

# Energy efficient buildings

Unveiling the energy performance and  
Siemens' Building Product Solutions



# The issues you face

## Impact of buildings



**40%**

of energy consumption derives from buildings <sup>1</sup>



**36%**

of CO2 emissions in the EU<sup>1</sup> originate from buildings

## Current building stock scenario



**35%**

of the EU's buildings are over 50 years old <sup>2</sup>



**75%**

of the building stock is energy inefficient<sup>2</sup>

## Energy efficiency potential



**80%**

of energy use in buildings comes from heating, cooling and hot water<sup>1</sup>

<sup>1</sup>Energy Performance of Buildings Directive, European Commission <sup>2</sup>New rules to boost energy performance of buildings, European Commission.

The EPBD's requirements are to be adopted by EU member states into national law. Every local implementation of the EPBD can be different.

<sup>1</sup>Indoor environmental quality

<sup>2</sup> A zero-emission building uses minimal energy, with remaining needs covered by zero-emission sources like renewable energy.

<sup>3</sup> 55% of the decrease in average primary energy use must be achieved through the renovation of the worst-performing buildings.



### Mandatory BACS capabilities

For non-residential buildings with HVAC capacity over 290 kW by **January 2025** (70 kW by 2030) and additional BACS capability of **IEQ<sup>1</sup> by 2026**.



### Mandatory lighting controls

For non-residential buildings with HVAC capacity over 290 kW by **January 2028** (70kW by 2030).



### New buildings

All new residential and non-residential buildings must have zero on-site emissions<sup>2</sup> from fossil fuels, as of **January 2030**.



### Existing buildings

**Residential:** Reduction of primary energy use of **16% by 2030** and **22% by 2035<sup>3</sup>**.

**Non-residential:** Gradual introduction of Minimum Energy Performance Standard (MEPS) to renovate the 16% worst performing buildings **by 2030** and the **26% by 2033**.



### Additional requirements:

- National building renovation plans for member states
- Introduction of building renovation passports
- Energy performance certificates
- Lifecycle emissions transparency for new & renovated buildings (to A+)
- More information [here](#).

# BACS capabilities required by the revised EPBD

## Non-residential



Monitor, analyze log and adjust energy usage



Benchmark the building's energy efficiency



Detect losses



Inform on losses and opportunities of energy efficiency improvements



Communicate & being interoperable with connected technical building systems



Monitor indoor environmental quality

New\*



Self-regulating devices and hydronic balancing

- New buildings: for each room or zone
- Existing buildings: when heat generator or cooling generators are replaced

New\*



Lighting controls suitably zoned and capable of occupancy detection

New\*

## Residential New\*



Monitor, analyze log and adjust energy usage



Inform on system's deviations



Optimize generation, distribution, storage, use of energy



Reaction to external signals

# Unlocking the energy savings potential of buildings



## Monitoring

building asset, maintenance and performance data



## Optimize









your maintenance programs to save money, reduce risk and improve performance



## Analyze

using a sophisticated analytic engine and experts in energy and operational performance

# ...which energy management issues are important for you?

	Reduce energy consumption and costs		Generate power on demand		Enable energy independence
Reduce taxes and levies		Ensure security of supply		Ensure power quality	
	Create energy transparency		CO <sub>2</sub> reduction		Fulfill regulatory requirements

# | Analyzing

# eu.bac – European Quality System, 2007

- Reducing CO2 emissions from the building
- System for quality control of energy-efficient building automation equipment.

eu.bac  
Cert

### Test Report Summary

Product Information	
Licence Number:	020705
Licensee:	Siemens Schweiz AG
Product Family and Model Number	Desigo RXC21.1

Test Specifications	
Tested Application:	Fan coil unit system 4 pipes
Temperature Sensor:	
- Type:	NTC 10 Kohms
- Time Constant:	8 min
Actuator:	
- Type:	Motoric
Valve	
- Characteristic:	Exponential

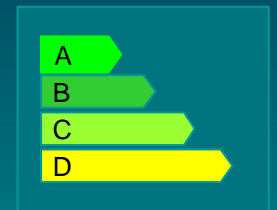
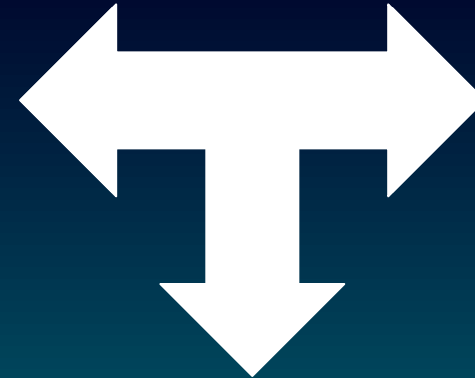
Test Result	
Temp	

31  
Frankf

eu.bac  
Cert

Siemens has been involved from the start

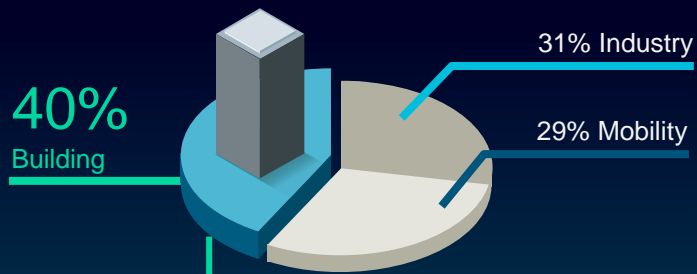
eu.bac  
Lyoner Straße 18 - 60528 Frankfurt am Main - Germany



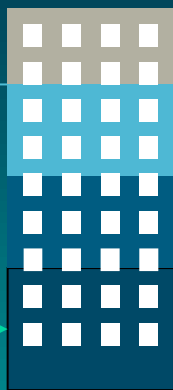


# Mapping of the buildings

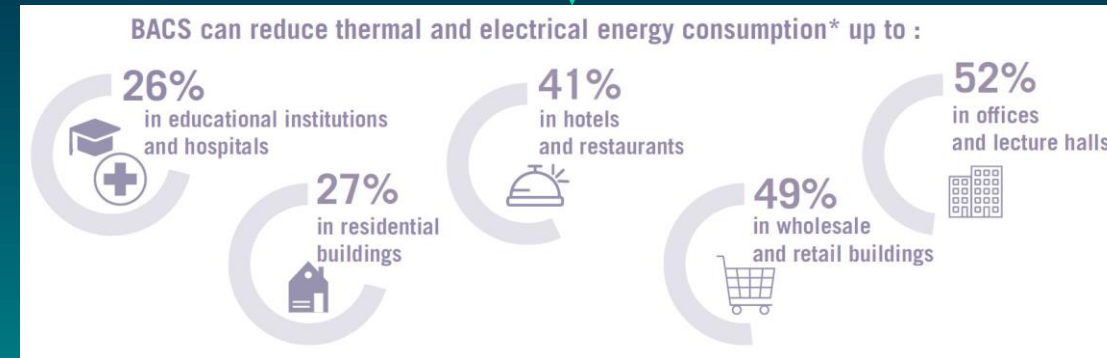
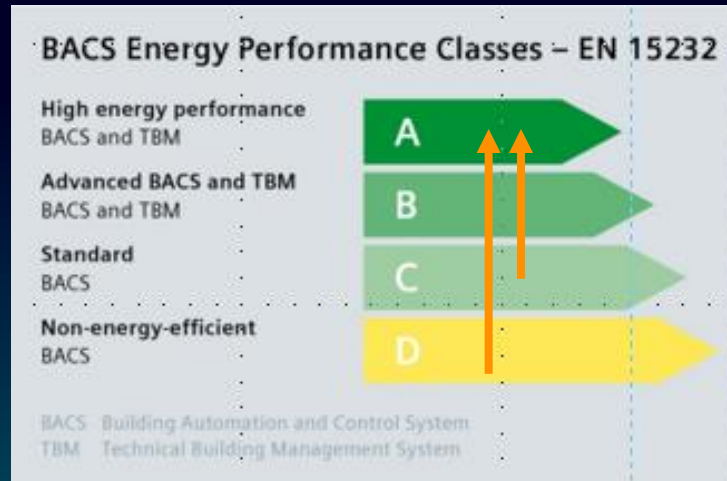
## Europe-wide energy consumption



Up to **80%** of the building costs arise in operation of the building.\*\*



- 30%** Maintenance, repair and modernization costs\*\*
- 40%** Energy costs\*\*



\*Source: [https://www.eubac.org/cms/upload/downloads/insight/eubac-insight\\_2002\\_EN\\_DE.pdf](https://www.eubac.org/cms/upload/downloads/insight/eubac-insight_2002_EN_DE.pdf)

