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SEZIONE AUTOMAZIONE
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Convegno Sezione Automazione ANIMP

SISTEMI DI AUTOMAZIONE: NUOVE SFIDE E OPPORTUNITA’

6 ottobre 2016

c/o Auditorium Maire Tecnimont (Milano)

Control and optimisation of water distribution systems in big cities
By Marco Clerici

- What is Aquatoria
- Operational aspects
- Optimisation aspects
- Aquatoria structure
- Telemetry solution
- Optimisation principles
- The cases of Minsk and Cairo

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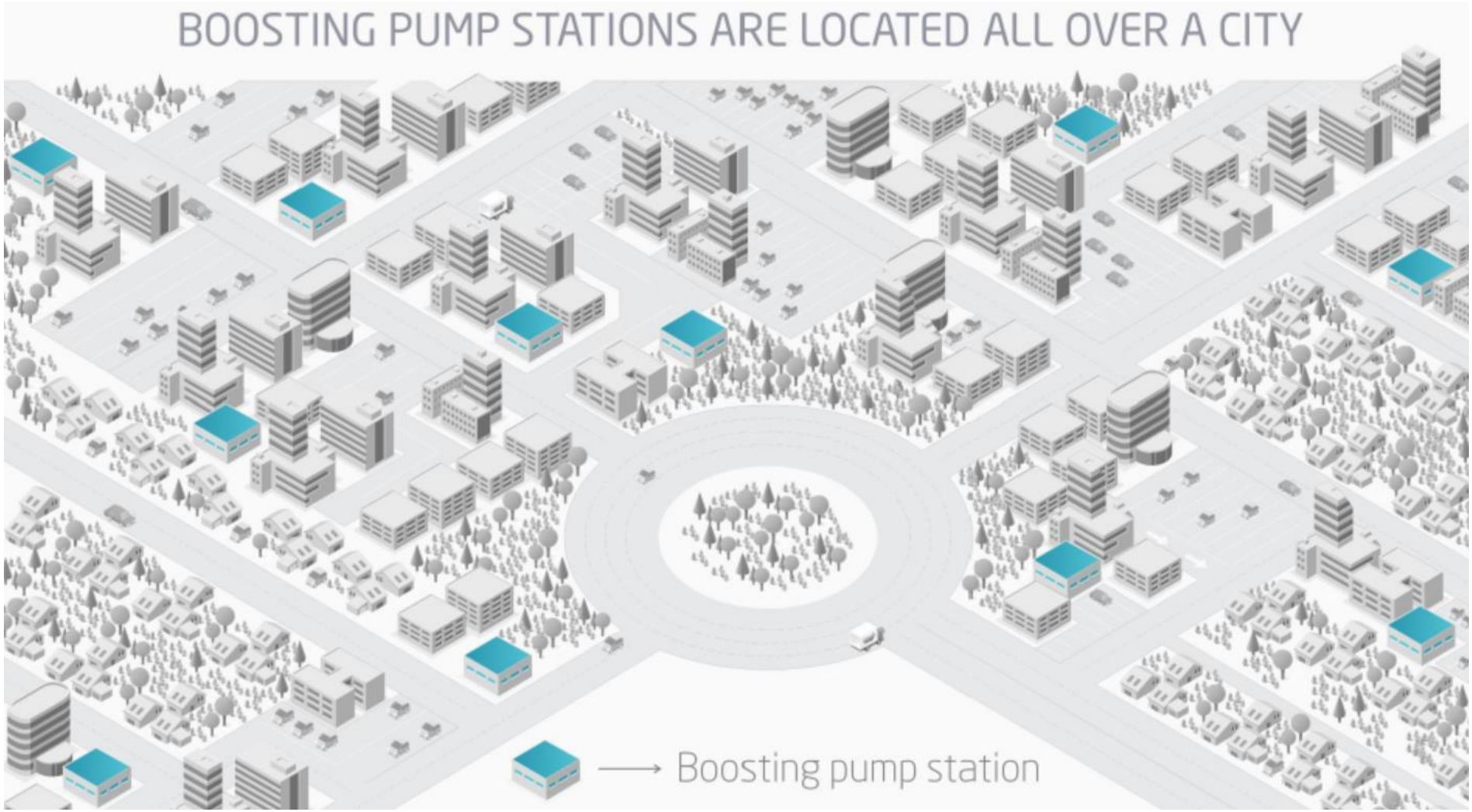
Control and optimisation of water distribution systems in big cities

WHAT?	Process optimization and control solution
WHERE?	Water wells Boosting Pump Stations Sewage Pump stations
WHY?	Energy Savings Leak decrease TCO decrease

Control and optimisation of water distribution systems in big cities



EFFICIENT BOOSTER PUMP STATIONS OPERATION ASPECTS

- EXCESSIVE WATER PRESSURE AT CONSUMER SITE ELIMINATION
- INEFFICIENT PUMP OPERATION MODE ELIMINATION
- OPTIMAL PUMP SELECTION

