mitigation and circularity between cropping systems and dairy production systems with flexible and context specific solutions being developed for key European areas and for Latin America.

2. Objectives

- Assess the status quo of crop-livestock-forestry integration of dairy production systems in key regions using case study farms
- Develop concepts for C and nutrient flows and circularity, protein self-sufficiency and improved manure nutrient utilisation
- Identify trade-offs and synergies between sustainability indicators of integrated crop-livestock-forestry systems

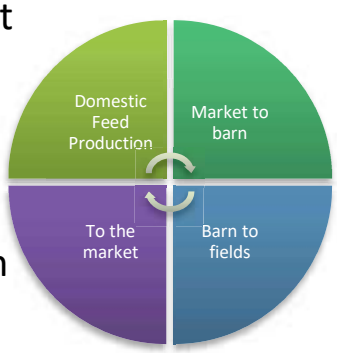


3. Methodology- Case study Analysis

- Data Collection from case study dairy farms
- Economic, Environmental and Social indicators
- Assess the integration between crops and dairy

4. Next stage of research

- Gross C and nutrient flows to be characterised
- Generation of baseline C footprint/ha at farm level and N and P balances
- Compare circularity across dairy farms



Acknowledgement: The author(s)/editor(s) acknowledge the financial support through the partners of the Joint Call of the Cofund ERA-Nets SusCrop (Grant N° 771134), FACCE ERA-GAS (Grant N° 696356), ICT-AGRI-FOOD (Grant N° 862665) and SusAn (Grant N° 696231). More information: www.eragas.eu/en/eragas/Research-projects/DairyMix.htm

Funded by:

Project partners:

BIOECONOMY IRELAND WEEK OCTOBER 17-23 2022

CircBioCityWaste

Converting urban waste streams into value-added products

@CirBioCityWaste
CircBioCityWaste
gaurav.rajauria@mtu.ie

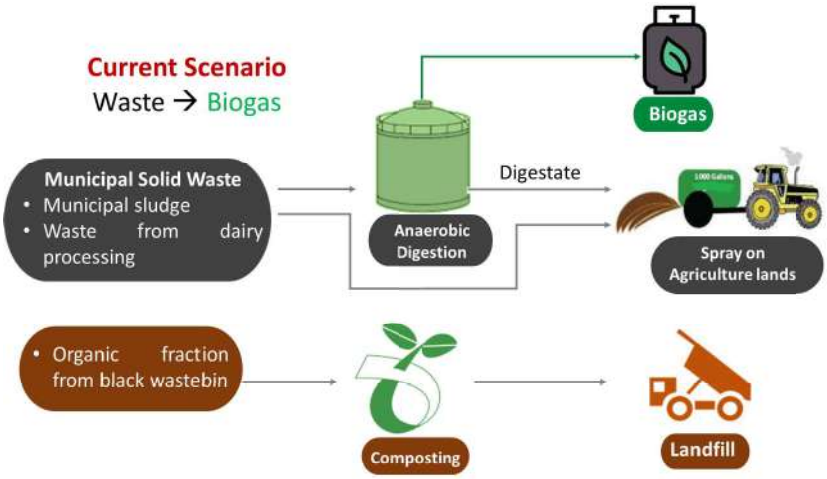
Team: Shon George Shiju | Ana Kaskova | Catriona Power | Jack O'Connor | M. J. Kearney | Marzena Kwapinska | James J. Leahy | Anushree Priyadarshini | Patrick Quille | Gaurav Rajauria

1. THE PROBLEM

	Total	Municipal	Household
	2 337 million tonnes by all economic activities and households	225.7 million tonnes of household waste and commercial waste	88 million tonnes Collected from the residual, recycling and organic bins
	14 million tonnes by all economic activities and households	3.1 million tonnes of household waste and commercial waste	1.9 million tonnes Collected from the residual, recycling and organic bins

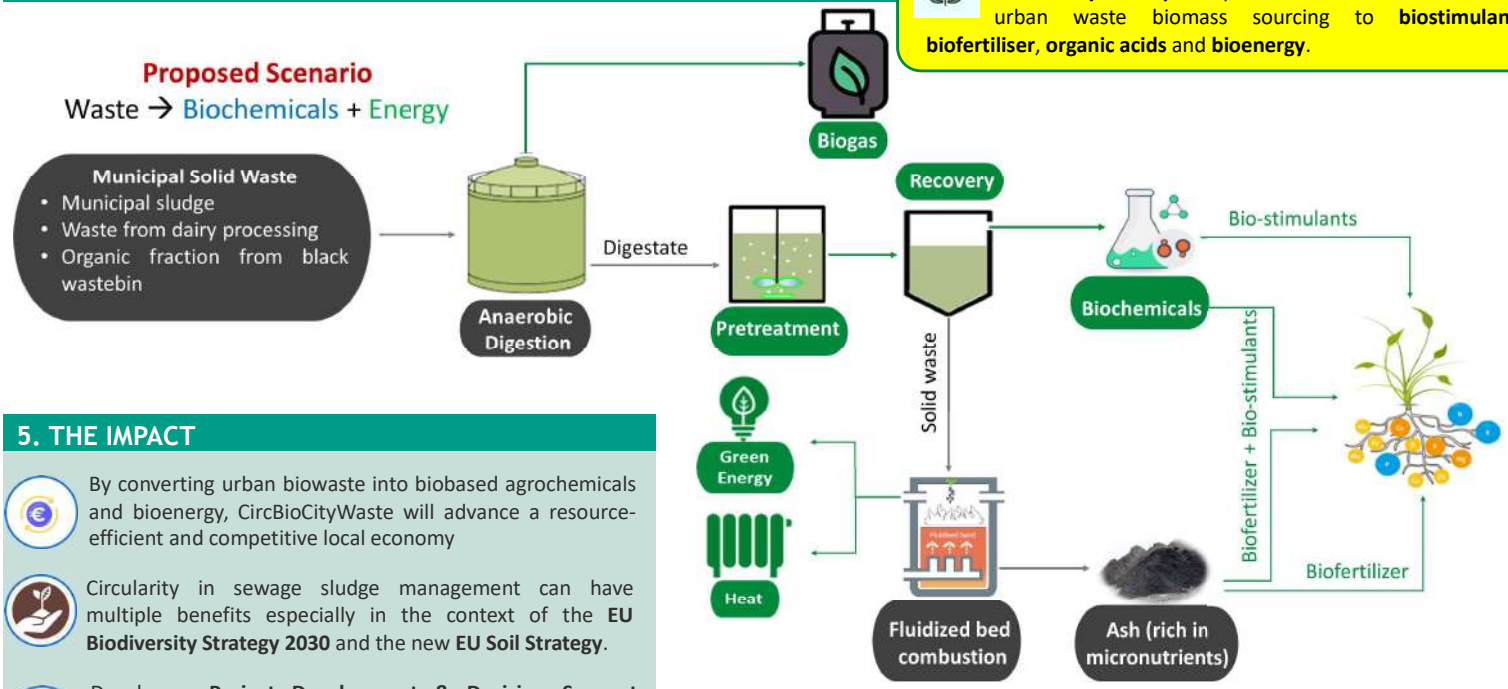
- Most of this waste ends up in **landfilling** or **incineration**, negatively impacting **soil** & **groundwater**, **resulting in GHG emissions**, & **land usage.**
- Ireland faces significant challenges to meet the upcoming EU recycling targets for 2020 to 2035 where **recycling rates of 50 to 65 % are expected.**

