Digital Technology Saves Milan WWTP Money and GHG Emissions

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Agenda

01 Who are we?

02 Nosedo WWTP, Milan, Italy

03 Challenges

04 Results

04 Solution

05 Main control strategies

06 GHG savings

07 Additional potential

VEOLIA HUBGRADE PERFORMANCE PLANT KEY TAKE-AWAYS

Hubgrade PERFORMANCE

- NEW WINDOW TO PLANNING CAPITAL UPGRADES
- OPTIMIZES EXISTING ASSETS

- OVER 100 REFERENCES WW
- PROVEN IN PRACTICE

+25 years of experience

100+ references

1000 years of operation
from 1992 to 2022

15 M PE

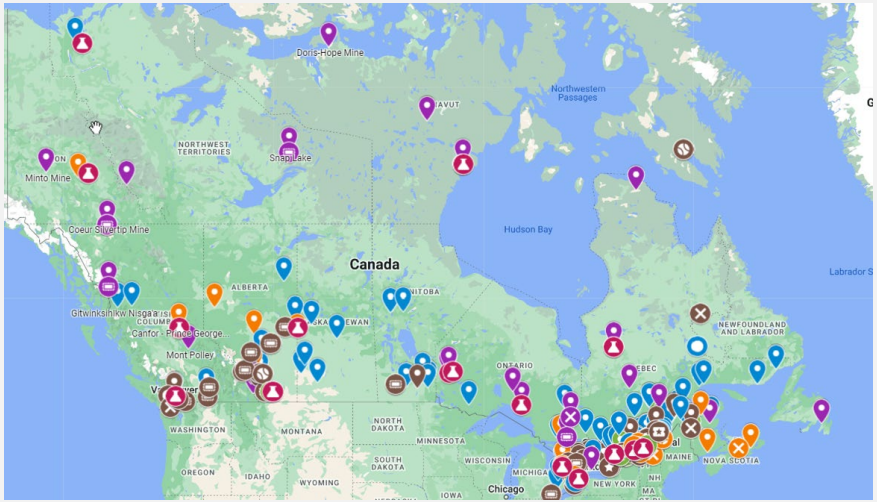
Municipal + Industrial Customers

13 Patents

- VEOLIA PROCESS EXPERTISE
- FIRST IN CLASS PARTNERS
- OPERATOR REMAINS IN CONTROL

Veolia Water Technologies Canada

- Veolia Environnement group
- $63B CAD 2022 revenues
- Water, waste, energy
- 75 years in Canada



NOSEDO WWTP (MILAN), ITALY
IMPROVEMENTS REQUIRED AFTER 15 YEARS

Construction & Operation
- *4 years to build the plant*
- *15 years DBO contract*

Commissioning of the Nosedo Plant
2004

2019
Handover to MM with planned renovation

Ambitions
- *Reduce operational costs*
- *Improve wet weather handling*
- *Improve biological load variations handling*
- *…*

