

Policy and data

ESPP – BioRefine – DG GROW Nutrient data to support decision making

DONUTSS workshop Ghent (3-4 Sept): industry, EU Commission and scientists propose actions on nutrient data support policy, investment or market decisions

Wageningen University P flows and balances of the EU States

Analyses of P trade, use, recycling and losses food consumption – production - waste chain - non-food sectors

Netherlands Nutrient progress in the Dutch Parliament

Netherlands Parliament to address P-recycling

EU decision on cadmium Why did it go wrong?

Failure to ban Cd in artists paints will hinder P-recycling

ISO 13065

New standard for sustainable bioenergy

September 2015: new ISO sustainability standard recognises importance of phosphorus and nutrients.

The Climate Trust Carbon market credits for nutrients

Barriers to crediting for nutrient use stewardship and efficiency, and how to overcome these

UNEP - GPNM

Global Phosphorus Task Team launched *Objective to engage global action for phosphorus*

sustainability and use efficiency

Innovation

Scotland

Innovation and concerted action

Nutrient management initiatives and innovation award

SCOPE NEWSLETTER

INEMAD: biobased fertilisers What do farmers want?

Survey show farmers will move to biobased fertilisers if they are cheaper, concentrated and ensure reliable nutrient input

LIFE ANADRY

Organic fertiliser from sewage biosolids

Anaerobic digestion for valorisation of sewage sludges

US EPA - USDA Nutrient Recycling Challenge

20 000 US\$ for ideas for P and N recovery from dairy or pig manure. Deadline 15th January 2016

Conferences

SludgeTech 2015 Fresh thinking on sludge management

The potential for sewage sludge as a valuable resource.

BioRefine Conclusions Final project conference

Three year project on nutrient recovery from biomass

Edinburgh Nutrient Platform UK

Meeting proposes Nutrient Platform UK (NPUK) objectives

Toledo, Spain

REFERTIL compost and biochar conference

Biochar and compost production, crop testing, regulatory aspects; nutrient recovery projects.

ESPP bio-nutrient circular economy workshop and general assembly Brussels, Wednesday 2nd December

ESPP (European Sustainable Phosphorus Platform) working meeting on policies and tools for the bio-nutrient circular economy, followed by the ESPP General Assembly



Policy

ESPP - BioRefine - DG GROW Nutrient data to support decision making

Stakeholders, scientists and European Commission services met in Ghent University, 3-4 September 2015, to discuss what nutrient data is needed to support decision making for nutrient (industry investments, markets, stewardship policy making), how to collect and make available this data, and proposed actions to move this forward.

Participants included the companies and European federations from the water industry, mineral and organic fertilisers, paper industry, phosphorus recycling technologies, alongside the European Commission (DG GROW, DG Environment, DG Research & Innovation), Member States, data users/managers (European Environment Agency, Eurostat/national statistics), industry sustainability and resource platforms, scientists involved in water, waste, material flows, environmental policy and agriculture.

A workshop summary report, speakers' slides and summaries of breakout table discussions are online at http://phosphorusplatform.eu/donutss

European policies

Francesco Presicce, DG Environment, outlined nutrient data requirements to support EU policy implementation, in particular in the water sector. Data and scientific knowledge on nutrient flows, coefficients, impacts, is essential, with data needs being defined by Directive requirements, and has a direct impact on users and the environment through implementation. The EU Consultative Communication on Sustainable Use of Phosphorus (see SCOPE Newsletter n° 95) also identified stakeholder need for data, and data is also very important in the context of circular economy.

Eric Liégeois DG GROW, explained that nutrient recycling can be a significant element in the EU's Circular Economy policy. A possible ambition could be 20 - 25% of fertilisers placed on the market, by around 2025, produced from bio-resources (secondary raw materials). Vincent Delvaux, DG GROW, presented status of the EU Fertiliser Regulation revision process (see details in workshop report online at *http://phosphorusplatform.eu/donutss*). This is now underway within the EU Commission Circular



Economy work, with the objective of publishing a proposed revised Fertiliser Regulation text by early 2016, to then be submitted to the Council and to Member States for decision.

The revised Fertiliser Regulation aims to ensure a level playing field for bio-nutrient fertiliser products, soil improvers and mineral fertilisers, through flexible, New Legislative Framework principles. "Recovery rules" will specify, for different recovered product categories, the eligible input materials, the treatment process criteria, the safety and quality requirements including specific contaminant limits where appropriate and the quality assurance procedure.

DG GROW intends that such criteria should already be prepared for the following:

- composts/digestates: EU Commission JRC proposed criteria already published https://ec.europa.eu/jrc/en/publication/eur-scientificand-technical-research-reports/end-waste-criteriabiodegradable-waste-subjected-biologicaltreatment-compost-digestate
- struvite: ESPP draft proposal submitted to JRC and published www.phosphorusplatform.eu
- biomass ashes (combustion of energy biomass, manures, sewage sludges, meat and bone meal): ESPP draft proposal submitted to JRC and published www.phosphorusplatform.eu
- biochars: ESPP has now started preparation of input to JRC (September 2015): please contact ESPP if you wish to contribute to or comment on this ESPP proposed draft info@phosphorusplatform.eu

Why nutrient data is needed?

Presentations and input included European, national and regional nutrient mass flow analyses MFAs (emphasising the challenges of using such information for decision making), nutrient data available and currently managed by European and national organisations, data held by industry federations and industry data needs for decision making, data needs for sustainability indicators, bv Kimo van Diik. Michael Wageningen University; Jedelhauser, Ludwig-Maximilian University Munich; Ottavia Zoboli, Vienna University of Technology; Joeri Coppens, Ghent University; Cynthia Carliell-Marquet, Birmingham University; Gerard Velthof, Alterra Wageningen UR; Christian Kabbe, Kompetenzzentrum Wasser Berlin and P-REX, Anne Miek Kremer, Dutch Central Bureau of Statistics and previously Eurostat; Geertrui Louwagie, EEA (European Environment

Agency); Philippe Eveillard, UNIFA (French national industry association of mineral and organic fertilisers and soil improvers); Wim Vanden Auweele, European Compost Network, Bertrand Vallet, EUREAU; Benoît Planques, ECOFI (European Organic-Based Fertilizer Industry Consortium) and Italpollina; Laetitia Six, Fertilizers Europe; Jori Ringman, Confederation of European Paper Industries (CEPI); Tomas Turecki, European Commission DG Research and Innovation; Frank de Ruijter: TSC, The Sustainability Consortium.

The workshop identified needs for nutrient data to support decision making in the following areas:

- bio-nutrient circular economy (policy definition)
- market evaluation ...)
- identify nutrient hotspots for industry actions / markets / investments: mapping of nutrients recycling potential
- EU Critical Raw Materials assessment (Materials Systems Analysis MSA)
- monitor and enforce implementation of EU policies
- product (food) footprints
- > sustainability indicators
- > LCAs.

Quantitative data is not sufficient for nutrient stewardship, because nutrient management (technical, logistics, economics) are influenced by, e.g.: **nutrient concentrations** (inc. N, P, K, Mg, Ca, ...), **forms of nutrients** in different flows and materials, contaminants and other elements (e.g. Fe, Al).

Time series (comparison of data over different years) are important to identify trends and changes, and so areas of opportunity or impacts of policy decisions.

Recommendations for actions

The DONUTSS workshop proposed the following actions:

- a) **Inventory** of existing data, typologies, data holders and users
- b) **Define data needs** for different users: relevant flows, type of data (volume, form of nutrient, concentration, nutrients, contaminants), degree of certainty/accuracy needed, spatial and temporal requirements
- c) **Identify the market potential** for recycled nutrients taking into account the amount of eligible raw materials for fertiliser production but also the efficiency of the existing treatment processes
- d) Collate existing project data, e.g. DIREDATE



- e) Explore **possible research** needs and possible R&D funding (Horizon 2020, COST ...)
- f) Identify **other data sources** to transpose for nutrients, e.g. bio-energy
- g) Develop stakeholder & EU inter-service **dialogue** on nutrient data: needs / available / management and **inter-sector networking** to identify which material flows can be really used (business opportunities: where, under what conditions)
- h) In particular: develop dialogue with **farmers** organisations, food industry, waste sectors
- i) Identify **existing monitoring** where nutrient analysis may be added for low additional cost
- j) Define which EU Directives/policies need or generate nutrient data, inc. other sectors (air, energy ...)
- k) Propose EU mandates for collection of key data
- Require harmonised publication of data in EUfunded R&D projects
- m) Identify **standards needs** (CEN, ISO ...) to support better nutrient data management
- n) Propose and define **nutrient indicators**, e.g. define "recovered" P and how to measure it (necessary to define targets for industry or policy makers)
- o) '**Big data**" (e.g. IT platform farmers / data transfer): involve companies involved in "big data" processing
- p) Awareness raising: promote need for data, data collection, monitoring: support for decisions for policy, markets and business, technology development ...
- q) Develop visual mapping (for communication to decision makers) of what is where / visualisation / hotspots

ESPP's objective is to continue the DONUTSS initiative with further work with stakeholders and institutions to now define how the different above objectives can be addressed, either by specific projects which ESPP network members might take on, or by concerted actions to be organised by industry and be competent public bodies.

DONUTSS "Data on Nutrients to Support Stewardship" workshop, organised by ESPP, BioRefine Cluster Europe, Ghent University, Wageningen University and Vienna University of Technology, with support from the European Commission, in Ghent 3rd and 4th September 2015: workshop summary report, speakers' slides and summaries of breakout table discussions are online at http://phosphorusplatform.eu/donutss

Wageningen University P flows and balances of the EU Member States

P flows were analysed in detail for the European Union (EU-27) using the most recently available coherent data (2005) at the individual Member State level and for the entire society including 31 main flows at the system level (see flow diagram) with 96 underlying sub-flows. It is the first time that P flows have been analysed for such a large region taking the country specific contexts into consideration.

The study shows **how different EU countries use**, reuse and lose P, and indicates possible options for more sustainable P management.

Until now, phosphorus (P) flow analyses were conducted for the EU-15 as a whole (Ott and Rechberger, 2012), and at the national level for several European countries including Austria (Egle et al., 2014; Seyhan, 2006), Belgium (Flanders) (Coppens et al., 2013), Denmark (Klinglmair et al., submitted for publication), Finland (Antikainen et al., 2005, 2008; Saikku et al., 2007), France (Senthilkumar et al., 2012), Germany (Gethke, 2012), Netherlands (de Buck et al., 2015), Sweden (Linderholm et al., 2012), Switzerland (Binder et al., 2009; Lamprecht et al., 2011), Turkey (Seyhan, 2006; Seyhan, 2009), and United Kingdom (Cooper and Carliell-Marquet, 2013).

In this study, addressing the whole of the European Union using country-level data, flow diagram and system boundaries were based on a whole society perspective, which includes the food system (food consumption-production-waste chain), as well as nonfood sector flows related to for example the pet food, detergent and forestry industries. Sectors covered are crop production, animal production, food processing, non-food production and consumption.

