NeZer - Promotion of smart and integrated Nearly Zero Energy Building Renovation measures in the European renovation market

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SUMMARY

IEE NeZer-project (2014-2017) promotes the implementation and smart integration of Nearly Zero Energy Building Renovation measures in the European renovation market by increasing knowledge of NZEBR concepts and benefits among institutional housing owners and in the whole building chain. The project consortium consists of research organizations and cities from Finland, Sweden, the Netherlands, Romania and Spain. This paper summarizes the first results of the project: 1) Stakeholder analysis and national clusters, 2) Selected building typologies and renovation technologies, 3) Energy Service Companies (ESCOs) in NZEBR, 4) Successful renovation cases. The paper also gives information about upcoming project results.

KEYWORDS

Nearly zero-energy renovation, Renovation technologies, Stakeholder analysis, ESCO, Renovation success cases

INTRODUCTION

Directive 2010/31/EU (EPBD) on the energy performance of buildings states that existing buildings undergoing major renovation shall fulfil minimum energy requirements. Renewable energy production shall be included if this is technically, functionally and economically feasible. The EPBD has resulted in the development of national building codes, norms for calculation of the energy performance of buildings and energy certification of buildings. However, major renovations aiming for nearly zero energy performance have not yet had a market breakthrough.

Energy-efficient renovation measures have been investigated in several research projects. In spite of the ambitious and relevant research results the gathered information is still shattered in various reports and weakly disseminated among practitioners, building professionals and decision-making stakeholders. The decision makers need knowledge on the gains of energy efficiency. This is valid both for private and professional decision makers. Knowledge today is often only accessible for specialists and is not communicated towards the public. Easy accessible information platforms with reliable information are needed to enable decision makers and other stakeholders to do better choices. Knowledge on the energy and non-energy benefits of energy upgrades can be a driver for future successful ambitious refurbishment.

The initiators and planners of the energy upgrade face several barriers of different categories as identified in the EU FP7 project BARENERGY\textsuperscript{1}. The economic barriers include the low energy price (to change behaviour) and the lack of cost effective products. The occupants’ and owners’ lack of knowledge regarding energy use and energy efficiency form the knowledge barrier. The given priority to comfort and high indoor temperatures and the priority to personal gains over the responsibility for the environment are individual and cultural barriers. Structural barriers relate to the lack of feedback on energy use, the lack of services for energy efficiency as well as organizational barriers related to

\textsuperscript{1}http://www.barenergy.eu/
the decision making processes in housing cooperatives. The political barriers include insufficient coordination of initiatives, incentives and regulations. Of these barriers NeZeR will concentrate on addressing and overcoming the knowledge barriers.

The knowledge barriers will be addressed by interpreting, implementing and explaining the existing knowledge about energy efficient building as concrete guidelines for NZEBR. The awareness about potential advantages from NZEBR will be increased among all stakeholders: decision makers, building industry and general public. The implementation of NZEBR in the partner cities and beyond will be secured by increasing knowledge in the whole building chain and among institutional housing owners with respect to NZEBR concepts.

METHODS

NeZeR-project aims to increase knowledge of Nearly Zero Energy Building Renovation (NZEBR) concepts and benefits among institutional housing owners and in the whole building chain. The main target groups are decision makers and property owners, actors in the building industry executing the renovation and producers of technical components and solutions for Nearly Zero Energy Building Renovation.

During the first year of the project, following reports have been delivered: “Stakeholder analysis and national Nearly Zero Energy Building Renovation cluster” (IVL 2014a), “Role of ESCO:s in Nearly Zero Energy Building Renovation” (IVL 2014b), “Technical solutions for energy reduced and renewable energy sources for optimal energy efficient renovation” (Tecnalia 2014) and “Booklet presenting successful NZEBR cases” (Tecnalia et al. 2015). This paper presents the main results of these reports, which are also available on the project website www.nezer-project.eu.

