

Passive House Office Building EnerGon

7 Years of Operation under Changing Terms of Use

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HEAT ENGINES AND ENVIRONMENTAL PROTECTION
The Role of Renewables in Energy Generation
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Sustainability means, to do something long term, without detriments



Structure

- 1 Passiv House EnerGon
- 2 Evaluation research
- 3 Measuring results
 - Measuring results for the whole building
 - Measuring results technical buildings equipment
 - Comfortableness
- 4 Costs analysis
 - Building costs
 - Operating costs



Building data



- Address: Lise-Meitner-Str. 14, D-89081 Ulm
- Storey: 5
- Surface/Volume ratio: $0.22 \text{ m}^2/\text{m}^3$
- Main usable floor area: $5\,412 \text{ m}^2$
- Gross volume: $32\,223 \text{ m}^3$

Implementation of the monitoring

- 2001–2006
Peter Obert, Gunter Lindemann
Steinbeis-Transferzentrum Energietechnik Ulm
within the scope of the SolarBau:MONITOR
program (support label Fkz 0335007G) of the
ministry for economy and technology.
- 2007–2012
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(Hamburg)

supported by the University of Applied
Sciences, Ulm



Figure: Atrium, interior view

Task of research

- Operation under changing terms of use
- Evaluation of different simulation programs under realistic conditions
e.g. PrimeroLicht (Daylight-simulation), Raummodell
(3-dimensional room simulation with focus to energy and comfort,
included stratification of air,
public domain: www.rom-umwelt-stiftung.de)
and others

Building services engineering

- Atrium as fresh air distributor
- Tempering
with thermal active concrete
core
- Heating
 - waste heat of cooling units
in kitchen and IT areas
 - District heating
(approx. 80 % biomass)
- cooling by 40 geothermal
earthprobes

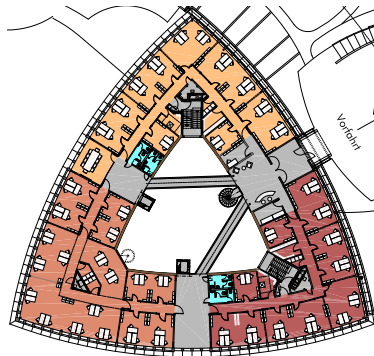


Figure: Entrance level

Measuring results for the whole building

Table: SolarBau demands and results, oriented on the net floor space

		SolarBau- demands	EnerGon
Heat consumption	kWh/m ² a	< 40	12.3
Energy demand ^a	kWh/m ² a	< 70	44.3
Primary energy demand (according to CO ₂ -emission)	kWh/m ² a	< 100	72.6

^awhole technical buildings equipment, incl. illumination

Measuring results technical buildings equipment: geothermal probes

Funktion

- 40 geothermal probes, each 100 m deep
- preheating of fresh air and cooling of concrete core just by water circulation between fresh air resp. concrete core and earth.

Without a heatpump!

Measuring results technical buildings equipment: geothermal probes

- Air preheating: approx. 50 MWh/a
- Concrete core cooling: approx. 120 MWh/a
- **Annual COP:** approx. $12 \text{ kWh}_{\text{therm}}/\text{kWh}_{\text{el}}$

Measuring results technical buildings equipment: Heat recovery

- **Special: imbalance**
 - Fresh air current: 28 000 m³/h
 - Exhaust air current: 18 600 m³/h
 - Difference: **exhaust air from kitchen** 9 400 m³/h
not participating in heat recovery!
- **Heat recovery rate** Φ (Nov. 1st 2004 to March 1st 2005): **51 %**
Variation: 43–62 %
- **Annual COP**: approx. 21,5 kWh_{therm}/kWh_{el}

Measuring results technical buildings equipment: concret core tempering

- Heat supply:
 - priority use of waste heat out of cooling units in IT equipment and kitchen (food-cooling chamber)
 - secondary use of district heating (approx. 80 % biomass)
 - measured maximum flow temperature in the heating period: **25 °C**
- cooling:
 - exclusive by geothermal probes
 - measured minimum flow temperature in the cooling period: **19 °C**
- specific electricity consumption: **approx. 1 kWh/m²a**