Trade, losses and accumulation

The total P import amounted to 2 392 Gg P/year (GgP = 000 tonnes P). The total export was 251 Gg P/year, indicating a **net EU import of 2 141 Gg P/year**. Roughly half of this annual surplus accumulated in agricultural soils in crop production (924 Gg P) and half was lost from the system (1217 Gg P).

About 76% of the P was imported by agriculture, of which 58% was used in crop production and 18% in animal production. The export of P from the



system mainly took place from food processing, with 86% of the total export. About half (54%) of the total P losses took place from the consumption sector, mainly from sequestration of P in sewage sludge and organic waste. More than one quarter (28%) was lost by the food processing sector, mainly as **incinerated meat and bone meal from slaughtering**.

The total primary P import was 1 777 Gg P, which is 74% of the total system import. About 78% of this total primary P import was used for mineral fertilizer production. The other 22% of primary P import was used for the production of inorganic feed additives in animal production (14%), detergent production in non-food production (6%), and the production of inorganic food P additives in food processing (1%).

P stocks

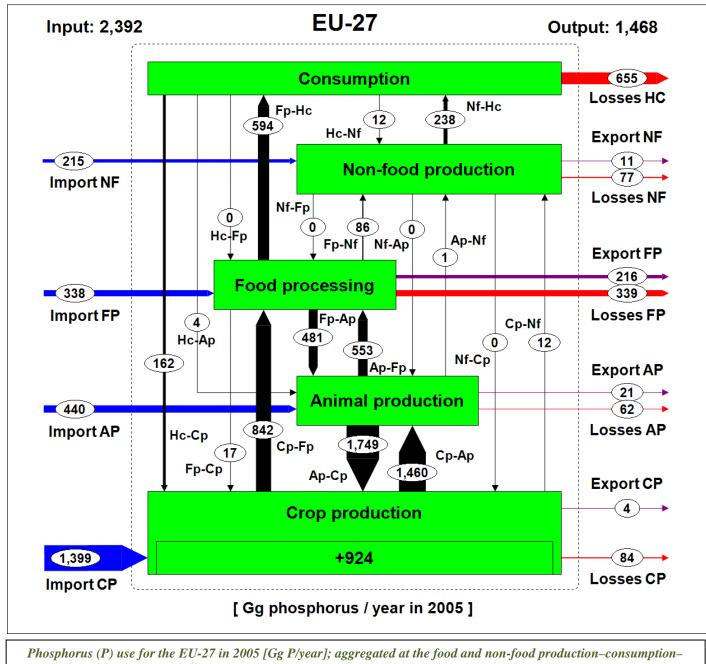
The EU soil P stock present in arable and grass land in 2005 was estimated at 150 802 Gg P based on the cumulative estimated annual agricultural P balances for the individual Member States, starting from 1961. The P stock in standing livestock in 2005 was estimated at about 534 Gg P. The P stock in living pets at about 11 Gg P. The P stock in the human population was estimated at about 322 Gg P.

Flows per sector

Total crop P withdrawal from the soil by harvested crops in crop production was 2 317 Gg P in 2005, equivalent to **4.9 kg P per capita** and 12.6 kg P per hectare. Total feed P quantity fed to livestock was 2 369 Gg P, including organic feed P (2 119 Gg) and inorganic feed P additives (250Gg). On average 26% was retained by livestock in animal products, mainly as animal carcasses, milk, eggs and aquaculture products (553 Gg P). In addition, 5 Gg P was exported in live animals. The other **74% was excreted as manure** P and almost fully applied to agricultural land (1 749 Gg P), representing the largest internal P (re)cycling of the system.

The food processing sector had a total input of 1 732 Gg P/year, of which 80% (1 394 Gg P) originated from crop and animal production, and 20% (122 Gg P) from imported crops, food products (including fish catches) and inorganic food additives. The total input was processed and delivered a total domestic food P supply of 594 Gg P, equivalent to 1.21 kg P/ca (per capita), including 0.06 kg P/ca inorganic food additives.





waste chain based on 96 sub-flows; showing the imports (blue), exports (purple), losses (red) and internal upward/downward flows (black) for crop production (CP), animal production (AP), food processing (FP), non-food production (NF) and consumption (HC) sectors (indicated with square blocks); the arrow thickness shows the relative flow sizes; the positive balance of +924 in CP represents annual net accumulation of P in agricultural soils in 2005

EU states showed large variation in food supply ranging from 0.92 to 1.36 kg P/ca. The plant- and animal-derived P contribution to the EU-27 food supply was on average 67% (0.75 kg P/ca) and 33% (0.4 kg P/ca) respectively. Additionally, 79 Gg P of food processing sector residues (mainly from slaughtering) was used as pet food ingredients in nonfood production.

The non-food sector supplied 238 Gg P to the consumption sector, including 75 Gg in pet food (0.15 kg/ca), 109 Gg in detergents (0.22 kg P/ca), 41 Gg in forestry products (0.08 kg P/ca), and 13 Gg in other non-food products such as tobacco, fibres and materials (0.03 kg P/ca).

The total input to the consumption sector was 832 Gg P for the EU-27. This food and non-food P input was equivalent to 1.7 kg P/ca/year ranging from 1.24 to 2.28 kg P/ca between Member States. After use of this input, P in food and non-food products ended up in several waste flows, of which only 177 Gg P was reused and 655 Gg P (79%) was lost from the system. The major fraction was lost via the wastewater system with 41% in communal sewage sludge (0.46 kg P/ca) and effluent (0.08 kg P/ca) from centralized (urban) treated wastewater flows, and 14% in other communal wastewater flows (0.19 kg P/ca). Large P losses also occurred via the solid waste system with 26% of the total consumption sector losses in food waste from households, retail and other food services (e.g. restaurants, catering), and 11% via pet excreta to public spaces, gardens and the municipal solid waste system.

Fate of waste

The total system P loss (1 217 Gg P) in 2005 was divided between incineration ashes (34% of total), landfills (5%), municipal solid waste (18%) including incineration and landfilling as potential final destinations, emissions to the hydrosphere (17%) and lithosphere (6%). and undefined (unknown) destinations (21%). Phosphorus rich ashes were mainly produced by incineration of slaughter residues in food processing (72% of total) and sewage sludge in the consumption sector (26%).

P use efficiency (PUE)

The results show generally that, of each sector's input, about:

- In **crop** production: **70%** was taken up by crops
- In animal production: 24% was retained in animals, milk and eggs
- In **food processing**: **52%** reached food products
- In non-food industry: 76% reached non-food products
- In consumption (households, restaurants, etc): 21% was recycled after consumption

Across all sectors, improvement of the relatively low PUE's is possible, although the practically reachable PUE in most cases is not 100%. There is, and will always be, an inherent inefficiency because of inevitable accumulation and diffuse losses. At the system level, the performance was analysed by the P cost of the system expressed in kg P input per kg P output. On average, for the EU-27 in 2005, 4.0 kg P system input was required to produce 1 kg P in



food and additives domestically supplied to the consumption sector.

Agricultural P balances and accumulation

The P balance of agriculture in the EU-27 had a surplus of 924 Gg P in 2005, equivalent to a surplus of 4.9 kg P per hectare and 1.9 kg P per capita. The average crop production input for the EU-27 was 17.4 kg P/ha, including the application of 9.2 kg P in manure (53%), 7.3 kg P in mineral fertilizer (42%), 0.7 kg P in sewage sludge (4%), and the remaining 1% divided between compost, fertilizers based on slaughter residues. deposition, pesticides and seeds/planting materials. The P balances showed large variation between the EU-27 Member States with high surpluses (positive balances) in most western European countries such as Belgium (23.2 kg P/ha/year) and the Netherlands (21.9), and deficits (negative balances) in many central and eastern European countries such as Slovakia (-2.8) and Czech Republic (-2.1). Countries with balances close to zero also exist, such as Romania (-0.3), Bulgaria (-0.1), Austria (-0.1) and Sweden (0.5).

Changes in P use over time

The input of the system increased from about 6 kg per capita in the 1960s, to a peak of about 10 kg per capita by the end of the 1970s. Thereafter, the input gradually decreased to less than 4 kg per capita in 2009. The relative share of crop production in total P input decreased from about 80% in the 1960s, 1970s and 1990s to 53% in the 2000s. The relative contribution of primary P input was reduced from about 88% to 70%. This reduction is much greater for mineral fertilizer use, since primary P use as feed additives in animal production and food additives in food processing have increased in the same period.

Conclusions

Although wide-ranging variation between countries, generally phosphorus use in EU-27 was characterized by "5 Ls":

- 1. Large dependency on (primary) imports,
- 2. Long-term accumulation in agricultural soils, especially in west European countries,
- 3. Leaky **losses** throughout entire society, especially emissions to the environment and sequestered waste.
- 4. Little **recycling** with the exception of manure, and
- 5. Low use efficiencies. because of aforementioned issues, providing ample opportunities for improvement.

As an answer to these "5 Ls" challenges, there are relatively large opportunities to use P more efficiently and effectively, including decreasing P losses from the system and increasing the recycling of P in residues and wastes. Next to P quantity, quality aspects are also very important factors in determining the recycling and substitution potential now and in the future. The "5 Rs" framework for sustainable P use proposed previously (Withers et al., 2015a) can be used to increase PUE in Europe:

- 1. Re-align P inputs to match actual P requirement.
- 2. Reduce P losses to water to minimize eutrophication risk.
- 3. **Recycle** P in bio resources more effectively to substitute inorganic fertilizer consumption,
- 4. Recover P in society's wastes, by-products and residues for re-use
- 5. Re-design P use in society with a focus on food systems

The availability, accessibility, completeness, quality and detailedness of data are important constraints in quantifying and monitoring nutrient flows in society as shown in this study, and therefore for supporting decision making. This is not only the case for mass flows, but also for the P concentrations of products and waste flows which should be better monitored over time for each country. There is a clear need for more and better data for nutrient flow analyses in order to manage nutrient and use them in sustainable way within a circular economy perspective.

The data on nutrients to support stewardship (**DONUTSS**) project proposed by ESPP aims to tackle these data quality and monitoring issues together with relevant stakeholders and the European Commission. See summary of DONUTSS workshop in this SCOPE Newsletter.

Phosphorus flows and balances of the European Union Member States", Science of the Total Environment 2015. DOI 10.1016/j.scitotenv.2015.08.048 http://www.sciencedirect.com/science/article/pii/S0048969715305519

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More detailed results and background information including flow diagrams for each EU-27 Member State can be downloaded here: https://www.dropbox.com/sh/pomgw6mj8b8k2j2/AAC1yPMRDVj kyzFtp3r1AQr8a?dl=0

DONUTSS project: http://phosphorusplatform.eu/donutss



Netherlands

Nutrient progress in the Dutch Parliament

The Dutch Parliament has announced to have a general meeting about the Circular Economy on the 17th of December.

