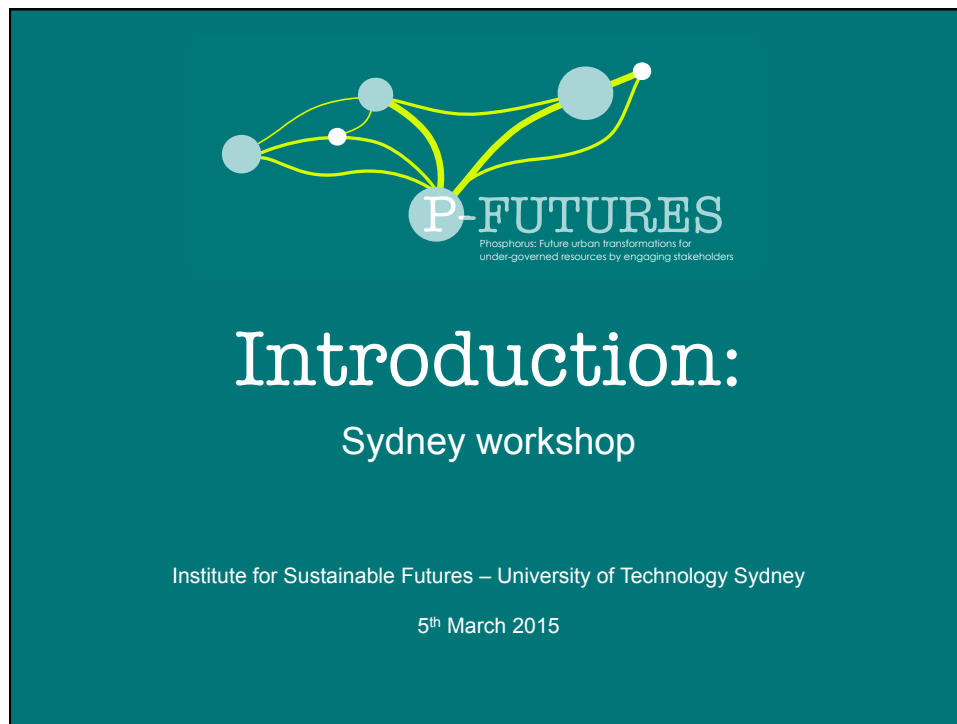


Integrating sustainable phosphorus
management into urban
decision-making and planning

Sydney workshop

Institute for Sustainable Futures – University of Technology Sydney

5th March 2015




International Research Partners



AUSTRALIA: Institute for Sustainable Futures, University of Technology Sydney



VIETNAM: Institute of Environmental Science and Engineering National University of Civil Engineering



U.S: Global Institute of Sustainability, Arizona State University



MALAWI: Centre for Water, Sanitation, Health and Appropriate Technology Development (WASHTED), University of Malawi



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international social science council

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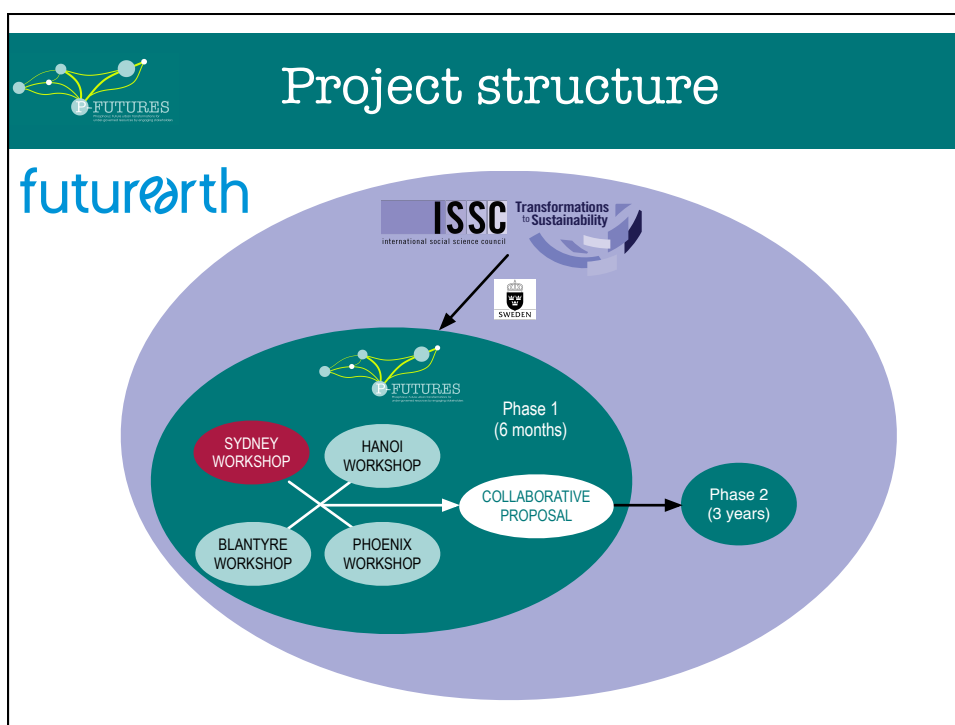





Overarching Project Goals

Together figure out what do we need to do to build sustainable cities in terms of food, water & waste in a rapidly change world

- Facilitate cities in transforming how they govern phosphorus, taking into consideration the unique **local context**, synergies with other **local sustainability goals**, and **global phosphorus security goals**.
- Co-develop a **sustainable urban phosphorus framework** with our partner cities (Sydney, Hanoi, Phoenix and Blantyre)
- Guide transformation towards phosphorus sustainability through building **capacity** and small-scale **projects**.





Workshop objectives

Specific objectives for this workshop are to:


- Explore **risks and vulnerabilities** for Sydney to the **global phosphorus challenge** (such as fertilizer price spikes, algal blooms, growing food demand, wastewater infrastructure, etc.)
- Explore **opportunities** for Sydney to **effectively adapt** to such challenges, taking into account Sydney's future visions and existing plans.
- Contribute to **shaping the research agenda** for a larger three-year project in all four cities (Sydney and other three cities) to develop tools to transform the way cities manage phosphorus



Workshop agenda

| Time | Program |
|---------------|---|
| 09:00 – 09:15 | Registration |
| 09:15 – 09:40 | Welcome and Introduction |
| 09:40 – 10:00 | Global phosphorus scarcity and pollution |
| 10:00 – 10:30 | Sydney's priorities related to food, planning, health, water & sanitation |
| 10:30 – 11:00 | Tea/Coffee Break |
| 11:00 – 11:40 | Sydney's priorities (continued) |
| 11:40 – 12:00 | International case studies of solutions to phosphorus challenges |
| 12:00 – 13:00 | Lunch Break  |
| 13:00 – 13:20 | Partner cities examples |
| 13:20 – 14:45 | Future pathways for Sydney |
| 14:45 – 15:00 | Design future collaboration and wrap-up |





