

Task 47

Non-Residential Building Renovation – The Potential, Opportunities and Barriers

A 50 - 90% reduction in heat consumption and a 50 - 70% reduction in overall energy demand are possible when renovating a building. Twenty exemplary renovation projects highlighted in SHC Task 47: Solar Renovation of Non-residential demonstrate how this can be achieved. Two buildings of these buildings achieved the plus-energy standard and one of them received the highest possible BREEAM score of “Outstanding.” And, all these buildings used commercially available products and systems.

Many studies show that buildings account for about 40% of the total energy consumption in OECD countries. Add to this fact that more than 50% of the existing building stock will still be in use in 2050 and that more than 50% of the buildings in many OECD countries were built before 1970. Recognizing these statistics, in April 2009 the EU Parliament approved a recommendation that member states set intermediate goals for existing buildings as a fixed minimum percentage of buildings to be net zero energy by 2015 and 2020. What does all this mean? That the potential is high and opportunities numerous for renovations that achieve a 50 - 90% reduction in heat consumption and a 50 - 70% reduction in the overall energy demand in the building.

Several of these exemplary renovation projects demonstrate that the total primary energy consumption can be drastically reduced and the indoor climate greatly improved. Because most property owners are not even aware that such savings are possible, they set energy targets that are too conservative, which then leads to buildings being renovated to mediocre performance standards and thus create a lost opportunity for decades.

The experts in SHC Task 47 analyzed highly successful renovation projects by focusing on the development of innovative concepts for the most important market segments. The Task narrowed its scope by working with mainly two types of non-residential buildings – offices and education buildings, including protected and historic buildings.

The primary indicator identified in all the successful renovation projects was a multidisciplinary, highly skilled group working towards a common goal. This group includes the building owner, the architect, consulting engineers as well as builders and contractors.

Key Findings

Findings from the 20 projects analyzed included:

- PV seemed to be more interesting for the building owner than solar thermal installations. One obvious reason was that most buildings are offices with limited domestic hot water

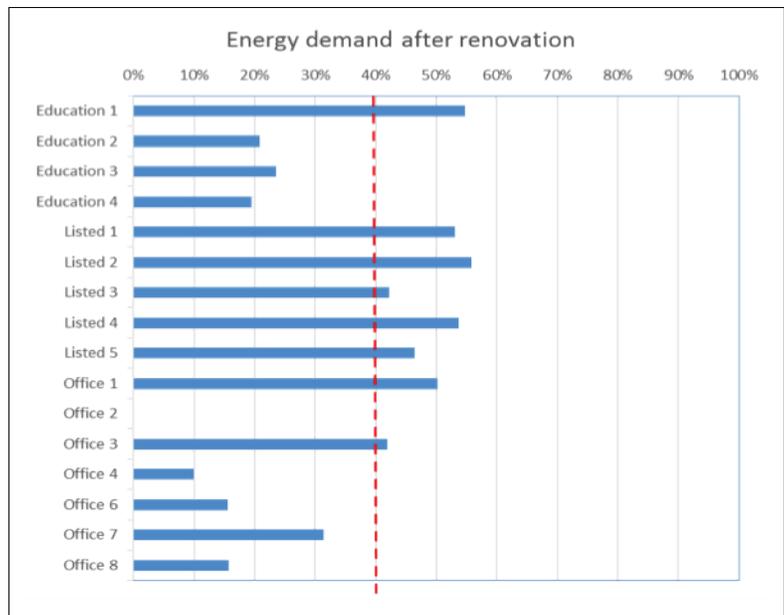


▲ **The Powerhouse Kjørbo in Sandvika, Norway (the office building of the SHC Task 47 Operating Agent, Fritjof Salvesen) received a BREEAM “Outstanding – As Built” certification. Two office buildings from the early 1980s were renovated using high insulation standard, PV and a ground coupled heat pump.**

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and heat demand. One exception was a monastery that installed a 360 m² building integrated solar system to cover 20% of the space and water heating.

