

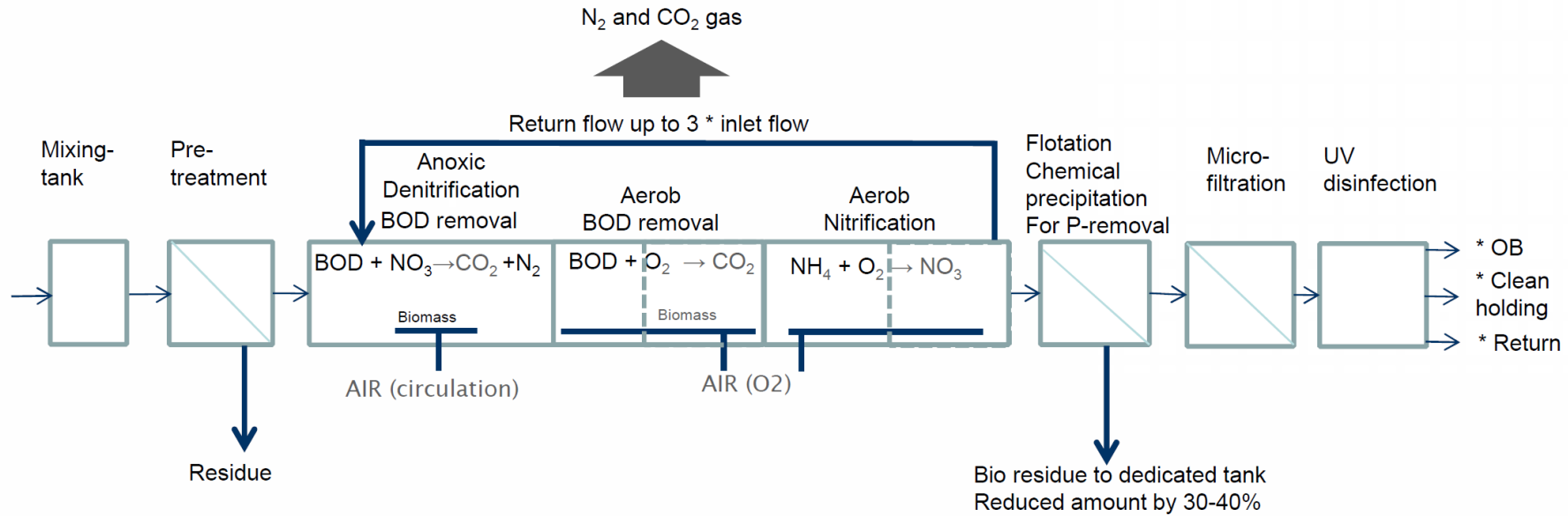
Framtidens slamhåndtering Fokus på miljø og klima

Pål Jahre Nilsen

VP Innovation

VOW

- How to treat nitrogen according to IMO MEPC 227(64)?



Typical removal rate

BOD	Nitrogen	Phosphorus	TSS
95%	85-90%	98%	99%

Forbehandling av slam til pyrolyse



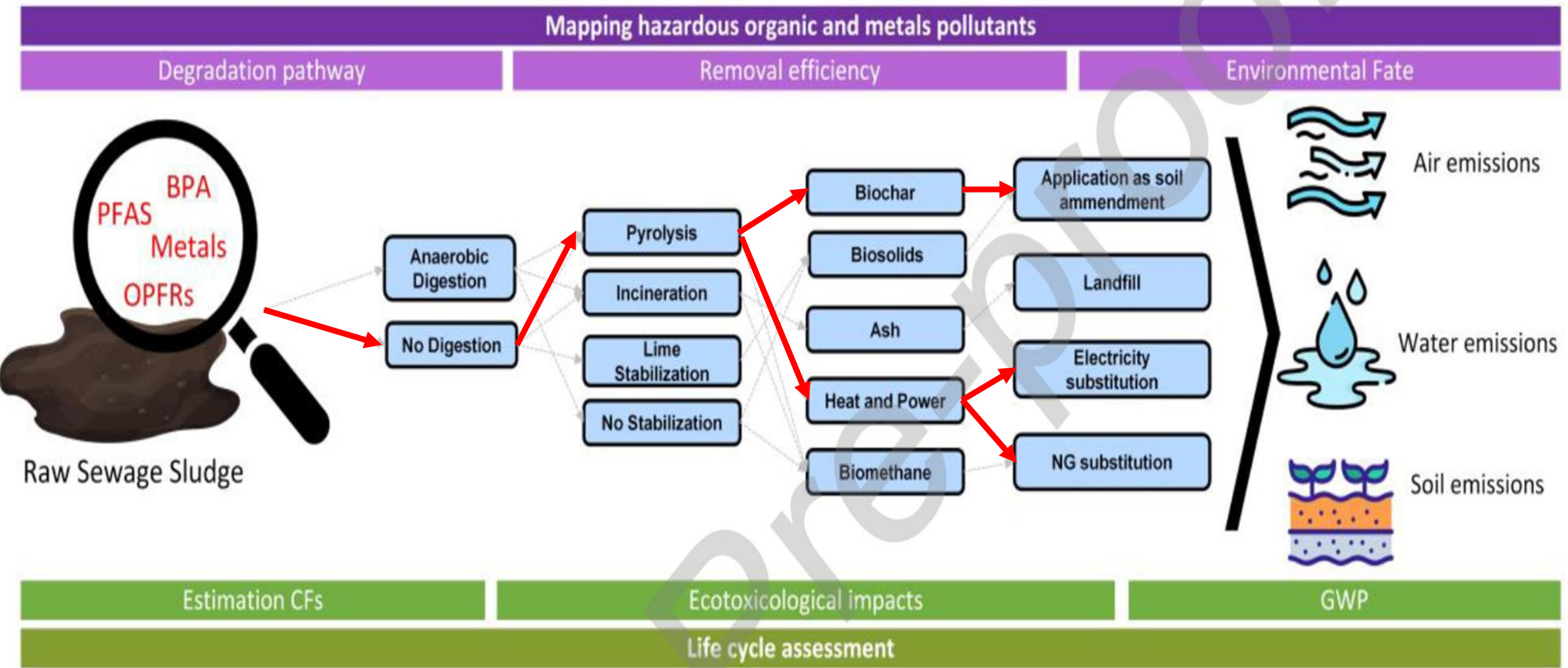
Termisk Hydrolyse av slam og matavfall i en kompakt og kontinuerlig prosess
Forbedrer mekanisk avvanning x2

