

The Phosphorus Challenge

**European Sustainable
Phosphorus Conference 2013**

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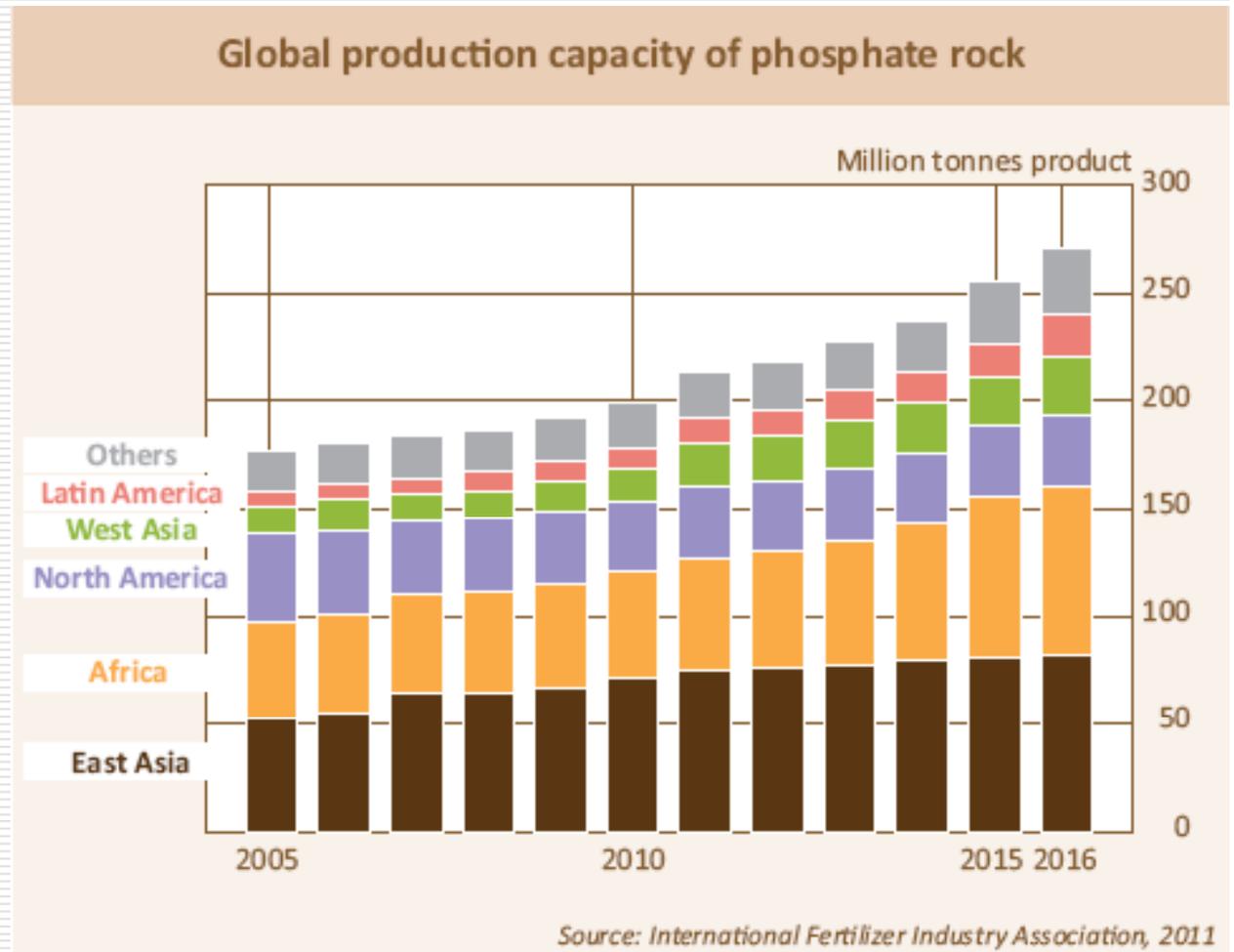
Professor Lars Stoumann Jensen
Univ of Copenhagen

Square Brussels, March 6, 2013



Phosphorus - a few facts

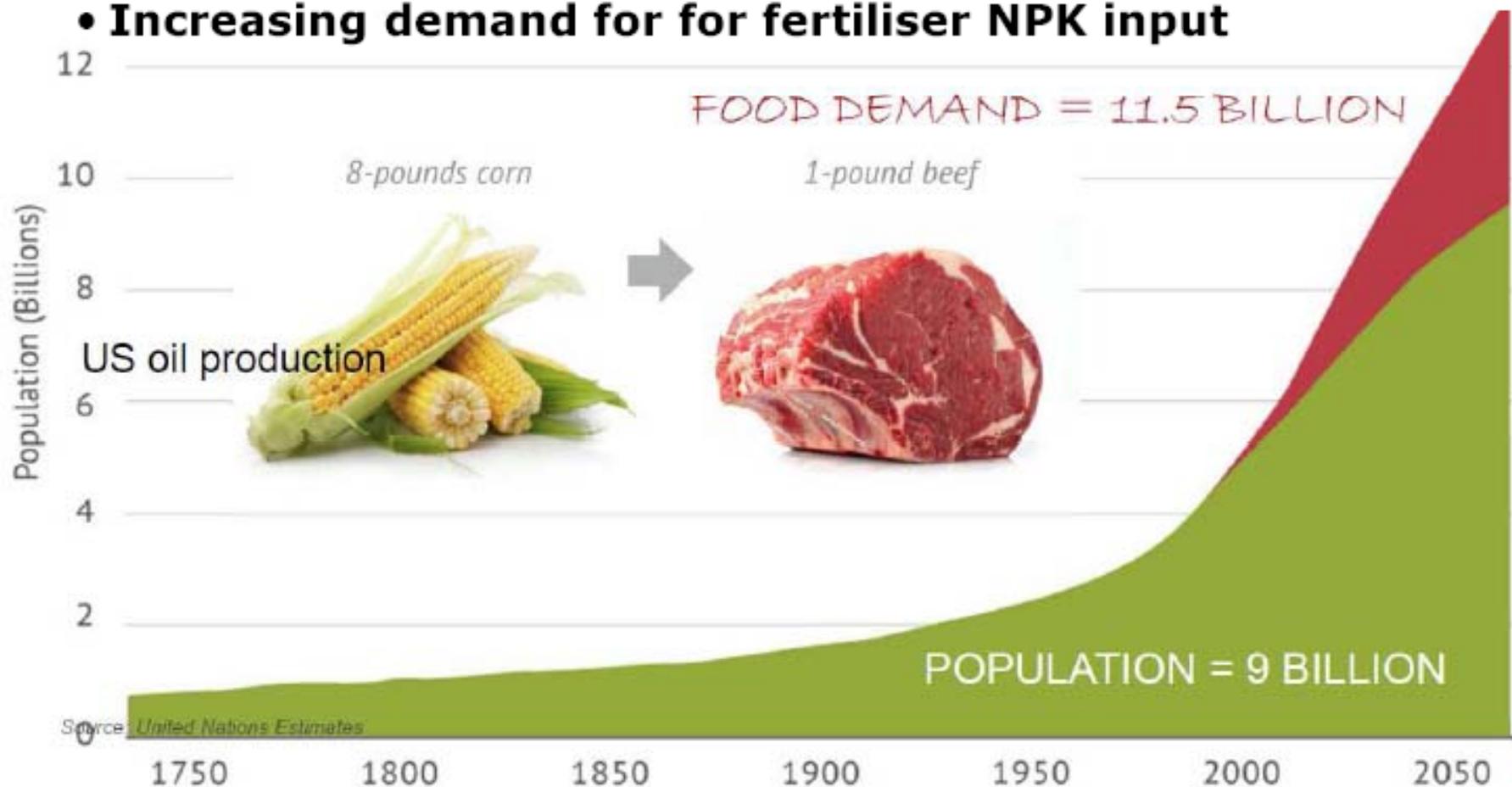
- ❑ Phosphorus is an essential element in all animals and plants
- ❑ Key ingredient in fertilizer
- ❑ Humans each require about 3 gm phosphate per day
- ❑ The world is now dependent on the finite commercial sedimentary rock phosphorus deposits
- ❑ Extraction is growing ca 6% per yr now
- ❑ Neither the UN or EU monitor P rock extraction



Global drivers

Increased and changing demand for food

- By 2050 world population will have increased from 7 to +9 bio.
- Preference for animal products with increasing wealth
- Diets in 2050 will require large increase in animal feed production
- 9 bio. people in 2050 = 11,5 bio. with a 2009 diet
- **Increasing demand for for fertiliser NPK input**

