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CiNURGi project

ESNI- NERM Conference| 28.4.2026
Erik Sindhöj
RISE – Research Institutes of Sweden

interreg-baltic.eu/project/cinurgi

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HELCOM

Baltic Sea Regional Nutrient Recycling Strategy

Support the implementation of the Baltic Sea Regional Nutrient Recycling Strategy:

- Develop and promote standards for safe and sustainable recycling of nutrients
- Develop strategies for implementing nutrient recycling as a measure to improve national and regional nutrient balances
- Increase the acceptance and use of recycled nutrients
- Create business opportunities around nutrient recycling
- Improve policy coherence concerning nutrient recycling in the Baltic Sea Region

Focusing on Target Groups for Nutrient recycling (NR)

TG1	End –users of recycled nutrients, includes farmers and farmer organizations, advisors
TG2	Industry and municipalities that will conduct NR and the production of recycled nutrient fertilizers
TG3	National and Regional Authorities

CiNURGi Best Nutrient Recycling Award

CIRCULAR NUTRIENTS FOR A SUSTAINABLE BALTIC SEA REGION

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This **#MadeWithInterreg** project helps drive the transition to a green and resilient Baltic Sea Region.

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FERTITEC

INNOVATIVE RECOVERY TECHNIQUES FOR ALTERNATIVE FERTILISERS

FERTITEC in brief

Ida Sylwan & Teresa Kalisky

RISE – Research Institutes of Sweden

28 April 2026 | ESNI-NERM Conference

PARTNERS

RISE Research Institutes of Sweden · Q-PLAN INTERNATIONAL · CETENMA Centro Tecnológico de la Energía y del Medio Ambiente · Luke Luonnonvarakeskus · IUNG · AgroApps · EAFF

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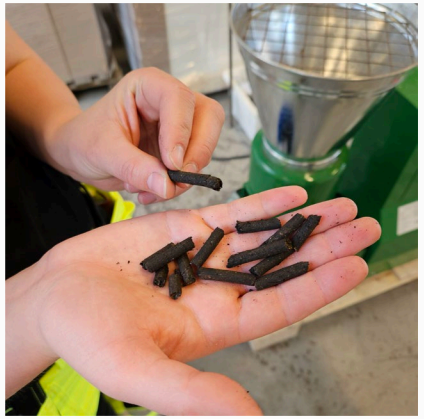

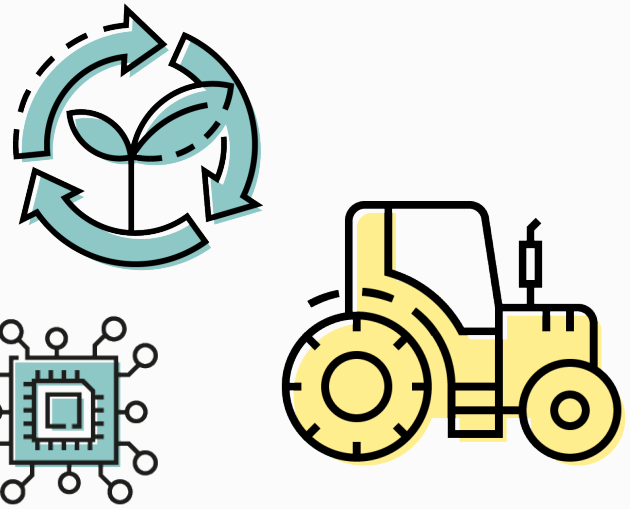

- ✓ Transform waste into high-quality fertilisers
- ✓ Promote biobased fertilisers that are environmentally sustainable and economically viabile
- ✓ Apply a community-driven approach, with ambition to live on after the project ends:
  - Online **expert panel** and **stakeholder forum**
  - Customised recommendations for the adoption of alternative fertilising products - **EcoFerti tool**
  - **Europe – Africa** collaboration

FERTITEC
INNOVATIVE RECOVERY TECHNIQUES FOR ALTERNATIVE FERTILISERS

Join our expert panel:

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Sterre van der Voort, BTG

Project co-coordinator

28 April 2026

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About

Horizon Europe project

January 2025 to December 2027

Coordination by

BTG Biomass Technology Group BV (NL)

with **8 partners across 7 countries**

Aim

FertiCovery aims to **remove barriers** and **promote nutrient recovery and bio-based fertilisers** from secondary raw materials such as biowaste, manure, and wastewater.

The project

FertiCovery has created a **longlist of >75 case studies** highlighting existing installations that transform secondary raw materials into alternative fertilising products across Europe and globally.

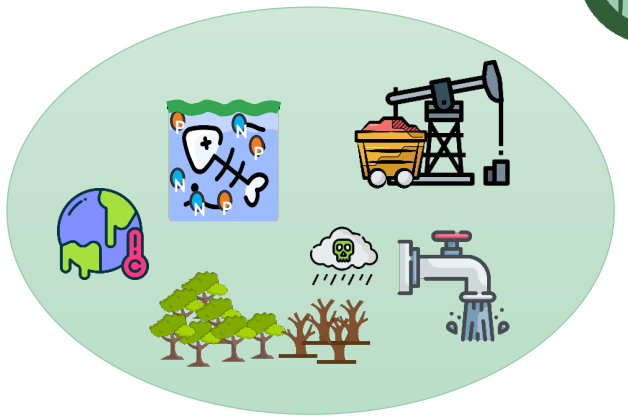
The project will provide a comprehensive **analysis of 25 nutrient recovery and bio-based fertiliser case studies**, detailing their feedstocks, value chains, products, and applications.

FertiCovery will develop **a multicriteria decision analysis report** and **datasheets showcasing the 10-15 most effective technologies.**

Active engagement with European and international stakeholders is implemented through **5 workshops and 6 open forum events**, fostering collaboration across the entire supply chain.

