Global Phosphorus Research Initiative

submission to the

Public consultation on the Raw Materials Initiative

About the
Global Phosphorus Research Initiative

The Global Phosphorus Research Initiative (GPRI) is a collaboration between independent research institutes in Europe, Australia and North America. The main objective of the GPRI is to facilitate quality interdisciplinary research on global phosphorus scarcity and sustainable responses for future food security. The GPRI also facilitates networking, dialogue and awareness raising among policy makers, industry, scientists and the community on the implications of global phosphorus scarcity and possible solutions.

The GPRI was co-founded in early 2008 by researchers at the Institute for Sustainable Futures at the University of Technology, Sydney (UTS), and the Department of Thematic Studies - Water and Environmental Studies at Linköping University, Sweden. Today, GPRI members also include the Stockholm Environment Institute (SEI) in Sweden, the University of British Columbia (UBC) in Canada and Wageningen University in The Netherlands.

GPRI members have researched and written extensively on the sustainability dimensions of phosphorus scarcity, including the *Sustainable Use of Phosphorus* Report for the European Commission D.G. Environment (see references in footnotes). Relevant publications, ongoing news and events can be found at our website: www.phosphorusfutures.net. Due to growing international interest in this emerging field, the GPRI is also developing a global network of concerned scientists, practitioners, policy-makers, industry, NGOs and citizens.

In response to *Q2 "Do you see any additional raw material that should be considered as critical?"* [POLICY AREA: DEFINING CRITICAL RAW MATERIALS],

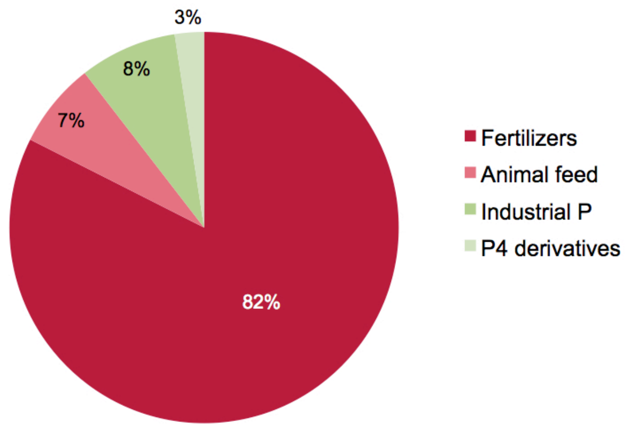
The members of the Global Phosphorus Research Initiative (GPRI) believe that phosphate is a critical raw material currently missing from the list of 14 such materials, and recommends it be added.

Justification for this recommendation is as follows:

1. Phosphorus has no substitute

There is no substitute for phosphorus in food production. Without phosphorus, we cannot produce food. Phosphorus is an essential element for all life, including plants, animals and bacteria[1]. Approximately 90% of all phosphate rock is mined for food production (fertilizers, feed and food additives) (figure 1).

Figure 1. Breakdown of phosphate rock end uses



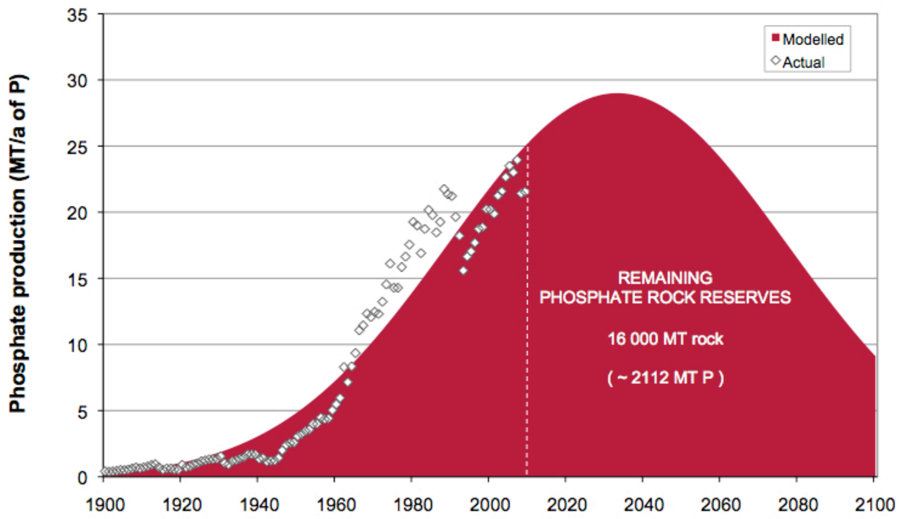
Data: Prud'Homme, M. (2010), World Phosphate Rock Flows, Losses and Uses, International Fertilizer Industry Association, Phosphates 2010 International Conference, 22-24 March, 2010, Brussels.