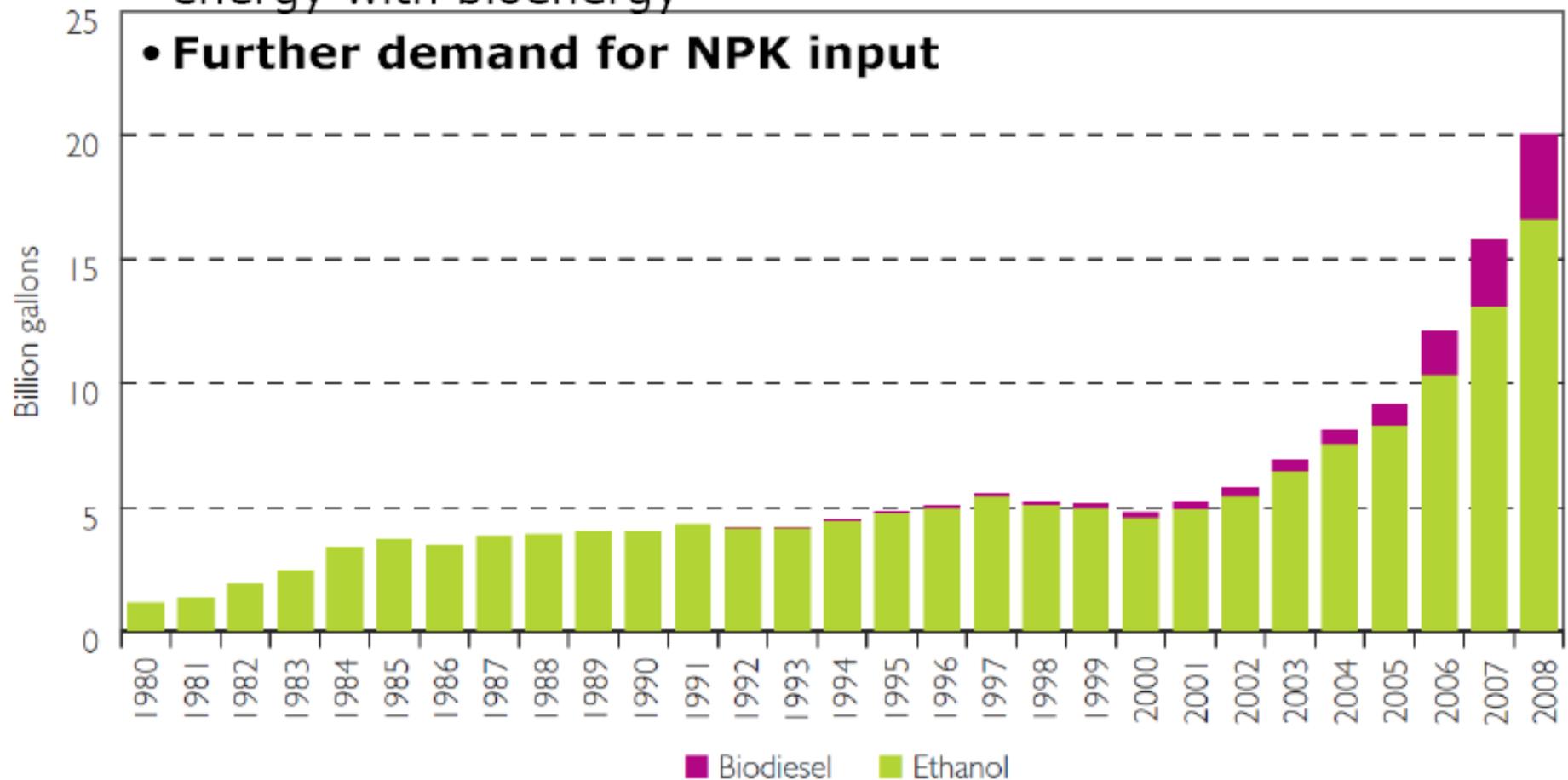


Global drivers

Increasing demand for bioenergy

- At the same increasing demand for replacement of fossil energy with bioenergy

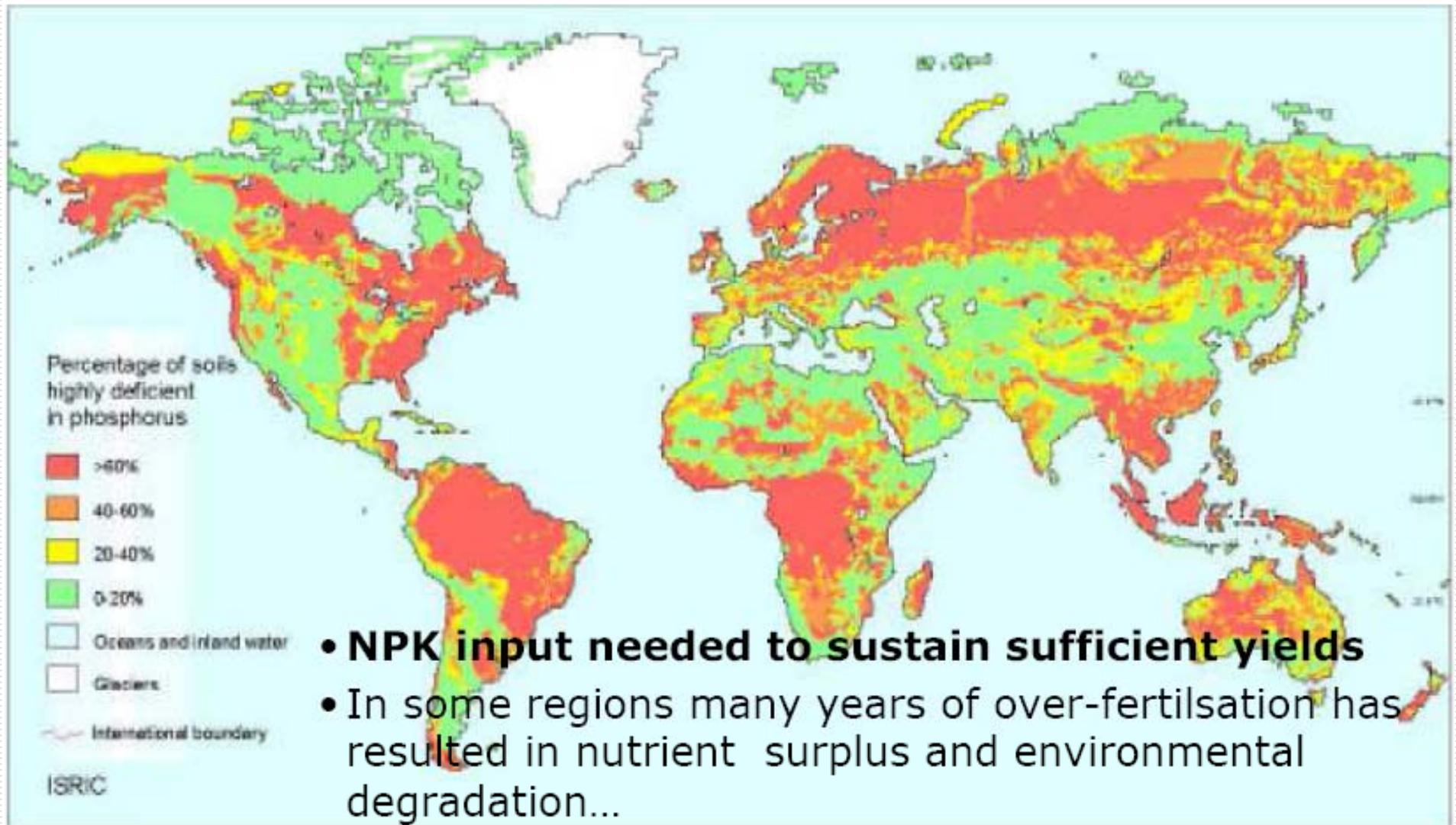
- **Further demand for NPK input**



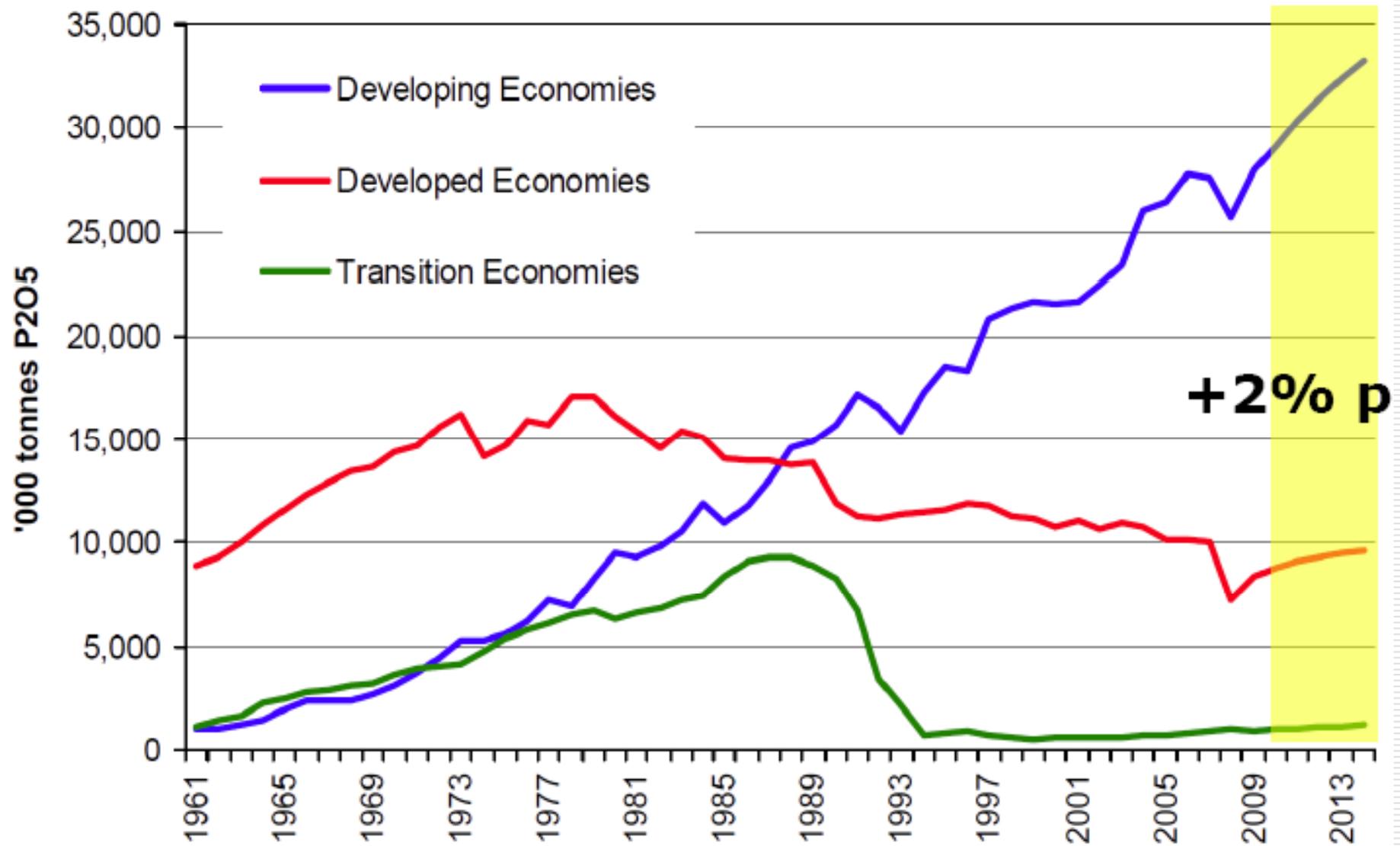
Source: Conway and Waage (2010), sourced from IEA data

Global drivers