Analysis of 25 case studies

- Technical assessment
- Environmental assessment
- Product Evaluation
- Market and Replication Potential
- Social Risks
- Feedstock analysis



Germination Tests (OECD 208)
Phytotoxicity on Maize & Wheat. — 14 Days

Leaching Analysis
Nutrient release in water environments. — 24 Hours + Modelling

Pot Tests
Long-term growth analysis. — 5 MONTHS

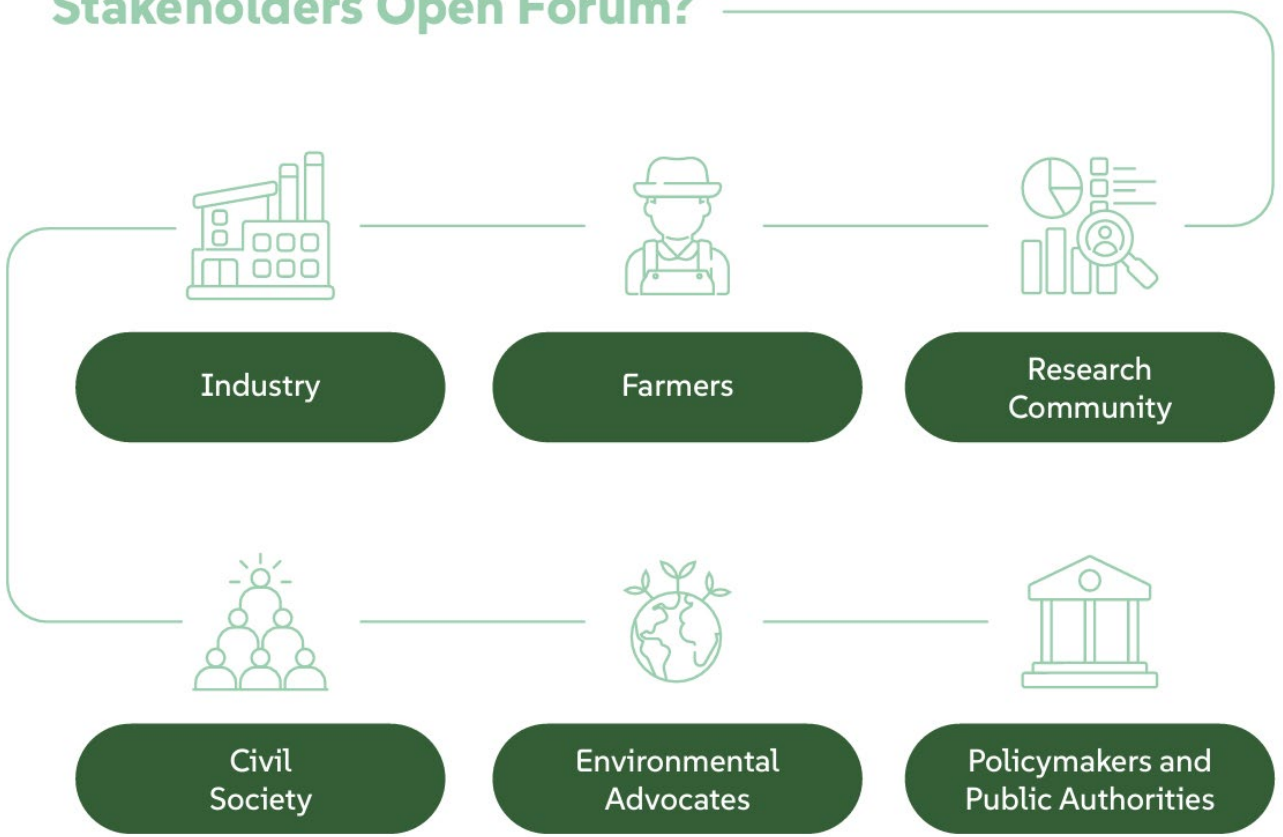
Critical Constraint: Biological growth cycles are fixed and cannot be accelerated.

Join our Open Forum of Stakeholders

The Open Forum focusing on "**bio-based fertiliser production and application**" allows for **discussions** and **validation** of the FertiCovery results and insights

Forum of Stakeholders

Who can join the Stakeholders Open Forum?



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Join our Open Forum of Stakeholders!

Forum of Stakeholders

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Potential for nutrient recycling

ESNI-NERM Conference, Brussels, April 28, 2026

Sari Luostarinen
Natural Resources Institute Finland

Luke NATURAL RESOURCES INSTITUTE FINLAND

https://interreg-baltic.eu/project/cinurgi

Information on the potential of nutrient recycling is the basis of planning measures to implement it.

D1.1: Maps of regional nutrient recycling potential, current practices, and bottlenecks

Luke
NATURAL RESOURCES INSTITUTE FINLAND

Potential for nutrient recycling
- Produced biomasses (amount, N, P content)
- Spatial distribution

Nutrient surplus/deficit areas
- Fertilization need
  - Fertilization limits, soil nutrient status, cultivated crops

Current status
- Current processing of biomasses, recycling/reuse technologies and practices already in use

Identification of bottlenecks & draft NR strategy
- Target groups involved to facilitate discussion

https://urn.fi/URN:ISBN:978-952-419-128-9

https://zenodo.org/records/17483354

Databases:

- Eurostat-based data: https://zenodo.org/records/17288096
- National data: https://zenodo.org/records/17287851

Project website:

https://interreg-baltic.eu/project-pilots/state-of-nutrient-recycling-and-its-potential-in-the-baltic-sea-region/

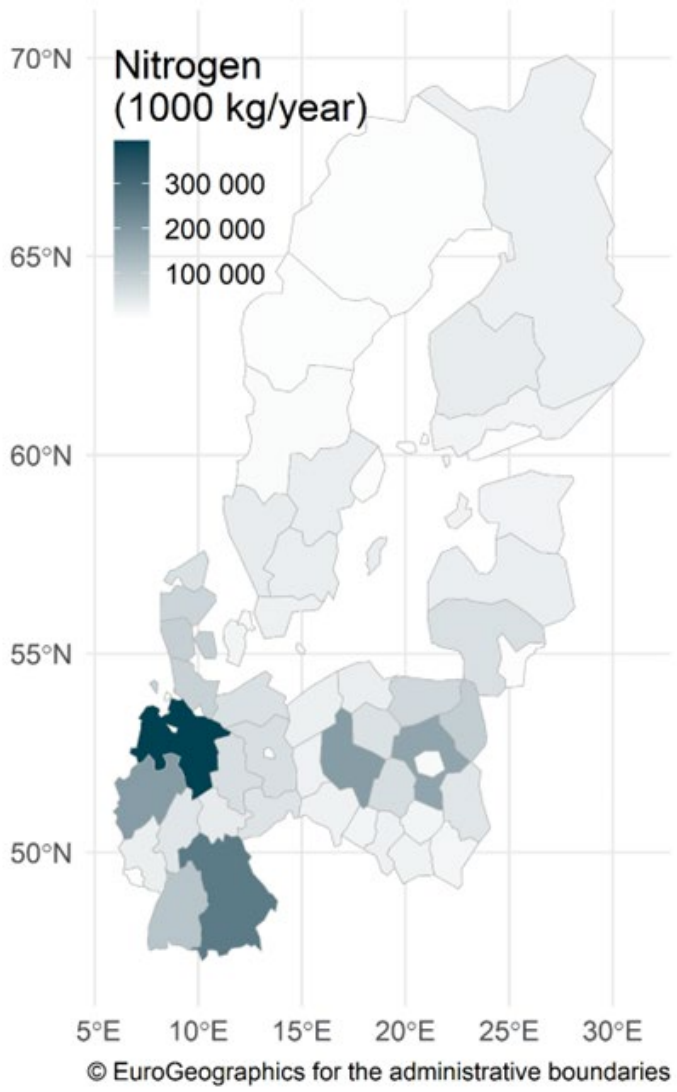
Nutrient recycling potential in the Baltic Sea Region (Eurostat)

