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Energy Efficiency through Advanced Electrical and Hydronic Control

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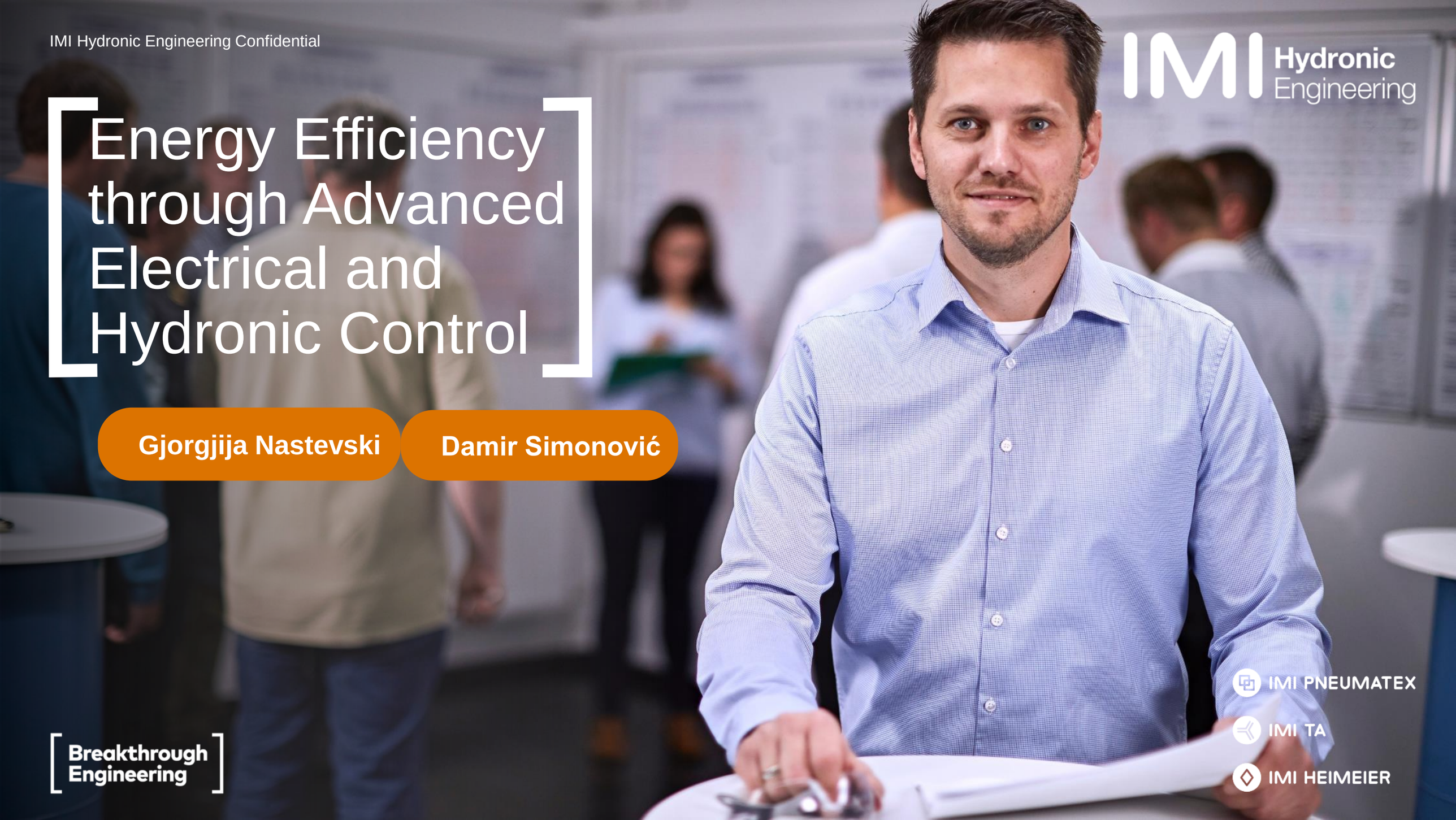

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Introduction

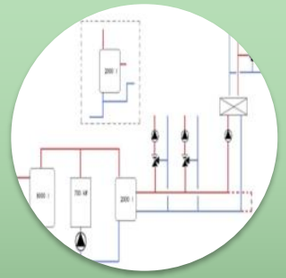
40% of the world's energy consumption is used in buildings*

