

Position paper

Circular bioeconomy: tools for resilient primary production and security of supply with added value

Johanna Buchert, Antti Asikainen, Johanna Kohl, Jani Lehto, Kari Ylivainio, Tuula Jyske, Kimmo Rasa, Mika Mustonen

The COVID-pandemic and the recent changes in the global geopolitics have drastically increased the importance of security of supply to ensure the functionality of our societies in Europe. Improving the security of supply, especially in terms of raw materials and inputs for energy and food, needs both immediate actions and longer-term planning.

Production of energy and food has been strongly dependent on availability of fossil energy. It's time for change. Luke with its European partners provides research-based solutions for the wise, resource-efficient and sustainable production and valorisation of renewable raw materials and waste. Our goal is to optimize nutrient cycles, make resource-efficient use of bio-based main and side streams, and underutilized biomasses, and ensure a just transition from linear to circular bioeconomy.

Luke contributes to the EU Circular Economy Action plan by 3 key messages:

- 1. Bio-based fertilizers can significantly improve food security**
- 2. Biomasses and their sidestreams can be valorised to added value products**
- 3. Diversity provides resilience and security to energy systems**



CASE BOX: At the EU level, H2020 project LEX4BIO (lex4bio.eu) provides information for efficient utilization of both nitrogen and phosphorus based BBFs, while ensuring food and feed safety, human health and environmental protection (Fig. 1), in various growing and soil conditions across the EU.

Figure 1. Enhancing circular economy by improving utilization of nutrient-rich side-streams as bio-based fertilizers.

1 Biobased fertilizers can significantly improve food security

Food production is facing unprecedented crisis in a form of climate change and geopolitical tensions. Nutrient-rich side-streams can **replace** imported mineral fertilizers, increase soil carbon content, and improve self-sufficiency in food production in the EU. The dependence on Russian natural gas on nitrogen production could be partly replaced by **recycled fertilizers** in the EU.

Possibilities to replace finite mineral P with various bio-based fertilizers (BBF) is analyzed by mapping the regional sources of nutrient-rich biomasses together with knowledge on P fertilization requirements across the EU.

FUTURE ACTIVITIES

Security of Supply leap

By developing novel processing technologies for converting sidestreams into efficient fertilizers, by developing novel protein and fibre sources and thereby decreasing dependency e.g. on imported soya.

Replacing mineral N- and P-fertilizers

With bio-based fertilizers while ensuring agronomic efficiency, food and feed safety, human health and minimising environmental losses.

- Recycled fertilizers from sides-treams RDI programme and Action Plan
- Novel protein and fibre sources RDI programme and Action Plan
- Nitrogen and phosphorus EU roadmap
- Critical evaluation and dissemination Action Plan on recycled fertilizers: The carbon sequestration potential, GHG emissions, impact on nutrient leaching, contribution on soil fertility and biodiversity

Manure is the main nutrient-rich side stream in the EU, containing both N (Fig. 2) and P. Efficient utilization of manure-based nutrients, requires novel processing technologies (Fig. 3) for converting them into a more transportable form, providing means for producing site-specific bio-based fertilizers across the EU.

Figure 2. Available manure-based nitrogen in the EU (lex4bio.eu)

