

# Abridged Report

## Title

Supplementary insulations („doubling“) of External Thermal Insulation Composite Systems (ETICS) on existing ETICS at residential buildings

## Motive / Initial situation

In order to achieve the climate protection objectives, it is necessary to modernize millions of residential buildings. Many buildings feature poor quality of insulation. Therefore even already insulated exterior walls need to be improved. The main objectives and assignments were the investigation of constraints, potentials, experiences and profitability of supplementing existing ETICS at residential buildings.

## Object of Research Project

The project aims at ETICS at residential buildings, which were installed since the 1960s and from today's perspective, feature insufficient insulation quality. ETICS with an insulation layer thickness of less than 10 cm ( $\lambda = 0.40 \text{ W/(m}^2\text{K)}$ ), respectively exterior walls with an U-value  $> 0.35 \text{ W/(m}^2\text{K)}$  are considered unsustainable. Those ETICS should be supplemented to achieve U-values smaller than  $0.20 \text{ W/(m}^2\text{K)}$ . For an ETICS with insulation layer thickness of 6 cm on a regular wall, this U-value is achieved via supplementing the insulation layer to 10 cm with  $\lambda = 0.035 \text{ W/(m}^2\text{K)}$ .

The expected energy savings due to doubling in a standard use case were calculated for four exemplary apartment houses. Result per  $\text{m}^2$  exterior wall: ca.  $22 \text{ kWh/(m}^2 \cdot \text{a)}$  of final energy.

## Market and potentials

According to data from the ETICS trade association and after consideration of offcuts, ca. 1.032,8 mio.  $\text{m}^2$  exterior walls of residential buildings and non-residential buildings were insulated via doubling between 1976 and 2015. For the year 2009 the insulation layer thickness of 53.5% of residential buildings' insulated exterior walls has been calculated to a maximum of 9 cm.

The assessment also revealed that around 490,8 mio.  $\text{m}^2$  of wall areas with existing ETICS are insufficiently thermally protected. This amounts to ca. 47.5 % of all wall area insulated with ETICS until the end of 2015. This means that ca. 2.2 mio. of residential buildings are equipped with an existing ETICS, which from today's perspective should be supplemented. As not every existing ETICS can be doubled, a general 15 % were deducted. The remaining ca. 417 mio.  $\text{m}^2$  wall area is the realistic potential for doubling.

If in 2030 all „realistic“ existing ETICS were supplemented, 9.7 TWh of final energy per year (ca. 33.0 PJ per year) could be saved compared to the status quo of 2015.

Table 1 shows the potential annual new savings of final energy, primary energy and  $\text{CO}_{2e}$ , which result from exploiting the realistic potential of doubling inadequately insulated external wall insulations.

## Circumstances, reasons and experiences with doubling

In 2015/16 the owners of 73 buildings, on which doubling has been put into effect, were asked about circumstances, reasons and experiences with doubling. 16 owners responded. Noteworthy results are:

- Doubling has been mostly undertaken on buildings, where the existing system was installed prior to 1995.

- Reasons for doubling are primarily improving thermal insulation, secondarily retrofitting the existing system and thirdly improving the design.
- Doublings are almost always part of larger modernization.
- On average, the thermal insulation of exterior walls improved by 63%. ( $\emptyset$ - U-value existing = 0.54 W/(m<sup>2</sup>\*K),  $\emptyset$ -U-value new = 0.20 W/(m<sup>2</sup>\*K)).
- The average insulation layer thickness of existing ETICS amounts to 5.6 cm, of the new insulation layer amounts to 11.8 cm and the total insulation layer thickness amounts to 17.4 cm.
- The average cost incl. VAT per m<sup>2</sup> structural component area is:
  - 107.33 € incl. scaffold, broadening verge, etc
  - 97.63 € without scaffold, broadening verge, etc

### Profitability

Calculations of profitability with the net present value method were done for four model buildings. It must be emphasized that there is great uncertainty with respect to both the assumed development of energy prices and inflation. The results of the calculation of profitability should thus be viewed as a rough estimate.

The calculation of profitability shows, that the investment into doubling an ETICS is viable from the perspective of the landlord over the entire expected life time of the investment if the modernization costs can be permanently allocated entirely to the tenants. The modernization levy leads to significant additional costs for tenants, which are not balanced by reduced heating costs - assuming a low energy price increase.

### **Result**

The planned objectives were achieved.

Buildings, which were insulated with ETICS <10 cm, must be supplemented with a thicker layer of insulation in mid-term in order to be sustainable. Supplementing an extra insulation makes sense compared to the demolition and reconstruction, also to avoid mountains of waste. Doubling can contribute to achieving the climate protection objectives in addition to measures listed in NAPE 2014. However, educating the owners and a targeted subsidy are helpful. Politics, manufacturers, processors and energy consultants are held to bring doubling ETICS on existing ETICS into play.

### **Basic information**

Short title: Doubling ETICS

Researchers / Project Management: Fraunhofer-Gesellschaft zur Förderung der Angewandten Forschung e.V. through its Institute for Manufacturing Technology and Advanced Materials (IFAM) located in Bremen  
 Institute directors: Prof. Dr. M. Busse / Prof. Dr. B. Mayer  
 Project Management: Architect Dr.-Ing. Klaus-Dieter Clausnitzer

Total costs: 142.443,20 €

Share federal subsidy: max. 92.743,20 €

Project duration: 24.5 months

## **Images**

Figure 1: Image1.tif

Legend: Example 1 of a doubled facade

Figure 2: Image2.tif

Legend: Example 2 of a doubled facade

Figure 3: Image3.tif

Legend: Chronological sequence of exploiting the potential of doubling ETICS on existing ETICS at residential buildings in Germany

Figure 4: Image4.tif

Legend: Sectional drawing of a dowel of the doubled ETICS

Figure 5: Image5.tif

Legend: Average insulation thickness for ETICS by year

Figure 6: Table1.pdf

Legend: Potential savings in end-, primary energy and CO<sub>2e</sub> in 2030 compared to 2015 due to doubling of existing, inadequate ETICS at residential buildings in Germany

Figure 7: Image7.tif

Legend: Reasons for doubling

Figure 8: Image8.tif

Legend: Exterior wall area insulated with ETICS per year of implementation