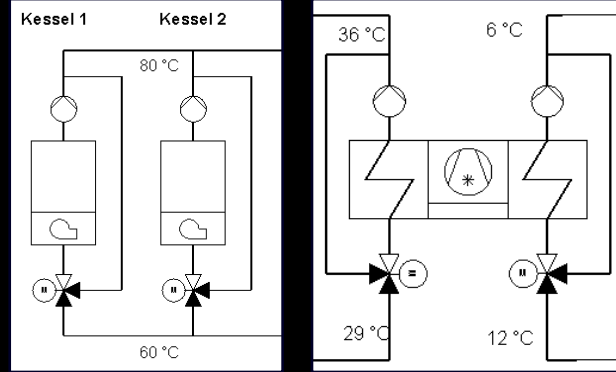
# Energy Performance Classification (EPC) Tool

## - A quick overview

### Building type



### Type of plant

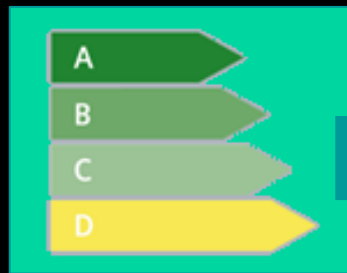


### BACS functions

5	LIGHTING CONTROL
5.1	1 HEATING CONTROL
1.1	3 COOLING CONTROL
3.1	4 VENTILATION AND AIR CONDITIONING CONTROL
5.2	4.1 Air flow control at the room level
6	0 No automatic control
	1 Time control
	2 Presence control
	3 Demand control
1.2	4.2 Air flow or pressure control at the air handler level
3.2	0 No automatic control
7	1 On off time control
	2 Multi-stage control
7.1	3 Automatic flow or pressure control
	4.3 Heat recovery exhaust air side icing protection control

### Energy consumption validation

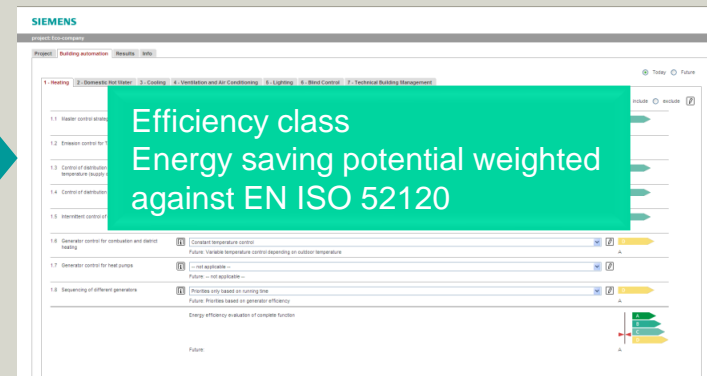
Energy consumption	Energy source	Energy consumption & costs per period [Year, period]
Type of consumer		
Thermal energy for heating		
Thermal energy for DHW		
Thermal energy for cooling		
Thermal energy for ventilation		
Electr. energy for Ventilation		
Electr. energy for light		
Electr. energy for auxiliary		
Heating degree days		
Year	Longstanding average	
HDD		
Heating season		
HDD		
Schematic diagrams of building technology plants		
<input checked="" type="checkbox"/> Heating	<input checked="" type="checkbox"/> Individual room control	
<input checked="" type="checkbox"/> DHW	<input checked="" type="checkbox"/> Lighting	
<input checked="" type="checkbox"/> Cooling	<input checked="" type="checkbox"/> Blinds	
<input checked="" type="checkbox"/> Ventilation & Air Conditioning	<input checked="" type="checkbox"/> Technical home and Building Management	



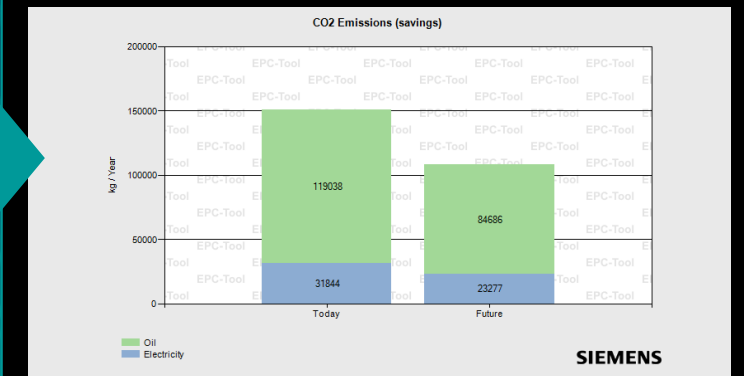
Checklist  
Current

EN ISO 52120  
New composition

### EPC tool



### Report and implantation steps




# Case Study - In the classroom: Intelligent EE automation significantly reduce energy costs



6'400 m<sup>2</sup>

- Radiators, no cooling
- Mechanical ventilation
- Traditional lighting

Standard Building Automation functionality  
(Class  according to EN ISO 52120 (EN 15232))

## Typical annual energy cost\*:

Electricity	4.03 €/m <sup>2</sup>	€ 25'800
Heating	<u>8.97 €/m<sup>2</sup></u>	<u>€ 57'400</u>
Total	13.00 €/m <sup>2</sup>	€ 83'200

## With intelligent Room automation, EN ISO 52120 Class

Reduce energy consumption by up to 25%\*\*:

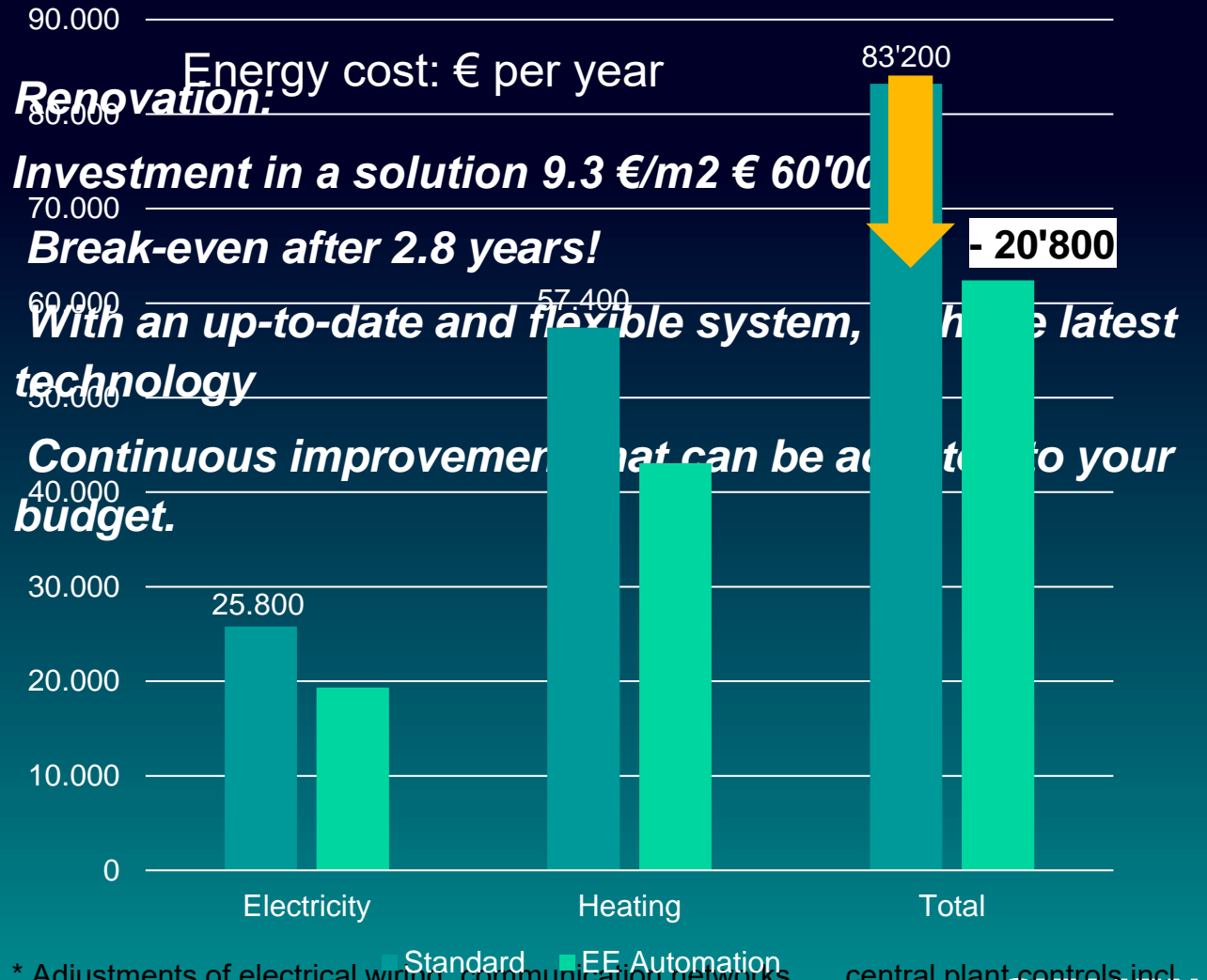
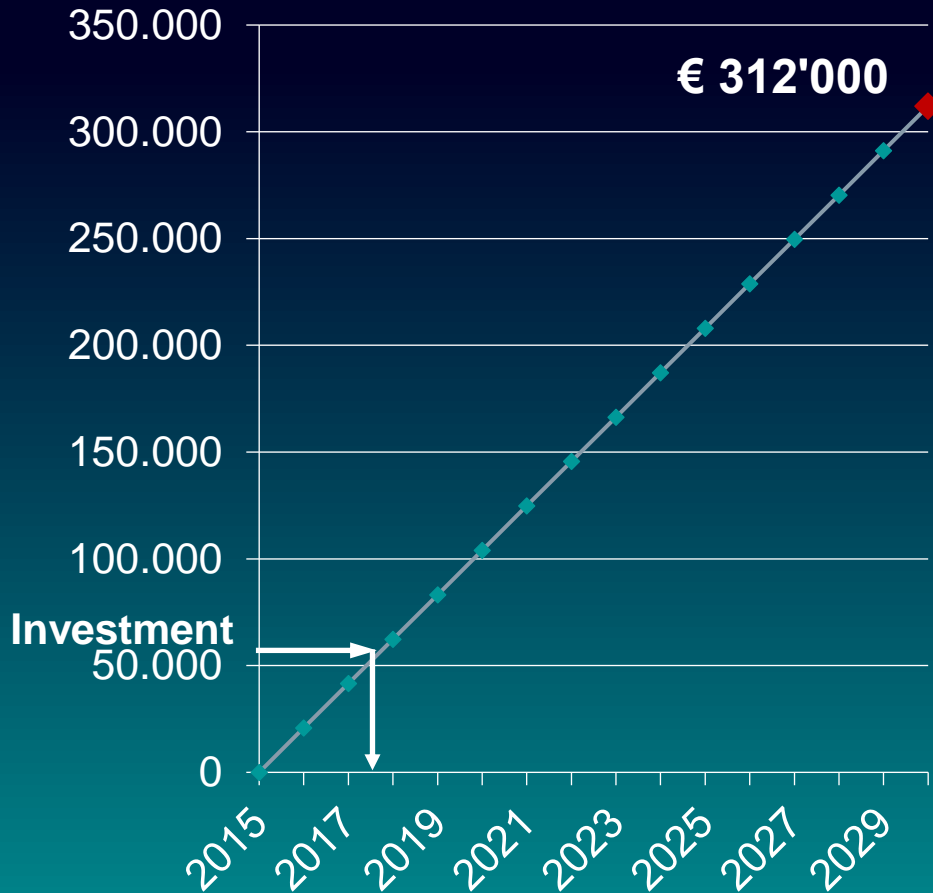
Electricity	- 1.01 €/m <sup>2</sup>	€ - 6'470
Heating	<u>- 2.24 €/m<sup>2</sup></u>	<u>€ - 14'330</u>
Total	- <b>3.25 €/m<sup>2</sup></b>	<b>€ - 20'800</b>

