Cover Delivery Report

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How NUTRIENT RECYLING AND REUSE FOR AGRICULTURE is a crucial component of a circular economy and how policy makers can support it

AN INFORMATION SHEET FOR POLICY MAKERS

The globe today is facing a series of potentially catastrophic challenges that pose an existential threat to the world, including the EU – climate change, environmental degradation, and a growing population demanding ever more limited resources. In its flagship initiative Green Deal, the European Commission strives to set up a plan to transform the Union's economy into a modern, resource efficient and competitive economy which can meet these challenges head on.

Recovering and reusing nutrients from biowaste, manure and sewage sludge is a crucial component of a biobased circular economy and will contribute to Europe's transition to a carbon neutral economy, can support the decoupling of economic growth from fossil resource use, and help restore biodiversity and cut pollution.

Nitrogen, phosphorus and potassium are essential for plant growth. About 75% of all phosphorus used in fertilisers in the EU comes from mineral sources – mostly imported, and mined from non-renewable phosphorus rock; and 65% of nitrogen used in fertilisers is mineral nitrogen – produced through the Haber Bosch process, a process that consumes large amounts of fossil fuels such as natural gas[1]. These nutrients are added to the land for crops to grow, removed from the land in the harvest and then eventually converted into waste or excrements as they journey through the food system. The greatest nutrient surpluses occur in areas of concentrated livestock production (through manure) and in urban areas (in sewage sludge and food- and municipal wastes). Surpluses of animal manure lead to excessive use of nutrients – unless regulated - which is having severe adverse effects on soil, air and water quality. The majority of the nutrients accumulating in sewage sludge and biowaste are not being reused and this is threatening the long-term sustainability of EU agriculture. Their recovery to reuse in agriculture presents an enormous opportunity to contribute to the EU meeting the targets set out in its ambitious and much needed Green Deal.

At biogas plants across Europe, entrepreneurs are working with novel nutrient recovery technologies to recover nutrients from the digestate into tailormade fertilisers that farmers need to replace synthetic mineral fertilisers.. They are converting organic fibres to replace peat in potting soil and to produce biodegradable plant pots for use in the horticultural industries and are set to make an important contribution to meeting the EU's Renewable Energy Targets[2] through their production of biogas.

Policy makers have already recognised nutrient recovery from biowaste as a vital component of the circular economy, not least in the development of a Fertilising Products Regulation[3], the release of the RENURE study[4] for the Nitrates Directive, and the recognition of nutrient recovery in the Farm to

[1] https://risefoundation.eu/wp-content/uploads/2020/07/2016_RISE_NRR_Full_EN.pdf
[2] https://ec.europa.eu/energy/topics/renewable-energy/directive-targets-and-rules/renewable-energy-targets_en
[3] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32003R2003
[4] file:///C:/Users/ehler001/Downloads/jrc121636_pdf_version_safemanure.pdf

Fork Strategy[5] and the New Circular Economy Action Plan[6]. However, the full potential of nutrient recovery and reuse from our wastes and by-products will not be recognised until the products can compete on a level playing field with other (synthetic) fertilising products. Working with biowaste is complex and requires expensive technologies and, like in many industries in our linear economy, reusing materials often comes at a higher cost than developing products from virgin materials. The technology to recover nutrients from bio-waste is well developed and applicable at the industrial scale, as shown by the SYSTEMIC project. **But greater incentives are needed to stimulate the market for recovered nutrients in order to scale up the circular economy to reach the carbon-neutrality goal and other objectives of the Green Deal.**

The European Parliament and Council have recognised in their Fit for 55 package[7] the need to **revise and update EU legislation** and to put in place new initiatives with the aim of ensuring that EU policies are in line with the climate goals agreed by the Council and the European Parliament, including the revision of the EU Emissions Trading Scheme, an inclusion of greenhouse gas emissions and removals from land use, land change and forestry (LULUCF), and a revision of the renewable energy directive.

The aim of this paper is therefore to inform policy makers regarding both the policy barriers recognized with the SYSTEMIC project and possible policy opportunities which can be developed within the Green deal and Fit for 55 framework and beyond.

