

# Phosphorus Recovery from Sewage



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Pete Vale, Severn Trent Water,

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# STW's current biosolids operation

- STW is the UK's 2<sup>nd</sup> largest water utility serving 8 million customers
- The sewage treatment process generates ~240,000 tds/annum of biosolids
- 100% of the biosolids anaerobically digested
  - at 40 digestion sites
  - ~165,000 tds/annum of treated digested 'sludge cake' produced
  - all of this sludge is used as an agricultural fertiliser
- 56 CHP engines (at 35 sites) convert the biogas to renewable electricity and heat
  - Producing ~ 175 GWh/annum of electricity (equating to ~ 22% of our total energy needs)
  - The heat is recycled to the anaerobic digesters

# Future developments

- Sewage already viewed as a resource, and not a waste
- but, additional value remains to be utilised

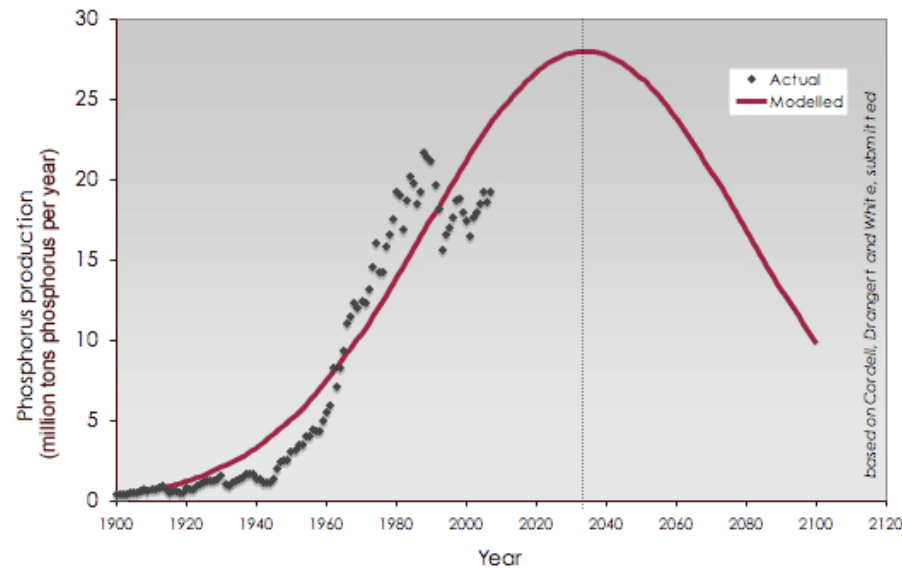




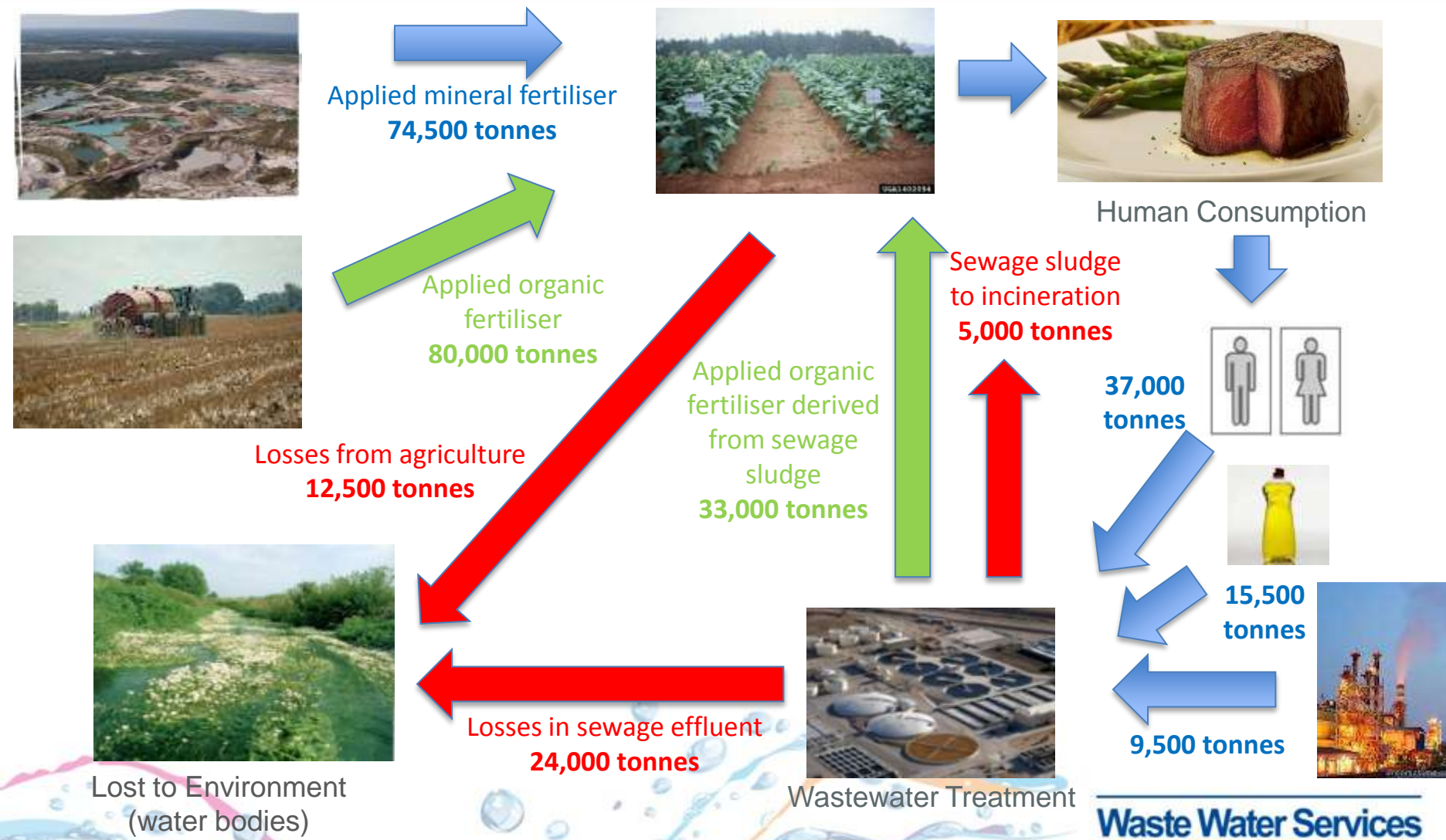
# Global Demand for Phosphorus

- “Phosphorus is as critical for all modern economies as water”
- “without phosphorus we cannot produce food. At current rates, reserves will be depleted in the next 50 to 100 years”
- “Peak phosphorus, say scientists, could hit the world in just 30 years”
- “In the past 14 months, the price of the raw material - phosphate rock - has surged by more than 700 per cent to more than £185 per tonne” (“The Times”, June 23 2008)