EFFICIENT BOOSTER PUMP STATIONS OPERATION ASPECTS

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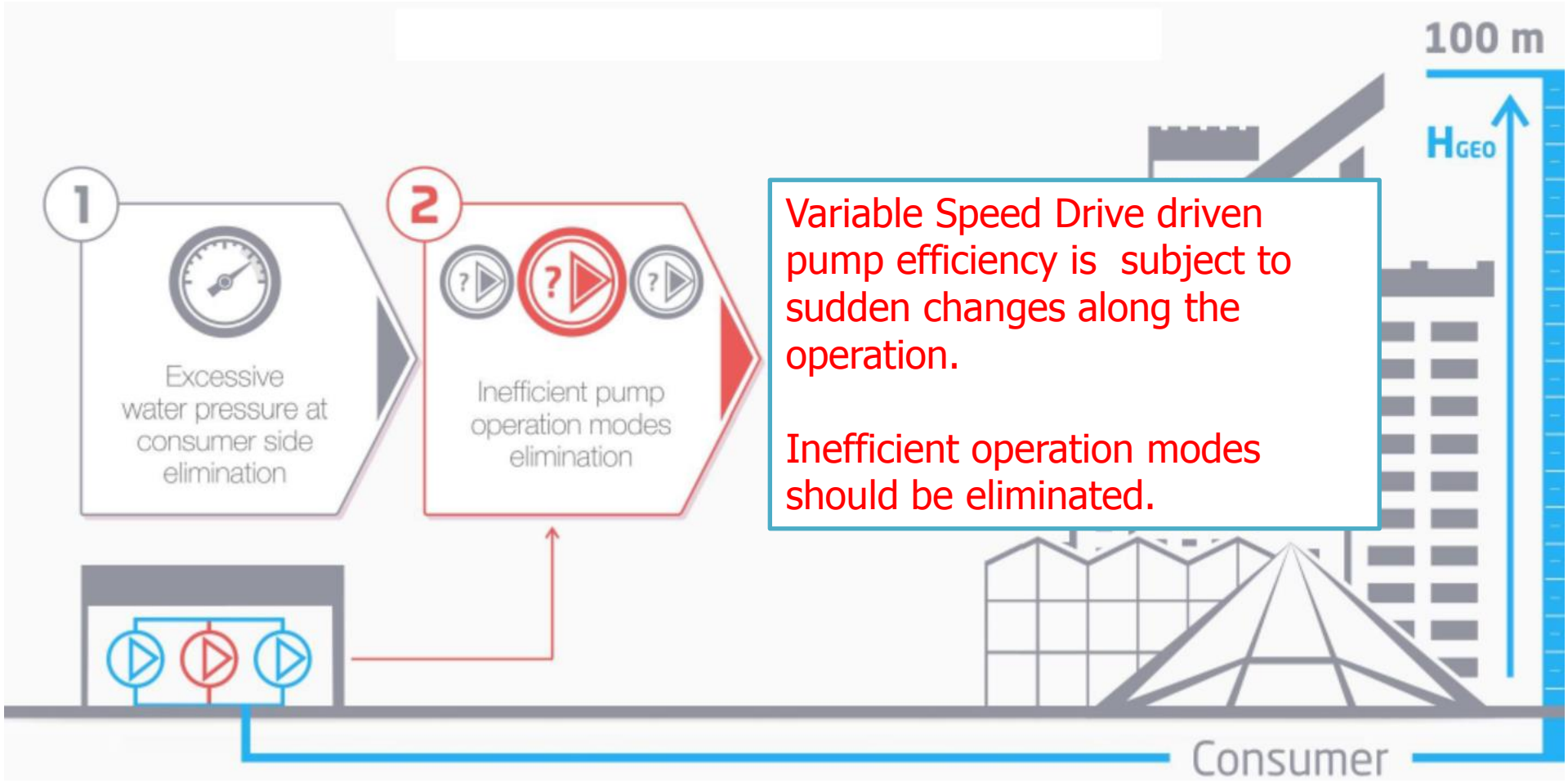
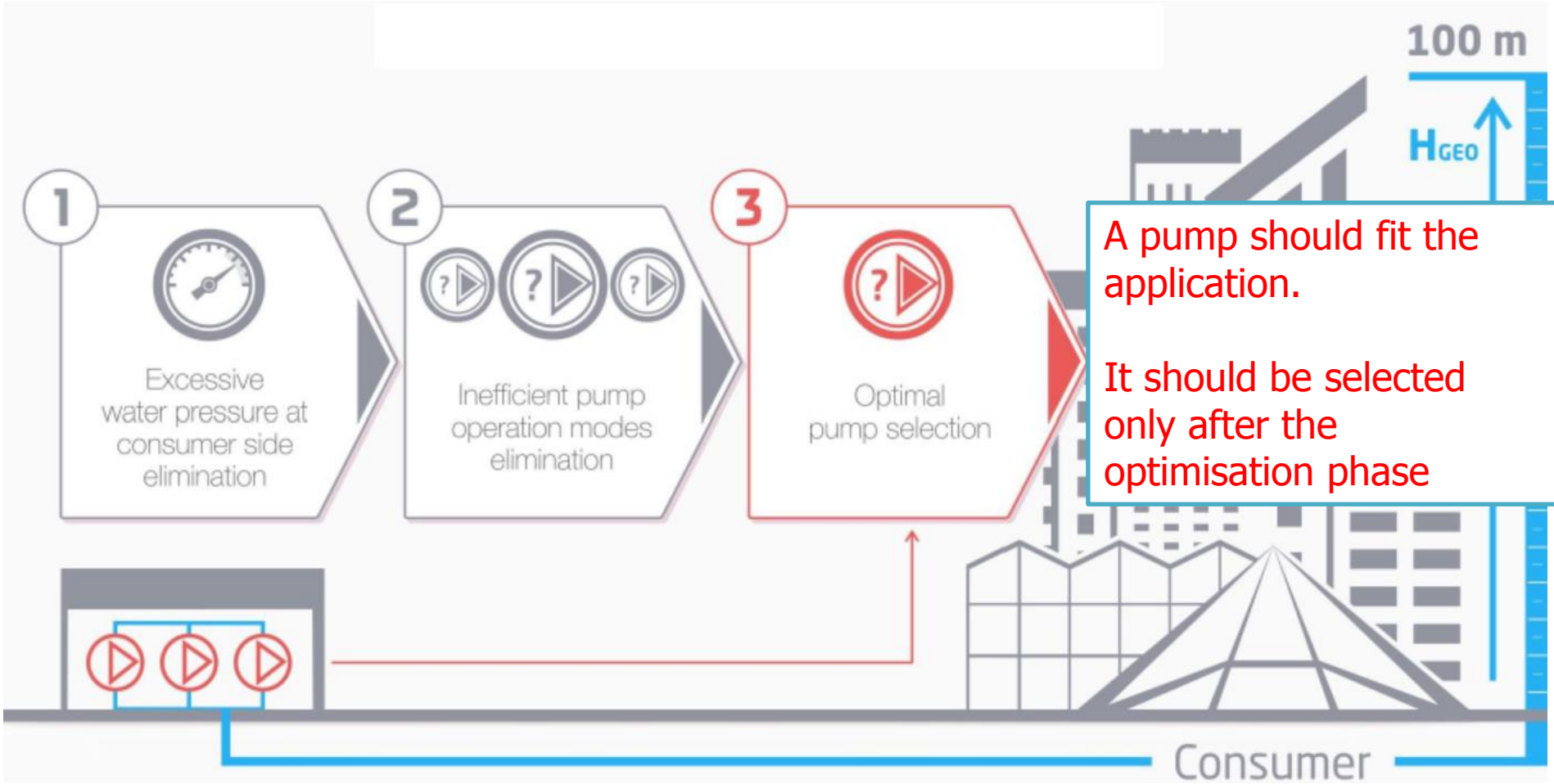


Variable Speed Drive driven pump efficiency is subject to sudden changes along the operation.

Inefficient operation modes should be eliminated.

EFFICIENT BOOSTER PUMP STATIONS OPERATION ASPECTS



A pump should fit the application.

It should be selected only after the optimisation phase

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OPTIMISATION SOLUTIONS

ENERGY CONSUMPTION DECREASE

LEAK DECREASE

TOTAL COST OF OWNERSHIP

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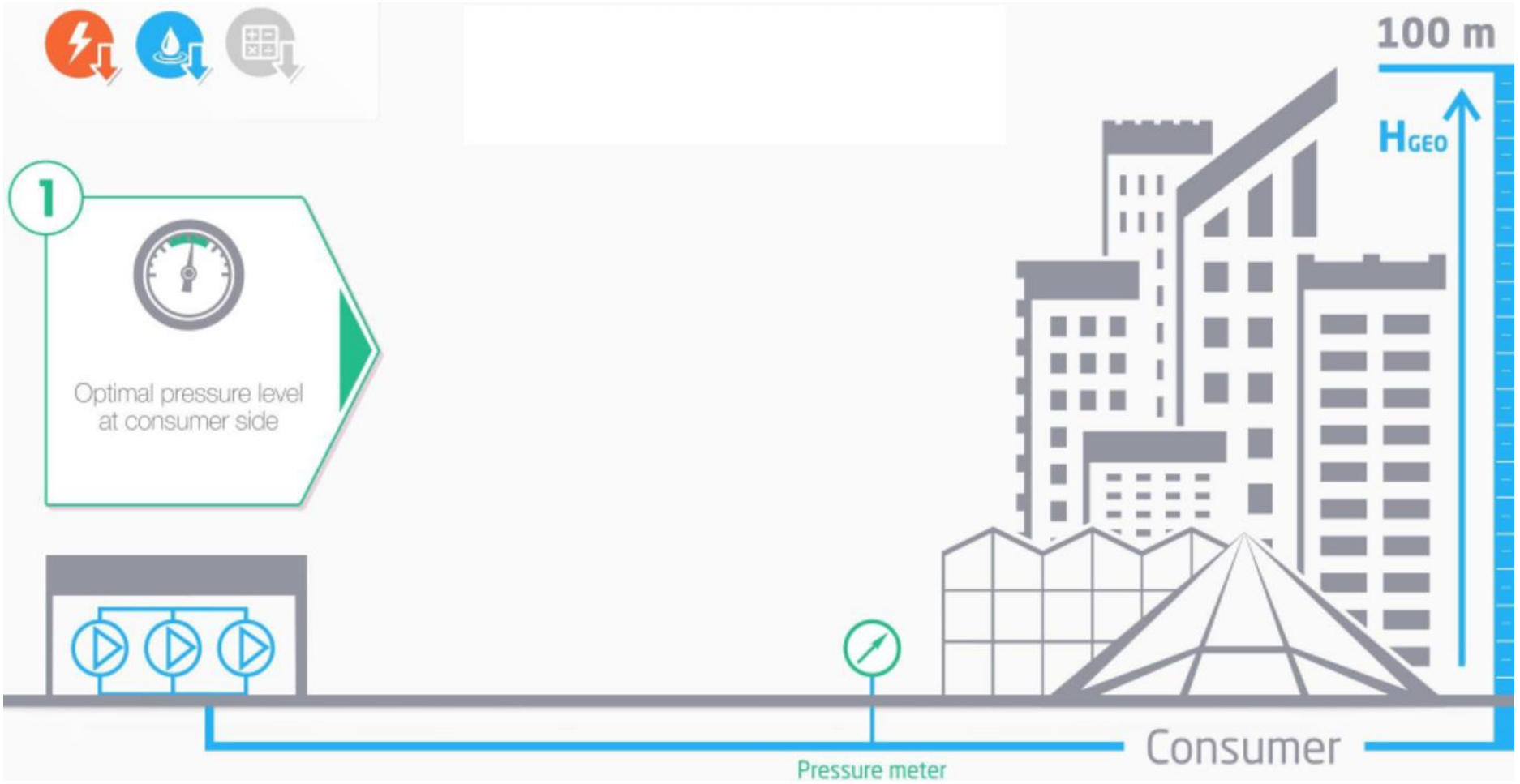
Optimisation Solutions



