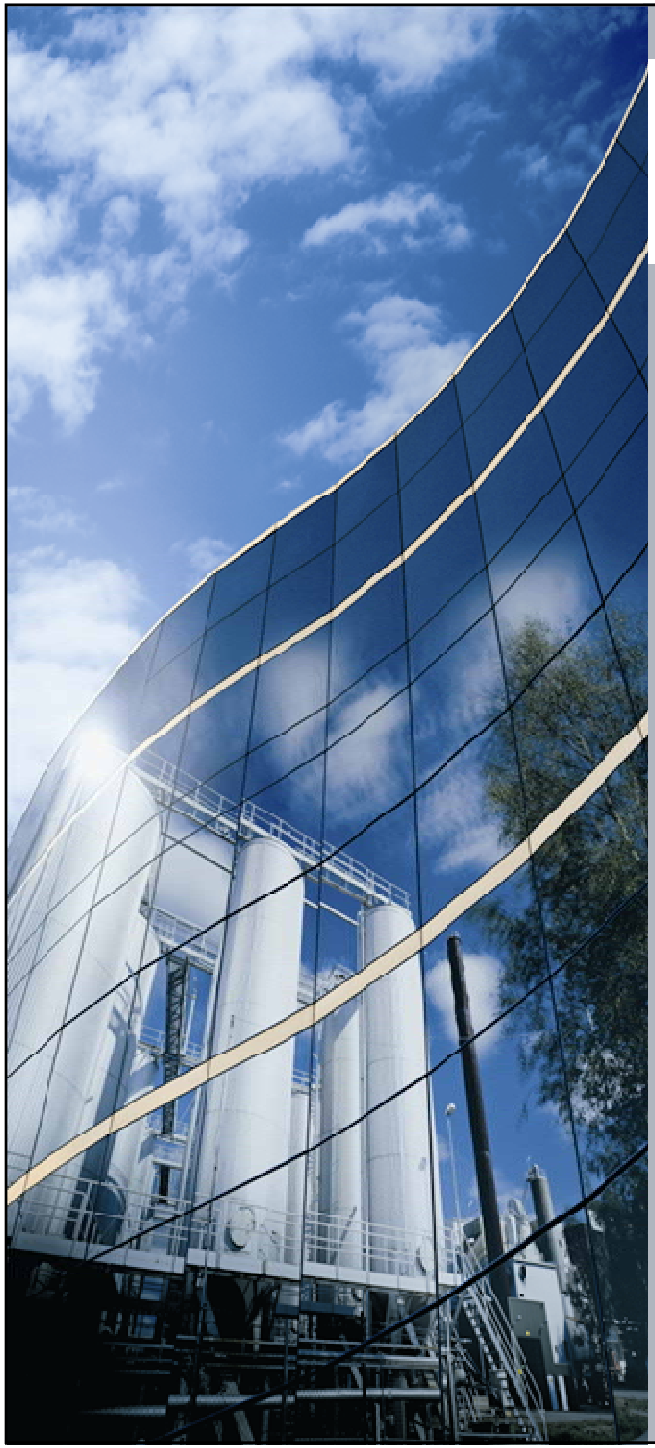


SIEMENS

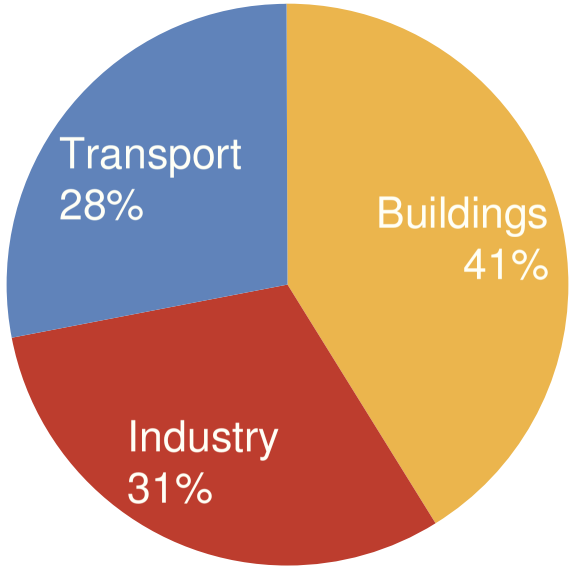
The impact of Building Automation on Energy Efficiency

Siemens with DESIGO and Synco
best in class

SIEMENS

Energy is a major issue for the European Union

Primary energy use in Europe



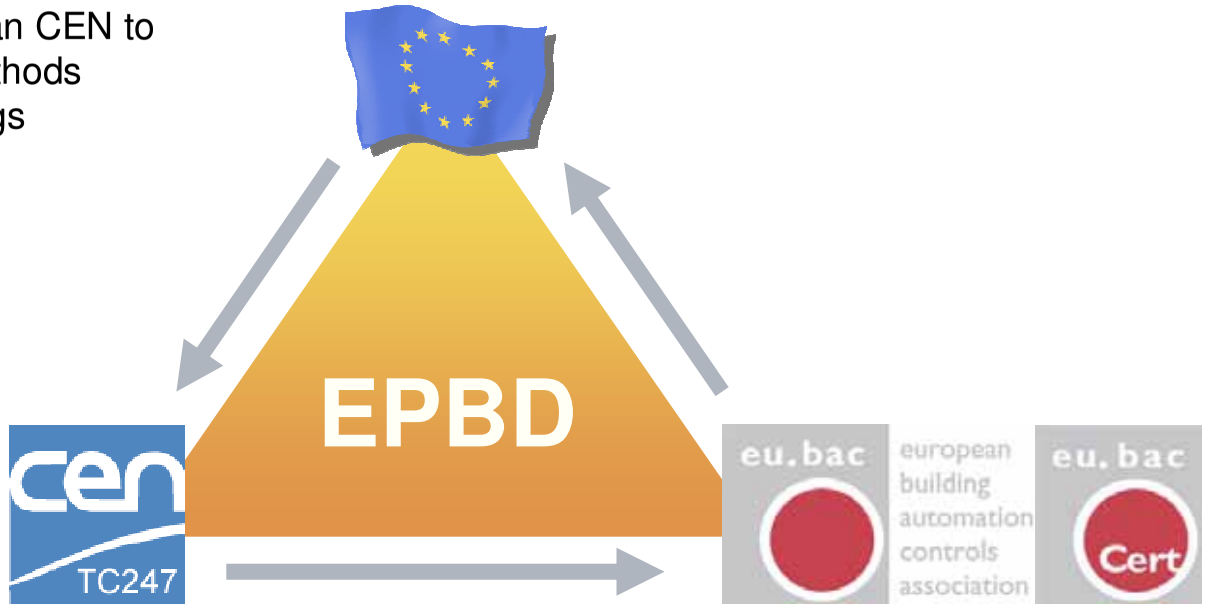
Impact of Building Automation
Efficiency improvement and modernization can save up to 30 percent

- **Dependency**
  Without provisions, dependency on external energy will rise to 70%
- **Environment**
  Energy production and consumption create 94% of CO_2 emissions
- **Supply**
  Influence on energy supply is limited
- **Cost**
  Substantial increase within a few years

SIEMENS

Legislation, standardization & certification

The EU mandated European CEN to standardize calculation methods for improving energy savings



CEN TC247
prepared and approved

- EN15232 impact of BACS functions on energy efficiency
- Product standards with energy performance criteria (e.g. EN15500)

eu.bac prepared the certification procedure and test method and proposed this certification to the European Community

CEN: European Committee for Standardization
EN: European Norm

EU and national legislation

European Parliament and the Council on the Energy Performance of Buildings

European Union Directive for Energy Performance of Buildings – EPBD

All EU-Members:
- Laws and Administrative regulations
- Calculation methods
- Energy certification of buildings

Starting 2006

RT2005
Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

ministère de l'Équipement des Transports du Logement du Tourisme et de la Mer

Office of the Deputy Prime Minister
Creating sustainable communities

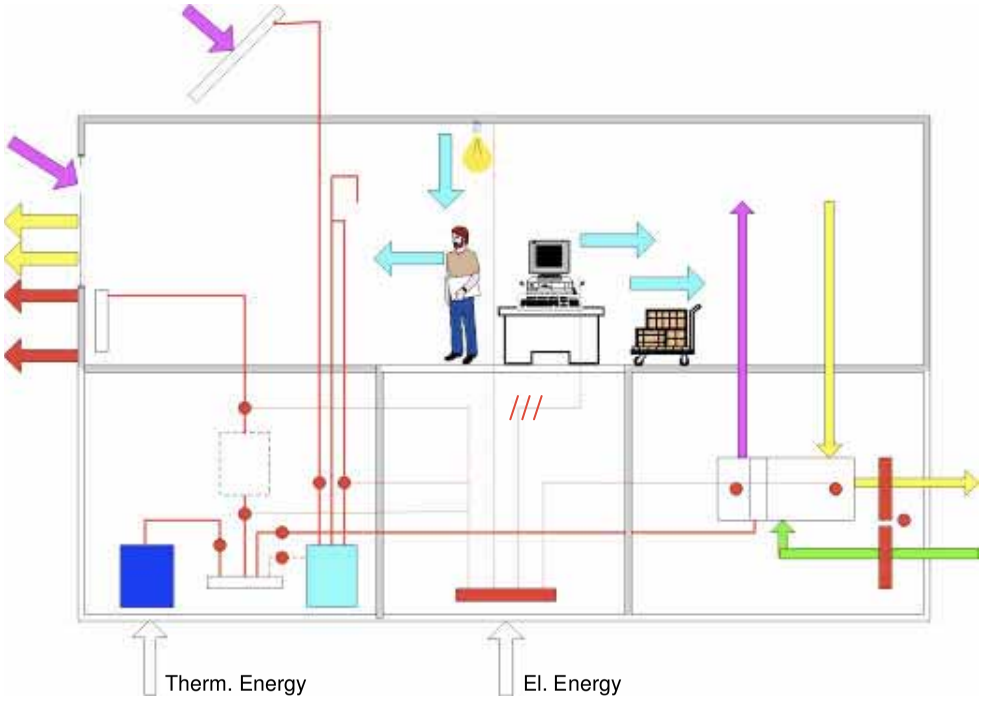
Part L of the Building Regulations and implementing the Energy Performance of Buildings Directive

DIBt

Energieeinspar-verordnung – EnEV

EPBD – Definition of Energy Performance of Buildings

Energy performance of a building means the amount of energy actually consumed or estimated to meet the different needs associated with a standardized use of the building, which may include:



- Heating
- Hot water heating
- Cooling
- Ventilation
- Lighting
- Auxiliary energy

Standardization related to energy efficiency

EU mandate for CEN to standardize calculation methods for energy efficiency improvement

EN 15232 **"Energy performance of buildings – Impact of Building Automation"**

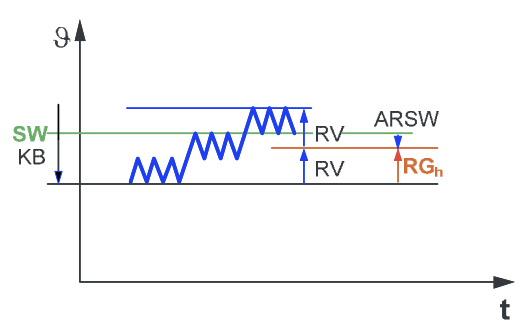
And

Product standards
(e.g. EN 15500, EN 12098)

- Terminology
- Product data's and **Energy performance criteria**
- Test procedure

EU norms for Building Automation

Product



EN 15500
Electronic individual zone control equipment

EN 12098
Control equipment for hot water heating systems

Products are certified by eu.bac

System

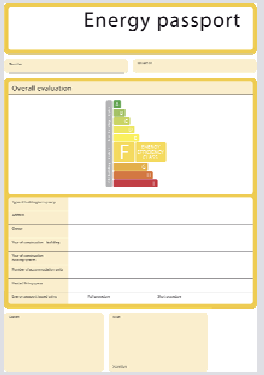
ISO EN 16484
Building automation and control systems, incl. BACnet protocol

ISO/IEC DIS 14908
LonTalk protocol

EN13321, EN50090
KNX protocol

EN 15232
Impact Building Automation on energy efficiency

Building



European Directive 2002/91/EC
Main legislative instrument to achieve energy performance in buildings

BACS* are the brain of the building

SIEMENS

BACS monitor, optimize, interlock and control

- Heating systems,
- Air conditioning systems,
- Cooling systems,
- Lighting systems and blinds,
- Fire and security systems,
- Elevators etc.

