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Adapting to changing conditions: leveraging AI in the operation of wastewater treatment facilities

Project partners

RENNES MÉTROPOLE

- Whole urban water-cycle
- 43 communities - 457,000 inhabitants
- 1500 km sewer system
- 25 WWTP (1,000-360,000 PE)
- Ambitious climate-program (by 2030)
  - -5%/year of electricity use of WWTP
  - -2%/year GHG emission of WWTP

IWA | Climate Smart Utilities

OKwind GROUPE

- Renewable energy - specialized in solar
- Energy transition on every scale
  - Decentralized energy production + self-consumption

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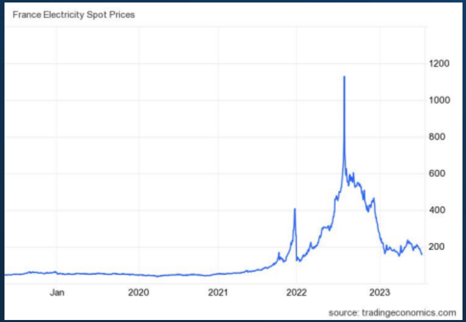
- Intelligent automation & control systems for energy and water operation optimization
  - Real-time control based on AI
  - stable effluent - robust performance
  - reduced energy demand

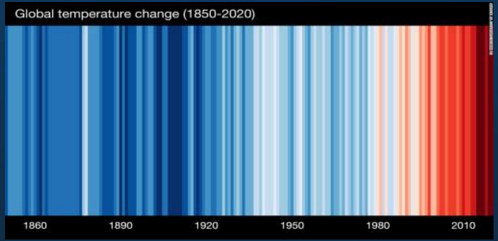
Current challenges and background

Operational costs



Sustainability

Direct and indirect GHG emissions



New regulations

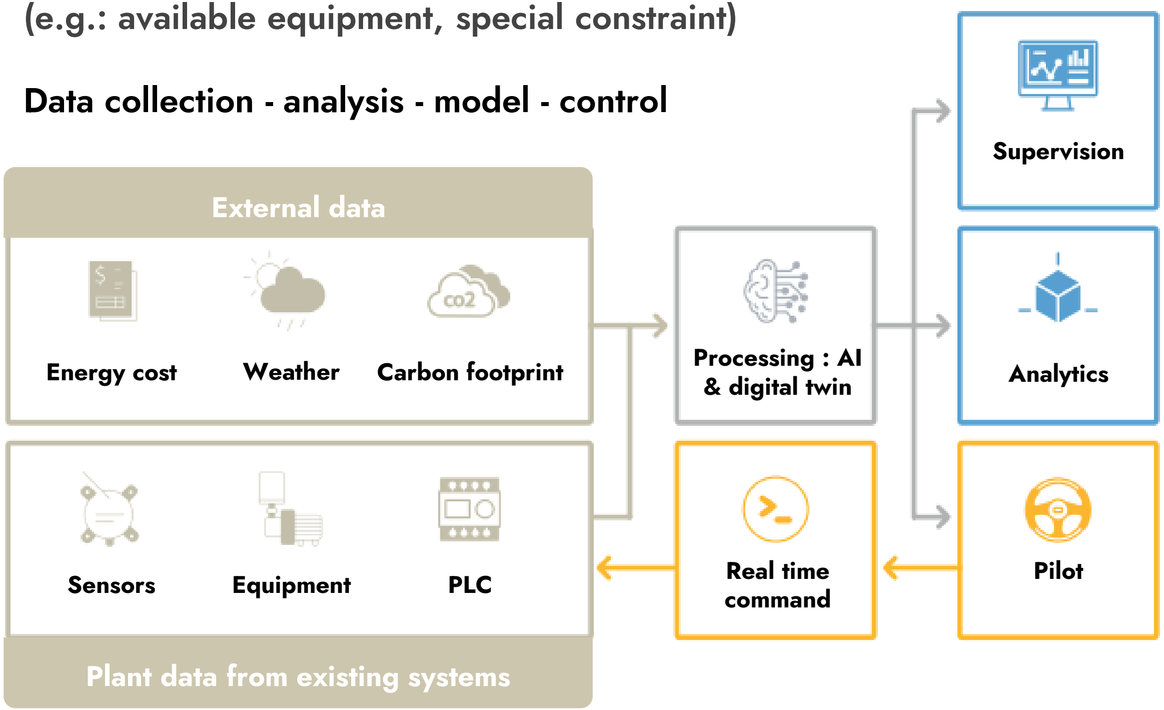
Updates to UWWTD

- Nutrient removal
- Energy efficiency
- Climate neutrality
- CEC, rainwater etc

Project approach, methodology

Project definition - site specific challenges
(e.g.: available equipment, special constraint)

