Intelligent Control for Wastewater Treatment

Fiware4Water
Demo case Amsterdam

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COP Digital Water, January 20th 2022

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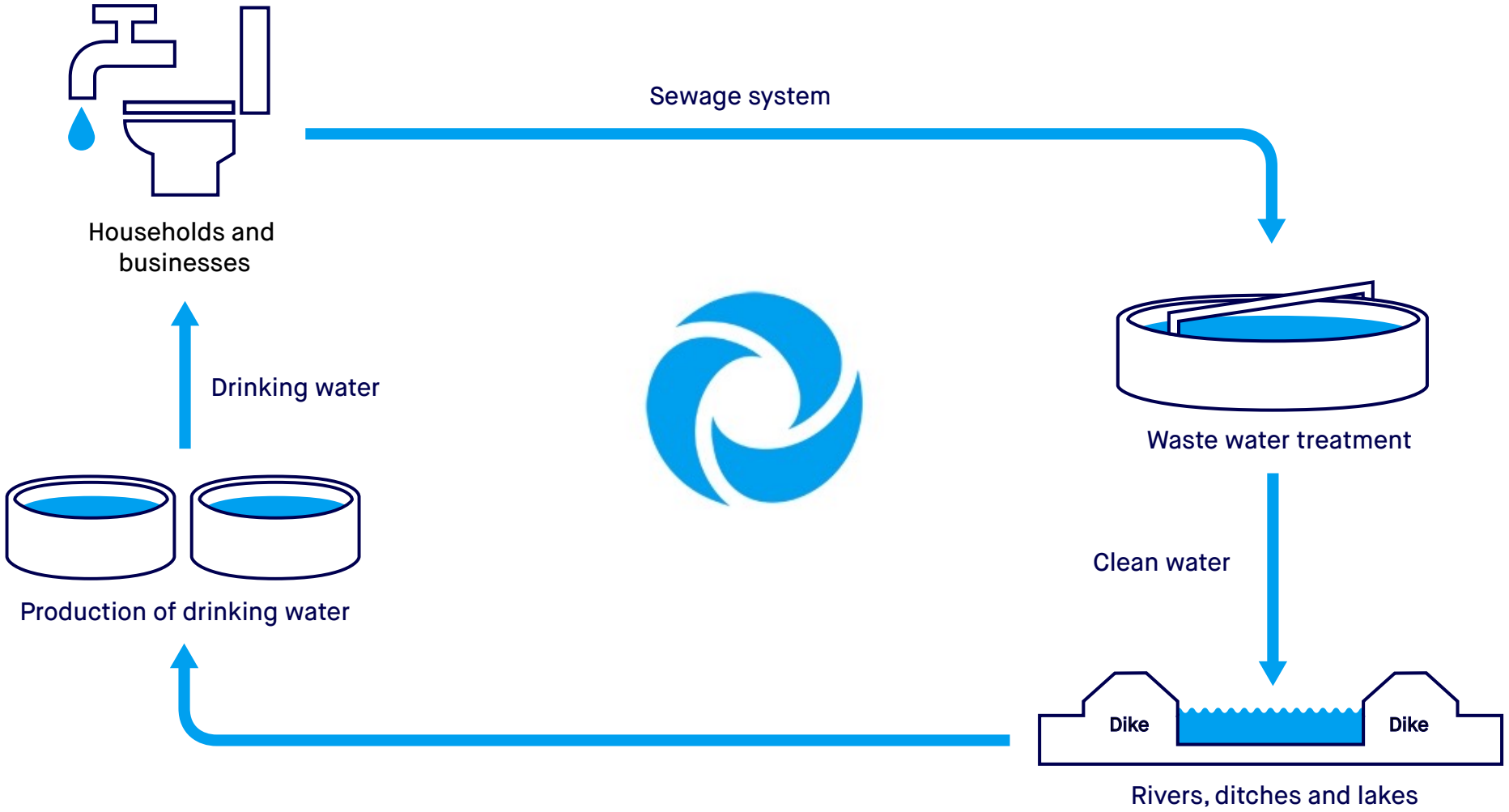
gemeente amsterdam

