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## Prioritising energy efficiency measures to achieve a zero net-energy hotel on the island of Gozo in the central Mediterranean

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### Abstract

Nowadays energy consumption of buildings in different countries comprises 20–40% of total energy use. In Malta, the building sector consumes about 35% of the total energy consumption, with hotels playing a significant role in producing carbon dioxide emissions. In this scenario and taking into consideration the EPBD goal for 2020, a review of all possible measures that can be considered to attain near or net zero-energy buildings has been made.. A case study has also been adopted to design a real new small hotel in the island of Gozo, Malta with the aim of making it a low energy building. An energy analysis software Design Builder-EnergyPlus has been used to simulate and optimise the energy use of the hotel, through improvements in the building's envelope. Polysun software has also been used to evaluate the performance of sustainable energy and high efficiency systems. A number of optimum solutions combining different systems together with improved building envelope design were then proposed to make the hotel a zero net-energy building.

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## 1. Introduction

In Europe, new buildings are striving to achieve energy efficiency and eventually become zero net-energy by 2020, as required by the EU Directive Recast on Energy Performance of Buildings Directive (EPBD) 2010/31/EU. Such buildings cannot just be created at the last minute but it will be a progressive process that eventually leads to the final target of zero net-energy buildings.

To that effect, a new small hotel is being planned to be built on the Island of Gozo, Malta. The intention is to make the hotel as green as possible in terms of energy demand and energy systems, within the confined space available of 12 m x 20 m.

Energy demand for space heating and cooling, water heating, ventilation and lighting, based on the current plans of the hotel has been evaluated in order to analyze how energy savings and renewable energy can be implemented, with the final goal of being the first near or net zero-energy building in Gozo, thus fulfilling the 2020 goal established by the EPBD Recast.

## 2. Net zero energy buildings (ZEB)

A number of definitions for ZEB are found in literature, depending on the project goals and the reference to be used by the design team and building owner. Such definitions are summarized as follows [1]:

- Off-site ZEB: This can be achieved using off-site energy without the use of any other source of sustainable energy from within the building itself.
- On-site ZEB, which can be divided into four options as follows:
  - Net Zero Site (Delivered) Energy: A Site ZEB produces at least as much energy as it uses in a year, when accounted for at the site.
  - Net Zero Source (Primary) Energy: A Source ZEB produces at least as much energy as it uses in a year, when accounted for at the source. Source energy refers to the primary energy used to generate and deliver the energy to the site. To calculate a building's total source energy, imported and exported energies are converted to primary energy using the appropriate site-to-source conversion efficiencies.
  - Net Zero-Energy Costs: In a Cost ZEB, the amount of credit the utility pays the building owner for the renewable energy exported from the building to the grid is at least equal to the amount that the owner pays the utility for the energy services and energy used over the period of one year.
  - Net Zero-Energy Emissions: A net-zero emissions building produces at least as much emissions-free renewable energy as it uses from emissions-producing energy sources.

According to the EPBD “Net Zero Source (Primary) Energy” is the definition used for the purpose of the directive. For the case of this hotel, all the energy used is electrical and therefore the appropriate fossil-fue to electrical energy conversion efficiency of 35% has been used.

## 3. Energy use in non-residential buildings: hotels

It is well known that the main environmental impact takes place during the operational phase of a building and even more so for a hotel, when compared to the energy used for building or demolishing it. This is one of the main reasons behind the added attention given to all buildings to reduce their energy consumption during their operational phase [2].

Furthermore, the efficient use of energy in the hotel sector is driven by other factors such as increased interest in green hotels, higher operational expenses and energy costs, greater demand for services that require energy for their operation and higher pressures on profitability and competition.

The actual target for Malta is to reach 22% of energy efficiency by 2020 [3]. In a touristic island like Malta and Gozo, the hospitality sector is gaining more importance with new hotels being built or new extensions being made to existing hotels, to cater for the increased influx of tourists to the Islands. In 2014, an all-time record of 1.7 million

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