The Evaluation Of Technologies For Small, New Design Wastewater Treatment Systems

About me …

- Greg McNamara
- School of Mechanical and Manufacturing
- Dublin City University
- Final six months of PhD

  "Economic and Environmental assessment of wastewater treatment – A Lifecycle Approach"

Background

- Research is funded by the Irish EPA as part of Horizon 20 /20 commitments
- Irish Water (IW) form a large part of the research steering committee
- Research is broken down into two strands:
  - Part a) LCA of wastewater treatment systems (WWTS) in Ireland
  - Part b) LCC of small WWTS in Ireland (500 - 2,000 PE)

Background

- > 87% of WWTS in Ireland are below 2,000 PE
- Many plants are old, overloaded and in need of significant capital investment
- There can be a culture of "regional tranching" of WWTS in Ireland

Main objective

- Enlighten toolkit users about the trade-offs between:
  - operation and capital expenditure, and
  - the economic and environmental costs

Specific objectives

- Carry out life cycle costing for a selection of systems
- Develop a decision support toolkit

Scope

- Toolkit should be able to be operated by both technical and non-technical users
- Toolkit should allow for variations in
  - Scale (500 – 2,000 PE)
  - Loading
  - Discharge limits
  - Temperature
  - Topography

Methodology

- Literature review
- Identification of feasible systems
- Data compilation
- Systems modelling
- Testing
- Validation