Data collection - analysis - model - control



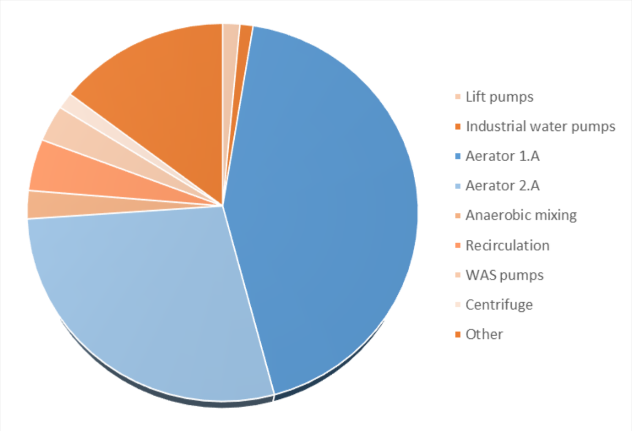
Interactive & customized performance dashboard
(e.g.: reports, discharges evolution, timelines)

Energy management
(e.g.: power disaggregation)
Anomaly detection
(e.g.: clogs, leaks detection, overflows, performance deviations)

Send automated, optimized and real-time commands to achieve specified objectives
(e.g.: Self consumption optimization, equipment control regulation)

2 Case study: Acigné WWTP

14,000 PE



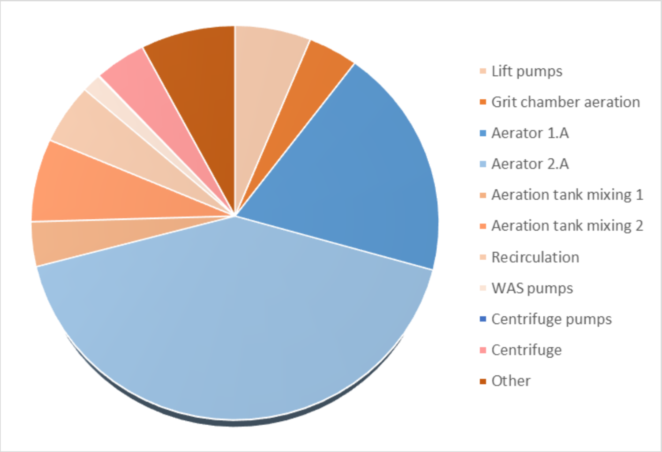
Aim:

Aeration optimization with regards to complete nitrogen removal

3

Case study: Cesson-Sévigné WWTP

30,000 PE



Aim:

Aeration optimization with regards to complete nitrogen removal

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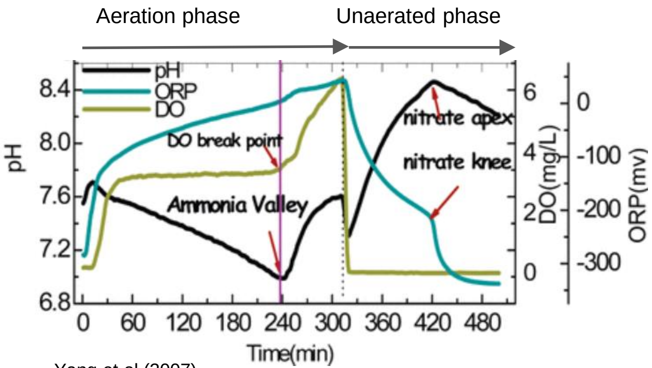
Lacking sensor data - Soft sensor development



