

SHIFT TO RENEWABLE ENERGY IN OIL COUNTRIES A CASE STUDY OF THE EMIRATI EXPERIENCE

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ABSTRACT: The United Arab Emirates aim to diversify energy sources by not relying mainly on traditional energy sources, including oil and gas, to reduce side effects on the environment. The UAE' energy strategy is based on the production of clean renewable energy to ensure a balance between economic needs and environmental goals.

Keywords: Petroleum dependency – Gross Domestic Product (GDP) - Renewable energy production and consumption - Conventional energy production and consumption.

JEL Classification: Q25; Q01.

1. INTRODUCTION:

After oil became one of the main sources of energy, it turns out that these sources of energy are depleted despite the presence of large reserves, and therefore it is necessary to look for new sources of energy, so scientists began to look for alternatives called renewable energy, as it is characterized by the inexhaustible compared to oil. This is why many countries are seeking to get rid of dependence on oil and interest in the development of renewable energy and now they aim to develop it to replace oil, among the most important of these countries that strive to face the dependence of oil and the development of renewable energy UAE. (M. Jamil; 2016) .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; and in this context, we saw that the problem of our research as follows:

Problematic:

What is the reality and prospects for the development and use of renewable energies in the UAE economy?

The importance of the research paper:

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The importance of the paper lies in the importance of renewable energy, especially in the oil countries, where investment in renewable energies received great attention in the 21st century for economic and environmental reasons in order to obtain sustainable and clean energy as a guarantee for the present and safety for the future. The problem of energy depletion is the non-renewable countries of the world that have contributed to the emergence of renewable energies.

The objectives of the research paper:

The fundamental objective of this research is:

- Try to provide a forward-looking vision on the ability of renewable energies to replace energy oil.
- Trying to identify the development of investments in renewable energies in the oil countries through a study of the UAE experience
- The role of renewable energy in achieving sustainable development in the in the Emirates.

Study methodology:

In an attempt to answer the problem, we used the descriptive approach by analysing the reality of petroleum dependency in UAE, and clarifying the extent to which country are interested in the production and consumption of renewable energy, as we have been looking at the reality of oil and renewable energy in UAE..

2. LITERATURE REVIEW:

- Omid Shokri Kalehsar (2019) **UAE becoming a leader in renewable energy; Sunday**; the Arab weekly magazine.

The United Arab Emirates intends to expand the use of new energies in pursuit of such goals as exploiting renewable resources that are not oil-dependent. The Emirates has become a hub for clean energy technology, providing funding to build renewable energy projects around the world and investing millions of dollars in fundamental research on energy, water, microelectronics, advanced materials and transport systems.

- Ministère français de l'économie et des finances (2018). **Energies renouvelables et développement durable aux Emirats arabes unis (EAU)**; Rédigé par DG Trésor .

The United Arab Emirates (UAE) has a very proactive policy in terms of sustainable development and has the ambition to become a model country in the fight against global warming. For several years, Masdar ("Abu Dhabi Future Energy Company"), with its sustainable city project and the growing deployment of its expertise and projects, has embodied this political ambition, both in the UAE and in many other countries.

- Sgouris Sgouridis (2013). **A Sustainable Energy Transition Strategy for United Arab Emirates: Evaluation of Options Using an Integrated Energy Model** ;Masdar Institute of Science and Technology, Abu Dhabi, United Arab Emirates .

The United Arab Emirates (UAE), despite its small size, is emerging into an influential player in global energy geopolitics. Perhaps counter intuitively, the UAE can successfully leverage a sustainable energy transition to strengthen its position as a global energy leader while providing tangible economic and environmental.

3. DEFINITION OF RENEWABLE ENERGIES :

Renewable energy, often referred to as clean energy, comes from natural sources or processes that are constantly replenished. For example, sunlight or wind keep shining and blowing, even if their availability depends on time and weather. (John Twidell, 2015).

Renewable energies are also often referred to as “green energies” or “clean energies”.

Renewable energy systems are a major topic when discussing the globe's energy future for two main reasons:

- Renewable energy systems provide energy from sources that will never deplete.
- Renewable energy systems produce less greenhouse gas emissions than fossil fuel energy systems.

While renewable energy systems are better for the environment and produce less emissions than conventional energy sources, many of these sources still face difficulties in being deployed at a large scale including, but not limited to, technological barriers, high start-up capital costs, and intermittency challenges.(student energy)

Are not harmful to the environment and have zero impact. Nonetheless, they have a low environmental impact compared to fossil fuels. That is why they are increasingly becoming important elements in companies' CSR strategies in terms of sustainable development. (Youmatter, 2020).