2. CURRENT PRACTICES IN TREATING MUNICIPLE SLUDGE



CircBioCityWaste is developing a first-of-a-kind **cascading biorefinery concept** to produce new value chains from urban waste biomass sourcing to **biostimulants**, **biofertiliser**, **organic acids** and **bioenergy**.

3. PROPOSED BIOREFINERY SOLUTION

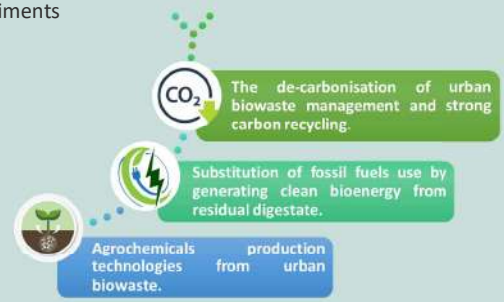


4. SLUDGE DIGESTATE: WASTE OR OPPORTUNITIES?

- Digestate strongly reduces GHG emissions
- Biogas are low GHG renewable energy carriers
- Saving money by using organic fertilisers
- Digestate's transport routes are usually shortened
- Replacing energy intensive mineral fertilisers
- 1 tonne of artificial fertiliser replaced with digestate saves 1 tonne of oil, 108 tonnes of water and 7 tonnes of CO2 emissions
- Avoiding GHG emissions from open decomposition of OM
- Digestate brings jobs and economic advantages

5. THE IMPACT

- By converting urban biowaste into biobased agrochemicals and bioenergy, CircBioCityWaste will advance a resource-efficient and competitive local economy
- Circularity in sewage sludge management can have multiple benefits especially in the context of the **EU Biodiversity Strategy 2030** and the new **EU Soil Strategy**.
- Develop a **Project Development & Decision Support (PDDS) tool** to foster investment for transforming the bio-based sector towards a circular bioeconomy.
- Development of novel pre-treatment technologies for valorising anaerobic digestate biomass into bio-based chemicals
- Identification of new biomass supply chains and associated impediments



Funding Partners

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Research Partners

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BIOPOST

BIOECONOMY IRELAND WEEK OCTOBER 17-23 2022

Sustainable, Biodegradable, Compostable, and Recyclable Plastics for Packaging and EOL Management

Purabi Bhagabati[1], Jessica De Micco[1], Bryan Dalton[2,3], Kevin O'Connor[2,3], Percy Foster[4], Tony Breton[4], and Ramesh Babu[1,3*]

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[4]Cré - Composting & Anaerobic Digestion Association of Ireland

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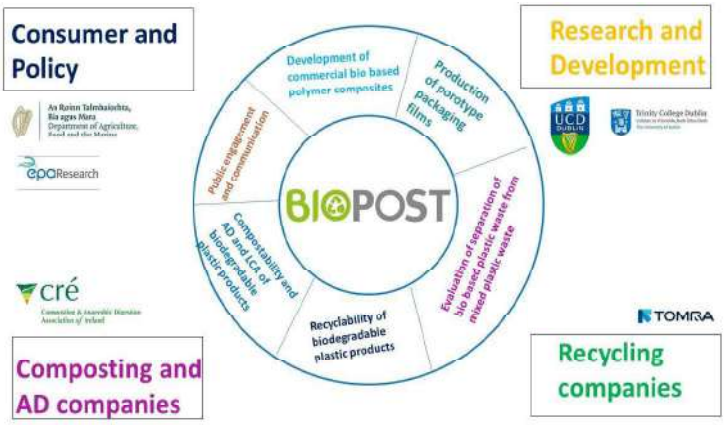
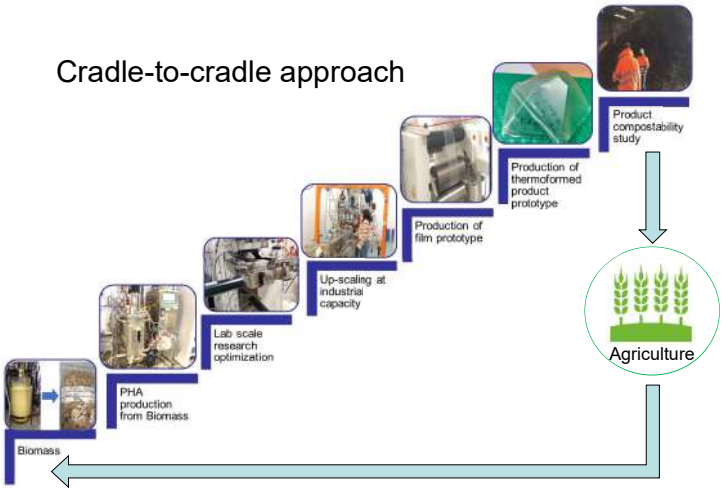
Addressing bioeconomy