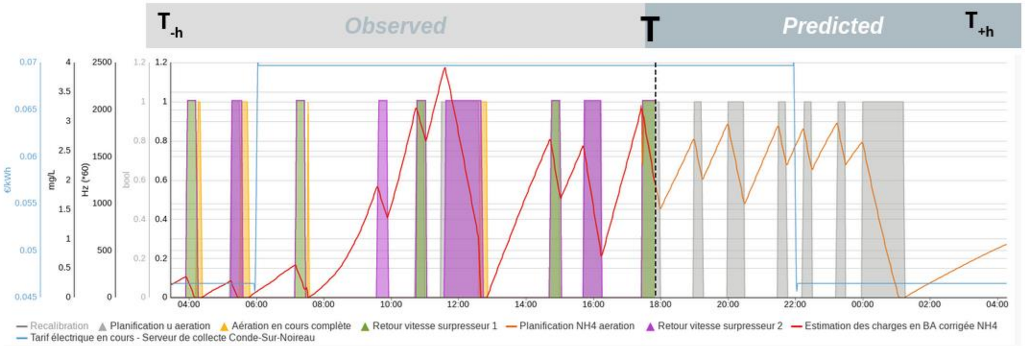
Yang et al (2007)

From research:

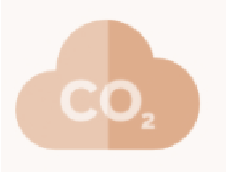
- available data: ORP, DO, pH
- specific pattern - indication of certain processes

In application:

- Training period (3 months)
- Using calibrated soft sensor and additional parameters for aeration planning

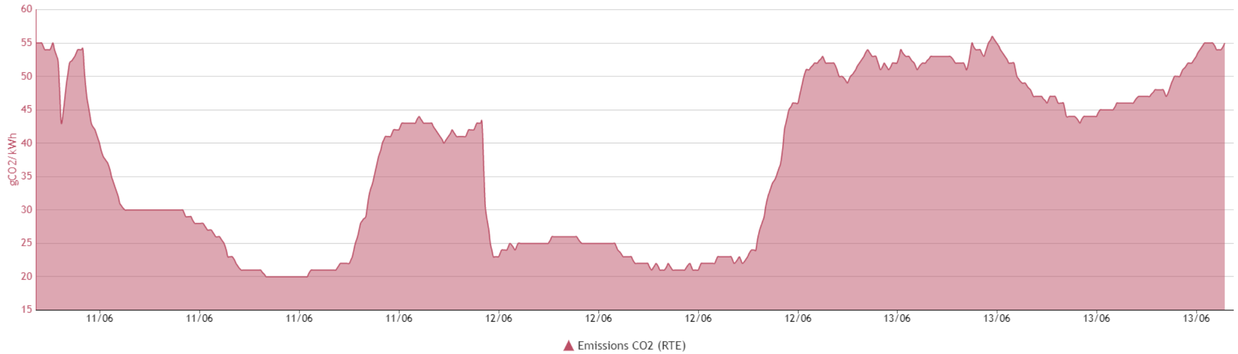


Carbon footprint of energy use



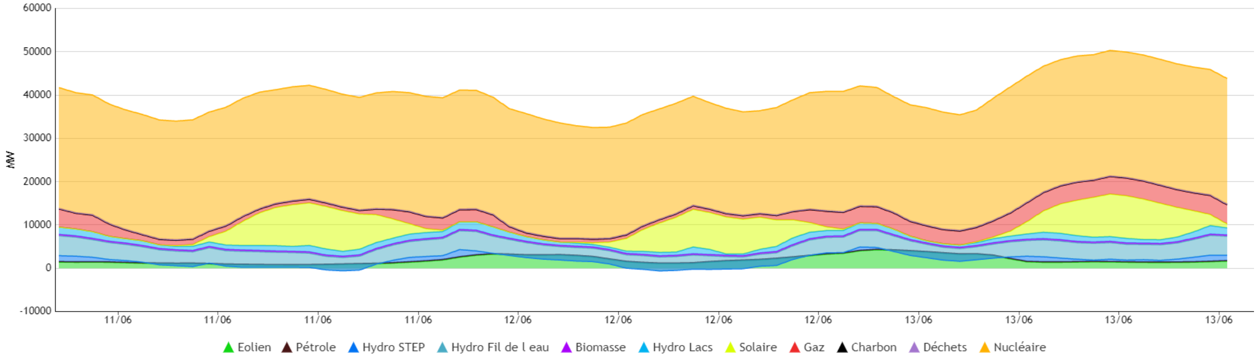
Carbon intensity of electricity

Source : RTE (éCO2mix)



