

A Review of Renewable Energy in the Middle East

Sepehr Sammak^{1,*}, Reza Rezaei², Narges Sammak³

1-Bachelor of Petroleum Engineering, Islamic Azad university, South Tehran Branch, Tehran, Iran

*Corresponding Author:: s.sammak1993@gmail.com

2-Bachelor of Petroleum Engineering, Islamic Azad university, South Tehran Branch, Tehran, Iran
email address²: Reza4rezaei@yahoo.com

3- Master of pure Math, Semnan University, Semnan, Iran
email address³: nsammak@ymail.com

ABSTRACT

Looking at how the various industries are expanding, what makes these industries necessary is the discussion of energy and how to provide this vital source for a country's productive industries. Since the beginning of the Industrial Revolution, the growth of energy consumption has accelerated dramatically and has now reached alarming levels. Before 1973, the main reason for the increase in per capita energy was the use of oil at a much lower price than today. At the same time, the economics debate was based on renewable energy. In addition to economic issues, environmental benefits from more rational use of oil were also raised.

In the same years of the Industrial Revolution, the first goal of the increasing expansion of industries based on energy production in any style and method, introduced the wrong model to provide energy to the world and today has left serious and irreversible damage to the natural life of the planet. Monitor the production process of industries with one eye, and the second eye focuses on how to ensure and clean it.

Keywords: Renewable energy technology, Middle East, Carbon dioxide emission

1. INTRODUCTION

In these days, energy plays an important role in the global economy, energy plays an important role in the global economy, security and politics. Each country needs to develop its resources and policies relating to energy and related environmental contaminants for better future planning [1]. The important issue of growing energy consumption is related to carbon dioxide emissions if fossil fuels are used. The growing trend of emissions in the world and the global warming are restricting any energy related developments. All governments consider the energy especially electrical energy resources as the main drive of country agriculture and industry. So, the energy development is a measure of power and the level of development in

future. Countries should utilize the remaining fossil fuel infrastructure development to bring renewable energies into dominant act since fossil fuels are running out. It can be seen that crude supplies in the world's energy are still used to convert it into electrical energy. In general, the energy resources in the world divided into two types of renewable and non-renewable. But non-renewable energy is not eternal. For example, the energy crisis in 1973 can be noted. In that year due to the scarcity of fuel in many parts of the world, people are faced with many severe problems. The oil embargo was lifted in March 1974, but oil prices remained high, and the effects of the energy crisis lingered throughout the decade. In addition to price controls and gasoline rationing, a national speed limit was imposed and daylight saving time was adopted year-round for the period of 1974–75. Environmentalism reached new heights during the crisis.

Many reasons, such as climate change, rising fossil fuel resource prices, increasing air pollution and reducing energy supply independence has caused renewable energy technologies are deployed rapidly in many countries [2]. For example carbon dioxide emissions in Iran, Iraq and Saudi Arabia From 2000 to 2010, have respectively increased by 35.7%, 21.75% and 15.6% [3], while these countries are able to using renewable energy. In Fig. 1, the carbon dioxide emission can be seen in the Middle East and North Africa from 2003 to 2010.

Geographical location of the Middle East close to the equator, and North Stream makes use of new and renewable energy sources such as solar and wind power as an important option. Therefore, the developing countries in this region can develop renewable energy infrastructure for future self-independency on energy demand. It is worth noting that independence of oil in economics of countries is very important in the perspective of the development of renewable energy. Mostafaeipour et al. [4] analyzed the renewable energy issues and electricity production in Middle East compared with Iran. Their study has explicitly demonstrated the presence of different sources of renewable energies in Middle East as well as in Iran. Development of a more sustainable energy sector in the Middle East seems promising for the near future. Sadorsky [5] investigated the dynamic relationship between energy and trade openness for a panel of 8 Middle Eastern countries. This is a particularly interesting panel data set to study because countries in the Middle East are among the fastest growing consumers of energy. The empirical results reveal a number of important relationships between income, energy, and trade. Alamdari et al. [6] studied a large number of sites in order to assess the wind energy in Iran. So his work can be used as a primary assessment for installing the wind farms. Also the potential sites for exploiting solar energy were investigated using data from 63 stations across Iran. The values for maximum, minimum, and average annual horizontal radiation were obtained for each station. Finally, the recorded annual average values of horizontal radiation at some stations were higher than 500W/m², showing their potential for photovoltaic applications that makes them recommendable for further study [7].