This paper covers three topics:

1. RENURE products
2. The EU Fertilisers Product Regulation (FPR)
3. The European Emission Trading System (EU ETS)

[5] https://ec.europa.eu/info/sites/default/files/communication-annex-farm-fork-green-deal_en.pdf
[6] https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1583933814386&uri=COM:2020:98:FIN
[7] https://www.consilium.europa.eu/en/policies/green-deal/eu-plan-for-a-green-transition/#

1. RENURE products

Both the use of manure, and products from manure, are regulated by the Nitrates Directive (91/676/EEC). This Directive aims to protect waters against pollution caused by nitrates from agricultural sources. Some regions are therefore designated as 'Nitrate Vulnerable Zones' (NVZ) where an application limit of 170 kg N of livestock manure/ha/year applies. As the nitrogen requirement of the crop may be higher than this application standard, the crops' additional nitrogen needs must be met with synthetic mineral fertilisers.

'Livestock manure' is defined as 'waste products excreted by livestock, even in processed form' (art. 2(g))[8]. So today, nitrogenous mineral fertilising products derived from manure are subjected to the same application limits as manure. They therefore compete with manure as a nitrogen source. As manure is abundantly available in regions with intensive livestock farming, farmers are unlikely to want to pay for recovered nutrients from manure when the recovered products are also restricted by the same application limit. This means that recovered nutrients still have to be transported over rather long distances to area's that are not designated as NVZ's and/or to area's with low manure production. This substantially reduces the potential to create added value for recovered nutrients. If farmers could use nutrients recovered from manure under the same conditions as synthetic fertilisers in NVZ, thereby removing them from the application standard of 170 kg N/ha/year, this could allow the nitrogen from manure to be used locally rather than transported over long distances. Overall, this could be a major boost for turning the current supply-driven market for manure products into a demand-driven market thereby reducing disposal costs for farmers and removing incentives for fraud.

The European Commission has recognised this barrier and the European Commission's Joint Research Centre has recently published the RENURE[9] report (Recovered Nitrogen from manURE) which proposes criteria to authorize manure-derived nitrogen fertilising products to be used above the application standard of 170 kg N/ha for manure set by the Nitrates Directive for NVZs. The criteria include a process definition[10] and quality criteria related to nitrogen (NH_4/TN ratio>90% **or** TOC/TN ratio <3.0 kg/kg) and maximum levels for zinc and copper.

Potential RENURE products include (but are not limited to):

- Ammonium salts from f.e. air washers and N strippers/scrubbers
- Concentrates from liquid fractions of manure obtained by reverse osmosis
- liquid fractions and concentrates after evaporation.

The SYSTEMIC project confirmed that both ammonium salts from stripping/scrubbing installations and reverse osmosis concentrates comply with RENURE criteria including the criteria for a minimum NH_4/TN ratio of 90% and a TOC/TN ratio<3.0.

[8] Nitrates Directive, article 2g. (g) 'livestock manure': means waste products excreted by livestock: or a mixture of litter and waste products excreted by livestock, even in processed form;

[9] SYSTEMIC contributed to the SAFEMANURE study which led into the RENURE report through the submission of product factsheets on Ammonium Sulphate, Ammonium Nitrate, Ammonium Water, Mineral concentrate and liquid fraction digestate, all of which can be found here.

[10] RENURE is obtained through a process where the handling chain for the manure(s) applied as input material involves a physical, chemical, or biological process step for the treatment of manure other than solely mixing, blending, drying, rewetting, granulation and/or storage, that increases the concentration of mineral N, urea N and/or crystal-bound N (% relative to total N) compared to the input material(s).

The SYSTEMIC project tested the agronomic efficiency of two types of ammonium salts and RO concentrates from co-digested manure and confirmed that the agronomic efficiency and their environmental effects were similar to synthetic N fertilizer. Hence, the use of these RENURE products will not enhance risks for nitrate leaching when subjected to the same application rate limits as synthetic N fertilizers.

