European Sustainable Phosphorus Platform

SCOPE NEWSLETTER

August 2014 n° 106 page 1

25 visions for sustainable phosphorus tomorrow

The European Sustainable Phosphorus Platform's call for texts for a **'vision for sustainable phosphorus in tomorrow's world'** received 110 contributions. A selection of 25 are printed here. The others are at *www.phosphorusplatform.eu* (under Downloads) and present a wide range of ideas and opinions. The selection here is considered to best reflect the text call objective of '**pathways to address the phosphorus challenge**'. They are printed as sent, and the opinions expressed are those of the authors, and not of the European Sustainable Phosphorus Platform.

The partners of the European Sustainable Phosphorus Platform

Society

Education will make closed nutrient cycles the next 'normal'

In the past years, the idea of establishing a circular economy that enables a sustainable management of materials has found ground. In this context, a lot of attention has been dedicated to the technological innovations to make this possible and the economic conditions to make this viable. However, the societal aspects of this socio-technical transition are of equal importance to ensure a sustainable use of phosphorus in the future.

Two main challenges are at the centre of our attention:

(1) ensuring **public support** and

(2) having a working population with the right **skills and knowledge**.

Ensuring public support

Closing material and nutrient cycles by using secondary materials from waste(water) have to become the next "normal". In order to achieve this, it will be key to involve citizens especially when projects are implemented in areas with dense populations (e.g. cities). Today, too often, technological innovations are implemented in a very "top-down" way. Private actors and governments make an agreement and afterwards inform citizens, having little attention for the fact that citizens are part of the innovation (for example, when secondary P is generated from households, or from buildings that are used by many people) or might experience some hindrance from new plants. By involving citizens more and increasing awareness on the need for a circular economy and sustainable materials management, **public support for these innovations will be higher and the use of secondary materials will become common sense**.

Skills and knowledge

A transition to a closed nutrient cycle is only possible by developing the skills, knowledge and competences required by resource-efficient, sustainable processes and technologies; and integrating these into our businesses and communities. Different skills are needed by different industrial players in the nutrient cycle.

Early identification of these skills and integrating them in our educational programmes is likely to play a significant role in the seizing of sustainable development opportunities.

Apart from new technological knowledge and skills, the introduction of green emphases into training programmes is an important lever in strengthening the skills of employees to fill the sustainable jobs of the future. More concretely, in relation to the establishment of a circular economy that enables sustainable materials management it will be key to **introduce a more integrated approach in many training programmes**. It is necessary that in every stage of the nutrient cycle employees are aware of both their own contribution and the contribution of others in other stages to closing the nutrient cycle. This enables to organize the whole cycle in the most efficient and sustainable way.

Closed nutrient cycles the next "normal"

Well-informed citizens that support innovations and a **well-trained working population** will make sustainable materials management and closed nutrient cycles the next "normal".

Sofie Bouteligier: Public Waste Agency of Flanders (OVAM), Policy Advisor - Policy innovation unit - European and international policy team, Stationsstraat 110, 2800 Mechelen, Belgium, sbouteli@ovam.be

Dirk Halet: Flanders Knowledge Center Water (Vlakwa), Strategic Coordinator, Graaf Karel de Goedelaan 34, 8500 Kortrijk, Belgium, dh@vlakwa.be

Phosphorus, the element we've learned to love

If we think of a vision for the future, phosphorus certainly has a key role in it. We may not be running out of it soon, as some would have us believe, but we can't afford to get to that point either.

If we care about sustainable use of metals, glass, paper and plastic, none of which are as important as phosphorus, we should care much more about a key element that feeds us.

Responsible phosphorus use

In a way, it's easy to care about phosphorus. If we use it, it's not going to go away after we discard it, because it's a chemical element. **It will turn up in places where we don't need it and don't want it, promoting growth of organisms indiscriminately**. This may destroy the quality of our surface water. Responsible phosphorus use is all about putting it where we need it most, and only there. In this way we prevent eutrophication and use its tremendous potential where it benefits us. We need to work on the prevention of phosphorus misplacement.

In another sense, it's very difficult to care about phosphorus. We can't see it or touch it, unless we get our hands on a bag of fertiliser. **Silently and modestly it plays its role without being recognized**. It's all around us and even inside us, invisibly, but we'd sorely miss it if we lost access to it. In this vision for the future, everybody knows about phosphorus, so they can care for it and appreciate its value.

Making the best use

In this vision, we make sure that our vital nutrients are used in the best possible way. **In fertiliser production** and processing, we will make sure that every gram of phosphorus is used, or failing that, is stored for future use if we need it. We will design our society and systems in such a way that **nutrients can be re-used** over and over again.

Chemistry will play a key role in extracting phosphorus wherever necessary. This should allow us to freely use phosphorus without guilt, in food production but also in industrial and technical applications.