Waternet water cycle utility Amsterdam



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Our service area

- 18 municpalities
- Ca 1,3 million inhabitants
- In Amsterdam all water tasks

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FIWARE 4 WATER

Demo Case #1 • Greece

Athens • Water Supply System
real time operational managment

Demo Case #2 • France

Cannes • Improving the Water Supply System

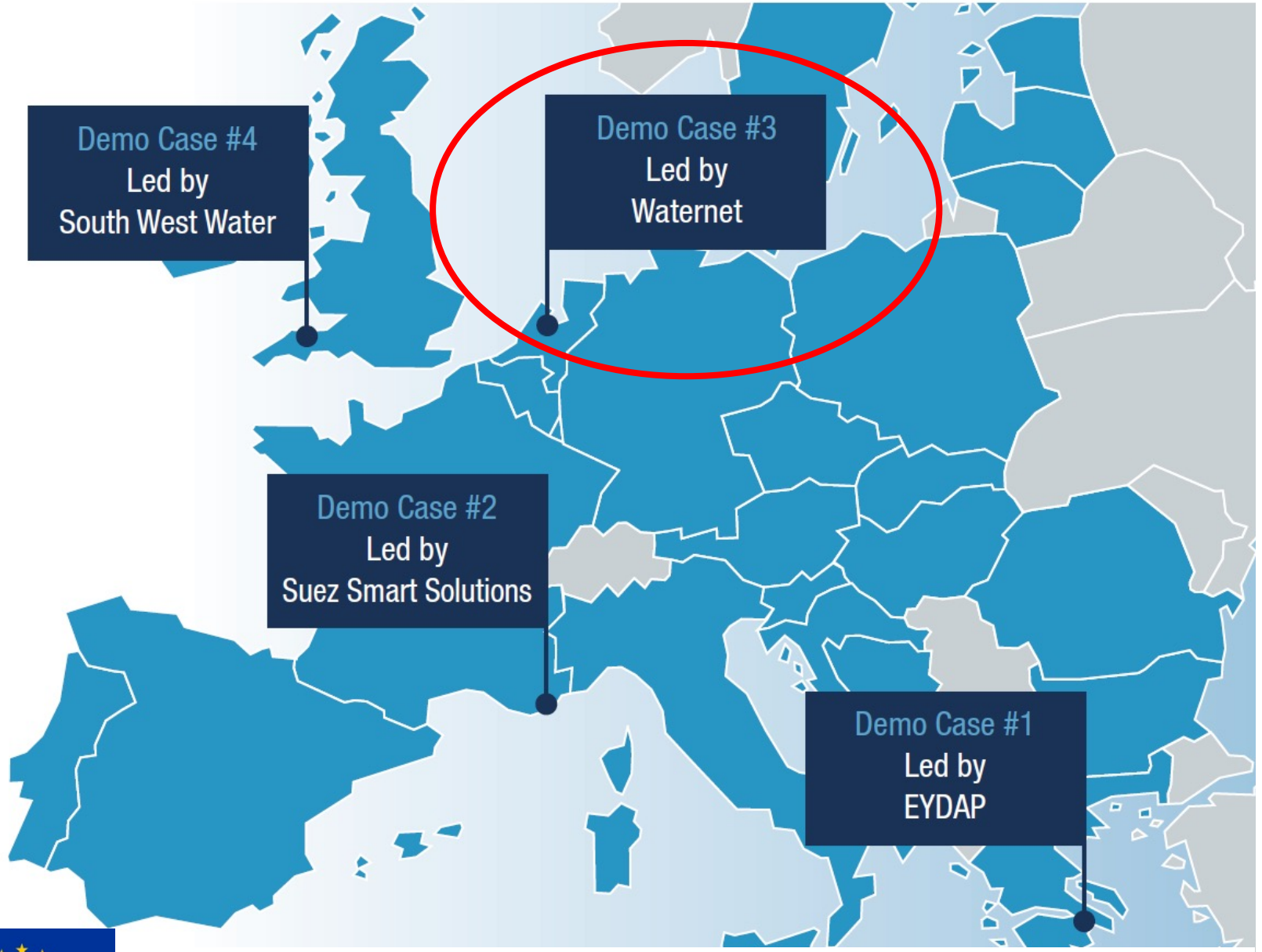
Demo Case #3 • Netherlands

Amsterdam • Intelligent control for wastewater treatment

Demo Case #4 • United Kingdom

Great Torrington • Smart Meters and Customers

www.fiware4water.eu



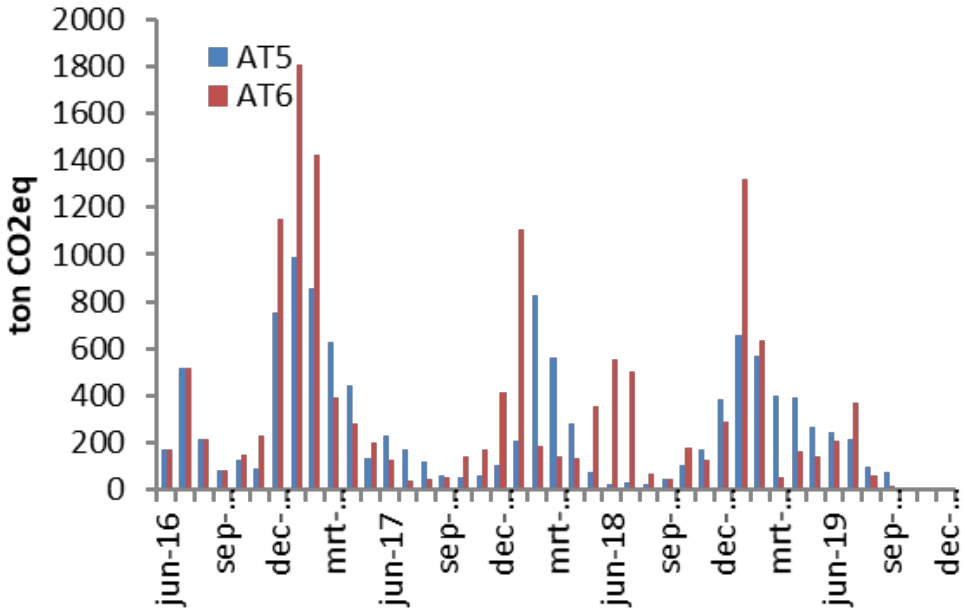
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 821036.