The meeting is a response to the letter sent by the Secretary of the Ministry of Infrastructure and Environment of the Netherlands to the Dutch Parliament addressing the question of phosphorus recycling. This letter resulted from input from the Netherlands Nutrient Platform, presenting the progress made in the Netherlands since the launch of the Phosphorus Value Chain Agreement of 2011 and outlining the challenges for the future. The Dutch Nutrient Platform underlines to the Parliament that we are not yet finished with phosphorus and that it's important to keep the topic high on the agenda.

For more information you can contact the Dutch Nutrient Platform at i.deweerd@nutrientplatform.org or visit the website www.nutrientplatform.org

EU decision on cadmium Why did it go wrong?

The European Commission (DG GROW) has published a decision rejecting Sweden's request to restrict cadmium (Cd) in artists' paints. The Swedish Water & Wastewater Association estimate that, where diligent source actions are undertaken to reduce industry cadmium discharges to municipal sewage (as under the REVAQ certification scheme), artists' paints represents around 10% of cadmium in sewage sludge, whereas less hazardous pigments are available and already on the market. Failure to prevent this source of cadmium at source is an obstacle to the development of the bio-nutrient circular economy.

Cadmium from hobby and artist paints is considered to be one of the biggest single sources of cadmium in sewage sludge in Sweden.

Already 10% of sewage sludge cadmium in Stockholm was from this source fifteen years ago (Sörme Lindqvist Söderberg 2003) and this % increases as other cadmium sources to sewage are terminated.

Most other sources of cadmium in municipal sewage are increasingly problems of the past, as a

consequence both of improving industry wastewater management (avoiding discharges of cadmium contaminated streams into municipal sewerage, e.g. from SMEs operating recycling) and because **industrial uses of cadmium are disappearing, as cadmium is now banned** e.g. in batteries (with very few specialist exceptions still authorised, but expected to be banned soon) or decorating paints (walls etc) and other industrial pigments. Therefore, although the **nearly 9 tonnes/year (EU) of cadmium in artists' paints** are estimated to contribute only c. 2% of cadmium in sewage sludge in average across Europe, this % can be expected to rise in coming years to the 10% estimated above in Sweden.

The Commission decision is based on the ECHA (European Chemicals Agency) RAC (Risk Assessment Committee) opinion, under application of Annex XV (European Chemical of REACH Regulation 1907/2006. This opinion considers only possible human health risks resulting from this cadmium reaching farmland on which sewage sludge is used as a fertiliser. Environmental risks of the cadmium in recycled sewage biosolids, and also health and environmental risks of the cadmium which leaves sewage works not in biosolids but in treated water, are not taken into consideration (because of the terms in which the submission was made by Sweden).

EUREAU, the European water industry federation,

has indicated its regret that this decision did not take into account cadmium discharges from sewage works and has underlined that **cadmium is defined as a priority hazardous substance** and that the Water Framework Directive 2000/60 requires to phase out priority hazardous substances.

EUREAU states "To restrict cadmium in hobby- and artist paints is probably one of the least complicated measures to reduce cadmium to the European wastewater treatment plants – and to the receiving waters. The phasing out of cadmium in hobby- and artist paints is one important step, but there is a need to keep the pressure on other cadmium users and dischargers to the wastewater".

Cost to the taxpayer

The **Swedish Environment Minister Åsa Romson** has declared (5th November on Swedish radio) that she will continue to work for a ban of cadmium in artist and hobby paints.

The cost to the EU taxpayer of the failure to ban cadmium in artists' paints is estimated by



EUREAU as 13 to 64 million ∉year per year, covering only increased sewage sludge costs, and not including additional discharge water treatment costs or environmental costs of cadmium in discharged water from sewage works.

The EU's negative decision, failing to ban cadmium in artists' paints, represents a **missed opportunity to reduce pollution at source and to facilitate recycling of sewage biosolids nutrients values**, either through agricultural application of treated biosolids (e.g. after anaerobic digestion or composting, recycling N, P, K and organic carbon) or through nutrient recovery processes (where cadmium may in some processes be transferred as a contaminant to the recovered nutrient product).

What action will now be taken by the European and Sweden water industries, and by concerned Member States, is unclear. However, the current situation does not appear acceptable and a renewed request for a cadmium ban in artists' paints may be forthcoming, taking into account not only cadmium contamination of sewage biosolids (an unnecessary obstacle to the bio-nutrient circular economy) but also cadmium in discharged treated water. Both health and environment aspects should be considered, in the context of Art. 191(2) of the Treaty of the European Union which poses the principle of prevention at source, the Water Framework Directive 2000/60 and the Priority Substances Directive 2013/39.

DG GROW 28/10/2015: "The Commission will not restrict cadmium in artists' paint" http://ec.europa.eu/growth/tools-databases/newsroom/cf/itemdetail.cfm?item_id=8530

European Commission decision, Official Journal of the European Union 356/01, 28/10/2015 (3 pages): "Communication from the Commission on the termination of the restriction process on cadmium in artists' paints under Regulation (EC) No 1907/2006 of the European Parliament and of the Council concerning Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)" http://eur-lex.europa.eu/legalcontent/EN/TXT/?uri=uriserv:OJ.C_.2015.356.01.0001.01.ENG

EUREAU www.eureau.org 8/9/2014 (5 pages) "The cost of cadmium for urban wastewater treatment plants" http://bit.ly/1RBv42a EUREAU www.eureau.org, 25/4/2015 (5 pages) "EUREAU comments on cadmium in paints, Annex XV Restriction Report proposal for a restriction for cadmium and its compounds in

artists' paints" http://bit.ly/lkyALTM Sweden Environment Minister position 5/11/2015:

http://www.svensktvatten.se/Aktuellt/Nyheter/Avlopp-och-Miljonyhetslista/Asa-Romson-ar-inte-nojd-med-EU-kommissionens-beslut-atttillata-kadmium-i-konstnarsfarg/

SvensktVatten position 5/11/2015 :

http://www.svensktvatten.se/Aktuellt/Nyheter/Avlopp-och-Miljonyhetslista/Bakslag-for-EU-forbud-mot-kadmium-i-hobbyfarger/ Swedish Chemicals Agency (KEMI), 17/12/2013 (202 pages) "Annex XV Restriction Report – cadmium and its compounds in artists' paints" http://echa.europa.eu/documents/10162/13641/annex_xv_ cd_in_artist_paints_en.pdf

ISO 13065 New standard for sustainable bioenergy

ISO (the International Standards Organisation) has published standard ISO 13065:2015 а "Sustainability Criteria for Bioenergy". Phosphorus is cited in key parameters to assess impacts, and nutrients are recognised as key both in limiting eutrophication and ensuring balanced soil fertility.

Guidance C7 requires reporting of "values and trends of key chemical, physical and biological parameters or metrics ...", citing for calculation of emissions and flows per process output the example of grams phosphorus applied per kg biomass produced.

Eutrophication

"Water" is one of the environmental principles, criteria and indicators identified by the standard (5.2.2.1). Water quantity and quality). Under indicators, eutrophication is specified and in Guidance eutrophication impact identification is listed (B4) as is phosphorus removal (B5). For P-removal, the treatment process should be specified. ISO measurement standards for eutrophication P (ISO 15681-2:2003) and N (ISO 29441:2010) are referenced.

Under "Soil quality and productivity", organic carbon and nutrients are identified as factors (5.2.3.1). Guidance indicates the need to assess changes in soil organic carbon and in soil nutrients (C3), to describe field practices (C4) such as tillage, fertilisation, crop rotations, and to counteract nutrient loss and buffering capacity (e.g. use of fertiliser, wood ash, logging residues), soil erosion and buffer strips (C5, C6) and refers to BMP (Best Management Practices).

For soil assessment, ISO: 14255:1998 is referenced for nitrogen "Soil quality -Determination of nitrate nitrogen, ammonium nitrogen and total soluble nitrogen in air-dry soils using calcium chloride solution as extractant" and ASTM D2974 - 14 for organic carbon "Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils". No standard is referenced for phosphorus or potassium.

ISO 13065:2015 "Sustainability criteria for bioenergy", ICS 13.020.99, 57 pages, 178 Swiss Francs http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.ht m?csnumber=52528



The Climate Trust Carbon market credits for farm nutrient stewardship

The Climate Trust, Portland, USA, in cooperation with The Fertilizer Institute, has published a report into using carbon market credits to promote nutrient use efficiency, based on work with the USDA and with corn and soy farmers in the US Midwest.

Nutrient stewardship techniques identified in the report are estimated to offer a potential of 0.7 - 2.7million carbon offsets per year (based on 10-15% of maize in the North Central region of the USA only), with considerable further potential in other crops and regions. However, implementation is likely to take at least 5-10 years, time necessary to convince of market viability.

The report, building on the previous NITRACE project, used 28 test fields to assess four existing protocols for carbon credit generation based on nutrient stewardship:

- Verified Carbon Standard: VM0022: Quantifying N2O Emissions Reductions in Agricultural Crops through Nitrogen Fertilizer **Rate Reduction**
- American Carbon Registry: Methodology . for Quantifying Nitrous Oxide (N2O) Emissions Reductions from Reduced Use of Nitrogen Fertilizer on Agricultural Crops
- Climate Action **Reserve**: Nitrogen Management Project Protocol Version 1.1
- American Carbon Registry: N2O Emission Reductions through Changes in Fertilizer Management

4R Nutrient Stewardship

The **NITRACE** project was based on analysing consequences of implementing "4R Nutrient Stewardship", as developed by the IPNI (International Plant Nutrition Institute *www.ipni.net*)

- **Right source**: the type of fertilizer applied can impact the amount of nitrogen that leaves the field.
- Right rate: Using field measurements of nitrogen in soils and knowledge of the crop's needs to better estimate the amount of fertilizer to apply.

- **Right time**: Timing the application to coincide with crop needs
- Right place: Applying nutrients closer to where the crops will be able to make the best use of them

Funding mechanism for action on nutrients

Funding to farmers for improving nutrient stewardship is possible under programmes such as the USDA Natural Resources Conservation Service's Conservation Stewardship Program (CSP) or Environmental Quality Incentives Program (EQIP) but these have lost funding through recent revisions to the Farm Bill. Carbon markets may offer an alternative revenue stream by the sale by farmers of carbon credits.

Voluntary carbon credit markets can provide an important testing ground for credit calculation methodologies. However, voluntary purchasers of credits from nutrient management have been slow to emerge, so making farmers question the value proposition.

Implementation and data challenges

Method difficulties for nutrient carbon crediting are identified:

- Defining additionality (improvements of nutrient stewardship compared to a "business as usual" scenario)
- Specifying the baseline, boundaries and crediting periods
- Recording requirements, monitoring and • verification.

A key challenge is that of data collection and management. Data should cover the crop planted, planting and harvest dates, GPS field boundaries, fertiliser application data, tillage events, yield, irrigation, soil type. This poses difficulty because agricultural data is fragmented.

