Wastewater Treatment & Re-use

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Content

- Introduction
- Source & Treatment: characterisation of waste flows – search for valuables
- Products : Biogas, Energy, Phosphorus, Nitrate
- Case examples

Brief About Witteveen+Bos

Witteveen + Bos

Witteveen + Bos GROUP

- independent engineering consultants
- found by Mr Bos (37) and Mr Witteveen (54) in 1946
- 4 Business Lines
  - Deltas, Coasts and Rivers
  - Infrastructure and Mobility
  - Built Environment and Urban Development
  - **Energy, Water and Environment**

- milestones 2016:
  - 1,100 employees Worldwide
  - turnover EUR 140 million (2016)

70 YEARS OF EXCELLENCE 1946 - 2016

Global Presence

- Netherlands (Amsterdam, Rotterdam, The Hague, Breda, Heerenveen, Deventer)
- Belgium (Antwerp, Brussels)
- United Kingdom (London)
- Indonesia (Jakarta)
- Kazakhstan (Almaty, Atryrau, Aktau)
- Latvia (Riga)
- Russian Federation (St Petersburg)
- Vietnam (Ho Chi Min)
- Singapore
- UAE (Dubai)
- Ghana (Accra)

6 Witteveen+Bos Sustainable Project Principals based on the 17 UN SDG's

- ✓Nature-inclusive and climate-proof design
- ✓Integration: applying the chain approach
- ✓Optimisation of functions
- ✓Social design, based on social sustainability
- ✓Participation by stakeholders and users
- ✓Trias principle for sustainable solutions.