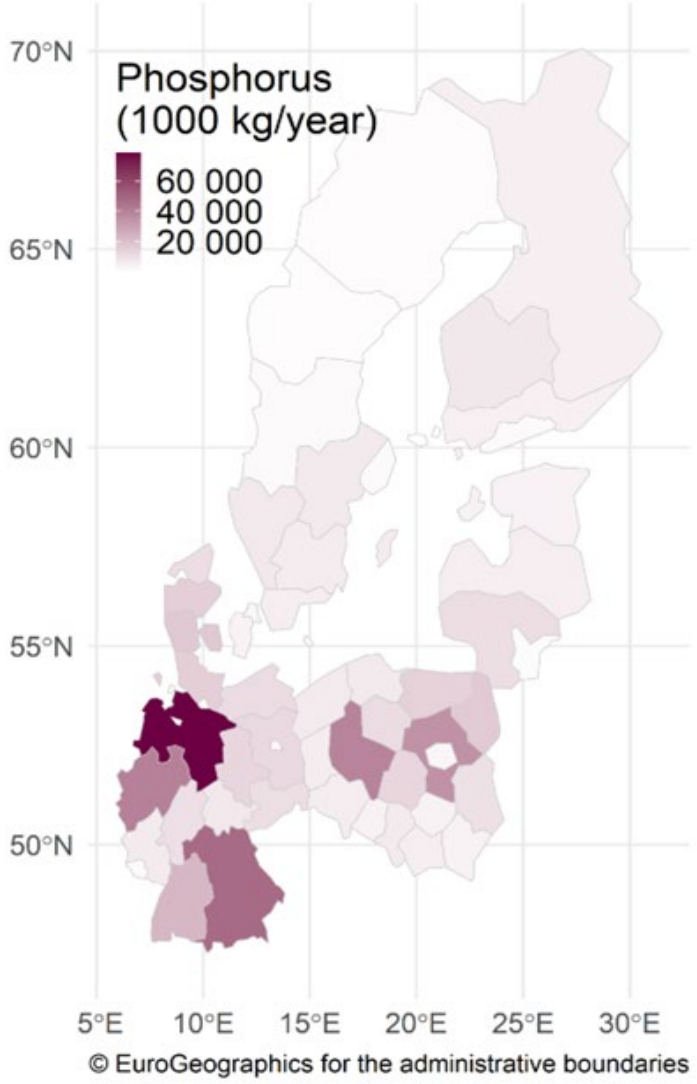
Country	Livestock manure + Sewage sludge + Municipal biowaste + Animal by-products	
	Nitrogen (t/a)	Phosphorus (t/a)
Finland	92,052	19,442
Estonia	22,554	4,065
Latvia	33,603	5,600
Lithuania	65,239	11,800
Poland	982,971	201,247
Denmark	266,742	51,353
Germany	1,477,077	292,365
Sweden	153,145	31,086
Total for the Baltic Sea Region	**3,093,383**	**616,958**

89% of N and 81% of P in manure

Method:
Data on amounts and location of biomasses based on Eurostat data and nutrient co-efficients from literature

Spatial distribution of nutrient recycling potential (Eurostat)

