

# The European GreenBuilding Programme

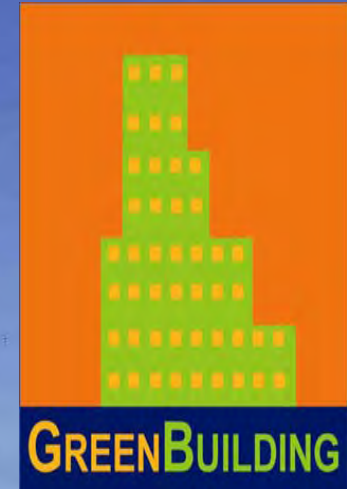
Evaluation 2006 – 2009

Paolo Bertoldi

European Commission DG JRC

Michaela Valentová

Czech Technical University in Prague



ACEEE 16 August 2010

- Voluntary programme, launched in 2005, managed by EC to trigger cost-effective investments in energy efficiency of non-residential buildings
- GBP main goal is to **stimulate “additional” cost-effective** energy efficiency and renewable energies projects in **non-residential** buildings to establish a markets for energy efficiency by the implementation of economically viable investments in energy efficiency
- 
- **Areas of action:** lighting, building shell, heating, office equipment, renewables, HVAC,



- Who can participate?
  - for existing buildings at least **25 % lower** consumption
  - for new buildings at least **25 % below** national requirements
- Benefits for the programme participants:
  - access to information, (technical) support for their energy efficiency actions, dissemination of their achievements, awards
  - Direct **financial** benefits by saving money and in most cases improving working conditions.
  - Indirect benefits resulting from the **growing attention** of consumers and investors.
  - Possibility to link the project to national **CO2 emission** reduction programme or other (Green/White certificates).
  - **Information** resources.
  - **Public recognition**/endorsement
- Benefits for the public administration
  - achievement of energy saving by deploying market forces and information, without strong intervention as in the case of regulation, shared goals with private sector



# GreenBuilding National Contact Points in 13 countries







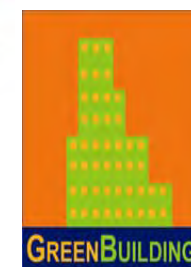
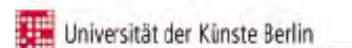
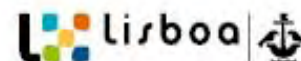
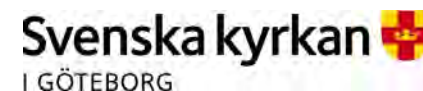
**JRC**  
EUROPEAN COMMISSION

# 167 Partners, 286 buildings (in 2009)

**ie**  
Institute for Energy

2010 ACEEE SUMMER STUDY IN ENERGY EFFICIENCY IN BUILDINGS

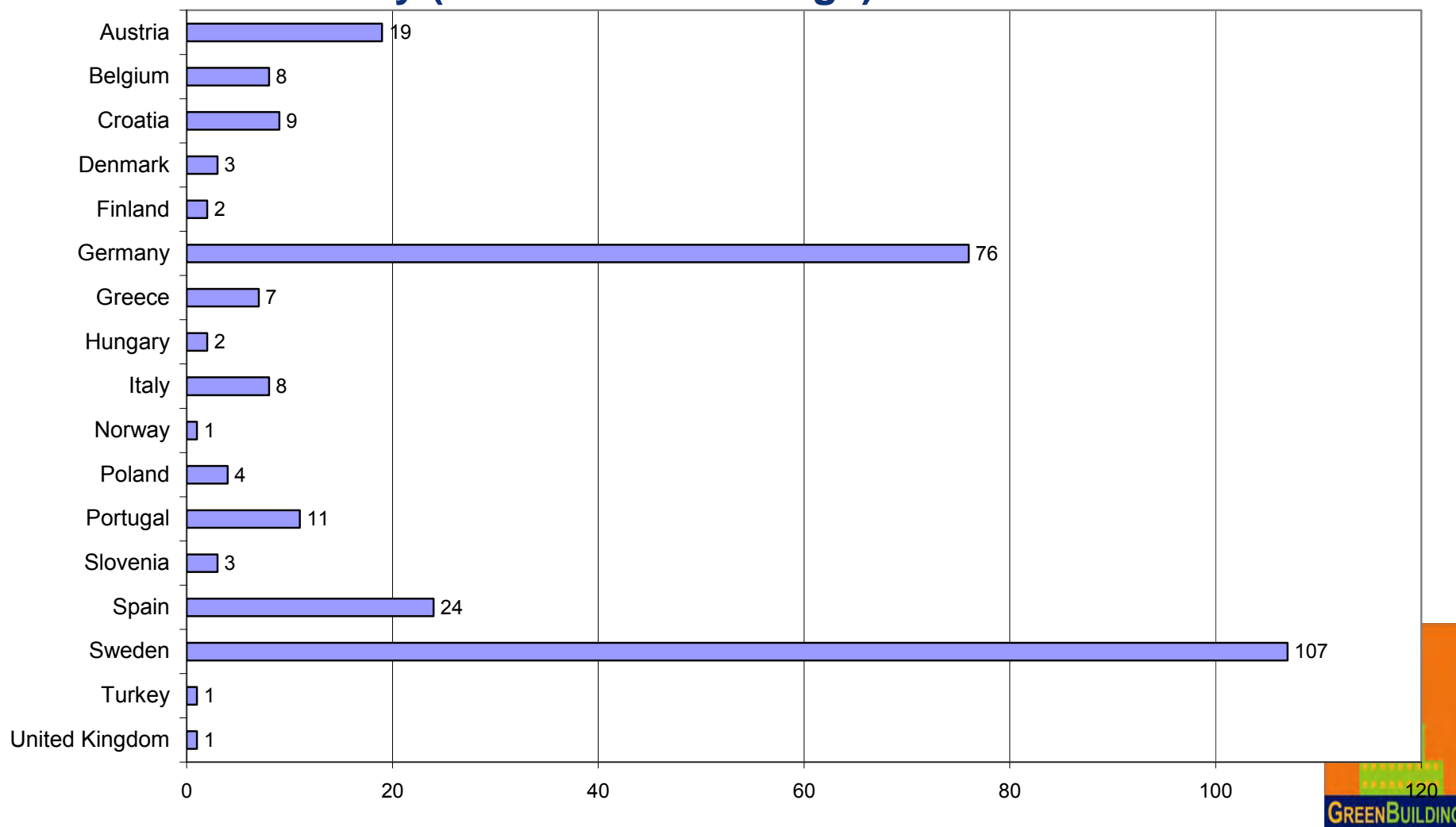
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286 GreenBuilding buildings:

- 37 % from Sweden (17 % of total savings)
- 26 % from Germany (40 % of total savings)

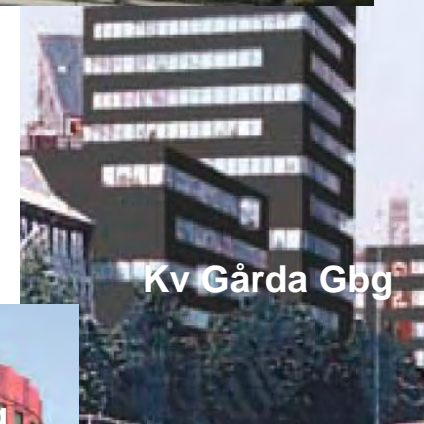




# There is a great interest for GreenBuilding in Sweden



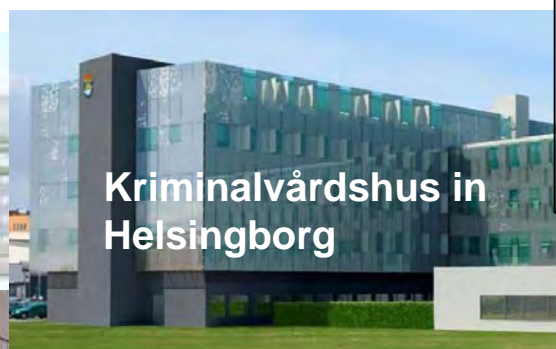
 **Skanska in Malmö**



**Kv Gårda Gbg**



**Kv Loen in Stockholm**



**Kriminalvårdshus in Helsingborg**



**Kuggen, Göteborg**



**NCCs Office in Malmö**



**Dockums in Malmö**



**Kv Pennfäktaren in Stockholm**





## Fastighets AB Brostaden

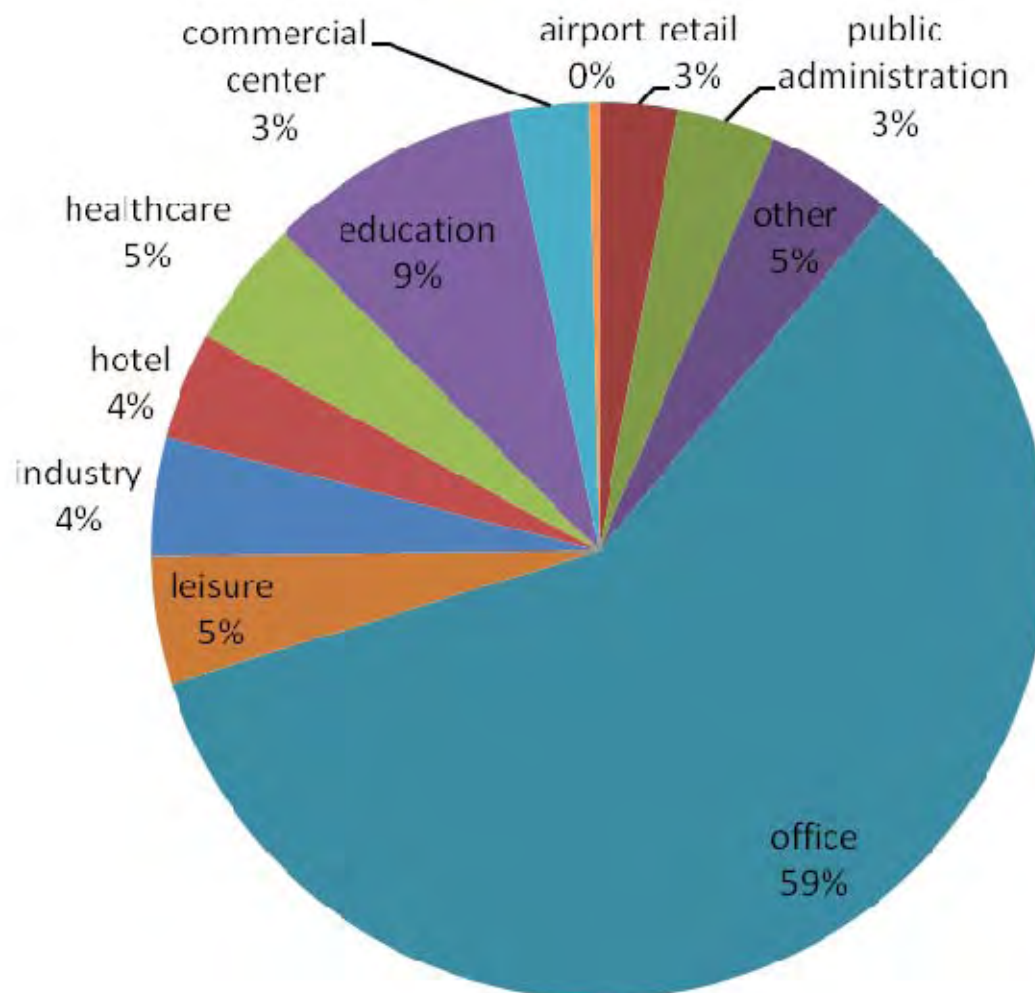
Sweden

**34 buildings  
refurbished**  
**38 % primary energy  
savings**  
**13 Million Kronor  
savings**



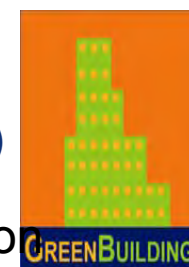
- 77 % private buildings, 23 % public buildings
- Average area is 15 500 m<sup>2</sup> (median 9000 m<sup>2</sup>)
- New buildings 44 % vs. 54 % refurbishments of existing buildings
- Existing buildings mostly built between 1960 and 1980
  - the oldest building in 1600
  - 9 buildings built before 1900