In fact BACS integrate the most important information of technical equipment in the building and act as a central point or "Brain" of the building

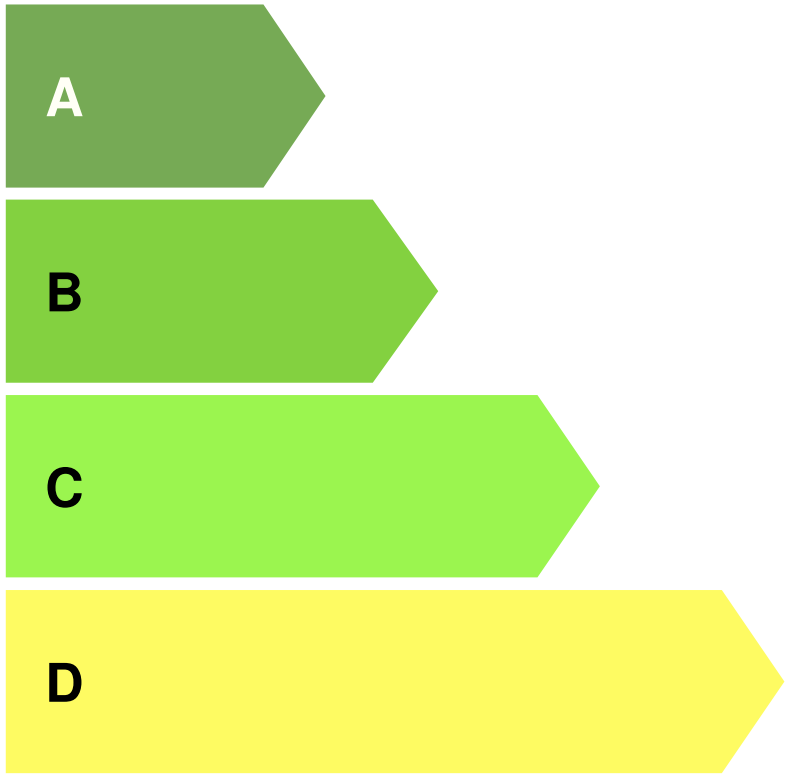
BACS functions influence

- The calculation of planned energy efficiency
- The real use of energy

* BACS: Building Automation and Controls System

Calculation procedures based on BAC efficiency factors – EN 15232

BACS Energy Performance Classes



Class A:
- High energy performance BACS and TBM

Class B:
- Advanced BACs and TBM

Class C:
- Standard BACS (is normally used as reference)

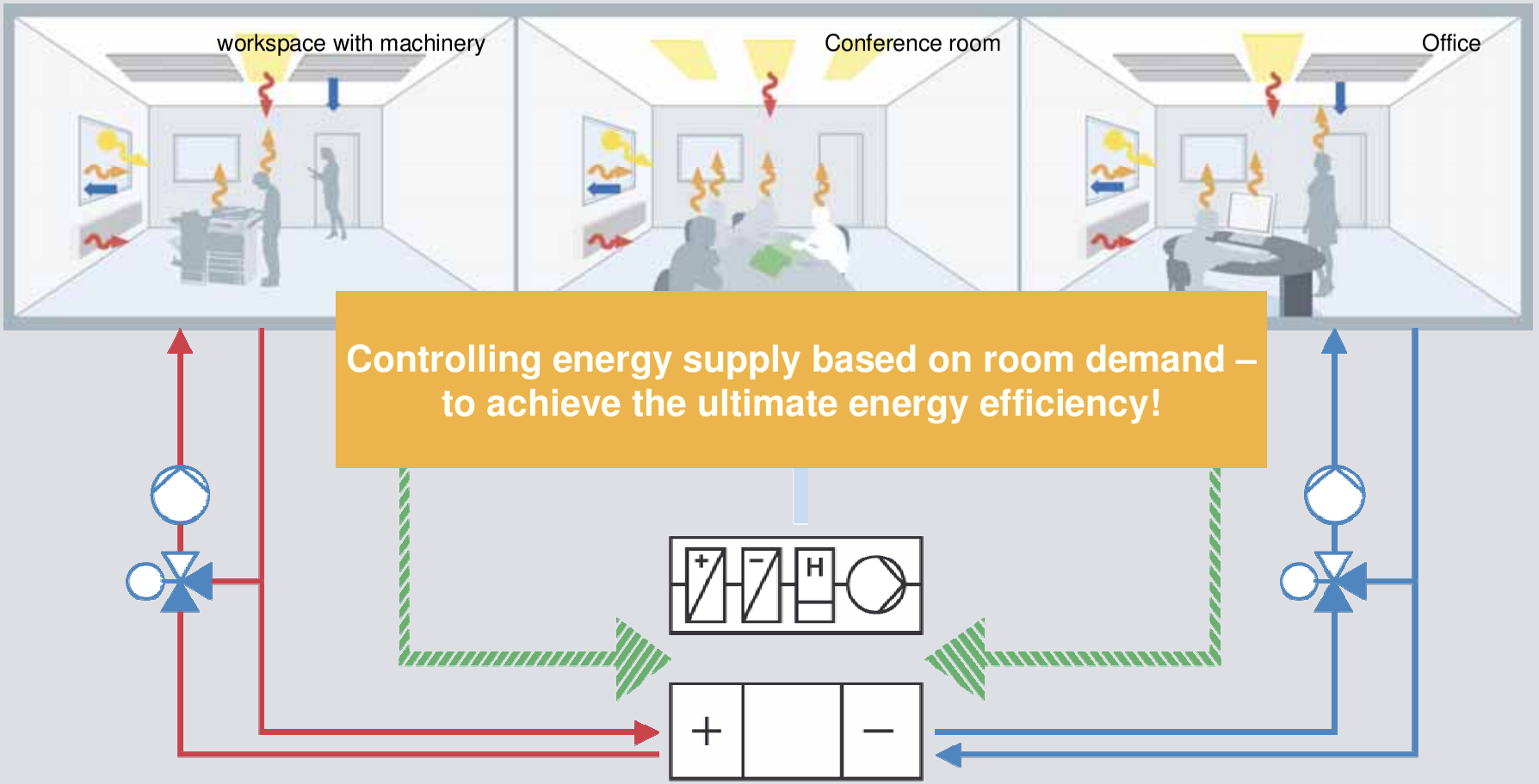
Class D:
- Non energy efficient BACS

BACS – Building Automation and Controls System
TBM – Technical Buildung Management Systems

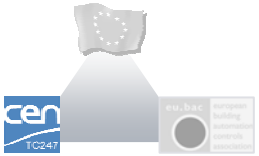
Energy efficiency under EN 15232: Targeting integrated room automation

SIEMENS

→ Demand control



Function list and assignment to energy performance classes – EN 15232



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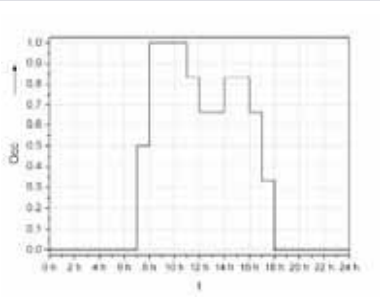
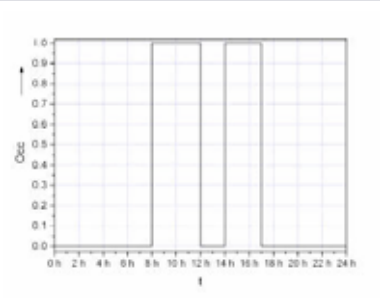
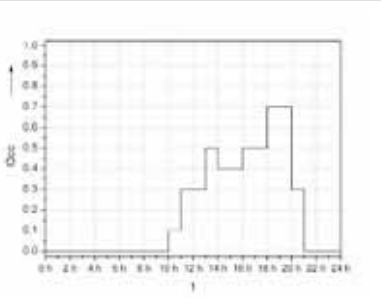
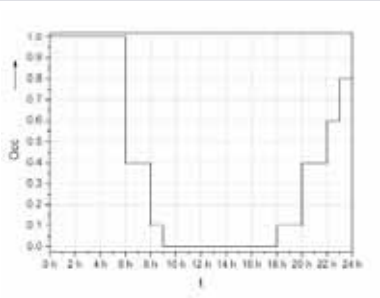
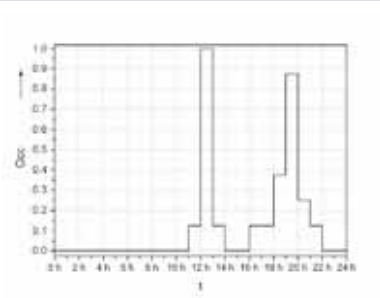
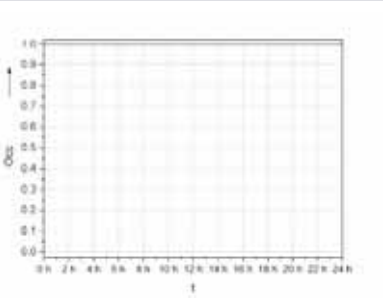
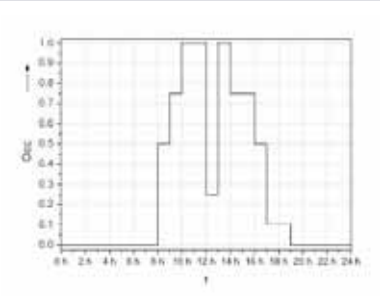
		Definition of classes							
		Residential				Non residential			
		D	C	B	A	D	C	B	A
Automatic control									
Heating control									
Emission control The control system is installed at the emitter or room level, for case 1 one system can control several rooms									
0	No automatic control								
1	Central automatic control								
2	Individual room automatic control by thermostatic valves or electronic controller								
3	Individual room control with communication between controllers and to BACS								
4	Integrated individual room control including demand control (by occupancy, air quality, etc.)								
Control of distribution network hot water temperature (supply or return) Similar function can be applied to the control of direct electric heating networks									
0	No automatic control								
1	Outside temperature compensated control								
2	Indoor temperature control								

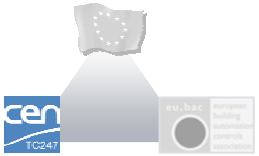
Unless differently specified by public authorities the minimum level of functions to be implemented corresponds to class C. Public authorities wishing to modify the minimum requirements shall adapt this table.

