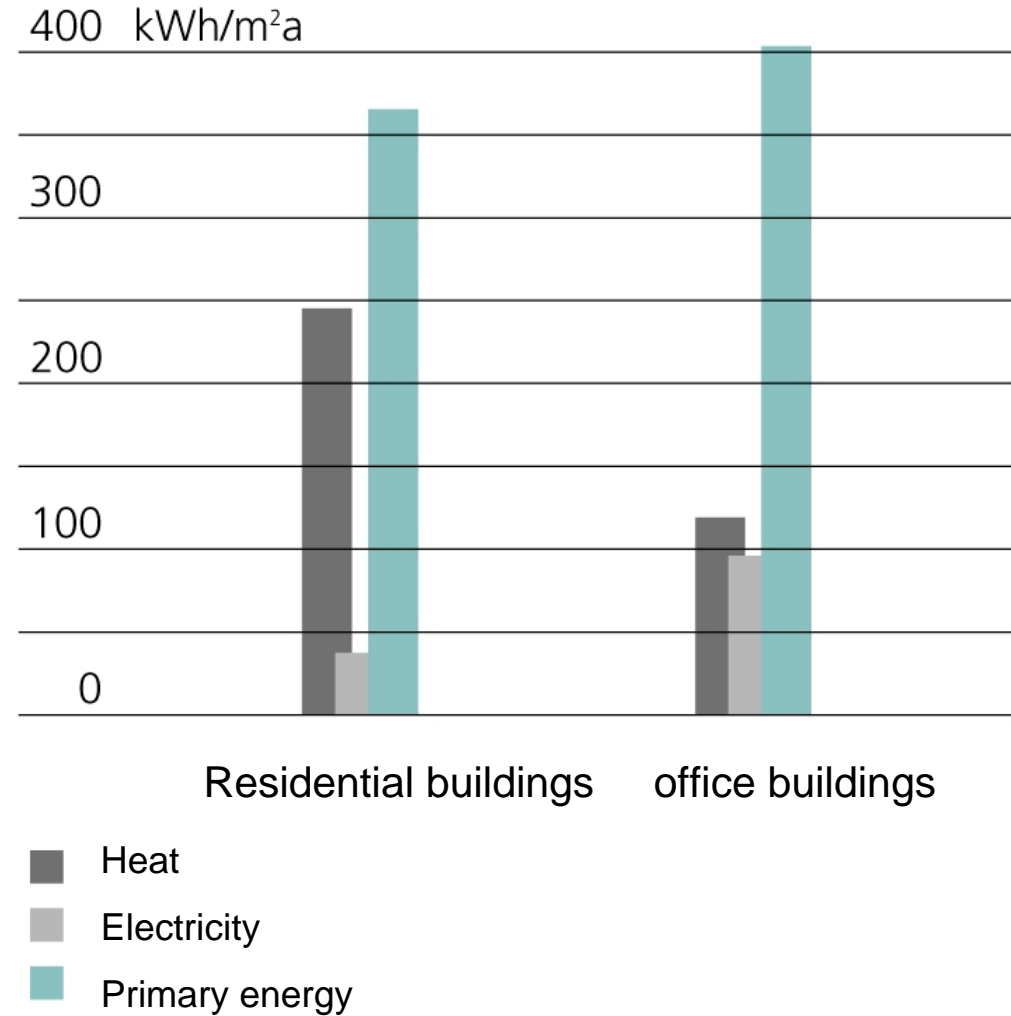


Energy Efficiency in Commercial Buildings

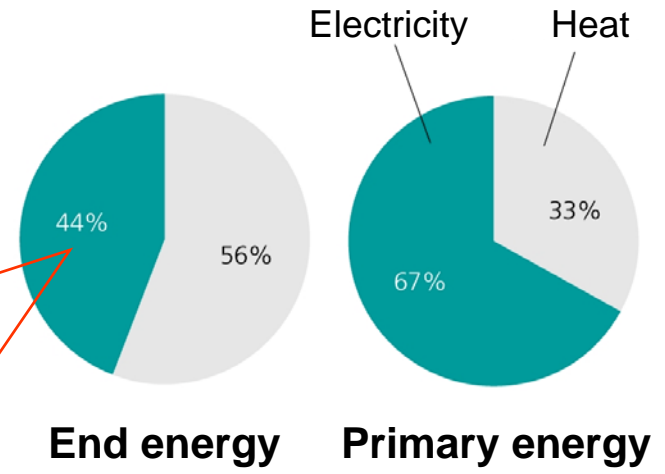
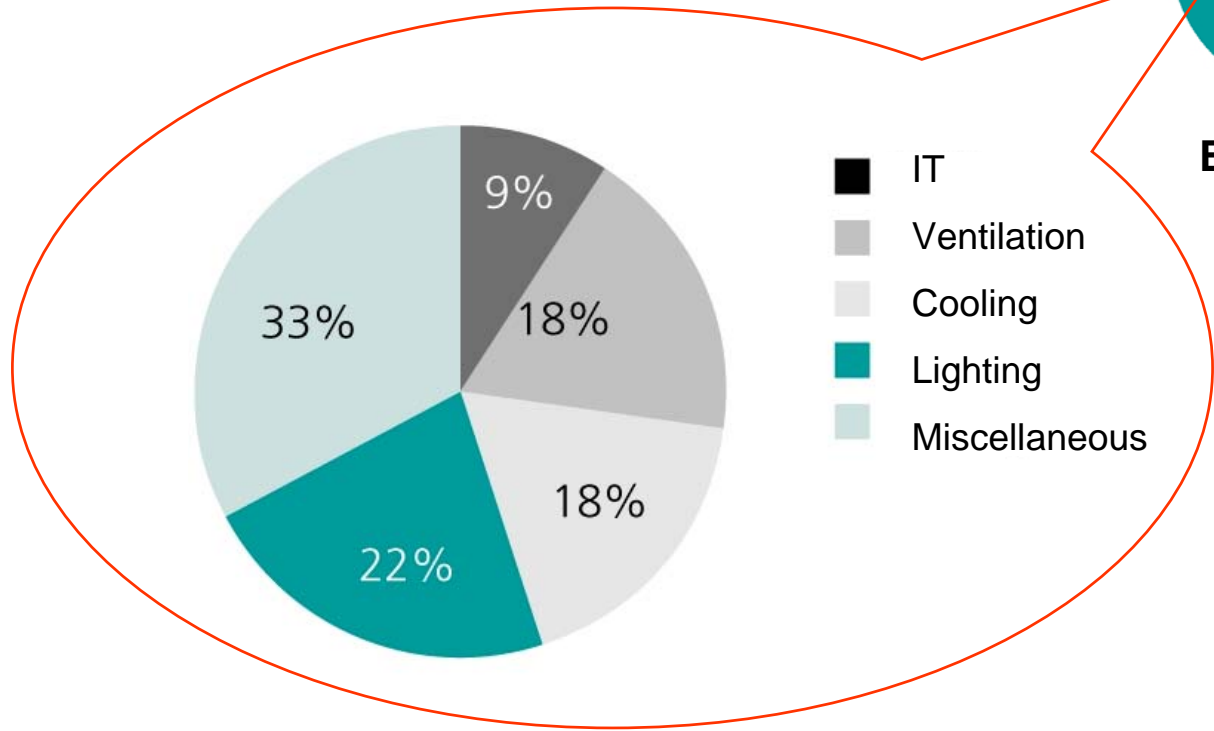
**Experiences and Results from the
German funding Program SolarBau**

