

Phosphorus Footprinting

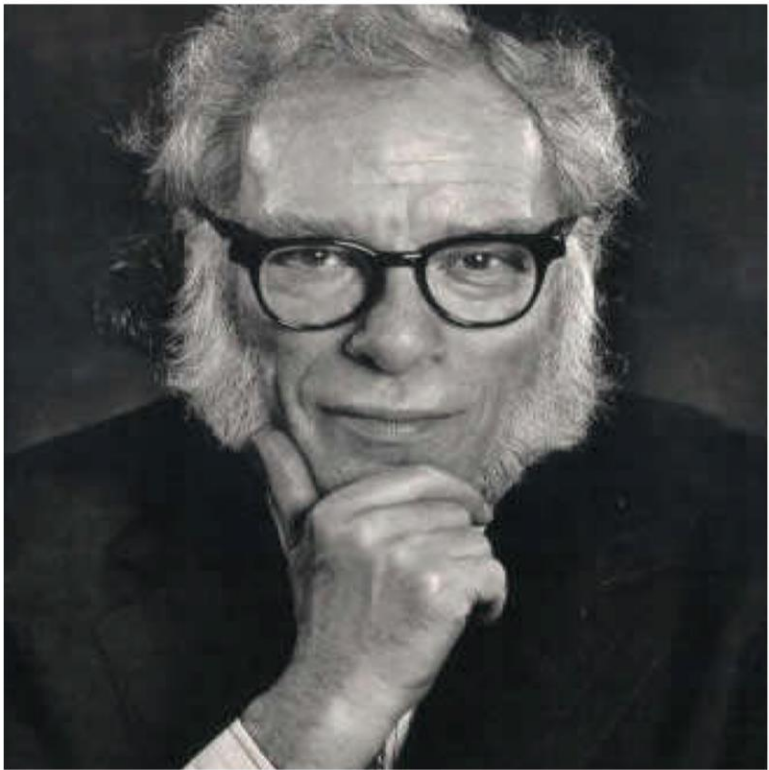
SIWW 2022 Water Convention



Dr. Andrew Shaw PE, BCEE, ENV SP

Global Practice & Technology Leader in Sustainability



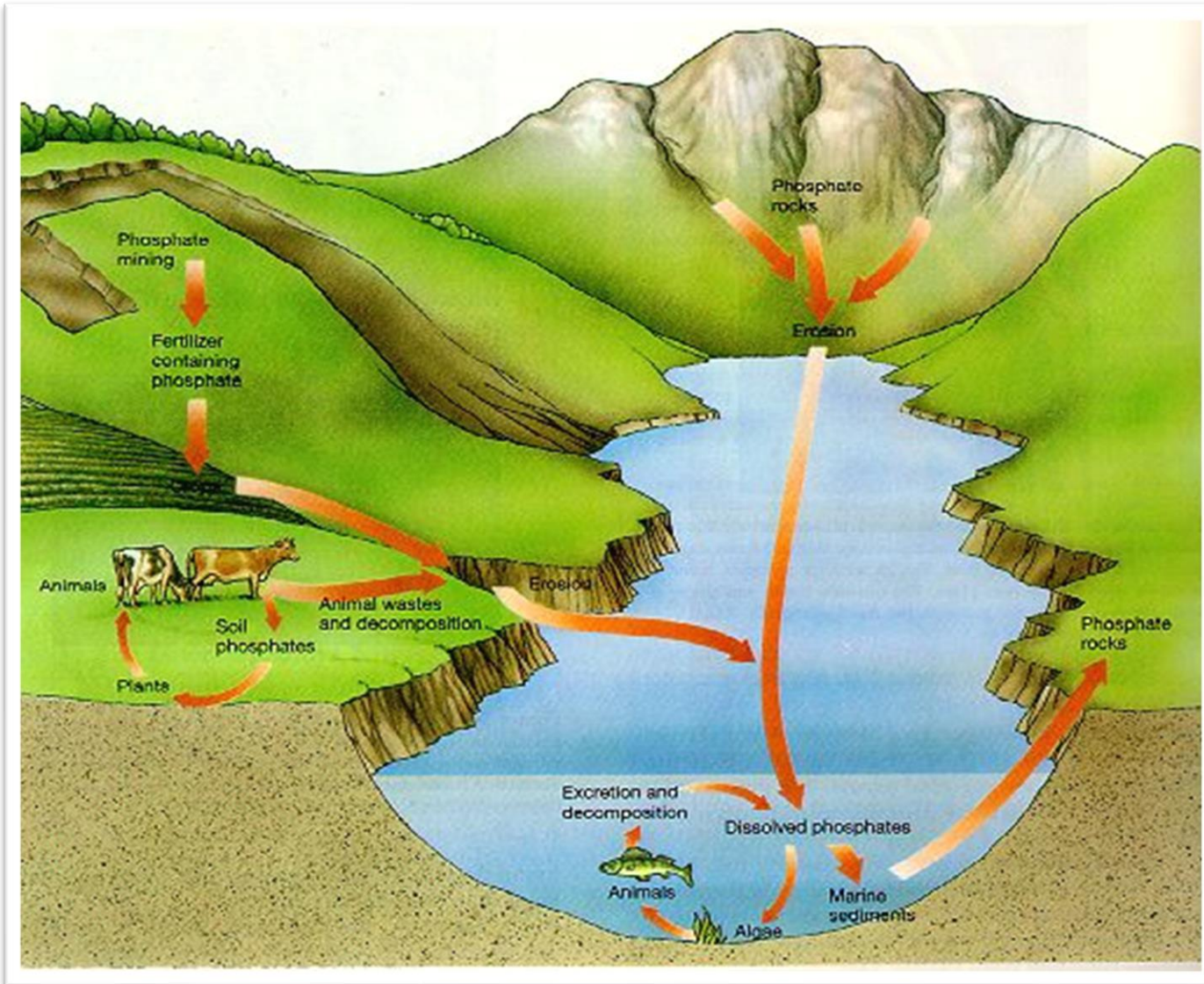


The Importance of Phosphorus

“We may be able to substitute nuclear power for coal power, and plastics for wood, and yeast for meat, and friendliness for isolation, but for phosphorus there is neither substitute nor replacement.”

