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SWAN-WaterLinks Webinar

Wastewater Digitalisation from Regional Lessons to Plant-Level Impact

March 3, 2026

3:30 PM GMT+8 | 6:30 PM AEST | 8:30 AM CET

Mai Flor
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Australia



Wastewater Digitalisation from Regional Lessons to Plant-Level Impact

March 3rd, 2026



Agenda

- Welcome & Short Poll
- Presentations
- Q&A / Open Discussion



WaterLinks
LINKING WATER OPERATORS THROUGHOUT ASIA



SWAN
ASIA-PACIFIC
ALLIANCE

SWAN Members

Global leaders in advancing smart water worldwide.



ASIAWATER 2026 SWAN WORKSHOP

Kuala Lumpur, Malaysia

April 8, 2026

Smart Water for Inclusive Growth:
Building Resilient Utilities Across Asia



ASIAWATER



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SWAN Workshops at Singapore International Water Week *South Asia & Asia-Pacific*

SINGAPORE
June 15 & 18, 2026



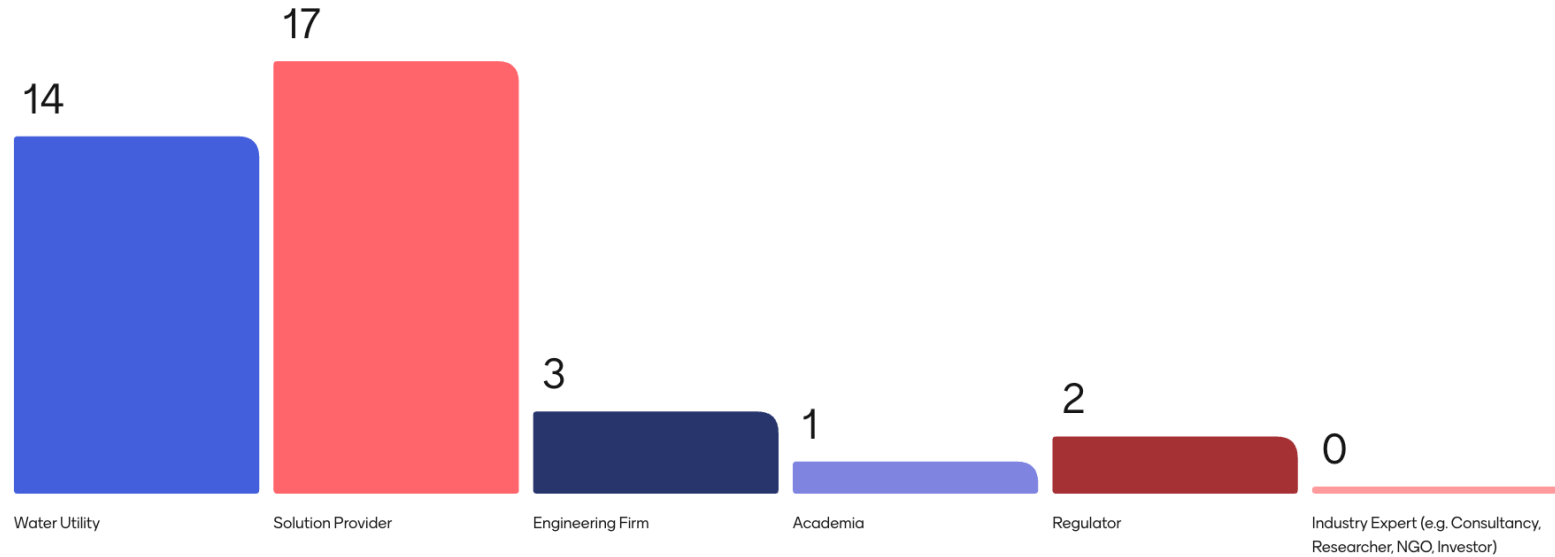
—○ Join the Conversation!



What country are you joining from?



What type of organisation do you work for?





WaterLinks

Dorai Narayana, Former Head of the Planning and Engineering Department (Indah Water Konsortium)
Board Member (WaterLinks)
Malaysia

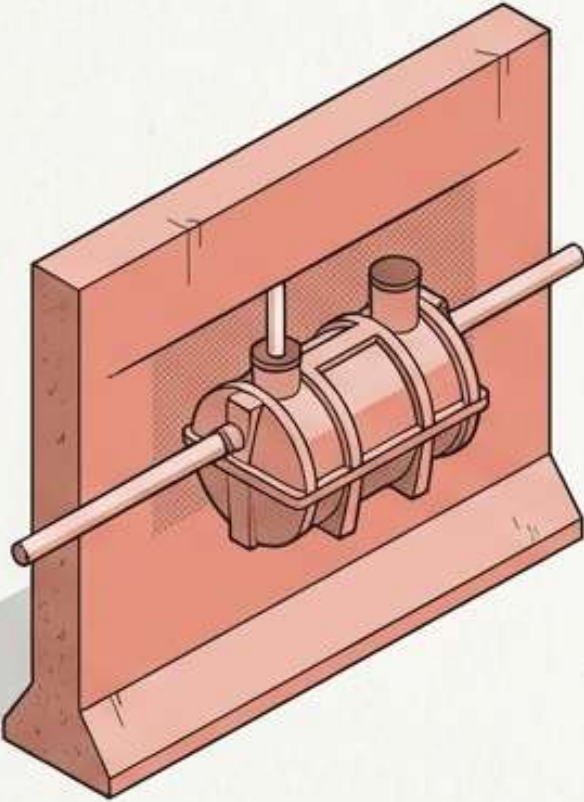


Wastewater Digitalisation

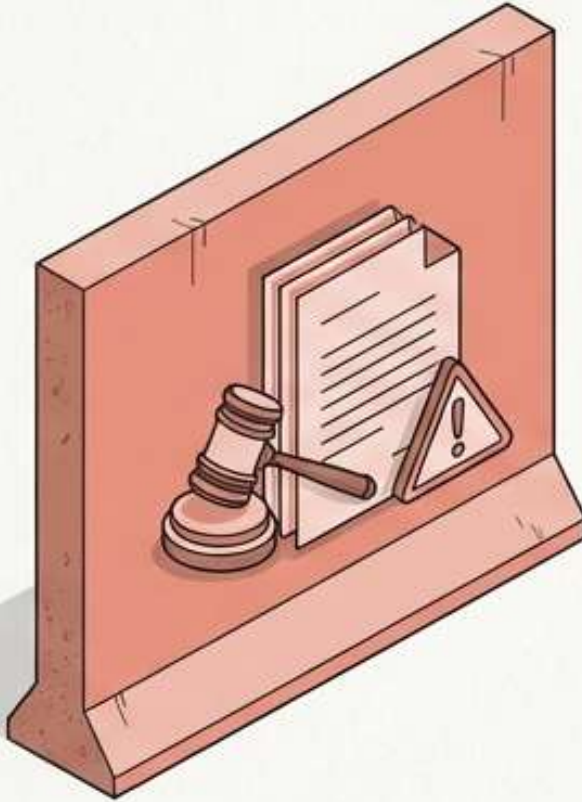
Setting the Regional Context

Dorai Narayana

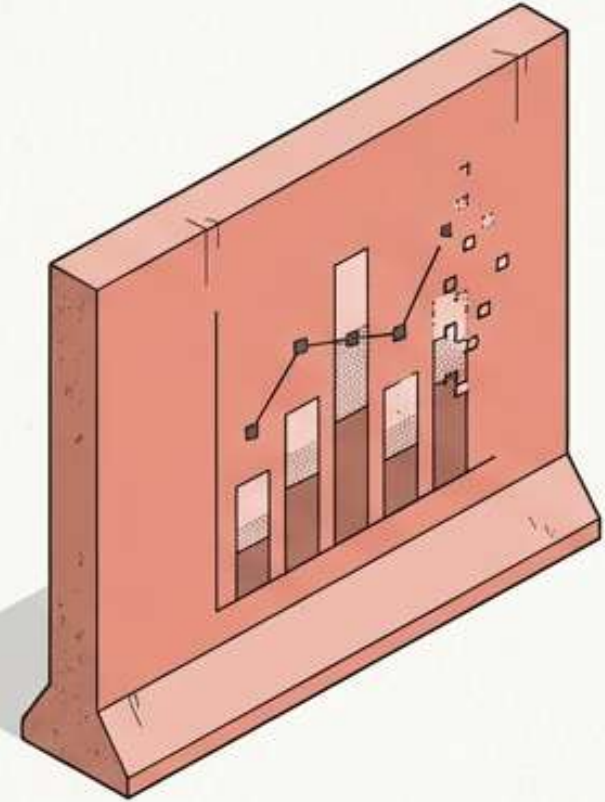
UNIQUE HURDLES IN THE REGION



Infrastructure Reality:
Predominantly
on-site systems.



The Governance Void:
Widespread lack of
regulatory governance.

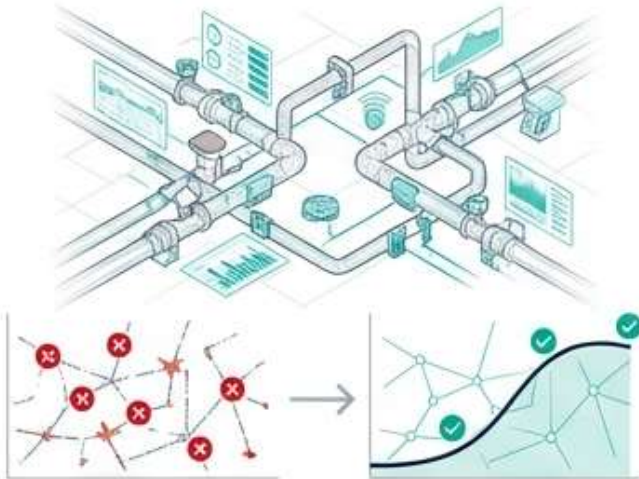


The Data Gap:
Insufficient, unreliable,
and incomplete data.