BACS efficiency factors determined for different user profiles

SIEMENS

Office		School		Wholesale centre	
Hotel		Restaurant		Hospital	
Lecture hall		**User profiles as defined by EN 15232**			

BACS efficiency factors – EN 15232



	Thermal energy				Electrical energy			
Class	D	C	B	A	D	C	B	A
Offices	1,51	1	0,80	0,70	1,10	1	0,93	0,87
Lecture hall	1,24	1	0,75	0,50	1,06	1	0,94	0,89
Education	1,20	1	0,88	0,80	1,07	1	0,93	0,86
Hospitals	1,31	1	0,91	0,86	1,05	1	0,98	0,96
Hotels	1,31	1	0,85	0,68	1,07	1	0,95	0,90
Restaurants	1,23	1	0,77	0,68	1,04	1	0,96	0,92
Wholesale & retail	1,56	1	0,73	0,60	1,08	1	0,95	0,91
Residential	1,10	1	0,88	0,81	1,08	1	0,93	0,92

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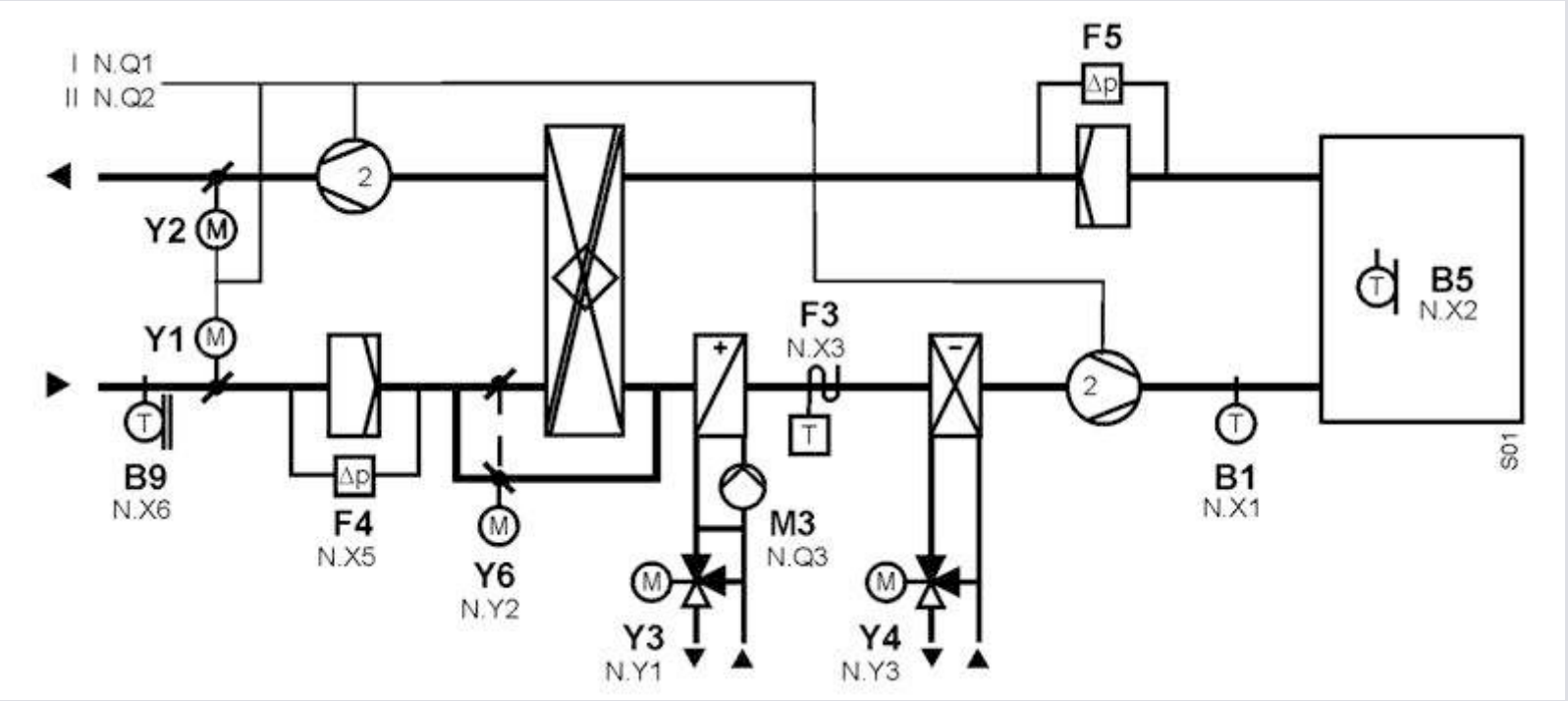
Example: Ventilation plant restaurant

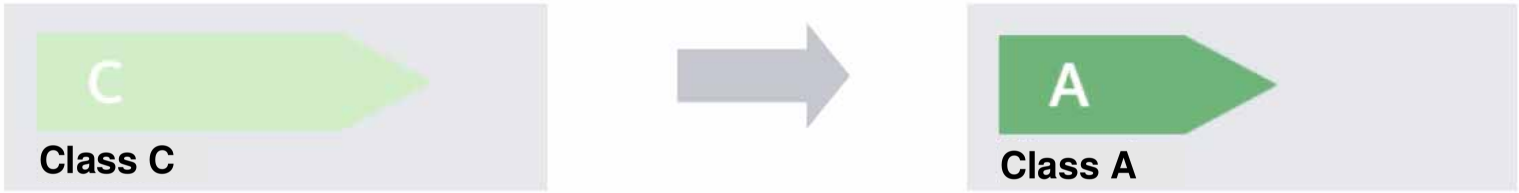
Schematic diagram



SIEMENS

Example: Ventilation plant restaurant

VENTILATION AND AIR CONDITIONING CONTROL		BT	Definition of classes							
			Residential				Non residential			
			D	C	B	A	D	C	B	A
Air flow control at the room level		9, 10								
0	No control									
1	Manual control									
2	Time control									
3	Presence control									
4	Demand control									
Air flow control at the air handler level		11								
0	No control									
1	On off time control									
2	Automatic flow or pressure control with or without pressure reset									
Heat exchanger defrost control		12								
0	Without defrost control									
1	With defrost control									
Heat exchanger overheating control		13								
0	Without overheating control									
1	With overheating control									

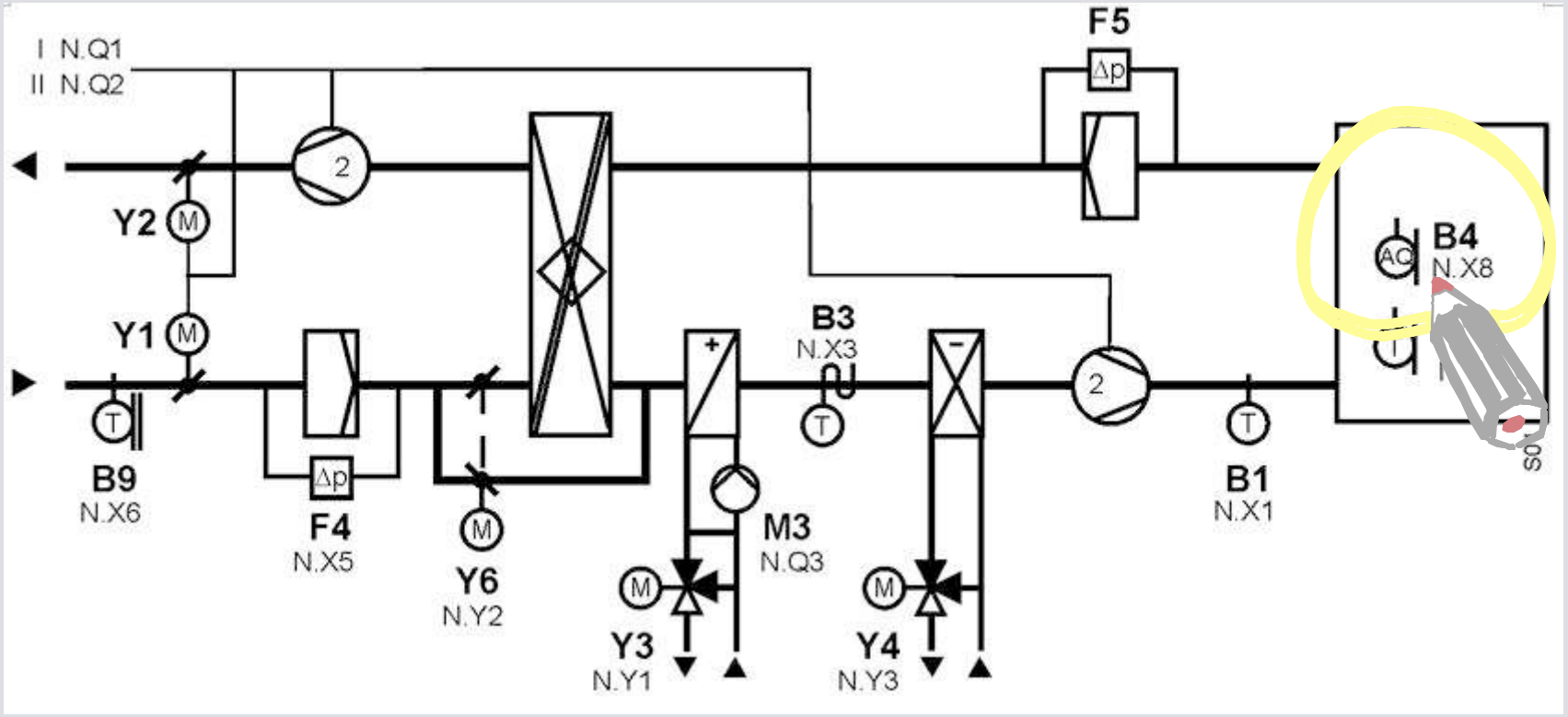


SIEMENS

Example: Ventilation plant restaurant

Demand control

Air quality sensor



SIEMENS

Example: Ventilation plant restaurant

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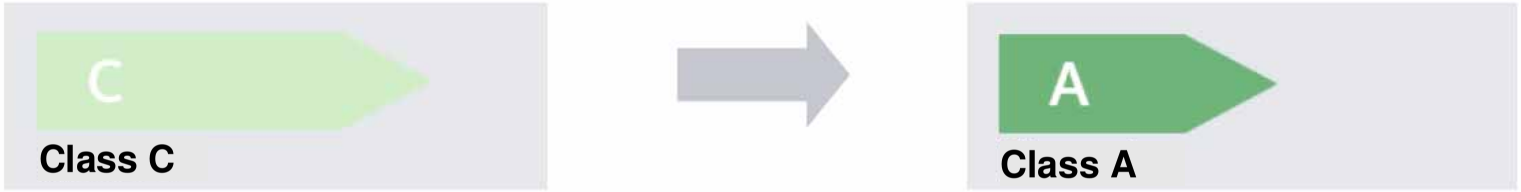
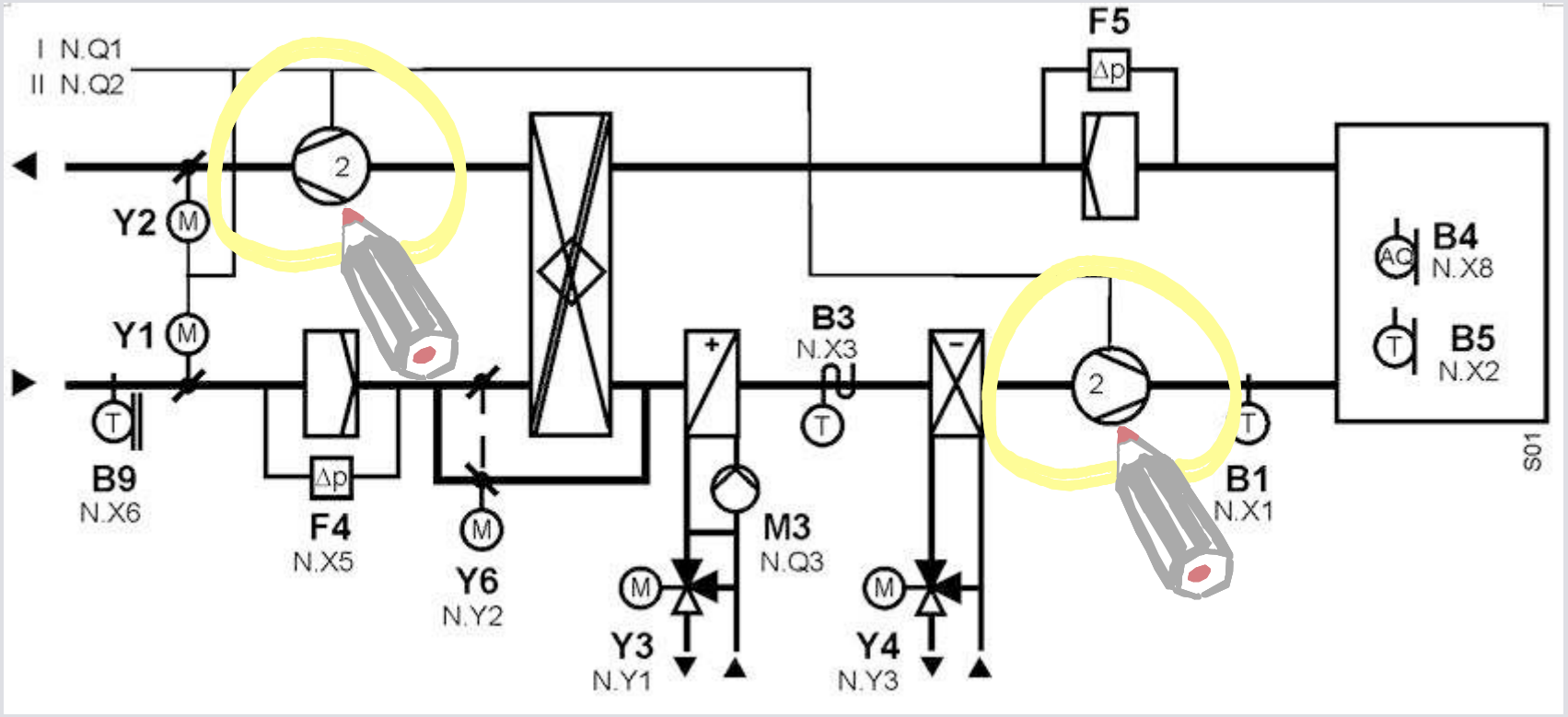