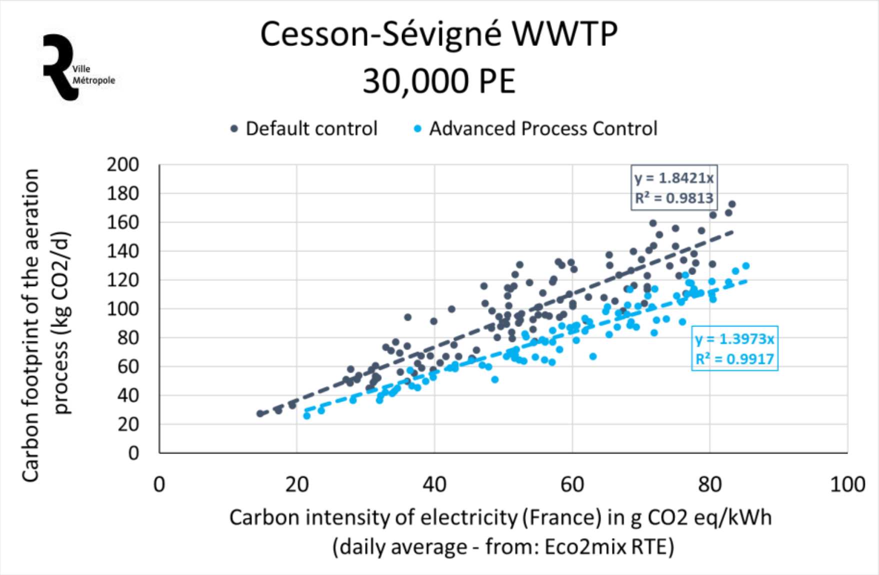
Origin of electricity mix, France

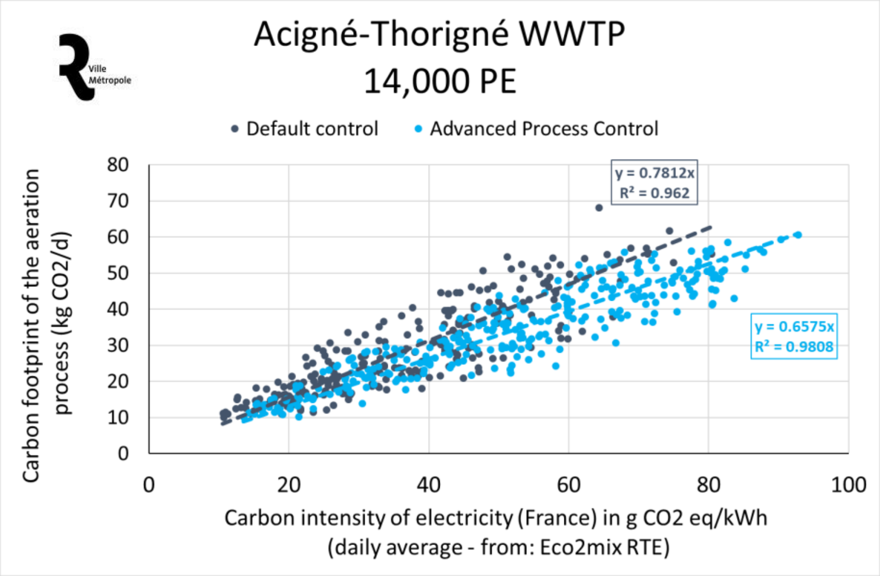
Source : RTE (éCO2mix)



