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## Events

### Implementation of EU UWWTD art. 20 P reuse and recycling rates, Madrid 8-9 June

ESPP workshop to input to the development of proposals for phosphorus “reuse and recycling rates” from sewage, update on P-recovery, with participation of the European Commission Joint Research Centre (JRC).

This workshop will enable direct dialogue between phosphorus recycling technology suppliers, wastewater operators, fertiliser companies and regulators working on defining the implementing criteria for the Urban Waste Water Treatment Directive nutrient removal and (art. 20) phosphorus “reuse and recycling rates”:

- EU policy context and UWWTD art. 20 implementation work ongoing: European Commission JRC
- Spain policy context: Spanish Ministry for Ecological Transition and Demographic Challenge
- Are “Quotas” an appropriate policy tool ? (recycled phosphorus content obligations for fertilisers)
- Sewage sludge incineration and alternative thermal processes: costs, logistics, energy recovery, phosphorus recovery
- Sewage biosolids valorisation to agriculture
- Digestion processes to release soluble P from sewage for higher recovery rates

To present an update on your recycling technology or to speak at this workshop, contact [info@phosphorusplatform.eu](mailto:info@phosphorusplatform.eu)

Workshop on phosphorus reuse and recycling from urban wastewater, Madrid, Monday 8<sup>th</sup> June 14h00 – Tuesday 9<sup>th</sup> June 12h30. Site visits Tuesday 9<sup>th</sup> afternoon. <https://www.phosphorusplatform.eu/WorkshopMadridArt20>

### 6<sup>th</sup> European Sustainable Phosphorus Conference ESPC6 24-26 November 2026, Benguerir, Morocco.

[www.phosphorusplatform.eu/ESPC6](http://www.phosphorusplatform.eu/ESPC6)

ESPC is the world's leading sustainable phosphorus event, every 2-3 years. Don't miss it! ESPC6 will include a site visit to an OCP phosphate mine, rock beneficiation and processing.

ESPC6 is co-organised by OCP Group and ESPP, with support of UM6P (Université Mohammed VI Polytechnique).

ESPC6 will take place at UM6P Université Mohammed VI Polytechnique, in Benguerir (one hour shuttle from Marrakech), with accommodation in Benguerir or Marrakech.



ESPC6 will address:

- ✓ Fertilisers, P-stewardship and their role in supporting sustainable food systems and food security
- ✓ Interactions between climate change and phosphorus, including impacts on P dynamics, carbon sequestration, soil fertility, crop productivity, and nutrient requirements
- ✓ P-recovery and recycling
- ✓ P-removal
- ✓ Sustainability in P mining and processing
- ✓ Other aspects of P chemistry, P management, and P different uses.

*In addition to site visit, side events may include a Young Nutrient Researchers Day.*

**Deadline for abstracts 30<sup>th</sup> April 2026.** Proposals for side events are welcome to [ESPC6@phosphorusplatform.eu](mailto:ESPC6@phosphorusplatform.eu)

## Regulatory

### EU consultation on Animal By-Products amendment to Fertilising Products Regulation

**Public consultation, open to 11<sup>th</sup> May 2026, on draft Delegated Regulation to include certain Animal By-Products (ABPs / “derived products”) into the EU Products Regulation under CMC 10.** If adopted, this will authorise use in CE-Mark fertilisers of the following ABPs, as such, under CMC10, subject to definitions, limitations and conditions:

- “processed” manure and insect frass (processed as per ABP regulations). Processed manure was already authorised by 2024/1682. Insect frass is added
- Glycerines
- Processed Animal Protein (PAP)
- Meat and Bone Meal
- Blood, horn and hooves products
- Hydrolysed protein (including from leather or textile industries) \*
- DCP and TCP

\* A chromium limit of 400 mg/kgDM TOTAL chromium applies to these and will limit the use of leather and textile processing by-products.

Use of these specified ABPs will be subject to definitions and conditions specified in this proposed amendment to the FPR and to those specified in the ABP Regulations amendment 2023/1605.

