NUI Galway
OÉ Gaillimh

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Further reading:

- The CIRCULATORITY GAP report
- Mapping the Role of Raw Materials in Sustainable Development Goals
- Report on the implementation of the Circular Economy Action Plan
- Towards a Resource Efficient Ireland
- Biorefineries distribution in the EU

For enquires contact:

Prof. Piet Lens
Established Professor
NUI Galway
piet.lens@nuigalway.ie

Mr. Juan Castilla-Archilla
PhD Candidate
NUI Galway
j.castillaarchilla1@nuigalway.ie

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Ryan Institute

Industrial sustainability and new business opportunities through biorefineries turning waste into value-added products

Background

Climate change is the major threat of this century arising due to human activities, such as overuse of fossil fuels, pollution and deforestation. In the last decade, greenhouse gas emissions in the European Union have decreased by around 17 %. However, the greenhouse gas emissions in Ireland have increased by 15 % (Fig. 1). Hence, it is imperative to develop alternative strategies to reverse this trend and combat greenhouse gas emissions to alleviate climate change.

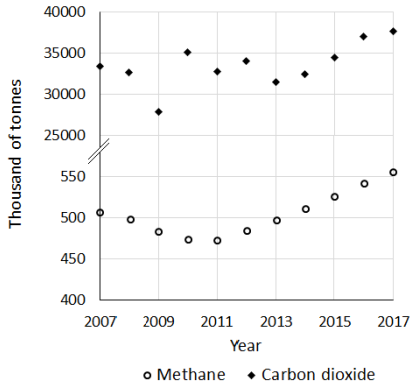

Figure 1 *Greenhouse gases production in Ireland (Source: Eurostat)*

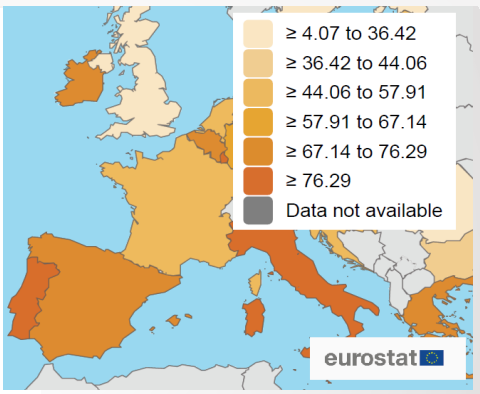

Figure 2 *Energy import dependency*

Biorefinery Approach

One alternative to mitigate greenhouse gas emissions is to move to a more sustainable economy by investing in the emerging biorefineries. This concept involves a combination of different conversion processes and manufacturing technologies that convert renewable biomass into a spectrum of intermediate and final products (chemicals, materials, energy and fertilisers), with the goal of replacing petroleum based products. This will allow Ireland to be less dependent on imported fossil fuels (Fig. 2), and rely on locally sourced sustainable resources. To avoid deforestation and loss of agricultural land for biomass cultivation, existing waste products can be used to fuel bio-refining. In such systems, biodegradable by-products and waste are used from relevant industries including dairy, poultry, meat and livestock, prepared consumer foods, beverages, forestry, fishing and municipal wastes. This approach is known as Circular Bioeconomy, where wastes are used as valuable entities for production of commodities.

Government Actions Needed

- Development of a national central facility for analysis and characterisation of solid waste for biorefinery purposes
- Design protocols and support for sampling and handling of biodegradable industrial solid waste
- Detailed national mapping of solid wastes generated and evaluation of the most suitable locations for biorefineries across Ireland
- Support for implementation of biorefining technologies across existing value chains in relevant sectors

Circular Bioeconomy

Total solid waste production in Ireland in 2016 was 44,047,000 tonnes (Eurostat). The Environmental Protection Agency (EPA) developed in 2015 the EPA Waste Classification for the correct disposal of these wastes. This classification allocated 843 types of solid wastes, divided in 20 different categories of wastes based on source, and subdivided by their characteristics. At least 37 of them have potential to be used as feedstock in a biorefinery. Some of the biodegradable wastes went to incineration or co-incineration (1,177,875 tonnes), landfill (570,000 tonnes), composting and biostabilization (607,700 tonnes) and gas production via anaerobic digestion (110,000 tonnes). The problem with these conventional treatments is the lack of recovered value, as well as the release of greenhouse gases. These wastes should be considered valuable resources, and the EPA Waste Classification should be updated focused on biorefining purpose rather than disposal management. This approach for production of high-value compounds, such as bioplastics or fine chemicals (Fig. 3) is in line with the Circular Economy Action plan developed by the European Commission.