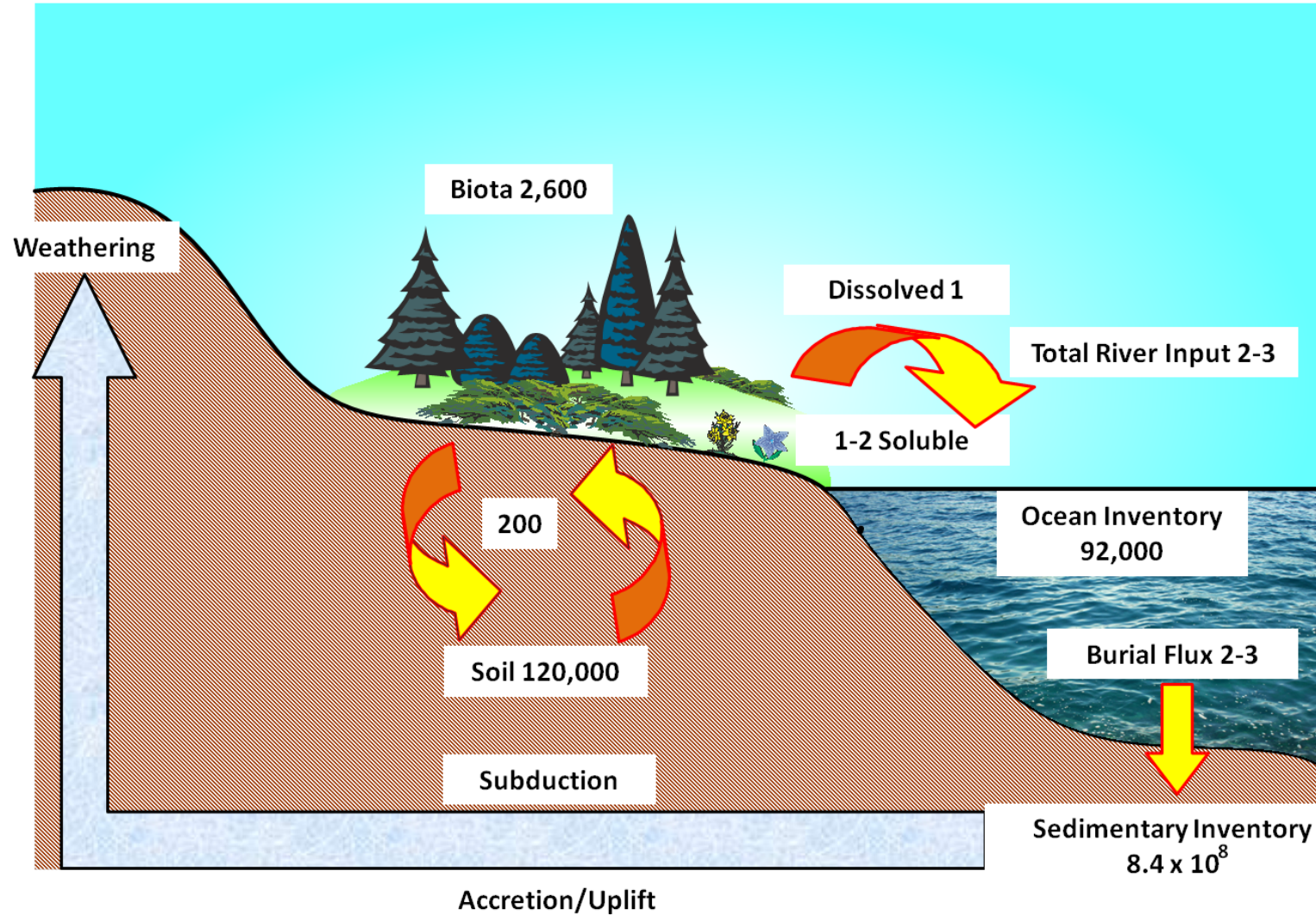
Isaac Asimov

THE PHOSPHORUS CYCLE



The phosphorus cycle in terrestrial and aquatic environments. Recycling of phosphorus is slow because no important form of phosphorus exists in gaseous form. Phosphorus that becomes part of the marine sediments may take millions of years to solidify into rock, uplift as mountains then erode away to become available to living things.