**Phosphorus production: When will it peak?**



# The UK's (simplified) phosphorus life cycle (2009 data)



DATA COURTESY OF UKWIR / BIRMINGHAM UNIVERSITY

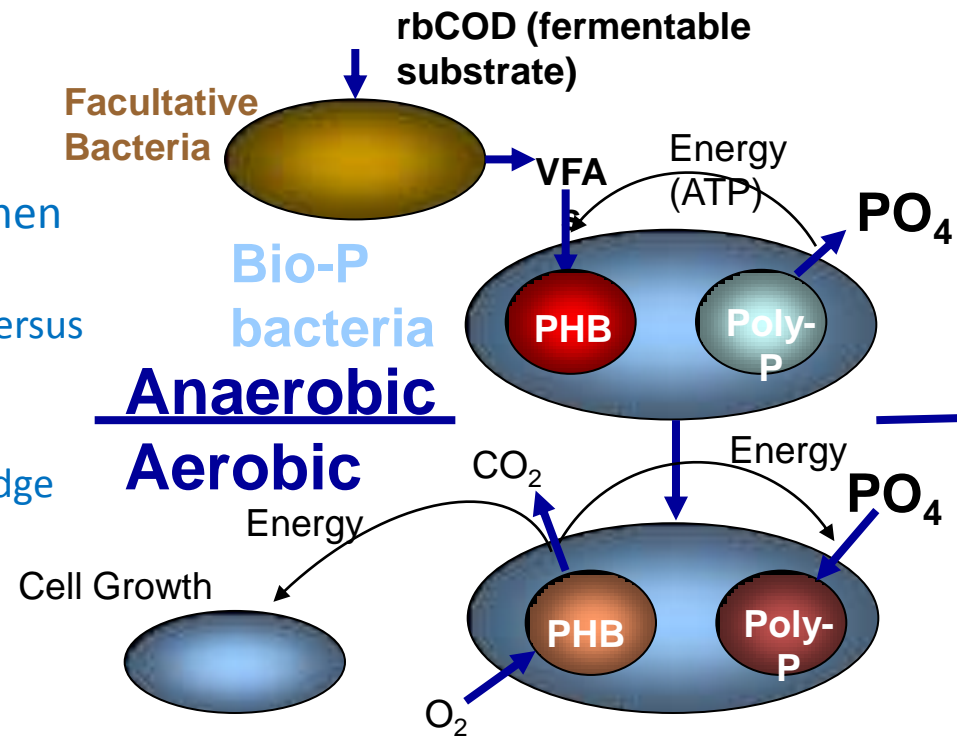
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# The role of the Water Industry in recycling P



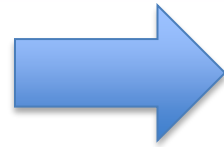
# How to recover more P

- Additional removal from sewage
  - Current options: chemical or **biological**
- Recovery of P from sewage much easier when have a bio-P process:
  - P concentrated in sludge (sludge ~4/5% P versus ~2% P)
  - ‘Extra’ P easily releasable
  - Bio-P organisms also concentrate Mg in sludge (& co-release with P)
- Recovery of P easiest in:
  - Digested sludge liquor (centrate), or
  - P stripped SAS filtrate
- P adsorption (& regen. of media) offers considerable future potential
- P most easily recovered in the form of **struvite**





# What is Struvite?



Naturally occurring

Exists in most wastewater plants  
(forms easily!)