\* for an average school building based on "fm.benchmarking Bericht" 2012/13

\*\* derived from EN 15232 improvement from Class C → Class A

# Investment: Intelligent EE automation provides lucrative life-time savings and a pretty interesting ROI

Savings over a life cycle (15 years)



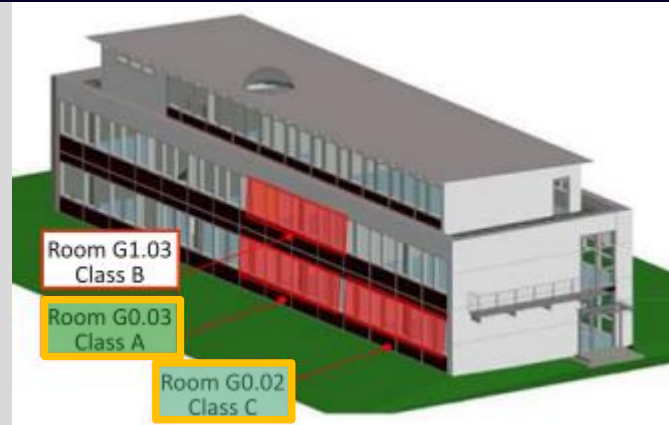
**Renovation:**  
**Investment in a solution 9.3 €/m2 € 60'000**  
**Break-even after 2.8 years!**  
**With an up-to-date and flexible system, you have the latest technology**  
**Continuous improvement that can be adapted to your budget.**

\* Adjustments of electrical wiring, communication networks, ... central plant controls incl.

# Energy Efficiency Automation (EE) tested by HBC studies – Biberach, University of Applied Sciences, Germany

## Scenario

Similar types of classroom with different levels of EE automation, was analyzed over a period of two years.



## Standard functionality (Class **C**) in Room G0.02

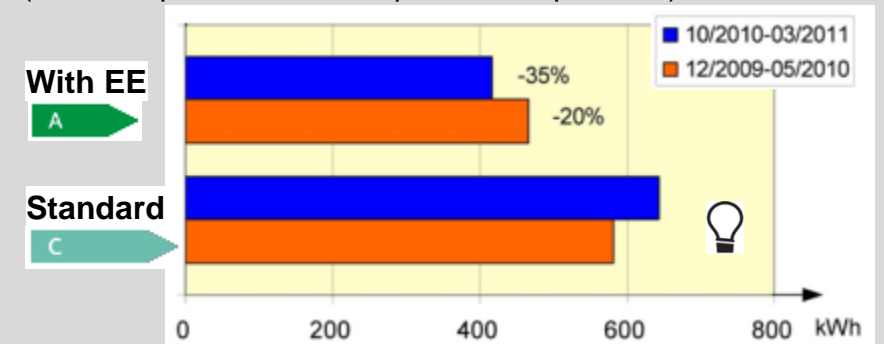
- Temperature control with thermostatic valves
- Manual on/off lights, without dimming

## Integrated Room Automation (Class **A**) in Room G0.03

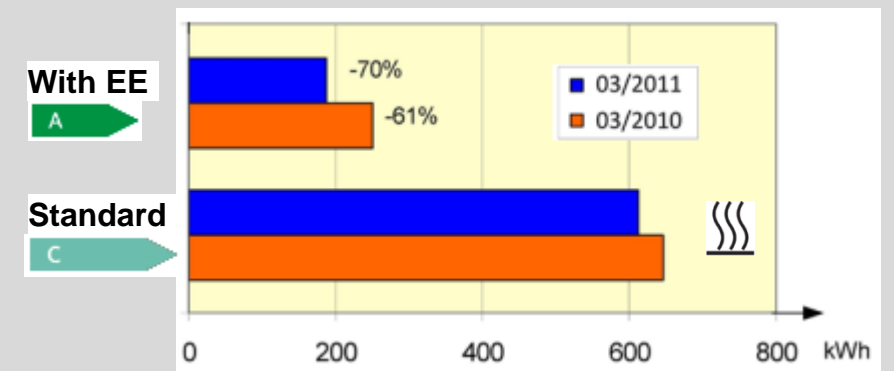
- Individual room temperature control with window switch.
- Light with automatic on/off (presence, daylight) and dimming of light.