A comparison between medical data and EARs (Electronic Agricultural Records) is made (p. 59), because the healthcare sector has already made addressing cross-platform progress in data standardisation, data security, data ownership questions and confidentiality management (HIPAA in the USA) and this know-how could be transferred to agricultural data.



The report recommends working with existing data collection tools: COMET-Farm, Field-to-Market, Nutrient Tracking Tool (NTT), The Sustainability **Consortium** toolkit, government agencies and private sector data systems. It is underlined that at present little nutrient data is in fact stored for long enough to support carbon market protocols (ten years + needed).

Barriers and proposals

The main barriers to nutrient credit implementation are considered to be difficulty in enrolling farmers, resulting from a lack of visibility and risk for credit markets.

Prices for credits in voluntary carbon markets are highly variable, depending on many factors, including project charisma and purchaser preferences. To address this, pilot projects are needed, to enable inthe-field demonstration of credit calculation and verification protocols. Further study of revenue impacts for farmers is also needed. Systems of market risk mitigation must be put into place (for both the credit purchaser and for the farmer).

The report notes that in "compliance markets", as opposed to voluntary markets (for example, in California), prices for offsets are much more reliable because they are linked to the price of allowances, which are auctioned using a predetermined price floor and with a predefined price increase of 5% per year (on top of inflation).

Enrolment of farmers in carbon credit schemes and marketing of these schemes are problematic, because of their complexity and interaction between different actors involved in schemes (aggregators, verifiers).

Data management systems and their cost, including ownership and privacy issues, are also a major challenge: connection of nutrient-carbon credit markets and sustainability certification may be an effective way forward to address this.

Press release "Crediting farmers for nutrient stewardship: assessment by The Climate Trust", 28/10/2015: http://www.climatetrust.org/crediting-farmers-for-nutrientstewardship-assessment-by-the-climate-trust/

"Promoting increased nutrient use efficiency through carbon markets", Report submitted on behalf of The Climate Trust in cooperation with The Fertilizer Institute, for the US Department of Agriculture (USDA), #69-3A75-11-139, October 2015 (106 pages): http://www.climatetrust.org/wp-

content/uploads/2015/10/Promoting-increased-nutrient-useefficiency-through-carbon-markets-2015-CIG-Report-151012-FNL.pdf

UNEP - GPNM GPNM Global Phosphorus Task Team launched

Convened by UNEP, and supported through resources from the Global Environment Facilityfunded Global Nutrient Cycling (GEF-GNC) Project, the first meeting of the "Phosphorus Task Team" of the Global Partnership on Nutrient Management (GPNM) took place in Edinburgh, Scotland $15^{\text{th}} - 16^{\text{th}}$ September 2015.

Participants included representatives of the fertiliser industry (International Fertilizer Industry Association) and related research (International Plant Nutrition Institute, Virtual Fertilizer Research Center), ESPP, Global Phosphorus Network, China Agricultural Research Institute and the International Nitrogen Initiative.



It was noted that nitrogen is already being addressed at the global level through several significant initiatives:

- (2006-2011)**NitroEurope** IP project http://www.nitroeurope.eu/ which produced the European Nitrogen Assessment, Cambridge University Press, 2011
- International Nitrogen Initiative (INI) www.initrogen.org which led to the CEH report produced with GPNM and UNEP "Our Nutrient World" (2013 see SCOPE Newsletter n° 96).
- Global Nutrient Management System and Global Nutrient Cycle Project (currently under finalisation Global with the Environment Fund GEF http://unep.org/gpa/gpnm/GEFProject.asp).

To date, however, there is no comparable global initiative on phosphorus which has been recognized by the GPNM as a shortcoming in the global nutrient management agenda.



UNEP GPNM

The GPNM Global Partnership on Nutrient Management was established under the aegis of of UNEP's Global Programme of Action for the Protection of the Marine Environment from Land Based Activities (GPA) and is responsive to global frameworks such as the 2012 Manilla Declaration on Furthering the Implementation of the GPA, and most recently the Sustainable Development Goals, in particular Goal 14 relating to conservation of the oceans in respect to excess nutrient fluxes into the marine environment.

However, to date, GPNM has principally addressed nitrogen and the issues around efficiency of use and impacts to the environment.

This launch meeting of the GPNM Phosphorus Task Team (PTT) discussed the global challenges of global phosphorus sustainability, introduced by presentations by Dr. Dana Cordell, of the Institute for Sustainable Futures, Sydney and Dr. Tina Schmidt-Neset of **Linköping University**. They indicated the importance of phosphorus stewardship to national and global food security, soil fertility and soil loss prevention, agricultural productivity and farmer livelihoods, and to environmental protection (eutrophication, biodiversity, marine dead zones ...).

The meeting discussions underlined synergies between phosphorus management and other issues, including nitrogen and other nutrients, bio-energy, soil health, climate change, biodiversity, water resources, food wastage, food prices

In particular, global dichotomies pose important challenges, with "excesses" in some regions of the world yet scarcities in other regions:

- phosphorus access difficulties and scarcity versus phosphorus pollution
- undernourishment versus obesity
- soil P deficiency versus 'legacy' P accumulation

The meeting confirmed the importance of bringing together stakeholders to recognise different perspectives and then to define a common vision for phosphorus sustainability and to propose shared solutions.

Guiding principles

The meeting proposed four leading guiding principles to define the objectives and work of the GPNM Phosphorus Task Team:

- Secure access of P fertilisers for all farmers
- Access to healthy diets for all peoples
- Our soils are fertile and support productive agriculture
- Our rivers, lakes and oceans are clean

These could be addressed with a **broad vision** based on an underlying objective of developing a circular economy in food systems.

Action plan

Proposed actions were discussed, which could be engaged both at a global level and through regional implementation. Some of the key actions included:

- development of an agreed model for the phosphorus cycle
- address full chain (mine -> fork) phosphorus use efficiency
- collate reliable data and propose indicators on phosphorus sustainability in food production
- facilitate and promote innovation dissemination
- present local case-studies and best practice examples
- develop / contribute to a toolbox of measures adopted to local or global contexts
- evaluate cost externalities of phosphorus use in the food chain
- assess opportunities for recycling and use of phosphogypsum

These actions could be taken forward by GPNM, supported by UNEP (GPA) **through global coordination and involving relevant stakeholders** (e.g. farmers and the agri-food industry sector, animal feeds, biomass, sanitation ...) in the context of international processes and frameworks including *inter-alia*:

- The UN Sustainable Development Goals; specifically linked to Goal 2 on food security and sustainable agriculture, Goal 6 on sustainable water management and Goal 14 on conservation of ocean resources
- UNEP International Resource Panel http://www.unep.org/resourcepanel/
- United Nations Environment Assembly (UNEA) (June 2016, Nairobi
- Food and Agriculture Organisation (FAO)



programmes on soil resource and input management

- Global Science Partnership and other initiatives on soil resources
- National phosphorus and nutrient policies
- Industry **sustainability indicators**

The meeting outcomes will be presented to the GPNM Steering Committee for decisions on how to take the process forward, including the development of an action plan.

For more information on the GPNM go to the website at: http://unep.org/gpa/gpnm/gpnm.asp

Innovation

Scotland Innovation and concerted action

At the Edinburgh UK nutrient platform meeting, 17th September 2015, the joined-up range of actions on nutrient management in Scotland were presented, including announcing winners of the SBRI (Scotland Small Business Research Initiative) award for SME innovation in nutrient management, which aims to identify new technologies idea and take from to implementation.

This project is managed by Highlands and Islands Enterprise (HIE), with support from a range of other partners including Innovate UK, Zero Waste Scotland, and the Scottish Government.

Barry Greig, Scottish Government, presented the **Scotland "HydroNation" strategy**, developed to respond to the 2013-established statutory duty of Ministers to develop the value of Scotland's water resources, both social and economic value.

Alayne Street-Perrott, Swansea University, Wales, indicated that a statutory mandate is now in place in Wales through the Well Being of Future Generations Act, 2015.

Scott Rodger, Scottish Water, explained that the company aims to improve the "waste to resource" approach at its waste water treatment works, with an immediate focus on smaller works. The value and need of nutrient recycling is recognised: the company recycles much of its biosolid products to farmland, and is exploring opportunities to realise best value in these product streams through R&D activities where appropriate.

Peter Wright, Scotland Environmental Protection Agency (SEPA), presented work with farmers addressing diffuse nutrient pollution, underlining the learning and economic challenges posed for farmers in the field. The 2008 Diffuse Pollution Regulation makes Good Practice mandatory in fertiliser and manure, livestock, crop and pesticide management. 3 500 farmers were individually met in 14 priority catchments. Around 50% of farmers were compliant with regulations at the first meeting, and after the visits nearly 75% were moving towards compliance.

Amanda Ingram, Zero Waste Scotland, explained the organisations work to use resources more efficiently, lose less and obtain more value, in particular supporting businesses to develop new ideas and innovations that add value to wastes, by-products and low value materials. Current evidence work includes feedstock resource mapping to progress the actions of the Scotland Biorefinery Roadmap (Jan. http://www.scottish-enterprise.com/knowledge-2015 *hub/articles/comment/biorefinery-roadmap*). R&D underway includes ammonia recovery in anaerobic digestion with Cranfield University.

Marc Stutter, Hutton Institute, outlined the new skills being developed, and the need for these, for innovation for sustainable phosphorus management in the UK, including in areas such as: different forms of P in soils and their plant availability, improving crop phosphorus acquisition, managing buffer strips both for erosion control and biomass production, accreditation, flexible legislation.

Janine Young (Scotland Environment Protection Agency SEPA) and Marc Stutter, outlined the challenge of diffuse phosphorus pollution from the c 150 000 septic tanks in Scotland, around 1/4 of which have no soak away to allow P absorption onto soil and prevent loss to waters. Participants suggested experience sharing with other EU states which have successfully legislated to require householders to upgrade septic tanks to strongly reduce environmental discharges.

HIE – SBRI innovation award winners

Diane Duncan, Highlands & Islands Enterprise (HIE), presented their "Green Growth" strategy, in particular assisting Small Medium Sized Enterprises with market entry using PPP (pre public procurement) support: this technique defines what problems the public sector needs solved and puts no specification on what the solution might be. HIE undertook a survey of the UK's water industry and identified key



challenges. These included the Water Framework Directive implementation (and tightening discharge consents) and priority substances (abatement), and nutrient recovery as a priority opportunities.