Measuring results use of electricity

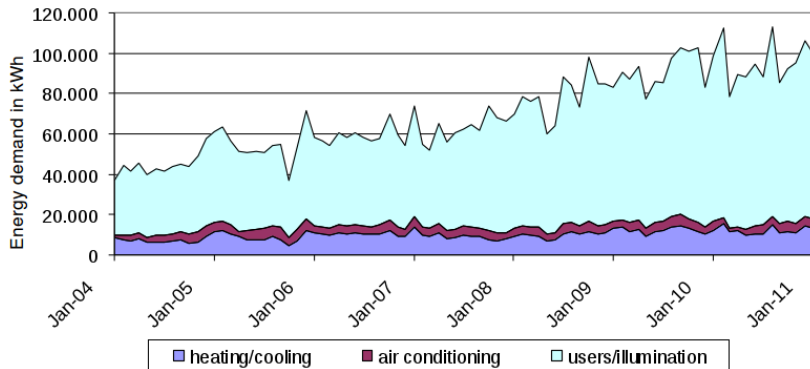


Figure: Energy demand of building services and tenants

Measuring results use of waste heat

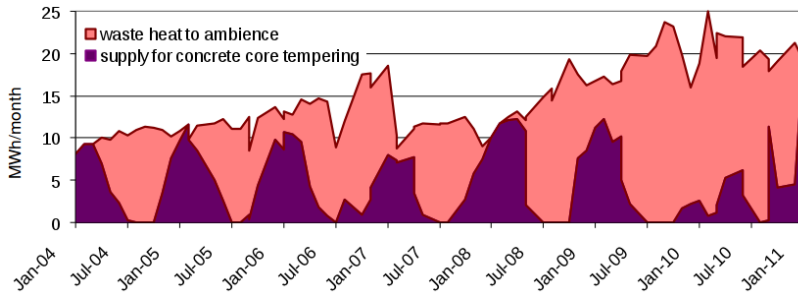


Figure: Exposure of the cooling units of heat supply

Measuring results soil temperature

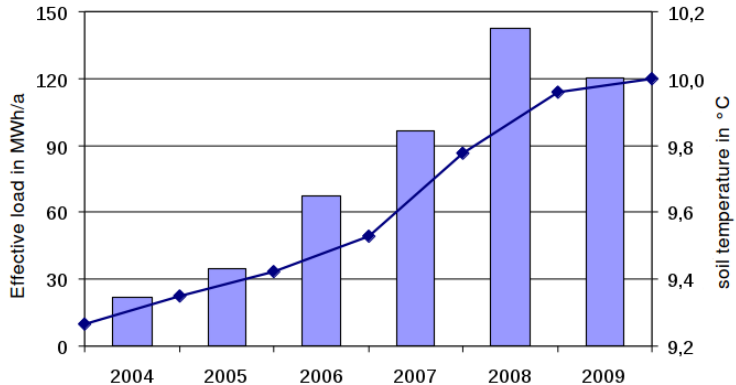


Figure: Development of the total soil temperature

Measuring results soil temperature

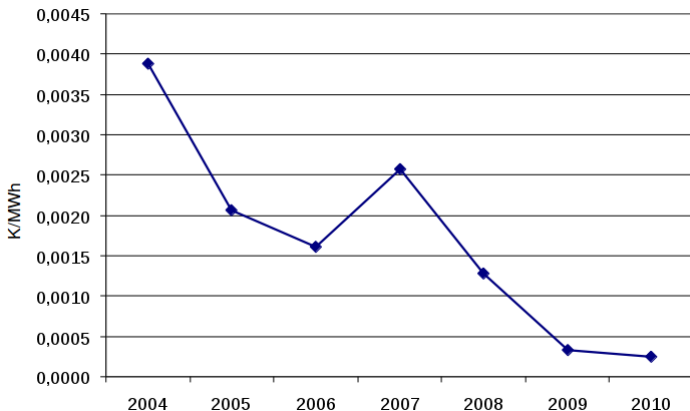


Figure: Specific warming and obvious saturation

Measuring results room climate summer/winter

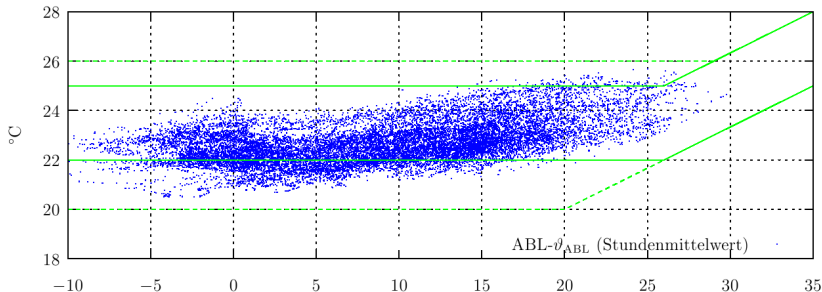


Figure: Room temperatures (hourly average) vs. outdoor temperatures, over 2 years of measuring

Measuring results air quality

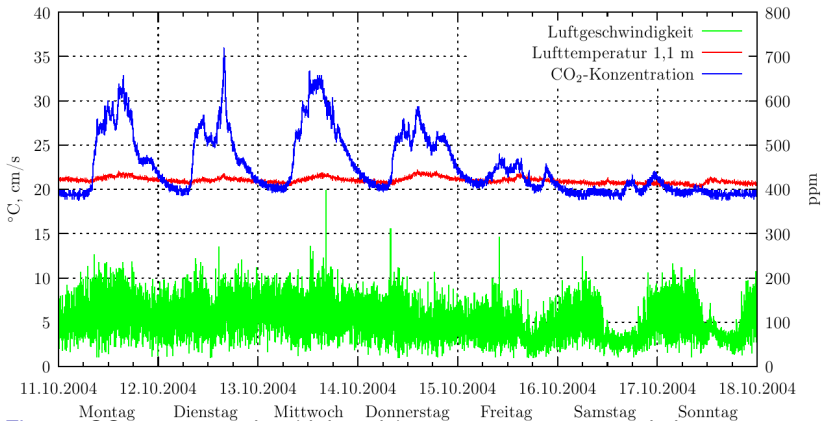


Figure: CO₂-concentration (right axis), room temperature and air movement (left axis) in an office

Costs analysis: building costs

- building costs of usual office buildings:
 - lowest level: simple buildings, poor comfort
approx. 1200 € per m² net floor space
 - highest cost range: high comfort, highly automated, handicapped accessible etc.
approx. 2000 € per m² net floor space
- EnerGon: high comfort, highly automated, handicapped accessible
by cost group KG 300+400 (contains planning costs)
accounted building costs: 1688 € per m² net floor space



Costs analysis: operating costs

Table: Operating costs EnerGon in comparison with OSCAR¹
in €/m² net floor space

	EnerGon	OSCAR
Current	0.40	0.36
Heating (district heating)	0.15	0.48
Maintenance + supervision	0.68	0.77

¹Office Service Charge Analysis Report

Summary

- EnerGon meets the expectations of heating demand and comfort
- The construction cost of EnerGon, compared with similar comfortable buildings, are moderate
- The operating costs are evident lower than of similar comfortable buildings

Project Members



- Building owner:
Software AG-Stiftung (foundation), D-64297 Darmstadt
- Architecture, construction documentation:
oehler faigle archkom, D-75015 Bretten
- Energy planning, building physics:
ebök engineering office, D-72072 Tübingen

Final report of monitoring

Final report of monitoring (124 pages, approx. 10 MB) can be downloaded at

[http://www.enob.info/fileadmin/media/
Publikationen/EnBau/Projektberichte/
17_MonitoringAB1_p2_Energong_k.pdf](http://www.enob.info/fileadmin/media/Publikationen/EnBau/Projektberichte/17_MonitoringAB1_p2_Energong_k.pdf)