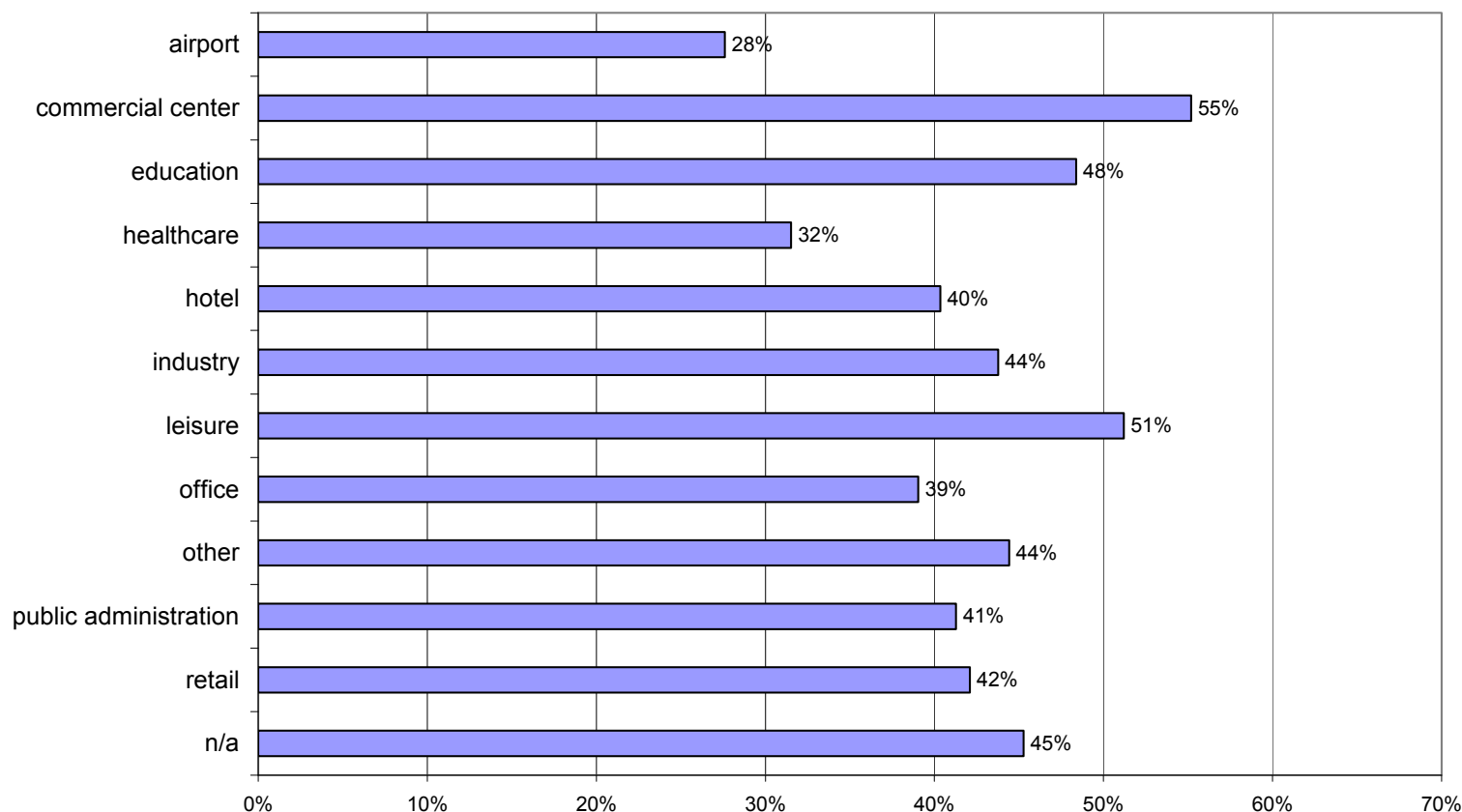


**Majority are office buildings (60 %)**

**“Other”:** e.g. church, technology centre, research institute, canteen, train station



- So far ca **304 GWh/year**
  - 12 GWh/year in one building
  - By 2020 this will have accumulated roughly to 3.3 TWh
- Savings of 41 % on average per building





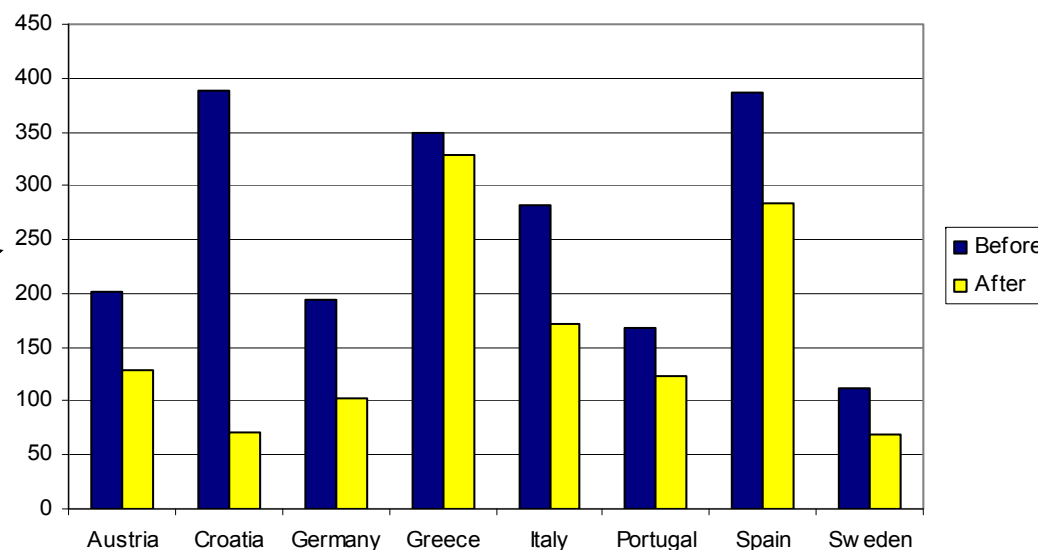


- Specific energy demand as one of the most important efficiency indicators
- Existing office buildings
  - Average **before** refurbishment: **150** kWh/m<sup>2</sup>.y
  - Average **after** refurbishment: **65** kWh/m<sup>2</sup>.y
- New office buildings
  - Average **reference** consumption **170** kWh/m<sup>2</sup>.y (or 184 kWh/m<sup>2</sup>.y including one extreme value)
  - Average **real** consumption: **100** kWh/m<sup>2</sup>.y