For memory, ABPs are already authorised for use in FPR composts, digestates and ash-derived products, by 2026/1605 and FPR CMCs 3, 5, 13.

**Public consultation, open to 11<sup>th</sup> May 2026,** “Products derived from animal by-products as component materials in EU fertilising products” [https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/16132-Products-derived-from-animal-by-products-as-component-materials-in-EU-fertilising-products\\_en](https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/16132-Products-derived-from-animal-by-products-as-component-materials-in-EU-fertilising-products_en)

### Consultations open on EU standard test methods for fertilising products

**CEN (European Committee for Standardisation) consultations on 20 draft standards for test methods for the determination of characteristics of materials, as required by EU Fertilising Products Regulation criteria.** Deadlines vary from 30<sup>th</sup> April to 11<sup>th</sup> June. The draft standards, under CEN/TC 260 “Fertilisers and liming materials”, cover measurement of arsenic, potassium, chloride, organic carbon, copper and other micronutrients, other elements and contaminants, measurement of particle size and of other properties, in different types of fertilisers, phosphonate content

*At this stage, technical content and editorial comments are invited. Comments can only be submitted via national standardisation bodies, and stakeholders should contact their national standardisation body to consult the draft standards and to comment.*

### Significant volumes of biological by-products could safely be recycled in animal feeds

**Bellona Foundation report concludes that current regulatory barriers restrict the use of biological by-products, limiting circular feed opportunities.** It refers to the **EU Feed Circularity Catalogue by FEFAC, ESPP and 6 industry federations** (see [ESPP eNews n°97](#)). The report underlines the importance of the bioresources valorisation cascade pyramid, with pharmaceuticals and biochemicals as priority, then human food, animal feed, biomaterials, fertilisers, before bioenergy and regrets that this hierarchy is not fixed by regulation in the EU. Aquatic bioresources are emphasised, in particular fish and shellfish processing residues and aquaculture sludge from fish farming. The report estimates tonnages of different types of aquatic and terrestrial animal by-products, food wastes, biorefinery and agricultural residues, and discusses potential for valorisation and challenges, including regulatory barriers. Processing methods to reduce sanitary risks are outlined. Examples are given of other countries in the world where such biological by-products are recycled in animal feed. Political framing is outlined, including bioeconomy objectives, biomass supply constraints, global food and feed supply risk, resilience, climate and circularity. A number of case studies are presented. The report concludes that Europe has substantial and readily available volumes of biological resources which are currently underutilised or down-cycled, whereas they offer potential for animal feed production if their use were authorised under appropriate safety conditions. Regulatory actions recommended include:

- Clarifying classification between feed materials and waste

- Harmonising Member State interpretations
- Guidance on safe use for biological by-products
- Allowing safe use as insect food to produce animal feed
- Reassess and remove where unjustified specific restrictions on certain streams, including updating the TSE Regulations

*“Regulatory barriers to the use of biological by-products in European feed production”, Bellona Report 2026, 45 pages <https://eu.bellona.org/publication/regulatory-barriers-to-the-use-of-biological-by-products-in-european-feed-production/>*