160-180 °C, 30min, dampekspløsjon ->

50% DS ut av sentrifuge, granulært, tørker raskt, slipper limfase

>50% reduksjon i tørker

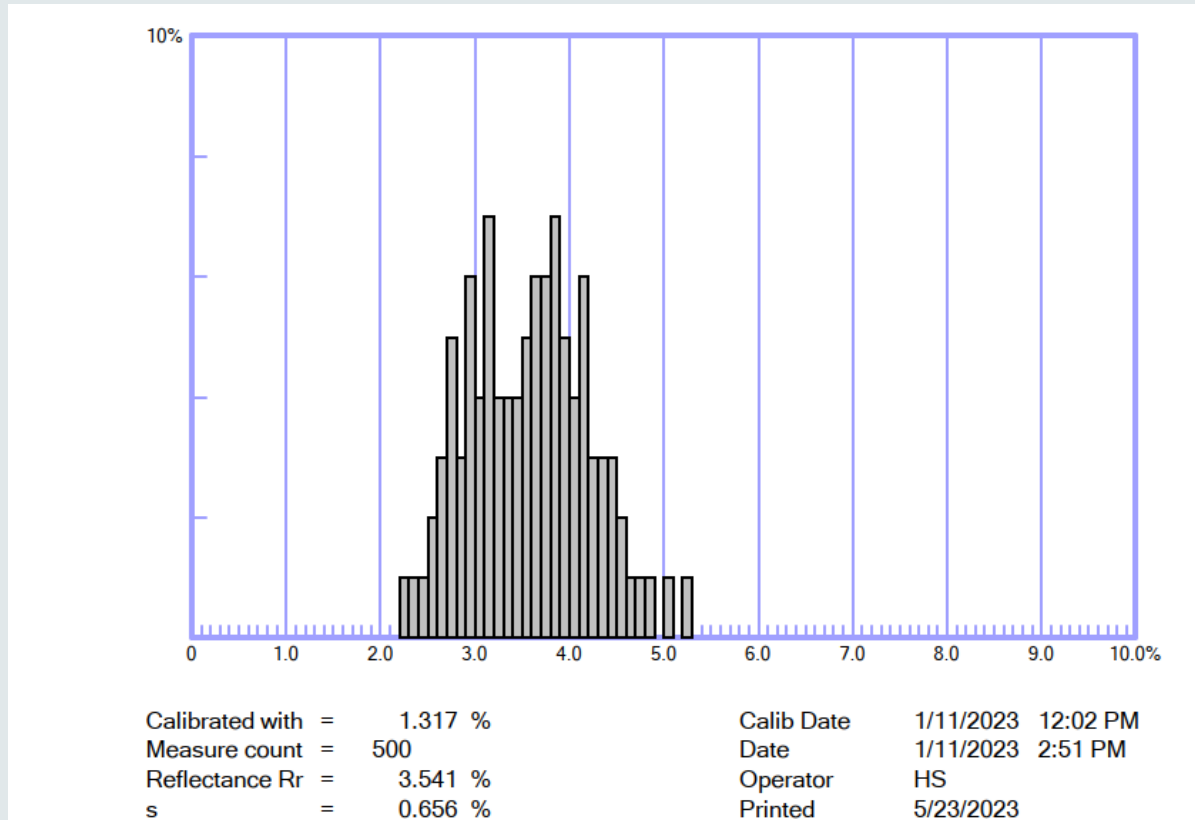
Best option for sustainability in a circular economy ?



