

Assessing the Effectiveness of Solar and Wind Energy in Sultanate of Oman

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The Sultanate of Oman is a fast growing region and has fifth largest economy in the GCC regions. The oil and gas sectors are the main promoters of Oman's economy. The reservoirs of natural resources are insufficient to satisfy for a continuation of the current trends. The electricity sector of Oman mostly depends on natural gas: 97.5% and Diesel: 2.5%. Renewable energy has no major role in the country's energy supply despite of having valuable wind and solar resources. This review paper tends to bring forward the current and future renewable plans and situations of solar and wind energy in Sultanate of Oman. Therefore this objective is achieved by carrying out literature review of the importance of the wind and solar sources according to the conditions of Oman and by visiting the existing renewable energy plants.

Keywords: Energy Sources, Renewable Energy, Solar Energy, Wind Energy.

Introduction

Like rest of the GCC, the Sultanate of Oman has large reserves of oil and natural gas which provide a cheaper source of power than renewable options made these countries to underutilize [1] the energy renewable resources.

Oman is reliant on its oil sector for the majority of its export incomes and government finances. Oman owns the largest oil reserves of any non-OPEC [1] country in the Middle East as well as momentous reserves of natural gas of which it is a leading exporter regionally.

Population growth and the development of heavy industry have put a stress on Oman's power infrastructure. Over the last few years through the adoption of enhanced oil recovery techniques on a large scale average oil production has increased. Consumption of petroleum products has doubled in the past ten years.

Over the last decade, tourism numbers and the corresponding hotel and luxury developments have expanded rapidly, which results in a large increase in the demand for power in a comparatively short period of time. [1]

The objective of this study is to present the current scenario of Wind and Solar energy sources in Oman and also discuss the future renewable plans regarding wind and solar energy sources.

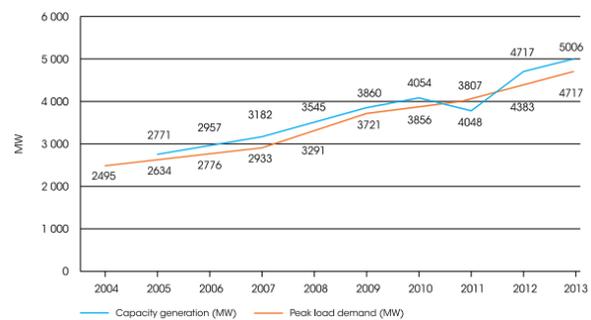
Overall demand of energy and supply of energy

In Oman continued growth in energy demand requires building new power plants. So far gas-based power plants are decided and mid-term prospective additions for energy reservation. [5]

Hence, there is an open window for investing in renewable energy generation, as well as introducing the end-users with renewable energy appliances, which operates on the renewable energy resources such as air conditioners which works on the absorption.

Power demand is based on the climate in Oman and is highly reliant on the weather variations. In summer the demand of energy is doubled than in winters. According to Oman Power

and Water Procurement Company (OPWP) [5], the single buyer of electricity and water in Oman, peak power demand reached 4.7 gigawatt (GW) in 2013; representing an 89% increase compared to 2004, see the figure



Renewable Energy Resource Potentials

In January 2005, Oman signed up a contract with the "Kyoto Protocol" and announced the formation of a Designated National Authority (DNA) [4] in 2009 to inspire and manage the utilization of renewable energy.

With a Royal Decree and a vision promulgated under Sultan Qaboos bin Said's "Vision 20/20" policy to produce 10 per cent of its total electricity requirement from renewable energy sources by 2020; it is clear that Oman is seriously interested to participate in the expansion of its renewable energy capacity over the coming years. [2]

The Authority for Electricity Regulation (AER) responsible for regulating the electricity and related water sector in Oman, [1] in 2008, commissioned an inclusive study to identify sources of renewable energy in Oman and how those renewable resources can be utilized.

The study highlighted solar and wind power as having the greatest commercial-scale potential for the country

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Solar Energy

Oman has a high ratio of “sky clearness” [1] and receives wide daily solar radiation ranging from 5,500-6,000 W/m² a day in July to 2,500-3,000 W/m² a day in January, giving it one of the highest solar energy densities in the world.

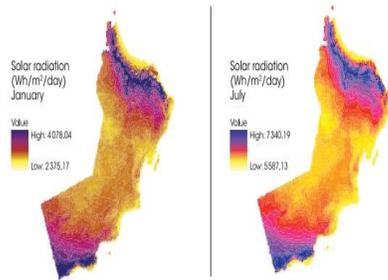


Figure 2: Solar radiation in Oman during January and July

According to a detailed study, on average the daily sunshine duration and solar radiation values for 25 locations in Oman. Marmul is considered to have the highest solar radiation in Oman followed by Fahud, Sohar and Qairoon Hairiti. The remaining cities in Oman have almost the same solar radiation values. Masirah Island, Salalah and Sur, have the lowest values. Salalah and Sur have significantly lower insolation compared with other stations due to the summer rain period in Salalah and the frequent periods of fog in Sur [5]. Generally the highest insolation is in the desert areas.