- Production of biodegradable polymers from renewable resources.
- Development of a biodegradable plastics film prototype for flexible packaging.
- EOL management:
  - Sorting of the biodegradable plastic films.
  - Mechanical recyclability of biodegradable plastic films.
  - Industrially compostable and biodegradable plastic films.



Production process design

Cradle-to-cradle approach



Product development

- Synthesis of Poly(hydroxy alkanoate) [PHAs] a class of biopolymer from microbial fermentation from waste cooking oil.
- Formulation of biodegradable polymer/polymer blend composite films for flexible packaging applications.
- Scale-up and production of the optimized formulations under industrial settings.

Extruded BioPost polymer samples in granules

Calendared films of BioPost polymer samples

Conclusion

- Biobased and biodegradable composites suitable for packaging applications produced on 50 kg Scale.
- Preliminary compostability studies of various commercial and indigenous polymer composites performed under Irish composting conditions.
- Product segregation and recyclability studies in progress.
- Aligning with Ireland's "Circular Economy and Miscellaneous Provisions Act 2022".

Acknowledgment

The project BioPost team acknowledges "Environmental Protection Agency, grant number 2019-RE-LS-4 for research funding, "Science Foundation Ireland (BiOrbic Bioeconomy SFI research centre 16/RC/3889)", and "Department of Agriculture, Food and Marine, Ireland".

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UCD DUBLIN

cré Composting & Anaerobic Digestion Association of Ireland

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An Roinn Talmhaíochta, Bia agus Mara Department of Agriculture, Food and the Marine

SeQUEsTER: Scenarios Quantifying land Use & emissions Transitions towards Equilibrium with Removals

David Styles, Colm Duffy, Remi Prudhomme, George Bishop, Mary Ryan & Cathal O'Donoghue

Background & Objective

Globally, the agriculture, forestry and other land use (AFOLU) sector is responsible for almost one quarter of all anthropogenic emissions but has vast potential for mitigation. Irish agriculture emits 20.5 Tg CO_2-equivalent (Tg CO_2e) annually, 34% of national GHG emissions, of which 92% originate from cattle (beef and milk production), 4% from sheep and 2% from other livestock. In addition, roughly 9 Tg CO_2e are emitted annually from drained organic soils and 2 TgCO_2e from exploited wetlands, while Irish grassland mineral soils and forests remove 2 and 5 Tg CO_2e yr^{-1}, respectively. As such, Ireland's land use, land use change & forestry (LULUCF) sector is a net emissions source of over 4 Tg CO_2e annually. Meanwhile, Ireland's Climate Action Bill sets a target for a 51% reduction in national emissions by 2030. Ireland's AFOLU sector has a key role to play in terms of both emissions reduction and CO_2 removal (CDR). However, global scenario modelling for climate stabilization lacks national resolution, particularly for the AFOLU sector, impeding effective national climate policy making. The objective of SeQUEsTER is to provide robust evidence on pathways towards climate neutrality by 2050 for Ireland's AFOLU sector.

Methodology

To navigate the contentious issues of animal destocking and land use change objectively, the SeQUEsTER team employed a randomised back-casting approach to establish which biophysically-possible combinations of agricultural activities and land uses *could* comply with various definitions of climate neutrality. A new national biophysical AFOLU model, "GOBLIN" (General Overview for a Back-casting approach of Livestock INtensification) was developed based on models available from previous projects, adapted to represent the emission accounting methodology employed in the National Inventory Report (NIR) for GHG emissions (Fig. 1). Model outputs were validated against the NIR by using NIR input data over 1990-2015, and validating the emissions output time series against NIR output data for those years. GOBLIN includes Tier 2 livestock energy requirements and emissions calculations alongside grassland nitrogen-response curves to model land sparing opportunities that could arise from intensification or reduced outputs (Fig. 2). Spared land gets assigned to rewetting (where organic soils have been drained), afforestation with various conifer-broadleaf mixes and harvesting rates, and extensification (i.e. destocking). GOBLIN was run 850 and 3000 times, in two lots with randomised input data, to identify which scenarios: (i) achieved climate neutrality by 2050, according to different definitions; (ii) sustained climate neutrality through to 2100.

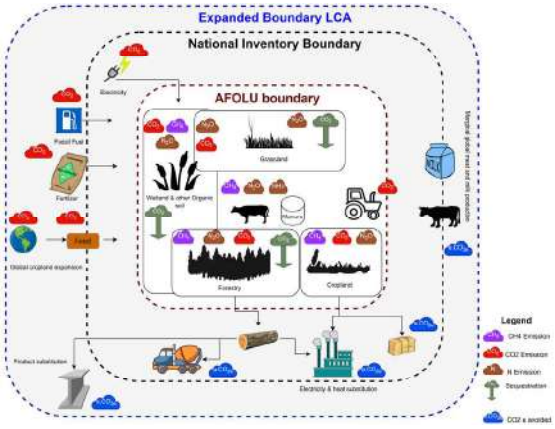

Figure 1. Key emissions sources and sinks critical to the determination of "climate neutrality" in Ireland's AFOLU sector accounted for in GOBLIN (white), alongside linked upstream- and downstream- sources and sinks to be included in subsequent life cycle assessment (LCA) modelling.

