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ESPP detailed input to
EU Sewage Sludge Directive Targeted Stakeholder Consultation
(Trinomics/Wood for DG ENVI)

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Q33. There are actions at Member State or regional level that target recovery of nutrients and energy from sewage (e.g. German phosphorus recovery ordonnance, Sweden phosphorus recycling policy, HELCOM sewage sludge handling Recommendation, etc.). In your opinion, how could the SSD facilitate such actions? -> Nutrient Recovery

ESPP considers that **requirements for nutrient recycling in the Sewage Sludge Directive** (SSD) would be coherent with the national and regional policies cited (Germany, Baltic …) and also with EU Green Deal policies, in particular the Circular Economy Action Plan, the Integrated Nutrient Management Action Plan and the Farm-to-Fork nutrient loss reduction target.

ESPP suggests that the Sewage Sludge Directive (SSD) should **specify minimum % requirements for phosphorus recycling from sewage sludge**.

Phosphorus recycling should be defined to include both:

- recovery in a final product where the phosphorus is a nutrient (e.g. as a fertiliser, animal feed[i] …) or in an intermediate phosphorus chemical for the phosphorus chemicals industry (e.g. phosphoric acid), and,
- appropriate reuse of the phosphorus through agricultural application of the sewage sludge, such that the phosphorus is applied according to agronomic recommendations to supply crop requirements, and such that use does not increase risk of phosphorus losses to surface waters

We suggest that **a phosphorus recycling requirement should be defined**

1. **as a % of the total phosphorus in the sewage 'connected'** (calculated to be entering the sewerage network). Defining recycling as a % of phosphorus "in sewage sludge" can result in ambiguities as to where this is measured (before or after dewatering) and could lead to conflicting messages with objectives of reducing sewage losses in sewer pipes, reducing atmospheric P losses in sewage treatment[ii] and increasing phosphorus removal in the sewage works.
2. to require either:
   - **recovery** of the phosphorus in a useful form, either as a chemical for use in the phosphate industry, or as a fertiliser respecting EU Fertilising Products Regulation or national fertiliser regulation criteria (plant availability, contaminant levels);
   - or **appropriate reuse in agriculture** after treatment such as anaerobic digestion or composting (a) which respects safety criteria for contaminants and pathogens, (b) where application corresponds to crop needs for nutrients (in particular for phosphorus which is often the 'limiting' factor and (c) calculation of crop needs takes into account the total P content of the sewage sludge

For further discussion, including positions of different stakeholders and shared discussion points, see pages 3-7 of ESPP Scope Newsletter n°129 www.phosphorusplatform.Scope129

A phosphorus recycling requirement should be applicable per water basin or across all sewage works of an operator or operators. This would enable **optimisation of cost-effectiveness** compared to a fixed % applicable to every sewage works.

Concerning the recycling requirement and contaminants, the SSD should **refer to the Water Framework Directive art. 9 on cost recovery of water services**, including environmental and resource costs. Cost recovery should concern not only "water consumers" but also industries which are the original source of costs.

It is probably unrealistic and ineffective to recover costs from the industry which is the main source of phosphorus in sewage, that is agriculture and the food chain. In particular, cost recovery based on phosphorus content of foods is probably not feasible, and could lead to unintended consequences (food P-content can be significantly different from P-footprint). However, **the costs of sewage sludge management, of nutrient recycling and of organic carbon valorisation are strongly related to contaminant levels**, which can hinder certain recycling routes or increase recycling process costs. According to the polluter-pays principle, cost recovery for nutrient recycling should therefore target industries at the origin of contaminants in sewage sludge: pharmaceuticals, microplastics (textiles, car tyres), industrial or consumer chemicals …

The priority for nutrient recycling from SS should be phosphorus, because (as indicated) some Member States or regional policies already have phosphorus recycling requirements from sewage, because Phosphate Rock is on the EU Critical Raw Materials List (confirmed on the 4th updated list, 4/9/2020, COM/2020/474) and because technologies for P-recovery are now available (see ESPP P-recovery technology catalogue).

A second priority should be **valorisation of organic carbon**, either by return to soil or by energy recovery.

