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## Nearly Zero Energy Buildings Application in Mediterranean hotels

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### Abstract

The European Union has set ambitious targets for 2020 and even more ambitious for 2050. In order to reduce the domestic GHG emissions by 80-95% -compared to 1990 levels- till 2050, the building sector has to do its part and to pass through a deep restructure. In this frame, the hospitality industry, responsible for 2% of the world's CO<sub>2</sub> emissions can play a crucial role contributing to the 2020 energy targets in the Member States.

This paper presents the scope and rationale of the European project "Nearly Zero-Energy Hotels" (NEZEH). The NEZEH project, co-financed by the European Commission aims to reinforce businesses operating in the hospitality sector to meet the challenges of competitiveness, reduction of energy consumption and adoption of green energy technologies, providing technical support and advice to selected hotels in order to develop sustainable and feasible large scale renovations towards Near Zero Energy consumption levels. The project covers six (6) Southern European countries – Spain, Greece, Italy, Romania, Croatia and France –locally and nationally. This need becomes more urgent as European law (Energy Performance of Building Directive recast) requires that -by 2020- all new buildings will be zero energy consumption (NZEB). However, the concept of NZEB is still not well developed in most EU countries and Member States should adopt specific policies and measures to accelerate the rate of large scale refurbishments of existing buildings.

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**Nomenclature**

|        |  |
|--------|--|
| EPBD   | Energy Performance of Building Directive                       |
| EU     | European Union   |
| GHG    | GreenHouse Gas   |
| HES    | Hotel Energy Solutions (project)                               |
| IEA    | International Energy Agency                                    |
| IPCC   | Intergovernmental Panel on Climate Change                      |
| MS     | Member State(s)  |
| NZE    | Near Zero Energy   |
| NZEB   | Near Zero Energy Building                                      |
| NEZEH  | Near Zero Energy Hotels  |
| RELACS | Renewable Energy for Tourist Accommodation Building s(project) |
| SME    | Small and Medium Enterprise                                    |
| UNWTO  | United Nations World Tourism Organisation                      |

**1. Introduction**

Buildings account for around 40% of total energy consumption and 36% of greenhouse gas (GHG) emissions in Europe [1]. The European Union (EU) has set ambitious targets for 2020 and even more ambitious for 2050 [2,3,4]. In order to reduce the domestic GHG emissions by 80-95% by 2050 compared to 1990 levels, the building sector has to do its part through a deep restructure. Focusing on the hospitality industry, which is responsible for 2% of the world's CO<sub>2</sub> emissions, Near Zero Energy Building (NZEB) applications could add important advantages:

- Energy consumption is usually higher in hotels than in residential buildings, so there is a larger potential for energy saving measures;
- Hotel guests can experience the comfort of living in NZEB, learning how relevant architectural and technical solutions can also be replicated at home;
- The competitive advantages gained by the initiators will push other hotels to imitate.

Within this frame, the rate of building renovations needs to be increased, as the existing building stock represents the sector with the higher potential for energy savings.

Currently, there is low awareness of the Nearly Zero Energy Buildings (NZEB) concept and there are limited successful demonstrations at the EU level to inspire and drive replications in the private non-residential sector. National markets lack familiarity and expertise with integrated design process and interventions and there is an inadequate number of qualified craftsmen and designers for NZEB. In the participating countries, there are, if any, different national approaches for the NZEB definition. The NZEB concept is not yet understood by the majority of providers/suppliers. Even the NZEB early adopters cannot easily find the appropriate technical actors.

To counter this, the European project "Nearly Zero-Energy Hotels" (NEZEH) will link the supply and demand side, bridging the gap between industry and the interested SME hotel owners and will mobilise

major key actors of the building construction industry increasing awareness about the challenges ahead with regard to NZEB targets. Additionally, in order to increase the rate of renovation in the hotels industry, but also to stimulate new constructions, the feasibility and profitability of such investments should be proved in the eyes of the SME hotel owners. The methodological approach and outcomes of the new European project NEZEH, to be implemented in the period April 2013- March 2016 is presented in the current paper.