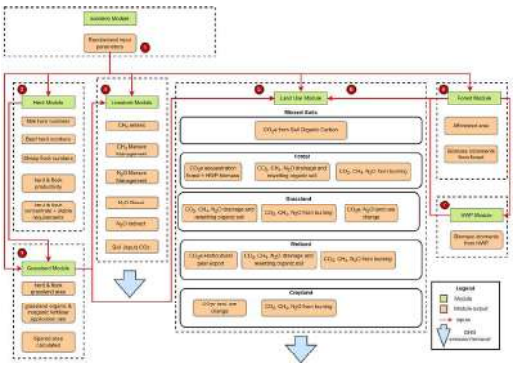

Figure 2. Module interaction framework depicting the flow of inputs to each of the GOBLIN modules, alongside the module processes and GHG outputs.

Results

Using a GWP_{100} "net-zero" GHG definition, 146 out of 850 scenarios modelled achieve AFOLU climate neutrality by 2050, and just 40 sustain that climate neutrality through to 2100, reflecting future declines in CO_2 removals by new forests (excluding potential downstream mitigation, which required further modelling effort). In the absence of technical solutions to dramatically reduce the emissions intensity of bovine production, national milk and beef output will need to be significantly curtailed to achieve climate neutrality.

Subsequent modelling of 3000 scenarios indicated that, in the best case, milk output could be maintained at 88% of 2021 levels, but that to achieve this suckler beef output would need to reduce to almost zero and forest cover would need to increase from 11% to 35% of national land area (Fig. 3). Reducing agricultural emissions is only one part of achieving climate neutrality. Active carbon dioxide removal on destocked land, via organic soil rewetting and ambitious afforestation, is imperative – and could moderate cuts required in milk and beef production, reducing international carbon leakage risks.

It is likely that methane will be set a separate non-zero target in future. Recent projections for climate stabilisation indicate that methane needs to be reduced by 24-47% globally. Figure 3 shows that, whilst there may be debate over Ireland's fair share of the global methane budget, a separate methane target is likely to considerably reduce the amount CDR, and therefore area of afforestation, required to achieve climate neutrality. Annual afforestation of 20 kha could be sufficient to achieve climate neutrality, if agricultural emissions can be halved.

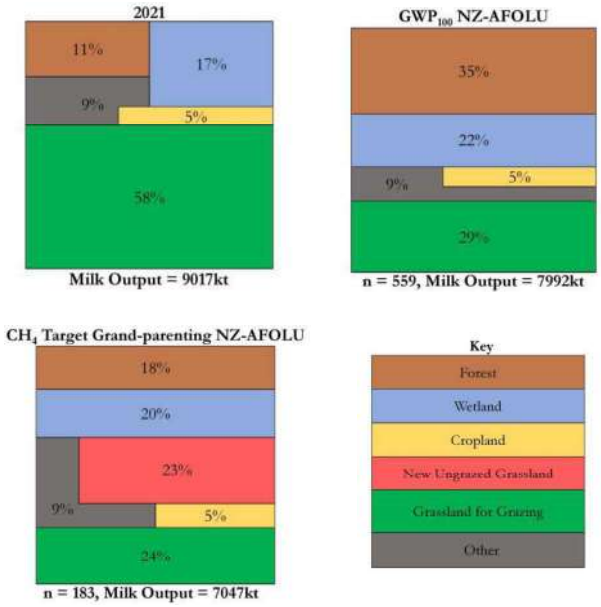

Figure 3. Examples of land areas under different uses in the baseline situation (top left) and under maximum milk output in compliance with a GWP_{100} emission balance in 2050 (top right) or with a separate methane target (bottom left).

Conclusions

Achieving climate neutrality, probably with a separate methane target, will require: (i) considerable abatement of livestock system emissions; (ii) reductions in animal numbers of circa 30%; (iii) rewetting circa 300 kha of drained organic soils; (iv) planting at least 0.5 million ha of new forest. Grassland destocking and afforestation could make large quantities of bio-based feedstocks available for the (future) bioeconomy. Cascading use of grass and wood could sustain climate neutrality well beyond 2050. However, afforestation rates need to increase quickly to have a realistic prospect of achieving climate neutrality by 2050. A coherent plan for abatement and diversification in the AFOLU sector, linked with development of the bioeconomy, is urgently need.

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BIOECONOMY IRELAND WEEK OCTOBER 17-23 2022

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DEVELOPING THE BIOECONOMY

A Guide for Local & Regional Authorities

1 DETERMINE BIOMASS QUANTITIES & CHARACTERISTICS

Gather data on biomass from agricultural census. What is available? Is pre-treatment required? Consider storage and transport too.

2 IDENTIFY TECHNOLOGIES & DEVELOP BUSINESS MODELS

Cascading technologies unlocks the full potential of biomass and offers new business models which derive optimum value from bioresources storage and transport too.

3 CONDUCT FEASIBILITY, MARKET & POLICY ANALYSES

The most important aspect to developing a successful bioeconomy initiative is to ensure economic, social, and environmental sustainability.

4 ENGAGE LOCAL ENTERPRISES

Bioeconomy should be integrated with Local Economic and Community Plans and County Development Plans, an industry perspective is crucial to achieving commercial success.

5 FOSTER INNOVATION SPRINTS

Innovation sprints fostering initial collaborations between industry, local further & higher education institutions, and Innovation clusters can help jump-start bioeconomy projects.

6 CREATE KNOWLEDGE NETWORKS

Strong knowledge and communication networks helps stakeholders identify collaborators and opportunities, nurture ideas, and ensure integration of science, technology, and innovation.

7 DEVELOP AWARENESS & COMPETENCIES

Develop awareness & competencies within the local authority. Information on the bioeconomy should be communicated at targeted organisations.