SIEMENS

Example: Ventilation plant restaurant

Air flow control

Variable speed drive instead of fan 2-stage



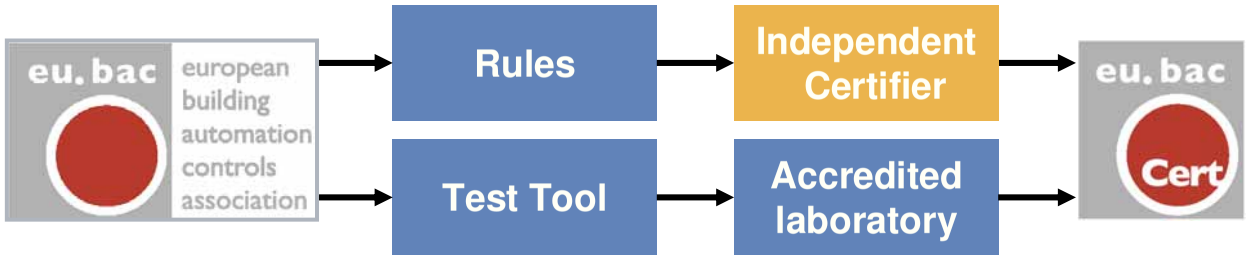
eu.bac – Certification for BACS

EU Mandate for CEN to standardization of Calculation methods for energy efficiency improvement

TC247: EN 15232 "Energy performance of buildings – Impact of Building Automation"

and

Product Standards
- Terminology
- Product data's incl. energy performance criterias
- Test procedure



Why eu.bac?

The European BACS industry joined forces and competences to propose practical solutions:

- For the reduction of greenhouse gas emissions in buildings
- For a European Quality Assurance system for energy efficient building automation and controls equipment
- For the introduction of a legal framework for energy savings performance contracting in buildings
  - Based on eu.bac Cert equipment and systems

Initiated by Siemens and first presidency

eu.bac Cert
Implementation plan

SIEMENS

First certified products in September 2007

- Individual zone controllers
- Stepwise release of various applications (e.g. hot water radiator heating, chilled ceiling, VAV etc.)

Further products under pre-paration by eu.bac

- Heating controllers incl. optimizer
- Field components (temperature sensors, valves and actuators, etc.)
- Building Automation Systems


LICENCE

eu.bac european building automation controls association

Test Report Summary

eu.bac Cert

Schweiz AG

he eu.bac mark for the product

RXC21.1

pplication(s)

Unit System

cation rules of eu.bac
rtificate 02002

re on 29 October 2012

Managing Director Winfried Brandt
eu.bac

d controls Association - eu.bac
nkfurt am Main - Germany

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	
Temperature Control Accuracy CA	Heating mode 0.2 K Cooling mode 0.1 K

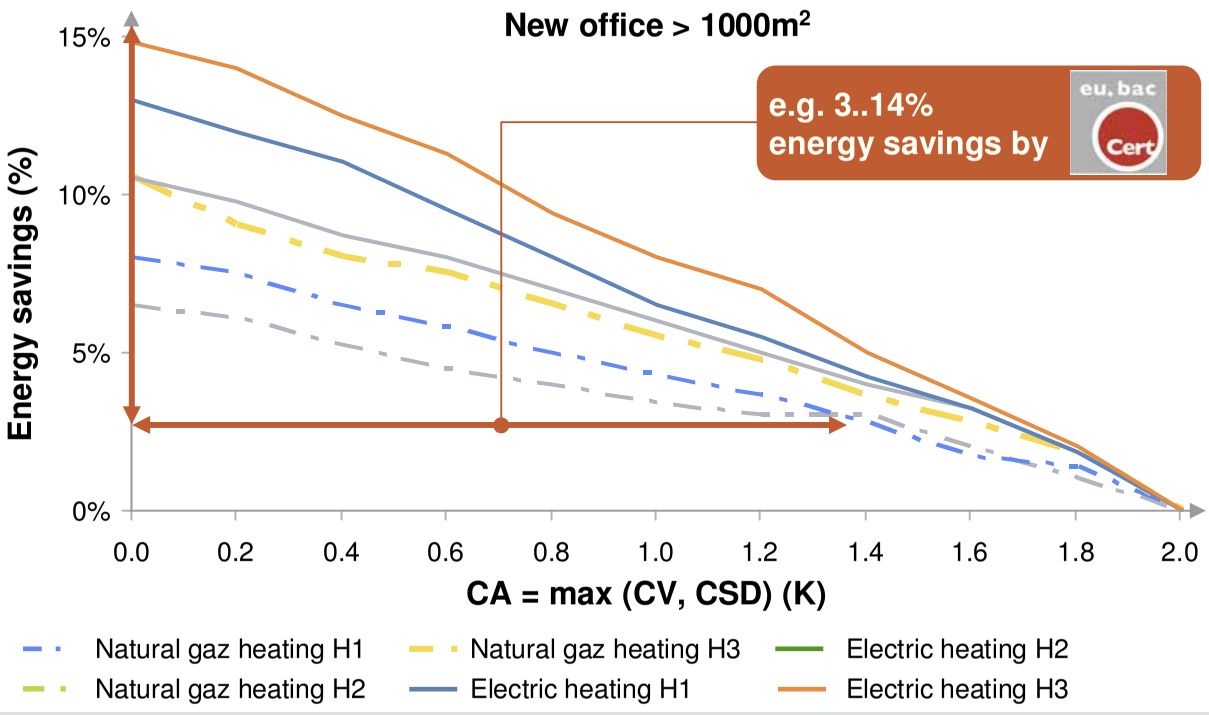
31 March 2008
Frankfurt am Main

Managing Director Winfried Brandt
eu.bac

european building automation and controls Association - eu.bac
Lyoner Straße 18 - 60528 Frankfurt am Main - Germany

Impact on energy savings of high quality room controllers

Energy savings



Temperature control accuracy compliancy CA:

- **Eu.bac: ≤1.4K (radiator heating)**
- **EN15500: ≤2.0K**

France

Source: CSTB France

SIEMENS

Siemens Building Technologies …

- Grants for EN 15232 efficiency class A and eu.bac Cert with high performance
- Delivers even higher system functionality than required under energy performance class A (EN15232)

Siemens grants for EN 15232 efficiency class A and eu.bac Cert with high performance

SIEMENS

Synco living **Synco700** **DESIGO**

Management level

Energy efficiency functions:

- Energy consumption report
- Alarm and status reports
- Trend reports
- Easy-to-use time schedulers, set points, etc.

Automation level

- Generation control with variable temp. dependent on outdoor temp. or load
- Sequencing of diff. generators based on various inputs
- Interlock heating / cooling
- Optimum start / stop
- H,x directed control
- Individual room control with central operation and data link to primary heating or cooling plant

Field level

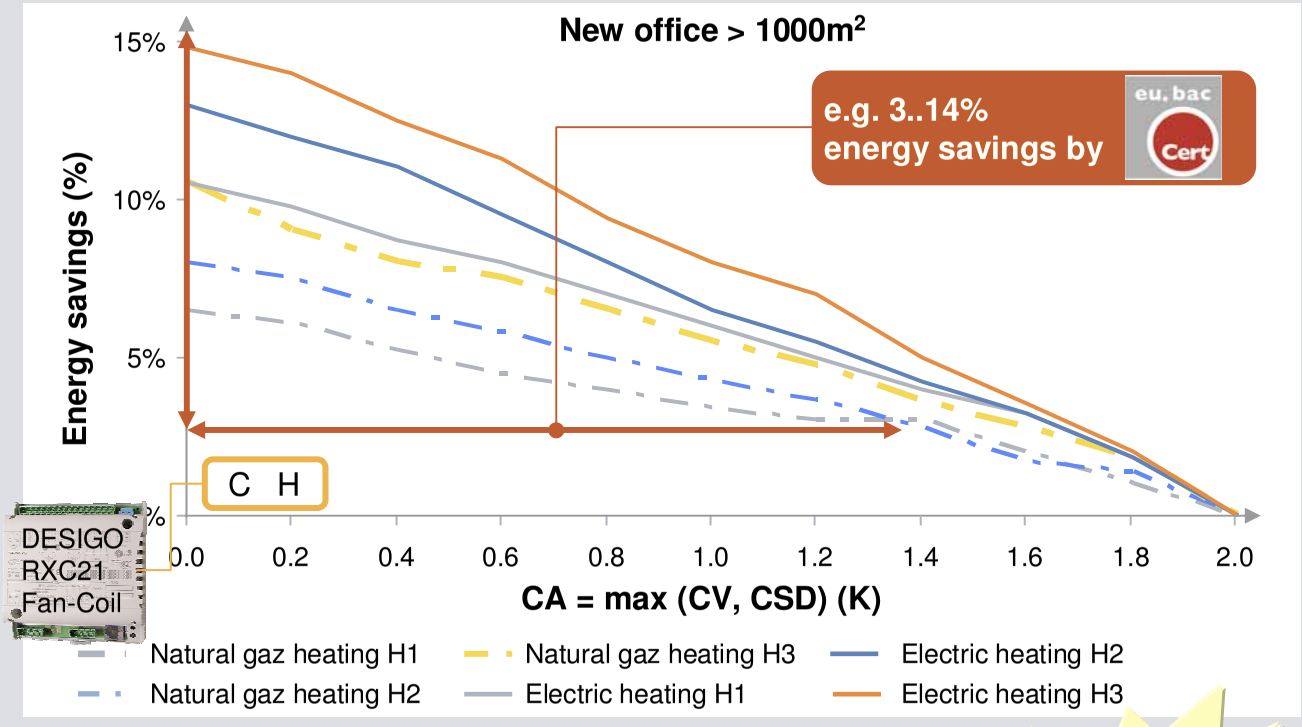
- Demand control with CO_2 or presence sensors
- Lighting and blinds control
- Variable speed pump and fan control

Test results for Siemens room controllers

Example: Fancoil with motoric actuator

SIEMENS

Energy savings



Temperature control accuracy compliancy CA:

- **Eu.bac: ≤1.4K**
- **EN15500: ≤2.0K**

Best in class

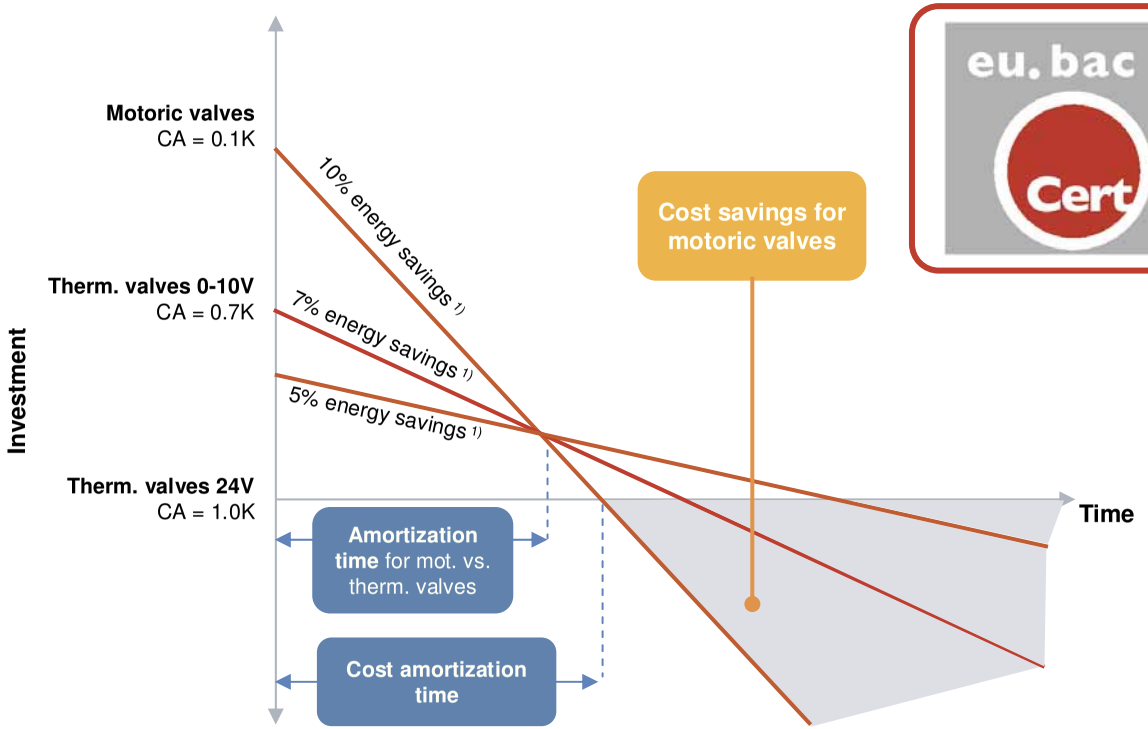
DESIGO™ RX

Source: CSTB France

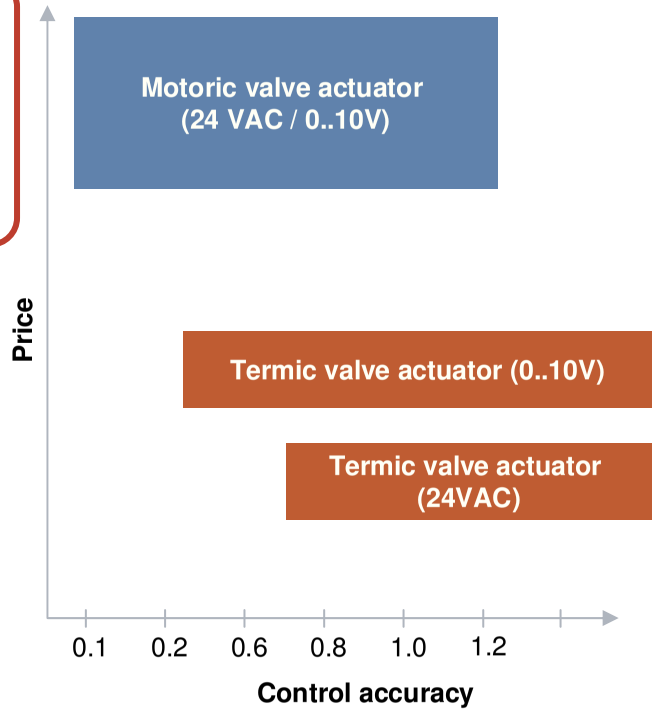
eu.bac Certification
Amortization time & cost savings

SIEMENS

Amortization time



Positioning of actuators



1) Compare to EN 15500 for natural gaz heating in South France

Amortize a DESIGO RX control circuit with motorized actuators compared to thermal (24V) actuators (2)

SIEMENS

		Energy savings	Reduction in energy costs			Amortization		
			Heating oil	Natural gas	Elec-tricity	Heating oil	Natural gas	Elec-tricity
		kWh per annum	EUR	EUR	EUR	Years	Years	Years
Old building	Large office, 3 fan coil	1,000	80	60	90	**3.1**	**4.2**	**2.7**
	Large office, 1 fan coil	1,000	80	60	90	**1.0**	**1.3**	**0.9**
	Small office, 1 fan coil	300	24	18	27	**3.4**	**4.7**	**3.0**
Average building	Large office, 3 fan coil	500	40	30	45	**6.6**	**9.4**	**5.8**
	Large office, 1 fan coil	500	40	30	45	**2.0**	**2.7**	**1.8**
	Small office, 1 fan coil	150	12	9	14	**7.5**	**10.7**	**6.6**
New building	Large office, 3 fan coil	250	20	15	23	**15.9**	**24.5**	**13.6**
	Large office, 1 fan coil	250	20	15	23	**4.2**	**5.8**	**3.7**
	Small office, 1 fan coil	75	6	5	7	**18.5**	**29.2**	**15.7**

Amortization m = Additional investment I / annual return R
Annual return R = annual energy cost savings minus interest on additional investment
Annual additional interest costs = 1/2 the additional investment * calculatory interest rate

Siemens delivers even higher system functionality than energy performance class A (EN15232) requires

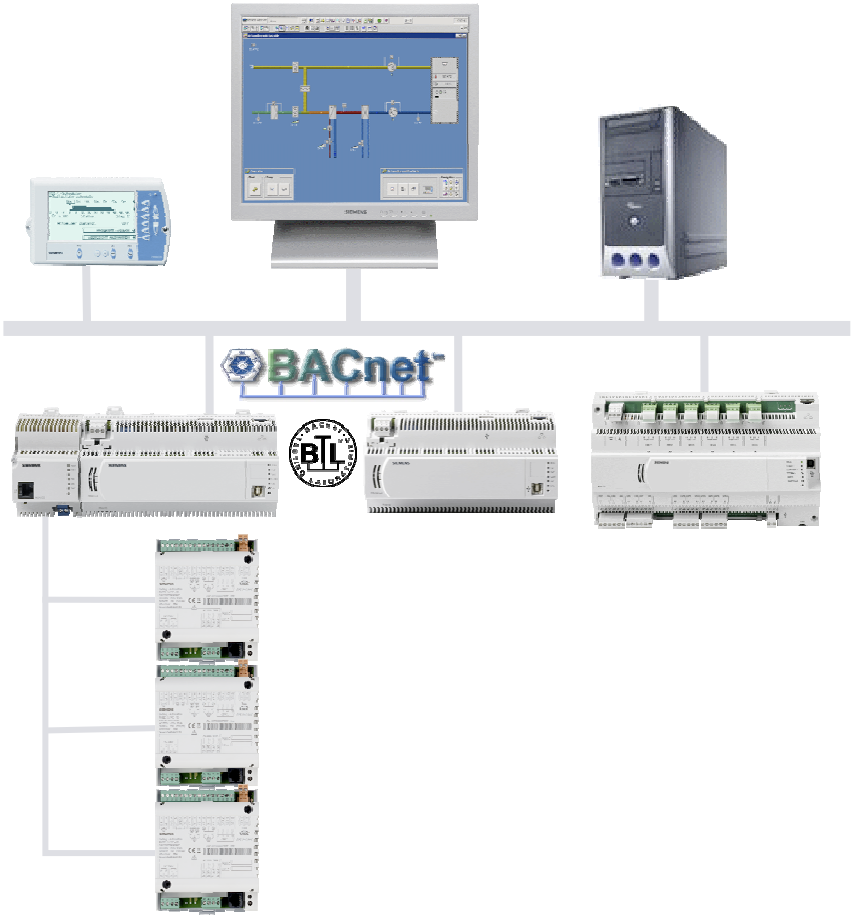
SIEMENS

New high quality energy functions:

- AirOptiControl: Low energy control solution for air handling unit and up to 10 rooms
- h,x directed control that considers actual energy demand and costs (heating and cooling, humidify and dehumidify)
- Predictive heating controller
- Control solution for Thermally Activated Building System (TABS)

Interoperability for:

- Room controller with primary contr.
- 3rd products (BACnet, LonWorks, KNX, Modbus, M-Bus)
- By means of:
  - BACnet V1.5 with BTL
  - Transparent integration of room automation



SIEMENS

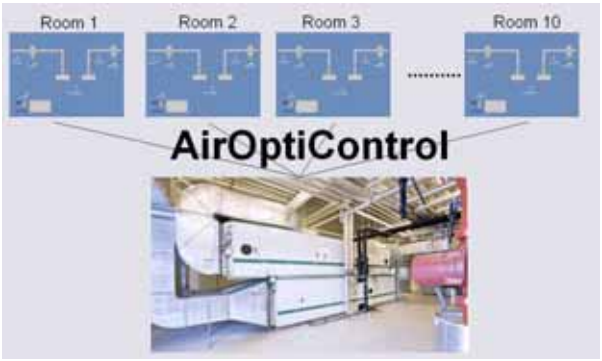
DESIGO - AirOptiControl - Low energy control solution

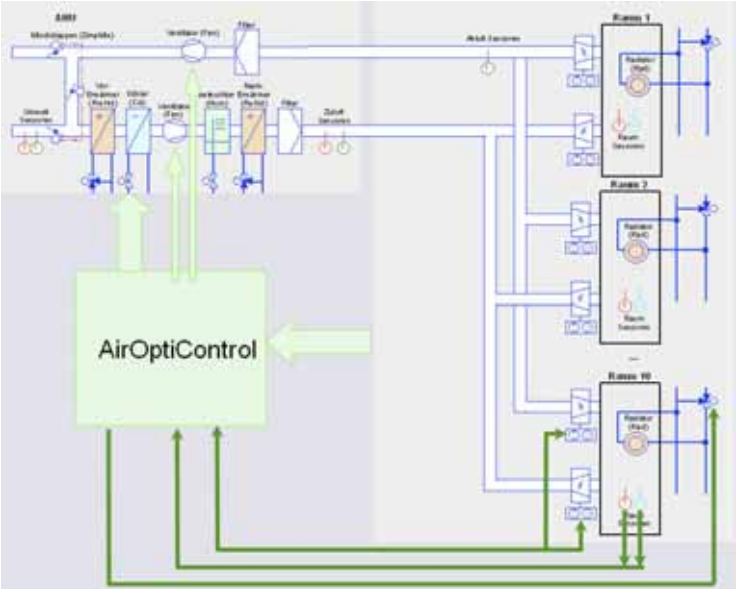
Key features

- New innovative control concept
- Low energy control solution for air handling unit and up to 10 rooms
- Unique “energy efficiency mode” to optimize fan control by considering
  - VAV damper position in the rooms
  - Comfort set point range for room temp., room air quality and opt. room humidity
- Room demand control

Key benefits

- Reduced energy consumption of up to 50%; means lower operating costs without sacrificing comfort
- Reduced maintenance cost → shorter runtime, less damper movements
- exceeds the requirements of energy efficiency class A as per EN 15232
- High quality, thanks to comprehensive tests → proven applications
- Highly efficient engineering and commissioning