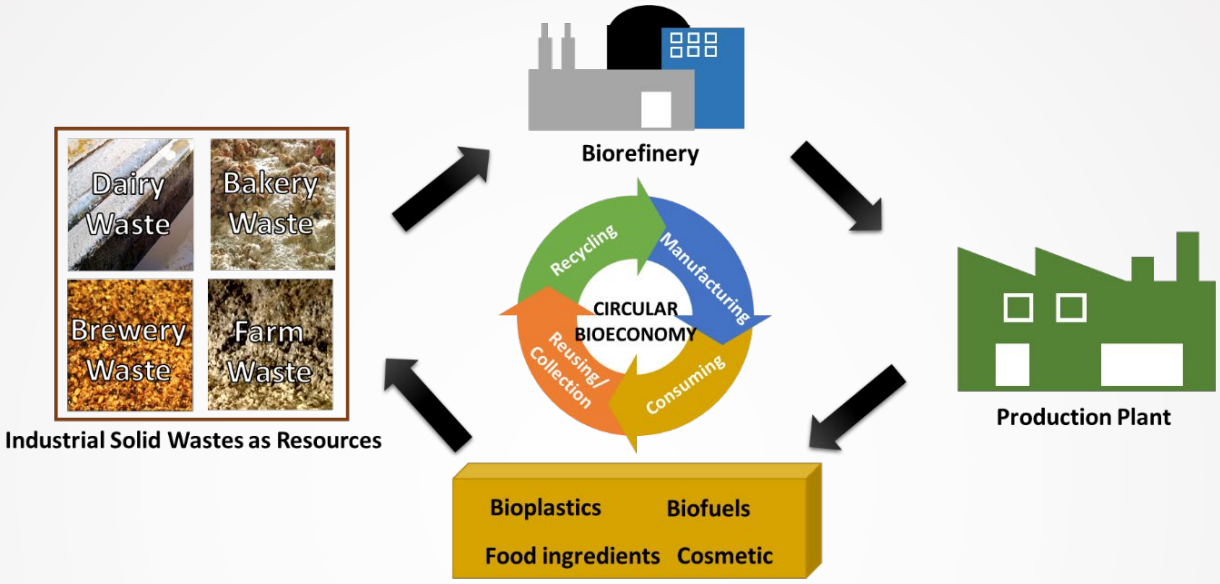

Figure 3 Diagram showing circular bioeconomy with the biorefinery as key step of this approach. In this biorefinery plant the solid waste is broken down, using chemical, physical and biological processes, up to single chemical molecules known as chemical building blocks. These chemical building blocks are combined in a production plant to make a range of commodities, i.e. bioplastics, biofuels, food ingredients or cosmetics.

Approximately only 9 % of the world operates in a circular economy. The biggest greenhouse gases emissions for material management is related with the extraction, processing and production stages (The Circularity Gap report). The development of biorefinery technologies, combined with the circular economy, will contribute towards a more sustainable world. The construction of technological hubs across Ireland, for collection, treatment and production of value added products from current wastes would reinforce the national economy and establish Ireland as a technological leader in this emerging sector and at the same time become more independent on fossil sources.

The data reference links can be found below:

- https://ec.europa.eu/eurostat/data/database
- https://ec.europa.eu/eurostat/databrowser/view/sdg_07_50/default/map?lang=en
- https://ec.europa.eu/eurostat/web/circular-economy/material-flow-diagram
- https://www.epa.ie/pubs/reports/waste/stats/wasteclassification/EPA_Waste_Classification_2015_Web.pdf
- https://www.circularity-gap.world/