50% of this is in HVAC systems alone*

(*) Sources: European Commission EPBD (point 6, pp1) & US Department of Energy's "Buildings Energy Data Book"

Energy savings on HVAC in buildings

Building structure
(insulation, double glazing, …)
- Best way to save energy
- Larger energy savings
- Long pay-back times



HVAC installation
- Use of new technologies
- System approach of hydronic design
- Shorter pay-back times

Human factor
- Avoid interferences with the HVAC system
- Educate tenants and maintenance team
- Never-ending task

Building modifications require adaptation or modernization of the HVAC installation to **take into account new heat gains/losses**

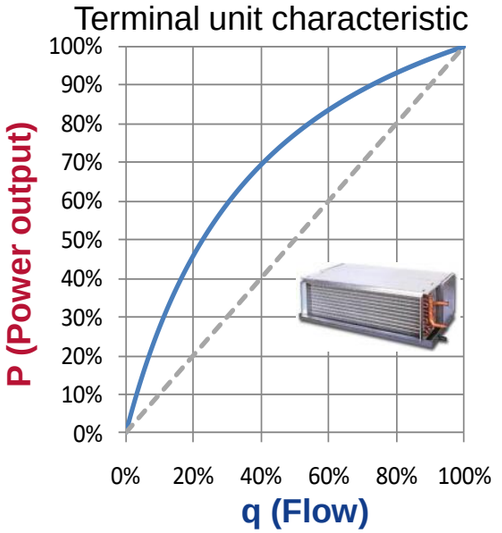
When modifying a HVAC installation one must **take into account the capabilities of people** using the installation

Introduction

In HVAC industry control is usually about temperature control. In this presentation the example will be room temperature control via Air Handling Unit's hydronic heating coil.

There are difficulties in such control loop:

- How to be energy efficient?
- How to provide good indoor conditions?
- How to compensate the disturbances?
- What is the right control signal value to be accurate & stable?
- Non-linear heat transfer – flowrate characteristic
  - *"20% the flow – 50% is the heat power"*
- Changing differential pressure's effect on control valve (authority)
- How to achieve low minimum controllable power?



Advanced Controller Concept

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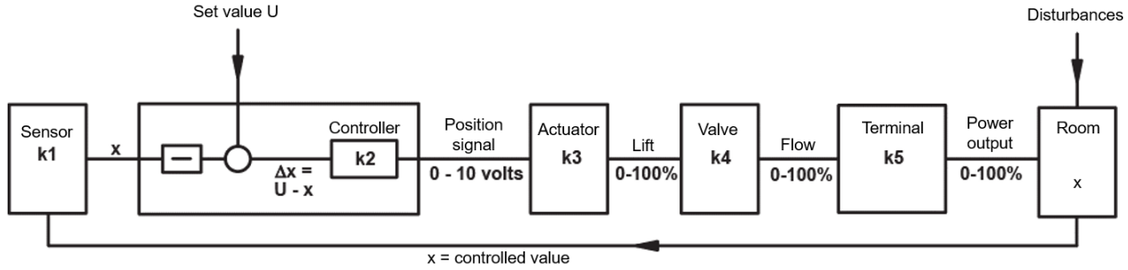
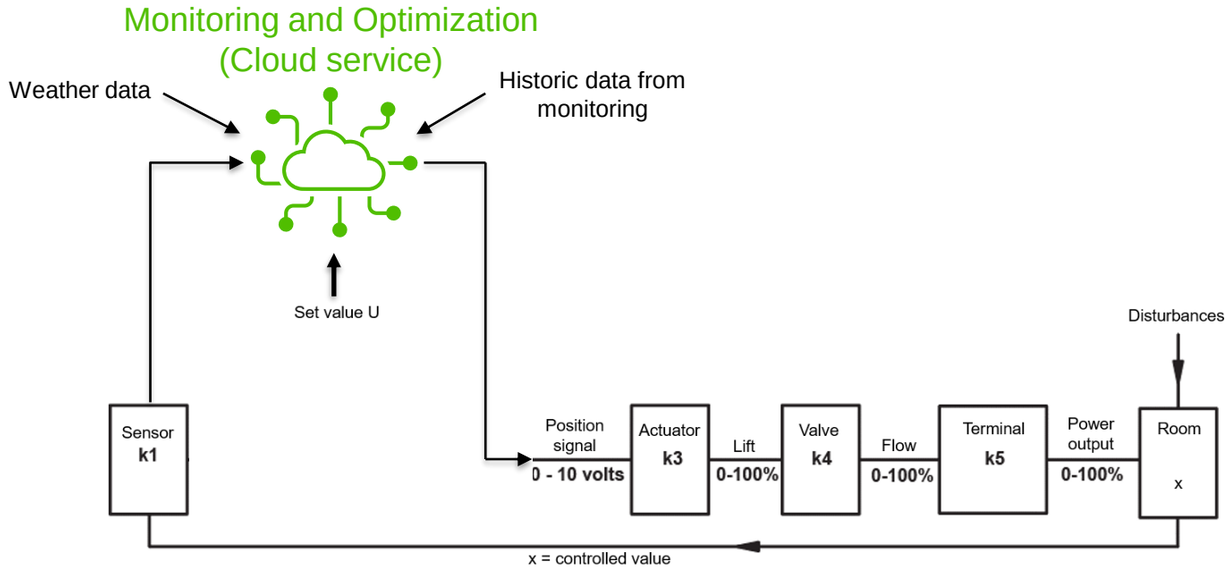
Advanced Controller Concept

