From wastewater treatment to space-inspired resource recovery with the Biomakery concept at La Trappe

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A water planet, also known as Earth
is facing fresh water shortages
Its inhabitants seem not to realize:
- they are all astronauts
- how affluent their home planet still is
- how resource-constraints limit Space travel
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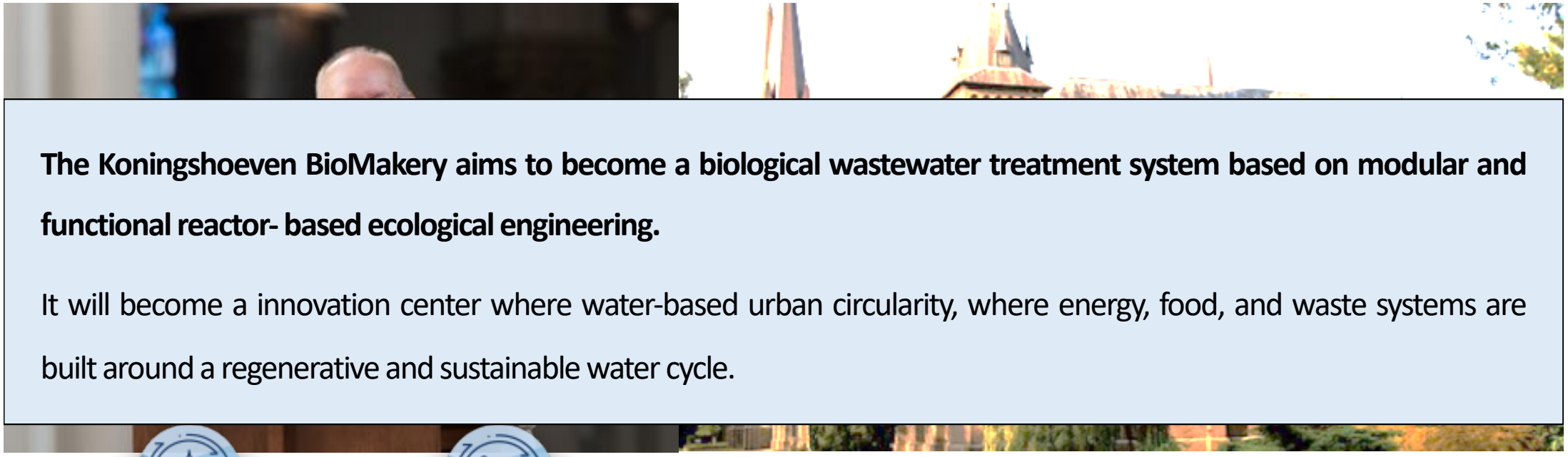
Abbey OLVv Koningshoeve – La Trappe



The Koningshoeven BioMakery aims to become a biological wastewater treatment system based on modular and functional reactor- based ecological engineering.

It will become a innovation center where water-based urban circularity, where energy, food, and waste systems are built around a regenerative and sustainable water cycle.

Water

Food

The nextGen consortium has received funding from the European Union's Horizon 2020 program under grant agreement No. 776541.

La Trappe - Site characteristics

Brewery water
360 m^3/day
High COD
Production 5 days a week Weekend no production
Cleaning chemicals: Fluctuating pH

Municipal Water
15-18m^3/day
Fluctuating N
100000 - 150000 visitors a year and ~20 monks, ~70 brewery and Diamant employees
Unknown: pathogens & OMP

