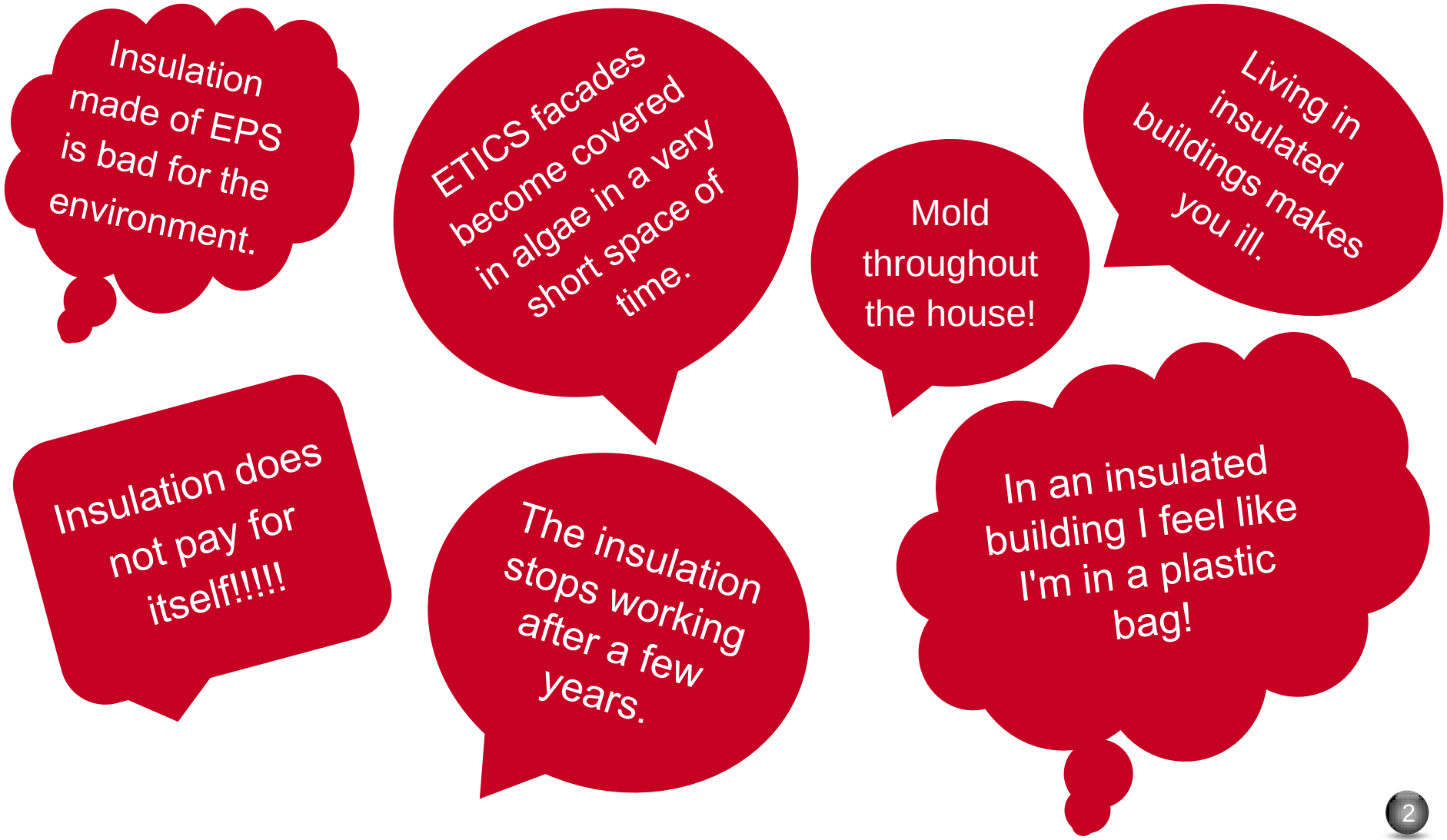
Brunck district – long-term monitoring

Integral evaluation of the long-term effects of energy efficiency measures

BASF
The Chemical Company

Thermal insulation myths



Brunck district – history

- Constructed in the 1930s as a settlement for workers
- Oil and wood-fired stoves (20 – 25 l/m²a)

- Completely destroyed in the Second World War

- Then rebuilt based on old plans

- 20 percent stood vacant in the 1990s
- Layouts not contemporary
- Poor materials

- From 1996 a concept for revitalizing the Brunck district was drawn up

Brunck district – today

Modernization of the neighborhood (1997 - 2006):

- Reconfiguration of the living environment
- Energy efficiency and eco-efficiency: first 3-liter house in stock in Germany among (?)
- Drawing up of innovative system solutions
- Involvement of the residents in the planning phase