The RENURE criteria as defined by the JRC use the condition 'TOC/TN<3.0 **or** NH_4/TN>90%' as quality criteria. The SYSTEMIC project showed that the TOC/TN criteria alone is no guarantee for a high NH_4/TN ratio. Examples are liquid fractions and concentrates after evaporation that do meet the TOC/TN criteria but have a NH_4/TN ratio that is substantially below 90%. (e.g. 60-70%). Such products are expected to have a lower agronomic efficiency as compared to products that do meet both quality criteria. It is therefore advised to strive towards production of RENURE fertilisers with a high percentage of mineral N in order to guarantee a high agronomic efficiency and low environmental losses.

Policy recommendations:

Based on the results of the SYSTEMIC project; the following recommentdations are given:

- SYSTEMIC project confirmed that RENURE products with a high NH_4/TN ratio can be used to replace synthetic N without increasing risks for nitrate leaching. SYSTEMIC therefore supports a rapid implementation of RENURE criteria in member states with NVZs.
- RENURE offers possibilities to reduce ammonia emissions from manure via the production of low-emission RENURE products such as acidic ammonium salts or nitrate-based N fertilisers. However, other RENURE products are susceptible to ammonia emissions and its large-scale use may have undesirable effects on N emissions in regions with intensive livestock farming that yet have to reduce N emissions. This calls for additional region-specific incentives to stimulate the production and use of low-emission RENURE fertilising products and low-emission application techniques.
- In regions were nitrate leaching from agricultural soils has to be lowered, additional measurements are to be taken to promote the use of N fertilisers with a high nitrogen fertiliser replacement values (NFRV) and reduce the use of untreated raw manure and/or increase legal NFRV's for raw manure.
- Production of RENURE fertilisers coincides with an increased production and use of solid fractions from manure. Solid fractions have a low NFRV, and may hence increase nitrate leaching, but are yet a source of organic carbon. Re-assessing and increasing legal NFRV for solid fractions from manure can be an effective and justified approach to control nitrate leaching under increased use of solid fractions.
- RENURE fertilising products may contain high levels of other macro- and micronutrients including sulphur (S) and potassium (K). SYSTEMIC asks for an obligation for producers of RENURE products to measure and report values of other macronutrients and to advice farmers on product-specific application rates in order to meet crop demand without causing excessive fertilisation of nutrients other than those being regulated by application rate limits.
- Blending of S-containing RENURE fertilisers with other organic fertilisers shall be discouraged as this increases risks for formation of toxic gases (H_2S) upon storage.

2. The EU Fertilising Products Regulation (EC/2019/1009)

Regulation of the European Parliament and of the Council laying down rules on the making available on the market of CE marked fertilising products and amending Regulations (EC) No 1069/2009 and (EC) No 1107/2009

On the 16th of July 2022, the EU Fertilising Products Regulation for free trade of fertilising products has come into force with the objective of placing secondary raw materials on the EU fertiliser market in order to better facilitate a circular nutrient economy. Whereas the previous EU fertiliser regulation 2003/2003[11] only regulated fertilisers from chemical (synthetic) origin for free trade, the new regulation also regulates fertilising products from animal and vegetative origin and thus provides an excellent regulatory tool for the free trade of fertilising products from renewable resources (including animal manure and products thereof) and potential access to important new markets. Free trade is particularly important for plants which operate near Member State borders who are currently forced into lengthy and costly bilateral negotiations to have their products approved in neighbouring Member States.

The fertilising products regulation lays out seven product function categories (PFC) (groups of fertilising products) which can only be produced from designated component material categories (CMC). Currently 15 CMCs are designated among which CMC 4 (fresh crop digestate) and CMC 5 (digestate other than fresh crop digestate) are relevant for biogas plant owners intending to market digestate and products thereof with other memberstates. There are however remaining barriers to overcome;

Ambiguity REACH registration for polymers used as additives needed for mechanical separation

It is common practice to separate digestate into solid fraction, liquid fraction or concentrates applying mechanical separation techniques. Solid and liquid fractions of digestate obtained through mechanical separating techniques are covered by CMC 4 and 5 including the 'additives needed for mechanical separation' under the conditions that the additives are REACH-registered including a safety report covering the use as a fertilising product. The most commonly used additives used for mechanical separation are flocculants and coagulants that typically contain polyacrylamide (PAM), i.e. a polymer, as main constituent. Polymers are yet exempted from REACH registration, only monomers need a REACH registration implying that polymers can – per definition – not comply. CMC1 excludes polymers as constituent of EC fertilisers however, an exception has now been made for 'biodegradable polymers' and 'water-soluble polymers'[12]. It remains however unclear whether this exception also applies when the polymer is used as an 'additive needed for mechanical separation' and whether this eliminates the need for a REACH registration of the polymer.