INTERNATIONAL AND NATIONAL IMPERATIVES ARE PUTTING PRESSURE ON GOVERNMENTS TO INITIATE IMPROVEMENTS



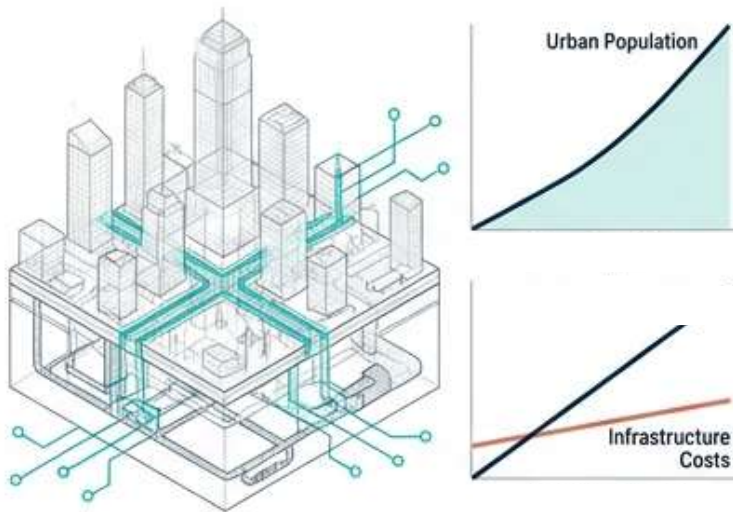
Service Delivery



**CUSTOMER DEMANDS AND
SERVICE ASSURANCE**



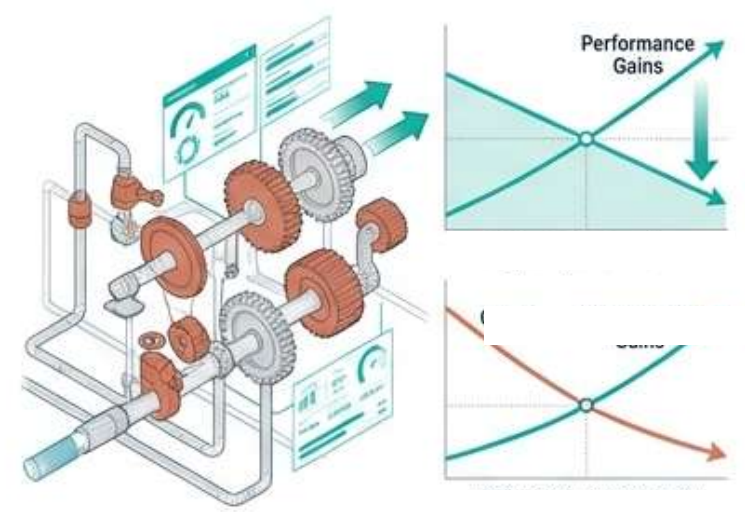
Coverage Expansion



**URBANISATION AND RELATED
PRESSURES**



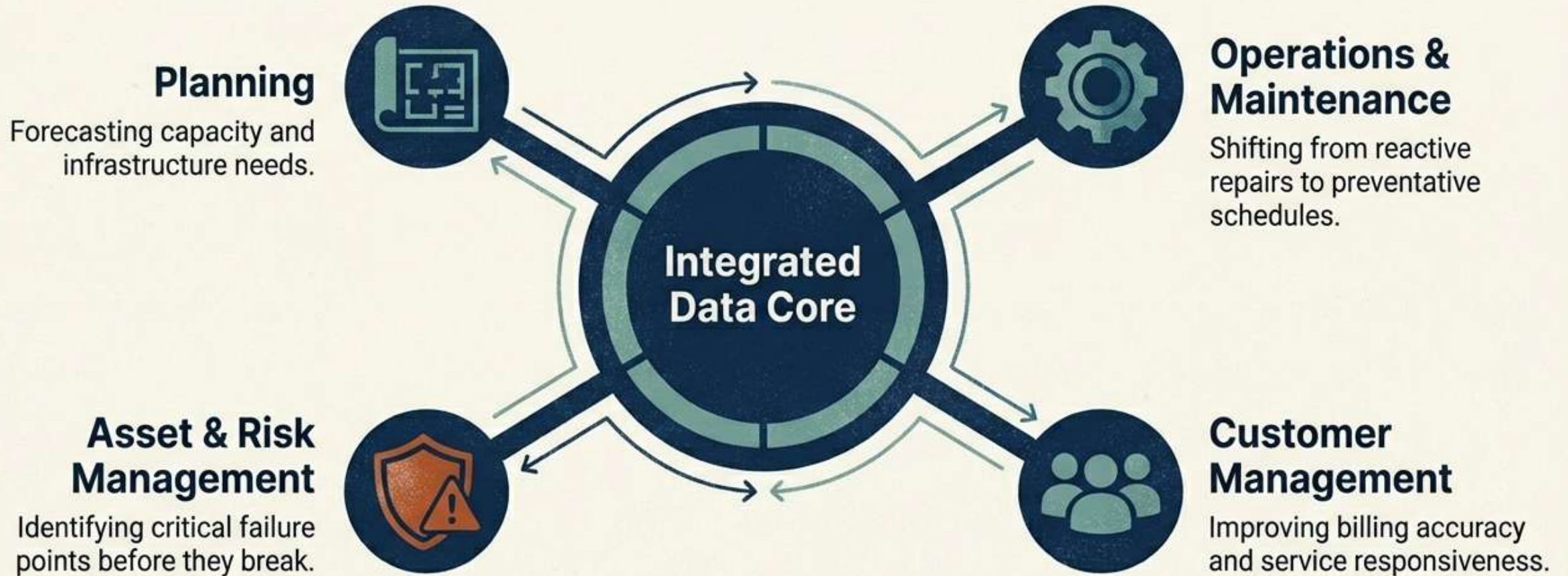
Efficiency



**MANAGING FINANCIAL
CONSTRAINTS THROUGH
EFFICIENCY IMPROVEMENTS**



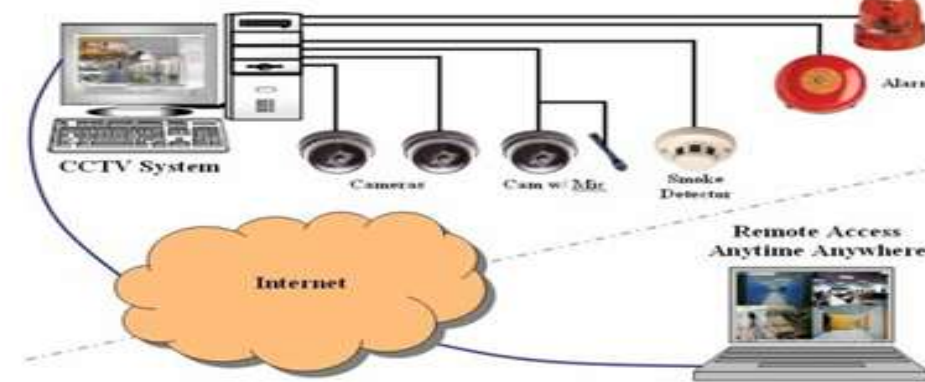
INDAH WATER KONSORTIUM, MALAYSIA: a success story





Tracking FSM services

Vehicle monitoring, routing, efficiencies



Remote unmanned STPs

- Early warning systems
- Electronic security systems



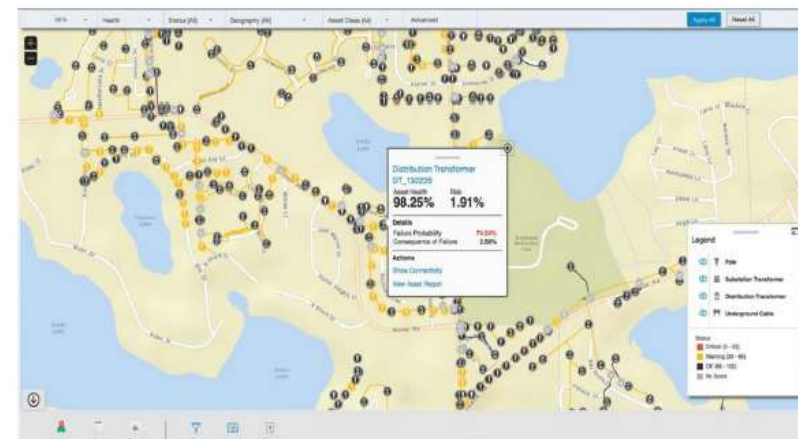
Sewer network: predicting events

- Flow modelling, detectors
- Level sensors
- Heat maps for preventive maintenance



Process control: efficiencies

- SCADA
- Equipment sensing: real time performance monitoring



Asset risk monitoring

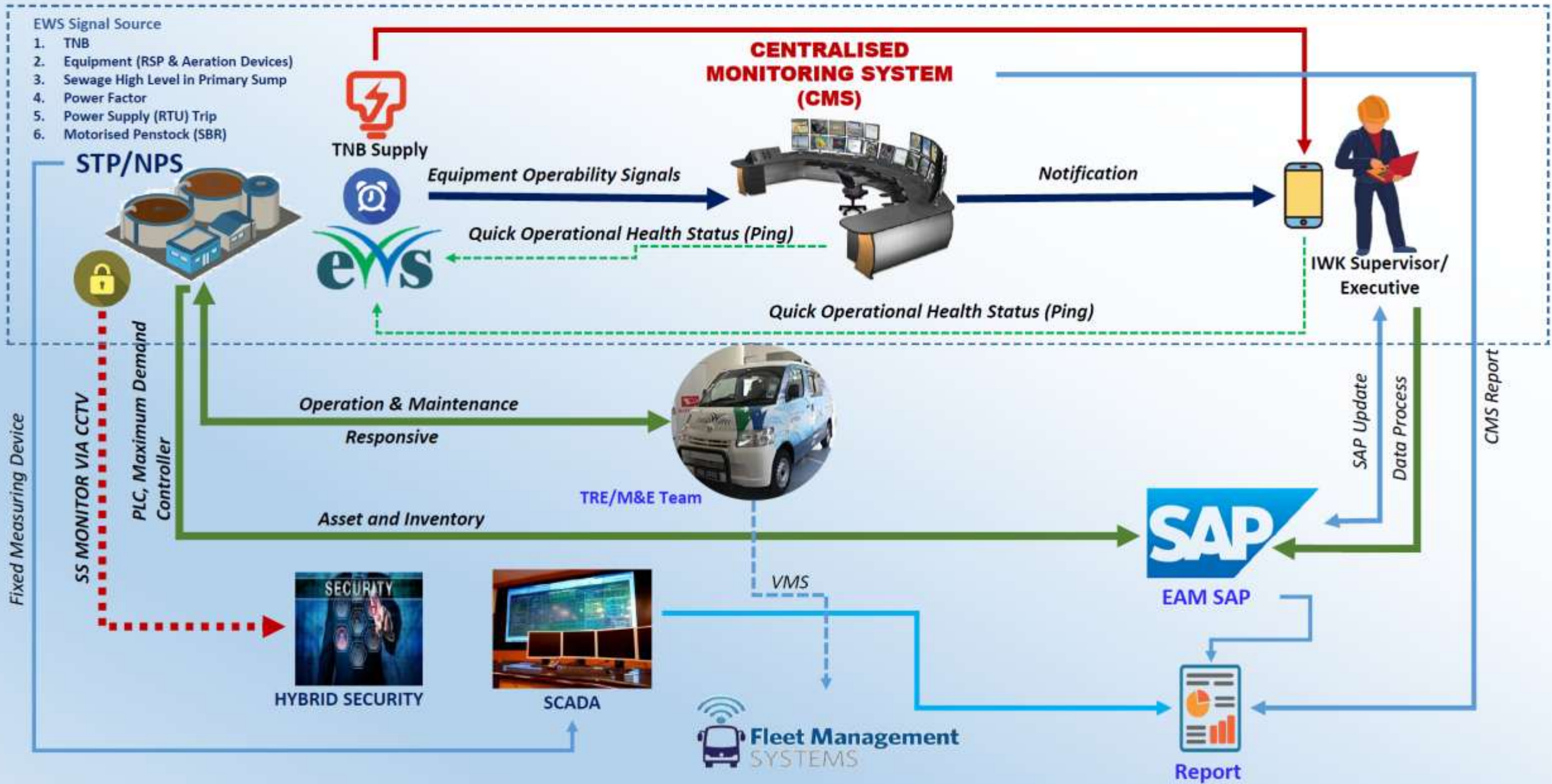
- operational priority
- maintenance strategies
- CAPEX plan



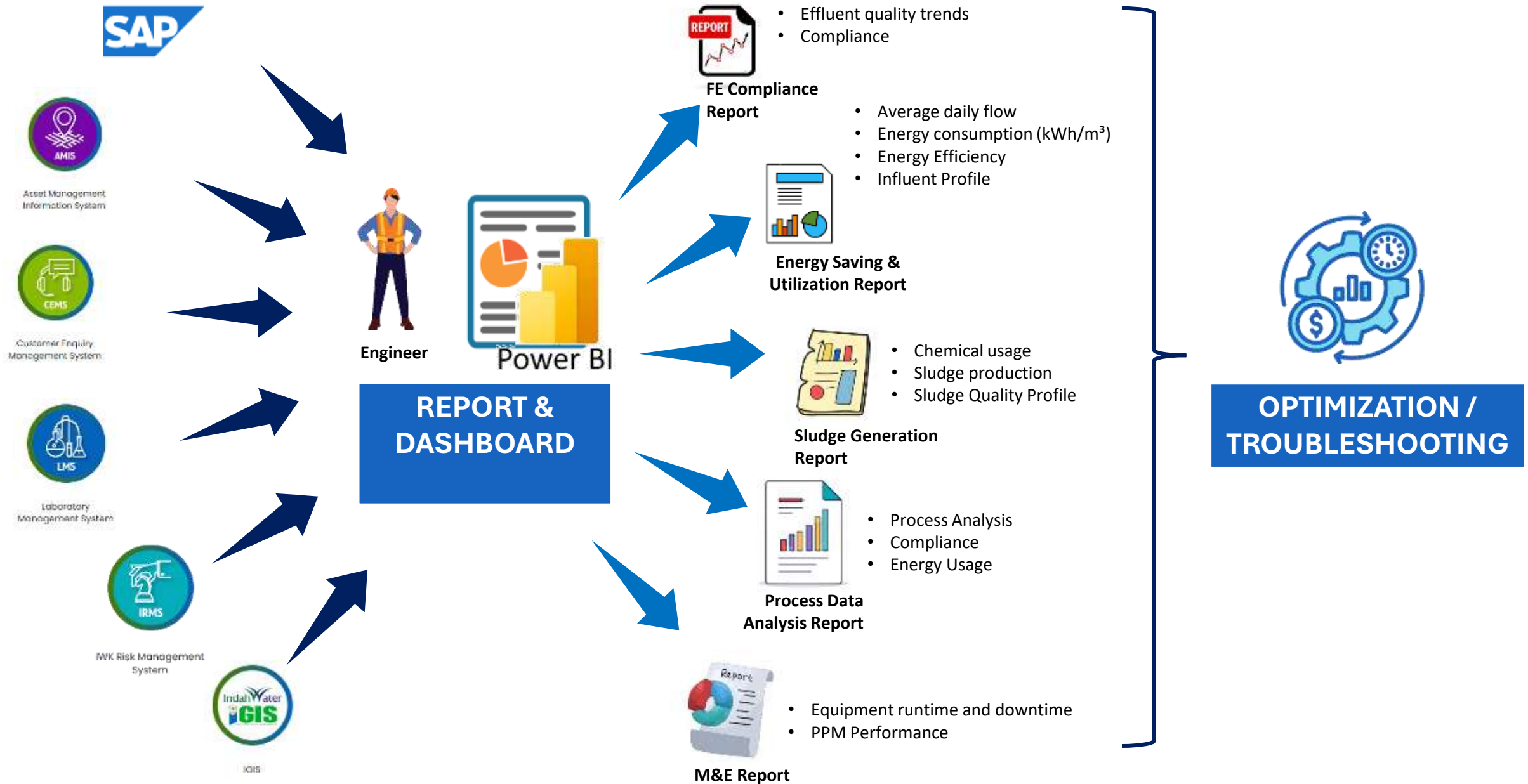
Integrated service request system:

- ***Automated work order***
- ***Workflow***
- ***Escalation***
- ***Feedback / closing***

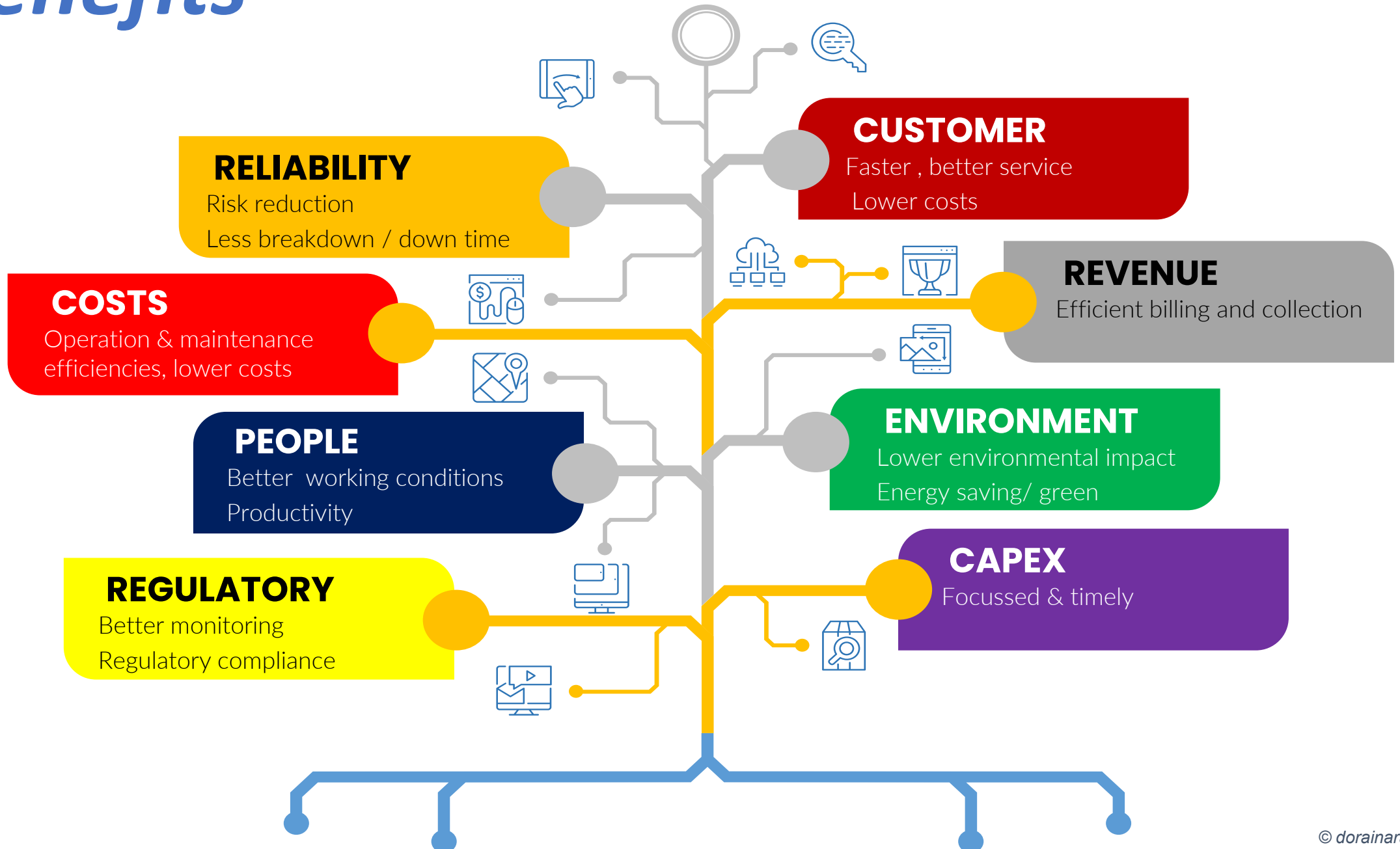
STP Monitoring System Overview



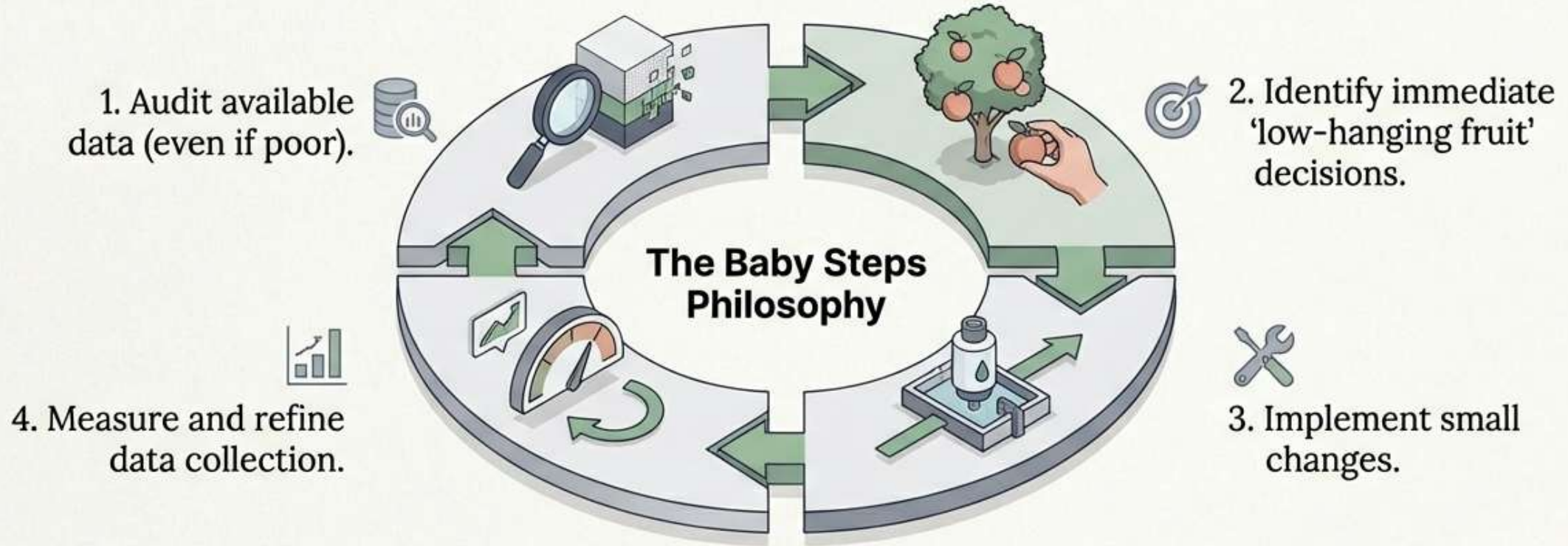
Indah Water Digital Integration Framework

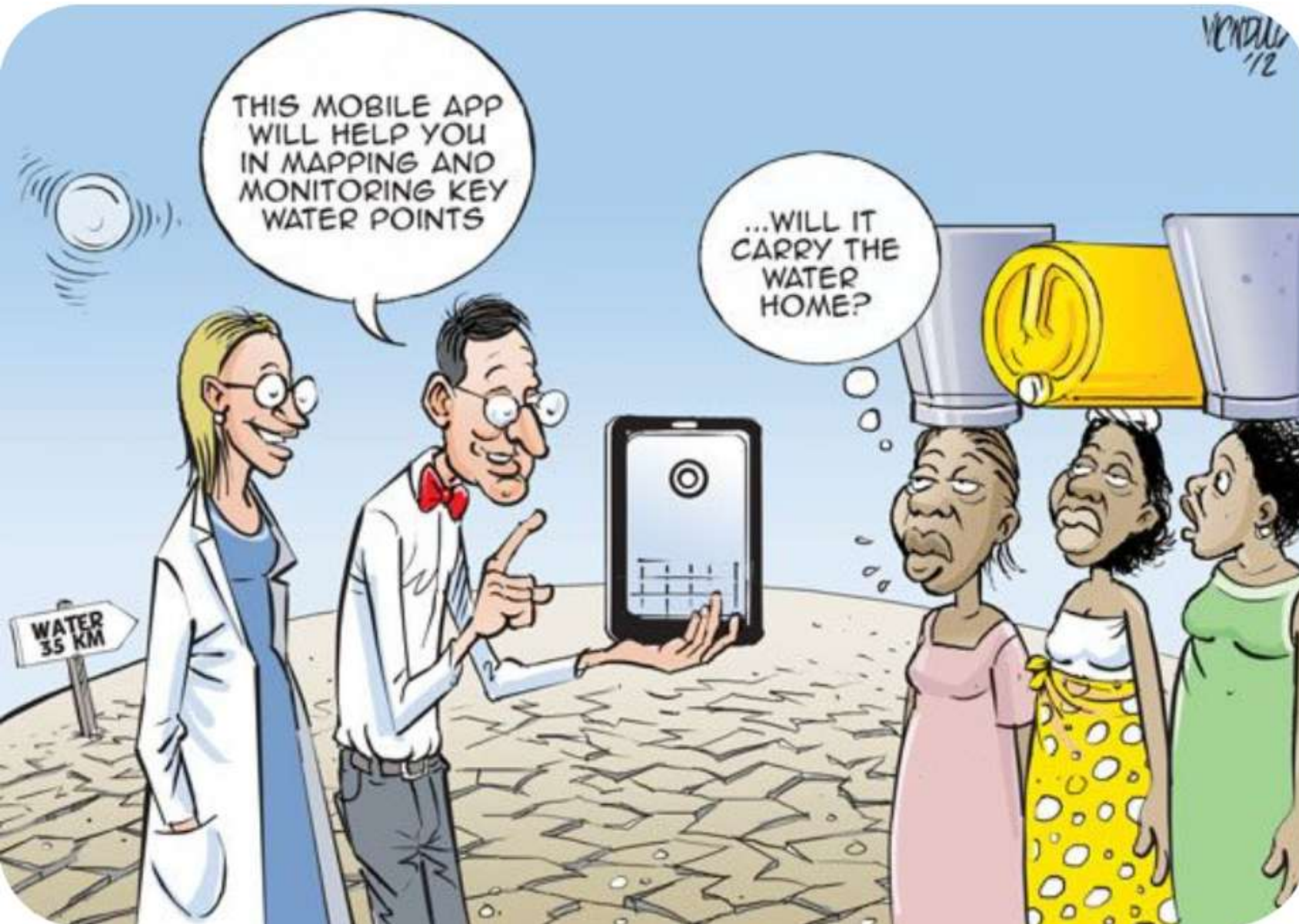


Benefits



Start where you are: using available data to drive initial decisions.





***Thank
you***



Hunter Water

Rahul Chhillar, GM Information, Control and Energy
Australia





CAPITAL DEFERRAL THROUGH DIGITAL UPGRADE – BELMONT WWTW CASE STUDY

Rahul Chhillar Hunter Water Corporation

FEBRUARY 2026

HUNTER WATER - CONTEXT

- 160 km north of Sydney
- Serving ~ 600,000 people
- 19 Wastewater Treatment Plants
- 10,000 + km of water and wastewater networks



WASTEWATER PORTFOLIO



Portfolio Overview

- 19 WWTWs (1,200–220,000 EP)
- Treatment technologies: ponds, BNR, EBPR, MBR, intermittent processes
- Sludge systems: aerobic + anaerobic digestion
- Discharge: ocean, inland waterways, reuse

Operational Objectives – Digitally enabled:

Maintain stable and reliable compliance performance.