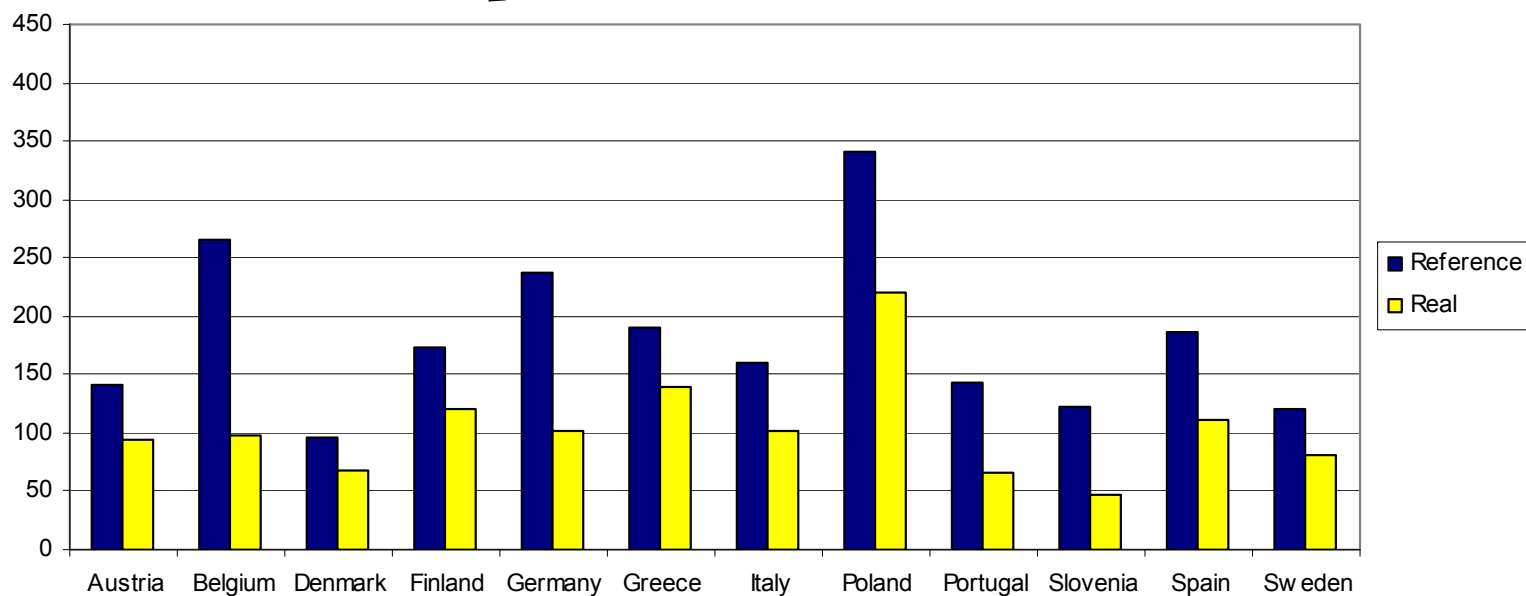


## Specific energy demand in offices (in kwh/m<sup>2</sup>.y)

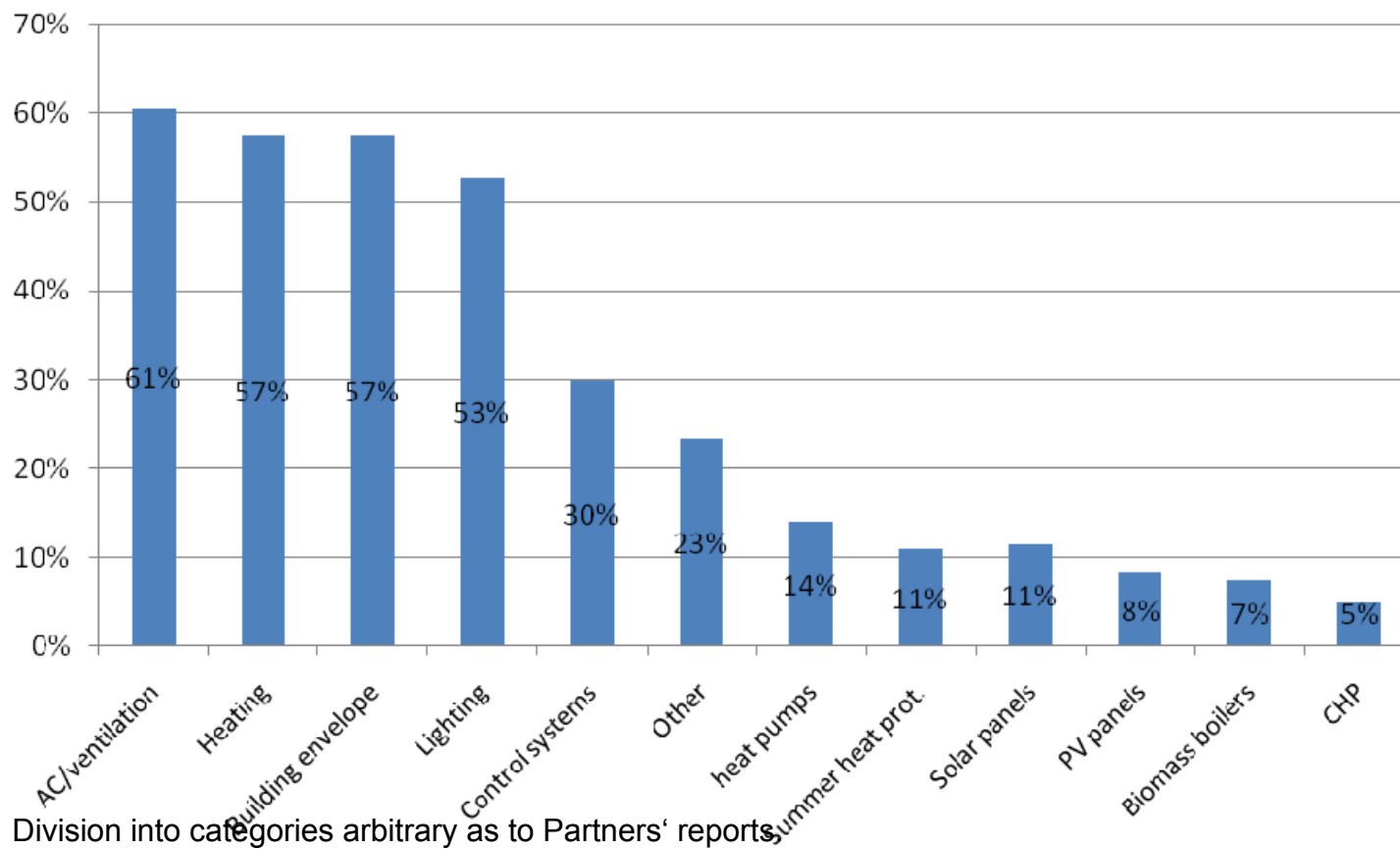
Existing buildings



New buildings



- Most common measures are HVAC, building envelope, lighting
- Heating in 85 % cases (“heating” in graph specifically means reconstruction of the distribution systems, etc)

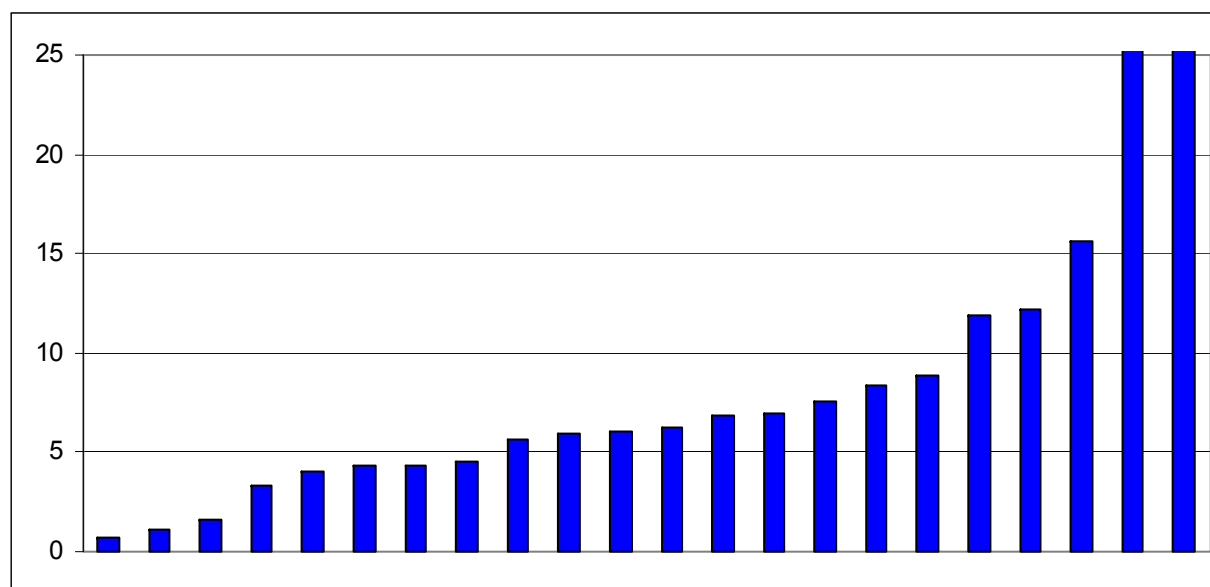


- **Heating:** thermoregulation valves, heat pumps (14%), district heating (specially in Germany and Sweden) – also from CHP, 7 % switch to biomass
- **AC/V** – heat recovery (more than 90 % efficiency), proper dimensioning of pumps and fans (frequency regulators), optimization of the systems
- **Building envelope** – scope differs from total insulation of the building to only featuring some parts of the envelope
  - Specifically, summer heat protection popular
- **Lighting** – because short pay backs, some Partners only focused on lighting.
- **RES** – biomass in heating, PV (8%), solar panels (11%)
- **Other** – energy efficient appliances, staff awareness raising, water consumption savings





- Economic effectiveness of the projects as one of the prerequisites to become a GBP
- Large variations between the projects
- On average the CCE is 0.21 EUR/kWh
- Median payback – 6.3 years (several extreme values make the average 9.6 years)



- The GBP requires that participating companies adopt an **Energy Management plan** and an **Energy Policy**, which reflects the company values.
  - Energy Management is closely linked to **Energy audits** as often said “you cannot manage what you don’t know you’ve got”.
- GBP also supports and promotes “good” Energy Managers, performance contracting and the ESCOs industry
- GBP creates awareness for important practices such as **M&V, energy audit, continuous maintenance, commissioning, “Green” procurements, Life Cycle Costing**



- GBP is well appreciated among the Partners and has been successful over its four year operation
- Yet, wider promotion is needed across relevant stakeholders.
  - GBP can serve as the benchmarking tool and in the same time promote the Partners and their achievements to the general public
- Wider publicity of the Programme will help to achieve its main goal: promotion of energy efficiency among building owners

## Benefits of Green Building Program as reported by a Partner

- Reduces our impact on environment
- Increases property value
- Improves operating income by approximately 1.8 M € / year
- Creates interest and focus on real estate technology
- Increases employees' knowledge of the properties
- Gives us more satisfied tenants
- Makes it easier for us to communicate environmental issues
- Increases brand value





Thank you for your attention.

**For further information:**

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Website:

<http://re.jrc.ec.europa.eu/energyefficiency/greenbuilding/index.htm>



## Best Refurbishment Projects

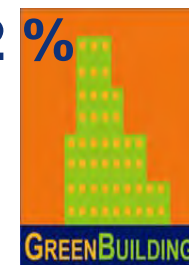
### Office Building Manschein



**GreenBuilding Partner:**  
**Siegfried Manschein  
GmbH**

**Austria**

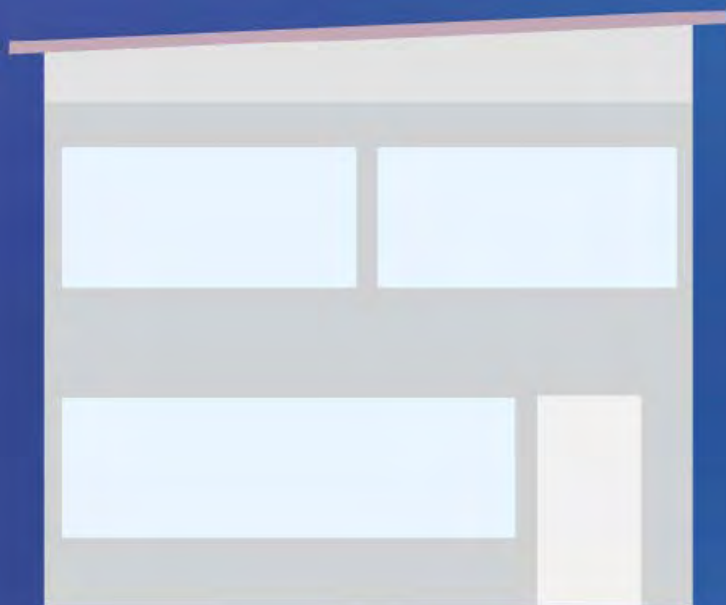
**Savings:**  
**Heating demand: 86 %**  
**Primary energy  
consumption: 82 %**







## EXISTENCE BUILDING



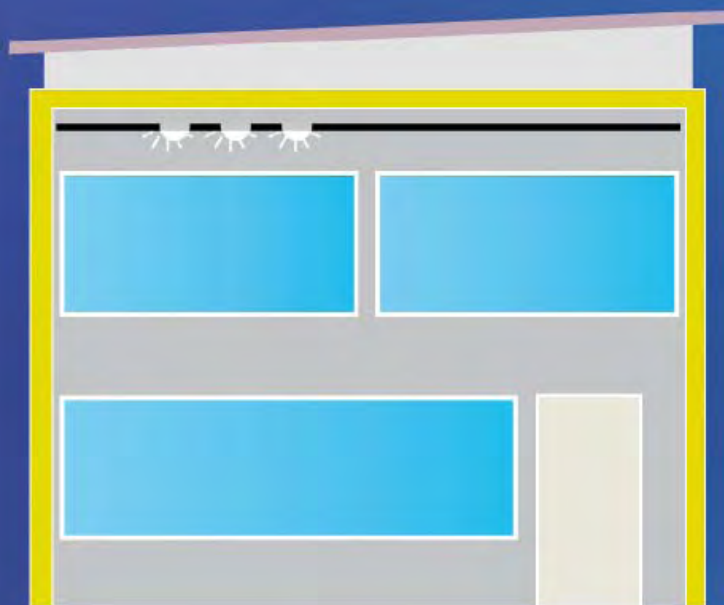
## CONSUMPTION







## LOW ENERGY BUILDING



## CONSUMPTION

[KWh/a]