[1] Johnston, AE (2000) *Soil and plant phosphate*, International Fertilizer Industry Association, Paris.

2. Peak phosphorus expected in coming decades

The main source of phosphorus for fertilizer production today is phosphate rock – a non-renewable resource. While estimates vary regarding when high-grade reserves will be depleted, we believe we are likely to see a peak in global phosphate rock production within the next few decades after which demand will exceed supply (figure 2)[2]. There are currently no alternative sources of phosphorus identified today that could replace mined phosphate rock in the short-medium term to produce the 20 million tonnes of P per year currently needed to supply world agriculture and industry. Developing alternative renewable sources (recovery and recycling to reduce and replace consumption of phosphate rock) at such a scale could take decades to develop and implement.

Figure 2. Peak phosphorus curve



Source: Cordell, D, Drangert, J-O & White, S (2009) *The Story of Phosphorus: Global food security and food for thought.* Global Environmental Change, 19 (2), p292-305

3. Global phosphorus demand increasing

The International Fertilizer Industry Association expects medium-term phosphorus demand to continue increasing at an average rate of 2-3%p.a. The long-term global demand for phosphorus can also be expected to continue increasing, due to:

a) Increasing global population – 9 billion expected by 2050;
b) increasing demand for more meat and dairy food, which require more phosphorus to produce;
c) increasing fertilizer demand for non-food crops such as biofuels;
d) increasing need to boost soil fertility in developing countries, especially in Sub-Saharan Africa where many poor farmers are working with phosphorus-deficient soils.

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[2] Cordell, D, Drangert, J-O & White, S (2009) *The Story of Phosphorus: Global food security and food for thought*. **Global Environmental Change**, Vol 19, Issue 2, May 2009, p.292-305.

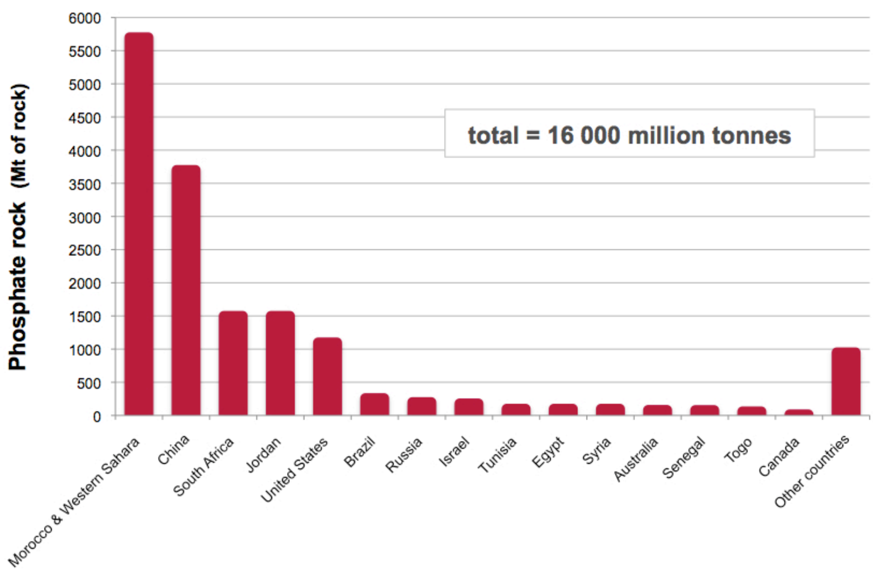
This means there will be a growing gap between demand and supply if no changes to the current phosphorus use trajectory are made[3].