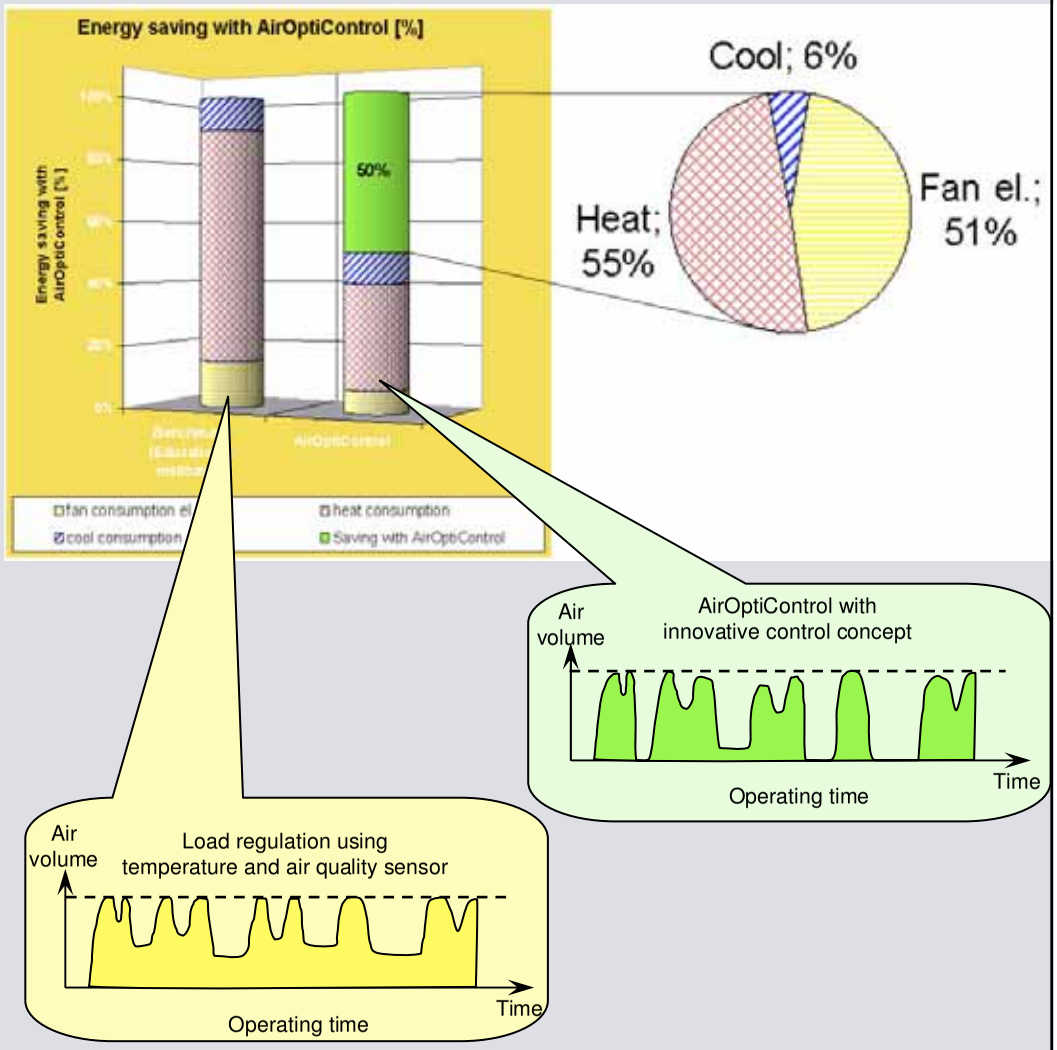




SIEMENS

DESIGO - AirOptiControl - Low energy control solution

- Experience and research show that the average airflow required is normally only about 50–60% of the dimensioned airflow.
- A typical room is used for only 60% of the time, and when it is being used, the load is only around 75%.
- In terms of total cost of ownership, there is no doubt that major savings can be made by **controlling the ventilation in each room**. Optimal indoor air quality is an added bonus.

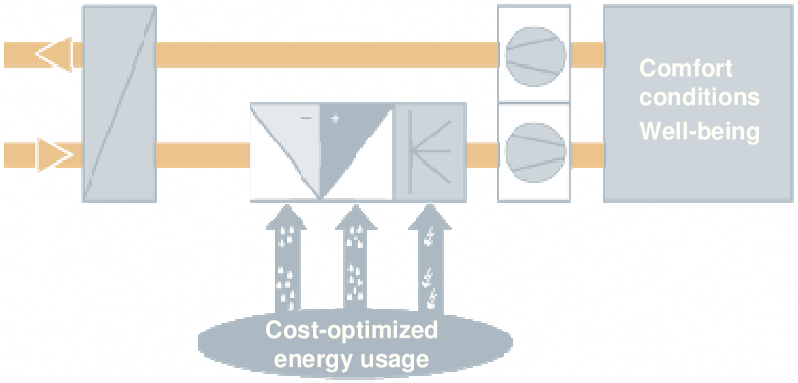


DESIGO
Economizer tx2 – Energy optimum control

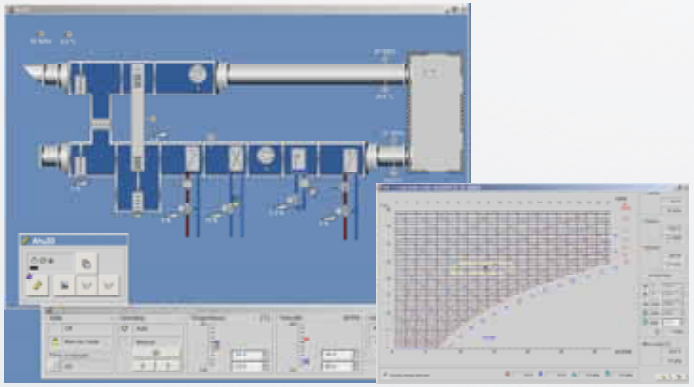
SIEMENS

Proven application designed to reduce energy consumption and operating costs of full air conditioning plants while ensuring optimum room comfort:

- Temperature and humidity control as an extract air-supply air cascade
- Absolute humidity control with setpoint range
- tx2-energy cost optimization for heat recovery or mixed air dampers



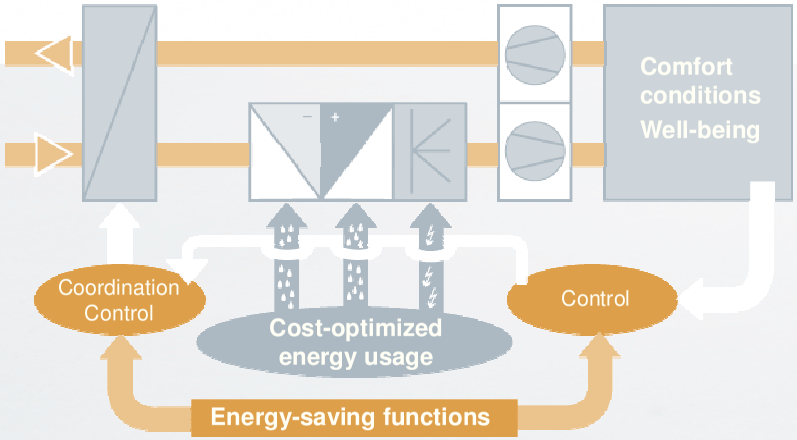
Operation and monitoring on DESIGO Insight:



DESIGO
Economizer tx2 – Energy optimum control

SIEMENS

- Optimum comfort with **energy savings of up to 50%** thanks to innovative control strategy
- **Minimized energy costs while ensuring optimum comfort** with full air conditioning plant; h,x-dependent control in the comfort zone
- **High protection of investment** thanks to standardized European efficiency classes
- **Short payback times** owing to low engineering and commissioning costs

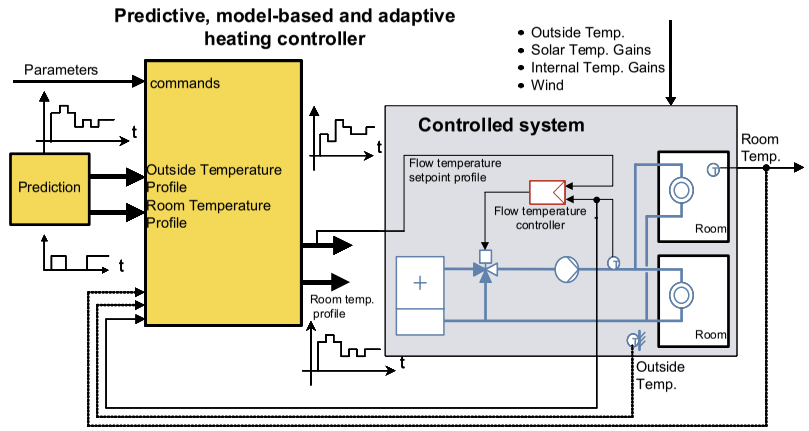


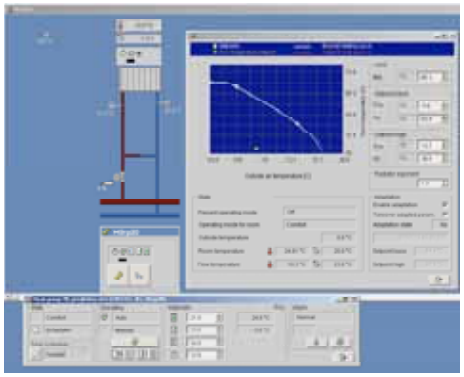
DESIGO™ V4
Predictive and adaptive heating controller

SIEMENS

Solution:
- Outside temperature prediction (integrated)
- Model-based optimization of supply water temp.
- Start / stop optimization
- Adaptation of model parameters, incl. adaptive heating curve
- Optimization of supply water temp. set point for min. energy consumption without sacrificing comfort

Benefits:
- ✓ Comprehensive control concept
- ✓ Comprehensive functionality with few settings
- ✓ One (fully adaptive) function to replace conventional solution consisting of separate functions (Heating curve, heating release algorithm, optimum start stop control)
- ✓ Proven standard solution





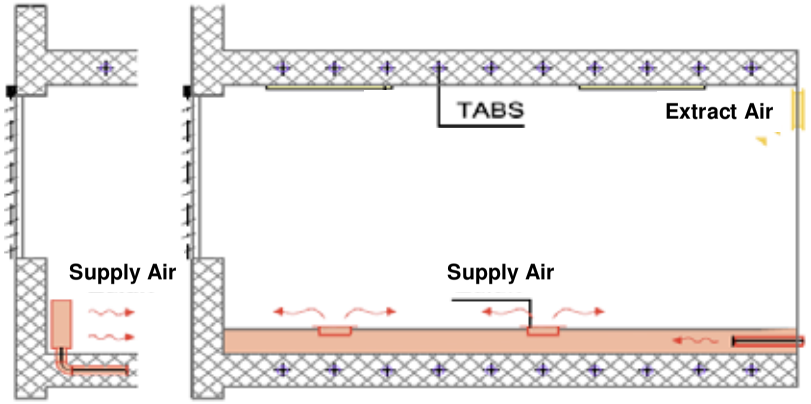
Thermally Activated Building Systems (TABS)

What are TABS?:

- Systems for low temperature heating and high temperature cooling by actively using a building structure's thermal mass

Advantages of TABS buildings:

- ✓ Energy-efficient heat and cooling generation
- ✓ Self-control effect for room temperature
- ✓ Low building investments (up to -30% @ standard solutions[1)])
- ✓ Low energy consumption (appr. -23% @ standard solutions[1)])



1) Reference: City of Zurich Dec. 2006

DESIGO™ V4
Thermally Activated Building System (TABS)

