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Engineering
EyobuNjineli
Ingenieurswese



Dr Caitlin Courtney~ Civil/Water Engineering

**Rethinking human urine as a valuable resource for water
and fertilizer production**

Industry Showcase 2025

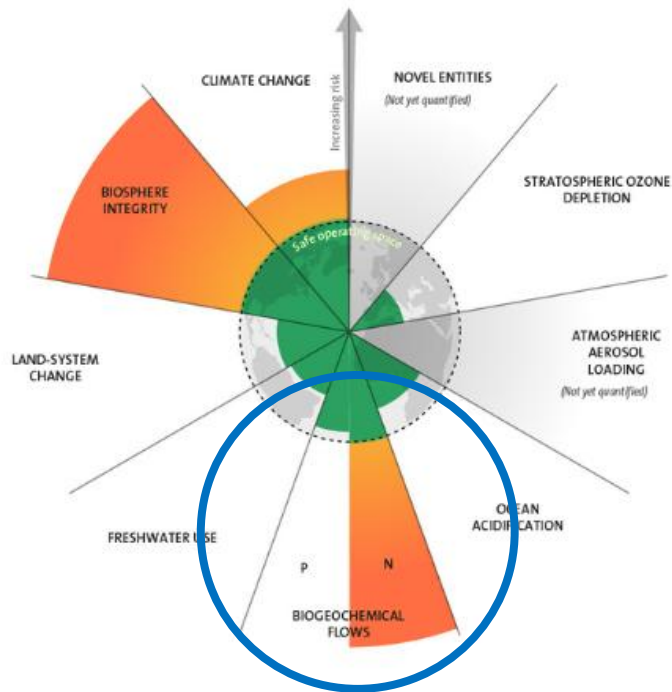
Planetary boundaries



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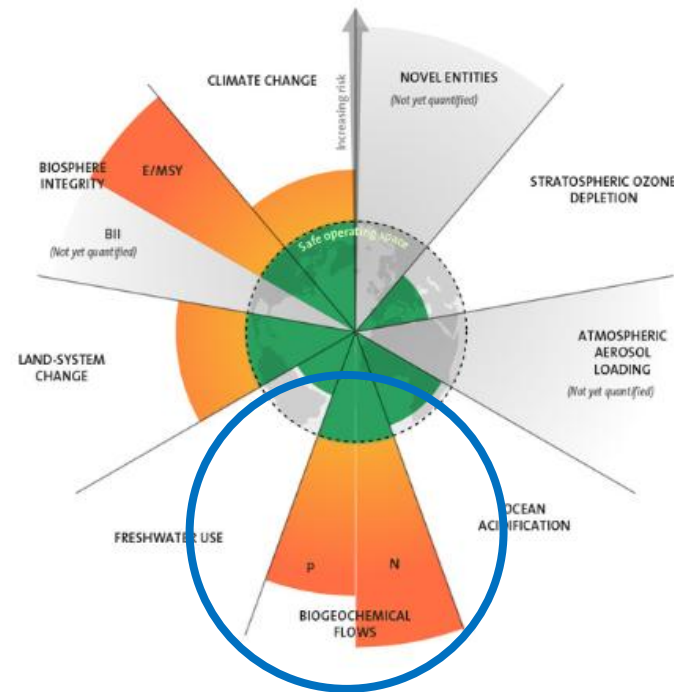
forward together
sonke siya phambili
saam vorentoe