\* as defined in ISO EN 52120 Standard „Energy Efficiency of Building Automation”

**Electricity** consumption shows a saving of - 35%  
(with an optimization from period 1 to period 2)

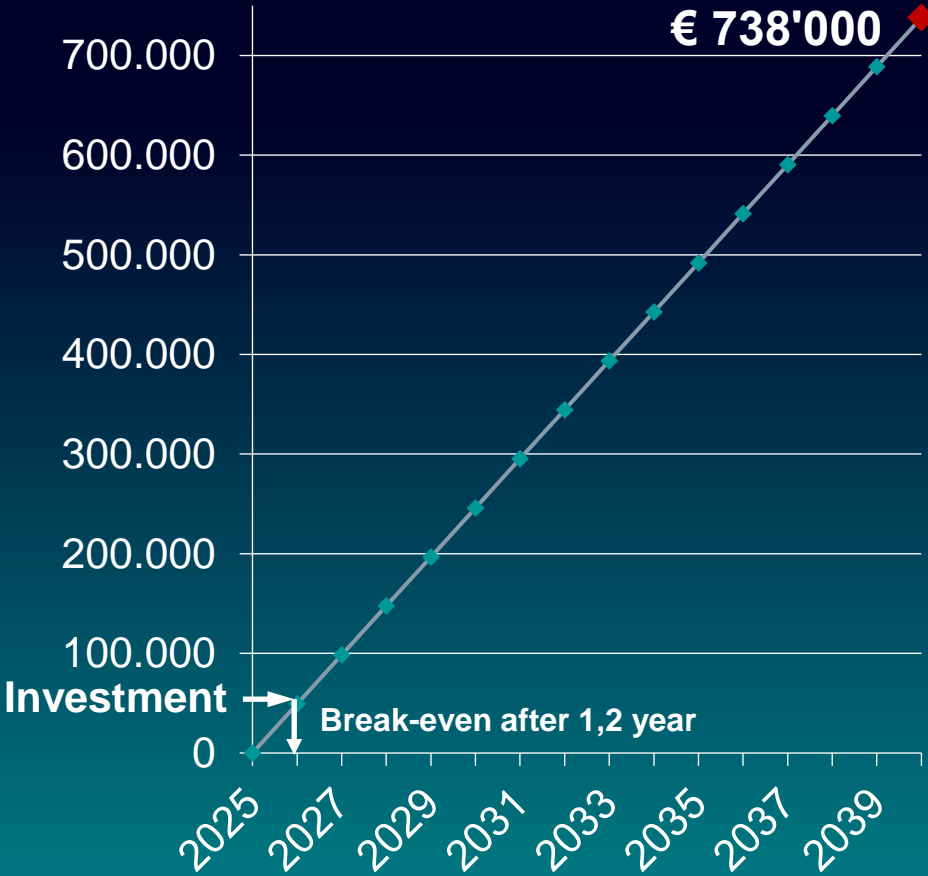
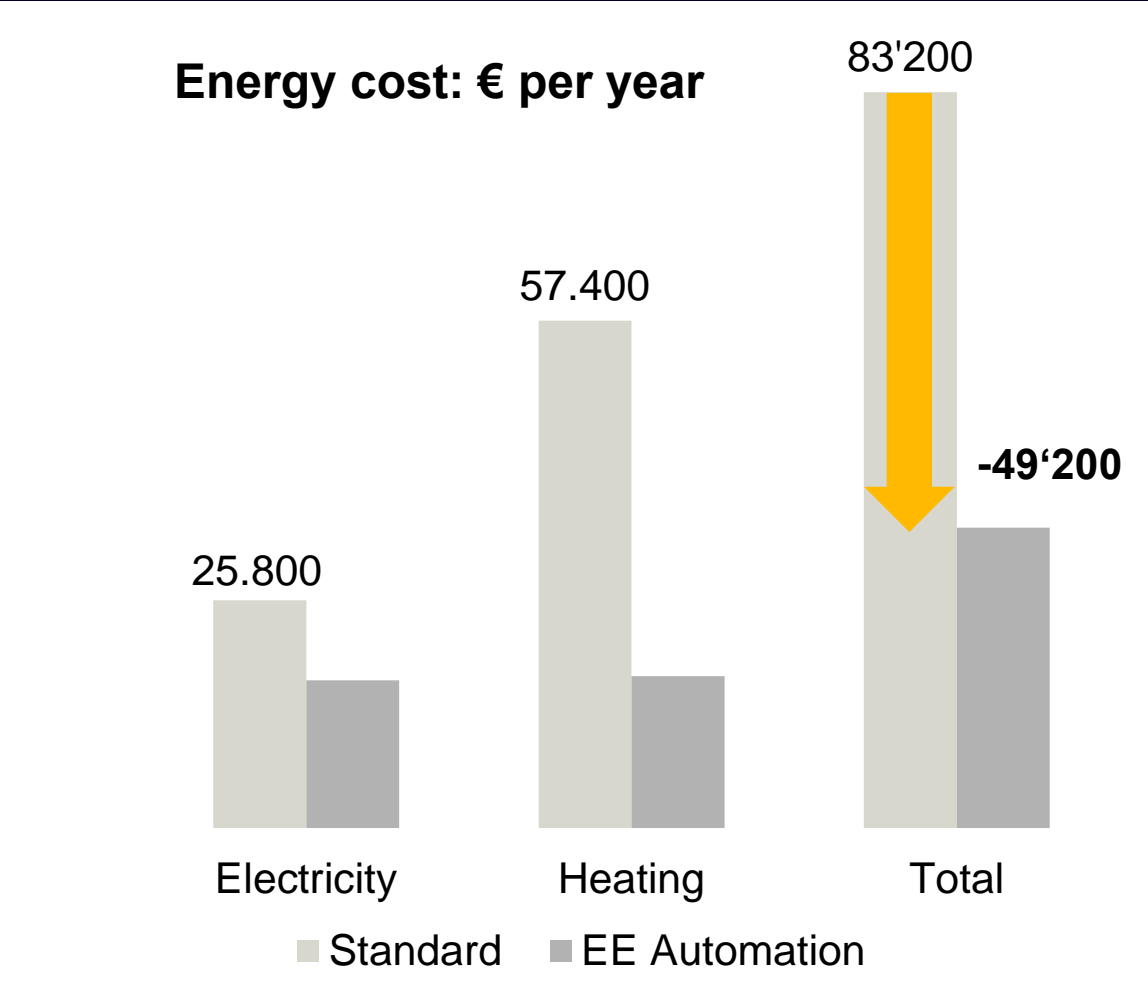


Impressive reduction of heat **energy consumption** of -70%  
(with an optimization from period 1 to period 2)



Source: REHVA Journal, September 2014, Prof. M. Becker

# University, Classroom: Energy cost is reduced by using Energy Efficiency Automation



## Roskilde Universitet - energiprojekt i samarbejde med Siemens



- Projektet gennemført: 2016-2020
- Areal: ca. 80.000 m<sup>2</sup>
- Projektets størrelse: 76 mio.kr.
- Tilbagebetalingstid: 14½ år
- Årlig besparelse: 5.2 mio.kr.
- Reduktion i energiforbrug: 26%
- Garanti: 5 år
- Kompetenceudvikling af universitetets tekniske medarbejdere
- RUC er det universitet i Danmark, som har det laveste energiforbrug
- Ifølge BYGST det eneste universitet, der har indfriet statens mål for energibesparelse

# | Optimize



The EPBD's requirements are to be adopted by EU member states into national law. Every local implementation of the EPBD can be different.

<sup>1</sup>Indoor environmental quality

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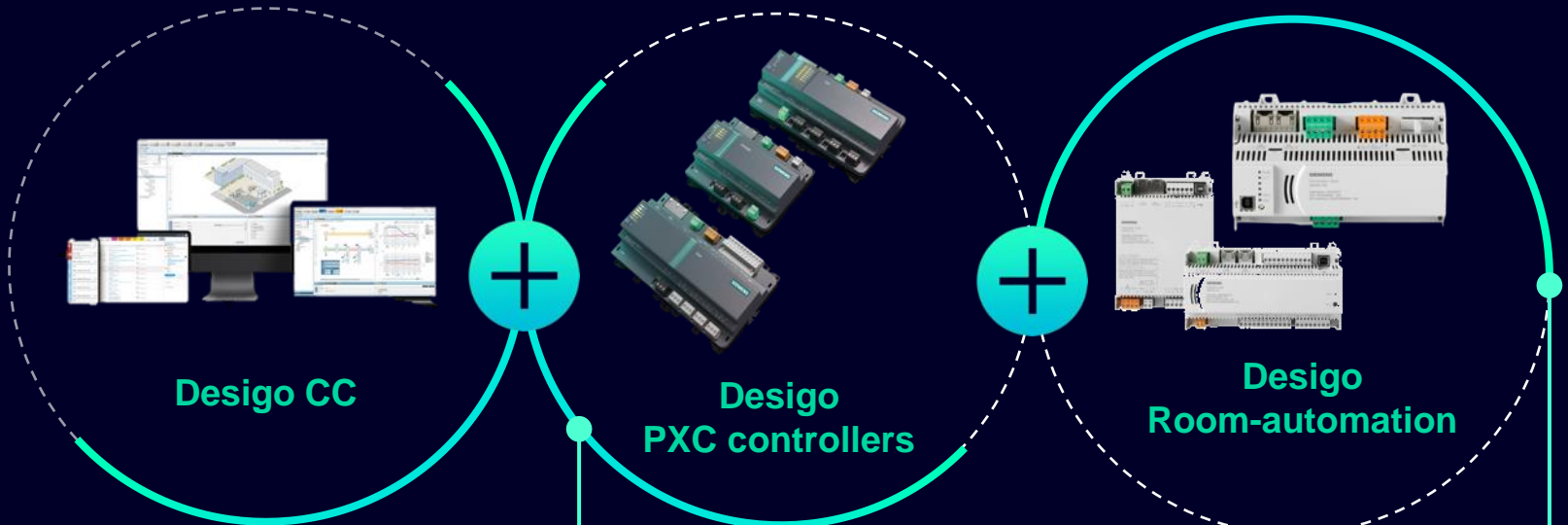
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### Additional requirements:

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- Energy performance certificates
- Lifecycle emissions transparency for new & renovated buildings (to A+)
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# Maximize buildings energy efficiency with our BACS solutions



Designo CC

Designo PXC controllers

Designo Room-automation

- Enabling demand-controlled heating, cooling and ventilation
-  **Siemens EcoTech** product

Room-automation with embedded DALI Lighting Controls



## Make more sustainable choices with Siemens EcoTech

Our new environmental label recognizes Siemens products that outperform in sustainability relevant criteria. The Designo PXC 4/5/7 controllers are now recognized as Siemens EcoTech!