Improve energy efficiency.

Reduce chemical usage and costs.

Optimise operations to defer capital investment

Benefits delivered/On Track

- Energy savings >\$400k this price path, plus \$1m per year from renewable energy program
- Chemical cost reduction of ~\$400k this year.
- Digital optimisation insights enabling capital deferral (Belmont case study)

DIGITAL CONTEXT



Digital Direction

- Use enhanced sensors to gain deeper, real-time insights into treatment processes.
- Apply advanced process control to turn data insights into operational optimisation and capital deferrals.
- Invest in digital platforms that quantify risk dynamically and guide smarter operational and capital investment decisions.

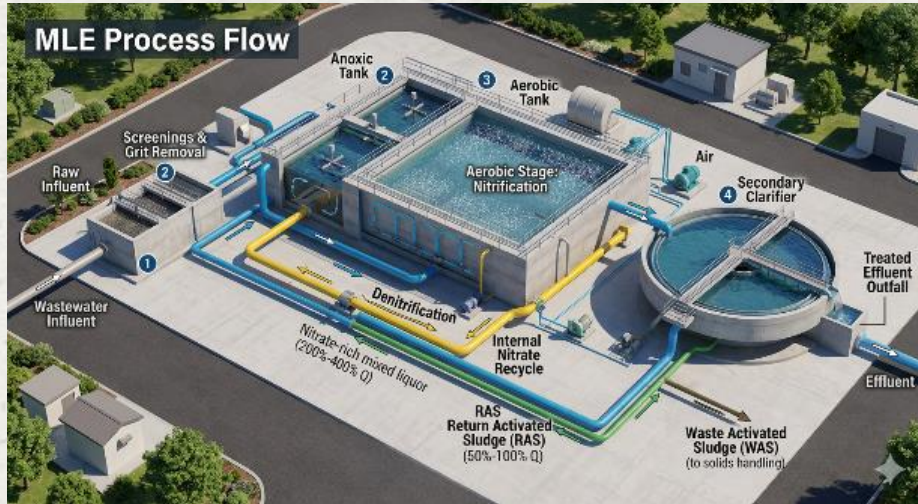
Digital and Automation Capability

- SCADA and PLC-enabled sites
- Sensors uplift: nutrient, solids, sludge blanket
- Advanced control strategies:
- Real-time RAS control
- Advanced DO control
- Intermittent aeration
- Chemical dose optimisation
- Operational dashboards
- ML platform

PROJECT CONTEXT – BELMONT WWTW



- Modified Ludzack–Ettinger (MLE) process
- Secondary clarifiers
- Aerobic digesters and Centrifuge dewatering
- Coastal discharge
- High wet weather inflow sensitivity



[Image reference](#)



PROJECT CONTEXT – CONVENTIONAL SOLUTION



Problem:

- Clarifier capacity constraints during wet weather
- Sub-optimal flow divider caused uneven flow distribution
- High solid flux during storms → noncompliance risk
- Occasional EPL licence TSS exceedances observed

Conventional Operation Setup:

- Reactors continuously aerated; RAS flow proportional to inflow
- Sludge storage capacity of reactors and clarifiers not utilised

Previous Recommendations:

- Construct additional clarifier capacity.
- Install a new flow divider to address uneven flows.
- Estimated capital



PROJECT CONTEXT – DIGITAL UPGRADE IMPLEMENTED



Hypothesis:

- Intermittent aeration during wet weather enables reactors to act as temporary sludge storage.
- RAS pumping dynamically adjusted based on real-time clarifier sludge levels.
- Online sensor data (ammonia and sludge blanket level) used for continuous automated control.
- Plant does not have licence ammonia limits so there is larger scope for control optimisation

Infrastructure and Control:

- Sludge Blanket analysers
- Ammonia analyser
- Realtime RAS adjustment
- Intermittent aeration logic
- PLC based automation

Improved process visibility through advanced sensors, coupled with smart control, optimises utilisation of existing infrastructure.

WHAT CHANGED OPERATIONALLY



Before:

- Continuous aeration
- Static RAS proportional to inflow

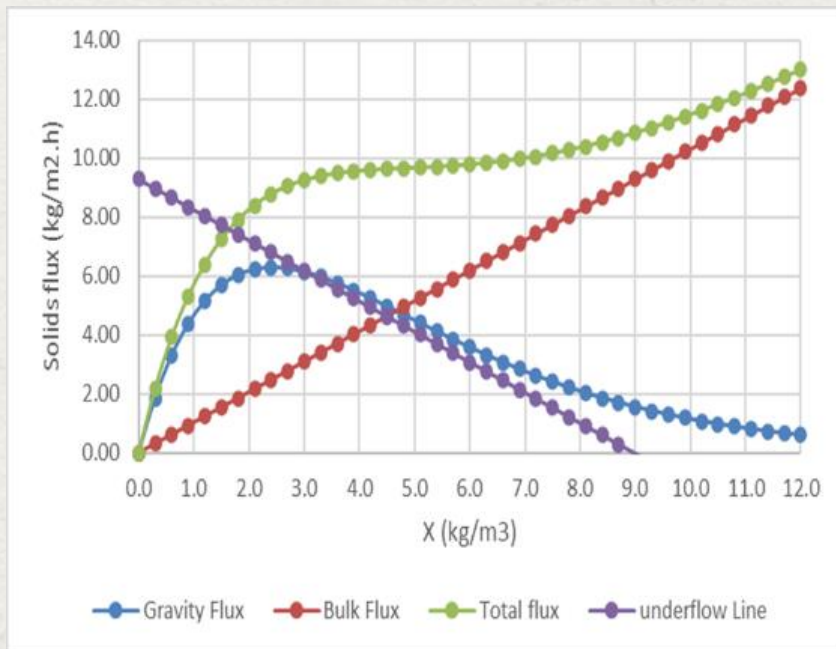
Available sludge storage in reactors and clarifiers was strategically leveraged to absorb peak solids loading during wet weather.

This buffering capacity is finite, and prolonged storage degrades process performance.

After:

- Reactors and clarifiers buffer solids during storms through intermittent aeration
- RAS rate according to sludge blanket height
- Aeration aligned to ammonia concentration

OPERATIONAL OUTCOMES



Solids flux capacity ↑ 23%

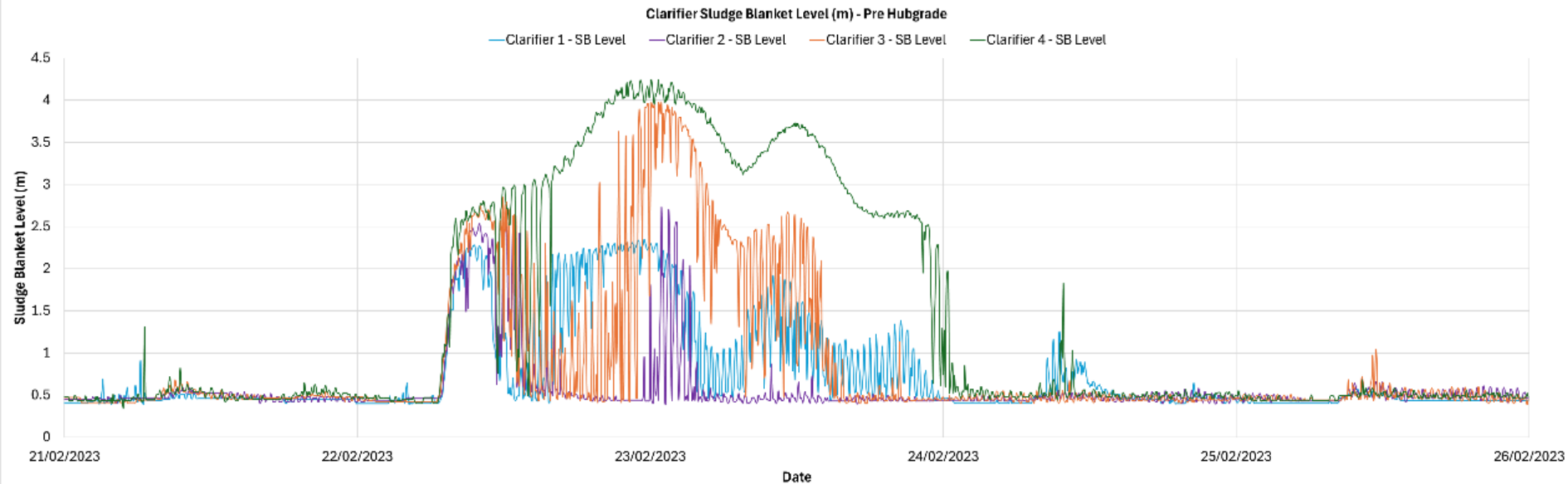
Compliant performance during storm with one clarifier offline

Maintained TSS compliance

Improved wet weather resilience

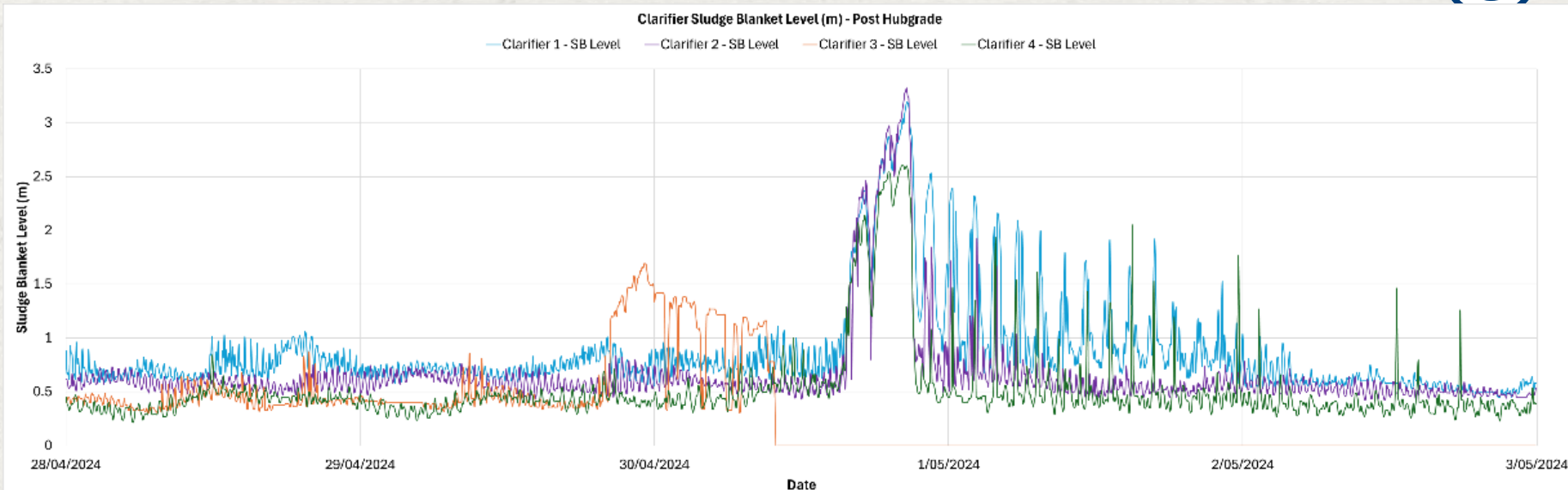
CLARIFIER SLUDGE BLANKET – PRE HUBGRADE

HUNTER



Parameter	Value
Rainfall	~ 90 mm
Clarifiers online	4
Maximum Sludge Blanket Height	>4 m (Clarifier 4), Approx. 4 m (Clarifier 3), <3 m remaining two clarifiers
Time required for sludge blanket stabilisation	2 d
MLSS – fully mixed	3,690 mg/L
Solids flux applied (if fully mixed)	9.3 kg/m ² /m

CLARIFIER SLUDGE BLANKET – POST HUBGRADE



Parameter	Value
Rainfall	~ 100 mm
Clarifiers online	3
Maximum Sludge Blanket Height	~ 3 m
Time required for sludge blanket stabilisation	0.5 d

ECONOMIC OUTCOMES



Deferred capital construction (>\$20m)



Supports projected 2050 loads (16% growth)



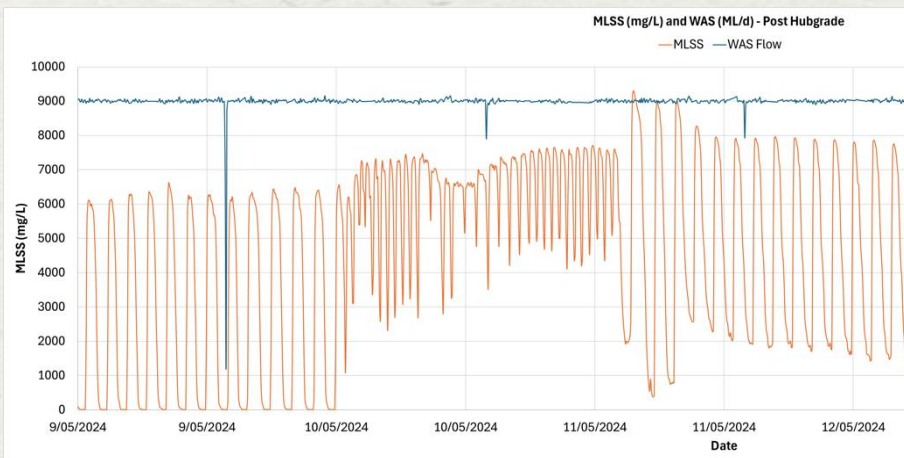
Energy Savings:

~40% site-wide reduction

25% from aeration upgrade – due to higher diffusers density (pre hubgrade)

15% from Hubgrade

CHALLENGES ENCOUNTERED



Sludge wasting – maintaining SRT

MLSS > 6,000 mg/L

PLC communication instability

Unequal clarifier loading persists

Optimisation pushed beyond defined operational limits resulted in process instability and reduced performance.