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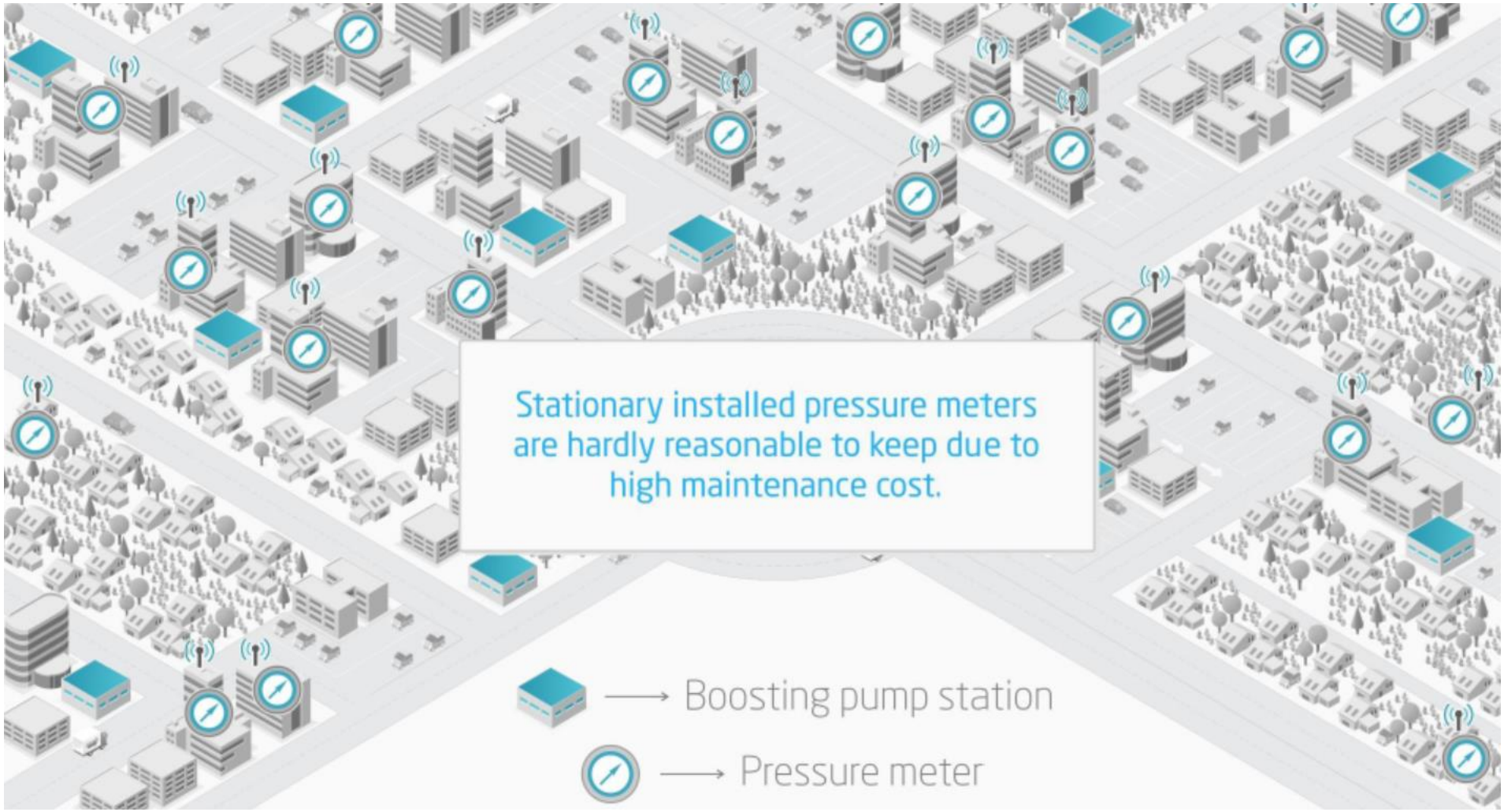
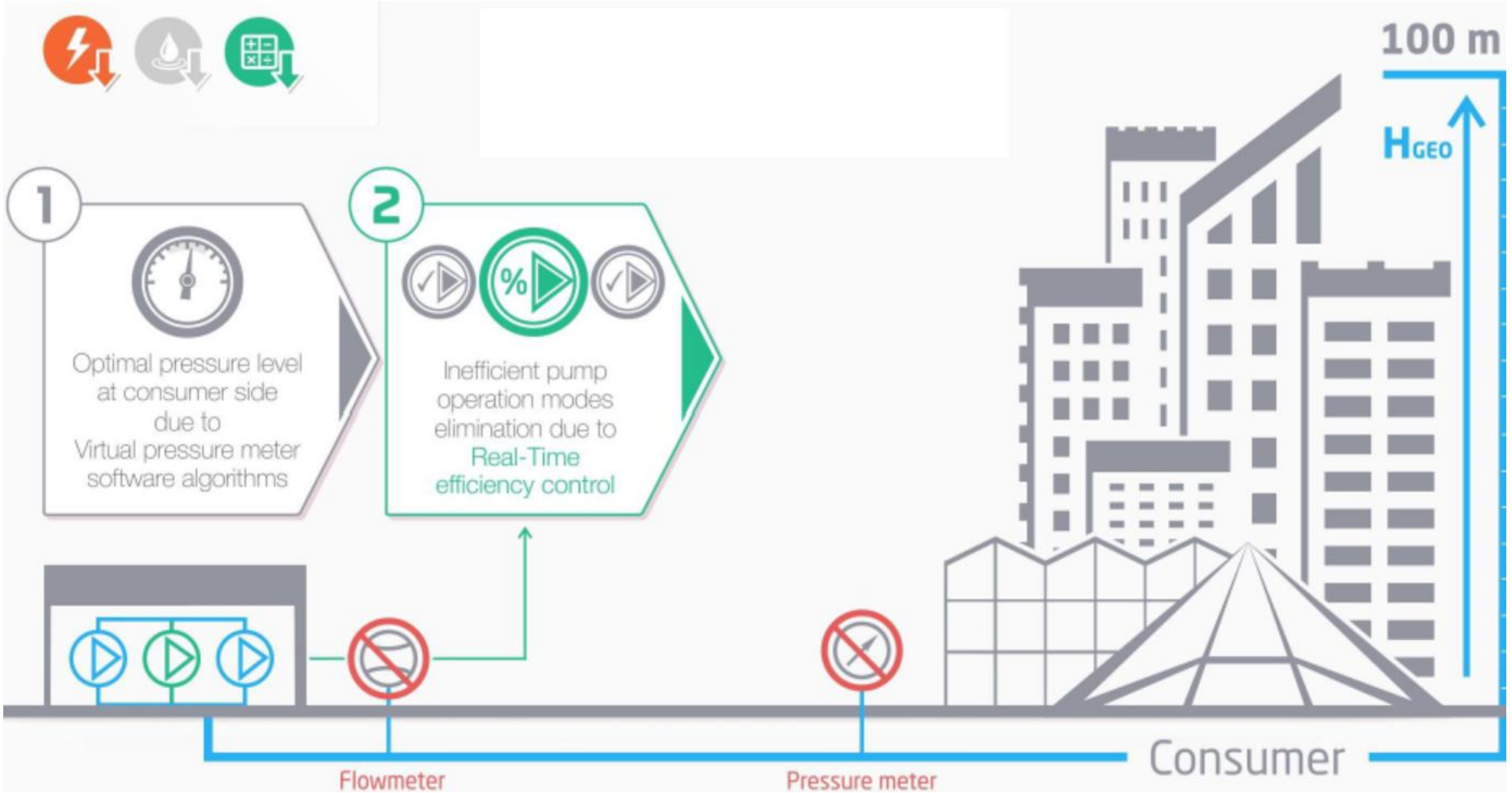