4. Geopolitical tensions can restrict phosphate availability

While all farmers need access to phosphorus, remaining phosphate rock reserves are controlled by just a few countries, including Morocco, China, South Africa, Jordan and US (figure 3). In 2008, China imposed a 135% export tariff on phosphate which essentially halted exports from the region. Morocco currently controls Western Sahara and the large phosphate deposits in this region, contrary to UN resolutions[4]. The US, formally the largest producer, consumer, importer and exporter of phosphate, now has less than a few decades left of its own reserves.

The European Union is highly dependent on phosphate imports for food, feed and fibre production, hence is vulnerable to future phosphate scarcity, geopolitical tensions and volatile prices[5].

Figure 3. World phosphate rock reserves by country



Data: Jasinski, S (2010) *Phosphate Rock, Mineral Commodity Summaries*, US Geological Survey.

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[3] Cordell, D., Neset, T. S. S., Drangert, J.-O. & White, S. (2009), *Preferred future phosphorus scenarios: A framework for meeting long-term phosphorus needs for global food demand*, International Conference on Nutrient Recovery from Wastewater Streams Vancouver, 2009. Eds D. Mavinic, K. Ashley and F. Koch. ISBN:9781843392323. IWA Publishing, London.

[4] Rosemarin, A., Bruijne, G. d. & Caldwell, I. (2009), *Peak phosphorus: The next inconvenient truth,* The Broker, August 2009, 15, p.6-9.

[5] Schröder, J., Cordell, D., Smit, A. & Rosemarin, A. (2010) *Sustainable Use of Phosphorus*, Final Draft, prepared by Wageningen University (The Netherlands) and Stockholm Environment Institute (Sweden), prepared for the EU Directorate General (Environment), EU Tender ENV.B.1/ETU/2009/0025.

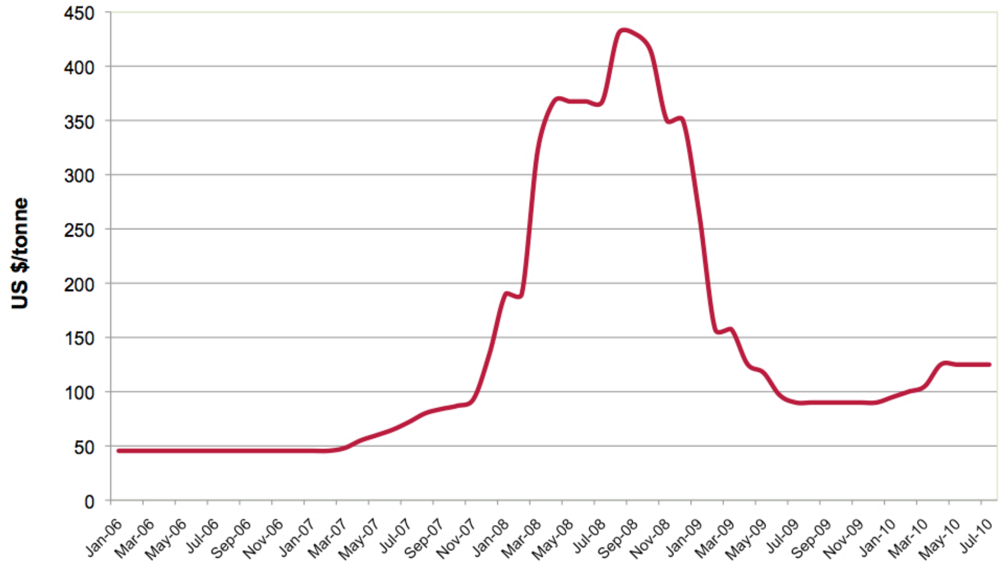
5. Quality is declining and energy is increasing

The quality of remaining phosphate rock reserves is declining, both in terms of decreasing phosphorus concentration (% P_2O_5) and increased associated heavy metals like Cadmium and Uranium. The energy cost of mining, processing and particularly transporting phosphate rock and fertilizers around the world to the farm gate is increasing[6]. This means extracting the same nutrient value from phosphate rock in the future will increasingly require more energy and raw materials, and generate more waste streams.