- It is not possible to make a significant relation between energy savings and renovation costs. However, for many projects with cost information available, costs for energy saving measures were between 70 and 210/m². The energy savings in these buildings varied from 45-60%.
- The total renovation cost for the two plus-energy buildings were quite similar, respectively 2,600 and 2,700/m². Both buildings added large PV installations.
- Windows, in most cases, were upgraded to a U-value of 1.0 W/m²C or less, and often down to the passive house standard 0.7 W/m²C.
- Many buildings were equipped with demand controlled mechanical ventilation systems with heat recovery, often in combination with controlled natural ventilation systems for summer months.
- Limited mechanical cooling was needed as the cooling demand is mostly covered by nighttime ventilation.
- Many buildings installed efficient lamps with daylight control and/or movement sensors.
- Pupils in one school project showed significant improvement in concentration test scores and health and well-being questionnaires after the upgrade of the ventilation system.



▲ **Figure 2. Percentage of energy demand after renovation for different building types. The red line represents the SHC Task 47 targets.**

Technology Status

A number of relevant energy efficiency products and systems exist on the market. It seems, however, that some countries, such as Austria and Germany, have a better developed commercial market than many other countries.

There is a need for optimized heating delivery systems for retrofit projects. The reason for this is that it is hard to find products that are adapted and optimized for buildings with very limited heat demand. Usually, the heating demand in retrofitted buildings can be supplied with supply water temperatures in the range of 30-40°C. And, this often requires the use of radiant heating systems, such as wall, floor or ceiling heating systems, which are operated with significantly reduced supply water temperatures. However, the installation of radiant heating systems is not always possible or is difficult to do because of the room height and available installation area.

For some buildings, it is not possible to reduce the energy demand as much as wanted due to restrictions or difficulties with the building envelope. To make the climate footprint of these buildings better, increased use of renewable energy may be a favorable option.

For historic and protected buildings, many regular energy saving measures are not compatible with preserving the old buildings character. Listed protected buildings often have requirements to keep the expression and architecture of the building, in some cases a change of the building's architecture expression is not legally possible.



Source: Claudia Dankl, AEE INTEC

▲ **Before and after photos of a school renovation in Schwanenstadt, Austria.**

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AUTHORITIES	Strengthen drivers	Eliminate barriers
Increase attractiveness	<ul style="list-style-type: none"> As part of information campaigns use relevant media and conferences to show good examples. Place particular spotlight on the enthusiasts (both within owner organization and advisors). Actors receiving grants also see this as confirmation of a good decision and see this strengthening the organization's image. 	<ul style="list-style-type: none"> Develop convincing arguments for nZEB. Endorse serious frontrunners. In some countries it is obligatory that companies have a statement about their impact on the environment. This could be extended by an obligation to state what energy labels their buildings hold. This increases the awareness of the issue of the energy efficiency of buildings.
Increase competitiveness	<ul style="list-style-type: none"> Increased tax on energy. Energy labelling systems provide a neutral reference for comparing buildings on energy performance and thereby increase the focus on this as a competitive advantage. 	<ul style="list-style-type: none"> Put in place training programs for all relevant crafts to be updated on nZEB upgrading. Announce stepwise enforcement of building codes.
Make it more affordable	<ul style="list-style-type: none"> Stronger subventions programs for owners upgrading towards nZEB (driver in some projects). 	<ul style="list-style-type: none"> Stronger subventions programs for owners upgrading towards nZEB standard (barrier in other projects).
Make it more available	<ul style="list-style-type: none"> Make sure the top management of building owner companies see the benefits of nZEB upgrading and as a consequence they will be more open for such initiatives within their own projects. 	<ul style="list-style-type: none"> When public bodies upgrade their own buildings, nZEB ambition should be required. In this way both experience and good examples are developed locally. Tender processes must be defined adequately to avoid pure focus on price. A partnering contact for the design phase seems to be a good solution for this. Facilitate arenas for the industry to meet with researchers and other companies to share experiences.