Control and optimisation of water distribution systems in big cities

Optimisation Solutions

Control and optimisation of water distribution systems in big cities

Optimisation Solutions



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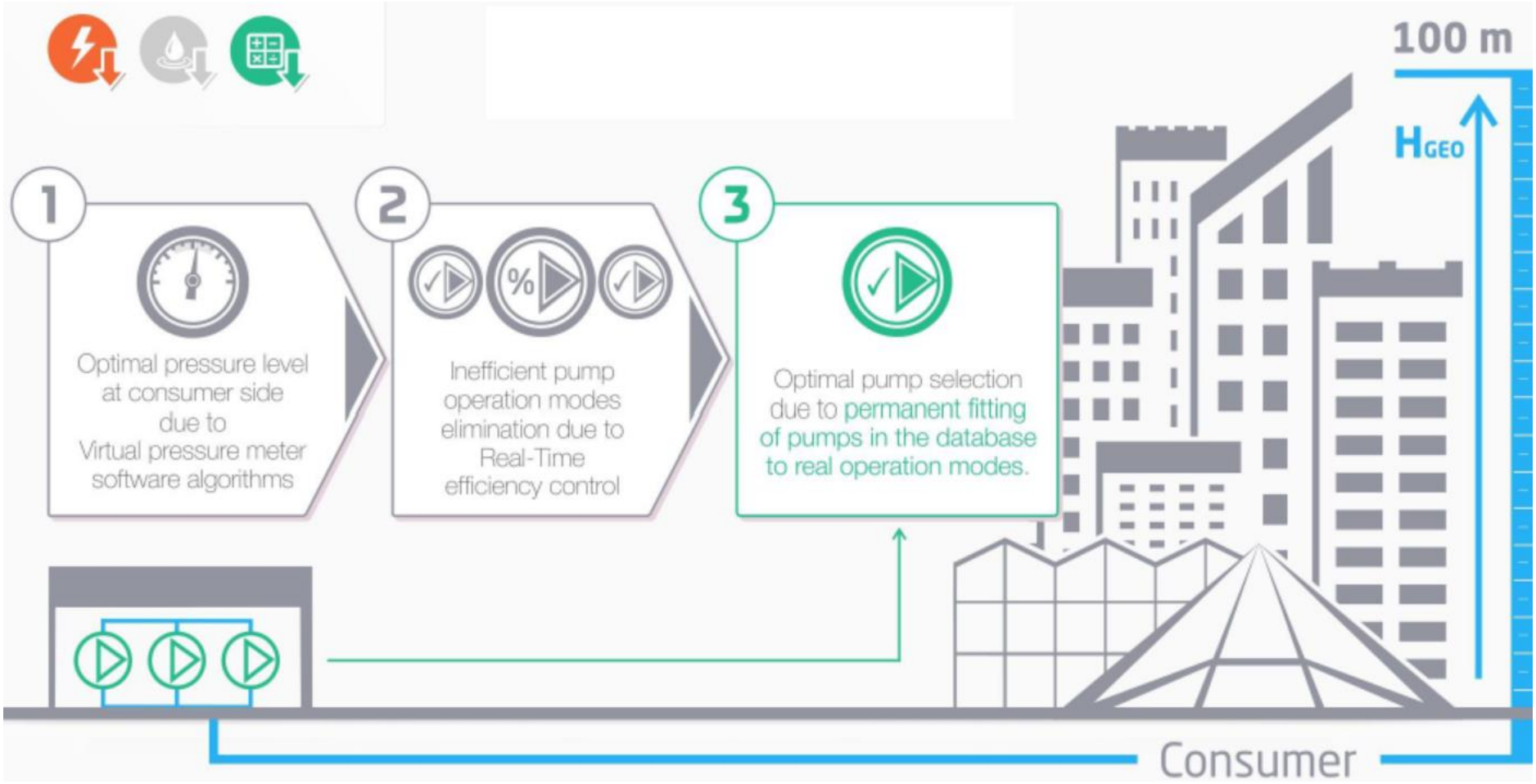
Optimisation Solutions



Aquatoria solution structure

Aquatoria workstation control software

Telemetry equipment

Control cabinets

Aquatoria solution structure

Aquatoria control software is based on control algorithms, parametrization and monitoring pages inside a SCADA system

SCADA SYSTEM

- VISUALIZATION
- ALARM HANDLING
- TRENDS
- REPORTING
- ARCHIVING

Application Configuration	• System TCO decrease (staff costs reduction)
Adaptive Control	• Energy saving alghoritms for pump station control
Analitycal reports	• Leak decrease due to comprehensive process analisys
Pump Selection Tool	• Energy saving due to proper pump selection.
Geo Module	• Localization for maintenance intervention, easy parametrization.
Process Analisys Tool	• Energy savings (due to precise monitoring) • Leaks decrease (due to precise monitoring)