Phosphorus


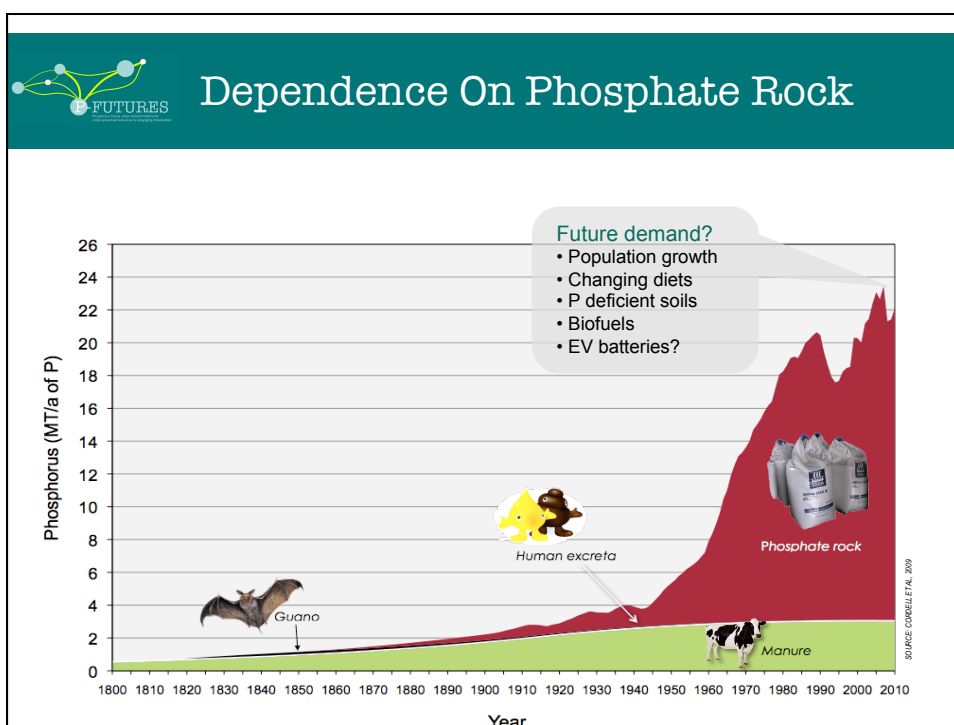
Essential to all living organisms (plants, animals, bacteria)

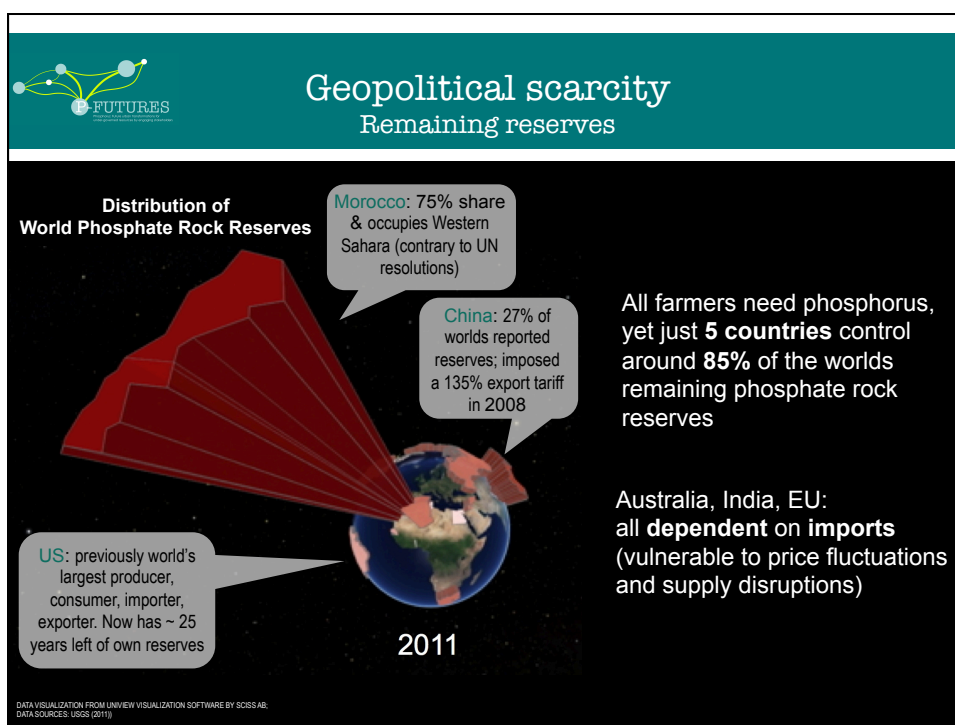
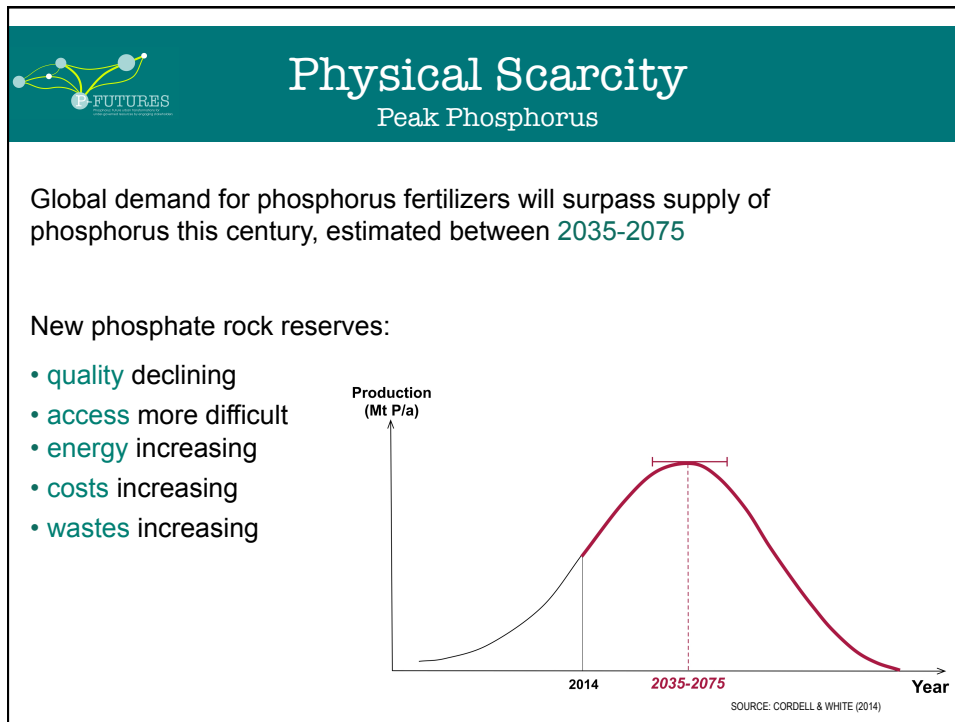
No substitute in food production, cannot be 'manufactured'

Chemical fertilizers (N,P,K) have contributed to **feeding billions** by boosting crop yields

Modern agriculture dependent on phosphate rock – **non-renewable**, high quality reserves becoming scarce