Digital Twin go live
- *11 features implemented*
- *12 months to go live*

Hubgrade Performance Plant is running
2020

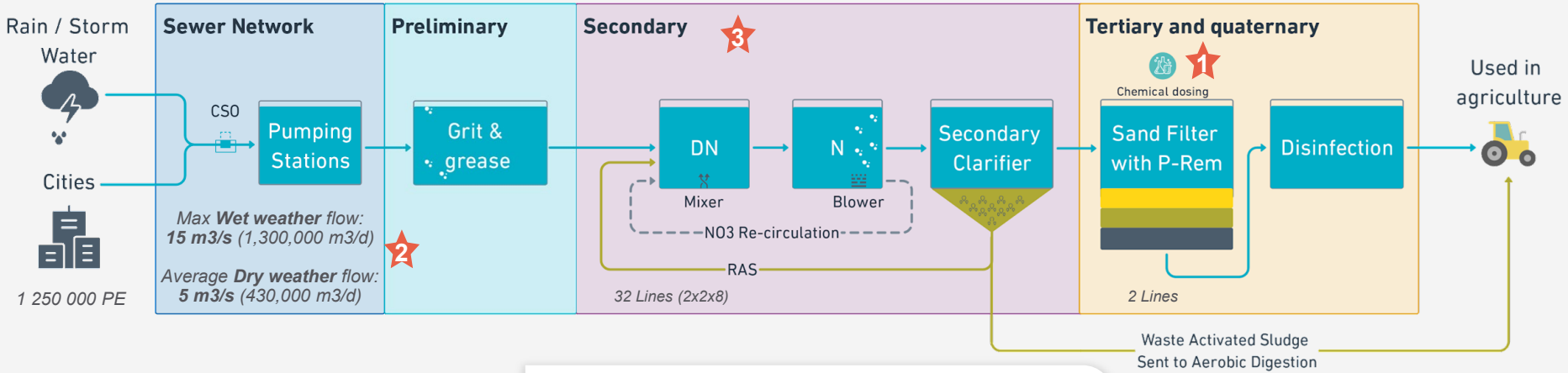
2021
First review of the performance guarantee

Contract is evaluated
- *Compliance*
- *Energy reduction*
- *Chemical reduction*
- *GHGs savings as a bonus*

Whats next?
- *New features under investigation*
- *Integration of sewer network*

End of the performance guarantee contract
July 2023

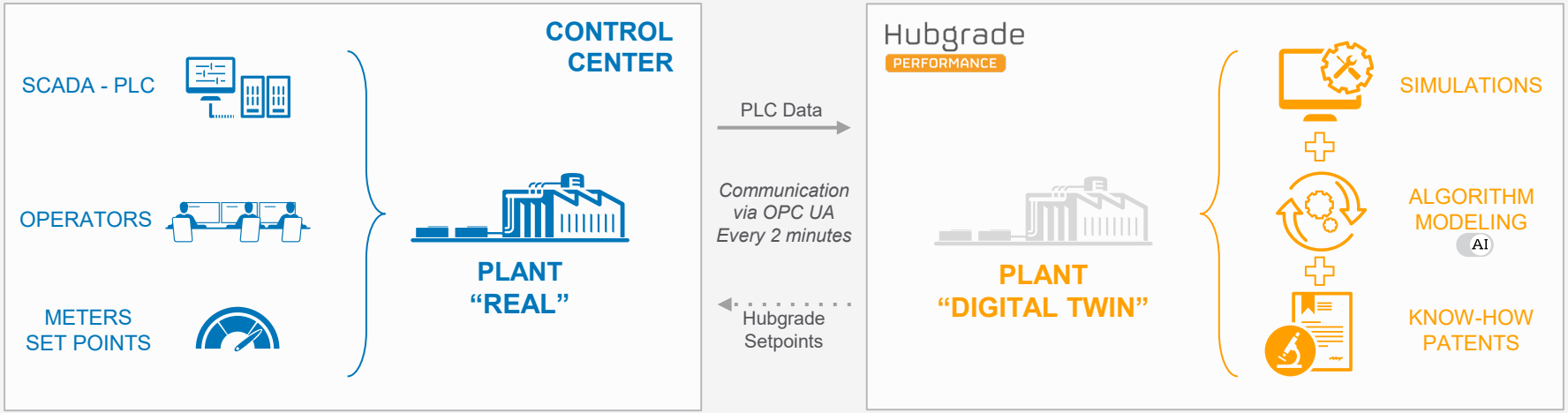
NOSEDO WWTP (MILAN), ITALY
1.25M PE - MLE



Challenges

1. *Reduce operational costs*
2. *Improve wet weather handling*
3. *Improve biological load variations handling*

