

Energy-efficiency improvements in a detached house

Demonstration Projects in Hannover

1



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BACKGROUND

Along with bringing energy-efficiency improvements to multi-dwelling houses, detached and semi-detached houses in the act2 areas of Hannover were to be subsidised and examined as part of Concerto. However, this was a less important goal because the savings potential in bigger cities in this sector only plays a subordinate role.

At the same time, mustering up savings potentials is a lot more complex, as has been shown in the past in Hannover. Therefore, the "Gut beraten starten" (Start with good advice) campaign was initiated in Ahlem, a Concerto district of the city. The campaign offers detached and semi-detached home owners an independent and free initial consultation on energy-efficiency improvements. The initiative is co-ordinated by the Hannover Region Climate Protection Agency, proKlima and the Hannover Chamber of Trade, in partnership with the State Capital of Hannover. The campaign will gradually be extended to all parts of the city and districts in the Hannover region (www.klimaschutz-hannover.de/Gut_beraten_starten.1665.0.html). The most ambitious of the four detached and semi-detached houses subsidised by Concerto will be presented below.

When they purchased their new home in Bergkammstrasse in 2008, the family concerned pondered over the extent to which the vital modernisations to the house were to be carried out. They quickly agreed to keep the house in its original style, but at the same time to bring extensive energy-efficiency improvements by using as many passive house components as possible.

DESCRIPTION OF THE BUILDING

Building type (year build, floor area)

The building is typical of the 1920s and 1930s. It is an almost cube-shaped, semi-detached house with a hip roof. The whole of the building envelope (exterior walls 36.5 cm of masonry) was still in its original, non-insulated condition.

Year built: 1938

Floor area: 160 m²

Heating system

- 21-year-old gas heating system to heat rooms.
- Electric continuous-flow water heater.

PROJECT DESCRIPTION

Goals

The goal of the energy-efficiency improvements was to achieve the Concerto **Kronsberg redevelopment standard**. To reach this goal, the building envelope and its technical installations were to be subjected to extensive improvements, so that the annual final energy demand for room heat was to equal a maximum of 55 kWh/m². Compliance with the Kronsberg standard and conversion of the heating system meant that the statutory requirements for new builds were exceeded by 30%. This allowed extra state subsidies to be claimed.

Measures implemented

Thermal insulation:

- exterior walls: 18 cm exterior insulation system (expanded polystyrene) ($U=0.16 \text{ W}/[\text{m}^2\text{K}]$)
- top storey ceiling: 30 cm mineral wool ($U=0.12 \text{ W}/[\text{m}^2\text{K}]$)
- cellar ceiling: 10 cm expanded perlite loose-fill insulation ($U=0.38 \text{ W}/[\text{m}^2\text{K}]$)
- windows: triple glazing ($U=1.0-1.1 \text{ W}/[\text{m}^2\text{K}]$)
- verification of airtightness $n_{50}= 1.48 \text{ h}^{-1}$

Heating system:

- 650 l storage tank with an integrated gas-condensing boiler was added
- 10 m² flat-plate collector in order to produce partially solar-powered hot water and to support room heating

Ventilation:

- central efficient ventilation system with heat recovery

Calculated improvements

The calculations for Concerto-standard verification in line with EnEV 2007 produce the following past and present values:

- Improvement to the building envelope (H'T)
 - past: : 1.43 W/(m²K)
 - present: 0.35 W/(m²K)
 - improvement of: 76%, (30% better than for new builds)
- The annual energy end-demand for room heat is 36 kWh/m² (the goal was: a maximum of 55 kWh/m², i.e. 35% better than the Kronsberg development standard).
- Specific solar collector yield: 350 kWh/(m²a)

Data capture and analysis

An analysis of the monitoring data after the improvements for the first two entire heating periods (2009/10 and 2010/11) has showed the following results:

Energy consumption

past: 201 kWh/(m²a) gas
 + approx. 15 kWh/(m²a) electricity for hot water
 = 216 kWh/(m²a)

present: 48.0 kWh/(m²a) gas
 + 17.5 kWh/(m²a) solar thermal energy
 + 2.5 kWh/(m²a) electricity consumption ventilation
 = 68.0 kWh/(m²a)

Special collector yield: 277 kWh/(m²a)