Enveloping measures for the different energy efficiency levels

3-liter house

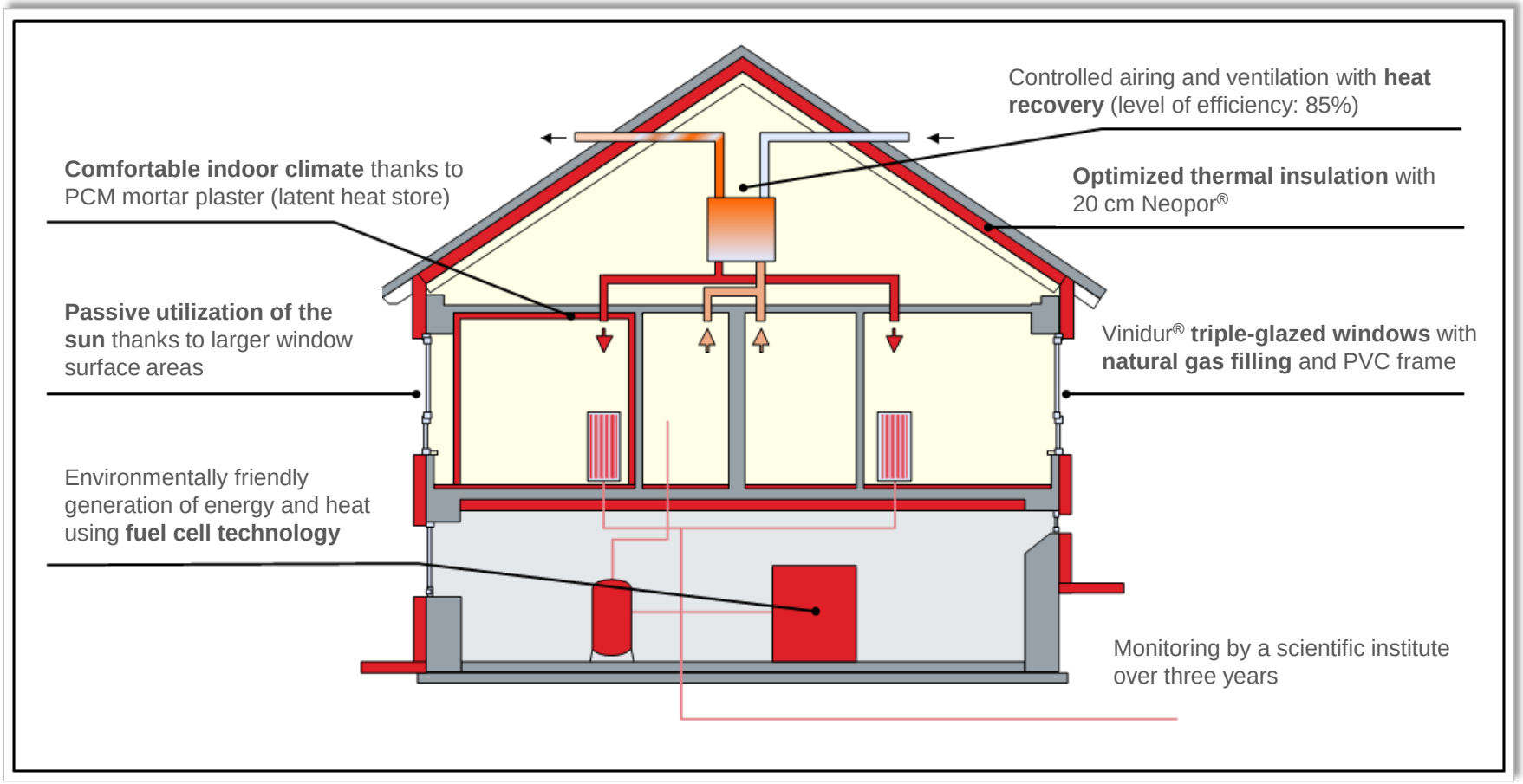
5-liter house

7-liter house

Energy-related modernization

Refurbishment measures		Area (m²)
3-liter house – energy-related additional costs = € 329/m² LS = 699		
External wall insulation	20 cm of TCG 035	623
Roof insulation	20 cm of TCG 035	350
Basement ceiling insulation	20 cm of TCG 035	292
Windows (triple glazing)	Uw = 0,8 W/(m²K)	108
5-liter house – energy-related additional costs = € 189/m² LS = 403		
External wall insulation	20 cm of TCG 035	433
Roof insulation	20 cm of TCG 035	211
Basement ceiling insulation	8 cm of TCG 035	179
Windows (double glazing)	Uw = 1,1 W/(m²K)	75
7-liter house – energy-related additional costs = 124 €/m² LS = 699		
External wall insulation	14 cm of TCG 035	619
Roof insulation	14 cm of TCG 035	350
Basement ceiling insulation	8 cm of TCG 035	292
Windows (double glazing)	Uw = 1,1 W/(m²K)	107

Technical concept of 3-liter house (stock modernization)

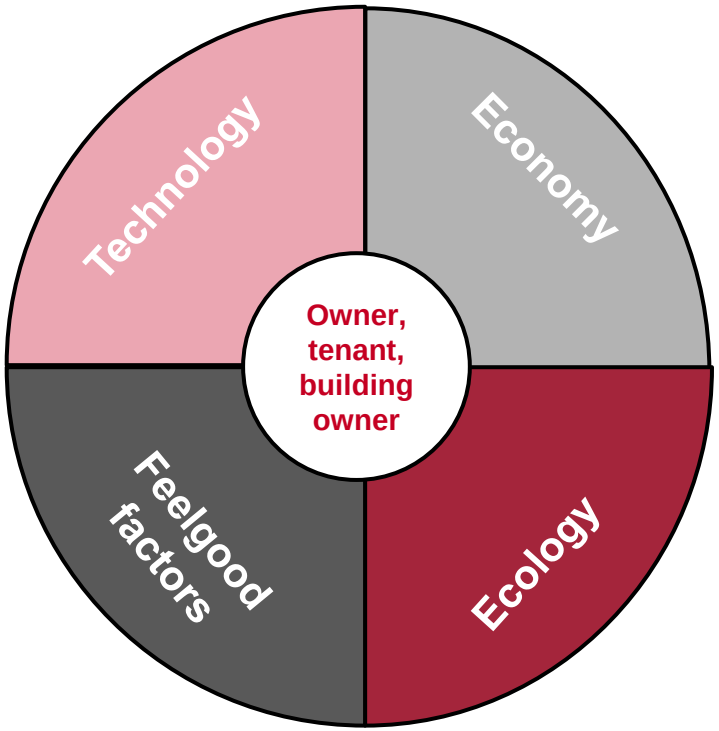


3-liter house after stock modernization

Brunck district – long-term monitoring

First integral long-term monitoring examining all aspects of sustainability

Technology:
How has the insulation material acquitted itself over ten years?



Economy:
What payback period for the individual measures can be achieved?
By how much are the heating costs reduced?

Feelgood factors:
Among others:
Do the residents feel good living in their home insulated with Neopor®?

Ecology:
How much CO_2 is saved as a result of the energy-related refurbishment?

Technical assessment

Technical assessment

Technical condition after over 10 years

Original text of expert report (survey):

"After over 10 years, the facade is presented in a visually good condition; virtually no aging and no algae growth on the exterior plaster is apparent."

Technical assessment

Verdict:

- Minimal damage which occurs cannot be attributed to the materials used. This damage was demonstrably caused by technical errors of execution during installation.
- Both the insulation material and the system as a whole display no age-related changes and are in full working order.
- No damage cause by woodpeckers, insects or micro-organisms (spiders, mold, algae growth)

Economic aspects

Long-term heat demand

Example:

7-liter house
80 m² dwelling

Situation in 1960:
1850 liters of heating oil
23 l/m²a

Situation in 2012:
296 liters of heating oil
3.7 l/m²a

1 liter of heating oil is equivalent to 10 KWh/m²a

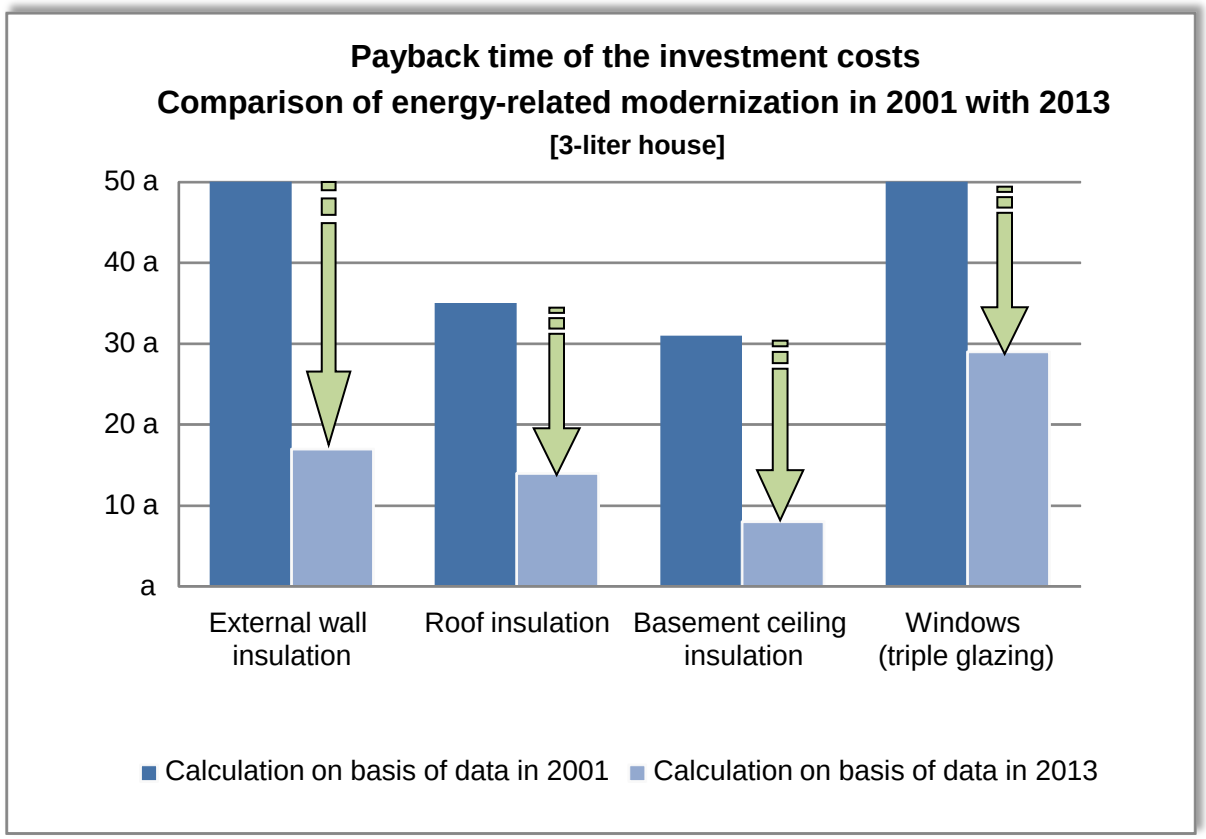
Saving effect of Brunck district modernization expressed as heating oil equivalent