BIOECONOMY IRELAND WEEK OCTOBER 17-23 2022

This guide has been developed as an output of the Agri Bio Circular (ABC) Economy project at University College Dublin. This project has been jointly funded by Department of Agriculture, Farming & the Marine and Sustainable Energy Authority Ireland under the SEAI National Energy Research, Development and Demonstration Funding Programme 2018, Grant number 18/RDD/365.

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seai

An Analysis of the Social and Private Return to Land Use Change from Agriculture to Renewable Energy Production

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1 University of Galway
2 BiOrbic Bioeconomy SFI Research Centre

Ollscoil na Gaillimhe University of Galway

An Roinn Talmhaíochta, Bia agus Mara Department of Agriculture, Food and the Marine

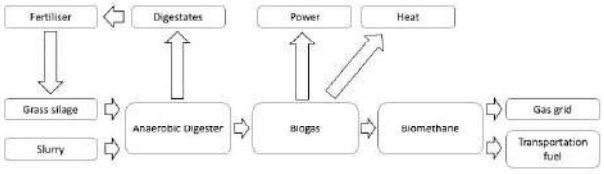
BIOECONOMY IRELAND WEEK OCTOBER 17-23 2021

Introduction

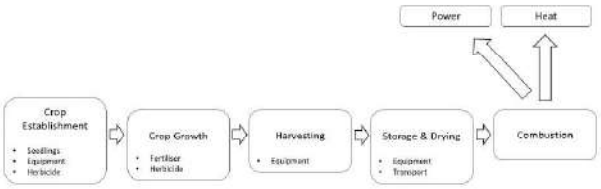
- Need to reduce greenhouse gas (GHG) emissions
- Shift toward renewable energy
- EU targets
  - RED – 32% of total energy needs with renewable energy by 2030
  - EU Commission proposes to increase the target in the directive to 45% by 2030
- Climate Action Plan 2021
  - Increase renewable energy production from electricity from 29% in 2020 to up to 80% by 2030 and
  - Double biomass supply as a fossil fuel substitute
- Need to explore how Ireland can increase renewable energy
- Also opportunity to replace fossil fuel technology with those from the bioeconomy
- Use domestic resources as feedstocks for novel technologies

Value Chains

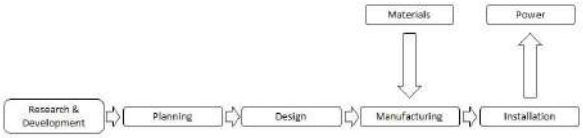
Biogas/Biomethane from Anaerobic Digestion



SRC Willow



Solar PV



Overview

- Look at short-run returns to renewable energy sources compared with agriculture
- Use of value chain perspective to examine land use decision
- Three case studies
  - Grass for anaerobic digestion to generate biogas/biomethane
  - SRC willow for heat/electricity generation
  - Solar PV for electricity generation
- Multiplier analysis using Bioeconomy Input-Output (BIO)

Methodology

- Compare marginal economic returns derived from agriculture and bioenergy feedstocks on per hectare basis
- Economic returns combination of private (market value) and social (market value plus future value of carbon)

Agricultural incomes and emissions

- Cost and revenue streams for main five agricultural systems: dairy; cattle rearing; cattle other; sheep; tillage
- Data from Teagasc National Farm Survey
- Emissions derived by applying IPCC inventory model – (emissions factors x activity data)
- Difference between the net total CO2e sequestered by the renewable energy displaced agricultural emissions gives total abatement for 1ha of converted land

Renewable energy incomes and emissions

- Agronomic and financial data for SRC willow derived from Styles et al. (2008) and Caslin et al. (2015)
- CO2e emissions data for SRC willow derived from Styles and Jones (2007)
- Solar income equal to rental price per land (€2,400/ha)
- Carbon values Irish government shadow price of carbon for non-ETS sectors for different years:
- 2020 - €32/tonne; 2030 - €100/tonne; 2040 - €163/tonne

Input-output

- Disaggregate renewable energy sectors using BIO in order to quantify the value chains associated with each case study
- Estimation of individual sectoral output multipliers

Results

SRC Willow vs. Agriculture

	Agriculture	Willow		CO2e Displaced	Private Return	Social Return		
	A	C	D	E	C+D -(A+B)	(C+D) – A + (E+F)*M		
M	€	€	€	CO2e t	0	€32	€100	€163
Dairy	1982	245	277	6.06	-€1460	-€1,266.08	-€854.00	-€472.22
Cattle rearing	776	245	239	3.86	-€292	-€168.48	€94.00	€337.18
Cattle other	864	245	310	5.26	-€309	-€140.68	€217	€548.38
Sheep	672	245	239	3.66	-€188	-€70.88	€178	€408.58
Tillage	1161	245	332	1.16	-€584	-€546.88	-€468	-€394.92
Total	1120	245	275	4.46	-€600	-€457.28	-€154	€126.98

Grass Silage vs. Agriculture

	Agriculture	Grass Silage		CO2e Displaced	Private Return	Social Return		
	A	C	D	E	C+D -(A+B)	(C+D) – A + (E+F)*M		
M	€	€	€	CO2e t	0	€32	€100	€163
Dairy	1982	185	277	6.36	-€1520	-€1316	-€884	-€483
Cattle rearing	776	185	239	4.16	-€352	-€219	€64	€326
Cattle other	864	185	310	5.56	-€369	-€191	€187	€537
Sheep	672	185	239	3.96	-€248	-€121	€148	€397
Tillage	1161	185	332	1.46	-€644	-€597	-€498	-€406
Total	1120	185	275	4.76	-€660	-€508	-€184	€116

