Dr.-Ing. Daniel Scherz

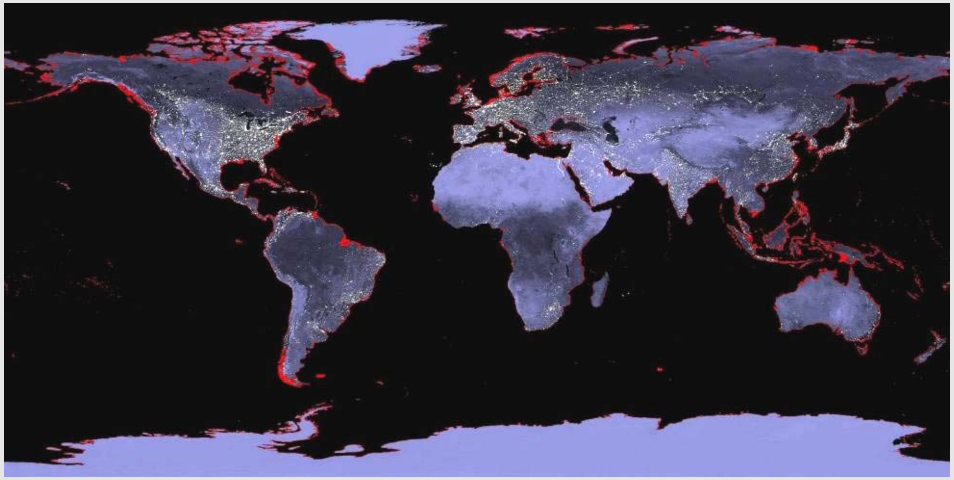
Energy efficient building design for the Mediterranean region

