selecting the optimal WWTP configuration including resource recovery units

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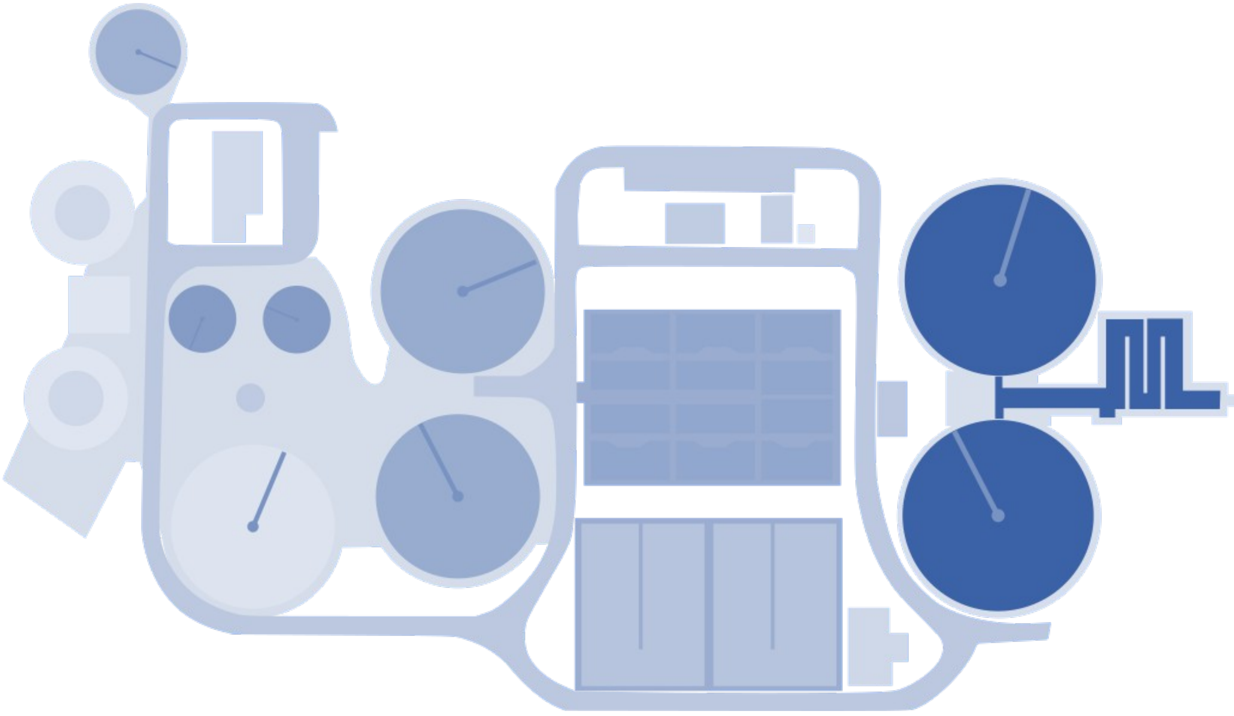
SMART-Plant

Scale-up of low-carbon footprint **MA**terial **R**ecovery **T**echniques for upgrading existing WWTP

Funded by the Horizon 2020 Framework Programme of the European Union under grant agreement No 690323

SMART-Plant



MAIN GOAL

REDUCE energy and environmental footprint
RECOVER valuable materials (water, cellulose, biopolymers, nutrients)
PRODUCE products exploitable in construction, chemical and agriculture

SMART-Plant

Started Juny 201

Ends in Juny 202

Scale-up of low-carbon footprint **MA**terial **R**ecovery **T**echniques for upgrading existing WWTP

SMART-Plant

Total EC funding

7,5M€

Scale-up of low-carbon footprint **MA**terial **R**ecovery **T**echniques for upgrading existing WWTP

SMART-Plant

Partners

26

Scale-up of low-carbon footprint **MA**terial **R**ecovery **T**echniques f
upgrading existing WWTP

SMART-Plant

SMARTech pilot-plants

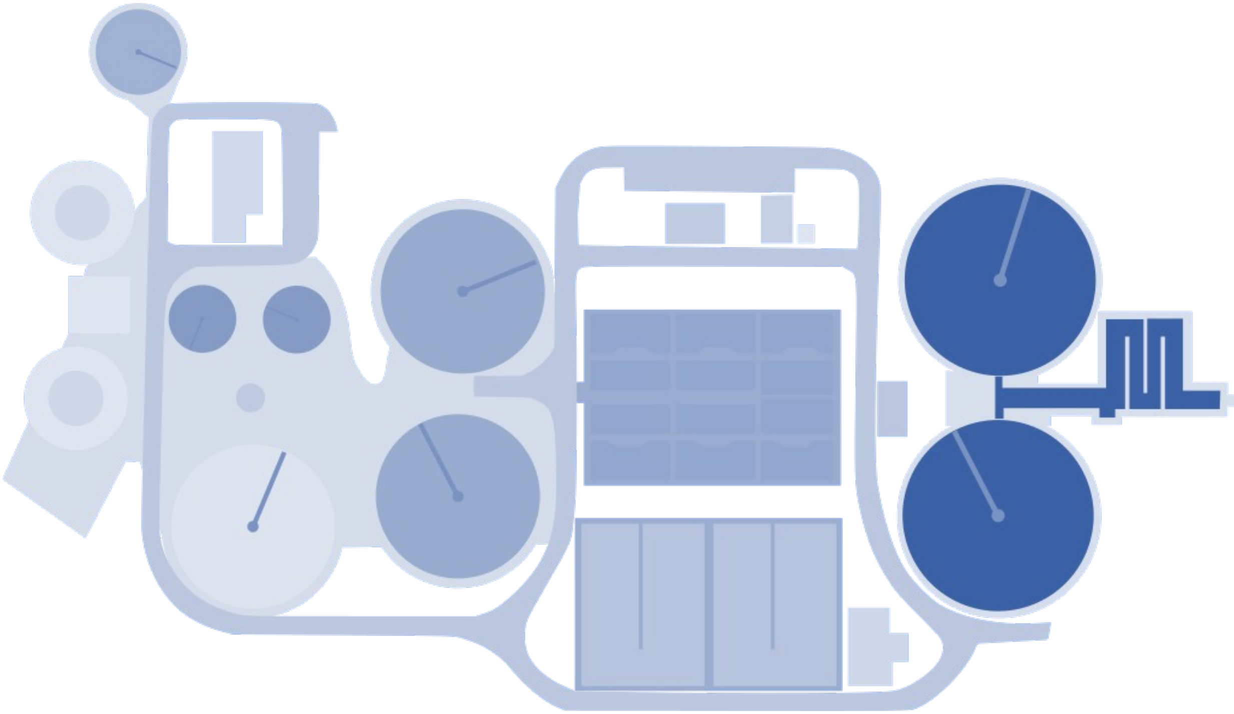
7

DSS objective

Advise the potential stakeholders on how to implement the SMART-Plant Technologies for their specific wastewater treatment problem

SMARTech process models

- Complex dynamics (ASM2d, ADM1)
- Discrete events (SBR)
- Complex control systems
- Large system of differential-algebraic equations (DAE)