100.000

75.000

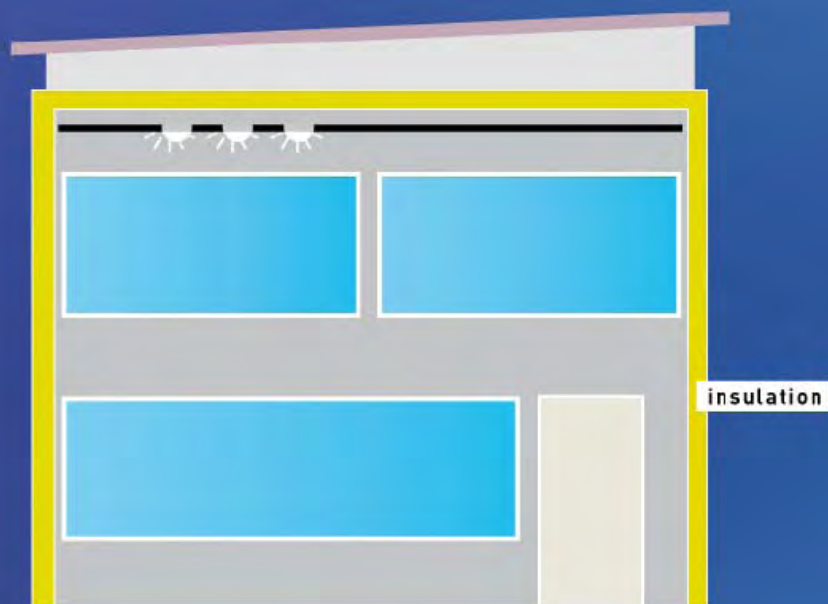
50.000

25.000



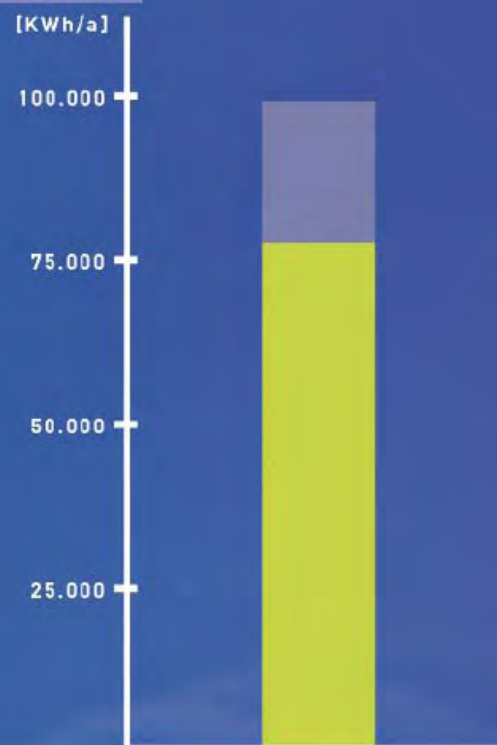


## LOW ENERGY BUILDING



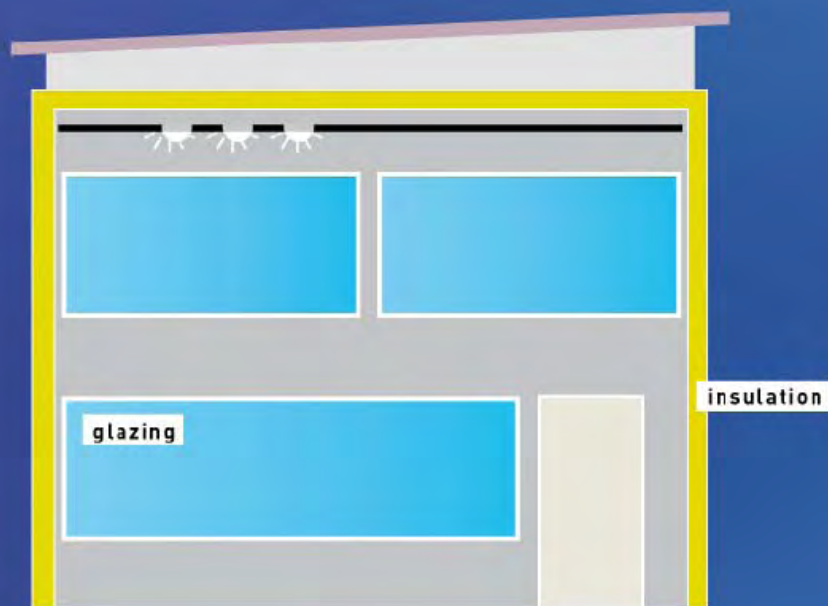
## CONSUMPTION

[KWh/a]





## LOW ENERGY BUILDING



## CONSUMPTION

[KWh/a]

100.000

75.000

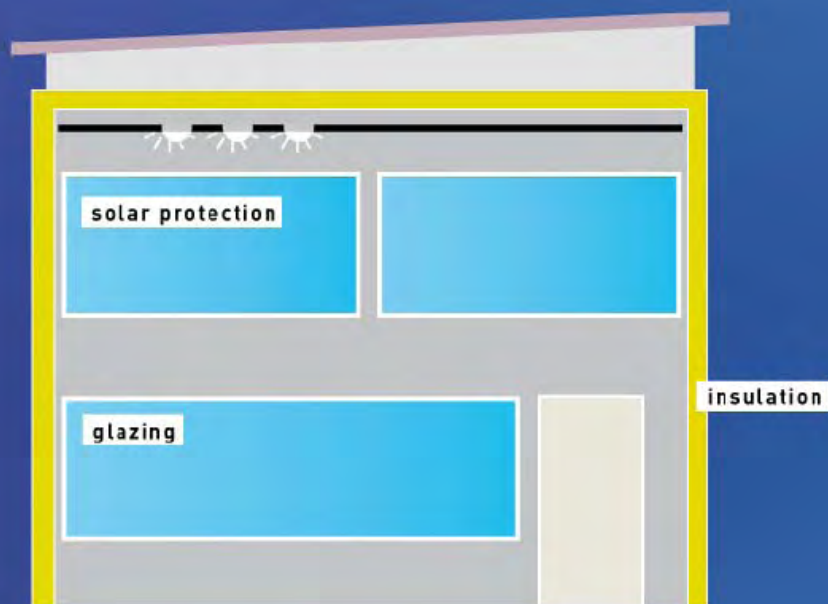
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25.000





## LOW ENERGY BUILDING



## CONSUMPTION

[KWh/a]

100.000

75.000

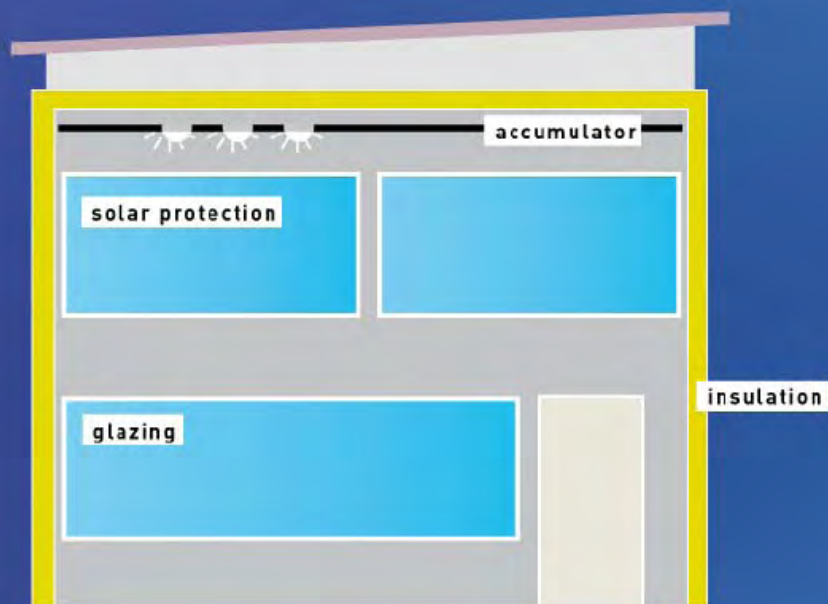
50.000

25.000





## LOW ENERGY BUILDING



## CONSUMPTION

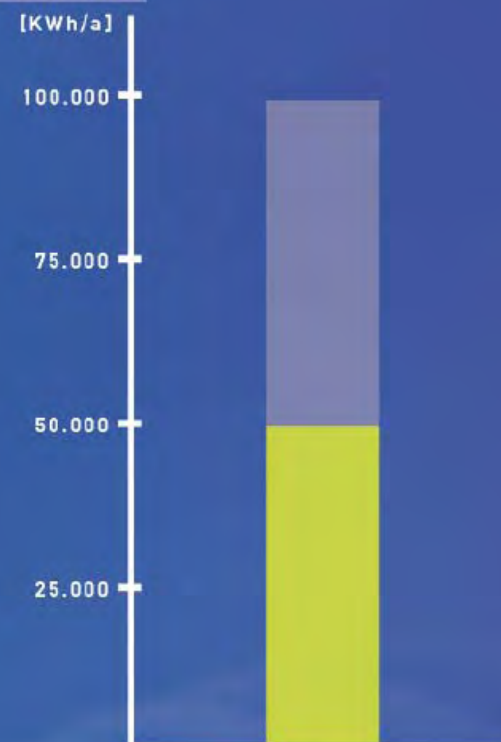
[KWh/a]

100.000

75.000

50.000

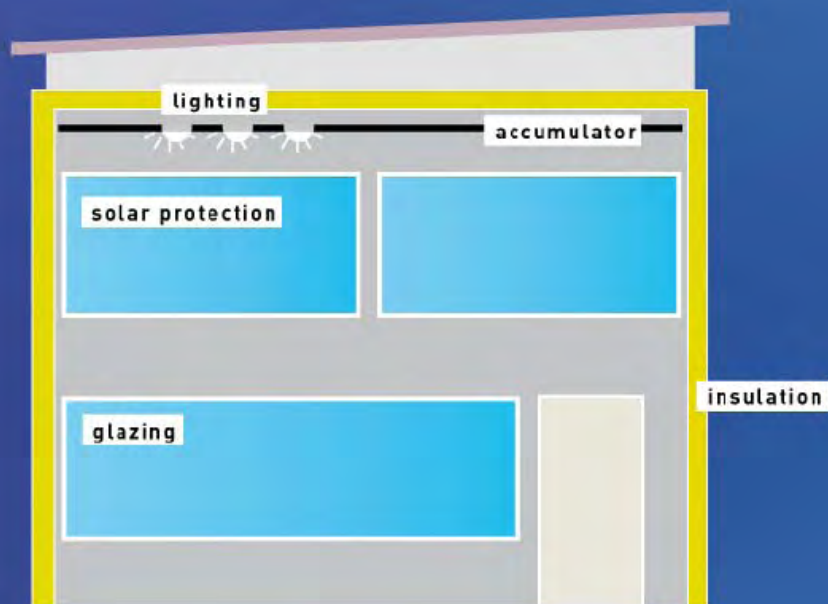
25.000







## LOW ENERGY BUILDING



## CONSUMPTION

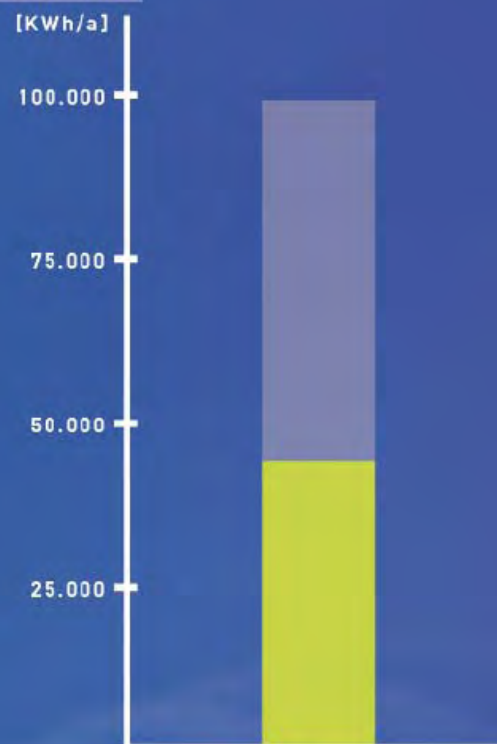
[KWh/a]