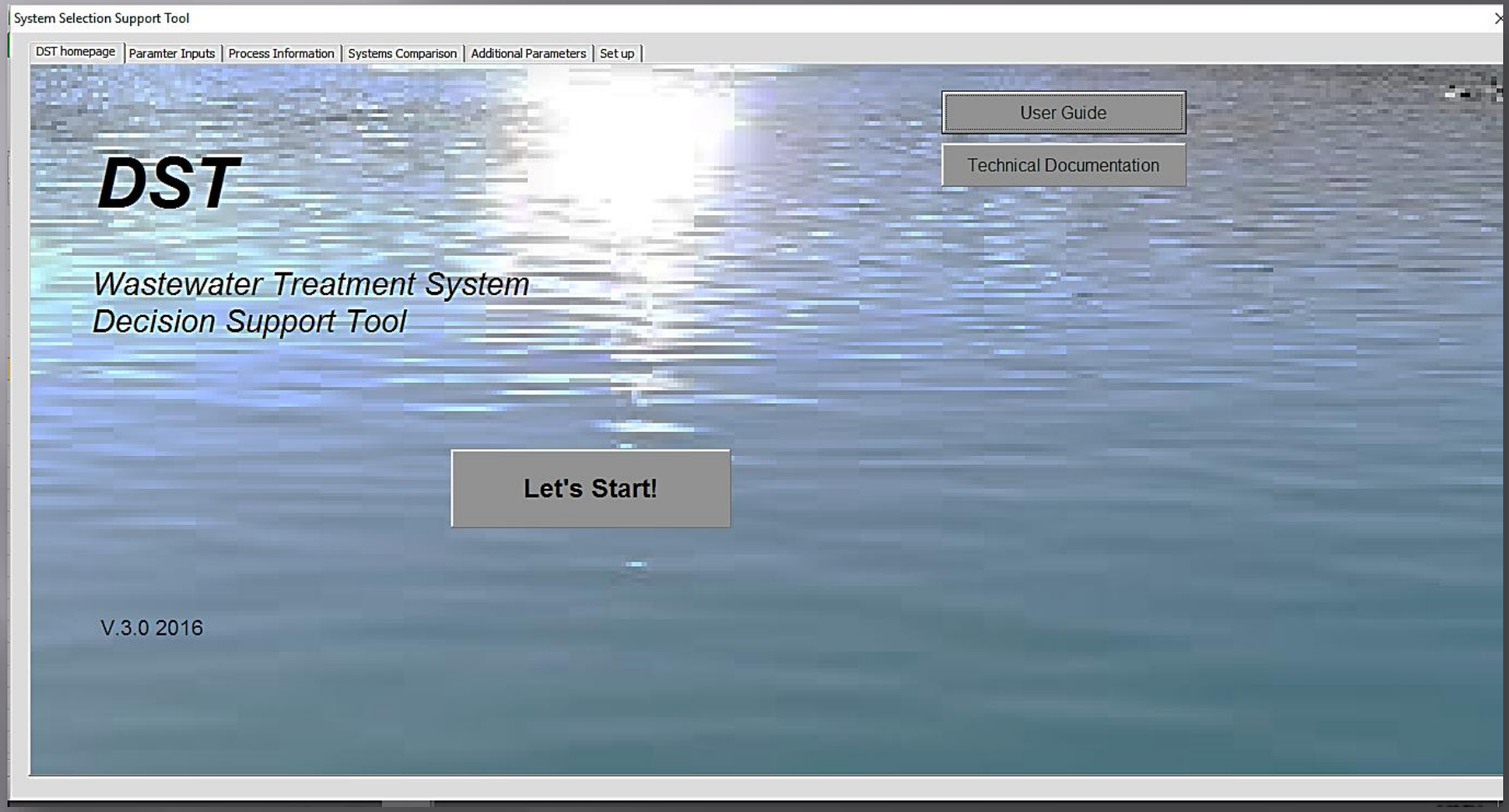
Systems

Systems	Abbv.	Family
Complete mix activated sludge	CMAS	Suspended growth
Anoxic/oxic	A/O	Suspended growth
Anaerobic/anoxic/oxic	A/A/O	Suspended growth
Extended aeration	EA	Suspended growth
Oxidation ditch	OD	Suspended growth
Sequence batch reactor	SBR	Suspended growth
Rotating biological contactors	RBC	Attached growth
Trickling filters	TF	Attached growth
Integrated fixed-film activated sludge	IFAS	Hybrid
Moving bed biofilm reactor	MBBR	Hybrid
Constructed wetlands	CW	Natural

