

Phos4SG
Recovering the “P” from PUB’s Used
Water Treatment for Improving
Singapore’s Food Security

EE Lim Ming Xiang
Technology Department

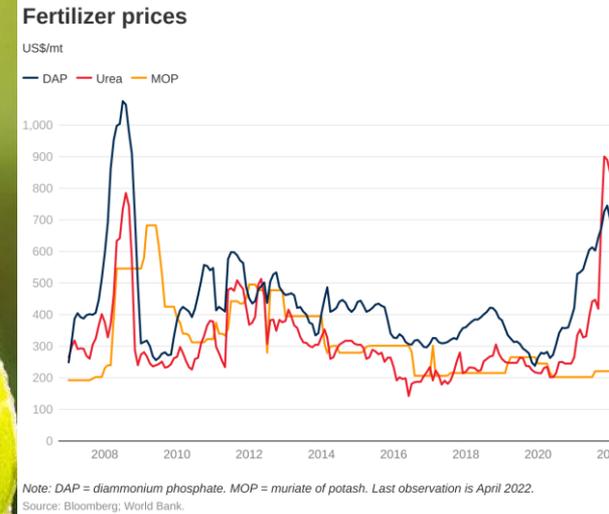
Singapore's "30 by 30" Vision

“Singapore aims to produce **30%** of the nation’s nutritional needs locally by **2030** to reduce its heavy reliance on imports and buffer impacts of global disruptions.”



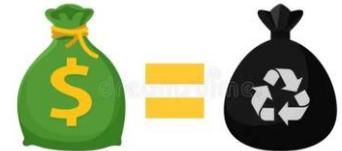
ISSUE: Global Phosphorus Shortage

- Singapore has no natural occurring Phosphorus reserves, and this non-renewable resource is projected to deplete in 50 -100 years
- Reliance on Phosphorus imports implies exposure to global volatility in supply and prices



Challenge Statement:

How might we recover “P” from PUB’s municipal WWTP Waste Streams for use in local hydroponics fertilizer solutions?





Estimated Availability of “P” in PUB waste streams

1

Dewatered Sludge (DWS)

250 - 1,000 MT / yr of P

Solid Content: 17% - 30%, 5 – 11 g of P / kg dry solids

2

Dewatering Centrate (DC)

