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European initiatives towards improving the energy efficiency in existing and historic buildings

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Abstract

Increasing the building sector's energy efficiency while reducing CO₂ emissions, constitute the main challenge that most European cities need to tackle. In Europe the building sector is responsible for nearly 40% of the total energy consumption. Considering the slow rates of constructing new buildings, a lot of attention needs to be paid to the already existing building stock. This paper presents some of the major projects carried out in Europe and their achievements regarding the integration of innovative technologies and use of different sources of renewable energy in existing buildings. Special attention has been paid to projects targeting historic buildings, since their significant cultural and historic values make their refurbishment and retrofitting process more complex.

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1. Introduction

The building sector is responsible for nearly 40% of the total energy consumption in Europe [1]. By combining technological and material advances and promoting the use of renewable energy sources, the European Union (EU) is attempting to reach the “20-20-20 climate goals”: 20% increased use of renewables, 20% reduction in greenhouse gas emissions and 20% increase in energy efficiency, by year 2020. Currently the EU-27 counts with 160 million buildings, one-quarter of them built between 1970 and 1990; in France and the Netherlands more than 35% are from this period, reaching up to 45% in countries like Finland [2]. Also more than 40% of the residential buildings have been constructed before the 1960s in a worse way than buildings from earlier decades [3]. Considering that new buildings represent only 1-1.5% of the building stock [4], in order to achieve substantial impact in terms of energy savings and greenhouse gas (GHG) reduction, renovation and retrofitting of existing buildings become a very

important challenge. Although the large variety of existing buildings does not allow to have a unique retrofitting approach, in the EU, the Building Directive 2010/31/EU includes the major aspects of renovation of existing buildings and the technical elements and/or systems of retrofitting [1].

An important group within the existing stock is formed by historic and heritage buildings. This building group is mainly characterized by bioclimatic design, durable construction materials and resilient architecture that is usually needs to be preserved in order to maintain the cultural values. It has been estimated that in the EU-27, the buildings stock built before 1919 represents 14.3% of the total [5]. Therefore, improving the energy efficiency of this group of buildings represents an important challenge that need the attention of policy makers, researchers and other actors.

The paper presents the objectives and results of different initiatives that aim at improving the energy efficiency of historic buildings, throughout Europe. In some cases, projects including existing, but not necessarily historic buildings have also been included due to their importance and/or use of state of the art technologies/RES.

2. Methods

This study is based on information collected from several projects carried out throughout European countries, with different climate and cultural conditions, all of them having in common the use of innovative technological solutions for increasing the energy efficiency and use of renewable energy sources (RES) in existing and with historic value buildings. The main information regarding each project will be described, considering partners, energy saving data, RES contribution and CO₂ emission reduction.

It is important to mention that in this paper, historic buildings are considered to be the buildings important from a History point of view. To be classified as historic, buildings must have sufficient age, a high degree of physical integrity and historical significance, attributes described in detail by [3]. In many cases the protection measures included in heritage laws exceed the limits of the buildings' identity conservation, making some of the innovative refurbishment and retrofitting techniques unfeasible for this group.

3. Projects description

NEW4OLD

The aim of the project was to refurbish and retrofit a 140 years old building (the Renewable Energy House) located in Brussels, as well as the creation of a network of light-house Renewable Energy Houses that would serve as focal points for sustainable energy policy discussion in different EU Member States, contributing in this way to the commercialization of RES among others [6]. It is considered to be a perfect showcase for the integration of innovative renewable energy technologies in old heritage buildings. Two main objectives were pursued: reduction of the energy demand for HVAC with 50% and covering the entire demand with 100% RES. The project finalized in 2010 and counted with the following partners: European Renewable Energy Council, Global Renewable Energy and Conservation Trust, 3E Engineering, Institute for Sustainable Technologies (Austria), the Institute for Thermodynamics and Thermal Engineering (Stuttgart, Germany), National University of Ireland and the National and Kapodistrian University of Athens, Greece.

Some of the energy efficiency measures include insulation of façade and roof: façade with 15 cm of Expanded Polystyrene; roof with 15 cm mineral wool; windows were replaced with new ones, with k-value 1.5 W/m²K; sun protective windows for roof glazing with a solar factor of g=0.35. The efficiency

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