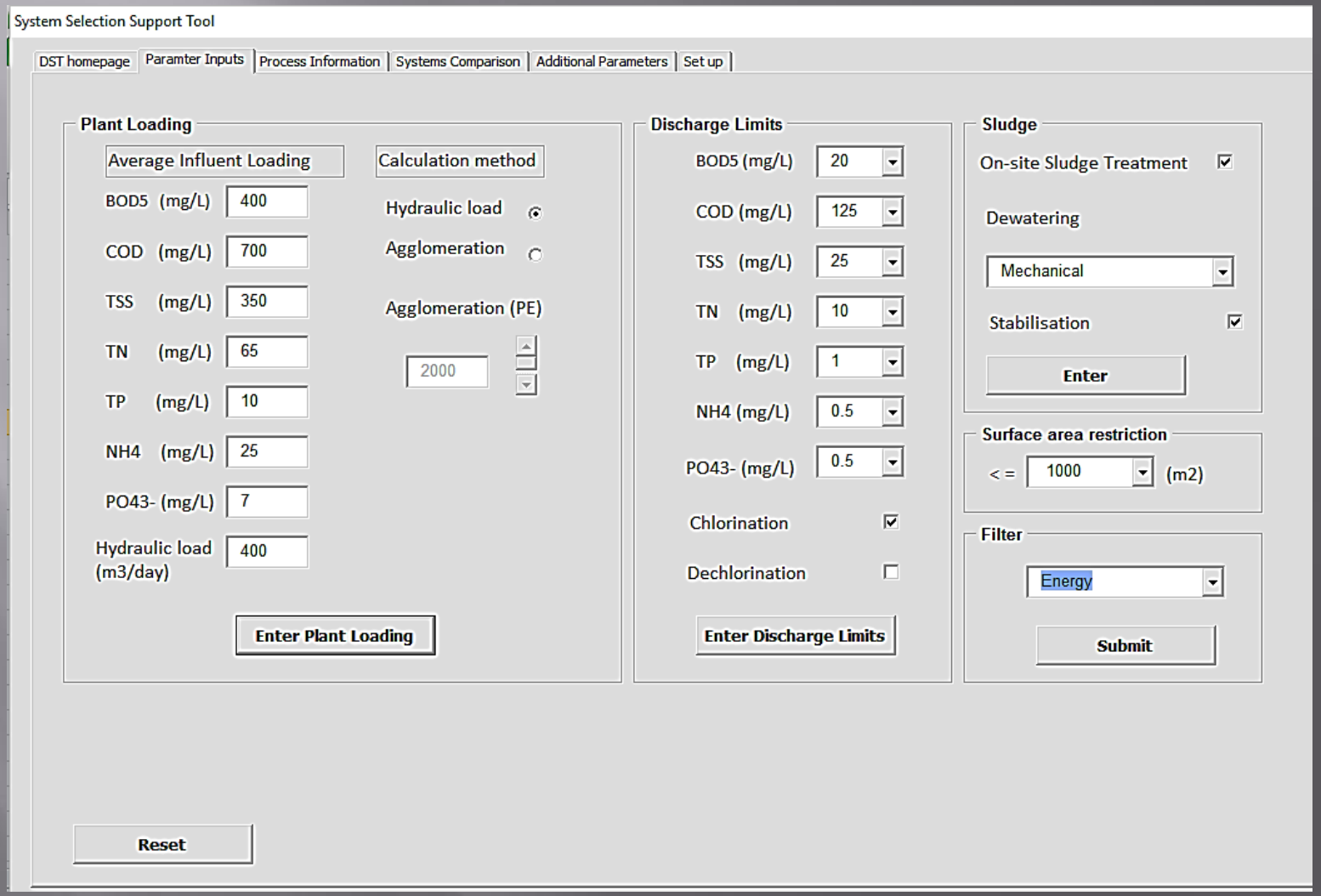
Modelling

- Models were developed for:
  - Footprint
  - Energy requirements
  - Chemical requirements
  - Sludge production
  - Capital expenditure
  - Operational expenditure
  - Lifecycle costing (NPV)

Decision Support Tool (DST)