HUBGRADE PERFORMANCE PLANT
REAL TIME OPTIMISATION AS A SERVICE



Strategy

Own Calculation AND **Digital Twin SetPoint**
Operator remains in control

Optimization

24/7/365 / Holistic / Best possible outcome
Handles multiple sets of Data

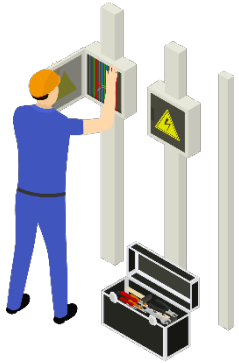
NB: this representation is not the real image of the network more a figurative way to understand the logic

REAL TIME OPTIMISATION AS A SERVICE
TO ANSWER VARIOUS NEEDS

Compliance

Ensure high level of water quality to comply with stringent regulations - **24/7-365**

Operational excellence



Reduce OPEX,
avoid investments and increase productive **uptime**

Sustainability

SUSTAINABLE DEVELOPMENT GOALS

Reduce your environmental footprint
Achieve sustainable development goals

BACK TO NOSEDO - PERFORMANCE GUARANTEE
RESULTS OVER EXPECTATIONS & ROI < 2 YEARS

RESULTS GUARANTEE

Compliance

Contractual
- Total N < **10** mg/l
- Total P < **1** mg/l

Achieved*
- Total N: From **7.1** to **4.6** mg/l
- Total P: From **0.90** to **0.84** mg/l

10 to 30% reduction

Operational excellence

Contractual
- Reduce Electricity & Coagulant OPEX by **400k€** / year

Achieved*
- Reduce Electricity & Coagulant OPEX by **740k€** / year

Reality**: 1,967k€ in 2023

85% more than expected

- 30%
- 60%

*Average for the past 2.5 years of contract

Sustainability

Contractual
- No requirement on reduction in CO2 equivalent

Achieved*
- **1.5k t/y** CO2 (elec & chemicals)
- **20k t** CO2 (BioP tank avoided)

25 000 tonnes of CO2 avoided

1 Euro = ~1.5 CAD$

**With current prices MM saved nearly 2M€ for the 3rd year

HOW DID WE OBTAIN SUCH RESULTS?
FEATURES AS A SERVICE - MORE THAN 50 FEATURES

Everywhere
- Digital lab

Pre-treatment, Industries

Biosolids

Hubgrade
PERFORMANCE

Sewer System

Tertiary Treatment

Preliminary Treatment

Secondary Treatment

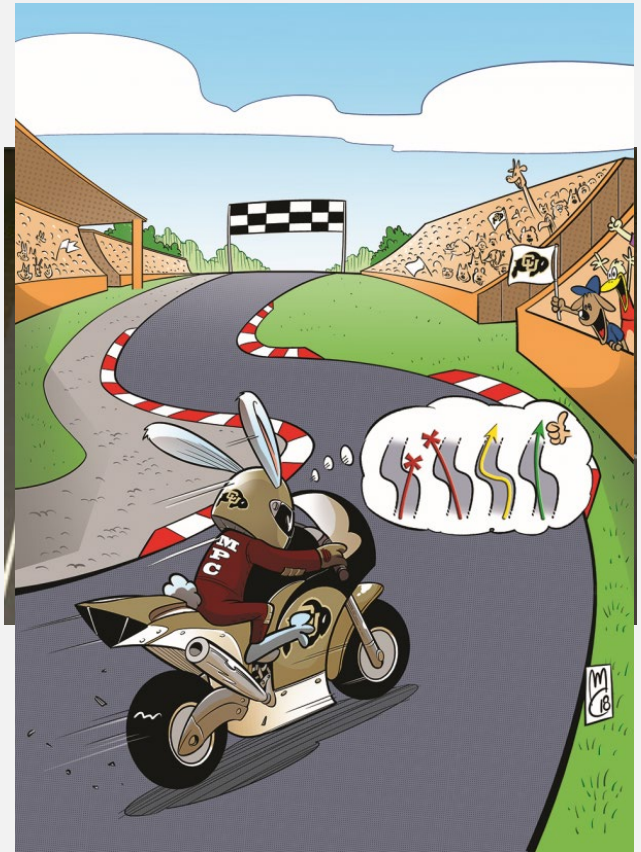
Primary Treatment

DO & Nitrogen Removal - AI
Based on Model Predictive Control (MPC)