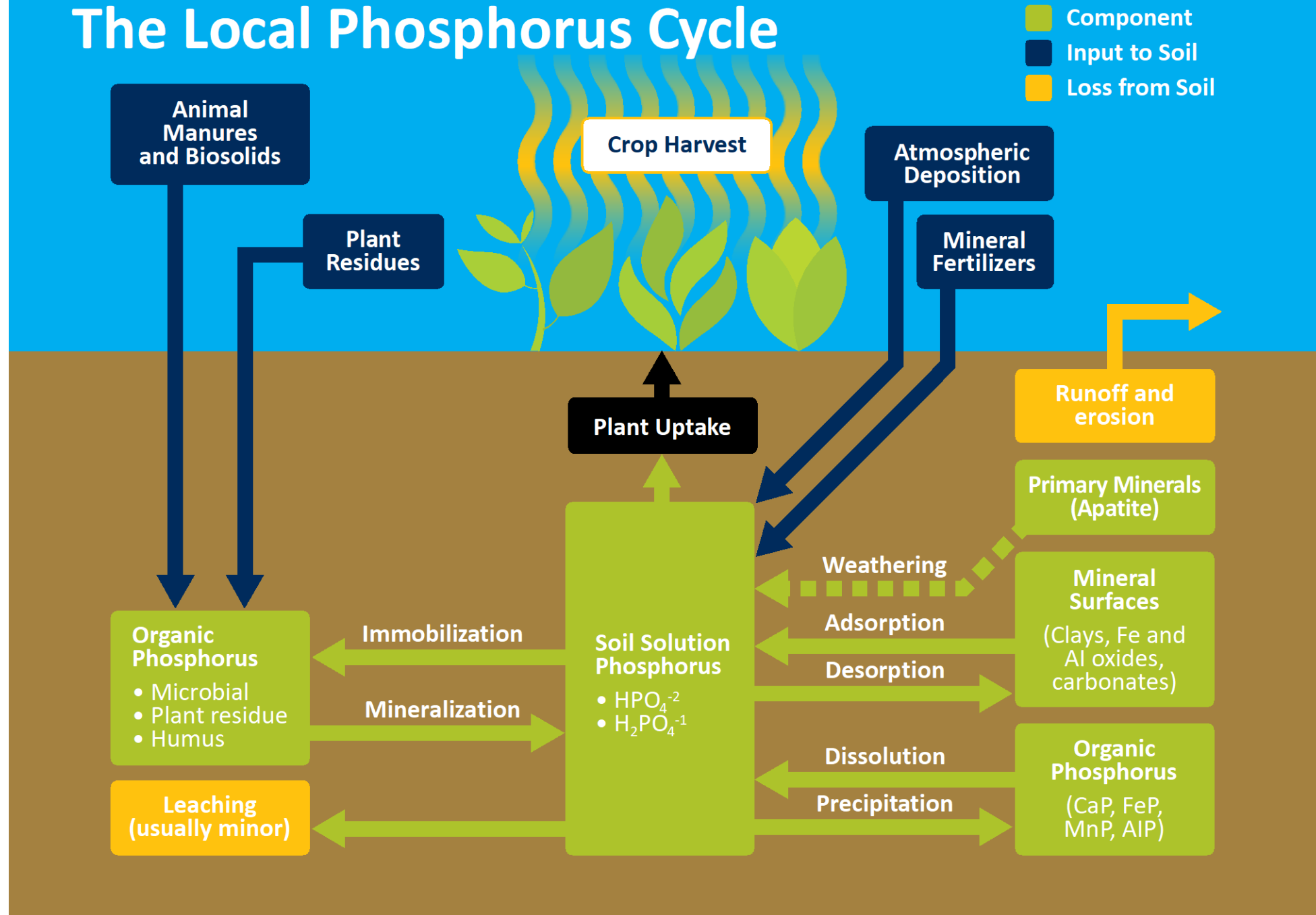
THE NATURAL PHOSPHORUS CYCLE



from Filipelli, 2002...
Quantities in Tg (10^{12} g) and Fluxes in Tg per year

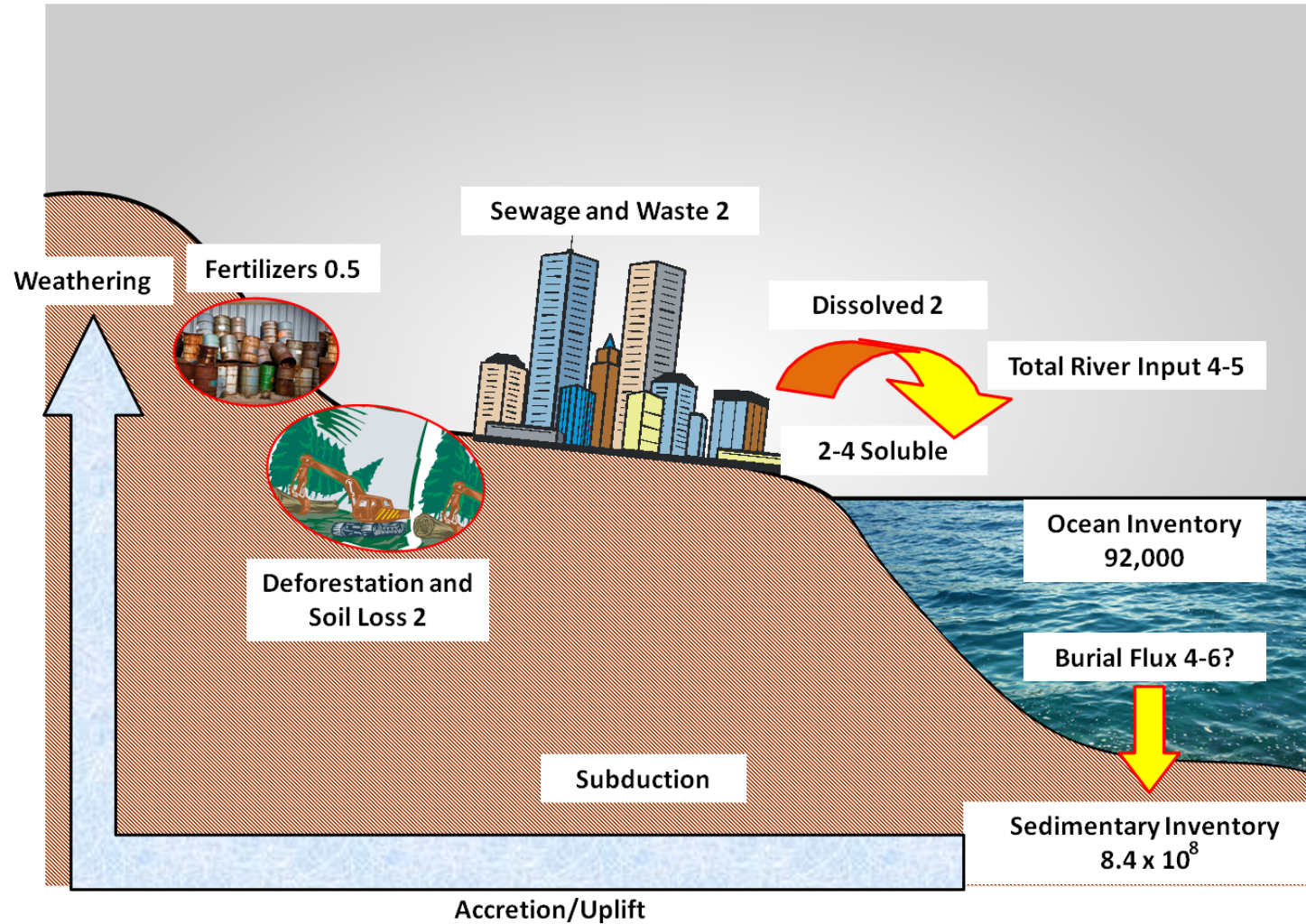


The Local Phosphorus Cycle





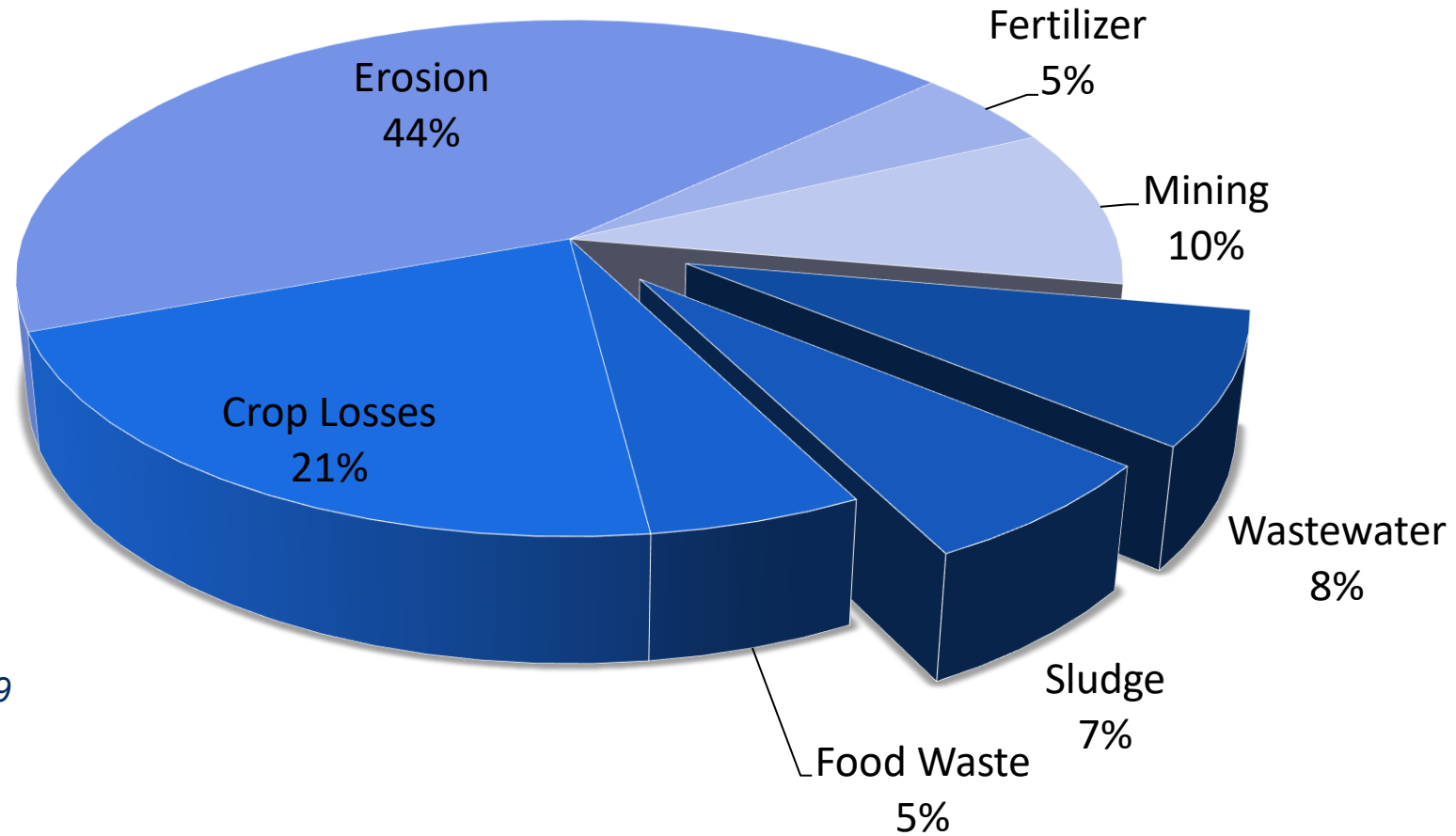
MODERN HUMAN IMPACTS...