S. Herkel, G. Löhnert, K. Voss, A. Wagner

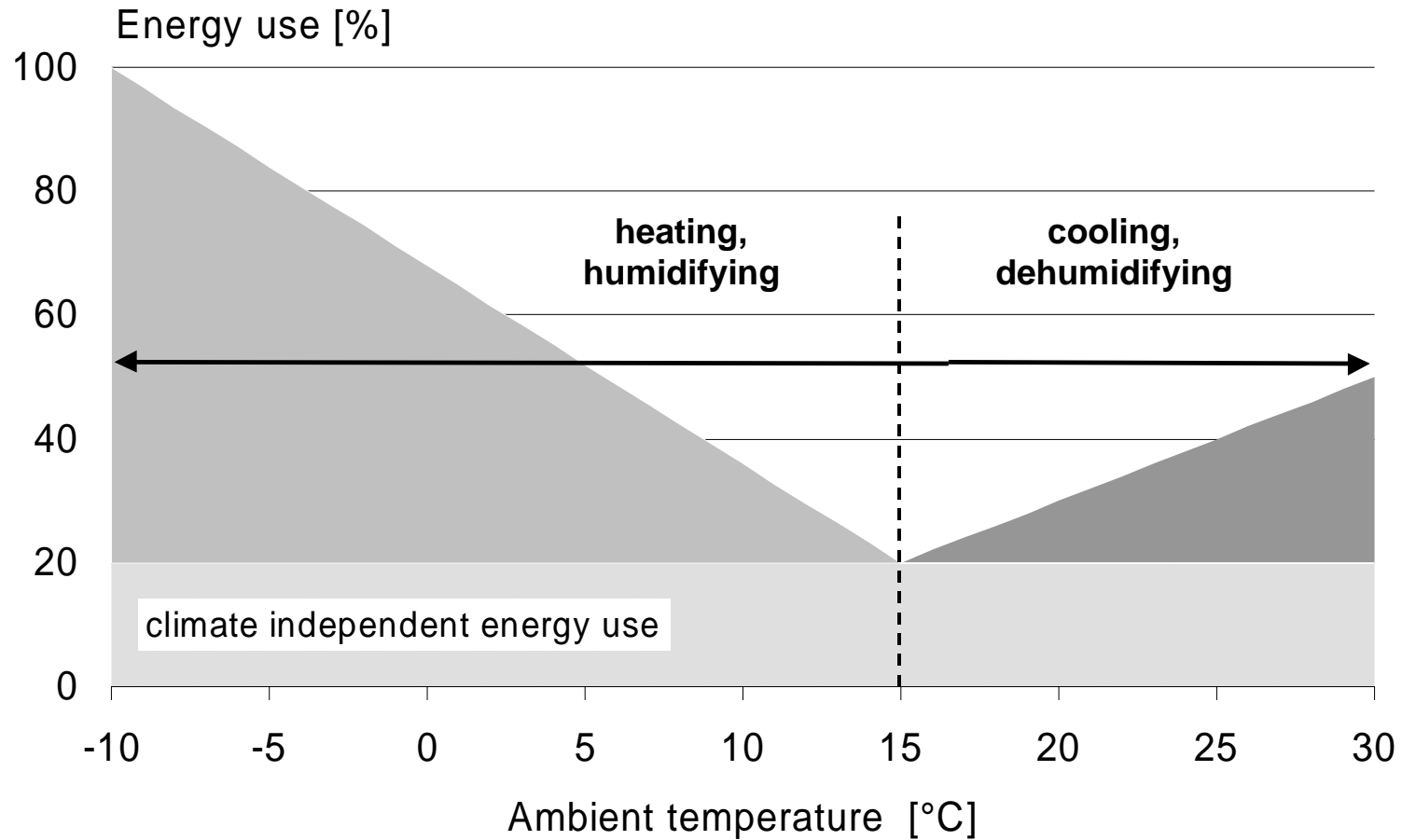
Energy consumption of the building stock in Germany