Visit our webpage to learn more: [siemens.com/SiemensEcoTech](https://www.siemens.com/SiemensEcoTech)



## Siemens field devices



HVAC Sensors



Dynamic Valves and Actuators



Damper Actuators



Heat and Energy Meters



Variable Speed Drives



Light- and blinds control

# BACS capabilities fulfilled

Desigo CC, Desigo PXC Controllers, Desigo room automation

## Non-residential



Monitor, trend, analyze energy usage, implement schedulers and command data



Benchmark reports and trends about the energy efficiency on room, floor, building and square-meter level



Get reports e.g. **data cleaning based on heating degree days to detect losses**



Get alarm notifications, report mailings about losses, provide trends about energy efficiency improvements



Communicate & being natively interoperable with connected technical building systems through open and standard protocols



Monitor indoor environmental quality

New\*



Self-regulating devices and hydronic balancing

- New & existing buildings: Room automation with PICVs in each room or zone
- Existing buildings: when heat generator or cooling generators are replaced, easily equippable with Intelligent Valves

New\*



**Native** DALI Lighting controls, zoned and capable of occupancy detection and constant light level control. **Additionally** native control of human centric lighting.

New\*

## Residential New\*



Monitor, trend, analyze energy usage, implement schedulers and command data



Inform on system's deviations



Optimize generation, distribution, storage, use of energy



Reaction to external signals

### Legend



Criteria is fulfilled



Criteria is currently not fulfilled

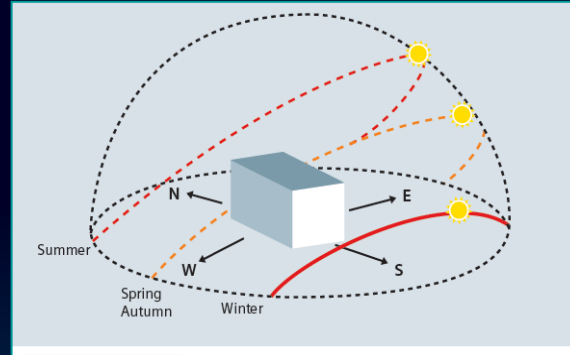
# Desigo System

- 200 proven applications and 25 energy-specific applications



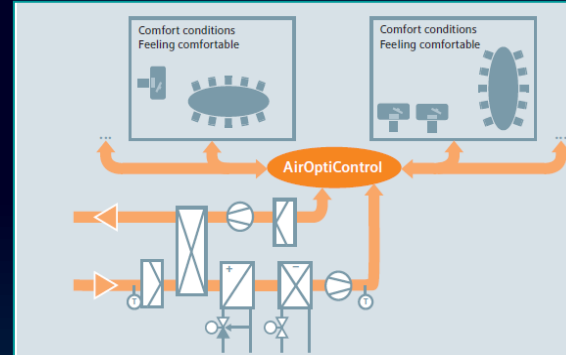
A  
Klasse A

RoomOptiControl: perfect room climate, optimized energy usage



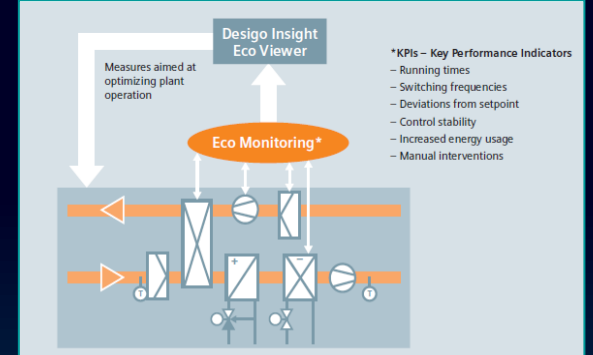
A  
Klasse A

Calculation of sun position: saving valuable energy in the building



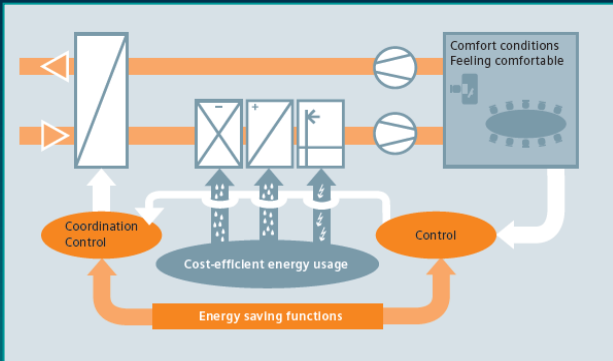
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Klasse A

AirOptiControl: optimized volumetric air flow saves costs



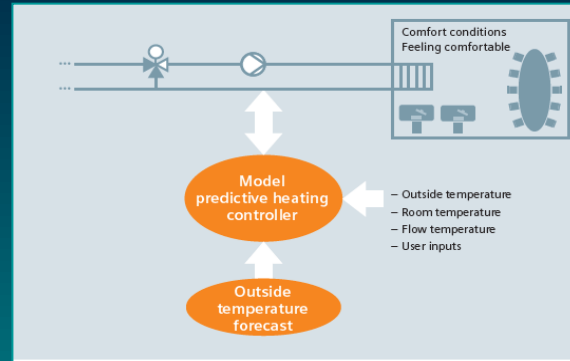
A  
Klasse A

Asset Performance: Energy management monitoring



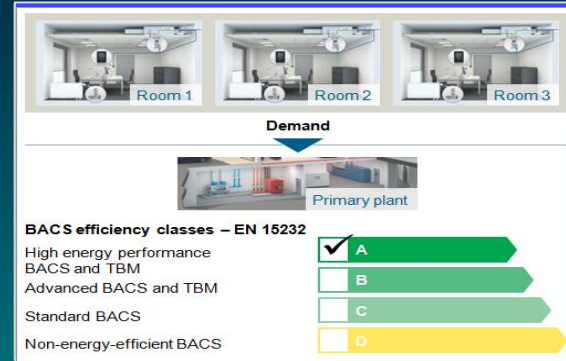
A  
Klasse A

tx2 Economizer: energy-optimized control of air conditioning plants



A  
Klasse A

Predictive heating controller: saving energy and costs



A  
Klasse A

Supply chain: Only the required energy is provided



A  
Klasse A

Annual Shading: Comfort, productivity and energy-efficient

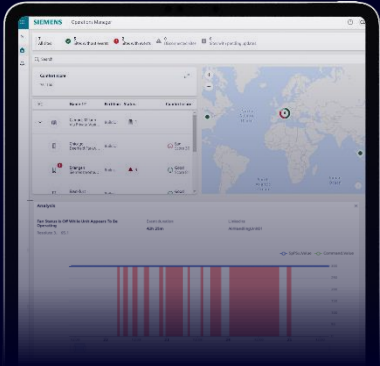
# | Monitoring

# Building X

AI-enabled applications, platform  
and connectivity for future-proof buildings



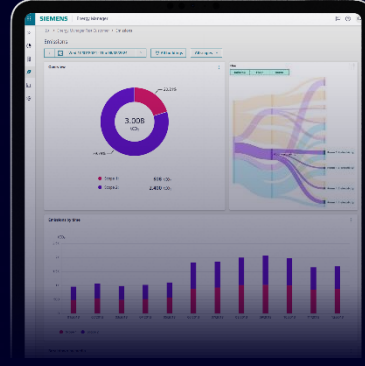
# Building X



**Operations Manager**  
Remote Monitoring and Control  
Fault Detection & Diagnostics



**Occupancy**  
Optimize your spaces &  
Cleaning activities



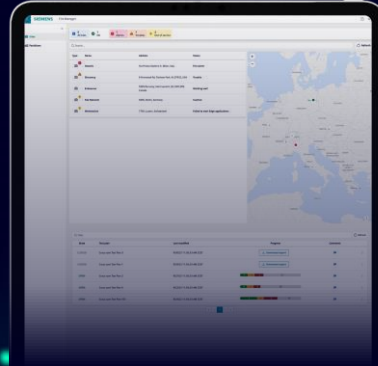
**Energy Manager**  
Budget Tracking  
Consumption Flows Monitoring