## 2. The NZEB definition

The Energy Performance of Building Directive (EPBD) recast [3] stipulates that all new buildings constructed in the EU after 2020 should be NZEBs. For existing buildings, Member States (MS) are drawing up national plans to increase the number of NZEBs. MS should have elaborated national definitions and will draw up national action plans for increasing the number of NZEBs, including policies and measures to stimulate the refurbishment of the existing building stock into NZEB.

The EPBD does not clearly define what a NZEB is, either for new buildings or refurbishments. Article 2(1a) provides a qualitative definition: a NZEB is a “*building that has a very high energy performance.... The nearly zero or very low amount of energy required should to a very significant extent be covered by energy from renewable sources, including renewable energy produced on-site or nearby.*”

At this moment, most MS have not yet defined NZEB nor established any plan to increase their number. However, “*The Commission shall by 31 December 2012 and every three years thereafter publish a report on the progress of Member States in increasing the number of nearly zero-energy buildings*”.

The EPBD clearly defines the role of the public sector as a front runner with a binding target, but does not give any guidelines on how to involve the private sector.

Energy consumption may vary a lot among different locations and categories of hotels but in general hotels are energy intensive. Three-quarters of the consumed energy is used for space heating, hot water production, air conditioning, ventilation, and lightening. A major refurbishment that achieves to transform the building into a NZEB will achieve a tremendous reduction with regard to the operational costs for the hotel, as well as the environmental impact from its operation.

IEA [5] identifies a number of barriers to improve energy efficiency in new buildings which can be equally applicable to energy efficiency retrofitting:

- Hoteliers focus on incremental costs with limited consideration about running costs; decision makers lack awareness of life-time operational costs.
- Lack of awareness amongst decision makers about best practice for energy efficiency (EE) issues and potential savings.
- Difficulty, in some markets, to implement EE measures that involve specific equipment or expertise not largely available Incorrect perception that to ensure the comfort of guests, high energy consumption levels are required
- Unwillingness to implement EE measures beyond the minimum standards described at national building codes.

## 3. Methodology

### 3.1. Targeted regions

The project aims to cover six (6) Southern European countries – Spain, Greece, Italy, Romania, Croatia and France – and one (1) Nordic country (Sweden), at local and national level . The consortium also involves two European networks the Federation of European Heating and Air-conditioning

Associations and the Network of European Regions for a Sustainable and Competitive Tourism and one international organisation (United Nations World Tourism Organization), which will contribute to spread the effects of the project across EU, ensuring that the methodologies and tools developed during the project will receive a widespread recognition in order to effectively trigger the refitting of buildings not only in the hospitality sector, but in the private sector in general.

All targeted regions have a robust tourism industry, but in different geographic/climate zones, with diverse touristic products and need for different technical solutions. At the same time, they face different level of maturity in terms of market's experience at EE and RE technologies and with regard to the NZEB concept familiarity and know-how.

The following entities participate to the NEZEH partnership:

- Technical University of Crete-TUC (project coordinator, GR)
- United Nations World Tourism Organization-UNWTO (ES)
- Network of European Region for a Sustainable and Competitive Tourism-NECSTour (BE)
- Federation of European Heating and Air-conditioning Associations-REHVA (NL)
- Istituto Superiore sui Sistemi Territoriali per l'Innovazione-SITI (IT)
- Sustainable Innovation (SE)
- Agency of Braşov for Energy Management and Environment Protection-ABMEE (RO)
- Energy Institute Hrvoje Požar-EIHP (HR)
- Creara consultants (ES)
- ENERGIES 2050 (FR)

### 3.2. Target Groups

The hospitality industry can play a crucial role supporting MS to reach the binding energy targets by 2020. Through this initiative, hotel owners and guests will be able to experience how selected architectural and technical solutions in buildings can save money without significant loss of comfort.

SME hotels represent the 90% of the European market and they are usually more reluctant to commit to energy saving measures and the use of RES. The main reasons are lack of capital, lack of knowledge and/or awareness. The activities of NEZEH focus to two main target groups: SME hotels (including hotel owners and employees), and hotel customers/guests.