from Filipelli, 2002...
Quantities in Tg (10^{12} g) and Fluxes in Tg per year

GLOBAL PHOSPHORUS CYCLE

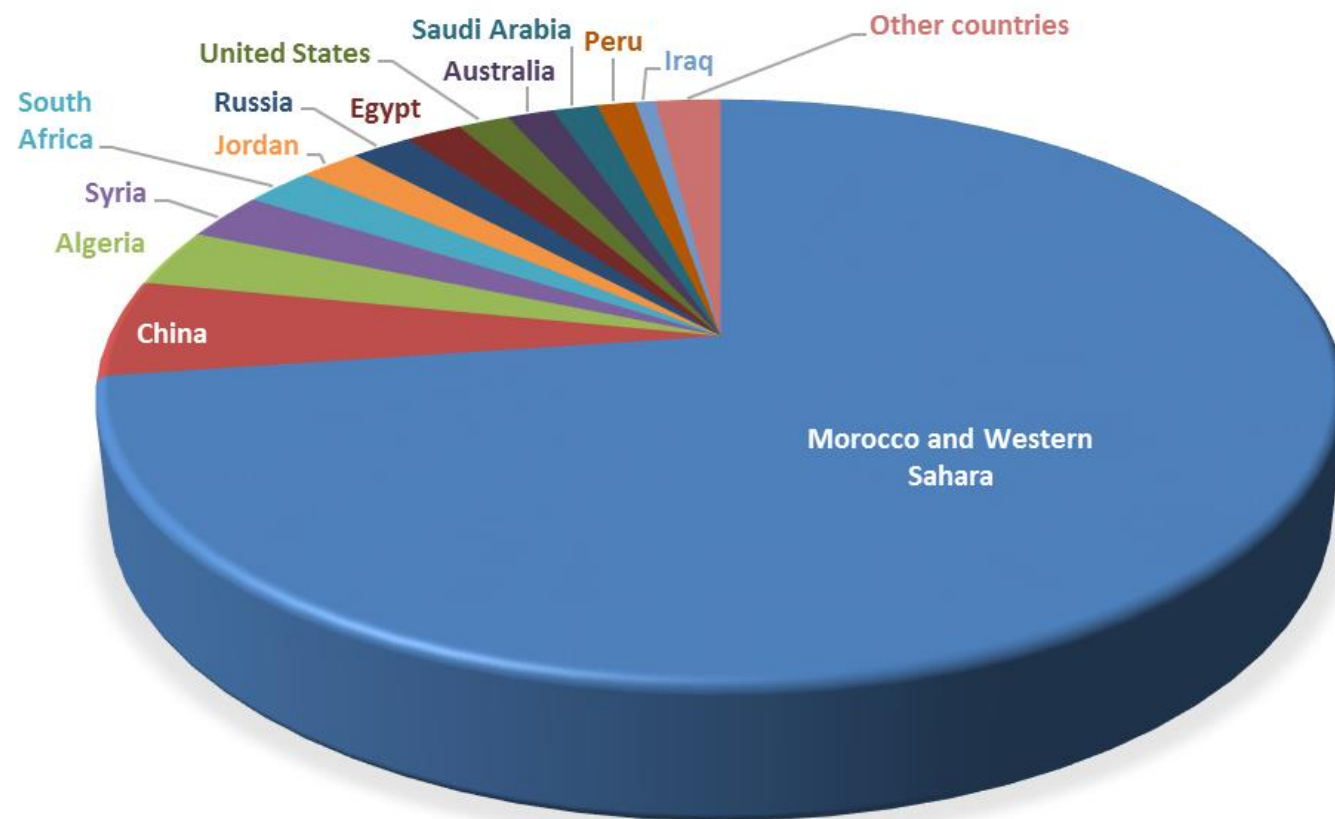
Outputs



from Cordell, 2009

Wastewater and Sludge are Significant Contributors to the Global Phosphorus Cycle

Why Recover Phosphorus – The Big Picture



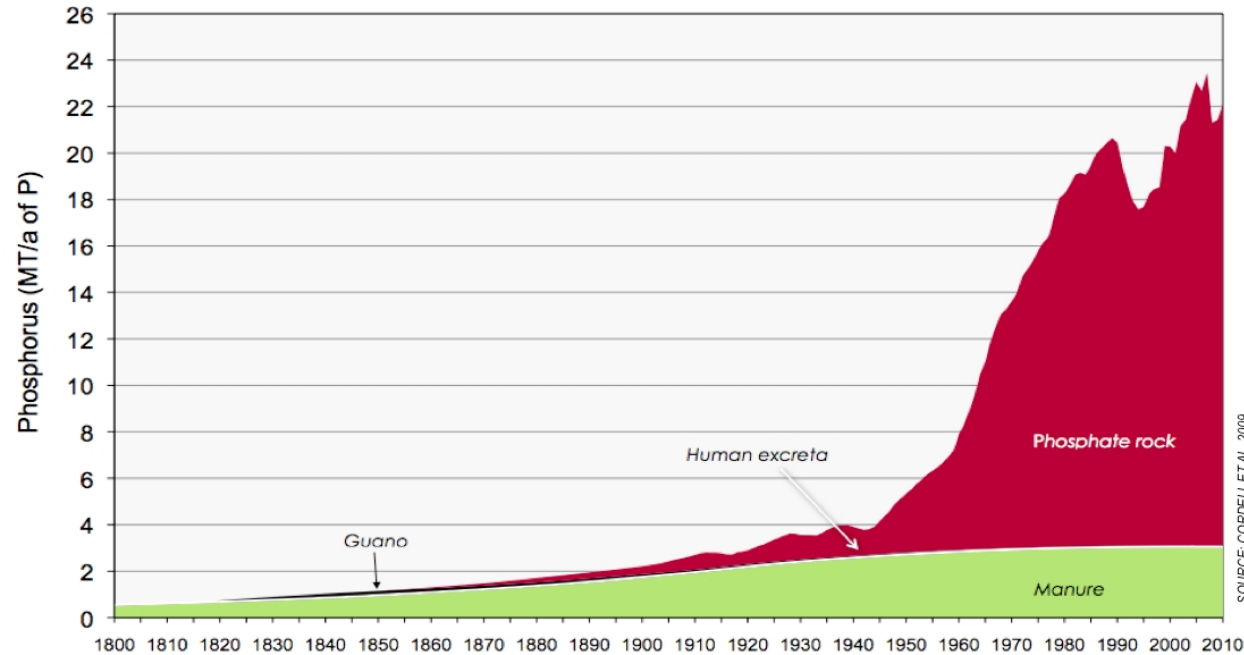
Current reserves projected to last 300 years at current extraction rates

Much less with projected annual growth in agricultural fertilizer use

Based on data from USGS Mineral Commodity Survey, 2016



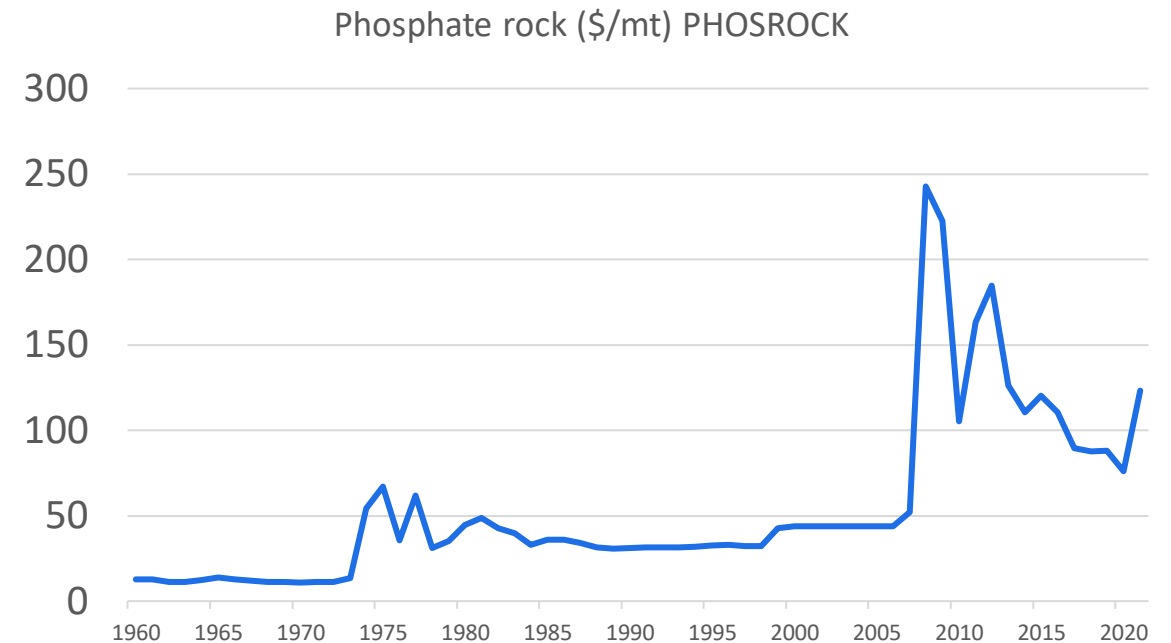
Why Recover Phosphorus – The Big Picture



Data courtesy of Phosphorus Futures –
Global Phosphorus Research Initiative

- Increasing dependence on phosphate rock mining as primary source
- Alternative source can reduce this dependence