The HIE - SBRI innovation award offers 40 000 UK£ first stage to accompany SMEs in taking an idea through to a business plan, then possibly 100 000 UK£ second stage to take to the market. From 40 SME submissions, 7 selected for the first stage award were presented:

- Derrick Emms, Sustainable Water Company www.sustainablewatercompany.co.uk/: PhosFate product has been developed by **peletising mine** wastes (iron ochre). An innovative process uses a strong binder, to enable the pellets to be handle, but avoids high pH so that they retain phosphorus uptake properties. The UK coal industry currently has a 1.4 million UK£/year disposal cost for ochres. The objective is to develop the pellets as a phosphorus removal material. Challenges are contaminants in some ochres and questions about the plant availability of uptake phosphorus, if the product is intended for land use, or development of a P-recovery process via P-desorption.
- > Malcolm Barraclough, OMB Technology http://omb-technology.com/ & Brathadair *http://brathadair.com/* : process for **resource** recovery from "pot ale", the waste stream from the first distillation in whisky production (acidic, 5% dry matter). The three larger distilleries in Scotland (c. 50% of whisky production by volume) already treat this waste, whereas smaller distilleries currently spread on land – but this poses environmental problems e.g. soil acidity, copper toxicity for sheep. A three stage process will (1) recover the solid content to be used as animal feedstuff (2) pH balance to remove and recover copper, phosphorus, ammonium as mineral solids (3) final stage uses micro-bubble technology to evaporate water and generate a syrup which can be used for anaerobic digestion. The aim is also to adapt the process to a wide range of industrial uses, e.g. treatment of biogas anaerobic digestion effluent, desalination, industrial evaporation.

> Jonathan Hughes, Pennotec

http://pennotec.com/ : crab and langoustine shell wastes (c. 4 000 tonnes/year produced in HIE region) are combined with lactic acid (SCOPE editor's note: can be bio-sourced from dairy industry by-products) to produce calcium lactate

and extract chitin, then used to produce chitosan (the only natural cationic polymer). Chitosan can be used for phosphorus removal from water (by absorption) then recycled in fertilisers.

Raghnall Maciain, UIST – ASCO

www.uistasco.com : seaweed is hand-harvested (cut at low tide) and dried in a biomass-burning boiler, to supply the agriculture and amenity industries. This leaves a seaweed membrane. The project is to process and market this seaweed membrane as a phosphorus adsorbant.

> The three other award winners are New Generation Biogas www.ngbiogas.com for robust enhanced biological phosphate removal, JFI Ltd (Ballyclare, Northern Ireland) for nano absorbents for phosphate recovery and priority substances, De Montfort University (Lancaster) for UV and microwave assisted catalysis for destruction of priority substances

HIE (Highlands and Islands Enterprise) "£400,000 environmental innovation competition winners announced" 18/9/2015: http://www.hie.co.uk/about-hie/news-and-media/archive/400-000environmental-innovation-competition-winnersannounced.html#sthash.wATqoVHK.dpuf

INEMAD: biobased fertilisers What do farmers want?

A survey of farmers in different European countries suggests that farmers will move from current chemical fertilisers to biobased fertilisers if these are less expensive, concentrated (require low labour to spread) and ensure certain nitrogen content.

The survey was carried out within the INEMAD project (FP7, Improved Nutrient and Energy Anaerobic through Management Digestion www.inemad.eu) in 8 EU countries, with 555 farmer survey responses analysed to date. The analysed results are being prepared for a scientific publication.

The study used a "choice experiment" methodology. Key attributes for an alternative fertilizer were identified through expert consultation and stakeholders meetings. The farmers were asked in the survey to choose 6 times between two alternative biobased products described on cards according to the key attributes or a third option indicating their preference to continue to use the current mineral fertiliser.



The attributes of biobased fertilisers considered were:

- Price
- Solid, liquid or paste form
- Volume to be spread
- Nitrogen certainty
- **Organic carbon**
- **Hygienic state**
- **Speed of nutrient release**

Farmers' preferences

Despite the variable numbers of farmer survey returns in different countries (from 23 in France to over 200 in Denmark), it appears that farmers preferences are very similar:

- Farmers generally have a preference for a bio-based fertiliser which is similar to the mineral fertilisers they use at present
- **Concentration** (and so volume for which spreading required), certainty of nitrogen, and price showed as consistent farmer wishes in nearly all cases
- Generally preference for solid forms was identified, but some countries expressed also preference for liquid products, probably corresponding to current product habits and machinery.
- Speed of nutrient release did not mostly figure as a priority
- Attention to **hygienisation** and presence of organic carbon varied between countries
- 10% of respondents indicated always their preference to continue using their current mineral fertilizer.

"Farmers' reasons to accept bio-based fertilizers: A choice experiment", poster at the BioRefine Conference, Ghent 2 September 2015, online at http://biorefine.eu/biorefinedownloads/biorefine-final-conference

J. Tur-Cardona, S. Speelman, A. Verspecht, J. Buysse, Dept. Agriculture Economic, University of Gent, Gent, Belgium. O. Bonnichsen, Dept. Food and Resource Economics, University of Copenhagen, Copenhagen, Denmark. L. De Bruyne, Social Sciences unit, Institute for Agricultural and Fisheries Research (ILVO), Merelbeke, Belgium. juan.turcardona@ugent.be

"What kind of biobased fertilizers do farmers prefer?", INEMAD 4th Newsletter 10/2015 http://www.inemad.eu/en/news-and-eventsuk/newsletter-uk/news4-uk/204-nl4-ce-ugent-uk.html

LIFE ANADRY Organic fertiliser from sewage biosolids

DAM (Depuración de Aguas del Mediterráneo) is leading the newly launched LIFE Project "ANADRY" (Dry anaerobic digestion as an alternative management and treatment solution for sewage sludge).

The objective of the project includes an integral solution for environmental management of sludge in small and medium sized wastewater treatment plants (WWTP) to **produce an organic fertiliser for agriculture**.

The project will develop an innovative concept for conventional sludge treatments in wastewater treatment plants, including **reduction** in energy consumption of the plant and the reuse and recovery of resources.

The project will be focused on the development of an innovative technology at semi-industrial scale, operating on **dry or high bio-solids concentration sewage anaerobic digestion (AD) under mesophilic and thermophilic conditions**.

This is particularly **adapted to medium to smaller sewage works** which are not currently equipped with any AD technology as well as new works or works upgrades where dry AD may be effective, and sewage works where sludge is dried then transported to centralised treatment.

The objectives are to **optimise biogas production and generate a stable hygienised digestate appropriate for use as an organic fertiliser in agriculture** from WWTPs that cannot afford any sludge treatment nowadays.

The **LIFE project** is EU supported, coordinated by DAM and includes as partners CEIT-IK4 (Centre of Studies & Technical Research of Gipuzkoa), the Murcia Regional Agency for sanitation and wastewater treatment (ESAMUR), the company Mendyra and EMWIS (Euro-Mediterranean Information System on Know-how in the Water Sector). The project kick off meeting took place 23rd September 2015 and the project will run for three and a half years.

"DAM to coordinate newly approved LIFE project on sewage sludge treatment by dry anaerobic digestion" http://www.damaguas.es/noticias.php?id=162



US EPA - USDA Nutrient Recycling Challenge

The US Environmental Protection Agency, partnering with the US Department of Agriculture and a number of agri-industry companies has launched a challenge for ideas to cost-effectively recover and concentrate nitrogen and/or phosphorus from dairy or pig manure in a useable form.

1-4 submissions will receive cash prizes of up to 5 000 US\$ plus contacts with possible industry investors or users.

This challenge is organised by Innocentive, a company which was previously organising the **Everglades Foundation Grand Challenge US\$ 10 million prize** for P-removal and recovery from dilute waters, e.g. rivers or drainage ditches, see SCOPE Newsletter n° 111 and *http://www.evergladesfoundation.org/stayupdated-grand-challenge/*. The Everglades Grand Challenge prize is continuing preparation, but now with NESTA *www.nesta.org.uk*

The EPA challenge asks participants to submit by 16th January 2016 their ideas for cost-effective nutrient recovery and concentration from pig or dairy manures, taking into account: producing products from the recovered nutrients, solid-liquid separation and decreasing water content of solids, producing low-nutrient effluent, other benefits (e.g. odor, pathogens, water reuse, energy recovery, animal health or production benefits ...), compatibility with existing animal production systems, portability, replicability, scalability, farmer-friendliness.

The dossier to submit (using the cover sheet available online) is expected to describe **technology and objectives, a development and optimisation plan**, and the submitter's competence and resources. A 10page guideline document available online describes expected dossier content, judging criteria, terms and conditions.

The idea remains the **intellectual property** of the submitter, but all submission content can be freely communicated and used by the challenge partners.

Promising submissions will be invited to a **2-day event** in Washington DC to meet potential partners and investors. Up to ten submissions may receive travel awards up to US\$ 1 000 for this. Submissions may also benefit from access to other funding or demonstration on dairy or pork farms.

Submitted ideas will be available to the project's agri-industry partners: American Biogas Council, American Society of Biological and Agricultural Engineers, Ben & Jerry's, Cabot Creamery Cooperative, Cooper Farms, CowPots, Dairy Farmers of America, Innovation Center for U.S. Dairy, Iowa State University, Marquette University, National Milk Producers Federation, National Pork Producers Council, Newtrient LLC, Washington State University, Smithfield Foods, Strategic Conservation Solutions, Tyson Foods, U.S. Department of Agriculture, Water Environment Research Foundation and World Wildlife Fund

US EPA "The nutrient recycling challenge" https://www.challenge.gov/challenge/nutrient-recycling-challenge/

Conferences

SludgeTech 2015 Fresh thinking on sludge management

Article by Marie Roberts, from Water & Sewerage Journal, with permission and with thanks http://www.waterjournal.co.uk/.

A new conference was launched this year to bridge the gap between academic research and industry looking into the potential for sewage sludge as a valuable resource – **SludgeTech**.



Held at the University of Surrey over two days 29-30 June 2015, the conference brought together academics from around the world to share their important research. The event included a wide range of challenging presentations in a warm and collaborative atmosphere.

The instigator of the event was Nick Mills, Wastewater Innovation Manager at Thames Water. "One of the drivers for setting up this new event was my frustration with 'sales pitch'-style papers.



I wanted to have an event where quality science came first and researchers were encouraged to showcase their work in front of industry. So with help from the steering committee, seed funding from the Royal Commission of the Exhibition of 1851 and support from CIWEM for a technical publication postconference, SludgeTech became a reality."

Maximising AD efficiency

Anaerobic digestion (AD) is the main process adopted by the water industry internationally for treatment to satisfy stability, microbiological and energy efficiency criteria. Maximising biomethane recovery and the AD contribution towards renewable energy targets is now a major priority. The conference opened with an investigation into how AD management techniques can improve efficiency. Research presented by **Cranfield University** showed increased methane production with exogenous CO₂ enrichment. Edmond Ndam of Newcastle University and Northumbrian Water had investigated the relationship between struvite and AD efficiency, and further papers looked at the effects of different dewatering techniques on process efficiency.

Resource recovery

There is also considerable potential for recovery of other biorenewable materials and industrial chemicals from sludge. Research presented by Hazel Prichard of the University of Cardiff created a stir when she revealed the quantities of gold found in incinerator ash as well as palladium and platinum (from catalytic converters) found in urban road drains. Dutch water company **De Dommel** showed how they were recovering both energy and phosphates at their centralised sludge processing plant, WWTP Tilburg. In the future, the WWTP envisages becoming a logistical centre for the treatment of sewage, sludge, manure and other biomass streams such as organic waste.