From the SLUDGEFFECT project, Hans Peter Arp, NGI

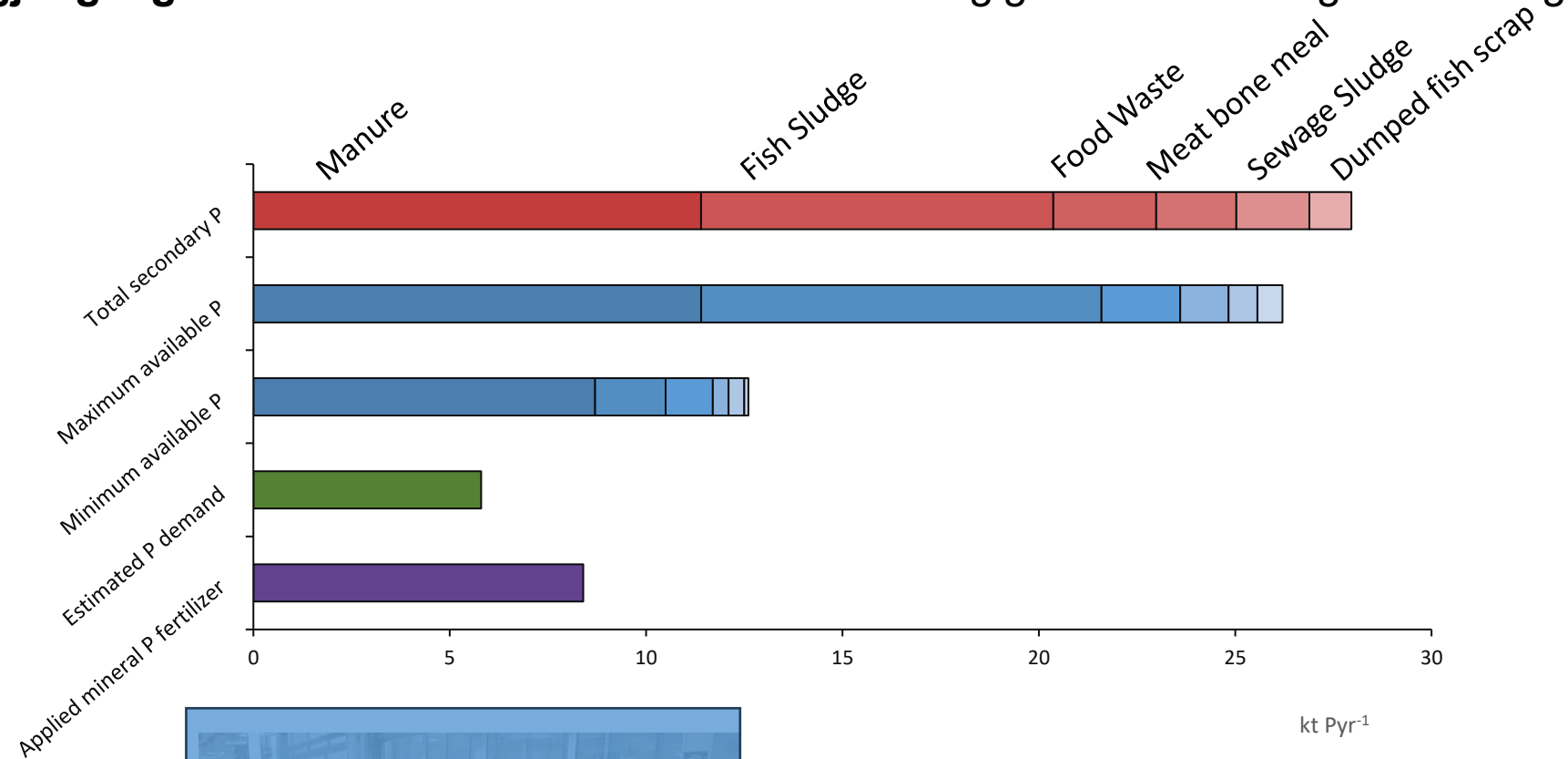
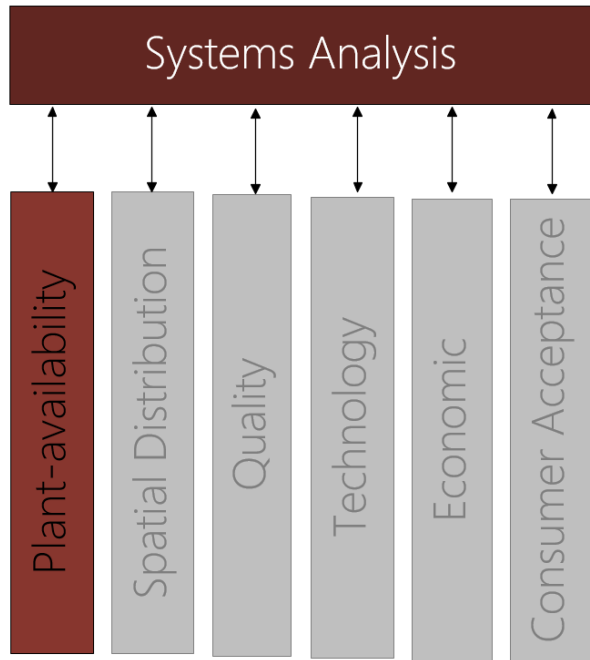
Lime stabilized digested sludge Biochar at 700degC

Carbon transformed to Inertinite = permanent storage in soil



Barrierer for effektivt P resirkulering

Plantetilgjengelighet av P i sekundære ressurser er avhengig av ressurser og behandling

