European Sustainable Phosphorus Platform

SCOPE NEWSLETTER

Contents

This ESPP SCOPE Newsletter

This Newsletter summarises two ESPP one-day workshops, on

- *proposing **policies to support market uptake of recycled nutrients** (market pull policies)*
- *possible **phosphorus "reuse and recycling" rates** under the revised EU Urban Waste Water Treatment Directive (UWWTD)*

*For each of these, ESPP will **submit proposals to the European Commission** based on the relevant "ESPP outline for proposals" sections in this Newsletter. Comments and input on these are welcome to ESPP info@phosphorusplatform.eu*

*This 151st SCOPE Newsletter also summarises the **16th edition of the CRU "Phosphates" Conference,** the annual industry meeting place which is also the world's biggest non-hybrid conference on phosphorus, at which ESPP organised a panel on sustainable fertilisers.*

ESPP workshop: Market "Pull" policies for uptake of recycled nutrients

This one-day workshop organised by ESPP, 13th March 2024 (see also second workshop 14th March, below), with around 50 participants in Brussels plus 40 online, discussed possible policy tools to support market uptake of recovered nutrients.

The EU Circular Economy Action Plan (2020, see below) refers to "stimulating the markets for recovered nutrients", but to date no significant EU policies have been proposed to implement this.

Discussions at this workshop summarised below will be taken forward by ESPP by preparing, with participants and with ESPP members, a draft policy proposal document which will be opened to stakeholders for signature then submitted to the European Commission, Parliament, Council and Member States.

European Sustainable Phosphorus Platform

Context

Robert Van Spingelen, ESPP President, opened the meeting and **Chris Thornton, ESPP**, introduced some elements of context:

- **EU Green Deal** COM(2019)640 (page 8)
  "The Commission will consider legal requirements to boost the market of secondary raw materials with mandatory recycled content (for instance for packaging, vehicles, construction materials and batteries)."
- **EU Circular Economy Action Plan** COM(2020)98 (ch.3,7 "Food, water and nutrients")
  "the Commission will develop an Integrated Nutrient Management Plan, with a view to ensuring more sustainable application of nutrients and stimulating the markets for recovered nutrients."
- **Revised Urban Waste Water Treatment Directive** (pending ratification), preamble (38), LINK:
  "Member States should, while taking into account national and local valorisation options, take measures to encourage the production and purchasing of recovered nutrients from urban wastewater and sludge."
- **EU Critical Raw Materials Act 2024** (pending ratification), art. 26.1, LINK:
  "*increase the use of secondary critical raw materials including through measures such as taking recycled content into account in award criteria related to public procurement or financial incentives for the use of secondary critical raw materials*".

The challenge for **nutrient recycling is that it is often "not economic":** recovery of nutrients from waste streams can be more costly than primary fertilisers, because of small scale, contaminants and safety requirements, decentralised logistics. Environmental & social benefits are not monetarised, in particular primary resource savings, but also nutrient pollution abatement, soil preservation, local job creation.

The additional cost of nutrient recycling must therefore be covered the waste generator sector (water industry, farmers …), recycled nutrient users (e.g. fertilisers industry) and/or by public subsidies. Policies for nutrient recycling, such as regulatory recovery targets for waste streams (obliging recycling), recycled 'quotas' for users, subsidies, CAP conditionalities, etc., will define how the additional cost of nutrient recycling is shared between different industry sectors and stakeholders.

In parallel to economic or regulatory policies to support market uptake, it is also essential to **address regulatory obstacles and market friction**. Market friction instruments include: monitoring of nutrient flows and secondary resources; information and training for farmers, fertilisers distributors, agri-food chai, supermarkets, waste managers; workforce upskilling; labelling and nutrient footprint; standards, secondary nutrient trading structures …

Vision from agriculture

Stephanos Kirkagaslis, European Commission DG Agriculture, indicated that **the CAP (EU Common Agriculture Policy) includes tools which can support nutrient recovery and use of recycled nutrients**, reflecting the inclusion of the nutrient circular economy in EU policies: Green Deal, Circular Economy Action Plan, Critical Raw Materials, towards reducing fertilisers import dependency, ensuring food security.

Use by farmers of recycled nutrients, or on-farm nutrient recovery, is included in Specific Objective n°5 of the CAP (Sustainable Development, reduce chemical dependency, foster efficient natural resources management). Nutrient recycling can be subsidised by both pillars of the CAP: Pillar I, participation of farmers in Eco-Schemes and/or Sectoral Interventions; Pillar II via agri-environment climate commitments and green investments. Support is subject to conditionality provisions (SMR Statutory Management Requirements and Good Agro-Environmental Conditions).

However, CAP implementation is adapted and decided by Member States (national CAP Strategic Plans).

For example, so far, in their CAP Eco-Schemes, seven Member States promote replacing synthetic with organic fertilisers or building up soil organic carbon. Moreover, support can be available under rural development interventions. Stemming from SWOT analysis, Eco-Schemes and agri-environment management commitments are agricultural practices for the voluntary (subsidised) participation of farmers, reflecting national needs. It is the responsibility of Member States to identify priorities, such as nutrient recycling.

CAP rules include the obligation for Member States to provide "farm advisory services", which must cover sustainable management of nutrients including (by 2024 latest) use of a Farm Sustainability Tool for Nutrients FaST (EU or other digital application) which includes "a balance of the main nutrients at field scale" (2021/2115, art. 15(4)g).

The CAP can also support innovation, notably in nutrient recycling, through EIP-Agri, CAP-Network, LEADER, while further agricultural research opportunities are available through Horizon Europe.

The CAP is an important tool to support nutrient recycling, but the extent to which it is supported depends on Member States strategy and priorities. Nutrient recycling could be supported by CAP subsidies or by conditionality obligations in a future CAP. However, farmers are already under pressure and further obligations without support would only aggravate the current situation. An additional difficulty is that at present monitoring of use of recycled nutrients is quite limited.

It is also important to remember that retailers can play a key role in driving market requirements through their purchasing specifications and their contractual agreements with farmers.

Dominique Dejonckheere, Copa-Cogeca (the European federation of farmers organisations and farmers cooperatives), underlined that EU fertiliser production is still much lower than before Russia attacked the Ukraine, and the resulting increase in natural gas prices. **Fertiliser prices are still higher than before this crisis**, which provides some incentive to recycle nutrients. However, wheat prices have increased less than fertilisers, putting economic pressure on farmers.

Copa-Cogeca has issues for decades now with EU "anti-dumping" measures on fertiliser imports. These are intended to compensate EU fertiliser producers for subsidised energy costs in other countries. The consequence is **higher fertiliser prices in Europe than elsewhere**, whereas EU farmers must compete against food imports, or compete to export grain, in an open global market.

CBAM (Carbon Border Adjustment Mechanism) for fertilisers will increase fertiliser prices by a further c. 30€/tonne, and again farmers are expected to pay.

Mineral fertiliser consumption in Europe has fallen by c. -6% since 2017, still some way from the Farm-to-Fork target of -20% by 2030. There are signs however that this is leading to lower crop quality (grain protein content).

Also, there are questions about how expected changes in livestock numbers (fewer ruminants, more pigs and poultry) will affect manure nutrient flows.

Copa-Cogeca suggests the following objectives to improve nutrient recycling:

- Facilitate manure transfer between farmers
- Enable appropriate recycling of manure-derived nutrients in Nitrate Vulnerable Zones (Renure)
- Support farmer investment in biomethane and nutrient recycling
- Recognise the value of manure for carbon capture and storage, water retention (climate resilience), soil health
- Improve the quality of sewage sludge, ensure monitoring and liability insurance for farmers. Farmers see sewage sludge as a valuable fertiliser, but are concerned about contaminants.
- Encourage soil liming to increase pH and so nutrient use efficiency, in particular of organic nutrients
- Include support for fertiliser management in CAP Strategic Plans
- To enable such actions, the budget of the CAP must be not reduced.

Water and waste industry

Sébastien Mouret, EurEau, outlined the water industry's vision of potential and challenges for nutrient recycling from sewage.

EurEau groups national federations of public and private wastewater and drinking water operators in 32 countries, representing nearly 500 000 direct jobs.

Sewage sludge management routes today differ widely across Europe and policy should not impose one route. Today, **nearly half of total sewage sludge produced in Europe is valorised in agriculture**, nearly always after processing (sanitisation, stabilisation) by anaerobic digestion and/or composting. Appropriate sewage sludge use in agriculture returns nutrients and organic carbon to soil, is low tech / low cost to society, compatible with energy valorisation (anaerobic digestion). Agricultural sewage sludge use is based on local relationships between farmers, local administrations and water operators and does not need long-distance logistics and supply chains.

However, EurEau recognises that quality of sewage sludge can be a challenge. Contaminants in waste water are largely transferred to sludge as part of the wastewater treatment process.

EurEau supports the objectives of Circular Economy, but recovered nutrients must find a market, despite that recovery is more costly than virgin fertiliser nutrients. This seems to be a problem in Germany.

EurEau's proposal is to set a mandatory blending quota, that is require that a specified % of nutrients in all fertilisers sold in Europe should be recycled. The % should be raised every e.g. five years. EurEau proposes that this be integrated into the EU Fertilising Products Regulation.

EurEau underlines **that prevention and separation of pollutants at source should be the priority**:

- The IED (Industrial Emissions Directive) bans industrial installations from releasing substances that could render sludge unusable for recycling,
- The EU proposed ban on dental amalgam (ESPP eNews n°82) will remove the main remaining source of mercury in sewage,
- Regulatory action is needed to restrict problematic industrial chemicals.