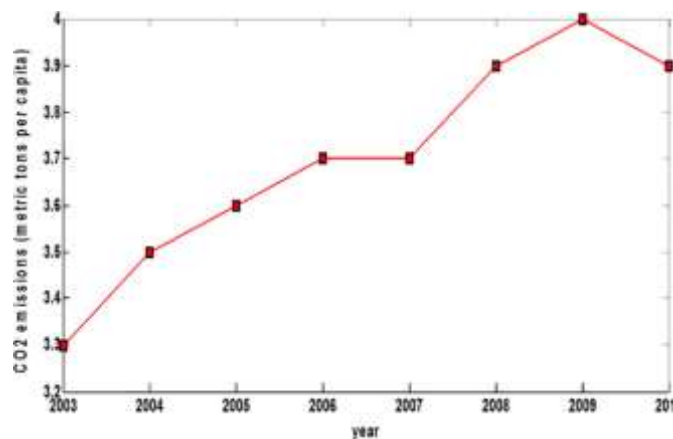


Fig. 1. Carbon dioxide emission in the Middle East [3].

Kazem [8] evaluated the status and future of renewable energy in Iraq. The uses of renewable energy sources, such as solar, wind and biomass, have been reviewed. He concludes with recommendations for the utilization of these energy resources. He concludes that Iraq has good potential for developing renewable energy. Shawon et al. [9] assessed wind energy potential and existing wind energy conversion technology used to harness the available wind in Middle East region with a detailed analysis on the economics behind deploying wind energy conversion technologies. He showed that the energetic and economic investigation of different locations in the ME region can

be expressed as prospective areas for regions 1 and 2 and below marginal areas for region 3 in terms of both wind potential and economy.

Zwaan [2] investigated the potential for renewable energy jobs in the Middle East. He estimates that renewables diffusion scenario for the Middle East jobs. It estimates a total required local work force of ultimately about 155,000 direct and 115,000 indirect jobs. Based on assumptions regarding which components of the respective wind and solar energy technologies can be manufactured in the region itself, all jobs generated through installation and O&M activities are assumed to be domestic. In this study energy consumption and energy issues at the Middle East (ME) region is investigated. At the second step, with using RET-Screen software data for solar and wind energies, potential of renewable energies in ME are assessed.

2. THE MIDDLE EAST

Renewable energy technologies are deployed with rapidly in creasing shares in many countries, most notably for reasons of mitigating climate change, reducing air pollution and enhancing energy supply independence. It is argued that the deployment of renewables may also be beneficial in terms of the stimulation of employment in a broad range of sectors directly or indirectly related to their use [10] . The reasons for choosing the Middle East as subject of

our study are multiple, including, first of all, the vast solar and wind energy potentials in essentially all countries in this region. Another reason for our interest in the development of renewables in this specific geographical area, in addition to their advantages in terms of contributing to cleaning ambient air from pollutants with concomitant health benefits in especially large cities, is the growing awareness by local governments of the eventual finiteness of their national oil and natural gas reserves. Ambitions in the Middle East to increase renewable energy deployment are driven by at least three other main considerations.

First, the region's average per capita greenhouse gas(GHG) emissions level is high as a result of fossil fuel intensive energy systems; with climate change mitigation efforts mounting across the world, there is a growing desire to curb emissions in the Middle East [11]. Second, in many countries in the region fuel requirements for electricity and fresh water supply consume a significant share of domestic oil production; especially with current high oil prices it is attractive to retain oil predominantly for foreign export [12].