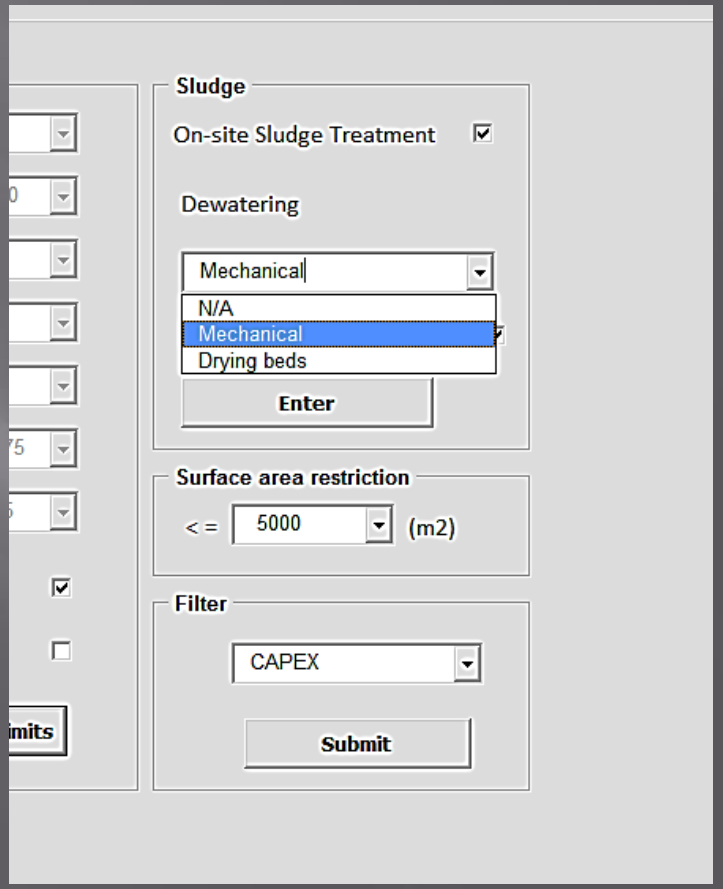


User input parameters

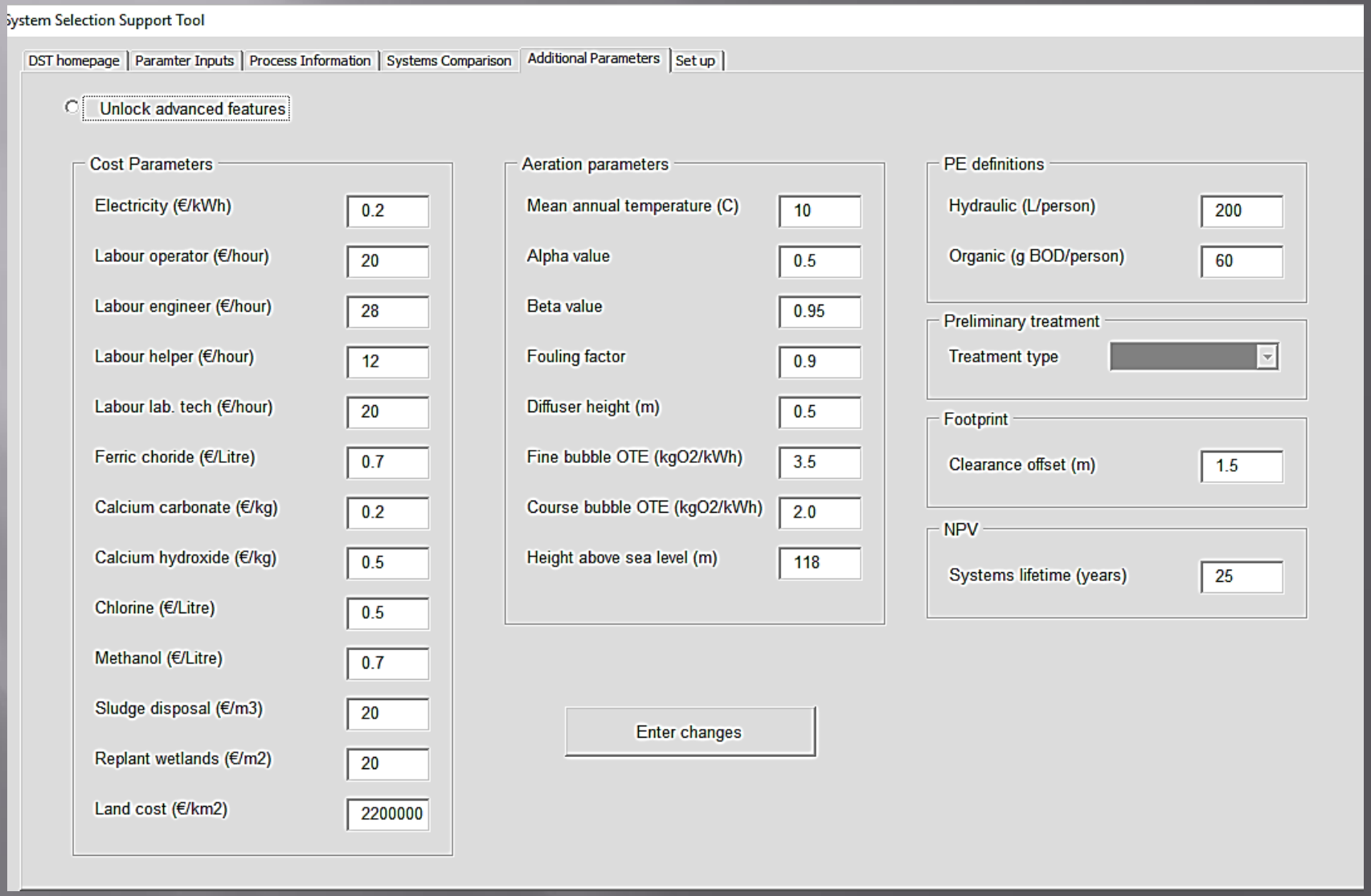


Sludge disposal

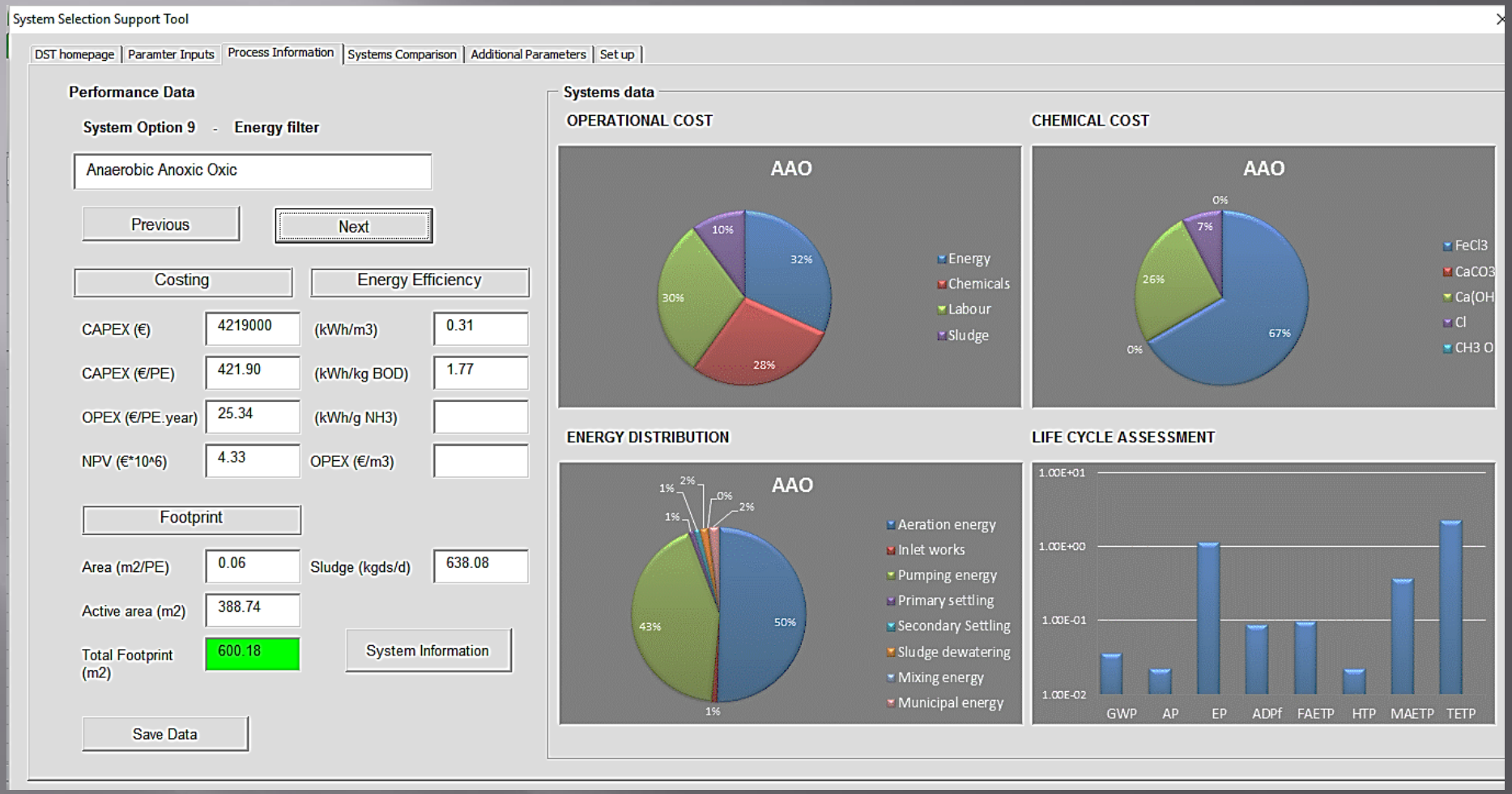
- Three sludge disposal options included:
  1. No treatment – contractor disposal
  2. Mechanical dewatering (centrifuge)
  3. Sludge drying beds