ASTEE, 2022

Aeration optimization in Cesson-Sévigné & Acigné





-24%

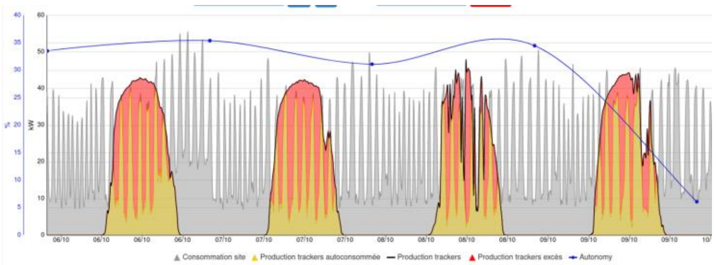
-16%

ASTEE, 2022

4

Case study: Laillé WWTP

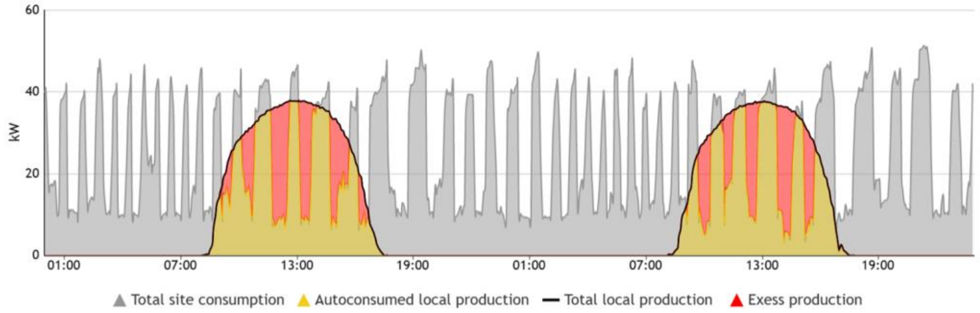
5,500 PE

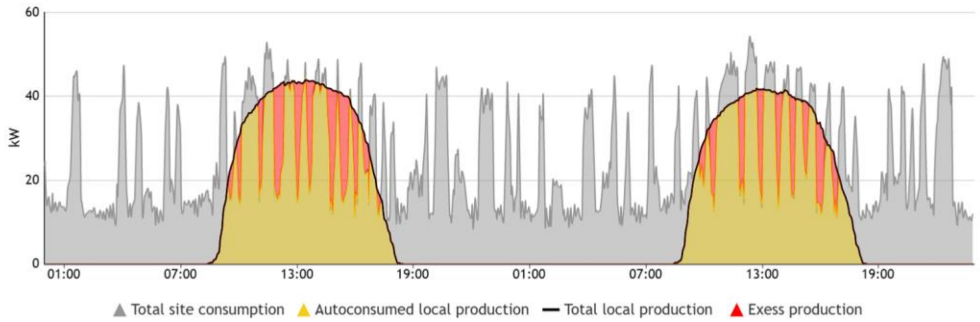


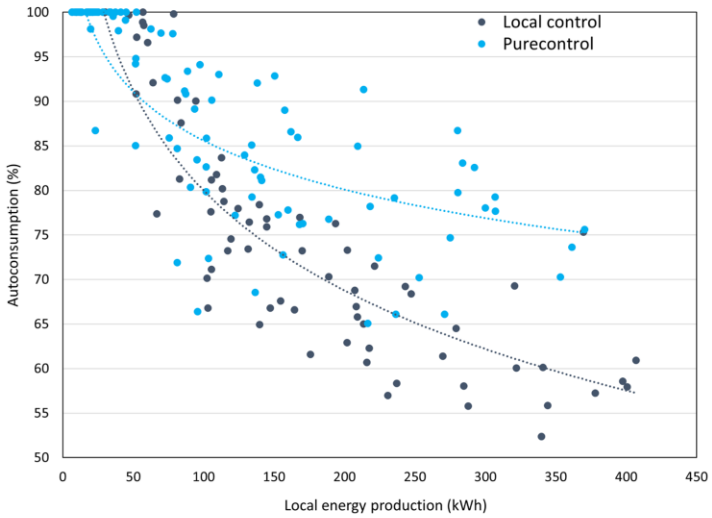
Aim:

Aeration optimization with regards of complete nitrogen removal and maximize self-consumption of locally produced energy

Aeration optimization: Laillé



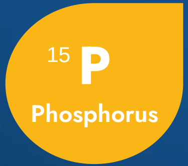




Pilot phase: 11/10/22 - 15/03/23

+15 % self-Consumption
in case of production higher than 200 kWh

Ongoing pilot projects



Phosphorus removal

Combined biological and physical-chemical P removal

- ❑ Soft sensor development for P
- ❑ Optimize chemical use
- ❑ Prioritize bioP

- ➢ Reduced chemical costs and related carbon footprint
- ➢ Reduced chemical sludge

N2O emissions

Reduction of direct GHG emissions - N2O

- ❑ ~300* more potent than CO2
- ❑ Up to 80% of carbon footprint of WWTP
- ❑ Multiple pathways during nitrification and denitrification

- ➢ Calibrated soft-sensor (hybrid model)
- ➢ Integrated into real-time control

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Thank you for your attention!

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