6. Cheap fertilizers will be a thing of the past

There is consensus among scientists and industry that the cost (and hence price) of phosphate commodities will increase in the long-term as the more difficult to access and lower quality deposits are mined. In the short-term, more price spikes such as the 800% phosphate rock price increase in 2008 (figure 4) could occur.

Figure 4. Phosphate rock commodity price



Data sources: World Bank Commodity Price Data; Minemakers Limited.

[6] Gilbert (2009), *The Disappearing Nutrient*, NATURE News Feature, vol 461, 8 October 2009, pp.716-718, http://www.nature.com/news/2009/091007/full/461716a.html

7. Phosphorus pollution is a global environmental problem

Phosphorus discharged from out-of-date sewage treatment plants, intensive livestock and poultry production and lost via agricultural erosion and runoff is contributing to a global epidemic of eutrophication in freshwater, estuarine and near shore ocean environments, and contributing to the loss of potable water resources, aquatic biodiversity and formation of large ocean "dead zones"[7]. Using phosphorus more efficiently and recovering phosphorus for reuse both offer the added benefit of reducing such pollution.

8. Lack of global governance and management of phosphorus

The current use of phosphorus for food production is also largely inefficient. For example, approximately 80% of the phosphorus contained in rock mined for food production never reaches the food consumed by the global population. Phosphorus is 'lost' from the food system at all key stages, including mining and processing, accumulation in agricultural soils, food processing, food consumption and excretion. For example, each year, the global population generates 3 million tonnes of phosphorus in excreta, most of which ends up in water bodies and can cause eutrophication if not intentionally recovered and reused[2].

There are currently no existing international organisations, policies, protocols or guidelines explicitly governing global phosphorus resources for long-term for future food security[8]. Phosphorus has largely been managed as a pollutant to date, which is reflected in current policy (such as the EU Water Framework Directive). New policies are required to also manage phosphorus as a critical global resource.

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[7] World Resources Institute (2008), Agriculture and "Dead Zones".

[8] Cordell, D. (2010), *The Story of Phosphorus: Sustainability implications of global phosphorus scarcity for food security*, Doctoral thesis. Collaborative PhD between the Institute for Sustainable Futures, University of Technology, Sydney (UTS) & Department of Thematic Studies - Water and Environmental, Linköping University, Sweden. No.509. Linköping University Press, ISBN9789173934404, Linköping.

9. Action is required

We believe that current global phosphorus usage practices are threatening the world's future ability to produce food and are responsible for widespread eutrophication. There is a pressing need to develop a coordinated response to global phosphorus scarcity, that includes:

a) the development and implementation of sustainable technologies and strategies for the recovery of phosphorus from the food system for reuse in agriculture. That is, the safe and efficient extraction of phosphorus through precipitation, incineration, compost or other means from all waste flows from agriculture, food production, households and industry (e.g. crop residues, animal and human excreta, food waste, wastewater)[9];

b) measures to substantially reduce the demand for phosphorus and reduce losses to water and non-arable land (including increasing efficiency of phosphorus use in agriculture, reducing spillages and wastage during food production and consumption and changing diets towards less phosphorus-intensive foods)[5]; and

c) effective and inclusive governance and associated institutional arrangements to ensure long-term phosphorus security from the European Union to Sub-Saharan Africa (including a combination of regulatory and economic instruments)[5,8].

We believe the action required to achieve phosphorus *security* should be aligned with the principles of sustainable development, and seek to identify synergies with solutions to other pertinent global challenges, such as climate change, water and energy scarcity, water pollution and food security.

Signed,

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[9] Mavinic, D., Ashley, K. & Koch, F. (Eds.) (2009) *Proceedings from the International Conference on Nutrient Recovery from Wastewater Streams* Vancouver, 2009, www.nutrientrecovery2009.com, London, IWA Publishing, ISBN: 9781843392323.