2008 phosphate price spike:
US\$50/tonne to US\$430/tonne



Economic scarcity

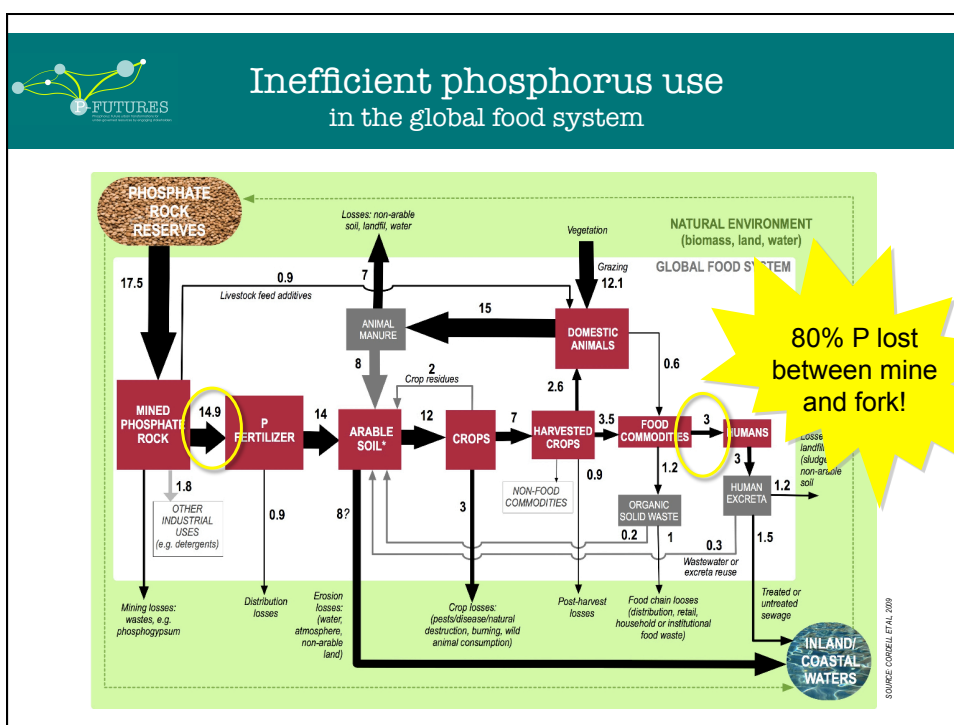
Lack of access to phosphorus


Farmers need both short- and long-term **access** to fertilizers

Almost a **billion** farmers lack purchasing power to access fertilizer markets

'**Silent**' demand from farmers with low purchasing power in sub-Saharan Africa, where soil fertility is low & food insecurity



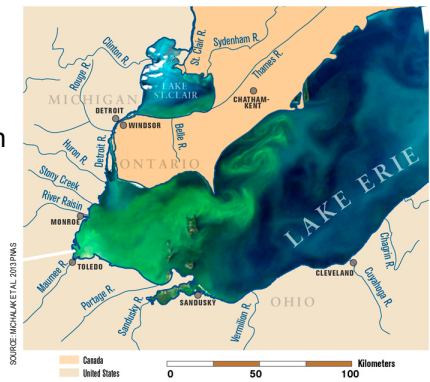






The Global Challenge

Too much

- Losses can cause **aquatic pollution** in lakes and coastal areas
- Algal blooms caused by too much P can pollute drinking water and be **toxic** to humans
- **Loss of oxygen** from algal blooms can destroy fisheries and negative affect recreation and amenities



SOURCE: MONAHAN ET AL. 2013 PINS





Losses from many sources

Concentrated and diffuse


Losses of phosphorus that cause problems can come from:

- **Runoff and erosion** from fields, gardens, and lawns
- **Sewage** that is not properly treated
- **Animal manure** if it is not properly contained
- **Detergents** and other products that are in urban water

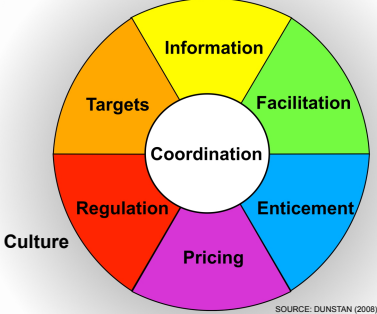


 **Lack of effective P governance**


There are currently no international or national policies, guidelines or organisations responsible for ensuring long-term **availability** and **accessibility** of phosphorus for food production



3RD SUSTAINABLE P SUMMIT, 2012



SOURCE: DUNSTAN (2008)

 **Phosphorus Vulnerability**

All counties are exposed to the same global phosphorus drivers (e.g. fertilizer price spikes)

But how we cope or respond depends on our **capacity** to adapt and transform and **local conditions** (e.g. access to resources like fertilizer subsidies or information, soil fertility, state of infrastructure)

What works in one region may be **inappropriate** and **ineffective** in another region.

In what ways is Australia, the U.S., Vietnam or Malawi most vulnerable to P scarcity?



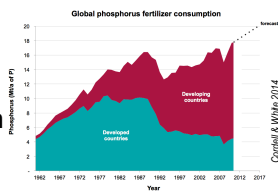

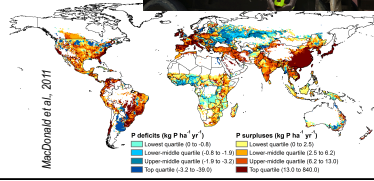


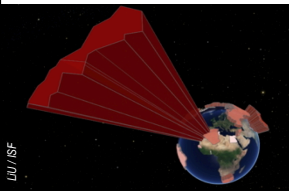

PHOTO: D. CORDELL




Phosphorus contradictions

1. **Global challenge:** scarcity ★ pollution
2. **Food security:** obesity ★ undernourishment
3. **Distribution of reserves:** producers ★ importers
4. **Fertilizer use:** over-application ★ under-application
5. **Soil phosphorus:** surplus ★ deficiency
6. **Farmer issues:** accessibility ★ managing excess
7. **Fertilizer demand:** increasing ★ decreasing



The Future

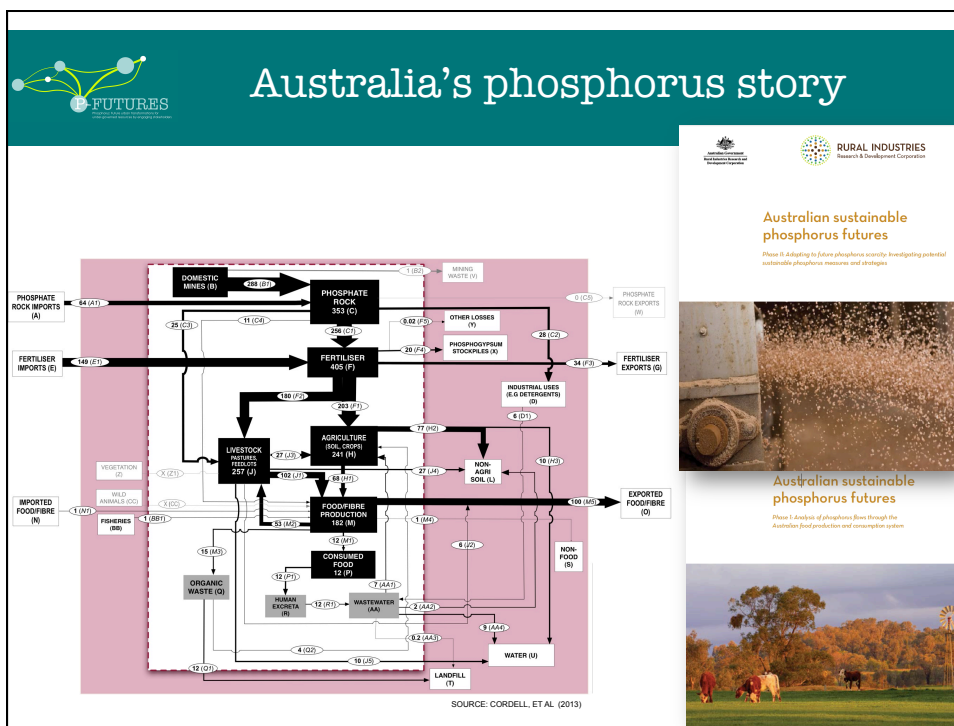
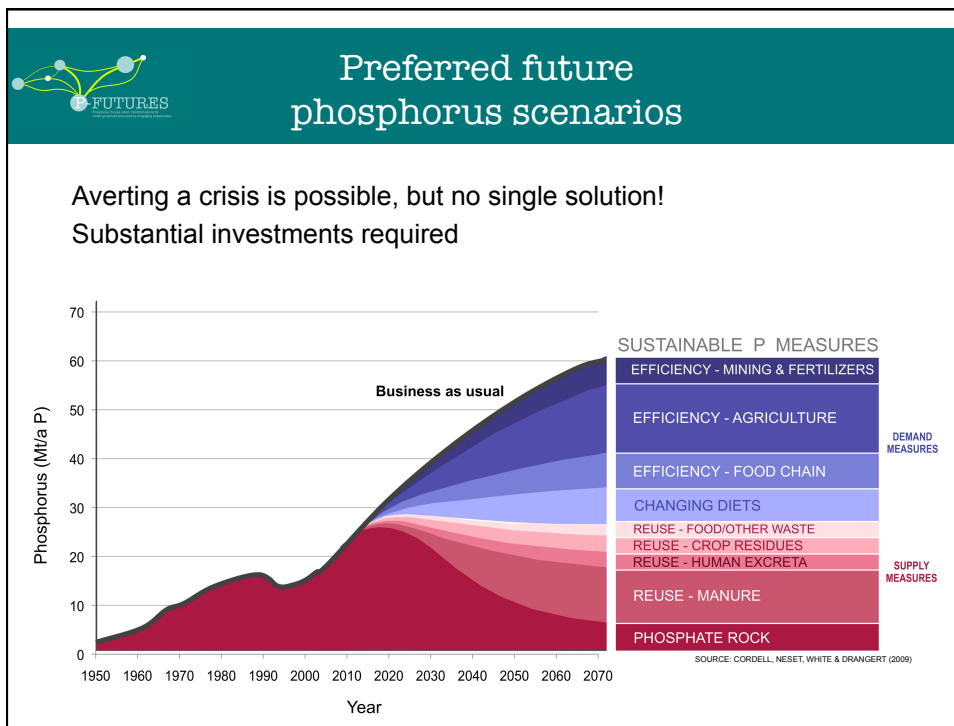
Hard landing vs soft landing


