Energy efficiency in building automation and control

Proven applications for heating and cooling supply

Answers for infrastructure.

SIEMENS

Efficient HVAC control protects the environment and increases comfort

Intelligent building automation from Siemens can reduce the energy consumption of buildings by up to 30%. The lower consumption, and thus increased energy efficiency, significantly reduces operating costs and contributes substantially to climate and environmental protection – without sacrificing comfort. Products and systems from Siemens are designed to provide ideal climate conditions, in any work environment or living space, with the lowest possible energy consumption.

Applications for a green future

■ **Comprehensive range designed to increase energy efficiency**

Whatever the usage or building application, Siemens offers the ideal products and systems. The portfolio range comprises all building automation components needed for an efficient energy generation, energy distribution, and energy usage. They are all designed for optimal compatibility with each other, resulting in energy-efficient interaction.

■ **Investment protection in every phase of a building's life cycle**

Siemens ensures full compatibility with the previous generation. The life cycle of the installed base is prolonged through simple migration. New technological innovations and applications help to increase energy efficiency and comfort in a building. All applications are tested and tuned in the unique 800 m² HVAC laboratory under real operating conditions. Your investments are thus secured – from the planning and construction phase to operation and modernization.

■ **Take advantage of years of experience, to protect the environment**

For many years, Siemens has followed a systematic approach to environmental management, promoting environmentally friendly technologies and the improvement of energy efficiency in buildings. Siemens is fully engaged, sharing its broad knowledge as a member and partner in various organizations and initiatives, and thus influencing current standards.

■ **A reliable partner worldwide**

As an experienced partner, Siemens not only combines products and systems into energy-efficient solutions, but also offers support in all project phases – from planning to installation and commissioning to maintenance. This also applies to renewable energies. In addition to in-depth training and practical tools for dimensioning and product selection, Siemens also provides a worldwide sales and service network.

Highlights

■ High energy savings of up to 30% as well as reduction of CO_2 emissions

■ Intelligent comfort through high control accuracy and individual room control

■ Complete range for energy-efficient building automation

■ Investment protection, thanks to energy-efficient innovations and high quality

■ High level of reliability, based on Siemens' many years of experience

■ Comprehensive support from a reliable partner

Saving potentials can be found in all areas – from individual rooms to energy generation.
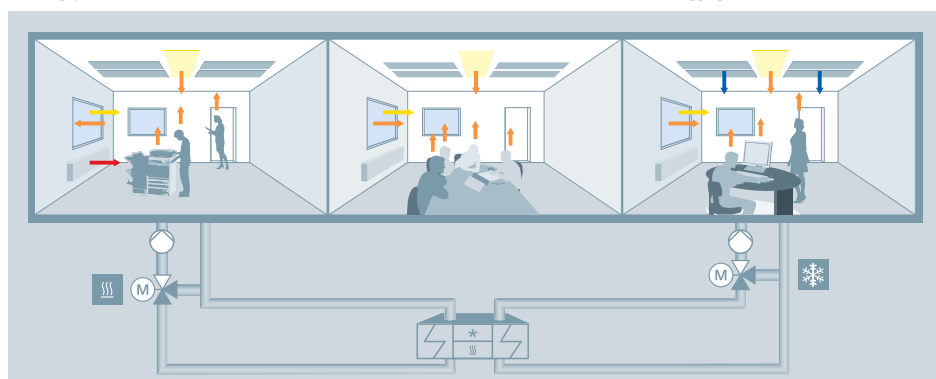
Legend

→ Solar radiation intake

→ Internal loads and outward thermal flow

→ Heating

→ Cooling

Office building of company VGSZ

Utilizing potential – saving energy

■ Urgent need for action

Buildings are responsible for around 40% of the worldwide energy consumption and offer an enormous saving potential. However, there are great differences among buildings. New buildings need up to five liters of heating oil equivalents per square meter. In contrast, existing buildings need approximately 25, some even up to 60 liters per square meter.

■ Building automation optimization that pays off

The manner in which a building is constructed can reduce its energy consumption. In combination with an energy-optimized automation of the technical installations of a building, energy consumption can be drastically reduced. These energy-efficient buildings use less energy, produce fewer CO_2 emissions, and offer better living or working conditions. Increasing the energy efficiency of buildings is best done during construction or during renovation. The saved energy costs usually amortize the investment costs within a few years.