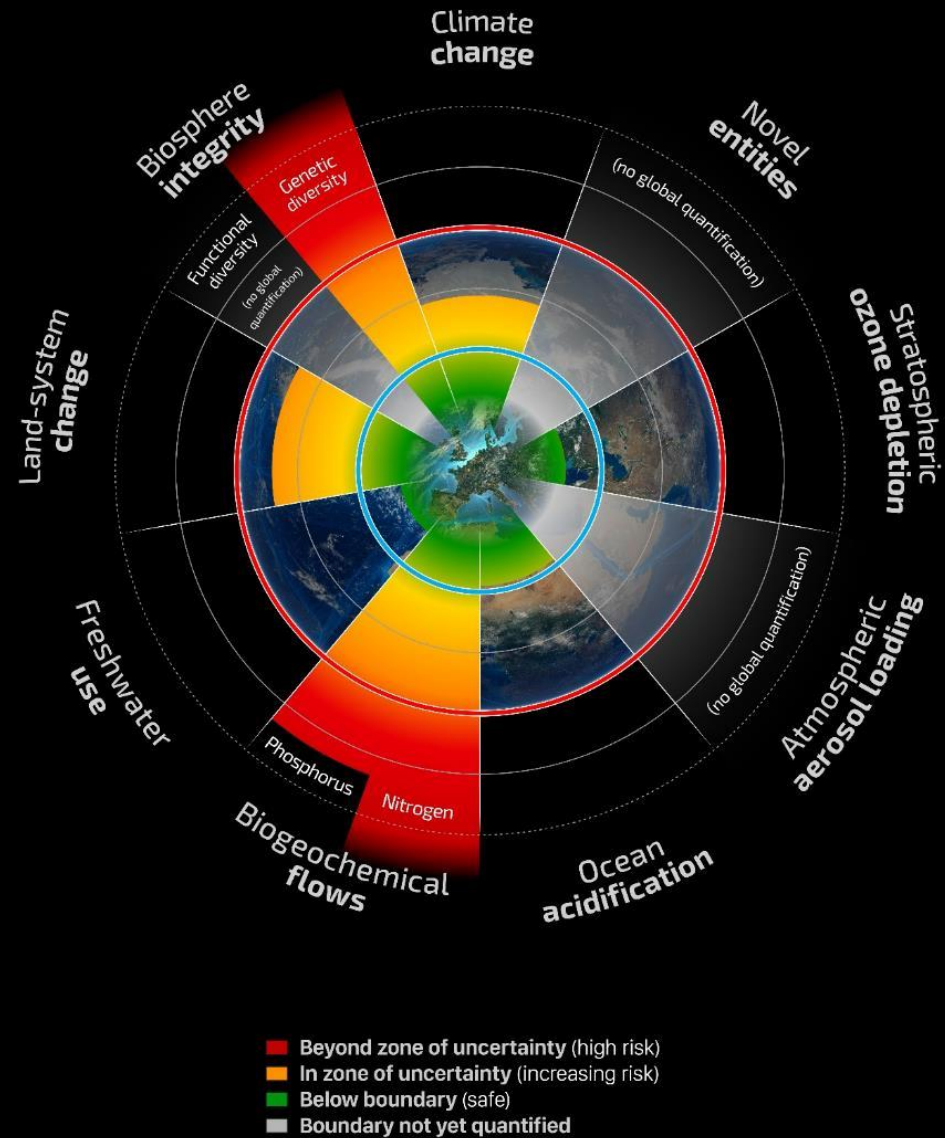
- Resource availability and price security
- Volatile market



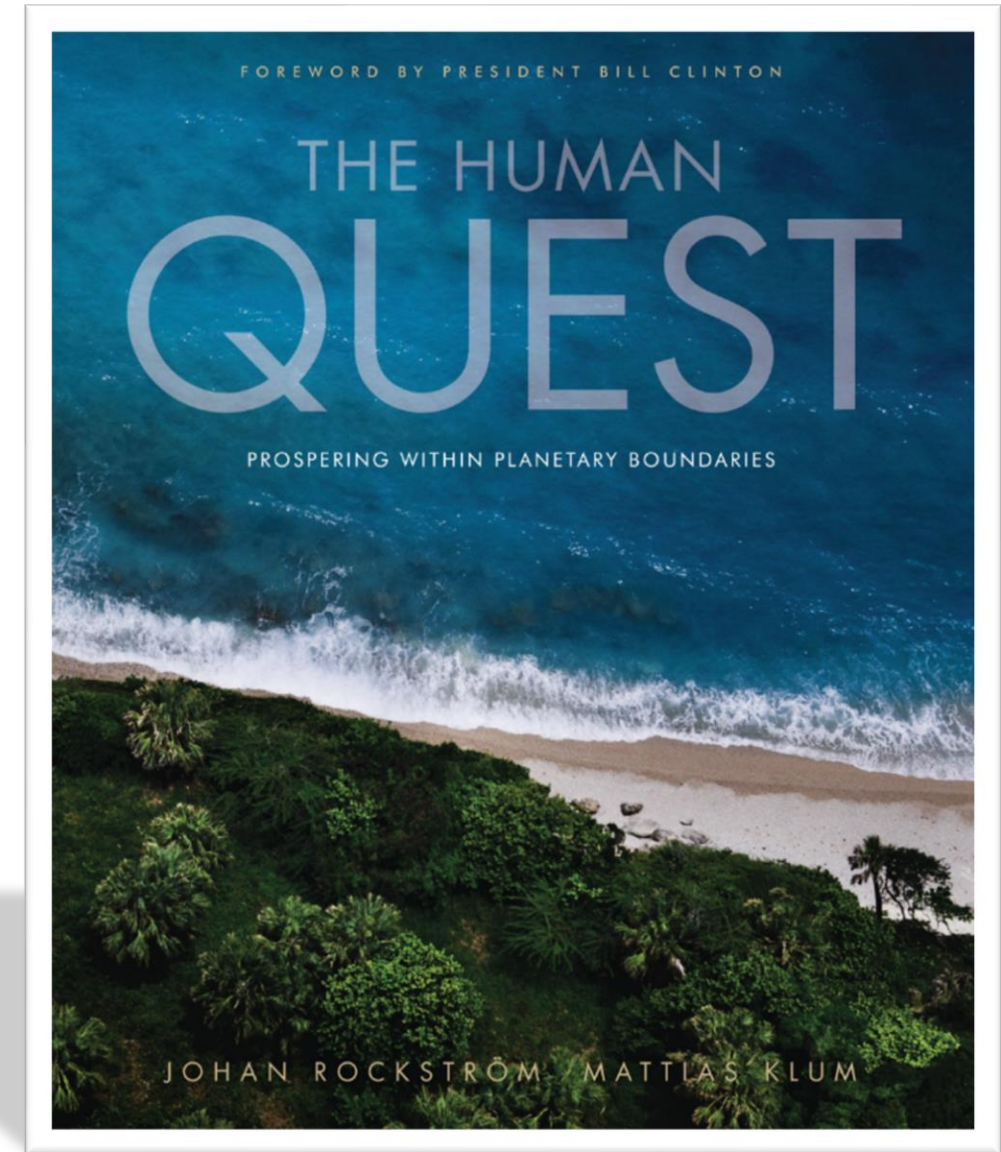
Data courtesy of World Bank Commodity Price Data

Planetary Boundaries

A safe operating space for humanity



Source: Steffen et al. Planetary Boundaries: Guiding human development on a changing planet, *Science*, 16 January 2015.
Design: Globalia





Phosphorus Recovery

- Production of soil amendment product
- Meet stringent effluent phosphorus targets (reduce P in recycle)
- Operational benefits (e.g., reduce/eliminate struvite formation)
- Mitigate limitations on beneficial biosolids use (reduce agronomic P loading)
- Improved environmental stewardship