## ESPP input to EU Livestock Strategy

**ESPP input to the public consultation on an EU ‘Livestock Strategy’ underlining the importance of manure management and nutrient recycling for environmentally and economically sustainable livestock farming in Europe.** ESPP noted that science suggests that a dietary animal : plant protein ratio lower than around 40:60 would result in more land being needed for food production, because livestock use biomass efficiently that humans do not want or cannot eat (grazing of grass, recycled materials) and generate manure, which is used as fertiliser. Extensive livestock are also crucial for biodiversity in many areas, by maintaining open countryside and pasture ecosystems (see [SCOPE Newsletter n°155](#)). ESPP noted that phosphorus (EU Critical Raw Material “Phosphate Rock”) is conserved in livestock: that is, all phosphorus in animal feed and fodder either goes to manure (which can be recycled as fertiliser, if efficiently applied when and where it is needed by crops or grass) or to the animal carcass, milk or eggs. The amount of phosphorus in livestock manure is of the same order of magnitude as that used in mineral fertilisers in Europe. Improving the effective recycling of nutrients in manure (nitrogen, phosphorus) is thus a vital element of the Livestock Strategy: to reduce EU dependency on imported natural gas (for nitrogen fertilisers) and on the CRM Phosphate Rock, and also to reduce water pollution (eutrophication) and achieve water policy quality objectives. Effective recycling of manure nutrients requires application of manure when and where it is needed, according to crop or grass requirements, including where appropriate processing of manure or digestate to enable storage and transport, facilitate application and improve plant use-efficiency. This may require addressing regional imbalances between livestock concentration and crop fertiliser needs by adjusting livestock numbers and regional distribution.

ESPP submitted the conclusions of the stakeholder workshop on phosphorus sustainability in livestock, organised in Saint Malo, Brittany, France, 5-7 March 2025, by ESPP with TIMAC AGRO (Roullier Group), Cooperl, BETA (Vic Spain), CEH UK, as part of the United Nations UNEP GEF uPcycle project. In particular, the 25 key messages of this workshop constitute a one-page contribution, included in the workshop summary (page 17 of [SCOPE Newsletter n°155](#), 2025).

*EU Call for Evidence “Livestock Strategy” [https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/16832-EU-livestock-strategy\\_en](https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/16832-EU-livestock-strategy_en) - ESPP input, 10<sup>th</sup> April 2026 [www.phosphorusplatform.eu/regulatory](http://www.phosphorusplatform.eu/regulatory)*

## Future EU Circular Economy Act

### Ellen MacArthur proposals for EU Circular Economy Act

**The Foundation proposes three aims for the upcoming EU Circular Economy Act: enabling an open EU market for circularity and waste, fiscal and demand levers for recycling and supporting industrial collaboration and value chains.** The Ellen MacArthur Foundation underlines the importance of circularity to EU competitiveness, decarbonisation and economic resilience. The Foundation emphasises the problems posed by differing Member State rules on waste, where a material can be a valuable secondary resource in one MS but a ‘waste’ in another, “creating red tape that hinders the growth of circular business models”. Priorities identified include:

- defining EU End-of-Waste (EoW) for additional material streams;
- facilitate EoW for minimally processed products, e.g. biobased materials;
- waste shipment rules should allow transport of waste and of materials for recycling, with simplified risk-based procedures;
- establish a common EU glossary for circular economy terms (reuse, recovery, recycling, refurbishment, remanufacturing ...), reflected in the EU Taxonomy;
- define custom codes for secondary materials and recycles;
- fix EU standards, harmonise, digitalise and simplify EPR (Extended Producer Responsibility) schemes, including through the EU Digital Product Passport (DPP);
- use EPR funding for separate collection, extraction of recyclable materials from mixed waste;
- despite the limited EU powers on fiscal policy, move towards reduced VAT for recycling, coherence between VAT and EPR;
- introduce mandatory circularity requirements into public procurement;
- support EU industrial alliances for circular economy, trans-regional circularity hubs;
- align skills and employment initiatives;
- include circularity into EU trade policies and international initiatives.

*“The EU Circular Economy Act: a critical opportunity”, Ellen MacArthur Foundation report, 20 pages, 23 March 2026 <https://www.ellenmacarthurfoundation.org/eu-circular-economy-act>*

## ESPP proposes to facilitate uptake of secondary nutrient materials

ESPP has requested a meeting with the European Commission to discuss how transport and use of secondary materials can be facilitated in the upcoming EU Circular Economy Act.

