



# QAiST

Quality Assurance in Solar Heating  
and Cooling Technology

## Solar Heating in Building Renovation or Retrofitting

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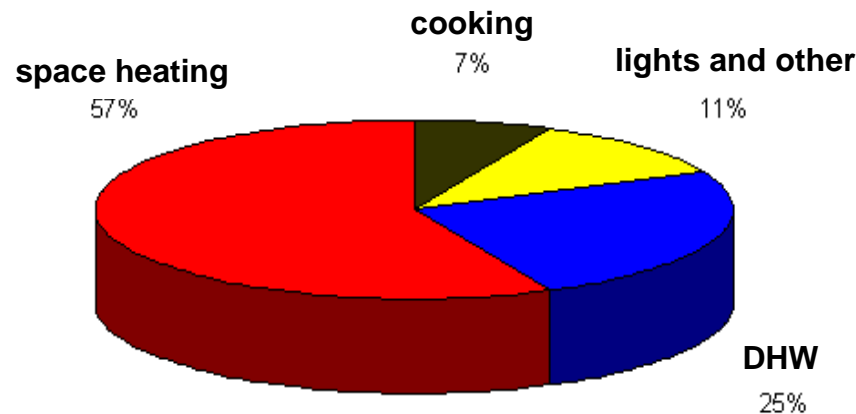
2<sup>nd</sup> International Conference – Solar Energy in Romania  
Bucharest, November 25<sup>th</sup>, 2010

# Outline

- Building renovation and retrofitting
- Passive usage of solar energy
- Active solar systems
- Integrative concepts with examples
- Conclusions

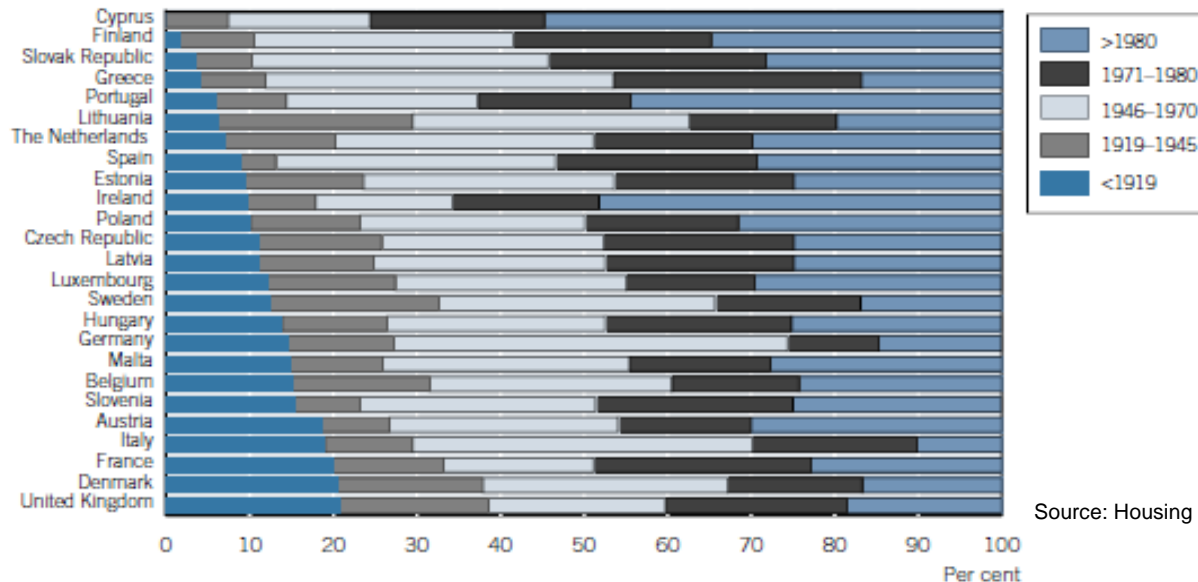
# Energy consumption in residential buildings

- Energy consumption of the buildings in Europe is ~40% of total energy end use
- Buildings in Europe account for ~36% of total anthropogenic CO<sub>2</sub> emissions



# Residential building structure in the EU

- Significant part of the energy consumption caused by buildings built 1946-1980
- Poor energy efficiency especially in multi-dwelling buildings from this period



Source: Housing statistics in the EU, 2004

# Energy policy

- EU energy policy target is to cut emissions to 20% below 1990 level by 2020
- The EPBD directive sees a development towards nearly zero energy for new buildings by 2020
- Usage of renewable energies has to be increased
- For existing buildings the member states have to draft proposals on increasing the number of low energy buildings on national levels
- Renovation plays an important role in reaching the energy targets
- By strengthening the energy performance directive, a 70% of the current EU Kyoto target could be achieved
- Additionally, ~300€ per household and year can be saved on energy costs – cost effectiveness

# Sustainable renovation

- Increasing the comfort of life
- Limiting overall energy consumption and especially consumption of non-renewables
- Limiting drinking water consumption
- Increasing the water resources
- Limiting the production of waste
- Limiting the consumption of territory and other resources

Source: Advanced and sustainable housing

# Solar energy use in renovation and retrofitting

- Improvement of the building envelope to significantly reduce the energy demand
- Usage of passive solar measures to decrease the energy consumption and improve the living comfort
- Usage of active solar thermal and PV to increase the renewable energy fraction of the total energy consumption
- Usage of PV to offset non-renewable energy use