Increases O & M costs

Impacts plant reliability

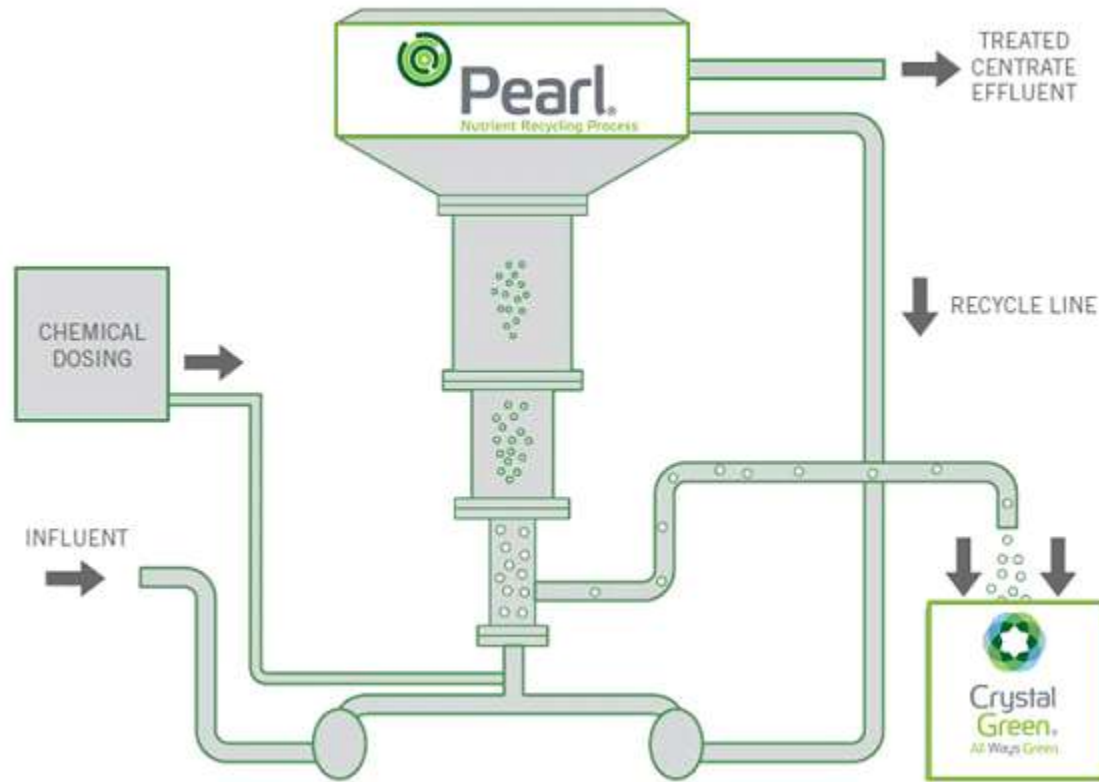


But, also a valuable  
slow release fertiliser



# Commercially available technologies

## 1) Ostar's Pearl<sup>®</sup> Process



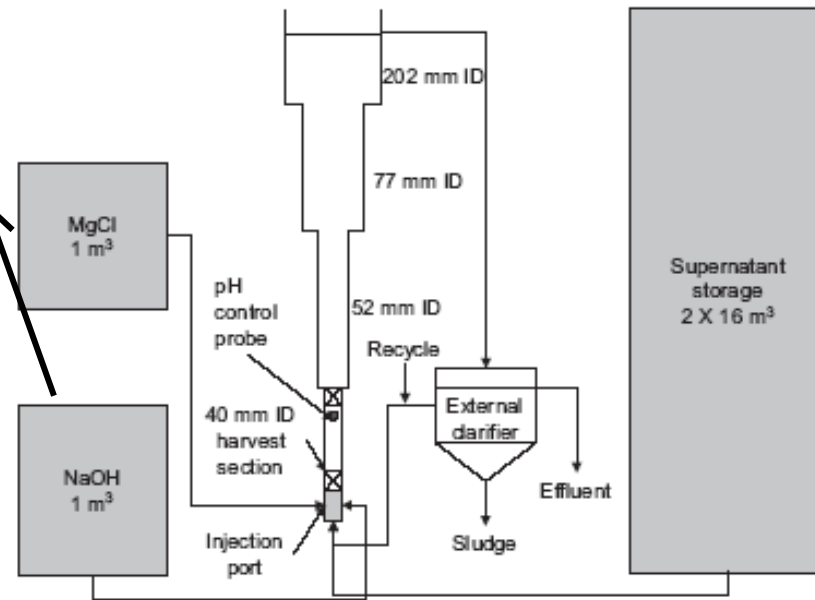
SCHEMATIC COURTESY OF OSTARA  
NUTRIENT RECOVERY TECHNOLOGIES INC

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# The Ostara Pilot Plant at Derby STW



Fig. 1. Pilot-scale struvite crystallizer reactor process design.  
MAP crystallizer



From Britton *et al*

J. Environ. Eng. Sci. 4 265-277 (2005)





# Full Scale Ostara Plant at Durham AWWTP,US



PHOTOGRAPH COURTESY OF OSTARA NUTRIENT RECOVERY TECHNOLOGIES INC



# The Ostara Struvite Product (Crystal Green®)

- Ready to use after drying
- No post processing - already in pelletized (prill) form
- Fully registered fertiliser – classified as a product in >20 US states, Canada & UK
- Trials undertaken
  - Turf, Nursery, and Specialty Agriculture
- Sustainable product
  - Low CO<sub>2</sub> emissions, renewable, reduced run-off & reusable locally



PHOTOGRAPHS COURTESY OF OSTARA NUTRIENT RECOVERY TECHNOLOGIES INC

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# Commercially Available Technologies

## 2) Paques: Phospaq Process

Reactor



Product



Full scale plant at Olburgen  
WwTW, Netherlands

PHOTOGRAPHS COURTESY OF PAQUES BV

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# Conclusions

- Treated sewage sludge already a significant and valuable P fertiliser.
- Recovery of P through struvite would allow up to 40% more P to be recycled.
- Application as struvite rather than treated sludge can be more targeted and allows more applications.
- Technology and product now commercially available.
- Severn Trent Water likely to have a full scale plant built and operating within a couple of years.