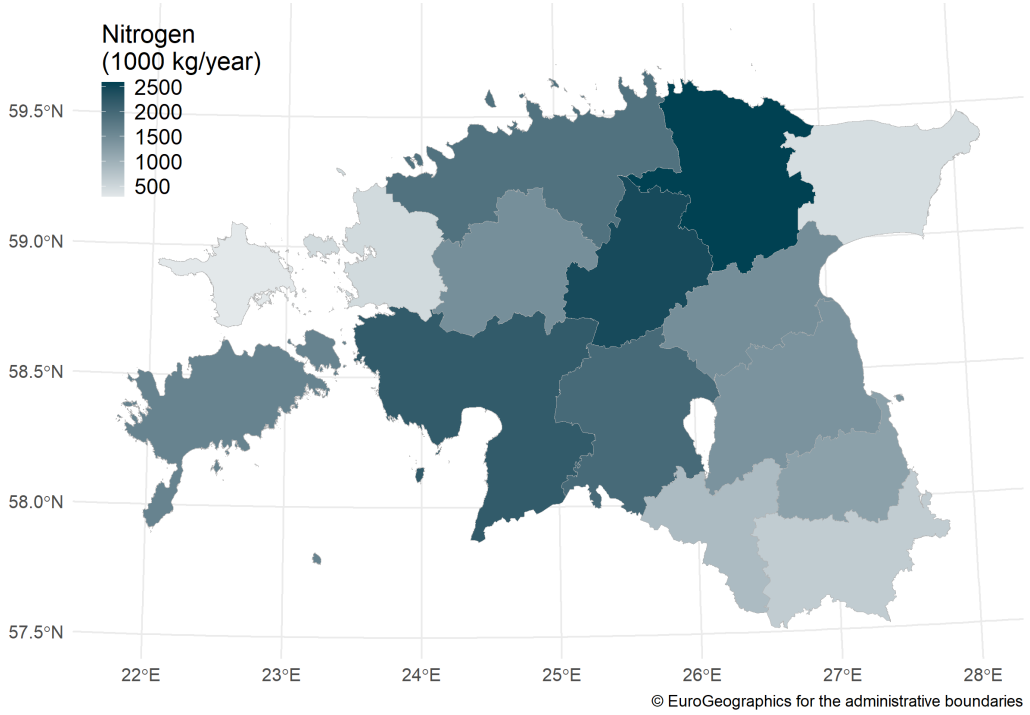


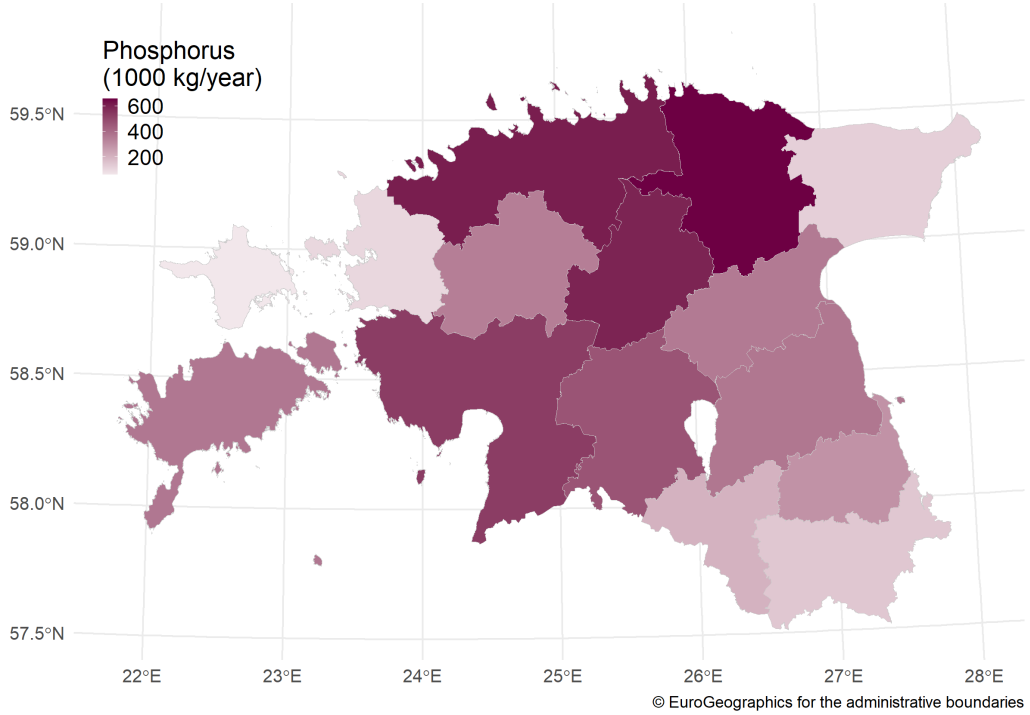


Nitrogen and phosphorus summed for livestock manure, sewage sludge and municipal biowaste in the Baltic Sea Region (animal by-products were also estimated).

Improved spatial distribution via national data sources

Example: Estonia





Recyclable nutrients per hectare of utilized agricultural land

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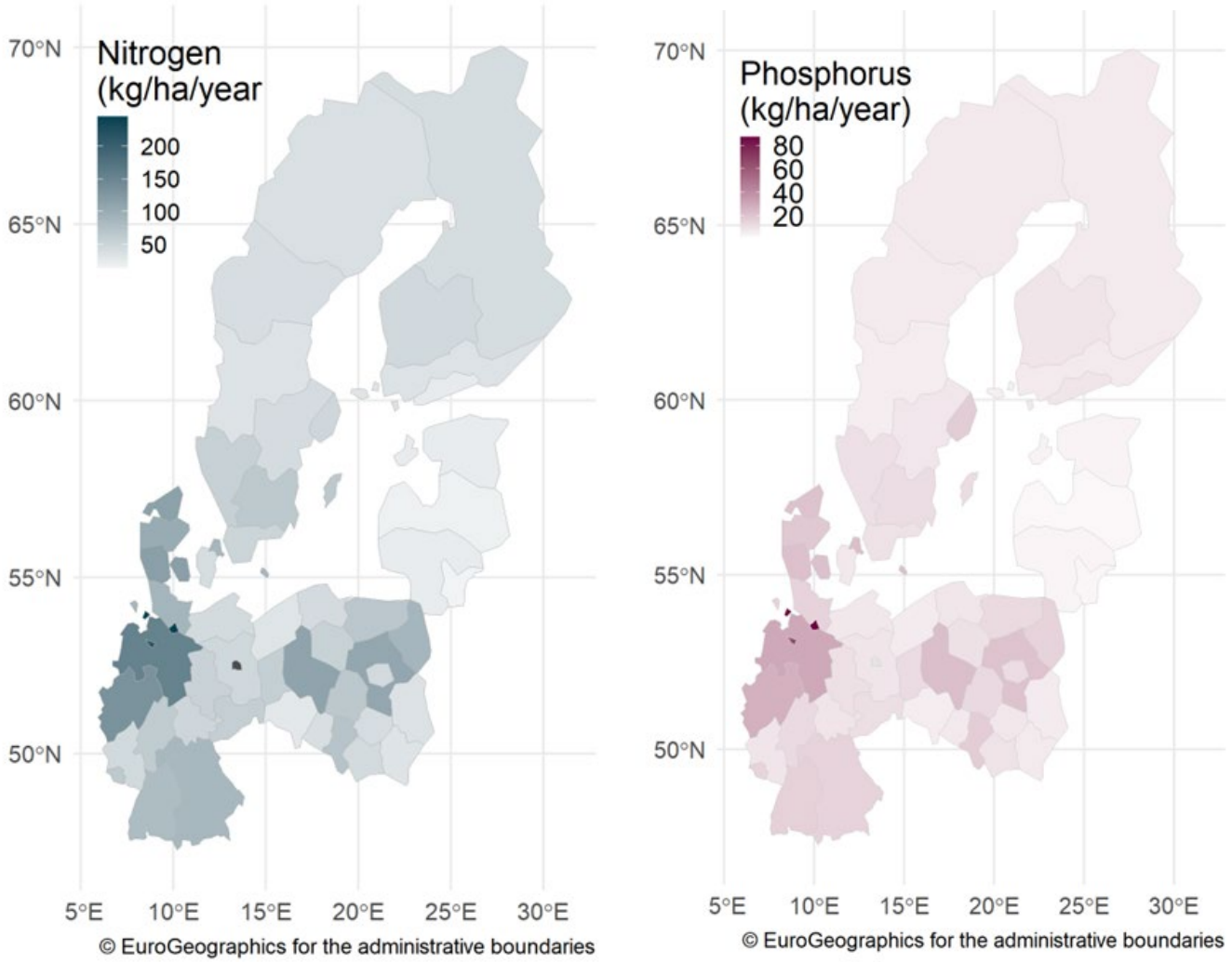
To improve the analysis, data on fertilization need should be coupled with data on recyclable nutrients.