The NEZEH project aims to give technical support and advice to the selected hotels in order to tackle the main market barriers that prevent SME hotel owners from investing in major refurbishment projects towards NZE consumption levels and to accelerate the rate of refurbishment of existing buildings into Nearly Zero-Energy Buildings (NZEB). The key target groups will be reached through targeted communication and capacity building activities in order to trigger their involvement and interest to the project outcomes and to encourage endorsement of the NZEB concept. These objectives require an effort to spread the knowledge about the concept of NZEB, promoting the front runners (SMEs hotels) to challenge replication and to motivate the whole chain (including technical actors, technology/product providers).

Focusing to the hospitality industry:

- Hotel guests can experience the comfort of living in NZEB, learning how some architectural and technical solutions can also be replicated at home.
- Energy consumption is usually higher in hotels than in residential buildings, so there is a larger margin for energy saving measures.
- The competitive advantages gained by the “front runners” hotels will challenge others to go for large renovations.

### 3.3. Key Actors

In many EU countries there is a lack of successful NZEB examples to replicate in the private non-residential sector. To counter this, the NEZEH project will link relevant actors and stakeholders of the building sector and the hospitality industry in order to bridge the gap between supply and demand, and to facilitate exchanging of practical and professional information in order to encourage the development of appropriate ad-hoc solutions for SME Hotels.

Key actors include Regional & National Authorities, Regional Energy Agencies/ Development Agencies, Policy makers, Local & regional financial institutions, Associations/members of Building Developers and engineers, Tour Operators and Hotel Associations.

This list of actors consists of a network of relevant actors from all participating countries and furthermore at EU level, linking the interested SME hotel owners/managers with the supply side (material & technology providers, sustainable building companies and experts, experienced architects) in order to facilitate the identification of potential partnerships and development of real NEZB projects. /

### 3.4. Structure of the Work Programme

In order to increase the number of NEZEHs it is important to work on different levels to convince SME hotel owners that such an investment is worthwhile and will benefit both their business and the environment in general.

The project will define: (1) the most appropriate techniques and technologies available for retrofitting SME hotels into NEZEH (2) financing opportunities and tools for the NEZEH investments and (3) appropriate methods, tools and channels to help the front runners to increase visibility, promote their competitive advantage and boost their business.

The project will deliver practical and flexible technical oriented tools to support the hotel owners to their investment decisions. Providing technical advice, the consortium will assist them to design feasible and sustainable NZE projects. Pilot projects, in seven (7) countries, will demonstrate the profitability and benefits of such an investment. More specifically:

According to different studies and surveys, assessed already by the Hotels Energy Solutions (HES) project [6], the main motivations for hotels to take EE measures and to invest in RES are to reduce operating costs, followed by the demand from customers, the hotel's image improvement, and the reduction of its environmental impact [7].

In order to trigger the refitting of the existing building stock it is important to prove the feasibility and the profitability of the investment and to familiarize the stakeholders of the building and hotel's sector with the concept. The hospitality industry can fit this role due to its visibility and its characteristics. NEZEH will help the hotel owners in their investment decisions through appropriate tools and capacity building activities, also by analysing the appropriate technical solutions, the existing incentives schemes and the possible financial options. Also, it will upgrade the already successful tool developed by UNWTO with the HES project, in order to empower SME hotel owners to easily understand which solutions they should choose in order to retrofit their hotel into a NEZEH, how much the investment will cost and which will be the return of investment.

Finally, the choice to invest in such a major refurbishment is not just driven by the aim to reduce operational costs, but it is also influenced by the raised marketing opportunities.

The pilot projects to be implemented will prove the feasibility and profitability of reaching an NZEH level. These examples will be promoted not only in the countries involved but also at European level in order to demonstrate the advantages of taking such measures and to foster replications.