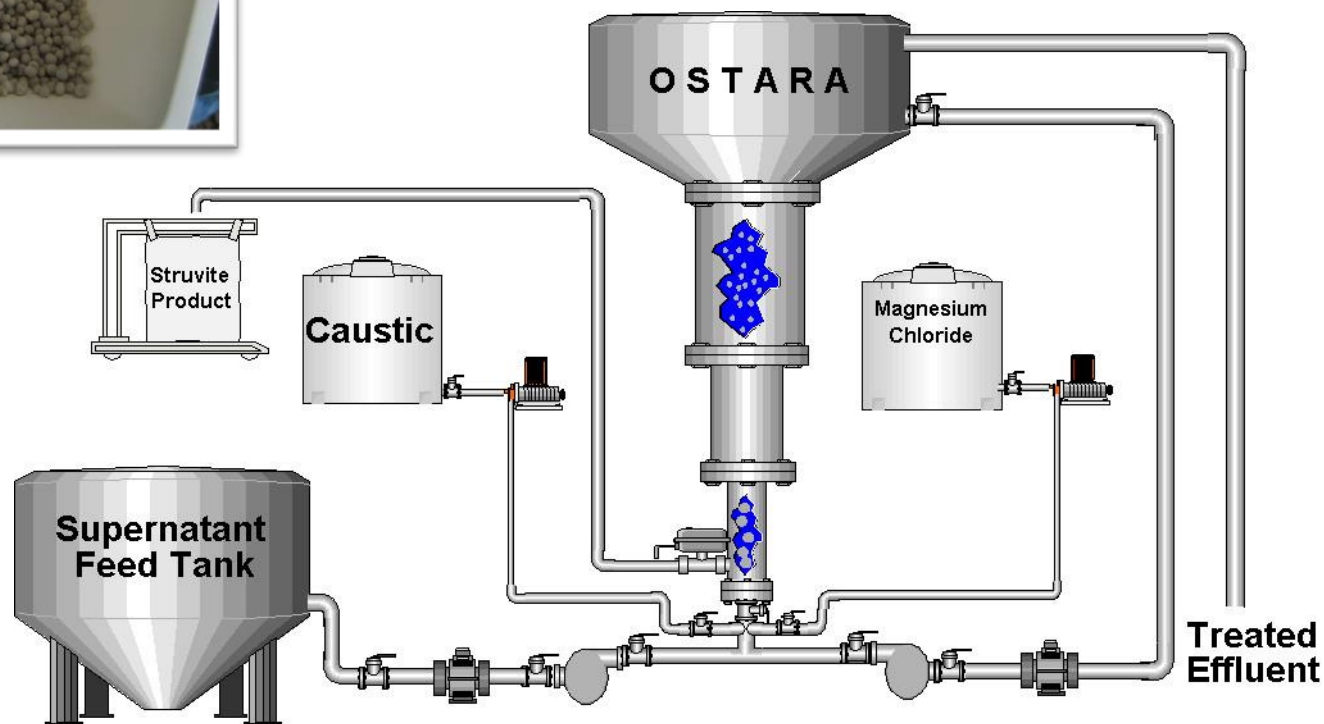
BEYOND REMOVAL – P-RECOVERY



Struvite

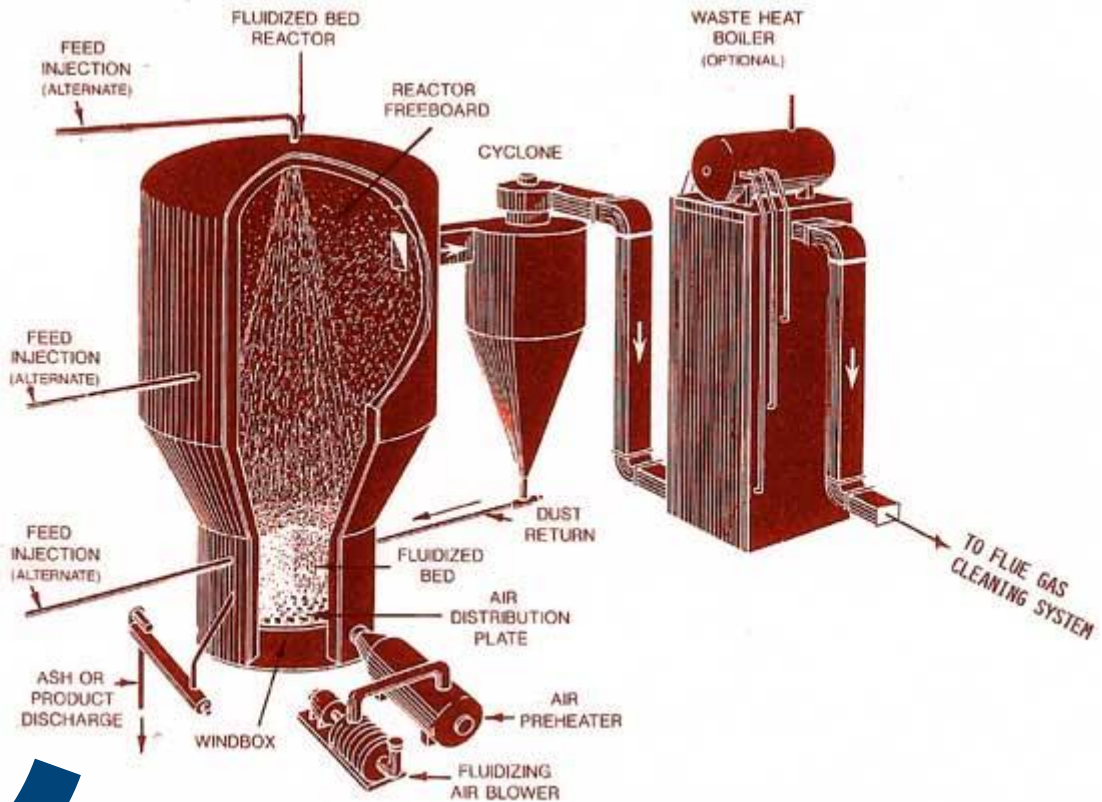


Also recovers
up to 20%
of nitrogen