▲ **Table 1: How authorities can contribute to increasing the number of nZEB retrofitting projects.**

INDUSTRY	Strengthen drivers	Eliminate barriers
Increase attractiveness	<ul style="list-style-type: none"> Identify the owner segments which focus on sustainability. Use relevant media and conferences to show good examples. Place spotlight on the enthusiasts (both within owner organization and advisors). 	<ul style="list-style-type: none"> Develop convincing arguments for nZEB.
Increase competitiveness	<ul style="list-style-type: none"> Research projects which focus on combining best innovations on component level in order to make more efficient retrofitting processes. Smart changes of floor plan can improve the area efficiency per employee. Also smart extensions of the existing building, for instance add an extra floor on the top may also improve the economy of the project. 	<ul style="list-style-type: none"> Better initial audits of the building will reduce the amount of unforeseen challenges. Systematic training programs to update the skills of all personnel involved in the projects; from planning, construction and hand over/use. Use of QA tools to assure the quality of a) products/systems, b) competence of the involved actors and c) processes.
Make it more affordable	<ul style="list-style-type: none"> Offer of ESCO contracts where the owner pays in accordance with the energy savings obtained. 	<ul style="list-style-type: none"> Offer of financing as part of the upgrading package.
Make it more available	<ul style="list-style-type: none"> Spread the experiences to new regions so new potential clients can see good examples in their neighbourhood. Make sure the top management of building owner companies see the benefits of nZEB upgrading and as a consequence they will be more open to such initiatives within their own projects. 	<ul style="list-style-type: none"> As it is a challenge to do deep retrofitting while the tenants stay in the building, use of prefabricated solutions may reduce the level of disturbance as well as the length of the on site retrofitting process.

▲ **Table 2: How the industry can contribute to increasing the number of nZEB retrofitting projects.**

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Market Opportunities and Barriers

As SHC Task 47 participants worked to identify the barriers and opportunities in the renovation process, it was important that they also identified the main barriers and how to address them to make the renovations attractive, affordable, cost effective and more accessible.

The methodologies applied to identify the barriers and driving forces included desktop studies of available building stock information and ownership structures in partner countries, interviews and in-depth descriptions of the decision-making processes used in ten case studies from six of the participating countries.

By systematically studying the drivers and barriers, suggestions for how to strengthen the drivers and eliminate or reduce the barriers were developed. The following tables present recommendations to authorities and industry.

The points in red text in Table 2 are the same as the recommendation to authorities, meaning that for these actions joint efforts should be undertaken. Of course, the other points work in conjunction with the measures that need to be taken by authorities.

The final decision regarding a project's level of ambition will always be made by the owner of the building. Learning from Carlson & Wilmot's "The Five Disciplines for Creating What Customers Want," there are five principles that should be in place for a successful nZEB renovation project:

1. A holistic understanding of the tenant's needs – which normally encompasses more than just energy efficiency,
2. Solutions offering values that completely fulfill the needs,
3. One or more enthusiastic person who is committed to the process,
4. A multi-disciplinary team (including occupants), and
5. Project support by top management and in line with the company strategy.

To read more about the Task's results and exemplary renovation projects visit the [SHC Task 47 webpage](#). Here you will find four free publications:

- *Lessons Learned from 20 Non-Residential Building Renovations* (52 pages)
- *Market Change: Upgrading of the Non-Residential Building Stock Towards Sustainable Standard. Recommendations to authorities and construction industry* (59 pages)
- *Sustainable Refurbishment School Buildings – A Guide for Designers and Planners* (331 pages)
- *Assessment of Technical Solutions and Operational Management for Retrofit of Non-Residential Buildings* (to be published 2nd quarter of 2015)

This article was contributed by Fritjof Salvesen of Asplan Viak AS, Norway and Operating Agent for SHC Task 47. For more information and to download the free reports go to <http://task47.iea-shc.org/>.

School "Tito Maccio Plauto" – Cesena (IT)

1. INTRODUCTION

PROJECT SUMMARY

- Major renovation of a primary school, built in the 60s'
- 440 students, 50 employees
- 20 classes (about 22 students)
- Area: 6.420 m²; Volume: 24.554 m³
- No previous energy renovation
- Intervention on:
 - building envelope
 - heating and ventilation system
 - RES

SPECIAL FEATURES

- Limited additional costs
- External insulation with re-design of architectural aesthetic features.
- Users' participation

ARCHITECT

- Municipality of Cesena - Department of Public Works Technical Office

OWNER

- Municipality of Cesena

Brochure authors: Ezilda Costanzo,
Michele Zinzi
Contact: ezilda.costanzo@enea.it



IEA – SHC Task 47

Renovation of Non-Residential Buildings towards Sustainable Standards

▲ This Italian school is of the 19 exemplary renovation project brochures available online.