Wastewater treatment plant Amsterdam West

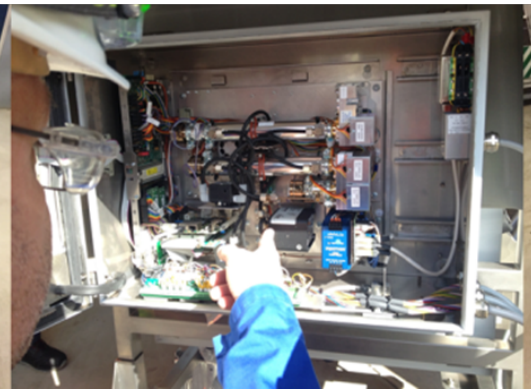
Nitrous oxide (N_2O) gas emissions

Real-time measurement in off-gas aeration tanks (ATs) of WWTP Amsterdam West starting 2016:

15 – 28 kton/year CO2-eq





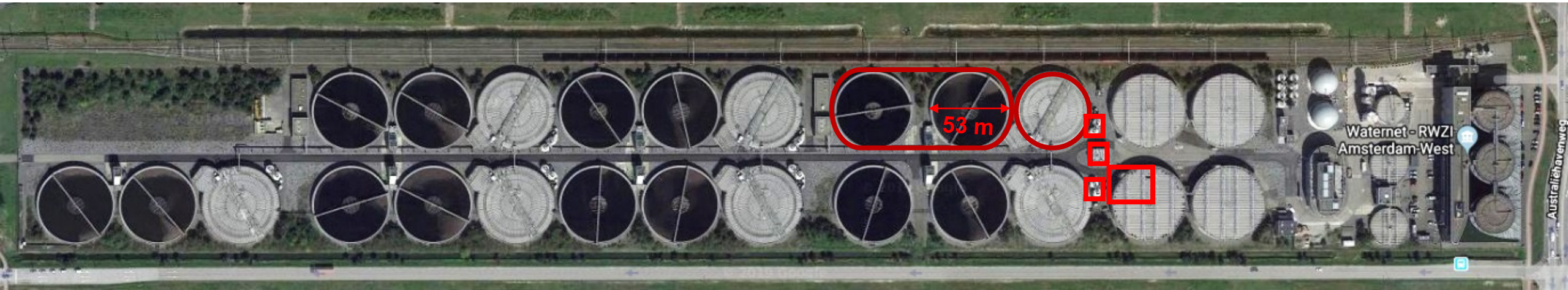




Full-scale research lane

Objective: Reduction of nitrous oxide emission and electricity use aeration