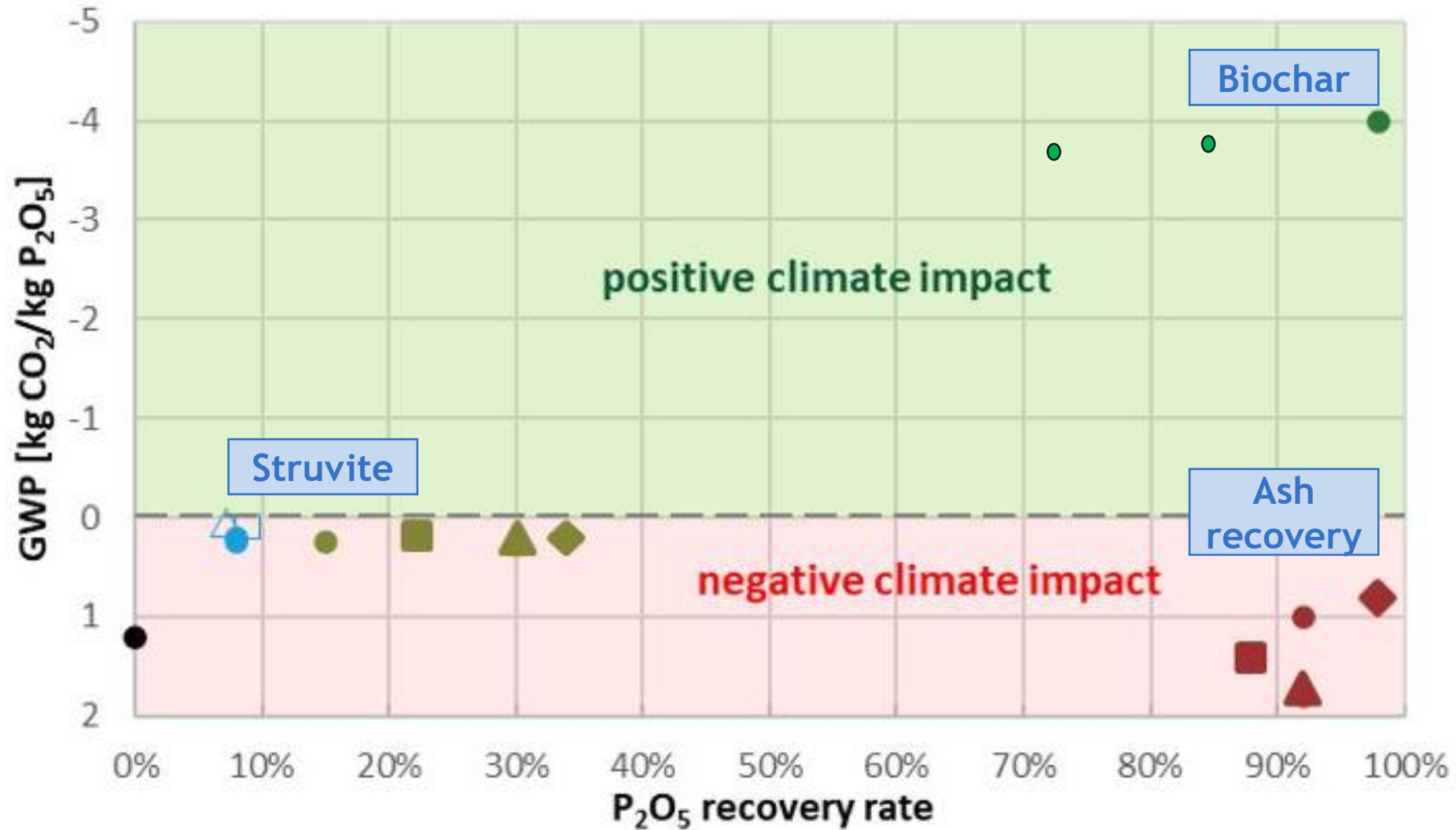


Kilde: Hamilton et al. 2017



Eva Brod (NIBIO) gjennomfører pottekserimenter for å analysere effekten av gjødsling med forskjellige sekundære ressurser

GWP of different P-recovery processes



We never thought it was SO bad with PFAS.....

- Subtle chronic effects (hormone disruption) - hard to quantify
- 2013: Tolerable daily intake 150 ng/kg body weight
- 2020: Tolerable daily intake 0.16 ng/kg body weight
- Soil quality guidelines;
 - 0.1 ng/g (based on toxicity)
 - 10 ng/g (based on practice)