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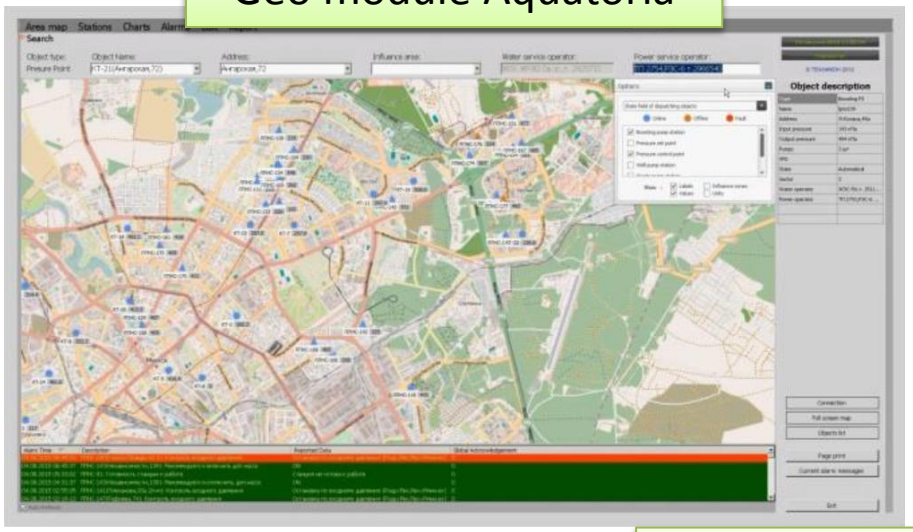
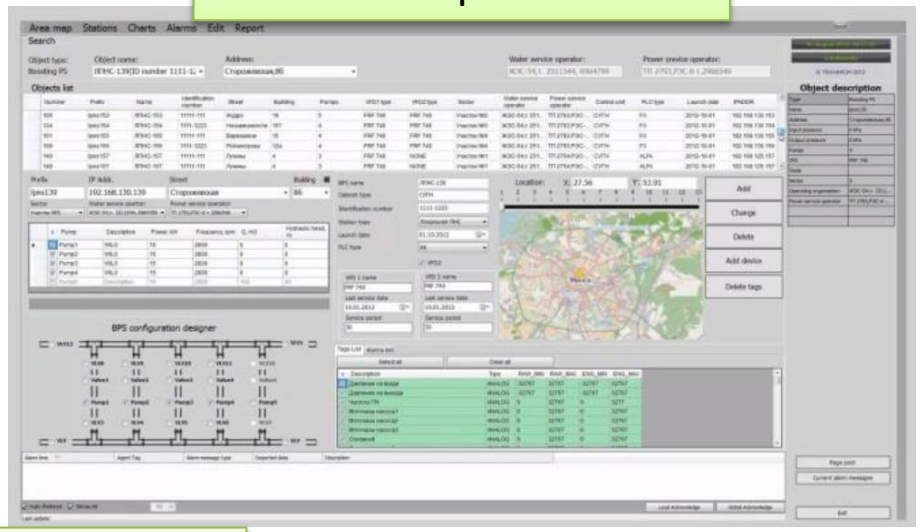
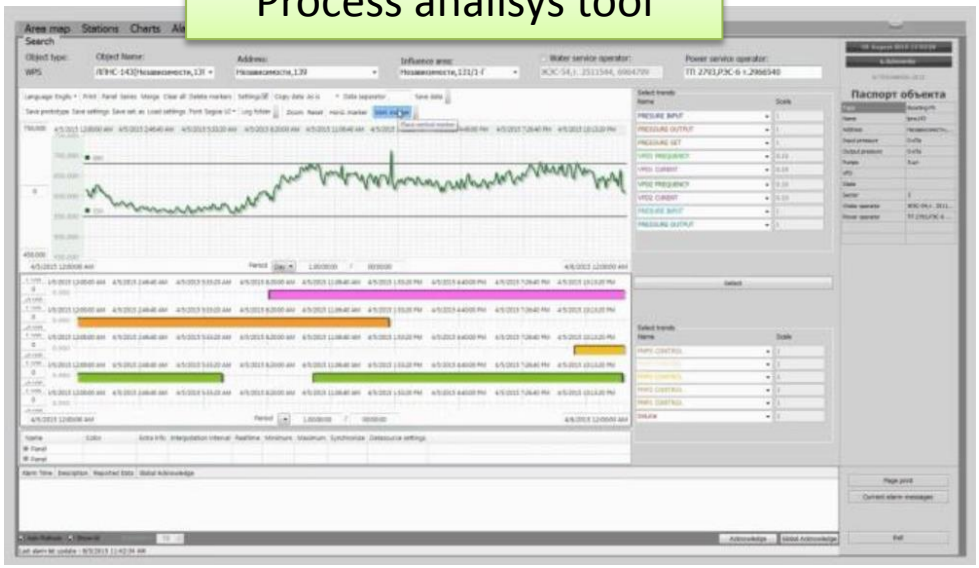
Geo module Aquatoria



New Pump addition



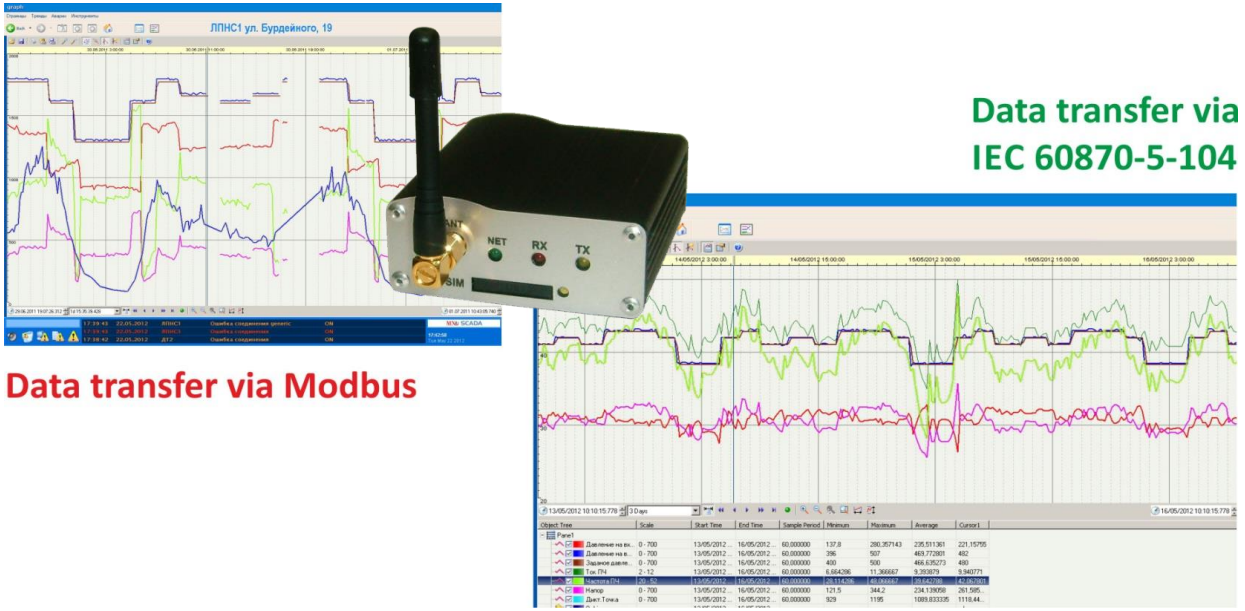
Process analisys tool



Telemetry solution

The telemetry structure of Aquatoria is based on following principles:

- ✓ Standard PLC on the market, to comply with existing installations
- ✓ Complete data transfer, no loss of data in case of missing communication
- ✓ OPC technology for interface of field equipment to the SCADA
- ✓ Single database of the process data for adaptive control implementation



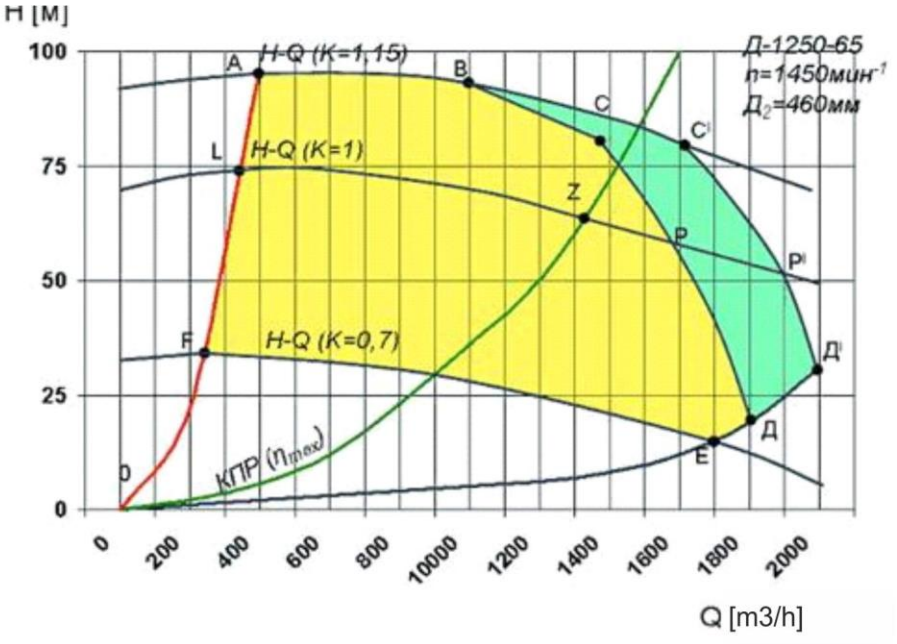
Principles of the optimization

The PLC in control cabinet collects information from pressure sensor, power consumption and pump rotation speed. These data are used in the math model in the PLC program and SCADA to calculate:

- Current pump efficiency running from an inverter
- Water pressure in remote control point