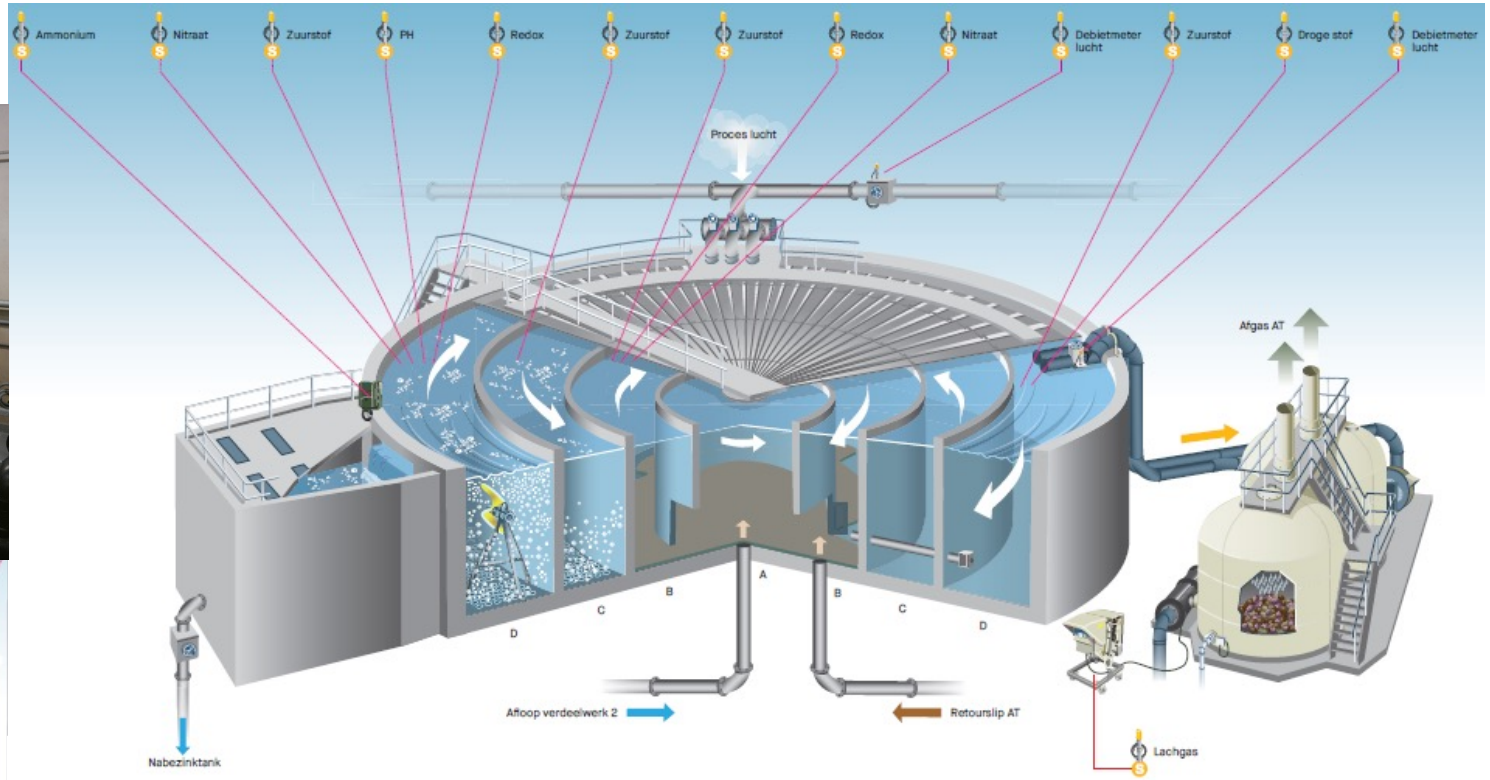
Installing additional sensors

Treatment optimisation with Artificial Intelligence



Additional on-line sensors

Research facility



Aeration tank

Off-gas

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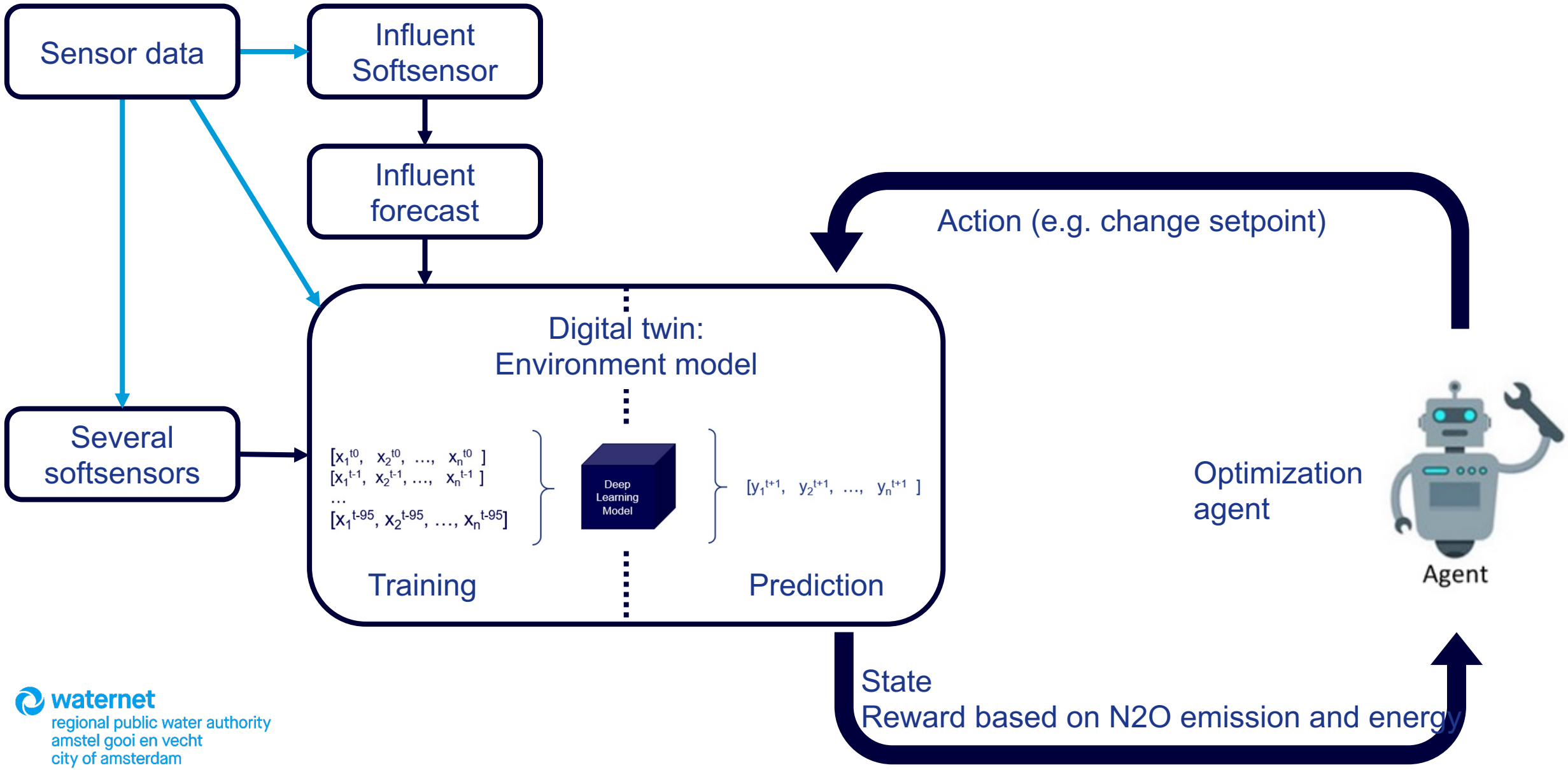
WWTP Amsterdam West AI setup