La Trappe – Status at start of Nextgen

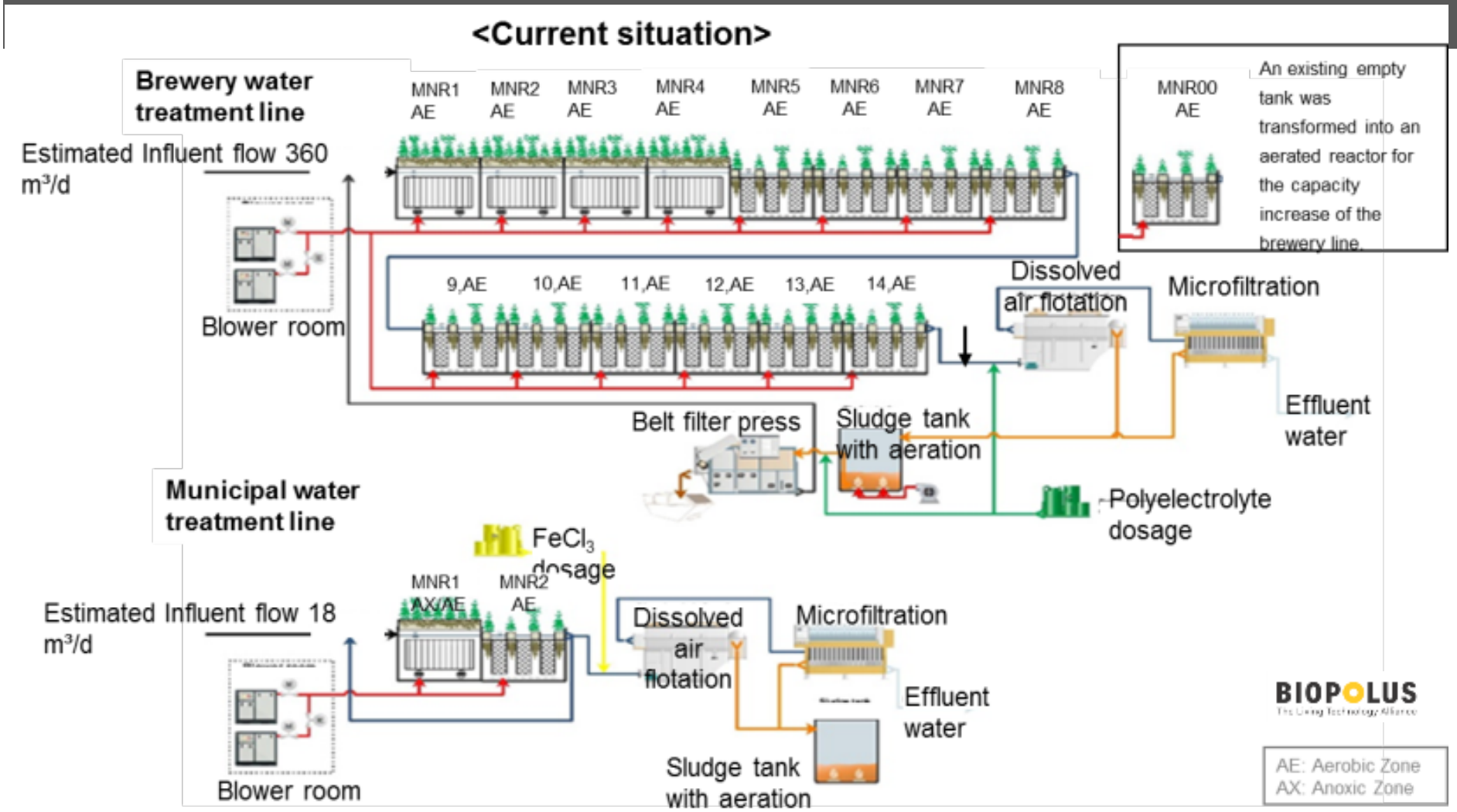
Brewery

Restaurant

MNR

Water discharge in canal
Preventing drought in area

Metabolic Network Reactor

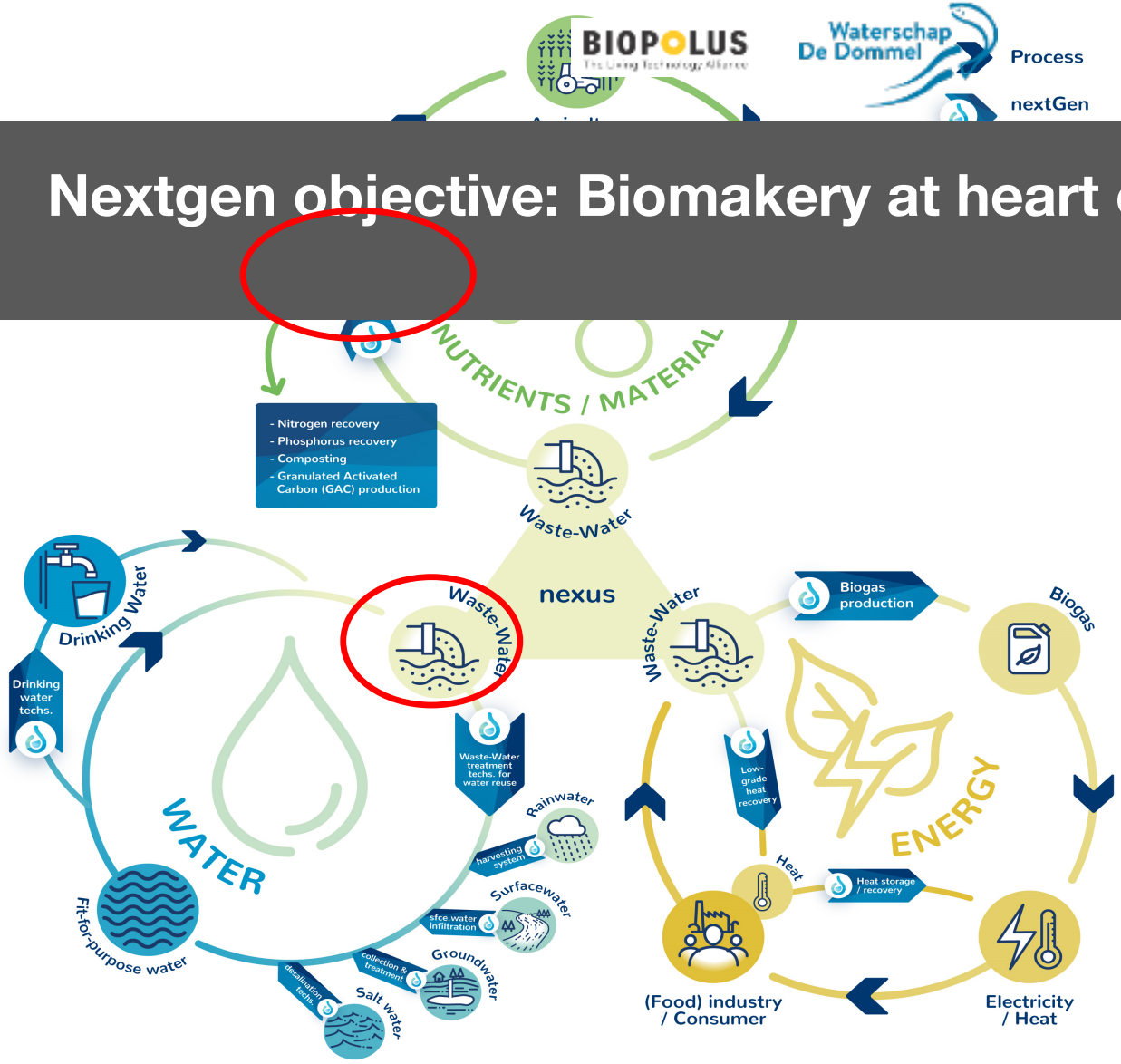


Nextgen objective

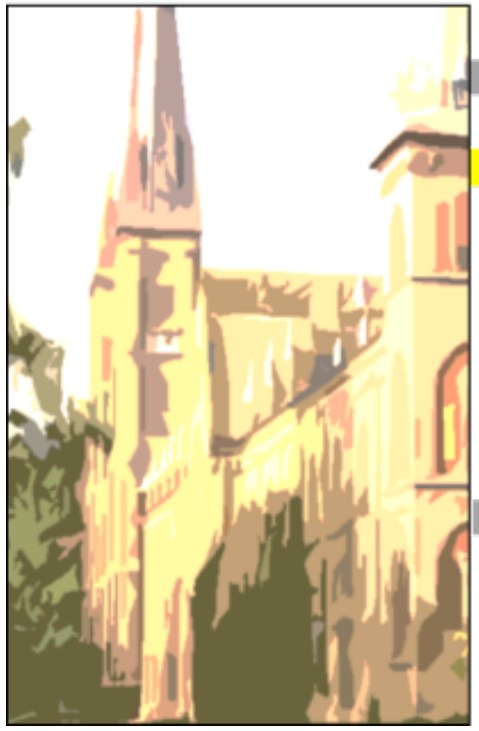
- ✓ Develop “Bio-makery - concept” for water reuse in decentralized areas and integrate MELiSSA technology
- ✓ Upcycle Metabolic Network Reactor (MNR) effluent for fit-for-purpose such as irrigation, bottlewashing or make up water for beer production

- ✓ Carbon, nitrogen and phosphorus recovery, with nutrients removed from the water converted into fertilizer used to produce plant or microbial protein