2009



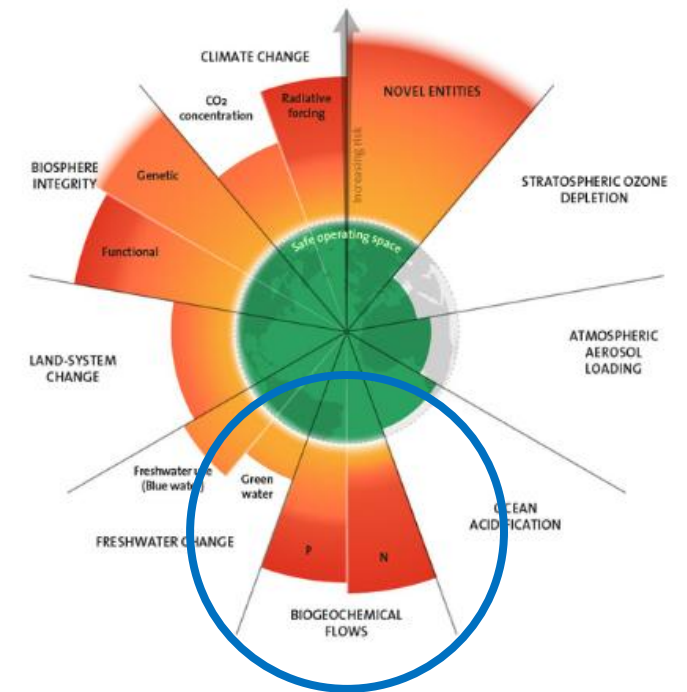
7 boundaries assessed,
3 crossed

2015



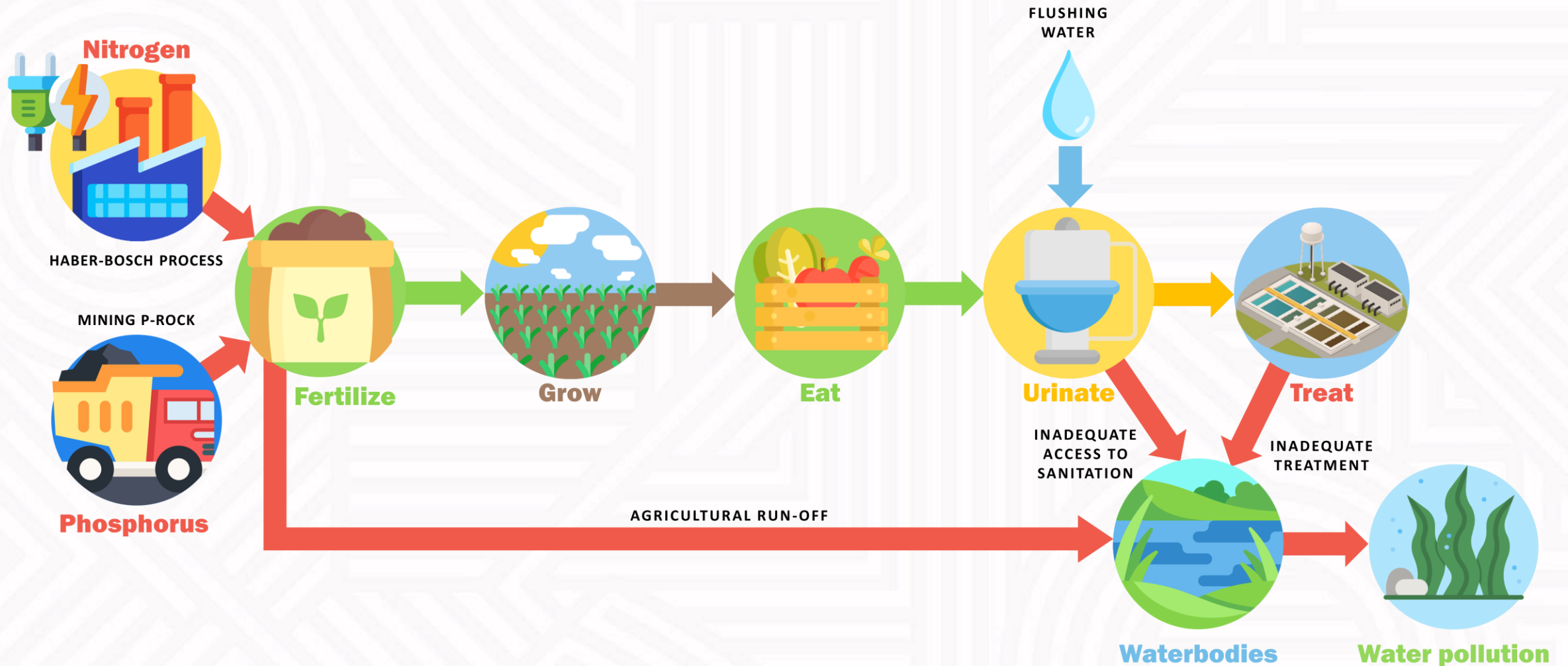
7 boundaries assessed,
4 crossed

2023



9 boundaries assessed,
6 crossed
Stockholm Resilience Center

The Status Quo: Nutrient cycle



The Status Quo: Sanitation & Wastewater Treatment



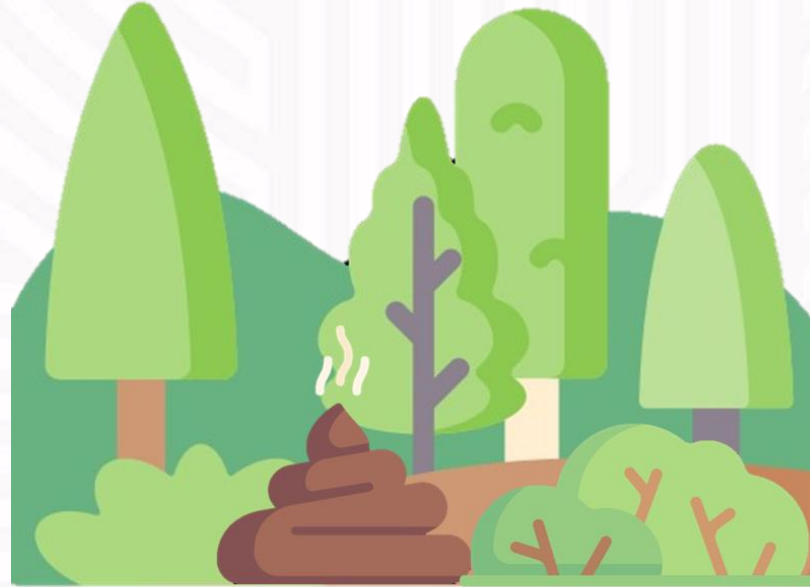
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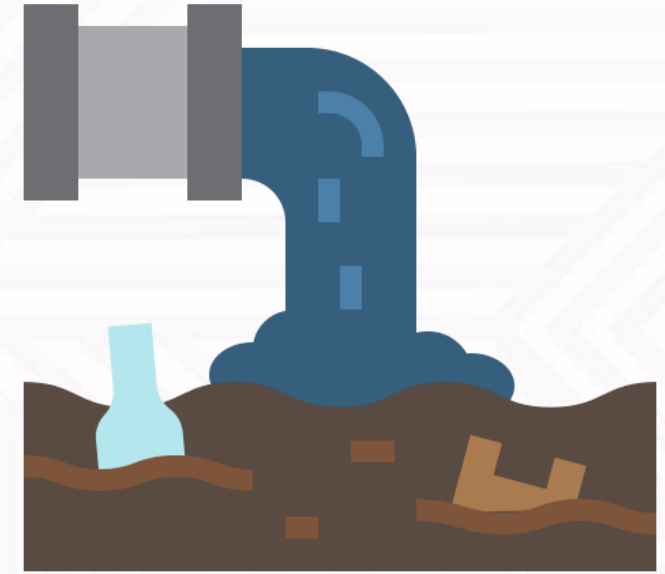
BASIC SANITATION

1.5 billion people don't have access



OPEN DEFECACTION

419 million people defecate in the open



GLOBAL WASTEWATER

44% of domestic wastewater is not adequately treated

Historical uses for pee!