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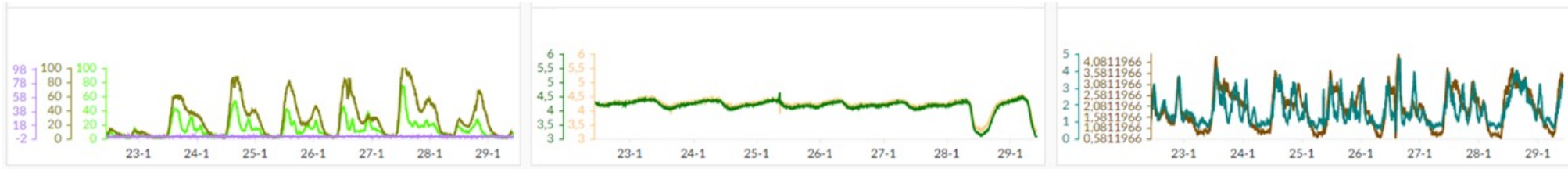
Data used in digital twin

- Setpoints e.g. oxygen setpoint in aeration tank
- Water flows e.g. influent, internal recirculation flows
- Water quality parameters e.g. oxygen, ammonia, nitrate, dry solids
- Air flows, incoming process air and off-gas flows
- Off-gas quality parameters e.g. N_2O
- Blower data e.g. energy use
- Air valves settings of the different compartments in the aeration tank