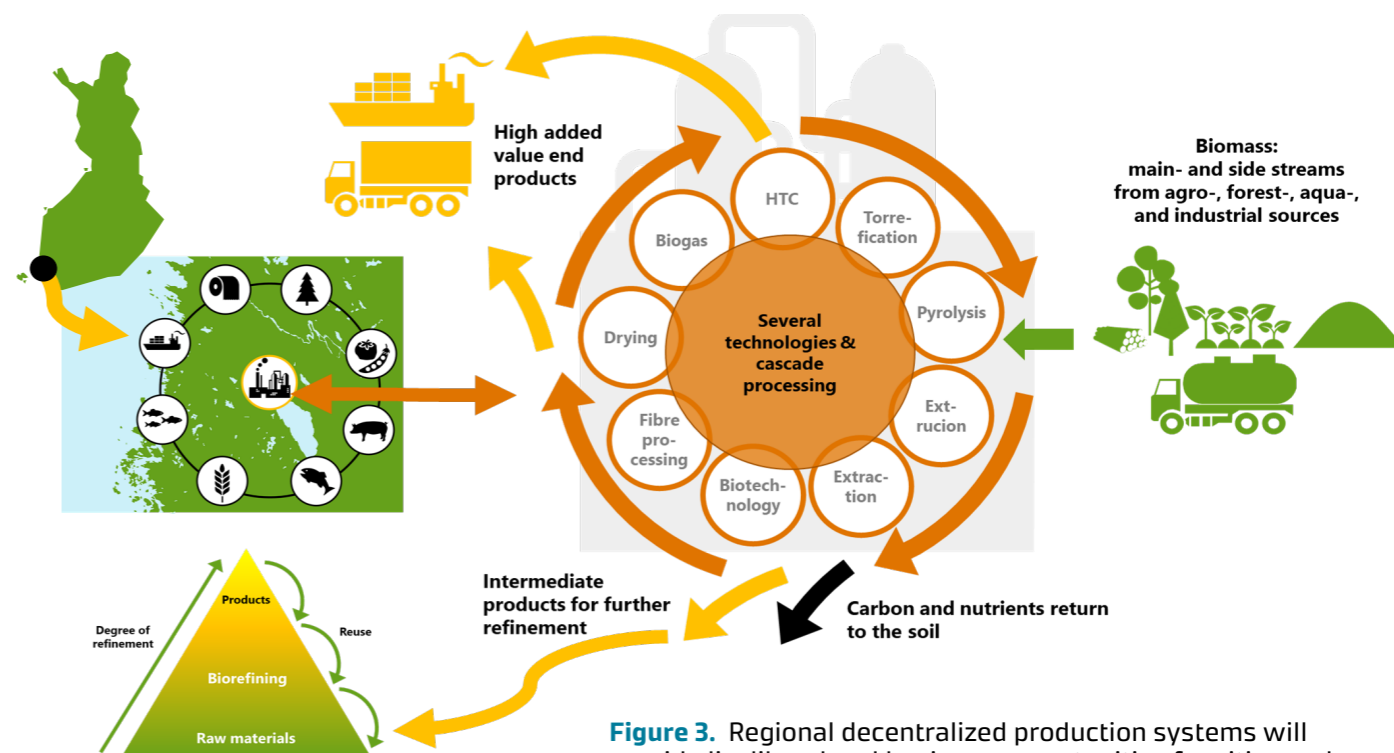
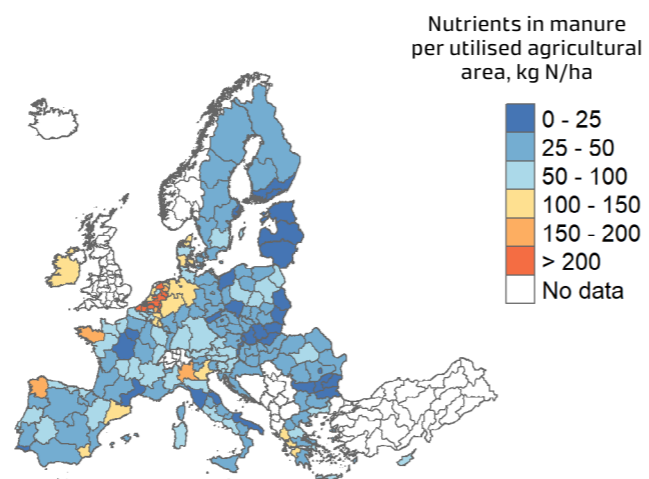


Figure 3. Regional decentralized production systems will provide livelihood and business opportunities for cities and rural communities. Comprehensive use of biomass can be achieved by cascade processing concepts.

2 Biomasses and their side streams can be valorised to added value products

Achieving the goals of Finland's bioeconomy strategy (50 billion EUR value by 2035) will require considerable investments on RDI for further refining and developing bio-based materials. **Cross-sectoral production chains and value networks** offer opportunity for new business (Fig. 3). Especially, RDI actions and change of mindset are needed in forest industry: **refocusing from bulk production towards refining lignocellulosic biomass into high added value products**, services, and business. New upgraded products utilizing all wood-based components (cellulose, lignin, hemicelluloses, components of bark and other industrial side-streams) are needed to increase our resource efficiency and add value for bioeconomy. The pace of change should be dramatic, considering the current level and volume of operations.

Regional activity is needed now. Various biomasses are accelerating the green transition by enabling regional production and new, cross-sectoral value networks (Fig. 3) to improve security of supply. The circular bioeconomy generates new innovations, products and businesses and thus also strengthens regional economies in the EU.

New decentralized and centralized production business models and logistics solutions for **underutilized** raw materials, as well as the wise and experimental utilization of main and secondary streams, require incentives from both the public and private sides.

FUTURE ACTIVITIES

Complex side-streams in use

From low hanging fruits towards utilization of complex biomass/ side stream sources – added value, energy, security of supply, and regional livelihood

- RDI programme: Complex sidestream sources - novel technologies and regional potentials in efficient use for high value products and recycled fertilizers.
- Policy action: beyond the sectors: integrate circular bioeconomy priorities within existing regulatory frameworks.