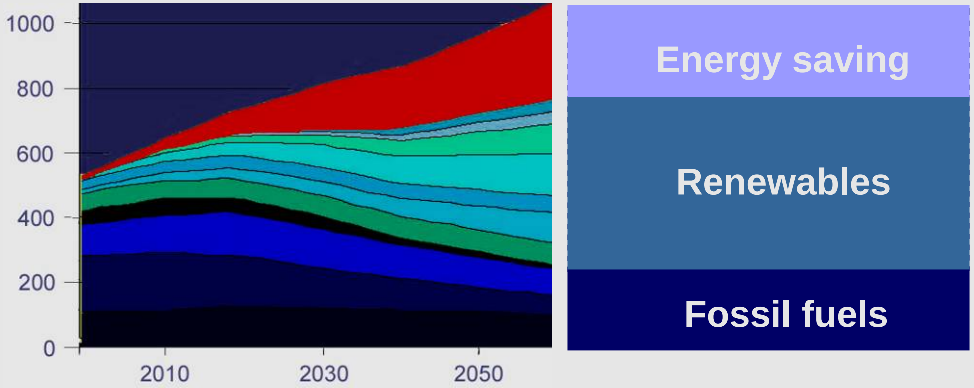
Exportinitiative Energieeffizienz

Bundesministerium für Wirtschaft und Technologie

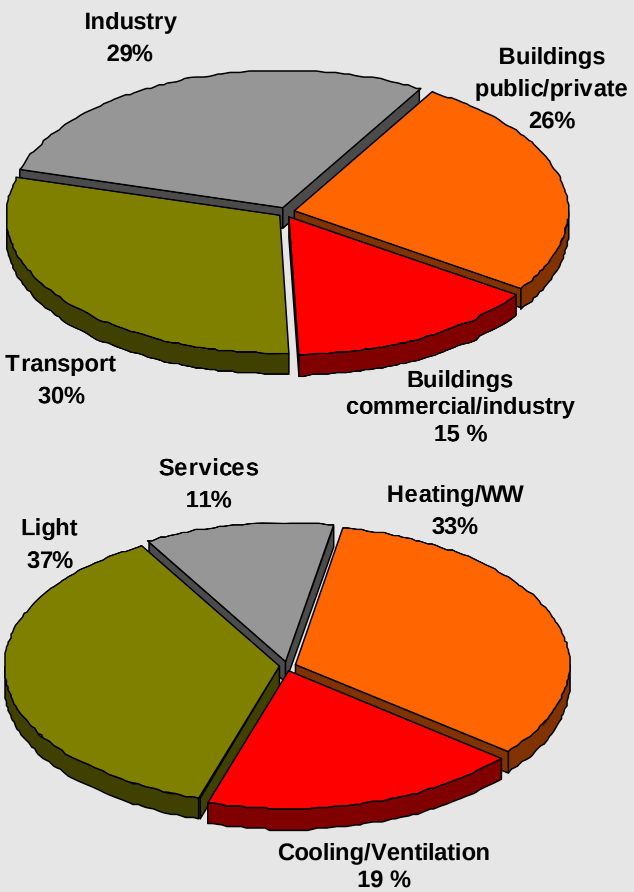
October 14, 2009
Mailand

1. Background - climate change and energy supply





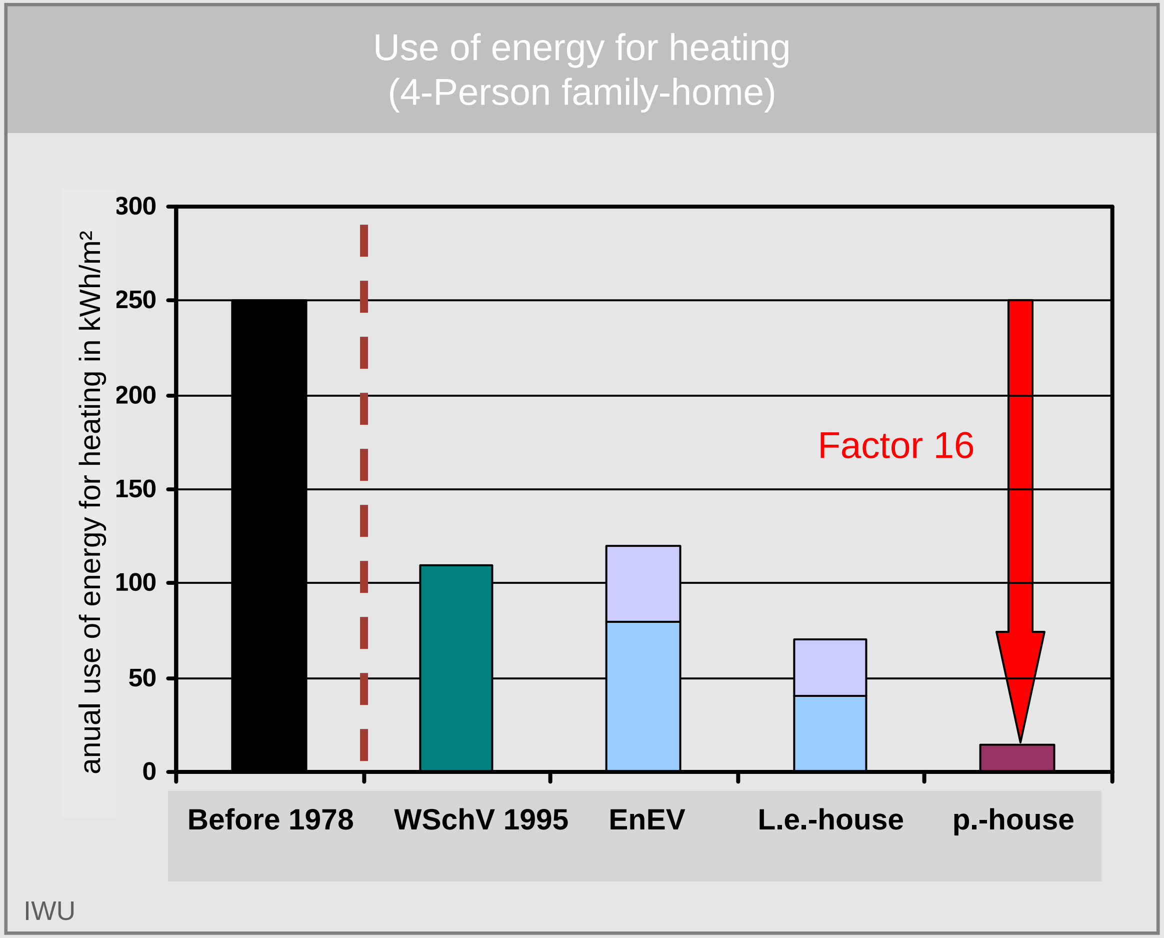
Primary energy use in the EU / in standard office buildings