Energy

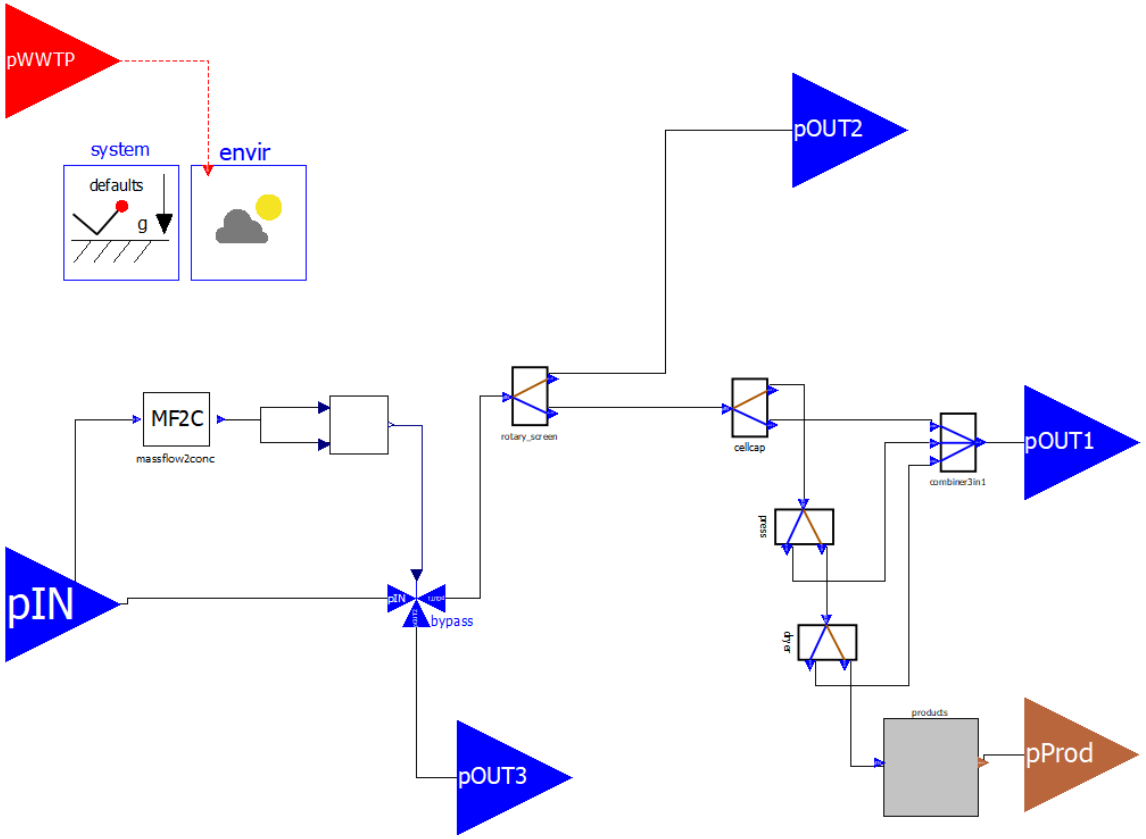
Biopolymers

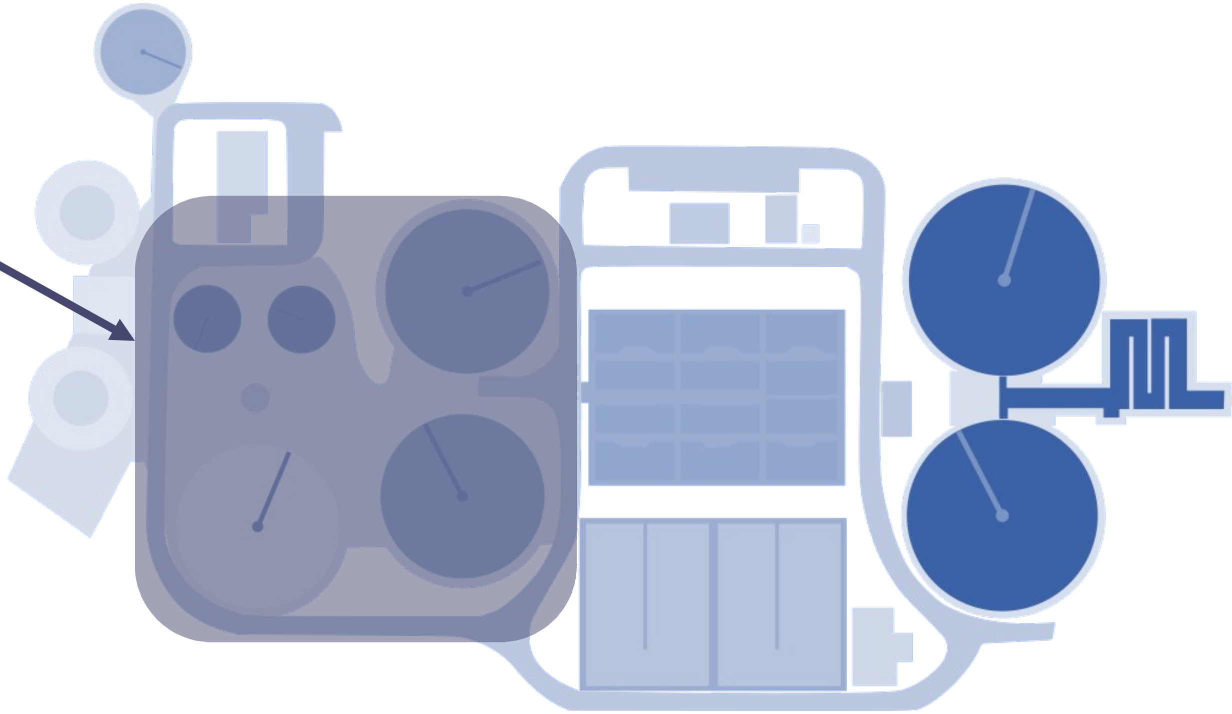
N-P

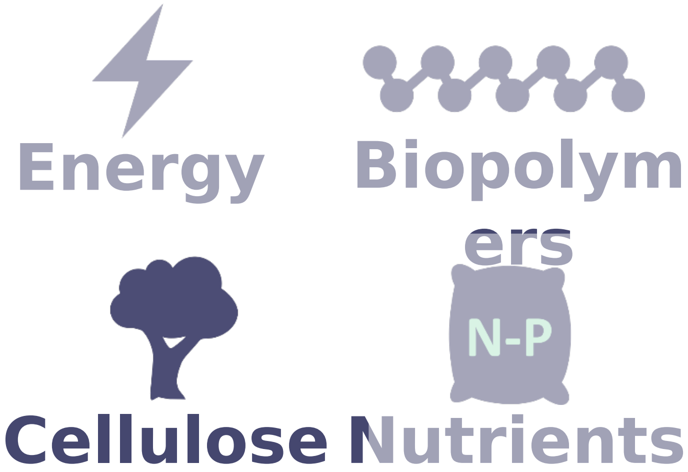
Cellulose

Nutrients

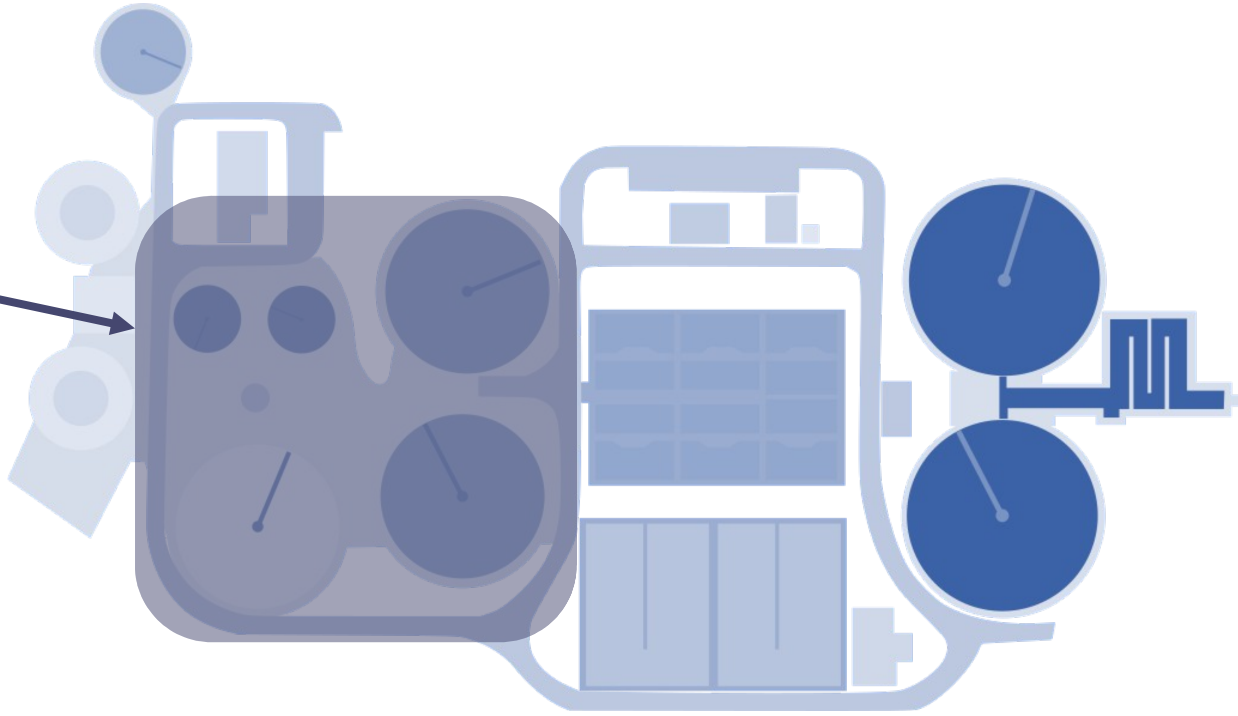
Dynamic fine-screen and post-processing of cellulosic sludge (ST1)