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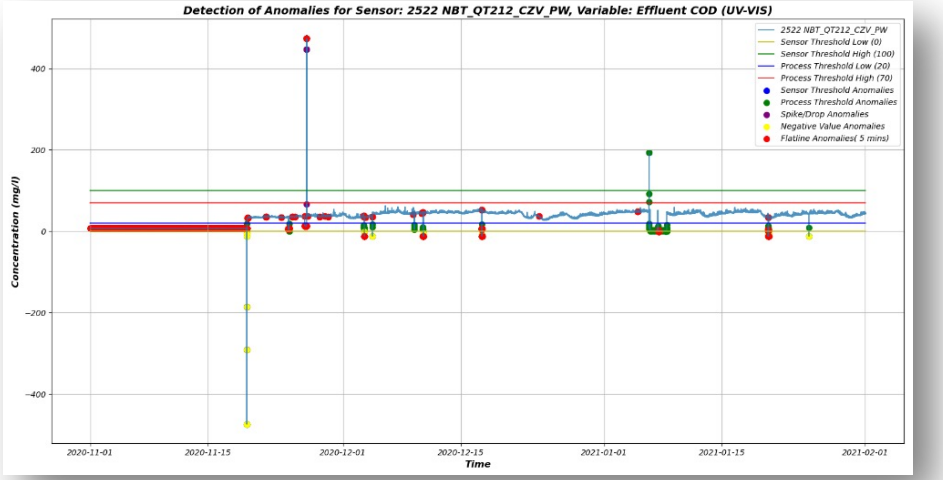
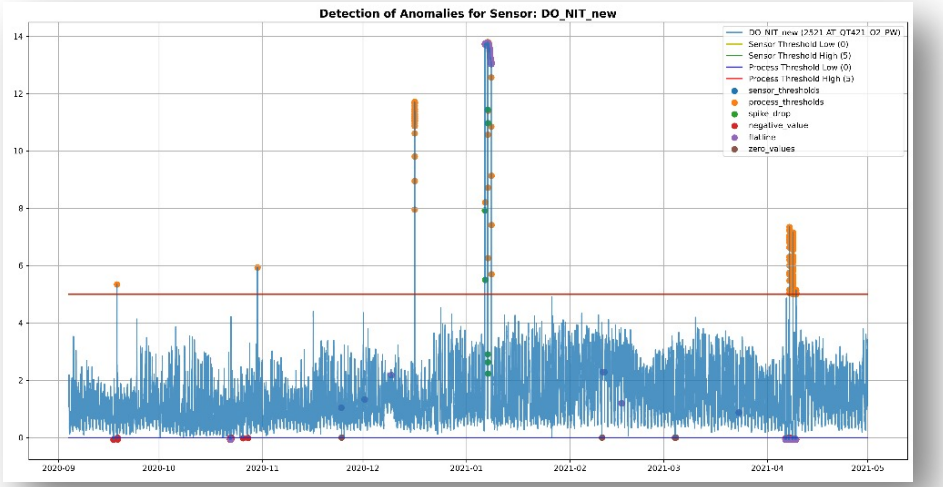
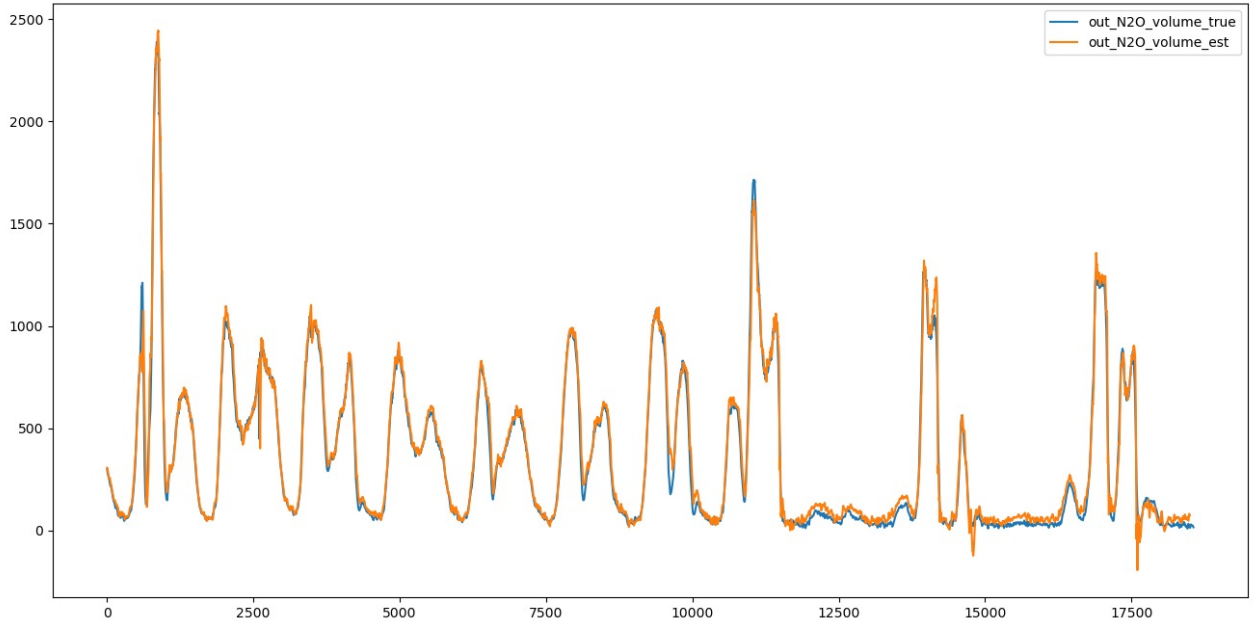
Automatic Data Validation and Data Quality Control

