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Energy Refurbishment Towards Nearly Zero Energy Multi-Family Houses, for Cyprus

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Abstract

Following Europe's 20:20:20 objective, this case study investigates refurbishment scenarios in order to achieve Nearly Zero Energy houses, in Cyprus. The study investigates amongst other aspects of the European recast, two approaches that will be decisive for the development of the building sector in Cyprus: The measures and techniques to be implemented in order to achieve nearly Zero Energy Houses (nZEB) in Cyprus and the analysis of cost optimisation. The research focuses on the Multi-Family House typology as classified in the framework of EU project EPISCOPE. The building was modelled using the official governmental software iSBEM_cy tool, according to the European Directives 2002/91/EC and 2010/31/EC. The aim was to upgrade it into a nearly Zero Energy Building (nZEB) by investigating the effectiveness of the energy refurbishment both in terms of energy savings and payback period. Two scenarios were developed in order to evaluate the energy efficiency and the cost effectiveness of the conservation measures. Through analysis of the results, the efficiency of each strategy and technique employed towards minimising the energy consumption and the greenhouse gas emissions was evaluated, in terms also of its cost effectiveness. Furthermore, the results of the research were investigated in order to assess whether the nZEB requirements, as developed by the MECIT, are appropriate for the existing Multi-Family houses in Cyprus and whether alternative strategies may be employed in order to meet the target of nZEB and to reduce effectively the energy consumption and the CO2 emissions.

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Keywords: Multi-Family Housing; Nearly Zero Energy Buildings; Cost-effectiveness

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1. Introduction

The residential stock is the biggest segment of EU floor space, reaching 75% of the total building stock, which accounts for 63% of the total energy consumption. In EU-25 there are about 196 million dwellings, with more than 50% of the existing residential buildings built before 1970 and about 1/3 of the dwellings built during 1970-19901.

Raising the bar for new buildings — especially given the explosion of new green building technologies and the growing popularity and accessibility of sustainable design — stimulates innovation and creates future environmental benefits. However, existing buildings in built-out cities are going to be responsible for the vast majority of resource use over any meaningful planning period. While new constructions add at most 1% a year to the existing stock, the other 99% of buildings are already built and produce about 26% of the energy-use induced carbon emissions2. Thus, one of the greatest challenges in urban sustainability today is energy retrofitting or greening the existing buildings.

Taking into account that the expectation for the structural life of a building often exceeds 60 years, while the envelope shows signs of obsolescence after only in 20 or 30 years2, it is understandable that a building completed in 2010 will undergo refurbishment during the next 10 to 20 years.

Within the residential sector, different types of single family houses (e.g. detached, semi-detached and terraced houses) and apartment blocks are found. Across the EU-25 countries, 64% of the residential building floor area is associated with single family houses and the remaining 36% with appartments3.

There is no “one size fits all” approach to retrofitting the multifamily housing stock. Multifamily buildings vary widely in terms of heating, ventilation, and air-conditioning (HVAC) and other relevant systems, building age, building size, tenant incomes, financing structures, ownership structures and other important factors that may affect energy efficiency and related decision-making. Policies must accommodate and reflect the diversity of both the building stock and its stakeholders.

Multifamily buildings account 21.7% of the total building stock in Cyprus. Although they tend to be energy efficient, on a per capita basis, because their shared-wall geometry means that less heating and cooling are lost to the exterior4, they have been identified as a particularly challenging area for energy conservation[1]. Many owners prefer to perform improvements at unit turnover. However, by renovating on a unit-by-unit basis, owners lose the economic benefits from retrofitting the entire building at once.

Very little data on the actual energy performance of multifamily properties is currently available, making the benefits of energy efficiency improvements difficult to quantify. Determining the most effective measures for multifamily housing energy performance will maximize both the ability of policies to advance energy efficiency within the sector and the compliance of the owners/stakeholders[5]. According to the law N.210 (I)/2012 it is necessary for each building or dwelling under construction or big scale renovation to proceed to energy audits and to issue Energy Performance Certificates (EPC). This is obligatory for buildings or dwellings to be sold or to be rent, resulting the increase both of the property’s value and cost attractiveness.

2. Methodology

According to the IEE Project TABULA and the ongoing IEE Project EPISCOPE[6], twelve residential building typologies were established as typical and representative of the national residential building stock in Cyprus[7]. These are classified according to their chronological period of construction and their architectural and constructional characteristics. The three building typologies consist of the Multi Family Houses (MFH), the Terrace Family Houses (TH) and the Single Family Houses (SFH). These are further divided into four different chronological periods, supported by the data collected from the Cyprus Statistical Service[8]. Each chronological division was defined based on the different constructional regulations and techniques that were applicable throughout the years, formulating the four distinctive chronological categories. These categories are the following: 1) before 1980, 2) between 1981 and 2006, 3) between 2007 and 2013 and 4) after 2014. The divisions were also guided by the rapid growth of the construction industry in Cyprus, which occurred after 1980, by the adoption of the European Directive 2002/91/EC in 2007 and the amendment of the Directive 433/2013, which was enforced in the beginning of 2014. Before the entrance of Cyprus in the European Union, there was no energy related legislation for the building sector.