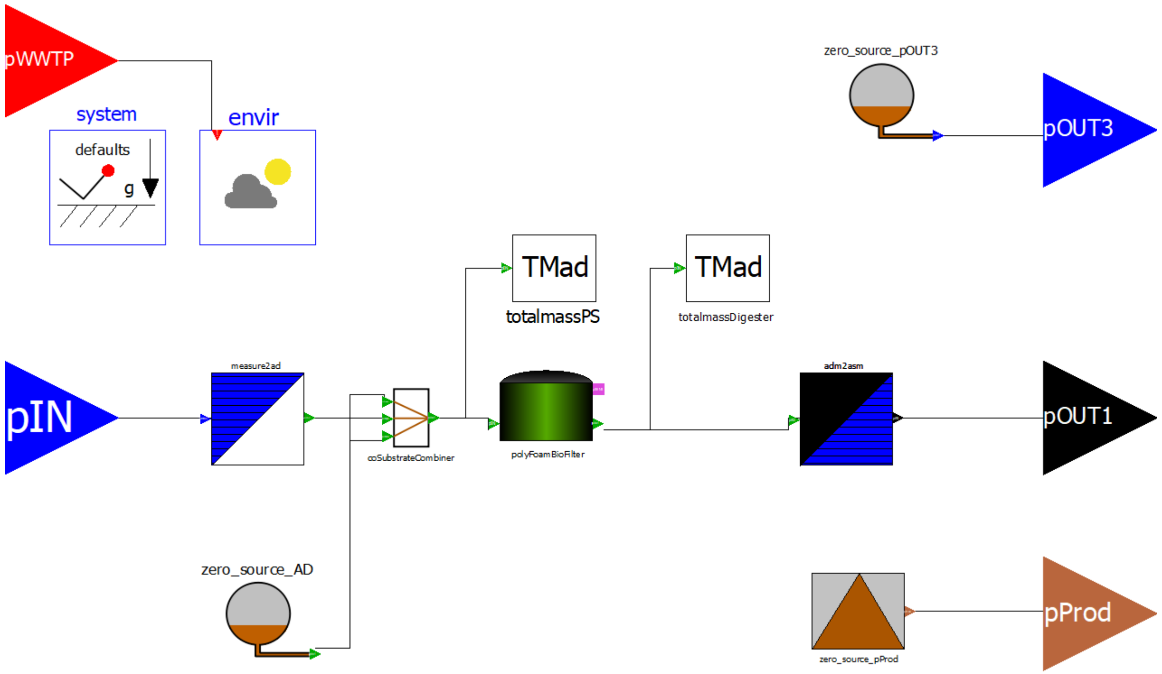


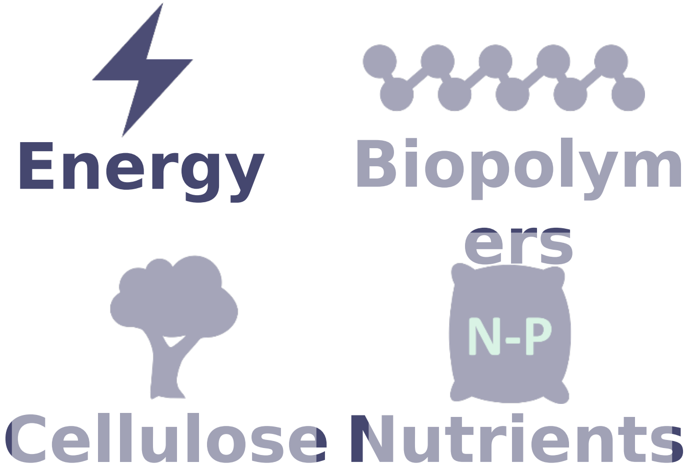




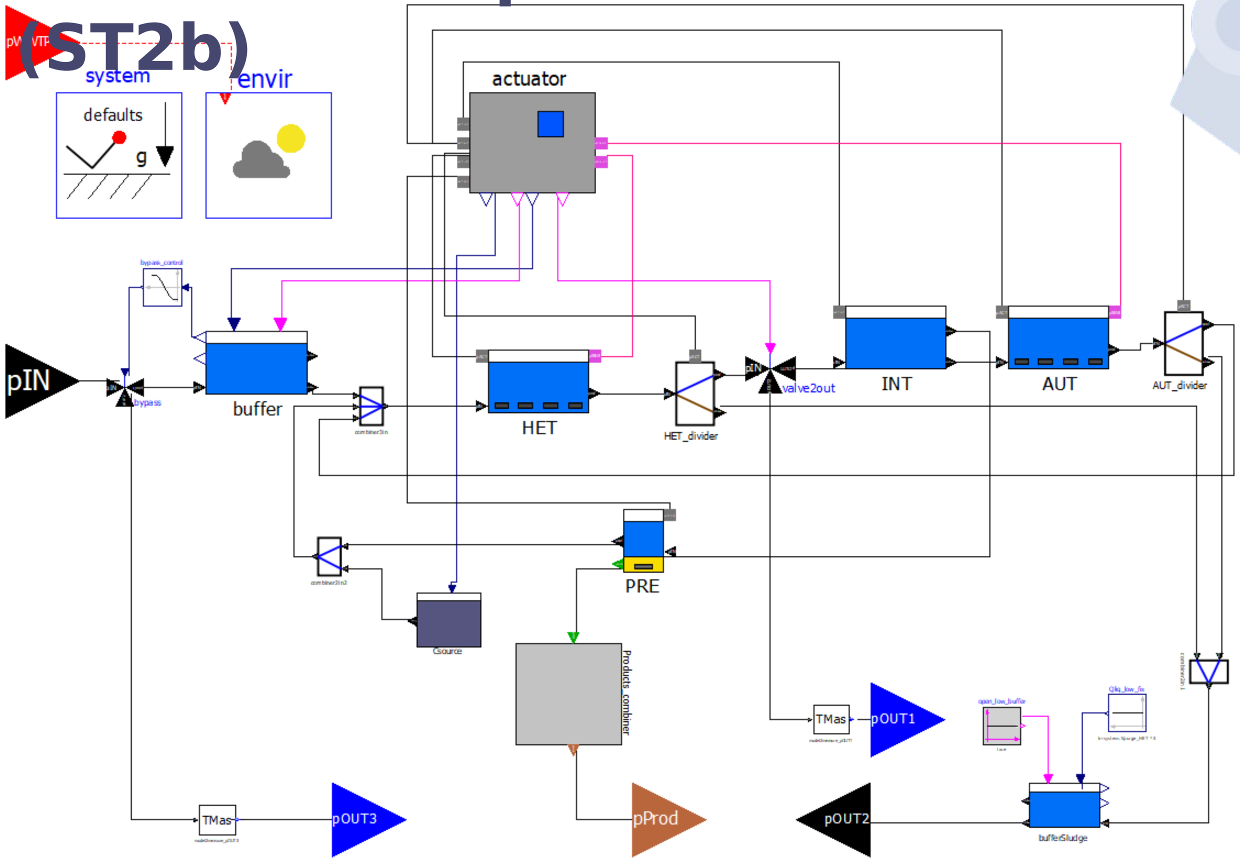
Polyurethane-based anaerobic digestion bio-filter (ST2a)

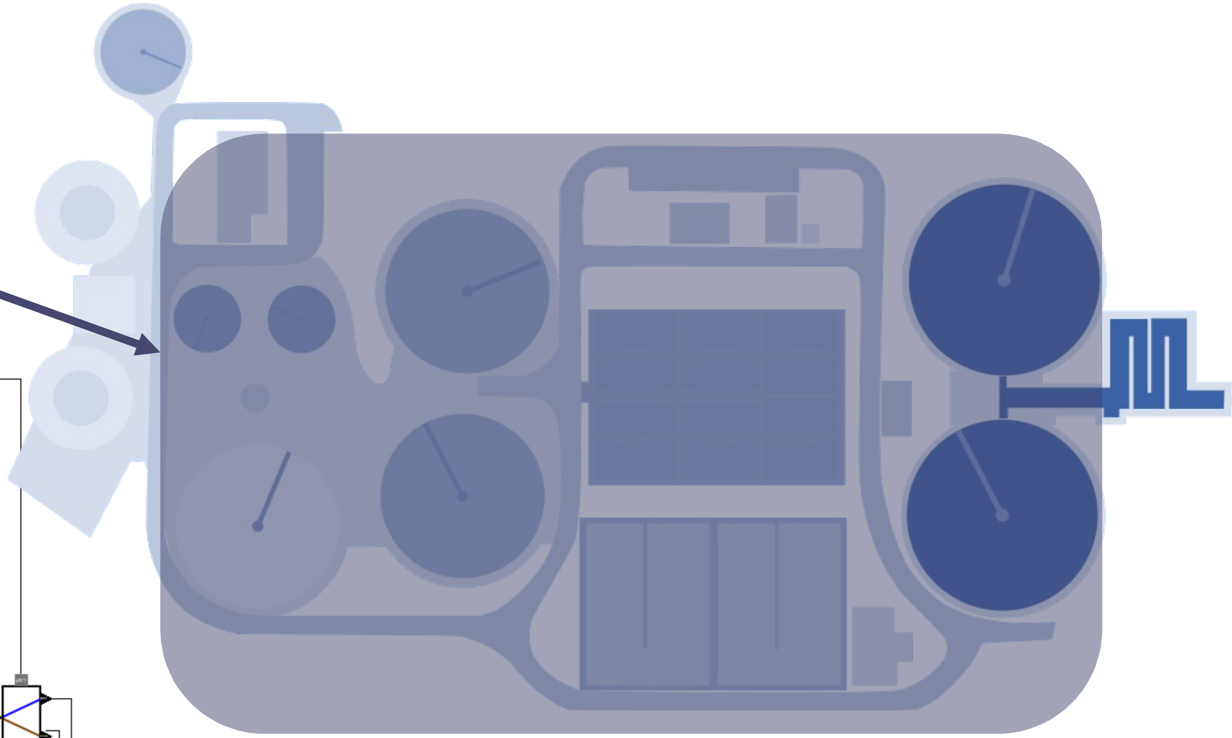






Short-Cut Enhanced Phosphorus and PHA Recovery (SCEPPHAR) main-stream process (ST2b)





