

Better than new buildings – best practices turn into national standard

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Abstract

Today an average existing residential building in Germany demands three times as much energy for space heating as a new building. Despite rising energy prices more than half of the economical energy saving potential stays untouched during refurbishment processes. Therefore dena supported by the Federal Ministry of Transport, Building and Urban Affairs initiated the project “Efficient Homes” (the German name of the project is “Niedrigenergiehaus im Bestand”). The strategy of implementing nationwide standards for existing residential buildings that are higher than the federal requirements for new buildings will be the focus of the paper.

The project relates to more than 143 existing buildings being refurbished since 2003, partly using highly innovative passive-house-technology. These buildings cover the whole spectrum of residential buildings from single family homes (containing one dwelling unit) as far as multi-family dwellings (containing 295 dwelling units). On average these renovated buildings demand more than 50 % less energy than federal minimum requirements for new buildings. The “Efficient Homes”-project objectives are:

- Development and testing of innovative and cost-effective low-energy standards
- Strategies for launching these standards and innovative techniques

- Know-how-transfer to all stakeholders (e.g. building owners, architects)

The refurbishment projects and the transferable, economical renovation-recommendations have a role-model-function: 2003-2005 33 buildings, 2005-2006 another 110 buildings. To strengthen this effect, dena has created a successful network of regional competence-centres. The nationwide PR accelerates know-how-transfer and the launch of innovative technologies.

Further steps: in 2007 the standards of the “Efficient Homes”-project will be implemented in a nationwide federal promotion programme. This leads to about 500 additional buildings per year from 2007 onwards. dena will accompany introduction and further development of these standards. The “Efficient Homes”-project will be expanded from residential to non-residential buildings (starting with schools and kindergartens in 2007).

Introduction

More than three quarters of the residential buildings in Germany were built before 1978 (see Figure 1). In average, these buildings demand about 225 kWh/m²a energy¹, which is evidently more than the energy demand of new buildings. Thus these buildings provide a large potential for increased energy efficiency. About 35 per cent of the dwelling stock is currently in the middle of its first renovation cycle. 28 per cent of the residential building stock is already facing its second renova-

1. Final energy demand for space heating and domestic hot water.

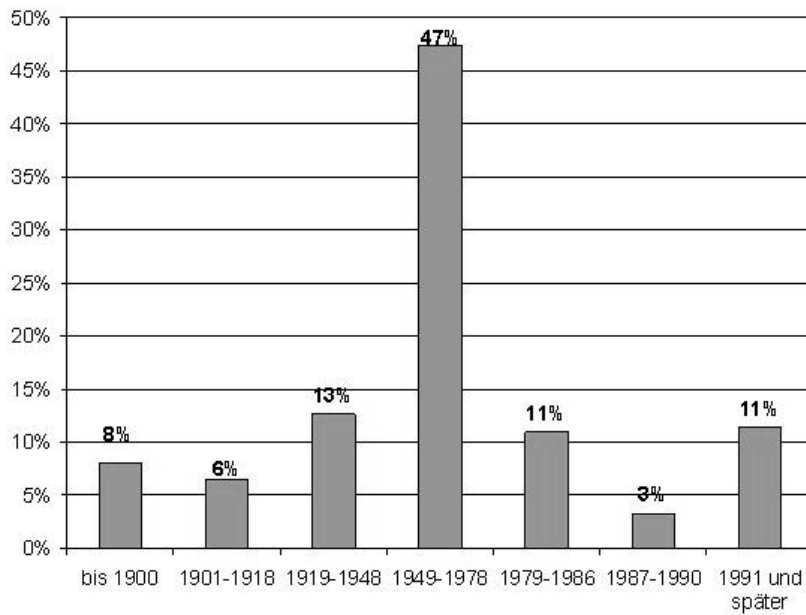


Figure 1. Age structure of residential buildings in Germany. (dena/Federal Statistical Office Germany, 2006)

tion cycle. Hence, about 50 per cent of the building stock will be renovated during the next twenty years.

The focus has to be set on the efficiency of these renovations, which is so far rather low. This means that in the vast majority of modernization processes only a minority of reasonable measures leading to an increased energy performance is being conducted.

Development – “Efficient Homes”

At present, an average of three times the energy required to heat a new building is used in older buildings. Yet despite rising energy prices, building refurbishment projects are still not

exploiting energy savings to their full potential. Over half of the economically feasible potential currently remains untapped after renovation. The Deutsche Energie-Agentur (dena) therefore initiated the project “Efficient Homes”, which can be traced back to a recommendation of the German Council for Sustainable Development.