**Comfort AI**  
Automate HVAC routines  
Occupations settings



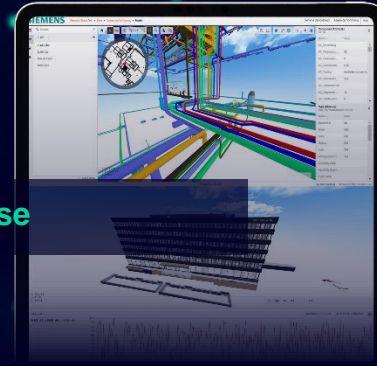
**Security Manager**  
Physical Access Control  
Alarms & Incident Management



**Fire Manager**  
Fire Safety Maintenance  
Remote Setup & Monitoring



**360 Viewer**  
Indoor Navigation  
Digital Twin w/ Real Time Data



**Life Cycle Twin**  
Data & Document Management  
Asset & Issue Management

..and more to choose

## Ready-to-Go Applications

Business Function Oriented Use Cases  
Faster Deployment & Time-to-Value  
Continuous Updates & Support

## Low-Effort Customizations

Low-Code Application Tailoring  
Flexible Visualizations & Reporting  
Reduced Development & IT Overhead

## Open Innovation Ecosystem

Interoperability: No Vendor Lock-In  
Marketplace of Trusted Solutions & Services  
Readiness to Expand & Scale

## Unmatched OT/IT Convergence

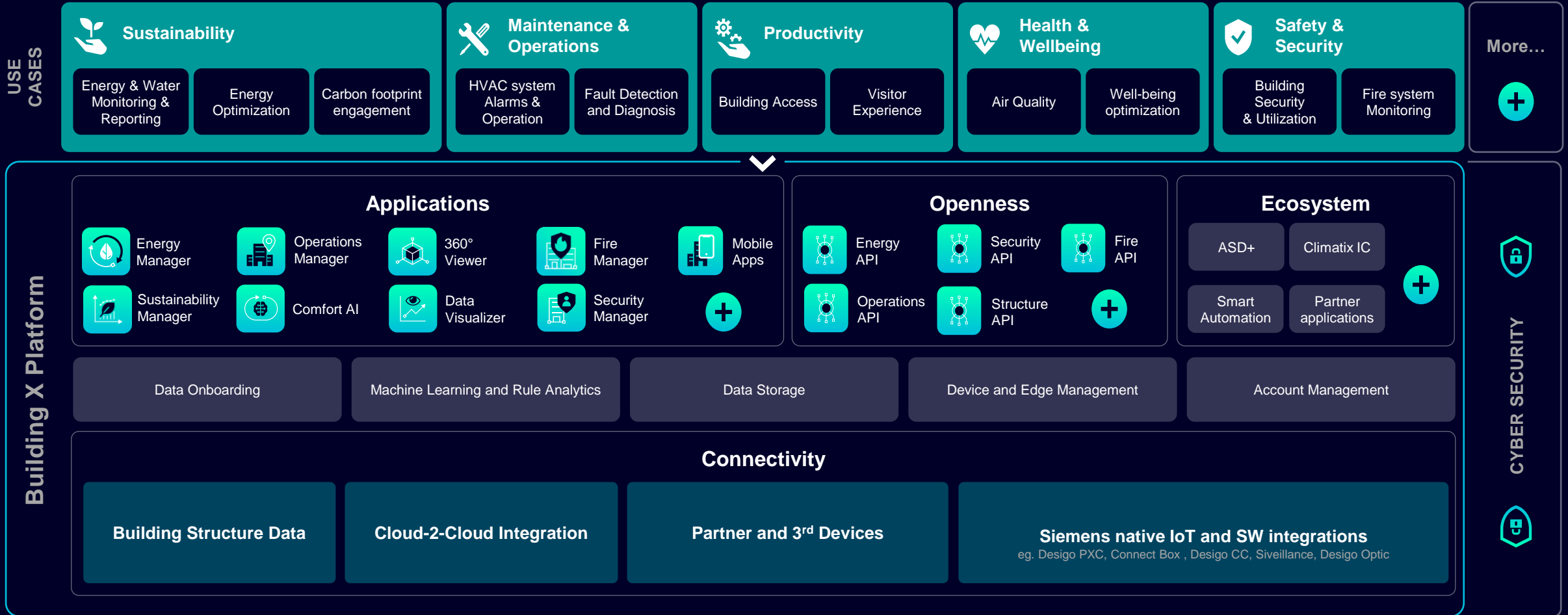
Full HW & SW Ecosystem Coverage  
Data Completeness & Quality  
Preservation of Existing Tech Investment



Growing Portfolio of Business-Oriented Applications

# Building X

## A platform to build on



Any field discipline & device



Any building architecture & vertical



# 3 Focus areas where AI-Enabled application can help you



# Operate and monitor building equipment and applications from anywhere

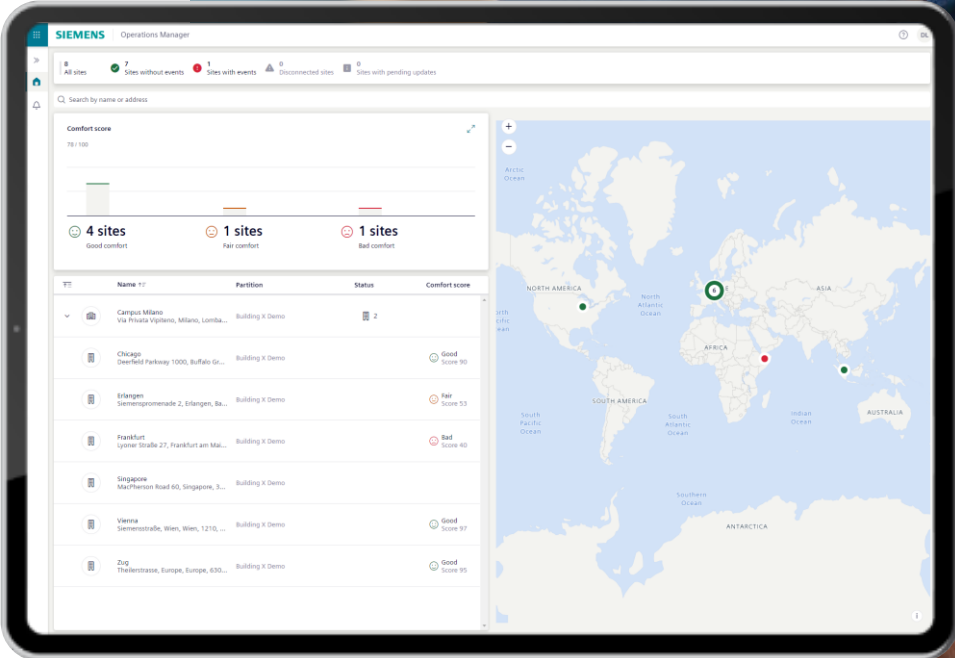
Always **be up-to-date** with regards to the systems' status and health in all your buildings – **single and multi-site**

**Save time and travel expenses** by digitizing your activities and **solving the issue remotely** – with easy access to your connected site

Get transparency about tenants' comfort thanks to **easy-to-understand KPIs – Comfort Score**

Troubleshoot unwanted conditions and better understand system behavior by analyzing **historical and actual trend data**

Get an **overview of all pending events** and additionally get notified via email/SMS for new events



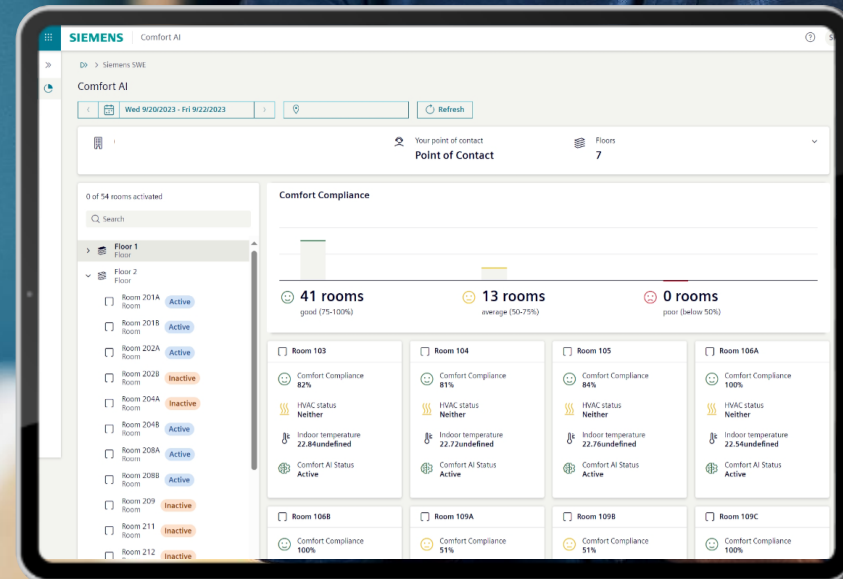
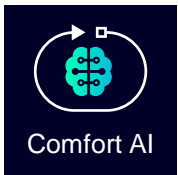
# Ensure a comfortable tenant experience while reducing your workload with AI