The worlds soils generally deficient in P...

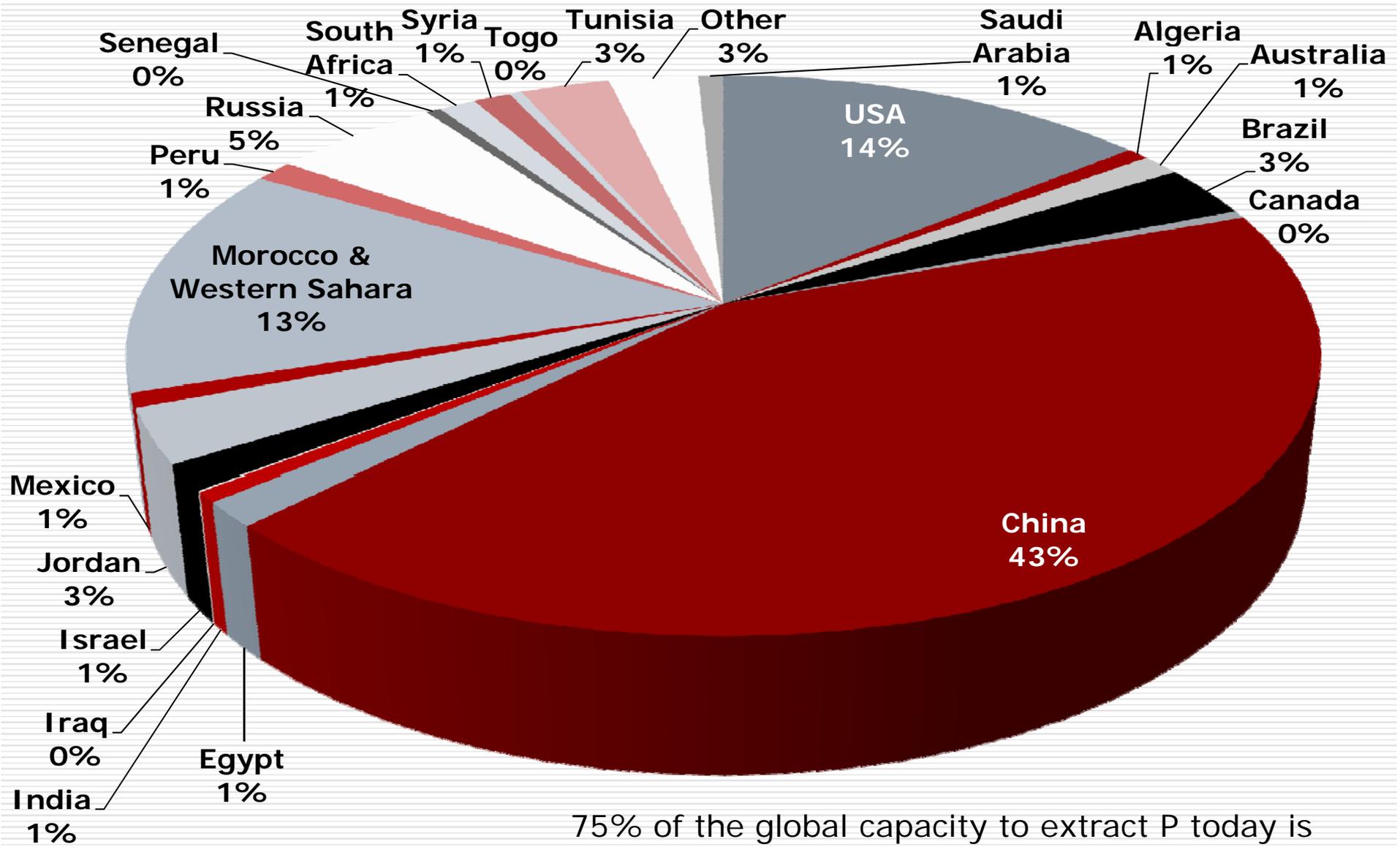


Resulting global driver: Increasing consumption of P fertilizer...



(Palliere, 2011; IFA Production and International Trade)

P-Rock Extraction 2012 (210 Mtons)



75% of the global capacity to extract P today is limited to US, China, Morocco and Russia; not being monitored by either UN or EU