As long as we make sure it gets back to us, there's no fundamental restriction to use phosphorus in whichever way we want. With only entropy working against us, we're all set for the future.

Schipper W., Independent Industry Consultant and Coordinator of the Global Phosphate Forum, Oude Vlissingseweg 4, 4336 AD Middelburg, The Netherlands willemschipper@wsconsulting.nl

Towards phosphorus security for a food secure future

Substantial progress has been made with respect to research and awareness on the global phosphorus challenge in the last five years alone. The 2008 fertiliser and food price spikes were a wake up call, reminding us of the inextricable link between phosphorus and humanity, and, exposing the fragility of the world's phosphorus and food system to even temporary perturbations.

New research has analyzed national phosphorus flows, global phosphate reserves and market dynamics and risks. Phosphorus recovery trials have increased and numerous global and national phosphorus platforms have been established. **There is now consensus that increased phosphorus recycling and efficiency are required regardless of the longevity of remaining phosphate rock**.

Fuzzy boundaries and contested agendas

However there is still much work to be done to shift the current precarious trajectory of phosphorus use and governance onto a more sustainable path to **ensure food and nutritional security for a growing global population, fertiliser access and sustainable livelihoods** for billions of the world's farmers and ecological integrity of the planets rivers, lakes and oceans. Like other complex or wicked sustainability problems, the global phosphorus challenge has fuzzy/contested boundaries and multiple co-existing agendas and goals. A sustainable phosphorus future will need to directly address these goals, in addition to the legacy of our current systems (weights the past) and future drivers or mega-trends (figure 1).

Goals for phosphorus security

Collective goals for phosphorus security might include:

- **Agricultural productivity**: Increase overall phosphorus use efficiency of the food system (beyond the farm) by increasing the number of people fed per tonne P input, or reduce total P demand while maintaining food/agricultural output;
- **National security:** Reduce dependence on phosphorus imports through diversification of sources, to buffer against price fluctuations and

geopolitical risks in producing countries;

- **Soil fertility**: Ensure soils are fertile in terms of total bioavailable phosphorus and C:N:P ratio, organic matter, moisture;
- **Farmer livelihoods**: Ensure farmers' needs are met by ensuring access to affordable phosphorus fertilisers and in a bioavailable and manageable form;
- **Environmental integrity and productivity**: Close phosphorus cycles by reducing losses and wastage of phosphorus throughout the food system, from mine to field to fork; and
- **Ecological integrity**: Reduce leakage of phosphorus from land to avoid eutrophication & pollution of rivers, lakes and oceans.

Backcasting to the future

So how do we get from where we are now, to where we want to go? There is a whole 'toolbox' of phosphorus recycling and efficiency measures available to us in all sectors from increasing efficient practices in mining and agriculture to low- or high-tech phosphorus recovery in the sanitation sector to changing diets.

Key will be taking an **integrated, context-specific approach that responds to local/regional drivers** to avoid investing in ineffective or partial measures.

What works in Europe will be different to Australia, China or Ethiopia. Finally, **technologies and practices don't implement themselves: effective policy instruments (regulatory, economic, facilitation) are required to stimulate and support such measures**.

Accountability means independent monitoring of transparent phosphate data is required. Shifting the current trajectory towards more desirable futures is possible if all key goals and associated stakeholders are included, to co-define and implement **more scientifically credible, policy salient and legitimate phosphorus strategies**.

Cordell D., Research Principal Institute for Sustainable Futures, University of Technology, Sydney (UTS) PO Box 123 Broadway, Ultimo, NSW, AUSTRALIA 2007 Dana.Cordell@uts.edu.au

Resources:

Cordell, D & White, S (2013) Sustainable Phosphorus Measures: Strategies and Technologies for Achieving Phosphorus Security. Agronomy, 2013, 3(1), p.86-116, http://www.mdpi.com/2073-4395/3/1/86

Cordell, D & White, S (2014), Life's Bottleneck: Life's bottleneck: sustaining the world's phosphorus for a food secure future, Annual Reviews of Environment and Resources, Vol. 39 (online volume publication: 17 October 2014), http://www.annualreviews.org/doi/abs/10.1146/annurev-environ-010213-113300

GPRI (2012), Blueprint for global phosphorus security, outcome of the 3rd Sustainable Phosphorus Summit, hosted by the Global Phosphorus Research Initiative co-founder, the Institute for Sustainable Futures at the University of Technology, Sydney (UTS), 29th Feb – 2nd Mar Sydney 2012, http://sustainablepsummit.net