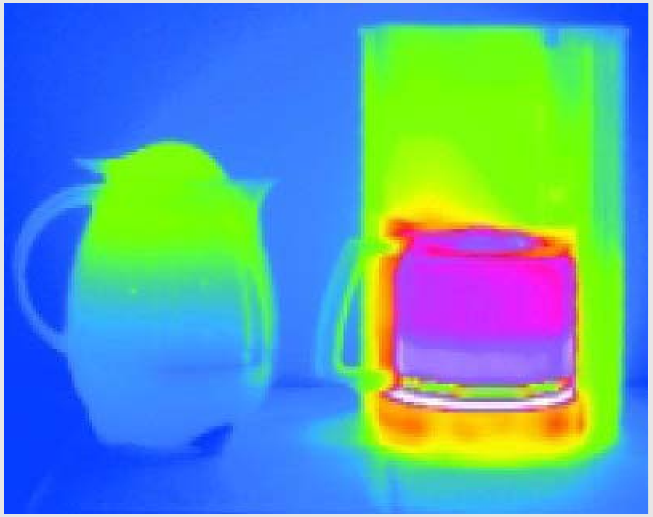


Data from the EC / IWU

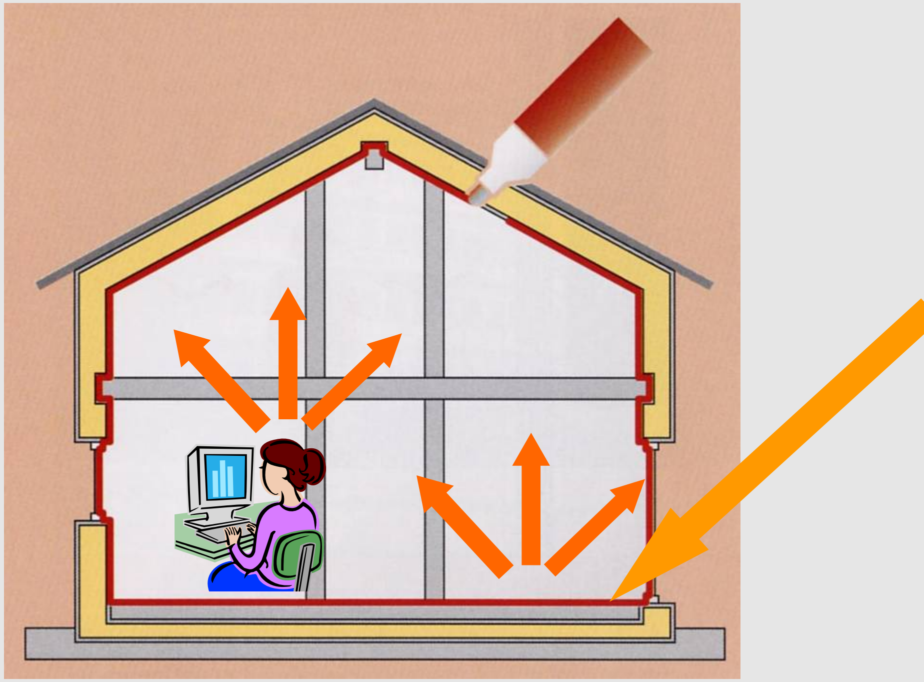
- **Cost-saving in the long run**
  Cost-effective energy saving potential of 20-30 %
- **Better comfort**
  Comfortable temperatures
- **Better building quality**
  Less damages and building repairs
- **Image improvement**
  Awareness of the social responsibility

2. *Solutions for cold climates - energy standards*





PHI



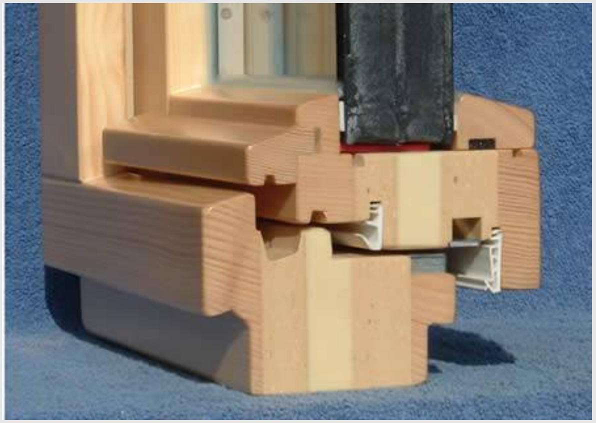
PHI

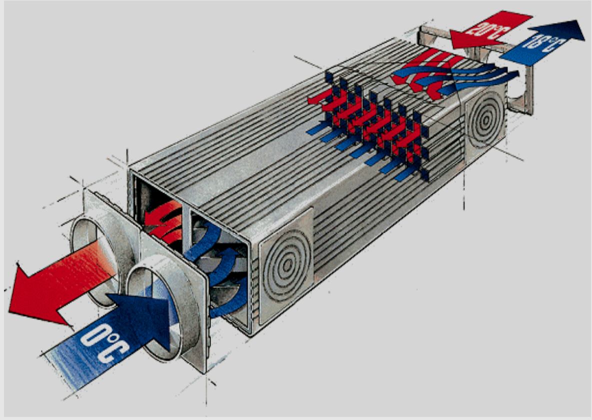
Use of heating energy: 15 kWh/m²a ▶ 1,5 l house

2. Solutions for cold climates - insulation


Rockwool


PH Roenn


Buck-Fenster



Paul Lüftungsanlagen

2. Solutions for cold climates - examples


PHI, Architecture Klaus Gierke


PHI, Architecture Casa Nova GmbH


PHI, Architecture Plan-R


PHI, Architecture Dipl.-Ing. Martin Zimmer

3. Solutions for warm climates - background

3. Solutions for warm climates - strategies

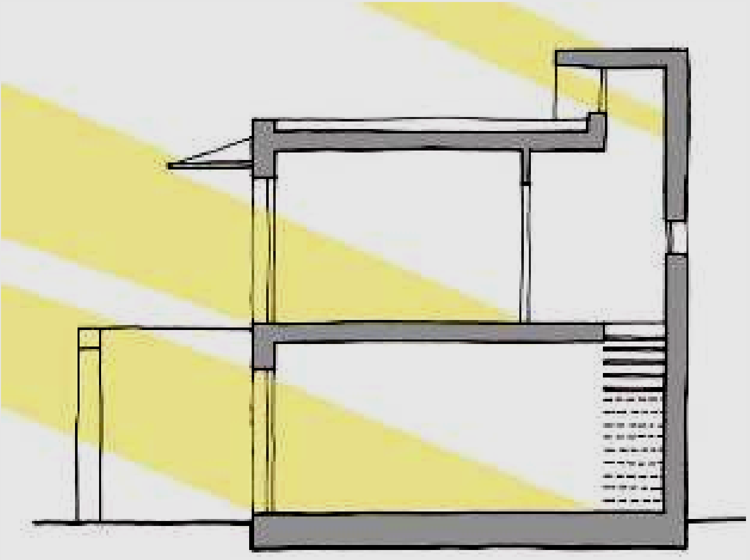
- **Building design and town planning**
  Adapted to the local situation

