Energy-efficient office buildings

In brief

- Energy-efficient design principles have recently become more popular in office buildings.
- So far, there is little research on how the various measures for extremely low energy consumption affect the well-being of building users.
- Preliminary results of an ITA study show that people working in the surveyed office buildings are very satisfied with the indoor climate and other workplace conditions even at ultra-low energy consumption.

What is it about?

Buildings have large potential for improving energy efficiency. Whilst ultra-low energy standards have become quite common in Austrian domestic buildings over the last 15 years, highly efficient office buildings found acceptance only recently. So far, specific energy consumption in office buildings was significantly higher than that in residential buildings. Optimal indoor climate usually involved high levels of energy consumption. This, however, is to change in the future.

So how does extremely low energy consumption affect the reported satisfaction of building users? In order to get initial answers to this question, we studied two ultra-energy-efficient buildings, a newly constructed building and a renovation project. Both buildings feature several up-to-date energy efficient technologies and concepts.

The new building, called ENERGYbase, is an office building in Vienna with 7,500 m^2, which was developed as part of a research project. The Vienna Business Agency built the building in 2008 and equipped it, amongst other things, with solar and heat pump technology, an automated ventilation and solar cooling system, and a rooftop wind turbine. The building is certified according to passive house standards, with the actual energy requirement per square meter per year being less than 10 kWh.

Also investigated was the main building of *Energie Steiermark* in the city of Graz (E-Office) – a ten-story office building from the 1960s which has been completely renovated and partially extended. The construction work was completed in 2010. The E-Office is equipped with photovoltaic and solar thermal panels, a heat recovery ventilation system and features highly efficient lighting technology. The heating energy consumption meets low-energy standards (approximately 23 kWh per square meter per year).

Photo: Hertha Hurnaus

ENERGYbase (case study Vienna)

User satisfaction was studied by means of a written questionnaire and a total of approx. 20 detailed semi-structured interviews. Furthermore, numerous interviews with architects, building services planners, facility managers and the owners were carried out. In addition, field observations and existing studies and monitoring data were taken into account.

Basic data

Project title:	Build to satisfy
Project team:	Ornetzeder, M., as part of a consortium led by J. Suschek-Berger (IFZ Graz)
Duration:	02/2012 – 01/2014
Funded by:	Austrian Federal Ministry for Transport, Innovation and Technology (bmvit)

Key results

Findings from the two case studies show that low levels of energy consumption in office buildings can be aligned with high levels of user satisfaction. Efficient heating and cooling systems and efficient use of electricity do not necessarily mean 'downsides for occupants'. On the contrary, it is possible to provide conditions in modern energy-efficient buildings that are even superior when compared to conventional office buildings, with significantly lower operating costs.

The users of the ENERGYbase are particularly highly satisfied with the perceived indoor climate. Although there are no options for individual control of the room temperature in this building, users appreciate the relatively constant conditions provided over the year. Only the inadequate ventilation capacities in meeting and seminar rooms are perceived as inadequate.

Open-plan offices in the ENERGYbase (Vienna)

Mainly due to very dry air in the winter months, the average level of satisfaction in the E-Office was considerably below the level of the ENERGYbase building. However, by installing a technical extension to the ventilation system, the building operators rectified this problem shortly after the study had been completed. The facility management also reduced initial problems with excessive noise in larger open-plan offices by means of subsequent adjustments.

In general, the study shows that high levels of user satisfaction are based on sound planning and construction of the buildings. Later, however, during the operating phase, well-coordinated interaction between facility management, building technology, and individual user needs is necessary.

What to do?

The two objectives – extremely low energy consumption combined with highly satisfied users – can only be achieved if they are jointly pursued at the start of the planning phase and throughout the building's operating life. For this it is necessary to consider different strategies and measures at different stages of the development.

- **Recommendations for the planning phase:** From the outset, a coherent overall approach should be adopted. The organisation of the planning should be based on the concept of 'integrated planning'. In addition, highly efficient office buildings need energy-related quality control starting at the design phase and encompassing the detailed planning and construction phases as well as the handover phase of the building. Planning coordinators may take the lead on this particularly important function.
- **Recommendations with respect to the indoor climate:** The building should allow for a constant indoor climate. Users perceive a gradual adaptation to the outside temperature as pleasant. Relative humidity should always be higher than 40 %. Acoustic comfort in office buildings is also very important for user satisfaction.
- **Recommendations for building operation:** Facility management is of particular importance where optimisation of energy consumption and user satisfaction is concerned. However, modern green office buildings require new competencies which must be considered in the future when training facility managers.

Further reading

Ornetzeder, M.; Wicher, M.; Suschek-Berger, J. (2016) User satisfaction and well-being in energy efficient office buildings: Evidence from cutting-edge projects in Austria. Energy and Buildings, Vol. 118, pp. 18-26.

Contact

Michael Ornetzeder

Email: tamail@oeaw.ac.at

Phone: +43(1)51581-6582

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