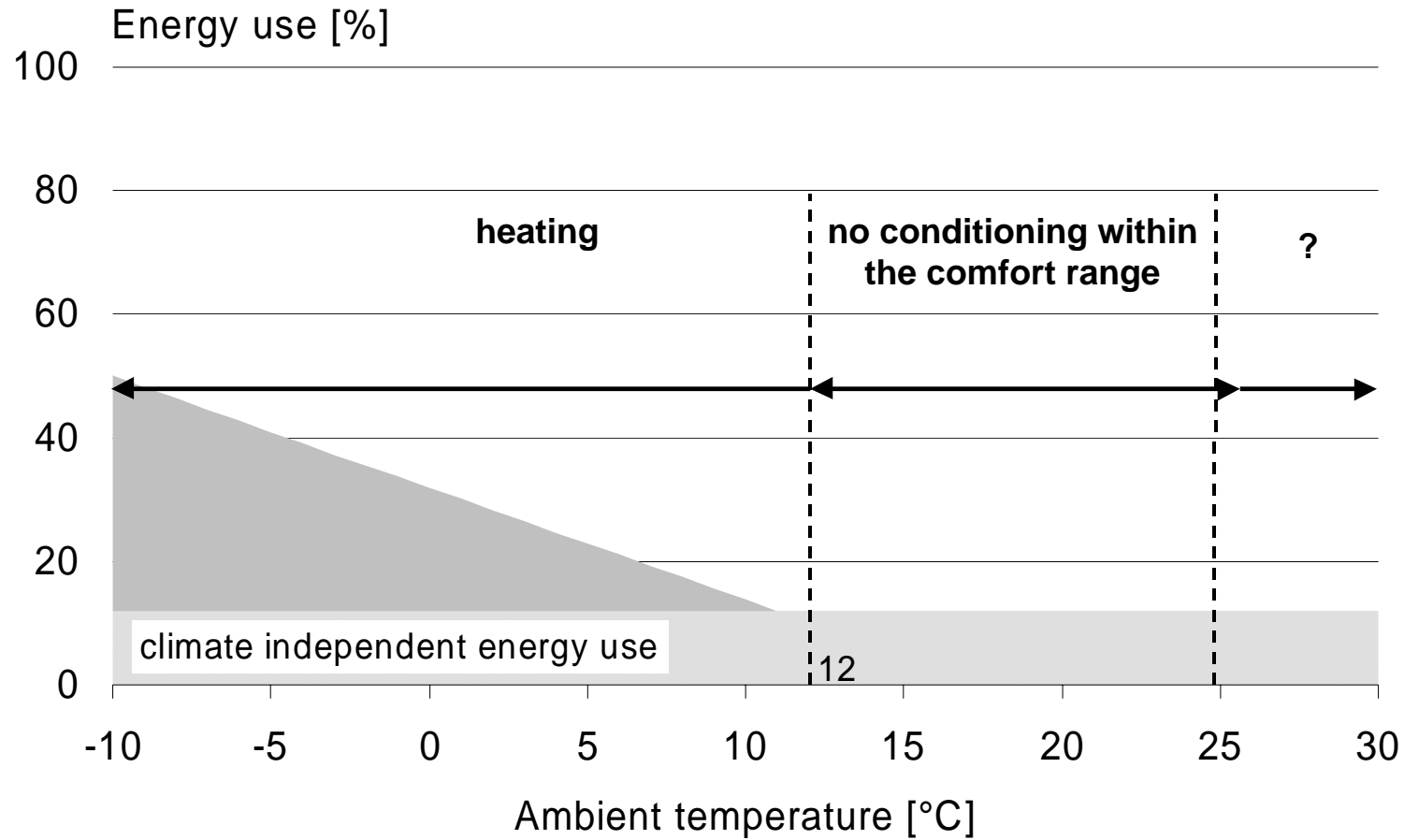
Energy demand of office buildings



Energy use of conventional office buildings

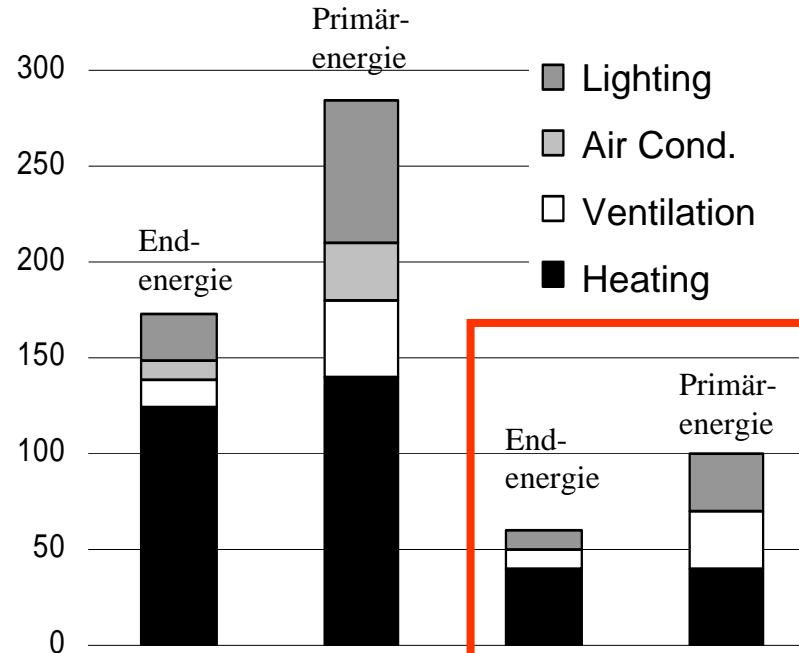


Energy use of lean office buildings



Targets of SolarBau

Energy in kWh/m²a



	Building Stock		SolarBau	
■ Lighting	25	75	10	30
■ Air Cond.	11	30	0	0
□ Ventilation	13	40	10	30
■ Heating	125	140	40	40

SolarBau Programme

23 funded buildings

6 Projects finished

12 Projects in monitoring

5 Projects in design phase / under construction



Typology:

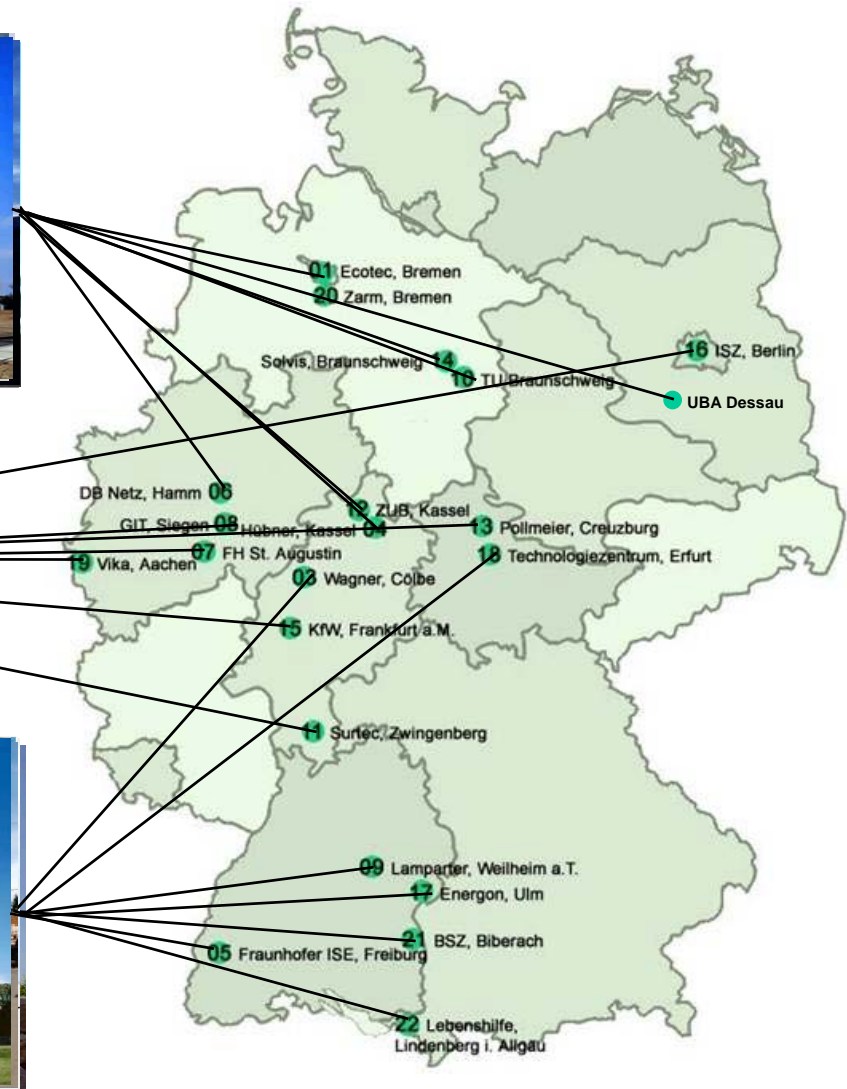
office buildings

factories

university buildings



Funded by the German Ministry of Economy and Labour, coordinated by PTJ Jülich

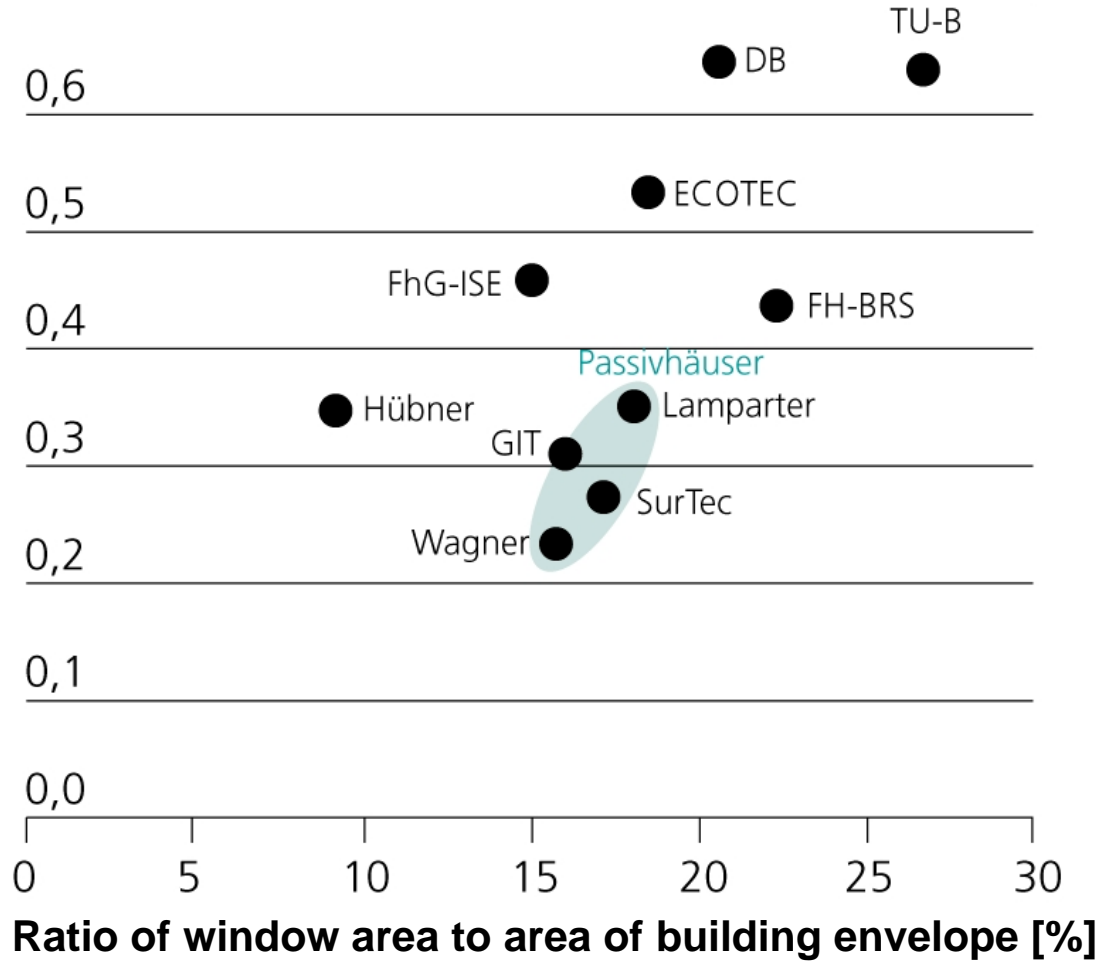


Heating

Building envelope

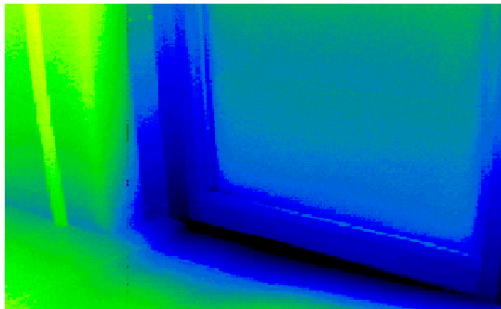


0,7 W/m²K, mean U-value of the building envelope

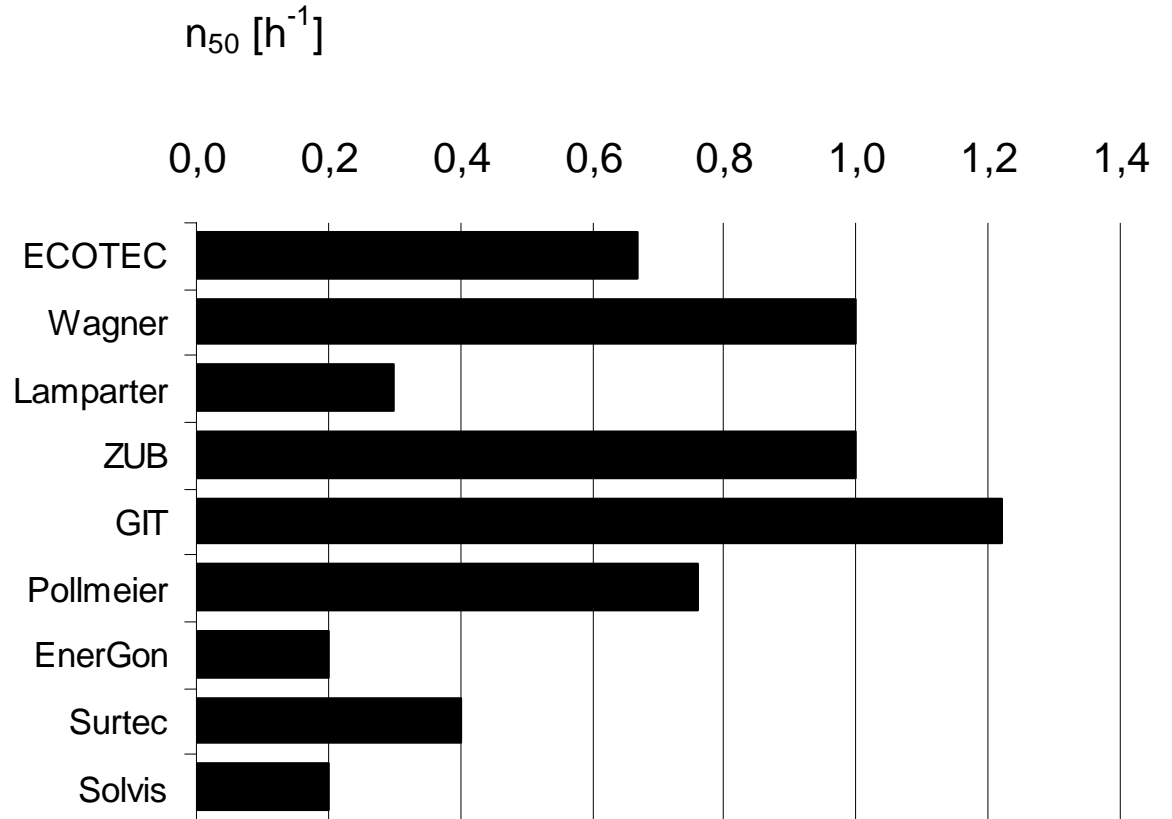


Heating

Air tightness

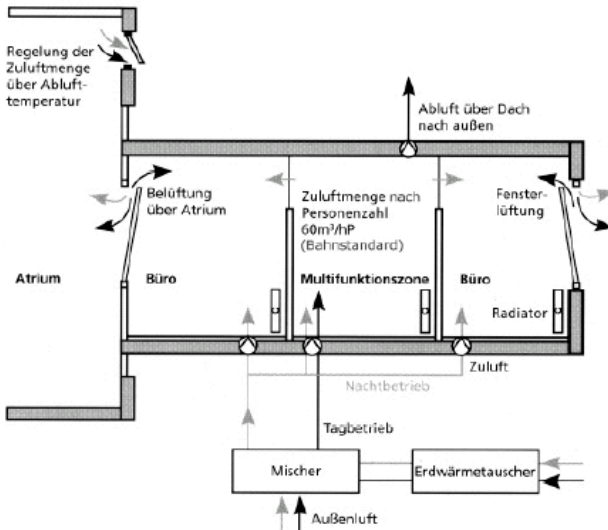