The reality and prospects of renewable energies in the United Arab Emirates:

Oil was discovered in Abu Dhabi in 1958 in the onshore fields. Production began in 1960, where oil is available in the United Arab Emirates, in the Emirates of Abu Dhabi and Dubai. UEA produces annually 20.5 million barrels per day, and Abu-Dhabi has 13 oil fields under operation, and production. In Dubai 5 fields under operation, and production, and the number of wells, have 1,200 well under operation and production at a rate of 1,600 barrels per day for each well. (adnoc). The UAE ranks eighth in the world in oil production, and plays an important role in stabilizing the world oil markets through its positive and balanced role in the Organization of Petroleum Exporting Countries (OPEC) and its distinguished relations with its partners in oil and gas production operations. (Embassy of United Arab Emirates)

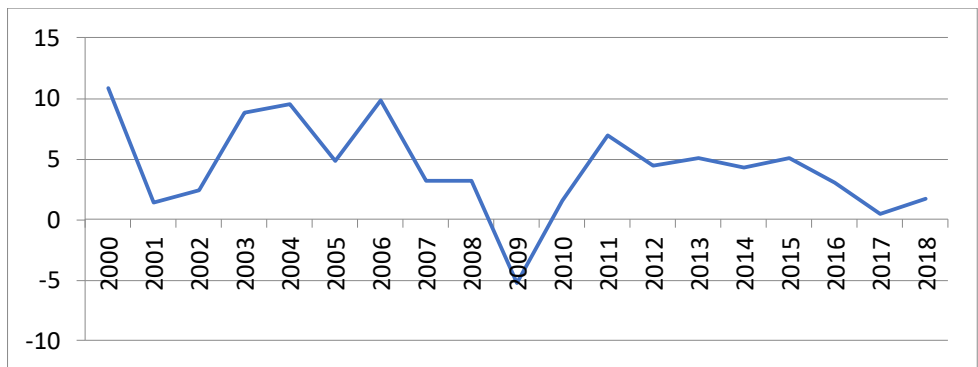
Petroleum dependency:

We will try to show the extent to which the UAE economy is linked to oil by examining the contribution of oil, crude GDP, and the contribution of oil exports to total exports.

The contribution of crude oil revenues to GDP:

Before addressing the contribution of crude oil revenues to GDP, we will discuss the development of the UAE's GDP rate.

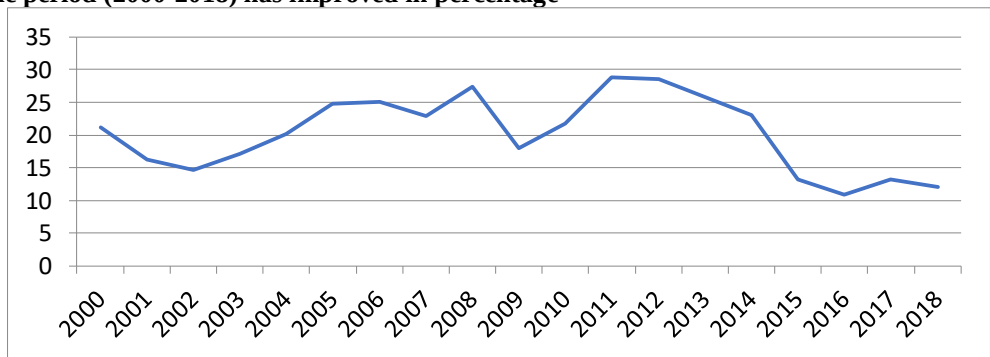
Figure (01): Emirates GDP development during the period (2000-2018) in percentage



Source: Prepared by the researcher based on World Bank statistics.

The growth rate of GDP in the UAE fluctuated between the rise and the decline, from 10% in 2000 to 9.8% in 2006, to decrease significantly as a result of the subprime crisis in 2009, registering a rate of -5.4% and then rising again in 2011, and also recorded 5% in 2015 despite the decline in oil prices in the second half of 2014. Emirates succeeded in diversifying the economy in increasing the contribution of non-oil sectors to GDP in recent years, (The World Bank; 2020).Emirates has focused on other industries, specifically the metal industry, furniture, wood industry, aluminium, building materials, machinery and equipment.(Industrial analytics platform; 2019) as for the contribution of crude oil to GDP, it is represented in the following form