Nitrogen recycling could also be considered, but this would need to take into account N losses during sewage treatment, so the recycling % should be based on total N in 'connected' sewage, not on N in sewage sludge. This is as suggested for phosphorus above. For N, calculation of losses to air in sewage sludge storage, processing and agricultural use is however complex.

Estimates of **phosphorus recovery costs** are provided by Nättorp et al. 2017[iii] (based on P-REX) who suggest costs of 0 – 3€ per annum per capita (for technical recovery as chemical or fertiliser products, compared to reference scenario of agricultural use of biosolids).

Nutrient recycling requirements in the SSD should be **accompanied by other EU policy tools** to enable and facilitate:

- **limits on contaminants** in SS, action to reduce contaminants at source (restrictions on problematic chemicals, use reductions, source separation of inputs to sewerage networks from industry, hospitals …), requirements on contaminant reduction in sewage and sludge treatments, see below;
- **scientific risk-assessment of contaminants**
- **EU-led consultation with the food industry, farmers, consumer associations** on contaminant management and biosolids valorisation, including on nutrient recycling
- **R&D support** for nutrient recycling, contaminant reduction, …
- continuing **regulatory action to enable commercialisation of appropriate and safe nutrient products derived from sewage sludge** and address regulatory obstacles:
  - reassessing the current exclusions of sewage sludge from composts, digestates and pyrolysis materials (biochars) in the EU Fertilising Products Regulation
  - obstacles to recycling of (appropriately processed and safe) sewage-derived nutrients in animal feed (see above)
  - inclusion of sewage-recovered struvite and calcined phosphates into the EU Organic Farming Regulation (the scientific committee EGTOP has already given a positive opinion[iv] on these two materials) and consideration of other recycled nutrient materials for admission to the EU Organic Farming Regulation annexes (this is conform to the general principles of Organic Farming which promote recycling[v])

Q 36. The table below presents the most common treatment techniques, disposal and nutrient recovery methods applied to sewage sludge in the EU. Over the next 10 years, how do you expect the use of the following sewage treatment/disposal/ recovery techniques to evolve? → Nutrient recovery → Other

A **wide range of different routes are today available for phosphorus recycling from sewage sludge**:

- **use of appropriately treated SS on farmland** (e.g. after anaerobic digestion and/or composting to ensure stability, avoid odour and remove pathogens), to supply nutrient needs of crops, so also returning organic carbon and micronutrients to soil. See "State of science on sewage biosolids" update on use in agriculture, 2018, ESPP SCOPE Newsletter n°129 www.phosphorusplatform.eu/Scope129
- **growing algae or plants** (micro-algae, duckweed, willow trees, phragmites reeds …) which can fix nutrients into biomass which can then be processed or used in production of cosmetics or biofuels, energy production, fertilisers, animal feed …
- **precipitation of phosphate salts** from sludge dewatering liquors, e.g. struvite, vivianite
- **recovery of ammonia salts** from digestor gas stripping
- **use of adsorbents to remove P** and recycling either by release of the P from the adsorbent and regeneration (recovery as a phosphorus chemical) or use of the P-loaded adsorbent as a fertiliser (e.g. use of natural minerals or biological secondary materials as adsorbents[vi]). Several recent science reviews of adsorbents are here www.phosphorusplatform.eu/Scope138
- **pyrolysis / gasification of sewage sludge** to recover energy, sanitise and produce a biochar or pyrolysis material which can be used directly as a fertiliser, or used as an active carbon for nutrient removal, before recycling
- **chemical or thermochemical P-recovery from sewage sludge or sewage sludge incineration ash** (e.g. Ash2Phos/EasyMining, Outotec AshDec, ZAR/Phos4Life, Pyrophos, Remondis…)
- **use of sewage sludge incineration ash as a raw material in fertiliser production** (adaptation of process to take ash as well as phosphate rock)
- **electro-thermal reduction of sewage sludge or sewage sludge incineration ash** to produce P4 (e.g. Italmatch/Recophos)
- **innovative processes** currently at the lab/pilot scale: electrolysis cells operating on sewage sludge or sludge ash, producing hydrogen and releasing phosphorus: ion exchangers …

Some of the above processes can ensure nutrient removal / tertiary sewage treatment at the same time as nutrient recovery.

Q40. Do you believe that there are chemical substances (e.g. chemicals of emerging concern) that should be specifically addressed by the SSD?