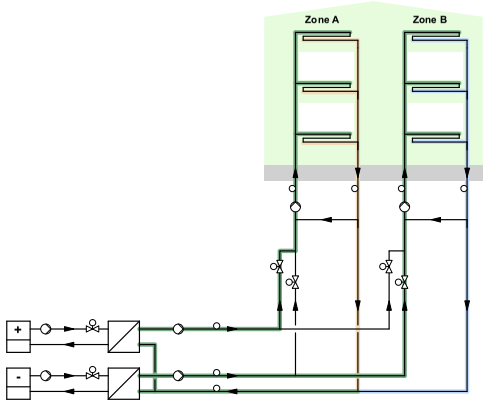
SIEMENS

Solution:

- Control as integrated part of TABS design
- Control parameters (e.g. heating and cooling curves) directly resulting from an integrated tool-supported design process
- Options:
  - Intermittent operation of circulation pump
  - Romm temp. correction (day to day)

Benefits:

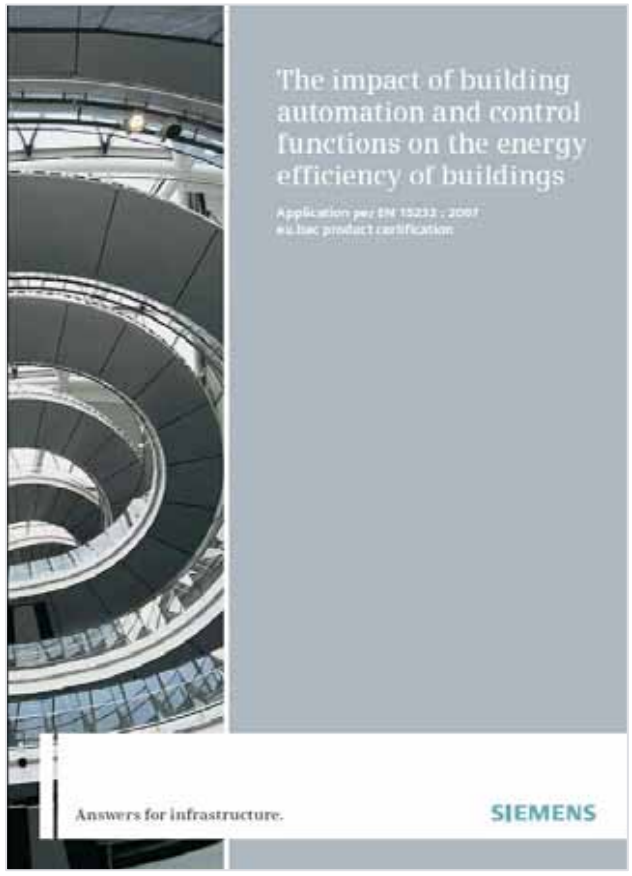
- ✓ Green building solution
- ✓ Reduced maintenance effort
- ✓ Reduced energy consumption
- ✓ Proven standard solution



Operation and monitoring on DESIGO Insight:

A new Siemens brochure:
Supports the Building Automation planning phase

SIEMENS



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Target groups:
All persons involved in planning phase of buildings and specifically Building Automation

Target and benefits:
- To become familiar with EN 15232 "Energy performance of buildings" – "Impact of Building Automation, Controls and Building Management"
- To become familiar with the benefits of product certification by eu.bac (European Building Automation Controls Association)
- To be able to select the BAC functions according to their impact on energy efficiency of buildings

Siemens EPC Tool - supports classification of Building Automation and Controls Systems

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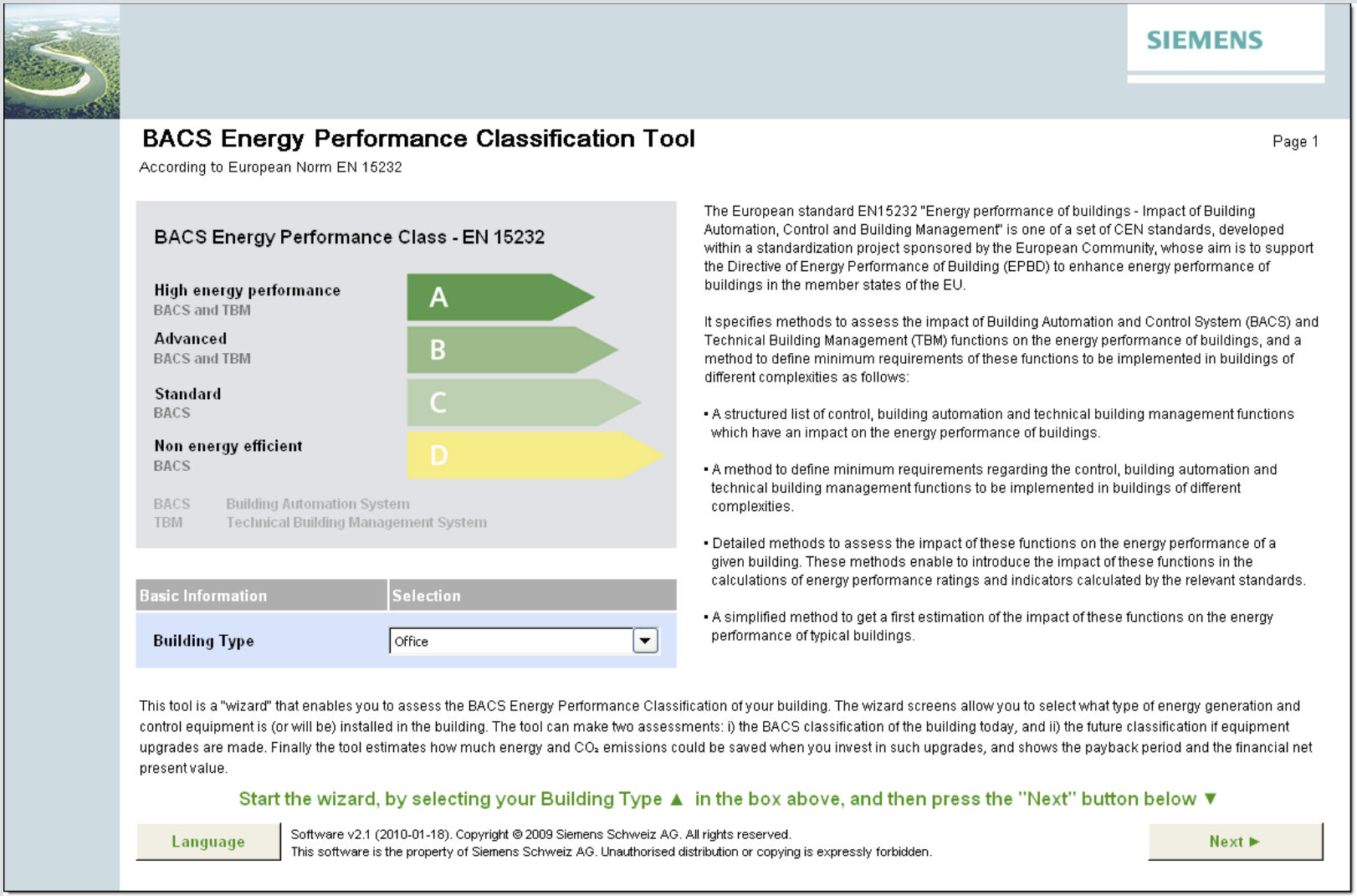

Conclusions

Impact of building automation on the energy efficiency

Typical categorization of energy saving potentials in buildings

SIEMENS

	Category	Measures, e.g.	Saving potential [%]	Amortization [years]

	**Building automation**	▪ Installation and optimized tuning of energy functions
		▪ Optimization during operation by
		  ▪ efficient use of BACS and weak point analysis
		  ▪ dynamic energy management
			5-30	0-5

	**Technical installations**	▪ HVAC, refrigeration, lighting ▪ Controls, motors, actuators, ▪ Power generation	10-60	2-10
	**Building envelope**	▪ Insulation, windows ▪ Thermal bridges, construction physics	>50	10-60

Conclusion: Invest first in building automation and control!
➔ Results in highest ROI quickly

Building automation and building management life cycle

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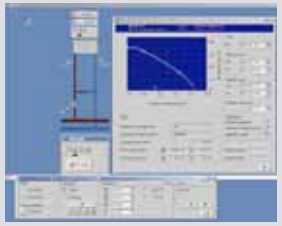
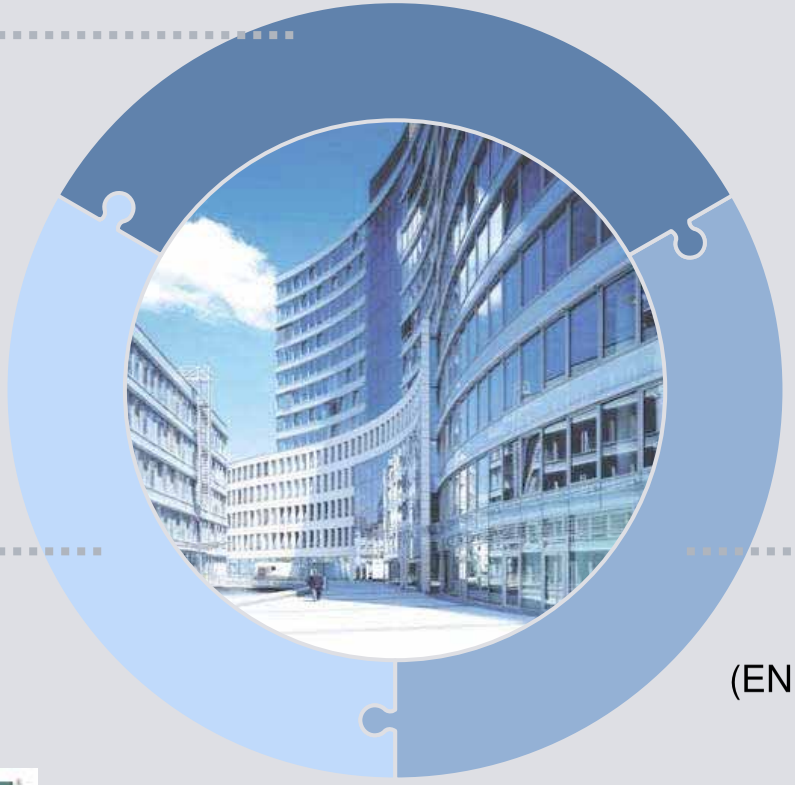
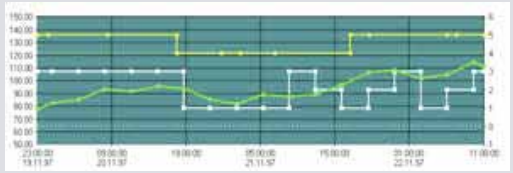
Adapt the operational parameters

Decide on additional automation





Monitor and analyze the building operation and technical installations



Specify and install energy functions with BACS (EN15232) and devices with

		Definition of classes						
		Residential				Non residential		
		D	C	B	A	D	C	B	A
Automatic control									
Heating control									
Emission control									
The control system is installed at the emitter or room level; for case 1 one system can control several rooms									
0	No automatic control								
1	Central automatic control								
2	Individual room automatic control by thermostatic valves or electronic controller								
3	Individual room control with communication between controllers and to BACS								
4	Integrated individual room control including demand control (by occupancy, air quality, etc.)								✓
Control of distribution network hot water temperature (supply or return)									
Similar function can be applied to the control of direct electric heating networks									
0	No automatic control								
1	Outside temperature compensated control								
2	Indoor temperature control								✓

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Conclusions about optimizing building operation

Even with building automation, you still need

- To identify optimization potential
- To know the coherences between the building, the technical installations,
  the environment and the user
- To master guidelines, directives and laws
- A willingness to constantly face new challenges!

The brain is still sitting in front of the monitor!!