Solar share (heating and hot water) = 27%

savings: 69% final-energy demand
 77% primary end-energy demand

CO₂ Balance

past: 8 340 kg/a

present: 1 850 kg/a

savings: 78 %

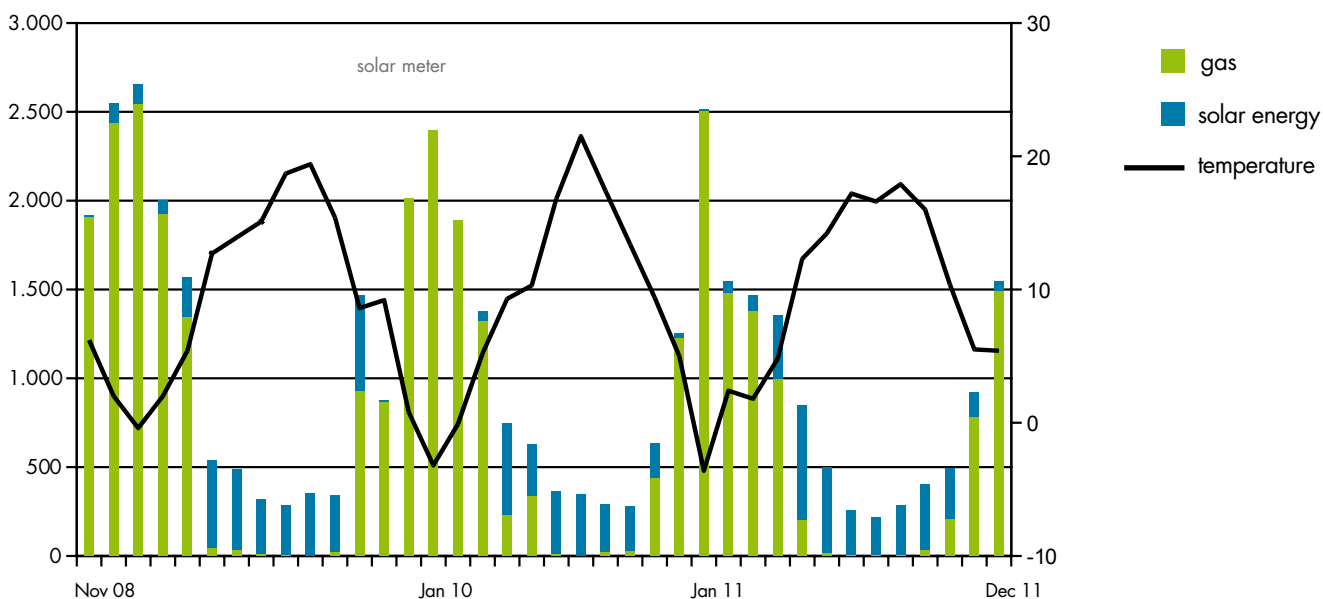


Figure 1: Monthly gas consumption and solar thermal heat production

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Demonstration Projects in Hannover

4

The success achieved in the first two years of operation is impressive. The standard achieved was actually lower than Kronsberg, the primary energy savings are at almost 80%.

At a level of about 20%, only the solar collector slightly underperformed. In the meantime, some steps have been taken to improve control technology in order to get closer to the target.

COSTS AND FUNDING

Costs

The total costs for energy-efficiency improvements brought to the house amount to €120 000 (€750/m²), of which 63% (€475/m²) were for improvements to the building's envelope, 27% (€200/m²) for renewing the heating system including the solar thermal collector and 10% (€75/m²) for the new ventilation system.

As a result, compared with average renovation costs of €350/m² for the multi-dwelling houses in Hannover, the total costs for the energy-efficiency improvements are more than double. Not just the costs for the building envelope but also the costs for planning and quality control at €15 300 or almost €100/m² are particularly noticeable. The potential for saving costs is relatively low because in proportion to the floor area concerned, specific expenditure is quite high. Therefore, subsidies for this target group should be higher.

Funding

The home owner financed the improvements and received subsidies and loans totalling €26 500, broken as follows:

- €13 750 KfW (repayment subsidy 11.6%)
- €2 210 BAFA (for the solar system 1.8%)
- €5 935 proKlima (5%)
- €4 452 Concerto (3.7%)

The purpose of the Concerto subsidies was to act as small incentives to achieve higher energy standards that go way above those required by law, and by proKlima and KfW.

PARTNERS INVOLVED

Partners and their roles

- Owner
- Planning: agw Architekten und Ingenieure, Hannover
- Data capture and analyses: proKlima

Companies contracted:

- Heating, ventilation: Corona Solar, Hannover
- Insulation: Eggers, Hannover
- Quality control: Ingenieurgesellschaft Bau+Energie+Umwelt, Springe-Eldagsen

Energy-efficiency improvements in a detached house

Demonstration Projects in Hannover

5

RECOMMENDATIONS

Barriers to overcome

The modernisation, planning and quality control involved a lot more work than originally thought in the first assessment of cost, time and materials. It required a huge effort to get the house air tight. Difficult factors were the cross-over points from unheated to heated areas, particularly to the non-insulated roof and to the cellar. A great deal of care also had to be taken with putting in the windows properly.

Lessons learnt

Using an energy assistant (funded by proKlima) proved to be invaluable for the extensive initial deliberations and making calculations on energy savings, for co-ordinating the subsidy applications and checking the quality of the work done. As a result, decisions could be made based on a reliable estimation of the savings and due care was ensured from the very beginning when all the measures were carried out.

Currently the heating costs for gas are only €55 a month.

Advantages

- Windows were put into the insulation level of the building envelope which produced deep window sills that offer a cosy, draught-free window the whole year round.
- A pleasant room temperature with constant fresh air thanks to comfortable ventilation with heat recovery.
- A noticeable reduction in the energy costs.

PHOTOS



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OTHER PROJECT DOCUMENTS

Media releases and articles	None
Brochures	„Beste Beispiele – Vom Altbau zum Energiesparmodell“ brochure (pages 10-13), proKlima, Hannover, September 2010 „Energetische Altbausanierung – Erfolgreiche Beispiele aus Düsseldorf, Hannover, Kiel, München und Nürnberg“ brochure (page 8), Difu, Berlin, Januar 2012
Date published	July 2012



act2 is a project cofunded by the European Commission within the Concerto Initiative

