

PLUS ENERGY IN REFURBISHMENT – PROOF OF CONCEPT

A. PASSER

Institute of Technology and Testing of Building Materials – Sustainability Assessment, Graz University of Technology, Austria, alexander.passer@tugraz.at

H. KREINER

Institute of Technology and Testing of Building Materials – Sustainability Assessment, Graz University of Technology, Austria

T. HALDER

Institute of Technology and Testing of Building Materials – Sustainability Assessment, Graz University of Technology, Austria

K. HÖFLER

Institute for Sustainable Technologies AEE INTEC, Austria

Summary

Many of the buildings built in Austria between 1950 and 1980 are now being retrofitted or refurbished. This implies a major contribution towards the European 2020 targets if these refurbishments are done to a high-performance or even plus-energy standard.

In this paper the successful refurbishment of the lead project “e80³-Buildings” of the research program “house of tomorrow – plus” will be shown in detail, presenting the development of high-performance retrofitting concepts, focusing on plus-energy buildings with the prefabricated façade elements, built-in building services and net integration.

A high-quality refurbishment towards plus-energy buildings is possible only through an integrated approach to refurbishment, including an energy concept. Thus it means a high-quality thermal refurbishment of the building envelope with simultaneous integration of energy-producing active elements (solar thermal collectors and photovoltaic elements), as well as network integration for electricity and heat.

Keywords: Plus-energy; building concept; existing buildings

1 Introduction

The construction sector and the real estate economy are currently in a state of change. Climate change, energy efficiency, scarcity of resources as well as human health and life cycle costing and value retention are the upcoming challenges. Sustainability in general is a crucial topic at the present time. But sustainable development is only possible if ecological, economic and social goals are equally emphasized and equally addressed.

The influence of the construction sector is of high relevance regarding sustainable development, as the construction sector plays a key role in the consumption of energy and resources as well as solid waste accumulation [1] and [2]. It is therefore of high importance to quantify the environmental performance of buildings in order to communicate their potential environmental impacts [3, 4].

Many of the buildings built in Austria between 1950 and 1980 are now being retrofitted or refurbished. This implies a major contribution towards the European 2020 targets if these refurbishments are done to a high-performance or even plus-energy standard.

Due to the change from an energy consuming building to plus energy buildings the main parts of a building and their functions need to be completely redesigned. A high-quality refurbishment towards plus-energy buildings is possible only through an integrated refurbishment approach including an energy concept. Thus it means a high-quality thermal refurbishment of the building envelope with simultaneous integration of energy-producing active elements (solar thermal collectors and photovoltaic), as well as network integration for electricity and heat.

In the paper the successful refurbishment of the lead project “e80³-Buildings” [5] – reconstruction concepts towards energy plus house standard with prefabricated active roof and facade elements, integrated home automation and network integration – of the research program “house of tomorrow – plus” will be described in detail. This project is realized as a case study – demonstration project – in Kapfenberg (Styria/Austria) by the property developer „Gem. Wohn- u. Siedlungsgenossenschaft ennstal“ in the years 2010 to 2013.

2 Case study

The case study is located in the northern part of Styria, a City called Kapfenberg. The projects consists out of 32 residential units, 2.800 m² gross floor area, with total construction costs of approximately 3,5 Mio €. The case study is part of the research program “house of tomorrow – plus” as a so-called lead project e80³-Buildings [5].

2.1 Architectural concept

One of the main issues of the architectural concept is to show the installed innovative building elements in the facade and on the roof actively. With the integration of active elements like PV-modules and solar thermal collectors as well as passive components the transition towards energy generation of building becomes a visible element of the energy concept for the public (see **Fig. 1**).



*Fig. 1 Rendering of the refurbished building
(Nussmüller Architekten ZT GmbH)*

2.2 Energy concept

The starting position for the refurbishment is a detailed site inspection and a calculation of the energy demand of the existing building. The heating energy demand was 101 kWh/m²*a. The main objective was to reduce this to approximately 15 kWh/m²*a.

To reach a plus-energy building the following key elements were integrated into the energy concept:

- high quality thermal refurbishment (opaque and transparent facade)
- controlled ventilation with heat recovery technology
- reduction of electric energy demand in households (e.g. smart meters and energy efficient equipment and lighting)

- use of solar (thermal) collectors for heating and hot water
- use of photovoltaics

The energy concept of the refurbished building is pictured in **Fig. 2**.

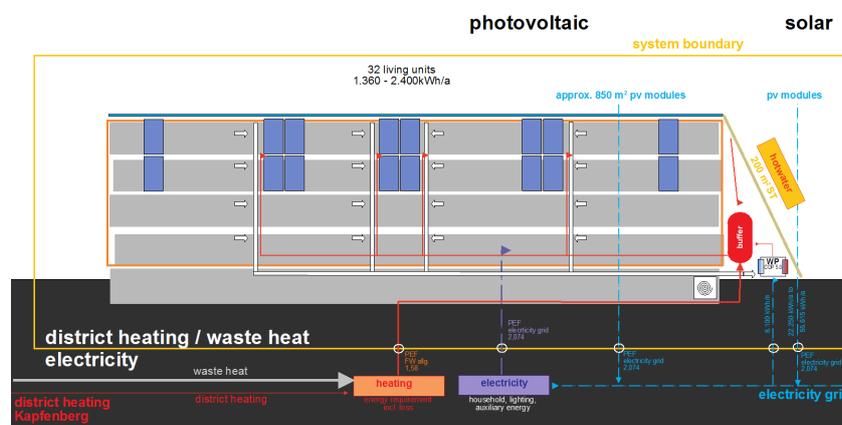


Fig. 2 Energy concept of the refurbished building (AEE INTEC, TU Graz)

2.3 Building sustainability assessment

In the past few years, an increasing number of building certification systems have been placed on the market. In Austria, three national certification systems currently exist, DGNB/ÖGNI [7], klima:aktiv [8] and ÖGNB (TQB) [9]. These certification systems implement different approaches to environmental performance, e.g. completely or partly using LCA methodology. The differences between these certification systems are described in [10, 11]. In the current project a complete assessment by the use of TQB-assessment system and monitoring [6] are part of the objectives for the research project. The results for the first assessment in the planning phase are pictured in **Fig. 3**.



Fig. 3 Result of the TQB-certification

3 Conclusions und outlook

The demand on buildings, which allow the enhancement of the principles of a sustainable development, will gain more and more importance in the private as well as the public sector. This trend is based not only on marketing demands but also due to the need of better life cycle performance. One of the instruments in proving the performance is building certification, which includes aspects as e.g. LCA and LCCA as well as user comfort (as part of the functional performance) or technical aspects.

For the building sector this results in increased requirements primary focusing on new buildings. Whereas the building stock offers the biggest potential to contribute to these targets.

In the current case study it is shown, that a high-quality refurbishment towards plus energy buildings is possible only through an integrated refurbishment approach including an

energy concept. Thus it means a high-quality thermal refurbishment of the building envelope with simultaneous integration of energy-producing active elements (solar thermal collectors and photovoltaic elements), as well as network integration for electricity and heat.

By the use of prefabricated elements the goal of a more energy efficient and lower environmental building sector can be reached.

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