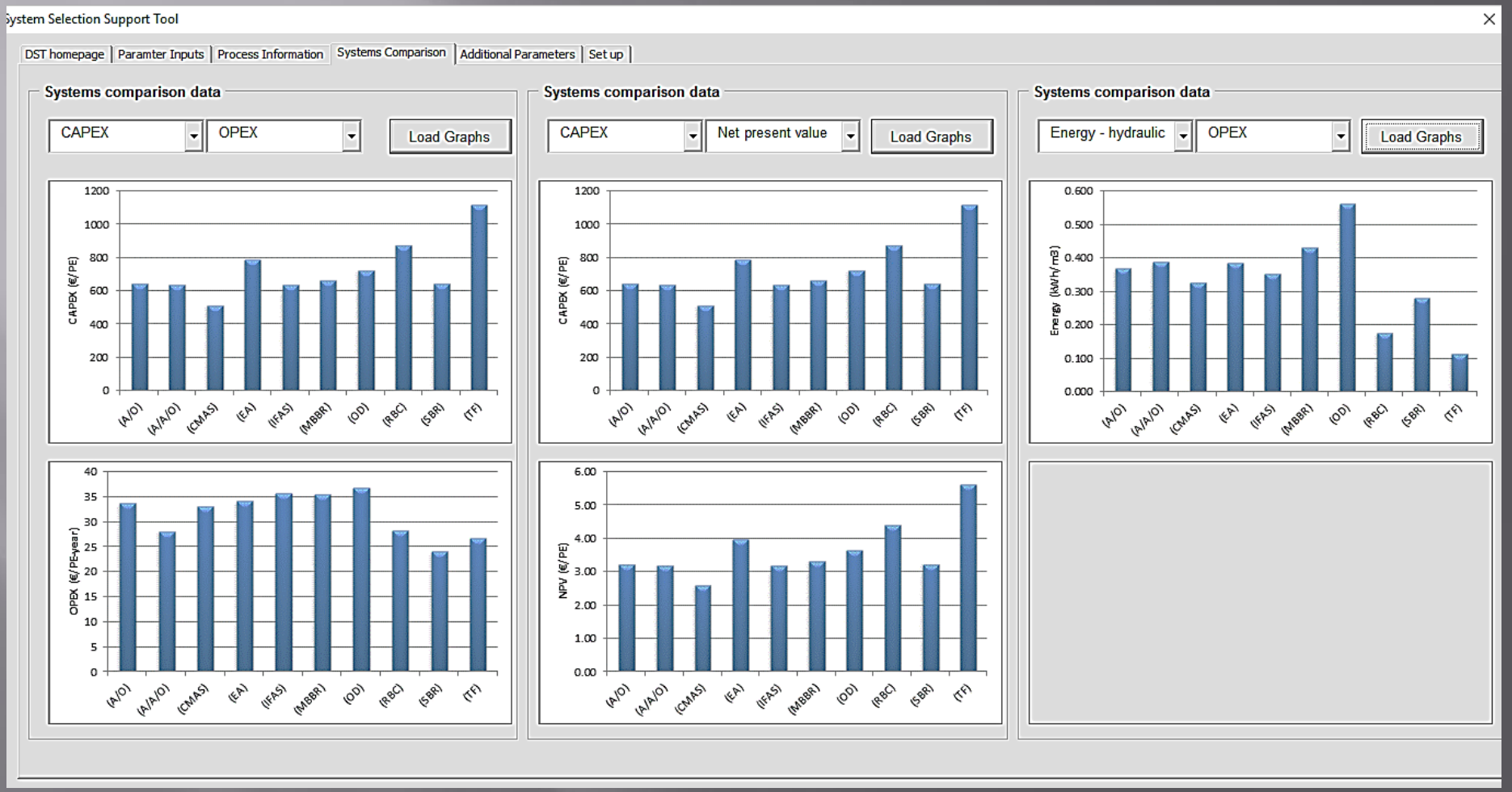
Additional parameters



Program outputs

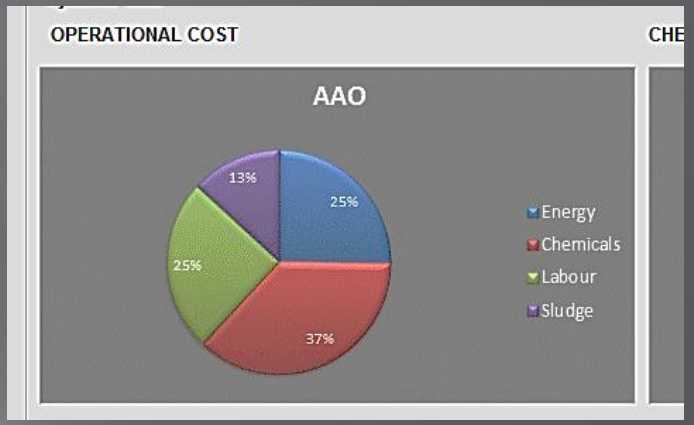


Systems comparison

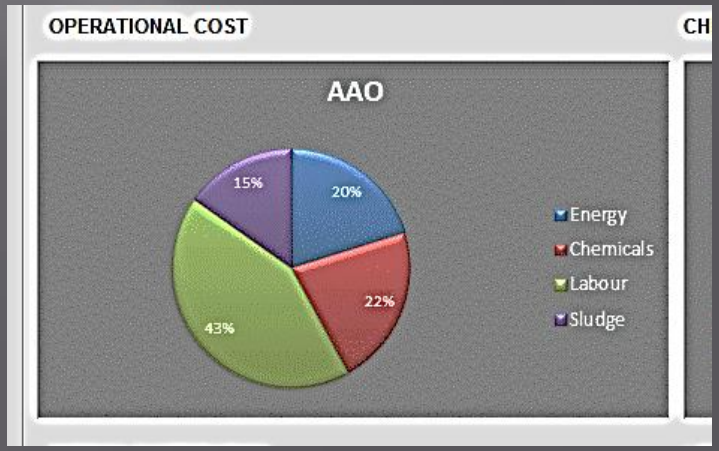


Preliminary findings - Labour

- Labour costs are subject to significant economies of scale
- Labour- hours, and required expertise estimations are often poorly calculated
- Underestimating labour requirements can lead to a decline in system performance and ultimately, system failure