Thermal hydrolysis

A series of presentations from engineering, academic and utility company viewpoints explored the merits of thermal hydrolysis plants (THPs). One presentation, from Dutch water company Vechtstromen, explained how they have centralised their sludge treatment to maximise THP energy recovery.

Effects on pathogens

Microbiologists also presented the latest research on the efficacy of different technologies in destroying pathogens: Stefano Giacalone related a study of E.coli inactivation across all Thames Water's conventional sewage sludge treatment sites and Sarah Fane came away with a best presentation prize for her explanation of a study into novel biosolids storage solutions to suppress E. coli.

End uses

Giuseppe Mininni from the Italian National Research Council's Water Research Institute presented the findings of the three-year EU-funded **ROUTES** project which compared outcomes from a number of sludge treatment technologies for agricultural end-products.

Environmental consultant Tim Evans presented the findings of an interesting market research project with United Utilities to find out how much farmers were prepared to pay for biosolids, which they currently receive free of charge.

Alternatives

Though agricultural recycling is currently considered the best practicable environmental option for sludge utilisation, acceptability of the practice varies widely between different European countries. Opportunities for post-AD energy recovery options involving pyrolysis or gasification that displace the land recycling operation are therefore of great interest to the industry and academic communities. One of the exciting developments in this area is a new process developed in Germany that creates biocoal for domestic heating from sewage sludge, explained by **Dr Dominik Peus from Antaco**.

Delegates came away from SludgeTech brimming with new ideas to put into practice and inform their decisions for the future. As Nick Mills says: "Exploiting our abundant resources is now becoming technically and economically feasible."

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SludgeTech2016 will take place : 27-29 June 2016, University of Surrey, Guildford, UK www.sludgetech.com



BioRefine Conclusions Final project conference

The final conference of the 3-year BioReg InterReg IVB project BioRefine (UK, Germany, Belgium, Netherlands, France) summarised the project outcomes including mineral recovery from combustion ashes, from waste water and from manure, valorisation of bio-nutrient organic fertilisers and concluded with an assessment of future perspectives.

One of the key objectives of the BioRefine project was to develop networking and information exchange. This has led to the **BioRefine Cluster Europe**, which networks 20 projects R&D related to nutrient and energy cycling, see SCOPE Newsletter n° 103 and www.biorefine.eu BioRefine has also supported preparation of a proposed UK Nutrient Platform (see summary of Edinburgh meeting in this Newsletter).



The BioRefine project final meeting, Ghent, 2nd September 2015, brought together some 60 representatives of research, industry and organisations public from 6 countries.

Barrier is economics

The main conclusion of the conference is that a large number of technologies to recover nutrients from various waste streams already exist, but most of them are not economical enough to get implemented in the current system. The expert panel highlighted that the economic context is the main driver to reach a circular economy in which nutrient recovery is common practice.

Erik Meers, Ghent University, opened the meeting, reminding of the **BioRefine project** objective, which is to complement initiatives underway elsewhere to recover energy and organic materials (chemicals) from biomass by recovery and valorisation of nutrients.

Gerard Velthof, Alterra Wageningen, outlined the global nutrient challenges: increasing demand for nutrients to produce food, regions of nutrient excess, environmental consequences and the need for strategies to improve nutrient use efficiency including reducing losses along the whole agri-food chain, recycling and redefining food systems.

Miller Alonso Camargo-Valero, Leeds University UK, presented phosphorus flow analysis from the UK (see Cooper et al. SCOPE Newsletter 113) and information on UK agricultural nitrogen budget. He underlined the importance of data to support tools for change, and that such tools exist for CO₂ but not to date for nutrients.

Wood ash

Frank Delvigne, University of Liège, explained that wood combustion ash contains significant resources of P and K (phosphorus, potassium): 0.15 - 0.93% P and 0.06 - 0.46% K. Regulation is complex, with a number of EU Directives applicable and a range of differing national and regional legislation concerning possible uses or wood ash (see ADEME 2007 http://www.ademe.fr/etat-lart-reglementation-

europeenne-valorisation-dechets-bois-cendres-bois), so that ash is used in agriculture in some countries but mainly landfilled in others.

A number of possible microbial technologies for purifying and valorisation wood ashes are currently at the research level.

Jérôme Gennen, Agra-Ost Belgium, estimated that nutrients present in wood ash P, K, Mg, Ca) are worth 40 –170 €tonne of ash. He presented field trials showing that on grassland, soil pH<4.5, the ash alone or ash+manure or ash+digestate were effective fertilisers, with results comparable to mineral PK fertilisers. Issues identified were heavy metal levels and particle size (necessary to grind the ash before use).

Biobased fertilisers

Emilie Snauwaert, VCM, presented an overview of the nutrient recovery techniques that can be applied on manure or digestate.

Some of these are still in the research phase, others are already well established in practice. This overview will be published on BioRefine website end 2015 http://www.biorefine.eu/biorefine/downloads

• **Biothermal drying (no external heat)** to ensure hygienisation and stabilisation of the product, adjustment of input materials to adapt the product to client farmer needs, then export mostly to France as a soil conditioner. The most used technique in Flanders is an intensive hall- or tunnel-composting process: because of the rise of temperature, emissions of ammonia and odour occur, so air treatment is needed where the



ammonia-rich air is washed with sulphuric acid in an acid air washer. This generates an ammonium sulphate solution which can be used as a mineral nitrogen-sulphur fertiliser.

- Filtration by reverse osmosis to treat the liquid fraction of manure/digestate, to generate a mineral concentrate, rich in N and K.
- Phosphate precipitation from manure/digestate as struvite or other phosphate salts: acidification can be used to increase the proportion of soluble P available for precipitation. Different pilot plants are running to test this technique.
- Pyrolysis (of solid manure) to generate gas, liquid bio-oil and biochars, but this is not yet being used for the treatment of manure. Today the only thermochemical conversion of manure that is used in practice is the combustion of poultry manure. HTC (hydrothermal carbonisation) can be applied to convert wet input materials into biochar. This can be applied as an alternative for drying and combustion of wet biomass. Today this innovative technique is pilot tested for the treatment of sludge from waste water treatment, but it could also be applied on manure or digestate.

Brecht Annicaert, Ghent University and Inagro, presented field trials and incubation trials with biobased fertilisers. The incubation trials showed that nitrogen mineralization was higher for the refined products from animal manure and digestate after a separation or filtration step, compared to animal manure and digestate, but lower than mineral fertilizers. Several field trials (cauliflowers, potato, sandy and sandy-loam soils) showed similar or better results with manure slurry digestate in combination with refinates, compared to manure slurry digestate in combination with mineral fertilisers. Nitrate residues left in soil after the harvest were more dependent on the weather and soil conditions than the fertilization strategy.

More agronomic research is needed on the soil value of organic carbon, potassium and other plant essential elements in biofertilisers and on the interactions between the different products.

Andreas Bral, Ghent University, presented modelling of manure production and valorisation systems, assessing economic aspects and greenhouse emissions. The biggest greenhouse impact is in many cases from methane emissions in transport and storage.

New perspectives

A range of nutrient recovery technologies were presented:

- Andrew Ross, University of Leeds UK: hydrothermal carbonisation, which involves the treatment of biomass in hot compressed water and could be applied to wet biomass such as algae, manures, sludge and AD digestate. At lower temperature processing (hydrolysis and HTC), phosphorus is extracted into the water as whereas at higher temperatures it is associated with the solid residue. Extraction of P can be increased by the addition of acidic additives. Phosphorus can potentially be recovered from the process waters by precipitation or membrane technology.
- Miller Alonso Camargo-Valero, Leeds University UK: uptake of nutrients by algae or plants to produce biomass used for energy or as a fertiliser/soil amendment
- Adrien Marchi, Aquafin: struvite recovery from digested pre-dewatering sludge of municipal sewage works with EPBR. Pilot tests with electroporation of the sludge were conducted to evaluate if this would increase the quantity of recoverable phosphorous from the sludge. Average increases of 18% and 5% free phosphate were observed on respectively non-digested and digested sludge. Tests of struvite recovery from urine collected at a festival were also successfully conducted. Crystal size optimisation appears as an important operational aspect to guarantee a maximum recovery and a proper valorisation.
- Ron Gerards, Waterleau: N recovery from anaerobic digestion by ammonia scrubbing of gases using sulphuric acid to recover ammonium sulphate, up to 15% concentration. Ammonia removal is shown to also improve biogas production.

Hubert Halleux, Prayon Belgium, presented the company's activities **producing technical phosphate products including food phosphates, agricultural and horticultural fertilisers, animal feeds**, with four production sites across the world. Prayon's Belgium site (Engis) can only use phosphate rock from certain regions of the world, in order to ensure the quality of the gypsum byproduct (calcium sulphate) generated in the production of phosphoric acid (5 tonnes of gypsum per tonne of phosphoric acid).

The company is looking to use secondary raw materials in its phosphoric acid production, but these must respect certain criteria: % P content,



absence of contaminants not removed in the Prayon acid process (e.g. titanium), low levels of organic carbon (react with acid), must not contain elements which will end up in the gypsum byproduct deteriorating its quality (e.g. iron, sodium).

Kees Langeveld, ICL Fertilisers, summarised the company's moves to **use secondary phosphorus materials as inputs in their fertiliser production processes**: use of struvite recovered from sewage works, use of MBMA (meat and bone meal ash) in phosphate fertiliser production (see SCOPE Newsletter n°s 113 and 115). **Wood ash** could be of interest to the fertiliser industry for potassium content.

Challenges of marketing biobased fertilisers

Hervé Guerin, Vivescia, explained the experience of selling bio-based fertiliser products to farmers in France. Vivescia is as a cooperative of 8000 farmers in North-East France, supplying around 1 million hectares with fertilisers and other agricultural inputs. cooperative and The buys sells some 700 000 tonnes/year (160 million €) fertilisers per year. Currently around 5% of the nutrients sold by the cooperative are bio-based. Vivescia wishes to further develop the market for recycled biobased fertilisers, to respond to farmers' needs for phosphorus and potassium and to the objective of sustainable farming.

Reliable quality is essential and farmers are increasingly demanding. For this, clear, simple and coherently applicable standards are necessary, which is not currently the case for e.g. digestates. The supply chain can play an important role in grouping actions such as testing, negotiate prices. Biobased nutrients require much more distributor staff time, to monitor quality and reliability of suppliers (more varied suppliers than for mineral fertilisers), to ensure accompanying advise to farmers (complex products), and to ensure documentation and traceability. Documentation provided by suppliers is often inadequate, and Vivescia has to do its own testing and produce its own documentation, both for regulatory purposes and to inform farmers. This generates significant costs which need to be recognised and compensated. Vivescia wants to develop biobased fertilisers with responsible suppliers within the framework of win-win partnerships.

BioRefine conference slides and conference summary: http://biorefine.eu/biorefinedownloads/biorefine-final-conference.