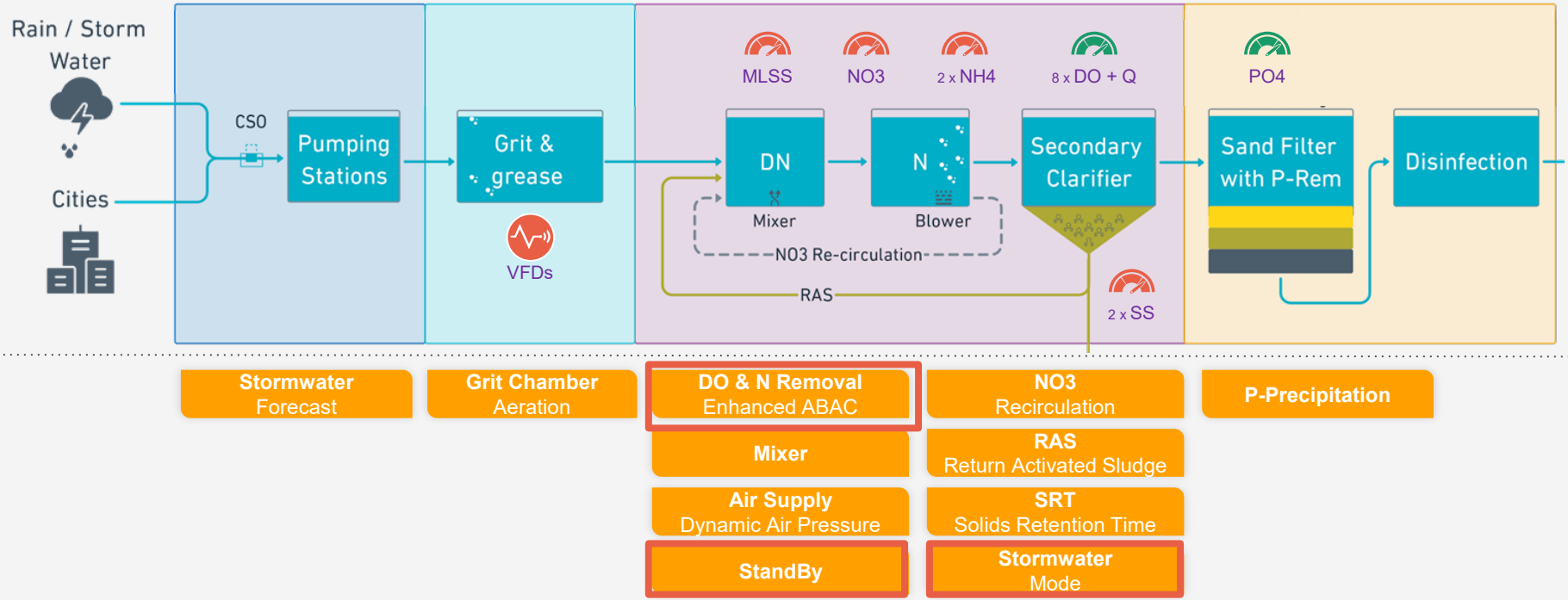
1. **Implement a model** switch predicts the future based on the history incl. time delays in sensors, equipment, biomass and loading

1. **Optimize** and “choose” the best optimization from a number of criterias

1. **Update automatically** the predictions and optimisation each 2. minutes as soon as new data/information are available