Third, oil and gas revenues have generated great wealth for the upper classes of Middle Eastern societies, including advanced technology and high-tech expertise such as associated with new more sustainable forms of energy. Fourth, over the coming years governments in the Middle East are likely to attempt to enhance the number of jobs in the private sector, in order to meet an imminently increasing demand from new job market entrants in the rapidly growing young-aged populations of their nations. If the claim is true that the establishment of a renewable energy industry generates net jobs, then it may constitute an opportunity to also help bridging the foreseen employment gap [13].

The Middle East is a region that roughly encompasses a majority of western Asia (excluding the Caucasus) and Egypt. The Middle East region represents an area of over 5.0 million square miles. The physical geography of the Middle East is varied. Vast deserts are common in the region. The Sahara desert runs across north Africa, essentially limiting settlement to along the Medi-terranean coastline and in Egypt along the Nile river. Mountain ranges exist throughout the region with some peaks rising as high as 19,000 feet. Snow is a common sight in these mountain ranges. Between the mountains, high plateaus are common [14].

The Middle East region has an important role in the global oil and gas market. Oil and natural gas resources in this region are the main source of income to countries in me. The region is strategically centered between Europe, Asia and Africa. All countries in the region have benefited from the blessings of oil and gas supplies. The major challenges are security, independence and smart using of this wealth for future [15]. In recent years, however, population growth rapidly, and changes in zonaln climate and water cycle, there has been a growing need for integrating the planning and design of renew- able energy and systems. Many recent events have ministered to emphasize this need [16]. Renewable energies omit the problems affiliated with fossil and nuclear energies such as pollution and environmental damages. Moreover, these resources are perdurable. Thus, they seem to be appropriate recourse to both fossil and nuclear energy. Only of a recent origin, the technology to use these resources is rapidly growing [7]. Much of the world's fossil fuels are located in this area . For example, fig. 2 shows over 56% of world oil reserves are in the Middle East . The Middle East

holds 36% of the world reserves of natural gas but generates only 9.3% of world production [17]. As stated, the geographical and climatic conditions of the Middle East are relevant to the use of solar and wind power. There is a large potential for renewable resources in the Middle East. Suitable radiations of the sun and good winds in during the year are the features of the area.

3. The Energy Consumption In The Middle East

The Middle East is an important region of the world to study the energy consumption and future of energy because this region of the world has experienced impressive increases in economic growth energy demand [5]. Over the period 1990–2006, real GDP in the Middle East, Africa, and Latin America grew at average annual rates of 4.3%, 3.6%, and 3.2%, respectively. According to the Wikipedia the Middle East consists of Bahrain, Egypt, Iran, Iraq, Cyprus, Jordan, Kuwait, Lebanon, Northern Cyprus, Oman, Palestine, Qatar, Saudi Arabia, Syria, Turkey, the United Arab Emirates, and Yemen[18].

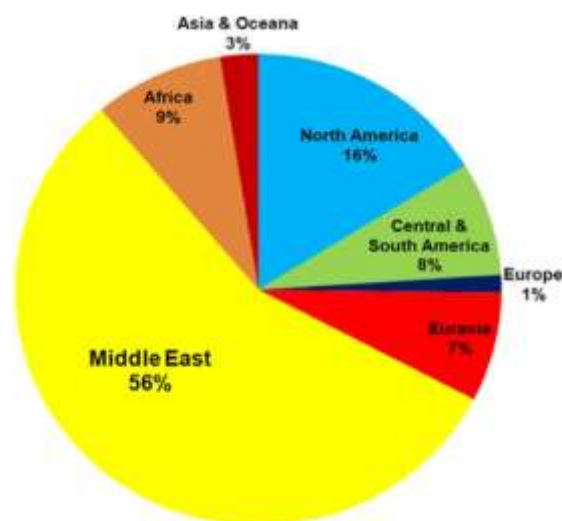


Fig. 2. Most of the world's oil reserves are in the Middle East[18]