The project commenced in November 2003 with the aim of using best practice projects to stimulate the transfer of knowledge, and to publicize and enhance innovative technologies for the energy renewal of buildings. Adaptable, economically feasible refurbishment recommendations invite emulation.

The result should be a more forceful introduction to the market of emerging energy-saving technologies for refurbishment, ensuring profitability in the medium term even without subsidization. Regional competence networks are initiated and supported to increase the multiplier effect of efficient refurbishment.

There are now 143 buildings (see figure 2) comprising 2,230 residential units in over 138,000 sqm taking part in the project. Around 49 % of the buildings belong to the housing industry, and the remaining 51 % are private properties (24 % private landlords and 27 % owners of single-family and two-family homes).

The building owners participating in the „Efficient Homes“-project can choose between two energy standards which were developed based on experience gained in the pilot phase. These standards are formulated in relation to state minimum requirements for new buildings as defined in the Energy Saving Ordinance (EnEV-N, in German “Energieeinsparverordnung”):

- “EnEV-N minus 30 %” the so called “efficiency standard” and
- “EnEV-N minus 50 %” the so called “future standard”

The German minimum requirements are referring to the primary energy demand of a building. Hence, in colder areas of the country buildings need better insulation to comply with minimum requirements. However it is possible to apply for



Figure 2. Spread of project participants over Germany. (source: dena, 2006)

Component	before refurbishment	measures taken	after refurbishment
exterior walls	1,27 W/(m²K)	15 cm insulation	0,20 W/(m²K)
roof	0,97 W/(m²K)	20 cm insulation	0,17 W/(m²K)
basement ceiling	1,19 W/(m²K)	10 cm insulation	0,28 W/(m²K)
thermal bridges	0,10 W/(m² _{surface area} K)	standard measures	0,05 W/(m² _{surface area} K)
windows	3,20 W/(m²K)	two-pane-heat-insulating glazing, conventional windows	1,1 W/(m²K)
ventilation	natural ventilation	ventilation with heat recovery	system efficiency > 80 %
heating systems	steady temperature boiler	new boiler, regulated pumps	condensing boiler

Figure 3. Possibilities how to reach the Low Energy Standard. (source: dena, 2006)

exceptions in case of conservation of ancient monuments. These applications are handed forward to a panel of experts discussing and checking the suggested solutions for each listed building.

The Federal Promotional Bank (KfW Förderbank) supports building owners willing to renovate their buildings to national minimum requirements. These building owners can apply for a low interest loan. Building owners participating in the “Efficient Homes”-project and hence modernising their buildings to higher energy standards than national minimum requirements are given special financial support offered as additional incentive.

The buildings are being refurbished as “low energy houses” (according to the energy standards at least 30 % or 50 % better than a comparable new building), in some cases using highly innovative passive house components which have until now generally been reserved for new buildings. Refurbishment has already been completed in some of the buildings.

The measures in Figure 3 are mentioned as examples how to reach the energy standards mentioned above.

Results – “Efficient Homes“

The problem stated above that the opportunities of modernization are not used to their full potential is successfully tackled by the “Efficient Homes“ project.

Figure 4 presents the age structure of the buildings participating in the project compared with the age structure of the relevant pre-1978 building stock as a whole, showing the participation in the project to be broadly representative in terms of age cohorts. The average energy demand² of these buildings was 336 kWh/m²a (see Figure 5). This demand has been successfully reduced by the modernization measures as applied within the project. After renovation these buildings have an average energy demand of only 44 kWh/m²a. This value is even below the average energy demand of comparable new buildings. According to the German minimum requirements new

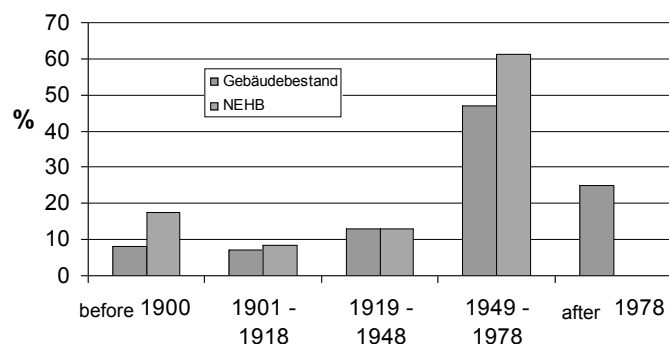
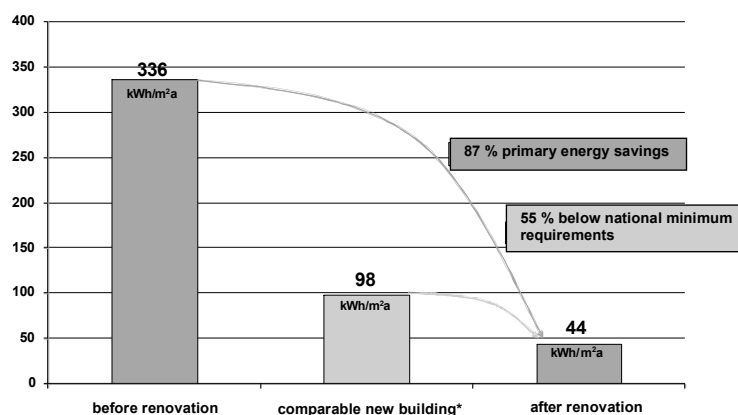