Business-as-usual future:

If we don't change current phosphorus use trajectory, we are heading for a **hard** landing: increasing **energy**, **costs** and **waste**, **volatile prices**, **geopolitical** tensions, reduced **farmer access** to fertilizers and reduced **crop yields**, **food insecurity** and **pollution**

Sustainable future (a soft landing):

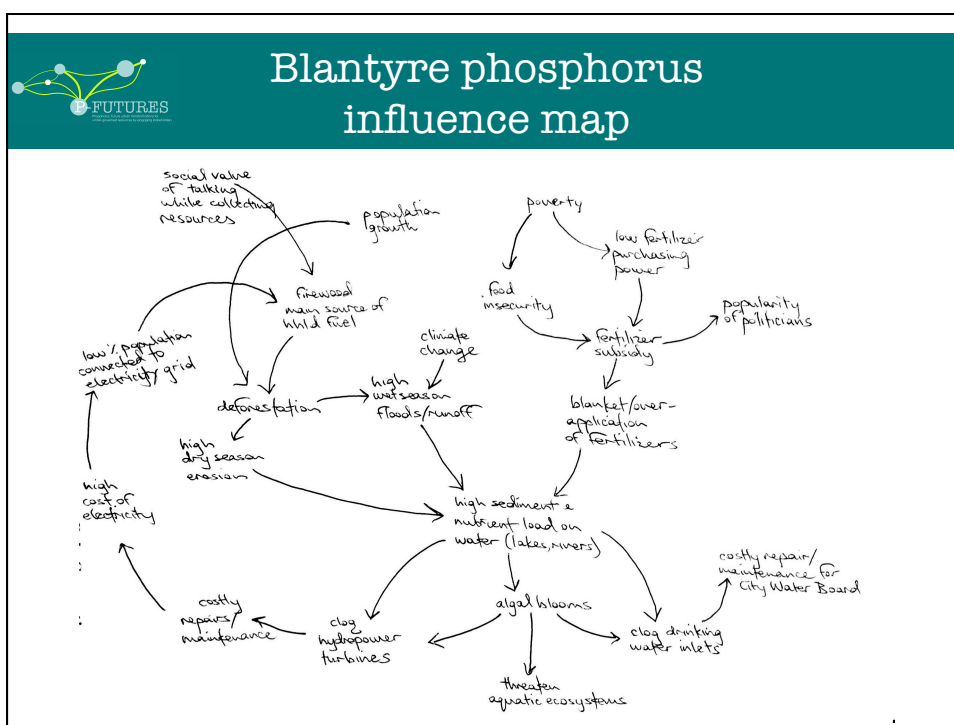
Phosphorus security ensures all farmers have short- and long-term access to sufficient phosphorus to grow enough crops to feed to world, while ensuring waters are clean and societal functioning

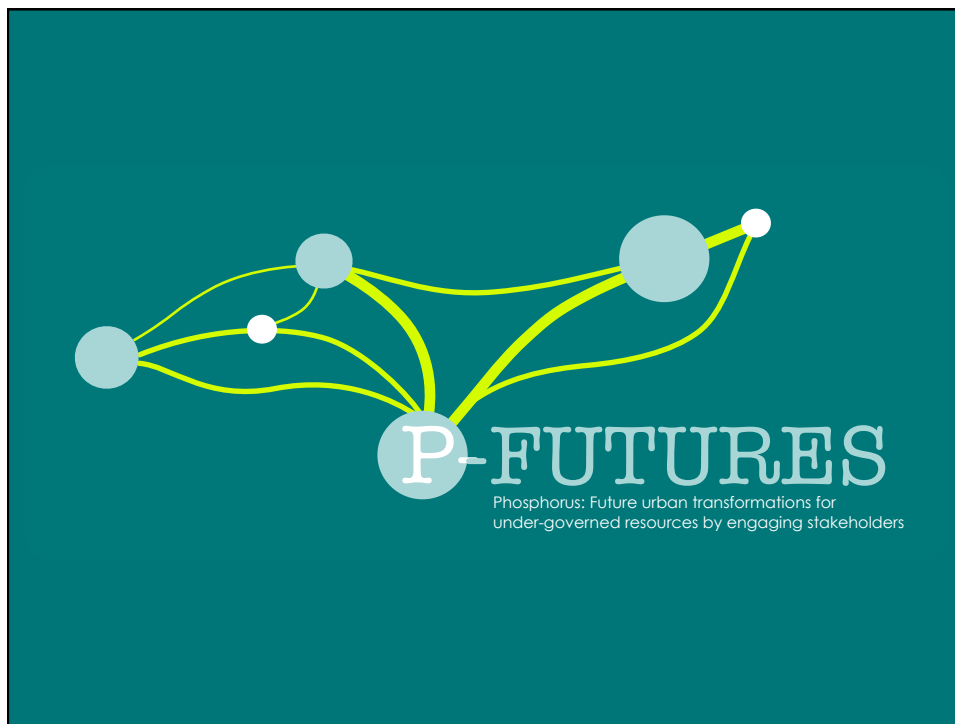





Activity

What are your sector 1-2 priorities?