Anders Finnson, Svenskt Vatten (Swedish Water & Wastewater Association) indicated that the federation's vision is to contribute to ensure both clean water and a secure food supply. Tomorrow's sewage works should be a resource recovery plant, for water, organics, nutrients and energy. Nearly all the phosphorus entering a sewage works ends up in the sewage sludge, around one fifth of nitrogen, but nearly no potassium, which is soluble.

Svenskt Vatten's sewage sludge management aims to respect the **waste hierarchy**: prevention (control at source of hazardous substances), reuse (valorisation of water and sludge in agriculture), where this is not possible: phosphorus recovery, use of sludge in landscaping, and as last resort sludge incineration for energy.

Nitrogen recovery may offer potential to reduce climate emissions.

For P-recovery to be societally viable, there must be market demand for the recovered products. This requires water operators to deliver recovered nutrient products in the right form and quality. Costs for P-recycling should fall as it is rolled out, but subsidy support to recycling will be needed for at least a decade.

Svenskt Vatten proposes:

- Include a progressive, obligatory recycled nutrient blending quota into the EU Fertilising Products Regulation
- Incentives to wastewater operators to produce materials demanded by the fertilisers industry
- Tighter cadmium limits on mineral fertilisers, considered by Sweden to be needed to protect soil and human health, can benefit recycled phosphorus sources

Nicole Couder, Suez, presented synergies between recovery of nutrients and carbon storage. Suez, amongst other activities, ensures sanitation for nearly forty million people worldwide.

Organic fertilisers, derived from food waste, green wastes, sewage sludge or other secondary materials, often via composting or anaerobic digestion (methane production), provide nutrients to crops, store and valorise carbon and contribute to soil structure and health.

As an example, France authorises the use of sewage sludge in fertilising products under demanding national quality standards (NFU), but with spreading under waste legislation (traceability, spreading plans …) and agricultural best practice. Soil monitoring and sludge quality assurance ensure that nutrients are supplied according to crop needs and conform to water quality protection plans.

Suez' proposals:

- Reward farmers for recycling of nutrients and carbon in organic fertilising products
- Include sludge management best practices, treatment of micropollutants into the EU Sewage Sludge Directive Revision
- Reduce the complexity of the EU Fertilising Products Regulation and facilitate the inclusion of other recycled materials, in particular organic industrial by-products and sewage derived materials
- Avoid subsidies which cause competition of organic carbon to energy versus to agriculture

Robert Naylor, Thames Water UK, summarised work underway in the **UK Wastewater Resource Recycling Working Group**, bringing together the UK water companies, regulators, industry experts and stakeholders.

The water industry sees that there are today a range of innovative routes to recover nutrients and other materials (e.g. polymers) from sewage sludge, but little roll-out to mainstream implementation. Obstacles are both a lack of market demand and regulatory obstacles.

The UK Resource Recovery Working Group's conclusions to date are:

- Long-term objective of bioresource recovery, need to move to holistic reuse of energy and different resources in sewage
- Recovery routes must generate products corresponding to market needs
- Need to address regulatory obstacles, in particular End-of-Waste. This is ensured for fertiliser applications by the EU Fertilising Products Regulation (FPR), but fertiliser use is the lowest value application. Interest to implement the FPR End-of-Waste approach for industrial chemical end-uses.
- Sustainability is a key driver for the water industry and its regulators. Need to include LCA, Natural Capital and social value into water industry economic assessments.

Proposals from a UK perspective:

- Implement regulations in the UK similar to the EU Fertilising Products Regulation (FPR) to open the fertilisers market for recycled nutrient products. Use experiences and learning from Europe to shape implementation in the UK,
- Introduce FPR style regulations to open markets for use of recovered nutrients in chemicals applications,
- Provide incentives for the water sector to collaborate with end-users on resource recovery and circular economy projects.

Martijn Bovee, Aquaminerals, The Netherlands, explained that this not-for-profit organisation is a joint venture of the water companies and water authorities, with the aim of selling water cycle secondary and recovered materials. Collective action enables innovation, sharing of risk and administration and a focus on economic efficiency and sustainability.

Aquaminerals currently recycles and markets calcium carbonate, CO_2, and iron sludge from drinking water treatment (the latter is used for H_2S removal in sewage works), struvite recovered from sewage treatment, and is working on vivianite and polymers (PHA, PHBV, EPS/Kaumera).

Struvite today is readily sold as fertiliser, indeed the challenge is lack of supply to reliably fulfil demand.

Vivianite (iron(II) phosphate) has a potential market to provide iron to plants where soils/crops require this. Some studies suggest effects as a phosphate fertiliser in other soils. But iron phosphates are currently excluded from the EU Fertilising Products Regulation (CMC12).

The costs of recovering nutrients are higher than the prices of primary nutrients. To avoid passing these costs back to the water user and taxpayer, Aquaminerals suggests that the costs should be paid by the fertiliser user (polluter pays principle).

Aquaminerals proposes:

- a progressively increasing blending obligation (quota) obliging use of a certain % of recycled nutrients in fertilisers, similar to the blending obligation for plastics in the Netherlands: plastic products will have to include a minimum % of recycled plastic from 2027.

Paolo Campanella, FEAD (the European Waste Management Association), emphasised the need for progressive and long-term policy targets for nutrient recycling, with policies to enable markets.

FEAD represents nineteen national industry associations across Europe, covering the resource and waste management industry.

Sewage sludge use in agriculture is an important route for nutrient recycling and carbon valorisation, in line with the Waste Hierarchy, with socially sustainable costs. Quality is essential. There remains significant potential for this route: for example, France uses c. 80% of its sewage sludge in agriculture, but only around 5% of France's fields receive sludge.

Where quality of sewage sludge does not allow land spreading, other technologies should be incentivised (e.g. incineration and nutrients extraction). In these situations, the legislation should evaluate the quality of the output, without hampering the use of the recovered nutrients based on the input quality.

FEAD considers that policy support is needed both for development and roll-out of phosphorus recovery technologies and for recycled nutrient markets, and proposes:

- Reduced VAT on recycled nutrients
- Green Public Procurement for secondary materials
- Ecotaxes on primary nutrients, in both fertilisers and chemicals

Lucile Sever, EBA (European Biogas Association) underlined synergies between anaerobic digestion (AD) to produce biogas/biomethane (green energy) and nutrient recycling: AD can take a range of organic inputs; nutrients in digestate are plant available; digestate returns stable carbon to soil and improves soil health.

EBA brings together nearly 250 companies, over 50 national federations, as well as research centres, in biogas production and technologies.

The EU Common Agricultural Policy (CAP) includes measures to reduce nutrient losses under conditionality of subsidies and voluntary measures. All Member States' CAP Strategic Plans mention R22 ("Sustainable Nutrient Management") but only five reward digestate use.

The EU Commission failed to fulfil its commitment to the Green Deal by not releasing the Integrated Nutrient Management Action Plan (INMAP), despite having published a preparatory study (JRC study in ESPP eNews n°76) and an EU consultation (see ESPP proposals in ESPP eNews n°69).

EBA proposes:

- Include a new GAEC in the next CAP on "recycling nutrients in agriculture" or include additional related eco-schemes in CAP strategic plans.
- Extend the commitment to EU "reuse and recycling" targets for phosphorus from municipal waste water (under the revised Urban Waste Water Treatment Directive, see in this SCOPE Newsletter) to other organic secondary material streams and to other nutrients.
- Similarly extend the EU taxonomy inclusion of P-recovery from municipal waste water to include and P and N to other organic streams, and extend the inclusion of anaerobic digestion or composting biowaste to also cover manure (§2.1 and §2.5 in EU Delegated Act 13/06/2023.
- Develop an online communication tool explaining nutrient recycling and inviting stakeholders and companies to sign up to express their support.
- Fix an EU blending target for recycled nutrients (minimum % of recycled nutrients in all fertilisers sold).

Stakeholders

Ana Robles Aguilar, BETA Technology Centre, University of Vic, Spain, and **Marzena Smol, Mineral and Energy Economy Research Institute, Polish Academy of Sciences**, summarised policy proposals under discussion between five EU-funded Horizon 2020 projects: Fertimanure, Lex4Bio, Walnut, Sea2Land, and Rustica, as below.

Horizon 2020 project proposals:

- Develop an agreed definitions of "secondary raw materials" and of "bio-based" fertilisers (see conclusions of ESPP workshop in SCOPE Newsletter n°150)
- long-term field trials to demonstrate agronomic effectiveness of recycled fertilisers (need for funding)
- harmonised methods to assess emerging pollutants in organic and recycled fertiliser materials (see work underway by CEN on harmonised testing to support EU Fertilising Products Regulation criteria in ESPP eNews n°85)
- mechanism to collect and regularly update information on prices of organic and recycled fertilisers placed on the EU market
- public database of information about organic and recycled fertilisers to inform stakeholders
- data on flows of secondary nutrients and recycling/reuse
- inclusion of secondary nutrients streams in national and regional waste management plans and circular economy policies: this should facilitate organisation of reliable input flows for recyclers.
- clarification and harmonisation of waste codes for secondary nutrient materials
- actions to improve farmer and consumer understanding and acceptance of recycled nutrient materials
- subsidies through CAP or ETS for production and use, based on CO_2 footprint for nitrogen recycling and on non-renewable resource consumption for phosphates

Sergio Cappucci, ENEA, Italy Phosphorus Platform, explained how nutrient recycling objectives are included in Italy's national legislation. He underlined the regulatory complexity, with 170 regional, national, and EU regulations identified as impacting fertilisers, sewage sludge, compost, critical raw materials, and relevant end-of-waste and by-products.