# Passive solar measures

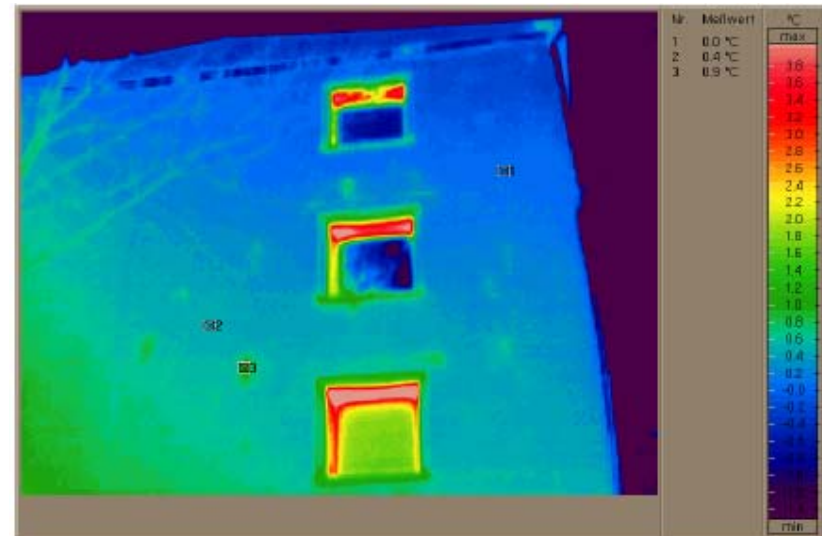
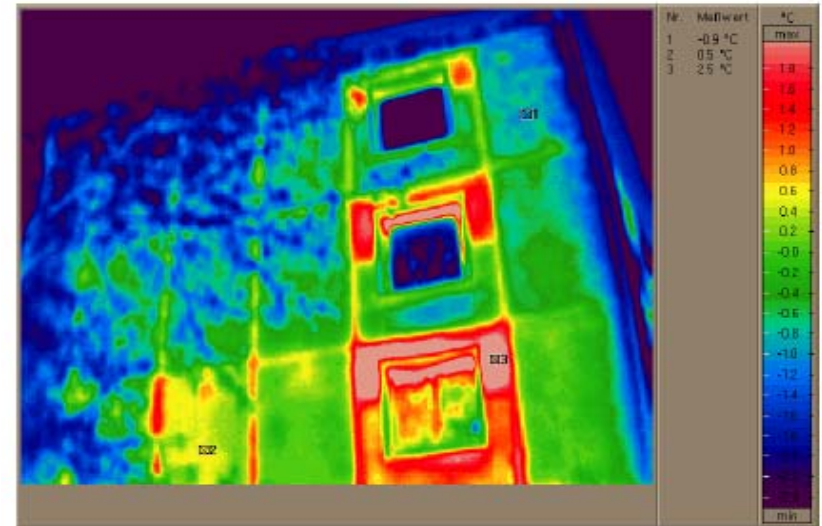
- Reduction of heating energy demand by passive solar gains
- Reduction of artificial lighting demand
- Improvement of living comfort: visual, acoustic
- No increase of cooling demand in summer if all measures (shading, construction etc.) optimally applied!





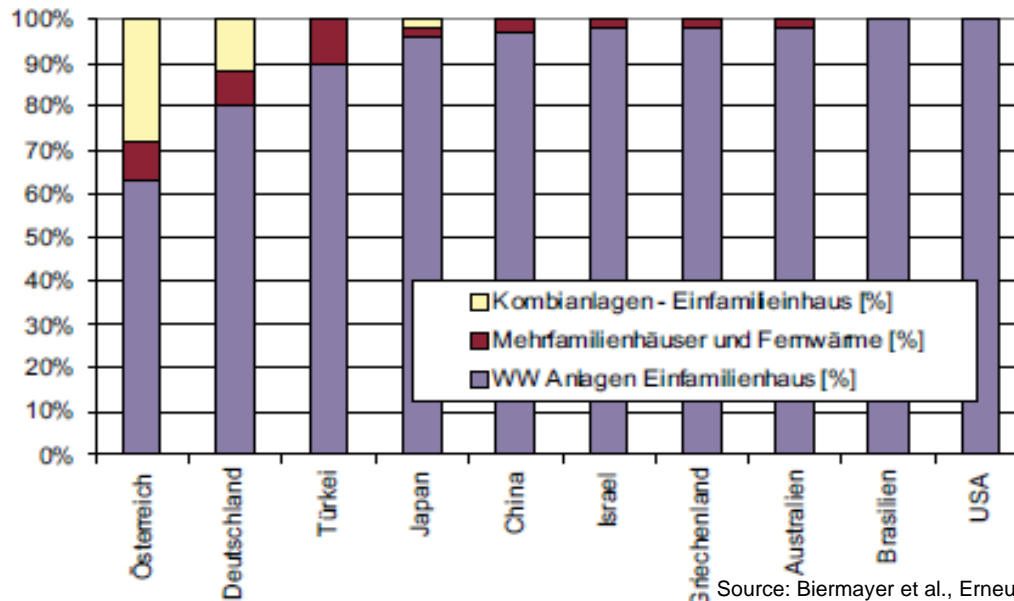
# Building envelope

- Improvement of the building envelope significantly reduces the heating energy demand and allows lower supply temperatures
- Better insulation and airtightness allows lower supply temperatures -> solar fraction increases



# Active solar systems

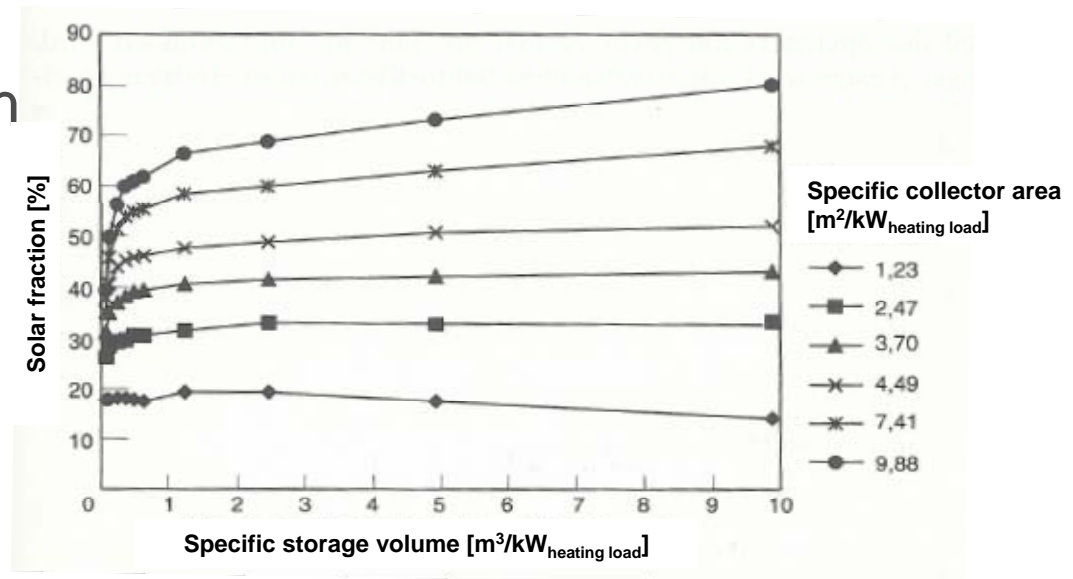
- Most of the current systems designed for DHW only
- Solar combi systems have been a clear trend in the recent years