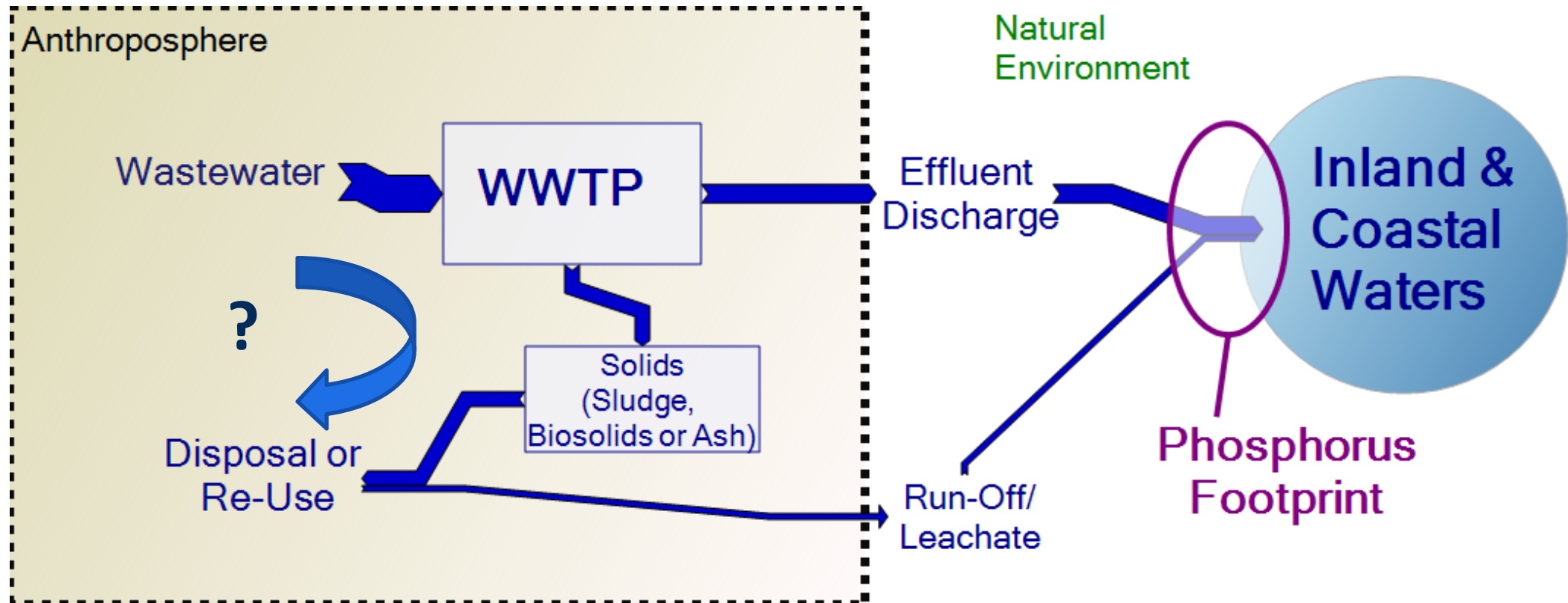


P-RECOVERY FROM INCINERATOR ASH

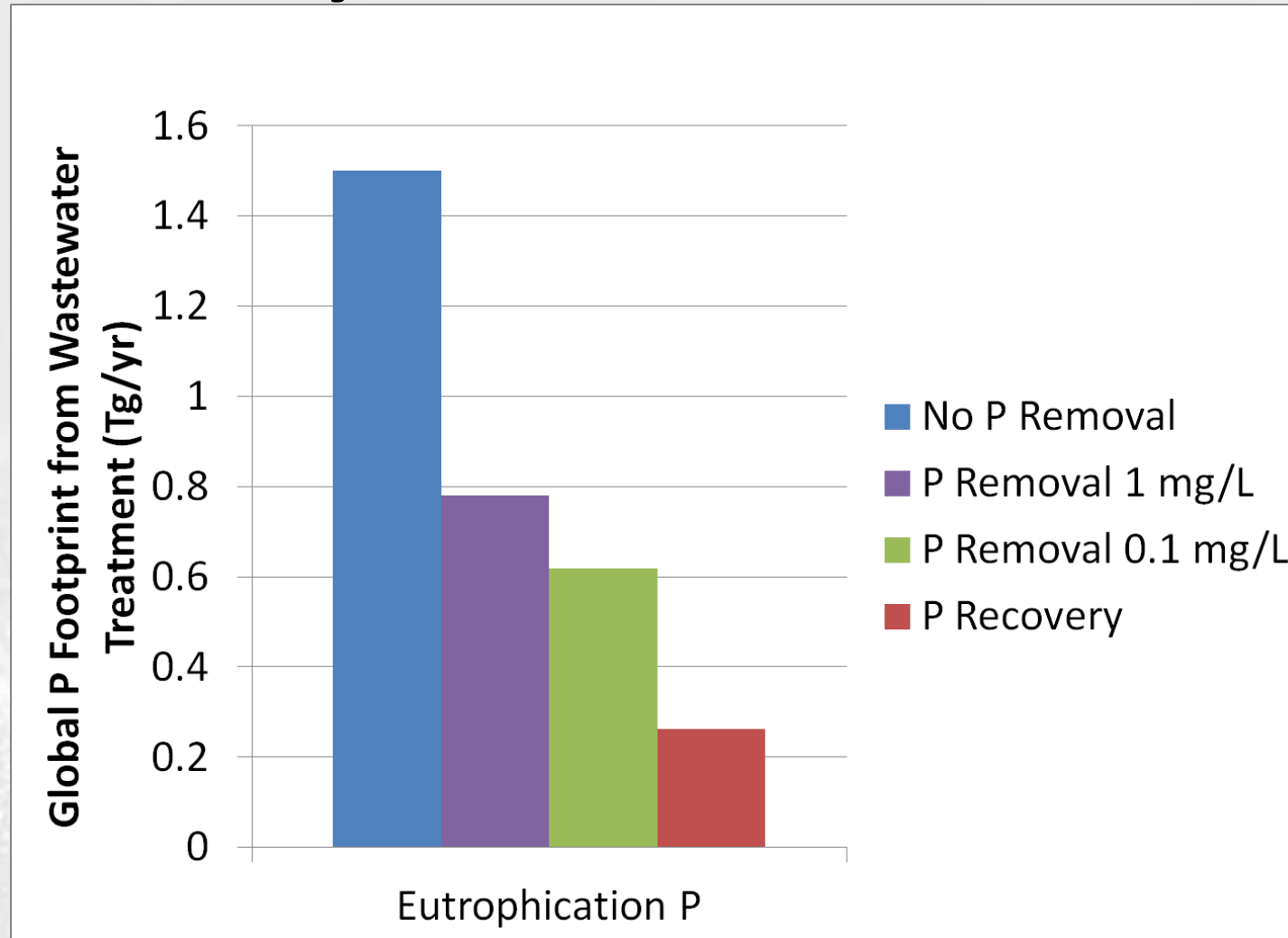
Deposit in
dedicated
site for
future
recovery