Nextgen objective: Biomakery at heart of Circular economy



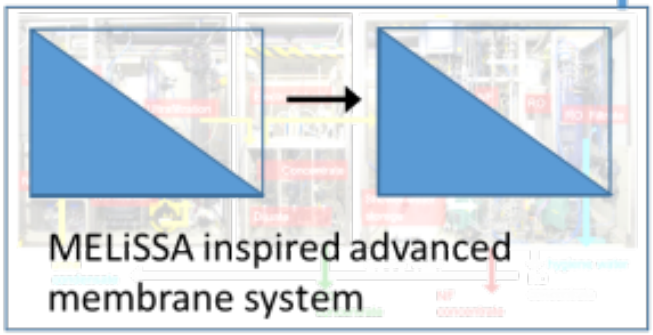
La Trappe – Addition of MELiSSA inspired technology



Brewery

Restaurant

MNR

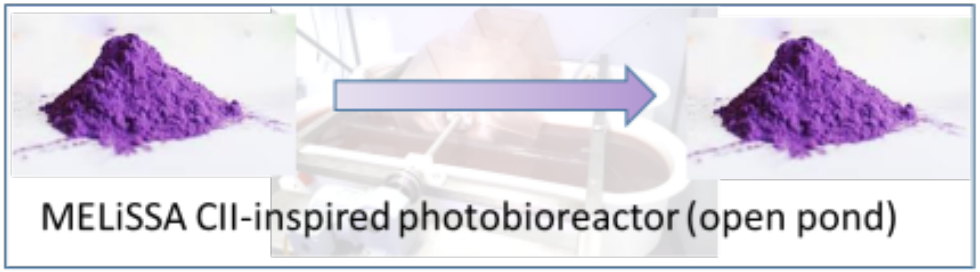


MELiSSA inspired advanced membrane system

Brine

Brewery

Urine



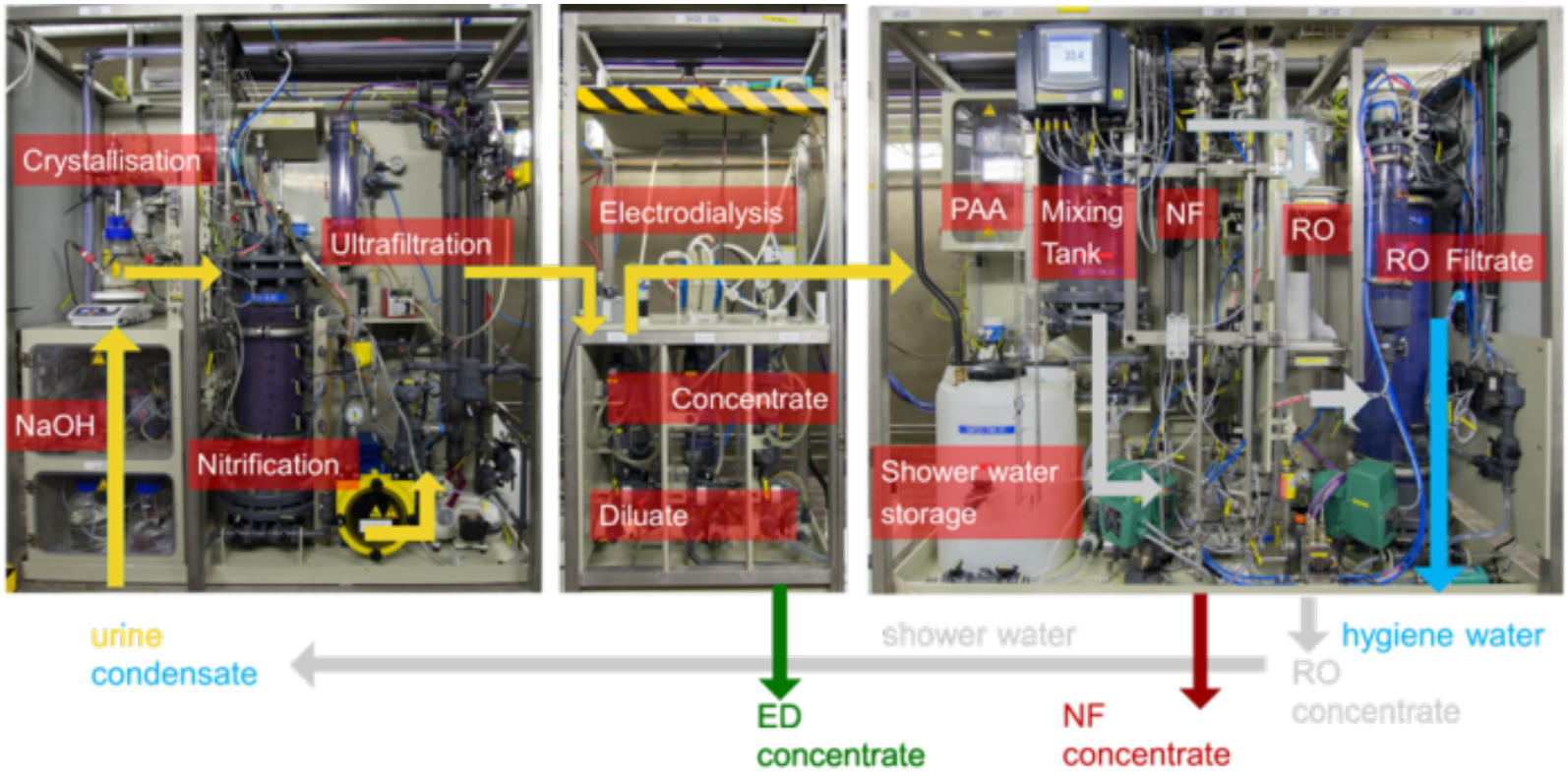
MELiSSA CII-inspired photobioreactor (open pond)