Source: Biermayer et al., Erneuerbare Energie in Österreich – Marktentwicklung 2007

# Design parameters

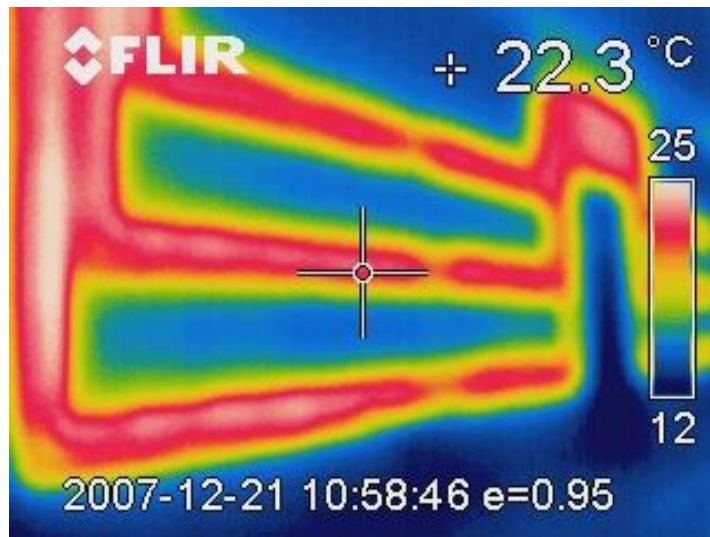
- Due to given boundary conditions, the system layout has to meet a number of constraints
  - Available area for collectors
  - Room for storage
  - Distribution system



Source: Marko, Braun - Thermische Solarenergienutzung an Gebäuden, Springer 1997

# Solar thermal for heating

- Solar fraction also varies due to the distribution system – low temperature systems favorable
- For retrofit buildings, wall heating sometimes more convenient



Source: [www.ib-strunz.de](http://www.ib-strunz.de)




Source: Haustechnik Horstkampf

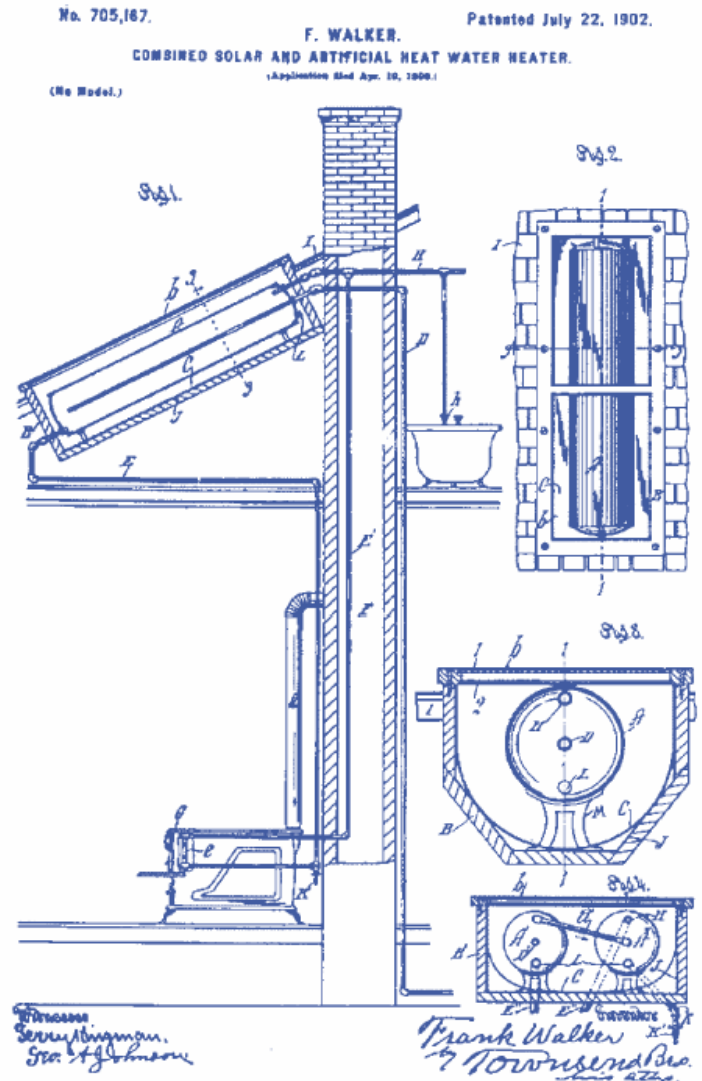
# Solar thermal for heating

- In most cases a cost-effective solution is a combination of a solar heat generator and a storage tank
- Heat Patent 1902 stems from a solar thermal system for the renewal of hot water
- For a sustainable solution, solar thermal systems should be used

**Climax Solar-Water Heater**  
 UTILIZING ONE OF NATURE'S GENEROUS FORCES  
**THE SUN'S HEAT** (Stored up in Hot Water for Baths, Domestic and other Purposes.)