Visualisierung möglicher Leckagen durch Infrarotphotos

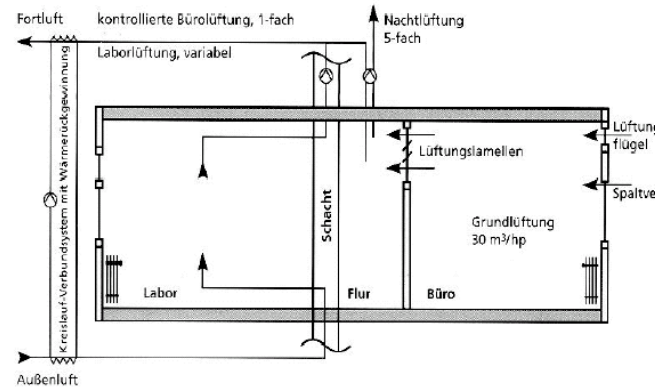


Heating

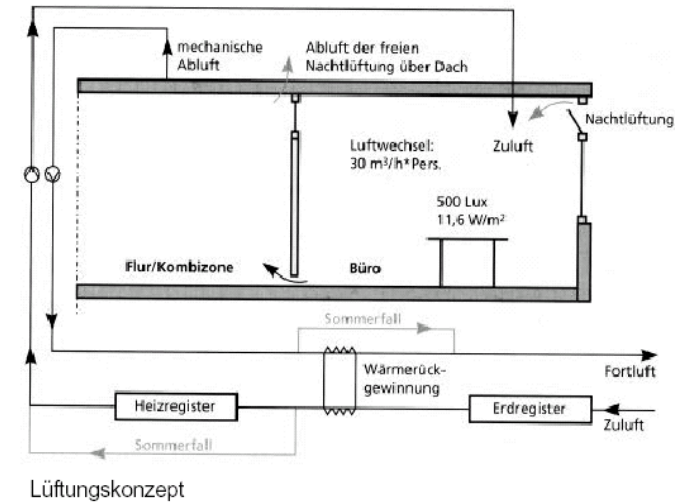
Different strategies for ventilation



DB Netz AG



Fraunhofer ISE



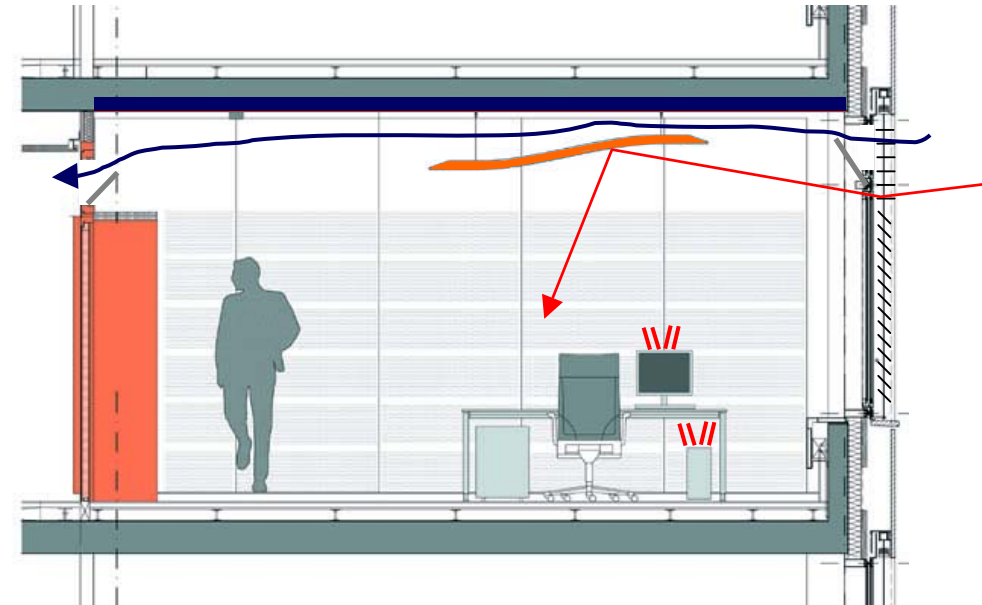
Lamparter



Passive cooling

Principles

KfW Frankfurt



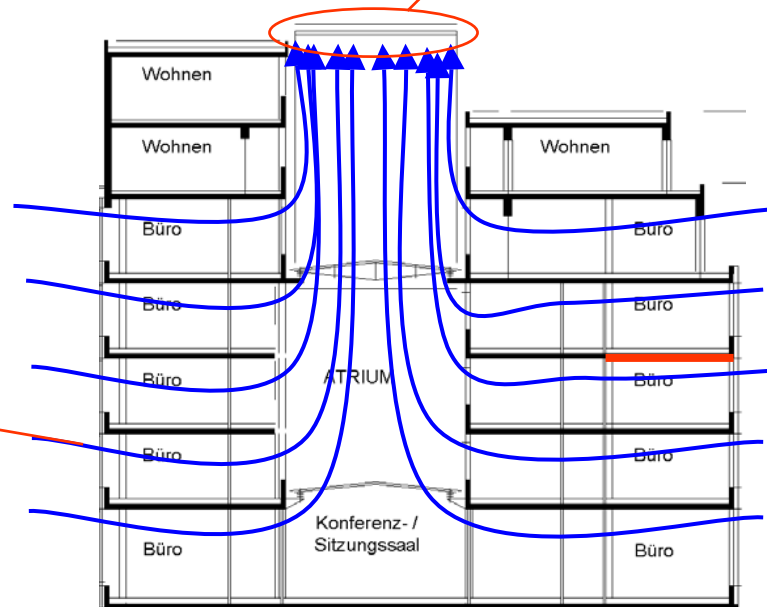
Source: RKW Architekten Frankfurt am Main und ip5 - ingenieurpartnerschaft