How many liters of heating oil were saved?

Saving per year:

- 3, 5 and 7-liter houses in existing stock:
  - 387,000 liters
  - 13 tankers (oil trucks)

Average payback periods for the individual measures in the 3-liter house (stock)



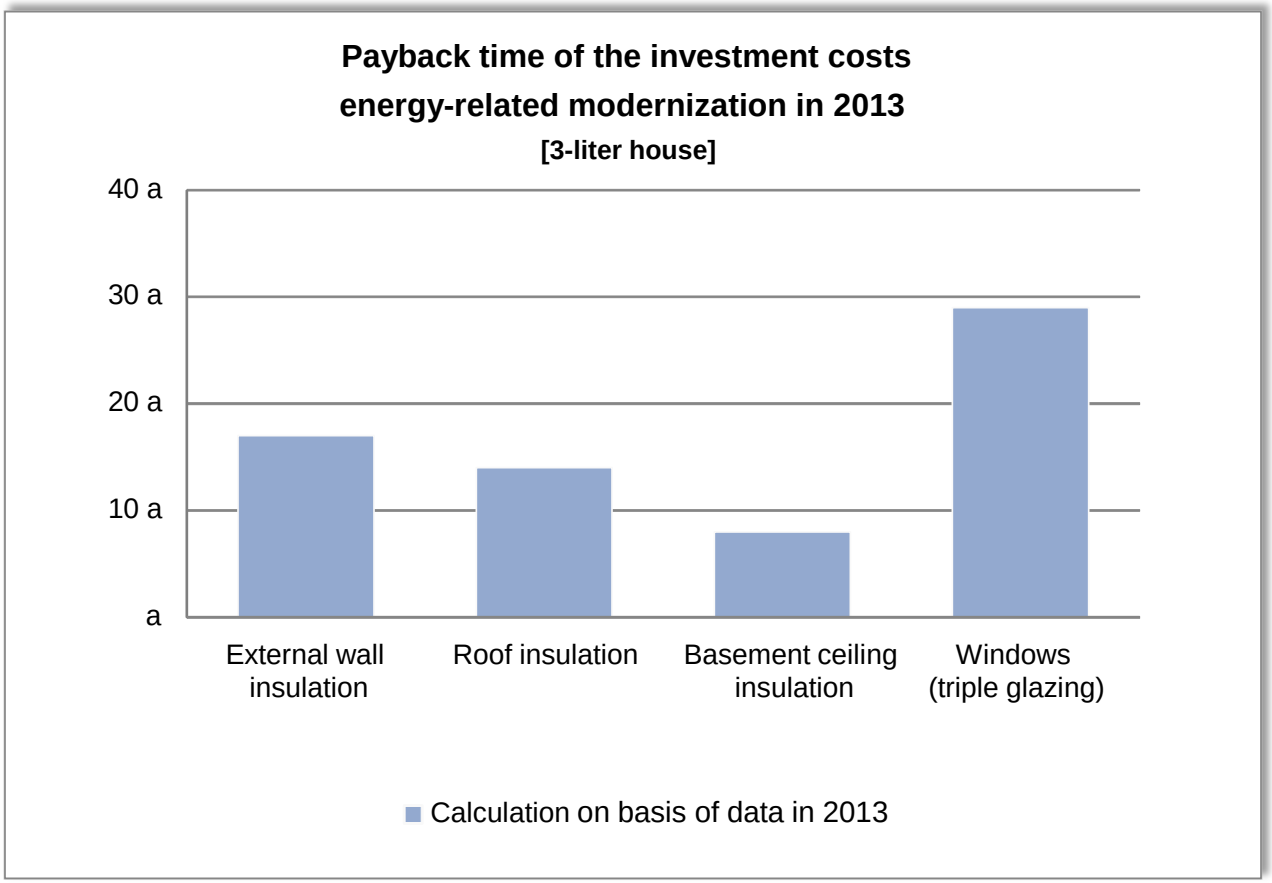
Comparison of the payback times for individual energy-related modernization measures on account of changes to the general framework conditions

Comparison of the economic viability of the implementation times in 2001 with 2013:

- Reduced material prices for energy efficiency technologies due to an increase in production capacities
- Strong rise in the price of energy - gas up 5.2% p.a.
- Capital interest rates (credit) fallen considerably in the last decade

- The payback period has reduced dramatically over the last 12 years.
- Strong argument for housing companies and real estate developers: The investments pay for themselves more quickly.

Average payback periods for the individual measures in the 3-liter house (stock)