\$25

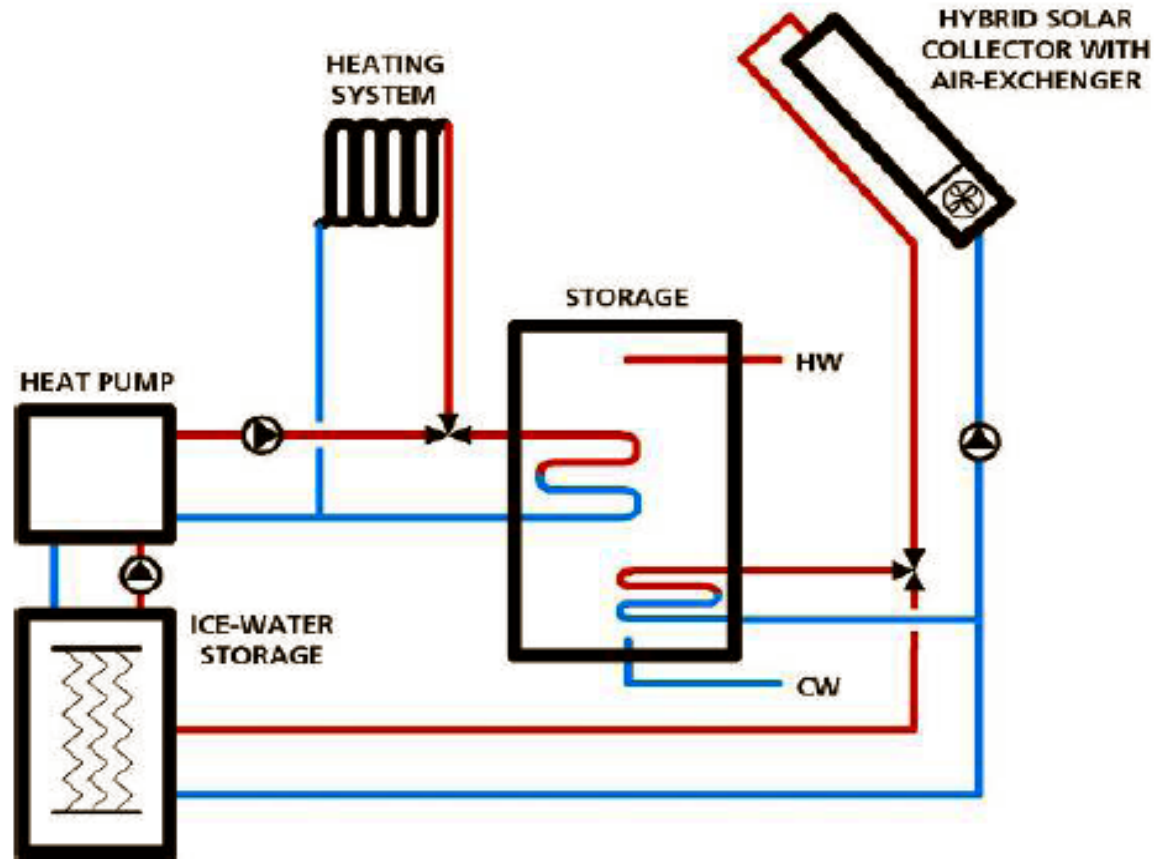
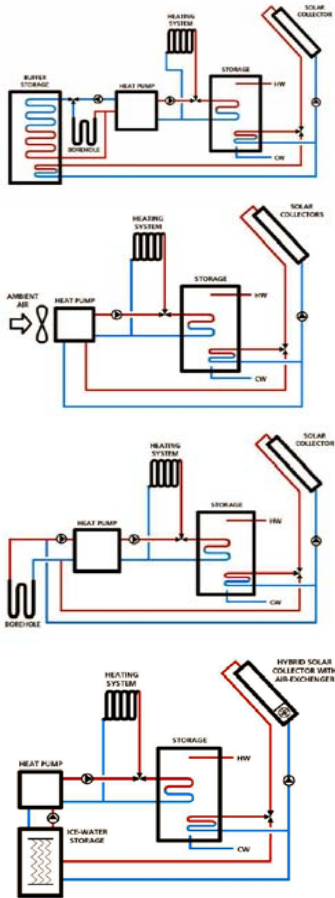




# Solar thermal and heat pump

- Synergies through integration
- Increase of heat pump source temperature
  - direct
  - indirect
- Heat pump mostly for heating -> better COP
- Lower temperatures from collector can be used
  - increase in solar fraction
- Higher collector efficiency due to lower supply T
- Defrosting with solar heat -> better COP

# Solar thermal and heat pump



# Solar thermal and heat pump

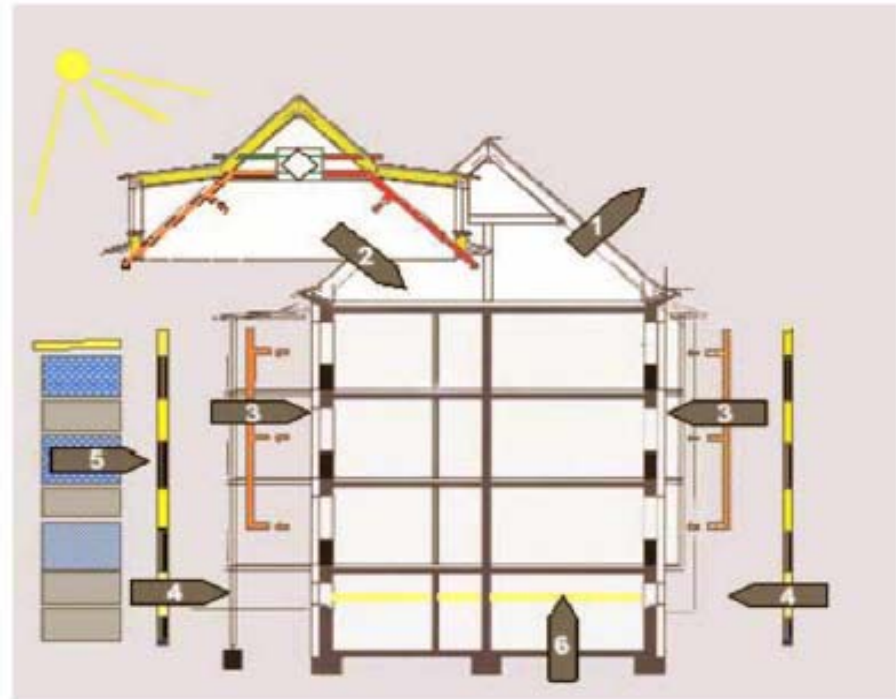
- Interesting for retrofit because:
  - Allows less intervention on the property (e.g. ground collectors)
  - Can improve the efficiency of the air-source heat pump (easy installation)





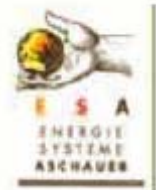
# Renovation with prefabricated elements