**Bring efficiency to the next level** using one single dashboard to configure and track comfort KPIs, monitor and control real-time automation activities on a building, floor and room level

**Monitor and automate HVAC routines** based on ever-changing environmental factors and space utilization, while keeping tenant's comfort in mind and improving their well-being

**Ensure well-being of people** by easily spotting comfort-inhibiting hotspots, taking relevant action

**Stay in control of your tenant's experience** despite automation and stop or resume any optimization activities at any given time with immediate effect or use the dashboard to trace any past activities





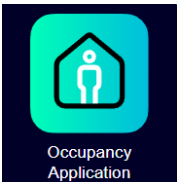
Occupancy Application

Optimize your cleaning activities

## Optimize cleaning activities with real-time data

Increase cleaning activity in high-traffic areas to improve occupant comfort and satisfaction.

Avoid unnecessary cleaning of areas that have not been used during the day.



# Make data-driven decisions by using accurate sustainability data

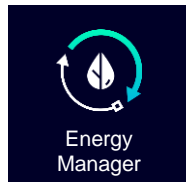
Access consumption and CO<sub>2</sub> emission data in near real-time for your **entire portfolio** in a consolidated view.

Easily **compare energy consumption** and related CO<sub>2</sub> **emissions** and **water** usage between **buildings**, and over time.

Leverage **AI-based forecasting and notifications** to be alerted to **potential budget overruns** and take action.

Use the power of data to **trigger** required optimization activities with operational teams and contractors.

**Spot outliers**, unusual behavior and **track consumption patterns** thanks to a **heatmap** on the site level dashboard which helps identify inefficiencies.



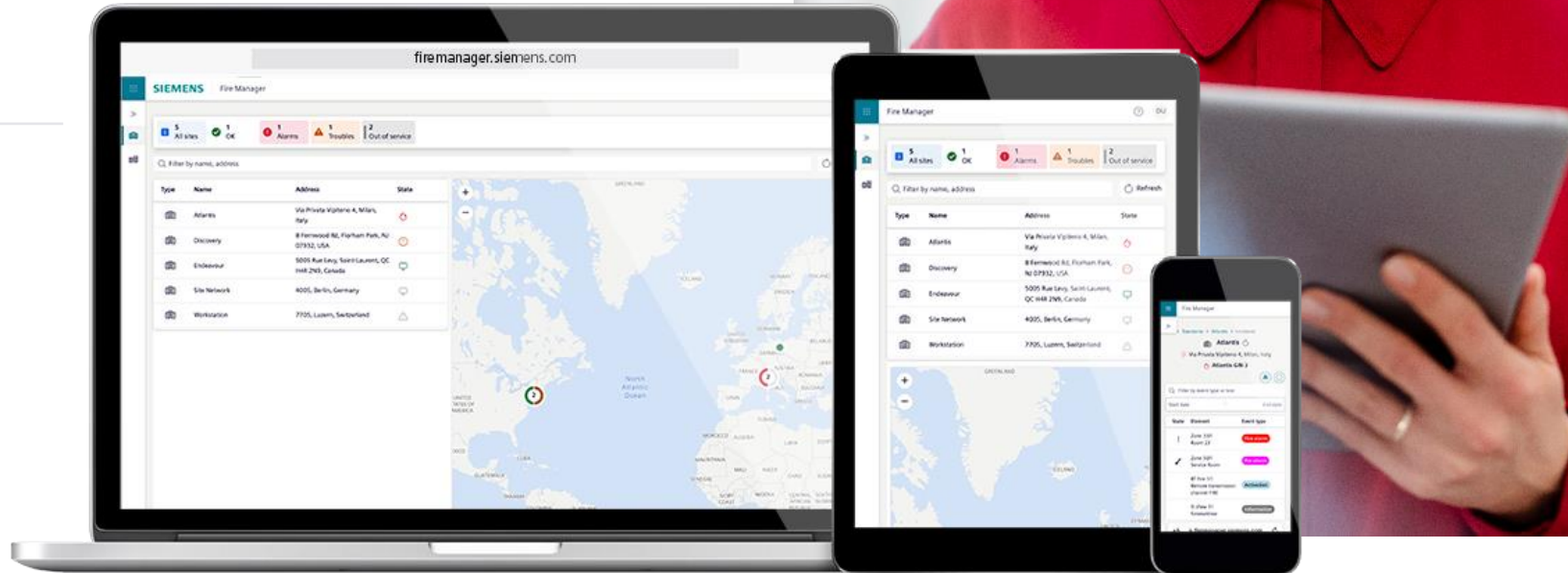
# Be fully aware of the status of your fire system and be notified in case of an event

Access to real-time data provides knowledge about the system's condition and enables **predictive maintenance**.

Ability to **remotely monitor** and manage fire safety systems from any location, **oversee multiple sites** and address potential issues promptly.

Significant administrative tasks related to **record-keeping** and **reporting** are less time-consuming

Assurance of **safety regulations** is less resource-intensive



# Smart and integrated security management in the digital age

**Flexible management of access to doors and buildings** with different tokens or smart phones, predefined workflows and centralized identity and access management to make security tasks easier.

Provide “out-of-the-box” dynamic alarms using **standard operating procedures (SOPs)** to resolve incidents.

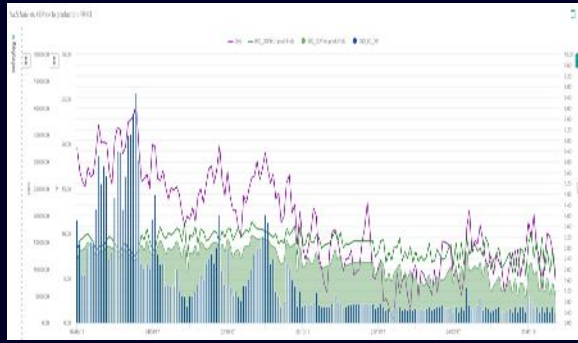
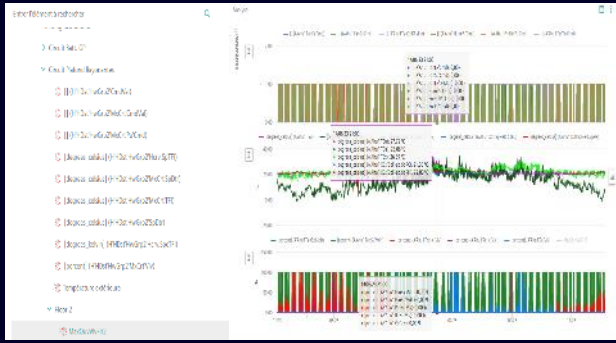
**Visualization** of site entry points, analysis of room utilization, identification of maintenance candidates to **improve overall security**.

**Extend your current on-premise inventory** (SiPass, SIPOINT, Siveillance Video) to protect your investment.

Cloud-based access control solution that **supports your needs with low investment** into infrastructure costs (ACC-AP door controller or smart locks).

