

STRUCTURE SHORT REPORT

Title

Extended version title: „energy+Home2.0 – Efficiency House Plus in the building stock - comparative technological, ecological and economic investigation of conversion of two inhabited, identical multi-storey apartment buildings“

Occasion/ initial situation

The climate-neutral building stock by 2050 can't be achieved with the current measures. At the same time, there are currently a million apartments missing. A key potential lies in multi-storey apartment buildings from 1949-1978. Since they are mostly rented and inhabited, the refurbishment rate is low. So far, there is a lack of solutions and the knowledge of how to lead them energetically, ecologically and economically meaningful into the future.

Object of the research project

At energy+Home2.0 it will be shown how a CO₂-neutral energy supply can be economically implemented for a representative multi-storey apartment building of the building age class 1949-1978 and can be combined with the creation of new living space without additional land sealing. An architectural enhancement of the external appearance and internal structure accompanies the transformation into an emission-free, contemporary residential building. Based on two inhabited building typologically representative multi-storey buildings (built in 1956), three different scenarios are developed and investigated:

- Refurbishment according to the Energy Saving Ordinance
- Refurbishment to the Efficiency House Plus according to BMU
- Increase and refurbishment to the Efficiency House Plus according to BMU

If the results are positive, the measures should be implemented on a reference building in Darmstadt-Eberstadt as a generalizable demonstrative project.

The findings on "energy+Home1.0", the first refurbishment of a detached house into an Efficiency House Plus with electro mobility, forms the basis of the research project. It was realized in 2011 and examined for its ecological and economic quality.

The present project is carried out based on the following work packages:

[WP 1] Basic evaluation

In the first step, both the study buildings and the settlement are analysed and documented. These include the building regulations, measurements and the inclusion of building geometry and plant technology. On this basis, the energetic quality of the investigation buildings is determined. Based on the building reception, potentials and obstacles for the further development of inhabited apartment buildings can be identified and the scenarios worked out.

[WP 2] Development and energetic investigation of three scenarios

Three alternative refurbishment scenarios are being developed for the study buildings. The refurbishment according to the Energy Saving Ordinance represents the legally required minimum. The refurbishment to the Efficiency House Plus according to BMU

represents a future-oriented strategy. The third, also future-oriented scenario is to combine the refurbishment to the Efficiency House Plus with the creation of new living space by increasing the building. The energy balancing takes place according to DIN 18599.

[WP 3] Ecological investigation

The environmental quality of the scenarios is examined by means of a life cycle analysis. It will be shown if the additional costs for the refurbishment to the Efficiency House Plus compared to the existing stock and an EnEV refurbishment are ecologically balanced. In addition, the environmental impacts of different building structures can be evaluated over the life cycle, which can be used as a transparent basis for decision-making in the planning process.

[WP 4] Economic investigation

Will the additional costs of the Efficiency House Plus be amortized over the life cycle of the EnEV scenario? Does the increase and / or refurbishment to the Efficiency House Plus represent a serious alternative from a real estate economic perspective? For each scenario, a life cycle cost analysis is created using the net present value method.

[WP 5] Increasing efficiency

Creative solutions should always be found in inhabited old buildings with predetermined structures and limitations. By way of example, possibilities for increasing the efficiency are investigated:

- Integral facade
- PV air collector
- PV-battery storage
- Electric mobility
- User interface.

[WP 6] Comparison of the results

A comparison of the energetic, ecological and economic parameters serves investors, builders and planners as a decision support for future refurbishments. At the same time, it is one of the foundations of potential analysis.

[WP 7] Transferability and potential analysis

The representativeness of the study buildings for multi-storey buildings of the building age class 1949-1978 and thus also the transferability of the concept are proved. On this basis, the environmental impact of transferring the concept to comparable buildings in Germany is estimated and the contribution to the German climate targets is forecast.

Conclusion

The aim was to demonstrate a transferable scenario for the economically and ecologically reproducible development of inhabited multi-storey buildings (built 1949-1978) to Efficiency Houses Plus on a reference building. The connection with an increase creates four additional apartments. The annual primary energy demand is -38 kWh/(m²a), the annual final energy demand is -8 kWh/(m²a). Greenhouse gas emissions are reduced to -268 kg CO₂eq/(m²_{NGFA}a). The energy-related additional costs amount to 187 €/m²_{BGF}. The costs are about 60% higher than with an EnEV renovation. Nevertheless, the standard achieves a net present value of 730 €/m²_{BGF} through the minimum of energy costs.

Key data

Short title: Energy+Home2.0

Researcher / project management: Prof. Dr.-Ing. Karsten Ulrich Tichelmann, Annekatriin Koch, M. Sc.

Total cost: 264.444,84 €

Share federal subsidy: 108.222,42 €

Project duration: 33 months

PICTURES:

Bild 1: Bild 1_Die Referenzgebäude in Darmstadt-Eberstadt repräsentieren den bewohnten Geschossbaubestand der Baualtersklasse 1949-1978.jpg

The reference buildings in Darmstadt-Eberstadt represent the residential building stock of the building age class 1949-1978

Bild 2: Bild 2_Szenario 1 - Sanierung nach Energieeinsparverordnung.jpg

Scenario 1 - Refurbishment according to the Energy Saving Ordinance

Bild 3: Bild 3_Szenario 2 - Sanierung zum Effizienzhaus Plus.jpg

Scenario 2 - Refurbishment to the Efficiency House Plus

Bild 4: Bild 4_Szenario 3 - Aufstockung und Sanierung zum Effizienzhaus Plus.jpg

Scenario 3 - Increase and refurbishment to the Efficiency House Plus

Bild 5: Bild 5_Die Aufstockung besteht aus seriell vorgefertigten Holzelementen.jpg

The increase consists of serially prefabricated wooden elements

Bild 6: Bild 6_Das Energiekonzept zu Szenario 3_Aufstockung und Sanierung zum Effizienzhaus Plus.jpg

The energy concept for Scenario 3_Increase and refurbishment to the Efficiency House Plus