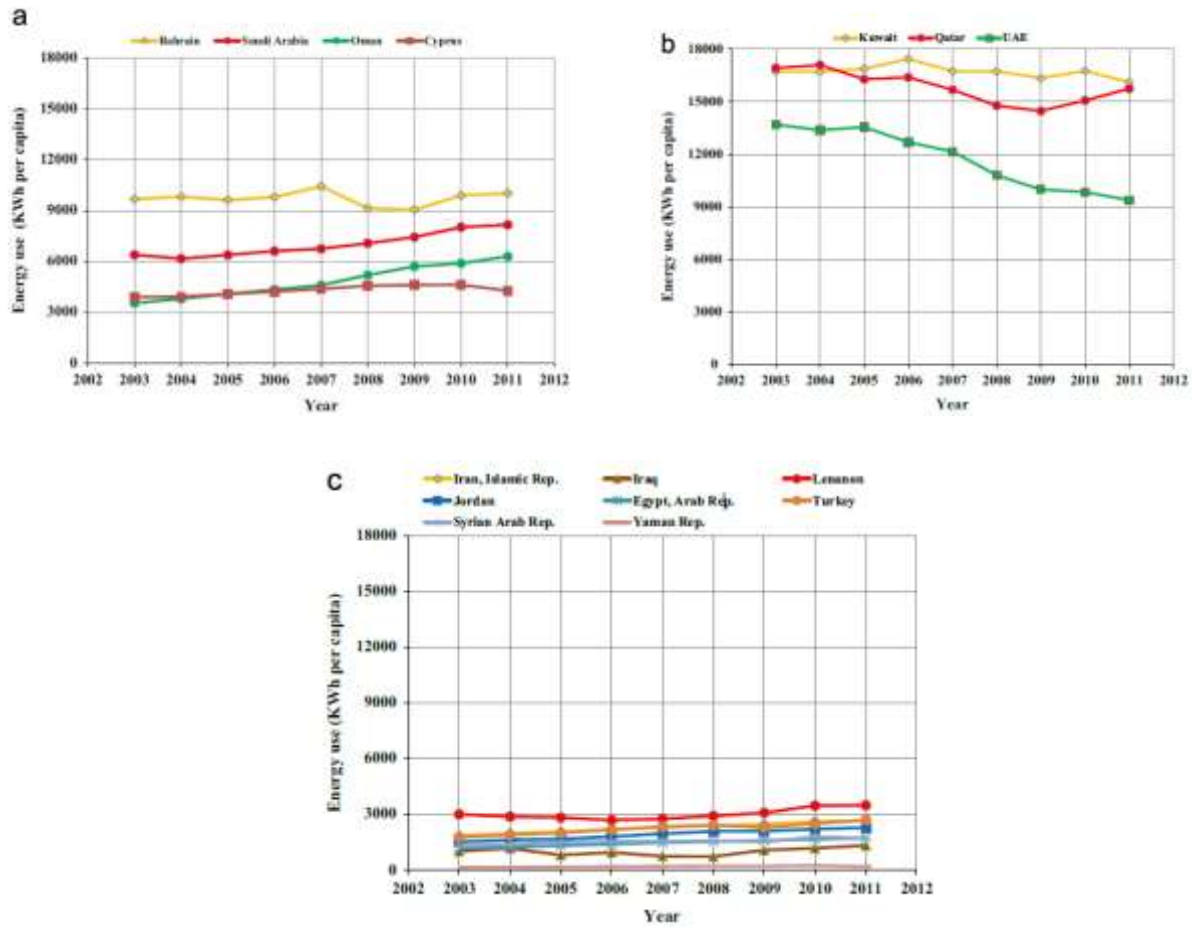


Fig.3. Electricity energy use in the Middle East countries (a, b & c) [3]

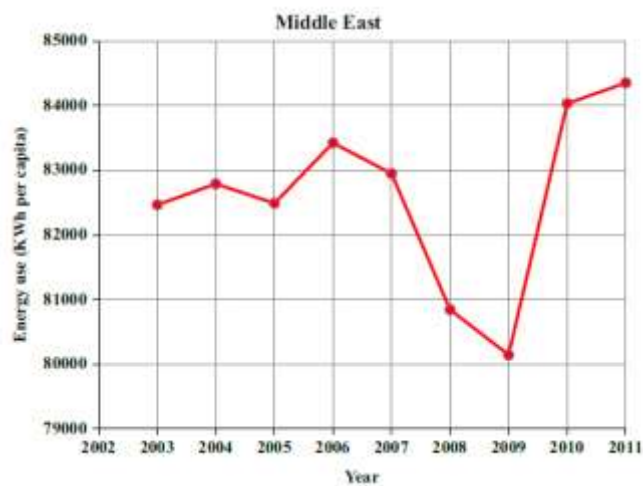


Fig. 4. Sum of the electricity energy use in countries in the Middle East [3]