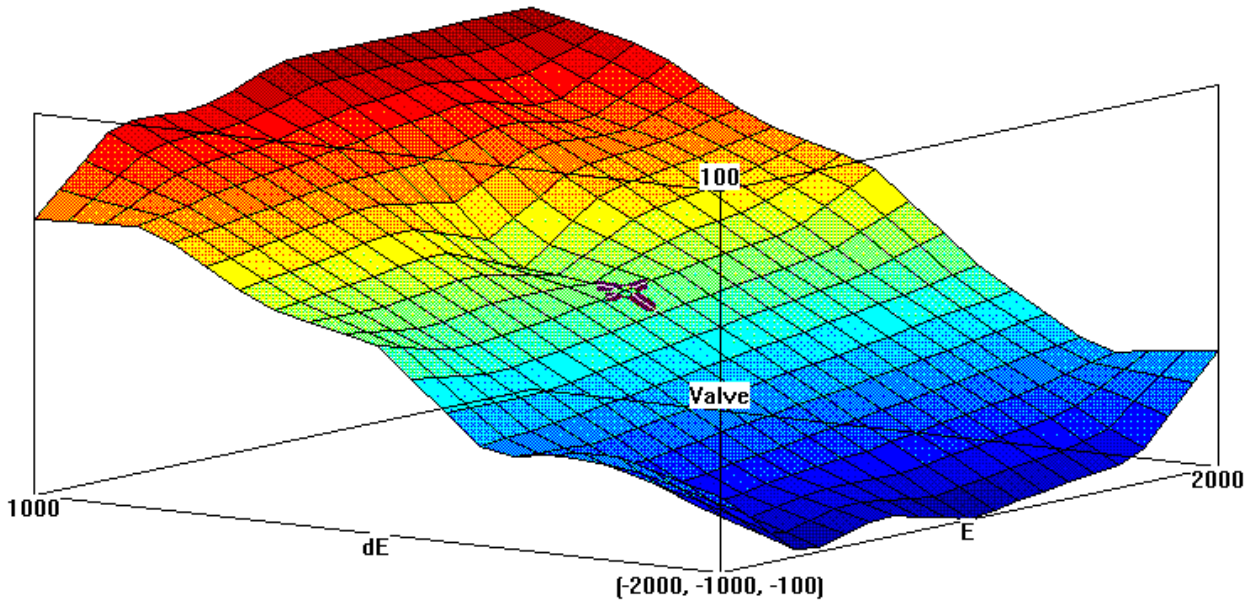
Thus, making the following possible:

- Low efficiency pump switch off
- Selection of optimal pump model based on real running modes



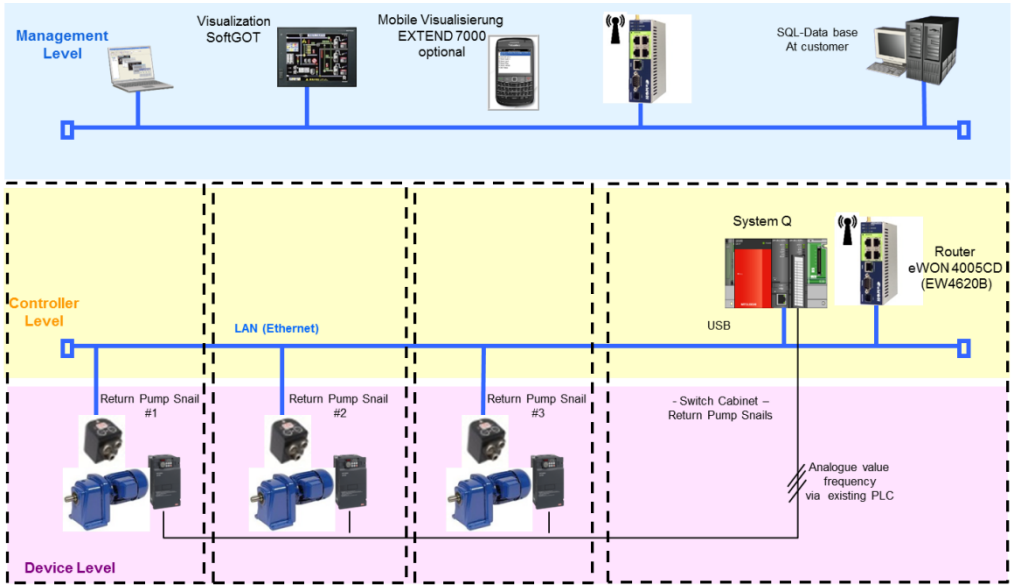
Principles of the optimization

The model is actually used in a Fuzzy Control Algorithm that looks to minimize the energy consumption of groups of pumping stations linked on a common hydraulic network.



Principles of the optimization

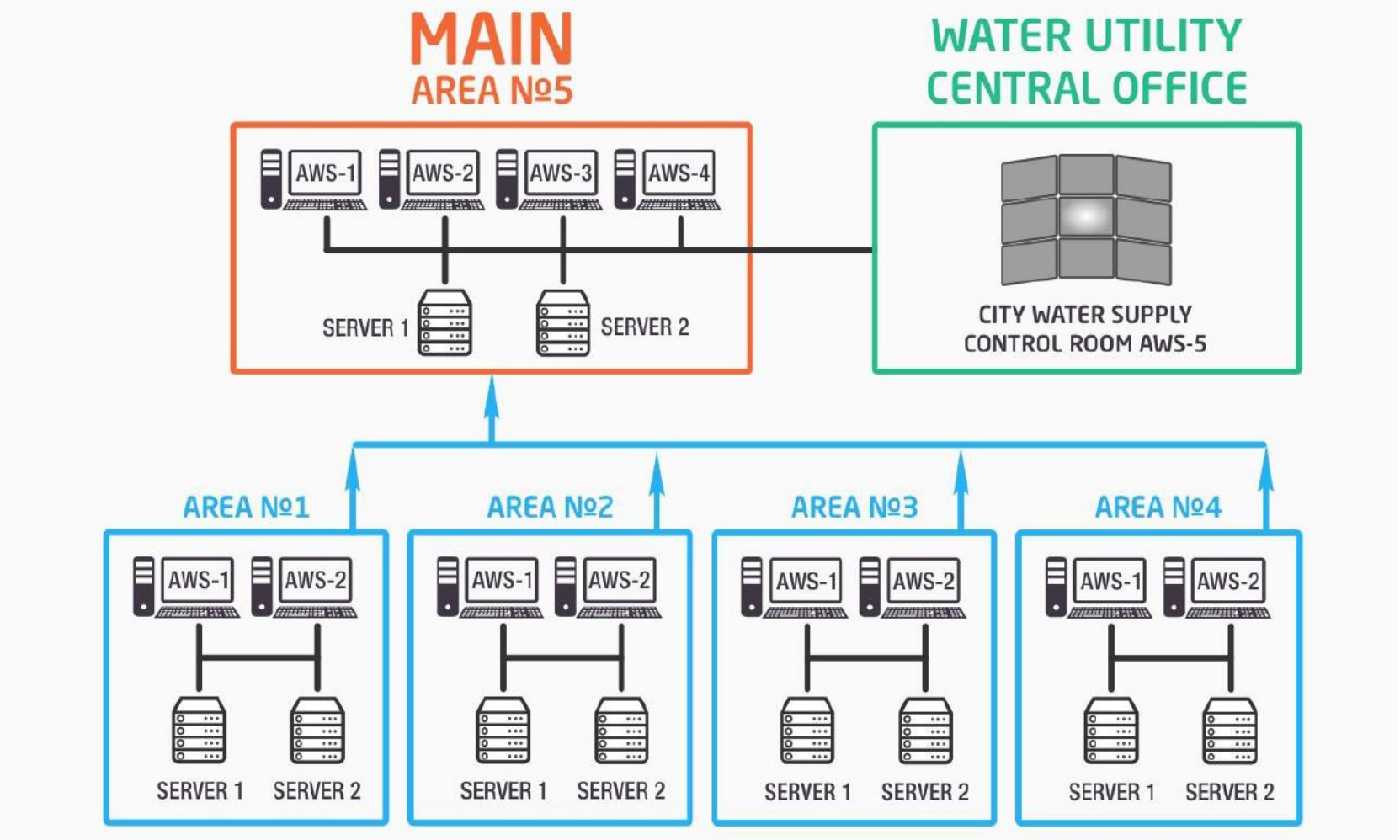
Addition of Condition Monitoring solutions for predictive maintenance on pumps