ESPP suggests to consider:

- **a new legal status ‘secondary nutrients for recycling’**, which would enable EU market access, transport and site permitting, but would retain (digital) traceability, producer cradle-to-grave responsibility, and application plan and declaration. This could enable to escape from the present impasse where EU End-of-Waste status is made inaccessible because of safety and origin concerns (hence the exclusion of many materials from the EU Fertilising Products Regulation FPR) and national End-of-Waste status is not recognised across country borders;
- **address obstacles to Industrial Emissions Directive site operating permit obstacles** which can hinder changing from ‘virgin’ inputs to secondary materials;
- **Green Listing of nutrient waste materials intended for recycling**, e.g. for (intended) EU FPR CMC materials, a ‘waste’ in one Member State which is an authorised fertiliser in another, ‘clean’ biorefinery residues and similar (from processing of plants, food and feedstuffs, etc. without dangerous chemicals).

ESPP letter to European Commission preparing the Circular Economy Act, 19<sup>th</sup> April 2026 [www.phosphorusplatform.eu/regulatory](http://www.phosphorusplatform.eu/regulatory)

## Fertilisers regulations

### ESPP requests clarification on various biorefinery / biowaste materials under FPR

ESPP has requested that the European Commission clarify whether or not, or under what conditions, various nutrient materials can be used as input materials to CE-Mark fertilisers under the EU Fertilising Products Regulation (FPR). This follows questions from operators wishing to process into fertilisers (and so recycle) organics and nutrients from secondary materials (wastes or by-products) from the food industry, biorefineries or separately collected household waste (“biowaste”, which is classified as an Animal By-Product (ABP) as it can contain discarded meat or dairy materials). The questions concern points. Materials concerned are: sterilised dairy processing residue streams; biochars from compost/digestate of biowaste (where the composting / anaerobic digestion process can ensure ABP sterilisation); input of pyrolysed animal by-products to FPR composts/digestates. If these nutrient recycling routes are in fact not authorised under the current ABP regulations and FPR wordings, then ESPP requests that the relevant regulations be modified to remove wording contradictions that are blocking recycling, and to allow recycling to fertilisers of nutrients which have been ABP-sterilised and so are safe.

ESPP letters to European Commission concerning the EU Fertilising Products Regulation, 8<sup>th</sup> April 2026 and 19<sup>th</sup> April 2026 [www.phosphorusplatform.eu/regulatory](http://www.phosphorusplatform.eu/regulatory)

## Research

### Modelling suggests EU farming could reduce P use by 21% without production loss

The JRC study calculations are based on 1 km grid modelling of soil phosphorus levels and P offtake in crops compared to soil P levels, considered to be optimum, of 20 – 40 mg P<sub>Olsen</sub>/kg. This level of soil phosphorus is applied in the study without differentiation between soil and crop types, and is in line with EU Member States threshold levels for optimal soil P levels based on Olsen extraction. The study is based on modelled soil P levels for a 1 km grid of Europe from Panagos et al. 2022 ([ESPP eNews n°73](#)) and Ballabio et al. 2019 ([ESPP eNews n°40](#)), and P offtake by crops from Muntwyler et al. 2024. It concludes that around one third of EU agricultural land has soil P higher than optimal levels, around half optimal and less than one fifth below the optimal range. The study modelling suggests that total P use in EU farming should be reduced by 5% to prevent P accumulation in soils which already have optimal or above optimal soil Olsen P. This would be a reduction of c. 100 ktP/y (for comparison, this is around 50% of the total P in EU sewage sludge \*). The study notes that in some regions of Europe, soil P is below optimal and is being “mined” (offtake > inputs), in particular in Southern France, Greece, Czech Republic and Hungary. Overall, the study modelling concludes that total agricultural P use in Europe could be reduced by 21% in order to reach optimal levels of soil P below 40 mg/kg by 2050, so without compromising crop production, with reductions in P use in particular in Northern France, Flanders, The Netherlands, Germany, Denmark, Poland and Ireland. This new study adds to results of previous JRC modelling published which suggested that EU farmland soils accumulated around 190 ktP/y on average from 2010-2019 (0.11 kgP/ha/y average across all agricultural soils) (Muntwyler et al. 2024 in [ESPP eNews n°83](#)).

