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An exploratory of residents' views towards applying renewable energy systems in Saudi dwellings

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Abstract

Saudi Arabia is experiencing a rapid growth in the demand for energy and residential buildings. The residential sector alone is responsible for over 50% of the total national electricity consumption. The energy supplies in Saudi Arabia are completely reliant on fossil fuels that are regarded to be the main source of greenhouse gas emissions. In order to promote sustainable development it is vital for Saudi Arabia to reduce the usage of fossil fuels. The country is yet to meaningfully explore the renewable energy recourses. Public perception is a key factor in the take-up of renewable energy in any society. Given the importance of the residential sector in the energy scenario of Saudi Arabia, the presented work aimed to investigate the acceptability of renewable energy systems (RESs) amongst the domestic users through a questionnaire based survey. It covered three RESs including solar photovoltaic (PV), micro-wind turbines and solar water heaters. The results revealed that, solar PV is the most preferred choice.

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1. Introduction

The world faces a string of serious energy and environmental challenges. Fossil fuel reserves, presently contributing to over 80% of the world's total primary energy consumption, for example, are declining, the demand for energy is on a steep rise and energy prices are fluctuating and rising [1,2]. The global primary energy consumption is reported to have increased by 29% from 2000 to 2010 and is forecasted to see a further 20% jump by 2020 [3]. In Saudi Arabia, the energy supplies are completely reliant on fossil fuels and electricity generation is based upon oil and gas power plants [4]. The country is experiencing a rapid growth in energy demand. Since 1990, for example, the demand has increased at an annual rate of 6% [5].

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To cope with the stresses caused by the economic and population growth, statistics suggested that the country plans to increase power generating capacity from the current level of about 55 gigawatts (GW) to 120 GW by 2020 [6]. The residential sector is the biggest consumer of electricity – it accounts for over 50% of the total national electricity consumption [4]. Furthermore, the residential sector is set to experience a rapid growth in coming year as the Saudi population is rising at a rate of 2.5% per year and only 24% of the Saudi nationals have their own homes [7]. Also, statistics suggested that around two-third of the population is under the age of 30 years [8]. To meet the needs of the constantly growing population, the country needs to build 230 thousands new homes annually through to 2020 [9]. It is therefore crucial to move towards sustainability by switching to energy-efficient and environment friendly practices and by exploiting the renewable energy resources in the country [10]. The Saudi building industry in general and the residential sector in particular can play a vital role in this respect [11]. However, there is uncertainty regarding the acceptability of the renewable energy systems (RESs) by Saudi residents [12]. The present work therefore aims to explore the Saudi residents' views towards applying these systems in their dwellings through conducting a questionnaire survey.

2. Potentials of renewable energy in Saudi Arabia

Saudi Arabia has a healthy potential for renewable energy especially for solar energy [13,14]. Fossil fuels, owing to their abundance and cheap availability remain to be the main source of energy in the country [13]. Since 1970s, many studies have shown the potential of solar and wind energy in the country but these technologies have not been exploited yet in any meaningful way.

The geographic location of Saudi Arabia is ideal for harnessing solar energy. According to the Saudi Solar Radiation Atlas, the country annually receives around 3,245 sunshine hours accounting for an annual solar radiation figure of over 2,200 kWh/m² [15]. The country can be classified into five inhabited climatic zones represented by Dhahran, Guriat, Riyadh, Jeddah and Khamis Mushait [16]. The weather records for these climatic zones have shown that the annual global solar radiation level ranges from 1,715 kWh/m² (in Dhahran) to 2,275 kWh/m² (in Jeddah) while the number of sunshine hours varies from 2,698 (in Khamis Mushait) to 3,397 (in Riyadh) [17]. The monthly data showed that the solar radiation level varies between 170kWh/m² (in Dhahran) and 250 kWh/m² (in Guriat) during the summer months and between 90 kWh/m² (in Guriat) to 190 kWh/m² (in Khamis Mushait) during the winter months (see Fig. 1a). The monthly sunshine hours were observed to vary from 165 (in Khamis Mushait) to 383 (in Riyadh) during the summer months and from 181 (in Guriat) to 236 (in Riyadh) during the winter months (see Fig. 1b).

Since 1970s, a number of research projects have been undertaken to evaluate the prospects of solar energy for applications like solar water heating, solar distillation of water, solar air heating, solar cooking, solar drying of agricultural produce and other product, solar lighting, solar refrigeration, solar water pumping, solar powered communication, and solar transport [18]. These studies have shown promising results for application of technologies like solar photovoltaic (PV), solar water heater (SWH) and solar drying while options like solar refrigeration and seawater desalination face some technical and economic barriers [18].

One of the earliest solar energy projects in the country was the development of solar village in 1981. At the time, it was a major research project - with 0.35 MW capacity of solar PV - located about 50km northwest of Riyadh [19]. There were however no considerable follow up developments until recent years. The total installed capacity has increased from 0.5 in 2002 to about 16 MW in 2014 [20].

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