■ Energy efficiency potential according to EN 15232

The EN 15232 norm "Energy Performance of Buildings – Impact of Building Automation, Control, and Building Management" was introduced to better leverage the energy saving potential for control and operation of buildings.

Thanks to this norm, the energy saving potential resulting from building automation can be specified, thus enabling one to derive measures that improve energy efficiency.

Efficiency class C describes functions that are used on a standard basis in building automation. Efficiency class B consists of more enhanced functions as well as applications to monitor the energy consumption with the building automation system. Building optimization and individual room controllers with a consistent demand control are a prerequisite for ensuring highly efficient energy systems. With these, energy will only be released when the user requires comfort conditions in the room. Thus, only the amount of energy that is really needed, along with the required temperature, will be generated and distributed.

Highlights

■ High energy saving potential in existing buildings

■ Reduced energy consumption, fewer CO_2 emissions, and increased comfort through building automation

■ Calculation of saving potential utilizing EN 15232

■ Fast amortization of investments

■ Only the energy that is actually needed is provided

The eu.bac certification stands for tested quality, control accuracy, and energy efficiency.

eu.bac
Cert

BACS efficiency classes – EN 15232

High energy performance BACS and TBM	A
Advanced BACS and TBM	B
Standard BACS	C
Non-energy-efficient BACS	D

BACS — Building Automation and Control System
TBM — Technical Building Management System

		Original function	Function after renovation
Room control		Thermostat without communication	Individual room control with: presence detector, window contact, time-based program for each zone
Time-based program		Fixed switching times	Optimized start/stop control (OSSC)
Heating limit		Heating limit switch	Demand-controlled
Multiple heating and cooling circuits		No evaluation	Demand-controlled
Heating and cooling demands		No evaluation	Demand-controlled
Control of supply temperature	Heating	Dependent on outside air temperature	Demand-controlled (inside temperature)
	Cooling	Constant value	Demand-controlled (inside temperature)
Control of pumps		On/Off	Pumps with variable pressure differential control
Interlock of heating/cooling		None	Complete interlock
Control of generator temperatures		Constant value	Load dependent
Operational sequence of generators		Fixed switch over	Based on generator efficiency

Energy saving functions designed to ensure the projected improvement.

Case study – energy savings of 30%

■ **Starting situation**

The office building of the company VGSZ, built 25 years ago, is deemed by the operator to be a candidate for renovation. An energy consumption analysis showed that the building uses up to 45% more energy compared to the own building portfolio or similar buildings.

■ **Building usage**

On the ground floor, the six-story building has a staff restaurant, reception area, and conference rooms. The five office floors have an identical layout, with individual as well as group offices arranged around two central infrastructure areas.

■ **Plant concept so far**

The office floors are equipped with fan coils that provide heating and cooling for the rooms using a four-pipe system. The temperature is controlled with a built-in thermostat that can be adjusted by the room users. The motorized blinds can be easily adjusted. Lights are switched on and off manually.

In this building, heating and cooling circuits running the length of the building were planned and realized. The supply temperature for the heating circuits is controlled dependent on the outside air temperature; the cooling circuits are kept at a constant value. Heating and cooling generators deliver their energy with a constant temperature throughout the entire year.

■ **Suggested solution**

The head of the Service Department, who is the decision-maker when it comes to renovations, commissioned Siemens to sustainably reduce the energy consumption of the building. With the EPC Tool (Energy Performance Classification Tool) developed by Siemens, which is based on EN 15232, a solution with an energy saving potential of more than 30% could be presented to the customer within just a short time. Essentially, it is based on individual room control of the office spaces and networking the room information with energy generation and distribution.

For the proposed solution above, a neutral, functional specification can be created using the Specification Text Selection Tool (STST).

Highlights

■ Energy saving potential of 30% thanks to individual room control and intelligent building automation

■ Calculation of energy savings with tools from Siemens

■ Comprehensive, flexible range for easy installation and commissioning

■ Competent consulting to increase energy efficiency

■ STST allows to efficiently create a comprehensive, neutral, and functional specification for BACS

Applications for individual room control

■ Feel comfortable – with a good conscience

How can you save energy in rooms yet still maintain optimal comfort? The individual room controllers from Siemens provide the answer – with their high control accuracy and intelligent energy saving functions. They enable individual adjustment of the room climate at the time it's needed.

■ Minimized control deviation

– Individual room controllers with actuators from Siemens offer high-precision control within an extremely narrow tolerance range of ± 0.2 Kelvin (certified by eu.bac); with standard room thermostats, on the other hand, the temperature fluctuates between 1 – 2 Kelvin.