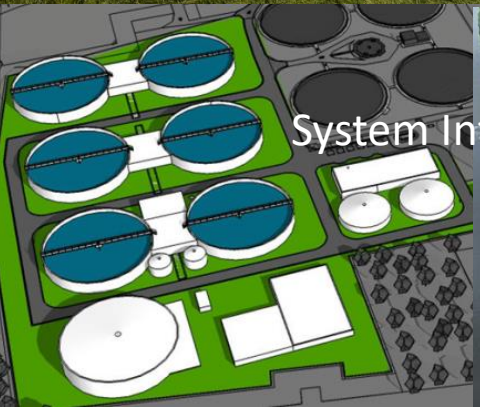

Municipal and industrial application
Food, beverage, Steel&Metals, Oil&Gas


Conventional activated sludge BNR


Conventional and advanced
sludge treatment


digestion and

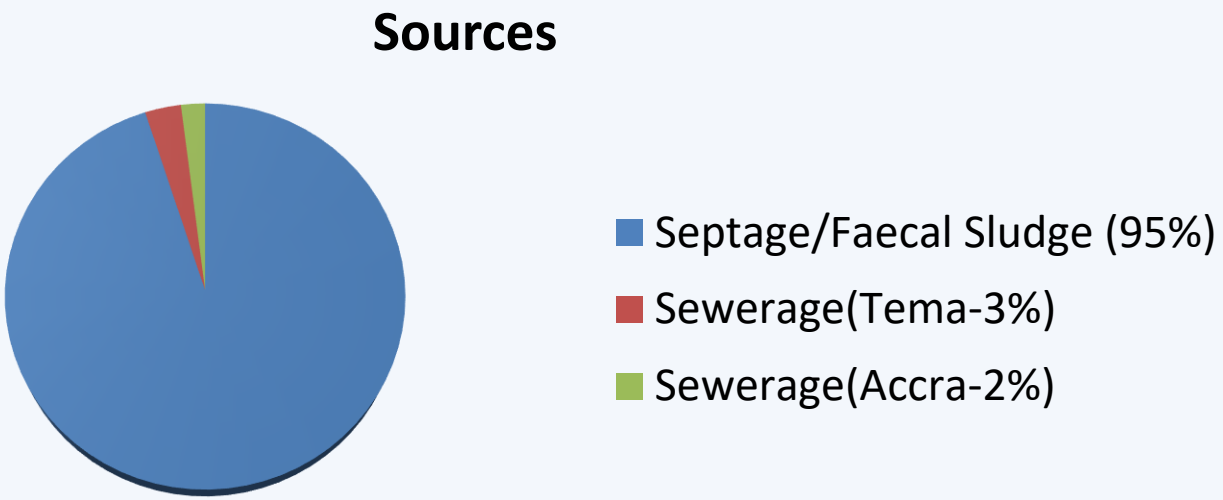

MBR, RO, Oxidation, GAC
Ultra Pure Water
Micro Pollutant Removal


System Integrator of Nereda™-Technology


Energy & Resource Factories
Waste2Value

Source & Treatment: characterisation of waste flows – search for valuables

Wastewater Resource in the Accra Region



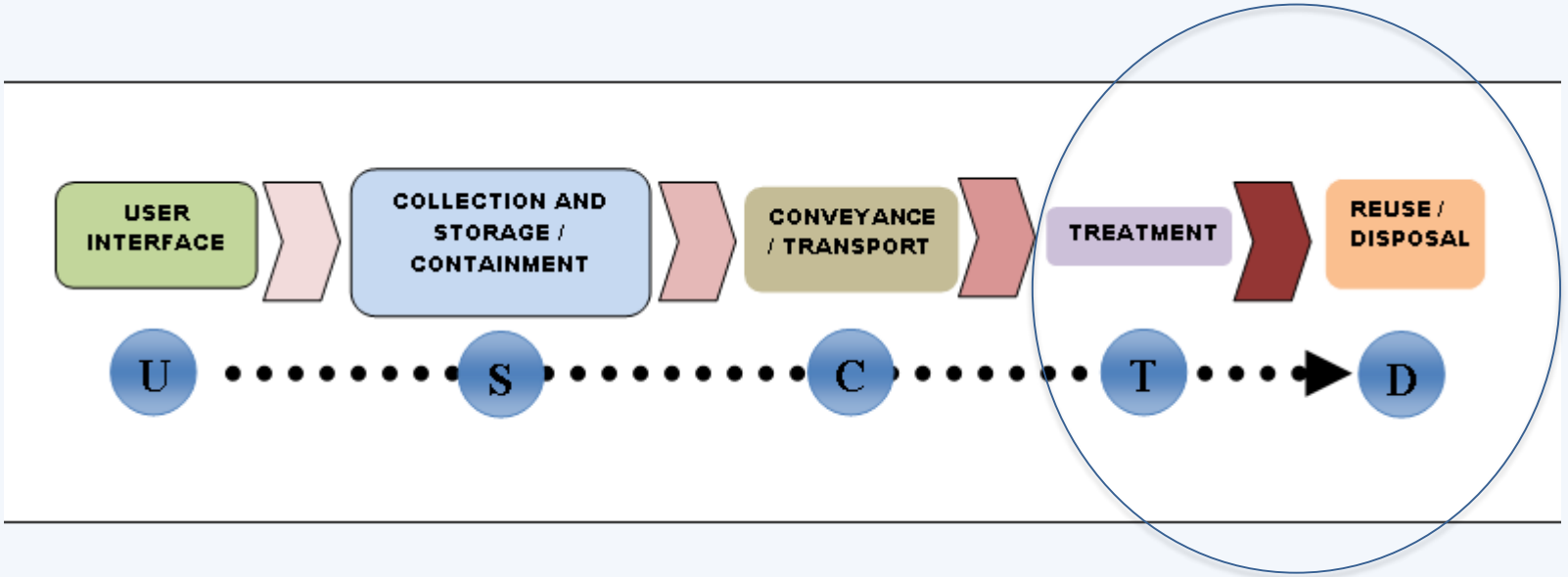
Characteristics of Faecal Sludge/Septage in Accra

- BOD & COD is higher than would be expected

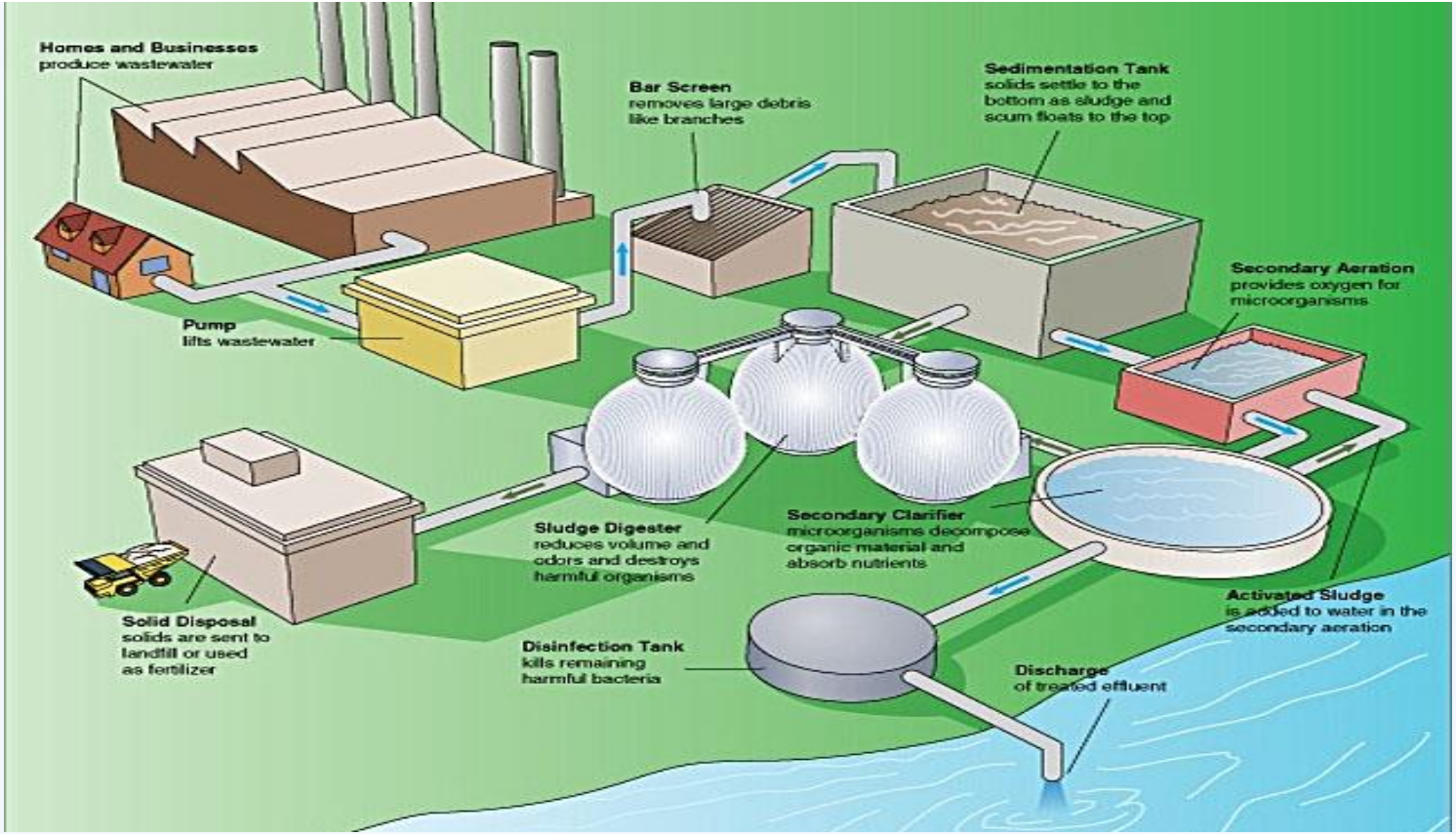
- Industrial waste water mixed with domestic