- Based on vibration and temperature sensing
  - Early detection of possible failure and indication of precise cause
- Data collection directly over telemetry to SCADA system
  - Reduction of personnel costs
  - Reduction of spare parts inventory

Control and optimisation of water distribution systems in big cities

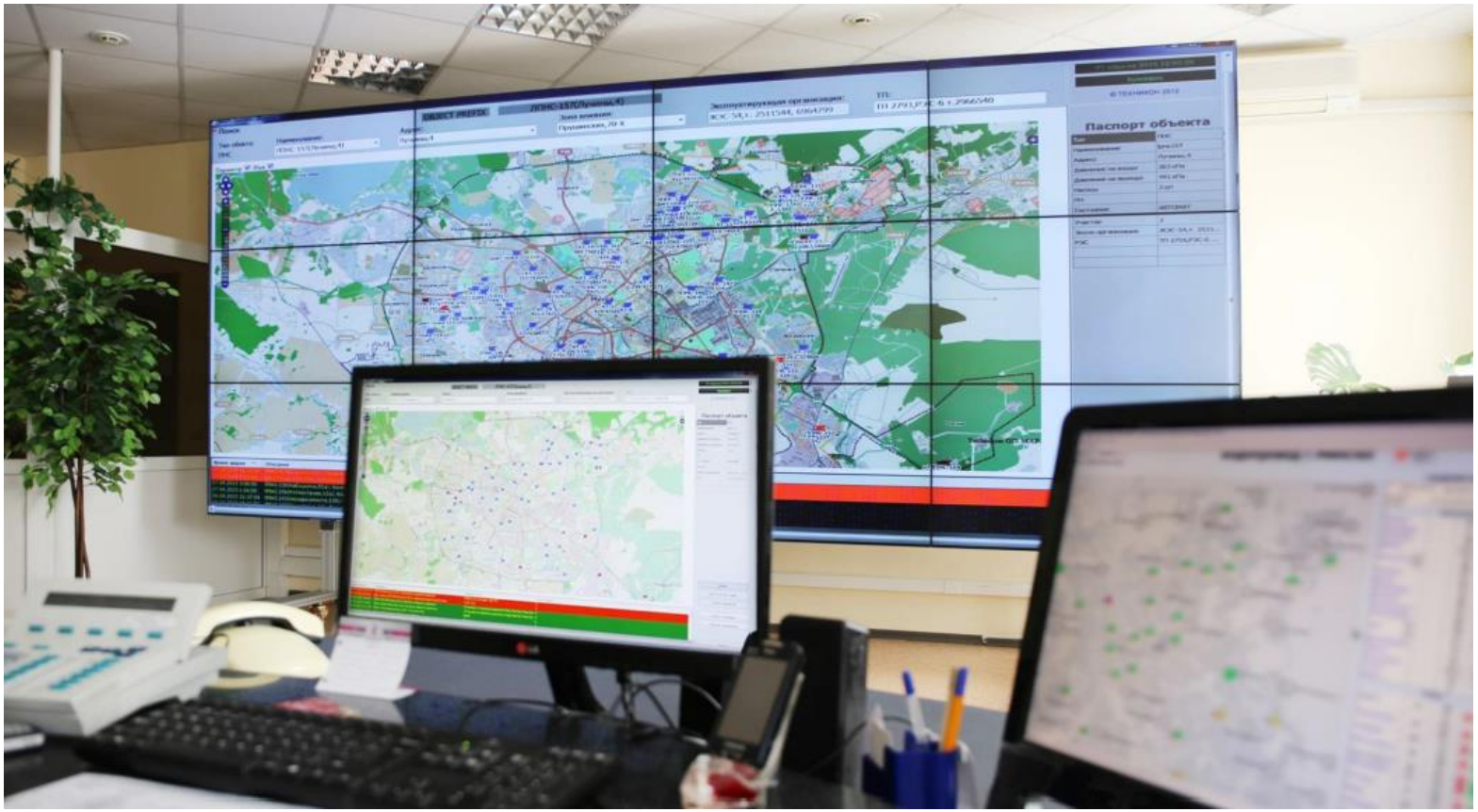
The Case of Minsk



Control and optimisation of water distribution systems in big cities

The Case of Minsk

The complete city of Minsk (around 2 Million people) is covered by Aquatoria solution



The Case of Minsk

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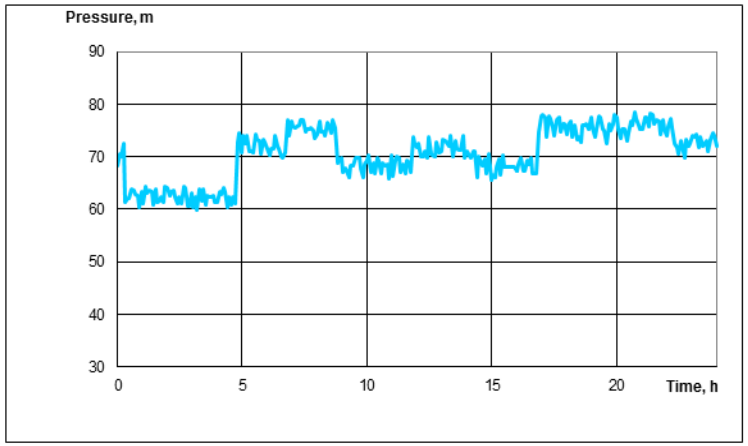
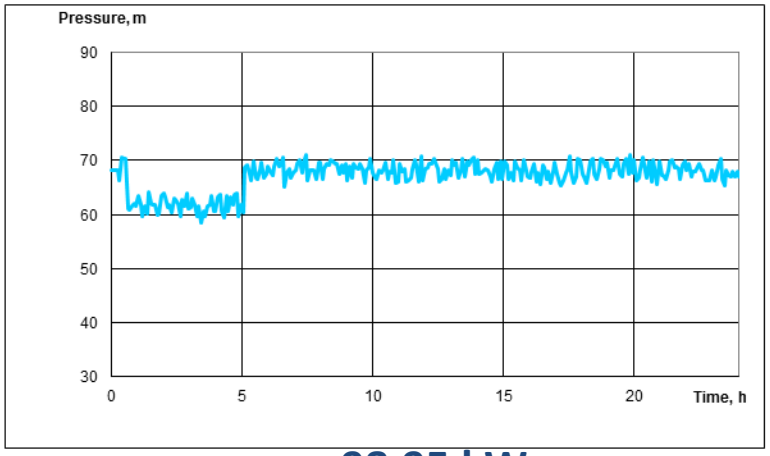
Pressure at the consumer side before optimization



126,18 kW

Pressure at the consumer side after optimization



98,95 kW

№	Characteristic	Rate
1.	Boosting pump station monthly energy consumption	786,56 kWh
2.	The average relative reduction in energy consumption by one local pump station	17,5 %
3.	Overall relative reduction in energy consumption within 11 local pump stations	16,8 %