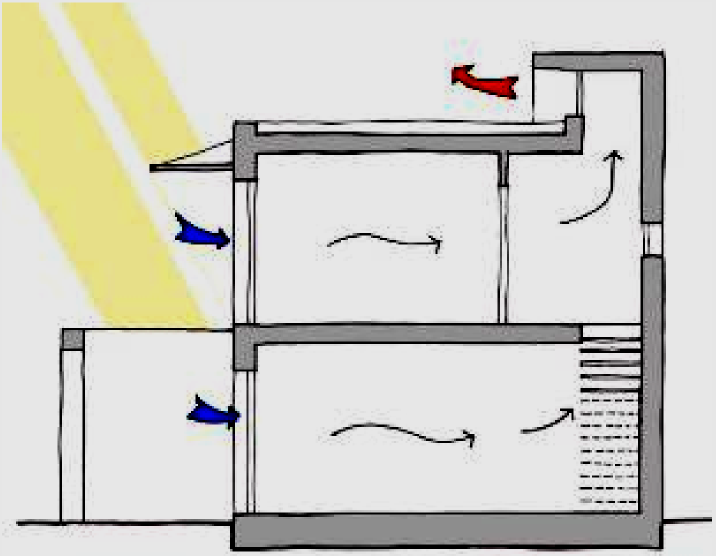
- **Building structure**
  To prevent energy losses and/or to utilize energy gains

- **Technical systems**
  Optimized and supported by renewable energy

3. Solutions for warm climates - building design

Shading concept summer / winter





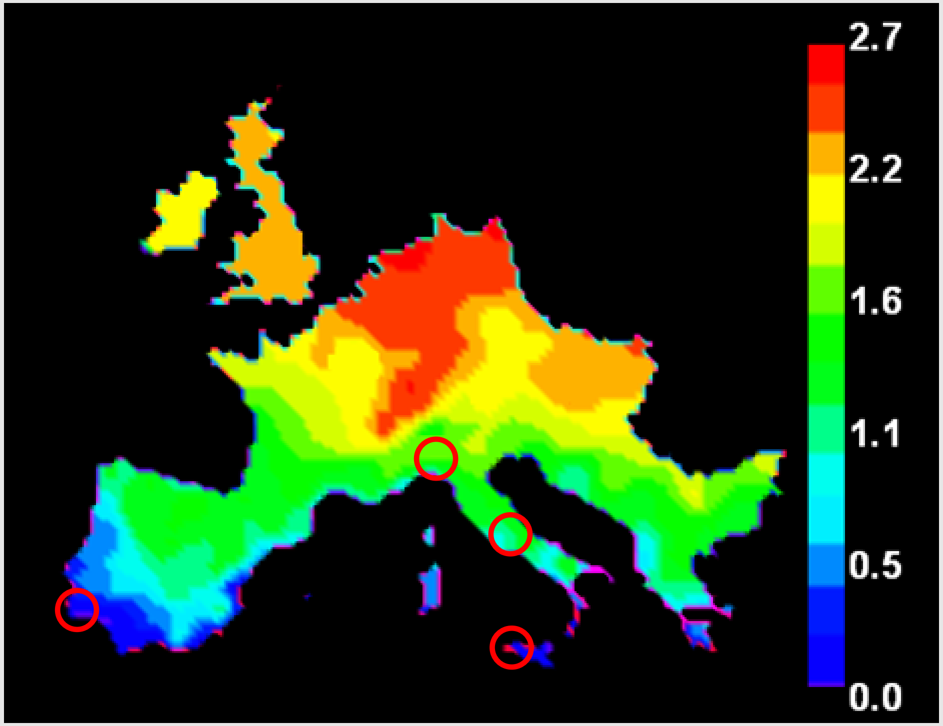
Passive-On project

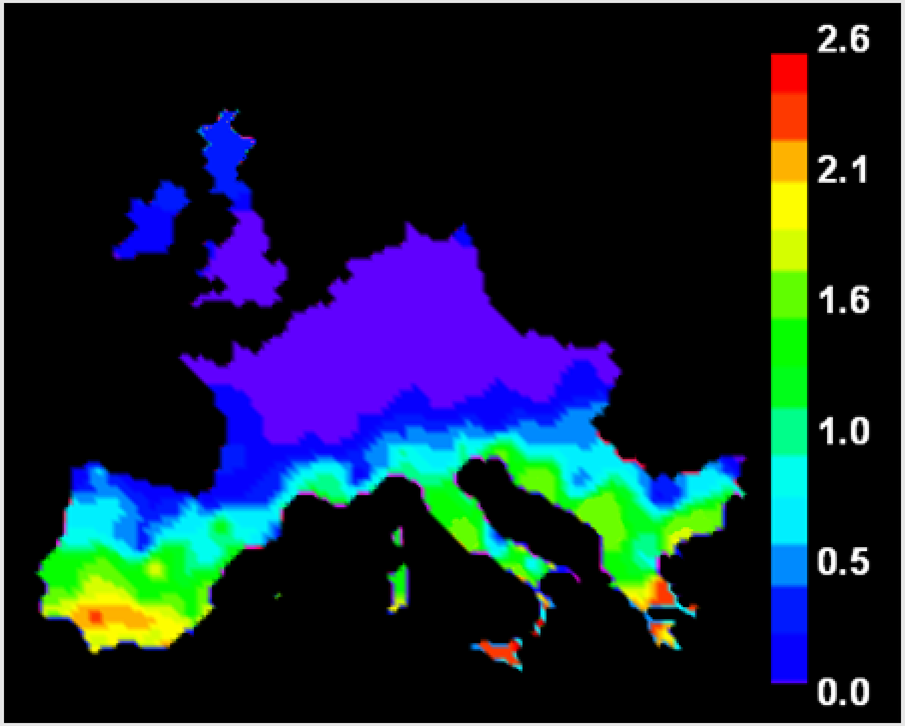
3. Solutions for warm climates - building design