100.000

75.000

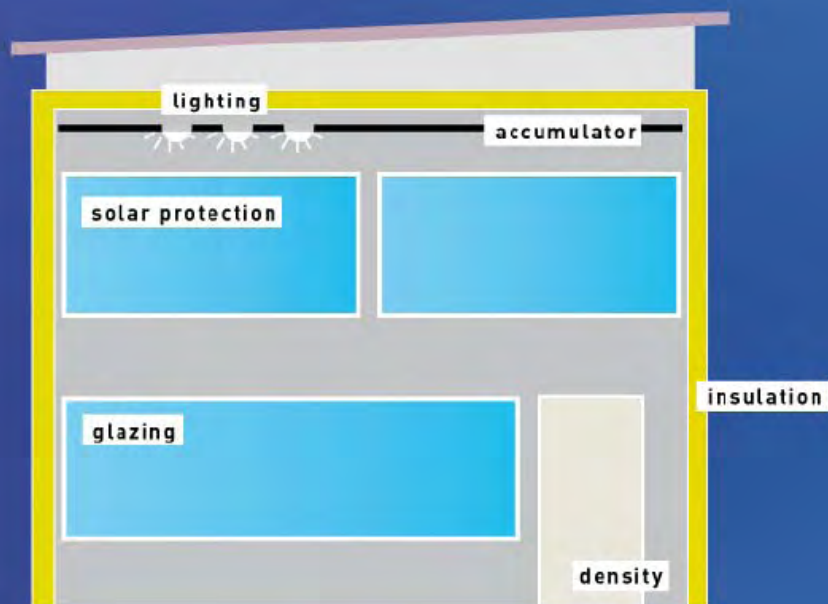
50.000

25.000

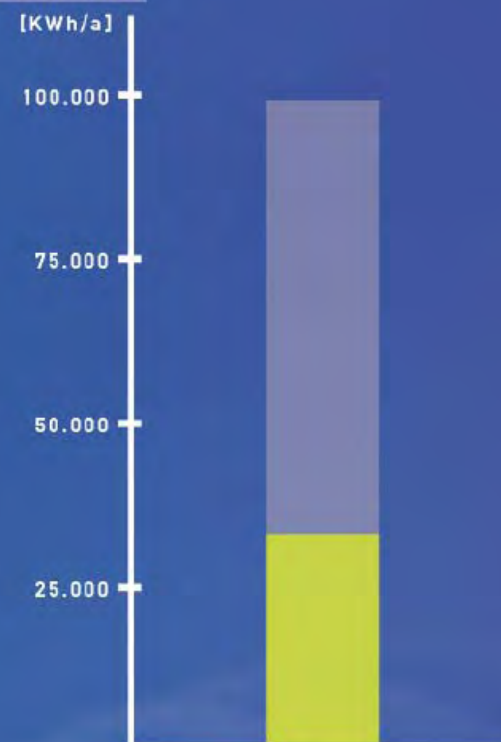




## LOW ENERGY BUILDING

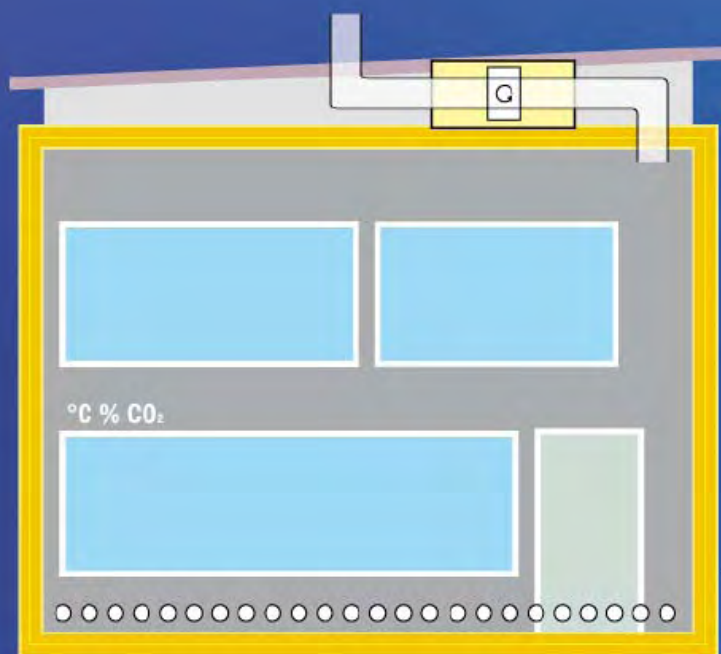


## CONSUMPTION





WINTER



CONSUMPTION

[KWh/a]

100.000

75.000

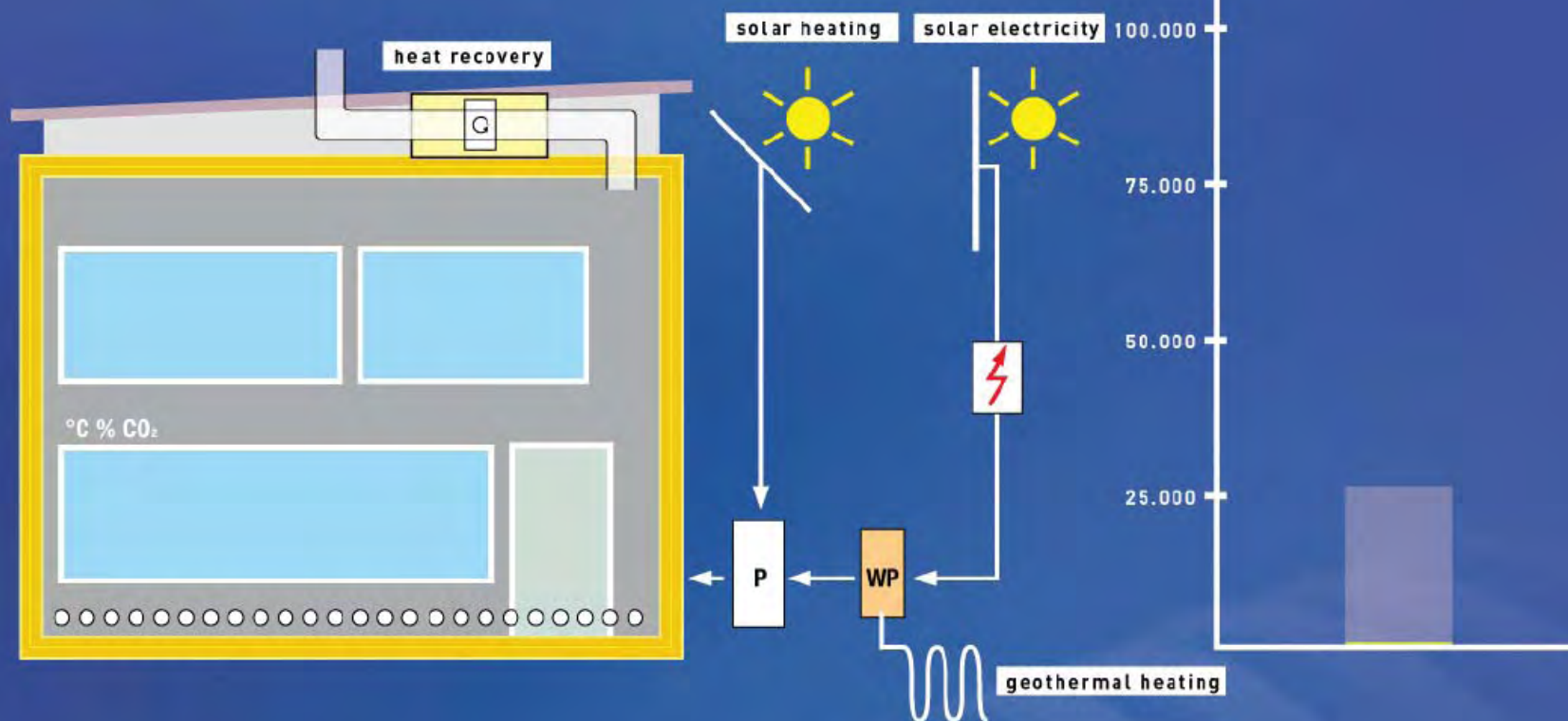
50.000

25.000





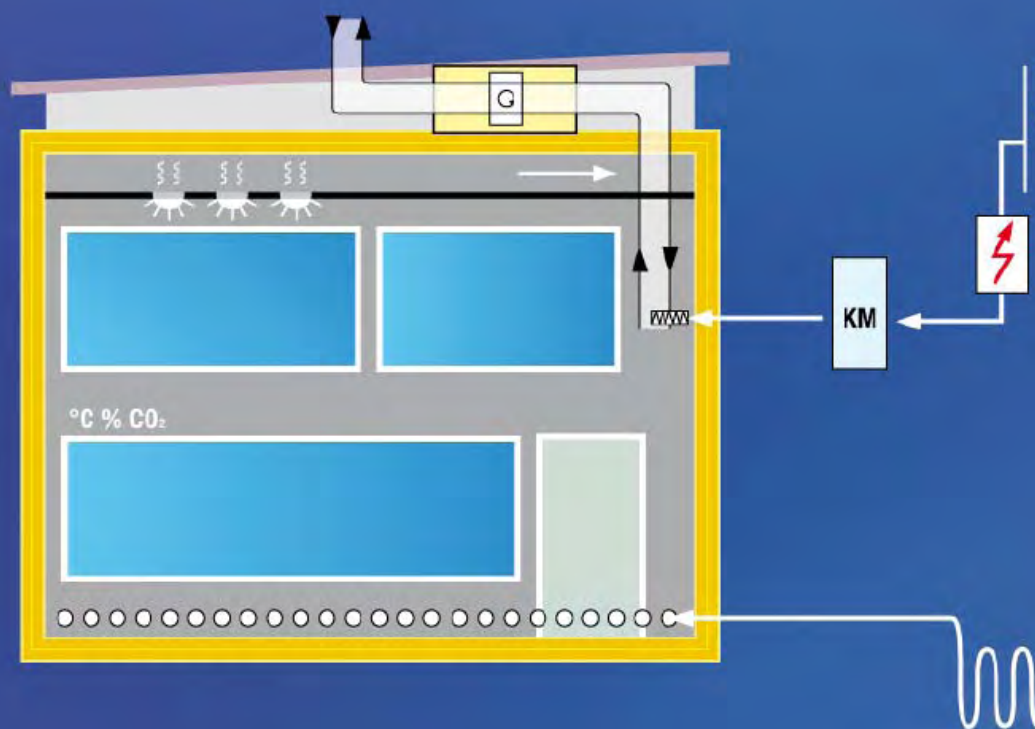
WINTER







SUMMER



CONSUMPTION

[KWh/a]

100.000

75.000

50.000

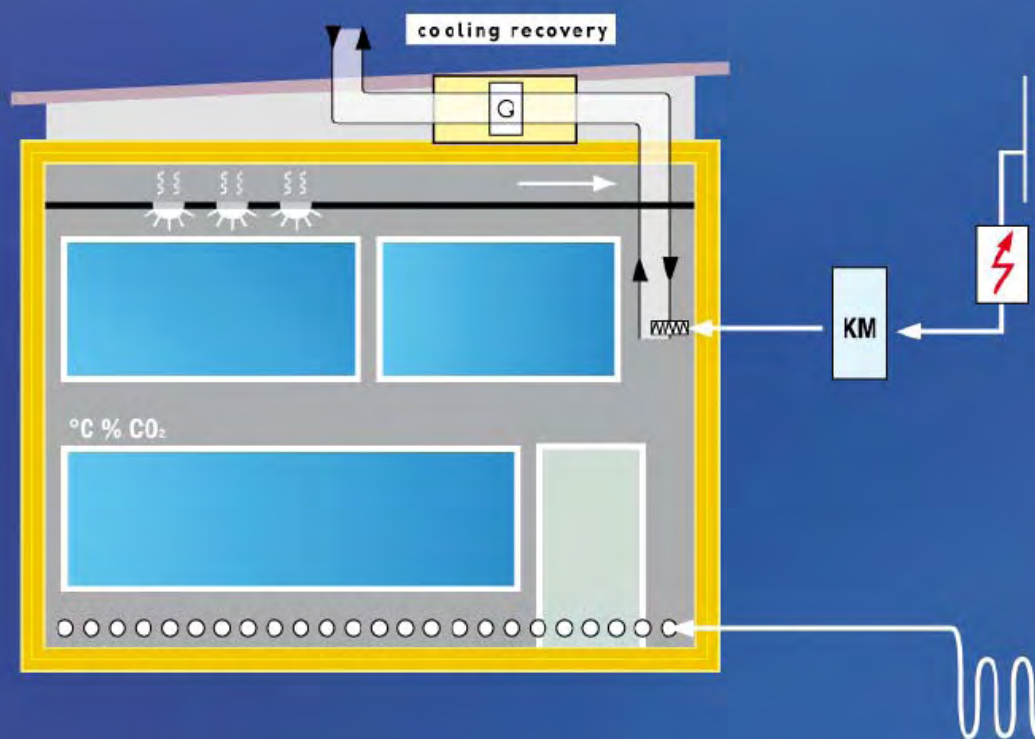
25.000

0





SUMMER



CONSUMPTION

[KWh/a]