\* 219 ktP/y in EU-27 sewage sludge in 2022, JRC draft report on the “combined minimum recycling rate for phosphorus” under the Urban Waste Water Treatment Directive, not publicly published, December 2025, derived from Van Dijk et al. 2016

“Opportunities for optimizing phosphorus inputs in EU agricultural soils”, E. Van Eynde (EU JRC) et al. *Environmental Science and Policy* 171 (2025) 104168 <https://doi.org/10.1016/j.envsci.2025.104168>

## Review paper on elevated phosphate and kidney damage

**Review of 400 studies discusses how kidney disease leads to risks of phosphate crystals in kidneys and questions whether elevated diet phosphorus intake could possibly contribute to kidney damage risk in healthy individuals.** In cases of kidney disease resulting in decreased kidney phosphate resorption or reduction in the number of functional nephrons, the concentration of phosphorus increases in nephrons in the kidney (in excreted urine: hyperphosphaturia), and can result in phosphate microcrystals forming in the nephron (damaging the kidney) or deposits in the renal collectors (kidney stones). However, the review shows that different studies reach different conclusions concerning the possible impacts of high dietary phosphorus intake on kidneys in healthy individuals (without CKD: chronic kidney disease). Six cited studies suggest that high phosphorus diets in healthy mice or rats induce kidney damage, whereas eight cited studies showed no kidney damage. Three epidemiological studies on humans show correlations between increased blood phosphate levels and kidney damage, but these do not show that diet phosphorus causes kidney damage. However, several animal and human studies do suggest that acute phosphorus intake (short term, extremely high) can cause kidney damage, but these are not representative of dietary phosphorus.

*"The effects of elevated phosphate on the kidney - damaging the gatekeeper", T. Mitchell et al., Pflügers Archiv - European Journal of Physiology (2026) 478:34, <https://doi.org/10.1007/s00424-026-03160-5>*

## 50% reduction in EU nutrient inputs needed to achieve safe planetary boundaries

**European Environment Agency (EEA) "Zero Pollution" outlook says 0.3 MtP/y are lost to surface waters in Europe, compared to 1 MtP/y inputs from mineral fertilisers.** The EEA document shows that phosphate and nitrate levels in surface waters have been significantly reduced in Europe from the 1990's through to around 2010 – 2015, but have since then stagnated or slightly increased. EEA notes that EU policies (revised Urban Waste Water Treatment Directive, Common Agricultural Policy Strategic Plans) will reduce phosphorus losses, but that intensive livestock production and imports of animal feeds will continue to generate phosphorus pollution in Europe and overseas. EEA consider that to achieve EU "[Zero Pollution Action Plan](#)" targets for nutrient losses and to remain within planetary boundaries, a 50% reduction of system nutrient inputs is needed. Eutrophication remains a significant cause of Quality Status objective failure of EU surface waters, and less than 40% of Europe's waters were in Good or High Quality status in 2021.

**The European Commission's mid-term review of the Zero Pollution Action Plan identifies nutrients as one of four areas where pollution has not been reduced and which remain a challenge** (nutrients, noise, microplastics, waste) and notes that "The actions aimed at helping farmers to adopt less polluting nutrients management practices, have been delayed due to the postponement of the Integrated Nutrient Management Action Plan" (INMAP, see ESPP eNews [n°76](#) and [n°69](#)). The Commission notes that the lack of regular data flows to assess nutrient losses is a knowledge gap. The Commission indicates that actions to reduce nutrient pollution will come with the revision of the Nitrates Directive, implementation of the CAP national strategic plans, the [Strategic Guidelines on EU Aquaculture](#) and the future Livestock Strategy.