The Italian National Strategy for Circular Economy (2022) aims to develop its own specific strategy tailored to Italy's economic, social, environmental, and industrial context in order to recycle and recover all materials wherever possible, without excluding thermal treatment. The National Programme on Waste Management (2022) recommends developing technologies to recover phosphorus from all potential sources including manure, and sewage sludge.

The Italy National Critical Raw Materials Decree (2022) and Technical Table (Sept. 2023) aim to ensure regulatory, economic and market conditions to guarantee a secure and sustainable supply of all critical raw materials, including phosphate rock and phosphorus (P_4) which are already listed by EU.

The Italian National Strategic Plan of the Common Agricultural Policy 2023-2027 does excludes sewage sludge spreading from subsidies to increase organic matter in soils (under the Strategic Research Agenda 04 "Input of organic matter to soils", SRA04), and subsidises the use of mixed composted soil improvers only if sewage sludge is not a component of the improver.

Andrea Salimbeni, Re-Cord (a public-private research consortium) proposed:

- tax on virgin minerals in inorganic fertilisers, by extending existing tools: ETS, CBAM.
- introduce nutrient use and recycled nutrients into the Agriculture-ETS currently under discussion (see EU study 2023, below).
- extend the EU Conflict Minerals Regulation to cover the critical raw material, phosphate rock (this regulation currently covers only tin, tantalum, tungsten and gold).
- include demanding phosphorus recovery requirements under the revised Urban Waste Water Treatment Directive (see workshop on this question in this SCOPE Newsletter), including requirements on safety/contaminants, plant availability of phosphorus and use according to crop needs.
- include requirements for minimum use of recycled nutrients in the CAP (e.g. 15% by 2030).

Christian Kabbe, Easymining, presented proposals from the **German Phosphorus Platform** (DPP). Germany passed legislation obliging phosphorus recovery from sewage in 2017 (Klärschlammverordnung – AbfKlärV 2017, see ESPP SCOPE Newsletter n°129) but roll-out is slow because of a lack of clarity concerning implementation which is the responsibility of the 16 German regions (Länder). Despite that technologies today exist, regulators continue to fund further research rather than roll-out. Nonetheless, **several full scale plants recovering phosphorus from sewage sludge incineration ash are today operational or planned** in Germany.

Currently, P-recovery costs around 0.03 €/m^3 wastewater, but these are initial start-up costs and will decrease with roll-out.

DPP has identified a number of **regulatory obstacles** to P-recovery implementation specific to German regulations (see DPP Political Memorandum 2024 in ESPP eNews n°84). Regulation should allow recovered nutrient products as fertiliser based on quality and safety (contaminant levels), not depending on input raw materials. Divergences between German and EU End-of-Waste status should be addressed.

A problem is that current **municipal wastewater management tenders** are still not integrating phosphorus recycling, because of lack of clarity on funding / cost transmission to users.

DPP proposes:

- a quota for recycled phosphates in fertilisers (related to distributor sales),
- pricing of environmental costs (externalities),
- taxation, e.g. of resource consumption,
- support for early starter municipalities, for example through an incentive system,
- financial benefit / penalty for municipalities implementing / not implementing phosphorus recovery.

Fertilisers industry

Nicolas Willaume, ICL, presented the company's experience in implementing phosphorus recycling from sewage sludge incineration ash, and the proposals of Fertilizers Europe, which brings together 15 mineral fertiliser manufacturers, representing the majority of Europe's production.

ICL has now produced and placed on the market recycled phosphate fertilisers produced from sewage sludge incineration ash (see Lucas van der Saag presentation at CRU Phosphates 2024 in this SCOPE Newsletter). This required

R&D to modify the production process, adaptation for scale-up and complex regulatory procedures. Further work is currently being carried out with farmers to increase their knowledge and understanding of the benefits of these products.

Fertilizers Europe's proposals:

- Facilitate and accelerate integration into the EU Fertilising Products Regulation of new recycled materials, new/modified processing methods
- Facilitate site permitting to enable intake of waste streams for recycling
- Provide R&D/innovation support funding to industry for process implementation of recycling and for small-scale, decentralised logistics
- Financial incentives to farmers to use recycled fertilisers, e.g. via the CAP ecoschemes
- Communication and information of farmers
- Develop an EU label for recycled fertilisers (with a minimum recycled nutrient content)
- Include all recycled nutrients in EU Organic Farming

Discussion

A key question is whether "market pull" policies are necessary, for example recycled nutrient quotas or ecotaxes on virgin nutrients. Some participants consider that the limited additional cost of P-recovery should be borne by water users, and that if recovery processes produce consistent, quality products, corresponding to user needs, then these will find a market.

- If water companies produce a material which end users do not want (e.g. a "fertiliser" which is too dilute, or not of reliable consistence, or incompatible with farmers' spreading equipment …), then they will end up with a stockpile with no outlet, or which ends up in landfill, or which is exported to less discerning non-EU countries. This is not however a problem of "market pull", it is a problem of no market because not a useable product
- Any P-recovery requirement should include that the recovered material must have product status or a recognised functional use, in order to ensure safety and contaminant limit requirements and to ensure that there is a potential market.

Participants recognise however that **nutrient recycling can be more expensive than production of virgin nutrients**, because of smaller scale local processing and/or logistics.

The question is then how to share this cost between water users, general taxpayers and nutrient users (fertiliser industry, farmers). This must take into account the difficulties faced by farmers passing on costs to supermarkets/consumers in today's agri-food system. A border compensation mechanism (CBAM) on imported food and feed products would protect EU farmers from competition by non-EU farmers not facing such costs, but would not enable EU farmers to be export-competitive.

There is agreement that **regulatory obstacles need to be addressed** and that tools to reduce market friction are essential to facilitate uptake of new recycled nutrient products (in particular reliable information of farmers).

Questions raised by participants:

- How to move from research to implementation. R&D project results are often not taken up by industry or regulators.
- How to ensure accessible and relevant information on costs of recycling, business models, … ? Are R&D case studies or literature-based tools widely transposable to and useable by operators in other countries, different agricultural systems, different waste water treatment structures, different business contexts ?
- How will possible future Agriculture-ETS (climate emissions trading system) integrate manure carbon management ?
- How to address the obstacle posed to manure nutrient recycling by the cost to farmers of processing without subsidising intensive livestock production ?
- How to monetarise external costs, such as eutrophication and consumption of non-renewable resources (phosphate rock) ?
- Challenges of passing P-recovery costs on to water users, who today pay widely varying amounts for water services, with different calculation methods (fixed bills, drinking water metering …)
- Should revenues from nutrient ecotaxes or CBAM be used to support nutrient recycling ? to support farmers ? compensate for social impacts (to poorer populations to cover higher food and water costs) ? to subsidise exports (prevent deterioration of competitivity of EU farmers on world market) ?
- How to improve on-farm and local enforcement of nutrient loss reduction targets and of EU Water Framework Directive Quality Status objectives ?
- How to prevent carbon credits for farmers resulting in levels of spreading of nutrient-rich organic secondary materials on fields which would result in excess nutrient application, so risk of nutrient losses ?

Participants note the need to ensure that market tools intended to facilitate use of recycled nutrients in fertilisers / agriculture do not have unintended negative consequences on **recycling of phosphorus to higher-value industrial applications**.

ESPP outline for proposals

on market "pull" policies for uptake of recycled nutrients

Following this workshop, discussions and input, ESPP's General Assembly has derived the following proposals.
Comments are welcome to ESPP.

ESPP will now invite other organisations and stakeholders to support these proposals and to jointly submit these to the new European Commission in Autumn 2024.

- **Policies should incentivise nutrient recovery only where the recovered nutrient product is of quality and corresponds to user needs and specifications.**
- Integrate into the **next CAP revision** (revision starting probably 2025)
  - support for fertiliser use optimisation, use of recycled nutrients and organic fertilisers in CAP Strategic Plans,
  - add a GAEC for the use of recycled nutrients,
  - propose that national CAP FaST tools should monitor the use of recycled nutrients,
  - include advice on use of recycled nutrients in the CAP FAS requirements (Farm Advisory Services),
  - support farmer investments in nutrient recycling and in digestate processing.
- **Condition farm carbon credits** (for spreading of organic materials) to nutrient balance and to application of nutrients according to crop needs and in a form available to crops.
- Propose inclusion of nutrients into future **agriculture ETS.**
- Extend the existing **CBAM** on fertilisers to cover phosphorus, including with a P-BAM on both P in imported fertilisers, animal feed and food products, and with a parallel mechanism to also ensure a level playing field for exports by EU fertiliser producers and farmers.
- Consider **including definitions of "recycled nutrient" and "bio-based nutrient" into the** FPR (EU Fertilising Products Regulation**),** under labelling criteria (Annex III).
- Call for an EU **study of possible impacts of a progressive quota on recycled nutrients**, covering all EU fertiliser sales (including of organic fertilisers), and of an accompanying recycled nutrient credit trading scheme. This study should assess possible benefits for nutrient recycling and possible negative impacts.
- Exempt certain recycled-N products derived from manure under the **EU Nitrates Directive** (exempt these from N spreading limits for processed manure) subject to: must not facilitate livestock production concentration, must be readily verifiable by authorities, must not allow untreated or scarcely processed manures.
  NOTE: see the Commission proposal of May 2024.
- Work with the Certified **Organic Farming** movement (IFOAM Europe) to admit further recycled nutrient products as inputs to Organic Farming.
- Extend the current **EU 'Taxonomy' (*)** to cover:
  - P-recovery from other secondary nutrient streams
  - N-recovery
  - processing of digestate and use as fertiliser