- Old vs. new concept



# Integrated passive elements

- Apartment building complex in Graz, Austria
- Work done under IEA ECBCS Annex 50



# Integrated passive elements

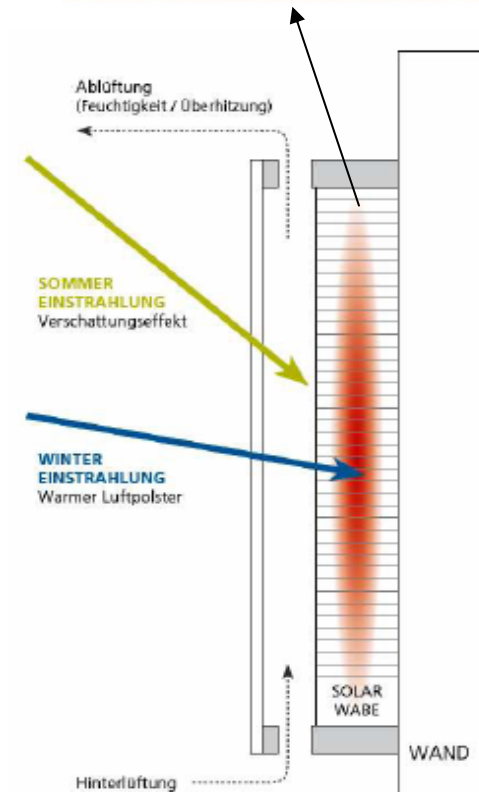
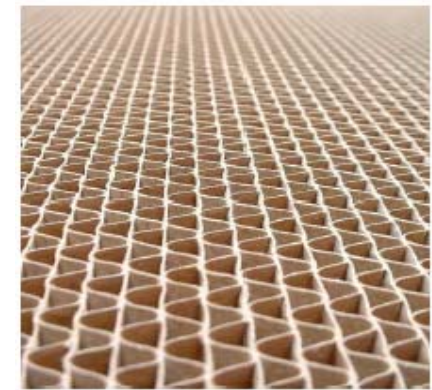
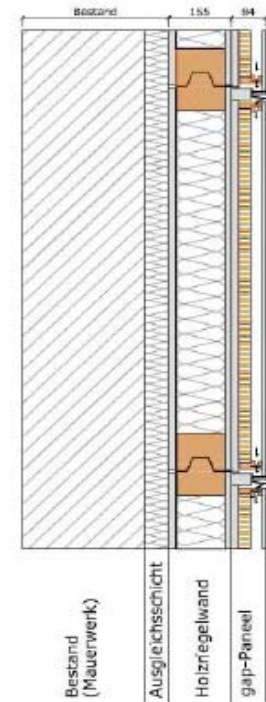
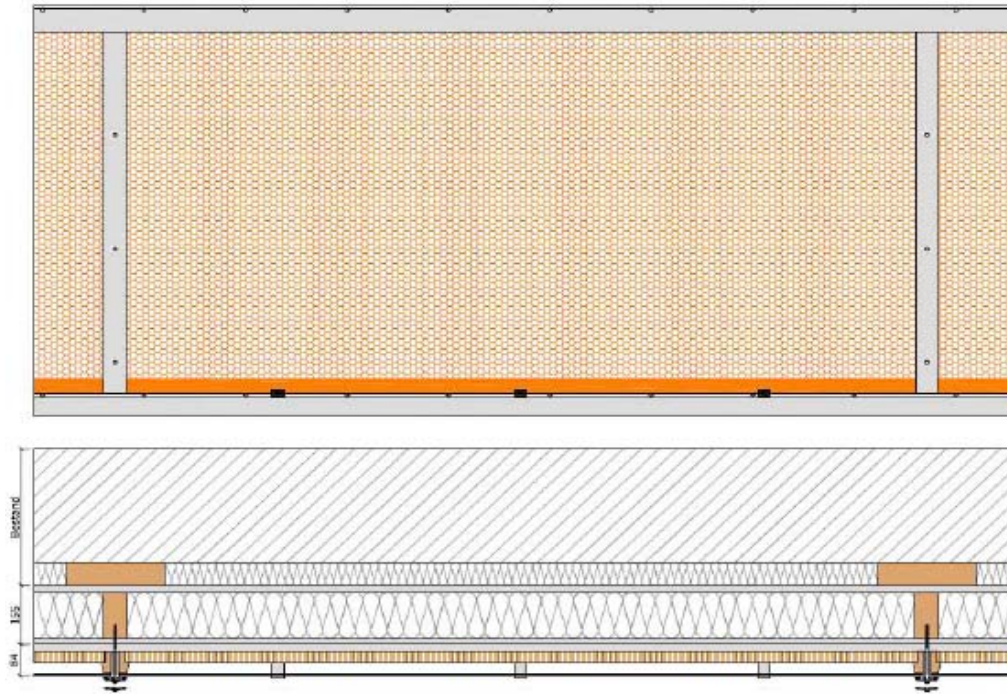
## Aims of the project

- Decrease of heating loads >80%
- Decrease of CO2 emissions >80%
- Decrease of heating costs from 0,4 € to 0,1 €
- Increase of the renewable energy usage
- Increase of the property market price
- Improvement of the quality of living
  - Controlled ventilation
  - Central heating and DHW
  - Increase of living space through balcony enclosure