Figure 4. Age structure of residential buildings participating in the dena project “Efficient Homes” (source: dena, 2006).



* according to national minimum requirements for new buildings as stated in the energy saving ordinance (EnEV-N)

Figure 5. Development of primary energy demand before and after renovation of the buildings participating in the project. (source: dena, 2006)

2. Primary energy demand per sqm and year
 $(Q_{p,space\ heating} + Q_{p,domestic\ hot\ water}) \cdot e_p$
 e_p : factor for the efficiency of the ventilation system).

buildings would demand 98 kWh/m²a. Hence, the high energy performance buildings of the project are more than twice as good if compared to similar new buildings (55 %).

The project has been divided into several project phases. The pilot phase had been conducted from 2003 until 2005. During this phase 33 multi family dwellings had been renovated. For the project start this building type had been chosen since multi family buildings compared to single and double family buildings in Germany are easier to insulate due to their architecture. During the second project phase - from 2005 until 2006 - the project had been opened for another building category. Privately owned single family and two family homes were allowed to participate as well. Another 110 buildings joined the project.

The challenge most participating building owners were facing was finding well-versed planners and architects in the field of modernising existing buildings to high energy performance buildings. Another barrier to be overcome occurred right after the planning phase in finding skilled craftsmen to carry out the modernisation measures. Since most of them varied from what the craftsmen were used to respectively was completely new to them and often involved new materials, the craftsmen needed to be willing to learn something new and to be supervised more intensely. Both, planners and craftsmen proved that a lack of knowledge exists, that stressed the importance of the project's objective to provide know-how transfer. Know-how transfer was conducted by online knowledge data base which had been established and expanded continuously and especially tailored workshops, which after the first period also included on-site visits of the modernisation objects. Within about two years more than 5 000 planners, architects and craftsmen attended these workshops. This number shows a vivid interest and the will to learn more about the topic.

After conducting two periods of the „Efficient Homes“-project, planners as well as craftsmen can benefit from the experience gained by prior modernisations. At the same time, planners and craftsmen that have been involved in prior periods of the project provide a basis of more experienced partners in the field of energy efficiency in existing buildings for building owners.

The “EnEV-N minus 30 %” as well as the “EnEV-N minus 50 %” standard have been tested since 2003. As mentioned before building owners participating in the “Efficient Homes”-project were given higher financial aid by the Federal Promotional Bank compared to building owners renovating their buildings complying to national minimum requirements. Restructuring their promotional system, the Federal Promotional Bank decided to take over the ambitious “EnEV-N minus 30 %” in their Federal Promotional Programme “CO₂ Building Rehabilitation Programme” (CO₂-Gebäudesanierungsprogramm) by the end of 2006. From 2007 onwards every building owner wishing to renovate its building in according to the “EnEV-N minus 30 %” standard can do. This was a vital step in magnifying the success of the project, in terms of transmitting its influence and impact into the wider market (see figure 6).

Conclusions and Outlook – “Efficient Homes“

The reaction to the project is being enormous and the interest of experts and end-consumers seems to be rising steadily. For example, the application process for the second project phase needed to be terminated one month earlier than primarily considered. This was due to the high number of building owners willing to renovate their buildings according to the project's standards. Furthermore, the project was mentioned in more than 265 publications with a total circulation of more than 14 million copies. It was presented in newspapers, popular as well as special interest magazines, on radio and on TV – both at regional and national level. As mentioned before, the workshops offered to planners, architects and craftsmen have already been attended by more than 5 000 people.