  ** Taxonomy P-recovery and anaerobic digestate sections, next cutoff end 2024.*
- Include the above in **Green Public Purchasing.**
- Engage a European Commission study into possible extension, beyond the revised Urban Waste Water Treatment Directive, of **phosphorus reuse and recycling targets to other secondary nutrient streams:** organic fraction of municipal solid waste, food processing, abattoirs, intensive livestock manure …
- Include in revision of the **EU Sewage Sludge Directive:** tighter contaminant limits, obligatory quality assurance schemes and best sludge management practices including for nutrient valorisation
- **Evaluate the potential for nitrogen recovery** in wastewater treatment, sewage sludge handling, from sewage sludge and other combustion / incineration processes (from NO_x offgas stripping).
- Launch a European Commission policy analysis **to develop an INMAP (Integrated Nutrient Management Action Plan**) and to enact the Farm-to-Fork and COP 15 - Biodiversity Strategy nutrient loss reduction targets.
- Continue actions to **address regulatory obstacles to nutrient recycling,** including:
  - admit further recycled nutrient materials into the EU Fertilising Products Regulation (FPR, CMCs), simplify and accelerate the process for such modifications to the FPR,
  - simplify and reduce costs of FPR certification,
  - authorise use of Cat.1 Animal By-Product ash in EU fertilising products (subject to EFSA opinion on safety),
  - facilitate and accelerate modification of site operating permits to allow fertiliser production sites and other industries to take in waste as input for nutrient recycling,
  - address obstacles to recycling of nutrients in animal feed regulations, whilst ensuring food-chain safety,
  - address End-of-Waste questions and incoherencies between different Member States.
- Develop a public, **online communications tool** to promote nutrient stewardship and recycling (with sign-up-to-support).

Agriculture-ETS

A study for the European Commission assesses possible approaches for pricing and trading of agricultural greenhouse emission and carbon farming (AgETS). The study concludes that any scheme would be complex, both in terms of administrative burden and of difficulty of assessing real GHG emissions and perennity of carbon "storage" in soils. The study notes that any agriculture-ETS system must be accompanied by wider policies, such as transitional aid to farms.

Over 13% of total EU greenhouse emissions are directly attributable to agriculture (this is without including agricultural fuel consumption), in particular from livestock (ruminant enteric fermentation, manure management), synthetic nitrogen fertiliser use, emissions resulting from drainage and cultivation of peatlands.

The first part of the study assesses five options for an AgETS (agriculture-ETS: emissions trading system), considered as a route to apply the polluter-pays principle to agriculture GHG emissions:

- On-farm ETS (applicable to farmers) for all GHG emissions, including net carbon capture/release from croplands and grasslands
- On-farm ETS for livestock emissions only
- On-farm ETS for peatland emissions only
- Upstream ETS (applicable to fertiliser and animal feed producers / importers only), de facto targeting livestock enteric fermentation and mineral N fertilisers only
- Downstream ETS (applicable to meat and dairy products), de facto targeting livestock enteric fermentation and manure management.

The upstream and downstream options are considered less effective to incentivise GHG emission reductions, because not directly applied at the point of emission. They also have necessarily narrower scope. However, **administrative burden for on-farm ETS would be considerable** (9 million farmers in Europe) and complexity would be problematic because there are currently no consistent MRV tools (monitoring, reporting, verification) neither for all farm GHG emissions nor for soil carbon capture.

Complexity of on-farm ETS could be reduced by including only larger farms and by using proxy data (e.g. standard emission factors per animal, per crop). Certified on-farm actions to reduce GHG emissions (e.g. best practice manure or fertiliser management) could justify a lower emission factor or voluntary credits.

A stakeholder survey suggested a mixture of support and opposition to on-farm ETS, but mostly support for a downstream ETS.

This part of the study concludes that a combined approach could be considered, **applying ETS to both upstream and downstream industries and to larger livestock farms**. The study notes that to move forward an EU harmonised farm GHG reporting tool must be developed and implemented, and extensive information provided to farmers to enable context-specific application and assessment of possible mitigation actions. **Transitional subsidies and other support to farms would be necessary**, combining CAP funds with ETS revenues. The study notes that a **CBAM (carbon border adjustment mechanism) for agri-food products** should be considered to accompany agriculture-ETS.

The second part of the study considers how AgETS could financially reward carbon removal from land use, land use change and forestry (LULUCF).

The study notes that LULUCF carbon removals are very context specific (soil, climate …) and so complex to monitor, report and verify. Carbon fixing plants and agroforestry have small per year per hectare carbon fixing sequestration and lack standardised quantification methods. Impacts of biochar on soil health and biodiversity are considered "uncertain" and GHG accounting of biochar soil incorporation is considered complex with questions on the stability of carbon sequestration.

Importantly, agricultural carbon sequestration is reversible. The risk of reversal can be reduced by eligibility restrictions, but it remains questionable to give credits for (reversible) carbon fixing to compensate GHG emissions. It is unclear how "temporary credits" for agricultural carbon fixing could function. A number of consulted stakeholders considered that credits for reversible fixing cannot be compared to reducing emissions (an avoided emission is permanently prevented).

"Looking at how to mitigate emissions from agriculture", European Commission news 13th November 2023 here.

"Pricing agricultural emissions and rewarding climate action in the agri-food value chain", Trinomics for the European Commission Directorate-General for Climate Action, November 2023, ISBN 978-92-68-09110-4, 360 pages, here.

ESPP workshop: Targets for Phosphorus "Reuse & Recycling" from urban waste water

This second one-day workshop organised by ESPP, 14th March 2024 (see also first workshop 13th March, above), with around 40 participants in Brussels plus 40 online, discussed proposals for **phosphorus "reuse & recycling rates" from municipal wastewater**, as specified in the revised EU Urban Waste Water Treatment Directive (UWWTD, pending official publication, Council-Parliament triologue agreed text here).

Context

Robert Van Spingelen, ESPP President, opened the meeting and **Chris Thornton, ESPP**, summarised the relevant texts of the revised EU Urban Waste Water Treatment Directive (UWWTD), as finalised early 2024 between European Parliament, Council and the European Commission in 'trilogue' (pending legal validation, translation and then official publication).

ESPP also noted for comparison the existing phosphorus obligations defined by German and Swiss national regulations (German Klärschlammverordnung – AbfKlärV 2017, Swiss Abfallverordnung, VVEA 2015, see SCOPE Newsletter n°129).

New art. 20 of the EU UWWTD requires that the European Commission will define (within 3 years of Directive publication) "**combined minimum reuse and recycling rate for phosphorus from sludge and from urban wastewater** …". Also, art. 30 requires an evaluation (by end 2033) "*of the opportunity and feasibility to set Union minimum reuse and recycling rates for nitrogen from sludge and/or wastewater*".

Art. 20 reads as follows (see above, pending publication)**:**

"Sludge and resource recovery
1. Member States shall encourage the recovery of valuable resources and take the necessary measures to ensure that sludge management routes are conform to the waste hierarchy [of the Waste Framework Directive 2008/98/CE] *. Such routes shall: (a) maximize prevention; (b) prepare for reuse, recycling and other recovery of resources, in particular phosphorous and nitrogen, taking into national or local valorisation options; (c) minimize the adverse effects on the environment and human health.*
2. The Commission is empowered to adopt delegated acts … specifying a combined minimum reuse and recycling rate for phosphorus from sludge and from urban wastewater not reused …, taking into account available technologies, resources and the economic viability for phosphorus recovery … phosphorus contents of the sludge and the level of saturation of the national market with organic phosphorus from other sources while ensuring that there is safe sludge management and no adverse impact on human health and the environment. The Commission shall adopt those delegated acts by [3 years after entry into force …".

The Directive preamble (§28) specifies the conditions and context of the reuse and recycling rates:

Preamble 28

- "*a minimum combined reuse and recycling rate should be defined at Union level … giving Member States the flexibility to choose whether to reuse and/or to recycle the urban wastewater and/or sludge to recover phosphorus, … take into account the phosphorus contents in sludge which can vary … , the level of saturation of each national market, e.g. the availability other sources of phosphorus from organic sources, for instance from livestock farming, and the possibilities of its absorption*".
- " *…reduce pollution at source from non-domestic sources will help improving the quality of the sludge produced and ensure its safe use in agriculture*".
- "*monitor micro-pollutants in sludge … particular attention should be paid to micro-plastics … when sludge is used in agriculture*".
- "*Member States should … take measures to encourage the production and purchasing of recovered nutrients from urban wastewater and sludge*".

Water industry positions

Anders Finnson, Svenskt Vatten (Swedish Water) **and EurEau** (European Federation of National Associations of Water Services), noted that in addition to the revised Urban Waste Water Treatment Directive (UWWTD), a number of EU policies support nutrient recycling. Particularly significant are the Common Agricultural Policy (CAP), the Taxonomy, the EU Fertilising Products Regulation, the future revision of the Sewage Sludge Directive.

Are also important, policies to reduce at source pollutants reaching sewage: the revised Mercury Regulation, the planned revision of REACH, and especially the announced broad restriction of PFAS (Perfluoroalkyl and Polyfluoroalkyl Substances), because **PFAS are a problematic, persistent contaminant in sewage** which can limit reuse and recycling options.