A simple comparison to identify potential regions of nutrient surplus and deficit, however:

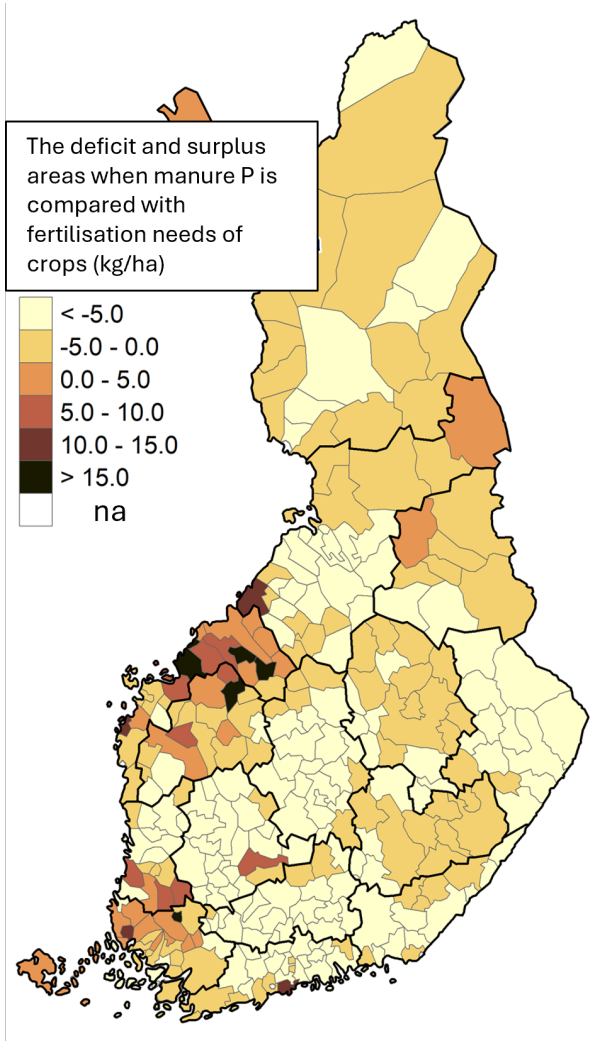
- It does not consider actual fertilization need, including the plants produced and the nutrients retained in soil.
- Thus, it underestimates the situation.



Example: a more detailed comparison between available P and P fertilization need

- **If a more detailed comparison is to be made, data requirements are significantly larger and also the spatial resolution should be quite precise**
  - Amount of nutrients in recyclable biomasses
  - Plants produced
  - Field area
  - Nutrient content in field soils
  - Fertilization limits, e.g. according to crop need

- Finnish example of manure phosphorus vs. P fertilization need per municipality (Lemola et al. 2023)



https://urn.fi/URN:ISBN:978-952-380-612-2

Recommendation:
Establish monitoring of nutrient recycling potential and implementation

- Develop a joint method to collect and present data to enable comparison. The method should include consideration national differences in data availability (e.g., a tier-approach).
- Designate responsible national organization(s) to collect the data on nutrient recycling potential and its status.
- Ensure required resources for regular monitoring and publication of results.
- Improve data availability for the monitoring as part of other data collections already existing.
- Ensure possibility to improve the monitoring methods and data exchange in an internationally equal level.

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Thank you!

More information:

https://interreg-baltic.eu/project/cinurgi/

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This #MadeWithInterreg project supports actions that facilitate the shift from linear to circular resource use.

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State-of-the-art

of bio-based fertiliser production technologies

Sterre van der Voort

BTG Biomass Technology Group BV

28 April 2026

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The bio-based fertiliser landscape

Wide range of feedstocks, technologies and products

Feedstocks

Manure

Biowaste

Waste water / sewage sludge

Urine

Woody biomass

Other solid biomass

Conversion pathways

Physical

Biological

Chemical

Thermal

Products

Compost

Digestate

Ammonium nitrate/sulphate

Organo-mineral fertilisers

Struvite

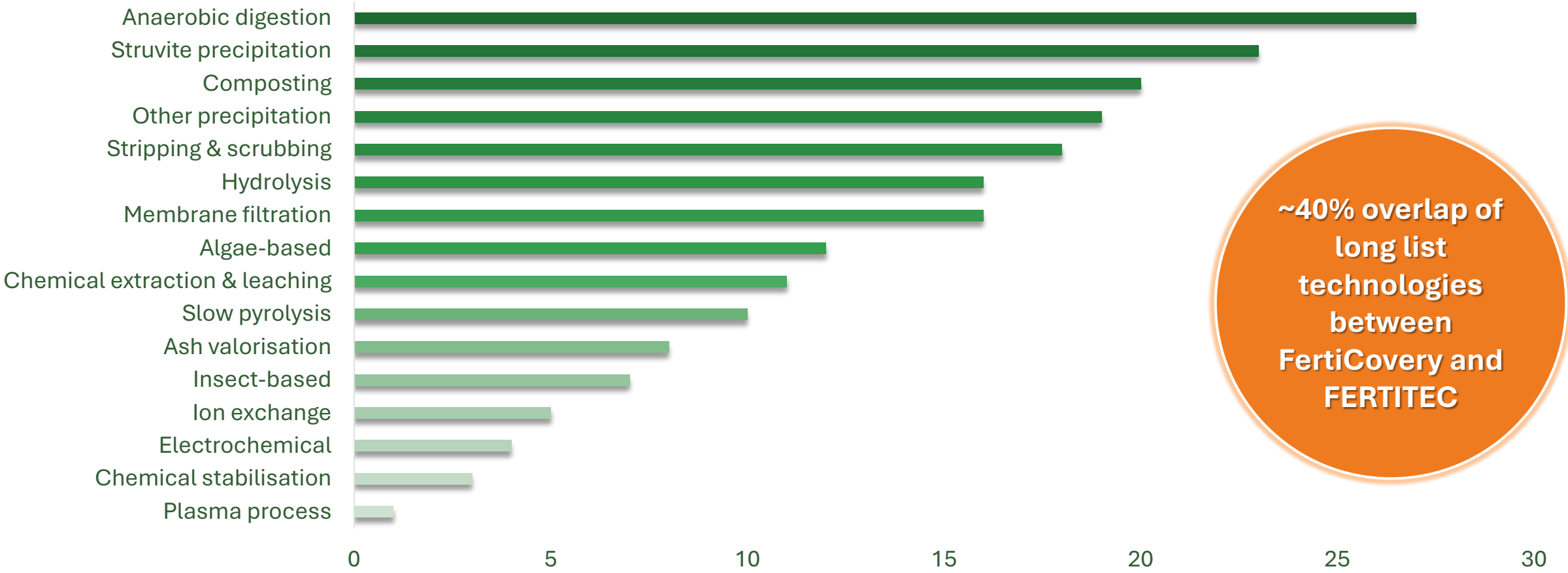
Biochar/hydrochar

3 projects each gathering data to identify opportunities and barriers for several value chains