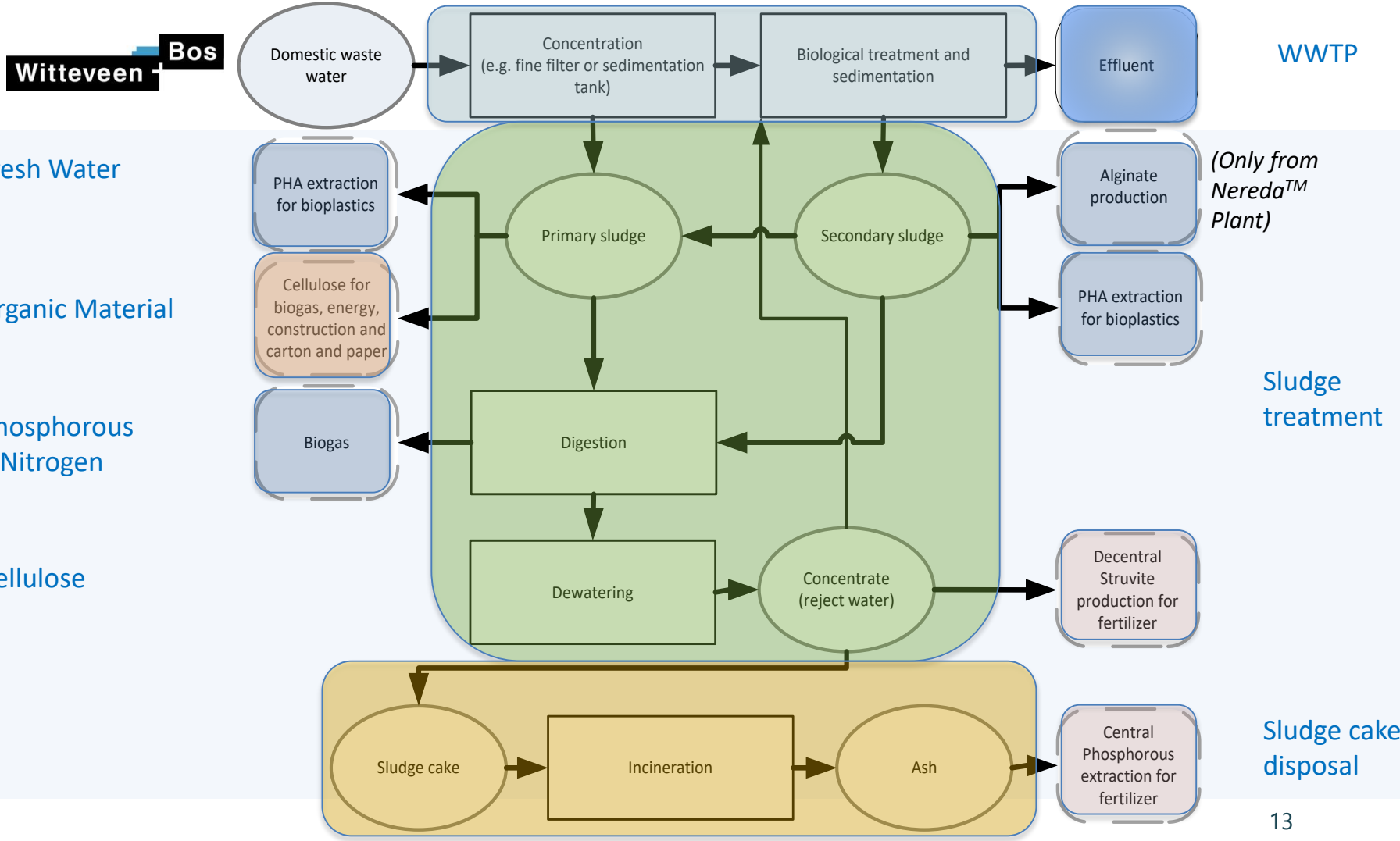
Parameter	Unit	Literature value IWA	Literature value IWA	Nuguaa Farms (analysis results)	Lavender Hill (analysis results)	Lavender Hill (analysis results)	Design value
		Public toilet	Septage (septic tank)	Public Latrine	Public Latrine	Public Septic	Public faecal sludge
				(3)	(4)	(5)	Average (3), (4), (5)
COD	mg/L	20,000-50,000	1,200-10,000	58,570	46,106	9146	37,941
BOD	mg/L	7,600	840-2,600	18,521	16,800	4560	13,294
COD/BOD	-	5 to 1	5 to 1	3,2	2,7	2,0	2.6
TSS	%	3.5 %	3.0 %	1.8 %	1.7 %	1.4 %	1.6 %
TDS	mg/L						
NH4-N / NH3-N	mg/L	2,000-5,000	1,000	534	535	140	403
NO3-N	mg/L		0.2-2.1	14.8	10.8	10.5	12
PO4-P	mg/L						
total P	mg/L	450	150	21.60	29.10	18.10	22.9