Phosphorus use efficiency in agriculture
Decreasing phosphorus losses to waterways

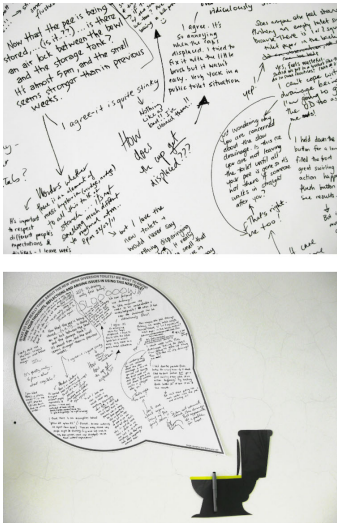



Natural buffer strip
Iowa, USA



Preventing algal blooms - fertilizer application guidelines
CHINA

Phosphorus recovery from wastewater
Investigating the social & technical challenges of urine diversion systems in practice

The 'Funny Dunny' trial in urban Sydney

Urban agriculture
Increasing food security & recycling local food waste, water, and sewage

Vacant lot garden
Accra, GHANA

Community gardens
Montreal, CANADA

Onions fertilized with urine (left) & without (right)
BURKINA FASO

Multi-stakeholder platforms
Dialogue & action through industry, government & science partnerships

European Sustainable Phosphorus Platform
EUROPEAN UNION

Participate Collaborate Innovate

European Sustainable Phosphorus Platform (ESPP)
Sustainable management of Phosphorus is crucial for agriculture, food, industry, water and the environment. ESPP brings together companies and stakeholders to address the Phosphorus Challenge and its opportunities.

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The phosphorus challenge

Twitter: @ESPP_EU
LinkedIn: European Sustainable Phosphorus Platform
Facebook: European Sustainable Phosphorus Platform
YouTube: European Sustainable Phosphorus Platform

News

Phosphate rock in EU Critical Raw Materials list
12 July 2014
The European Commission has added phosphate rock to the list of 20 Critical Raw Materials, for which supply security is at risk and economic importance is high. Phosphate rock is identified as non-renewable and of high economic importance. This


National Strategic Phosphorus Advisory Group, AUSTRALIA

GENERAL/WHOLE SYSTEM:

- Phosphate Rock:** Domestic production, P ROCK IMPORTS, P FERTILIZER EXPORTS, P FERTILIZER IMPORTS.
- Fertilizer Industry:** Fertilizer production, Fertilizer exports, Fertilizer imports.
- Farm:** Fertilizer application, Fertilizer use, Fertilizer loss.
- Food/Fibre Production:** Food and fibre production, Food and fibre exports, Food and fibre imports.
- Food Eaten:** Food consumption, Food waste, Food loss.
- Human Excreta:** Human excreta, Human excreta management, Human excreta recycling.
- Landfill:** Landfill, Landfill management, Landfill recycling.
- Soil/Water:** Soil and water, Soil and water management, Soil and water recycling.
- Industrial Purposes:** Industrial purposes, Industrial waste, Industrial recycling.
- Other:** Other phosphorus uses, Other phosphorus management, Other phosphorus recycling.

Key Stakeholders:

- Chris Carter:** SUSTAINABLE MINERALS RESEARCH (UK) Research
- Laura Carson:** SUSTAINABLE MINERALS RESEARCH (UK) Research
- Michael Barnes:** SUSTAINABLE MINERALS RESEARCH (UK) Research
- Gary Skirrow:** OFFICE OF ENVIRONMENT & HERITAGE (AUSTRALIA) Policy development of agriculture, minerals & energy
- Russell Harding:** NUTRIENT MANAGEMENT (AUSTRALIA) Policy development of agriculture, minerals & energy
- Griffin Turner:** MELBOURNE SUSTAINABLE SOCIETY INSTITUTE (UK OF MELB) Policy development of agriculture, minerals & energy
- Neil Day:** FERTILISERS AUSTRALIA Supply, demand, efficient application of fertilizers
- Anna-Louise:** FERTILISERS AUSTRALIA Supply, demand, efficient application of fertilizers
- David Eys:** FERTILISERS AUSTRALIA Supply, demand, efficient application of fertilizers
- Richard Strauss:** SUSTAINABLE AGRICULTURE (AUSTRALIA) Research
- David Gough:** STONY WATER Research and sustainable treatment



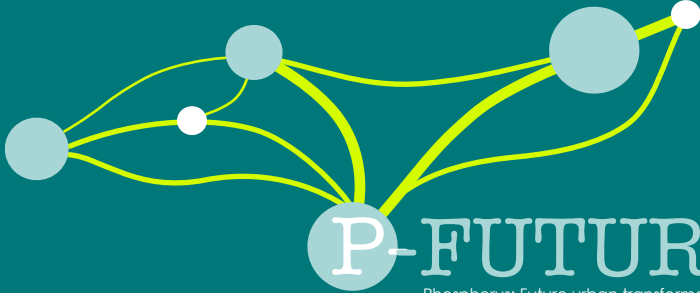
Toolbox of phosphorus solutions

Selecting context-specific options
from a range of sustainable phosphorus technologies & practices

| Sector | SUPPLY MEASURE (S) | | DEMAND MEASURE (D) | |
|--------------------------------|---|---|--|--|
| | Recycling (S1) | New source (S2) | Efficiency (D1) | Reduce demand (D2) |
| Mining (M) | MS1.1 – mine tailings ^a | MS2.1 – phosphate rock ^a | MD1.1 – reduce avoidable losses | MD2.1 – (all other measures) |
| Fertilizer (F) | FS1.1 – phosphogypsum ^b | FS2.1 – algae, seaweed | FD1.1 – reduce avoidable losses | FD2.1 – (AD2, LD2, PD2) |
| Agriculture (A) | AS1.1 – crop waste ^{a,b,c} AS1.2 – (LS1, PS1, WS1) | AS2.1 – (FS2) AS2.2 – green manure | AD1.1 – fertilizer placement AD1.2 – application time AD1.3 – application rate AD1.4 – soil testing AD1.5 – erosion reduction AD1.6 – microbial inoculants | AD2.1 – plant selection AD2.2 – improved soil characteristics |
| Livestock & Fisheries (L) | LS1.1 – manure ^{a,b,f} LS1.2 – bone ^{a,g} LS1.3 – blood ^a LS1.4 – fish ^a | LS2.1 – phosphate rock (supplements) ^h | LD1.1 – fertilizer placement LD1.2 – application time LD1.3 – application rate LD1.4 – soil testing LD1.5 – erosion reduction LD1.6 – microbial inoculants LD1.7 – phytase enrichment LD1.8 – manure P reduction LD1.9 – wastewater management | LD2.1 – plant selection LD2.2 – improved soil characteristics LD2.3 – animal selection LD2.4 – changing diets |
| Food production (P) | PS1.1 – food production waste PS1.2 – cooked food waste | PS2.1 – phosphate rock (additives) ^h | PD1.1 – reduce avoidable losses PD1.2 – producing food closer to demand PD1.3 – consumer food planning/preparation | PD2.1 – reduce P-intensive diets PD2.2 – reduce per capita overconsumption PD2.3 – healthy bodies PD2.4 – minimize use of P additives |
| Wastewater & human excreta (W) | WS1.1 – urine ^{a,c} WS1.2 – faeces ^{b,c,d,h} WS1.3 – greywater ^{c,h} WS1.4 – untreated wastewater ^a WS1.5 – treated effluent ^a WS1.6 – struvite ^{a,b,f,g} WS1.7 – biosolids ^{a,b,f,g} WS1.8 – sludge ash ^g | | WD1.1 – repairing cracked pipes WD1.2 – minimizing sewer overflows WD1.3 – soil management WD1.4 – avoid dumping biosolids in water WD1.5 – reduce spreading biosolids on non-ag land | |


Recycled via: ^a direct reuse, ^b compost, ^c precipitation, ^d fermentation, ^e dewatering, ^f other chemical treatment.