Conversion pathways

Identified bio-based fertiliser production technologies

Landscape → Screening → Representative cases



~40% overlap of long list technologies between FertiCovery and FERTITEC

Technology Selection Criteria

From Longlist to Shortlist

Landscape → **Screening** → Representative cases

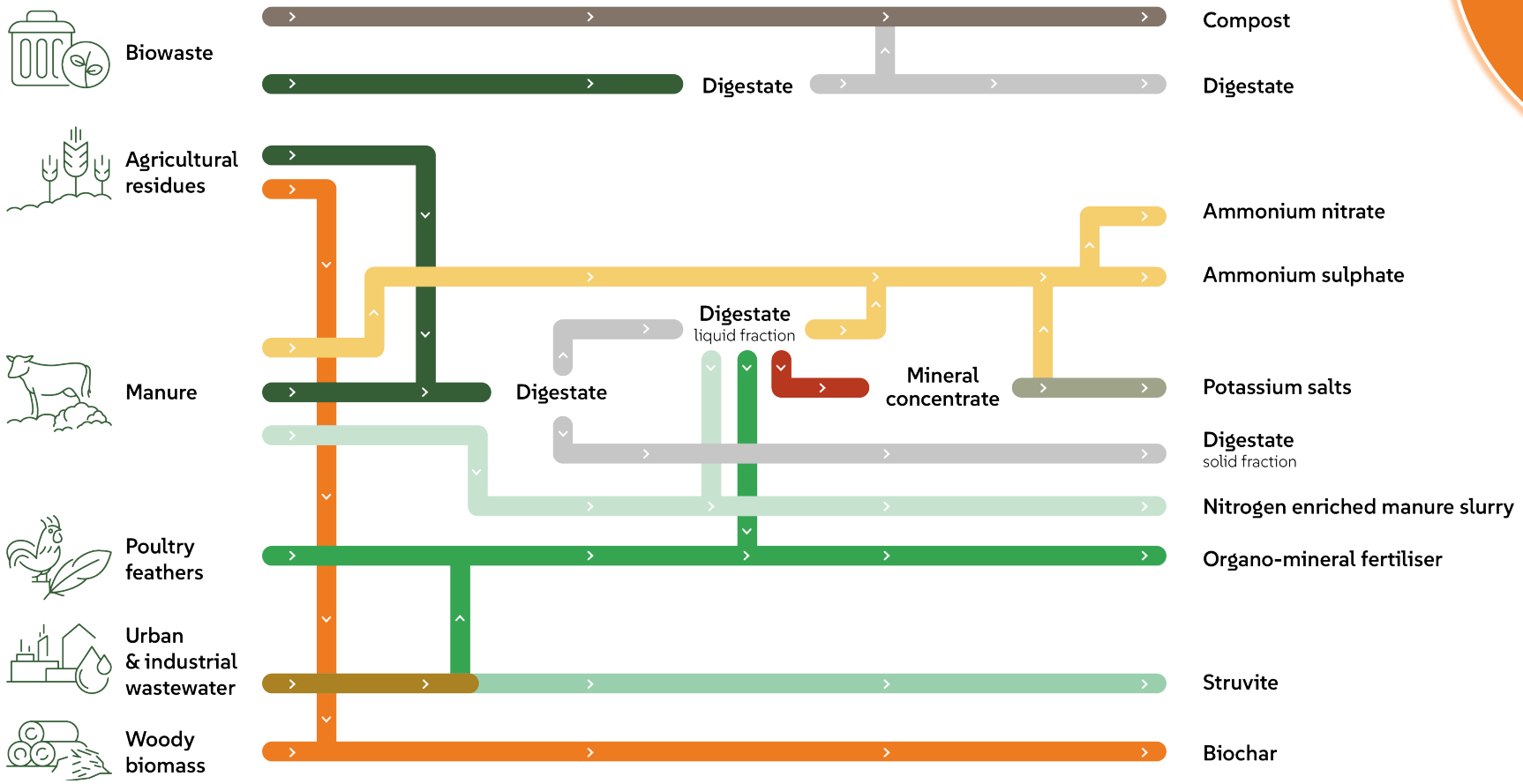
> 45 different value chains will be assessed by the projects

- **Value chain distribution across EU**
- **Technological maturity (scale, TRL)**
- **Applicability of technology and products**
- **Data availability**

Value chains

Matching technology to context

Landscape → Screening → Representative cases



No single technology dominates but solutions available for most situations

- Stripping and scrubbing
- Membrane filtration
- Evaporation
- Plasma process
- Hydrolysis
- Wastewater treatment
- Precipitation
- Slow pyrolysis

Opportunities for bio-based fertilisers

The case of struvite production: large untapped potential

Landscape → Screening → Representative cases

Many mature technologies available, but not widely deployed

Struvite

10.9
ktonnes
Current production

→ **28x**
growth potential

310
ktonnes
Total EU potential

Source: FertiCovery D5.2

Key takeaways & next steps

Technologies ready

Mature technologies available for a range of feedstocks and products

Feedstock available

Wide availability of feedstocks across EU

Market crucial for deployment

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Scaling Circular Nutrient Solutions: From Regional Innovation to European Best Practice

Market development, bottlenecks & barriers

ESNI-NERM Conference 2026, Brussels | 28 April 2026

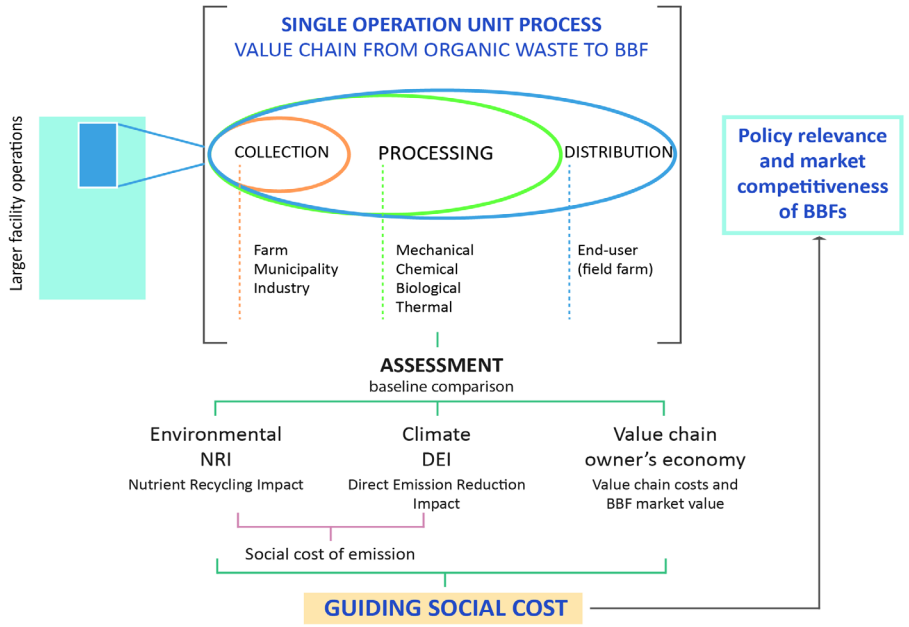
Henning Lyngsø Foged, Organe Institute (ORGANE)

interreg-baltic.eu/project/cinurgi

The research

Setting the scene

- To understand the market, we **analysed 11 value chains** (selected out of 24, identified via a call) for production of Bio-Based Fertilisers (BBFs) from organic wastes from farming, industry or municipalities. The value chain scope was confined to collection, processing and distribution. Evaluation happened in line with that after a Single Operation Unit Process (SOUP) methodology, having NRI, DEI and GSC as key indicators.