Passive cooling

Night ventilation with stack effect



KfW Frankfurt

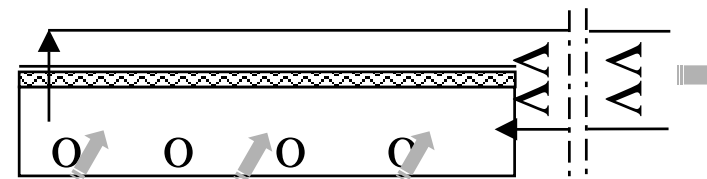


Passive cooling

Earth-to-air heat exchangers

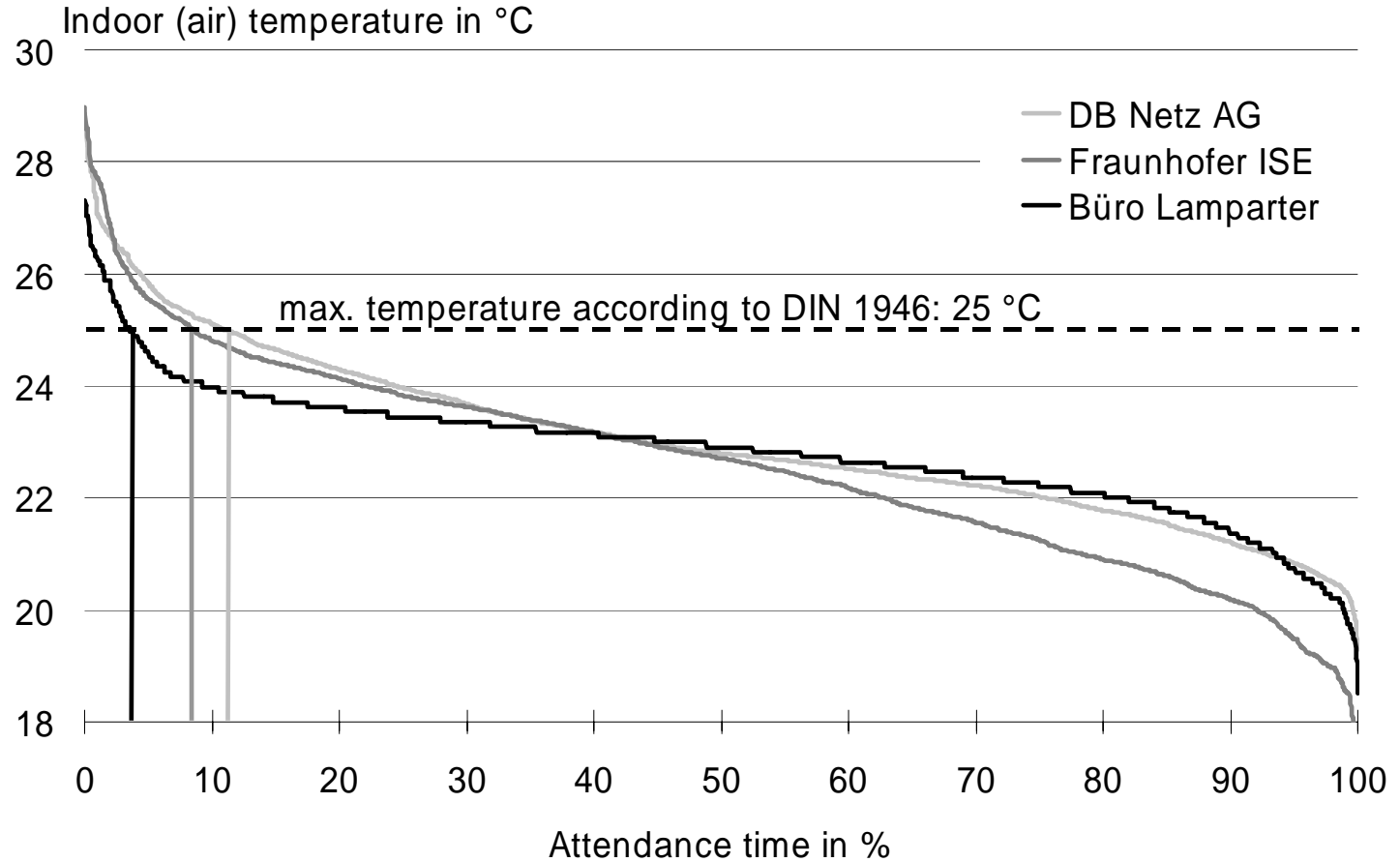


Activating internal building mass



Slab cooling with ground water

Passive cooling - Resulting indoor air temperatures of three projects over a period of one year



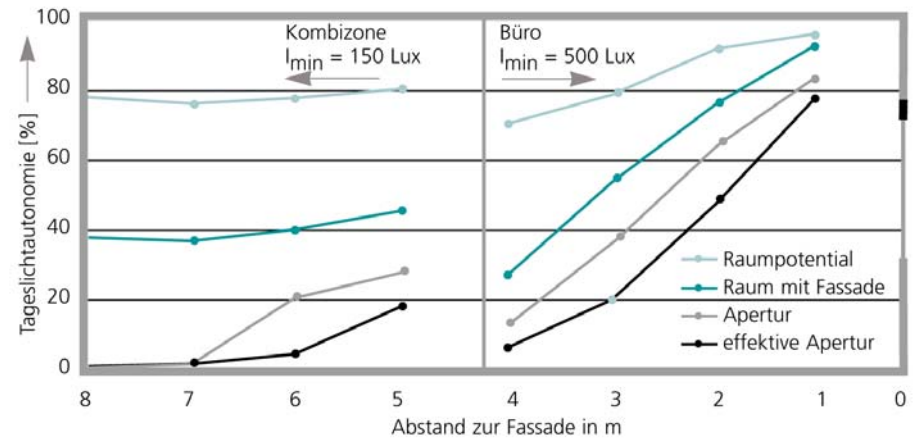
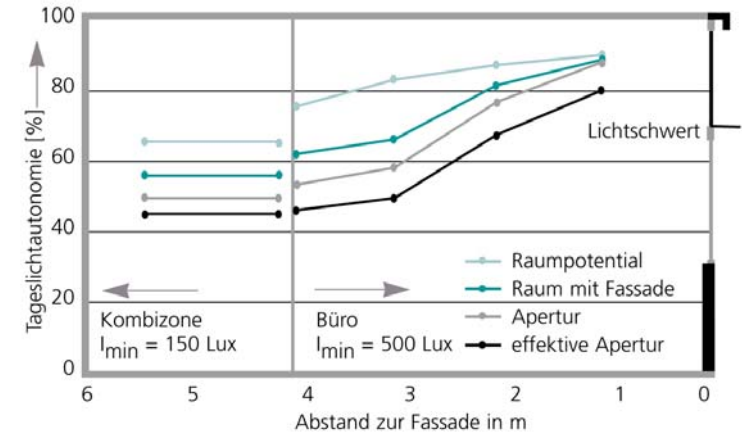
Lighting - daylight autonomy