**Leather
softening**



**Stain
remover**



**Textile
industry**



Gunpowder



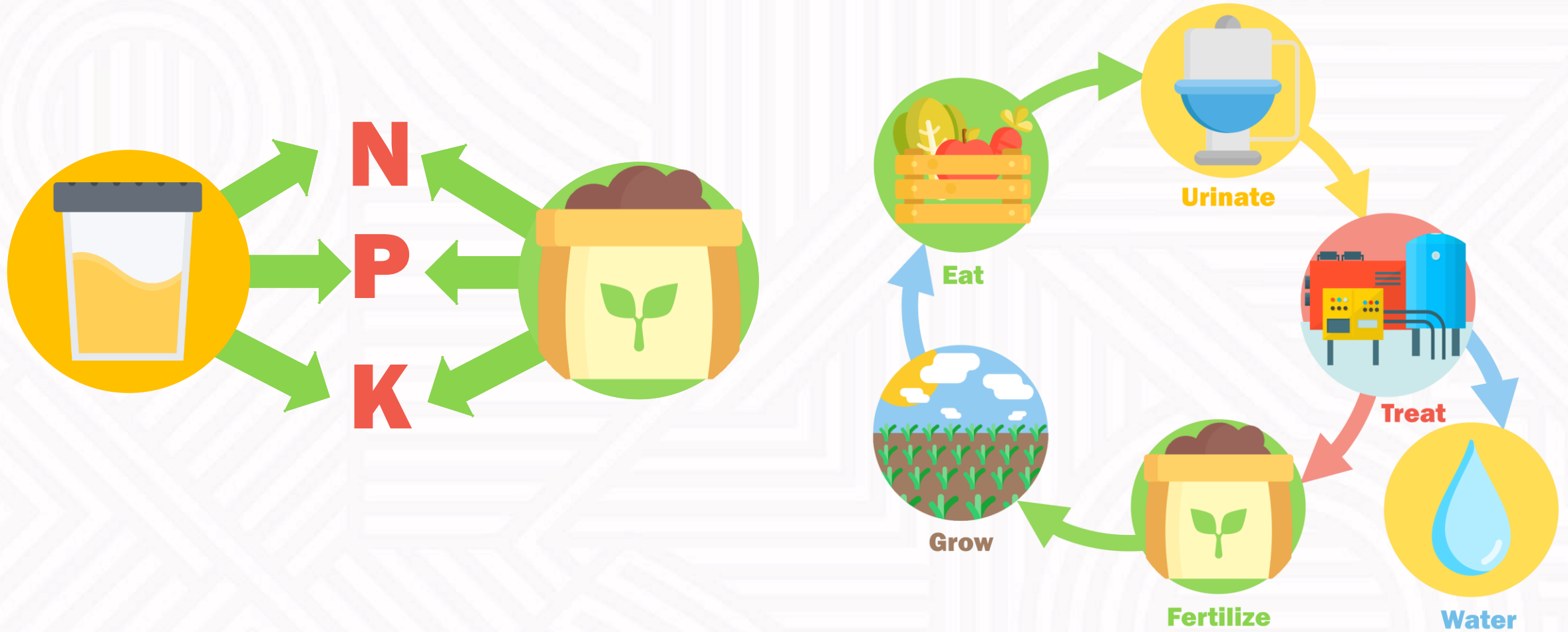
**Teeth
whitening**

Nutrient recycling to advance the circular economy



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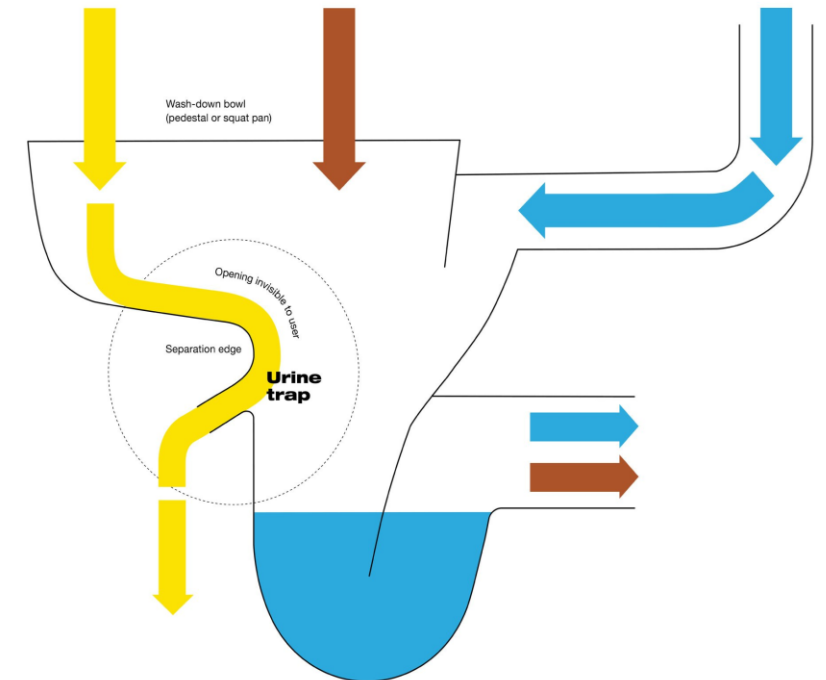
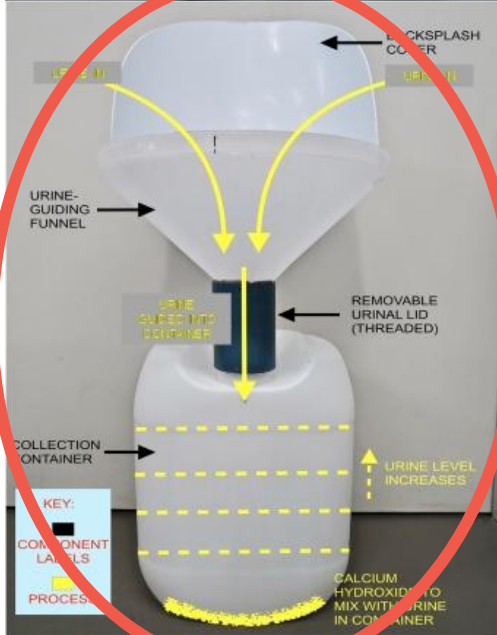