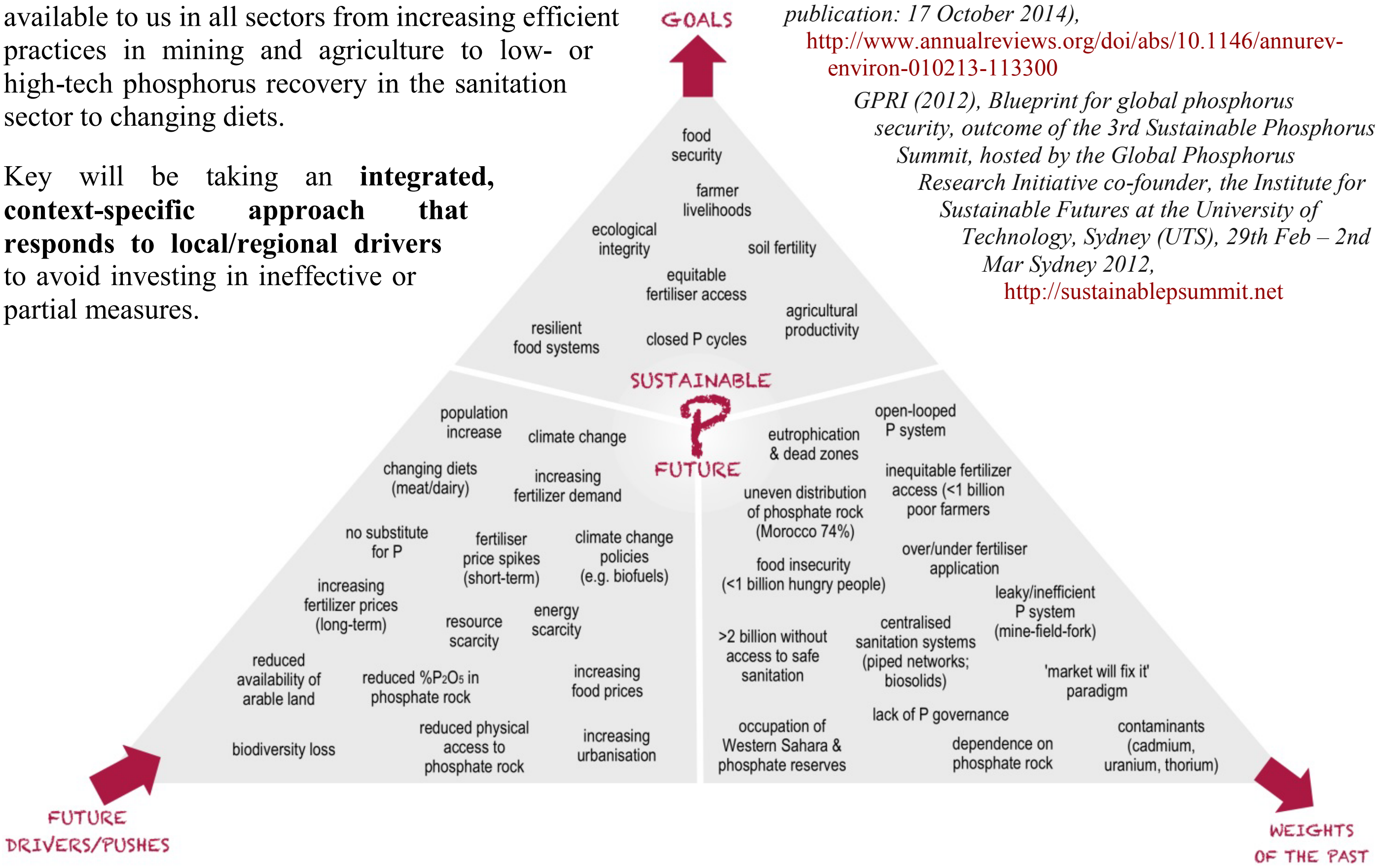

Figure 1: Defining sustainable phosphorus futures are informed by weights of the past, future drivers (mega trends) and aspirations (future goals).

Putting a phosphorus bounty on society's bad behaviour

Phosphorus (P) mining and fertiliser application has enabled increased food production, disrupted the global P cycle by 400% (Filippelli 2008) and caused widespread eutrophication. Eutrophication is the planets greatest cause of water quality deterioration (Smith & Schindler 2009).

Efforts to reduce P accumulation in the ecosphere have focused on increasing agricultural P use efficiency and the recycling of P from wastes. **However, this will not be sufficient to achieve P sustainability**. These advances should be viewed as components of the whole system.

Consumer behaviour

We argue here that focus on the behaviour of the consumer (i.e. society) is just as important as improving behaviour of the producers (i.e. agriculture).

The global P cycle (Figure 1) is driven by **the motor of human consumption**. As the global population grows so too does its P-demand. This is compounded by the relatively large population increase of the middle class whose P-demand continues to grow, largely due to **increasing meat consumption** (Childers et al. 2011).