Energy

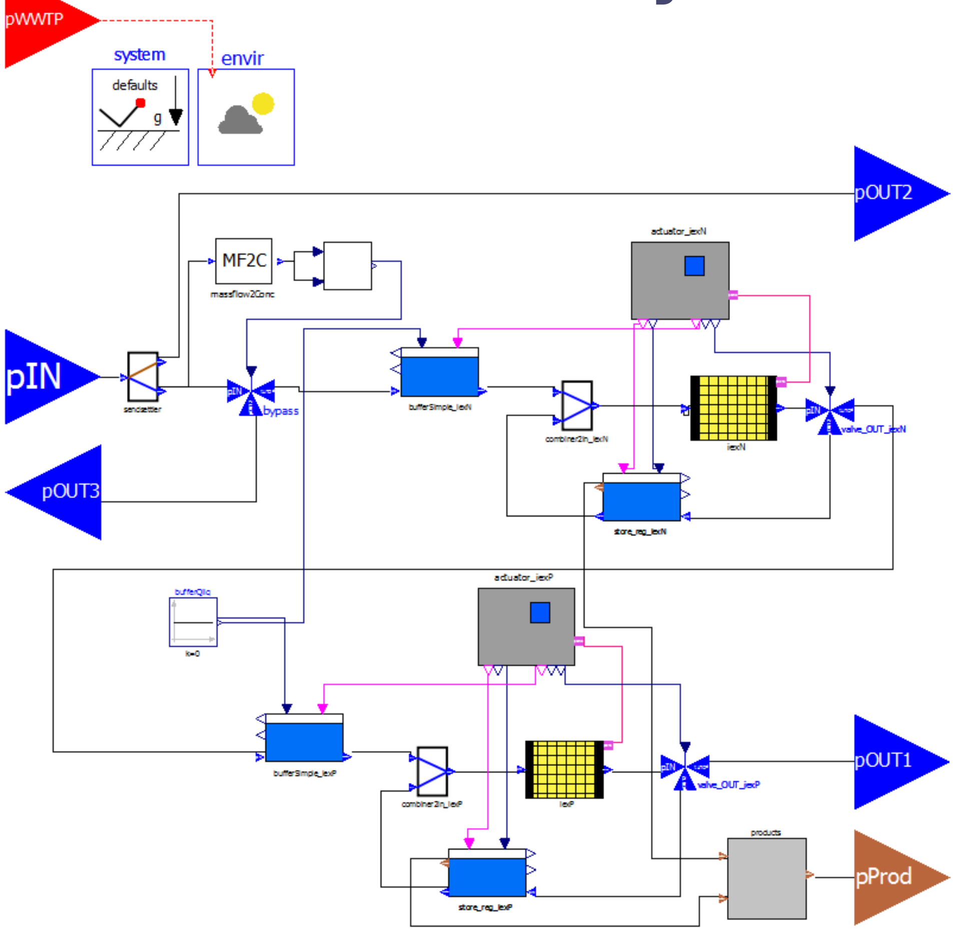
Biopolymers

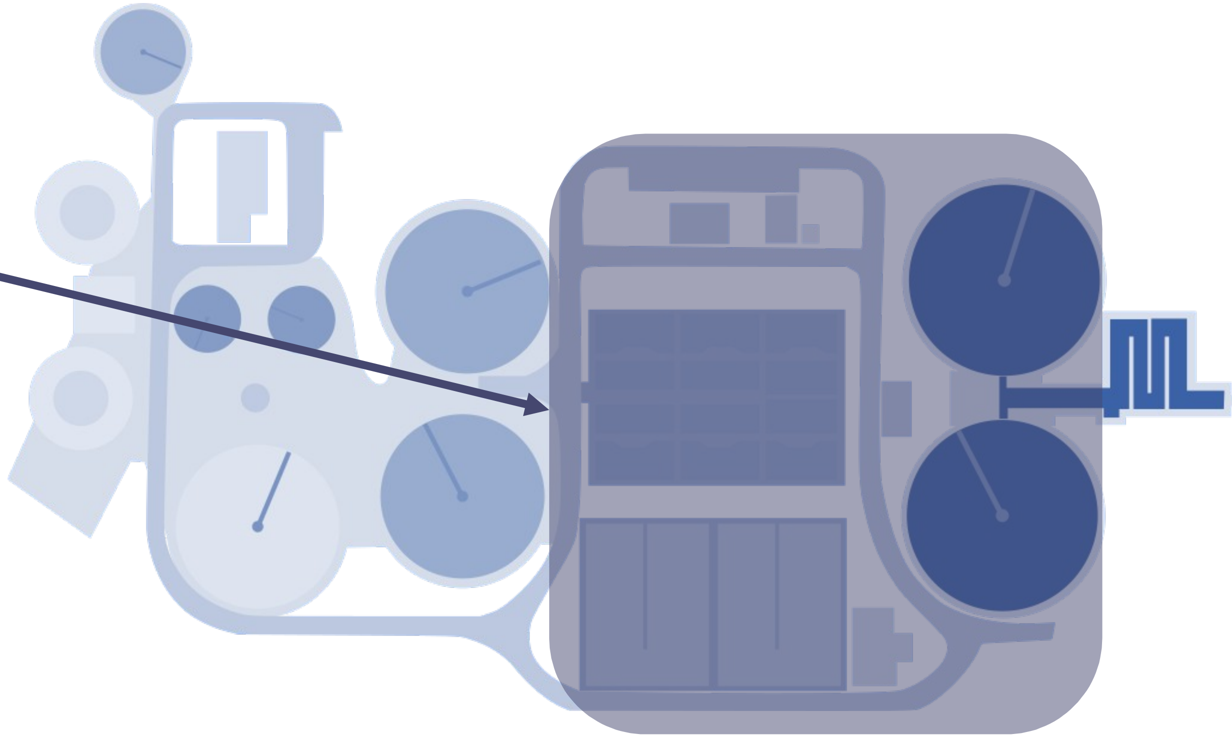
Cellulose

N-P

Nutrients

Tertiary hybrid ion exchange for N and P nutrients recovery (ST3)