EurEau note that the **EU Taxonomy** (criteria for green financing) now includes phosphorus recovery from waste water (EU Delegated Act 13/6/2023). The taxonomy criteria require recovery of at least 15% of waste water treatment plant (wwtp) incoming load, or at least 80% of P from sewage sludge incineration ash. The Taxonomy requires that the recovered phosphorus must be used in either a CE-Mark or national fertiliser or in another functional application.

EurEau proposals for UWWTD reuse & recovery rates:

- How should the rates be aligned with the Taxonomy criteria (15% / 80%) ?
- What are feasible rates for P and N real reuse – with and without a legislation for also creating a pull in the market?
- Fixing rates as % of inflow ensures neutrality between different processing and recovery routes.
- Rates should be required as a total for each Member State, to allow optimal implementation between different wwtps.
- How to take into account that some catchments and Member States are already nutrient-saturated with livestock manure ?
- Agricultural use of treated sewage sludge should be allowed and included in calculating the ratio, where nutrients are supplied to crop needs, but with strict quality control and contaminant regulation. This should also be included in revision of the EU Sewage Sludge Directive.

Jean-Yves Stenuick, Aqua Publica Europea (the European association of public water operators, with 70 members serving 90 million people) noted that it is difficult to assess crop use of phosphorus when sewage sludge is used in agriculture.

- Smaller sewage works, which tend to have lower levels of contaminants, should be able to continue to valorise sludge in agriculture, because of logistic costs for incineration or P-recovery.
- Sewage sludge quality specifications should be EU-wide to avoid some Member States over-regulating.
- Other circular economy aspects should be considered (e.g. use of incineration ashes in construction materials) and energy savings (e.g. use of sludge as fuel for cement kilns).
- Sludge thermal treatment routes other than incineration should be considered, as these may be compatible with phosphorus reuse and recovery.

Mark Craig (Severn Trent Water and UKWIR – UK Water Industry Research) noted that P reuse & recovery targets would not be practical at the waste water treatment plant (wwtp) level, as sewage sludge is often transported from several wwtps to one central treatment site.

He noted that it must be avoided that the material recovered ends up stockpiled because there is a disconnect between what is recovered and what the market wants/needs. Recycling targets should be formulated with focus on making sure that the P recovered will be put to beneficial use.

For UKWIR, account should be taken that:

- Influent and effluent P are already monitored at many wwtps (where P-removal is required) but not at all wwtps
- Biological phosphorus removal alone cannot often reliably achieve low P-discharge consents (such as 0.5 mgP/l), and is incompatible with many existing wwtp infrastructures (e.g; trickling filters).
- Chemical P-removal, using iron or aluminium salts, make P inaccessible for P-recovery via struvite.
- Fixing reuse & recovery targets as national totals would enable flexibility between operators, so efficient implementation.

Mark Craig noted that **nitrogen recovery in wwtps raises a number of questions**: Is this important in that nitrogen is not a non-renewable resource ? There is no necessity to do this from a strategic resource availability perspective. Would not free market forces alone provide sufficient incentives if N recovery from wastewater is or becomes cheaper (in whole life cost terms) than current production methods ? Are potential recovery quantities from wwtps significant ? Is it feasible to re-engineer wwtps from N-removal to N-recovery ? Denitrification is essential to biological P-removal processes, which reduce reliance on chemicals and enable subsequent struvite recovery, so there is a compatibility question. Denitrification also and improves operation in conventional secondary treatment (e.g. to avoid formation of nitrogen bubbles in sludge sedimentation tanks, which interfere with floc settling) ? Is it not more important for climate impact to efficiently eliminate N_2O emissions, e.g. using catalytic air covers ?

Pieter De Jong, Wetsus, for Water Europe, an association promoting water-related research, presented the association's Resource Recovery Working Group. **The objective is to transform wwtps to product recovery**. This will take time, so P reuse and recovery rates should start low and be progressively increased. A challenge is creating a market for recovered nutrients and so producing materials with added value.

Technology options

Christian Kabbe, EasyMining, presented the company's processes for **recovery of high quality, pure nutrient salts from waste streams**: Ash2Phos® P-recovery from sewage sludge incineration ash, Ash2Salt® -recovery from municipal solid waste incineration ash and Aqua2N® N-recovery from liquors. He underlined that recovery processes need to deliver a quality product corresponding to market demand, reliably, in significant volumes.

EasyMining's proposals:

- Minimum nutrient recovery rates should be set as >80% of P from ash, >90% K from ash and > 90% of soluble ammonia N from liquors and >15% total-N recovery upstream of incineration. These recovery rates are operational with EasyMining technologies.
- Quality of recovered products is essential to ensure that they have a market: regulation should require that recovered nutrients must respect relevant product market specifications (fertiliser regulations, industrial quality standards).
- Targets should promote clean recovery technologies which do not lead to accumulation of pollutants in soils, based on science.
- Polluter-pays principle should cover recovery costs.

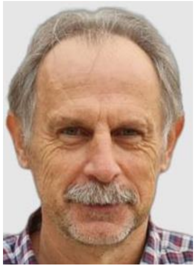
Stefan Karlowsky, P2GreeN HorizonEurope project and Leibniz IGZ (Institute for Vegetables and Ornamental Crops), Germany, explained that this EU-funded R&D project is demonstrating, at pilot scale, **source separation of urine and faeces and processing to fertilisers, and water reuse from sewage treatment in agriculture** in Sweden, Germany, Spain. Source separation of urine enables efficient N and P recovery. He regrets that source separation is not mentioned in the revised UWWTD.

P2GreeN proposals:

- UWWTD reuse and recycling rates should take into account different routes and technologies, in particular upstream source separation and nutrient recovery
- Rates should be calculated as % of estimated total population and business discharge, not as % of each individual wwtp inflow.

Reindert Devlamynck, Inagro, Belgium, discussed duckweed (*Lemna* sp.) ponds as a route for water purification and nutrient recovery. Duckweeds are the fastest growing flowering plant known, on liquid substrates, can be harvested and used to produce fertilisers or animal feed (they contain (of dry weight) c. 40% protein, c. 40% carbohydrates and c. 20% minerals). **Trials on pig slurry in an open duckweed pond showed 100% P-removal of which around 40% is harvested in the duckweed** and c.60% ends up in sediment, which can also be collected. One quarter of the input N is taken up by duckweed and three quarters removed by (de)nitrification.

UWWTD reuse and recovery targets should consider combinations of nutrients and organic matter, transport and land application costs, nutrient loss from soil or crop uptake, uses other than fertilisers.



Wim Moerman, NuReSys, indicated that **struvite or potassium struvite ($MgKP_4$) can be a cost effective route for phosphorus recovery, because it ensures operational improvements** (preventing nuisance scaling of equipment, improving sludge dewatering, improving biological P-removal). Most of the phosphorus present in liquor streams in soluble inorganic form (orthophosphate) is recovered, but not P in organic forms. Rate of recovery of P as struvite can be improved by anaerobic digestion, to solubilise phosphorus, also enabling nitrogen and energy recovery.

Bengt Hansen, Kemira, presented the **ViviMag®** process, which uses magnetic separation to capture phosphorus as vivianite (iron (II) phosphate) from sewage sludge. In particular, after anaerobic digestion of sewage sludge, most of the iron is present as vivianite.

A pilot installation (1 m^3/h) shows **capture of 30-40% of P in sludge, or 50% after anaerobic digestion,** which could possibly be increased to 60% with higher dosing of iron salts. This pilot is currently operating at Hoensbroek wwtp, The Netherlands, after successful trials at Schönebeck WWTP in Germany and Odense WWTP in Denmark in 2022 - 2023., and a demonstration scale (9 m^3/h) installation is planned for 2025 in Breda, The Netherlands.

Vivianite is currently excluded from the EU Fertilising Products Regulation (FPR) by iron limits in CMC12) but the phosphorus solubility in NAC is 92% (NAC = neutral ammonium citrate, as specified in the FPR for phosphate fertilisers). Pot trials with ryegrass suggest that vivianite can reach c. 90% of the yield achieved with commercial phosphate fertilisers. Vivianite has a market as an iron fertiliser in several European regions where soils are iron deficient and may find a market in industrial applications, depending on quality.

Kemira's proposals:

- Recovery should not be limited to only one option: sludge incineration and P-recovery from ash. Different technology routes and flexibility should be given to wastewater treatment plant operators, including phosphorus recovery both from sewage sludge and from wastewater.
- ViviMag® is a low Capex and decentralized phosphorus recovery technology, which should be part of a smart overall concept for phosphorus recovery.
- Economic costs are a concern for wwtp operators: affordable phosphorus recovery methods should be prioritised rather than focussing only on high P recovery percentage.

Céline Vaneeckhaute, Université Laval, Canada, underlined that nutrient recovery **targets should depend on different regional factors**: soil conditions and crop needs, farmer preferences for different fertiliser forms, varying sewage phosphorus concentrations and wwtp effluent discharge limits. Decision support tools can facilitate such target setting and implementation.

Roberto Canziani, Politecnico di Milano and Phoster project, considered that **nitrogen recovery requires further study,** including carbon / energy comparison with mineral nitrogen fertiliser production. Currently, maybe recovery of 15% of total N in sludge is a realistic target.