RESULTS

Stakeholder analysis and national clusters

Key target groups for NZEBR were identified on a national level by performing a stakeholder analysis in Finland, Sweden, the Netherlands, Romania and Spain (IVL, 2014a). The stakeholder analysis report was also translated into Finnish, Swedish, Dutch, Romanian and Spanish. Here a stakeholder was defined as anybody who can affect or potentially be affected by an organization, project, development etc. Stakeholders can be either individuals or groups at any level in the society from global, national and regional down to household level.

The stakeholder analysis assessment was performed in following four steps: 1) stakeholder groups were identified, 2) the level of power and interest of each stakeholder group for NZEBR was assessed on a scale from 1- 5 (1=very low, 2=low, 3=neither high nor low, 4=high, 5=very high), 3) stakeholder groups were categorized into four categories (Key Players, Meet Their Needs, Show Consideration and Least Important) and 4) the analysis was summarized.

Stakeholder groups representing authorities, manufacturers of NZEBR and RES components, networks and interest groups were identified as Key Players in all participating countries. Among the building owners, public building owners were identified as Key Players in Sweden, Finland and in the Netherlands. In the Netherlands also private building owners were identified as Key Players. In Romania and Spain building developers were categorized as Key Players instead of building owners. Construction companies were considered to belong to Key Players in Sweden, the Netherlands and in Spain.

Based on the stakeholder analysis national clusters have been established in Finland, Sweden, the Netherlands, Romania and Spain. These national clusters will secure the impact of NeZeR-project both during and beyond its duration. During the project the national clusters will serve as a platform for providing input to different project activities, evaluating outcomes and taking advantage of the results.

Energy Service Companies (ESCOs) in NZEBR

A central question in the current economic situation is how to finance the ambitious renovation. A market overview was performed showing the similarities and differences between participating countries regarding barriers and success factors for Energy Service Companies (ESCOs) on the market (IVL, 2014b).
An ESCO is defined as a natural or legal person that delivers energy services and/or other energy efficiency improvement measures in a user's facility or premises, and accepts some degree of financial risk in so doing. The payment for the services delivered is based wholly or in part on the achievement of energy efficiency improvements and on the meeting of the other agreed performance criteria.

Energy service projects usually include the following elements: site survey and preliminary evaluation, guarantee of the results by proper contract clauses, project financing, operation and maintenance. There are several different ESCO contracts of which the most common is Energy Performance Contracting (EPC) (Bertoldi et al., 2014). Other energy service contracts include Energy Supply Contracting, Chauffage and Comfort contracting (Bertoldi et al., 2014).

The EPBD and the EU Directive on energy end-use efficiency and energy services have encouraged governments' motivation for setting energy saving targets and practicing energy efficient procurement. In most of the countries, energy service contracting has therefore been promoted as one of the ways to achieve energy savings in the existing building stock. The market overview showed how the popularity of energy service contract types differs between countries and the similarities and differences between countries regarding barriers and success factors for energy services on the market.

Energy service contracting has not been used widely in NZEBR of residential buildings. There are several reasons for this. Firstly, NZEBR are performed in the partner countries in pilot scale rather than as the normal renovation procedure, also the energy service market is still developing in the partner countries. Secondly, ESCO:s usually focus more in municipal buildings than residential buildings as it is more profitable and less risky to have a contract including several buildings with varying savings opportunities. Private actors also often require a shorter payback time. Thirdly, ESCO services in the form of EPC etc. with guaranteed savings in many cases have been about “picking the low-hanging fruits” such as automatic control, adjustments of ventilation, etc., which might give savings of 15-30% with relatively small and inexpensive measures. NZEBR level requires more extensive renovation measures (insulation of the building envelope, replacement of windows, management of thermal bridges, RES installation) which are often related to higher costs and longer payback time while the outcome doesn’t always reach the calculated performance. To guarantee savings on these types of projects is more risky for the ESCO. Fourthly, the procurement rules and the complex procurement and bidding process are also mentioned as a barrier for energy service projects. In both Finland and Sweden projects have been halted because of suspicions that the project did not follow the procurement rules, which has resulted in a lack of trust for the energy service concept. Fifthly, in most markets there is also a need for more information, education and dissemination regarding energy service concepts, because they are highly complex and require much effort and competence from the customer side.