Energy

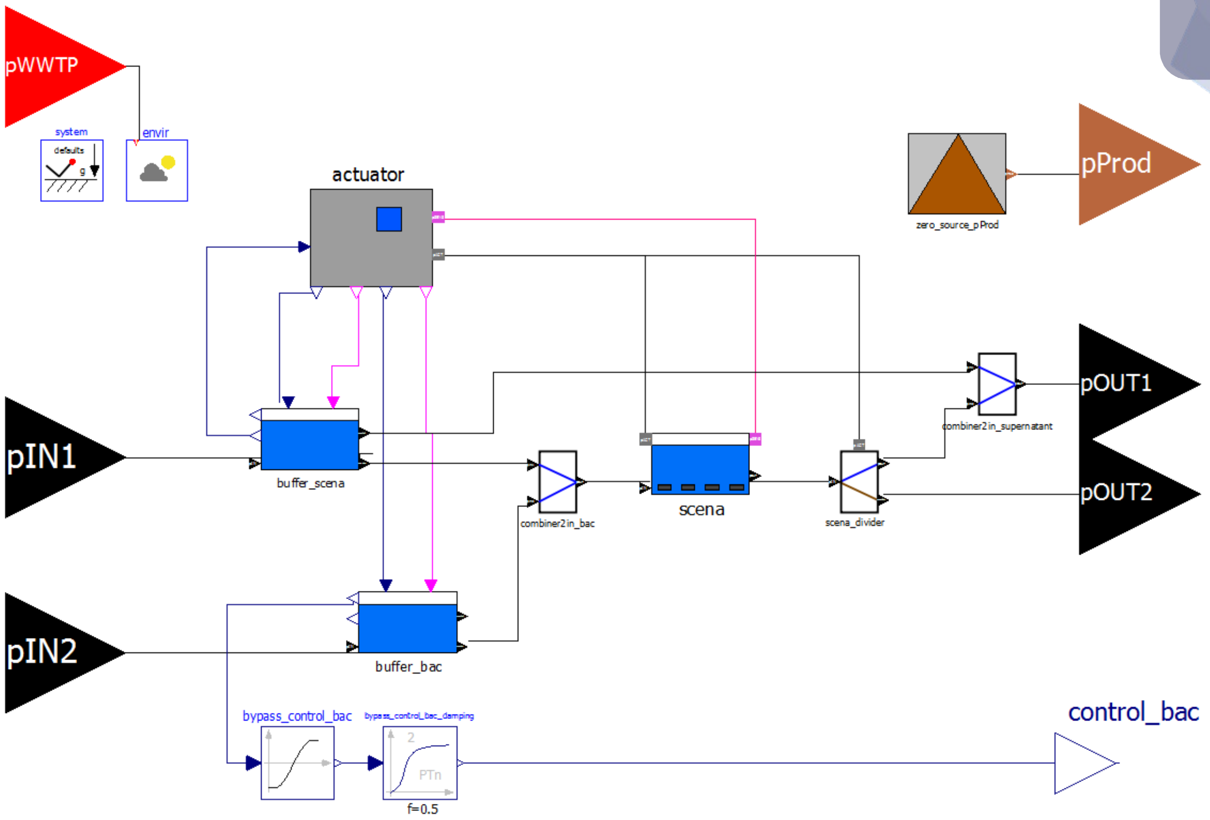
Biopolymers

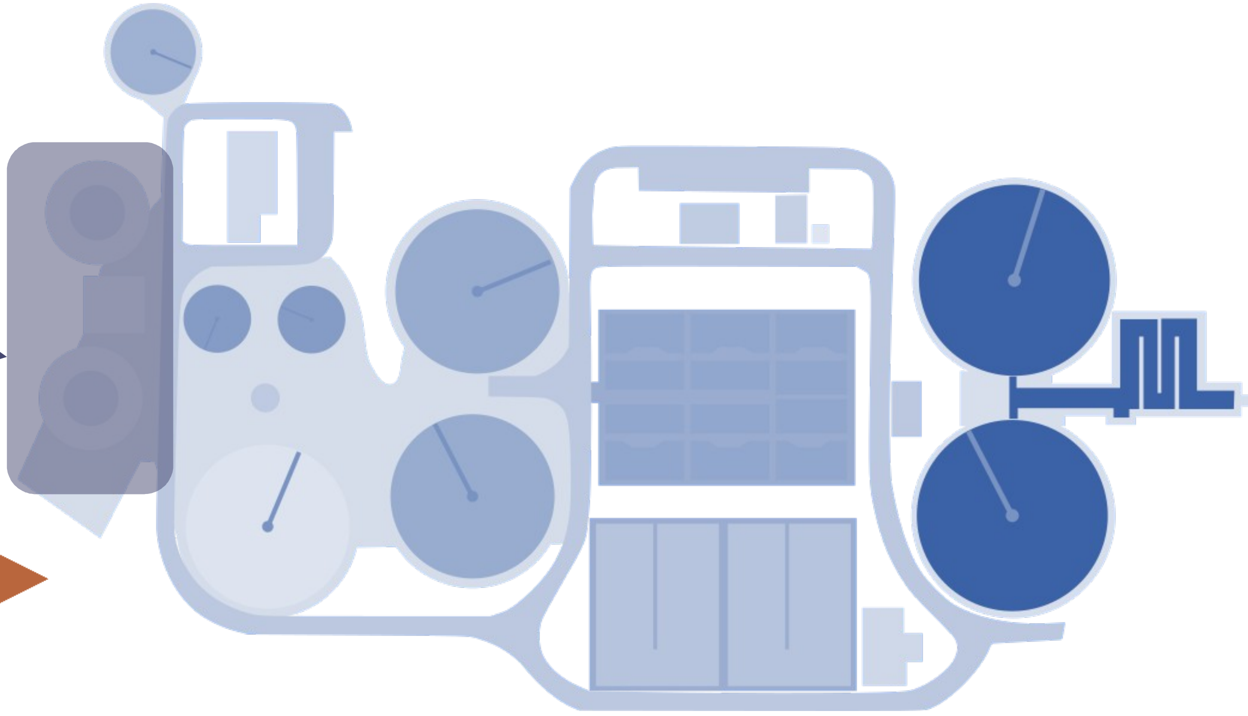
Cellulose

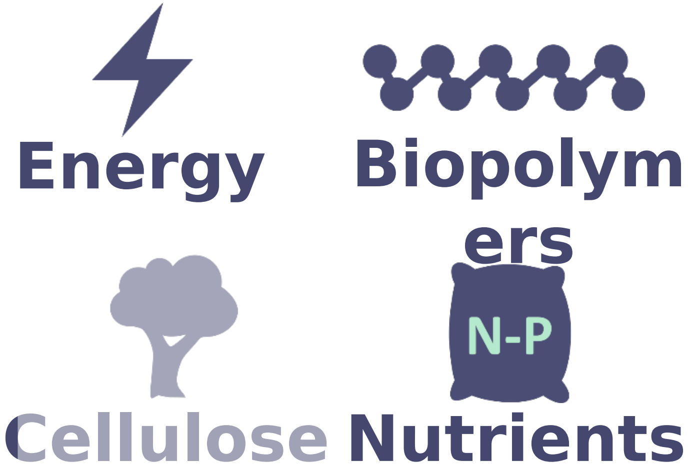
N-P

Nutrients

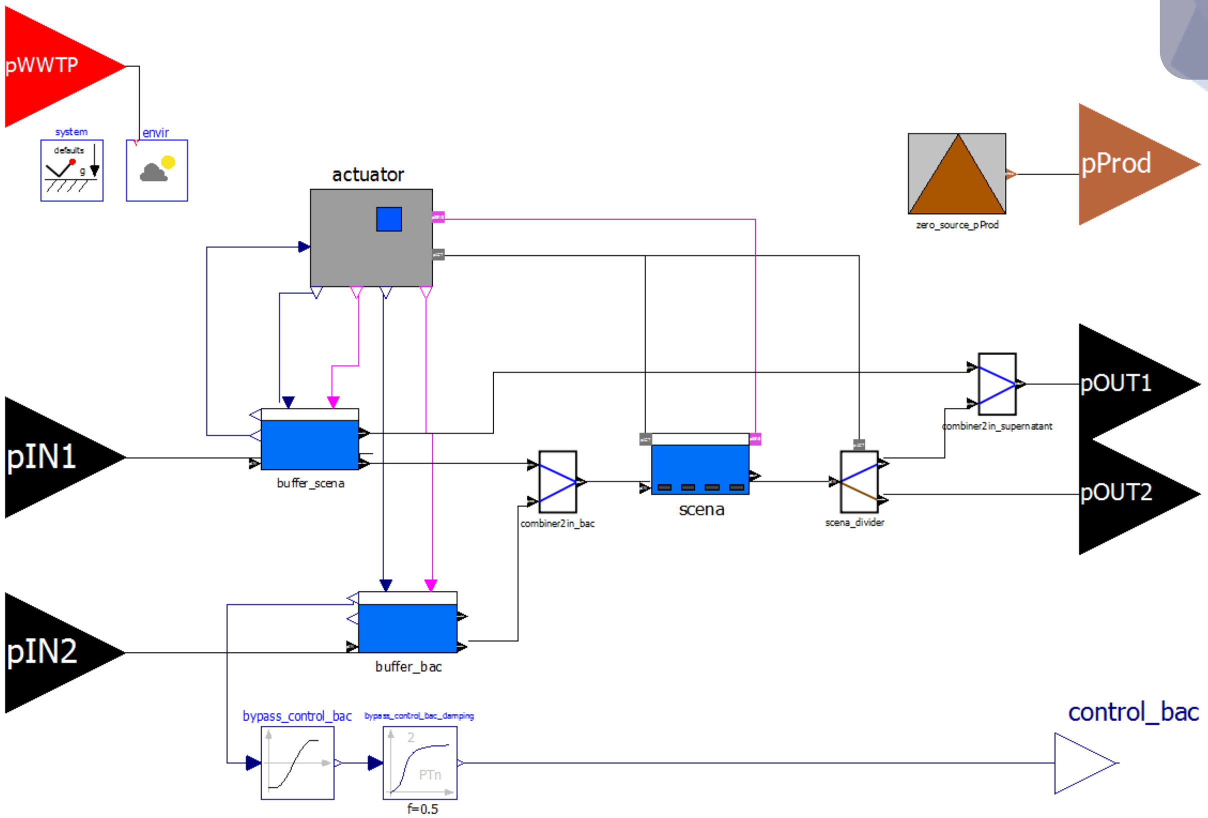
Short-Cut Enhanced Nutrient Abatement (SCENA) and ordinary digestion side-stream process (ST4a)

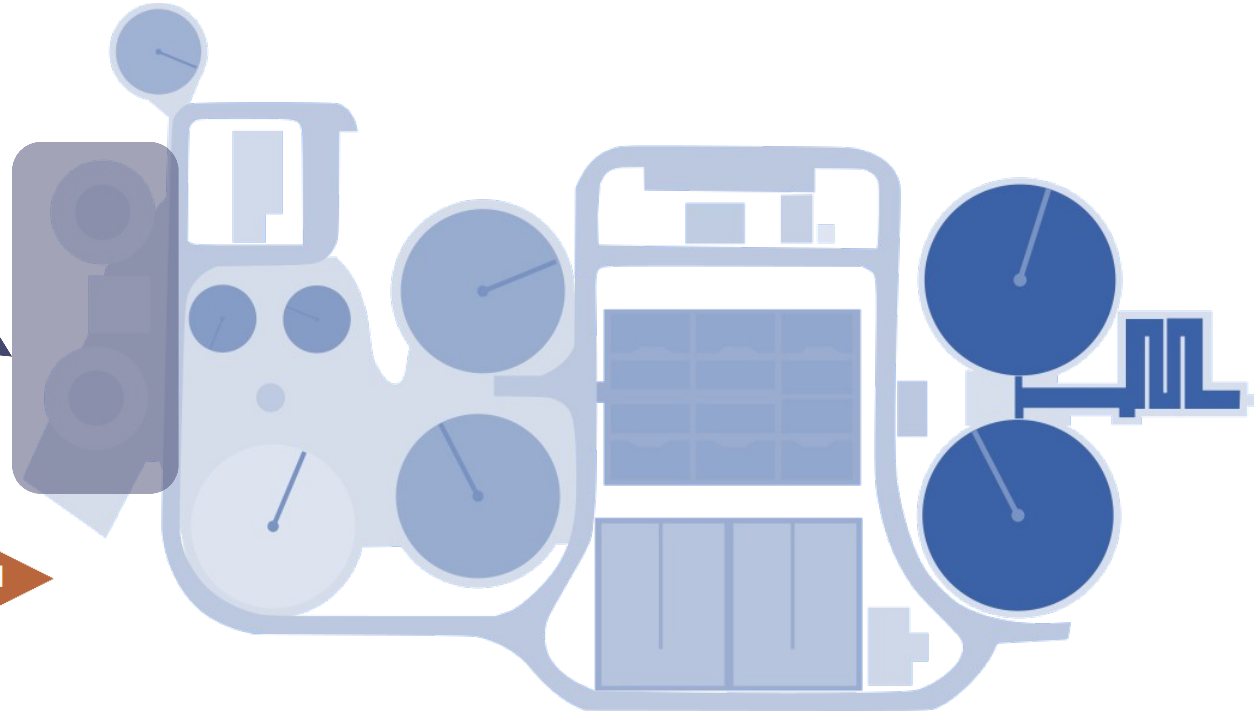






SCENA and CAMBI-enhanced digestion side-stream process (ST4b)