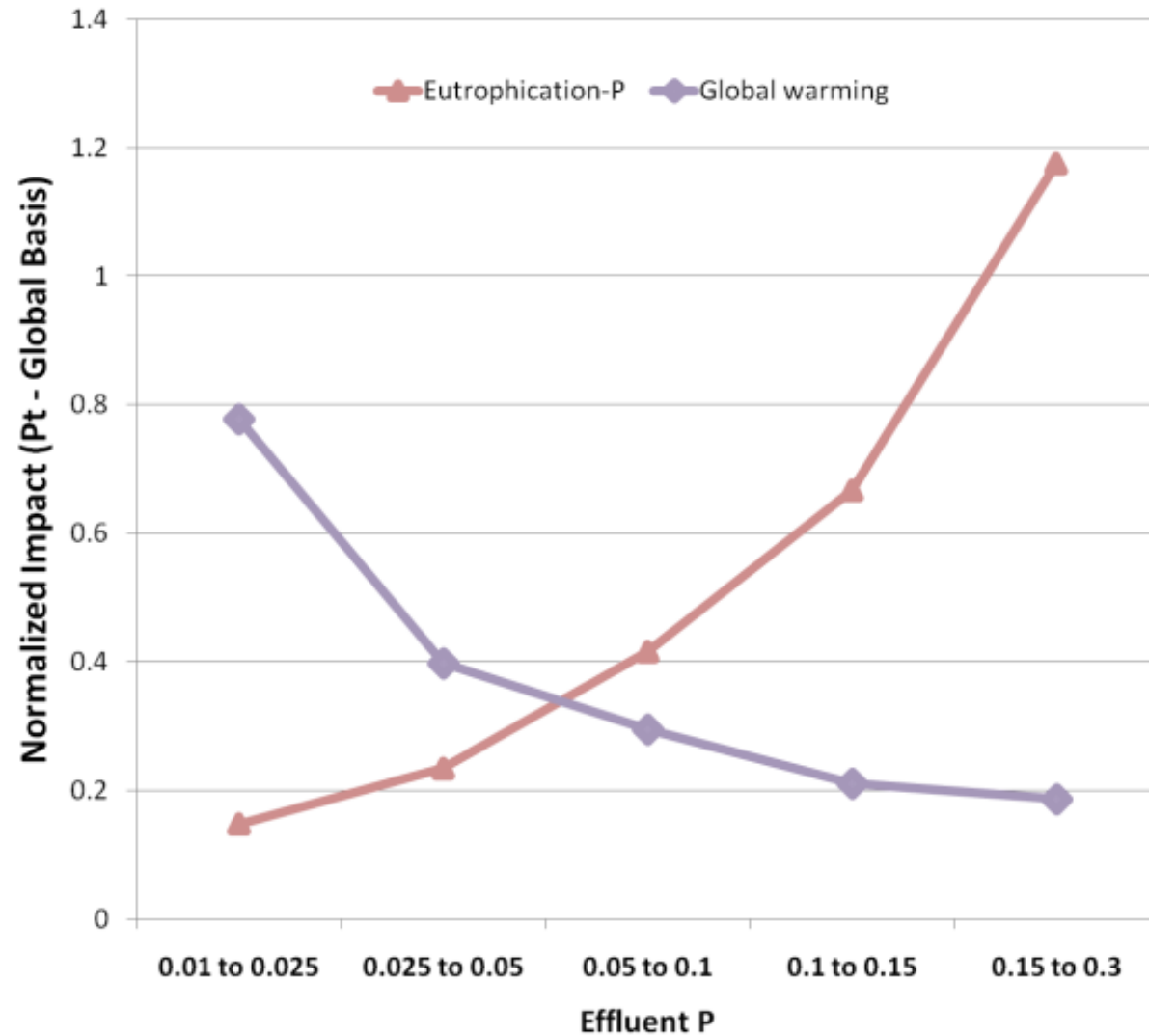
WASTEWATER TREATMENT PHOSPHORUS FOOTPRINT



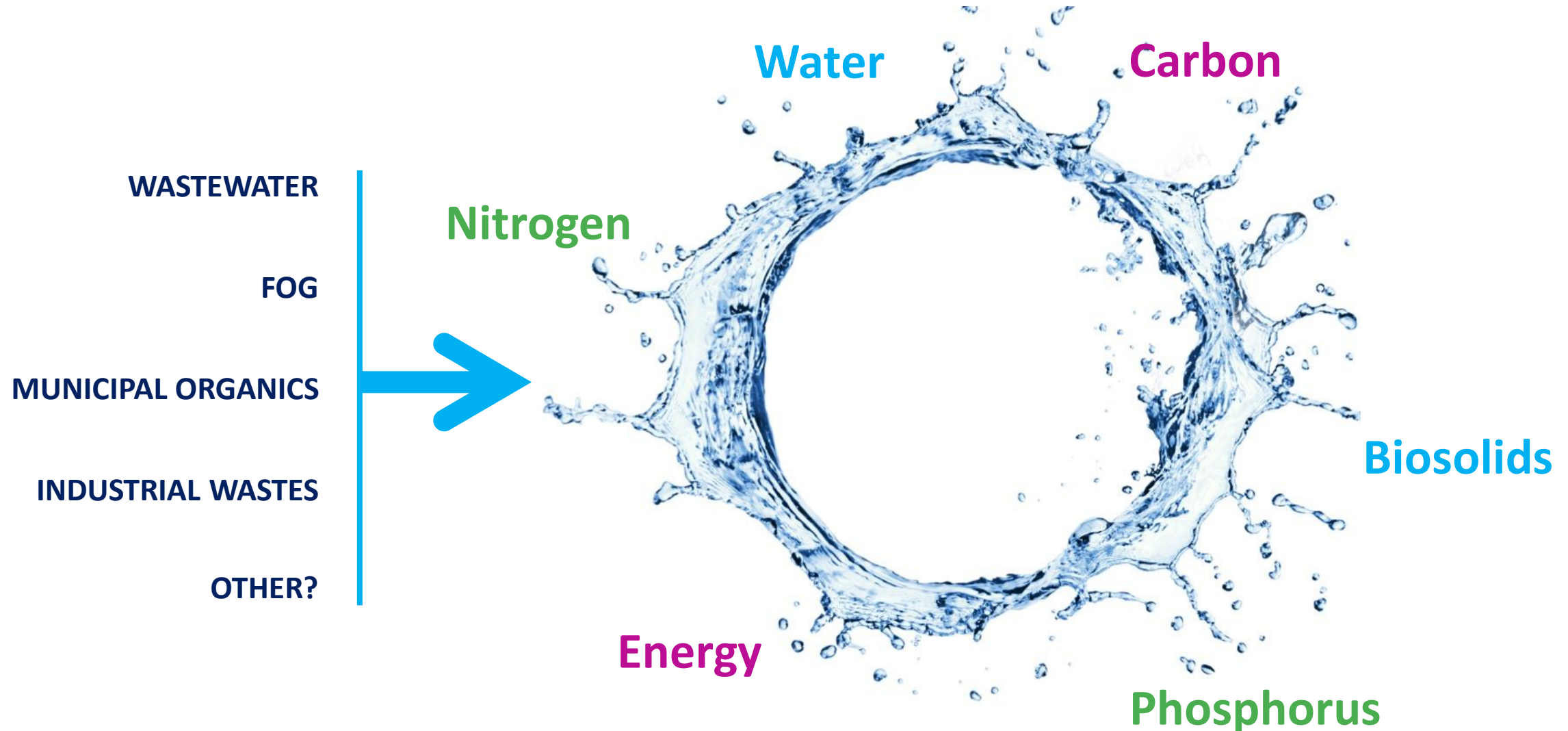
Potential Impact of P Removal and P Recovery



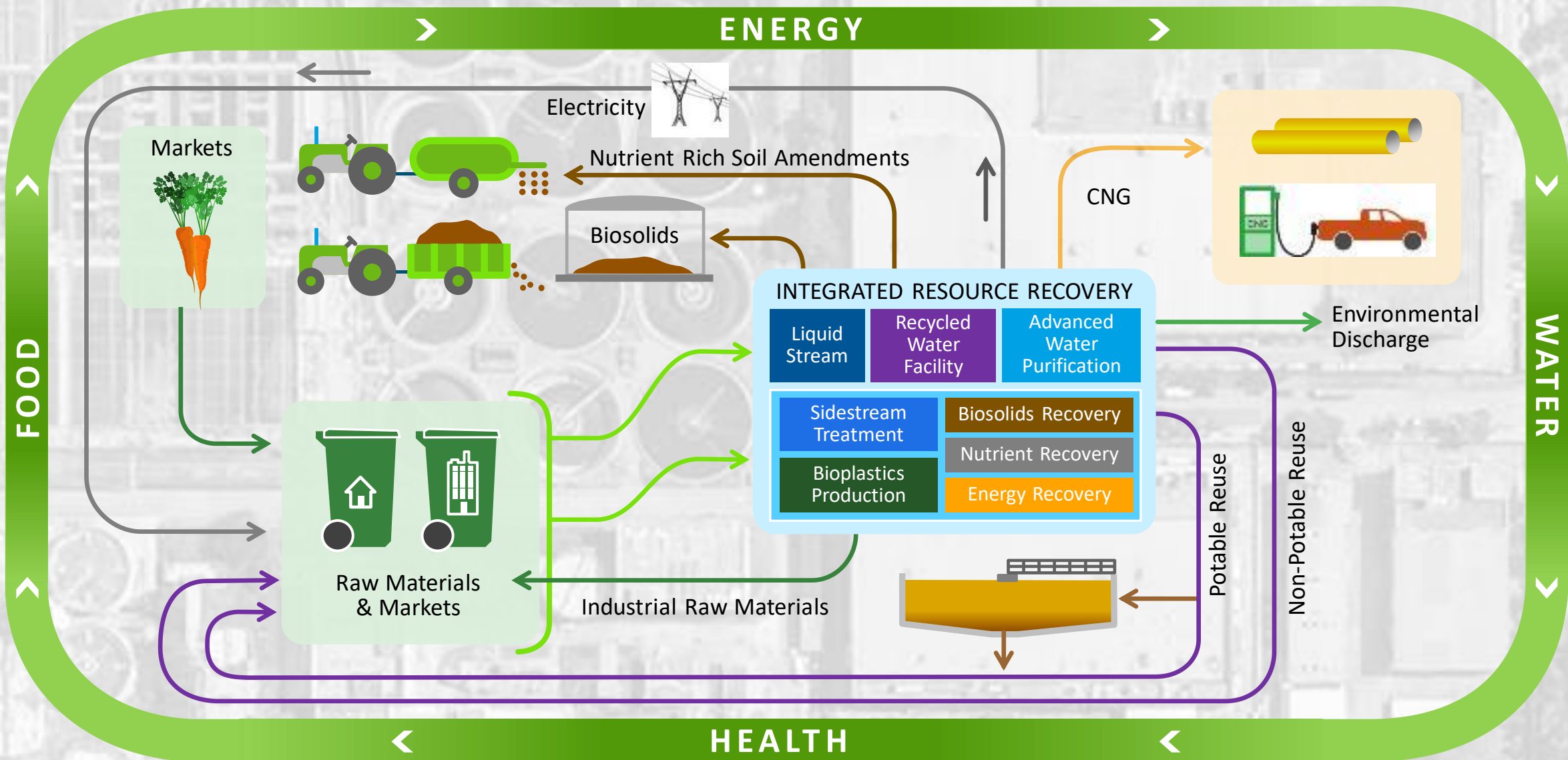
What About Carbon Footprint?



The Transformed IRRF in a Circular Economy



INTEGRATED RESOURCE MANAGEMENT



CONCLUSION – THE BIG 3 FOR WASTEWATER TREATMENT

- Water Footprint
(Depending on Locality)
- Phosphorus Footprint
- Carbon Footprint



In order of Influence for Wastewater



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BLACK & VEATCH