Pyrolysis of biosolids enables circularity

Taking contaminants out of circulation

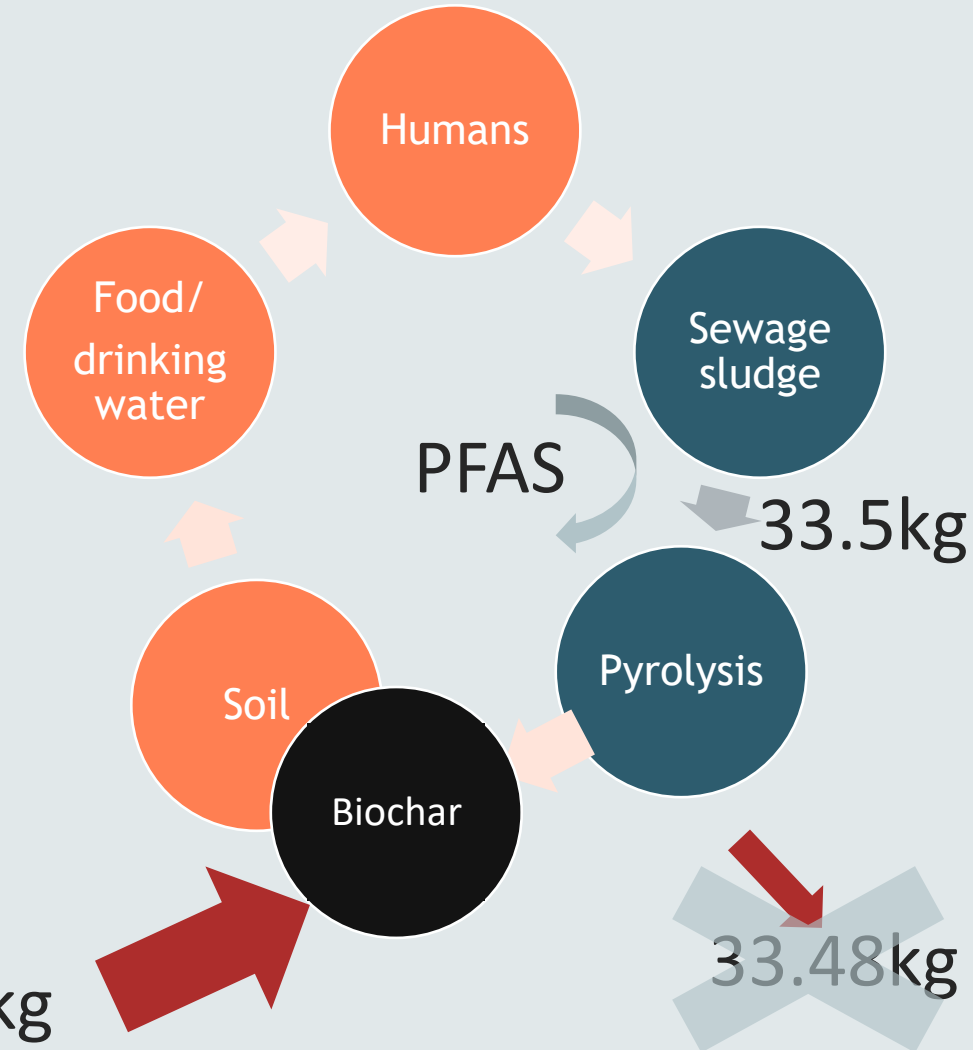
Demobilising PFAS in soils

➤ 135 000 tDS/yr sewage sludge in Norway

➤ Pyrolyze at $\geq 600\text{ }^{\circ}\text{C}$

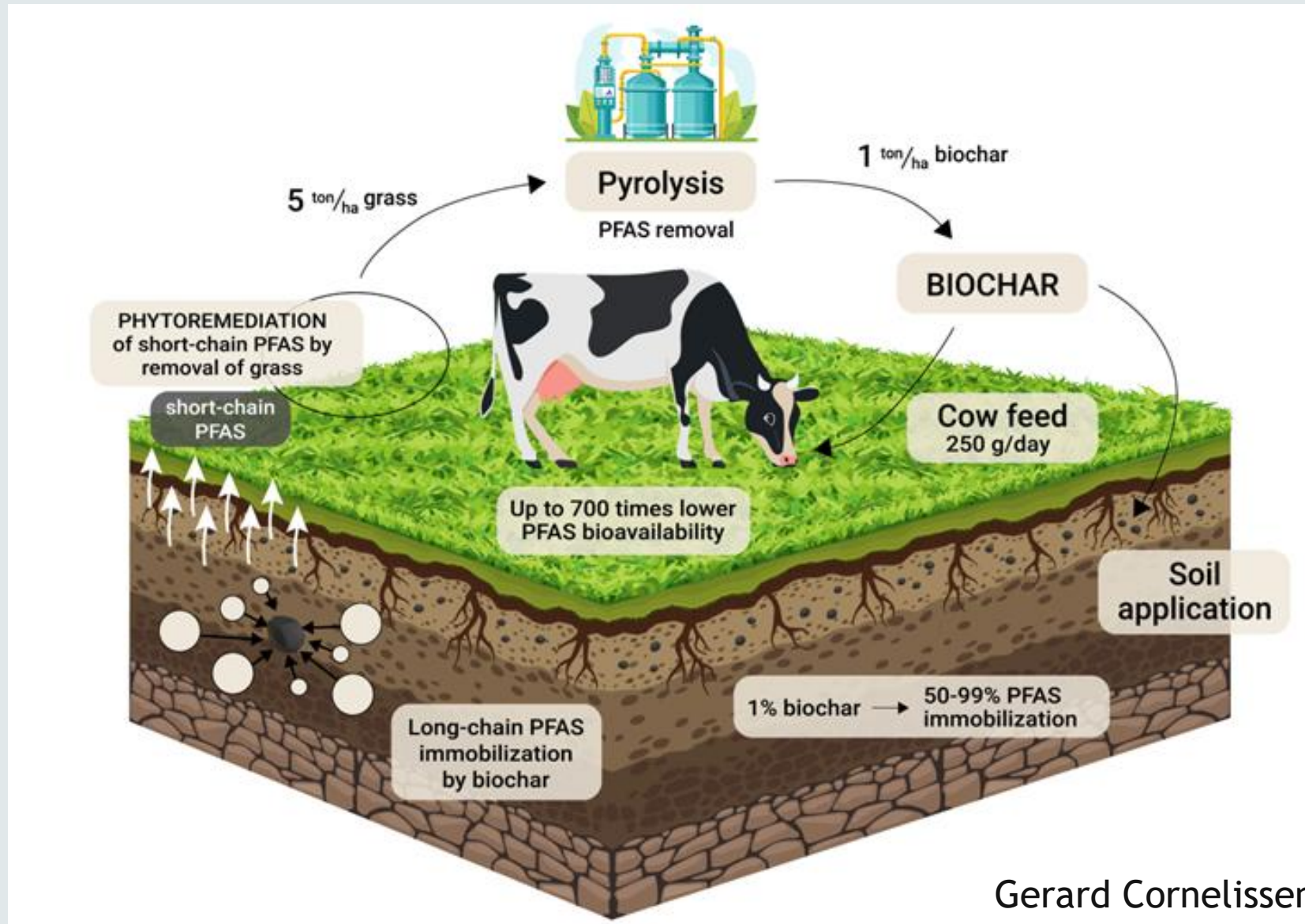
– 33.5 kg of PFAS (56 target PFAS) decomposed

