

## Impact Objectives

- Identify systemic innovation approaches to recover and recycle valuable mineral components from organic waste streams into new products
- Integrate these optimally into a local or regional circular economy

# Towards a circular economy for Europe's agriculture and food system

Senior research scientist *Dr Oscar Schoumans* talks about the work of the **SYSTEMIC** collaboration which involves investigating and demonstrating the valorisation of biowastes to close nutrient cycles



**One of the main outputs from the project SYSTEMIC (Systemic large scale eco-innovation to advance circular economy and**

**mineral recovery from organic waste in Europe) is a roadmap to facilitate solutions for biowaste in the EU. Can you explain how this will look and the value it delivers?**

The roadmap will give a vision on how Europe can best deal with biowaste and imbalances in demand and supply of nutrients which will be beneficial for policy makers and actors in the whole value chain. Experiences on barriers and opportunities will be synthesised, which will be based on the information from five demonstration plants and selected outreach locations also interested in nutrient recovery. Major successes and challenges will be discussed with policy makers, end-users and other stakeholders. Recommendations will be given to solve major challenges. This will facilitate the systemic roll-out of Circular Economy solutions for biowaste (such as organic waste streams like sewage sludge, manure and food waste) in Europe and enhance the economic competitiveness of small and medium enterprises (SMEs) and industries.

**How will SYSTEMIC overcome the main barriers limiting integrating valuable components from organic waste streams into a circular economy?**

SYSTEMIC is a demonstration project of large-scale digestion plants where nutrient recovery techniques are implemented. This project will demonstrate the technical feasibility of nutrient recovery technologies and determine the quality of the end-products as a substitute for chemically-produced mineral fertilisers. Scientific information on the agronomic and environmental quality and impacts of the products is key to overcoming barriers related to the use of these new fertilisers by farmers or industry as secondary resources. Policy makers also require this kind of information in order to adapt European or national legislation to overcome legal barriers.

**Can you outline the role and types of outcomes of the Living Labs?**

In SYSTEMIC the demonstration plants will share their successes and challenges with 11 selected outreach locations. These are facilities that are interested in the business case for nutrient recycling and are considering implementing nutrient recovery techniques at their own site. We were overwhelmed by the interest of biowaste treatment plant owners across Europe who wanted to join the project as an outreach location. As a result, associated plants were identified who will receive the SYSTEMIC information and can join meetings. For example, a Spanish plant owner said: "I have no one nearby to talk with about anaerobic digestion and all the practical issues that I face regarding the disposal of

the products. I'm so glad to be here and share experiences with other experts".

The Living Lab approach will be used to facilitate the process of sharing information and experiences between the SYSTEMIC consortium and the outreach locations, as well as other associated plants. During these meetings practitioners, industry and researchers are brought together to exchange ideas on innovations. Collaboration will lead to concrete solutions for implementation of nutrient recovery techniques and reuse of new products in the other regions of the outreach plants.

**What particular strengths do the SYSTEMIC partners bring to the project?**

The SYSTEMIC partners are diverse and from across Europe, bringing in experience and knowledge on nutrient recycling. The SMEs and industrial partners have a leading position in the development and implementation of novel Nutrient Recovery and Reuse (NRR) solutions and the valorisation of recovered products. SMEs invest about €13.8 million in cash on top of the €9.5 million project budget (€7.8 million requested) demonstrating that participating businesses trust in the proposed solutions and that SYSTEMIC is a full market-and business-driven innovation project. Research institutes are responsible for delivering scientific evidence of the viability of the demonstration plants and the agronomical, environmental and economic aspects of the new approaches. ●

# Revalorisation of biowaste

*By working at five demonstration plants and numerous outreach locations, the **SYSTEMIC** project evaluates the economic feasibility of technologies recovering energy and nutrients from biowastes, ultimately increasing the sustainability of Europe's agriculture and food system*

Funded by the EU Horizon 2020 from 2017 until 2021, the SYSTEMIC project aspires to demonstrate the viability of a Circular Economy approach for nutrients. This approach is for the use of biowastes to substitute mineral fertilisers and to increase the value of organic residues. 'In short, the main challenge is how to convert biowaste into products that can be used as secondary resources by fertiliser industries or that meet with the demand of crops for nutrients and are safe to use and environmentally friendly,' summarises SYSTEMIC coordinator Oscar Schoumans.

There are 15 partners involved in the project who are based across Europe in the Netherlands, Belgium, Italy, Finland, UK, Germany and Austria. 'The SYSTEMIC partners are diverse and from all over Europe, bringing in experiences and knowledge on nutrient recovery and reuse,' highlights Schoumans. In the coming years, novel nutrient recovery technologies will be tested

in five large demonstration plants: Groot Zevent Digester (Beltrum, The Netherlands) - where pig manure and agro-industrial waste will be converted into biogas, nitrogen-potassium concentrates, mineral phosphate fertiliser and organic soil improver; AM Power (Pittern, Belgium) - dealing with the production of biogas, nitrogen-potassium (NK) fertiliser and organic fertiliser from manure and food waste; Aqua & Sole (Pavia, Italy) - in which sewage sludge will be transformed into biogas, ammonium sulphate fertiliser, and organic fertiliser; Rika Biofuels Friday (Kent, United Kingdom) - aiming to employ poultry manure in the production of biogas and ammonium sulphate fertiliser, and organic fertiliser; and Benas-GNS (Ottersberg, Germany) - where biogas, ammonium sulphate and calcium carbonate will be obtained from corn silage and poultry manure.