Top P-rock Exporting Countries

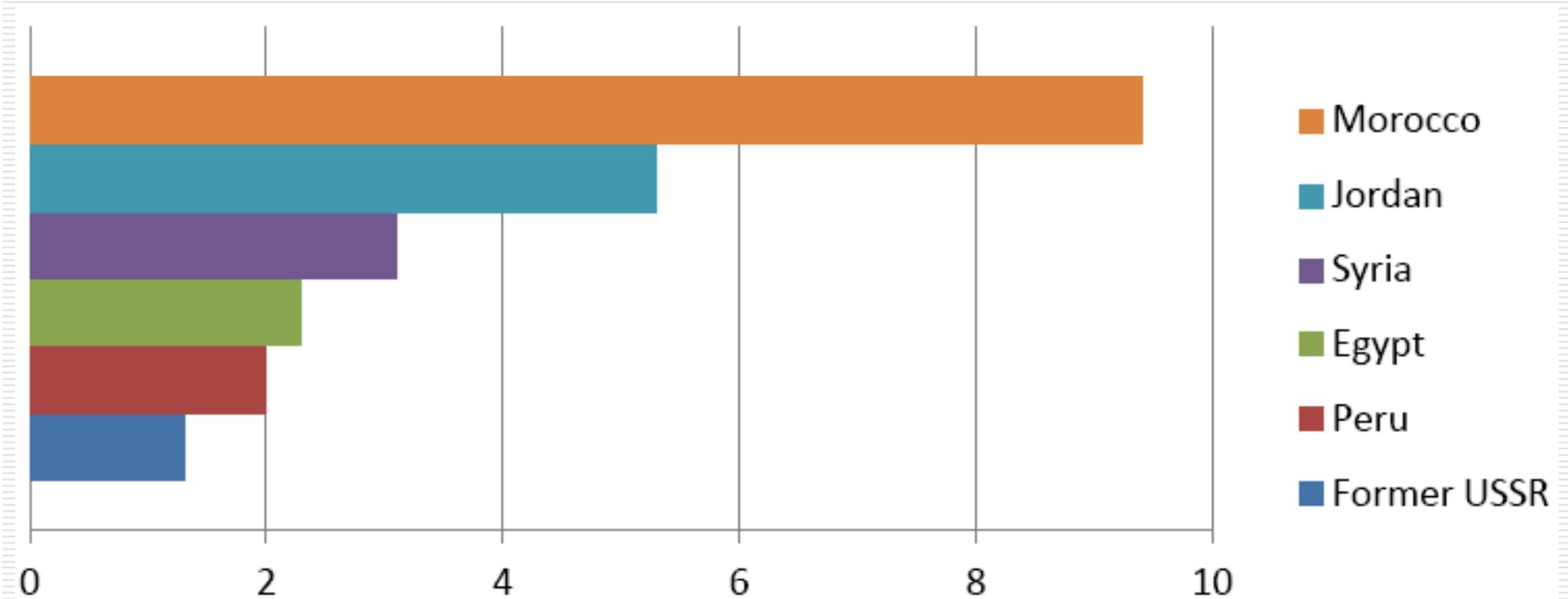


FIGURE 5: PHOSPHATE ROCK EXPORTS BY COUNTRY IN MMT ³³

Total of 30 Mt/yr traded. That's only 16% of the global amount mined.

From HCSS 2012

Main Sources of P-rock in the EU (Mt/yr)

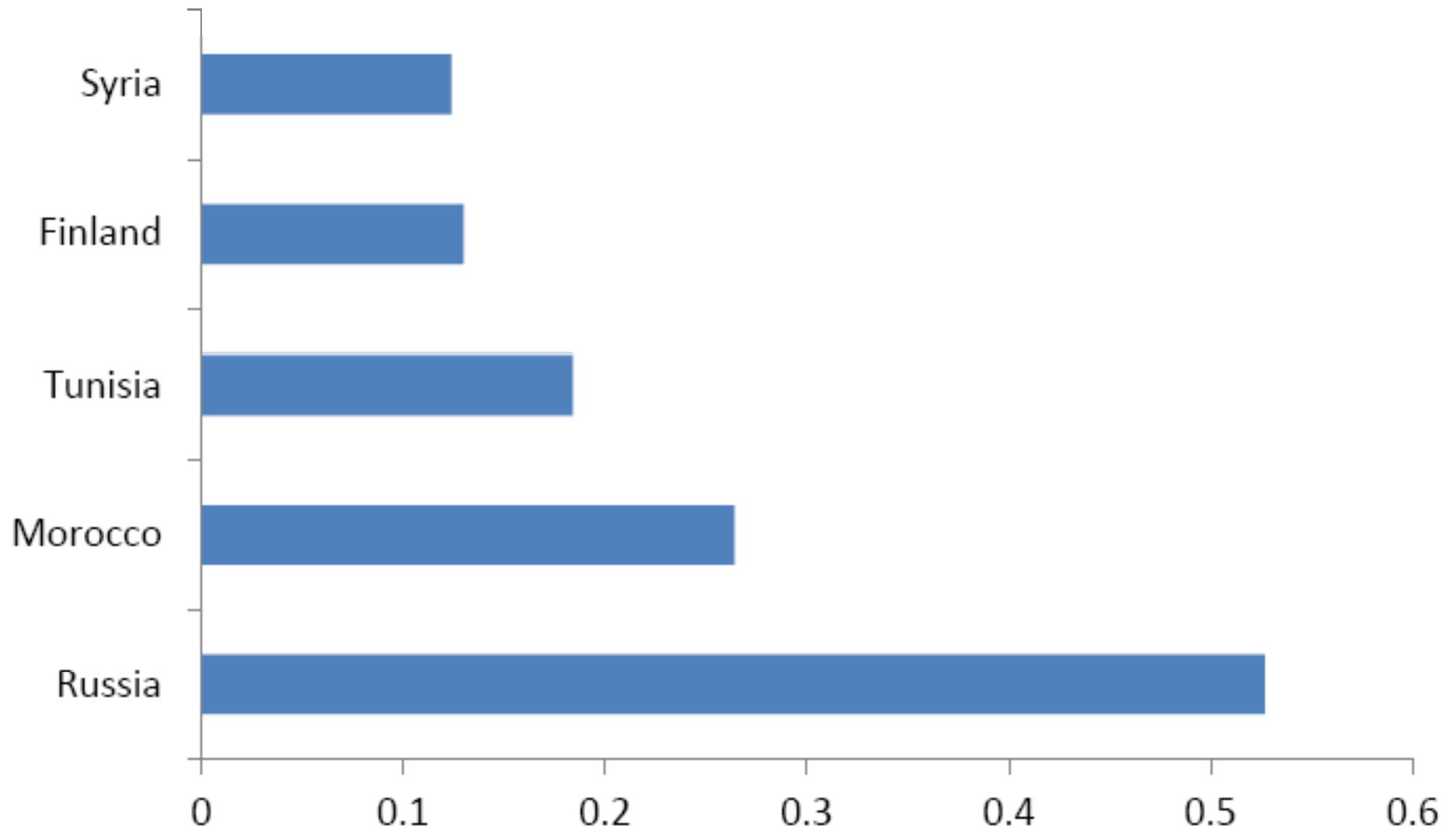
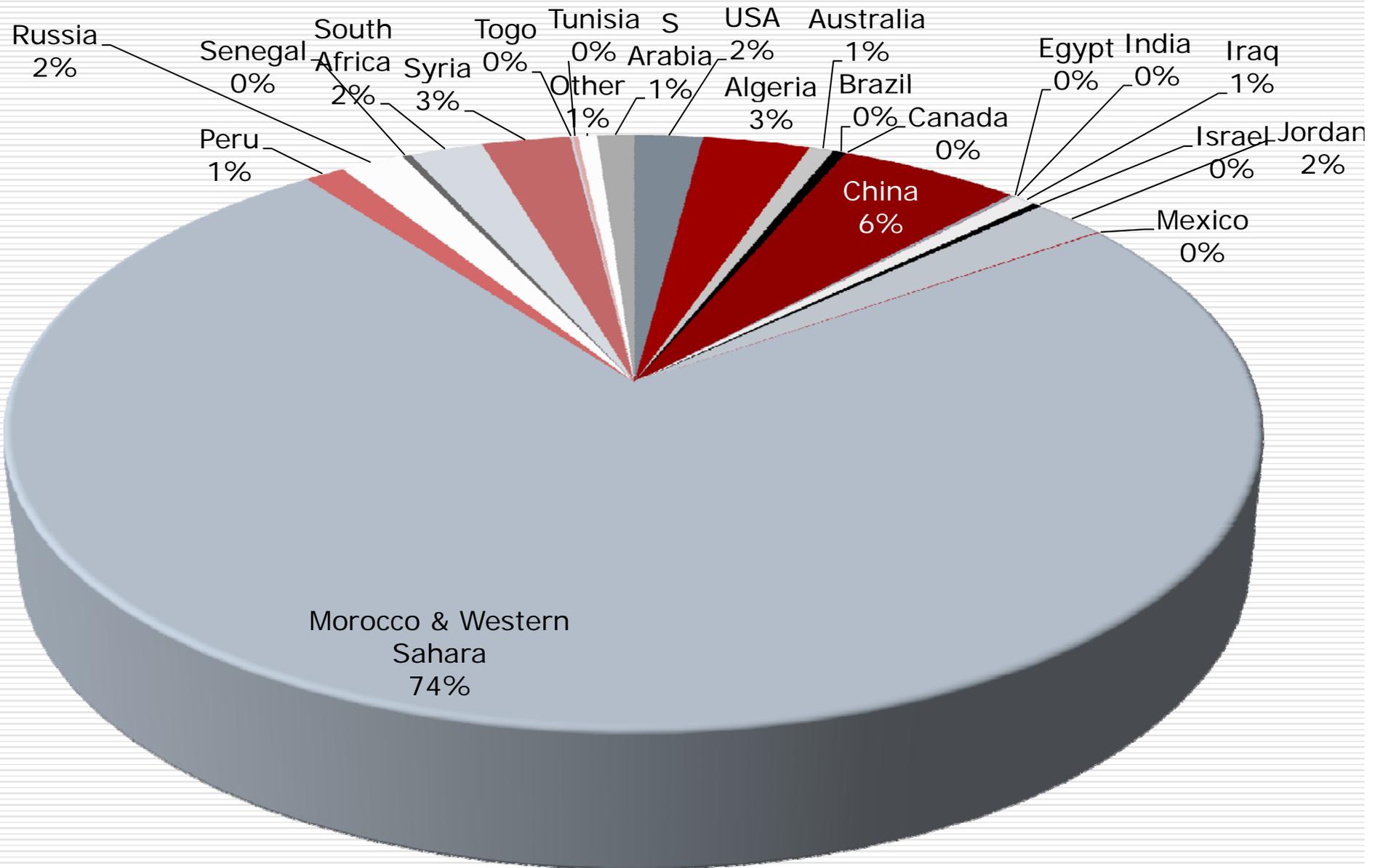