3

Diversity provides resilience and security to energy systems

Finnish energy production has become an example of versatile and **resilient** energy system, where bioenergy has a big role in its **flexibility and diversity**. The more energy system has volatile sources such as wind and solar, the more balancing capacity is needed. Hydropower has been traditionally used for balancing short-term fluctuations.

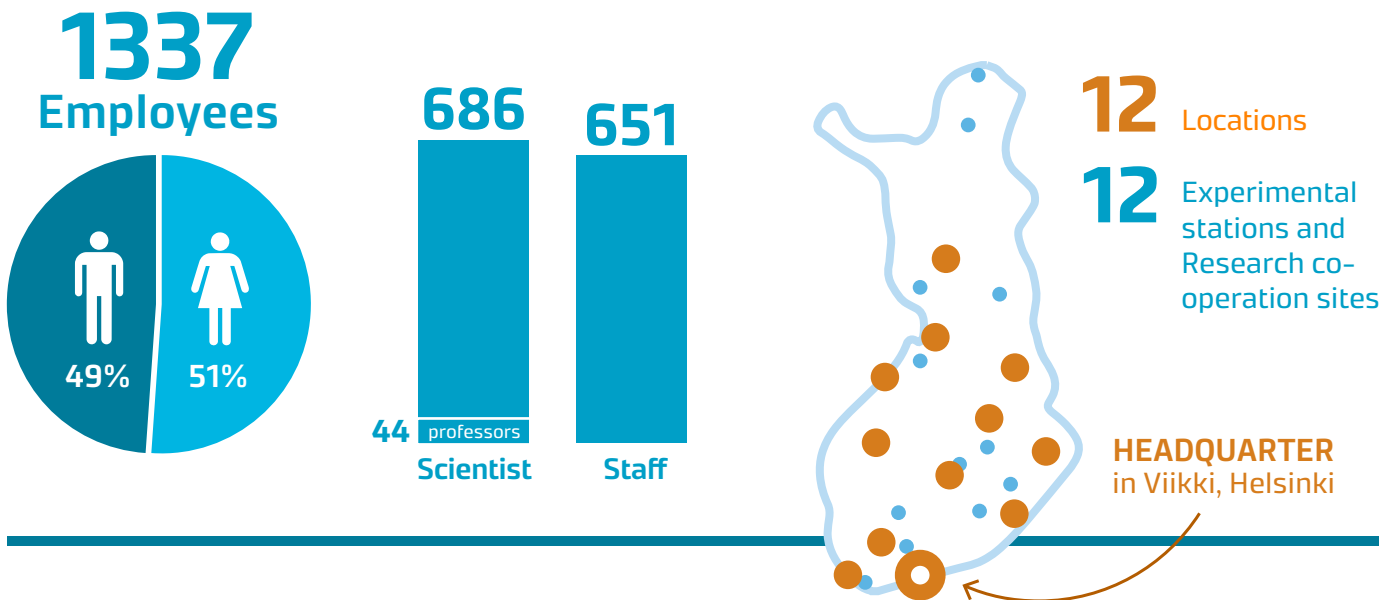
Bioenergy can even reduce consumption peaks e.g., on winter providing alternatives for houses mainly relying on electric heating. The **functionality** of bioenergy and its logistics chain in the EU must be maintained in the future. In the short term, decisions may have to be made (e.g., regarding the use of peat/coal) that conflict with long-term goals (e.g., combating climate change) due to the current geopolitical situation. Furthermore, industrial symbiosis provides ways to integrate biogenic carbon capture as green source for carbon (Fig. 3).

FUTURE ACTIVITIES

RePower by bioenergy and nitrogen economy

Develop decentralized energy systems based on renewable by-products and waste, incl. biogas, taking into account in particular the utilization of nutrient-containing by-products such as manure or urea. Utilisation of the biobased CO₂ for the hydrogen economy. Define the role of bioenergy in the flexible future energy systems

- Scaling up: Focus on piloting and industrial scale demonstrations
- Implementation plan: Functionality and acceptability of the bioenergy has to be secured in EU and national level policy processes and by increasing RDI efforts of the primary production



You can find us online

> **luke.fi**



Natural Resources Institute Finland (Luke), Headquarters:
 Latokartanonkaari 9, FI-00790 HELSINKI
 Phone: +358 29 532 6000

Luke Position Paper
 Circular bioeconomy: tools for resilient primary production and security of supply with added value

<http://urn.fi/URN:NBN:fi-fe2022091258371>