100.000

75.000

50.000

25.000

0

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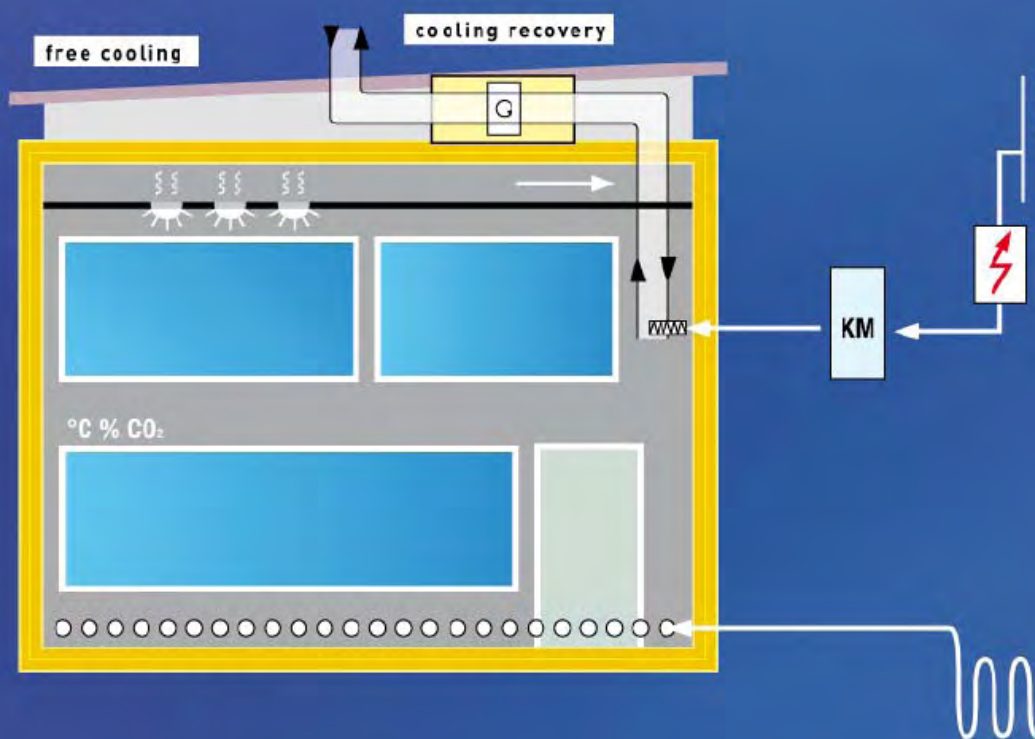
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SUMMER



CONSUMPTION

[KWh/a]

100.000

75.000

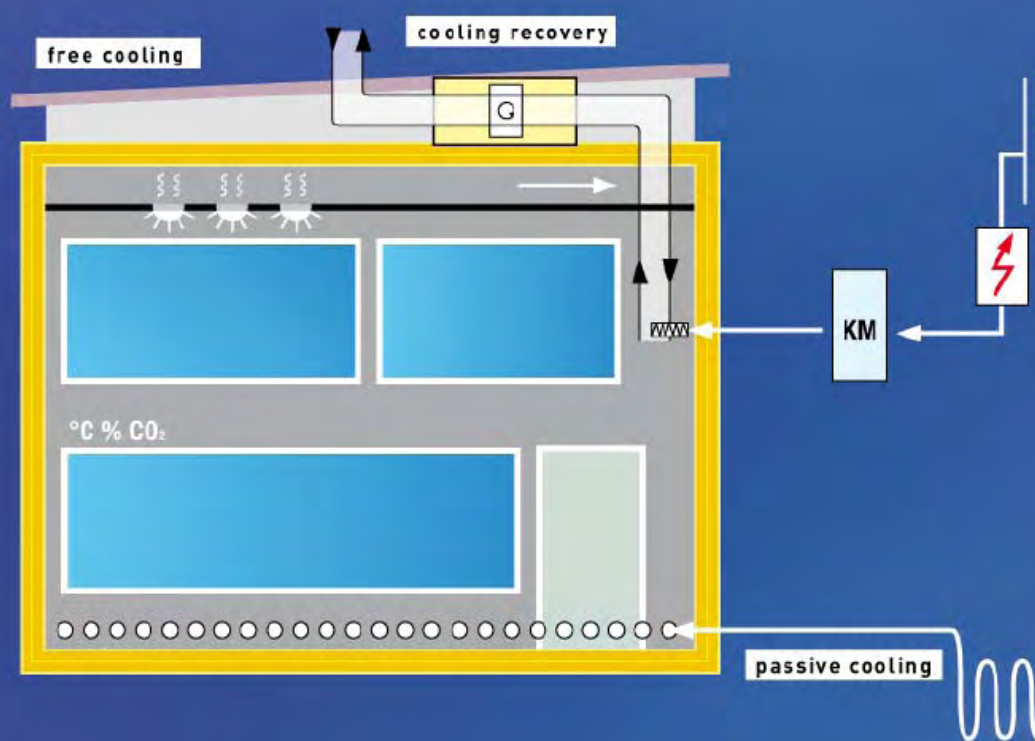
50.000

25.000





## SUMMER



## CONSUMPTION

[KWh/a]

100.000

75.000

50.000

25.000

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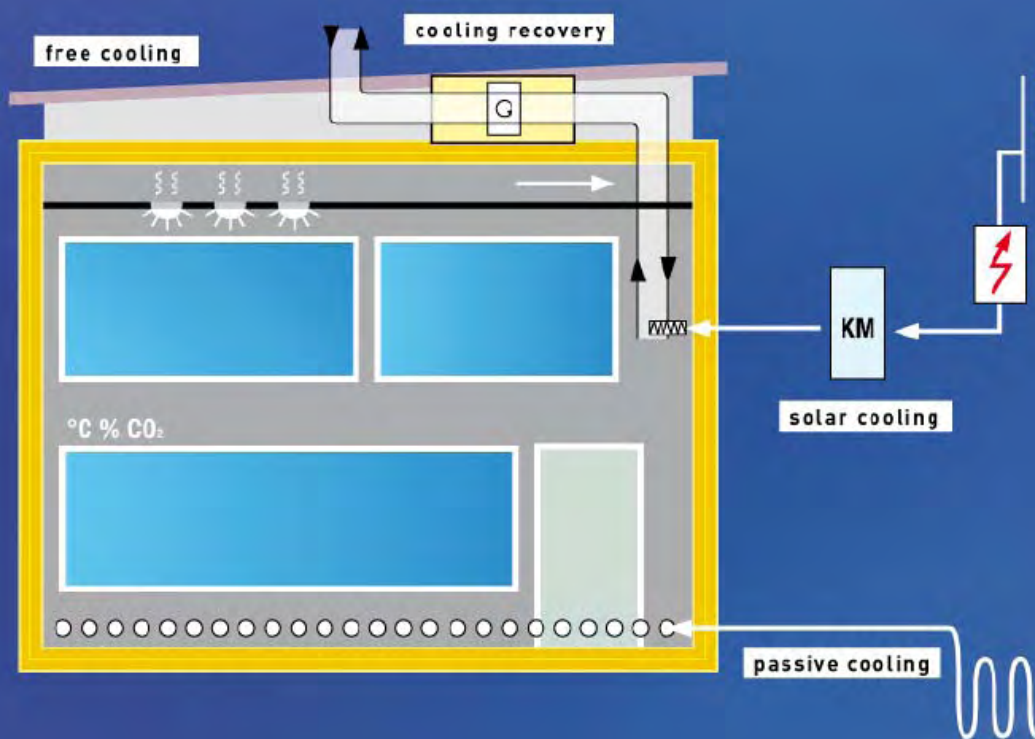
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SUMMER



CONSUMPTION

[KWh/a]

100.000

75.000

50.000

25.000

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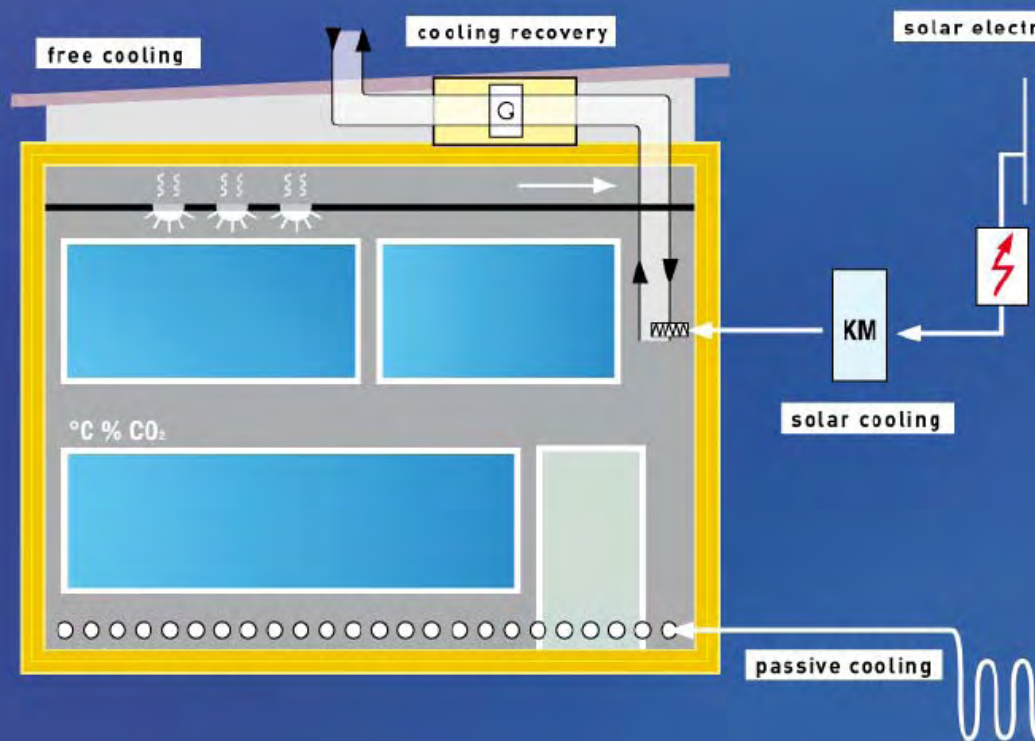
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SUMMER



CONSUMPTION

[KWh/a]

100.000

75.000

50.000

25.000





## Best Refurbishment Projects

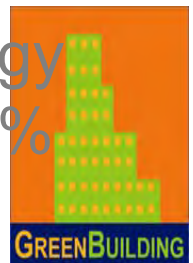


Secondary School  
Hengersberg

**GreenBuilding** Partner:  
Hauptschulverband  
Hengersberg

Germany

Savings:  
Primary energy  
demand: 81 %



## Existing building:

Secondary school, erected : 1967 - 69

Heated net floor area: 2936 m<sup>2</sup>

Number of pupils: 290

Fuel consumption total: 1.086.671 kWh/y

Fuel consumption/ m<sup>2</sup>: 370 kWh/m<sup>2</sup>y

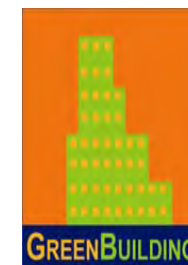
Heating production: gas/oil boiler 580 kW





## measures - building envelope

- | - measures                                       | U-value (W/m <sup>2</sup> K) |
|--|------------------------------|
| - wall insulation, 30 cm, 1930 m <sup>2</sup> :  | 0,100                        |
| - roof insulation, 50 cm, 2500 m <sup>2</sup> :  | 0,070                        |
| - floor insulation, 16 cm, 2500 m <sup>2</sup> : | 0,150                        |
| - elimination of thermal bridges                 |                              |
| - windows, triple-glazing, 953 m <sup>2</sup> :  | 0,700                        |
| - airtight construction :                        | n 50 ≤ 0,6                   |
| - mobile external shading, automatic/manual      |                              |