One of the aims of the “Efficient Homes”-project was raising awareness related to the vast energy efficiency potential hidden in the existing building stock. This had been conducted by local and national PR. The reaction of building owners, the press and experts prove that this aim has been reached. Moreover, the increased awareness is actually turning into action, which can be seen by the rising number of participants in the project and from 2007 onwards by the building owners applying for the

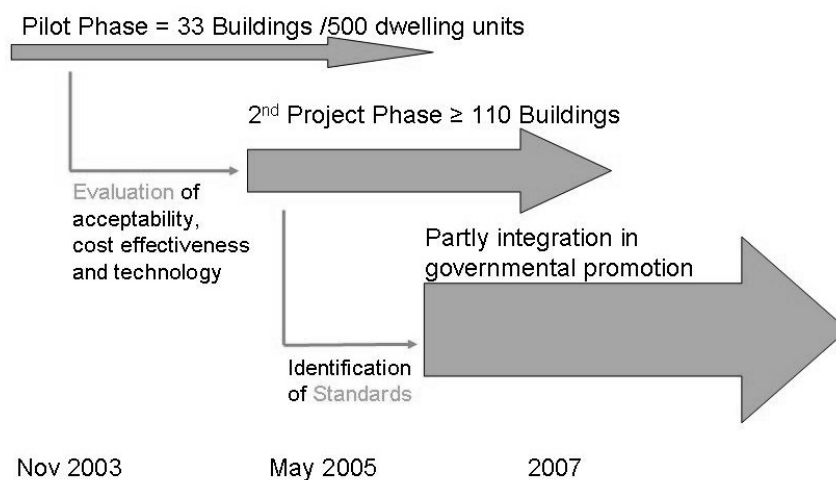


Figure 6. mechanism from pilot action to public promotion. (source: dena, 2006)

“EnEV-N minus 30 %”-standard implemented in “CO₂ Building Rehabilitation Programme” open to everyone.

There certainly still exists a lack of knowledge and know-how (as written above). Nevertheless, raising the awareness related to the topic will also enhance the need for planners, architects, craftsmen and other actors involved on the supply side of renovating the existing building stock to close this gap, since the demand side, e.g. end-consumers starts taking stock in the topic as well. Therefore the project offers several possibilities, e.g. the project website containing the knowledge data base and short presentations of each of the participating modernisation objects, various publications addressing building owners, planners, architects and craftsmen and workshops offered to the latter three all over the country all year long.

Despite the written above the project also demonstrated that the substantial energy saving potential hidden in the existing building stock can be exploited by applying state-of-the-art measures and materials. Furthermore it proved that the rather innovative passive house modules, e.g. passive house windows, which had predominantly been used for new constructions so far, can also be applied in the process of renovating existing buildings.

Besides the already established communication and dissemination activities related to target groups which would disseminate the information, e.g. architects, planners, local energy agencies, the focus of the project related PR and know-how transfer is being widened stepwise to the end-user at the moment. In addition to an interactive CD-ROM presenting several films shot during and after renovation at objects of the project, the main event will be an open day of high energy performance buildings. It will be conducted early summer 2007, introduced by local and national PR several weeks prior to the event. All participating renovation objects can open their doors to the public, but there will be certain towns addressing the public's interest by inviting them to a town festival with a lot of attractions for families and general public. The festival will be located in the city centres to catch the attention of large parts of the pedestrians. The attractions include e.g. information about high energy performance buildings in general, information about the high energy performance building of the city, painting competitions for kids, catering, etc. For those who wish to see and experience a high energy performance building themselves, shuttles busses and a tour through the building are provided.

In March 2007 the third project phase will have started. Since the “EnEV-N minus 30 %” has been opened to the public, the project will focus on the highly innovative “EnEV-N minus 50 %” standard. Beginning with January 2007 it has been possible to express one's interest in participating in the project. Within three weeks only and without any special PR apart from a short notice on the homepage of the project, more than 150 building owners took their chance to be listed; another proof for the growing awareness and interest in high energy performance renovation.

The “Efficient Homes”-project can be seen as part of a policy mix of the German government aiming at increasing the energy efficiency of the existing building stock. Financial subsidies in form of low interest loans of the Federal Promotional Bank are linked with the project's communication measures, know-how transfer and PR each on the local as well as on the national

level, e.g. in form of regional centres of competence. The best practice examples spread all over the country are of high importance in the process of implementing energy standards for existing buildings which are higher than national minimum requirements for comparable new buildings. Figure 2 presenting the spread of the best practice examples also reveals their role model function they are obviously representing. The dark spots are objects of the pilot phase and around these dark spots the light grey spots of the second project phase are situated.

The combination of measures as applied within the “Efficient Homes”-project turned out to be successful and convincing so that this project which is focussing on residential buildings is going to be adapted for non-residential buildings. The pilot for non-residential buildings will have started in Spring 2007. At first the focus is set on schools and kindergartens. After modernisation the participating objects have to prove a 20 to 40 per cent better energy performance (will have to use 20 to 40 per cent less energy) compared to national minimum requirements for newly constructed non-residential buildings.