– The high control accuracy enables the room to have a lower setpoint value and thus increases energy efficiency.

■ Individual room temperatures

– Site-specific energy output: In every room, an individual room temperature can be set that meets the desired comfort needs.

– Energy output when it's needed: Individual time-based programs and presence detectors ensure that the temperature is increased from pre-comfort to comfort level only when the room is occupied. In addition, they activate the energy saving mode at night as well as on weekends, holidays, and during vacation periods.

■ Window contact

– Once the control recognizes via a connected window contact that a window has been opened, it
  • automatically closes the control valves in the room,
  • stops the energy output, and
  • activates the protection mode to prevent damage.

– This prevents energy waste and promotes energy awareness among users.

Legend

	Outside air temperature		Open
	Comfort mode		Close
	Pre-comfort mode		Solar radiation intake
	Economy mode		Internal loads and outward thermal flow
	Room temperature setpoint		Heating
	Actuator heating/ cooling		Cooling
	Control mode		

Temperature fluctuation

K
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2

Room
setpoint
value

Minimal control
deviation

Common control
deviation

Time

Saving potential up to 10%

30 °C   24 °C   C

30 °C   23 °C   C

30 °C   26 °C   C

20 °C   28 °C   C

Saving potential up to 12%

−3 °C   21 °C   H

−3 °C   H
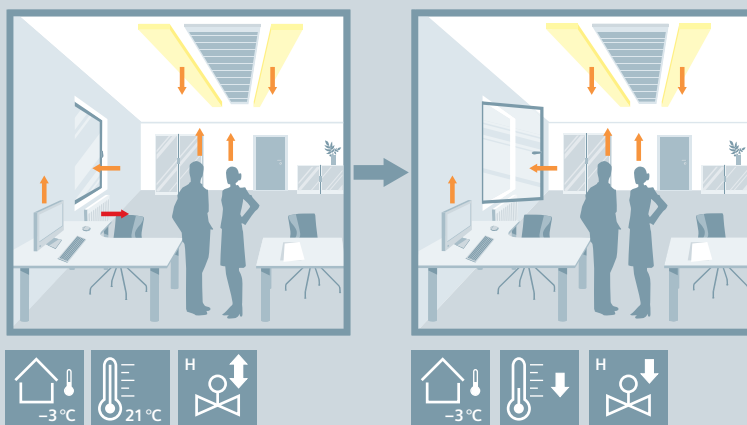
Saving potential up to 5%

Applications for energy-efficient distribution

■ **Saving without sacrifice –
thanks to optimized distribution**
To achieve maximum energy savings, it is
not enough to simply use the corresponding
applications for the room controls. There is
also significant opportunity to maximize
the energy distribution and to lower energy
consumption – without sacrificing any com-
fort in living spaces or work environments.

■ **Optimized start/stop control (OSSC)**
– Thanks to the optimized start/stop control,
the control switches the heat on at the
appropriate time to ensure that the stipu-
lated setpoint value has just been reached
when occupants enter the rooms.
– The control switches the heat off before
the occupants leave the room, while main-
taining the comfort mode.
– This saves energy at night, on weekends,
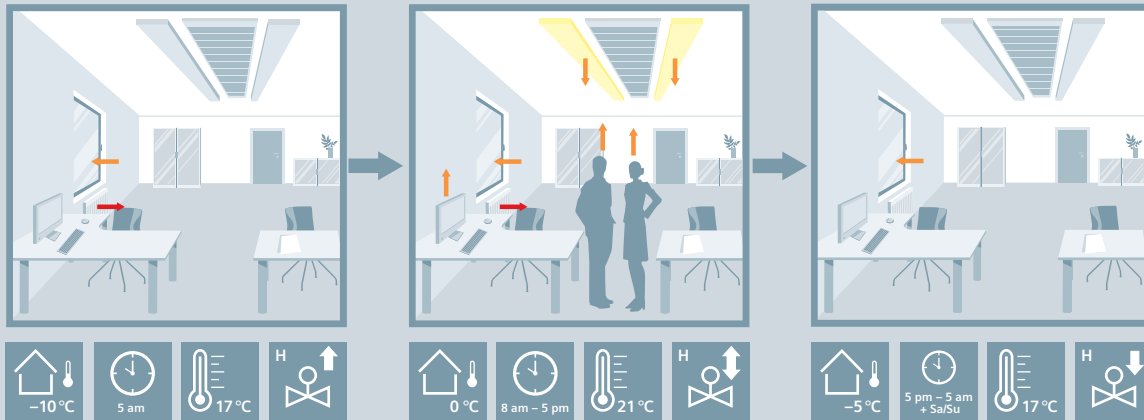and during vacation periods.