Results:

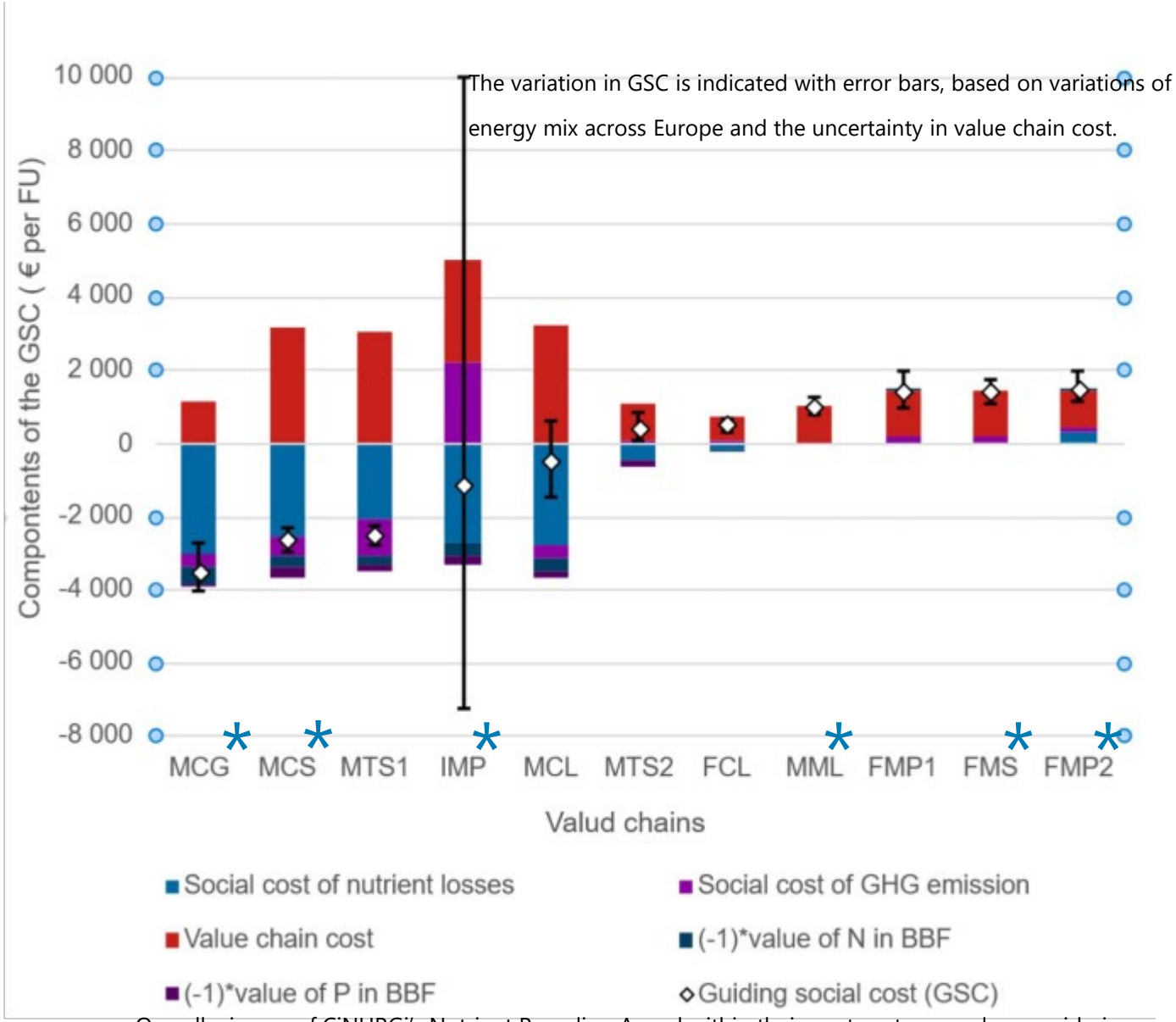
- *Foged, H. L., Sylwan, I., & de Morais Lima, P. (2026).: Identification and Assessment of Innovative Nutrient Recycling Solutions: Environmental, Climate, and Economic Performance. Technical Report. https://doi.org/10.5281/zenodo.18628679*
- *Priscila D. Lima, Ida Sylwan, Oksana Valetska, Henning Foged (2026) Bio-based fertiliser – custom-made method for evaluation of its production; environment, climate and overarching economic performance. Frontiers in Environmental Economics, section Resource Economics 5:1805879. https://doi.org/10.3389/frevc.2026.1805879*
- *Foged, H. L., Sylwan, I., de Morais Lima, P., Virtanen, E., Laakso, J., Valetska, O., Sarvi, M., Brown Stummann, C., Virolainen Hynnä, A., & Witorożec-Piechnik, A. (2026).: Market Evaluation and Review of Policy Affecting Nutrient Recycling. https://doi.org/10.5281/zenodo.18628997*

Socio-economy

Modest BBF value

Digging deep into the real cases has been an eye-opener; whereas others have concluded that farmers are unwilling to pay as much for BBFs as for mineral fertilisers (e.g. Moshkin et al., 2023), high production costs of BBFs (e.g. Hermann and Hermann, 2021)), and that environmental impacts vary between BBFs (e.g. Rashid et al., 2025), we found in addition

- a **modest socio-economic value of bio-based fertiliser production;**
- The **highest socio-economic benefits related with municipal organic wastes** (wastewater);
- A very marginal climate impact, whereas the socio-economic **most important factor is nutrient recycling / the avoidance of nutrient losses**
- **Moving nutrients (in specific P) in farm wastes via BBF production (mechanical separation is a key technology) is cheap as** also demonstrated by Arate et al. (2022)
- **Market competitiveness of BBFs almost non-existing**



* Overall winners of CiNURGi's Nutrient Recycling Award within their waste category, also considering market potential, farmer valuation and policy aspects.