KEY LESSONS LEARNED



1. Optimisation is not limitless: Process boundaries must be defined before pushing control.
2. Sensors enable insight — not magic: Value comes from integration into control logic.
3. Energy savings are real — but monitor ammonia impact
4. Optimisation reduces risk — it does not eliminate it
5. Sludge wasting strategy must adapt to aeration strategy
6. Practical takeaways:
 - Targeted sensors to enhance process performance visibility
 - Integrate sensors feedback with control logic to optimise
 - Explicitly define operational boundaries
 - Understand integrated impacts of optimisation

FINAL MESSAGE AND WHERE DOES IT APPLY GLOBALLY



Targeted sensors provide deep process insights that uncover optimisation opportunities and maximise the use of existing assets.

Define optimisation boundaries clearly, and ensure sensors are integrated with analytics, control, and dynamic risk quantification to guide operational and capital investment decisions.



Engineering outcomes are digitally enabled — SMEs remain central, digital selects the best platforms, and cost–benefit analysis guides value.



Deep data insights support dynamic risk quantification, improving operational and capital investment prioritisation across the organisation.

THANK YOU

Any questions?



Call

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1300 657 000, 24 hours, seven days
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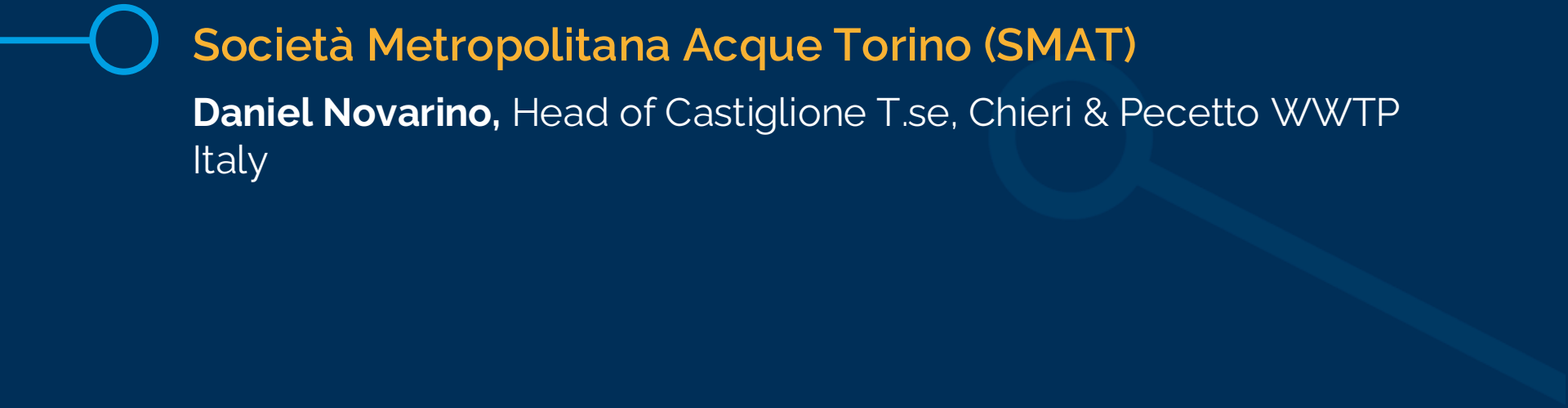
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Società Metropolitana Acque Torino (SMAT)

Daniel Novarino, Head of Castiglione T.se, Chieri & Pecetto WWTP
Italy

SWAN-WaterLinks Webinar: WasteWater Digitalisation from Regional Lessons to Plant-Level Impact

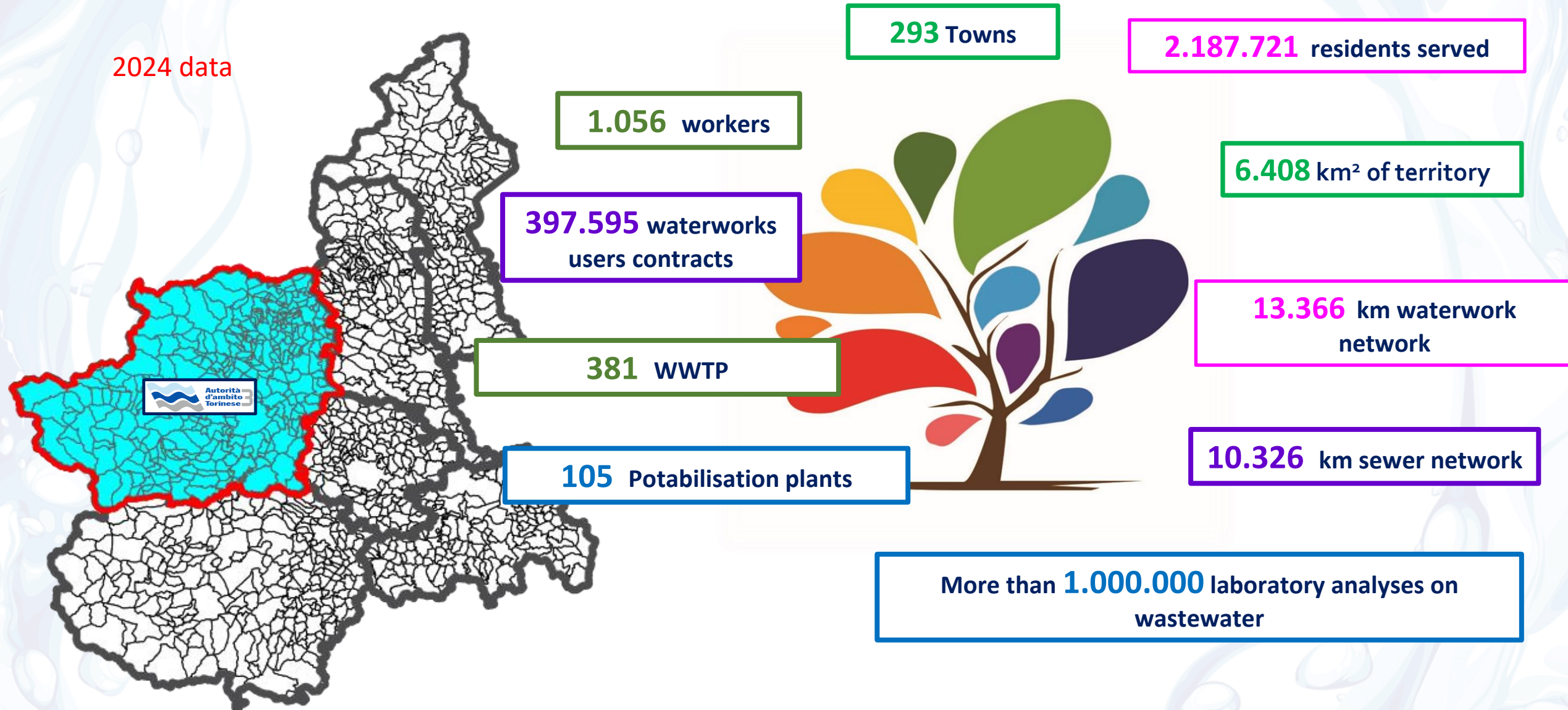
Tuesday, 3° of march 2026

*Digitalisation and efficiency in WWTP:
Turin Centralised WWTP case study (SMAT)*

Eng. Daniel Novarino
WWTP Responsible

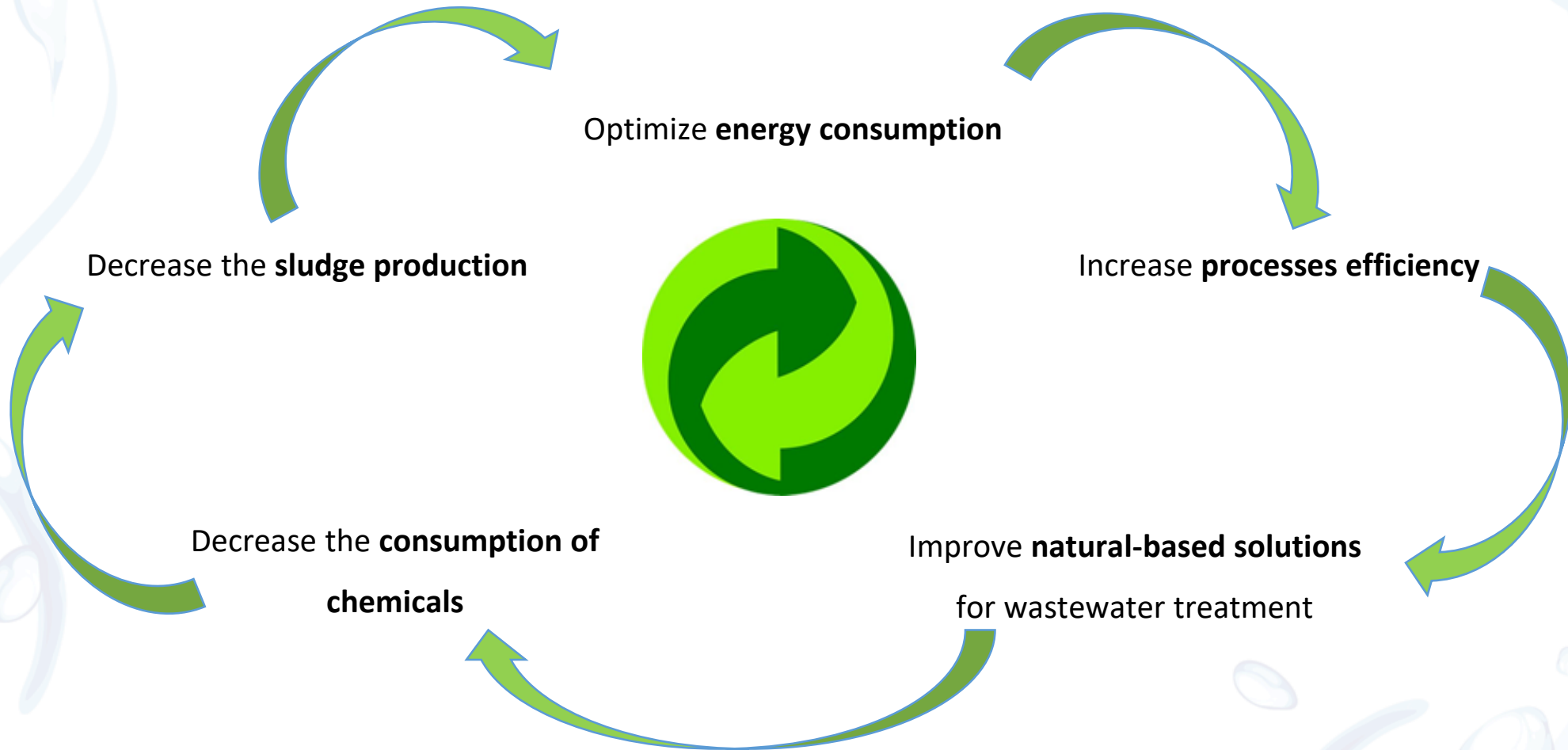


2024 data

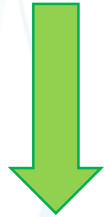


WWTP are complex systems that need a lot of energy for their processes

The main goal is related to the reduction of energy consumption → decrease the amount of energy for people equivalent (p.e.) treated