Using today's technology a controller's operation can be enhanced by:

- Using networked devices - IoT
- Using optimized control logic
- Using data gathered via energy monitoring
  - *This will be the basis of optimizing*
- Multiple sensors in the same controlled area

Traditional closed control loop

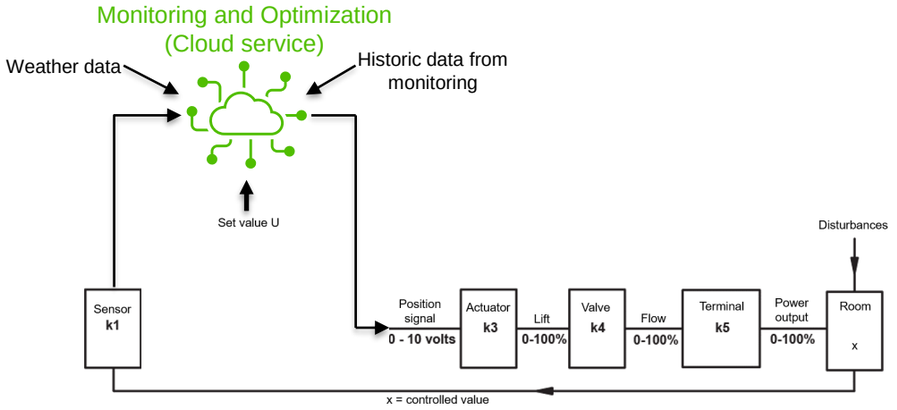




Advanced Control loop concept

Advanced Controller Concept

To apply this concept to a building five steps will be taken.



Advanced Control loop concept

1. Inspection and analysis
2. Installation
3. Calibration
4. Optimizing
5. Data displayed in real-time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Advanced Control Valve
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Advanced Control Valve

This is the new generation of IMI Hydronic Engineering's control valve the **TA-Smart.**

It is built around three key principles:

Control

- *Power or flow control mode. ΔT limitation / T_{return} limitation. Ability to control even very low flowrates.*

Measurement

- *Measurement of flowrate, supply and return temperatures. Using these: heat power & energy*