### 3.5. NEZEH tools and results

Following the outcomes and recommendations from previous projects that have already targeted SME hotel owners (HES [6] and RELACS [8]), NEZEH will develop intuitive and easy-to-use tools that will answer their most frequently asked questions: When I will recover my investment? What technical and technological solutions are best for my hotel? Will this investment have a real impact on the image of my hotel?

The main results by the end of the project will be:

- An **EU level NEZEH community network**, facilitating exchanges between the supply (material & technology providers, sustainable building companies and experts, experienced architects, etc) and the demand side (SME hotel owners), where interested SME hotel owners may find support and answers, in case they are willing to start a refurbishment project.
- A practical **e-tool**, that will empower SME hotel owners to assess their energy consumption state and to choose best technical solutions in order to reach a NZE level under a ROI precondition; the consortium will upgrade and adapt the e-tool developed by the HES project
- **10-14 pilot projects**, in 7 countries, will benefit from direct technical assistance in order to elaborate a “ready to go” project for retrofitting their building into a Nearly Zero-Energy Hotel and proceed for actual investment, in order to act as a success story inspiring other hotel owners.
- Tailor made **marketing guidelines and a set of promotional tools** to be incorporated in the NEZEH initiators' communication campaigns, in order to help them to communicate their environmental profile to the general public and hotel guests and to widely promote their business to potential customers and tour operators,

The selected **pilot projects** will be a testbed to prove the effectiveness of these tools. Simultaneously they will become a powerful example to inspire emulation by other hotel owners.

An important aspect affecting the investment decision is the possibility to finance it. The project will undertake a study in each targeted country on the availability of financing tools for large scale refurbishment projects in SME hotels resulting in a **position paper** to help authorities to boost NZEB applications.

In parallel, it is important to foster a positive attitude and inspiration not only to hotel owners but also to involved stakeholders (architects, engineers, construction companies, builders, material/equipment providers, technology installers, operation/maintenance craftsmen and industry). A key objective is to encourage the endorsement of the NZEB concept by the technical community, key actors and policy makers; this will be done through the **NEZEH communities, targeted** capacity building activities and appropriate **training material for building actors**.

Finally, the project aims to intensively promote the developed tools among SME hotels owners and to present the project's methodologies to the relevant public authorities and policy makers for challenging replication.

## 4. Barriers to be addressed and major outputs

Taking into account the existing studies and initiatives regarding the use of RES in hotels like HOTRES [9,10,11] the barriers that prevent owners from taking investment in EE and RE technologies could be classified in two main groups:

**Economic Barriers:** Almost all hotels have difficulty obtaining financing for any type of investments; SME Hotels often have poor credit ratings that make their loans more costly. In addition they have

difficulties to apply for financial aid and support from public funding because of the lack of time, personnel and knowledge. This type of barriers is much more intense today and stiffen any investment decision due to the economic crisis, especially in Mediterranean countries.

**Awareness Barriers:** It is clear that all hotels, and particularly SME hotels, need support on how to reach the NZEB level, how to address specific technical issues and how to draft a feasible retrofitting plan. Having a tool which helps them to obtain an initial idea of suitable interventions and to calculate the return on their investment, will help them to consider the refurbishment of their buildings.

To the above broad types of barriers, more specific barriers could be added given the specificities of the NZEB concept and the different national definitions in the Member States: To these types of barriers that affect generally the adoption of EE and RE measures we should add specific barriers given by the specificity of the NZEB concept:

- Unawareness of the concept among the stakeholders of the building sector
- Unclear legal framework
- The retrofitting of the building will probably cause a closure or a partial closure of the hotel. The major outputs of the action will be:
  - An integrated set of decision support tools to assist hoteliers in identifying appropriate solutions and designing feasible and sustainable NZEB projects.
  - A dynamic communication channel between the building sector and the hotels industry, which will enable the exchanging between demand and supply side and the endorsement of the NZEB concept.
  - Demonstration pilot projects in 7 countries to act as “living” examples, aiming to increase the rate of NZE renovation projects in the targeted countries.
  - Practical training and informational materials and capacity building activities to support nationally the implementation and dissemination of NEZEH projects.
- Integrated communication tools to increase awareness for the NZEB benefits, to promote front runners and to foster replication; challenging much more SMEs to invest in refurbishment projects in order to achieve NZE levels.