Energy

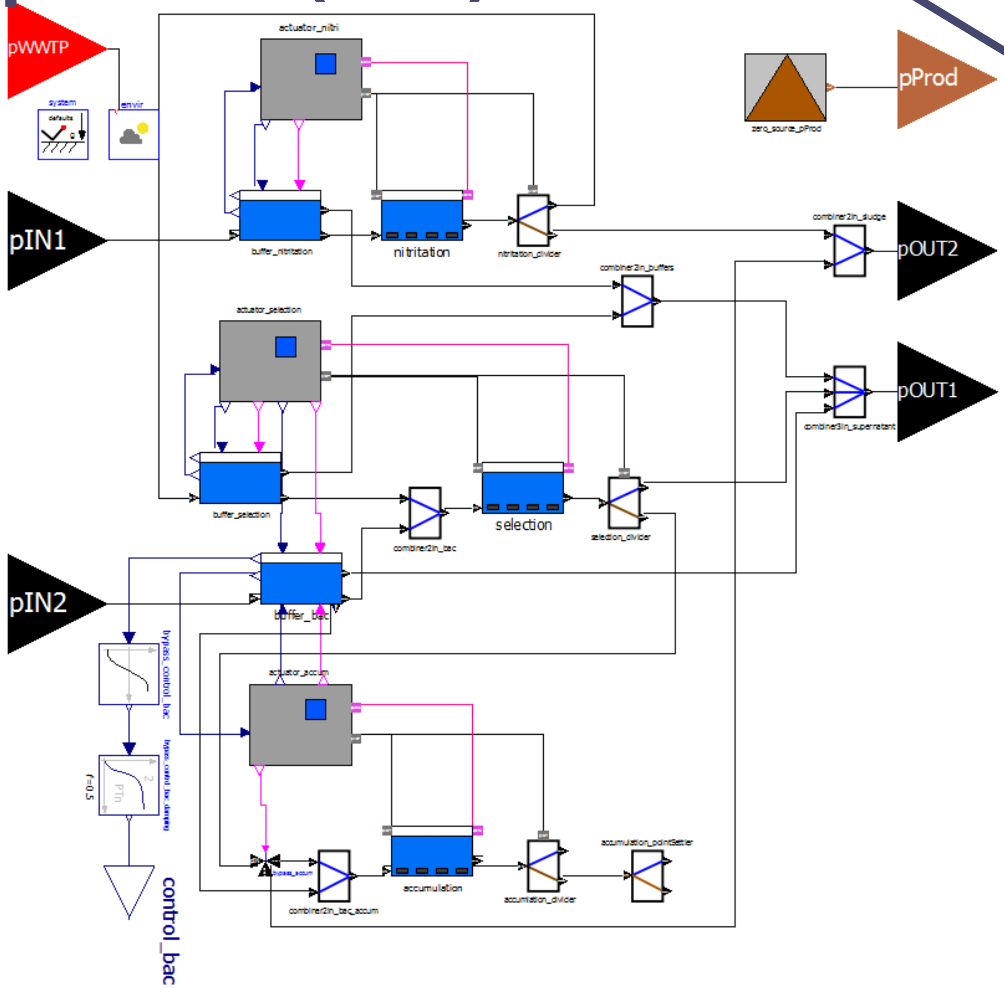
Biopolymers

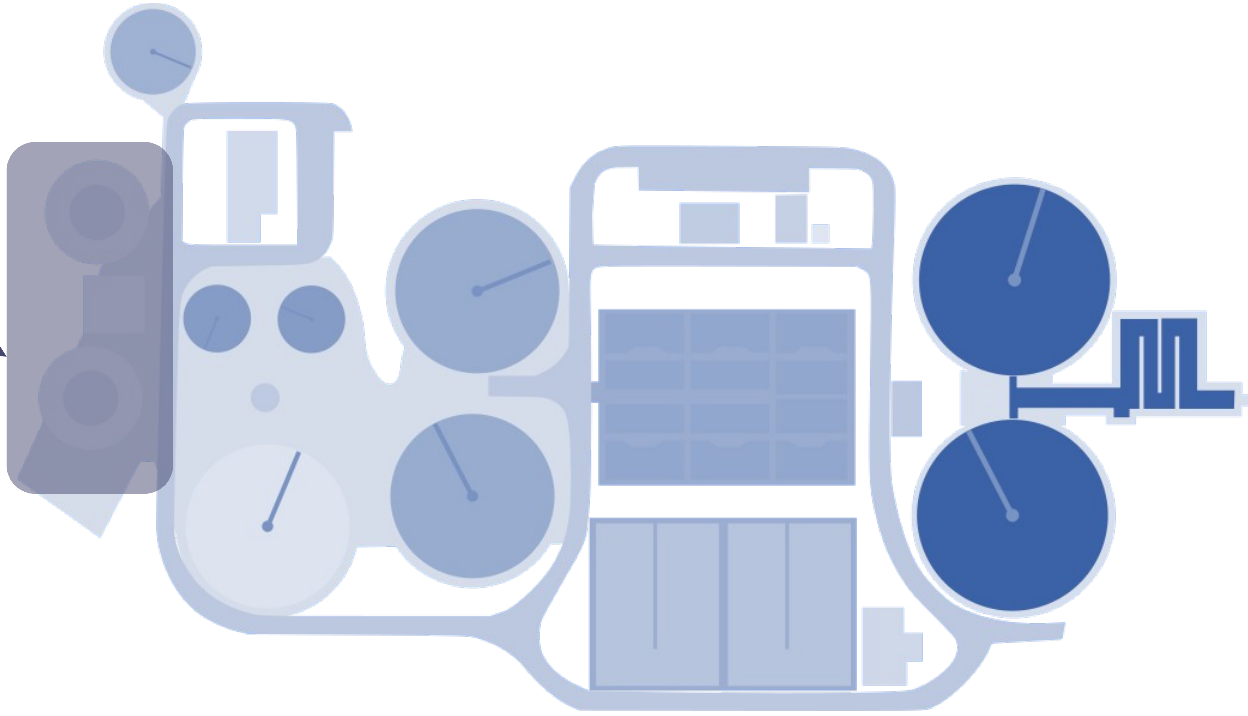
Cellulose

N-P

Nutrients

SCEPPHAR side-stream process (ST5)





Energy

Biopolymers

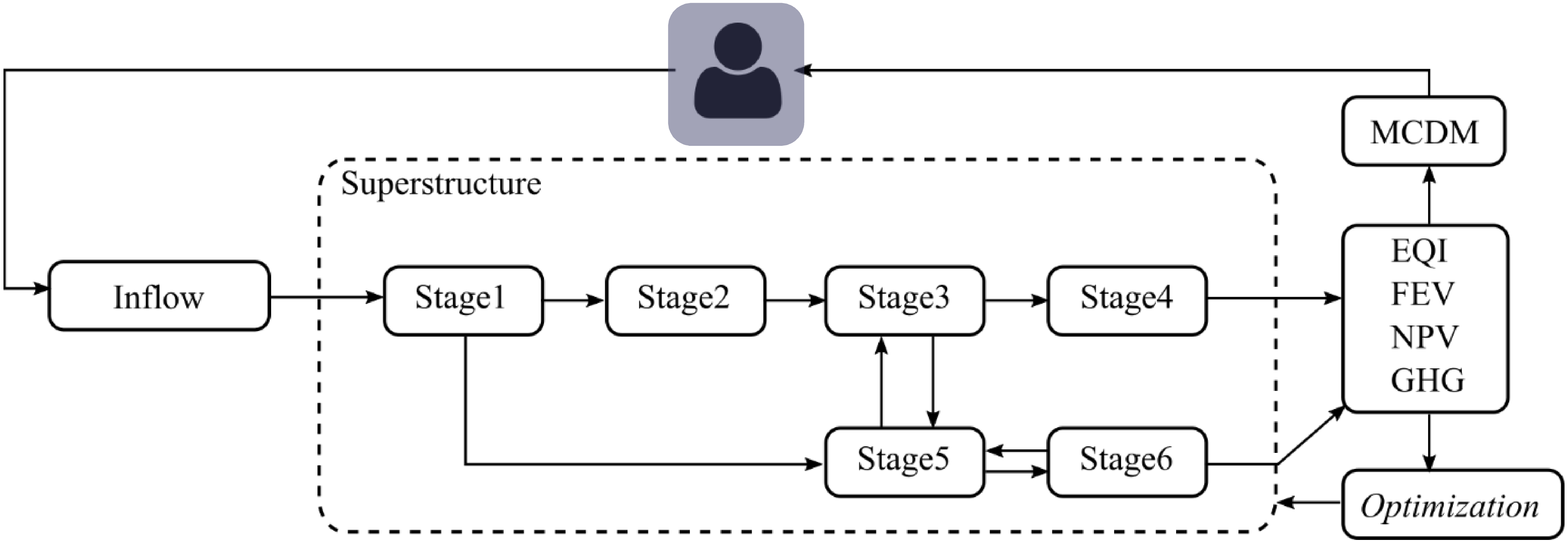
Cellulose

N-P

Nutrients

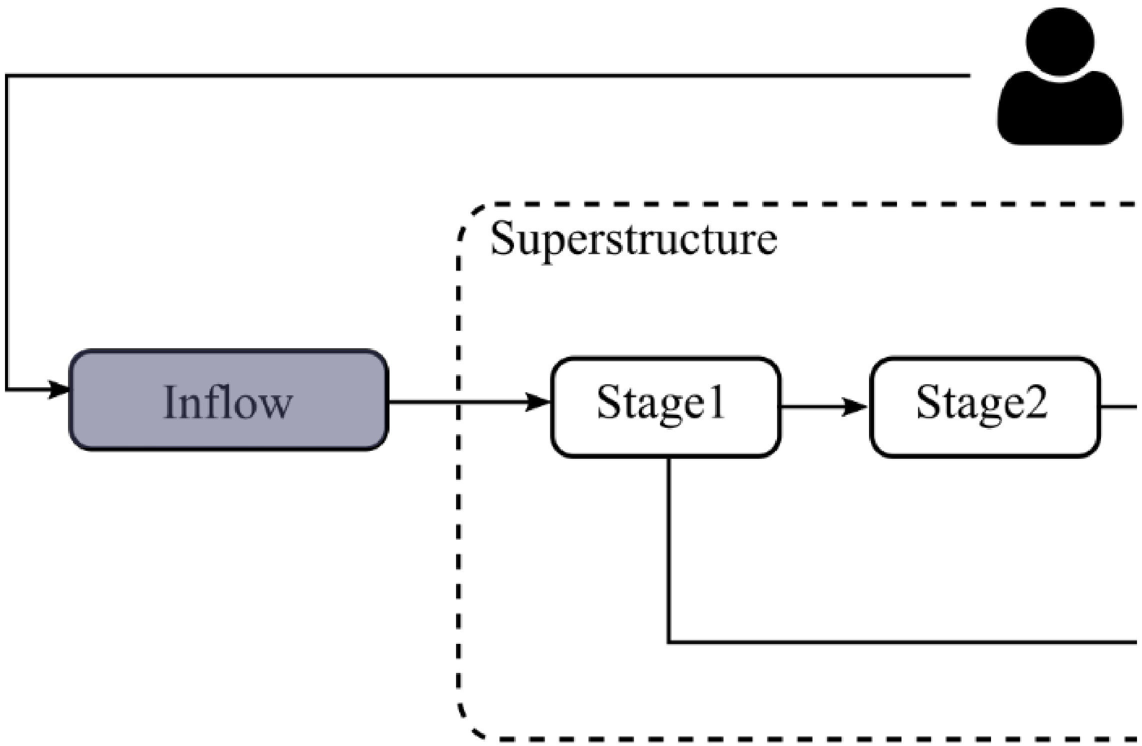
Which plant configuration is best for me?

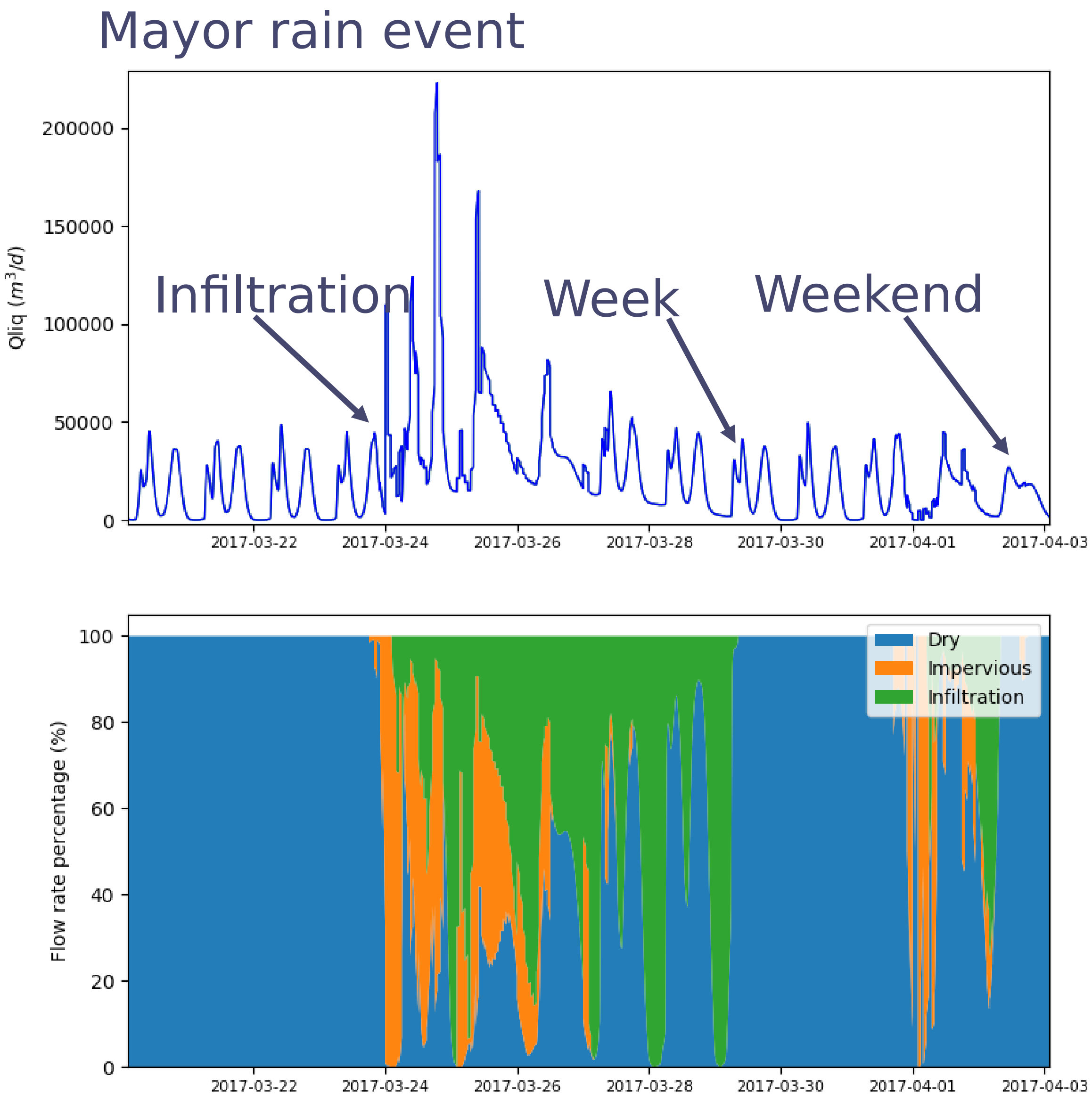
Try our hyper-tech solution Decision Support System!