Communication

- *Variety of connectivity options possible at the same time*

Advanced Control Valve

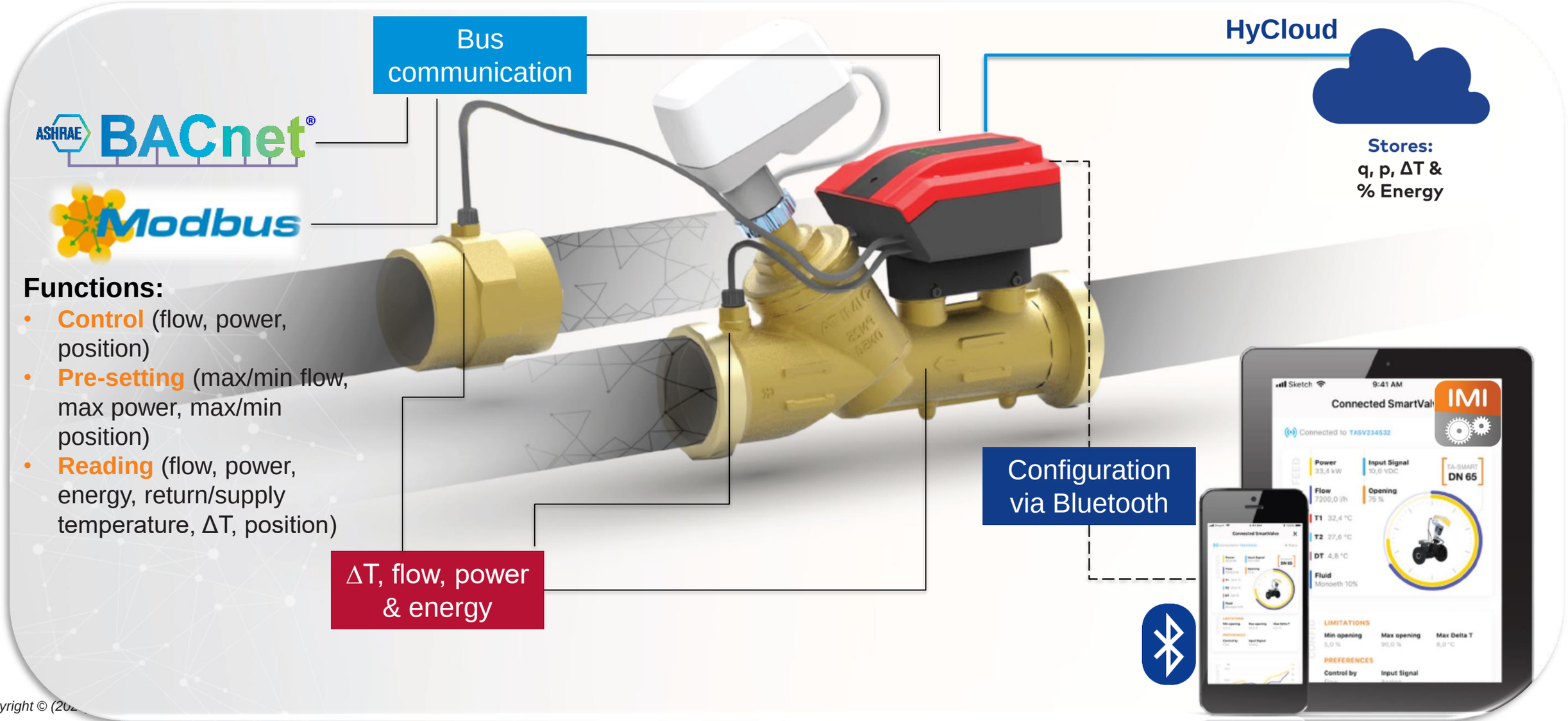
This is the new generation of IMI Hydronic Engineering's control valve the **TA-Smart.**

- Integrated ultrasonic **flowmeter**
- Purpose built valve body for **2way control** and **flowmeter**
- Accurate hydronic control and dynamic balancing
- Smartbox for **high level communication**
  - *Bus communication*
  - *Bluetooth*
  - *Communication with HyCloud data logging service*

DN32-50: U-Skew
(patent applied)