SOURCE: CORDELL & WHITE 2013




P-FUTURES

Phosphorus: Future urban transformations for under-governed resources by engaging stakeholders




Sustainable phosphorus solutions

Examples from your partner cities....

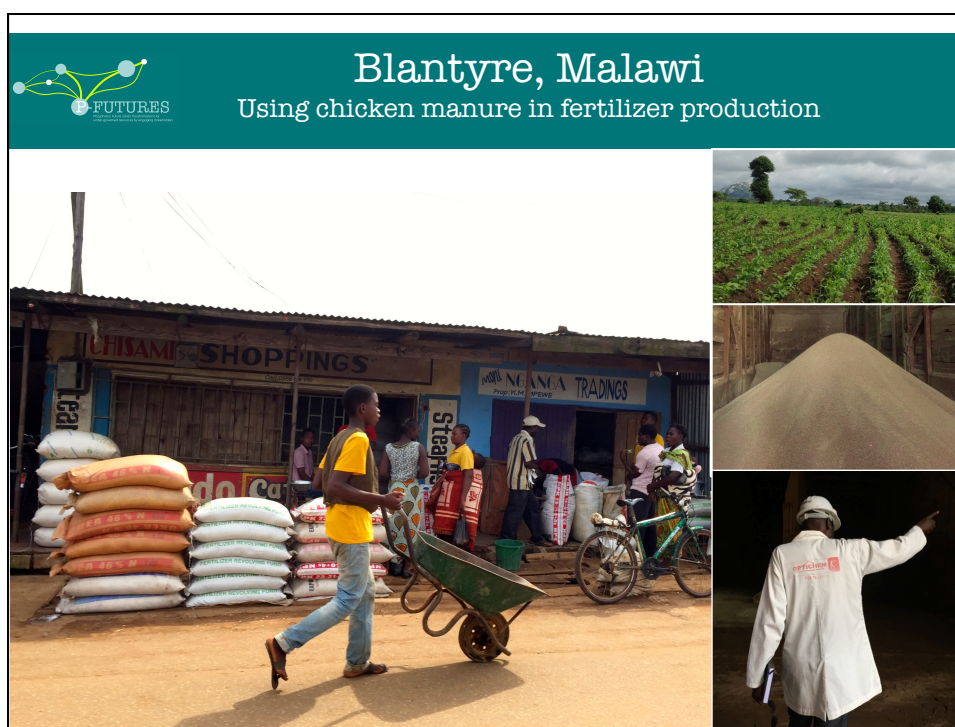


Phoenix, USA

Wastewater recycling to agriculture



SOURCE: CARDENAS





Sydney, Australia

Potential for local food production & phosphorus reuse







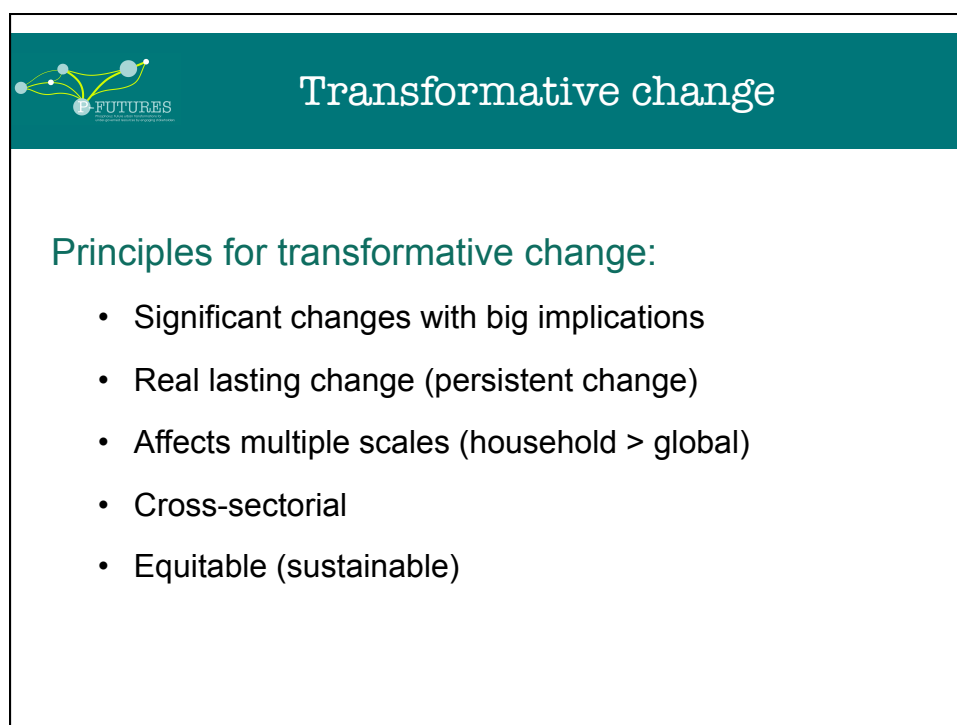
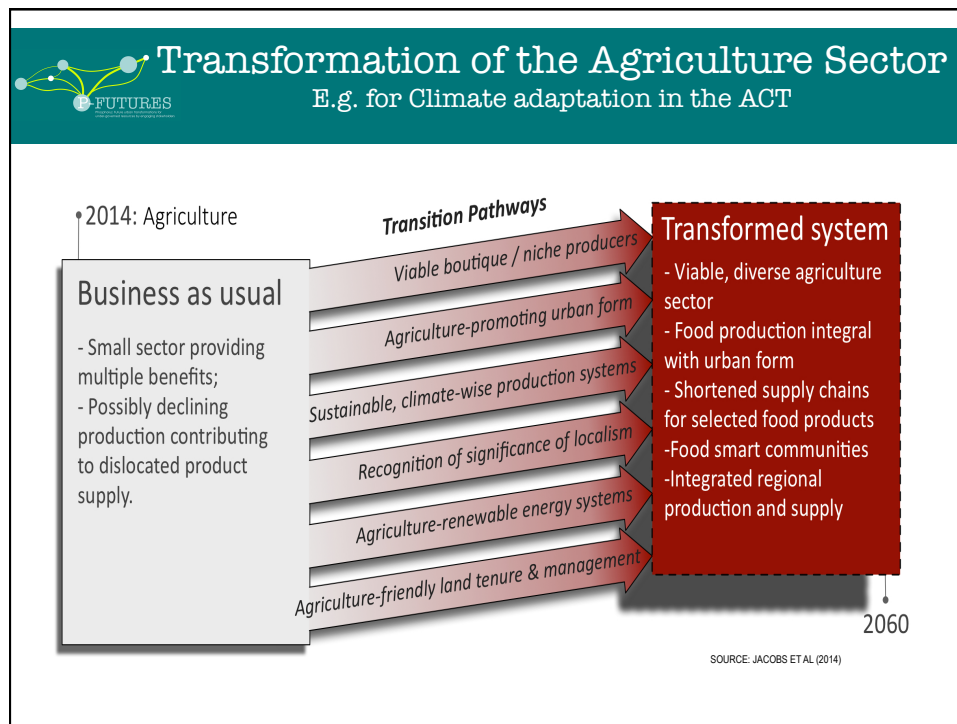