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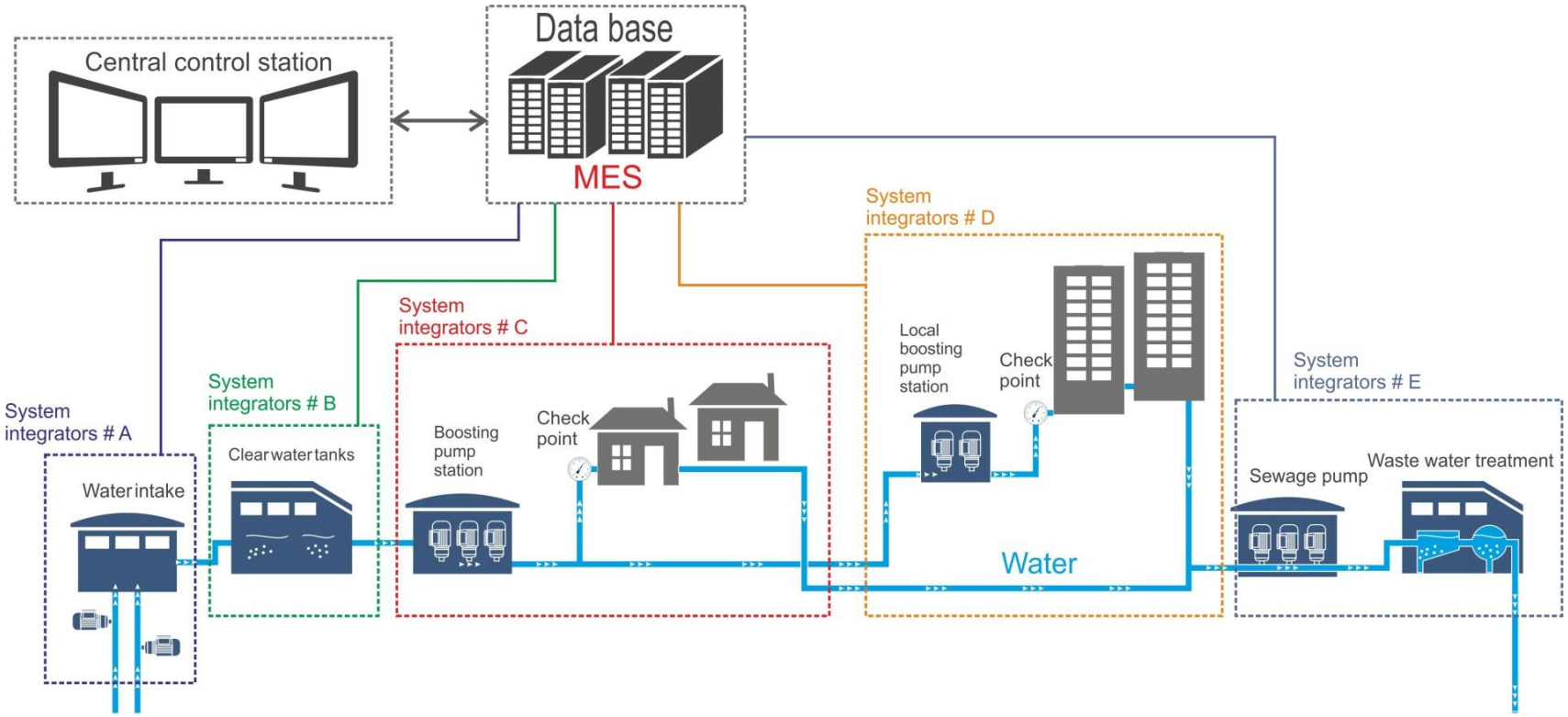
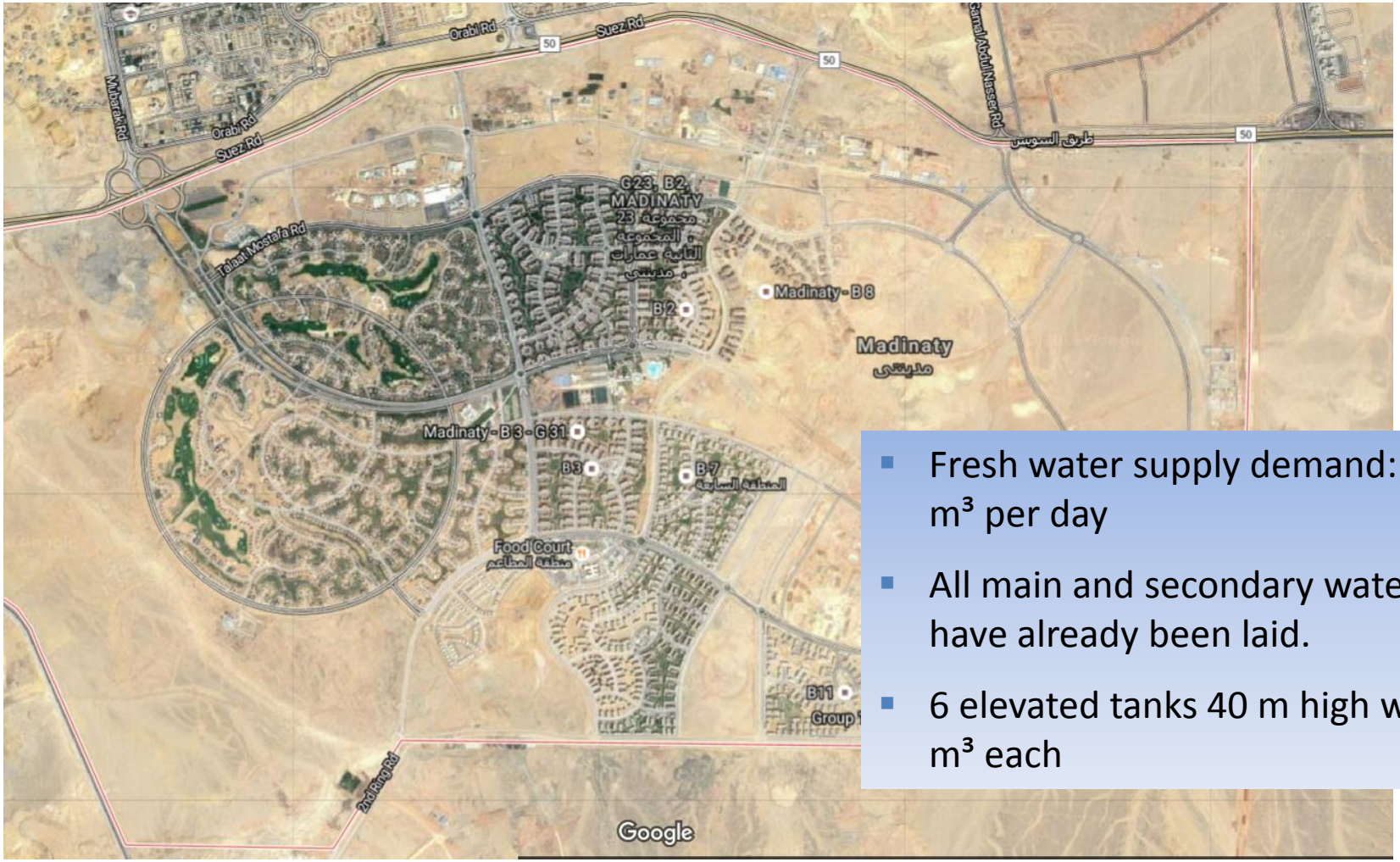
The Case of Cairo

Project on-going in one of the new city outside Cairo, Madinaty (1 Million people at project completion)



Control and optimisation of water distribution systems in big cities

The Case of Cairo



- Fresh water supply demand: 139,500 m³ per day
- All main and secondary water pipes have already been laid.
- 6 elevated tanks 40 m high with 7,000 m³ each

The Case of Cairo

- ✓ Installation of electronically adjustable Pressure Reducing Valves (PRVs) in the city with remote control functionality: pressure fluctuations significantly decrease after PRV implementation on the tanks outlet.
- ✓ Leakages also decrease due to general water pressure decrease. Valves and PVC pipelines breakdown decrease.
- ✓ Implementation of a central SCADA system enabling the monitoring and control of the system and thus the water pressure
- ✓ **Excessive water pressure reduction after implementation of adjustable PRVs with 3 pressure presets is saving approx. 5,177.5 m³ of water per day and 705.4 kWh of energy per day (annual savings: 1.9 million m³ and 257.5 MWh per year).**

Grazie per la cortese attenzione