DN65-80: V

Advanced Control Valve



Proof of Concept

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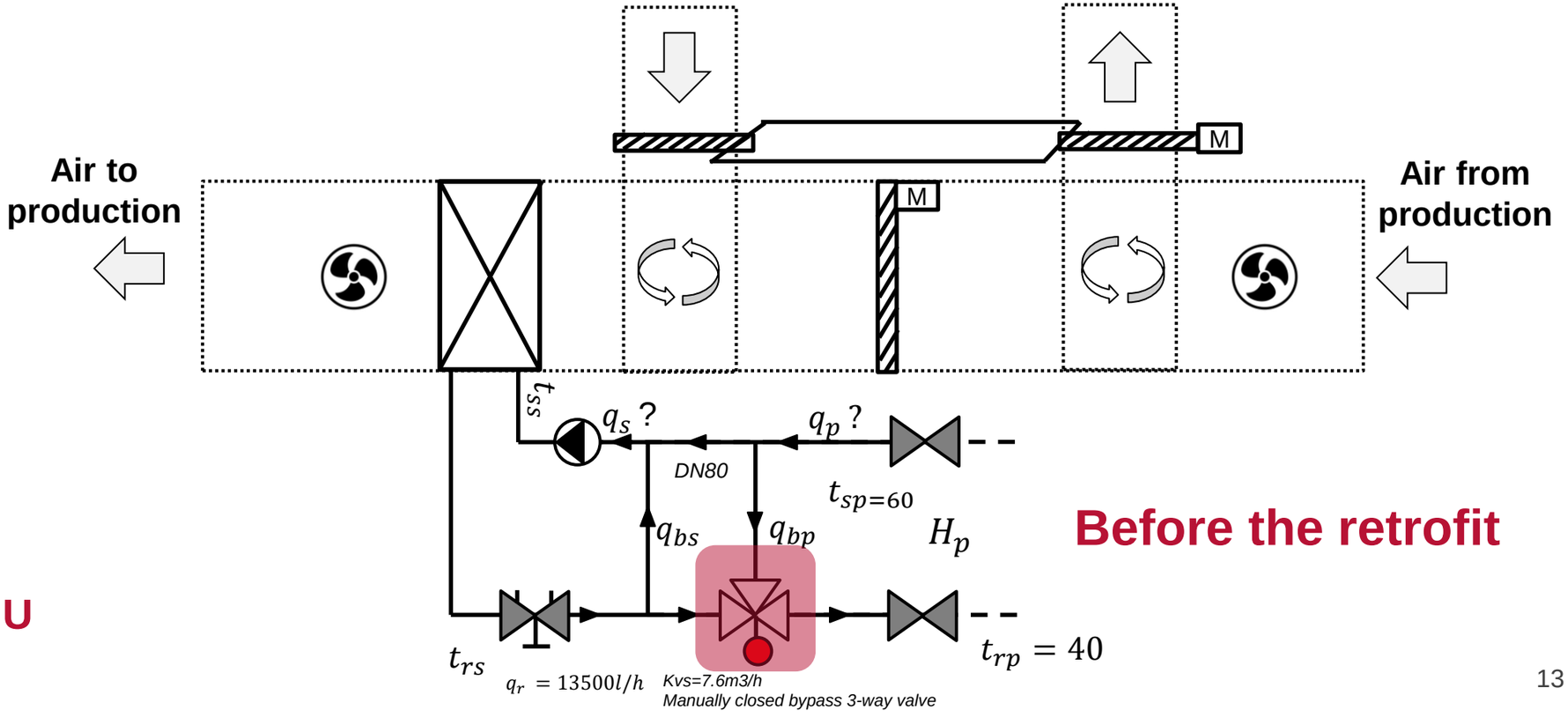
Proof of Concept

Work began early 2022 to retrofit an AHU heating coil in IMI Hydronic's Erwitte factory in Germany with the advanced control system and the TA-Smart valve. Nominal heat output of the coil was 600 kW

The goal was to improve comfort and reduce energy use.

