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Abstract

Current trends in energy supply and use within the building sector in Egypt are patently unsustainable and uneconomical; they are not environmentally and sometimes not even socially viable. Renewable energy has recently started to attract considerable attention as a future energy source. After major problems with electricity blackouts the photovoltaic (PV) market, in particular, has been growing significantly in Egypt over the last 5 years. This study was conducted to develop an evaluation method to assess the potential of applying passive design and low carbon and construction strategies together with PV systems for electricity power supply. A one year Building Performance and Post Occupancy Evaluation was carried out for a selected case study in Baharia, Egypt using records of energy use, demand profiles, and monitored thermal behaviour in indoor environments, together with a review of occupants' satisfaction. The outcome of this study offers an applicable methodology for assessing the performance of mixed use off-grid low carbon and PV plus-energy buildings. The results aim to serve as a base for future national legal requirements for a zero carbon and PV plus-energy solar building practice especially in off-grid desert settlements in Egypt.

Keywords: Plus-energy building, low carbon construction, Post Occupancy Evaluation, Building Performance Evaluation, occupants' comfort (indoor climate), off-grid.

1. Introduction

Energy efficiency is becoming progressively more important, both in terms of affordability and energy security (Guzowski, 2010; Hootman, 2013). In a time of increasingly high fuel prices and rapidly diminishing conventional energy resources, buildings with low carbon emissions that adopt passive techniques and are powered with renewable energy sources are recognized nowadays to have the potential for climate change mitigation and energy reduction (Hoque and Iqbal, 2015; Rosenzweig et al., 2011). The need for power grows much faster in less developed nations than in those that are already industrialized (Urban, 2014). North African and Middle Eastern (MENA) countries anticipate 24 million new housing units by 2030 (Visser et al., 2013). This will lead to a rise in energy problems in the MENA region if the countries carry on constructing energy inefficient buildings (Tolba and Saab, 2009). According to Foster et al. (2010), solar and wind energy are now viable alternatives in the provision of low cost options to supply electricity in developing regions compared to the fossil fuel energy options that currently supply the conventional electricity grid.

Energy use in buildings in Egypt accounts for around 50% of the country's annual energy use (NREA, 2013). By the beginning of 2015 Egypt had taken concrete steps to establish its first