Waste and Waste Water value chain



General treatment overview




Witteveen + Bos
Domestic waste water
Concentration (e.g. fine filter or sedimentation tank)
Biological treatment and sedimentation
Effluent
WWTP
Fresh Water
Organic Material
Phosphorous + Nitrogen
Cellulose
PHA extraction for bioplastics
Cellulose for biogas, energy, construction and carton and paper
Biogas
Primary sludge
Secondary sludge
Digestion
Dewatering
Concentrate (reject water)
Alginate production
PHA extraction for bioplastics
(Only from Nereda™ Plant)
Decentral Struvite production for fertilizer
Sludge treatment
Sludge cake
Incineration
Ash
Central Phosphorous extraction for fertilizer
Sludge cake disposal

Digestion of organic waste and sludge

Waste minimisation and max bio-energy production:

- Decrease of final waste production due to organic waste conversion;
- Decrease water content for further handling;
- Sludge stabilisation to prevent uncontrolled decomposing;
- Odour and pathogen reduction for a more hygienic product;
- Generation of power (and heat).

Cost reductions:

- Mostly reduced by decreasing volume of sludge;
- Reduced amount and volume lowers transportation costs;
- Disposal options reduced by controls on land filling and agricultural use.

Several choices of optimizing digestion process

- Affects waste reduction methane generation phase of digestion;
- **Mesophilic digestion**: 30 – 40 °C, retention time of 15 – 25 days. Stable, traditional (inefficient) technology;
- **Thermophilic digestion**: 45 – 55 °C, retention time of 10 – 15 days. Requires more control but greater biogas yield;
- Advanced Digestion: **Thermal Pressure Hydrolysis**: Pre-treat sludge at 160°C and high pressure (6-7 bar), up to 40% more biogas, Class A Biosolid production.

Products : Biogas, Energy, Phosphorus, Nitrate

Why Resource Recovery from Waste and Waste Water

Main Drivers: Cost Savings + Sustainability

- ✓ Reducing further (central) treatment (costs)
- ✓ Saving energy (costs)
- ✓ Decrease of final waste residues (costs)
- ✓ Resource recovery (added values and benefit, sustainable)
- ✓ Reduction of green house gas emissions (sustainable)

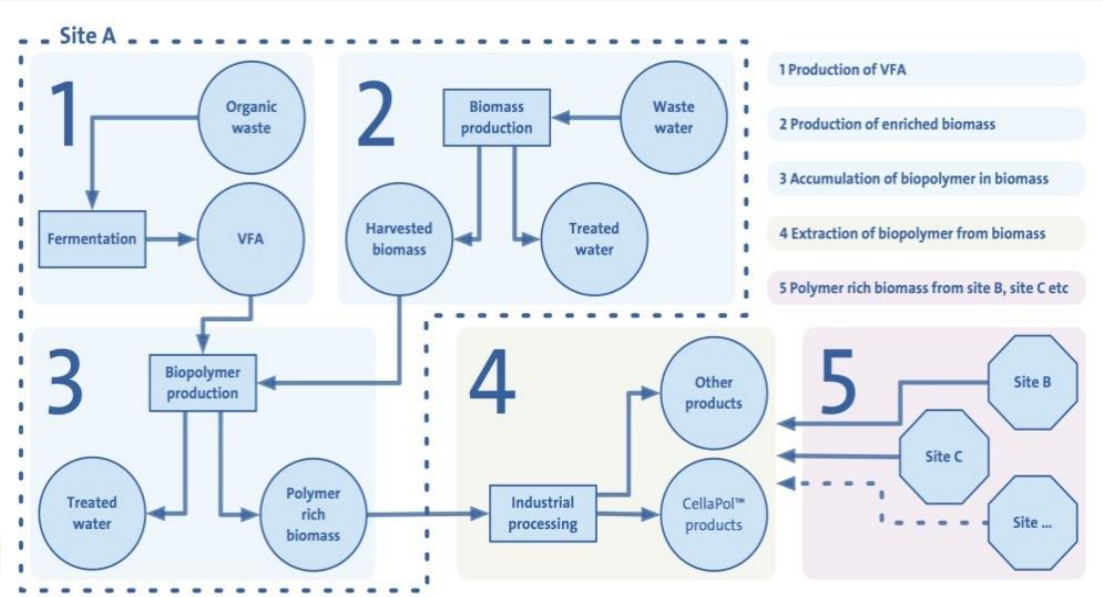
Resource Pinching: Identify your own resource values