*"Zero pollution monitoring and outlook 2025", EEAJRC Report 13/2024, published March 2025  
<https://www.eea.europa.eu/en/analysis/publications/zero-pollution-monitoring-and-outlook-report>*

*"Mid-term review of the Zero Pollution Action Plan 'Delivering clean air, ocean, freshwaters and soil', European Commission report, 29 January 2026, COM(2026)42, <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52026DC0042>*

## US nutrient surpluses stabilised since 1980's despite increasing agricultural productivity

**US EPA data 1987-2017 shows a 20% reduction in nitrogen surplus and near stable phosphorus surplus, despite increasing population and agricultural production, with +25% use efficiency improvements for N and P in agriculture.** The US Environmental Protection Agency (EPA) National Nutrient Inventory (NNI) provides estimates for agricultural, urban, atmospheric and natural nitrogen and phosphorus flows at the country and HUC12 scale (watershed hydrological unit) since 1987 (since 1950 for agriculture). Agriculture accounts for 66% of N inputs and 91% of P inputs (2007-2017), with around half of P inputs from manure and around half from fertiliser (total P inputs approx. 4 000 MtP/y). Around half of both N and P agricultural inputs is removed in crops, the remainder of P accumulates in soil or is lost to surface water. From 1997 to 2017, crop P offtake increased more than inputs (390 MtP/y vs. 260 MtP/y). Regional analysis suggests that, contrary to the national trend, P surplus increased in the Great Plains and other agriculturally intensive regions, with P surplus hotspots occurring in areas with intensive livestock production, such as southeast North Carolina and northwest Iowa. Despite +40% population increase since 1987, sewage works emissions were reduced by -9% for N and -19% for P, by improved wastewater treatment (combined with P-free detergents for P). This study does not estimate what part of P surplus accumulates in soils and what part is lost to surface waters, but other studies cited show reducing nutrient loads carried by major US river systems to the sea (Gulf of Mexico, Chesapeake Bay).

*"The US EPA's National Nutrient Inventory: Critical Shifts in US Nutrient Pollution Sources from 1987 to 2017", M. Brehob et al., Environ. Sci. Technol. 2025, 59, 27836–27852, <https://doi.org/10.1021/acs.est.5c08196>*

## Decarbonisation, geopolitics, fertilisers markets and agri-food economics

**Articles in Fertilizer Focus emphasise the strong impacts of trade policy politics on fertiliser supply and prices, strategic importance of ammonia decarbonisation and implications for the food industry and for agricultural resilience.** Russia and China have become the world's leading global fertiliser suppliers and are using this to advance geopolitical objectives through supply and price policies. China has strongly developed nitrogen fertiliser production, and because it has little gas resources, largely uses coal to produce ammonia, with high greenhouse emissions. Nitrogen fertiliser production is indicated to contribute over 2% of total greenhouse emissions, and decarbonisation for fertiliser importers such as the EU can offer synergy with escaping import dependence. Analysis shows that changes in fertiliser prices, which are very volatile, are related strongly to changes in trade policies: sanctions, export tariffs or use subsidies in different countries in the world, more than to energy price or shipping supply. Fertiliser price peaks, in importing countries, are passed through to food prices, resulting in an increase in food industry turnover (increased prices, whereas volumes are inelastic). Increased food prices contribute to inflation and recessionary impacts on the overall economy. Higher fertiliser prices also impact agriculture, leading to changes in crops, reduced fertiliser application, and so reduced yields, resulting in overall lower agricultural productivity. Current trade obstacles for fertilisers, including US import tariffs, China export restrictions, sanctions on Russia and Belarus (and now also gas and fertiliser transport disruptions) are impeding production investment, and will lead to future price and supply constraints.