■ **Heating and cooling control
based on demand**
– The energy demand signals (valve posi-
tions and temperatures) from the rooms
are collected and then summarized and
evaluated per heating and cooling circuit.
– The notice of demand derived from this
is transmitted to the generation and
distribution, where flow rates and supply
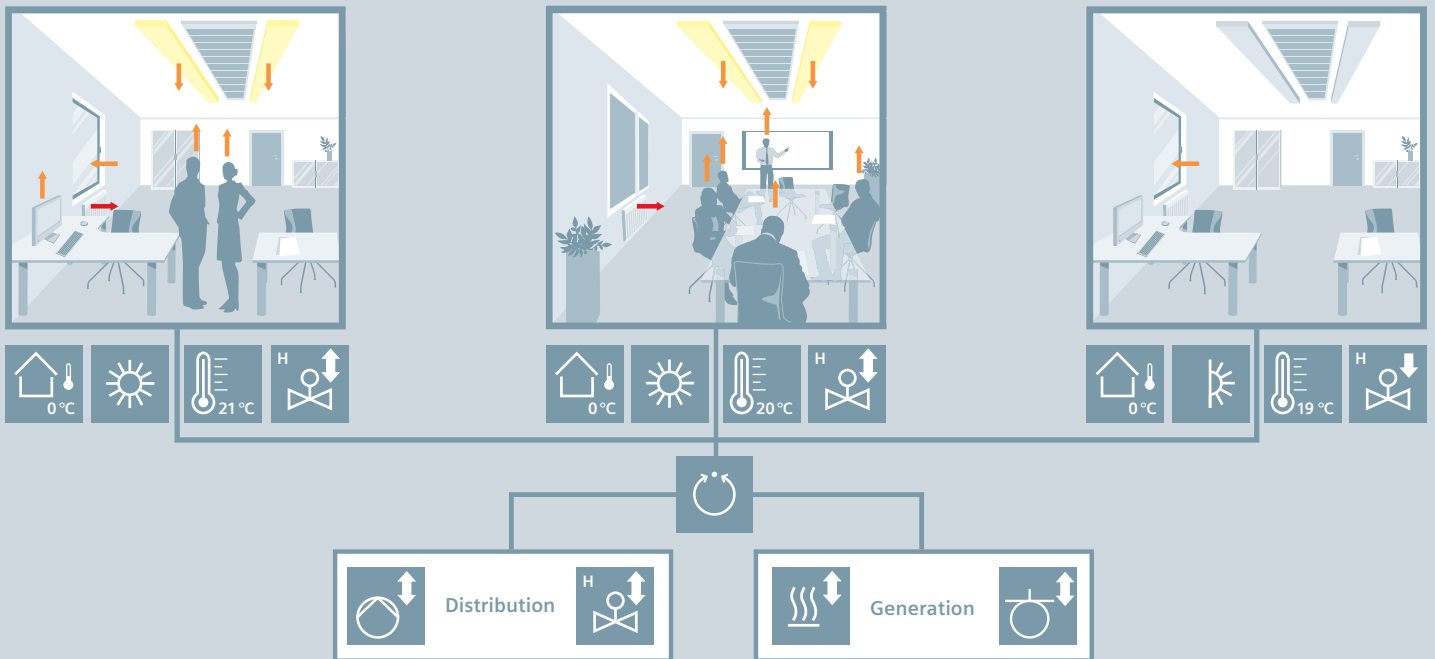temperature are adapted to the actual
demand.

Legend

	Outside air temperature		Heating generator
	Demand control		Control mode
	Comfort mode		Open
	Pre-comfort mode		Close
	Pump		Solar radiation intake
	Room temperature setpoint		Internal loads and outward thermal flow
	Actuator heating/cooling		Heating
	Time of day		Cooling
	Supply temperature		