Figure (02): The contribution of crude oil revenues to GDP in the Emirates during the period (2000-2018) has improved in percentage

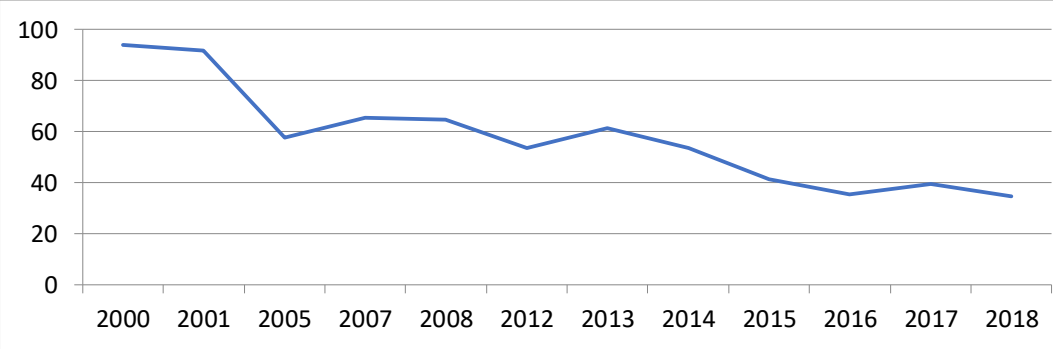


Source: Prepared by the researcher based on World Bank statistics.

With regard to the contribution of oil revenues to GDP, it was 11% in 1998 because of the Asian Tiger crisis, rising to 26% in 2006, then again Decreased in 2009 because of the mortgage crisis to 19% and then decrease significantly to 13% in 2017, because of the post-oil preparation.

Oil Exports:

Figure (03): the evolution of the percentage of the contribution of oil exports to the total exports of the Emirates during the period (2000-2018) in percentage



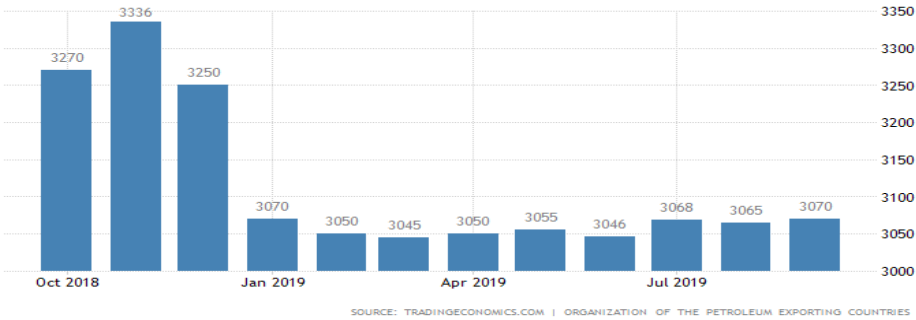
Source: Prepared by the researcher based on World Bank statistics.

Following the development of the percentage of Emirates ‘oil exports from total exports note that this percentage experienced fluctuation between the rise and the decline from year to year, after it represented 93% in 2000. It represented only 65.35% in 2007 to decrease significantly, for example 53% in 2012, 35% and 34% in 2016 and 2018, respectively. This decline is due to the UAE's recent efforts to achieve a more diversified economy through expansion in the non-oil sector and the strengthening of tourism and export services.

Crude oil production in the Arab Emirates:

The observer of the development of oil production in the Emirates notes that this production is declining recently due to the new permanent strategy of Emirates to invest in renewable energies based on diversification of sources of income for the UAE economy.

Figure (04): Crude oil production in the UAE during the period (October 2018-June 2019) million barrels



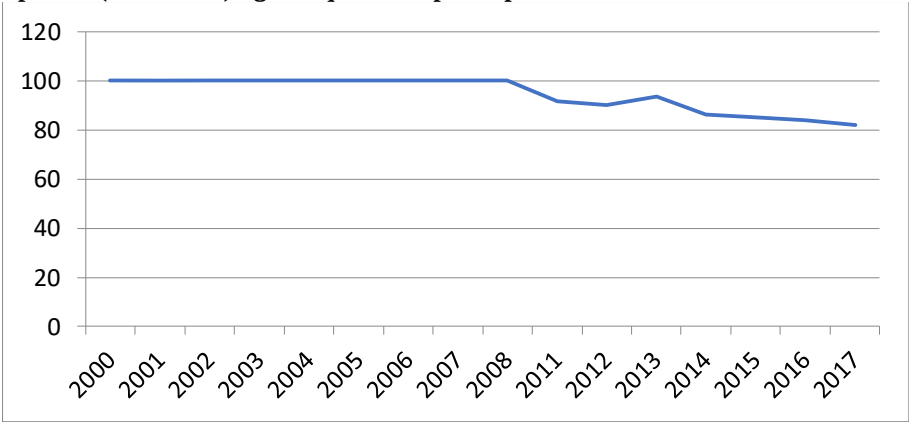
Source: Trading economics "United Arab Emirates Crude Oil Production »; ‘available at: <https://tradingeconomics.com/united-arab-emirates/crude-oil-production> ;visited.(2020/06/19) .