**Develop solutions** tailored to your needs by using built-in **low-code environments**





### Air Distribution System (AHU, Fans, VAVs) Generic equipment check list (if components and points available)

<b>Sensors check</b> <ul style="list-style-type: none"> <li>Sensor defect</li> <li>Sensor calibration</li> </ul>	<b>Heat recovery</b> <ul style="list-style-type: none"> <li>Heat recovery bad performance</li> <li>Heat recovery not operating</li> <li>Heat recovery control loop wrong</li> </ul>	<b>Controls</b> <ul style="list-style-type: none"> <li>Simultaneous heating and cooling</li> <li>Simultaneous humidifying and dehumidifying</li> <li>Heating at high temperature</li> <li>Cooling at low temperature</li> <li>Inefficient heating control (combination heating coil, mixed air damper, heat recovery)</li> <li>Inefficient cooling control (combination cooling coil, mixed air damper, heat recovery)</li> <li>Inefficient humidity control (combination heating coil, cooling coil, humidifier, heat recovery, mixed air damper)</li> <li>Night cooling not in use during summer night</li> <li>AHU operates outside the building usage</li> <li>...</li> </ul>
<b>Setpoints check</b> <ul style="list-style-type: none"> <li>Dead zones</li> <li>Consistency with common settings and building usage</li> </ul>	<b>Humidifier</b> <ul style="list-style-type: none"> <li>Humidifier over/under</li> <li>Humidifier defect</li> <li>Heat recovery control loop wrong</li> </ul>	
<b>Fans</b> <ul style="list-style-type: none"> <li>Fan over/under</li> <li>Fan defect</li> <li>Fan control loop wrong</li> </ul>	<b>Dampers</b> <ul style="list-style-type: none"> <li>Damper over/under</li> <li>Damper defect</li> <li>Damper control loop wrong</li> </ul>	
<b>Coils</b> <ul style="list-style-type: none"> <li>Leaking valve</li> <li>Pump defect</li> <li>Pump or valve over/under</li> <li>Valve control loop wrong</li> </ul>		

### HVAC Summary

**Cooling**

- The top ramps of MFB are running for a long period (700 h/y w. 5102 h/y). All the lower ramps are running for a shorter period (below 10 h/y). It can be normal as they are outdoor ramps.
- The ramp of the MFB was checked for a long period.
- Chiller 1 is active even at very low temperatures. It was not the case since the beginning of the year 2023 but from 01 of May it is gradually controlled only on Chiller 2 especially for a given setpoint. This decreases Chiller 1 performance and leads to a higher and longer operation.

**Heating**

- A leaking valve still makes us needed to open only at low outside temperature (only 200 h/y). When it opens, most of the time the second boiler also works for 15 to 30 h. This could be delayed to improve maintenance and gas consumption.
- The boiler that is in use stays at a high temperature despite the fact that the pump is off and the presence of a check valve. Does the valve work effectively?

**Humidification**

- During a long period there is only a small difference between the outside air temperature and the supply temperature of AHU on periods where AHU is not running. Are the sensors still placed? Is the outside air damper working?
- During the summer period the humidifiers are switched off in manual mode. This has no consequence but could maybe be done on a more efficient way on District heating system.

**Rooms**

- There is sometimes a cooling or heating demand but the broken pump is not running. This leads sometimes to unexpected sequence and a decreased overall RH although this is quiet zero.
- The pump of the heating center is in operation and no unit heating valve is open. The mixing valve of the circuit is always open at a minimal value. This leads to a better mixing and potentially a better humidity but leads to an energy waste and could be revealed.
- One room always constant resistance since the 02/03/2023 - communication error with the controller or controller without power.

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### Heating group valve leaking

ID [PG020715565] Heating group valve is leaking  
Building M  
Room T1, Vestibulo - Convector

**Description:**  
Supply temperature (T7) is about 9°C higher than setpoint (10.0°C) and is increasing when heating group valve (McGrV1) is closed.

**Action:**  
Please check the valve and actuator.  
- It could be misaligned -> replace it properly.  
- It could be defect -> a new one and replace it.  
- It could be a leaking valve -> replace the valve.

**Annual Savings:**  
Savings on heat consumption due higher temperature on heat distribution.  
Heating: 18 046 [kWh/a]  
Electricity: - [kWh/a]

**Assumptions:**  
Pump flow: 15 m³/h  
Flow temperature increase with valve leakage: 9 °C  
Distribution loss heating: 50 %  
Operation time: 1920 hours/year

**Impact:**  
- Life Cycle  
- Energy consumption

**Comment - Navigator:**  
Valve to be replaced as reception of new one -> @22.02.2023 13:34:40 [727525]  
Valve has been checked, when fully closed, temperature dropped. -> @02.03.2023 12:38:44 [732642]

The figures shown on this page are just a time selection to highlight punctually the fault during the service period. SIEMENS

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# Heating group valve leaking

ID [PG025715505] Heating group valve is leaking

Building M  
Kring 1: Ventilator - Convectoren

**Description:**  
Supply temperature (TFI) is about 9°C higher than setpoint (SpDtr) and is increasing when heating group valve (MxCrtVlv) is closed.

**Action:**  
Please check the valve and actuator.  
• It could be misplaced --> replace it properly  
• It could be defect --> a new one and replace it  
• It could be a leaking valve - > replace the valve

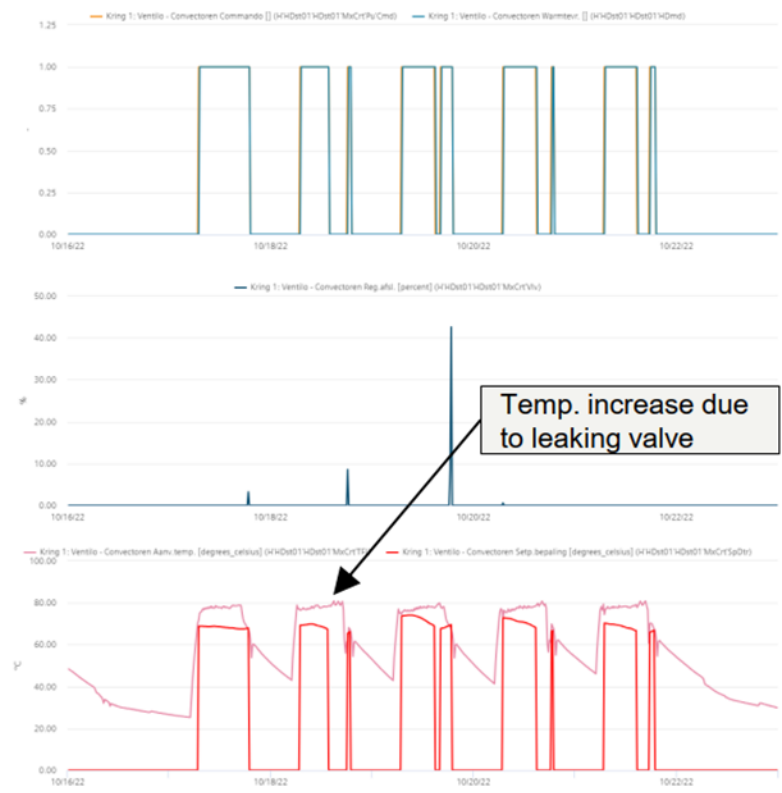
**Annual Savings:**  
Saving on heat consumption due higher temperature on heat distribution.

**Heating:** 10 046 [kWh/a]  
**Electricity:** - [kWh/a]

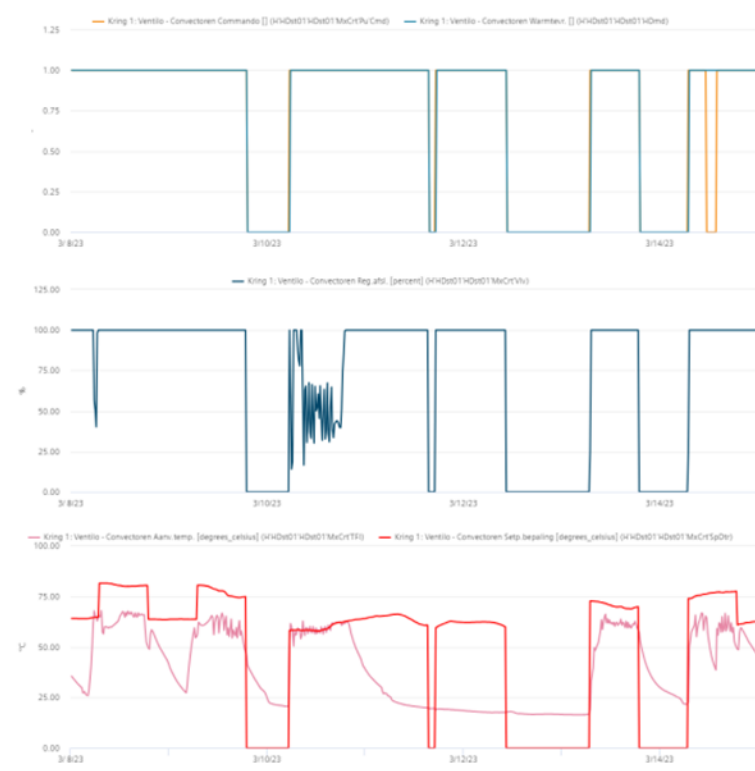
Assumptions:  
Pump flow 5 m3/h  
Flow temperature increase with valve leakage: 9 °C  
Distribution loss heating: 10 %  
Operation time: 1920 hours/year

**Impact:**  
• Life Cycle  
• Energy consumption

## Heating group valve is leaking



## Valve fixed



**Comment - Navigator:**  
 Valve to be replaced as reception of new one --- @22.02.2023 13:34:40 [727525]  
 valve has been checked. when fully closed, temperature dropped. --- @02.03.2023  
 12:38:44 [732642]

The figures showed on this page are just a time selection to highlight punctually the fault during the service period.



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# | Thank You