Phoster proposals for UWWTD phosphorus reuse and recycling rates:

- Leave freedom to use different technologies.
- "Reuse" (considered to mean: sludge application in agriculture under waste legislation) or "recycling" (considered to mean: P-recovery as a fertiliser or other functional product) should be decided depending on regional context (e.g. agricultural nutrient demand).
- Minimum rate of 50% of total P in sewage, increasing over time to 70%.
- Define rates as % of P in sewage, not per capita (because per capita P can vary with diet, business P releases, etc).
- Set as regional or national total
- Monitoring by regional / national authorities
- Provide accompanying guidelines on possible reuse and recovery routes, regionally adapted, with cost – benefit analyses.
- Strict limits on contaminants, including microplastics, should be set at the EU level by revising the EU Sewage Sludge Directive (for sewage sludge use in agriculture).
- Sewage sludge use in agriculture should be subject to national quality certification, and use limited to crop needs. Plant availability of phosphorus should be demonstrated by plant trials.

Pål Jahre Nilsen, Vow/Scanship and **European Biochar Industry Consortium (EBI)**. Scanship has today 70% of the market for sewage treatment installations on cruise ships. Large ships have wwtps treating 50 000 p.e., applying the world's strictest discharge limits (the ship must be able to operate anywhere), compact design, only one operator. Sewage sludge is dried with thermal centrifuges to 50% dry matter, then pyrolysed to produce stable biochar, which is taken off ship at ports.

Pyrolysis conserves phosphorus into the biochar,. Trials of sewage sludge biochar (produced at 600°C) show that it can be 90% as effective as mineral phosphate fertiliser. Pyrolysis at 600°C (10 minutes) can eliminate PFAS, microplastics and pharmaceuticals.

Pyrolysis can provide an alternative route to incineration for organic contaminant destruction in sewage sludge, conserving phosphorus and enabling return of organic carbon to agricultural soils. The Swedish REVAQ quality criteria allow biochar from sewage sludge if the sludge itself fulfils the criteria, considering that concentration of heavy metals in the biochar corresponds to phosphorus concentration.

A position paper on sewage sludge biochar is recently posted on EBI web page https://www.biochar-industry.com/2024/sewage-sludge-as-feedstock-for-pyrolysis-and-gasification-materials/

EBI considers that:

- **sewage sludge should be authorised as an input to EU Fertilising Products Regulation CMC14** (Pyrolysis and Gasification Materials), subject to temperature-time-conditions criteria (ensure elimination of organic contaminants).

Laure Blezat, Geocycle/Holcim and **Cembureau** (European Cement Association), indicated that **there are around 200 cement plants across Europe, so that for many sewage works this offers a potential regional solution for sludge valorisation**. Combustion of sludge in cement works ensures complete elimination of organic contaminants (high temperatures, prolonged residence time), neutralisation of heavy metals (immobilised in cement) and enables energy valorisation (use of cement production heat to dry sludge then use of dried sludge to replace fossil fuels for cement kiln firing).

However, phosphorus in sludge used in the cement kiln is lost (immobilised in the cement). Also, phosphorus has negative impacts on the process and on clinker (an intermediate in the cement production process). **The cement industry is therefore looking for processes to remove P from sludge upstream**, so allowing continuing energy valorisation and depollution in cement kilns, and to enable achievement of future UWWTD P reuse and recycling targets – and for partners to develop such processes.

ESPP outline for proposals

on targets for Phosphorus "Reuse & Recycling" from urban waste water as required by art. 20 of the revised Urban Waste Water Treatment Directive (here)

Following this workshop, discussions and input, ESPP's General Assembly has derived the following proposals. **Comments are welcome to ESPP before end June 2024**. ESPP will then submit these proposals to the European Commission.

- **Keep different technology and sludge management route options open**, subject to ensuring safety, quality and crop availability of nutrients when used in agriculture (see below). Not limit to only the options of incineration or agricultural sewage use (as in the 2023 JRC report for the Sewage Sludge Directive, see ESPP eNews n°81).
- ESPP understands the UWWTD art. 20 wording "*reuse and recycling targets*" to mean:
  - **"reuse" = land spreading** with nutrient content substituting fertiliser use (see proposed conditions below)
  - **"recycling" = extraction of or processing to a phosphorus product** which can substitute mineral nutrient use in fertilisers or industrial applications
- For P-recycling, **technologies are today available which can achieve:**
  - 80% P recycling from sewage sludge incineration ash
  - at pilot scale**, 50% P-recycling from total wwtp P-inflow** (including from ash).
  This recycling rate of wwtp input currently requires a combination of processes (e.g. digestion or sidestream processes plus phosphate precipitation) so this target should be initially lower and then increased with implementation deadlines. A higher recycling rate, maybe 70% wwtp input, could be considered later as a function of results and costs of full-scale operation.
- Coherent with the above, **the 15% from P-inflow specified in the EU Taxonomy should be increased**.
- Targets should be **fixed as % of P-total in wwtp inflows** (widely measured, can be estimated for smaller wwtps) but with also (as in Germany) an **additional specific rate for recovery from ash where sewage sludge is incinerated**.
- **Targets should also take into account upstream P recycling,** e.g. by "credits" for separated urine and faeces, P recycling or reuse onsite in e.g. food processing … P-losses by e.g. sewerage network leakages, storm overflows are addressed elsewhere in the UWTD and would be too complex to account into targets.
- The EU target for % of total P in sewage (see above) **should be applicable at each Member State national level** (same target for each MS). This allows optimisation of cost/efficiency, across each Member State, between wwtps of different size or configuration, allowance for regional differences (e.g. manure availability). Monitoring and reporting should be by Member States to the European Commission, to ensure that the target is are achieved by each MS. An EU "P recycling" credits trading system could be established to further improve implementation cost efficiency between MS.
- As specified in the EU Taxonomy, **recycled phosphorus must be a product with a market**: **either a certified CE-Mark or national fertiliser, or corresponding to market specifications for industrial functional applications of phosphorus**. Nonetheless, there should be flexibility to develop innovative new phosphorus products if a potential market can be justified.
- **Where phosphorus is reused by sewage sludge application in agriculture** (not as a certified fertiliser product), this should be:
  - after stabilisation and sanitisation (often by anaerobic digestion, enabling methane production),
  - under waste or equivalent permitting with monitoring, traceability, transparency, producer-responsibility,
  - application plan limited to crop nutrient requirements,
- **For sewage sludge use in agriculture, a quality and management certification scheme should be implemented, either with national systems, or at the EU level with a system of Notified Bodies** (validated to deliver certification by the European Commission). Certification should cover contaminants and safety, nutrient content and nutrient plant availability, management and application according to crop needs and to protect water quality. This would contribute to confidence of investors, farmers, supermarkets and consumers, given that food products are then placed on the EU market. This should be integrated into the **EU Sewage Sludge Directive** revision.
- The **extension of reuse and recycling targets to other secondary phosphorus sources** should be evaluated: organic fraction of municipal solid waste, food processing, abattoirs, intensive livestock manure …
- For this, **better data and monitoring of secondary phosphorus streams are needed**. *Note: the Critical Raw Materials Act 2024/1252 (OJ 11th April 2024) requires (art. 26.7) that the Commission define a "list of products … and waste streams … considered as having a relevant critical raw materials recovery potential" (ESPP eNews n°84).*
- Possible reuse and recycling **targets for nitrogen or other nutrients raise questions** and should be studied, including: impacts on other wwtp priorities (energy, N_2O, organics removal …), carbon emissions compared to synthetic N fertilisers, realistic N-recovery potential.
- **Policies should support user demand for recycled nutrients.** See proposals in SCOPE Newsletter n°151).

Summary of CRU Phosphates 2024

https://events.crugroup.com/phosphates

The CRU "Phosphates" conferences are "the" annual phosphate industry professional event, and the prime opportunity to connect with the phosphate industry, from mining through rock and acid processing, to fertilisers, feed phosphates and technical phosphates.

This 16th CRU Phosphates 2024, in Warsaw, brought together more than 370 participants with 50 company stands and 50 presentations in the double agenda: commercial - market – regulatory, and technical and industry operational.

ESPP organised a panel session on sustainable fertilisers, with Robert Van Spingelen, ESPP President, Marzena Smol, (Mineral and Energy Economy Research Institute of the Polish Academy of Sciences), Laia Llenas Argelaguet (BETA Tech Center, University of Vic Spain), Sara Stiernstrom (EasyMining, Ragn-Sells), Marc Sonveaux (Prayon) and Lucas van der Saag, ICL Fertilisers.

This SCOPE Newsletter summarises the plenary and market sessions at CRU 2024. We do not include summaries of technical sessions and technology showcases, which included a wealth of in-depth information on phosphate processing developments. All presentation slides from the conference (plenary, market, technical, showcases) are available to conference registrants from CRU.

CRU Phosphates 2025 will take place in Orlando, Florida 31 March - 2 April 2025 https://events.crugroup.com/phosphates/
Summary of CRU Phosphates 2023 Istanbul – *ESPP eNews n°74*

Market outlooks

Humphrey Knight, CRU, opening the Phosphates 2024 conference, presented an overview of the global phosphate fertilisers market today. P-fertiliser prices have dropped back from their 2023 peak (Russia's war on Ukraine) to 2022 levels (post-Covid). The 2023 peak was around 80% of the peak price reached in 2008 and around twice the 2022 level.

Crop prices have however fallen even more and are back to around 2020 (pre-covid) levels. **This means that P-fertilisers are less affordable for farmers** (fertiliser price vs. crop price) so that farmer demand is expected to decrease over the coming year or so. On the other hand, stocks of P-fertiliser are low, so overall demand is expected to be firm.

Phosphate fertiliser production prices are expected to continue to increase (energy costs, increasing use of capacity), and shipping costs face major geopolitical and climate risks (Red Sea, Panama Canal). Combined with demand, this is expected to result in pressure to increase prices.