Urine Diversion and Collection Systems



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Resource Recovery Options



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Liquid Fertilizers



Concentrated
liquid urea



Ammonium
nitrate

Solid Fertilizers

Calcium
Phosphate



Struvite ($\text{NH}_4\text{MgPO}_4 \cdot 6\text{H}_2\text{O}$)



100% dehydrated urine

Urine recycling
companies around
the world



wasted



Pee-cycling



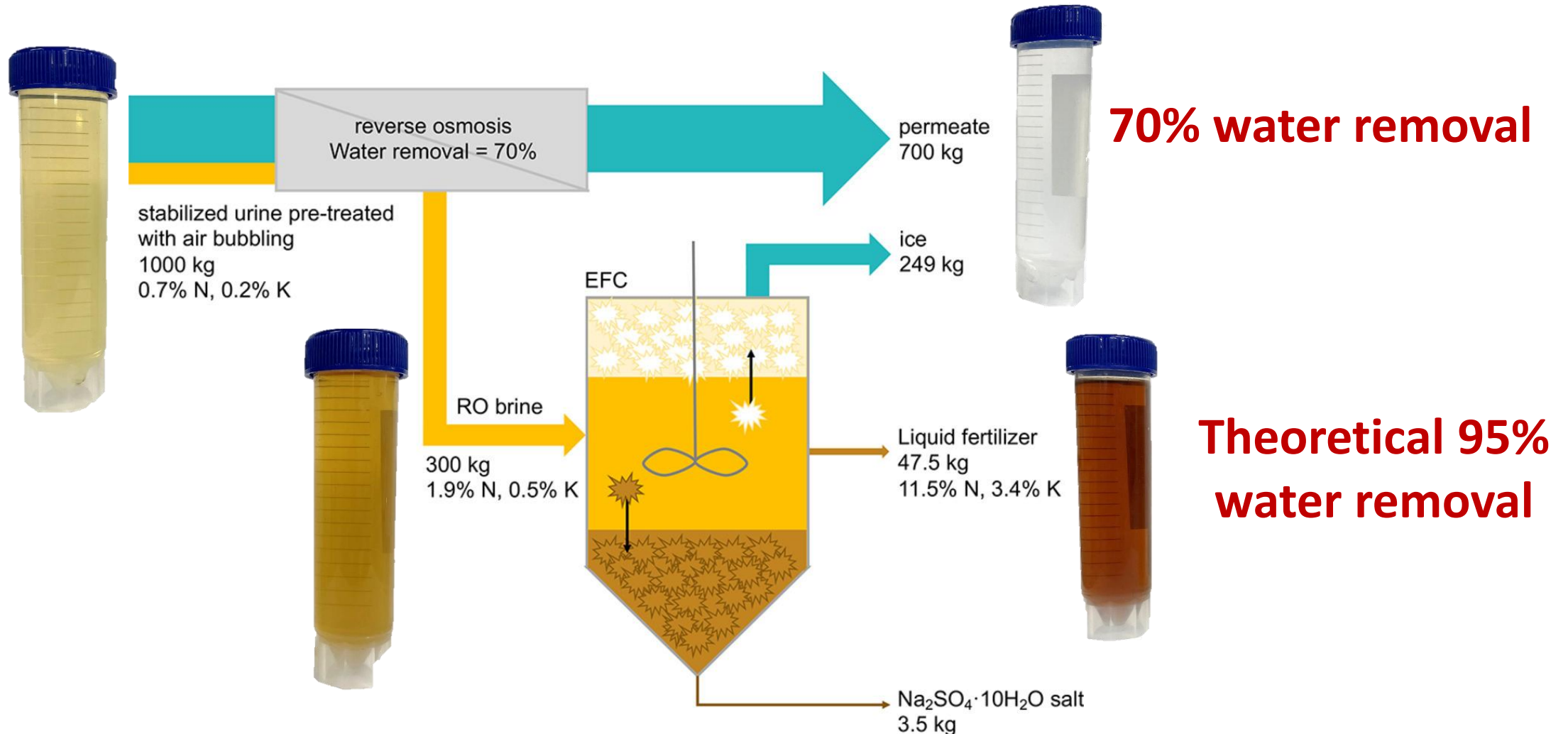
Sanitation³⁶⁰

Treatment Technology Development

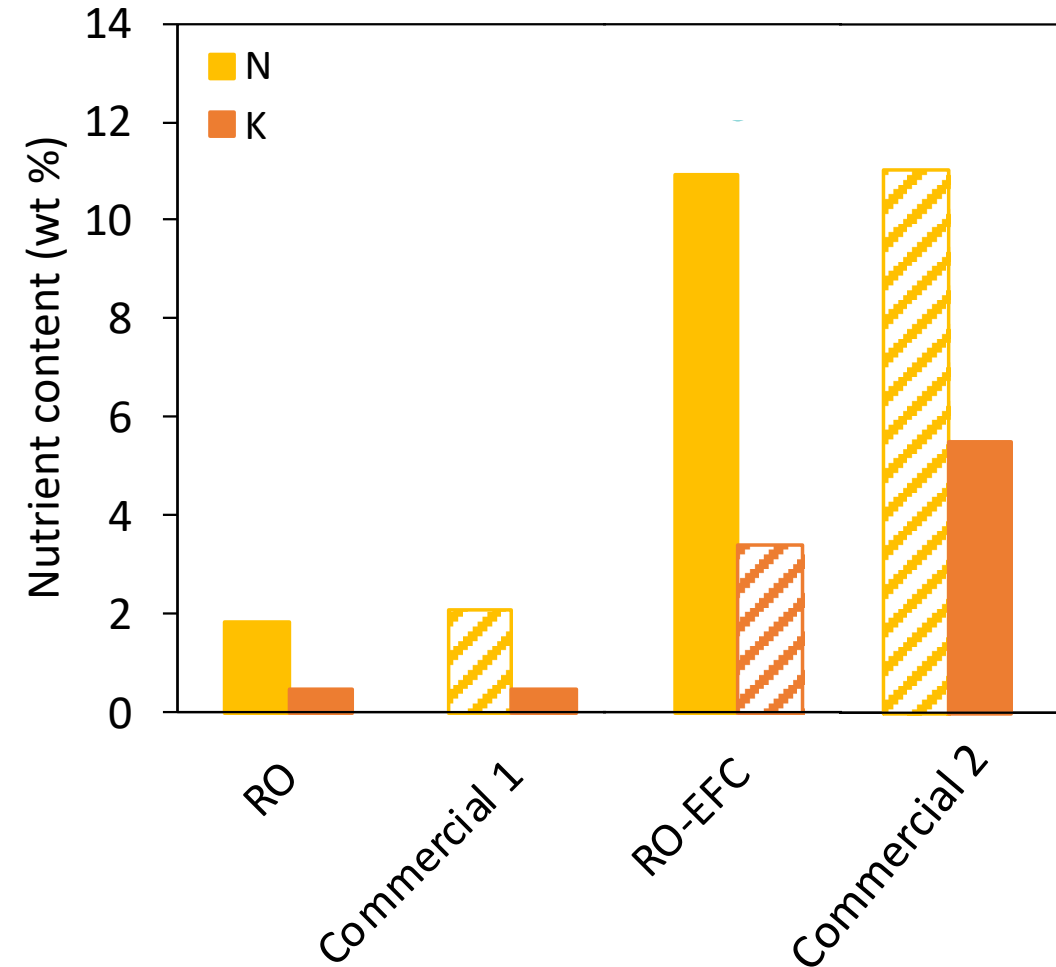
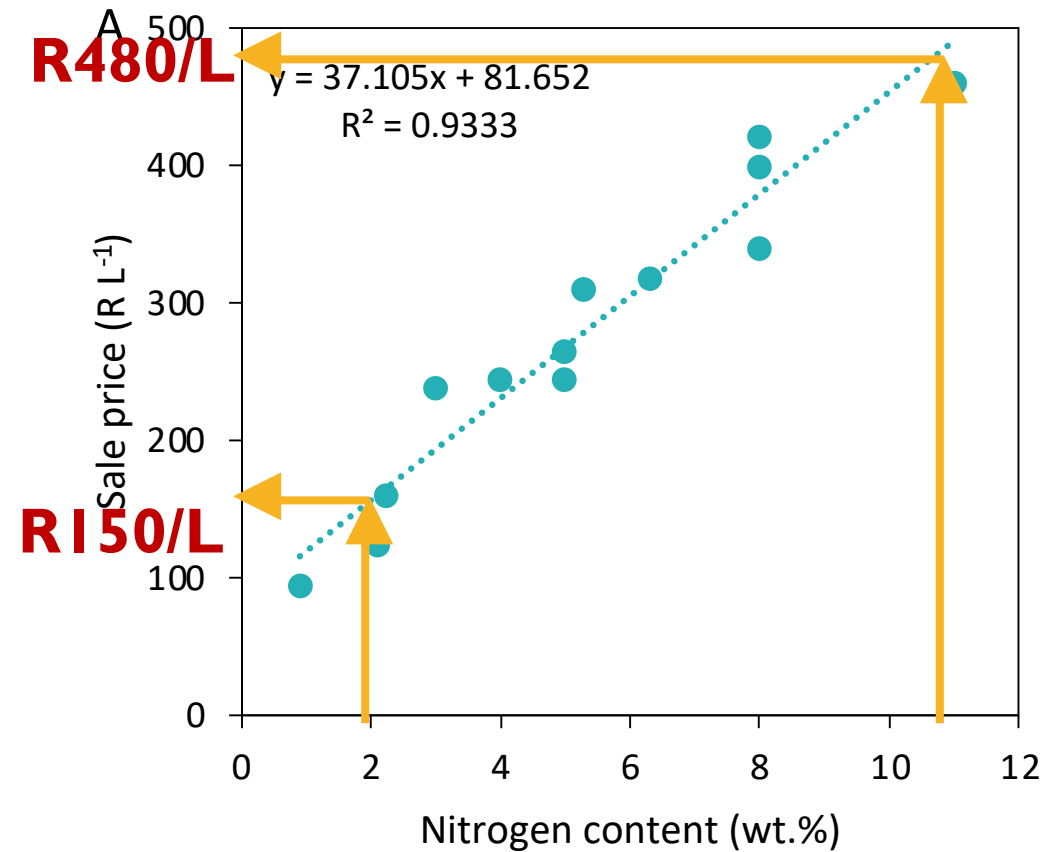