*Fertilizer Focus, November/December 2025, Features: Fertilizer supply chains, markets, global trade "How geopolitics and decarbonization are disrupting fertilizer supply chains", R. Quitzow, M. Balmaceda, A. Goldthau, "When fertilizer markets freeze. The hidden costs of supply disruptions", H. Morão, "Fertilizers under pressure as U.S. tariffs reshape global input trade", V. Piñeiro, J. Glauber Joseph, J-P. Gianatiempo.*

## Overestimating Planetary Boundaries for nutrients: flows versus stocks

**Planetary boundaries for N and P are currently based on annual flows, whereas those for climate change are based on stocks (atmospheric CO<sub>2</sub>), leading to non-comparable representations and over-assessments for nutrients.** For coherence, the authors propose to calculate climate change Planetary Boundary based on annual flows (CO<sub>2</sub> only) not atmospheric stocks (could be extended to other climate gases). Estimating Planetary Boundary stocks for nitrogen or phosphorus is considered not feasible because of seasonal variations, movements between different forms and stocks, and highly variable local impacts depending on whether the stock is in freshwater, coastal water or deep sea, in soil or in biological materials. Annual flow boundaries for CO<sub>2</sub> can be defined by assuming an objective of net-zero and so fixing the annual Flow Boundary as the estimated global CO<sub>2</sub> sink, or by taking the GIEC estimated total carbon emissions budget and dividing by 30 years. In both approaches, Planetary Flow Boundaries suggest that CO<sub>2</sub> climate emissions currently exceed the safe boundary around 2x more than do nitrogen and phosphorus inputs, whereas current Planetary Boundary models show nitrogen and phosphorus with around 2x higher exceedance than climate change. The paper does not address whether other factors considered in Planetary Boundary studies could be analysed by flows rather than stocks, such as biosphere integrity, biodiversity, land system change and ocean acidification.

*"Perspective. Ensuring consistency between biogeochemical planetary boundaries", P. Wolfram et al., Nature Sustainability 2026 <https://doi.org/10.1038/s41893-026-01770-6>*

See overview of studies on nutrient Planetary Boundaries in ESPP eNews n°104 [www.phosphorusplatform.eu/News104](http://www.phosphorusplatform.eu/News104)

## Reader Contribution: suggestions on Planetary Boundaries for Phosphorus

*This text is submitted by Aleksandra Drizo, Tunghai University, Taiwan. It is not ESPP editorial content. We thank Professor Drizo for this input and welcome other short contributions (200 words maximum) on this or other themes.*

**Planetary boundary (PB) assessments for phosphorus (P) have primarily focused on ecological endpoints such as freshwater eutrophication, coastal hypoxia, and risks of ocean anoxia** [Rockström et al. 2009, Carpenter & Bennett 2011]. These approaches have clarified threshold risks at global and basin scales. In parallel, complementary analytical tools have evolved, including flow-based indicators such as Net Anthropogenic Phosphorus Inputs (NAPI), soil P balances and legacy P accounting, P use efficiency (PUE), and regional nutrient budgeting frameworks [Bennett et al. 2001, de Vries et al. 2013]. Continued discussion has emphasised freshwater versus marine control variables and the importance of regionalised thresholds aligned with water quality objectives [[Rockström et al. 2009, Liu et al. 2025].

While these elements are well developed, their integration into a boundary-oriented, multi-indicator governance framework remains limited. I suggest a structured three-tier approach combining (i) ecological impact endpoints (freshwater and marine), (ii) regional P imbalance and equity mapping, and (iii) an Anthropogenic Excretion Surplus Indicator (AESI). AESI estimates the minimum metabolic P surplus from humans and livestock that requires capture or redistribution, explicitly separating unavoidable P production from management capacity. By incorporating wastewater removal efficiency, manure management performance, and safe agronomic assimilation capacity, AESI connects ecological thresholds with practical nutrient governance and food security considerations. This approach is consistent with the Global Biodiversity Framework and UNEP's target to reduce nutrient losses by at least 50% by 2030 [United Nations Environment Programme UNEP, 2021], providing a quantitative tool to identify where recovery and redistribution efforts are most urgently needed. AESI thus represents the minimum metabolic P surplus that must be prevented from reaching freshwaters or coastal systems to remain within regional ecological limits. Due to the 200-word limit, conceptual mathematical formulations are provided in a separate attached document [here](#).

## ESPP Members



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