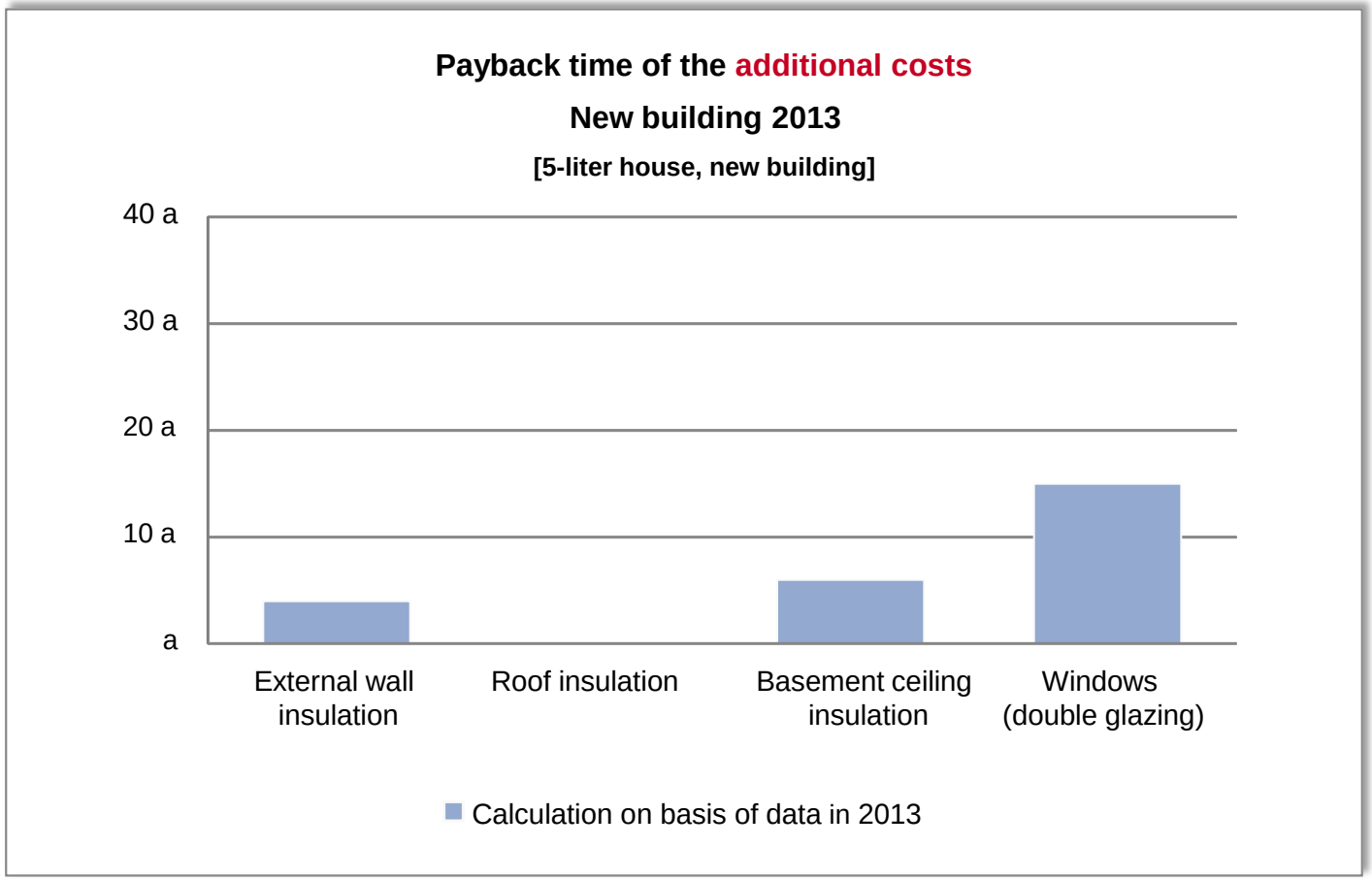


Comparison of the payback times for individual energy-related modernization measures

The payback periods for energy efficiency measures on the shell of the building have shortened in the last decade.

- Reduced material prices for energy efficiency technologies due to an increase in production capacities
- Strong rise in the price of energy - gas up 5.2% p.a.
- Capital interest rates (credit) fallen considerably in the last decade

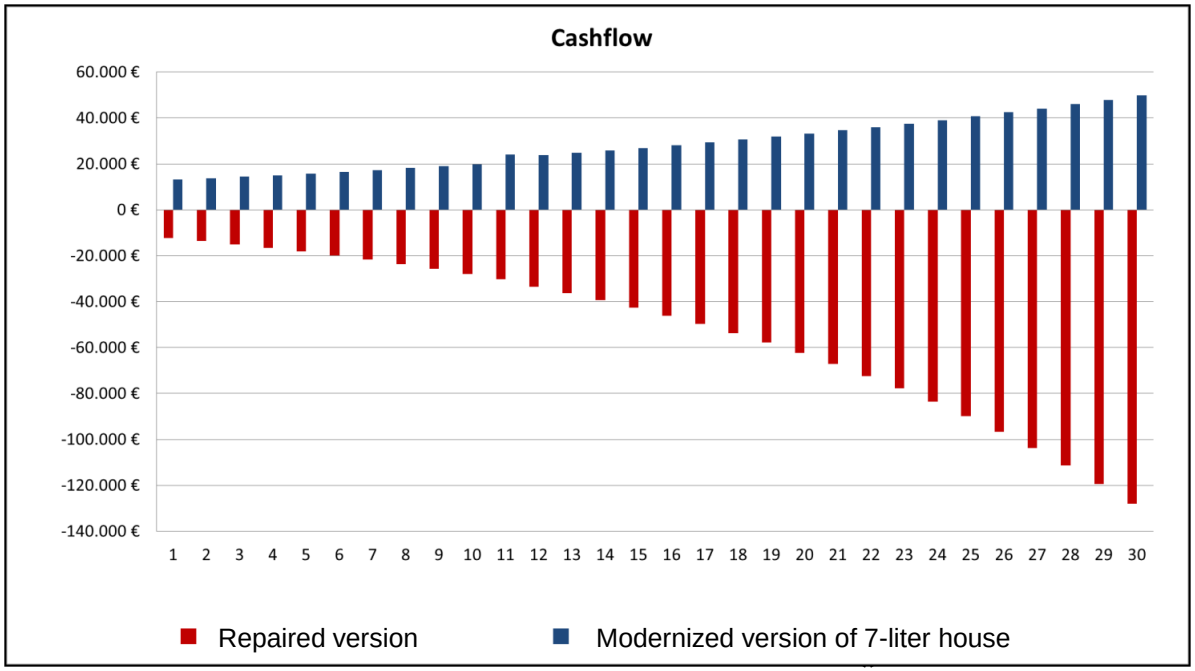
Even shorter payback periods in new buildings



Comparison of the payback times for individual energy-related modernization measures

*** No additional thermal insulation required**

Examination of economic viability of concept as a whole (example of 7-liter house in stock)



Cash flow comparison from the point of view of the housing company

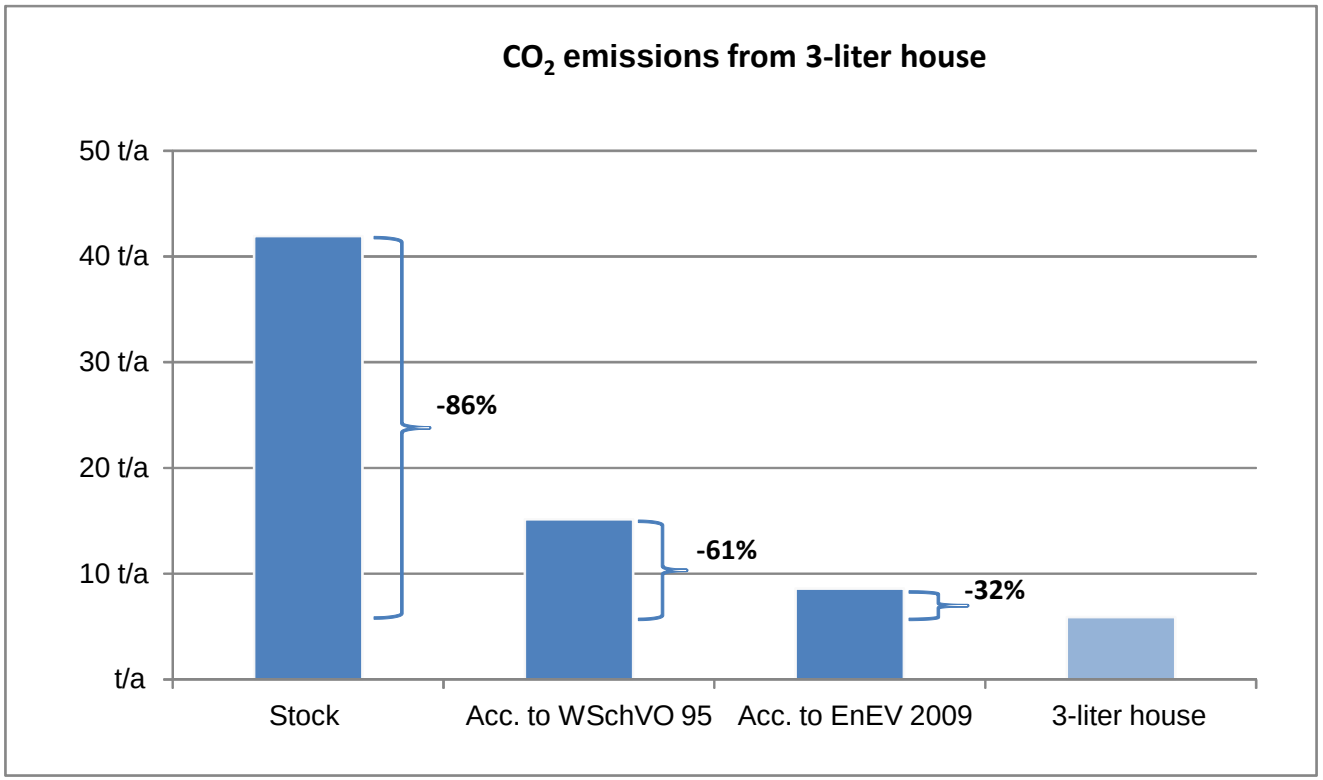
Stock modernization to produce 7-liter house:

- **Additional investment:** € 450 per m^2
- Adaptation of the dwelling's floor plans and fixtures and fittings to reflect today's requirements
- Reduction in the **thermal heat demand** of around 70% (today around € 11 per m^2 per year)
- Reduction in the **proportion of vacant property** from 20% to 3%
- Reduction in the annual **repair costs** of 70%
- Positive **cash flow trend**
- Higher **value of the building**
- Overall **payback time** is **less than 13** years

Ecological aspects

Carbon Footprint Brunckviertel

- CO_2 saving of 8,300 metric tons in modernized Brunck district within 10 years

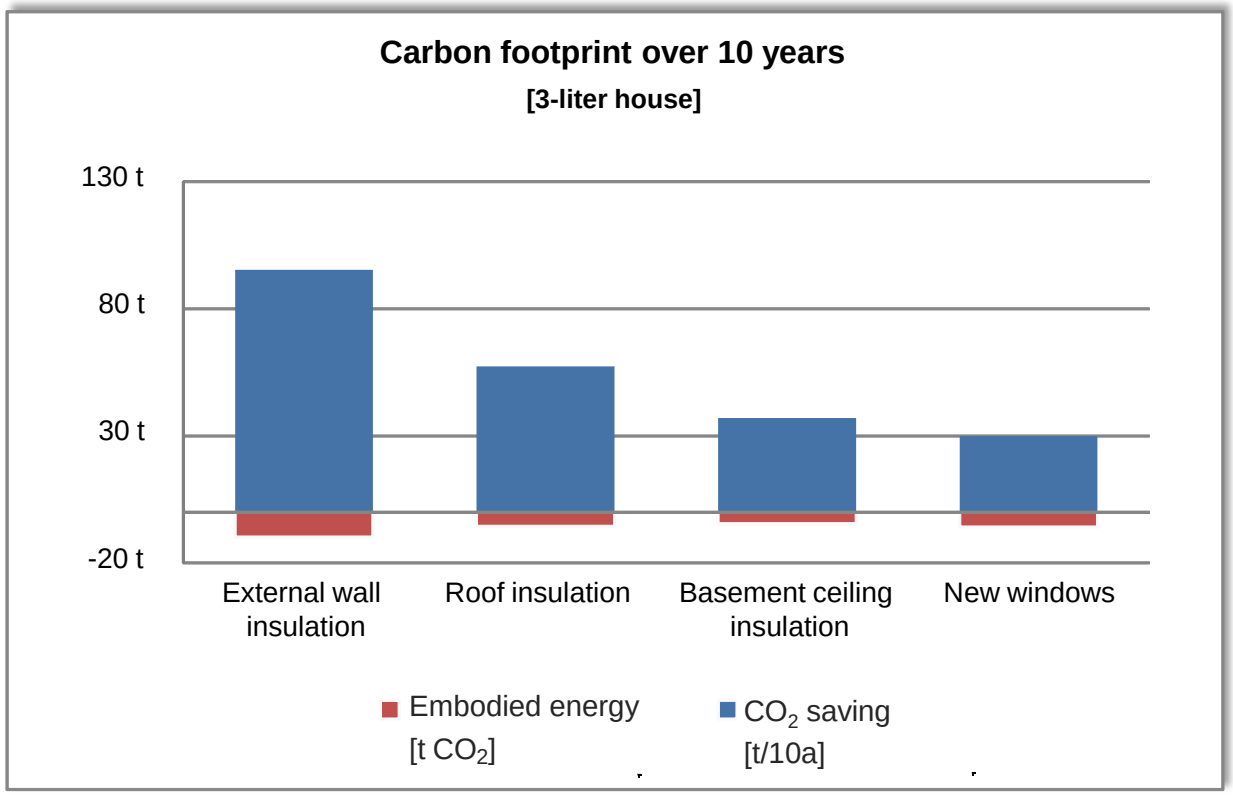


The annual CO_2 saving of 830 metric tons is equivalent to around **60 hectares of forest** which would be needed to offset the CO_2 emissions.

60 hectares

Ecological payback time

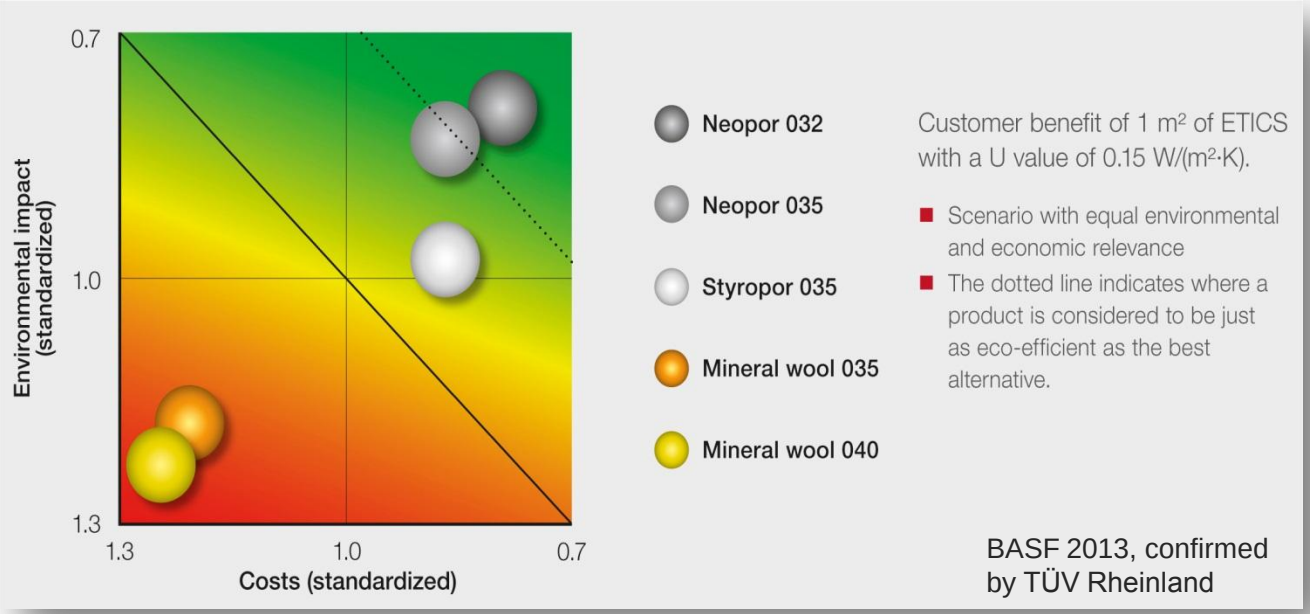
Comparison of "embodied energy" with "CO_2 saving in 10 years":
The ecological payback time is around one year.