The responsibility for reducing the human P footprint falls upon the **the individual whose lifestyle must be changed**. Policy makers, industry, scientists and

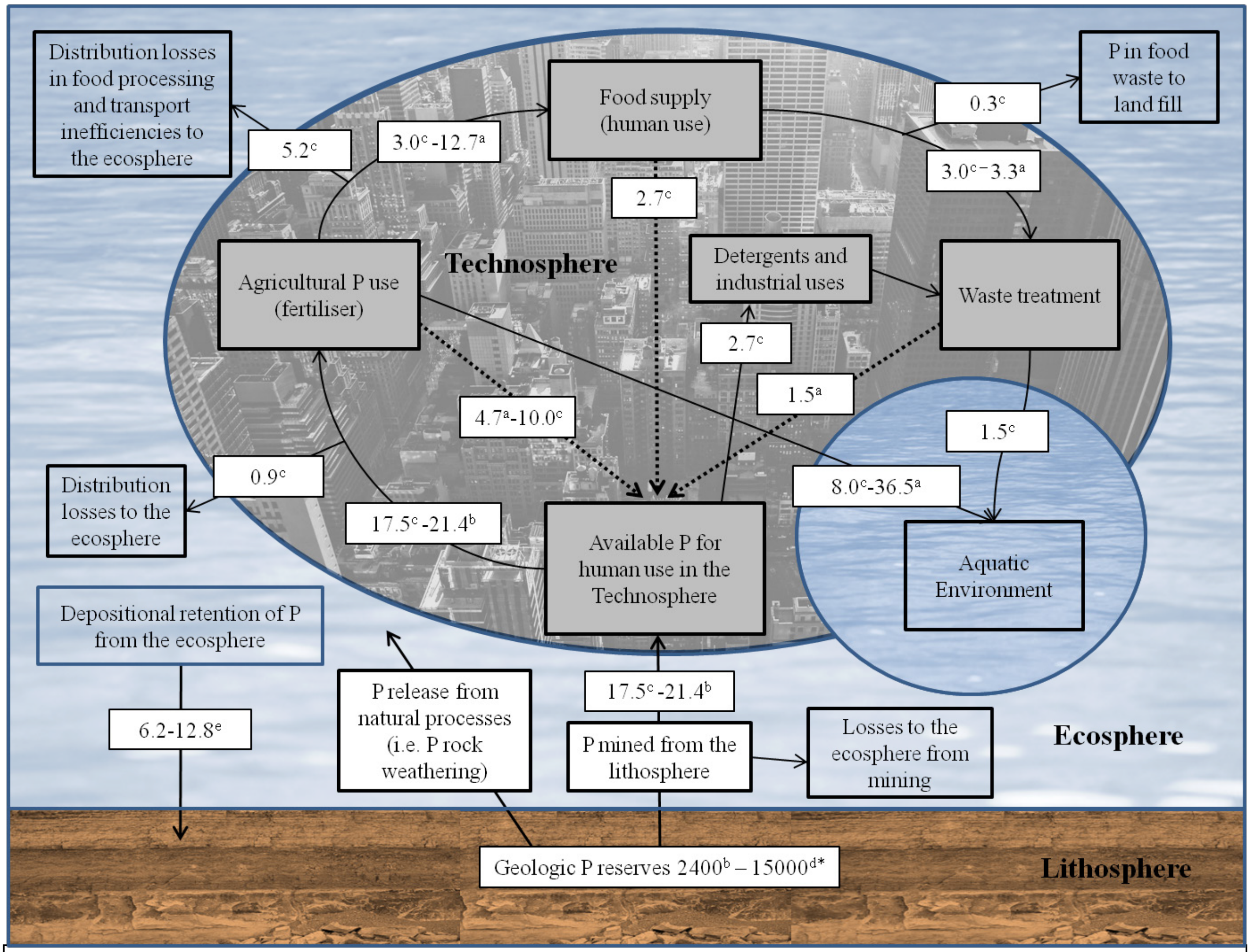

*Figure 1. The global P cycle. Solid arrows represent flows of phosphorus (P), dashed lines represent recycling of P within the technosphere (grey area). Figures in boxes represent estimates of P flows in million tonnes (MT) year-1 (*estimated P reserves in MT). Superscripts correspond to the data source for each P flow estimate: a) Liu et al. 2008, b) Villalba et al. 2008, c) Cordell et al. 2009, d) Gilbert 2009 e) Pierrou 1976. P accumulation in the ecosphere (blue area) is equal to the sum of all losses from the technosphere, the rate of P release from natural processes (i.e. P rock weathering) and losses from P rock mining, minus the rate of depositional retention into the lithosphere (brown area).*