STEP1: Design problem set-up

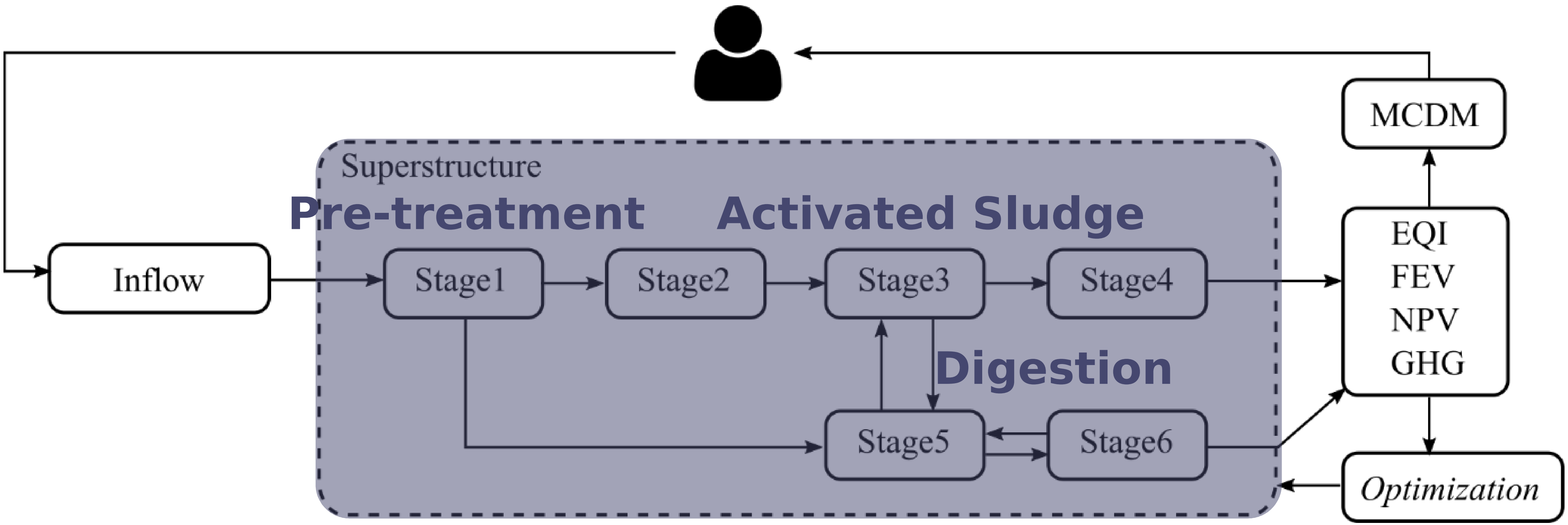
- **New design or retrofit**
- **Geo-location (weather)**
- **PE, legal limits, etc.**



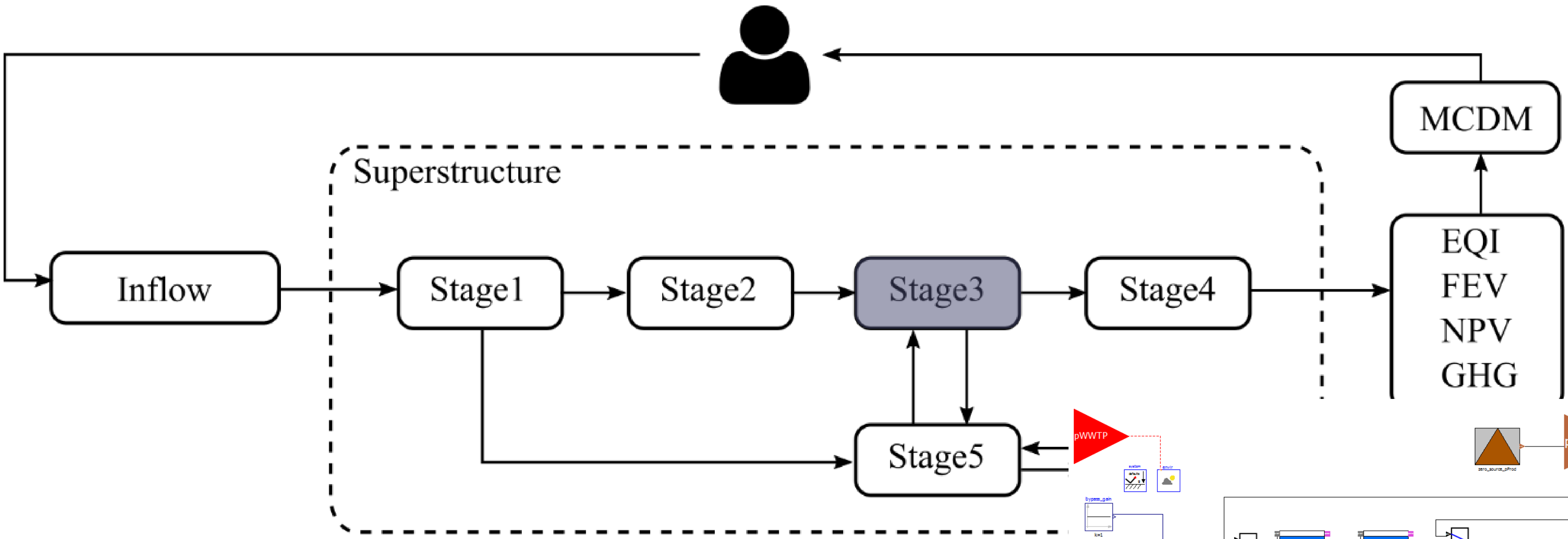


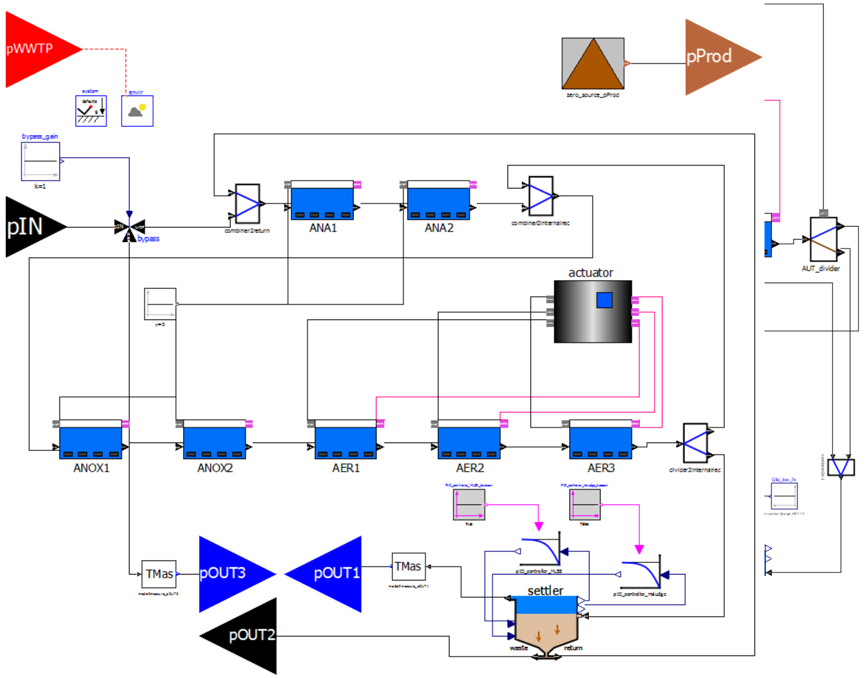
STEP2: Wastewater inflow generati

- Dry weather model
- Wet weather model
- Sewer model



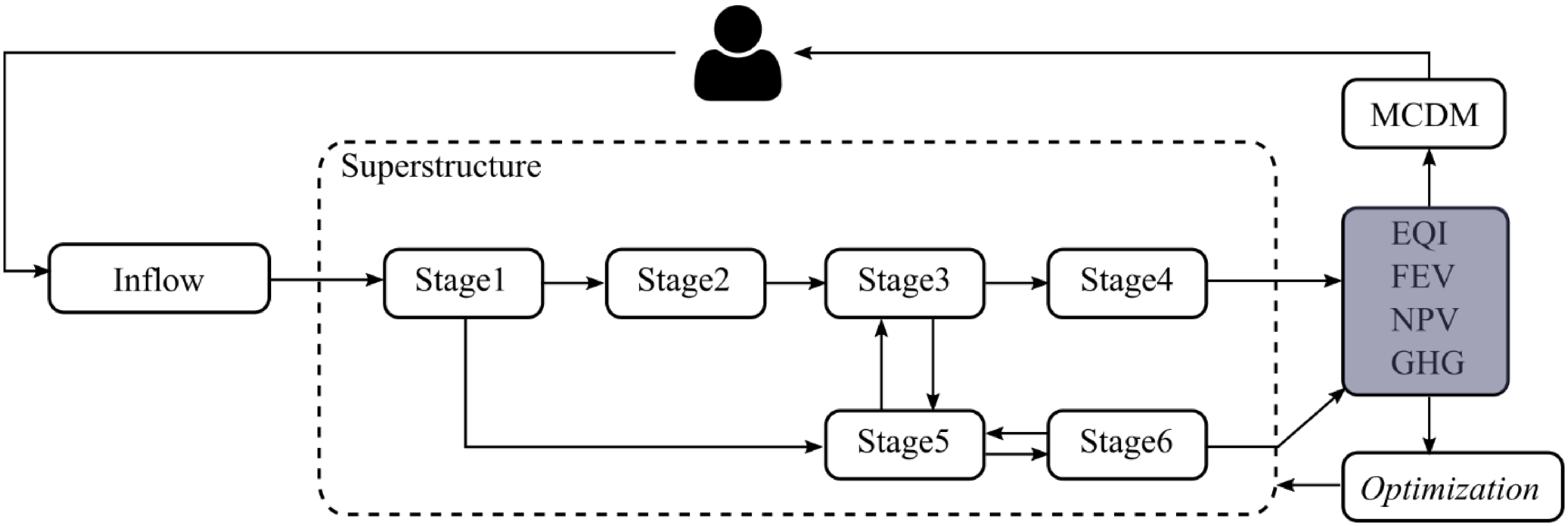
STEP3: Superstructure generation and simulation