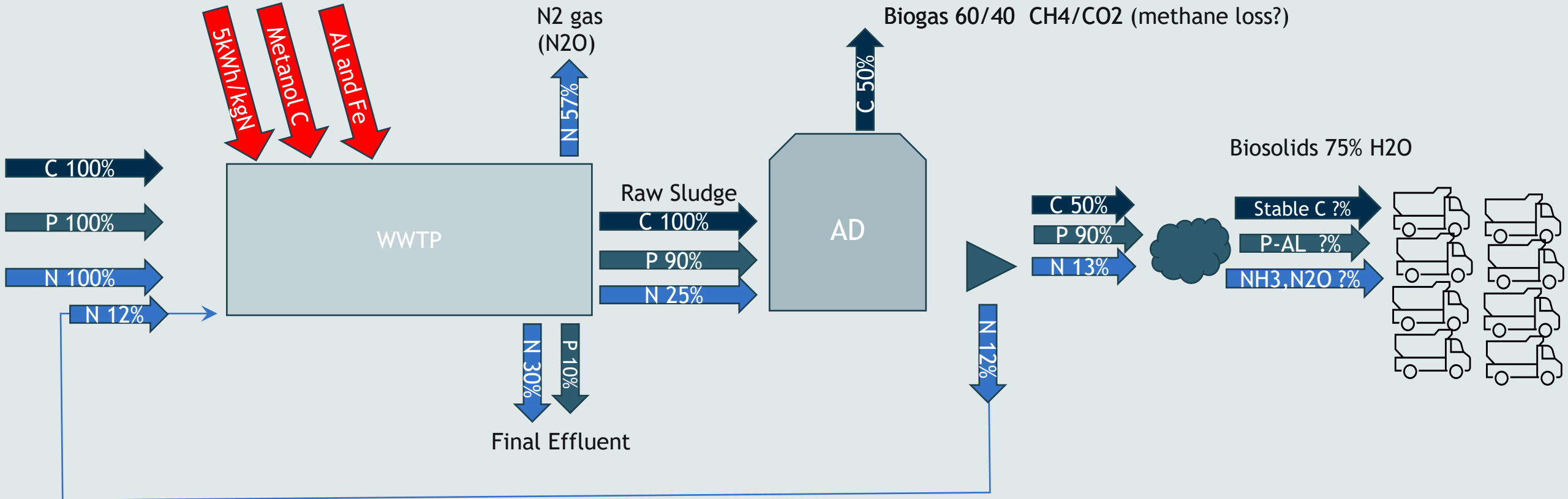
– Up to 700 kg of PFAS sorbed through remediation of 2 200 000 ton soil (3% BC; 50% yield)