## measures - building envelope

### - measures U-value ( $\text{W/m}^2\text{K}$ )

- wall insulation, 30 cm, 1930  $\text{m}^2$ :  
0,100

- roof insulation, 50 cm, 2500  $\text{m}^2$ :  
0,070

- floor insulation, 16 cm, 2500  $\text{m}^2$ :  
0,150

- elimination of thermal bridges

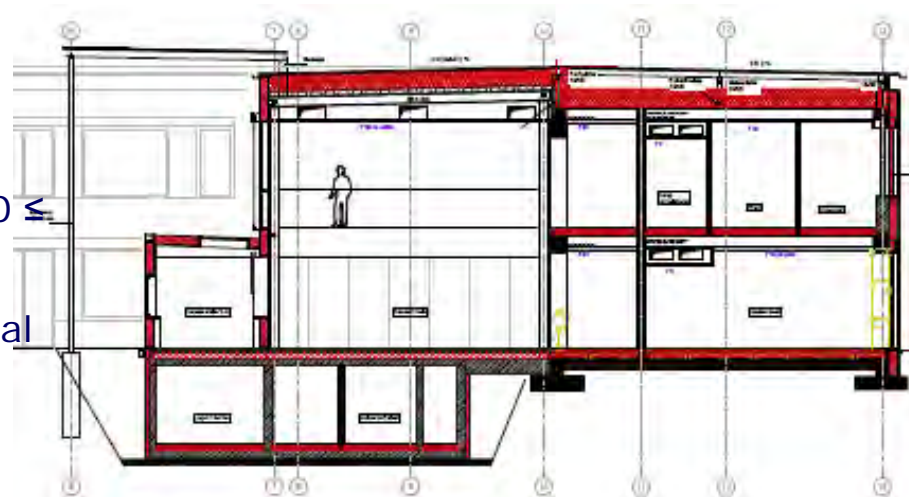
- windows, triple-glazing, 953  $\text{m}^2$ :  
0,700

- airtight construction:  
0,6

- mobile external shading, automatic/manual

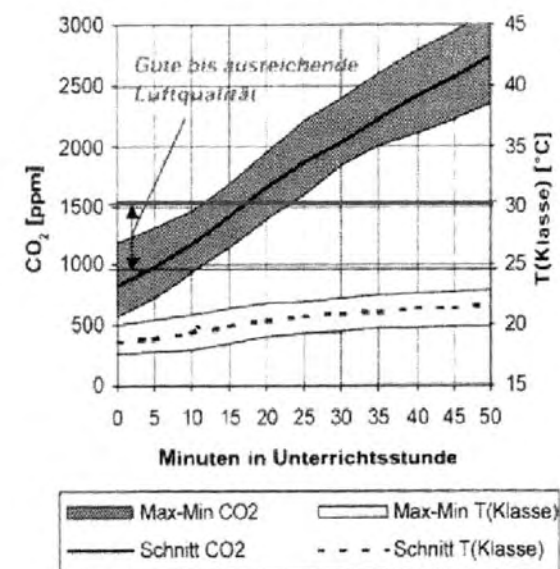


$n \leq 50$



## measures – plant systems

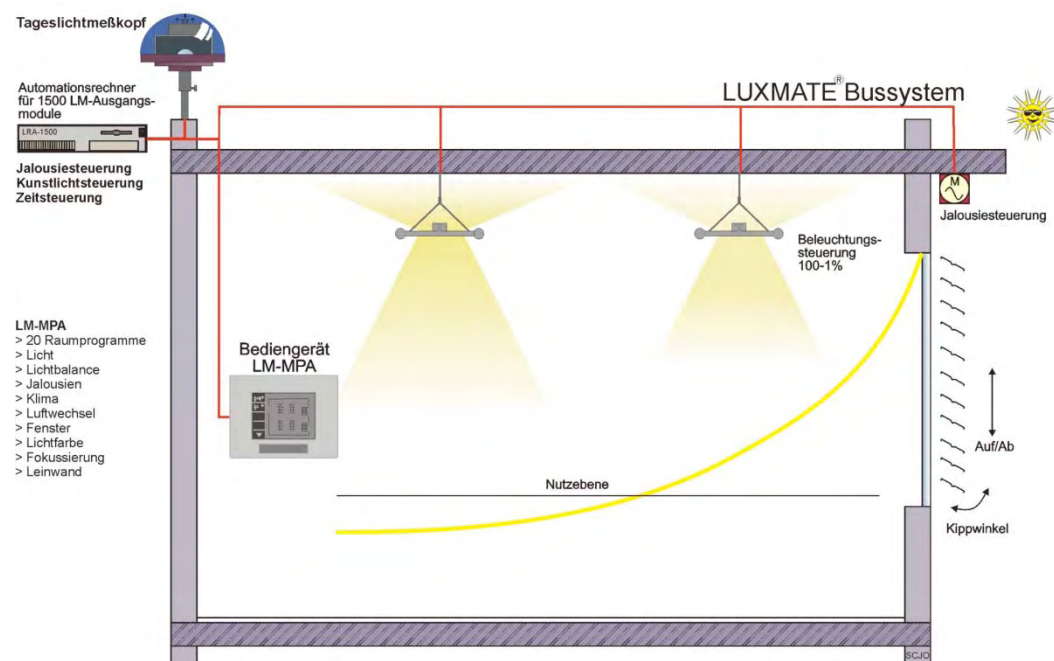
- heating plant, biomass boiler, wood 150 kW
- solar thermal plant 28 m<sup>2</sup>
- ventilation system, heat recovery: 92 %





## measures – plant systems

- mobile external shading as daylight system, automatical /manual
- daylight controlled lighting



## After renovation:

First phase completed by: Jun. 2010

Totally completed by: Dec. 2011

Heated net floor area: 3.560 m<sup>2</sup>

Number of pupils: 290

U-value building envelope: 0,179 W/m<sup>2</sup>K

Fuel consumption total: 75.160 kWh/y

Fuel consumption/ m<sup>2</sup>

(primary energy): 21 kWh/m<sup>2</sup>y

Biomass boiler: 150 kW

Saving heating energy:  
93 %

Electric consumption: 11,6 kWh/m<sup>2</sup>y

Saving electric consumption: 38%

Complete new image



West-elevation



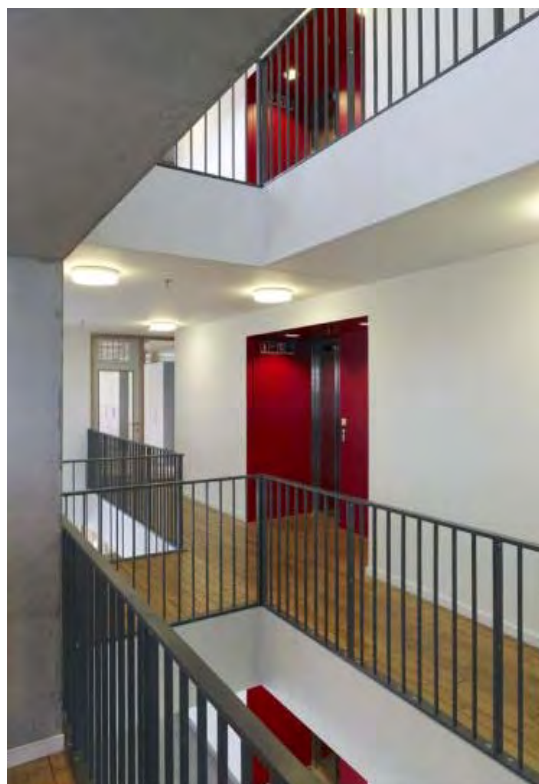
East-elevation



South-elevation



## Best New Projects



### Port of Ghent Office

**GreenBuilding** Partner:  
Haveenbedrijf Gent agh

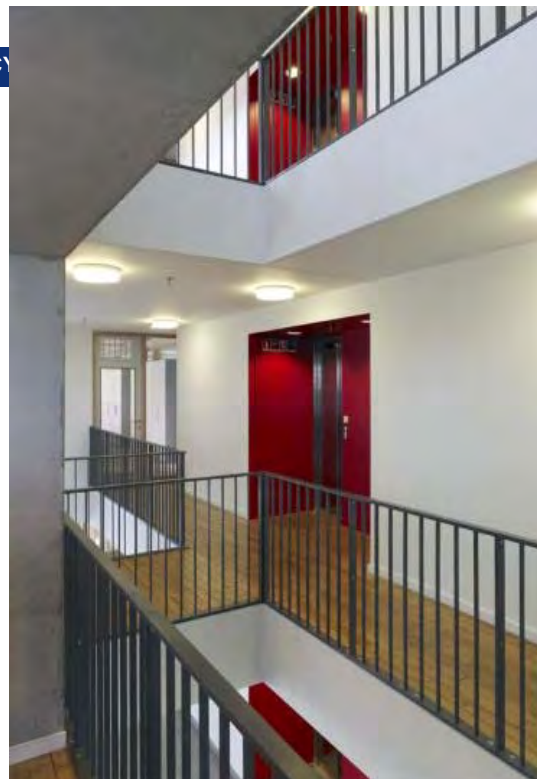
Belgium

Savings:  
Primary energy  
demand: 67 %

(compared with Belgian building code)



## Port of Ghent office



GreenBuilding Partner	Port of Ghent
Building type	office building
Location	Ghent, Belgium
Year/period of construction	2006
Year/period of refurbishment	-
Building area	1800 m <sup>2</sup> (net floor area)
Points quantitative criteria	74% of maximal score*

c2



## Slide 48

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**c1**

NB = new building

RB = refurbished building

AT = country code

01 = number within the country (there can be two nominees per country for both new and refurbished buildings)

csp, 1/7/2010

**c2**

Please add kind of area

csp, 1/7/2010





<b>Energy indices</b>	92 kWh primary/m <sup>2</sup> a, E34
<b>Energy savings and basis of calculation</b>	The primary energy demand is 67 % lower than the Belgian (Flemish) building code (i.e. E100)
<b>Building envelope</b>	<p>First Belgian office with passive house certificate, thus:</p> <ul style="list-style-type: none"> <li>- U-value: 0,28 W/m<sup>2</sup>K (very good insulation of the building envelope e.g. wall insulation of 25-30 cm and roof insulation &gt; 30 cm)</li> <li>- very airtight building envelope</li> </ul> <p>Via mobile external sunshading, ground tube and night cooling combined with high thermal mass a good summer comfort can be realised without active cooling.</p>
<b>Building services - HVAC</b>	<p>Mechanical Ventilation with heat recovery</p> <p>Condensation boiler for pre-heating air, no radiators (passive house)</p>

## Slide 49

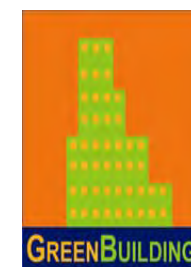
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c3

eg. heating demand/m<sup>2</sup>, final energy demand/m<sup>2</sup>, primary energy demand/m<sup>2</sup>, final energy consumption/m<sup>2</sup>  
Please indicate which energy indices you use - see example.

csp, 1/7/2010

<b>Renewable energy</b>	Ground tube
<b>Other measures</b>	<div>c4</div> Use of daylight, shading and regulation of lighting Energy efficient lighting
<b>Energy management</b>	Monthly monitoring of energy consumption
<b>Replication and innovation</b>	<ul style="list-style-type: none"> <li>- Innovative: first 'passive' office in Belgium. Nominated for Belgian architecture and energy price for non-residential Buildings (2007)</li> <li>- Highly replicable cost-effective passive house building concept</li> </ul>