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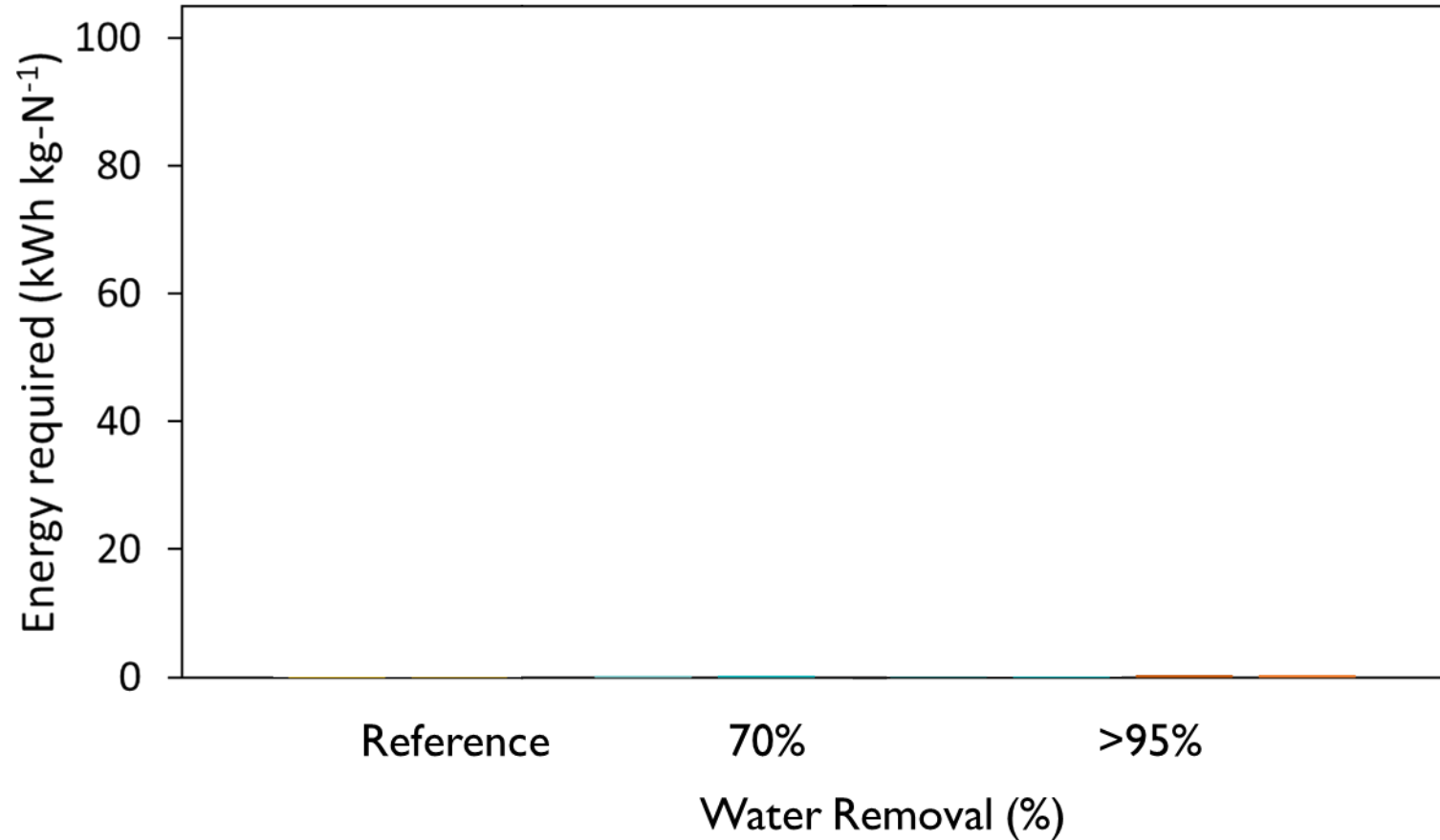
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Fertilizer comparison & Value



Energy Consumption



RO-reverse osmosis, EFC - eutectic freeze crystallization, AD – alkaline dehydration, ND – nitrification and distillation