FIGURE 8: MAIN SOURCES OF PHOSPHATE ROCK IN THE EU IN MMT IMPORTED PER YEAR³⁸

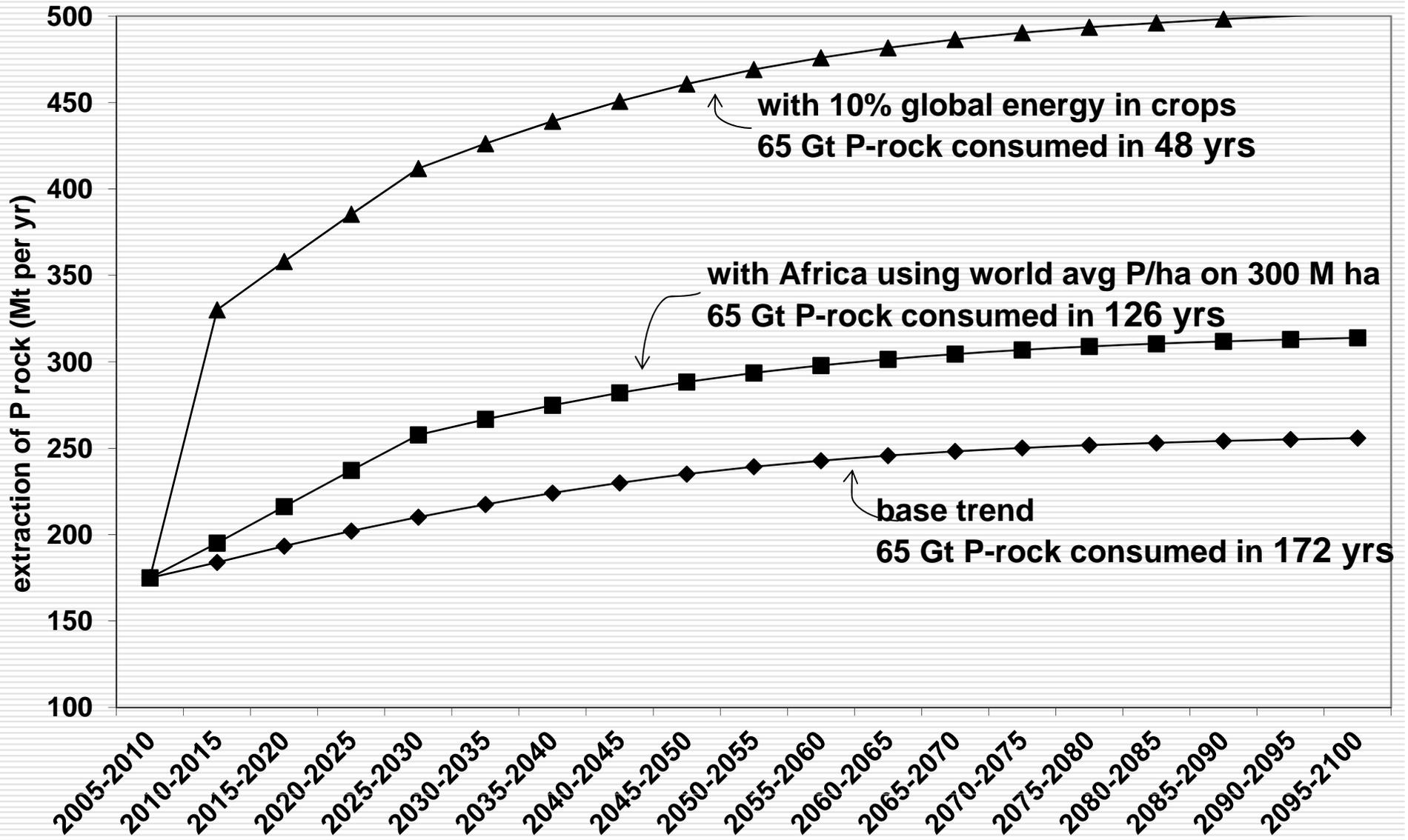
From HCSS 2012

P-Rock Reserves 2013 (67 Gigatons)



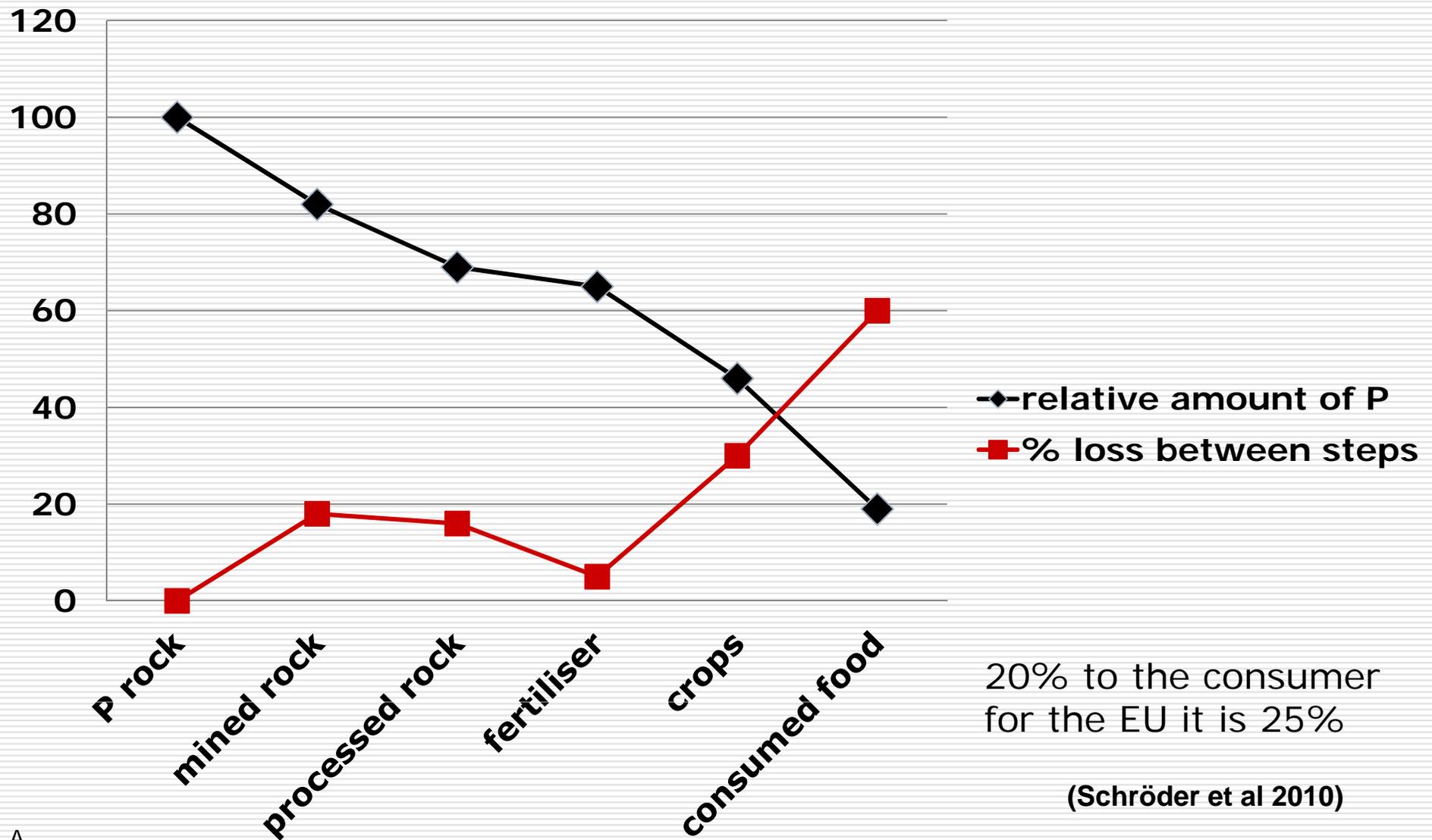
Iraq reserves reduced by >5 Gtons in Jan 2013 by USGS. US and Chinese cheap reserves depleting within 30-40 years. Morocco near monopoly developing.