# Integrated passive elements

- Façade elements



# Integration of passive elements

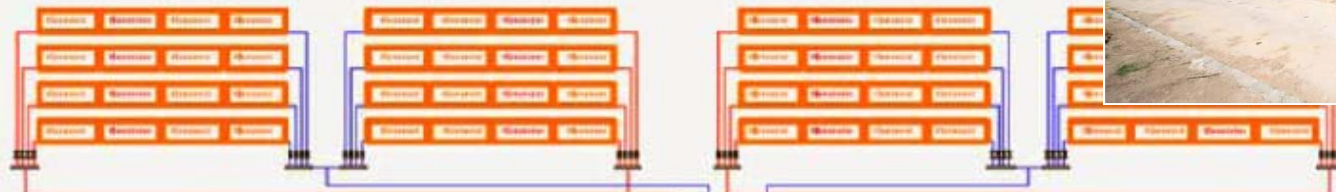




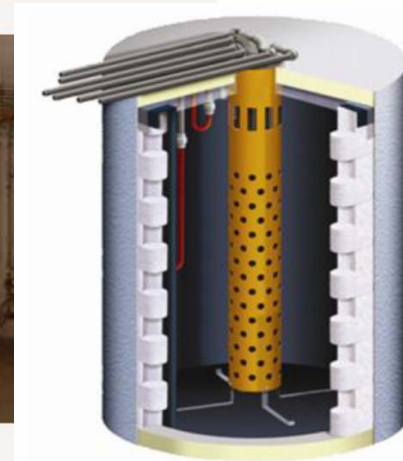
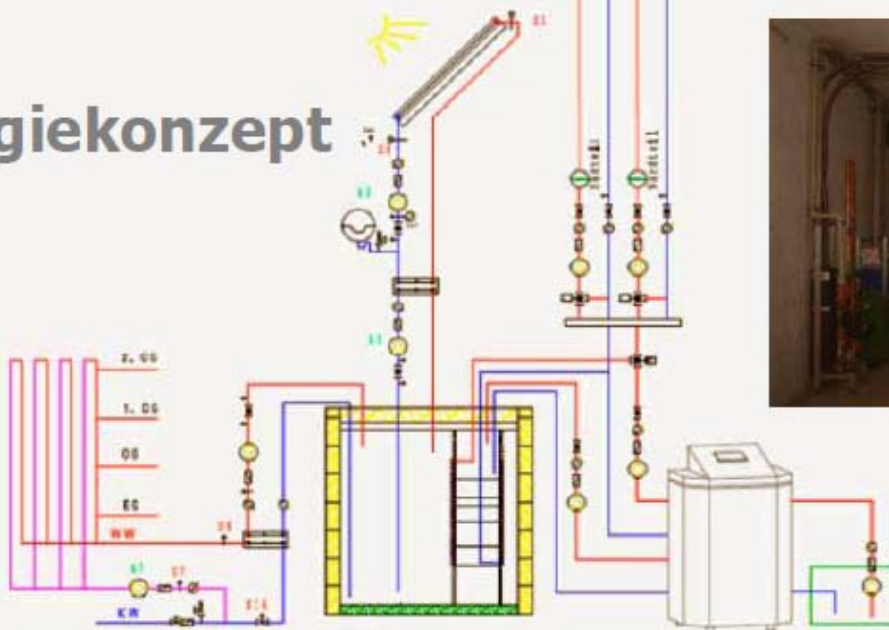
# Integrated passive elements