Production Hall served by AHU



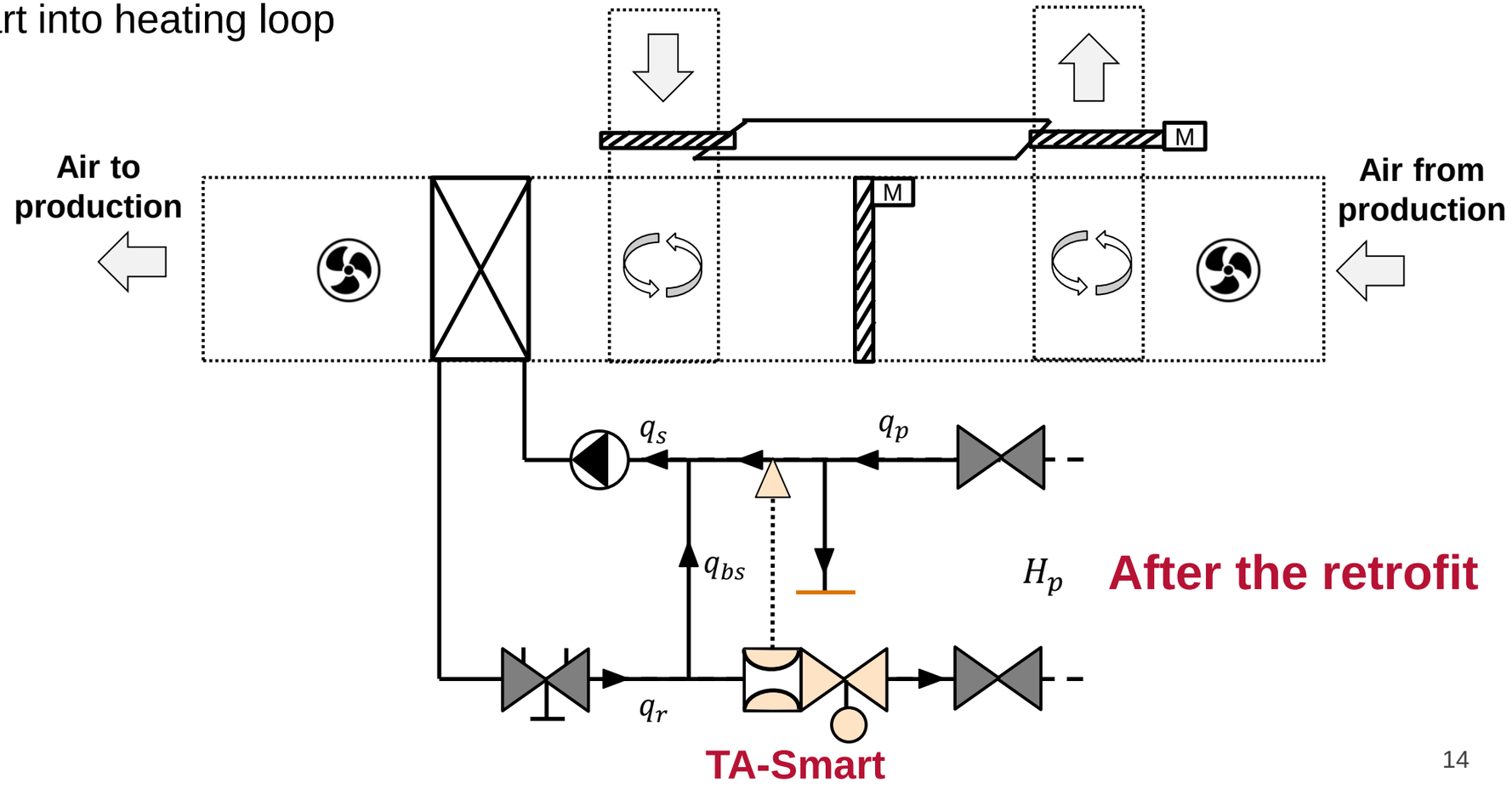
Before the retrofit

Proof of Concept

The retrofit had two main parts:

- integration of advanced controls into existing control system
- installation of DN80 TA-Smart into heating loop