## EFFICIENT NUTRIENT RECYCLING

In the EU, half of the phosphorus and nitrogen applied annually to croplands

derived from non-renewable sources (such as phosphate rock) or produced by processes consuming large amounts of fossil fuels (like natural gas) for the production of mineral nitrogen fertilisers, while a high percentage of valuable nutrients are lost through the incineration (poultry manure) and/or export of manure or solid manure fractions. 'Our current predominantly linear nutrient use must be turned into one that contributes to the Circular Economy and offers a viable solution for the processing of biowaste while reducing CO<sub>2</sub> emissions, reuse of nutrients and preventing nutrient losses,' Schoumans points out.

Additionally, especially in regions with intensive farming, more manure, and thus more nutrients, is produced than can be applied on the fields due to restrictions in application standards. Those restrictions are needed to prevent emission of nutrients to the environment and to reduce eutrophication (nitrogen and phosphorus enrichment) of waterbodies. As a result, large amounts of manure are transported from the region with a mineral surplus to nutrient demanding areas. In Northwest Europe the transport distance can be a couple of hundred kilometres, a secure but costly and non-sustainable process. 'The challenge is to close the nutrient cycle in the nearby region of a biowaste treatment plant.'

A treatment plant obtains the organic waste streams from the nearby region and should produce several fertilisers which are required in the region for agricultural production. ▶



SYSTEMIC project will boost the implementation of circular solutions for biowaste in Europe reusing nutrients for fertilisers including nitrogen (N), phosphorus (P) and potassium (K).



*The main challenge is how to convert biowaste into products that meet demand and are safe to use and environmentally friendly*

In the end, only the surplus of nutrients in the region should be exported as small volumes with high concentrations. A market driven regional approach is needed in the first place' highlights Schoumans. 'In this way the resource will contribute to the Circular Economy.'

#### TECHNOLOGIES WITH PROMISING RESULTS

SYSTEMIC demonstrates the feasibility of novel technologies and sharing information on areas such as mass balances of nutrients in agriculture, performance and challenges of the installations, use of chemical and energy inputs or overall business cases. 'This information is crucial for all stakeholders along the nutrient value chain in the food system, especially those interested in the recovery of nutrients for their recycling in sustainable agriculture,' outlines Schoumans.

At the five demonstration plants, technologies such as anaerobic digestion, pasteurisation, nitrogen stripping, reverse osmosis and recovery of carbonate, phosphorus and lignocellulose are being developed for the integration of organic waste streams into a circular economy by producing new resources. With such a large investment, the industrial partners play a leading role in the development of these technologies.

Because the construction of the new nutrient recovery technologies at some plants is currently taking place, the full results of the project are yet to come. The implementation of the nutrient recovery technologies and start-up of the systems at the demonstration plants is planned for 2019. 'Next year, we will learn whether these

systems can indeed produce the products with the envisaged quality. It will also give the first indication of the market price, and so a more realistic picture of the business case for each demonstration plant,' he continues.

Some of the main challenges faced by the project so far are of a legal nature. 'In May 2018, we had already a policy research workshop dealing with barriers and aspects of the Nitrate Directive,' says Schoumans. 'We did facilitate the process by showing the product quality, as well as agronomic, environmental and legal aspects regarding nitrogen-recovered products in the light of the Circular Economy.'

The results of the SYSTEMIC project will be disseminated through already existing platforms. These include: the Biorefine Cluster Europe (BCE), which interconnects projects and people within the domain of sustainable and bio-based resource management; Water Supply and Sanitation Technology Platform (WssTP), which addresses the challenges of an integrated and sustainable management of water resources; and the European Sustainable Phosphorus Platform (ESPP), which deals with the sustainable use of phosphorus and other nutrients at the EU level. 'All experiences gained during the project will be synthesised and communicated in regular interaction with policy makers at regional, national and at EU level, in cooperation with the European Parliament' concludes Schoumans. 'Throughout the project the results and summaries will be published on the website. During several workshops and conferences, the outcome will be presented to a broad audience.' ●

## Project Insights

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### PARTNERS

- Wageningen University and Research (NL)
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- RIKA Biofuels Development Ltd. (UK)
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- European Biogas Association (BE)
- Rural Investment Support for Europe (BE)

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### BIO

**Dr Oscar Schoumans** has focused over the last ten years on nutrient recovery from manure in areas with intensive livestock production and high agricultural phosphate surpluses. Schoumans is senior research scientist at Wageningen Environmental Research, part of Wageningen University and Research, and coordinates the H2020 SYSTEMIC project and a Dutch project of the farmers organisation and the Ministry of Agriculture called "Added-Value of Manure and Minerals by means of nutrient recovery". Additionally, he is involved in scientific evaluations of the Manure Act and Water Framework Directive.



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