3 Scenarios Towards Global Depletion of "commercial" Phosphorus

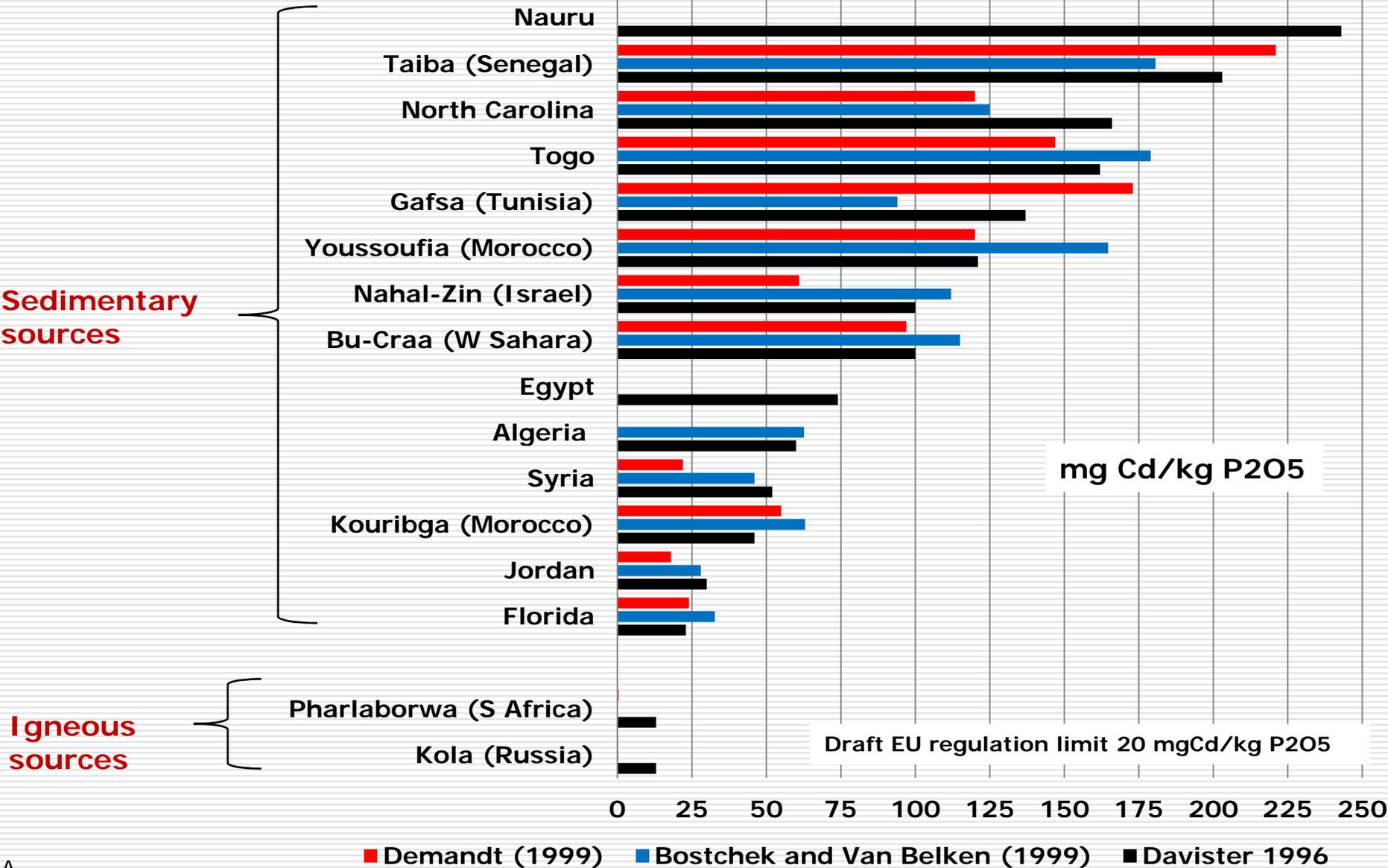


10% global energy as crops will deplete all cheap P in <50 yrs

Global Supply Chain Losses of Phosphorus: From Mine to Fork



Cadmium Content of the Commercial Phosphate Rocks



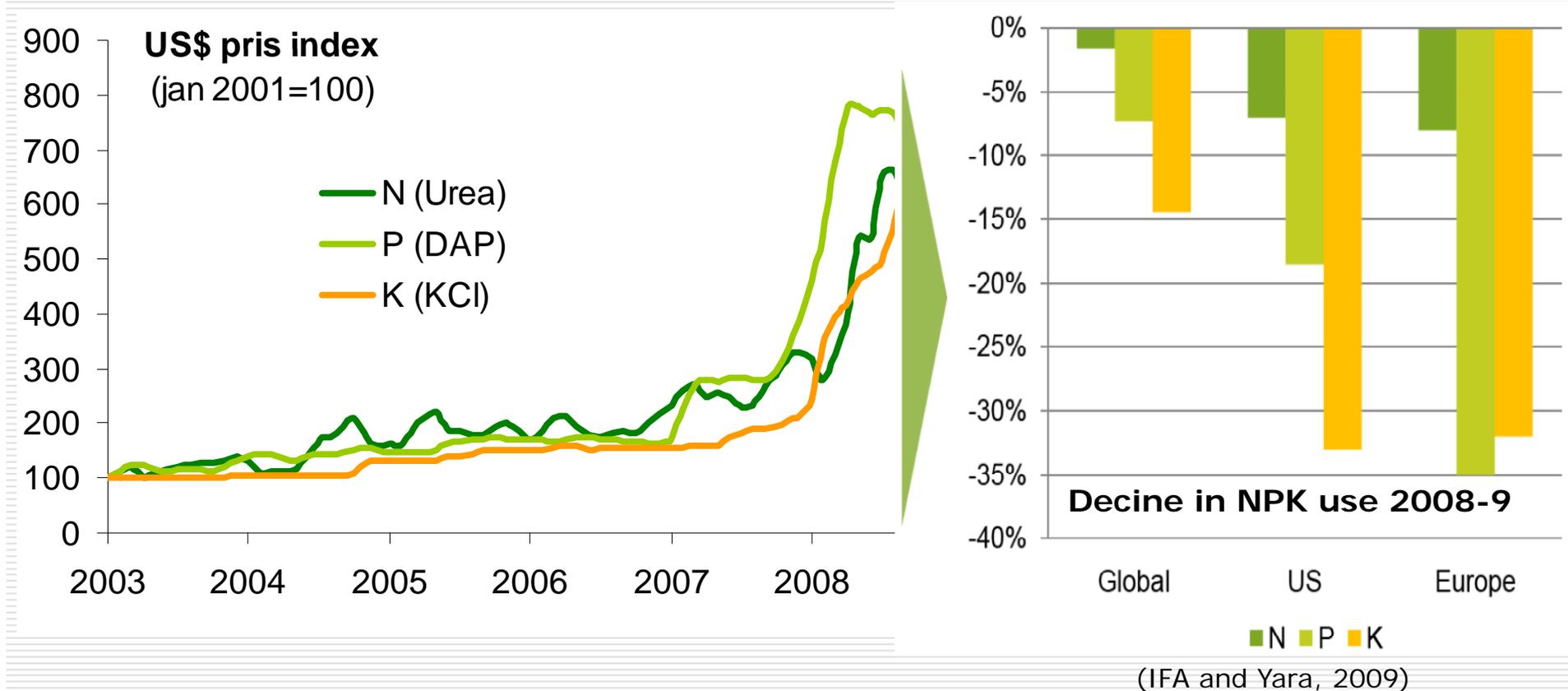
Price of Phosphate Rock Concentrate 32–33% P₂O₅ FOB Morocco and FAO Food Price Index (2002–2004=100)