HUBGRADE + SENSORS + EQUIPMENTS
1M € PROJECT - 1 YEAR TO SET IT UP



ENHANCED ABAC - DO & N REMOVAL
BASED ON NH_4, NO_3 AND POSSIBLY PO_4

OPEX · Energy · Compliance · Capacity · Footprint

PATENTED

DO & Nitrogen Removal

WHY

- Ensure compliance
- Reduce OPEX (energy)
- Reduce CO_2 emissions
- Lower SVI (Easier sludge settling)

HOW

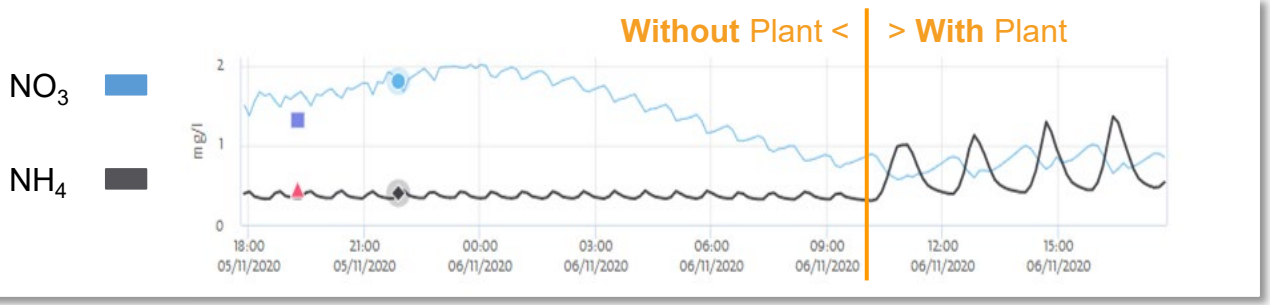
- Avoid over-aeration
- Enhance the usage of COD for NO_3 removal.
- Enhance balancing of N/DN processes according to load variations.

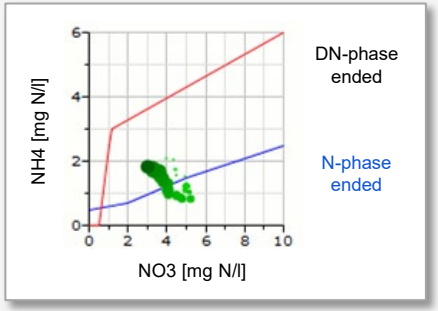
WHAT

Two patented optimized controls:

- regulating the DO set point
- regulating N/DN switching phases.

Providing set points for intermittent aeration and DO based on real-time measurements of NH_4. NO_3 and PO_4 in the aeration tanks.





STANDBY® MODULE

OPTIMIZE DURING LOW LOADS OR GOOD PERFORMANCE

OPEX | Energy | Chemicals | Compliance

PATENTED

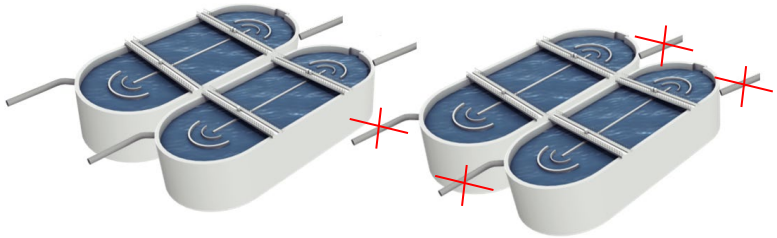
Standby

WHY	HOW	WHAT
○ Reduce OPEX (energy) ○ Reduce coagulant due to Enhanced Bio-P ○ Enhanced biomass	○ ***Temporary*** standby/close down process lines when low load/good performance has been detected ○ Let biomass go anaerobic and remove P	Patented real-time optimization: Providing set points for relevant standby of 1 or many lines by stopping inlet, mixer, aeration, internal pumping