- **Organic Material** (carbon):
  - Convert into:
    - Renewable (bio) gas for electricity production (via digestion, enhanced digestion)
    - Bio materials, like bio plastics (PHA/PHB), alginate (Granular Sludge), fatty acids
- **Nutrients** (P, N):
  - Convert into:
    - Bio Fertilizer (struvite)
    - Phosphoric acid
    - Ammonia sulphate, Ammonia Nitrate, Protein production (nitrogen conversion)

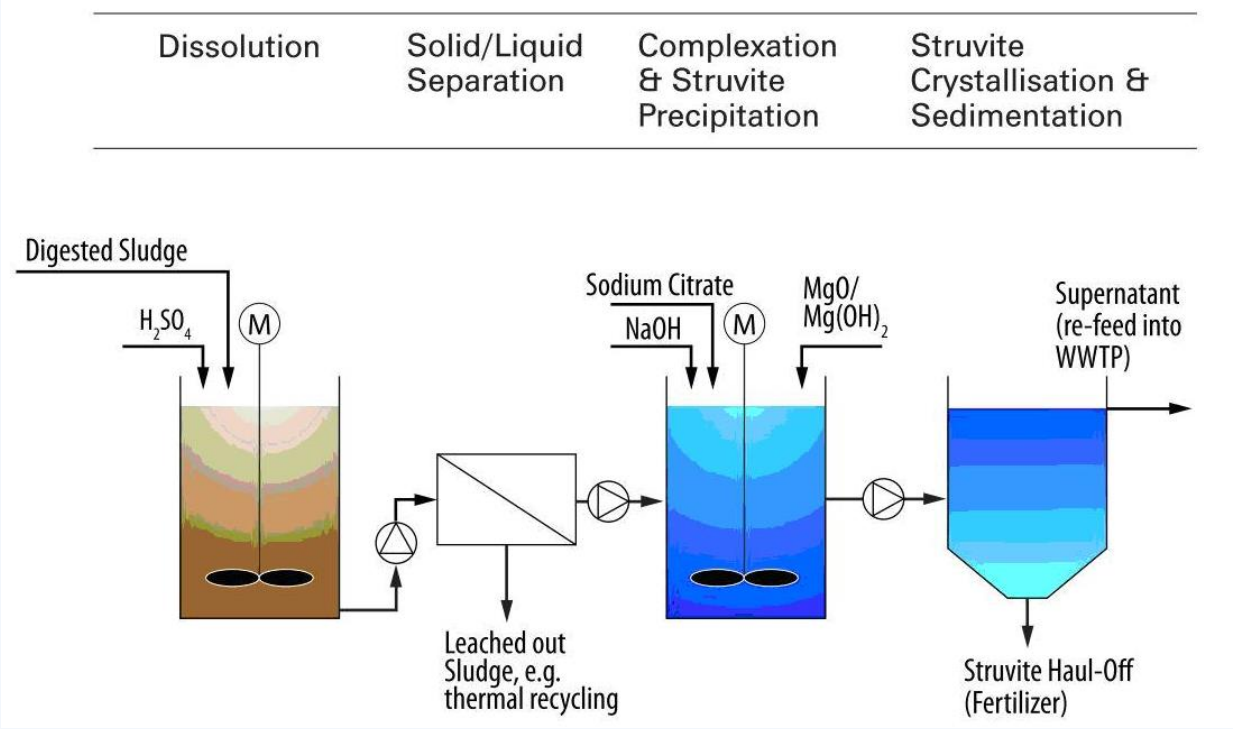
Further up-valuation of organic material: bio-plastic production

PHA from waste

- PolyHydroxyAlkanoaat
- Biological degradable polyester
- Process under development
- High value product