However, **phosphate prices are and will continue to be mainly influenced by national/corporate policies**: Morocco has decreased phosphate rock exports despite increasing production capacity (see Maria Gamboa below). China is limiting exports. India fertiliser subsidy levels significantly modify demand and subsidies may increase in 2024 which is an election year. US countervailing import duties may reach a legal conclusion …

Demand for lithium iron phosphate for LFP battery cathodes (see below) is expected to increase considerably, with challenges for phosphoric acid purification capacity, but will only represent only around ten per cent of phosphate rock consumption.

An important point is the considerably increased divergence between prices of different qualities of phosphate rock (meaning high versus low P-content, not meaning low cadmium).

Andy Jung, Mosaic, underlined that **global crop yields have ceased to increase over the last decade**, possibly as a consequence of climate disruption. Fertiliser demand is linked to crop prices. 70% of world phosphate fertiliser use is on grain crops, in particular soya and corn (for which prices have been falling) and rice (prices increasing). Fertiliser demand and trade is strongly influenced by national policies (subsidies, import and export tariffs or quotas) but overall and long-term, P-fertiliser demand depends on production (crop yield). Nitrogen can be fixed from the atmosphere by plants and microorganisms, phosphorus cannot. Increases in phosphorus uptake by crops, for example by solubilising soil P, mean mining soil P reserves and cannot in the long term replace phosphate fertiliser inputs.

Maria Gamboa, CRU, further explained trends in the phosphate rock market. **Exports of rock have considerably decreased from Russia** (sanctions or voluntary purchaser policies). **Morocco exports have also decreased significantly as the producer tries to align the implied P_2O_5 price in phosphate rock with that of finished. fertilisers.** Although, rock exports from other countries have increased (Jordan, Egypt), this has resulted in strong price pressure on high quality rock as supply remains exceptionally tight. (high P content: BPL [bone phosphate lime] > 68%).

Juan von Gernet, ICL Fertilizers, **Juan von Gernet, ICL Group**, estimates the **global specialty fertilizer market** at between 20-25 Mt/y, which corresponds to a value of 18-24 billion US$. Market data is opaque because of the wide range of products and the lack of clear definition of the products by regulatory bodies and/or industry associations.

As is the case in commodity fertilizers, specialties have been subject to significant volatility in recent years. New trade barriers, covid, energy price swings, the battery energy boom and a growing focus on sustainability have all had an impact. The outlook is promising though. Regulation, environmental and economic factors are expected to support **growth in the range of 5% per annum through to 2027**. The market pace will also change. New entrants, some with large budgets, and greater competition will likely drive consolidation in the coming years.

Purified Phosphoric Acid and Lithium Iron Phosphate batteries

Mauricio Fortuna and Sam Adham, CRU, in two separate presentations, summarised market trends for technical phosphates (not covering P_4 derivatives).

Demand for **animal feed phosphates**, currently around 10% of world phosphate rock consumption, has recovered after prices fell back from the 2023 peak, and is expected to increase slowly with livestock production.

Significant demand for technical phosphates is expected for **Lithium Iron Phosphate (LFP) batteries**, which use lithium iron phosphate ($LiFePO_4$) cathodes.

LFP batteries to date offer lower energy density (kWh/weight ratio) than lithium-nickel-manganese-cobalt (NMC) batteries (the most widely used "lithium ion batteries"), which do not use lithium iron phosphate. However, LFP batteries are cheaper per kWh and have a longer life time (number of charge cycles). Unlike NMC batteries, LFPs can be fully charged/discharged without reducing their service life. They are today the preferred technology for grid storage batteries, are now being adopted in all types of electric vehicles.

A more recent technology is LMFP (lithium manganese iron phosphate) cathodes. These use similar amounts of technical phosphate than LFP. Both are thus considered together as "LxFP".

Overall today, LxFP represents around 80% of all vehicle and grid storage batteries produced worldwide. Predictions for LxFP development could be changed if sodium-ion battery technology becomes competitive (price, performance, industrialisation).

Demand for technical phosphates for LxFP battery cathodes is expected to multiply by around 7x from around 0.3 MtP/y to around 2,3 MtP/y by 2035 (compared to around total 20 MtP/y extracted from mined phosphate rock).

This does not take into account phosphorus in lithium hexafluorophosphate ($LiPF_6$) the most widely used lithium salt in battery electrolytes, with world production currently around 50 000 t/y (c. 10 000 tP/y) and expected to also be multiplied in coming years. $LiPF_6$ can only be produced via P_4 not from purified phosphoric acid.

Lithium iron phosphate can be manufactured by two routes: via technical MAP (mono ammonium phosphate), a legacy route which is in decline, or from purified phosphoric acid (PPA). This is expected to lead to **tightness in global supply of PPA.**

On the other hand, China is building considerable capacity for lithium iron phosphate production and is expected to have in coming years >80% of world lithium iron phosphate production capacity (down from nearly 100% today). This capacity looks likely to considerably exceed expected demand.

Tim Cotton, Novaphos, also discussed purified phosphoric acid capacity (PPA). Novaphos is the carbo-thermal process for producing phosphoric acid directly from phosphate rock (not via sulphuric acid), previously known as JDC, see ESPP SCOPE Newsletters n°s 141 and 86.

He considers that **battery cathode lithium iron phosphate production requires purified phosphoric acid (PPA) of purity level similar to food grade**. The cost and environmental impact of acid purification is related to the levels of contaminants in the starting acid. Currently, the phosphate industry concentrates contaminants in fertilisers to generate a relatively clean side stream to go to purification. However, this is limited and cannot supply expected future demand for acid purification. To limit the purification capacity needed to address this, one approach can be to produce phosphoric acid from igneous phosphate rock, which has lower contaminant levels. However, igneous rock also is often "low grade" (low phosphorus to calcium and silicate ratio). The Novaphos (ex. JDC) process is designed to operate with low grade rock.

Phosphate mine projects

John Passalacqua, First Phosphate. This is a mineral development company focused exclusively on developing production of lithium iron phosphate for LFP batteries, with an igneous (low contaminant) surface phosphate rock mine project in Quebec. Mr. Passalacqua underlined the **need to massively develop Purified Phosphoric Acid production capacity** outside China. If this does not happen, he considers that vehicle and battery manufacturers could eventually abandon LxFP and move to other battery technologies.

Brian Ostroff, Arianne Phosphate, presented a second phosphate mining project in Quebec (surface, igneous rock). He suggested that the low Ca/P in igneous rock could enable lower sulphuric acid consumption in rock processing to "wet acid", and lower contaminant levels, so possibly reducing cost of acid purification for applications such as LxFP battery cathode materials.

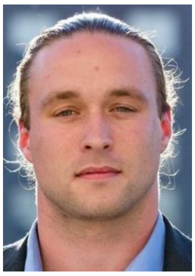
Michael Wurmser, Norge Mining, a mining company with plans to exploit large underground igneous phosphate rock deposits in Norway, underlined the need for EU resilience of phosphate rock supply ("just-in-case" economy) because of supply chain vulnerabilities and geo-political instability. He also noted the importance of socially responsible and sustainable mining, e.g. using green energy. Norge Mining's deposits also contain vanadium and titanium (EU listed Critical Raw Materials) which the company intends to produce. **Mr Wurmser indicated that Norge Mining plans to build a P_4 furnace and phosphoric acid purification facilities**.

Joe Garofoli, Roc Global, which provides capital raising and advisory services to power, energy, and natural resource companies. considers that investors can be reluctant to invest in phosphate mines and processing because the market is unstable. This is because of current domination of the global market be a few suppliers and because prices and supply are largely influenced by national policies rather than market trends. Also, investors are not familiar with the industry and it has poor historical performance (cyclical market). Outside China, the industry is hampered by lack of government support and slow permitting.

Fertiliser innovation and nutrient use efficiency

Karl Wyant, Nutrien, the world's largest supplier of crop inputs and services, reminded that phosphorus use efficiency (PUE) by crops varies widely from c. 5% to c. 30%. Unlike nitrogen, much of the unused phosphorus will remain in soil and is available for future crop cycles, but low PUE means increased risk of phosphorus losses to surface waters and economic losses for farmers.

Phosphorus Use Efficiency depends mainly on soil conditions. Soil P sampling and monitoring of yield per kg P input are thus both essential. The number of P soil samples taken annually by US farmers has increased from around 3 to 12 million per year over the last fifteen years, but more are needed, because often soil conditions vary within fields and one sample per field is inadequate. Better data is also needed on P returned to fields in crop residues and on how P uptake is related to soil organic carbon.



Hunter Swisher, Phospholutions, presented the company's RhizoSorb technology, composed of a patented and proprietary material which is incorporated into mineral P fertiliser production to enhance crop P uptake. The chemical modifies the phosphorus concentration gradient so facilitating plant P uptake irrespective of environmental conditions. Based on over 300 field trials, the company indicates that P applications can be reduced by around half without losing yield, that yield can be increased in low-P soils, and that potential for P loss to surface waters can be reduced by a factor of four because P is bound to the surface of RhizoSorb.

The product is **certified by the US EPA as an "Enhanced Efficiency Fertilizer"** in the eutrophication-sensitive Chesapeake Bay catchment, enabling subsidies to farmers for its use.

Mr. Swisher underlined the long and expensive timeline from R&D at Pennsylvania State University to industrial roll-out, from 1991 to today, consequence of the need for multi-year field trials, technology scale-up to implementation using fertiliser industry technology and existing farmer spreading equipment, obtaining investment and official recognition.