Research themes & Current focus



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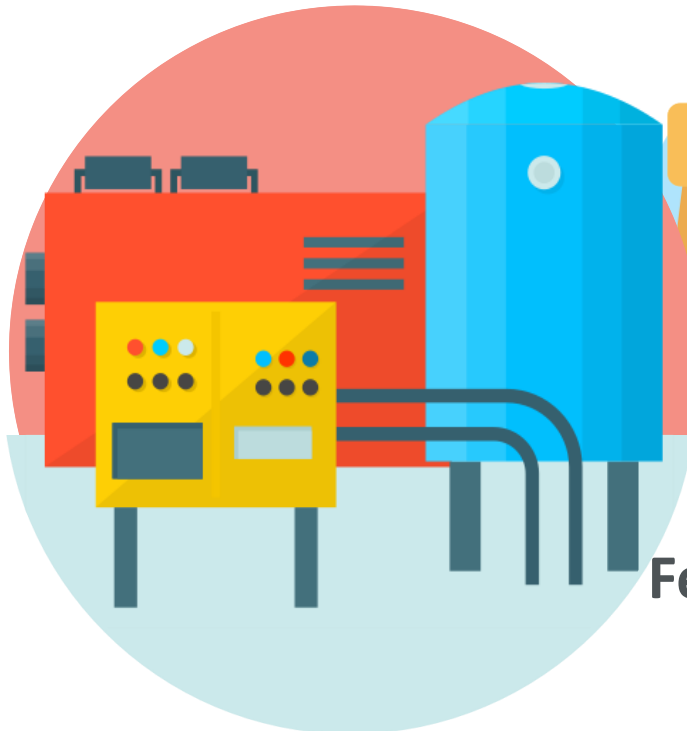
Urine collection