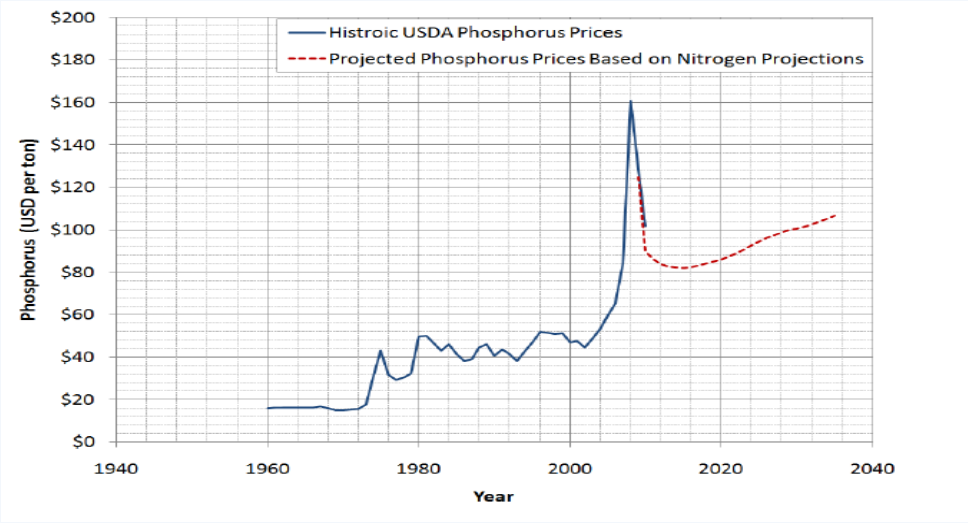


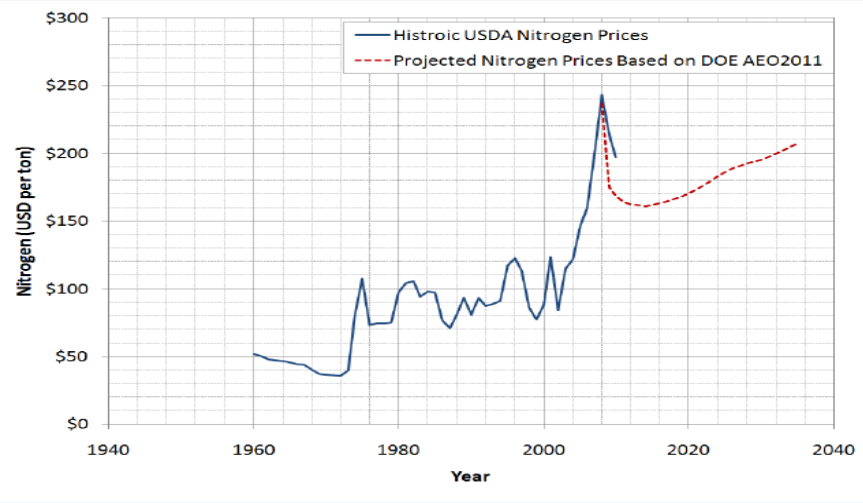
Struvite processes



Struvite installations

Market price developments (Phosphorous)

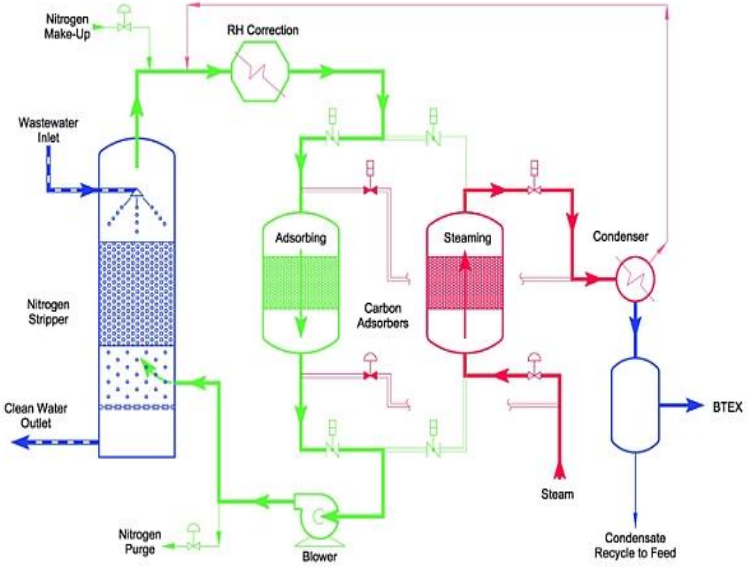




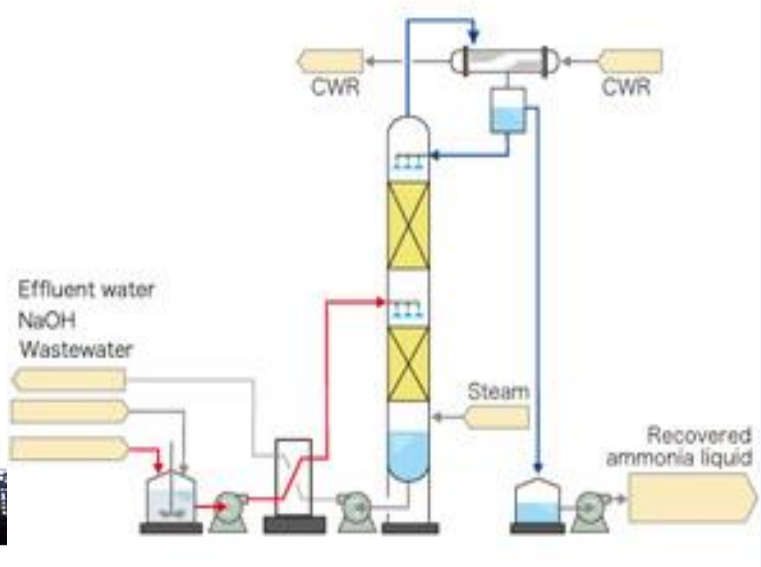
Nitrogen recovery routes

Mainly Ammonia stripping (from NH_4 enriched water from off gas flows)