1. Installation of an energy consumption monitoring system



Biological processes for nitrogen removal are the most important in terms of energy consumption

2. Installation of a process controller based on alternating phases of aeration into biological tanks for nitrogen removal



This technology is mature and widely diffused

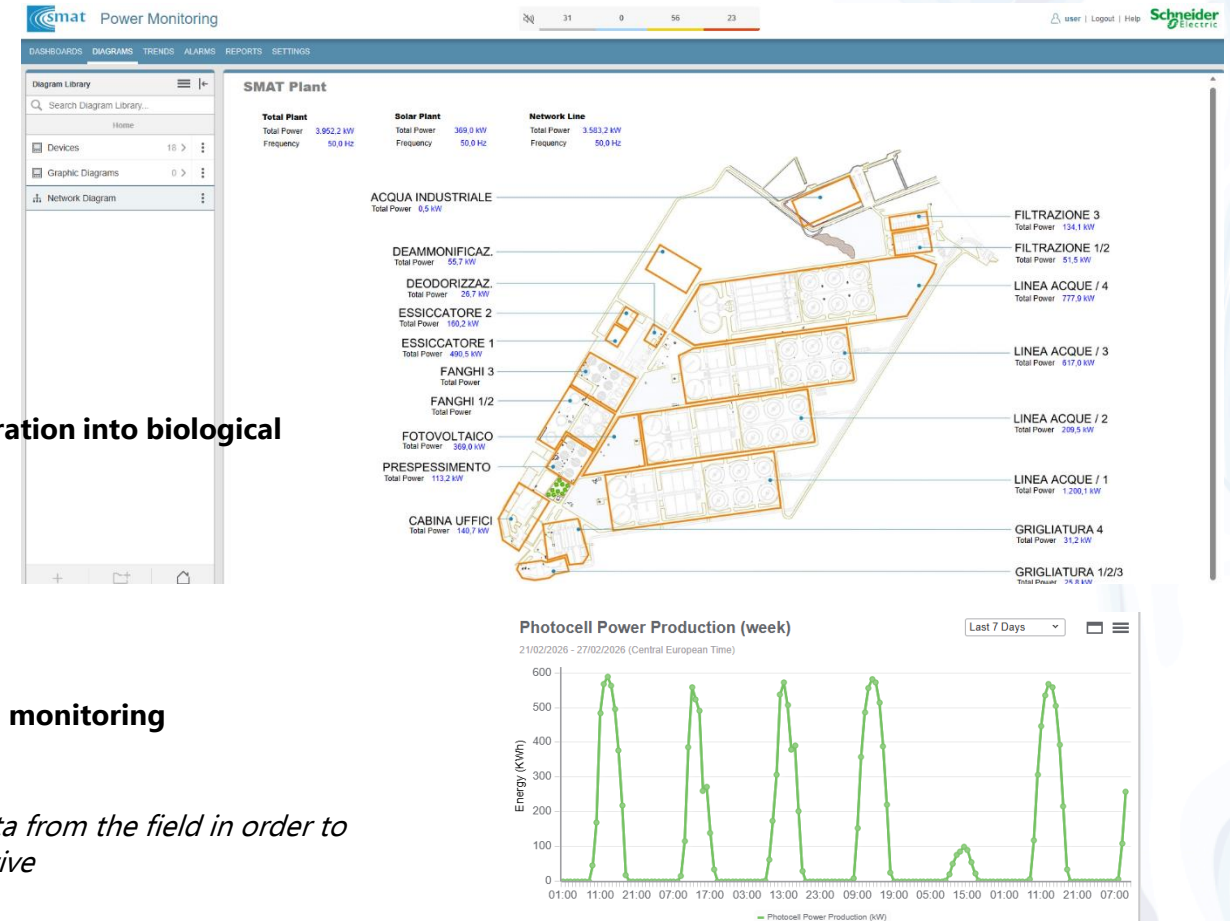
3. Installation of ammonia and phosphorous analyzers for process monitoring



The technology needs robust data from the field in order to be effective

4. Combine different technologies for nitrogen and phosphorus removal

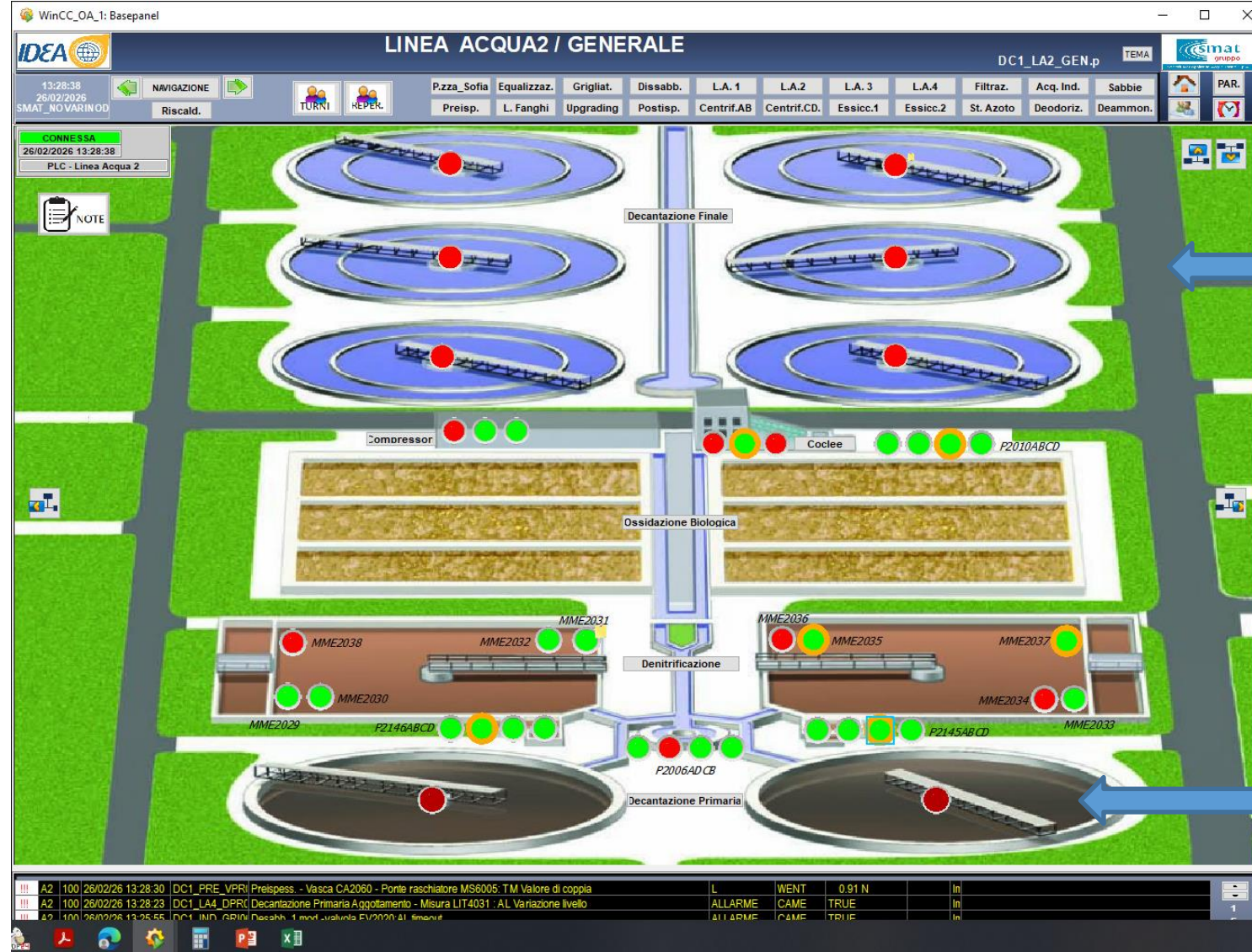
Use of Anammox bacteria and PAO (polyphosphate-accumulating organisms)



Modernization of WWTP machinery fleet

- Revamping of the turbocompressors
- Revamping of the air diffusers
- Revamping of the ammonia analysers

From a traditional predenitrification – nitrification biological treatment plant...



Low digitalization rate system

To final filtration (sand & anthracite)

Secondary sedimentation

P removal

Use of chemicals for phosphorous removal

Nitrification tanks with continuous aeration

N removal

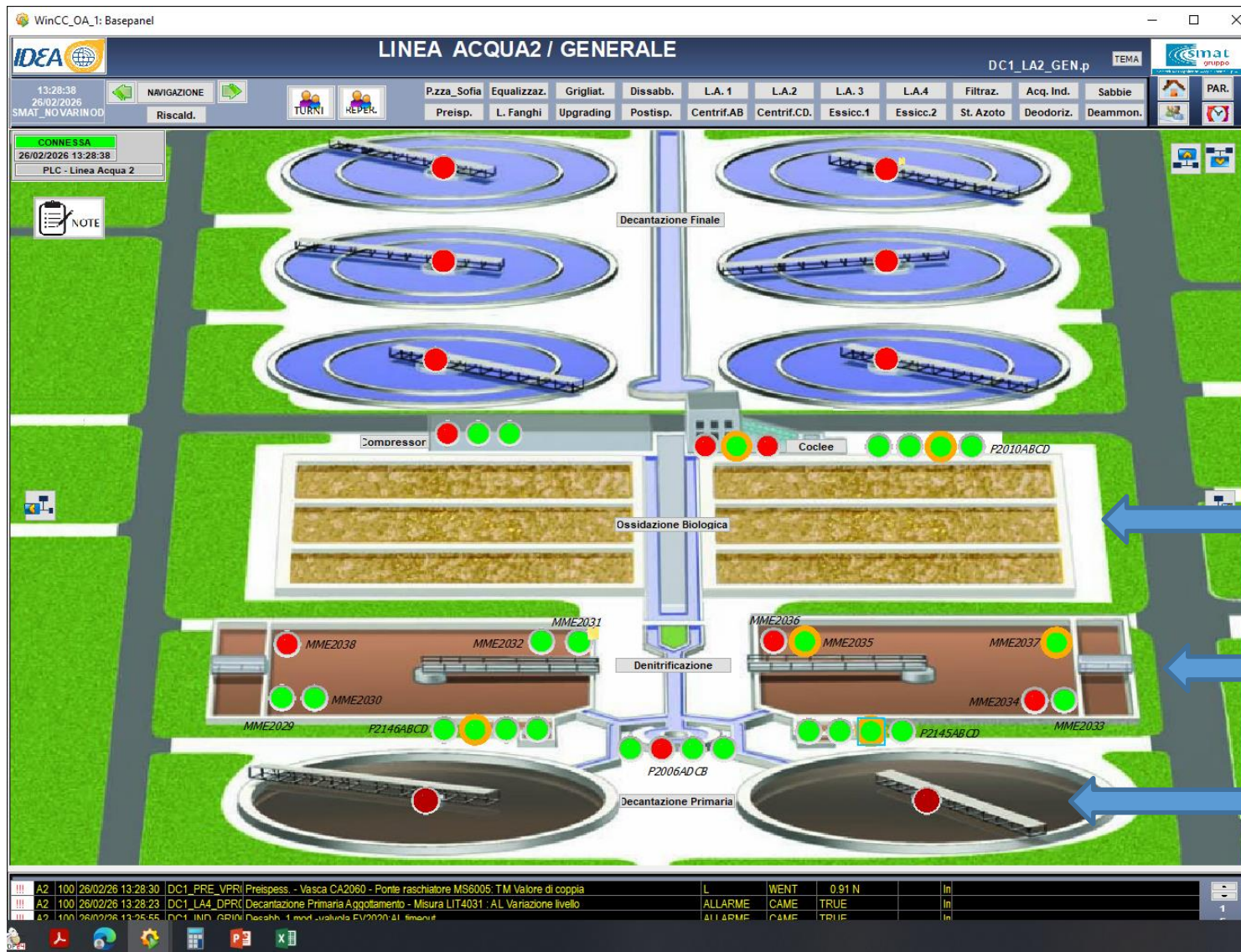
Pre-denitrification Tanks with mixed liquor ricirculation

COD, BOD removal

Primary sedimentation

...to a new alternate aeration biological treatment plant!