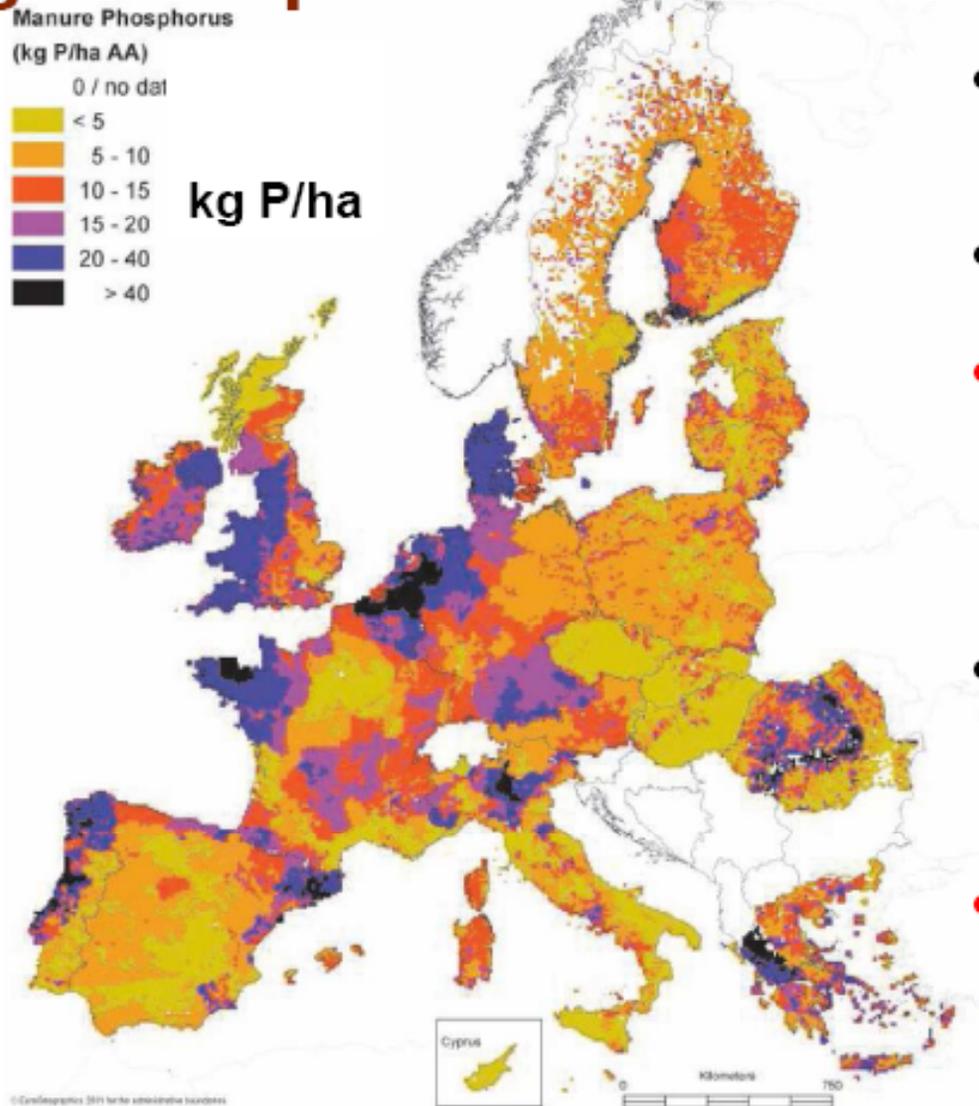
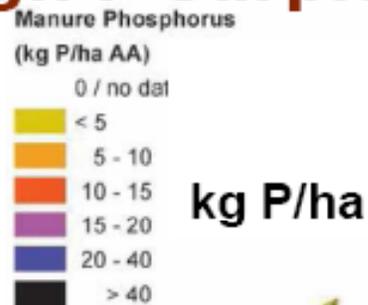
Source for historical data: FAO, Fertilizer Week (British Sulphur Consultants, a division of CRU International Ltd.)

Fertiliser NPK market price fluctuations

- 2008 price peak, during the "food-crisis", resulted in huge declines in fertiliser consumption by farmers
- Especially P in Europe
- Farmers are starting to look for alternatives to fertiliser....



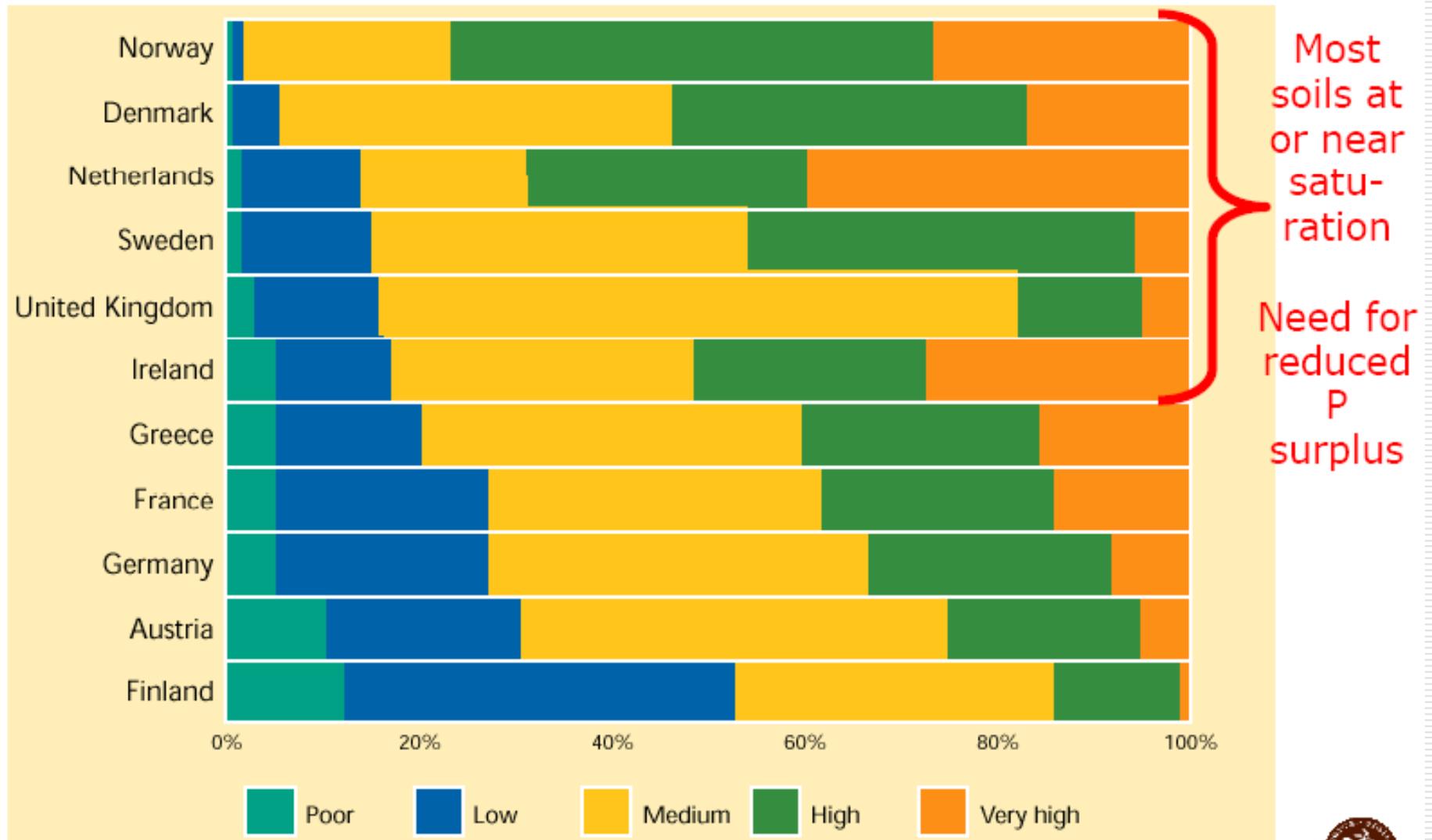
European drivers: The paradox of high P surplus in livestock intensive regions



- High N and P surpluses in countries/regions of intensive livestock
- Surpluses must be reduced to avoid environmental impacts
- **Need for technologies for livestock manure treatment, processing and re-distribution**
- Increasing mineral fertiliser prices => higher market value of alternative fertilisers / fertilisation technologies
- **Significant potential for greentech development / new fertilizer from recycled waste emerging in the market**