700 – 1,050 MT/ yr of P

P Concentration: 200 – 300 mg / L

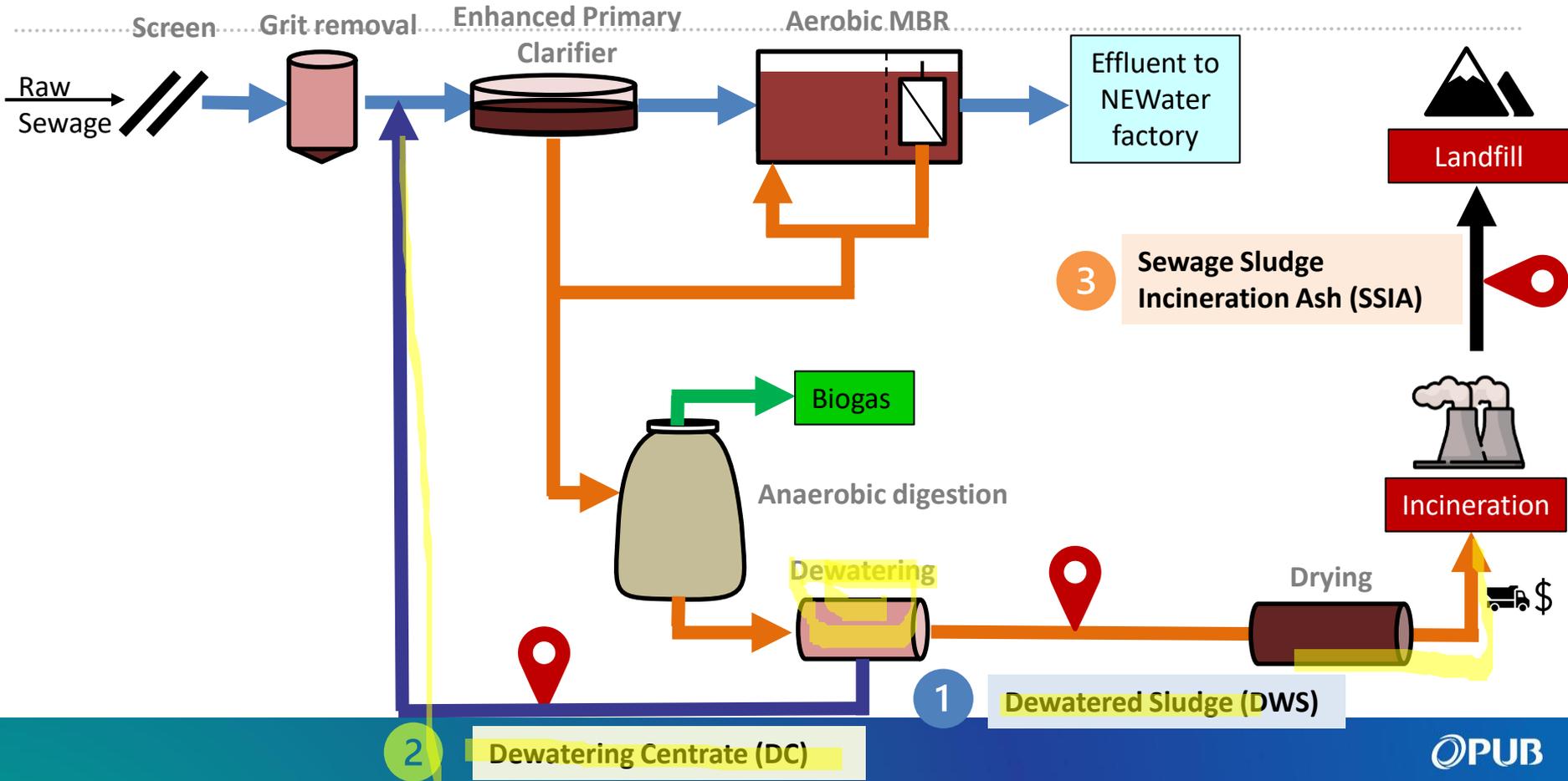
3

Sewage Sludge Incineration Ash (SSIA)

1,650 – 2,580 MT/ yr of P

Solid Content: 55 – 86 g of P / kg dry solids

“P Location in Used Water Treatment Process



PUB/SFA's experience with P recovery for Hydroponics Cultivation

Observations & Limitations

- 1) Struvite from Dewatering Centrate (DC)
 - Struvite is slow-releasing in nature and cannot be readily dissolved in nutrient solution
- 2) Dewatering Centrate (DC) + Commercial Nutrient Solution (CNS) at different mixing ratios
 - Bioaccumulation of contaminants observed in the harvested hydroponically grown vegetables
 - Impeded growth yield of crops



Key Considerations for Proposal Submission

Recover Phosphorus in readily soluble form

Free from contaminants (Heavy metals, Pharmaceuticals, etc)

Consistency of Crop test results with recovered P

Integration with existing WRP process

Techno-economic analysis

Expected Project Outcomes

PUB will be providing batches of selected waste product to the awarded applicant.

The awarded applicant shall further develop the following piloting scopes, once selected:

1. Characterisation of batch waste sample provided by PUB
2. Develop prototype for P recovery to recover P in readily soluble form
3. Develop hydroponics nutrient solution using the recovered P
4. Conduct actual hydroponic crop testing using the nutrient solution developed^
5. Assessment of hydroponic crop test results*
6. Techno-economic analysis for P recovery scheme, upon scale-up

^to include comparison with commercial nutrient solution

*include lab-tests to confirm the absence of bioaccumulation of trace contaminants harmful for human consumption)

If the pilot is successful, PUB/SFA may further scale up the solution with the solution provider(s).

Thank You



MAKE
EVERY
DROP
COUNT