- **Narrow streets**
  Buildings shade themselves and the streets
- **Light colours**
  Better reflexion of the sunlight
- **Thick walls made of dense material**
  Better temperature storage
- **Plants and water in and around the building**
  Improvement of the microclimate
- **Shading adaped to the local climate**
  Solar gains in the winter and/or shading in the summer

3. Solutions for warm climates - building structure

Passive-On project, Climatic Severity Index (CSI), Winter / Summer





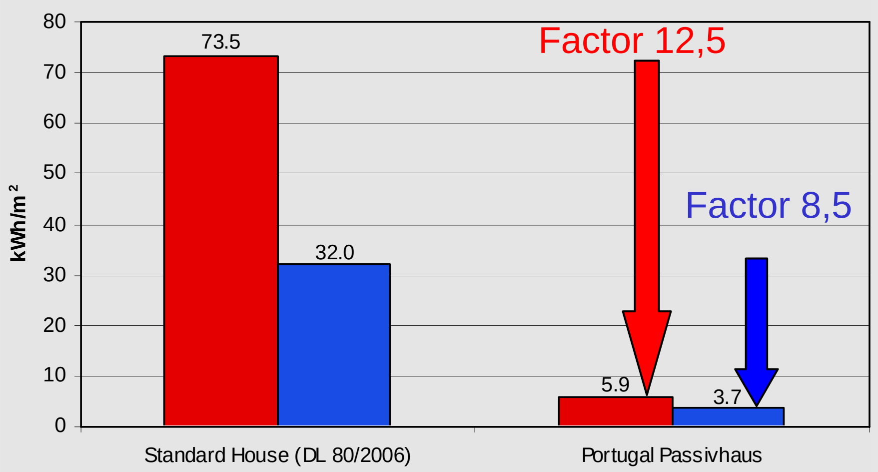
Passive-On project

Insulation thickness and effect on the energy demand in different climates

		Milan	Rome	Palermo
External walls	U-value (W/m^2K)	0.14	0.32	0.23
	Insulation (cm)	25	10	15
Under roof	U-value (W/m^2K)	0.15	0.32	0.23
	Insulation (cm)	25	10	15
Foundations	U-value (W/m^2K)	0.32	0.32	1.7
	Insulation (cm)	10	10	0

Passive-On project

	Milano	Villafranca	Roma	Palermo
Heating load				
28 cm	19.9	20.0	7.2	0.48
20 cm	23.0	22.9	9.1	0.95
15 cm	26.3	26.2	11.1	1.57
Cooling load				
28 cm	0.86	0.69	2.38	6.6
20 cm	0.85	0.68	2.42	6.7
15 cm	0.85	0.67	2.46	6.7