Giwog Dieselweg Graz Hydraulisches Haus 4-6-8-



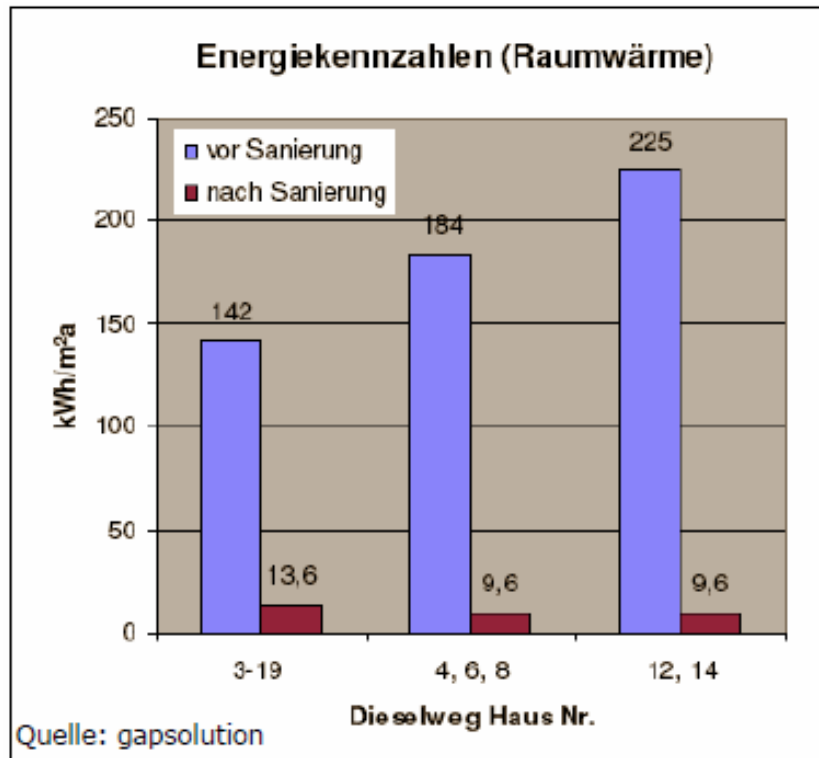
## Energiekonzept



Quelle: gabsolution

# Integrated passive elements

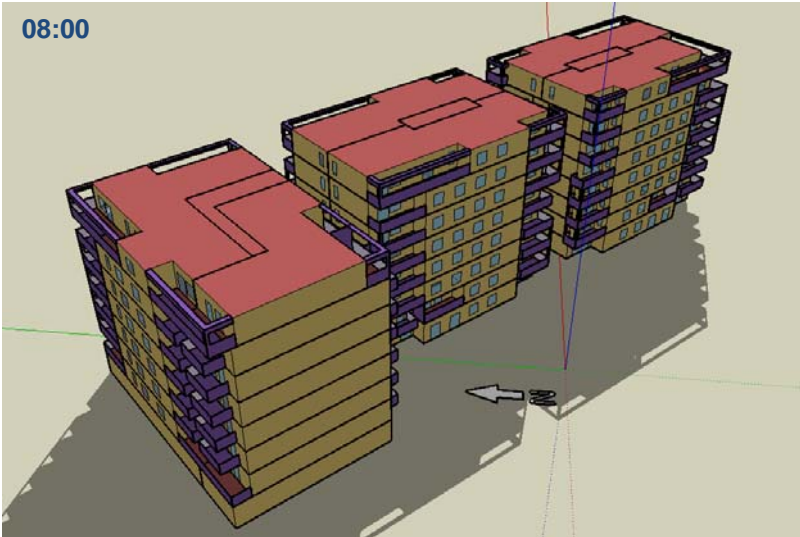
- Outcome



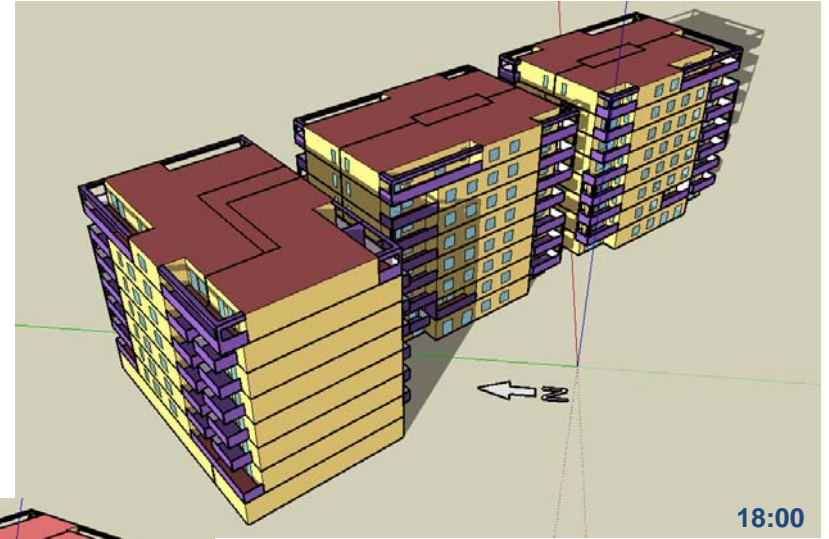
# Influence of the surroundings

June 21<sup>st</sup>

08:00



18:00

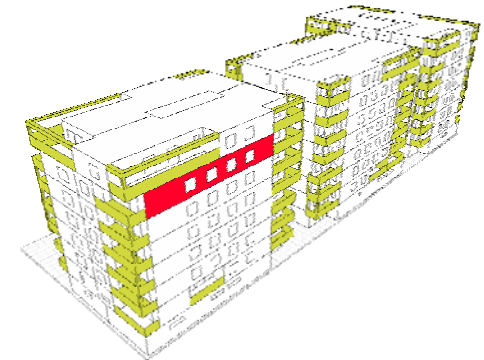
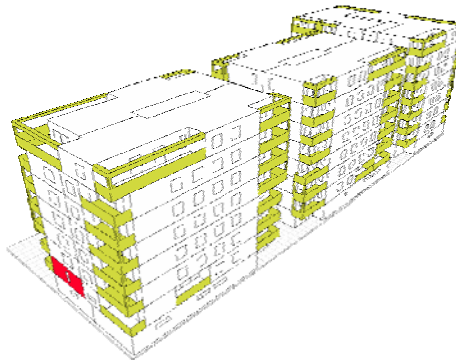
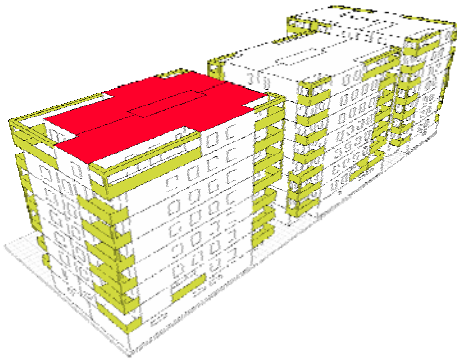


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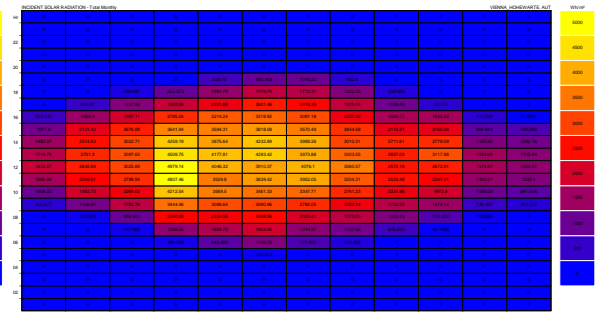
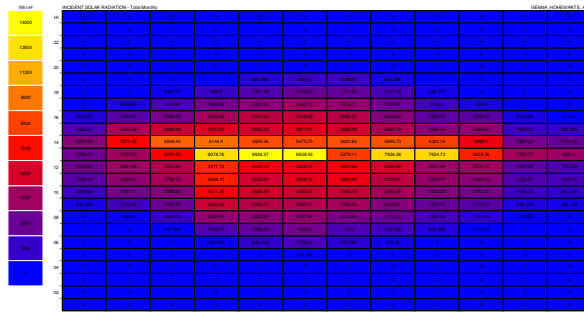
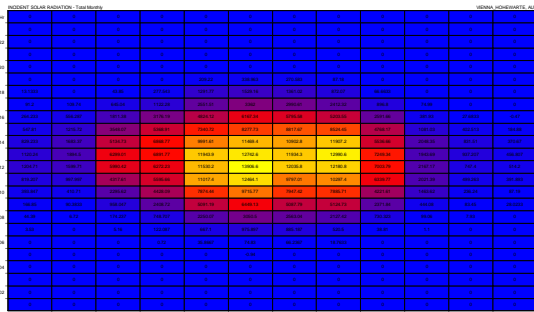




# Influence of the surroundings



hours



months

# Integrated active elements

## Project MPPF – Multifunctional Plug and Play Façade

- Competence centre including a number of Austrian companies and R&D institutions
- Aims:
  - Integration of a number of functions into façade elements
  - Development of integrated control strategies



