



## Accounting for Environmental Impact in the Bioeconomy

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SCIENTIFIC



TECHNOLOGICAL



ECONOMIC



ACADEMIC



ENVIRONMENTAL

### SUMMARY

When you figure out the environmental cost of making something, do you take everything into account? Dr Fionnuala Murphy at UCD School of Biosystems & Food Engineering takes a close look at various processes that use bio-based materials - from generating biofuels to making products from algae and agricultural and plastic wastes - and finds the true environmental cost across the life-cycle of those processes.

Dr Murphy's work has already helped to move towards more sustainable sources for bio-fuel generation and, through major European projects, she is contributing to the development of a more sustainable bioeconomy that reduces levels of agri-food waste by using it for higher value products.

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### The Full Picture

With climbing levels of carbon dioxide in the atmosphere and rising tides of plastic all around, it's crucial to source products and energy as sustainably as possible. But how do we know the true environmental impact of a particular source of energy, or a product? It's an important insight to have, if we are to engineer more sustainable approaches.

That's why Dr Murphy audits the life-cycles of such processes. “It's important to look at the whole picture,” she says. “For example, when biofuels were first used, they were considered carbon neutral, but when you look into the overall environmental impacts, particularly from deforestation, there was a price being paid in terms of carbon after all, and so there was room for improvement.”

To carry out a more thorough evaluation of the environmental cost of a process, Dr Murphy gathers an inventory of the supply chain and inputs, including electricity, chemicals and transport where appropriate, then she uses mathematical models and software to calculate the impact of inputs and outputs on the environment.

### Unmasking Carbon Burdens

Dr Murphy's work on auditing the true environmental impact of processes across their life cycle has already **helped to underpin a change in practice in Ireland**. Her analysis of palm kernel shells being used as biomass to generate electricity at a power station in Edenderry, County Offaly, brought to



light a higher emissions cost than had been reported. The shells were imported from Indonesia, and were being used along with peat in the station, but they incurred some carbon burdens that had not adequately been factored in.

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## Agri-food, Algae and Plastic Waste

To help reduce the impact of waste from the agri-food sector, many researchers and companies are seeking to recoup valuable products and services from those waste streams and byproducts.

To work out the environmental costs and benefits involved, Dr Murphy is working on major projects to assess the environmental impacts of existing and potential new technologies on these processes.

One of those projects is AgroCycle, which is co-ordinated by UCD and involves 26 partners from across Europe and China, involving university researchers and industry. The aim is to take stock of current waste streams from agri-food in Europe, which currently produces around 700 million tonnes of waste each year, and to develop ways to add value and reduce the environmental impact.

In Ireland, the dairy industry is facing new challenges and opportunities since milk quotas were abolished and milk production is expanding, and Glanbia is co-ordinating another Horizon 2020 project, AgriChemWhey, to explore how to add value to byproducts of milk processing. “It’s the biggest funding award under Horizon 2020 that Ireland has ever received,” explains Dr Murphy.

The 22-million-Euro project will build a first-of-a-kind, industrial-scale biorefinery at the Bioeconomy Innovation and Piloting Facility at Lisheen, Co. Tipperary, to add value to more than 25,000 tonnes each year of excess whey protein and de-lactosed whey permeate. The result will be products

that can be used in human nutrition and in fertilisers.

Dr Murphy’s role in AgriChemWhey is to **assess the environmental impact of the whole life-cycle for these new processes and products**. “Dairy processes are responsible for a large proportion of Ireland’s greenhouse gas emissions,” she says. “So if we can develop ways to reduce or offset the emissions as milk production expands, that will be very positive for the environment.”

She is also applying her life-cycle-assessment expertise to SpiralG, working with industry partners in Europe on a bio-refining approach to derive pigments from a marine alga called *Spirulina arthrospira*.

“Phycocyanin is a pigment widely used in the pharmaceutical, cosmetic and food industries,” she explains. “I am working with industry partners in Italy, France and Germany as they develop approaches that can **sustainably produce phycocyanin and other useful products** from these extremely fast-growing cells.”

In Portlaoise, Dr Murphy is working with another industry partner, clean-tech company TRIFOL, to generate products from waste plastic. Through a Science Foundation Ireland Industry Fellowship, she is helping them to **optimise the life-cycle of their processes to convert waste plastic to diesel fuels, lubricants and waxes**.



## Boosting the Bioeconomy

The overarching impact of Dr Murphy’s work lies in **strengthening the bioeconomy, which derives value from natural or bio-based resources**. The bioeconomy is a strong focus of research and development in Horizon 2020, and it follows the publication of Europe’s Strategy on Bioeconomy in 2012. To maximise the environmental benefit and value in the bioeconomy in Ireland, Prof Murphy will lead a major new project funded through the Sustainable Energy Authority of Ireland called ABC Economy that will analyse how bioresources can best be used in different regions of the country.

“When we are building the bioeconomy, the more local the better, because it reduces transport costs and it promotes

rural growth and job creation,” says Dr Murphy. “When we are designing and developing these processes, it’s important that we optimise them, and by gathering the evidence and modelling the processes, my research is enabling that.”

## Research References

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AgroCycle is a ca. €8 million (ca. €7 million from the European Commission, ca. €1 million from the Government of The People’s Republic of China) Horizon 2020 research and innovation project addressing the recycling and valorisation of waste from the agri-food sector.

AgriChemWhey will receive €22 million in funding from the Bio-Based Industries Joint Undertaking (BBI JU) under the European Union’s Horizon 2020 research and innovation programme and will seek to build a first-of-a kind, industrial-scale bio-refinery which will take by-products from the dairy processing industry and convert them into cost competitive, sustainable lactic acid.

SpiralG will receive circa €4 million in funding from the Bio-Based Industries Joint Undertaking (BBI JU) under the European Union’s Horizon 2020 research and innovation programme and will seek to produce phycocyanin from *Spirulina arthrospira* in the frame of an industrial biorefinery concept.