Ecological footprint over 10 years for different energy efficiency measures

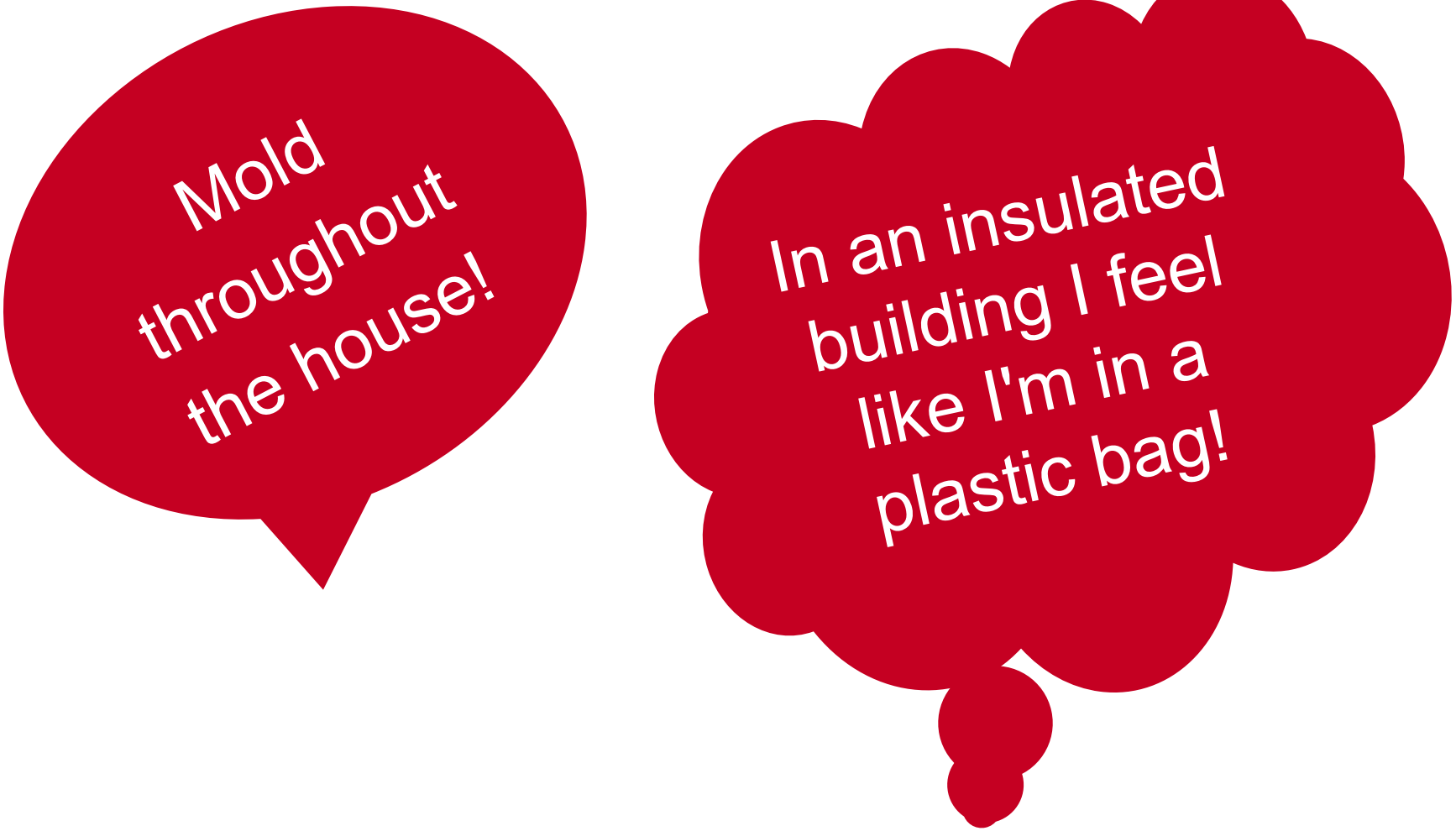
Eco-efficiency of Neopor®

Exemplary eco-efficiency – alongside the long-term monitoring the eco-efficiency analysis of Neopor® was updated.



Eco-efficiency analysis of different insulation materials: comparison of different insulation material technologies looking at the "economy" and "ecology"

Survey of residents



Survey of residents

- **Carried out by:** Institute of Trendscouting at the University of Applied Science and Art Hildesheim / Holzminden / Göttingen

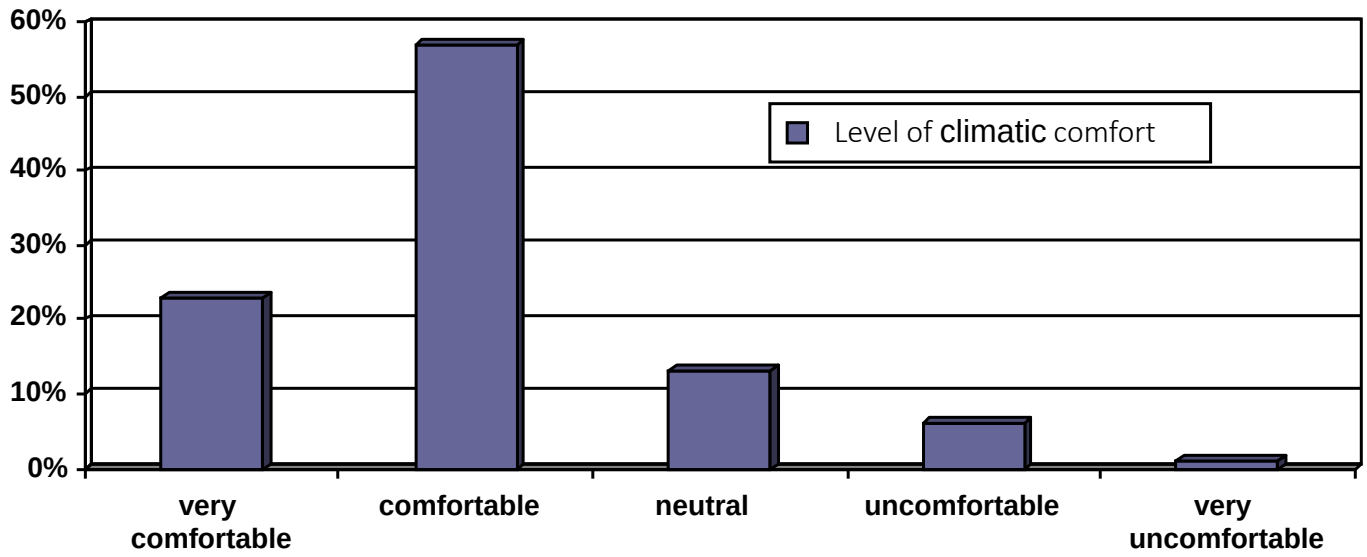
– 1st part of the survey in Ludwigshafen in August 2012: approx.120 households
– 2nd part of the survey in Darmstadt in May 2013: approx. 60 households

bauverein AG darmstadt

HAWK Hochschule für Angewandte Wissenschaft und Kunst Hildesheim Holzminden Göttingen