| −10 °C | 5 am | 17 °C | H ↑ |

| 0 °C | 8 am – 5 pm | 21 °C | H ↕ |

| −5 °C | 5 pm – 5 am + Sa/Su | 17 °C | H ↓ |

Saving potential up to 7%

| 0 °C | ☀ | 21 °C | H ↕ |

| 0 °C | ☀ | 20 °C | H ↕ |

| 0 °C | 19 °C | H ↓ |

| Distribution | H ↕ |

| Generation | ↕ |

Saving potential up to 10%

■ Demand control of the supply temperature

– The supply temperature is provided to the rooms based on the valve positions.
– Auxiliary energies and a reduced energy demand are taken into account.
– In the case of low energy demand, the group valves close and switch off the pump.
– Reduced water temperatures result in lower heat losses.
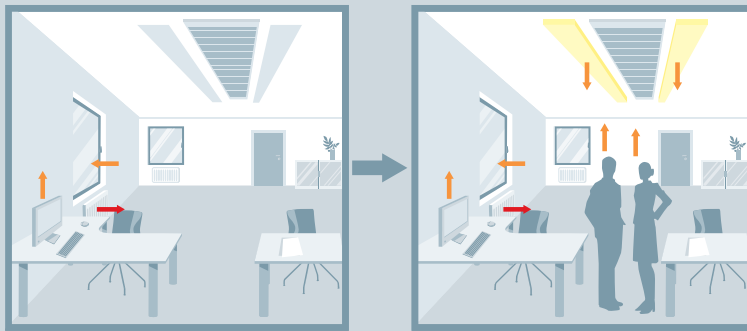
■ Demand control of the pump

– In the case of lower energy demand, the room control valves close and the differential pressure in the piping system increases.
– The constant control of the differential pressure reduces the volume flow and the output of the pump decreases. This reduces the energy consumption.
– The speed control with variable differential pressure achieves an even higher electrical energy saving.
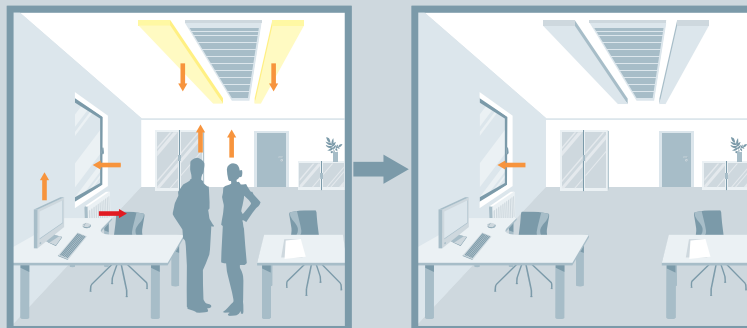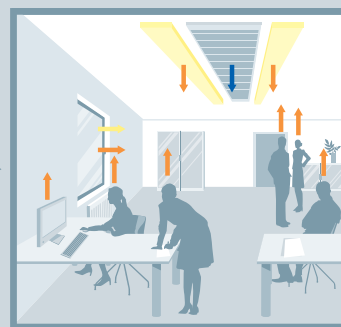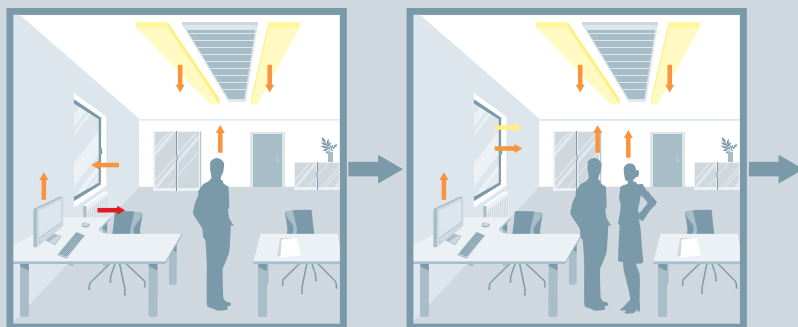
■ Interlock of heating/cooling

– The room control reduces energy losses through the heating/cooling sequence. The demand-controlled h/c setpoints prevent the room from being heated and cooled at the same time.
– If the temperature fluctuates within the set neutral zone between the h/c setpoints, the room is neither heated nor cooled.
– The greater the difference between the h/c setpoints of the individual room controllers, the more efficient is the locking of the supply.

Legend

Outside air temperature (30 °C)	Supply temperature
Demand control	Control mode
Comfort mode	Open
Pre-comfort mode	Close
Pump	Solar radiation intake
Room temperature setpoint (23 °C)	Internal loads and outward thermal flow
Actuator heating/cooling	Heating
Neutral zone (H 21°C C 23°C)	Cooling
Volume flow	

Saving potential up to 3%

Saving potential up to 50%

Saving potential up to 5%

Applications for energy-efficient generation

■ Efficient control in the energy plant
The systematic control of the energy generation also increases the energy efficiency of a building. Whether heating boilers or chillers – generators that operate only when and as long as needed use less energy. And generator temperatures that correspond to the actual needs reduce energy losses.