Mixing | Air

Standby OFF

NH_4+NO_3



~~Mixing~~ | ~~Air~~

Standby ON

PO_4

SMART BIO-P®

ENHANCED BIO-P IN EXISTING N/DN TANKS

OPEX Chemicals Compliance Capacity

PATENTED

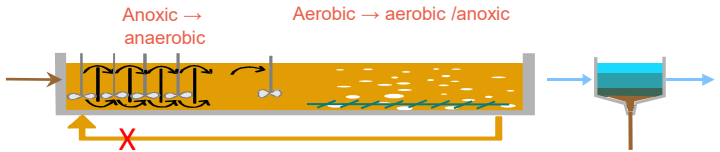
SMART Bio-P®

WHY	HOW	WHAT
○ Enhance biological P-removal ○ Reduction of chemicals OPEX	○ Real time control to create temporary anaerobic phases during low load/good performance & low flow	Find a time slot for growth of Bio-P bacteria somewhere in existing volume.

Adaptable to all activated sludge plant designs (incl. IFAS)

Example: Conventional plugflow ASP - MLE

Change of process in the upstream anoxic/aerobic sections to temporary anaerobic



SMART BIO-P℗ - ENHANCED BIO-P IN N/DN TANKS

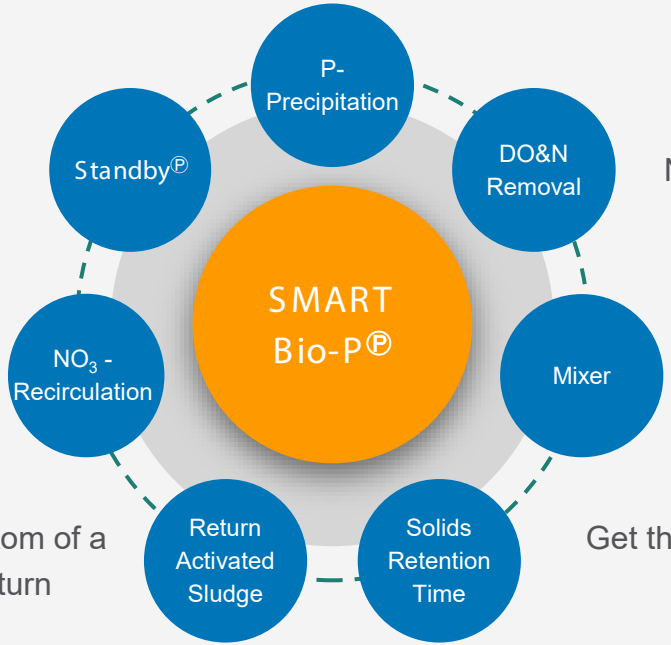
REDUCE COAGULANT DOSAGE

Adjust the dosing of coagulant chemicals according to the need and load

Increase anaerobic time with temporary closure of biological lines

Minimise or stop nitrate & DO return to upstream tanks

Increase hydrolysis at the bottom of a settler. Minimise nitrate return



Increase P-release/uptake by N/DN intermittent aeration and DO control

Increase hydrolysis rates in mixing OFF periods

Get the right sludge age for Bio-P removal

STORMWATER MODE®
FEATURE IN DETAIL

OPEX Energy Chemicals
Compliance Capacity

Stormwater Mode

WHY
- Increase flow through biological WWTP during rain events
- Reduce sludge escape during rain events

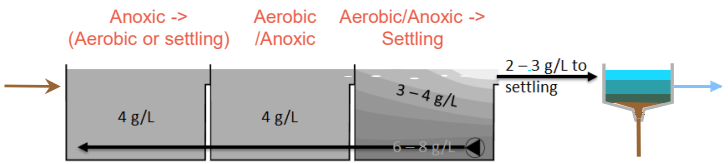
HOW
- Real time control of settling phases to keep activated sludge inside the process tanks during highflow