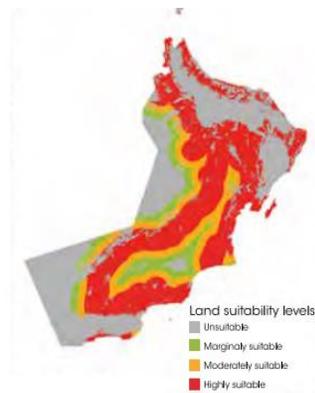


Figure 3: Spatial distribution of land with suitable levels for solar photovoltaic energy projects

The solar energy can be utilized in the following ways to produce energy:

Photovoltaic Energy

This technology operates on the principle of using solar cells arranged on panels to convert solar radiation into electricity [1]. Currently it is used minimally in Oman at a number of locations to provide lighting, water heating and water pumping.

Concentrating solar power

This concept is a bit different from the above mentioned photovoltaic energy production [1]. Here electricity is produced by mirrors concentrating sunlight onto a small central area. This light is converted to heat, which in turn drives a turbine generating power.

Direct Normal Irradiance (DNI) [7] value is the key factor defining an area's suitability to this form of energy production. In Oman the estimated amount is 2,200 kWh per m² per year. This could yield 19,404 TWh [1] of electricity a year.

Some Common Mistakes

The Oman is one of the world leaders in the field of enhanced oil recovery techniques. However currently gas extraction methods are being used, Petroleum Development Oman (PDO) [1] is exploring the use of solar technology as a next generation method.

In July 2011, PDO awarded the first solar thermal enhanced oil recovery (EOR) project to “Glass Point Solar”. This project will use a 7MW solar array to produce 11 tons/hour of high pressure steam which will be used to extract 33,000 barrels of oil. It will also provide 24 hour heating. [5].

Wind Energy

Oman is blessed with a long coastline and exposure to the strong summer and winter monsoon winds [1]. It has an average wind speed approximately over 5 m/s and an estimated 2,463 hours of full load per year, [5] in result making wind power an economically feasible form of renewable energy.

Recent studies undertaken in 2010 have confirmed that four locations at Thumrait, Masirah, Sur and Qayroon Hyriti are the most suitable for the production of wind turbines with an estimate that the construction of two sites at Thumrait and Qayroon Hyriti of 375MW each would produce 2.3TWh a year of electricity. This corresponds to 12 per cent of Oman's 2010 electricity production. [5].

One disadvantage of wind over solar is that wind is more seasonal. Studies undertaken in Oman show that, in general, wind speed is higher during the summer months of June, July and August and is lower during October and November. [4]

In 2009 a case study was carried out on Masirah Island to investigate combining wind power with diesel generation to create a hybrid system. [4] This concluded that this form of technology could be of considerable use in the rural areas and produce cheaper power than the current system.

Several studies have been conducted especially in the coastal and southern parts of Oman for assessing wind energy resource

in Oman. [5] These studies confirm wind power as a promising renewable energy resource for power generation.

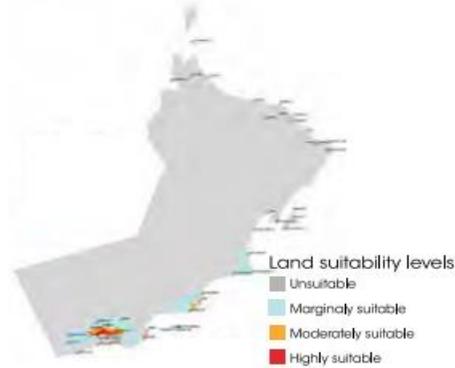


Figure 4: Land suitability index for wind energy at 50 m for the Sultanate of Oman

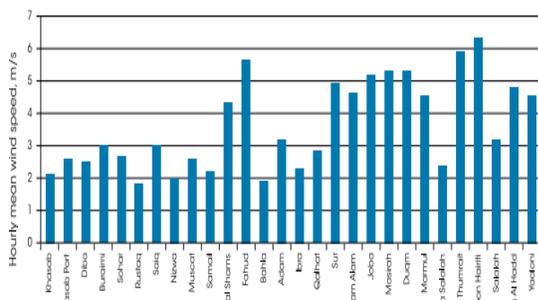


Figure 5: Hourly measured mean wind speed at 10 m above ground level at 28 meteorological station.

Table 1: renewable energy sources current and future projects in Oman

Renewable energy sources projects in Oman	Projects and their power capacity		
	Projects	Renewable energy type	Power capacity
1	Solar Project in Al – Mazyonah [5]	Solar	303 KW
2	Concentrated Solar System Installed in KOM [5]	Solar	6 KW
3	Wind Powered Pumping station [5]	Wind	10 KW
Future Projects			
4	Wind power Project in Masirah [5]	Wind	470 KW
5	Solar Projects in Al- Shofar and Wusta Regions [5]	Solar	200 KW
6	Wind Project in Willayiat of Thamrait [5]	Wind	4,20 KW

Conclusions

It is found that currently Oman lacks in the energy production from renewable energy sources and has implemented some solar plants on small scale whereas, Oman has future plans to promote renewable energy as projects like 200 MW solar plant in Dakhiliya region and 50 MW wind plant in Dhofar region are under considerations. In conclusion, it can be stated that Oman has untouched potential of Solar and Wind energy therefore, resource assessment and in depth importance of renewable sources should be an achievable milestone. This review paper can be a source of positive impact as it highlights the current situation of renewable sources including the future plans Oman is implementing in order to obtain vision 2020.

ACKNOWLEDGMENT

I would like to present a token of thanks to Oman Environmental Services Holding Company (be'ah), Dr. Mohammed Abushammala (Civil Engineering Department, Middle East College) for helping me throughout this project. I would also like to expand my sincere gratitude to all those who have directly or indirectly helped me to complete this project.

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