TA-Smart installed



After the retrofit

Proof of Concept

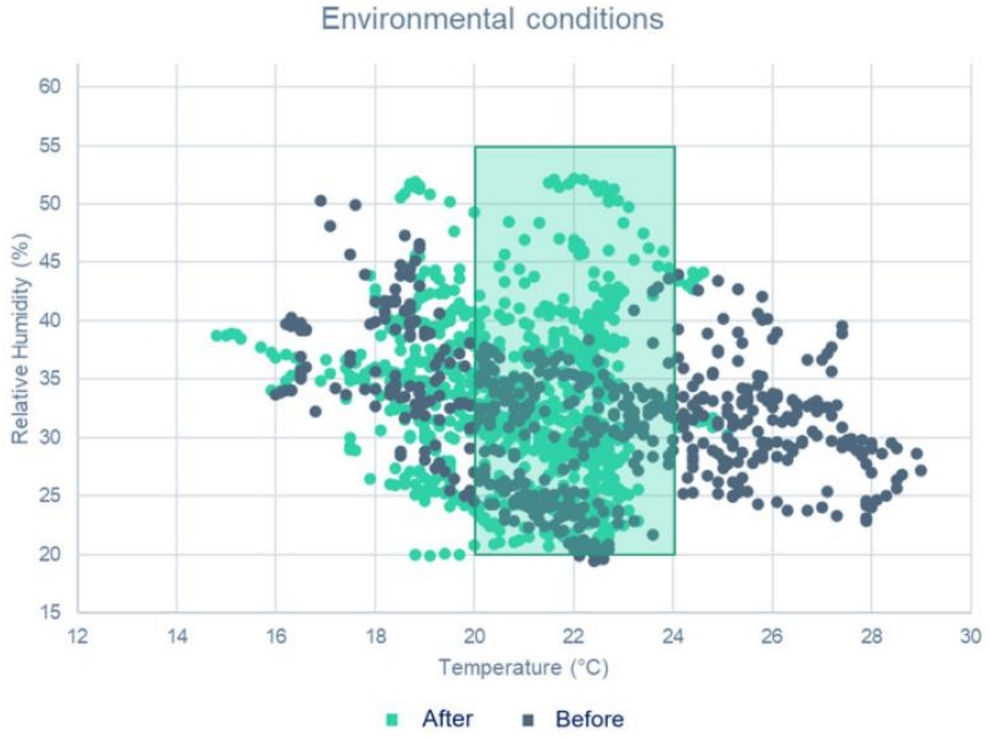
Stage 1

- TA-Smart is used as a standard control valve (position control)
- The control signal was from the existing controller (no optimization)

Stage 2

- TA-Smart was used in flow control
- The control signal is now passed through the advanced controller to have optimal setpoint for the valve

Result in indoor climate:



Proof of Concept

Stage 1

- TA-Smart is used as a standard control valve (position control)
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Stage 2

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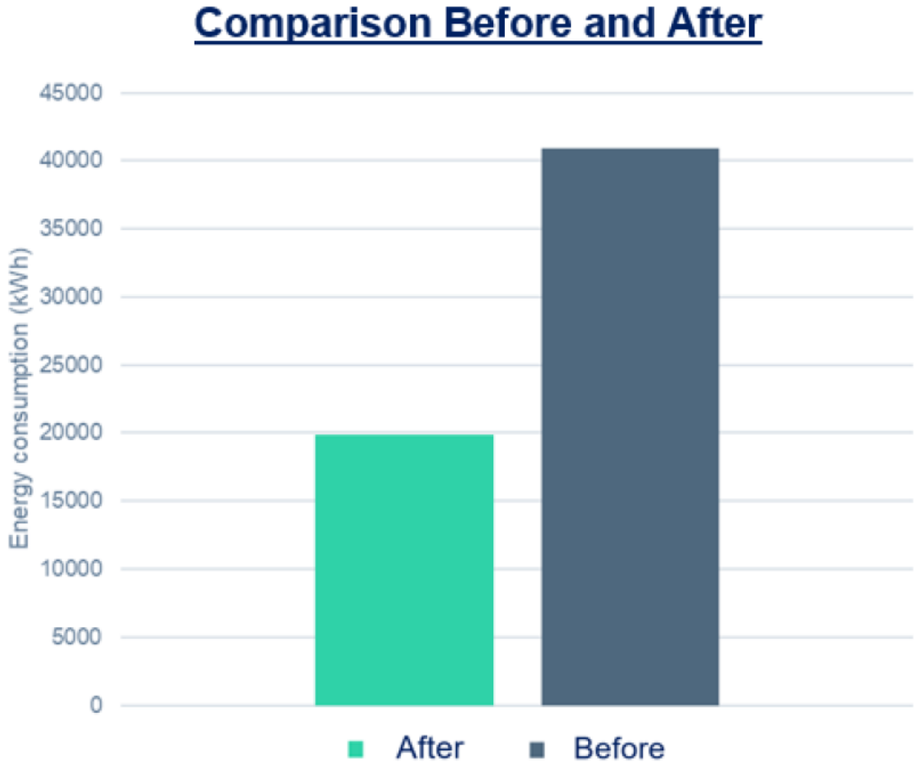
Result in energy use:



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Thank you for your attention!

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