World Academy of Science, Engineering and Technology
International Journal of Energy and Power Engineering
Vol:11, No:12, 2017

Renovate to nZEB of an Existing Building in the Mediterranean Area: Analysis of the Use of Renewable Energy Sources for the HVAC System

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Abstract : The energy renovation of existing buildings represents an important opportunity to increase the decarbonization and the sustainability of urban environments. In this context, the work carried out has the objective of demonstrating the technical and economic feasibility of an energy renovate of a public building destined for offices located on the island of Lampedusa in the Mediterranean Sea. By applying the Italian transpositions of European Directives 2010/31/EU and 2009/28/EC, the building has been renovated from the current energy requirements of 111.7 kWh/m² to 16.4 kWh/m². The result achieved classifies the building as nZEB (nearly Zero Energy Building) according to the Italian national definition. The analysis was carried out using in parallel a quasi-stationary software, normally used in the professional field, and a dynamic simulation model often used in the academic world. The proposed interventions cover the components of the building's envelope, the heating-cooling system and the supply of energy from renewable sources. In these latter points, the analysis has focused more on assessing two aspects that affect the supply of renewable energy. The first concerns the use of advanced logic control systems for air conditioning units in order to increase photovoltaic self-consumption. With these adjustments, a considerable increase in photovoltaic self-consumption and a decrease in the electricity exported to the Island's electricity grid have been obtained. The second point concerned the evaluation of the building's energy classification considering the real efficiency of the heating-cooling plant. Normally the energy plants have lower operational efficiency than the designed one due to multiple reasons; the decrease in the energy classification of the building for this factor has been quantified. This study represents an important example for the evaluation of the best interventions for the energy renovation of buildings in the Mediterranean Climate and a good description of the correct methodology to evaluate the resulting improvements.

Keywords : heat pumps, HVAC systems, nZEB renovation, renewable energy sources
Conference Title : ICAESE 2017 : International Conference on Advances in Energy Systems Engineering
Conference Location : Barcelona, Spain
Conference Dates : December 14-15, 2017