■ Control of the generator temperature
– By evaluating the heating or cooling demand signals, the generator temperature can be adjusted to the actual temperature needs of the user.
– The output is set higher or lower, as needed, in steps or in a modulated way.
– Heat or cooling losses within the generator that are caused by unnecessarily high or low temperatures are thus minimized.

■ Operational sequence of the generators
– If multiple generators are available for the energy generation, the priority control releases those aggregates for operation whose power and effectiveness optimally meet the current energy demand.
– The sophisticated switching of the operating sequence influences the generators in such a way that they can be operated with a high degree of use – thus ensuring energy-optimized operation.

Legend

Outside air temperature	30 °C	Supply temperature	
Demand control		Control mode	
Comfort mode		Open	
Pre-comfort mode		Close	
Cooling		Solar radiation intake	
Pump		Internal loads and outward thermal flow	
Room temperature setpoint	23 °C	Heating	
Actuator heating/ cooling		Cooling	

Distribution

Generation

Saving potential up to 3%

Heat pump

continuous

50 kW
COP = 4.7

Boiler 1

Gas modulating

100 kW
η = 1.1

Boiler 2

Fuel oil 2-step

100 kW
η = 0.9

Demand

Sequence

B1

B1

B2 St2

B1

B2 St1

B2 St1

HP

HP

HP

HP

B1
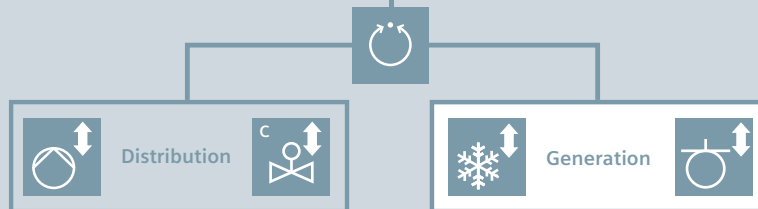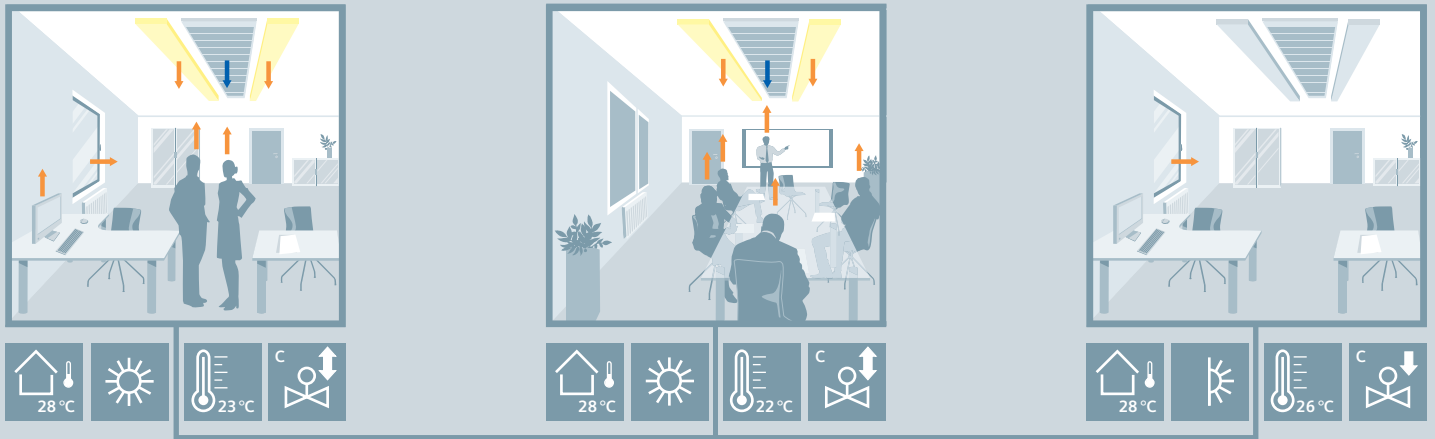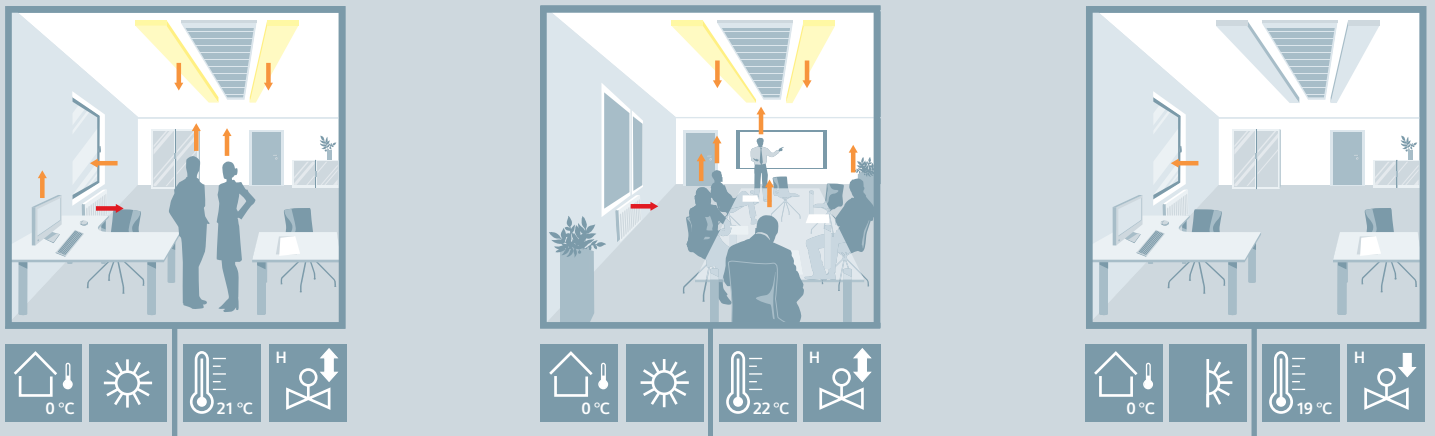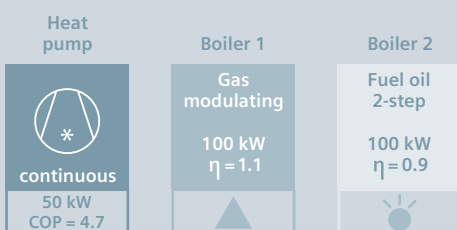
Saving potential up to 3%