Competence Centers for  
Excellent Technologies



FFG



KWF

Kärntner  
Wirtschaftsförderungs  
Fonds



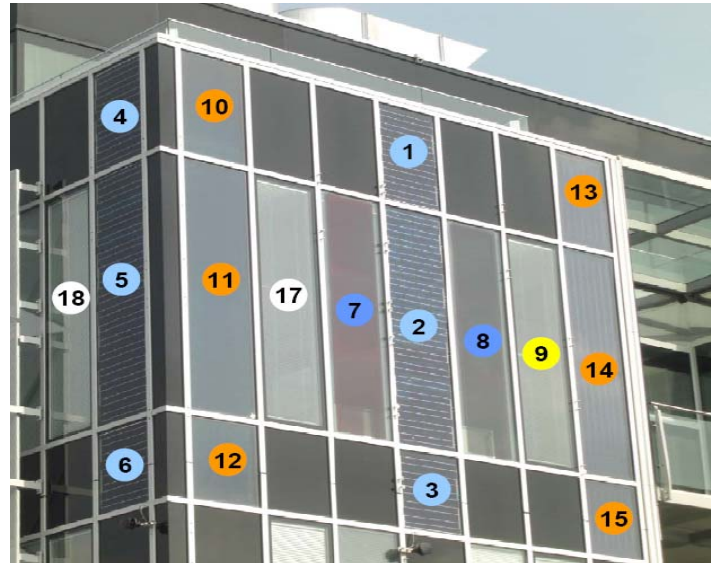
Intelligent Energy Europe

# Integrated active elements

## Ambient Conditions

### Outdoor

- Temperature
- Humidity
- Wind
- Solar radiation



### Indoor

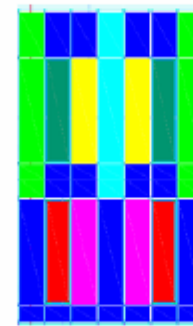
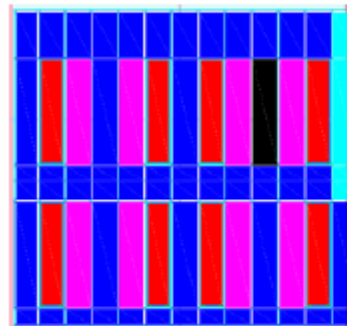
- Temperature
- Humidity
- Irradiance
- Room comfort

### Façade Elements

- Performance
- Efficiency
- Temperature
- Humidity

West façade

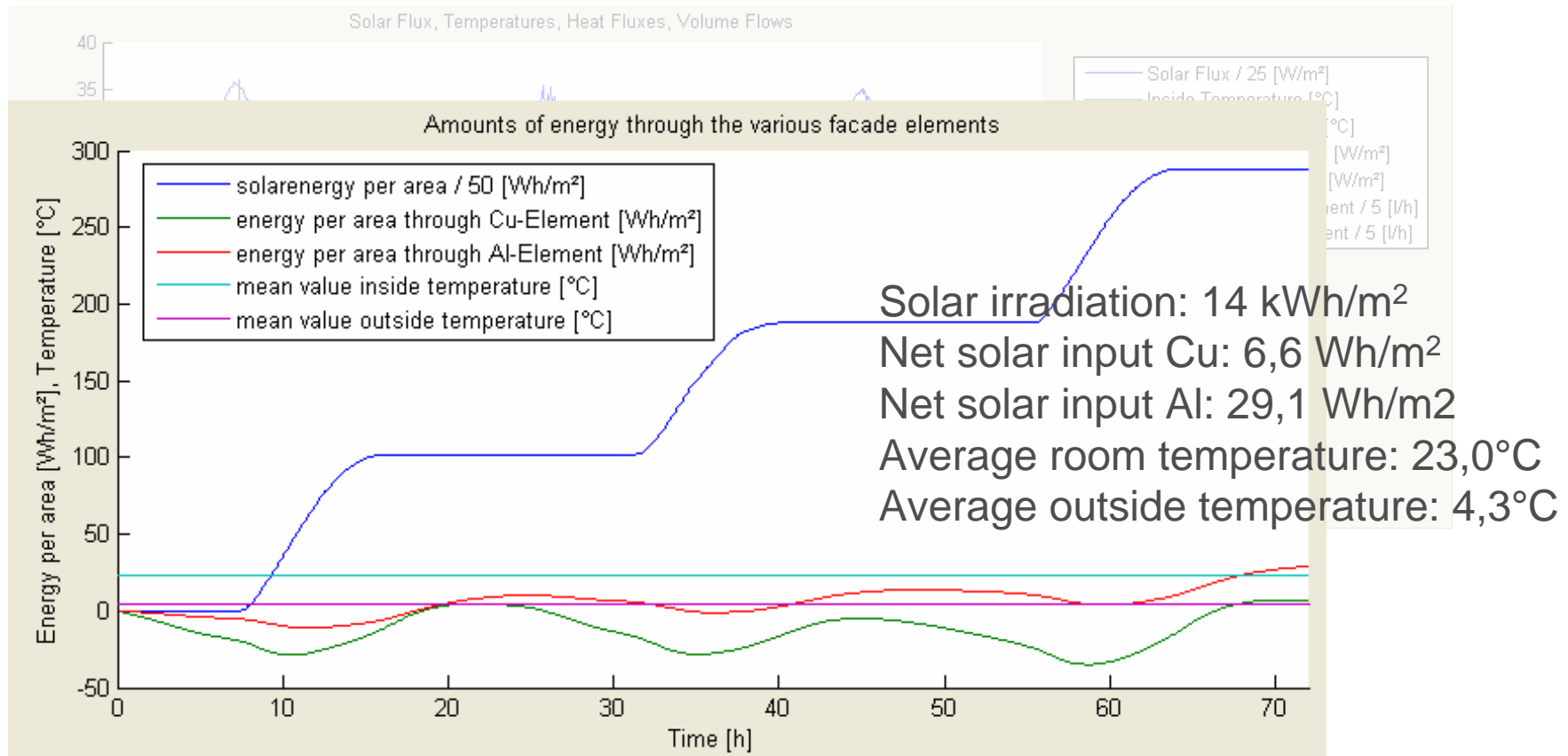
South façade



- Opaque panel
- Glass with PV
- Window
- Opaque panel with PV
- ST collector
- HVAC module
- Electrochromic glazing
- Glazing with shading

# Integrated active elements

## MPPF - first results south façade on 27.10.2010



# Conclusions

- Renovation of existing, low efficiency buildings plays an important role in cutting the emissions
- Solar energy can be used both passively and actively
- Combination of solar thermal and other technologies delivers feasible results
- New, integrated concepts of renovation are available and developed

# Thank you for your attention!