Summary:
Legislation – Standardization – Certification

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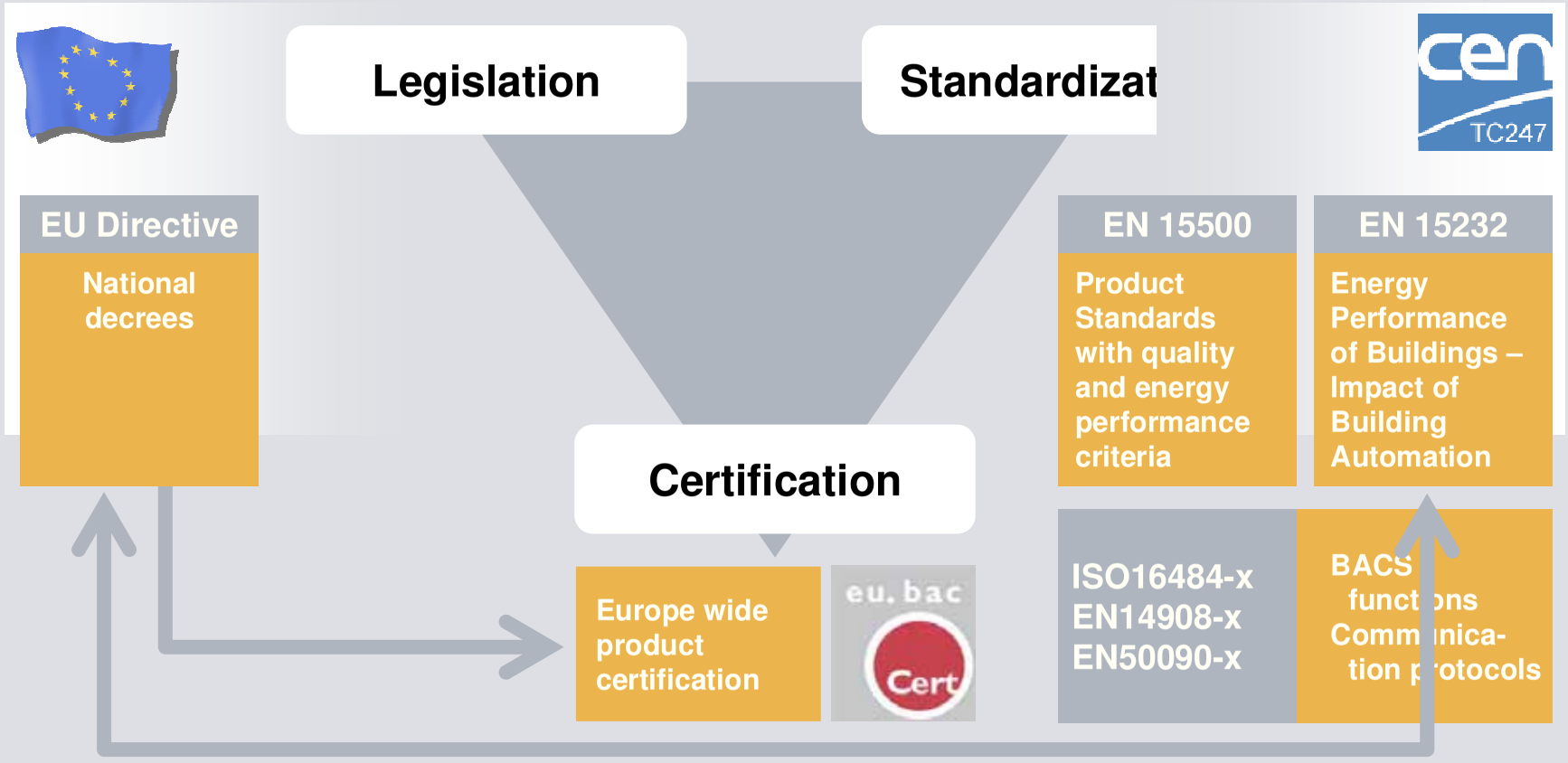

Building Automation industry can substantiate the value of BACS

The value of BACS = Saving potentials by intelligent use of Building Automation (EN 15232)

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Hotels

Th.32% El.10%

Education

Th.20% El.14%

Hospitals

Th.14% El.4%

Residential

Th.19% El.8%

Restaurants

Th.32% El.8%

Shopping C.

Th.40% El.9%

Offices

Th.30% El.13%

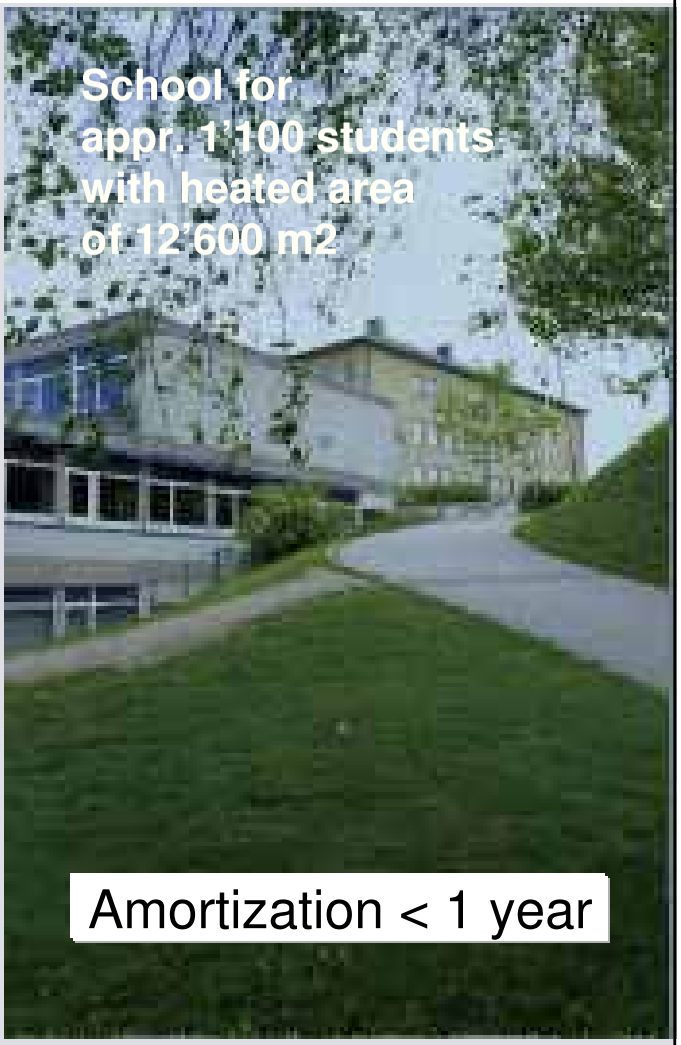
Determined by means of building simulation / FH Aachen DE

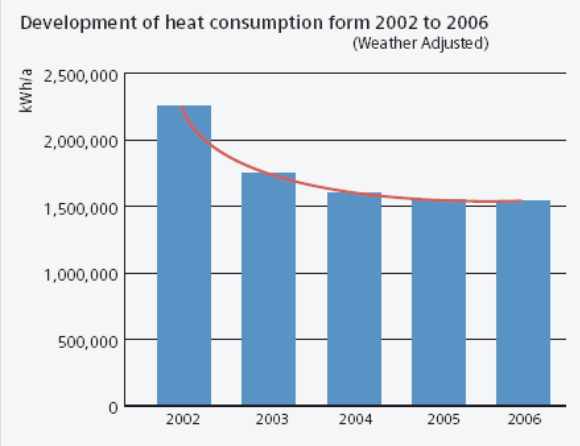
Siemens reference project:
City of Boras, Sweden – school campus Erikslund

SIEMENS

Measures taken:

- Control parameters and set point values optimized, time programs adjusted
- Demand controlled energy production; The district heat connection was turned off during the summer months
- non-functioning dampers replaced, that were letting in too much fresh





Result:

Energy reduction for

Heating (DGD adjusted)**:**

707'000 kWh → 32%

Electric:

100'000 kWh → 14%

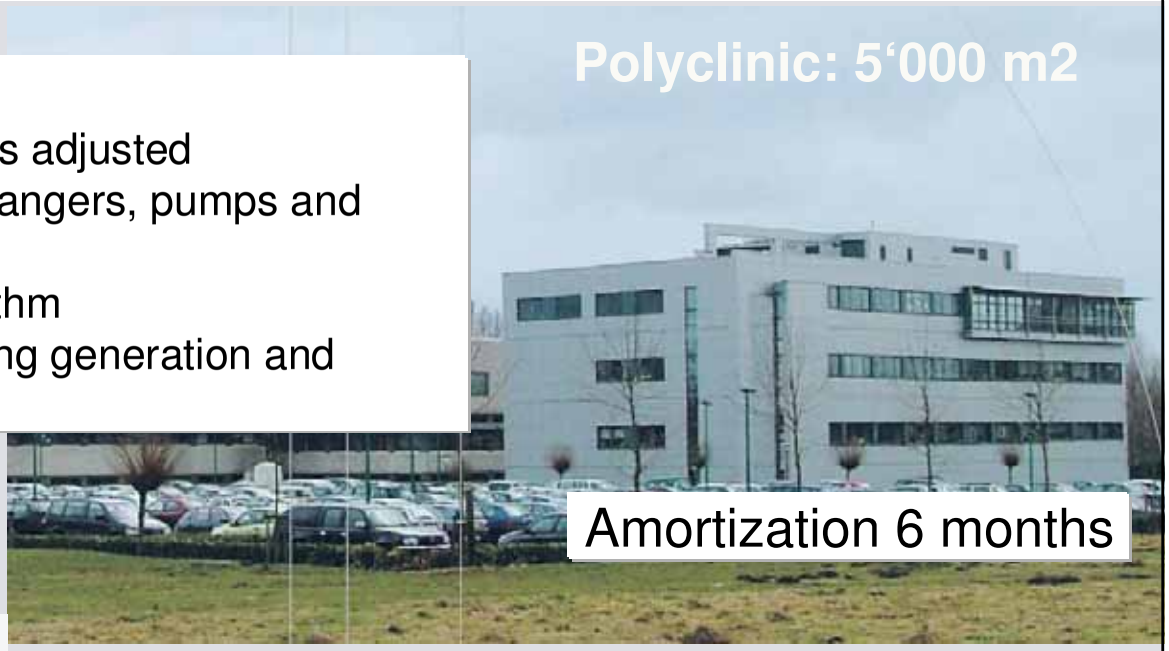
CO2: - 824t

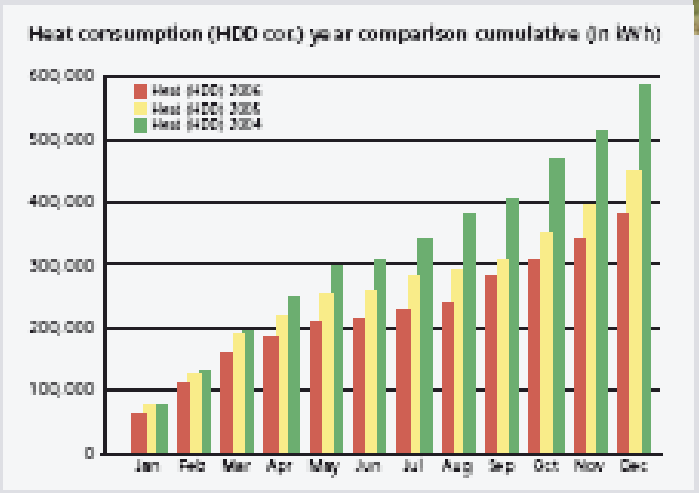
Siemens reference project:
Hospital in Belgium - Algemeen Stedelijk Ziekenhuis Aalst

SIEMENS

Measures taken :

- Set point values and time programs adjusted
- Optimized control of the heat exchangers, pumps and valves
- Implementation of an OSTP algorithm
- Improved control strategy for cooling generation and distribution





Result:
Energy reduction for
Heating (DGD adjusted)**:**
341’098 kWh → 35.7%
Electric:
295‘376 kWh → 15.8%
CO2: - 22%