Solar PV vs. Agriculture

	Agriculture	Solar PV		CO2e Displaced	Private Return	Social Return		
	A	C	D	E	C+D -(A+B)	(C+D) – A + (E+F)*M		
M	€	€	€	CO2e t	0	€32	€100	€163
Dairy	1982	2400	0	7.4	€418	€655	€1,158	€1,624
Cattle rearing	776	2400	0	5.2	€1624	€1,790	€2,144	€2,472
Cattle other	864	2400	0	6.6	€1536	€1,747	€2,196	€2,612
Sheep	672	2400	0	5.0	€1728	€1,888	€2,228	€2,543
Tillage	1161	2400	0	2.5	€1239	€1,319	€1,489	€1,647
Total	1120	2400	0	5.8	€1280	€1,466	€1,860	€2,225

Output Multipliers : SRC Willow – 2.31; Biogas – 2.22; Biomethane – 2.42; Solar PV – 1.29

Conclusions

- Market return from growing bioenergy feedstocks less than for all the main farming systems in Ireland but more than for cattle and sheep farming when social value of at least €100/t of CO2e applied
- Market and social return is higher for using land to erect solar PV than any of the main agricultural activities
- Output multipliers show the potential of the bioenergy value chain to contribute significantly to economic activity in Ireland. This is particularly important for rural regions that would supply the primary inputs across the value chain .

Research funded by the Department of Agriculture, Food and the Marine (DAFM), the Sustainable Energy Authority Ireland., and the BiOrbic SFI Bioeconomy Research Centre

Circular Bioeconomy Outlook Study 2030-2050

Kevin O'Connor, James Gaffey, Liz Gavin, Nicholas Holden and Jane Stout

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Introduction & Aims

Climate action, sustainable food and bio-based systems

- The main aim of this report is to provide an outlook on the potential of a circular bioeconomy to support climate action, sustainable food, and bio-based systems over the 2030 to 2050 period.
- A sustainable and circular bioeconomy can help build resilience in our local biological resources (biodiversity), environment, economy, and society.
- A circular bioeconomy can help us to address challenges that are key to our everyday lives, from climate change mitigation and adaptation to regional economic and social development, to ensure the availability of food, energy, and materials upon which we depend.
- We examine here the innovation potential of the Irish bioeconomy with international examples provided to stimulate ideas and discussion.

Biorefineries and their Products

- Biorefineries are industrial units that perform the refining of biological resources.
- The products from biorefineries are many and varied, from high-value chemicals used in cosmetics, pharmaceuticals and food additives to high volume bio-based plastics or chemical building blocks (Figure 1).[1,2]

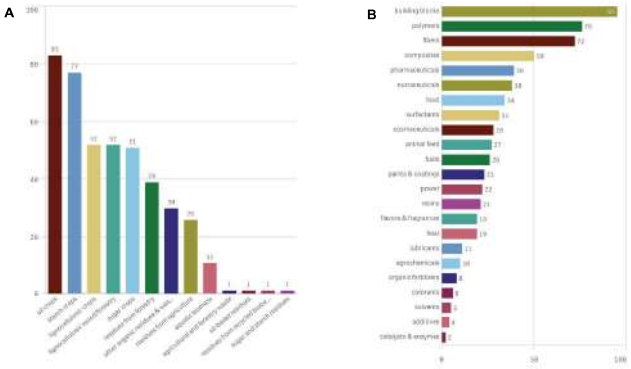
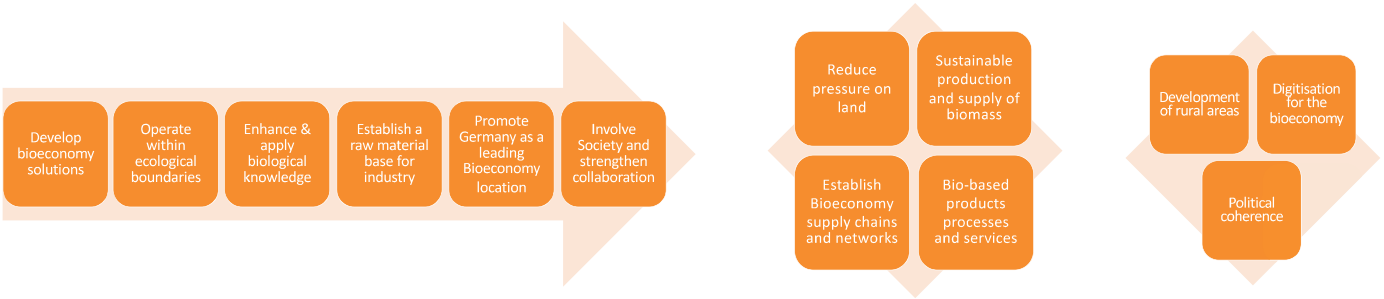


Figure 1 A) Starting materials and **B)** products of biorefineries in Europe[1,2]

Feedstocks, Technologies and Products for Ireland

Feedstocks	Conversion Technologies	Products
• Agricultural products and side streams*	• Fermentation	• Proteins
• Marine by-catch	• Anaerobic digestion	• Building block chemicals
• Seaweed	• Insect technologies	• Bio-based and biodegradable plastics, fibres, and textiles
• Forestry residues	• Biocatalysts/enzyme technologies	• Bioactives
• Food waste	• Chemical/thermochemical technologies	• Bio-based fertilisers and bio-based pesticides
• Biogenic carbon dioxide	• Carbon capture and re-use	• Natural Capital and ecosystem services

Case Study: German Bioeconomy Strategy



Recommendations

- Ireland needs a national Bioeconomy Strategy (setting out clear KPIs for success) aligned the Bioeconomy Action Plan
- Play to regional strengths (biomass supply/feedstock, local knowledge and skills)
- Harmonised pathways for Bioeconomy projects/initiatives to work through (Public private partnership?)
- Deep national and regional demonstrators needed
- Education and training programmes needed
- Business models for the new Bioeconomy initiatives for primary producers and businesses