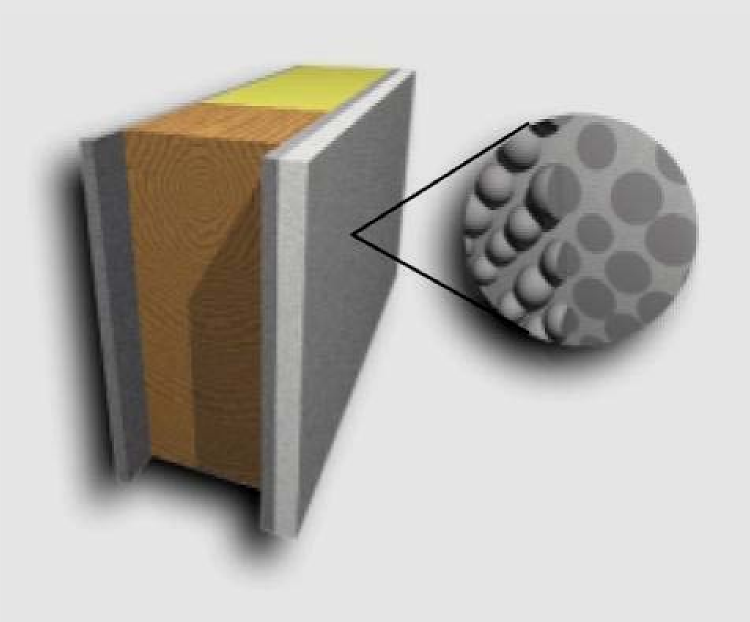


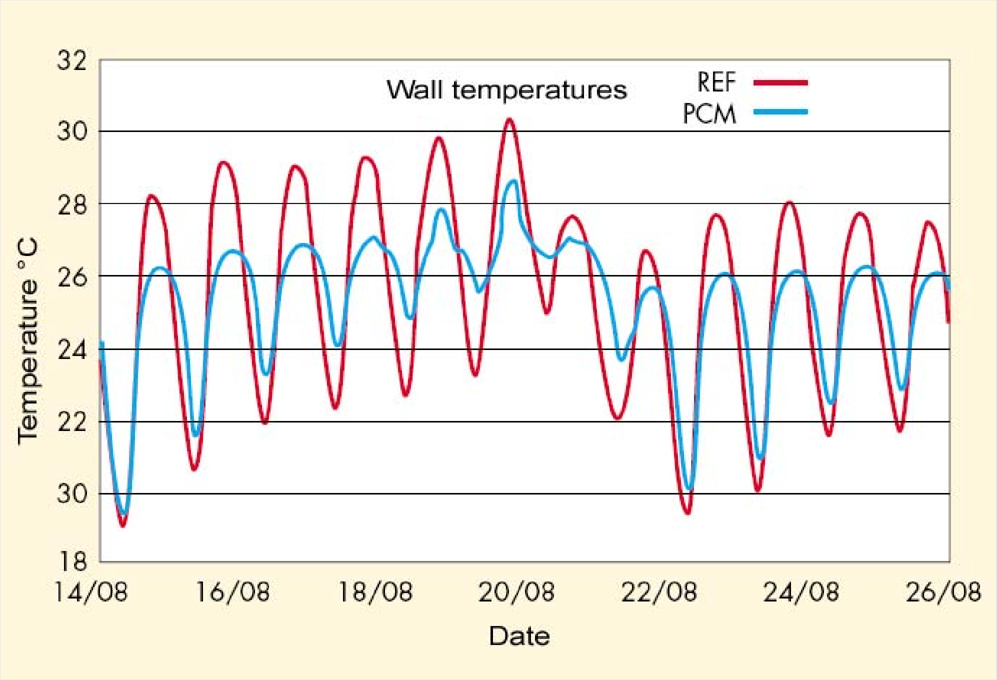
Life cycle costs for PH buildings in different climates

		France	Germany	Italy	Spain Granada	Spain Seville	UK
Extra Capital Costs (€/m²)		103	94	60	24,1	20,5	73
Extra Capital Costs (%)		9%	6,71%	5%	3,35%	2,85%	5,54%
Total Energy Savings (kWh/m²/year)		55	75,0	86,0	65,5	37,6	39,7
Total Energy Savings (%)		45%	50,0%	65,4%	57,3%	40,7%	26,4%
Extra Costs per saved kWh/m²/year		1,87	1,25	0,70	0,37	0,55	1,84
LCC 10 years€	Standard	143.731	184.716	193.817	101.828	98.385	108.337
	Passive	152.621	190.104	190.437	95.676	96.100	111.988
LCC 20 years€	Standard	160.343	204.942	221.148	117.928	108.689	117.875
	Passive	160.552	200.579	198.458	103.647	102.290	117.256
Cost-Benefit Ratio, 10 years		-0,72	-0,48	0,39	2,13	0,93	-0,65
Cost-Benefit Ratio, 20 years		0,02	0,39	2,63	4,94	2,60	0,11
Discounted Payback Period (years)		19.5	19	8	4	5	19

Passive-On project

Phase Change Materials (PCM)



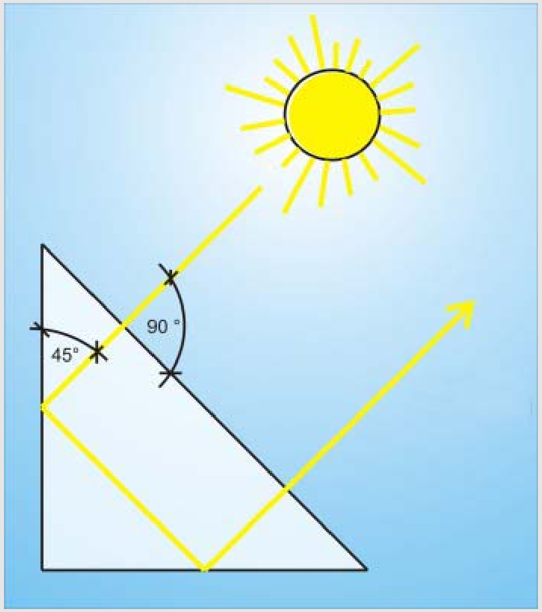


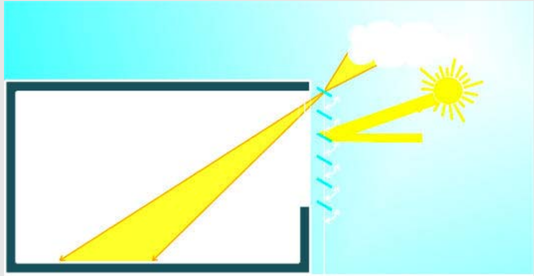
BINE Informationsdienst IV/02

Day: **Rising heat load > PCM change from solid to fluid > absorption of heat**

Night: **Cool air ventilation > PCM change from fluid to solid > release of heat**

