



# **Living in Efficiency Houses Plus**

## **Results of two studies**

### **Summary**

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In 2011, the German federal government began to fundamentally restructure the country's energy supply, with the aim to phase out nuclear energy by 2020. Against this background, the Federal Ministry of Transport, Building and Urban Development (BMVBS), part of the research initiative "Future Building," initiated the development of highly energy efficient buildings (the "Efficiency House Plus Standard"). This project has been continued by the Federal Ministry for Environment, Nature Conservation and Nuclear Safety building (BMUB), since 20014.

The first step of the research program was the implementation of the "Efficiency House Plus with Electric Mobility" in Fasanenstrasse 87A in Berlin. This was followed by the implementation of the "Efficiency House Plus Standard" on 35 single and multi-family houses, as well as a project in the renovation of old buildings. Among these, suppliers of prefabricated houses, a multi-generational housing project and two holiday apartments were encouraged as part of the so called network "Efficiency House Plus Standard". The model projects reflect a variety of architectural styles, and high and low-tech buildings.

Efficiency Houses Plus are buildings that generate more energy as they need it. All model houses have been, or will be subjected to technical and social science monitoring.

The social-scientific monitoring provides insight as to what extent the concepts are suitable for everyday use, and how satisfied their inhabitants are with their houses. Of particular interest is the acceptance of implemented technologies by their users, and whether and how living in an Efficiency House Plus affects energy usage patterns.

Two studies will be presented: the social monitoring of the Berlin "Efficiency House Plus with Electric Mobility," as well as the results of the study on clients living in houses with "Efficiency Plus Standard". Both studies were conducted by the Berlin Institute for Social Research (BIS).

### **Efficiency House Plus with Electric Mobility**

Since it began in 2012, the "Berlin Efficiency House Plus with Electric Mobility" has undergone a long-term live test. Two families have lived in the house for 12 or 15 months. As part of the social scientific research both families were regularly surveyed using questionnaires and interviews. The key questions were: What is the inhabitants' assessment of the building (architecture, indoor climate)? How do they cope with the building services and their control? How is electric mobility used in everyday life and how practical is it? How do they consume the energy produced by the house? What problems did they face during the test period?

Both families felt very comfortable living in the house. The size and layout of the

building met their needs; the interior design was appealing, and the house was cozy. The overall room climate (temperature, humidity, air freshness) was considered to be adequate, although there were some problems.

Among the problems that had to be addressed was the air-water heat pump, that broke down several times during the first test period. A thermal separation of the two floors helped to ban a 'chimney effect', which had led to overheated upper rooms in summer and had kept the warmth inside the livingroom.

One problem that was not solved was that sometimes the house became too warm in summer. Both families wanted – in addition to the ventilation system - to have the possibility to open a window on the street side to enable some ventilation. Apart from that both families described the ventilation as powerful and reliable working. Although they did mention a latent background noise, and lower humidity during the heating season.

Both families criticized the fact that the sensor-based ventilation control could not be regulated manually. On the other hand, both families found that the control of home automation via touch panel and smartphone was largely intuitive; only the setting of scenarios needed an introduction. They greatly appreciated being able to monitor the house via smartphone when they were out.

The electric or hybrid vehicles were used by both families mainly to take their children to school in the neighborhood, and also for longer trips. For urban daily mobility, the purely electrical powered vehicle worked very well. For longer distances, the hybrid vehicle, with additional engine capacity, proved to be the most practical, because the fast-charging network is not yet developed sufficiently and reliably nationwide.

The women especially appreciated the pedelecs, and used them for their daily commuting and for purchases. The charging by induction was both: simple to use and comfortable.

### **Survey of owners of the network "Efficiency House Plus Standard"**

The social scientific survey began in January 2013, and includes both qualitative and quantitative methods.

Since some construction projects have not yet or only recently been realized, even two years after the study began not all results can be presented.

The study aim was to find out whether the builders of Efficiency Houses Plus are a particular social group. Why do they move into this type of house? What are their expectations and fears? How do they evaluate the functioning and control of the building services and the quality of living? Does living in such a house change their everyday energy use?

The social background of the owners is quite homogeneous: Most of them are highly educated and in good professional positions. This demonstrates that only a certain social group is both willing and economically able to build such a house.

In terms of general attitudes towards technology, ecological principles and energy saving behavior, the builders are a tech-savvy, ecological and energy-conscious group.

These attitudes form the basis of their motivation to build an energy-plus house. In the foreground there are also ecological-economic reasons such as "to save energy", "to make a contribution to environmental protection," and "to be independent of the public power supply". In addition, the owners are fascinated by the modern technology implemented in the houses and they want to try something new.

The status-oriented motive, that they "wanted something that hardly anyone has" plays a subordinate role.

The idea to build an energy-plus house arose in almost all house builders during the planning process: most of them were planning energy efficient homes and then extended the standard to the "Plus" at the suggestion of architects, energy consultants, or home sellers. In some cases, participating in the development program: "Efficiency House Plus standard," led to an increase in the energy efficiency standards.

However during the planning and construction process, as well as the balancing of the building services, a number of problems had to be solved. For all parties involved, including the providers of prefabricate houses there was a lot of new territory. Here, some progress is likely to occur in the coming years, due to the growing experience with this type of construction in the crafts, and the pooling of knowledge on the planning level.

When asked about what expectations and fears builders had, and to what extent these became a reality, a expected lower energy consumption as well as reduced heating costs could be reached while living in the new building. The hope that one would have pride in one's own house occurred as well. But regarding the calculated and the actual energy balance, there were considerable deviations.

The regulatory options for heating and ventilation systems were positively assessed, both in terms of functionality and reliability.

The principle of an Energy House Plus encourages people to use highly efficient electrical appliances. Furthermore, it encourages them to operate devices when the energy production of the house is particularly high. The calculations on the energy produced, and the visualization of energy yield and consumption seem to create a greater energy awareness and to promote more economical consumption. In the interviews an increase in energy awareness became apparent, and a growing ambition to make do only with the energy produced from the house.

The aim of the greatest possible self-sufficiency of external energy supply has been largely achieved. The energy produced by the house is sufficient for the residents throughout the year. On the other hand, complete self-sufficiency is still lacking, because the storage facilities are not powerful enough to cover less "energy-efficient" phases of the year.

The results of both studies show that living in an Efficiency House Plus can be highly comfortable and brings no loss of itself. Living in such a house gives the energy issue a strong presence in everyday life and promotes the most efficient use of resources. This proves that the "Efficiency House Plus" adequately realizes the main motivations to build such a house: to save energy, protect the environment and be independent of fossil fuels and their pricing.