Polymers, mostly PAM, are widely used on biogas- and manure treatment plants to increase the efficiency of mechanical separation processes. Clarification on the use of PAM-based additives in CE fertilising products is therefore crucial as owners of digestate- and manure treatment plants are yet unsure about whether their solid- and liquid fractions can comply with criteria use as CE marked fertilising product. A clear statement on the conditions for use of polymers for mechanical separation will also give an impulse to industry to speed up research and development of environmentally safe polymers.

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[11] Regulation (EC) No 2003/2003 of the European Parliament and of the Council of 13 October 2003 relating to fertilisers https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32003R2003

[12] COMMISSION DELEGATED REGULATION (EU) 2021/1768 of 23 June 2021 amending, for the purpose of its adaptation to technical progress, Annexes I, II, III and IV to Regulation (EU) 2019/1009 of the European Parliament and of the Council laying down rules on the making available on the market of EU fertilising products. https://www.wb6cif.eu/wp-content/uploads/2021/10/CELEX_32021R1768_EN_TXT.pdf

Unclarities in the definition of 'biowaste'

The objective of the new EU fertilising product regulation is to enhance reuse of nutrients from waste streams and by products. CMC 3, 4 and 5 cover the use of 'biowaste within the meaning of Directive 2008/98/EC' in production of compost or digestate. Directive 2008/98/EC defines biowaste as;

"biodegradable garden and park waste, food and kitchen waste from households, offices, restaurants, wholesale, canteens, caterers and retail premises and comparable waste from food processing plants;"

This definition of biowaste however excludes several waste streams that are yet considered safe by member states and are hence already being processed in biogas plants. An example Flotation sludges from food industry and sludges from waste water treatments solely treating waste water from food industry.

- Sludges or solid fractions obtained by f.e. settling, flotation or filtration of process water from food industry as these waste streams qualify as sewage sludge following the definition of sludge in the sewage sludge directive (86/278/EEC).
- Sludge or solid fractions from waste water treatment plants solely treating process water from food industry as these qualify as sludge according to Directive 86/278/EEC.
- R**esidues from feed industry, as 'feed processing plants' are not included in the definition of bio-waste.**
- Other residues from food processing which are not 'comparable' to "biodegradable garden and park waste, food and kitchen waste from households,.."

The FPR intends to increase the reuse of nutrients from waste streams but it's narrow definition of 'bio-waste' may actually have an opposite effect as biogas plant owners may terminate the intake of safe waste streams in order to comply with the FPR or may choose to continue to trade and exporting their products under national regulations and bilateral agreements between member states.

Policy recommendations:

- SYSTEMIC asks the EC to solve the unambiguity about the obligation for a REACH registration for polymers (PAM-based) additives used in solid/liquid separation processes including the safety report covering use as a fertilising product.
- SYSTEMIC asks the EC to stimulate and subsidize research projects with the goal to develop biobased and fully-biodegradable alternatives for PAM-based additives used in solid/liquid separation processes.
- SYSTEMIC asks to reconsider the current definition of 'biowaste' avoiding the use of the ambiguous term 'comparable with' and including residues from food processing industry
- SYSTEMIC asks to create possibilities for use of other waste materials under CMC 3, 4 and 5 that are yet considered safe by national authorities but fall outside the definition of biowaste. This includes, but is not limited to, waste streams and sludges from food- and feed processing.

