Short report

Title

Further development of the EnEV verification procedures and requirements under consideration of the building life-cycle

Reason / Initial situation

The essential requirements for the energy efficiency of buildings in Germany are defined in 2019 by the Energy Saving Ordinance (EnEV) and the Renewable Energies Heat Act (EEWärmeG). When evaluating the energy quality of a building, however, only the energy demand during use phase is considered. Energy expenditures for the manufacturing and maintenance of buildings, on the other hand, are not to be taken into account, so that there is significant potential for savings in the building sector beyond the building use phase.

Scientific studies have shown that by tightening the energy requirements of buildings in the past, on the one hand the energy consumption of the building stock could be reduced. On the other hand, the percentage of energy required for the manufacture and maintenance of buildings has increased in comparison to the energy required for building operation.

In the interest of achieving Germany´s ambitious climate protection targets, it therefore no longer seems appropriate to continue to neglect the energy expenditure for the manufacturing and maintenance of buildings when assessing the energy quality.

Topic of the research project

The aim of this research project was to further develop the calculation method of the EnEV in order to be able to take into account not only the energy demand resulting from building operation, but also the energy expenditure for the manufacturing, maintenance and disposal of building components.

The research work included the presentation of already existing basics for the further development of the EnEV. In addition to the national sustainability certification systems "Assessment System for Sustainable Building" (BNB), "German Sustainable Building Council" (DGNB) and "Sustainable housing" (NaWoh), which contain approaches for calculating the life-cycle related primary energy demand, the standard DIN EN 15978 was described, which deals with the division of the building life-cycle into different life-cycle stages. Furthermore, the database ÖKOBAUDAT (provides information about the energy expenditure for the manufacturing and disposal of building components) was presented as well as the building life-cycle assessment tool eLCA (makes it possible to calculate the primary energy demand during building life-cycle on the basis of quantity data on building components and component cross-sections).

Based on this basic knowledge, approaches for the further development of the EnEV were worked out, taking into account the building life-cycle. Over a consideration period of 30 years, the average annual primary energy demand, non-renewable for building manufacture, maintenance and conditioning is to be calculated. Building manufacturing includes the energy required for the procurement of raw materials, the transport of these raw materials to the manufactures of building materials and the production of building materials and building components. For building materials and building components with a shorter service life than the consideration period, the energy demand for the manufacture of identical replacement components and for the recycling and disposal of obsolete components should be accounted for, if a replacement appears realistic. The energy expenditure for the manufacturing and maintenance of buildings can be calculated with the eLCA tool, whereby the program uses the ÖKOBAUDAT database. By using the tool, possible exterior walls, cellar walls, interior walls, pillars, windows, doors, gates, stairs, foundations, base plates, ceilings, balconies, floor constructions, roofs, heat generators, cooling generators, ventilation centres, energy stores and heat distribution pipes of houses are to be recorded in a quantity determination. To compensate for neglected building components, the results of building manufacturing and maintenance must be multiplied by a surcharge factor of 1.1. By using an EnEV software such as ZUB Helena Ultra, the energy demand for building conditioning must be calculated on the basis of the DIN V 18599 series of standards, whereby only the heated areas of the building must be included in com-

parison with the eLCA calculation. The energy required for building conditioning corresponds to the energy used for heating, cooling, ventilation, hot water supply and lighting (to be considered only for non-residential buildings). In comparison to a standard DIN V 18599 calculation, however, a future decreasing primary energy factor, non-renewable, must be considered for the energy source "electricity mix". With the help of Microsoft Excel, the results from the eLCA tool and an EnEV software can be combined, whereby the calculated average annual primary energy demand, non-renewable during the building life-cycle, is to be related to the net room area (NRF) according to DIN 277-1 of all rooms in a house, not taking into account possible vehicle parking areas and lanes.
These new approaches were applied to four real buildings (single family house, semi-detached house, terraced house, apartment house). On the one hand, it was examined whether different common construction practice variants of the example buildings can be calculated under consideration of the further developed EnEV approaches. On the other hand, using the example of the houses, it was calculated and evaluated how the life-cycle related annual primary energy demand, non-renewable changes if the thermal insulation level of the building envelopes and the technical building equipment are varied.

Conclusion
On the one hand, the examination of variants has shown that all 21 variants of the four example buildings can be calculated without major problems by using the further developed EnEV approaches.
On the other hand, the life-cycle related calculations with variation of the thermal insulation level and the technical building equipment have shown that the approach of the individual measures considered, with the exception of the natural gas condensing boiler variant, has paid off for all the example buildings examined from the primary energy point of view (non-renewable) in comparison with the EnEV 2014 reference building standard. The additional energy expenditure for the realization of a single measure can be more than compensated by the energy savings resulting from the building conditioning. Over the considered building life-cycle of 30 years, the calculated energy demand could be reduced compared to the EnEV 2014 reference building standard, if, for example, an optimized thermal insulation of the example buildings was considered. Moreover, the calculations surprisingly showed that the KfW efficient house 55 standard sometimes results in a lower primary energy demand, non-renewable during the building life-cycle, compared to the KfW efficient house 40 standard.

Key data
Short title: Further development of EnEV verification procedures

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Total costs: 248,831.24 €
Part of federal funding: 166,372.64 €
Project duration: 30 months