STEP3: Superstructure generation and simula

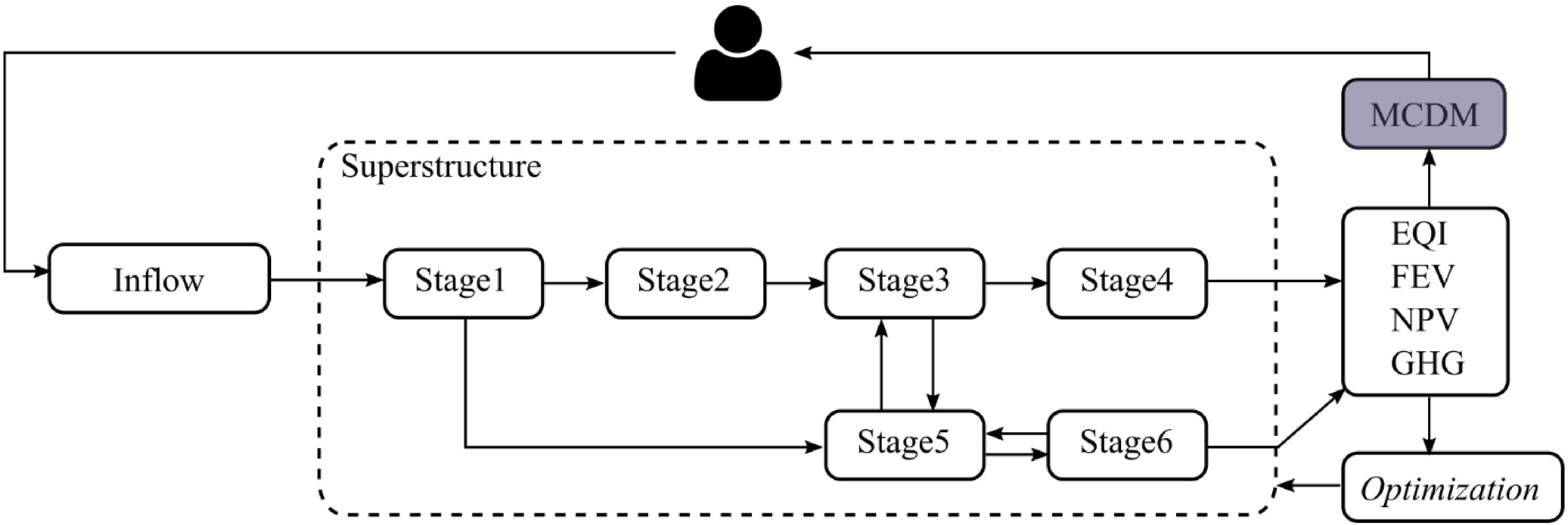
Conventional A2O process
Redeclare Stage3 with ST2b
Automatic built-up of WWTP configurations



STEP4: Objective values estimation

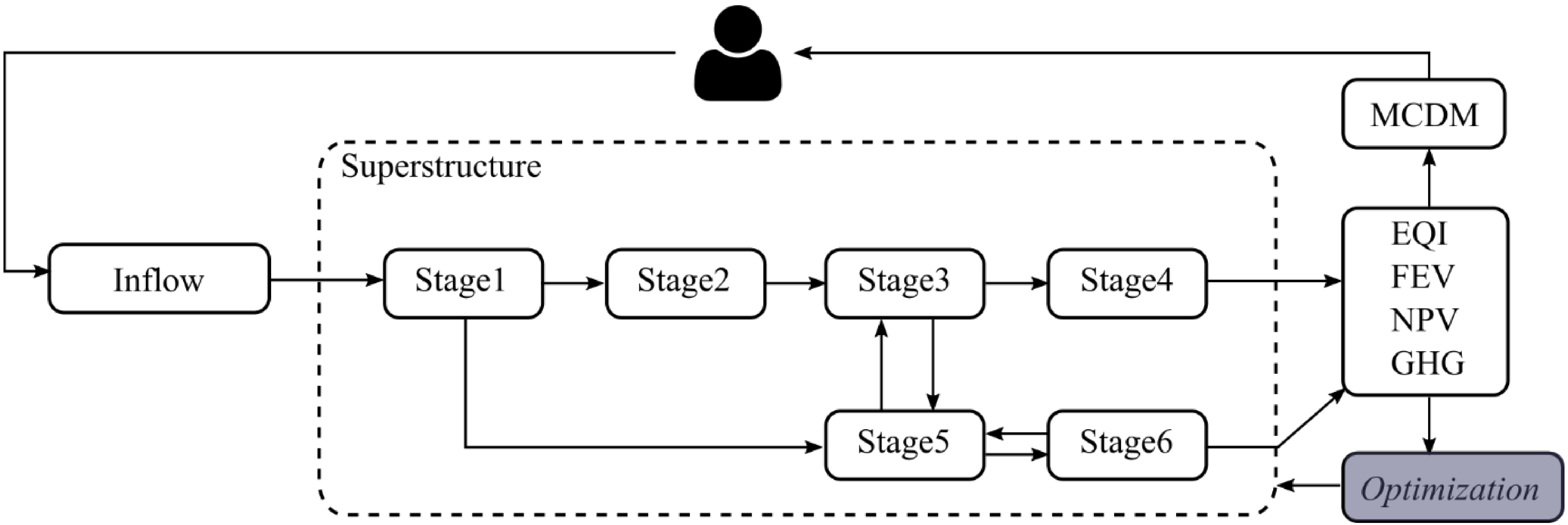
- **Effluent Quality Index (EQI)**
- **Frequency Effluent Violations (FEV)**
- **Net Present Value (NPV)**
- **GreenHouse Gas (GHG) emissions**

Compute for all possible WWTP design configs!



STEP5: Design configuration sorting

lulti Criteria Decision Making (MCDM) based on user preferences
echnique for Order of Preference by Similarity to Ideal Solution (TOPSIS

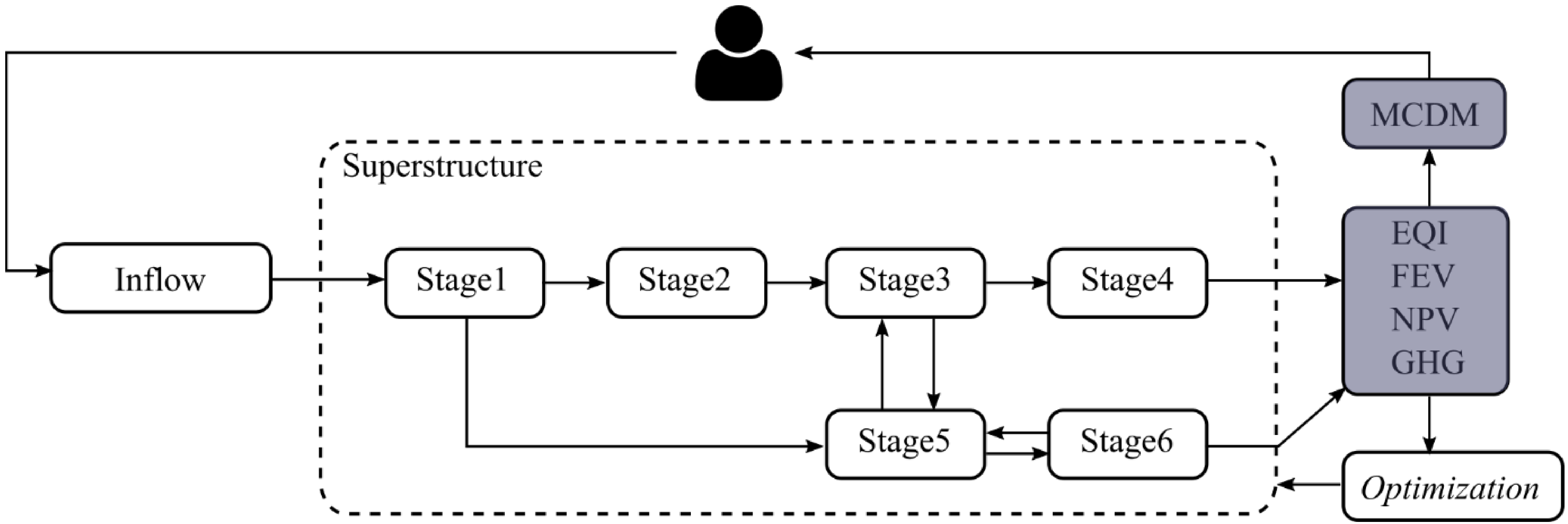


STEP6: Design parameter optimization

Minimize NPV optimizing Volume, S/L separation capacity, etc.

Constraints on FEV, HRT, SOR, etc.

Decrease configurations to optimize with MCDM



STEP7: Uncertainty analysis

Input and parameter uncertainty

Sensitivity analysis given the optimal design

Conclusions

- Design is based on dynamic and static process models
- Effluent limits fully accounted
- Design of discrete event processes (e.g. SBR)
- Design integrates the WWTP control system
- Influent model for Europe

For future work

- Test global optimization strategies for design optimization
- Build user friendly web-interface
- Perform simulations in a distributed computing environment
- Integrate other resource recovery technologies
- Increase the range of application of the inflow model to North America
- Integrate Life Cycle Analysis frameworks

Questions?

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