High digitalization rate system



To final filtration (sand & anthracite)



Secondary sedimentation



Biological tank for nitrogen removal using intermittent aeration



Ex pre-denitrification
Now, phosphorous biological removal tank



Primary sedimentation

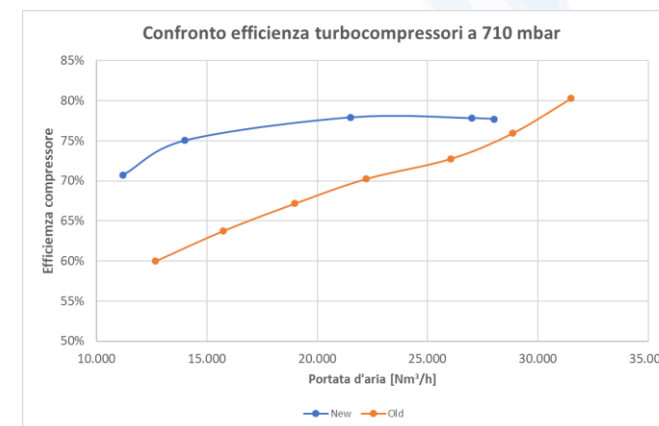
N removal

P removal

Biological process in anaerobic condition

COD, BOD removal

- Turbochargers have the function of meeting the air demand required by the biological treatment section of wastewater.
- The energy consumption of the aeration unit typically accounts for about 50% of the electricity consumption of a treatment plant.



Activity description	year 2017												year 2018												year 2019											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	
Idea and project																																				
Public tender																																				
Challenges after public tender																																				
Activities on site																																				

The intervention included the following activities:

- replacement of 9 turbocompressors serving the oxidation section
- **replacement of the control and command panels for the turbocompressors**
- **replacement of the flow control valves for each tank in every module**
- estimated payback time during the design phase: 6.2 years



Investment: 2.800.000 Euro

Energy consumption: - 2.950 MWh/y

Predisposition for future digitalization of the process

Intallation of a process controller as main digitalization goal



Objectives of the intervention

- improve the removal of nitrogen compounds
- achieve a 78% reduction as TN for regional targets
- energy savings
- preserve mechanical and electrical equipment, avoid too many interventions on medium voltage switches.



Challenges related to a complex system

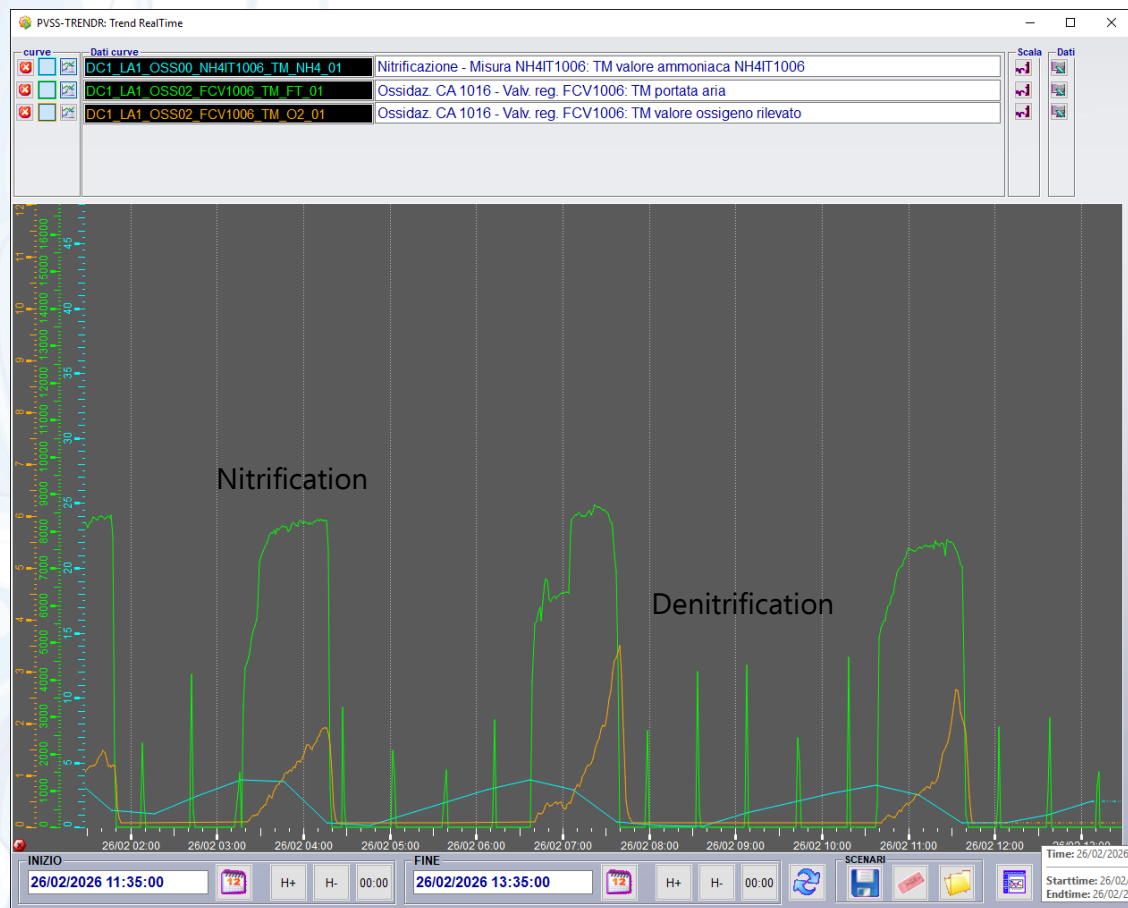
- 4 modules, each with 6 independent tanks
- 2+R compressors for each module and air control valves in the 6 tanks of the module
- presence of ammonia and nitrate probes in each tank
- compressors powered by medium voltage (6000 V)

Solution

Implementation of a custom regulation system based on the specifications defined by SMAT → installation of a process controller capable of keeping at least 2 tanks aerated at all times while keeping the turbo-compressor running as priority 1 → no 'on-off' effect. Optimal distribution of air flow to the tanks → control of air flow to the diffusers by adjusting the minimum openings of the globe valves.

[illegible]

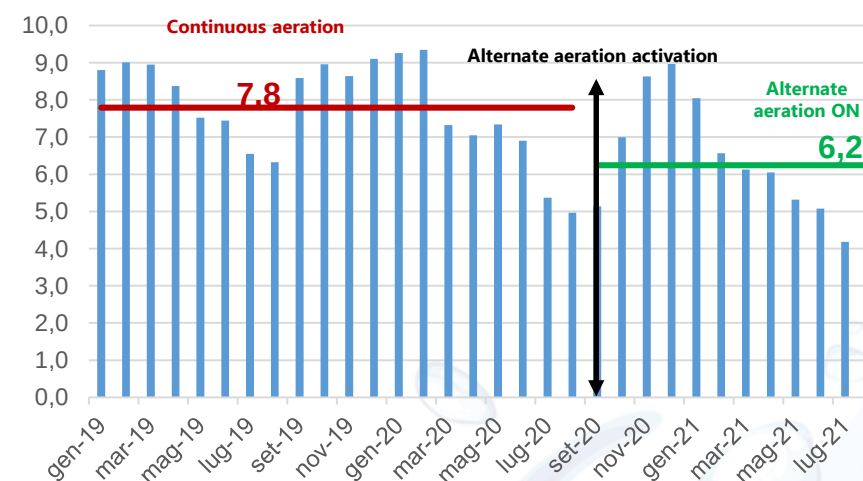
- The intervention carried out following the replacement of the turbochargers involved the introduction of a **control and regulation logic** for the aeration of the biological oxidation tanks.
- The control logic is based on **alternating phases of aeration** and compressor shutdown in order to ensure the succession of oxidative conditions (nitrification) and anoxic conditions (denitrification).
- The system, by acting and regulating the duration of the two phases, ensures the delivery of the right amount of air with the dual benefit of minimizing energy consumption and maximizing treatment performance.

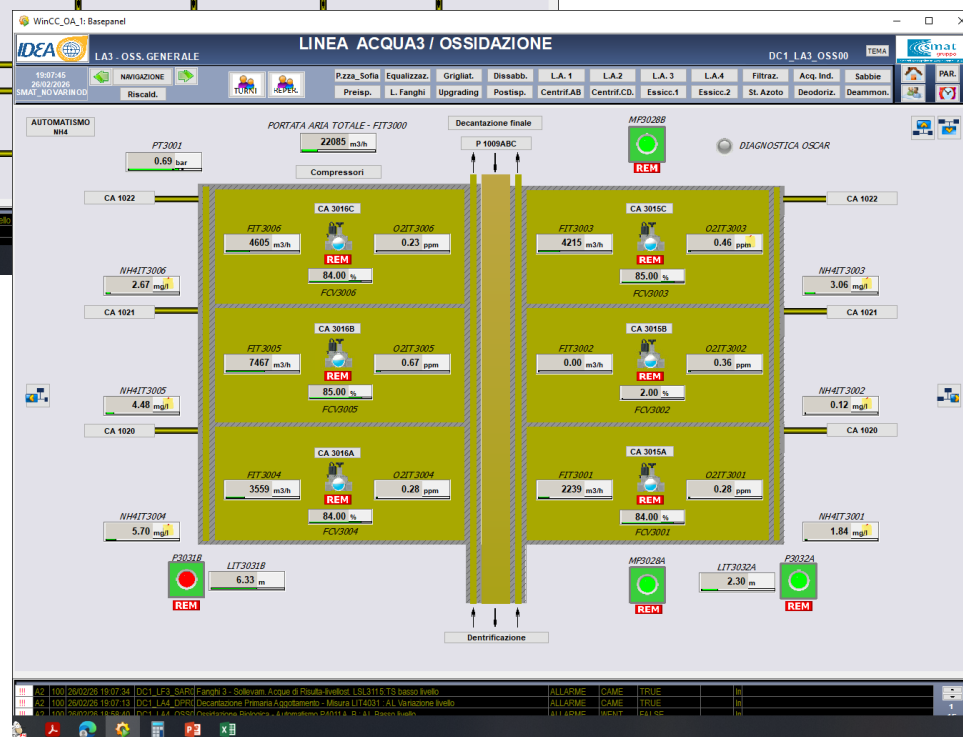
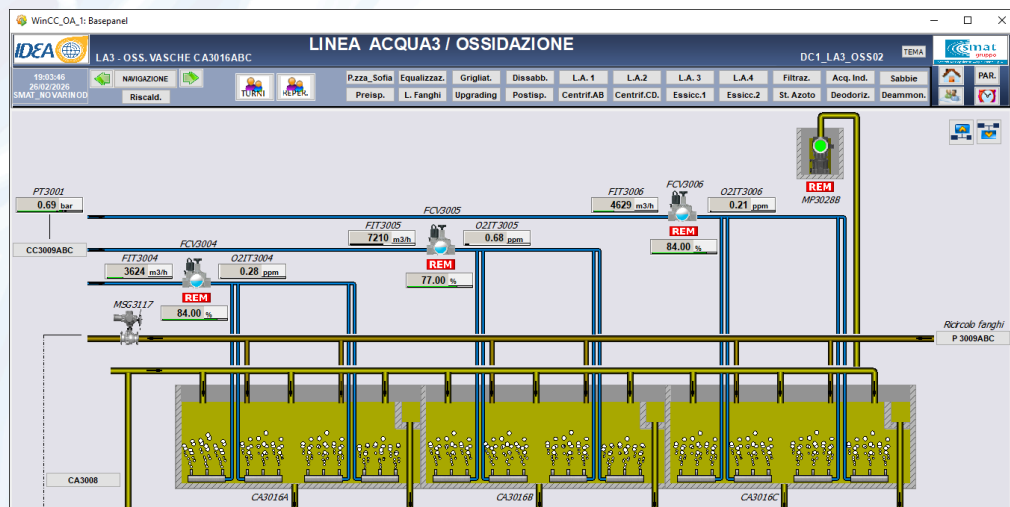


Nitrification: aeration is turned ON when ammonia value reach the set point. Oxygen slowly increase in the tank

Denitrification: aeration is turned OFF when ammonia is consumed. Oxygen rapidly decrease in the tank and denitrification occurs

