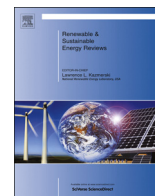




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Renewable energy technologies adopted by the UAE: Prospects and challenges – A comprehensive overview

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ABSTRACT

The United Arab Emirates (UAE) is an oil-rich country which is located in the eastern part of the Arabian Gulf. The country is considered among the highest energy consumer in the world. Likewise of the other GCC countries, UAE's economy mainly depends on the oil, gas and other fossil fuels. In the recent timings, with a continuous increase in UAE's population require further demand in its energy production which is essential for its economic growth. However as the fossil fuels are limited sources, consequently additional sustainable and renewable energy (RE) resources are necessary to be explored. In this context, the UAE is considering alternative RE resources to overcome such issues as well as to reduce environmental pollution and its carbon emission. The present work addresses the issues and challenges related with the RE resources technologies, in the scenario of UAE. The possible current, RE resources choices for UAE and potential future prospects of such technologies are mentioned. Further at the present timings, renewable energy resources such as photovoltaic energy, concentrated solar power, wave energy and fuel cell energy etc., which UAE's is mainly focusing are reviewed. Similarly the past and ongoing research work conducted on such technologies has been also discussed. It is expected that by exploring RE technologies, with proper utilization and with better planning these renewable energy sources will provide a suitable solution for the UAE's energy, economy and environmental issues.

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1. Introduction

In a modern world, as we look into today, would have not been possible without energy. Energy plays a major key role in the development and progress of a nation. It is a fact that the progress of a nation could be estimated in terms of how much energy it consumes per person. In a today's era energy is so important that affects our lives, and livelihoods down to the grass root levels.

Energy might best be described in terms of what it can perform for us. We cannot see energy, only its effects; we cannot make it, only utilize it; and we cannot destroy it, only waste it through inefficient manner [1].

Two major categories of energies are: (1) renewable energy and (2) non-renewable energy. The formal case of energy is the type of energy obtained from regenerative or virtually inexhaustible sources of energy that occurred in the natural environment. Some examples of this type of energy include solar energy, wind energy, geo thermal, wave power etc. They are present whether we harness them for practical uses or not. This is also commonly referred as non-conventional sources of energy [1].

While the latter case is related to the energy obtained from static stores of energy. Such sources remain bound unless released by human interaction. Some of the examples of the non-renewable energies are fossil fuels of coal, oil, and natural gas. This type of energy is initially in an isolated energy potential which requires an external action to initiate its supply for practical utilization. Sometimes, it is also called finite energy or conventional sources of energy [1].

The United Arab Emirates (referred as UAE) is located in the Middle East and in the eastern part of the Arabian Peninsula. The land of UAE is largely hot and dry desert [2]. It consists of the seven emirates. Among the seven states, Abu Dhabi is by far the largest and controls 90% of all oil and natural gas reserves in the UAE. The federal government of the UAE recognizes that diversification of its economy plays a vital role in maintaining its growth. The other additional main industrial activities in the country are construction, aluminum, chemicals and plastics, metals, and heavy equipment [2].

In the present world, the emergent worldwide commitment to sustainable development places a special responsibility on technology policy. Such situation creates specific challenges for any oil-rich economy like the UAE in which reliance on conventional sources is generally seen as the backbone of its survival. Therefore, in the past few years the United Arab Emirates (UAE) has taken some important key steps to establish a renewable energy (RE) sector to address its CO₂ emission problem and to diversify its economy [2]. Generally the reduction of CO₂ emissions from energy use can be done in three ways: energy efficiency, RE, and carbon capturing and sequestration. According to report of CDIAC [2,9] the UAE and other Gulf states have the highest CO₂ emissions per capita. It is worth to mention that according to the World Energy Council (WEC) report the total current CO₂ emission to the planet by GCC countries is about 2.25%, in which UAE's contribution is 0.4% [36]. The CDIAC report further clarifies that the UAE has the second highest water consumption per capita after the

United States. The historical CO₂ emissions in the UAE can be seen in Fig. 1 [2,9].

Generally, the renewable energy is considered an attractive option because it substitutes for fossil fuel and the economic feasibility of RE technologies is improving with time [2,3–4]. Although carbon capturing and trading are effective and provide practical solutions for reducing CO₂ emissions, they do have some uncertainties concerning GHG inventories in the context of compliance evaluation related to an emission trading program [2,5,6]. Furthermore, CO₂ is still emitted and remain a problem. On the other hand, fossil fuel will remain as the main source of energy for decades to come, nevertheless eventually alternative sources of energy will surpass fossil fuels [2,7].

The aim of this work is to present an overview of the activities UAE is employing to attain the country's development via sustainable and renewable energy resources. The paper will highlight the possible potential and challenges the UAE's is confronting in order to utilize and adopt such RE resources and their respective technologies, which can substantially contribute to the country's energy requirement. Here, the possible RE resources and the choices which are being utilized and employed by the UAE's are reviewed extensively. Moreover the article focuses on the research and development in dealing and adopting such RE resources. A conclusive summary of work has been mentioned in the last section of the paper.

2. Possible choices for UAE

The two factors namely the climate change and fossil fuel depletion are the main reasons, which have attracted recent attention on finding alternative energy resources. Renewable energy (RE) is considered as an obvious choice in order to reduce carbon dioxide and other pollutants contributing to global warming [10]. In such scenarios, the deployment of RE in any country will have an impact on its sustainability. Such deployment of RE will provide that country a wide variety of socioeconomic benefits such as contributing to the diversification of energy supply, enhancing its the regional and rural development, and creating an opportunity for a domestic industry and job creation potential [2,8].

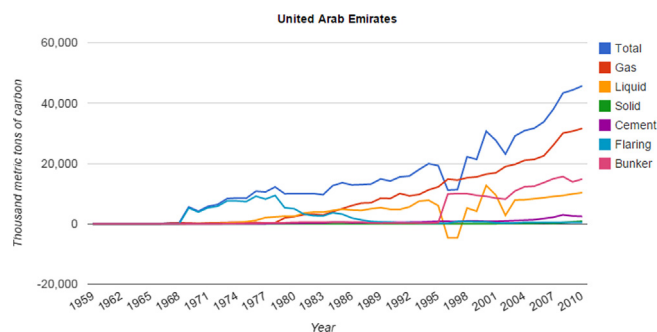


Fig. 1. The historical CO₂ emission in the UAE. [Taken from courtesy of Ref. [9] CDIAC (2014)].

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