1. Baldoni, E. et al.,(2021): Chemical and material biorefineries in the EU. EC, Joint Research Centre (JRC) [Dataset] PID: http://data.europa.eu/89h/24e98d11-ef06-4233-8f69-1e123938e891
2. Baldoni, E et al., (2021): Chemical and material biorefineries outside the EU. EC, Joint Research Centre (JRC) [Dataset] PID: http://data.europa.eu/89h/bd890922-fc66-41ca-b032-e02754b34a22

This project "Circular Bioeconomy outlook study 2030-2050" is supported by the EPA Science fast track to policy Grant No. 2021-GCE-1021

MTU Ollscoil Teicneolaíochta na Mumhan Munster Technological University

Barryroe CO-OPERATIVE LIMITED

BIOREFINERY GLAS

Grassa GREEN REFINED SOLUTIONS

UCD DUBLIN

CARBERY

GRASS BIOREFINERY

Fresh grass

Press juice

Press cake

Nutrient-rich whey

Fructo-oligosaccharides

Protein concentrate

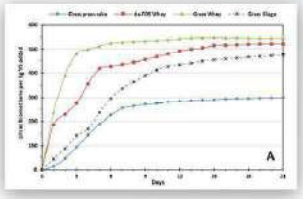
Press cake silage

Rumiant Feed

Fertilizer, Bioenergy

All of the biorefinery by-products tested were shown to be suitable feedstocks for anaerobic digestions. Based on modelling, it was found that most of the heat and electricity energy needs of the biorefinery could be met by using the grass whey as a feedstock for anaerobic digestion coupled with CHP.

		Grass press cake	Grass whey	De-FOS whey	Grass silage	Dairy whey
C:N ratio		19:1	17:1	9:1	17:1	-
Biogas and biomethane production (L/kg)	VS	530.7 (390.3)[a]	895.8 (544.9)[a]	597.4 (520.3)[a]	988.1 (479.0)[a]	(510-908)[a]
	DM	486.9 (286.2)[a]	707.7 (430.3)[a]	478.2 (416.5)[a]	737.2 (436.9)[a]	(280-338)[a]
	FM	289.0 (111.6)[a]	143.0 (8.7)[a]	41.0 (36.1)[a]	132.9 (78.8)[a]	-
Final weighted biogas composition	CH_4 (%)	58.0	60.8	67.1	58.3	-
	CO_2 (%)	41	38.1	31.8	41.1	-
	O_2 (%)	0.1	0.2	0	0	-
	H_2S (ppm)	17.6	6.7	87.7	4.3	-
	NH_3 (ppm)	0	5.7	533.9	9	-
Biodegradability	%	55	70	63	-	-



Feed, Food

Approximately 11g of FOS enriched extracts from each 1 L of grass whey. FOS concentrate was used as sole carbon sources to grow 3 strains of Lactobacilli, 2 Bifidobacterium strains and Escherichia coli respectively. The FOS showd comparable activity to control prebiotics used were Inulin and an on-the-market FOS.

Prebiotic Index			
Probiotic Strain	Grass FOS	Commercial FOS	Inulin
L acidophilus	1.12±1.3	1.09±0.8	0.88±0.6 *
L fermentum	1.67±0.9	1.32±0.8	3.67±0.7 *
L plantarum	1.44±0.5	0.78±0.7 *	-0.354±0.6 *
B animalis	1.89±0.45	2.05±0.11	5.98±0.41*
B breve	3.65±0.98	4.01±1.12	2.76±0.23 *

Prebiotic index comparing Grass-based FOS with Commerical FOS and Inulin

Monogastric Feed

Protein concentrate was tested as a partial replacement for soybean meal in 9-week old weaner pig diets at Carhue Piggeries in Barryroe Cork. The pigs fed with the protein concentrate displayed higher daily feed intake and higher average daily weight gain over the 31-day trial compared to pigs on a conventional weaner diet.

Date of Weighing	Daily Feed Intake (kg/d)		Feed Conversion Ratio		Average Daily Gain (kg/day)	
	Treatment	Control	Treatment	Control	Treatment	Control
Period 1	1.023	0.995	1.77	1.67	0.577	0.590
Period 2	1.247	1.182	1.83	1.83	0.683	0.646
Period 3	1.386	1.301	1.90	1.86	0.729	0.699
Period 4	1.512	1.400	2.04	2.05	0.742	0.682

Results of weaner trial comparing treatment (grass-protein based) v/s control diet

Press cake was tested at UCD Lyons Farm as a 66% replacement for silage in dairy ruminant diets over a 77-day period. The cows on the press-cake diet demonstrated similar milk yield as those on the control diet, indicating a high nitrogen use efficiency in the treatment diet. The losses of N and P in the faeces of cows on the treatment diet were lower than in the control diet. A RUSITEC analysis showed up to 15% reduction in rumen methane in the case of cows on the treatment diet.

	Treatment	
Item	GS	PC
DMI (kg DM/d)	19.33	18.00
Feed efficiency	1.31	1.27
Milk yield (kg/d)	28.02	27.33
No significant difference in milk quality		
Nitrogen Intake and Output		
Intake kg/d		
Feed N Intake (kg/d)	0.71[a]	0.60[b]
N output (kg/d)		
Milk	0.19	0.18
Faces	0.21[a]	0.15[b]
Urine	0.29[a]	0.24[b]
NUE (%)	27.25[a]	33.03[b]
Methane Emissions Analysis Rusitec		
Gas production (l/d)	1.31	1.26
Methane (mmol/d)	6.61	5.71

Results of dairy cow trial comparing treatment (press-cake based) v/s control diet

PUBLICATIONS

- Serra, E., Lynch, M.B., Bock, M., Gaffey, J., Sanders, J.P.M., Koopmans, S., Pierce, K (2020) "Effect of feeding press cake silage as replacement for high quality grass silage on milk production", EAAP Annual Meeting 2020, 1 December 2020.
- Ravindran, R., Koopmans, S., Sanders, J.P., McMahon, H. and Gaffey, J., 2021. Production of Green Biorefinery Protein Concentrate Derived from Perennial Ryegrass as an Alternative Feed for Pigs. Clean Technologies, 3(3), pp.656-669.
- Ravindran, R., Donkor, K., Gottumukkala, L., Menon, A., Guneratnam, A.J., McMahon, H., Koopmans, S., Sanders, J.P. and Gaffey, J., 2022. Biogas, Biomethane and Digestate Potential of By-Products from Green Biorefinery Systems. Clean Technologies, 4(1), pp.35-50.