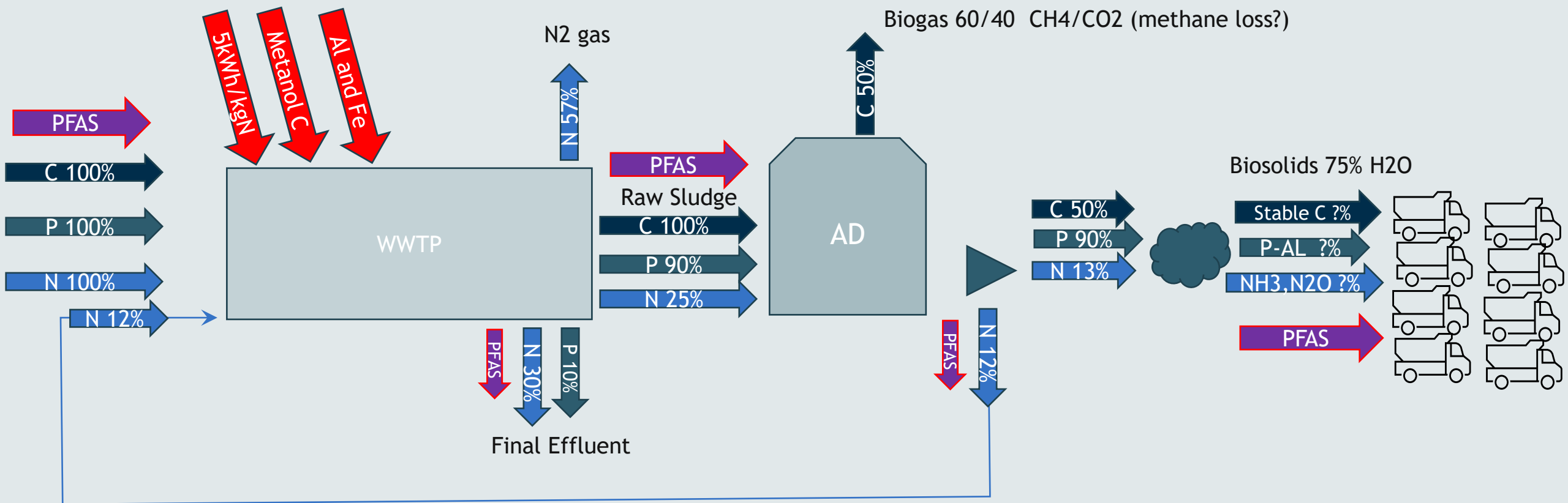


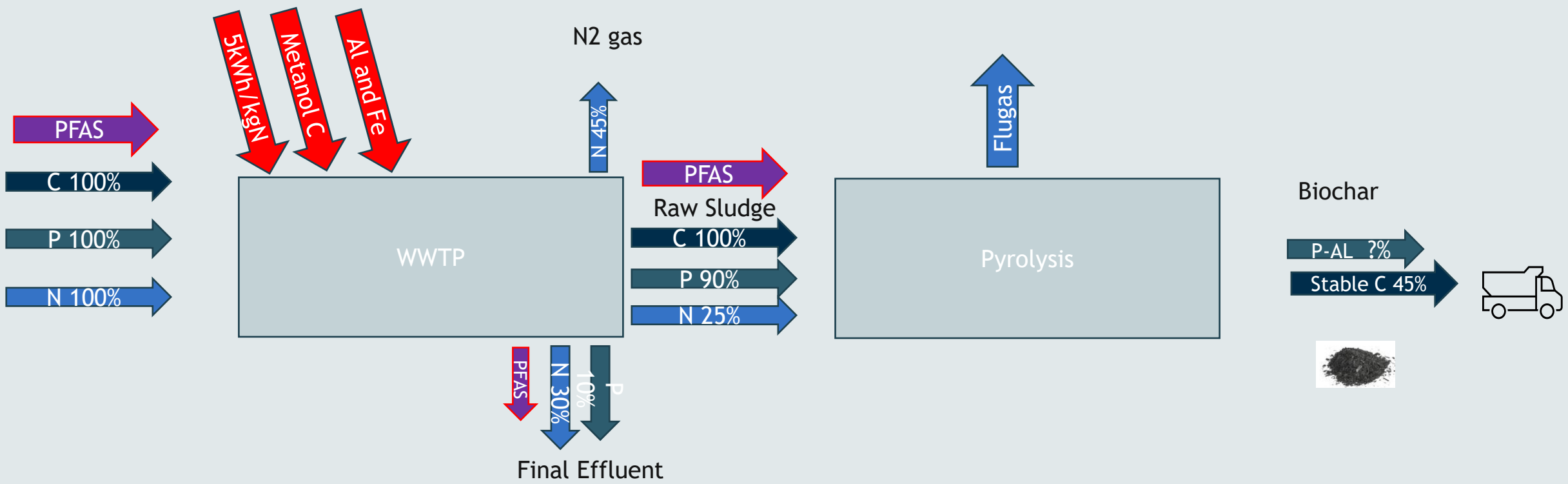
Based on R&D project with Cornelissen and Sørmo in NGI 700kg

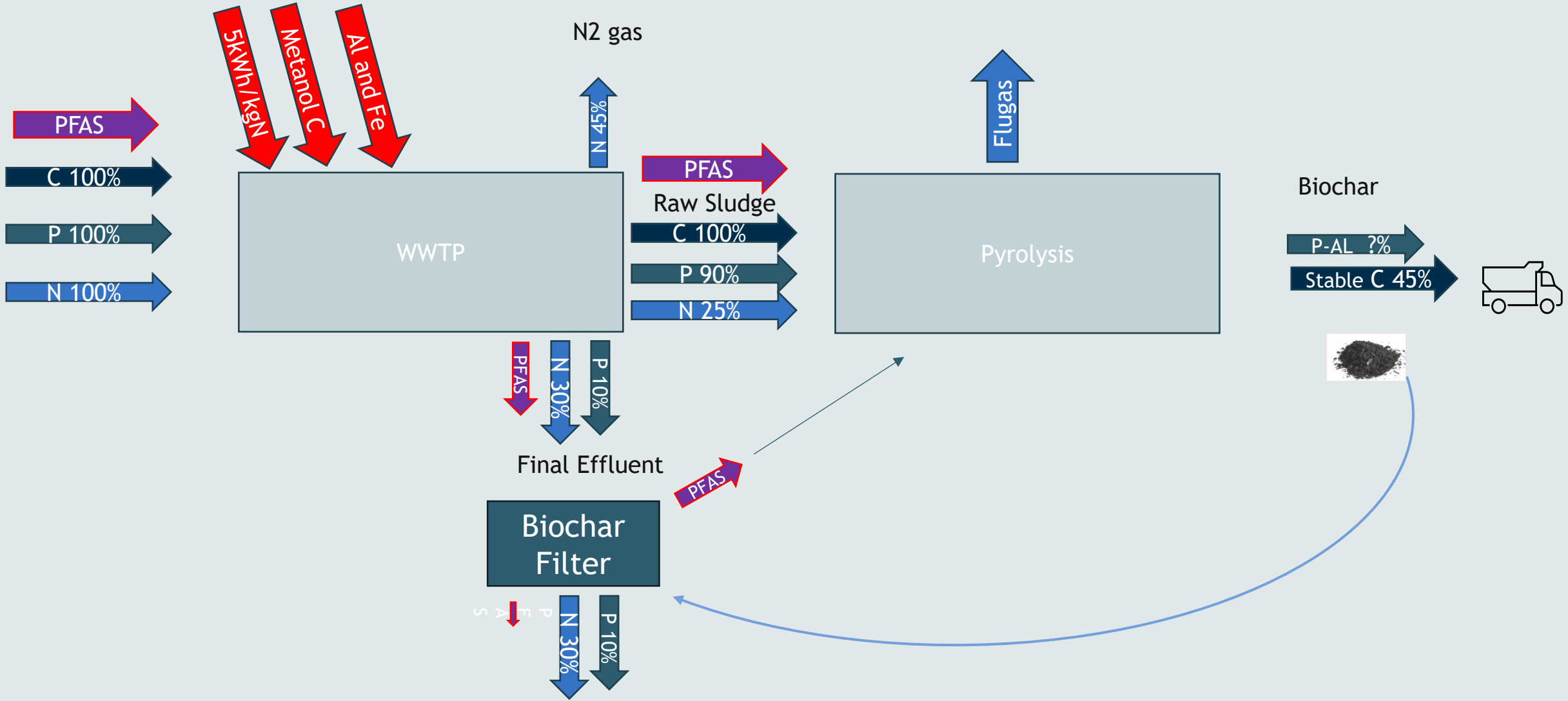
VIRTUE: A Virtuous Cycle of Phytoremediation, Pyrolysis and Biochar Applications towards Safe PFAS Levels in Soil, Feed and Food











Benefits of Raw Sludge Pyrolysis

Environmental Fate

Air emissions

High temp combustion of pyrolysis gas with flue gas cleaning
Simpler, cheaper and more efficient than solid waste incineration
Unlock economy of scale, offset large central plants
Minimum AD – no digestate, Offset methane emissions
85% reduction in transport out of gate