To overcome the barriers presented above, the energy service business models should be modified to better fit the market demand and more information and training is needed to push the market development forward. Energy service contracts carry a long-term perspective and they integrate implementation of energy efficiency measures in the building phase with the operation phase of the buildings. This advantage should be better highlighted.

**Selected building typologies and renovation technologies**

The scope of the project is in urban residential houses and dwellings, where the specific types of residential houses are selected in each of the five partnering countries in order to choose the most important national house types. The result of the initial investigation in the project was that NeZeR will address multi-family buildings contracted during the 1960-1980 period (Tecnalia, 2014). The selection was based on building types, where the energy rehabilitation would imply a major impact due to their high replication, energy reduction potential (lack of energy-related standards in that period) and number of affected dwellings or families. According to IMPRO-Building project (Nemyr & Uihlein, 2008), 53% of the building stock are single-family houses (including two-family houses and terraced houses) while 37% are multifamily houses and 10% are high-rise buildings. Additionally, 49% of the EU population lives in high density urban areas which are mainly composed of multifamily houses. The constructive characteristic, energy performance, type of ownership/residents and location has been collected for these representative buildings in each country (Figure 1).
Figure 1: Description of multi-family buildings constructed between 1960-1980 in partner countries

NeZeR will develop NZEBR criteria and packaged solutions for increasing the energy performance of the existing residential buildings. The criteria will be based on three interventions levels named Moderate, Deep and NZEB intervention which will be established for three climatic zones in Europe. In each case a limit value for energy demand and consumption will be established in order to reach specific energy certification.

In order to ensure the increase of energy performance, each package solution will include different technologies which can be classified as passive solutions for walls, windows and roofs, HVAC systems and renewable energy sources. The packaged solution will depend on the building characteristics and the climatic zone. For instance, ground source heat is, in most of the cases, incompatible with multi-family buildings located in urban areas, mainly due to lack of communal areas. On the other hand, the implementation of RES implies significant investment. Thus, well designed package solutions must be considered.

As a first step towards formulating packaged solutions these existing and innovative technologies have been presented as technology data sheets in Tecnalia (2014). In order to facilitate energy renovations, traditional technologies and innovative technologies that are available on the market for at least 5 years have been considered. These data sheets (Figure 2) include a general description of the solution as well as application possibilities, concept drafts and pictures, innovativeness level, advantages, disadvantages, potential problems as well as execution, sustainability and market aspects.
Successful renovation cases

Lack of knowledge on the possibilities and benefits from ambitious renovation is usually a barrier for Nearly Zero Energy Building Renovation (NZEBR). Access to understandable and trustworthy information on the alternatives for renovation is one way of overcoming this barrier. Therefore 30 successful European renovation cases (Table 1) have been analysed and collected into a booklet showing the general description, technologies before and after the renovation, possible barriers and success factors faced in the renovation, organization and process of the renovation and links to further information (Tecnalia, 2015). This booklet has also been translated into Finnish, Swedish, Dutch, Romanian and Spanish and will be provided both as pdf and printed versions.
Table 1. Collected 30 European success cases