Day light use





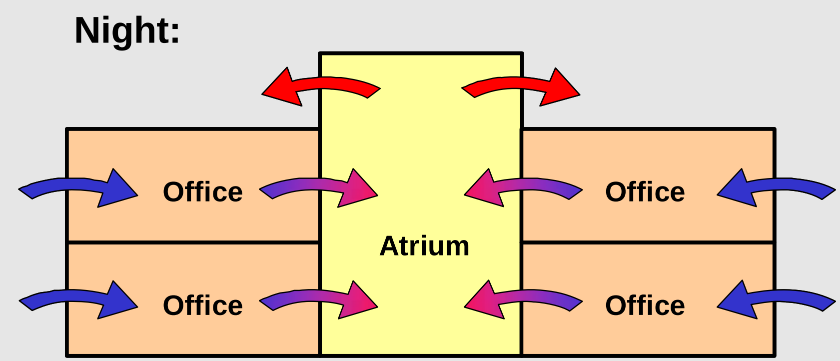
Haas-Arndt/Schädlich

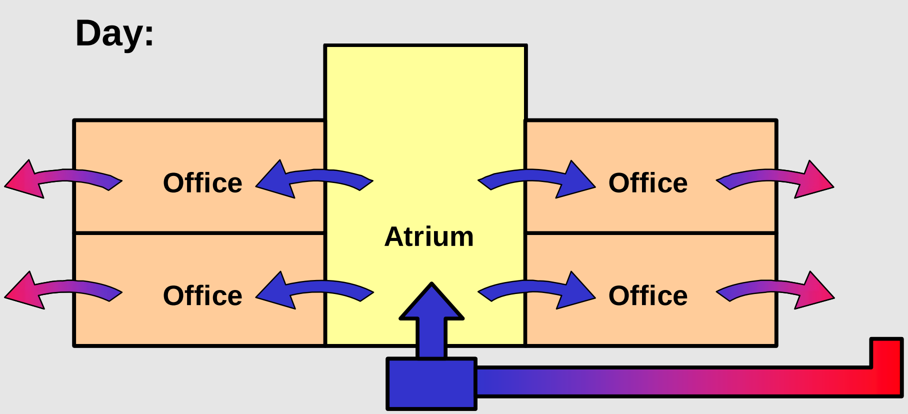
Energy saving potential through daylight use up to 70%

Passive house strategy for warm climates

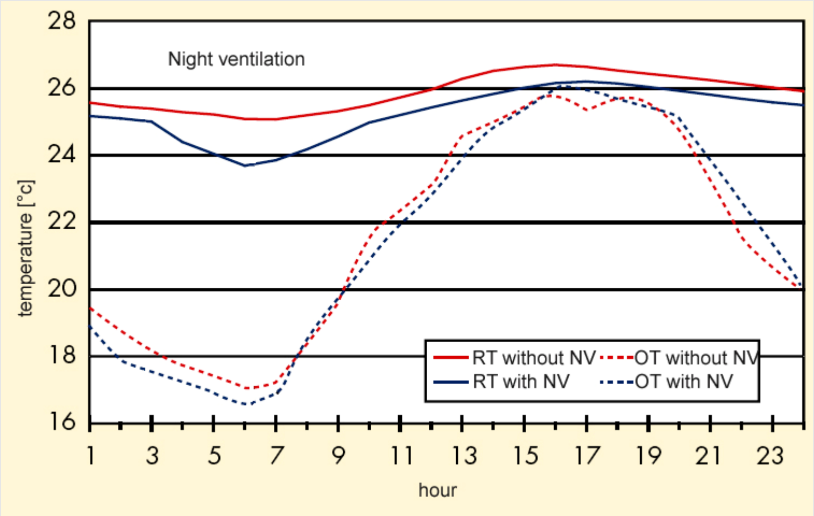
- **Definition for PH standard in warm climates:**
  Heating and/or cooling demand < 15 kWh/m²a
  Primary energy < 120 kWh/m²a
- **Insulation important, but lower thickness than in colder climates**
- **No insulation of the ground floor in very warm climates > heat sink**
- **Thermal mass of building important to reduce the temperature peaks**
- **Shading important to reduce the heat load**
- **Requirements for air tightness not as high as in colder climates**
- **Reduction of cooling load can make active cooling system redundant**

Night ventilation





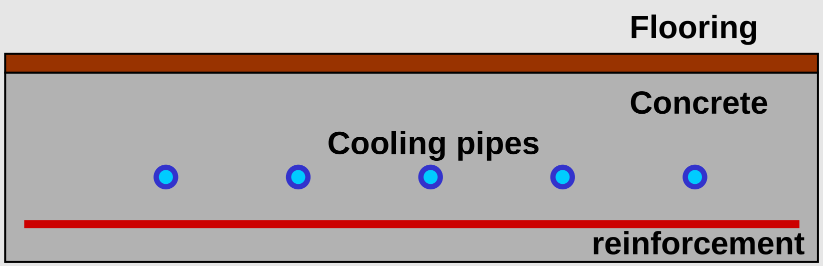
- **For low cooling demands**
- **Supported by high thermal mass of building**
- **Night ventilation if temperatures 5h < 21°C**
- **Detailed planning and simulation necessary**