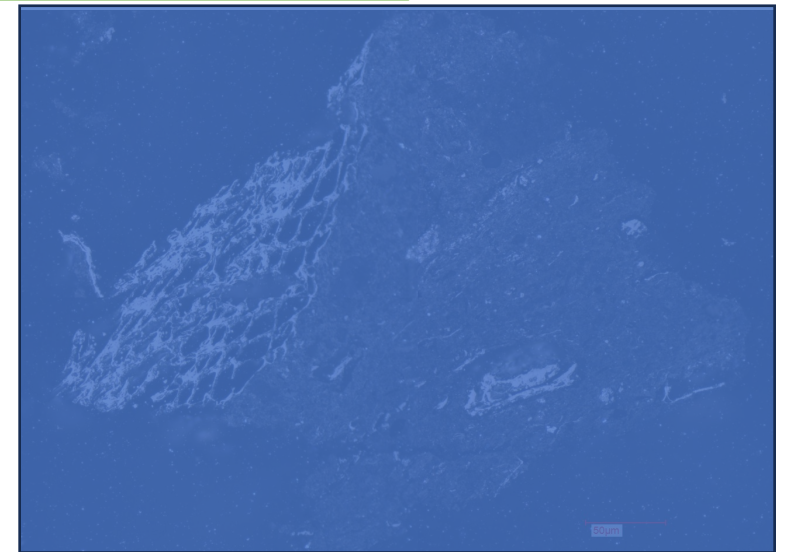
Water emissions

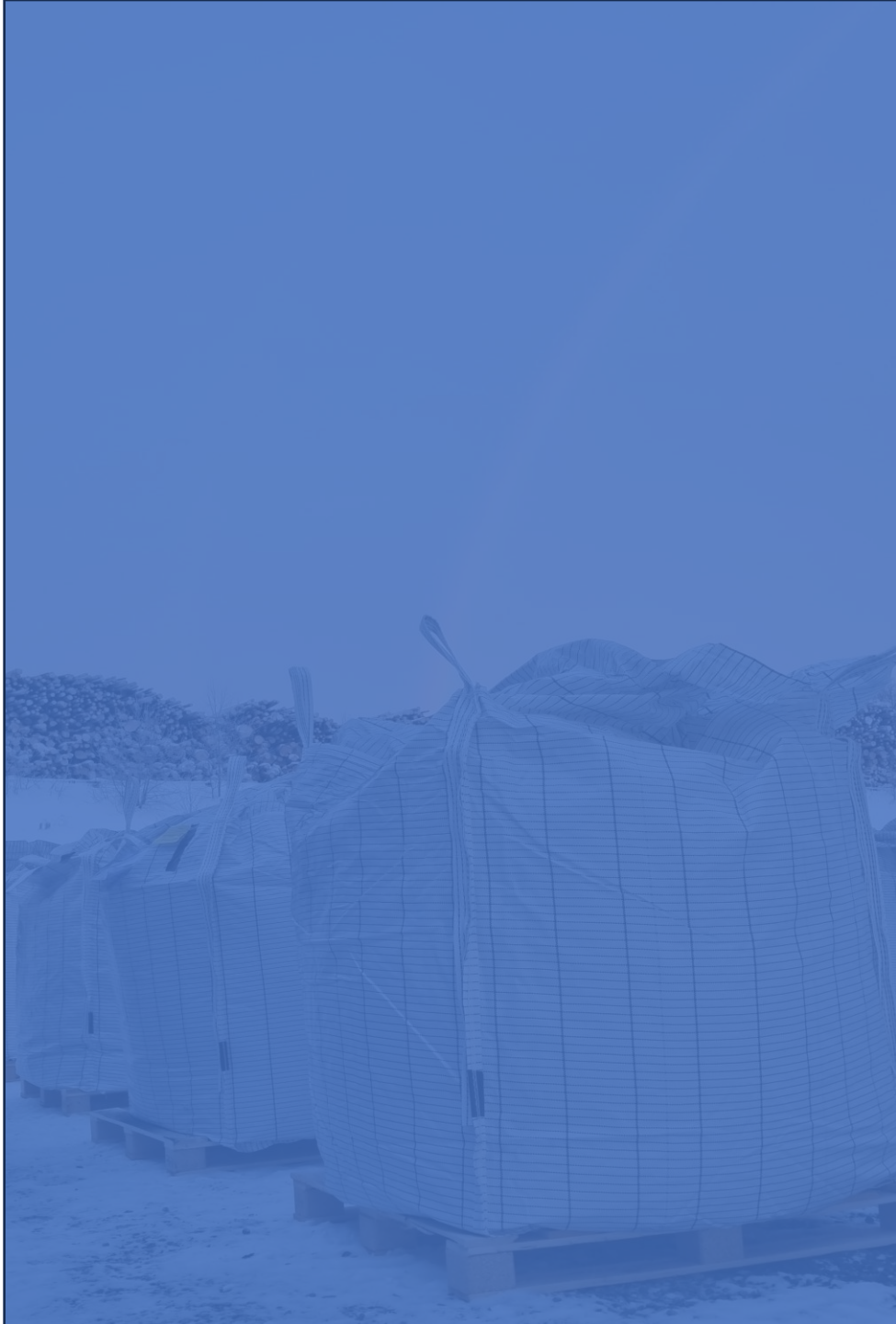
Minimum AD – high DS, low water, no digestate, reduced Final Effluent
Concentrated flows for nutrient recovery NH₄
Biochar as filter media for final polishing in quaternary treatment

Soil emissions

Eliminate pollutants in biochar
Can be a good sorbent for soil remediation
Can reduce N₂O
Sequester carbon
Lock in heavy metals, reduced leaching
Improve water stress resilience

GWP





«Somewhere under the rainbow»

Takk for oppmerksomheten

paal@vowasa.com

VOW