Zuhause fühlen... LUWOGE BASF Gruppe

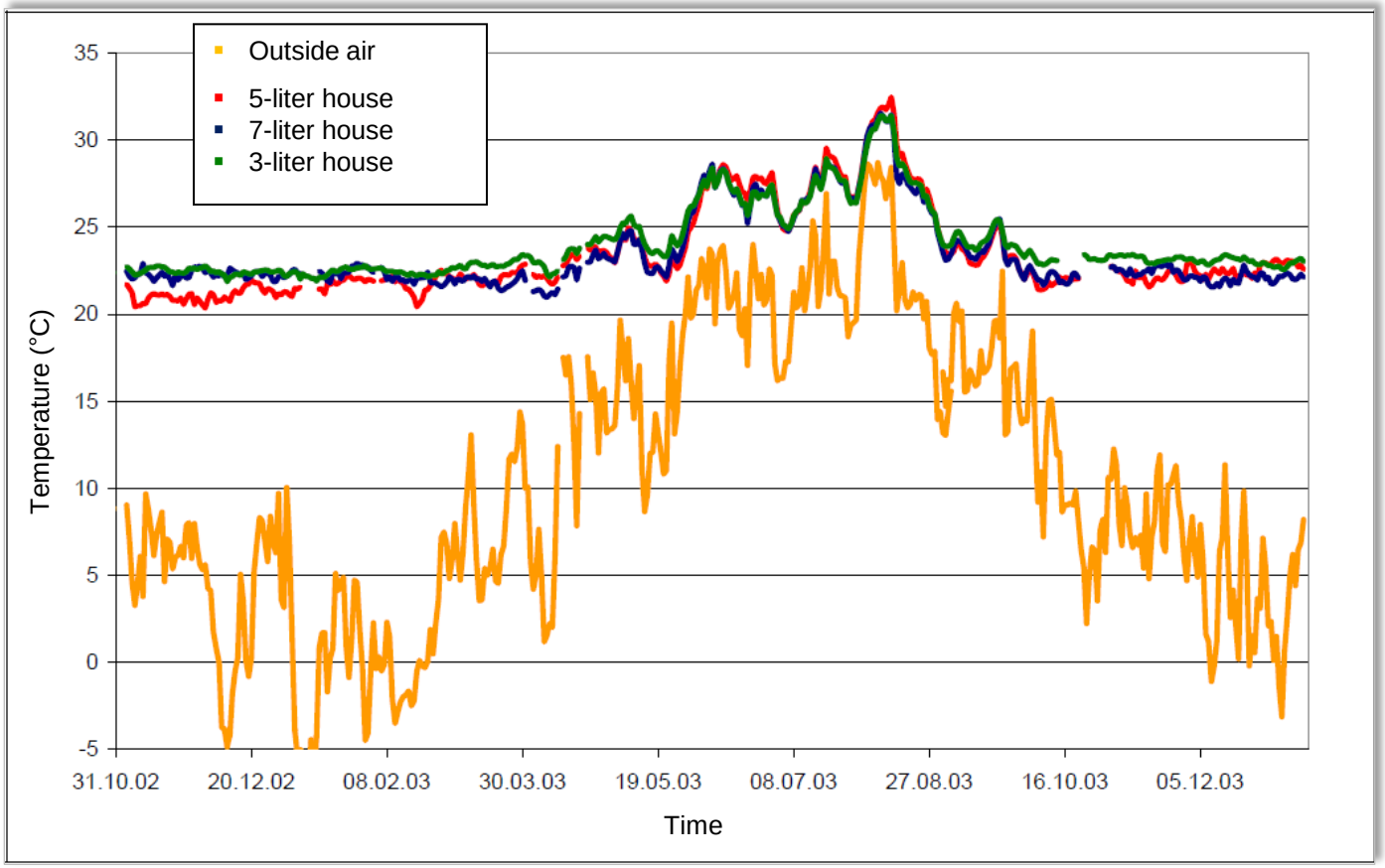
Assessment of quality of housing



- **Summer:** some instances of overheating due to insufficient options for shading or a lack of ventilation or shading performed by the user

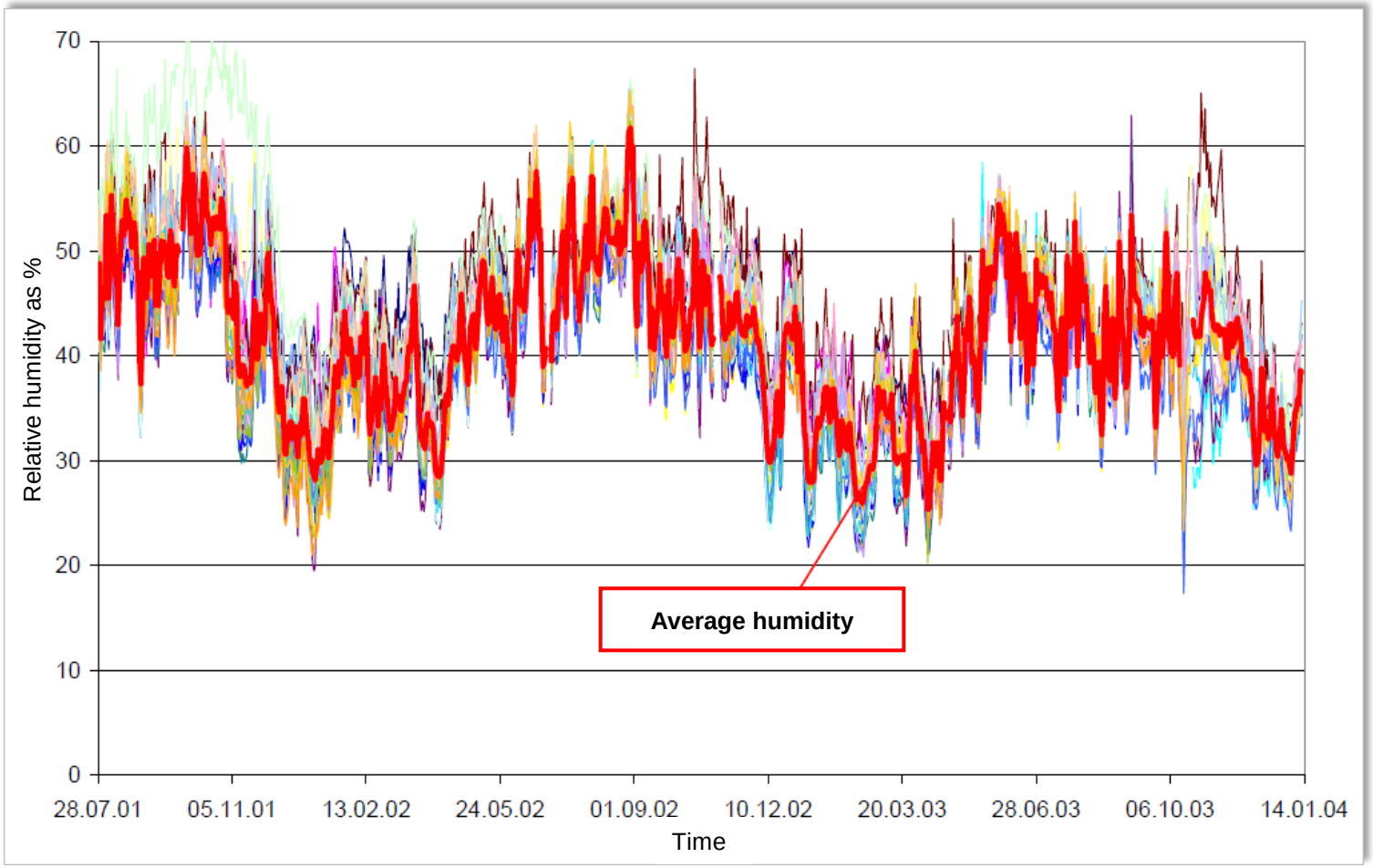
- **Winter:** excessive ventilation on cold days results in a great drop in temperature in the dwelling which can only be made up for slowly by the heating systems which are installed.