MELiSSA inspiration: CONCORDIA Research Station

French/Italian research station on Antarctica

- Aim to not contaminate pristine environment
  - 90%+ recycling of grey water for 10-15 overwintering sc
  - Semi-autonomous operation for 8 years
  - Very robust: limited maintenance required

MELiSSA inspiration: WTUB



De Paepe et al. (2018); Lindeboom et al. (2020)

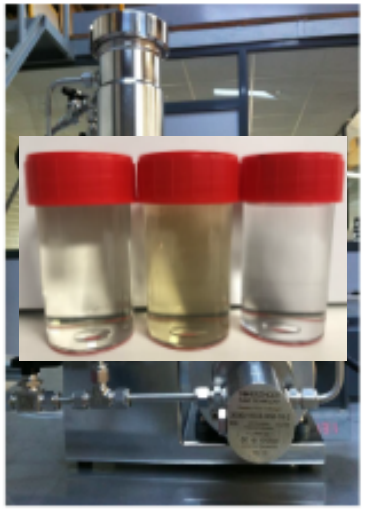
MELiSSA Advanced membrane systems – off-site tests

5L Raw brewery water send to France

2400 µS/cm

Ultrafiltration

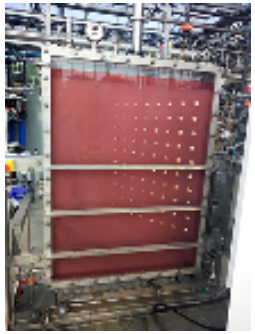
Reverse Osmosis



Potable water quality reached

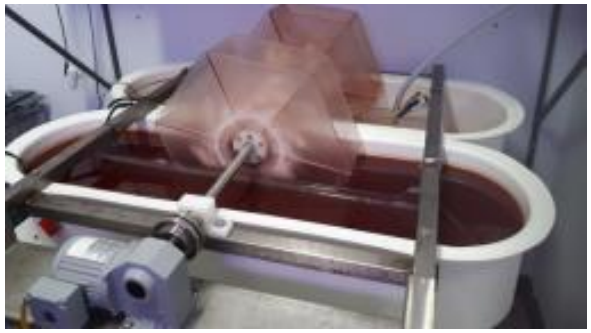
118 µS/cm

MELiSSA CII-inspired photobioreactor – off-site tests



MELiSSA Purple Bacteria Reactor (axenic conditions)

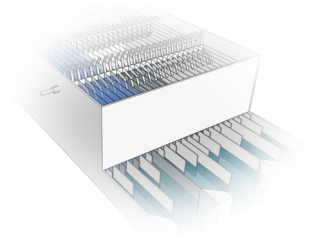
Translated into terrestrial open pond application in co-operation with UAntwerp



Operating Axenic conditions reactor not financially realistic for waste materials

ESA Proof-of-concept

AMSTERDAM INSTITUTE FOR ADVANCED METROPOLITAN SOLUTIONS



Hybrid futuristic reactor?