The BIOREFINE project has received European Regional Development Funding through INTERREG IV B. Investing in Opportunities

Edinburgh **Nutrient Platform UK**

The fourth meeting organised towards establishing a Nutrient Platform UK (NPUK) in Edinburgh, 17^{th} September 2015. showed increasing stakeholder interest, with 78 participants. Proposals for the platform's role and actions, funding and organisation were presented.

This was the fourth meeting towards a UK nutrient platform, following meetings in London (ESPP, 2013, SCOPE Newsletter 98), Leeds (BioRefine, 2014), London (BioRefine, April 2015, SCOPE Newsletter 113) and was organised by BioRefine and HIE (Highlands & Islands Enterprise). This is the final such meeting funded under the BioRefine project which is finishing this year.

International actions on nitrogen

The meeting opened with Will Brownlie, CEH (Centre for Ecology and Hydrology CEH, UK), presenting international actions towards sustainable management of the nitrogen cycle:

- European Nitrogen Assessment (Cambridge University Press, 2011)
- UNEP publication "Our Nutrient World" (see SCOPE Newsletter 96 and http://www.unep.org/gpa/documents/publications/O *NWExecutiveSummaryEn.pdf*), which proposed a "20:20 by 2020" target (improve NUE Nitrogen Use Efficiency by 20% and reduce emissions by 20 million tonnes N globally by 2020
- **INMS (International Nitrogen Management** System) project, under development with UNEP / GEF (Global Environment Fund) to propose implementation strategies for 4 world regions and develop models and monitoring

Miller Alonso Camargo-Valero (Leeds University), presented the CVORR project (Value Systems in Resource Recovery) which is developing a systems analysis methodology, including assessing added value and defining metrics, with nutrient and energy recovery from waste water as a case study.

Status of UK nutrient platform project

Andrew Gadd and Malcolm Bailey (Link2Energy) updated on status of development of the UK nutrient platform. Consultation of participants at previous meetings had identified the following stakeholder wishes:



- information on a wide range of subjects, covering all nutrients
- authoritative voice on nutrient recycling, with academic underpinning
- data bank on innovation, best practice, case studies, dissemination
- nutrient flow data
- collaborative projects •
- challenge barriers: economic, recycled product quality, regulatory
- R&D to market, enable supply chains

An outline proposal paper has been circulated proposing a vision, rationale and role for a future **UK nutrient platform**. This proposes a "six-pack" of actions:

- Network management
- Database of skills and expertise
- Liaison with regulators
- Linking to R&D funding and promoting innovation
- Define metrics for sustainability and resilience
- Roadmap of supply chains

Proposed next steps are to establish a 'steering committee' to take forward the UK nutrient platform proposals, define an operating budget, put together necessary funding, which could be a combination of membership fees, project funding, innovation funding.

The UK nutrient platform outline document (4 pages) and the Edinburgh presentation slides from the above speakers are online at http://link2energy.co.uk/uk-nutrient-platform-september-2015

Toledo, Spain **REFERTIL compost and biochar** conference

The EU REFERTIL project international conference on advanced biochar and compost processes took place in Toledo, Spain, 17-18 September. with 85 participants from 10 countries.

The conference, hosted by Biomasa del Guadalquivir, presented applied science and industrial engineering developments to convert local organic biowaste and by-product streams into safe biochar and compost products, so enabling recycling of phosphorus. A number of nutrient recovery developments underway in Spain and elsewhere were presented.

The conference's main message is "in a world with finite resources there is no infinite development opportunity with sustainability, unless a resource efficient circular economy is fully implemented".

Edward Someus, Terra Humana, Hungary, explained that the REFERTIL applied research project (EU R&D funded FP7) included biochar and compost science and understanding, industrial production technology with the objective of zero emission performance, economical, market competitive and regulatory validated product applications, taking into account environmental and climate protection aspects. The project successfully developed, field tested, accredited laboratory evaluated and national authority permitted industrial biochar production and products

The REFERTIL demonstration biochar production unit (operated by Terra Humana in Hungary since 2004) processed 100 tonnes of different input materials to produce biochars, and the REFERTIL project partners produced 2 000 tons of composts from different plant waste input materials. These products were field tested and analysed in the Wessling accredited laboratory, see below.

REFERTIL conclusions

The REFERTIL project conclusions propose the following success factors for producing biochars ready to be placed on the market for farmers:

- no one process fits for all biochar input materials
- the processing of **animal bones as a biochar input** requires higher temperatures and more advanced technological design than production of biochar from plant materials
- in all cases, industrial production technology performance is essential to ensure biochar product quality and safety
- poly aromatic hydrocarbons: REFERTIL considers that a maximum limit of PAH_{19} 1-6 mg/kg in the product should be the key production process quality performance indicator
- regulatory validation is essential: national fertiliser regulation authorisation (or CE label when the future EU Fertiliser Regulation is implemented), REACH registration, production operating licence ...
- product quality should be controlled by an accredited laboratory
- competitive economic cost and market are key challenges



REFERTIL proposes biochar product criteria to ensure that products are high grade, fully quality controlled and safe for human health and the environment under any climatic and soil conditions. A biochar standards report and EU regulation harmonisation proposals have been delivered to the EU Commission (DG RTD) and will be published soon on the REFERTIL website http://refertil.info/

Eric Liégeois, European Commission, DG GROW, made a video presentation of status of the EU Fertiliser Regulation revision. For details on the Fertilisers **Regulation revision dossier see in the DONUTSS** workshop summarv report on http://phosphorusplatform.eu/donutss

Biochar and compost quality

Gabor Bordos Wessling Hungary Ltd, explained that this laboratory carried out for the REFERTIL project over 500 analyses of different material samples (biochars, soils, composts, input waste materials, plant materials) from 11 countries, including over 100 different biochars from 7 producers in 6 countries. Nitrogen, phosphorus, organic carbon content and contaminants (PAHs, PCBs, dioxins) were measured. PCBs and dioxins were not detected (at the quantification limits at Wessling of 0.01 mg/kg for PCBs and 1 - 50 ng/kg for dioxin congeners). PAHs are therefore proposed as the main indicator for contaminants in biochars, with a proposed upper limit of 6 mg PAH₁₆ /kg, noting that high quality biochars can achieve <1 mg/kg PAH₁₉. Through this work, Wessling has obtained accreditation for biochar quality and safety analysis (Wessling-NAT-1-1398/2012 (08.10.2014) issued by the Hungarian National Accreditation Body NAT). Wessling is thus the first laboratory in Europe to obtain specific accreditation for biochar analysis from a national accreditation body. Based on mutual recognition agreements (EC 765/2008, EA MLA, ILAC MRA) accreditations by national NAT bodies are recognised internationally.

José María Gómez, Biomasa del Guadalquivir (Spain), presented an overview of nutrient (N and P) recovery optimization through composting, based on a **REFERTIL** survey of 21 composting facilities across Europe and composting trials in Hungary and Spain. Based on this, the REFERTIL project will propose input comments on the EU draft End-of-Waste criteria for composts and digestates http://susproc.jrc.ec.europ a.eu/activities/waste/documents/IPTS%20EoW%20Biodegradable%20wast e%20Draft%20Final%20Report.pdf (see SCOPE Newsletter 99). The European Commission (DG GROW) is

considering using these published draft End-of-Waste criteria as published by JRC as the basis for criteria for the product annex for composts and digestates under the EU Fertiliser Regulation revision.

Biochar technologies

Terra Humana, has obtained Hungary national for biochar use in agriculture (Hungary National Food Chain Safety Office permit n° 02.5/67/7/2009 with CLP Classification Labelling and Packaging Regulation update n° 02.4/102-2/2015). The company has also obtained an industrial biochar production factory operating authorisation for its site 30 km South-West of Budapest, Hungary (Hungary Industry Safety Office n° FES/01/0851-11/2015). The site started operating at 6700 tonnes/year and is authorised for up to 20 800 tonnes/year. REFERTIL considers that these are important references for the EC 2003/2003 Fertilizer Regulation revision process.

Edward Someus presented the results of the REFERTIL project on ABC (Animal Bone Biochar) as a recovered organic fertiliser and renewable phosphorus source. This ABC is produced using as input animal bones after rendering at 133°C (Category 3 Animal By-Products) using a specific thermal process. This "3R" process operates at temperatures of up to 850°C in oxygen free conditions, using an innovative, horizontally arranged, indirectly heated rotary kiln. The product contains 13% P and can be used as an organic fertiliser (NOTE: here 'organic' means carbon-containing, as opposed to inorganic = mineral), as a growing medium, or as an adsorbent material for waste water treatment. The macroporous ABC biochar enables adsorption of organic molecules from water, and the carbon-enriched biochar can then be composted for agricultural valorisation.

"3R" process tests included inputs of both plant materials and animal bones. The Terra Humana biochar technology and products are now RTD Technology Readiness Level TRL8 and the company's objective is to achieve TRL9 in 2016 with construction of a medium-scale 20 800 tonnes/year input capacity industrial biochar production unit.

Jorgen Krabbe, Frichs AS Denmark, presented the Sublimator technology, which uses "flash" pyrolysis at 750°C or higher to "crack" volatile carbon molecules in biomass carbon input directly from solid to gas, so producing a clean gas for electricity generation or other uses, and a residual biochar solid.



The rapid expansion of the biomass carbon materials "activates" the remaining non-gasified carbons, giving the resultant biochar properties similar to activated carbon. This technology has to date been tested at full scale with an input capacity of 1 200 Kg/hour, using straw as input material, operated for 1 000 hours duration.

Vladimir Fristak, Austrian Institute of Technology, presented studies using showing that impregnation of wood biochar with different mineral ions (magnesium, potassium, aluminium, copper or iron) improved their capacity for phosphorus removal from water. Depending on the mineral used, such materials after phosphorus uptake could possibly be used as a soil amendment or fertiliser, but the possible agronomic impacts should be assessed.

Agronomic testing of biochars and composts

Massimo Pugliese, Turin University, presented greenhouse pot trials in Italy on vegetable crops (tomato, peppers, lettuce) to evaluate effects of composts and biochars as soil amendments or growing media. Composts from animal wastes and municipal biowaste showed negative impacts (germination inhibition) if used at > c. 15% addition to soil. However, composts showed good fertiliser effect at equivalent 10 - 30 tonnes/ha. Green waste composts showed to be effective as growing media with some pathogen suppression effects. Animal bone char showed good fertilisation effects, but plant material biochar showed no significant fertiliser effect. Application of composts and biochar together had positive impacts.

Henning von Alten, Gottfried Wilhelm University (Germany) showed that the addition of a mycorrhizal fungi (AMF) in combination with certain composts or animal bone char could improve plant growth. Plant biochar showed less fertiliser effect. Positive synergy effects with one compost was shown to be partly the result of compost organisms (effect reduced by compost sterilisation).