WHAT
Find a place for settling of activated sludge somewhere in existing volume

Adaptable to all activated sludge plant designs

Example: Conventional plugflow ASP - MLE

Settling in selected sections N/DN in other sections



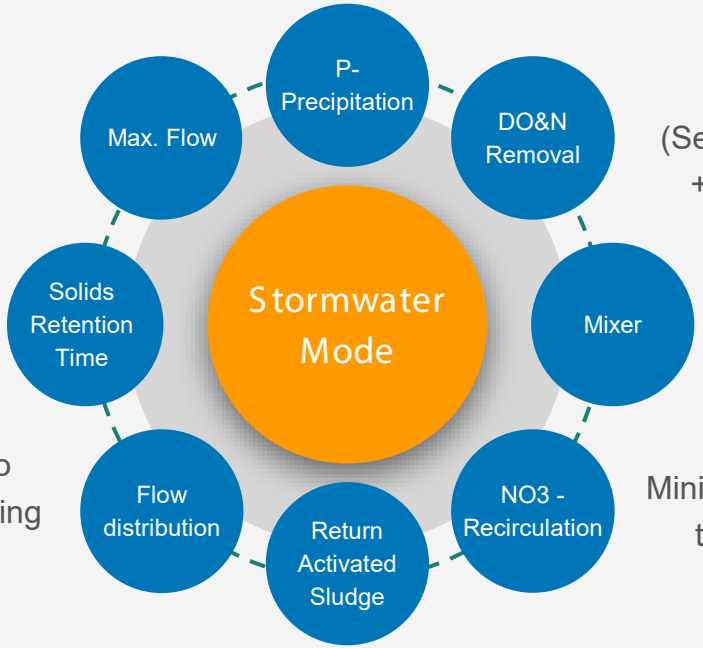
STORMWATER MODE® - BETTER HANDLING OF RAIN

PREPARE FOR RAIN (SETTLING, FORCED RAS FLOW, CLEANING...)

Increase flow to a Maximum

Minimise biomass (sludge age) to improve settling

Distribute flow to settling tanks to balance sludge level between settling tanks



Choose process in each section (Settling, Nitrification & Denitrification) + aeration intensity (DO setpoint)

Stop mixing in settling sections

Minimise internal pumping to minimise turbulence and improve settling

Minimise internal pumping to improve settling
Balance sludge level between settling tanks

BACK TO NOSEDO
APPLIED MODULES

DO & Nitrogen Removal AI
SMARTGrid Spot Price

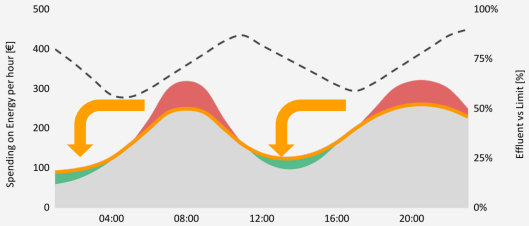
OPEX

Main Benefits*:

- Energy consumption is balanced & postponed to lower price period.
- 10 to 20 % more OPEX savings 400 k€/y (600 k$CAD/y)

Extra CAPEX:

- Nothing needed (apart Hubgrade ;))



N_2O-minimization

Footprint

Main Benefits*:

- Minimize N_2O emissions by up to 80% balancing the N / DN periods based on N_2O measures

Extra CAPEX:

- Additional N_2O sensors

Dry Weather Equalization

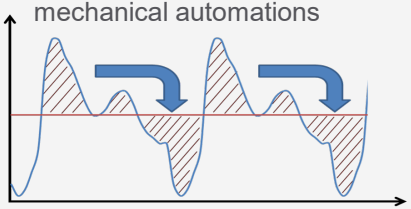
OPEX

Main Benefits*:

- Usage of unused volumes in the system (pipes and/or basins in the sewer & wwtp network) as storage volume(s)
- 15 to 30% more OPEX savings 650 k€/y (1000 k$CAD/y)

Extra CAPEX:

- Hydraulic sewer pre- study + potential mechanical automations



*:Compliance is always the priority

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- FIRST IN CLASS PARTNERS
- OPERATOR REMAINS IN CONTROL


THANKS - Questions?
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