Designed by TUDelft BSc minor Environmental Engineering students

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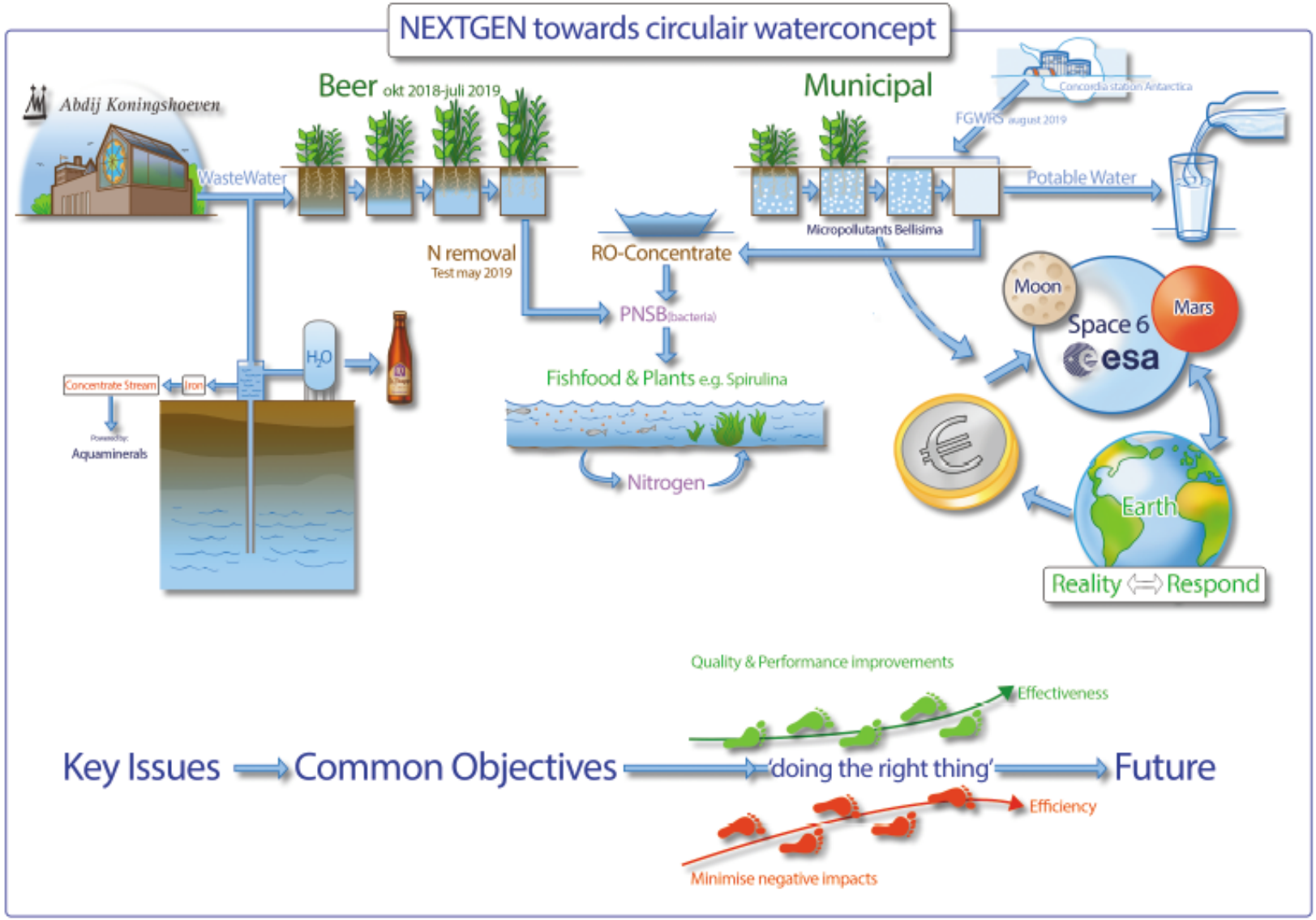
SEMILLA
IPSTAR Circular Systems

Future Biomakery



BIOPOLUS esa SEMILLA FGWRS

Thank you

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