## Slide 50

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c4

Please indicate which energy index you use and delete the use you do not use.

csp, 1/7/2010

## Best New Projects



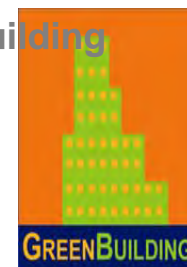
### Office ENERGYbase

**GreenBuilding** Partner:  
WWFF Business and  
Service Center GmbH

Austria

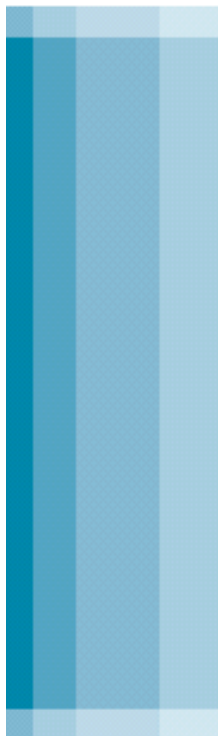
Savings:  
Heating energy  
demand: 72 %

(compared with Austrian building  
code)



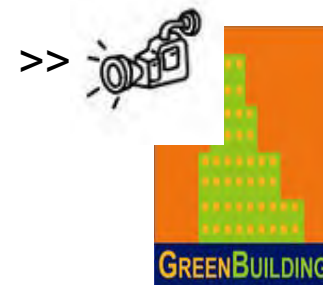


## energy efficiency – renewable energy – wellness at work

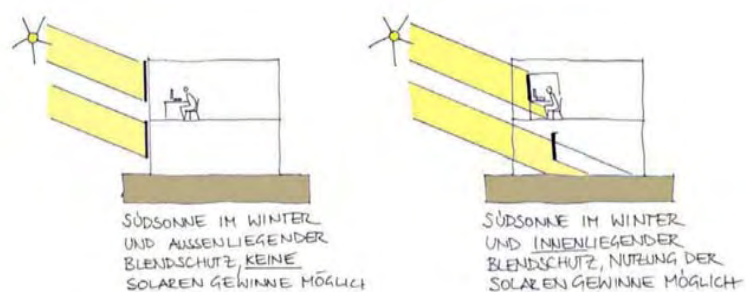


## Key Facts ENERGYbase .....

- **offered space** – 7.500 sqm lettable floorspace
  - 1.300 sqm for study program
  - 1.000 sqm for research laboratory
  - 5.200 sqm for office use
  - 65 parking lots
- **costs** –
  - total investment 14.5 Mio. €
  - subsidies: Interreg III A, BM VIT Haus der Zukunft, PV Förderung der Stadt Wien

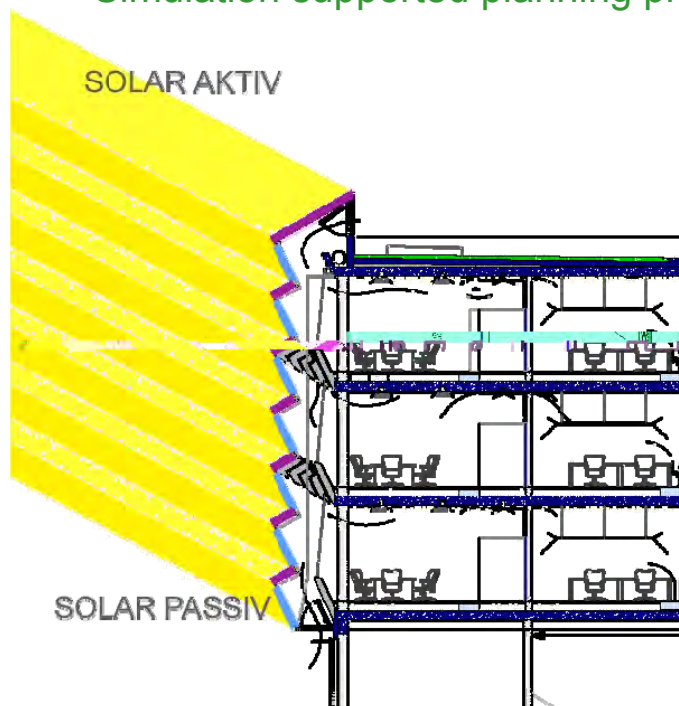
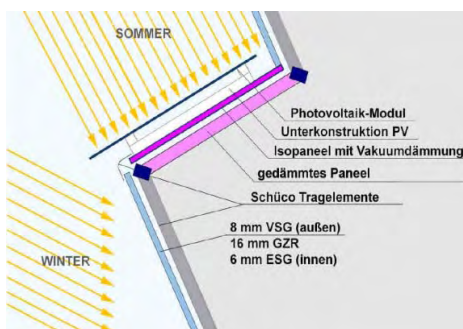


## FORM FOLLOWS ENERGY



- Close integration of the building and energy concept
- Optimization with the use of solar profits
- Simulation supported planning process

## South facade as a solar generator



## ENERGYbase – how it works .....

- **Heating:**
  - concrete core heating via ground water and heatpump
  - Integration of a solar thermal unit
- **Cooling:**
  - Free Cooling with concrete core cooling via ground water
  - Solar Cooling
- **Ventilation:**
  - controlled ventilation and deaeration with heat recovery
  - during winter air conditioning system with specials plants
- **Photovoltaics:**
  - 400 sqm photovoltaic unit integrated in the south facade
- **Solar:**
  - 300 sqm of thermal collectors integrated in the south facade
- **Building envelope:-** The building envelope is designed in passivhouse standard which means a maximum of isolation
  - heat energy demand < 15 kwh/m<sup>2</sup>a
  - mixed construction with concrete and wood
  - windows with triple glazing





## ENERGYbase – what it needs .....

• heat energy demand:	9,89 kwh/m <sup>2</sup> a
• cooling energy demand:	5,78 kwh/m <sup>2</sup> a
• lightning:	7,10 kwh/m <sup>2</sup> a
• hot water:	2,20 kwh/m <sup>2</sup> a
<u>total:</u>	<u>24,97 kwh/m<sup>2</sup>a</u>
<u>costs/m<sup>2</sup>/month:</u>	<u>0,20 €</u>





## concept photovoltaics ENERGYbase – Form follows Energy

### South facade ENERGYbase:

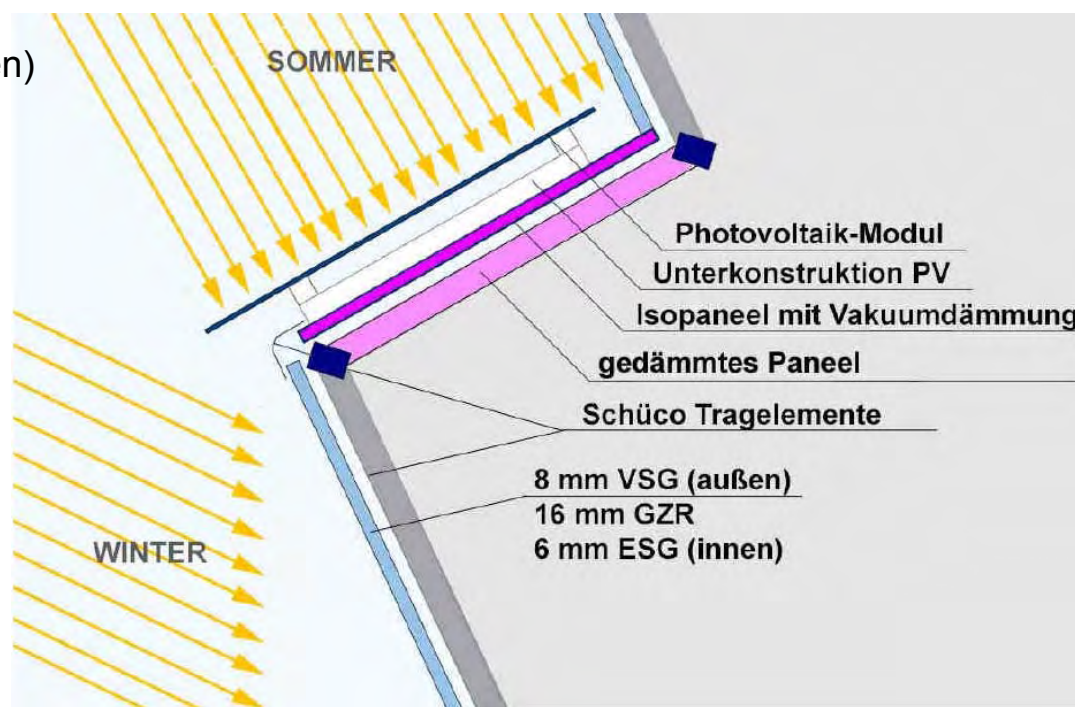
- angle PV-panels:  $31,5^\circ$  (zur Horizontalen)
- angle glazing:  $63,4^\circ$  (zur Horizontalen)

### Summer:

- aktive use of solar energy with PV
- shading the building's inside

### Winter:

- aktive use of solar energy with PV
- passive use of solar energy für heating



PV-Module 31,5°

Glazing 63,4°

ENERGYbase facade – normal vertical facade

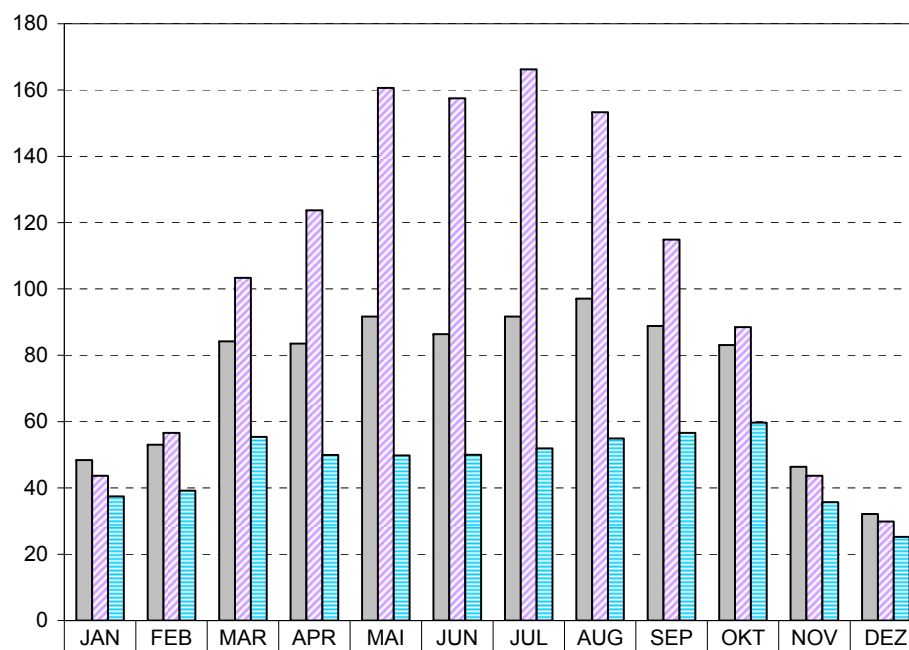
# Building-integrated photovoltaics

Solarenergie auf die Modulfassade im Vergleich zu einer vertikalen Fassade  
(je m<sup>2</sup> Fassadenfläche)

- reducing the solarenergy on the glazing during summer
- maximising the solarenergy on the pv modules



kWh/m<sup>2</sup>



	JAN	FEB	MAR	APR	MAI	JUN	JUL	AUG	SEP	OKT	NOV	DEZ
vertikale Südfassade	48	53	84	84	92	86	92	97	89	83	46	32
PV_Panel	44	57	103	124	161	158	166	153	115	89	44	30
Verglasung	37	39	55	50	50	50	52	55	57	60	36	25