Andy Jung, Mosaic, suggested that the phosphate fertiliser industry should set realistic sustainability objectives. Priorities could include improving Phosphorus Use Efficiency in the field and soil health, recycling of phosphate production wastes (gypsum) and recycling of organic waste streams. For phosphorus in organic wastes, the challenge is that secondary resources are dilute and diffuse (small scale).

A question is **how to pass on the costs of sustainability, but for phosphorus these costs are small** compared to overall fertiliser production costs.

Sustainable fertilisers

Two conference panels, organised by CRU and ESPP, addressed **sustainable fertilisers and nutrient recycling**, with industry and research experts.

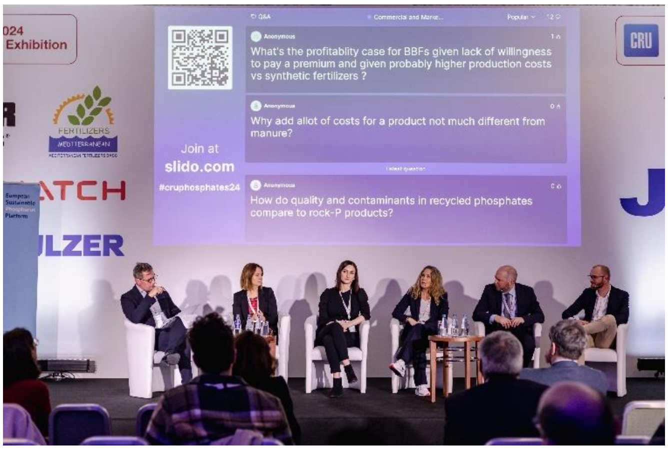
Anthony Zanelli, ICL Fertilizers, noted the challenge of differing sustainability standards across the world. The EU is now implementing **CBAM (Carbon Border Adjustment Mechanism) for fertilisers** (see ESPP eNews n°85) to push towards lower carbon emissions and ensure a level playing field in Europe for fertiliser manufacturers. Imported fertilisers will have to pay an import tax, calculated to compensate costs of lower EU average emissions compared to world average, unless they can document low carbon production. CBAM current targets CO_2 emissions of nitrogen fertilisers. ICL considers that CBAM should be extended to phosphorus content (non-renewable Critical Raw Materials).

Lucas van der Saag, ICL Fertilizers, indicated that **ICL has now commercialised a first batch of 1 000 tonnes of recycled fertiliser, 'Puraloop', with phosphorus 100% from sewage sludge incineration ash,** produced at ICL's Amsterdam phosphate fertilisers production site. This is the first ash-based recycled fertiliser to obtain the EU Fertilising Products Regulation CE-Mark.

The ash undergoes acidification in the existing fertiliser plant, then granulation. Handling and chemistry are different from using phosphate rock and has necessitated process adaptation. Specific REACH registrations have been prepared and submitted ("reaction products from the acidulation of sewage sludge ash with sulphuric acid" and "reaction products from the acidulation of sewage sludge ash with ortho-phosphoric acid", EC n° 954-735-5 and EC n 955-079-2). **EU Fertilising Products Regulation FPR certification** has been obtained (FPR Conformity Assessment Module D1) published under code: FD 007811 001.

Further production is planned at ICL's Amsterdam plant. ICL's German production site in Ludwigshafen will also start this new process in coming months.

ICL notes that the recycled fertiliser has specific characteristics different from synthetic mineral fertilisers. The ash contains negligible cadmium and fluorine, has no odour, but does contain iron and aluminium. The ash-recovered fertiliser achieves EU FPR phosphorus crop availability criteria (>80% NAC solubility of P) and has shown good results in agronomic trials.



Sara Stiernstrom, EasyMining (Ragn-Sells waste management group), presented the company's three nutrient recovery technologies:

- **Ash2Salt**: recovery of purified potassium salts from municipal solid waste incineration ash. One full-scale plant operating since 2023 (130 000 t-ash/year) in Stockholm.
- **Ash2N**: nitrogen recovery (as ammonium salt solution) from aqueous phase of wastewaters. 4 m^3/h input pilot tested since 2022.
- **Ash2Phos**: recovery of purified (feed-grade) calcium phosphates from sewage sludge incineration ashes. Two full-scale plants under permitting / construction at Helsingborg, Sweden, and Schkopau, Germany (both 30 000 t-ash/y input, 15 000 t/y production of calcium phosphates)/

If P were recovered from the c. 40% of EU sewage which is currently combusted, this would represent c. 0.11 MtP/y.

EasyMining's recovered calcium phosphate (RevoCaP) offers high purity, <5% water content and low CO_2 footprint. The calcium phosphate respects the EU Fertilising Products Regulation CMC13 criteria. It is 100% citric acid soluble and 75% - 80% NAC soluble. Trials have shown high digestibility with pigs and poultry, comparable to commercial animal feed phosphates.

Marc Sonveaux, Prayon, explained that Prayon aims is to reduce the consumption of primary mineral phosphate resources by **maximisation of the use of secondary phosphates for its productions in Europe and promotion of technologies able to process phosphate containing waste streams**. He outlined several of the company's recycling technologies:

- **Ecophos DCP, GetMoreP and magnesium leaching processes:** upgrading of low-grade phosphate rock or mine waste streams to DCP "Superock" using dilute hydrochloric acid or dilute sulphuric acid, to remove amongst others heavy metals, magnesium, iron and aluminium. Superock can then be used for clean phosphoric acid production.
- **Phosphoric acid recycling**: recycling and upgrading of spent phosphoric acids from uses such as metal treatment.
- **Ecophos Loop Process (PELP**: phosphate-containing ashes are attacked with phosphoric acid, then the phosphoric acid is purified using three-stage ion exchange (separation of calcium/magnesium, iron, aluminium) then recycled back to the process.
- **Gypsum** from Prayon's phosphoric acid production, Engis, Belgium, from mainly sedimentary rock, is 85% valorised in construction materials with low waste generation.

Bryan Gooch, Nutrien, underlined the need to invest in phosphate rock mine capacity and **improve sustainability and supply resilience of phosphate rock mining**, to meet future global food needs (see above discussion of phosphate mining projects).

Laia Llenas Argelaguet, BETA Tech Center, University of Vic Spain presented results from the Fertimanure Horizon 2020 research project, which has demonstrated the "biorefinery" approach, producing 18 different recycled fertiliser products from manure at five sites in five different EU countries. Field trials have shown that these recycled products are effective fertilisers, with similar nutrient loss risk to synthetic fertilisers (but with somewhat lower N_2O emissions in use). A stakeholder survey shows that **farmers would not pay more for a manure-derived fertiliser** than for a mineral fertiliser, and that the form of the product (compatibility with existing fertiliser spreading equipment), nutrient plant availability and concerns about possible contaminant risks are key purchasing decision factors.

Marzena Smol, Mineral and Energy Economy Research Institute of the Polish Academy of Sciences, presented results from the Lex4Bio Horizon 2020 research project, looking at a range of recycled fertilisers produced from different secondary materials. The Life Cycle Analysis of recycled fertilisers is not always better, but the objective is to decrease consumption of and dependency on non-renewable raw materials. A survey of 2 000 farmers showed that key motivations are sustainability and soil health and that challenges are price, concerns about consumer acceptance and lack of experience.

Fanny Tham, Race for the Baltic, presented the association's actions to reduce losses of fertilisers in handling in ports. Indications are that **up to 0.05 – 0.06 % of the dry bulk fertiliser is fertiliser cargoes can be lost in ports (10 - 30 tonnes from a bulk cargo ship)**, dropped onto the quayside from where it is washed into the sea, or dropped directly into the sea between ship and quay.

According to the Swedish Environmental Code, ports should avoid dropping any substance into the sea. This is why some of the best practises defined by Race For The Baltic in terms of handling dry bulk fertiliser in ports have been included in the Swedish Environmental Protection Agency's Guidance for Ports on Environmentally Hazardous Activities.

Race For The Baltic has developed, in collaboration with fertiliser ports in Sweden, Denmark and Poland, a cover to prevent fertiliser dropping into the sea between the ship and the quay side. The organisation has also developed a manual on best practices related to handling dry bulk mineral fertilisers in ports. One port that has implemented some of these practices reported a fertiliser reduction loss of 67%.

Discussion

Participants noted that fertiliser and food industry sustainability objectives, limits on cadmium levels in fertilisers and policies for food security and fertiliser supply resilience are drivers for nutrient recycling. However, transition incentives are needed to support farmer and market uptake.

A challenge is **scale and logistics**. Current mineral fertiliser production and distribution is centralised and large scale, but secondary nutrient sources are generally local and small scale. Solutions can include processing to concentrated, easy-to-transport materials (such as combustion ashes) or local processing and distribution of organic and organo-mineral fertilisers.

Long-term agreements need to be found to **share costs/benefits between fertiliser producers/distributors and waste producers/managers**. The fertiliser industry tends to see secondary nutrients as a potential revenue stream (gate fee for waste) whereas the waste producers hope to be paid for nutrient content.

In discussion at the ESPP panel, public policy needs identified include:

- Incentives for initial uptake of recycled fertilisers
- Regulatory nutrient recycling requirements for waste streams
- Information and communication to support end-user acceptance
- R&D towards production of nutrient-concentrated products, compatible with transport and industrial logistics
- Open regulation, facilitating placing on the market of recycled nutrient products, based on product quality and safety not on input materials, including harmonisation of different legislations (fertilisers, animal feed)
- Continuing widening of EU Fertilising Products Regulation and of acceptance of recycled nutrients in Certified Organic Farming.
- Improve handling of fertilisers in ports and elsewhere to reduce losses to surface waters.

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