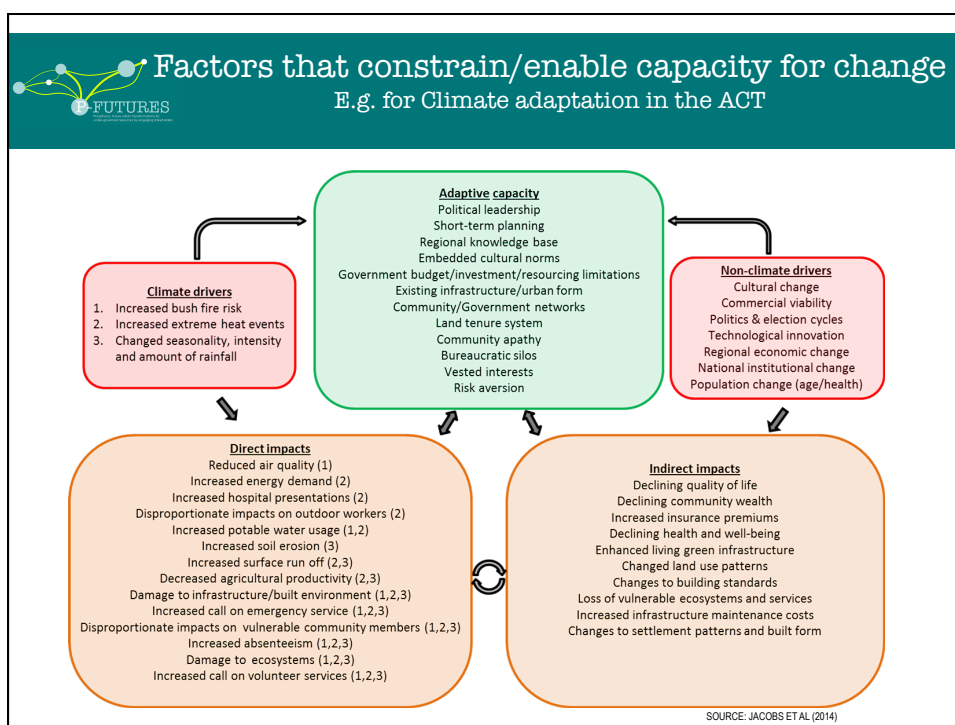
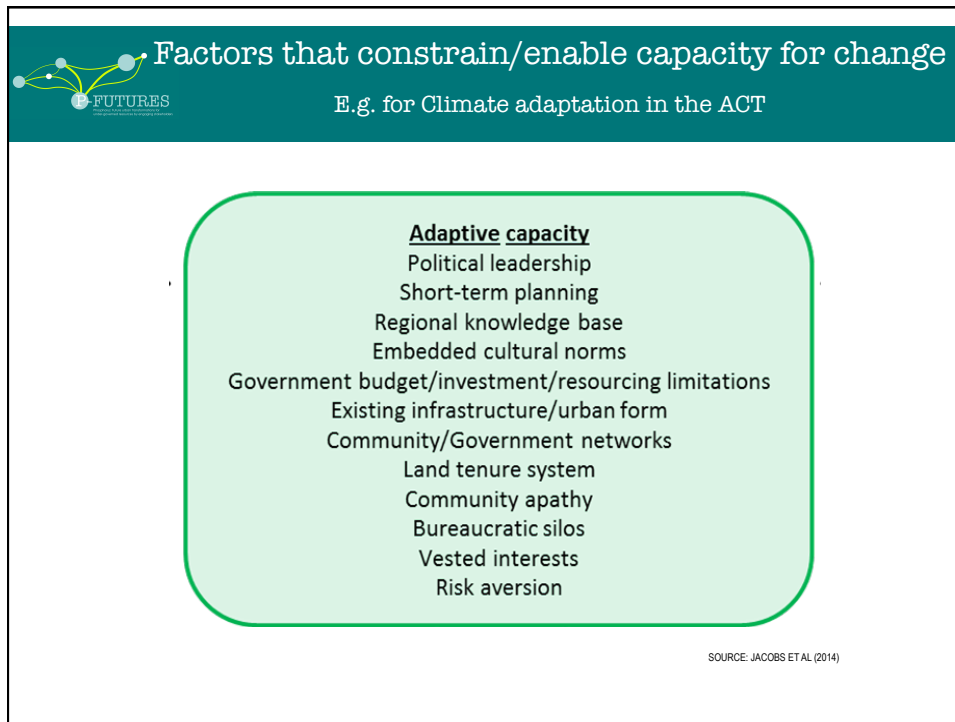
Transforming Sydney


**If there's one big sustainable P initiative
you could see in Sydney, what would it be?**

Or what are the existing initiatives that are already happening on the ground?









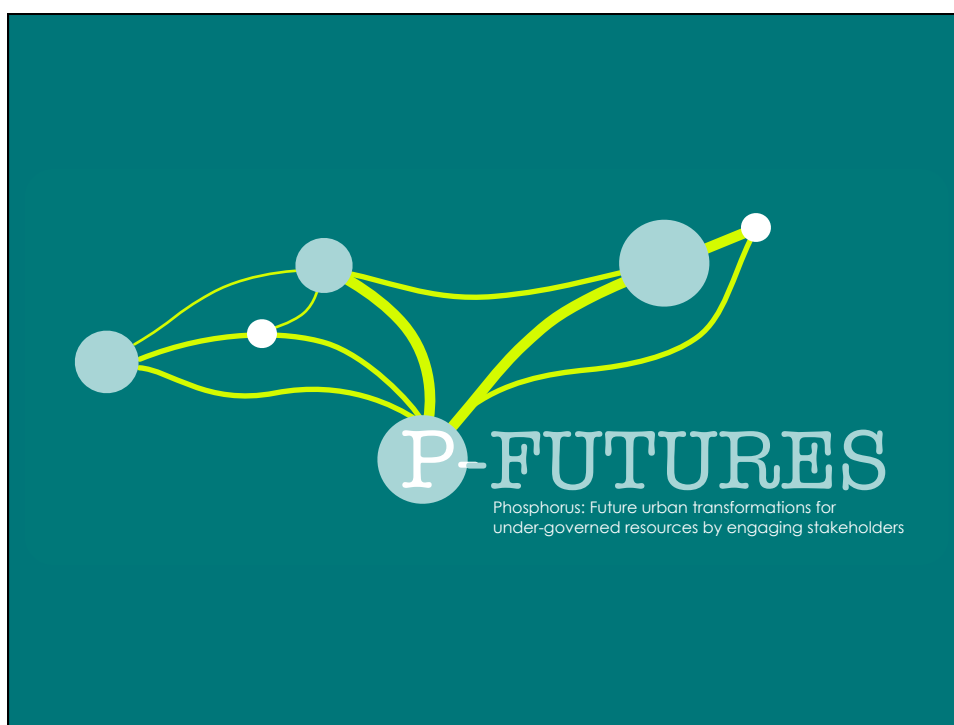
Activity

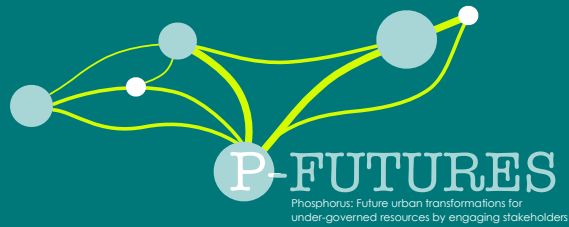
What would be your P-FUTURES slogan?