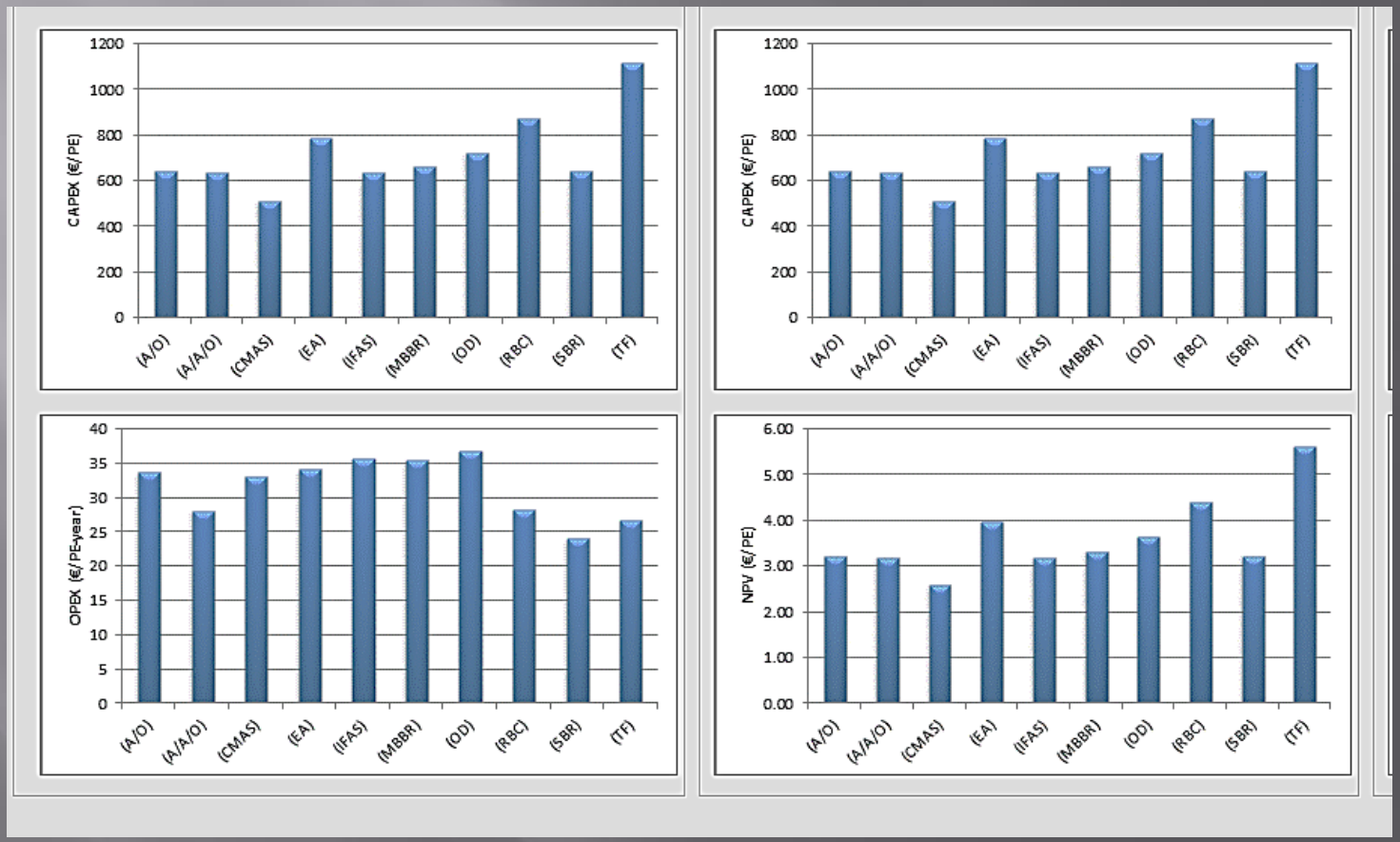
2000 PE



500 PE

Preliminary findings - CAPEX

- Capital expenditure dominates lifecycle cost



Limitations

- Capital expenditure estimations are prone to significant uncertainty
- Low energy estimations - based on first principles – not reflecting full economies of scale
- Oxygen transfer efficiency (OTE) assumptions need further analysis/parameterisation
- Specific component life times required

Further work

- A general address of assumptions
- Inclusion of a sensitivity analysis function
- Inclusion of LCA component of program
- More detailed capital expenditure breakdown
- Further OTE investigation needed
- Additional sludge treatment options

Thank you for listening

Questions?