BIOECONOMY IRELAND WEEK OCTOBER 17-23 2022

An Roinn Talmhaíochta, Bia agus Mara
Department of Agriculture, Food and the Marine

Cláir Chistí Eorpacha Struchtúrtha agus Infheistíochta na hÉireann 2014–2020
Cómhaoinithe ag Rialtas na hÉireann agus ag an Aontas Eorpach

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The European Agricultural Fund for Rural Development: Europe investing in rural areas

BIOREFINERY GLAS

https://biorefineryglas.eu/

WWW.BIOMASSTOBIOCHAR.IE

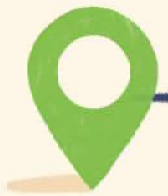
BIOMASS TO BIOCHAR FOR FARM BIOECONOMY

WHAT IS BIOCHAR?

Biochar is a **charcoal-like substance** which can be made from agricultural and forestry biomass which when mixed with other biomass such as crop residues, food waste or manure, and buried in the soil, forms **Terra Preta** which is one of the richest soils on the planet, and **a way to quickly increase the long-term soil carbon store.**

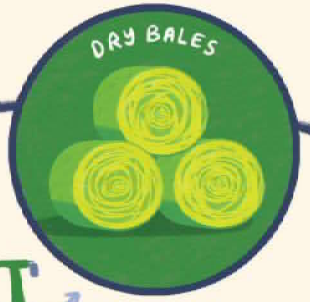
WHY IS BIOCHAR SO IMPORTANT TODAY?

Biochar provides a **sustainable** and readily available solution for unutilised farm biomass and provides a **positive carbon contribution** to the environment. Also, carbon trading markets that sponsor carbon sequestration, could help **supplement the farmers' income** while increasing the sustainability of Ireland's agriculture sector.



YOU ARE HERE

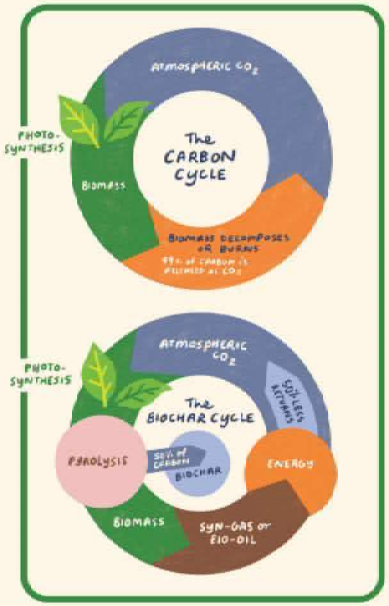
FARM HABITAT MANAGEMENT of RUSHES, BRACKEN, HAZEL, FURZE etc.



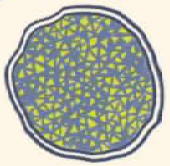
HOW IS BIOCHAR MADE?

Biochar is made by a process called **pyrolysis** which involves heating biomass, such as field rushes, bracken and scrub vegetation in a low oxygen environment at temperatures ranging from 400°C to 800°C.

Generating heat for potential use/storage



RUSH BIOCHAR CLOSE UP



ADDED TO SLURRY

- Increases nutrient value
- Teagasc trials show reduction of ammonia emissions of **75%** and our own trials show methane reductions of **33%**

ADDED TO SILAGE

- Improves feed efficiency
- Reduces greenhouse gas emissions
- Adsorbs toxins & pathogenic enzymes in the rumen and gut of cattle
- Improves livestock housing environment

A PHYSICAL FORM OF CARBON FOR YOUR CARBON CREDITS.

BENEFITS

- Locks up carbon in soil
- Increases soil PH
- Reduction in Nitrous Oxide (N_2O)

FOR WATER PURIFICATION

Decontamination - helps to adsorb pesticides and fertiliser run-off in water and removes biological & chemical contaminants.

CONCLUSION

The use of biochar in livestock farming offers many interesting solutions to the increasingly complex problems of modern-day farming.

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www.biocharireland.com

Illustrations: Ruth Graham

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BIOECONOMY IRELAND WEEK OCTOBER 17-23 2022

Small Biogas Demonstration Programme

SmallScale FarmBIOGAS

irbea irish bioenergy association

Demonstrate farm biogas plants from on-farm materials including:

- ⇒ **Slurry**
- ⇒ **Farmyard manure**
- ⇒ **Silage**
- ⇒ **Other farm and crop wastes**

Objective of a farm biogas plant:

- ⇒ **Complement existing current farming operation**
- ⇒ **Existing farm production to be maintained**
- ⇒ **Produce energy to satisfy an onsite demand (i.e. heat, electricity, fuel)**
- ⇒ **Produce digestate for fertiliser replacement and better nutrient recovery**

For further information: www.irbea.org/farmbiogas @farmbiogas

Lead Project Partner: Irish Bioenergy Association (IrBEA)

Project Partners: Teagasc, Laois Partnership, Tipperary Cheese

Kindly funded by the Department of Agriculture, Food and Marine through European Innovation Partnership

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BIOECONOMY IRELAND WEEK

OCTOBER 17-23 2022

ALL VOICES TOGETHER

Collective action and change

irishbioeconomy.ie

#allvoicestogether

#irishbioeconomy

CONNECTING IRELAND'S BIOECONOMY