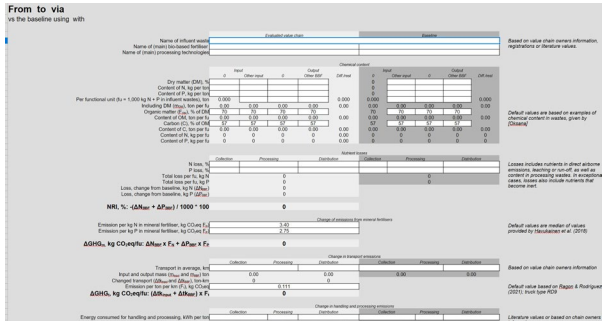
Turning organic wastes into BBFs

High impacts variability

The value of BBF production depends on the value chain configuration, baseline and local context. The market competitiveness of BBFs remains limited, while more than half of the analysed value chains are justified from a socio-economic perspective. BBF production proves most viable in cases where the alternative treatment of the nutrient-rich organic waste would be disposal without nutrient recycling such as incineration.

- No general statements about the environmental, climate or economic impacts of BBF production can be given.
- General policy support for the BBF market cannot be recommended since it would also sustain solutions with negative impacts for the society.
- We need to be able to identify the socio-economic beneficial value chains, and we developed a method for that, made it available in **a BBFevaluationTOOL, easy and simple to use**.

Foged, H. L., Sylwan, I., & de Morais Lima, P. (2026). BBF evaluation tool (Final Version 2026). Zenodo. https://doi.org/10.5281/zenodo.18628819

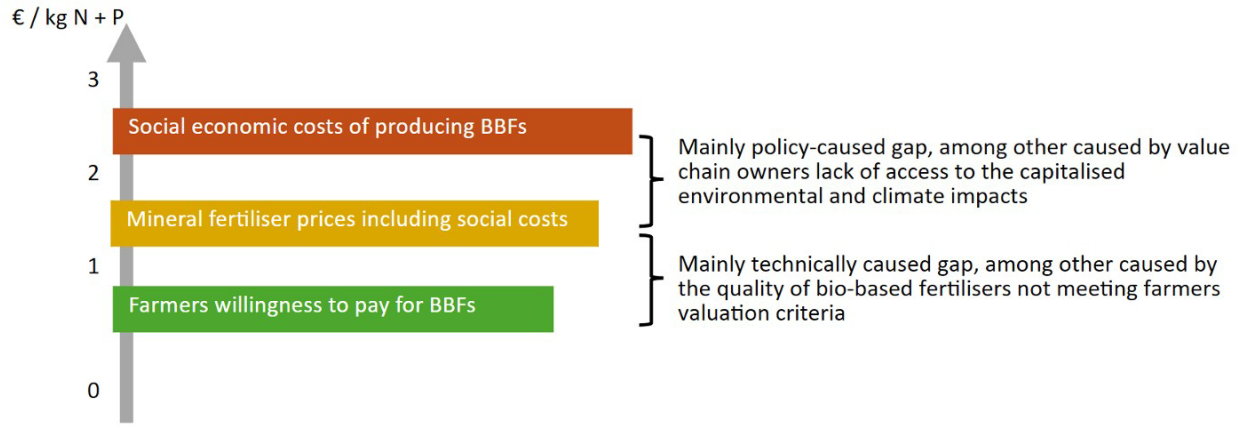


BBF value chain assessments

Farmers unwilling to pay for BBFs

BBFs do not meet farmer valuation criteria

- It is **important that research develop better BBFs**, ie identify ways to convert nutrient rich organic wastes in a more efficient way, causing less process loss of nutrients and less process energy consumption, while matching crop farmers valuation of bio-based fertiliser much better than now.
- Among top-priorities for crop farmers are
  - Fertilising effect (readily available N and P nutrients (water soluble/extractable nutrients);
  - Nutrient concentration;
  - Ease of handling
  - Low risk
  - …
- Remember the wise saying “The customer is always right”!



Ecosystem services from BBFs

It has a considerable value

- **Realising healthy BBF markets also require political will to revert societal values of ecosystems services to the BBF value chain operators** - the mechanisms are already part of the EU CAP.
- However, consequently, it seems logic that effective policies in the same time should penalise nutrient-rich organic waste processing that leads to pollution of the air and water with nitrogen, loss of phosphorus and conversion of organic matter to greenhouse gases. These processing methods, counterproductive to recycling goals are especially those based on thermal processing (incineration, pyrolysis), oxidative processing (nitrification-denitrification, composting, aeration), that generally are meant for getting rid of nutrients and making the waste "stable".
- Socio-economic impact elements of BBF production comprise
  - Value of Direct Emission Impact
  - Value of Nutrient Recycling Impact
  - Value of domestic fertiliser production
- We assessed the socio-economic value of BBF production as shown to the right - it is not easy for politicians to navigate in!
- **Reverting the socio-economic value of BBF production to the value-chain operations via subsidisation would increase the number of market competitive cases from two out of 11 to six out of 11.**

Based on 11 analysed value chains for BBF production, the socio-economic value of impacts on climate emission, nutrient recycling and domestic fertiliser production was assessed per kg N + P as:

- *Averagely €1.11*
- *Minimum € 0.09*
- *Maximum € 6.67*

Terminological bottlenecks

Nothing can be achieved before you agree what should be subject to change

Nutrient-rich organic waste

Bio-based fertiliser

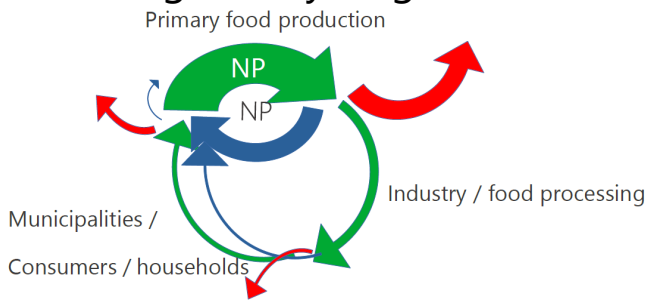
Soil improver

Nutrient Recycling Fertiliser

Nutrient-poor organic waste

Would a revised definition of some waste types be relevant for removing unjust end-of-waste criteria bottlenecks?

- Our CiNURGi project showed that there is a great confusion about the meaning of these words.
- Effective research and policies cannot be made before clear definitions are established.
- A major misunderstanding is that EUs Fertilising Products Regulation (EU/2019/1009) shall be a reference for such definition – but its purpose is alone to regulate, what is brought to the market.
- Another major misunderstanding is that all products mentioned in the FRP are fertilisers – read the preamble.
- Even the meaning of recycling seems to cause problems



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