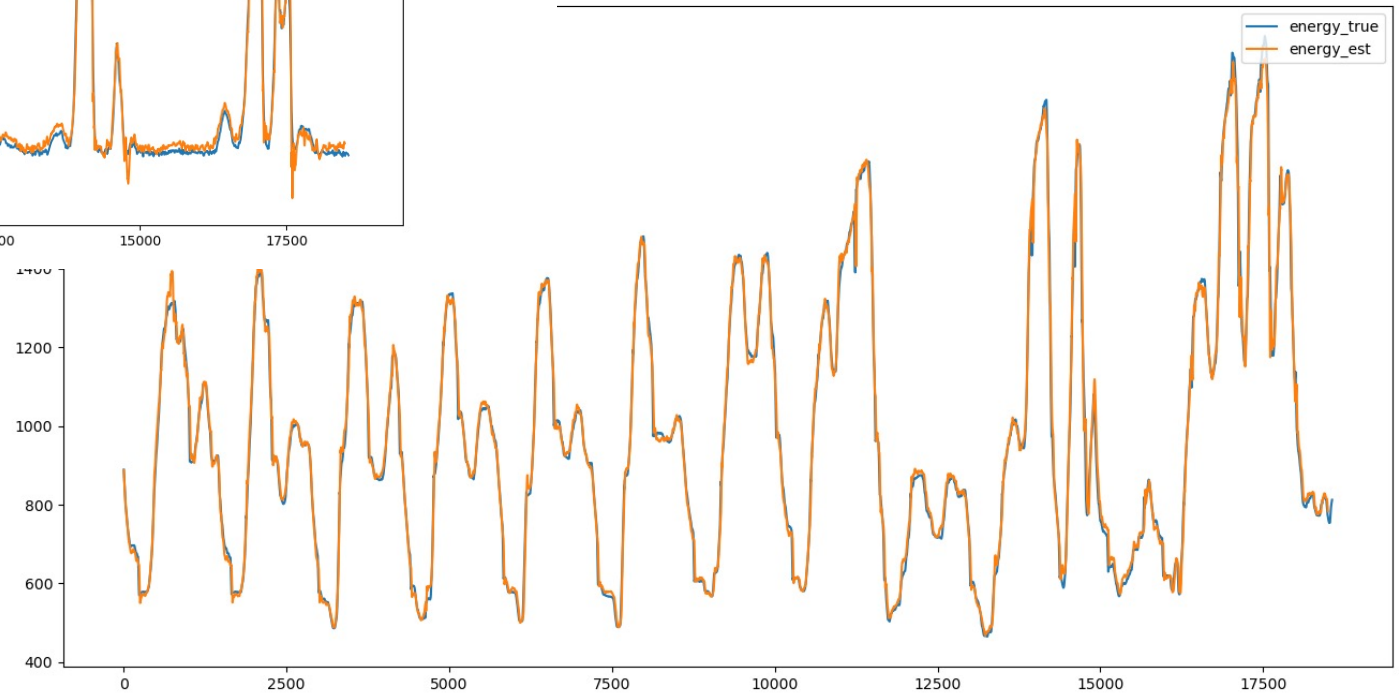
- Simple statistical methods to detect gross sensor anomalies due to sensor failures.
- Collection of crucial metadata on sensors and guidance from process technologists.
- Detection of contextual anomalies using model-based detection.
- Development of soft sensors for crucial parameters (such as NH4 in aerobic tank) for data reconciliation.
- Conduct a (near) real-time data validation process using Fiware.





Validation results for N_2O emissions and blower energy use





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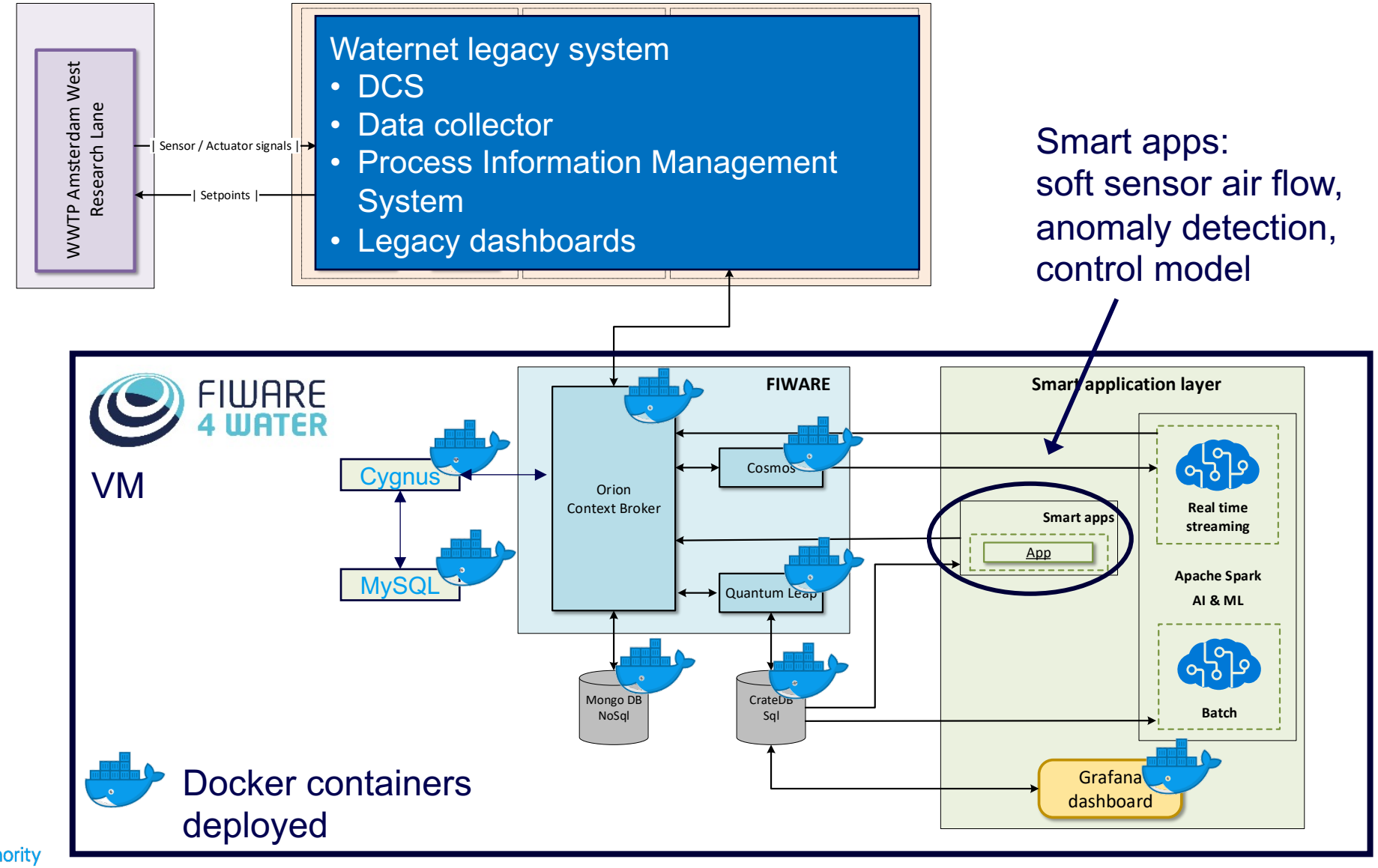
Integration of FIWARE to legacy system