- Ammonia sulphate $(NH_4)_2SO_4$ products
- Ammonia Nitrate NH_4NO_3 products



Ammonia Separation and Recovery Process

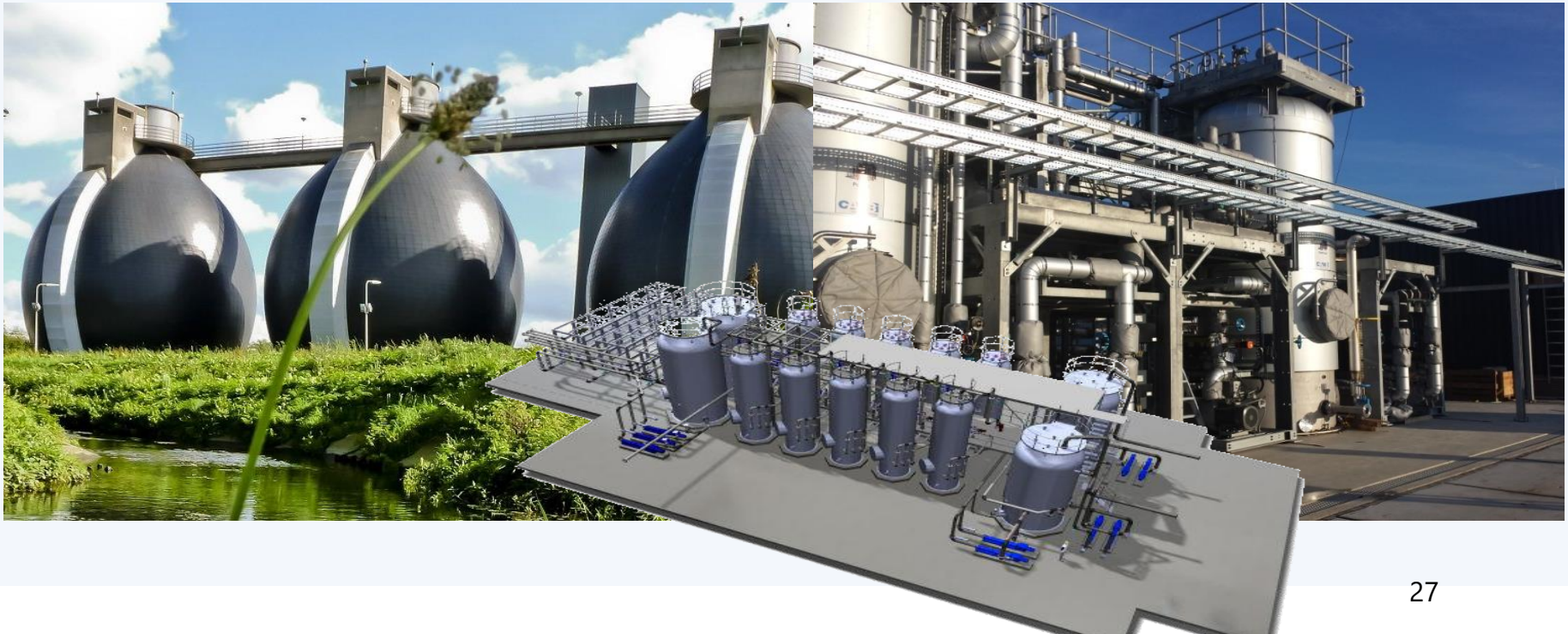


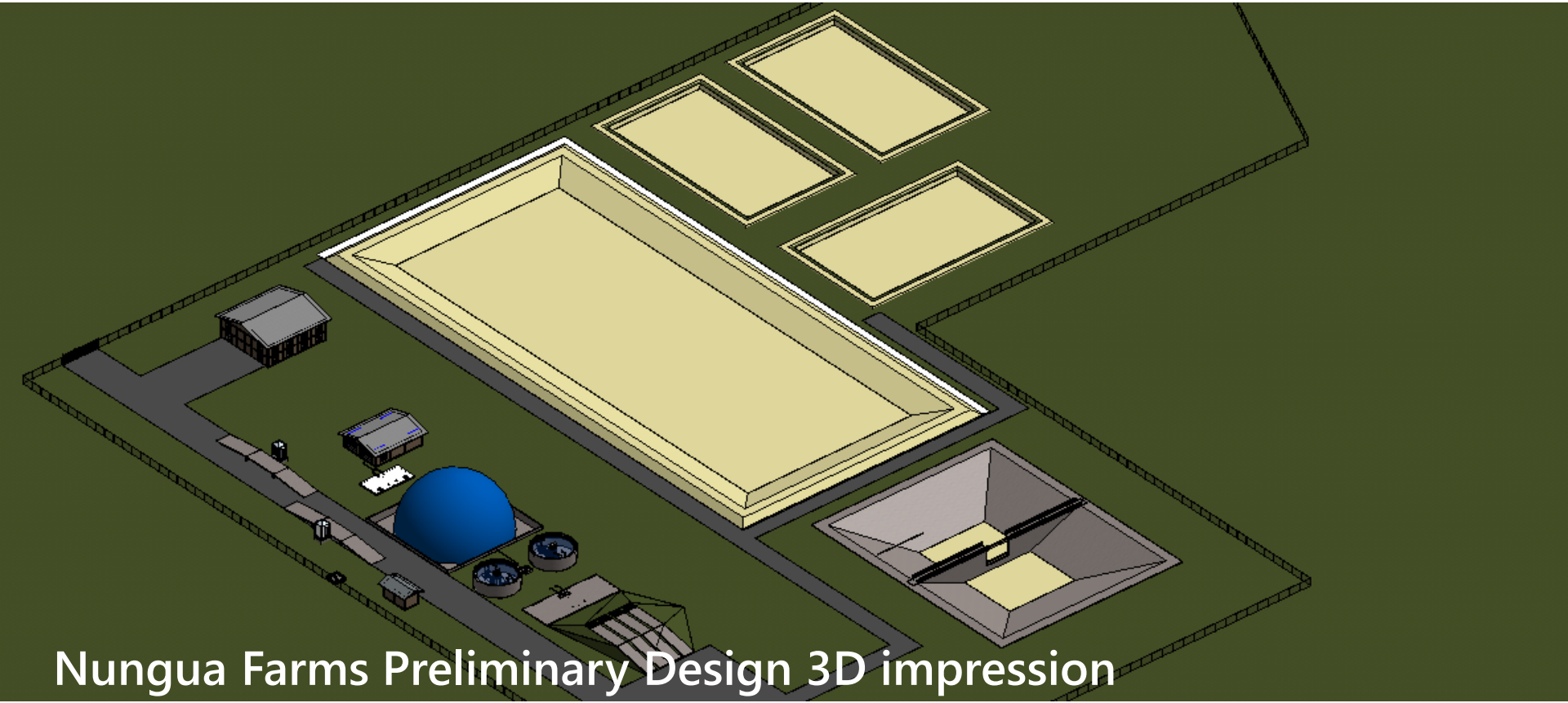
Selected reference Waste2Value projects of W+B