Lamparter



DB Netz AG



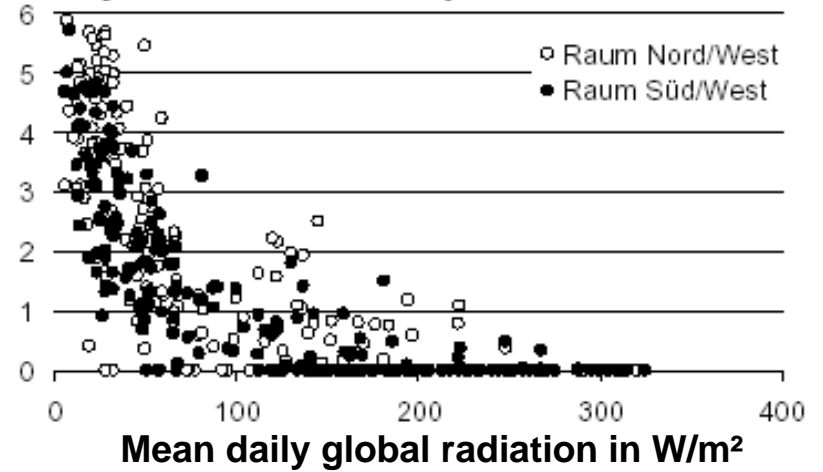
Lighting -

Electric power demand for artificial lighting as a function of global radiation

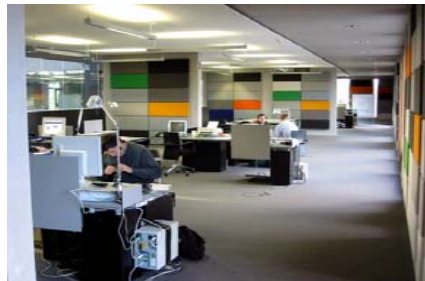
Lamparter



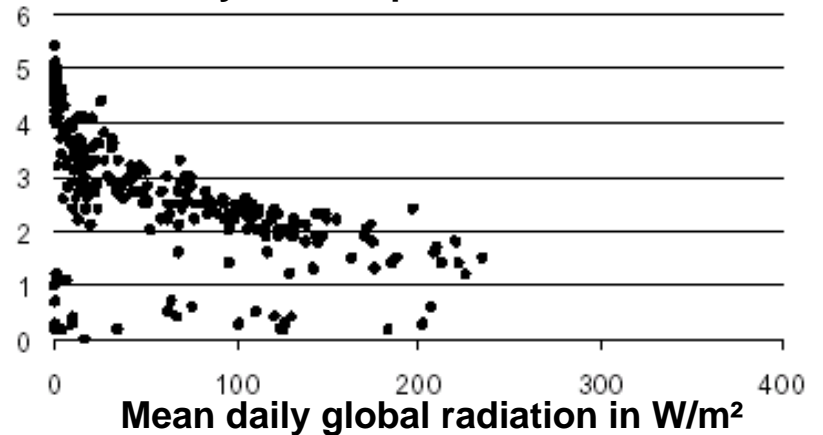
Mean daily electric power demand in W/m²



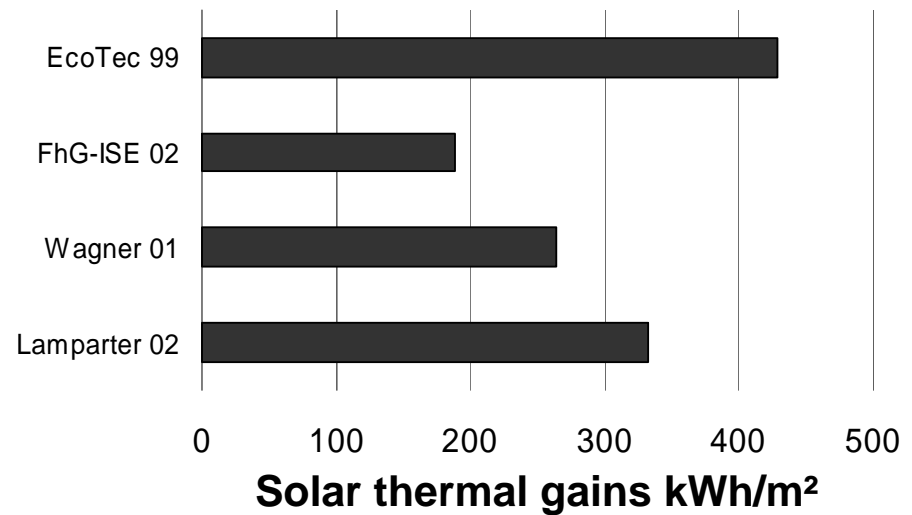
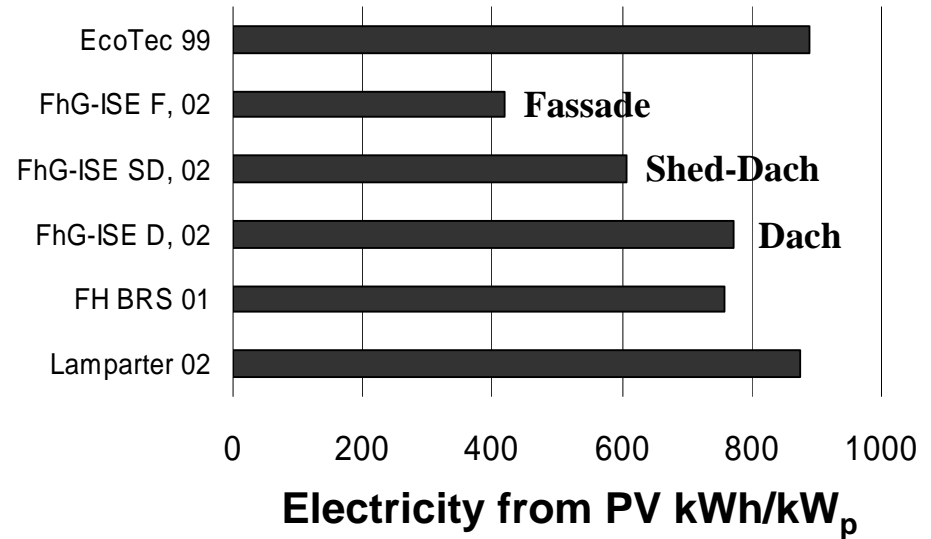
Pollmeier