ESPP suggests that the following should be targeted by the SSD:

- **PFAS (i.e. PFOA, PFOS, PFNA and PFHx) and other perfluorinated chemicals**.
  See EFSA Opinion 6 July 2020[vii]
  It can be hoped, however, that this is a "temporary" problem and that the restrictions on import, production and use of these chemicals proposed in SWD(2020)249 [viii] will result in these chemicals no longer being found at significant levels in sewage sludge (will take some time because of their persistence).
  The restrictions put into place need to cover the whole family of perfluorinated chemicals ensure that there is not a regrettable substitution by similar perfluorinated chemicals, and SS monitoring needs to verify that PFAS levels fall following restrictions and that the levels of other perfluorinated chemicals do not rise.

- **Human and veterinary pharmaceuticals**
  For discussion and references for recent research and expertise on risk and perception pharmaceuticals in sewage sludge, see ESPP SCOPE Newsletter summary of Malmö workshop 2017[ix]
- **Non-biodegradable organic chemicals used in cosmetics**
- **Brominated flame retardants and other PB or PT plastic additives**
- **Cypermethrin**
- **TBT** (tributyltin)
- **Microplastics**

For further information we refer to the detailed and documented **UKWIR CIP2 studies**, for example, identified perfluorinated chemicals and fluoranthene, brominated flame retardants, cypermethrin and TBT as priority industrial contaminants[x]

ESPP underlines that the SSD should limit levels of contaminants in sewage sludge and loads to soil in case of biosolids application, but should also **specifically address reduction of contaminants at source**, both by reductions in use (including restrictions for industrial and consumer chemicals which are found at significant levels in sewage sludge and are not broken down in sewage treatment) and by separation from municipal sewerage networks of contaminants flows (e.g. industry discharges, hospitals …). The SSD should also address the objective of improving breakdown or removal of contaminants in sewage treatment and sewage sludge processing. For example, more R&D is needed to establish whether anaerobic digestion processes can be modified to improve breakdown of pharmaceuticals (whilst maintaining biogas production).

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[i] There is currently a regulatory obstacle to recycling of nutrients from sewage sludge to animal feed: the EU Feed Regulation 767-2009, Annex III, point 5 includes under Prohibited Materials: "*All waste obtained from the various phases of the treatment of the urban, domestic and industrial waste water, as defined in Article 2 of Council Directive 91/271/EEC of 21 May 1991 concerning urban waste water treatment, irrespective of any further processing of that waste and irrespective of the origin of the waste waters*." ESPP has asked DG SANTE to address this obstacle.

[ii] Phosphorus losses to air during sewage treatment are probably generally not significant, but may occur in some specific conditions. E.g. nearly 20% of P removed from sewage in an oxygen limited membrane reactor was released as phosphine "Global phosphorus dynamics in terms of phosphine", W. Fu & W. Zhang, Climate and Atmospheric Science (2020) 3:51 ; https://doi.org/10.1038/s41612-020-00154-7

[iii] "Cost assessment of different routes for phosphorus recovery from wastewater using data from pilot and production plants", A. Nättorp, K. Remmen & C. Remy, Water Sci Technol (2017) 76 (2): 413-424 http://dx.doi.org/10.2166/wst.2017.212

[iv] EGTOP Opinion 2/2/2016 https://ec.europa.eu/agriculture/organic/eu-policy/expert-advice/documents/final-reports/final-report-egtop-on-fertilizers-2_en.pdf

[v] Regulation 2018/848 (replaces 834/2007) art.5(c) specifies as a "general principle" of Organic Farming "the recycling of wastes and by-products of plant and animal origin as input in plant and livestock production"

[vi] E.g. FILTRAFLO™-P crab carapace-based P-adsorbent https://www.nweurope.eu/media/12161/phos4you_p-rich_biomass_en_nov2020.pdf

[vii] https://www.efsa.europa.eu/en/news/pfas-food-efsa-assesses-risks-and-sets-tolerable-intake

[viii] https://ec.europa.eu/environment/pdf/chemicals/2020/10/SWD_PFAS.pdf

[ix] www.phosphorusplatform.eu/Scope123

[x] https://ukwir.org/the-national-chemicalinvestigations-programme-2015-2020-volume-3-wastewater-treatmenttechnology-trials