Annette Vestergaard, SEGES Denmark, presented field trials of biochar from wood waste and biochar from straw in four locations in Denmark in winter wheat and spring barley. The trials started in 2012 and included 1st 2nd and 3rd year effects. In one trial, a small positive effect on wheat yield was identified, in other cases effects were not significant or were slightly negative.

There is a big need to investigate which biochars give positive yield effects to which crops, climates and soil types, and to develop application techniques according to this. The biochar from wood waste showed to significantly reduce soil mineral nitrogen, for all 3 years after application, which could potentially be positive in reducing nitrate leaching risks.

Annette Vestergaard also presented a survey of 400 farmers in Denmark, Italy, Spain and Poland, suggesting that farmers want biochars and composts to contain documented nutrient value or soil improving substances, and have standardised quality. The price must be related to an expected yield effect.

Joeke Postma, DLO, Wageningen, The Netherlands, presented pot trials of Pythium infection in tomatoes, showing that compost but not biochar reduced this infection. The infection was also reduced by adding an microbe strain of *Pseudomonas* antagonistic chlororaphis.

Bruno Glaser, Martin Luther University Halle-Wittenberg, Halle (Germany) summarised current understanding of how biochars interact with soils and other factors in agricultural application, underlining that to date scientific study results are contradictory showing a clear need for further investigation. Biochars have high contents of condensed aromatic carbon compounds and low contents of functional groups (e.g. phenolic or carboxylic). Biochar is generally porous (mainly pores > $20 \ \mu m$).

The following are important examples of the complexity of biochar interactions with soil:

- Interaction with soil minerals will generally only occur after partial oxidation generates functional groups
- The chemical content of biochar is generally water repellent, but the porous structure will attract water
- Biochar carbon content is generally recalcitrant, but the surface pores will attract readily biodegradable carbon
- Stability and reactivity of biochar are key to its interactions with soil (e.g. carbon sequestration, nutrient holding capacity, soil aggregation ...)

Biochar content of poly-condensed aromatic carbons appears to be a very important parameter for predicting agronomic properties and effects.



Nutrient recovery projects in Spain

Joaquin Suescun, Veolia (Spain) presented a project developed with Canal de Isabel II Gestion water company, Madrid, into phosphate recovery as struvite at Madrid SUR municipal waste water treatment works (biological nutrient removal, with anaerobic sewage sludge digestion, currently treating 1.2 million p.e.).

The technology selected by Canal de Isabel is Ostara's PearlTM reactor to obtain Crystal Green® fertilizer. A contract was signed in January 2015 with Veolia as contractor to install a turnkey plant, with a potential of 2.4 tonnes/day of Crystal Green®.

Sofia Grau, Depuracion de Aguas del Mediterraneo (DAM) presented the PHORWater LIFE+ project at Calahorra municipal waste water treatment plant (La Rioja, Spain, biological nutrient removal with anaerobic sewage sludge digestion). The simulation programme **DESSAS** and a study of nutrient flows in different fluxes in the sewage works have been applied and indicate that, in order to reduce phosphorus returns to the sewage works inflow and nuisance deposit problems, the optimal point for installing struvite recovery is in the mixed sludge upstream of the anaerobic digester. After testing of a pilot at laboratory scale, a pre-industrial scale struvite precipitation reactor is under development (see SCOPE Newsletter n°97).

Björn Podola, University of Cologne, Germany, presented the LIFE+ TL-BIOFER project to demonstrate the removal and recovery of nitrogen and phosphorous from primary effluent municipal wastewater using a biofilm photo-bioreactor. The nutrients captured in the growing algal biomass, can be recycled by using this biomass as bio-fertilizers.

32 clonal algal cultures were developed from microalgae samples from a wastewater treatment plant pilot installation, including unicellular and filamentous green algae, cyanobacteria, diatoms. These strains were laboratory tested, showing biomass production of $8 - 12 \text{ g/m}^2/\text{day}$. Based on these results, **a pilot** installation to treat 12 m³/day of wastewater is currently being built and will be operated at El Viso-Villaralto municipal waste water treatment works Cordoba, Spain.

Manuel Conde, Superior Gastronomy and Hostelry School of Toledo, Spain, presented the work underway to separately collect the school's food wastes, using biodegradable plastic bags (Novamont).

This bio-waste will then be converted into biogas and liquid and solid biofertilisers at the Algodor Research and Experimental Production Centre, developed by Biomasa Peninsular and the University of León (CLAMBER project, Castilla La Mancha Bioeconomy Region, http://clamber.castillalamancha.es/ managed by IRIAF-Regional Institute of Research for Agro-industries and Forestry).

Gloria Batllò, Catalonia Waste Agency (ARC), **Spain**, explained the agency's action producing some 30 000 tonnes/year of high quality compost from 375 000 tonnes of separately collected domestic and commercial organic wastes. The compost is used mainly in agriculture.

Javier Branas Lasala, Fertiberia fertilisers company, Spain, presented the NewFert project, which has been approved under the EU Horizon2020 BBI JU (Bio-Based Industries Joint Undertaking http://www.bbi*europe.eu/*) programme in 2015. Fertiberia, together with the project partners (University of León, Drague &Mate International, KWB, IRSTEA and Proman Consulting), will develop processes to allow the reuse and valorisation of nutrients from biowastes (sewage, manure and household waste, etc.) making them suitable as a secondary raw material in the fertilizer industry.

Outside Spain, Jennifer Bilbao, Fraunhofer IGB (Germany) presented the Bioecosim project to recover energy, ammonium sulphate, phosphate and a biochar soil amendment product from manures, using a process chain including solid-liquid separation, superheated steam drying, pyrolysis, phosphate precipitation, permeable membrane gas and pelletisation (see SCOPE Newsletter 100).

Bastian Piltz, University of Cologne, Germany, summarised possible routes for nutrient recovery in decentralised sanitation (EcoSan), including using microalgae to recover nutrients from separate toilet steams (urine or black water) by biomass production, which could then be used as a fertiliser or animal feed.

REFERTIL project final conference "Advance compost and biochar processing: solution for economical phosphorus recovery", 17-18 September 2015, Toledo, Spain. http://refertil.info/refertil-conference-2015

Conference abstract book (28 pages): http://refertil.info/sites/default/files/refertil_international_conferenc e_abstract_book.pdf

Horizon2020 news "Making green organic fertiliser from bones" https://ec.europa.eu/programmes/horizon2020/en/news/makinggreen-organic-fertiliser-bones



ESPP General Assembly and bionutrient circular economy workshop

Brussels, Wednesday 2nd December

ESPP (European Sustainable Phosphorus Platform) is organising a working meeting on policies and tools for the bio-nutrient circular economy, followed by the ESPP General Assembly

Discussion may include: waste disposal constraints, targets, CAP incentives, natural capital accounting, externalities, dynamic standards, fiscal tax shift ...

ESPP General Assembly: regulatory actions underway: fertilisers, EMAS, standards, BAT. REACH ..., DONUTSS data on nutrients to support stewardship, budget 2016, election of ESPP Board (members only may vote)

ESPP non-members will are welcome, but places are be LIMITED to 60 persons. Please indicate by email if you interested in attending: info@phosphorusplatform.eu Participation without prior registration by email is NOT possible.

Blog

Sustainable P Initiative blog

http://www.phosphorusplatform.eu/blog.html

Nutrient Platforms

Europe: www.phosphorusplatform.eu Netherlands: www.nutrientplatform.org Flanders (Belgium): http://www.vlakwa.be/nutrientenplatform/

Germany: www.deutsche-phosphor-plattform.de

America Partnership on Phosphorus North Sustainability NAPPS https://sustainablep.asu.edu

Upcoming events

- *15-18 Nov. Minneapolis, US ASA-CSSA-SSSA-ESA soil science meetings www.acsmeetings.org including session 'Tracking Legacy Phosphorus in Lakes and Rivers' https://scisoc.confex.com/scisoc/2015am/web programpreliminary/Session14624.html
- 18-19 November, Minneapolis, SERA-17 promoting promote innovative solutions to minimize phosphorus losses from agriculture http://www.cvent.com/events/2015-sera-17-meeting/eventsummary-4eb969f0be224a25821b4372c54c34a5.aspx
- 23-24 November, Brussels, WssTP water research brokerage event (Horizon 2020 projects) http://wsstp.eu/events/wsstp-h2020-brokerage-wgs-event
- \$ 25-26 Nov., Berlin, Germany, Global BioEconomy Summit 2015 http://gbs2015.com
- 2 Dec, Belgium (TBD) ESPP General Assembly and working meeting on bio-nutrient circular economy. To participate: info@phosphorusplatform.eu
- ☆ 3-4 Dec 2015, Ghent, Belgium, ManuResource II (manure valorisation) http://www.manuresource2015.org/
- 10-11 Dec., Cambridge UK, IFS (International Fertiliser Society) agronomic conference http://fertiliser-society.org/event/the-2015-ifs-agronomicconference.aspx
- 14-18 December, San Francisco, AGU (Am. Geophysical Union) Conference, Workshop
 'Human alteration of the P cycle'
 https://agu.confex.com/agu/fm15/preliminaryview.cgi/Session8517
- 15-19 Jan. 2016, Arizona, US P-RCN (Sustainable Phosphorus Research Coordination Network) https://sustainablep.asu.edu/
- 15-24 January, Berlin, Green Week, http://www.gruenewoche.de/en/
- 10 Feb2016, Leeuwarden Netherlands, EIP Water Conference http://www.eip-water.eu/save-date-next-eip-waterconference-10-february-2016-leeuwarden
- 9-10 March, Berlin, Germany, SUSCHEM 2nd International Conference on Sustainable Phosphorus Chemistry www.susphos.eu



European Sustainable Phosphorus Platform

- * 13-15 March 2016, Paris, Phosphates 2016 (the phosphate industry conference) http://www.crugroup.com/events/phosphates/
- ✤ 7-10 Mar. 2016, Berlin, European Workshop on Phosphorus Chemistry and 2nd International Conference on Sustainable Phosphorus Chemistry (SUSPHOS) www.susphos.eu
- 27-29 June, Guildford, UK, SludgeTech 2016 www.sludgetech.com
- 16-20 Aug 2016, Kunming, Yunnan, China, 6th world Sustainable Phosphorus Summit (information under "Events" on ESPP website)
- 5-9 Sept 2016., Windermere, Lake District, England, International Organic Phosphorus Workshop 2016 http://soilpforum.com/
- 12-16 Sept 2016 Rostock, Germany, 8th
 International Phosphorus Workshop (IPW8),
 Phosphorus 2020 Challenge for synthesis
 agriculture & ecosystems
 http://www.wissenschaftscampus-rostock.de/
- ✤ 3-4 October, Leeuwarden, WETSUS Conference

Updated events listing online at: http://www.phosphorusplatform.eu/events/upcoming-events To add your event, please contact info@phosphorusplatform.eu

ESPP website "Opportunities" section

http://www.phosphorusplatform.eu/opportunities

Offer or find: - partners to work on a project - promote/find employment - find/offer funding - research collaborators

Send information to info@phosphorusplatform.eu

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