Average room temperature



- The average room temperature all year round is considerably above 20°C - comfortable range (without having too great an impact on the heating bill)

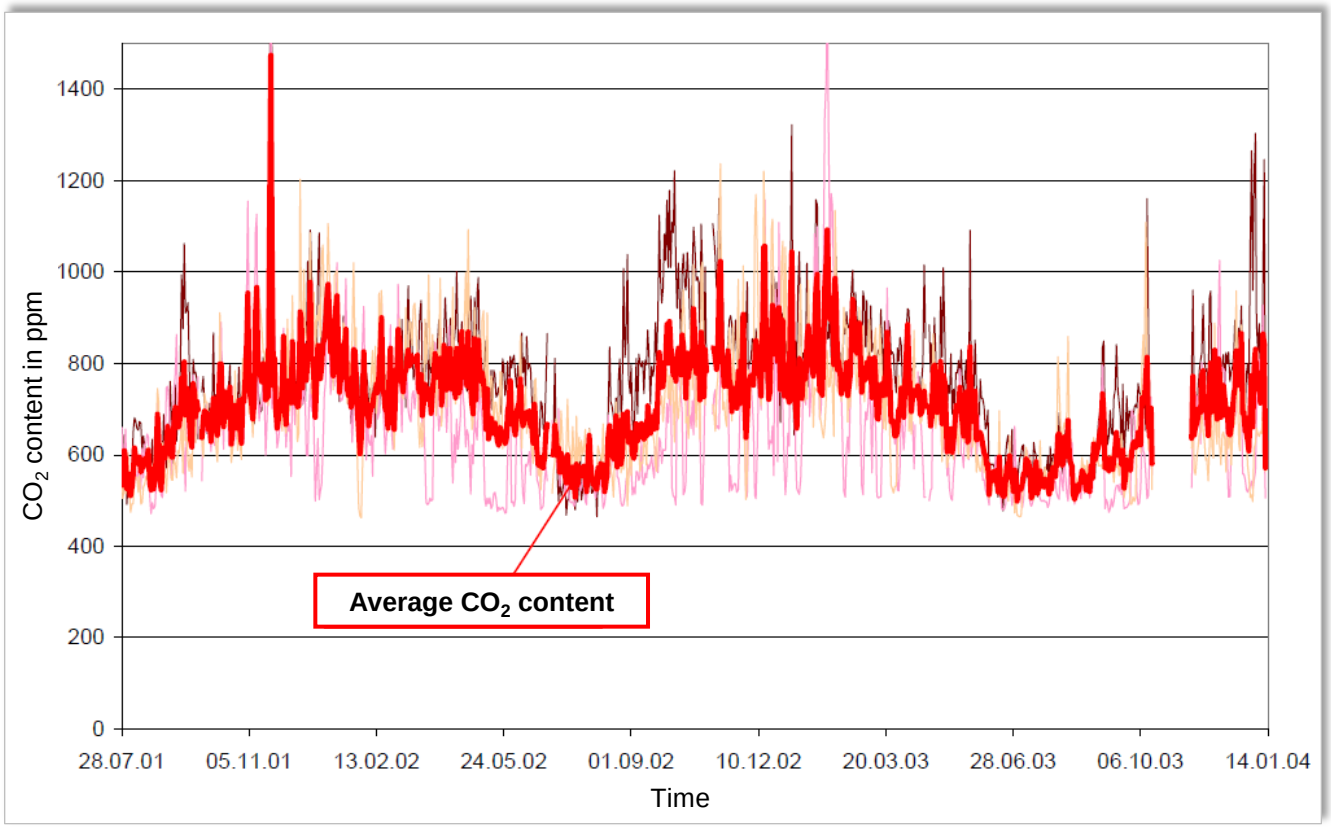
Atmospheric humidity



- The humidity values measured for the different energy-efficient houses are all in the comfortable range of between 40% and 60%.

CO_2 concentration of the indoor air

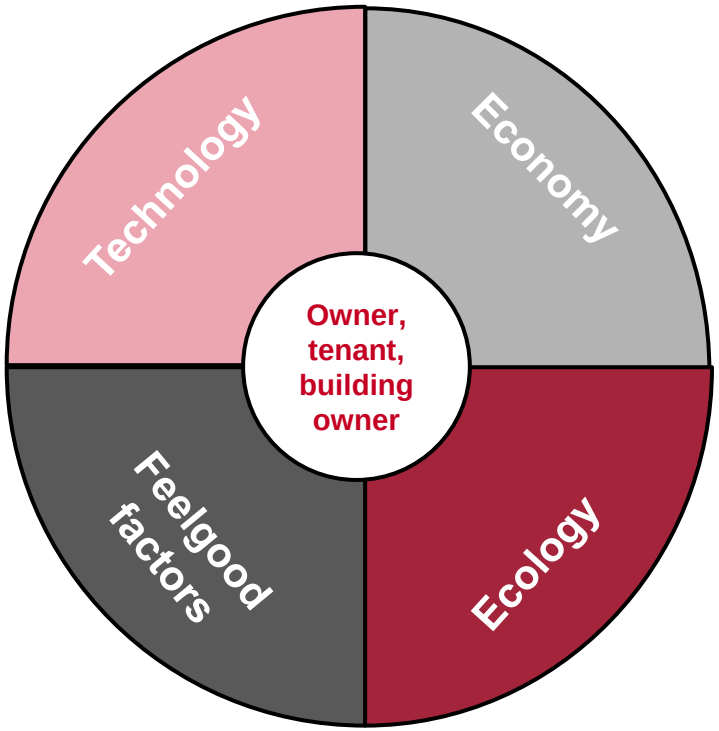
CO_2 concentration of the indoor air inside the 3-liter house



- A ventilation system with regulated air extraction and supply and heat recovery is installed in the 3-liter house.
- The CO_2 concentrations measured in the 3-liter house are below the DIN limit (1500 ppm) and also mainly below the Pettenkofer hygienic limit (1000 ppm).

Brunck district – Summary

Technology:
System does not display any aging-related damage; insulation is fully intact.



Economy:
360,000 liters of heating oil per year are saved.

Reduction in energy consumption of around 80%

Feelgood factors:
Over 80% of residents feel "comfortable" or "very comfortable" in their home which is insulated with Neopor®.

Ecology:
8,300 metric tons of CO_2 are saved.

Reduction in the carbon footprint of around 80%

Thanks You for Your attention!
www.neopor.de

BASF
We create chemistry