Research results show that the energy consumption especially in recent years, in the Middle East is growing. The trend of energy consumption in the region has been studied [19]. Fig.3a, b and c shows that electricity energy use (kWh per capita) has been increasing in most countries in the Middle East.

For example, Iran is one of the large countries in the Middle East and has large reserves of oil and gas (9% of the global oil reserves and more than 15% of the global gas reserves). However, the inner use of fossil fuels and electricity energy has increased drastically due to its population growth, industrial development, and higher living standards, a situation that may lead in the near future to its reduced oil exports. Electricity consumption in Iran from 2006 to 2011 has increased by 20% [7]. Fig.4 shows that energy consumption in the Middle East particularly since 2009 has greatly increased, while the amount of fossil fuel reserves are dwindling and this is a warning for countries in this region to develop alternative energies to generate electricity.

4. WEATHER DATA

Three hundred and ninety two locations are uniformly distribute across the Middle East region (ME) for collecting and recording monthly weather data. Data were collected from RETScreen International software. RETScreen is a software program developed by Natural Resource Canada [20] and available for public use for feasibility analysis of clean energy projects, including energy-efficient technologies and renewable energy systems, such as wind energy, small hydro, photovoltaic, biomass heating, solar air heating, solar water heating, passive solar heating, ground-source heat pump, and combined heat and power projects. The RETScreen is now being used by more than 35,000 people in over 196 countries around the globe, as reported in the [21–27].

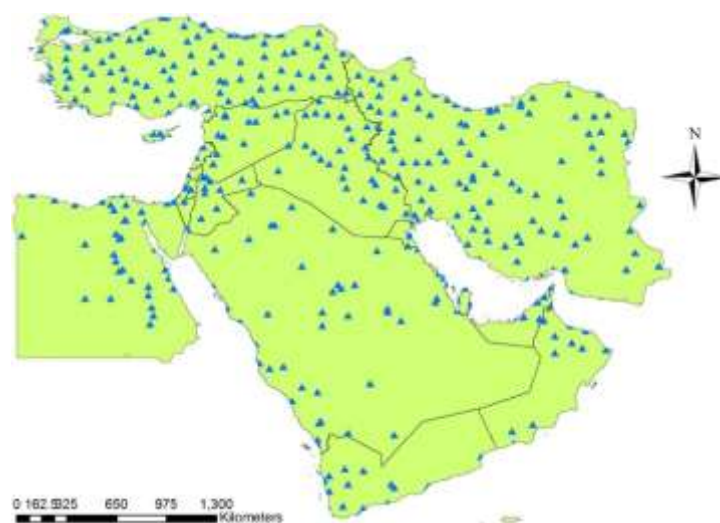


Fig. 5. Locations of the stations used in this study[32]

may obtain climate data from ground monitoring stations and/or from NASA's global satellite / analysis data. If climate data is not available from a specific ground monitoring station, data is then provided from NASA's satellite/analysis data. The source of the data (i.e. "ground" or "space") is indicated next to the data in the climate database dialog box.

The amount of data collected (which comprise radiation and wind speed) is large enough and the area covered is vast enough to yield reliable estimations of radiation and wind speed in different regions. Fig. 5 presents the locations of the stations used in this study. Table 1 summarizes the number of studied stations in the region.