3. The European Emission Trading System (EU ETS)

Current natural gas and electricity prices make production of biomethane and biogas derived electricity highly profitable. The same holds true for biobased fertilisers, e.g. ammonium sulphate from biogas plants. Yet, this is not guaranteed for the future. Consequently, the EU ETS should be considered to provide additional and future proof incentives for nutrient recovery and reuse. Extending the EU ETS to farms is already widely discussed and may be proposed by the European Commission in the context of the Carbon Farming Initiative. It could also be applied to nutrient recovery and reuse in the following ways, thereby providing the much-needed financial incentive to promote an attractive and growing market for recovered nutrients.For the manufacturers of biobased fertilisers and tailor-made fertilising products

Through the production of pipeline grade biomethane by upgrading biogas. At natural gas market prices as of June 2022 (about € 130 MWh Dutch TTF), biomethane is highly competitive without any additional supporting incentives. In addition, waste derived biomethane can safe 2 kg fossil CO_2/m^3 methane and could therefore apply an equivalent carbon price for avoided emissions. As of June 2022 with CO2 traded at € 83/t in Europe, this would be an equivalent of € 0.16/m³. This approach, combined with a guaranteed bottom-line price in case gas and CO_2 tariffs returned to pre-2021 levels within the next decade could replace the current feed-in tariff system that varies per member state and was perceived as too expensive for consumers or taxpayers. A combination of market prices and ETS scheme-based incentives would be applicable EU wide and could provide a level playing field for biogas producers.

Nitrogen fertilisers produced through Haber Bosch process are responsible for the emission of 3 - 4 tonnes of CO_2 per 1 tonne of nitrogen. The production of a biobased nitrogen fertiliser produces less CO_2 than a conventional N fertiliser due to its use of residual heat, renewable electricity and, where available, secondary materials (e.g. gypsum from flue gas cleaning). The nett benefit in terms of CO_2 savings is however case-specific and dependent on the boundary conditions used for the calculation of the CO_2 emissions related to the N recovery process. Therefore, if producers of biobased fertilisers are able to prove a CO_2 reduction, they should be able to receive a payment for the saving of CO_2 emissions.

The farmers could receive a fee if digestate or manure (Nutrient Fertiliser Replacement Value (NFRV) of about 50%) is replaced by recovered nutrients with a high NFRV (which causes less losses to the environment, and therefore should rewarded). This could be based on the same calculation as for the producers of the biobased fertilisers. For every tonne of synthetic nitrogen fertiliser replaced by biobased nitrogen fertiliser they would get ½ the carbon price based on the evidence-based assumption that synthetic nitrogen fertiliser is twice as nutrient efficient as untreated manure.

For the fertiliser industry

The fertiliser industry is already a part of the ETS and in theory, has to buy carbon credits. However, we currently have a system whereby around 90% of industry credits are given for free, leaving little incentive to reduce emissions. If these 'free' credits are phased out as currently discussed and planned in the context of introducing the Carbon Border Adjustment Mechanism (CBAM), it will become increasingly advantageous for the fertiliser industry to buy in recovered N and P rich products to blend into their own fertilisers. Also, very high natural gas prices of € 130.00 (Dutch TTF) as of June 2022 which are not supposed to return to pre 2022 levels anytime in a foreseeable future make ammonia production and consequently N fertilisers expensive and biobased N products (like ammonium sulphate / ammonium nitrate) commercially attractive. This will boost the implementation of N recovery technologies and increase the supply of biobased N fertilisers most particularly due to recovery of N from communal waste water, from manure and from digestate without additional financial incentives provided legislators offer planning security.

Failing that, the second option would be to establish and incremental obligatory binding quota system for biobased ammonia in synthetic N fertilisers with clear targets. A similar approach could be applied as has been used for ethanol quotas in gasoline.

Policy recommendations:

To certify comparable CO_2 savings made through nutrient recovery and reuse as carbon credits in the EU ETS scheme, in particular:

- To farmers using biobased recovered fertilisers
- For the fertiliser industry to reduce its own carbon emissions through the inclusion of recovered nutrients in the production of its own fertilisers
- To the producers of biobased fertilisers both for a) for the production of biomethane as a renewable energy and b) rewarding the comparable CO_2 savings from producing biobased fertilisers compared to synthetic fertilisers and to untreated biowaste, manure and sewage sludge.

For more information on SYSTEMIC or questions concerning the recommendations please contact us:

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