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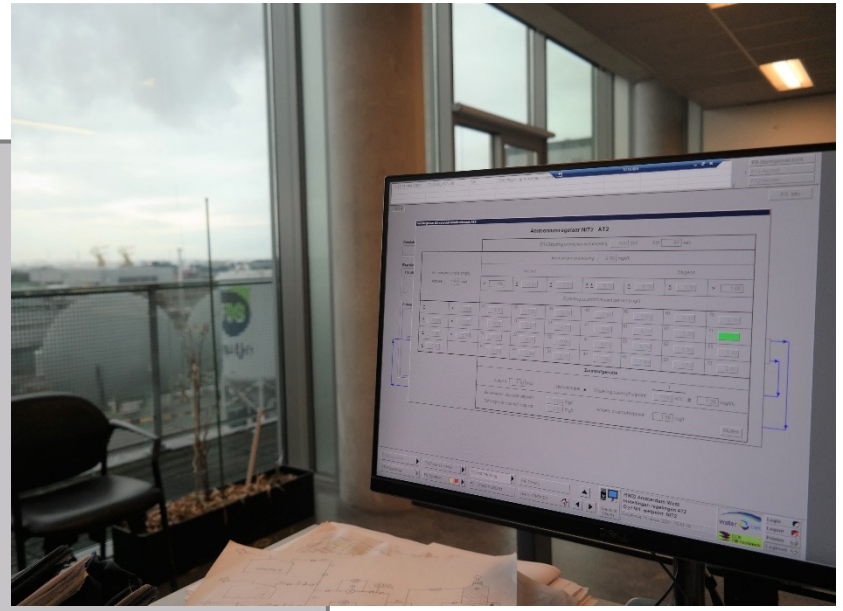
AI control implementation



IG11.4

Datalab zuurstofsetpoint

Minimum waarde 0.80 mg/l
Maximum waarde 10.00 mg/l
Filtertijd (gemiddelde berek.) 10 min.
Gefilterd setpointwaarde 2.50 mg/l

Regelkeuze: Datalab

Datalab klepstand(en) regelafsluiters

Minimum waarde 0 %
Maximum waarde 100 %
Filtertijd (gemiddelde berek.) 25 min.
Vertr.tijd 2e klep openen 60 min.
Gefilterd klepstand 0 %
2e regelafsluiter openen

Regelkeuze: Datalab

Bepaling zuurstofsetpoint

Handingave zuurstofsetpoint

Zuurstofsetpoint 2.00 mg/l

Automatische bepaling zuurstofsetpoint

DWA-bedrijf dNH_4/dt 0.00 mg/l
Actueel ammoniumgehalte NIT2 0.00 mg/l
Ammonium tabelregelaar dO_2/dt -1.08 mg/l/h
Bijstelling setpoint per 1000 sec. 0.80 mg/l
Instellen

Regelkeuze: HAND / AUTO

O_2 setpoint 2.50 mg/l

PID regelaar (+ / -) Instellen

Begrenzing: Maximaal 100 %, Minimaal 10 %

Keuze regelstrategie: 1 Instellen; 2 Instellen

Regel-afsluiter 1: 45 %

Regel-afsluiter 2: 45 %

Nitrificatie compartiment

Actueel zuurstofgehalte NIT2 0.64 mg/l

Lessons learned

- Installing and maintenance of new sensors is time consuming
- Constantly checking data quality gives lots of new insight in the processes
- With fast agile implementation you learn quick and you fail quick
- Close interaction between data scientists and technologists is essential
- You need data scientists ánd machine learning engineers
- We just started to explore the power of implementing AI