BINE Informationsdienst I/03

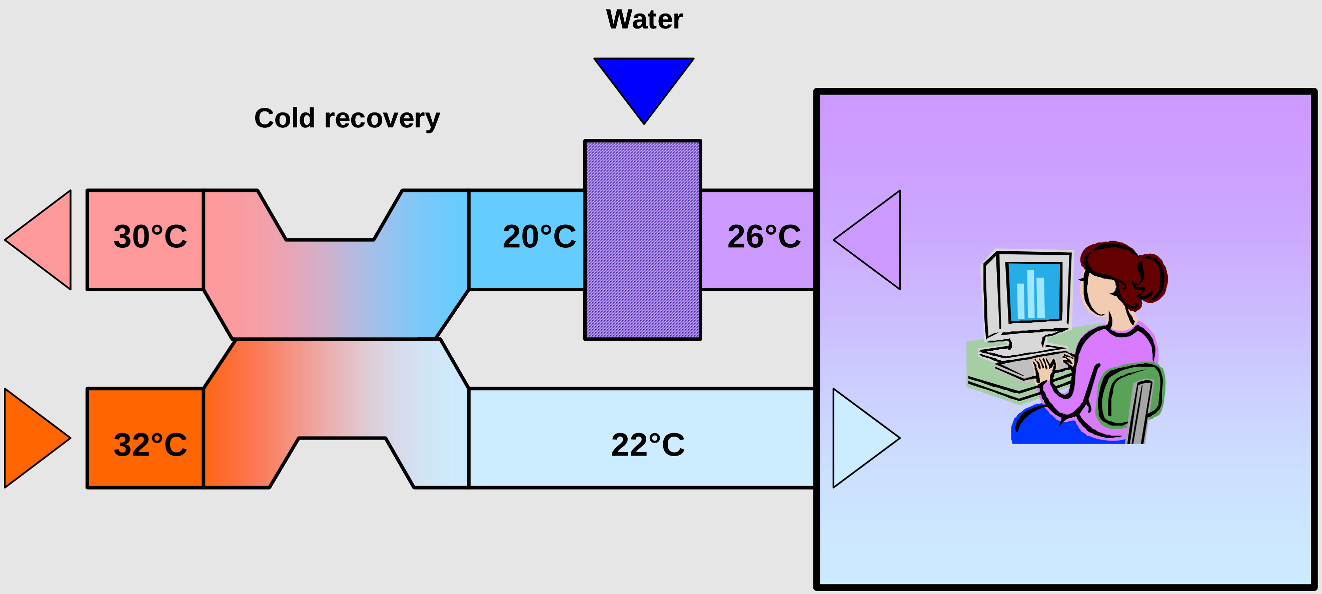
Thermal activation of building components and cooling ceilings

REHAU AG



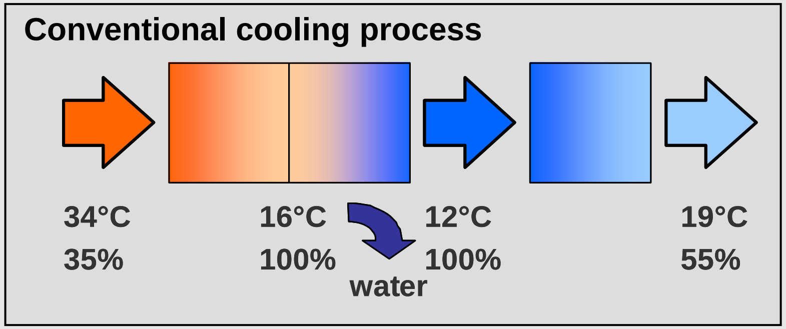
- Air cooling or fluid cooling systems
- High thermal mass of building components
- Usable for cooling and heating
- System temperature > 22 °C and < 28°C

Adiabatic cooling

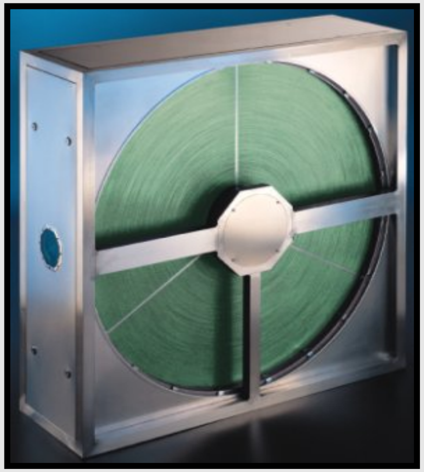


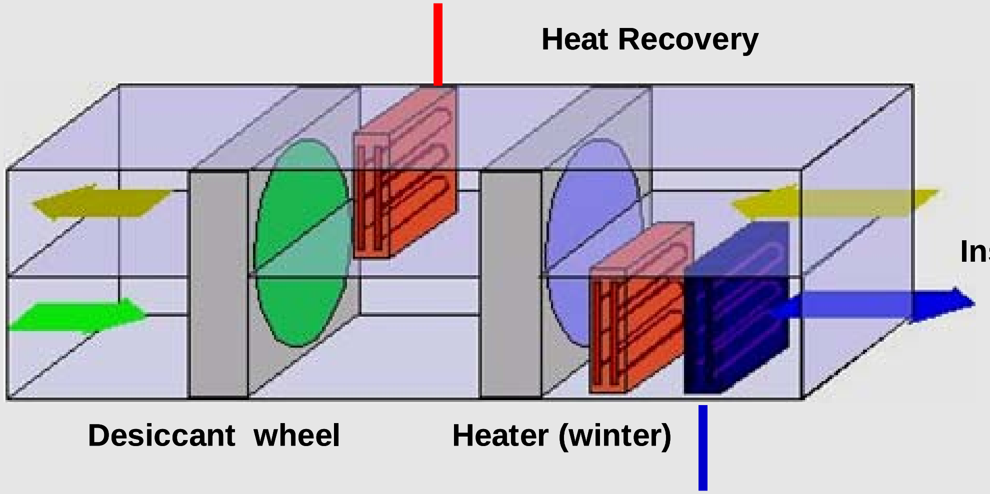
Use of water: 1 l for 1 m² office space per day

Desiccant assisted air conditioning



- Main demand shifted from cooling to heating
- Less overall energy demand
- Heating with solar or waste energy
- Cooling without electricity use


Prof. Dr.-Ing. G. Schmitz



3. Solutions for warm climates - summary

- **Energy saving in buildings because of climate change and energy supply situation, but also marketing advantage**
- **For cold climates proved solutions already exist (example Passive House)**
- **With little changes these concepts also work in warmer climates**
- **An optimized building design and building structure can make an active cooling system redundant**
- **If there is a need for active cooling different solutions with low energy demand and/or use of renewable energies exist**

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Thank you !

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