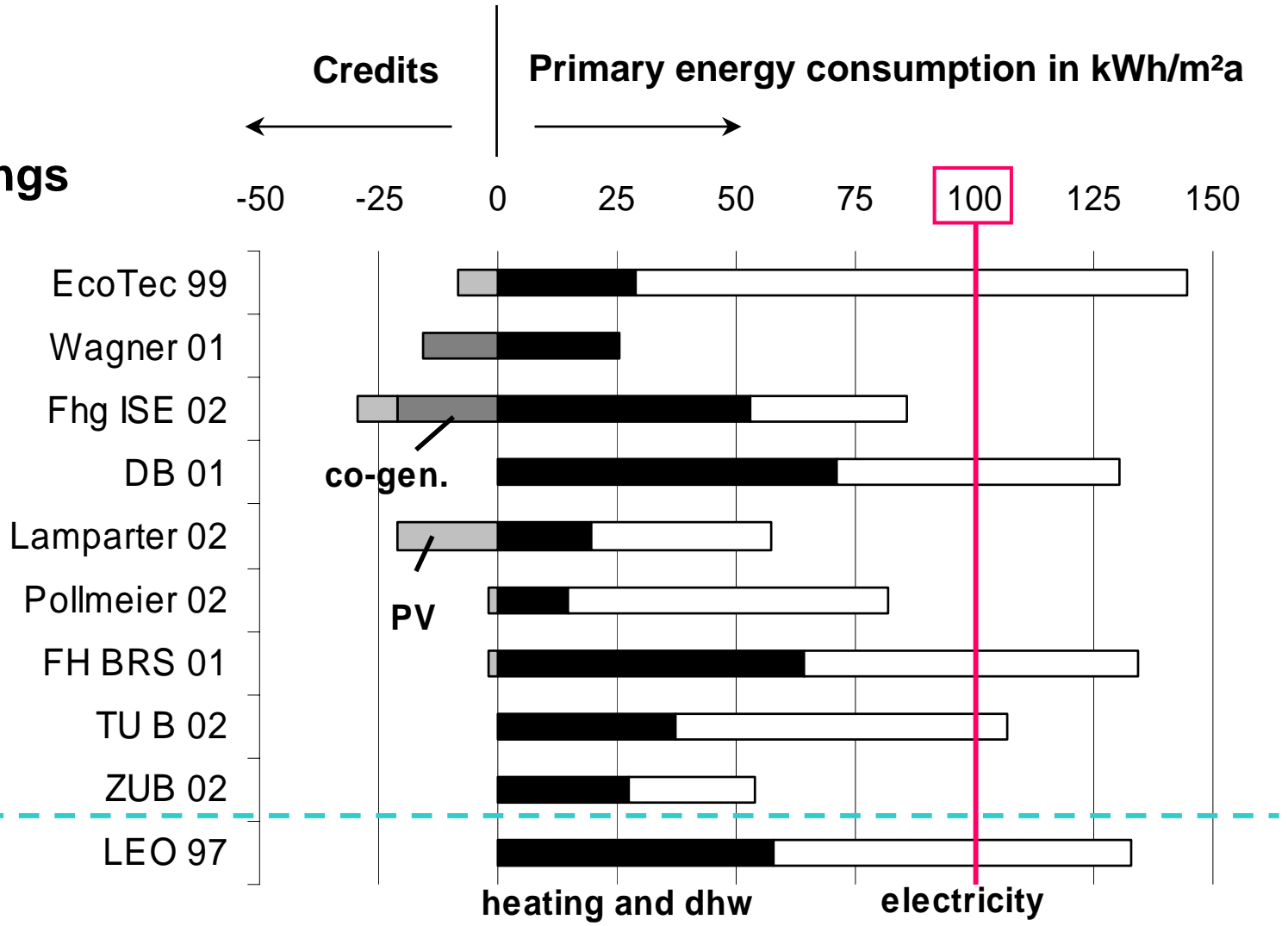
Mean daily electric power demand in W/m²



Solar Systems



Primary energy consumption of monitored buildings

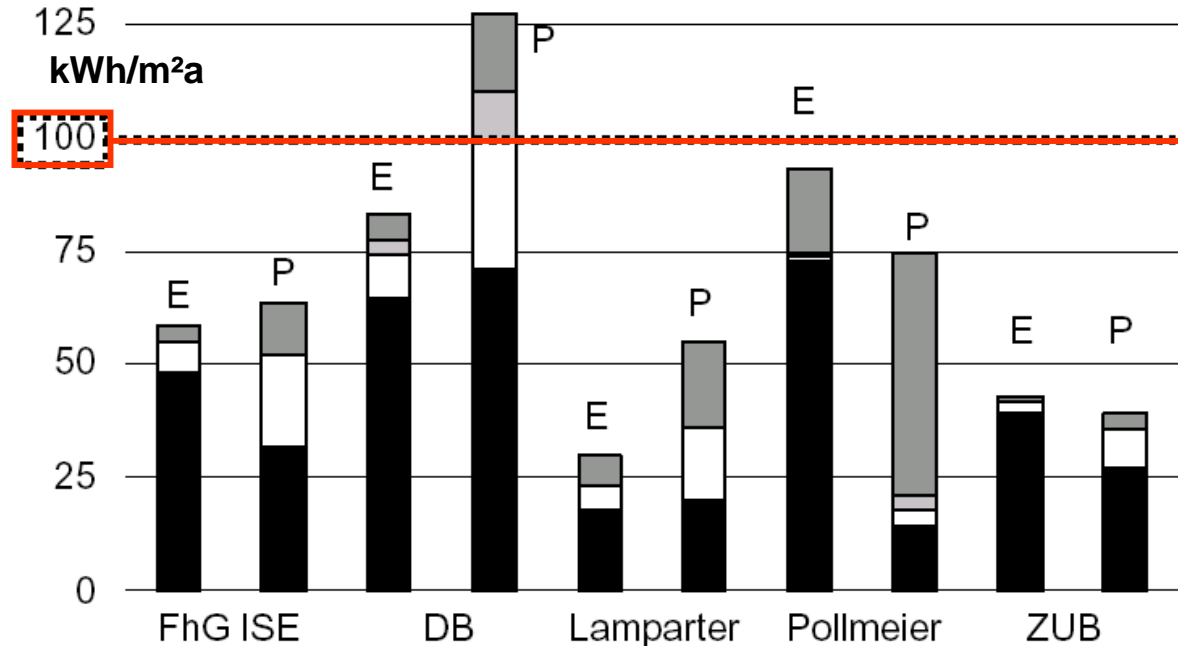


Energy consumption

for lighting, cooling, ventilation and heating



E: End energy
P: Primary energy



■ lighting	3,7	11,1	5,7	17,1	6,2	18,6	18,0	54,0	1,3	3,9
■ cooling	0,0	0,0	3,5	10,5	0,0	0,0	1,1	3,2	0,0	0,0
□ ventilation	6,8	20,4	9,6	28,8	5,5	16,5	1,0	3,0	2,7	8,1
■ heating	48,1	31,6	64,5	71,0	18,0	19,8	72,9	14,6	39,0	27,3
total	59	63	83	127	30	55	93	75	43	39

Conclusions

A primary energy consumption of less than 100 kWh m⁻²a⁻¹ can be achieved with investment costs that are comparable to conventional projects

Low heating energy and passive building standards are transferable to commercial buildings, low electric energy demand is a real challenge

Passive cooling strategies showed promising results, robustness of concepts has to be improved, because no back-up is available in case of unusual situations

A better quality assessment of the planning and building process as well as of the operation of the building has to be achieved for a maximum of workspace quality

...

Ambitious energy targets and high work space quality can go hand in hand very well with high quality architecture