Investments that amortize quickly

For the energy-optimized solution with the suggested energy saving functions, the calculation with the EEC Tool* developed by Siemens results in the following values:

Energy source	Consumption before renovation	Savings		
		Consumption	Costs	Percentage
Fuel oil	39,150 liters	11,200 liters	6,720 EUR	29%
Electricity	79,000 kWh	38,000 kWh	6,080 EUR	48%
Total	498,000 kWh	158,000 kWh	12,800 EUR	32%

In addition to the above mentioned energy savings, CO_2 emission will be reduced by 30%.

The modernization of the building automation was realized parallel to an interior renovation. Thus, installation and connection of the individual room controllers as well as networking with the new primary controllers could be accomplished easily.
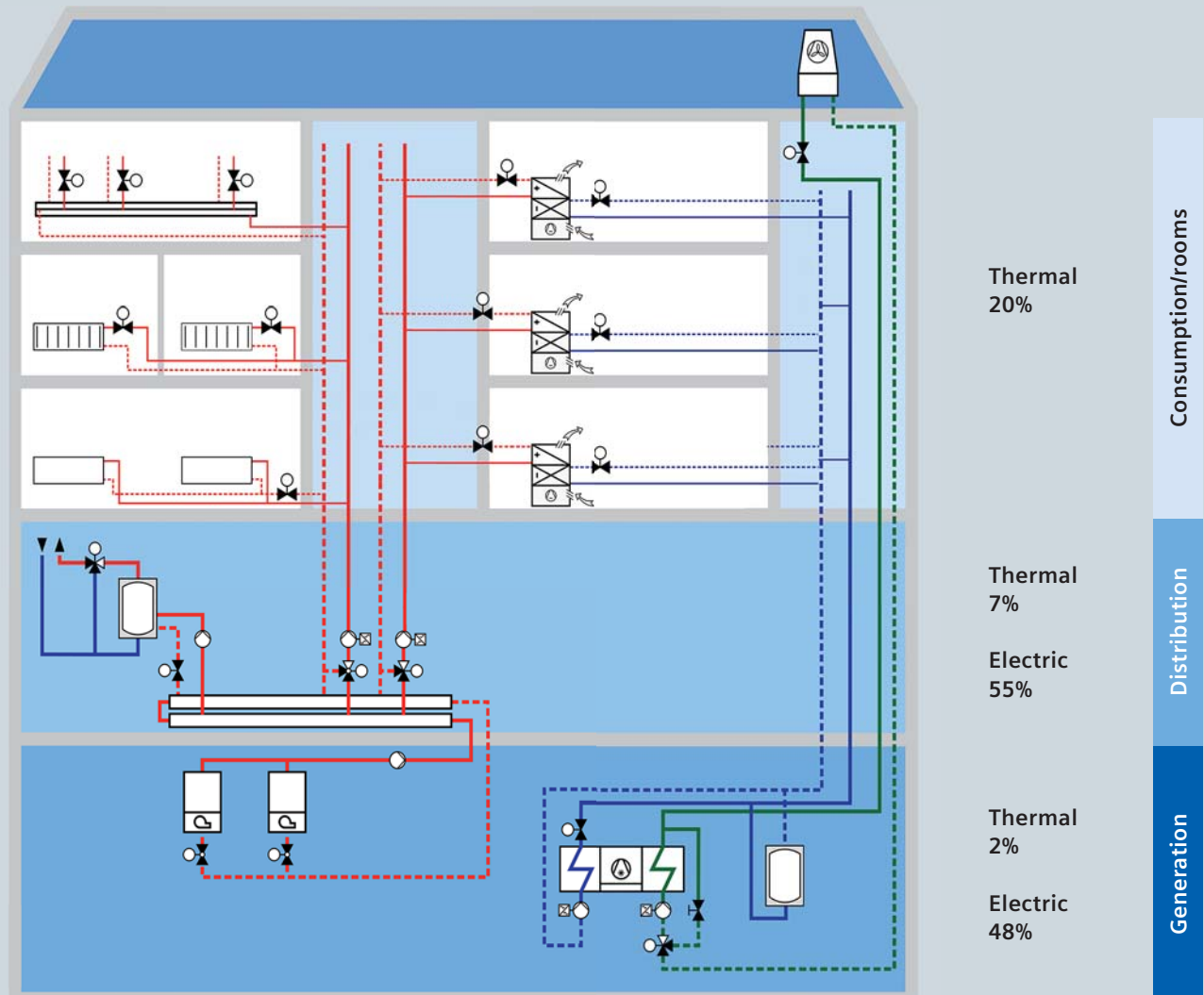
Investment costs:
– Automation components   43,000 EUR
– Wiring, installation   14,000 EUR
– Commissioning   11,000 EUR
– Total costs   68,000 EUR

Simple amortization without discounting and without inflation occurs after approx. 5 years.

Additional information on energy efficiency can be found on the Internet at **www.siemens.com/energy-efficiency**

Energy savings related to the case study

Thermal
20%

Thermal
7%

Electric
55%

Thermal
2%

Electric
48%

Consumption/rooms

Distribution

Generation

* Energy Efficiency Calculation Tool

Product range

The following products help to fulfill the conditions for efficiency class A based on EN 15232.

DESIGO in combination with individual room controllers RXC/RXB/RXL

For large and complex buildings

Synco 700 in combination with individual room controllers RXB/RXL and RDG/RDF

For larger buildings and basic to advanced tasks

Field devices

For all fields of applications:
– Sensors for all media
– Damper actuators
– Valves and actuators

Answers for infrastructure.

■ **Megatrends driving the future**

The megatrends – demographic change, urbanization, climate change, and globalization – are shaping the world today. These have an unprecedented impact on our lives and on vital sectors of our economy.

■ **Innovative technologies to answer the associated toughest questions**

Throughout a 160-year history of proven research and engineering talent, with more than 50,000 active patents, Siemens has continuously provided its customers with innovations in the areas of healthcare, energy, industry, and infrastructure – globally and locally.

■ **Increase productivity and efficiency through complete building life cycle management**

Building Technologies offers intelligent integrated solutions for industry, commercial and residential buildings, and public infrastructure. Over the entire facility's life cycle, our comprehensive and environmentally conscious portfolio of products, systems, solutions, and services for low-voltage power distribution and electrical installation technology, building automation, fire safety and security ensures the:
– optimum comfort and highest energy efficiency in buildings,
– safety and security for people, processes, and assets,
– increased business productivity.

www.siemens.com/energy-efficiency