Table.1 Number of locations in each country[32]

Country	Location number
Bahrain	1
Cyprus	7
Egypt Arab Rep.	38
Iran	103
Iraq	27
Jordan	9
Kuwait	2
Lebanon	2
Oman	13
Qatar	5
Saudi Arabia	44
Syria Arab Rep.	14
Turkey	105
UAE	7
Yemen Rep.	15

5.ENERGY PROSPECTUS IN THE MIDDLE EAST

As energy consumption increased in the Middle East due to its economic growth, this situation has led to increased pollution and energy crisis. Thus, renewable and clean energy is essential for any future development of this region. According to the geopolitical circumstances and investigations in the field of new energy in this region, it can be said that the region potential for solar, wind and hydropower energy is very promising. Thus, energy development in the three areas is studied. Renewable energies eliminate the problems associated with fossil energies such as air pollution and greenhouse gases. More- over, these resources are unceasing. Only recently, the technology to use these resources is very rapidly growing.

Solar power is the conversion of sun light in to electricity, either directly using photo voltaic(PV), or indirectly using concentrated solar power(CSP). Concentrated solar power systems use lenses or mirror sand tracking systems to focus a large area of sun light into a small beam [14]. Solar energy is clean, renewable and available all over the world. Solar energy can be applied in many ways, such as [6]:

- Generate electricity by using photovoltaic solar cells;
- Generate hydrogen by using photo electrochemical cells;
- Generate hot and cold air by using of solar chimneys;

- Generate hot water by using solar panels.

In addition to the advantages of renewable energies, the use of solar energy is affiliated with greater benefits as follows [28]:

- Reclamation of contemptible lands;
- Reduced emphasis on national power grid network;
- Ameliorate water quality across the nation; and
- Acceleration in electrification of Remote areas.

Wind power is the conversion of wind energy into a useful form of energy. Wind power, as an alternative to fossil fuels, is plentiful, renewable, widely distributed, clean, produces no greenhouse gas emissions during operation and uses little land [29]. The strength of wind varies, and an average value for a given location does not alone indicate the amount of energy a wind turbine could produce there. To assess the frequency of wind speeds at a particular location, a probability distribution function is often fit to the observed data. Different locations will have different wind speed distributions [18].

Power generation from winds usually comes from winds very close to the surface of the earth. Winds at higher altitudes are stronger and more consistent, and may have a global capacity of 380 TW [30]. Recent years have seen significant advances in technologies meant to generate electricity from high altitude winds.

Wind energy is the kinetic energy associated with the movement of mass of air. Wind energy systems convert this kinetic energy to more useful forms of power. Electricity producer by wind power system has lower CO₂ emissions in comparison with traditional fuels. Therefore has less greenhouse effect. Also wind energy makes many jobs.

Hydro-power or water power is power derived from the energy of falling water and running water, which may be harnessed for useful purposes. Hydroelectric power uses the kinetic energy of moving water to make electricity. Dams can be built to use the hydropower of a river. Hydropower is currently the most common form of renewable energy and plays an important part in global power generation. Worldwide hydropower produced 3288 TW h, just over 16% of global electricity production in 2008, and the overall technical potential for hydropower is estimated to be more than 16400 TW h/yr. Hydropower's storage capacity and fast response characteristics are especially valuable to meet sudden fluctuations in electricity demand and to match supply from less flexible electricity sources and variable renewable sources. The costs of power production from hydropower can vary widely depending on project details, but usually fall into a range of \$50

to 100/MW h. Upgrading existing hydropower plant projects offers further options for cost-effective increases in generation capacity.

Due to the favorable geographical conditions, particularly in the north and west of Middle East hydropower can be used. Especially using of micro and pico hydropower potential in impassable areas can eliminate the cost of electricity transmission and electricity to be produced from nature.

6. CONCLUSION

The use of renewable energy has started to be an interesting issue for people and also governments in Middle East, especially in Iran where all different types of renewable energy sources (RES) are available and also possible to implement for gaining required energy. There are many different kinds of renewable energy sources like geothermal, bio fuel, tidal and so on, but wind and solar energies are more available and accessible than other types in Middle Eastern countries. Nowadays, the rapidly increasing demand for electrical energy and the high restriction on pollution levels have led to an increasing interest in large-scale utilization of renewable energies across many countries in Middle East.

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