In the long term the project will help the European hospitality sector to reduce operational costs, to improve their image and products and so to enhance their competitiveness contributing in parallel to the EU efforts for the reduction of GHGs.

## 5. Contribution in the EU targets

The project aspires to contribute to the EU 2020 targets (Table 1).

Table 1. Quantitative targets towards 2020

| Overall objective   | Target within the action duration  | Target by 2020  |
|---|--|---|
| To contribute to the EU 2020 target on energy efficiency and renewable energy sources | Cumulative investment made by European stakeholders in sustainable energy: 21.6 M€ | Cumulative investment made by European stakeholders in sustainable energy: 160 M€ |
|   | Renewable Energy production triggered: 165 toe/year                                | Renewable Energy production triggered: 1,238 toe/year                             |
|   | Primary energy savings compared to projections: 1,197 toe/year                     | Primary energy savings compared to projections: 8,977 toe/year                    |
|   | Reduction of GHGs: 2,372 t CO <sub>2</sub> e/year                                  | Reduction of GHGs: 17,787 t CO <sub>2</sub> e/year                                |

The main assumptions are the following:



1. Due to the current economic crisis in most of the participating countries 12 pilot projects are foreseen, as a moderate scenario. In the targeted countries the pilot projects' showcase will be more influential and additional growth is expected.

2. There is a great heterogeneity of the hotel sector and climate differences between the targeted countries.

3. Assumptions with regard to the hotels' characteristics:

- average ground area: 2,000 m<sup>2</sup>
- average consumption: 350 kWh/y/m<sup>2</sup> for full year operation
- mix of energy consumption: 33,3% electricity (grid), 33,3% heating (50% natural gas + 50% oil), 33,3% cooling (grid)
- 20% use of renewables (50% for heating, 50% for electricity)

4. In order to reach a NEZEH level:

- the hotels will reduce their energy consumption to: 100 kWh/y/m<sup>2</sup>
- they will produce 80% of its needs by RES (50% for heating, 50% for electricity)
- the cost per refurbishment project is estimated as: 900 €/m<sup>2</sup>

5. As concerns the CO<sub>2</sub>eq emissions to be achieved the following indicators were taken into account:

- oil CO<sub>2</sub>eq emission factor: 0,267 tCO<sub>2</sub>/MWh (IPCC, 2006)
- natural gas CO<sub>2</sub>eq emission factor: 0,202 tCO<sub>2</sub>/MWh (IPCC, 2006)
- EU energy mix of power generation CO<sub>2</sub>eq emission factor: 0,475 tCO<sub>2</sub>/MWh (ENTSO-E)

## 6. Sustainability and EU impact -Conclusions

The developed tools will be maintained after the project's end. The Technical University of Crete, which is the project coordinator, will draw a sustainability plan in order to keep alive the NEZEH international community and the e-tool, in collaboration with UNWTO.

In the long term, the successful example of the pilot projects and the wide dissemination campaign of the project's results in other EU countries will foster a 2<sup>nd</sup> wave of NEZEH initiatives thus starting a snowball effect. The increasing number of NEZEH may:

- inspire the supply side to provide more suitable solutions, reducing the costs for the demand side;
- raise the visibility of the NZEB concept to a large number of hotel owners;
- increase the number of "green" hotels thus having a positive effect over the demand.

In the long-term, NEZEH will support the hospitality sector to reduce operational costs and to improve its image and services, so as to enhance their competitiveness and sustainability contributing in parallel to the EU fight against climate change and energy uncertainty.

The NEZEH initiative will have a positive impact in reducing the building sector's CO<sub>2</sub> emissions before 2020. At the same time, it will encourage a wide visibility and endorsement of the NZEB concept demonstrating to the private sector the profitability of refitting buildings. This will be a fundamental step in order to reach the goals set in the Energy Roadmap for 2050.

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