E.g.

P-FUTURES:
Solid waste management transforms lives
Silver water, golden maize







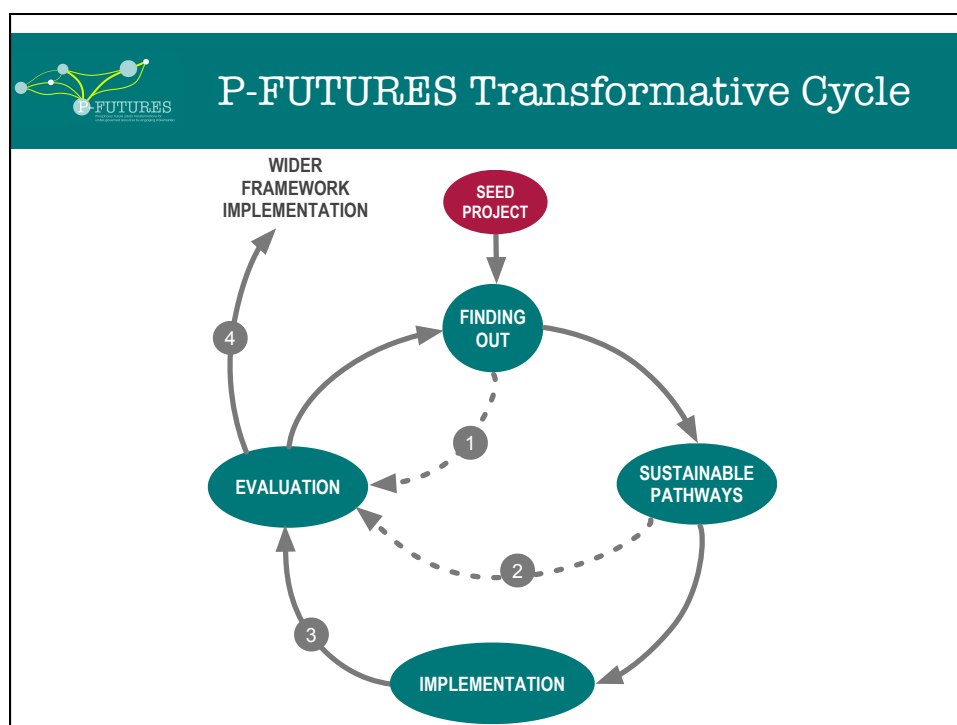
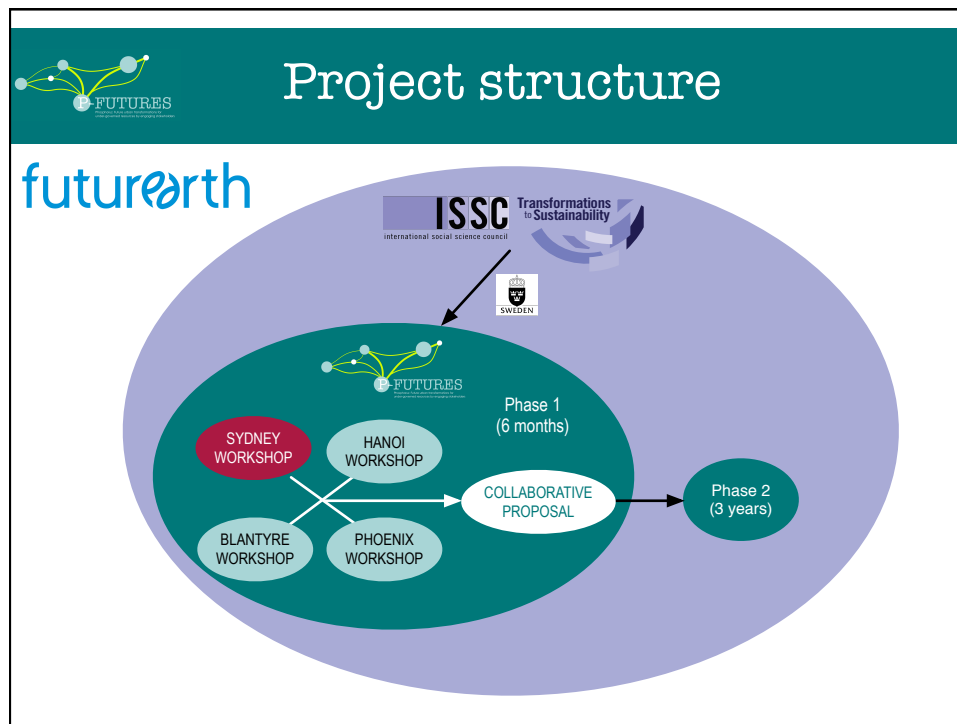
Next steps:

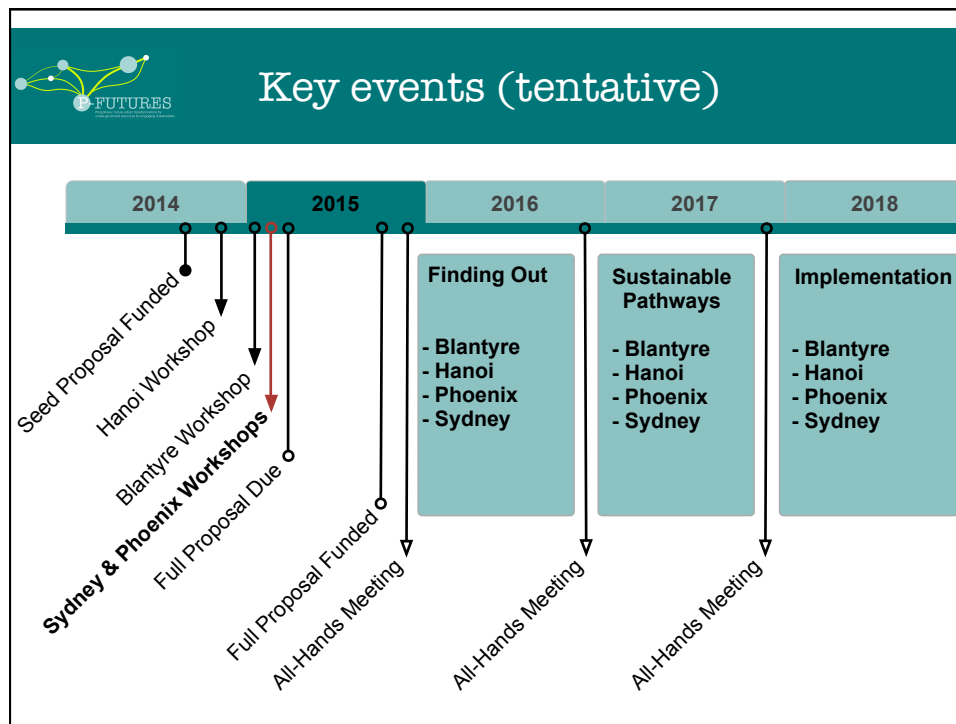
Designing a future collaborative project



Overarching Project Goals

Together figure out what do we need to do
to build sustainable cities
in terms of food, water & waste
in a rapidly change world





P-FUTURES: Sydney

What do we still need to find out in order to move towards a healthy, food and water secure Sydney in relation to phosphorus management?

How can this 3-year project help us create that knowledge and capacity to implement sustainable phosphorus management?

What can your group contribute to this project and to transformational goals around phosphorus management?