User perceptions & regulations



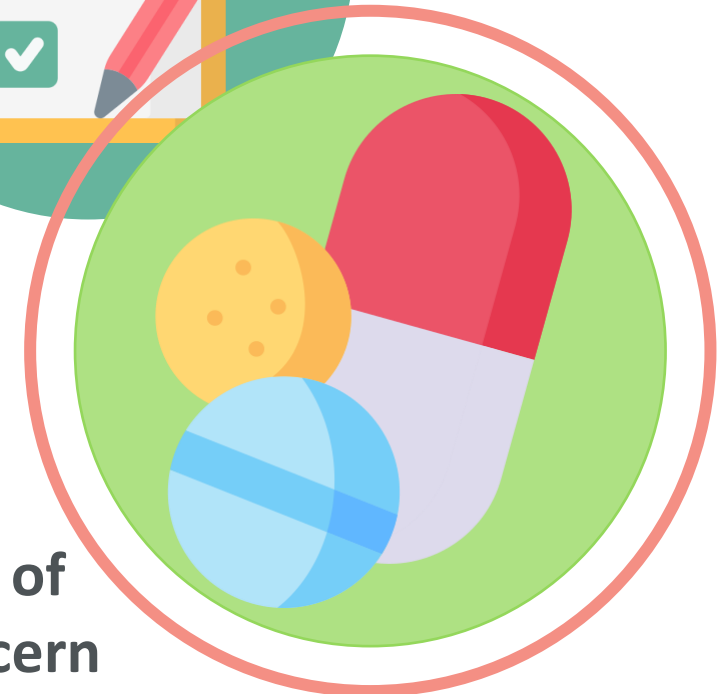
Treatment technologies



Fertilizer effectivity

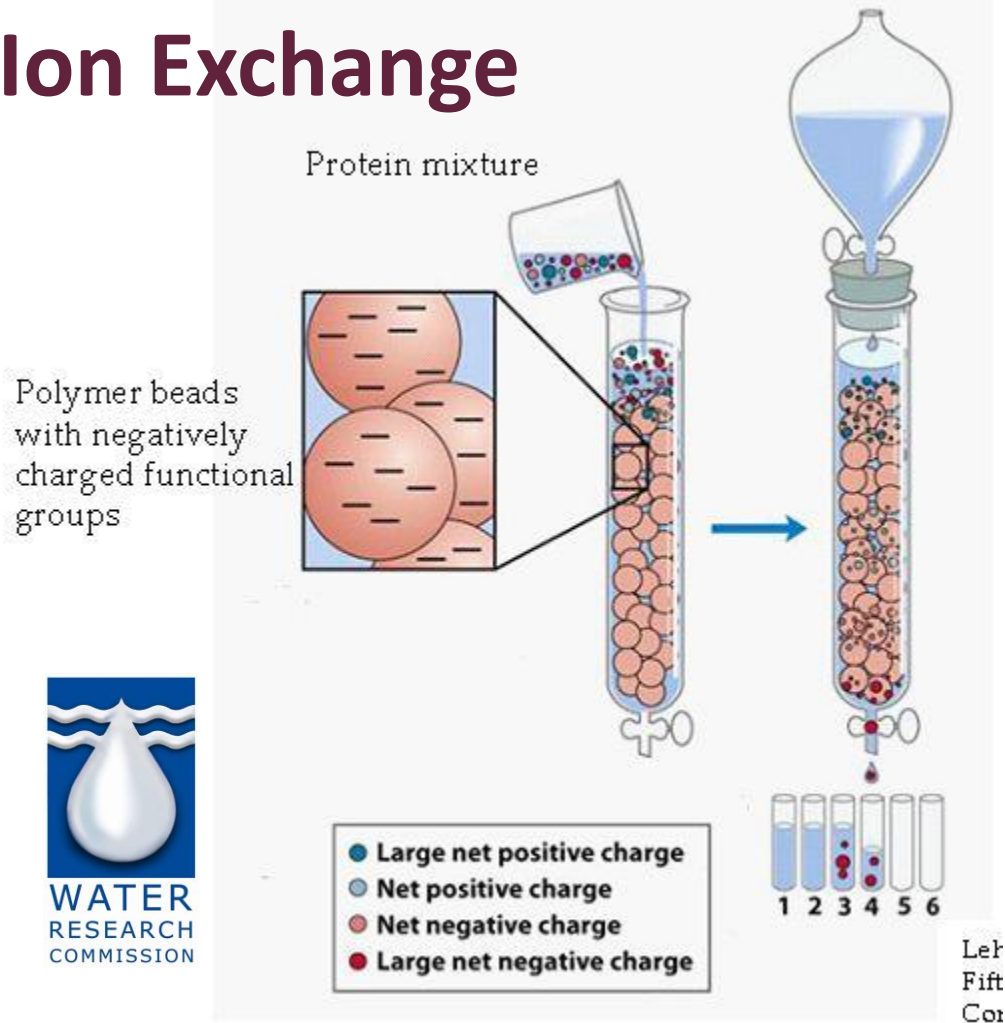


Contaminants of emerging concern

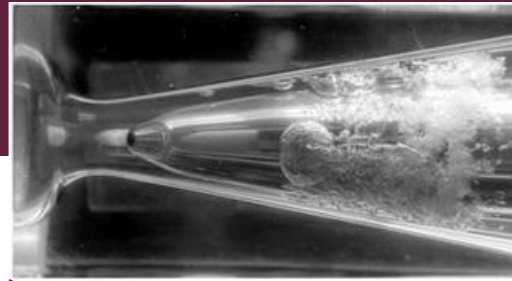


Current Research

Ion Exchange



Lehninger Principles of Biochemistry Fifth Edition, © 2008 W.H. Freeman and Company



Hydrodynamic Cavitation



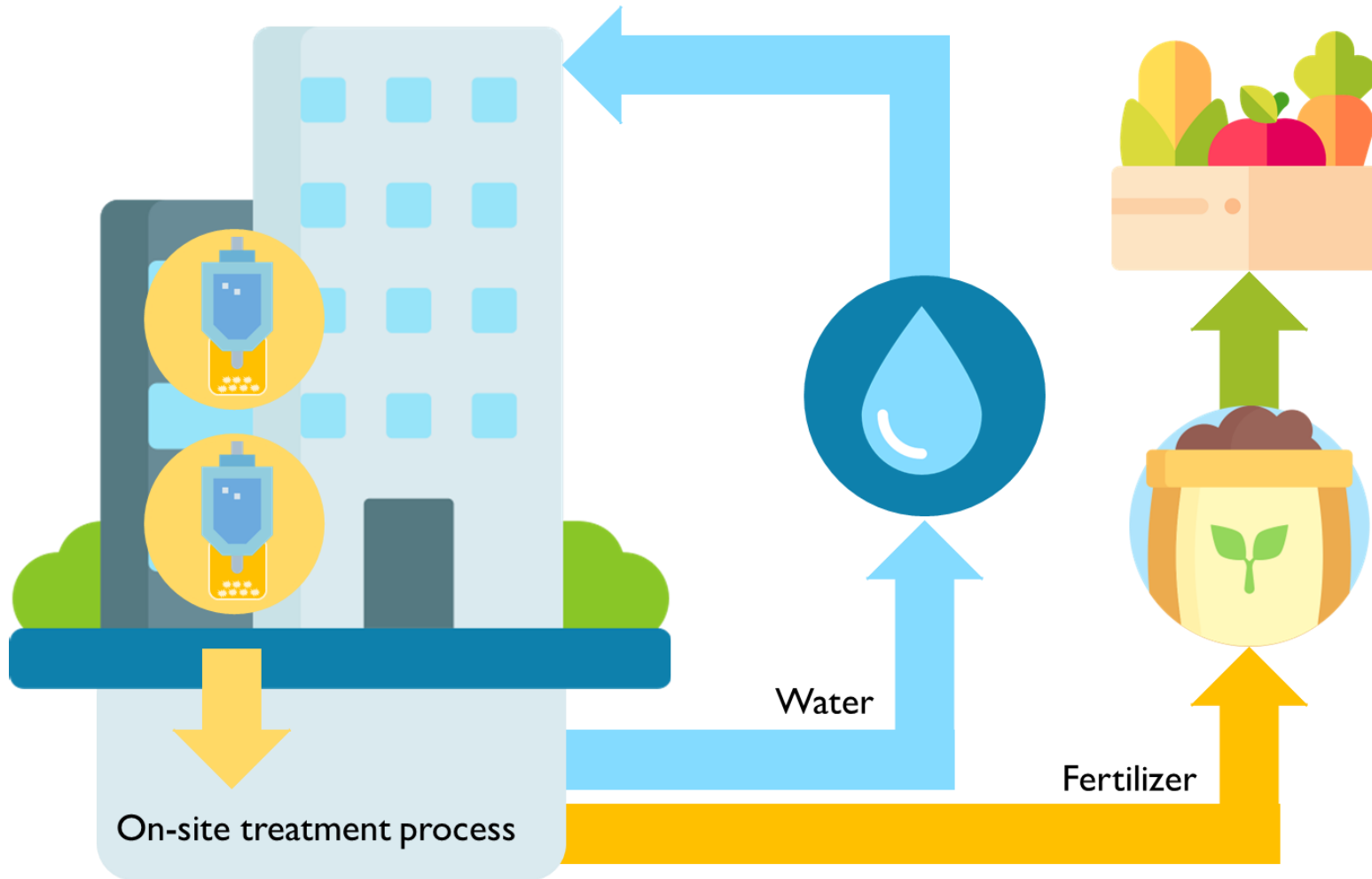
National
Research
Foundation

Vision for the future



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- Retrofitting existing buildings
- Ensuring new builds have dual piping systems
- Installing waterless urinals

Vision for the future



**Exxaro building in
Centurion**

Vision for the future

How can nutrient recovery lead to improved sanitation provision?





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Thank you
Enkosi
Dankie