Energy and Resource Factory Apeldoorn: TPH TurboTec + Thermophilic digestion + P+N struvite from digestate + centrate

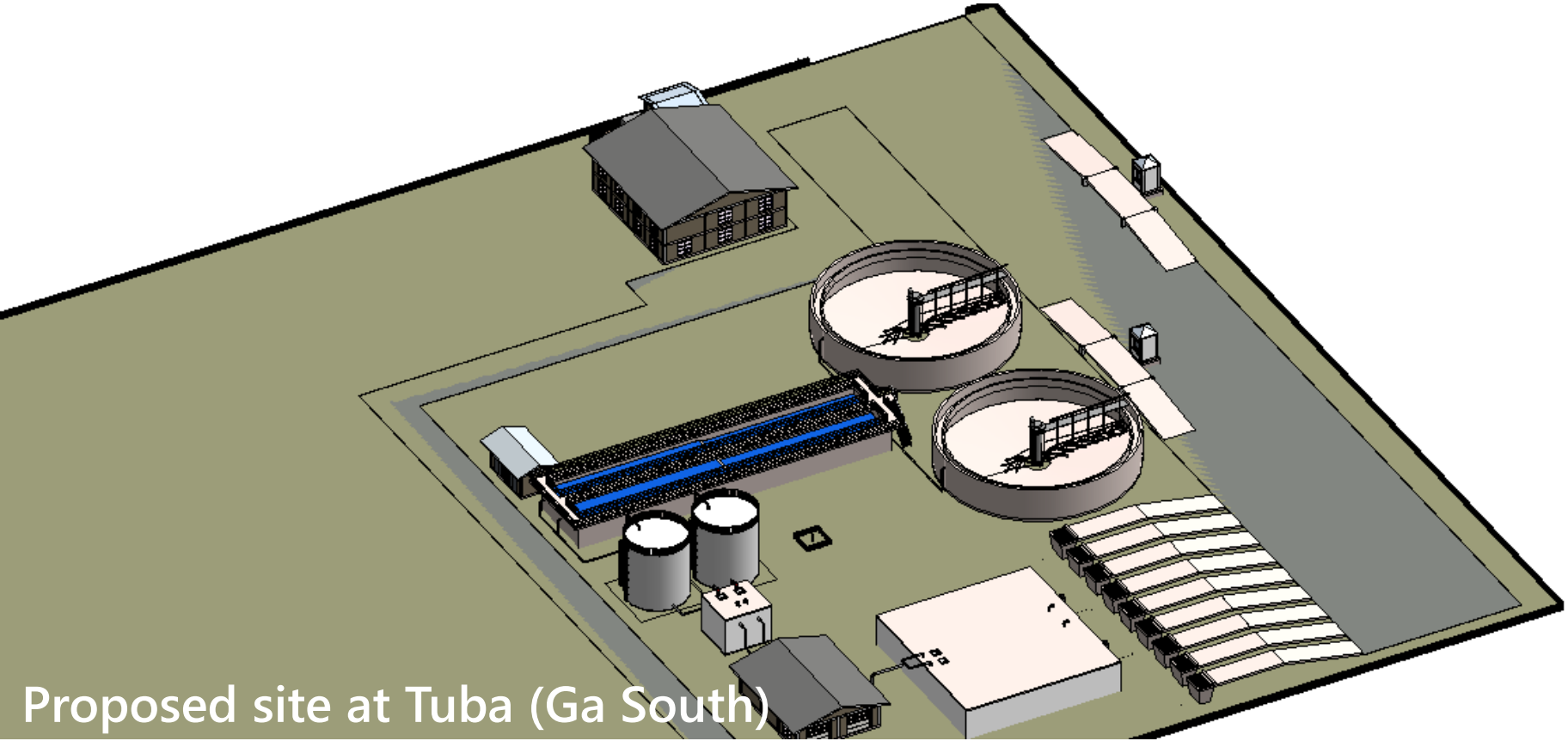
Energy+Resource Factory Apeldoorn: Energy, P and N

Energy Factory Hengelo: P+N struvite from centrate





Nungua Farms Preliminary Design 3D impression



Proposed site at Tuba (Ga South)

Thank you

www.witteveenbos.com