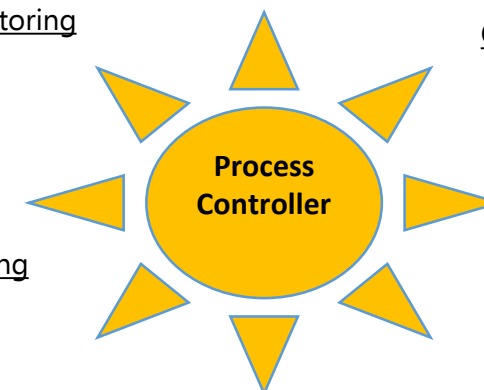
TN out of the plant





Ammonia monitoring

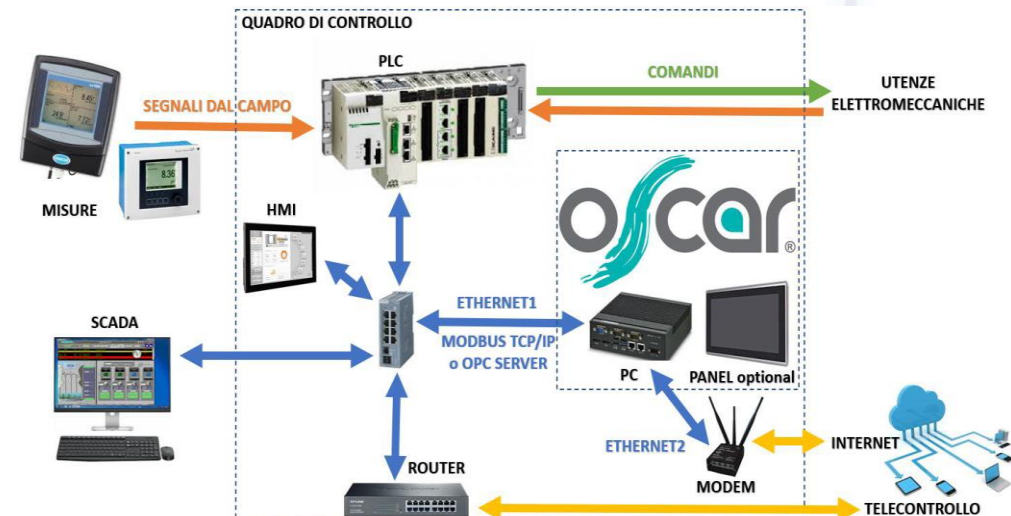
Oxygen monitoring



Air pressure monitoring

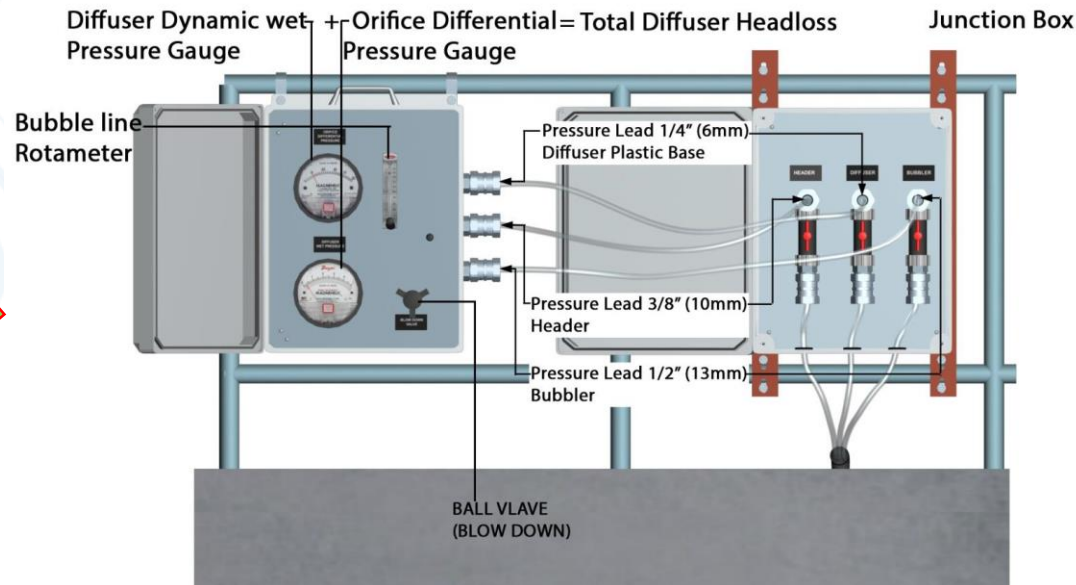
Air flow monitoring

Valve position monitoring



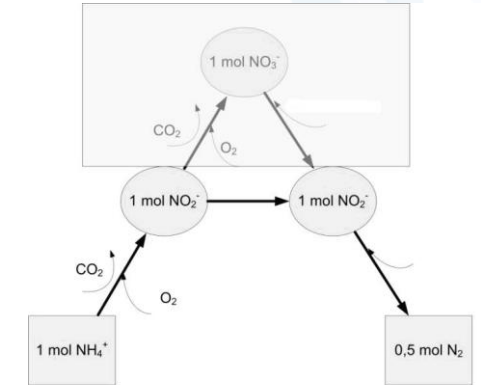
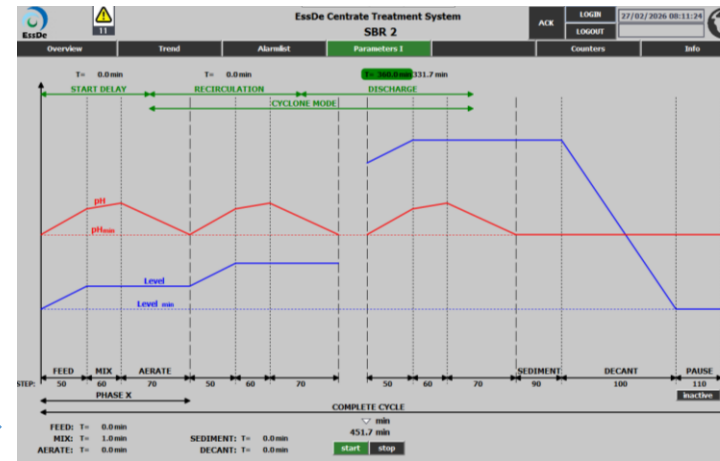
The project includes:

- complete replacement of the air distribution network in the 24 oxidation tanks of the biological section (33,374 diffusers);
- replacement of all the mixers in the 4th module;
- replacement of the current probes for measuring ammonium with analyzers for monitoring the ammonium and orthophosphate parameters
- **Installation of a pressure monitoring system for analyzing the efficiency of the system**



Deammonification with Anammox bacteria for nitrogen removal and phosphorus removal with PAO bacteria are two natural based solution that can be developed if a correct monitoring system is installed.

- phosphorous is controlled using specific analysers on site
- the deammonification section is based on an innovative technology for the effective and efficient removal of nitrogen from the sludge line wastewater (an nitrogen-rich stream resulting from the dewatering of treatment plant sludge downstream of anaerobic digestion);
- the adopted process is based on specific bacterial strains, called Anammox, capable of removing nitrogen with excellent performance and significantly lower energy consumption compared to traditional technologies;
- the deammonification section of the Castiglione T.se plant currently represents the largest application in Europe of Anammox technology in the field of urban wastewater. **AMMONIA IS CONTROLLED INDIRECTLY USING OTHER PARAMETERS (OXYGEN, pH)** →

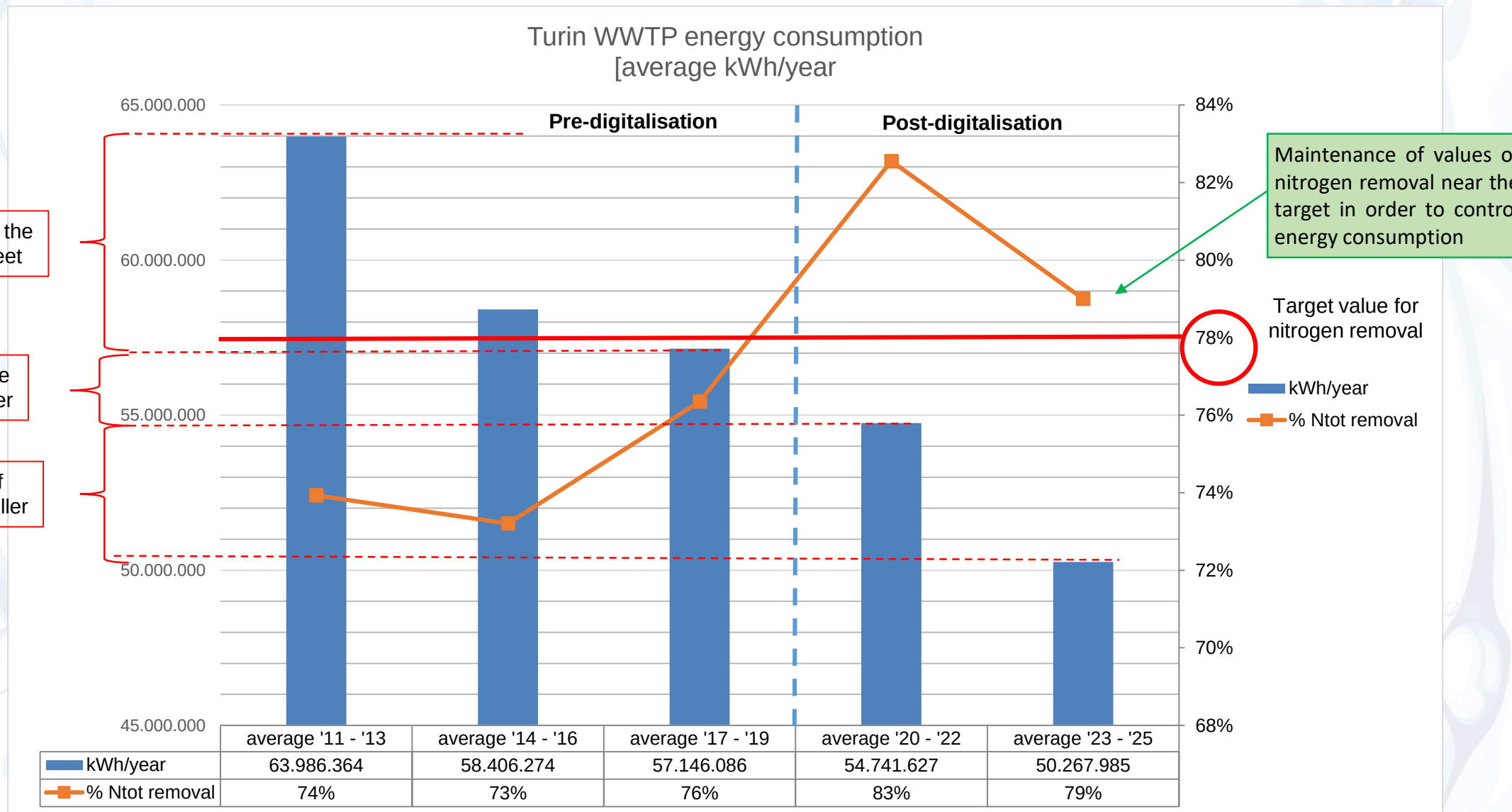


Compared to the traditional process:

- 95% savings in organic substances
- 60% energy savings
- 80% reduction in sludge



Parameter	U. m.	Traditional	Deammonification	Δ
Total nitrogen removal	[kg N/y]	420.480	420.480	-
Specific energy consumption	[kWh/kg N]	4,0	1,67	-2,3
Total energy consumption	[kWh/y]	1.681.920	702.202	-979.718



Traditional processes for nitrogen and phosphorous removal are simple to be improved but their efficiency in terms of nutrients removal and energy consumption is low

Different and more technological processes can be easily performed at every plant scale, but it is necessary to pay attention on many factors:

1. The **cost – benefit ratio** because digitalisation have a cost in terms of machinery, process controllers and maintenance
2. The improve of digitalisation in a WWTP without a **revamping of machines** and infrastructure could be ineffective
3. Digitalisation in WWTP can be achieved only if there is a **deep knowledge of biological processes**. The process controller helps managers in controlling processes, but it's not enough. This aspect is more important if natural based solutions (such as deammonification with Anammox bacteria or phosphorous removal with PAO bacteria) are improved in WWTP as a consequence of digitalisation.

One of the most important challenge concerns the training of the personnel involved into process control



It is necessary to create new professional figures in WWTP

- Process managers
- PLC managers
- Experts in process instruments and probes maintenance

New challenges for the near future!

Adapt WWTP to the new requirements of European Law concerning wastewater treatment

- **New limits for nutrients**
- **Energy neutrality** for WWTP

N_{tot} → 10 mg/L for plant with 10.000 to 150.000 p.e.

N_{tot} → 8 mg/L for plant with more than 150.000 p.e.

P_{tot} → 0,7 mg/L for plant with 10.000 to 150.000 p.e.

P_{tot} → 0,5 mg/L for plant with more than 150.000 p.e.

THANKS FOR THE ATTENTION!



Daniel Novarino



—○ Q&A/Open Discussion





Closing Remarks

Mai Flor, Executive Director (WaterLinks)





Thank you & take care!

Please contact:

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