<table>
<thead>
<tr>
<th>Country</th>
<th>Renovation cases (total number)</th>
</tr>
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<tbody>
<tr>
<td>Austria</td>
<td>2 multi-family buildings in Wien and Rankweil, school and kindergarten in Windigsteig (3)</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>3 multi-family buildings in Sofia (3)</td>
</tr>
<tr>
<td>Finland</td>
<td>2 multi-family buildings in Riihimäki and Oulu, single-family house in Luumäki (3)</td>
</tr>
<tr>
<td>France</td>
<td>1 multi-family building in Paris (1)</td>
</tr>
<tr>
<td>Germany</td>
<td>3 multi-family buildings in Heidelberg, Berlin and Munich (3)</td>
</tr>
<tr>
<td>Italy</td>
<td>1 multi-family building in Torino (1)</td>
</tr>
<tr>
<td>The Netherlands</td>
<td>3 multi-family buildings in Rotterdam, Amersfoort and Groeningen (3)</td>
</tr>
<tr>
<td>Norway</td>
<td>3 multi-family buildings in Åsane, Myhrerenga and Kristiansand (3)</td>
</tr>
<tr>
<td>Portugal</td>
<td>1 single-family house in Pontes village (1)</td>
</tr>
<tr>
<td>Romania</td>
<td>1 student hostel in Deva, 2 multi-family buildings in Timisoara (3)</td>
</tr>
<tr>
<td>Spain</td>
<td>Mogel district in Eibar with 15 blocks, Cuatro de Marzo district in Valladolid with 30 blocks, 1 detached house in Madrid (3)</td>
</tr>
<tr>
<td>Sweden</td>
<td>3 multi-family houses located in Stockholm, Gothenburg and Alingsås (3)</td>
</tr>
</tbody>
</table>

DISCUSSION

Lack of knowledge on the possibilities and benefits from ambitious renovation is the most important barrier for NZEBR. Access to understandable and trustworthy information on the alternatives for renovation is one way of overcoming this barrier. Furthermore, currently, there are plenty of technologies on the market in order to reach Near Zero Energy Buildings. The key issue is to create a gear that fits all stakeholders to promote and install technologies, rather than develop new ones.

The strategic objectives of NeZeR are 1) to establish the basis for NZEBR beyond the project time frame by forming the NZEBR national clusters ensuring the continuous implementation and utilization of the project outcomes, 2) to make NZEBR the prevailing means for refurbishment and 3) to improve the performance of the existing residential building stock, decrease the energy use of the building stock, achieve significant emission reductions of the building sector, and decrease the non-renewable energy dependency of Europe.

To fulfil these objectives NZEBR national clusters have been established in all participating countries based on an excessive stakeholder analysis thus identifying the most important Key Players in each country and setting up national clusters, which provide input to project activities and feedback for project results. A market overview was performed regarding barriers and success factors for Energy Service Companies for financing of NZEBR measures. 30 European successfully executed NZEBR cases have been analysed and collected into a booklet to identify technical barriers and highlight the advantages of NZEBR implementation. As a first step towards formulating packaged NZEBR solutions the existing and innovative technologies for walls, windows, roofs and HVAC systems renovation as well as implementation of RES have been presented as technology data sheets.

CONCLUSIONS

NeZeR project will continue until February 2017. The ongoing activities are organization of national design competitions, which improve knowledge in the building chain and produce market-ready NZEBR concepts. City-specific NZEBR action plans are being developed for eight European cities: Stockholm, Helsinki, Espoo, Porvoo, Amersfoort, Rotterdam, Timisoara and Sestao. Also concrete guidelines for developing similar action plans in other European cities will be developed. National roadmaps with general descriptions of how to achieve mainstream NZEBR and utilization of RES from the perspectives of the different stakeholder groups will be created to secure that NZEBR and integration of RES will be the preferred options in future urban residential renovations.

The feasibility of NZEBR over traditional renovation will be emphasized by feasibility studies and LCA, LCC and CBA calculations. Also appropriate fiscal incentives and successful business models for the different participating countries will be studied.
The comprehensive and ambitious dissemination and awareness strategy promotes NZEBR and exchange of experiences through workshops, study visits, common exhibitions and seminars.

ACKNOWLEDGEMENT
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