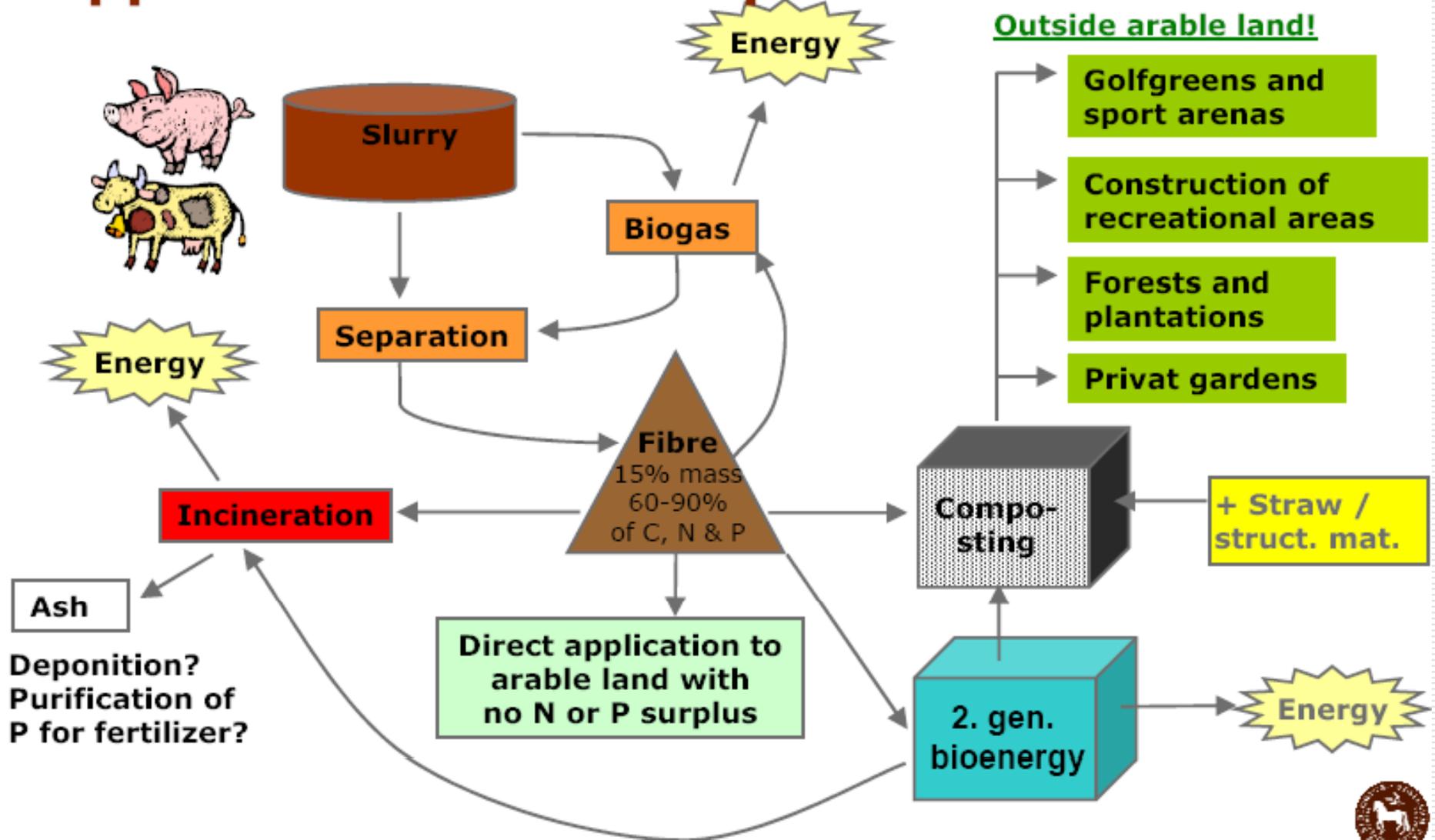
Plant available P status of European soils



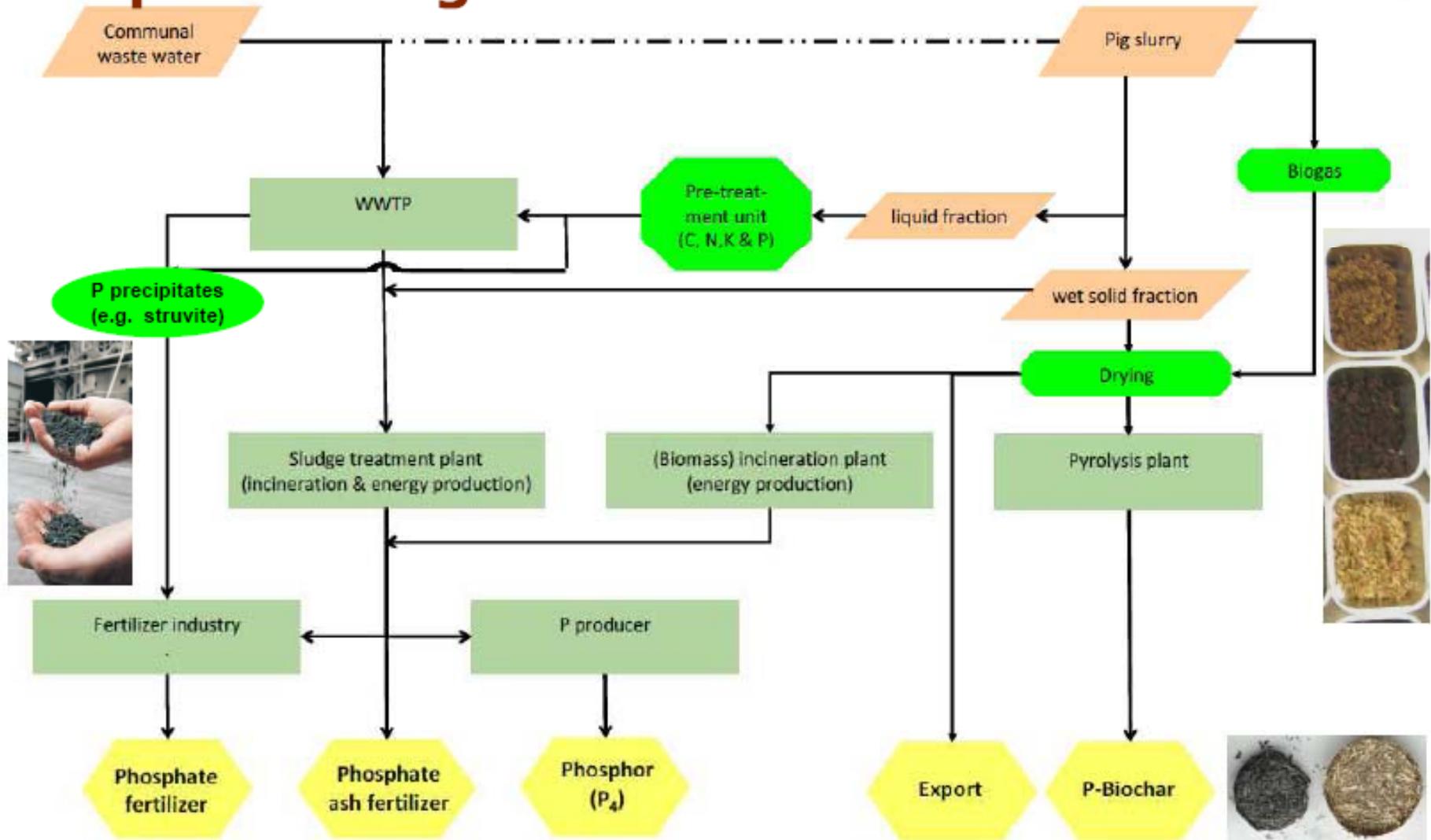
(www.efma.org)



Animal manure separation – new opportunities for P separation and use



Co-processing wastewater and manure P



Net total econ. costs (at large scale) similar or only slightly higher than current disposal costs in NL

(Schoumann et al., 2010, Alterra report 2158)

Conclusions

- ❑ Phosphorus is an essential daily component of our diet and agriculture system and the world is dependent on finite fossil sources
- ❑ Commercial sources are dominated by only a few countries and these are outside the EU
- ❑ Rock phosphate extraction is not monitored by weither the UN or the EU
- ❑ Geopolitical changes could affect the stability of supply
- ❑ Global demand mainly from the developing countries is increasing currently at 5-6% per year and prices are increasing
- ❑ Only about 16% of the mined P-rock is traded
- ❑ Only 20-25% of the mined P-rock ends up in the food we eat
- ❑ Now important to become more efficient with how we use the mined sources and secure and reuse the P we have in manure and solid and liquid waste streams