Crude oil production in the UAE increased to 3,070 million barrels per day (bpd) in July from 3,050 million barrels per day in April 2019. It was at 1 million barrels in November 2018. (Trading economics; 2020).

Oil energy consumption:

Emirates has strived to reduce oil energy consumption in recent years by switching to natural gas-fired electricity generation and investing in renewable energy sources, which has contributed to a certain decline in oil energy consumption as shown by the following figure:

Figure (05): Oil energy consumption of total energy consumption in Emirates during the period (2000-2017) kg oil equivalent per capita.



Source: Prepared by the researcher based on World Bank statistics.

Oil consumption in Emirates recorded a value of 11,435.91 kg oil equivalent per capita in 1997, to begin to decrease gradually at the beginning of the 21st century, registering 9716.63 kg oil equivalent per capita in 2005 and a value of 7458.87 and 7765.58 kg oil equivalent per capita in 2010 and 2017 respectively.

Production and consumption of renewable energies in the Emirates:

At the 1997 Kyoto Conference, Japan, most heads of state agreed to reduce carbon dioxide production in the following years to avoid major threats to climate change due to pollution and fossil fuel depletion, as well as the social and political risks of fossil fuels and nuclear energy.

Several factors have made leaders of countries and peoples seriously think about the need for clean energy that reduces risks to the universe and life, and as the International Renewable Energy Agency (IRENA) says, renewable energies are less expensive than fossil energy such as oil and coal, as the prices of solar cell panels have decreased by 80% since 2008, Wind

energy, groundwater and hydropower are considered competitors and worthy of fossil energy, which motivated decision-makers to choose clean energy for the desired benefit of economies, the benefit of all people, and the sustainable development of society.(Hai Muhammad;2019) .

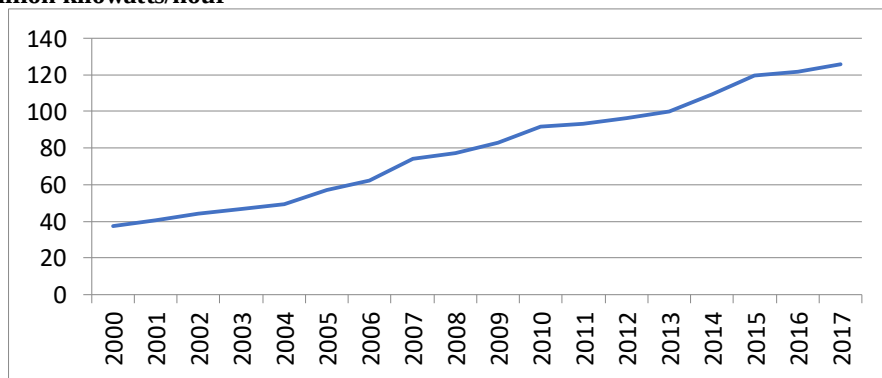
Renewable energy production:

The sources of clean energy are varied, including tidal energy, hydropower, hydropower, wind energy, solar energy, bio-energy, and geothermal energy Renewable energy has become economically attractive in the oil-rich United Arab Emirates (UAE). Ramping up renewables to 10% of the country's total energy mix, and 25% of total power generation, could generate annual savings of USD 1.9 -13824 by 2030 through avoidance of fossil-fuel consumption and lower energy costs. With health and environmental benefits factored in, the transition to renewables could generate additional net annual savings of USD 1 billion to as much as USD 3.7 -13824 by 2030. (irena.2015).

Solar energy production:

The UAE depends on generating electricity from solar energy, as shown in the following figure.

Figure (06): Solar energy production in the UAE during the period (2000-2017)
billion kilowatts/hour



Source :Knoema (2020) **Émirats Arabs unis – Emirates Arabs Unis - Production nette D'énergie solaire “** ; Disponible sur le site: knoema.fr/atlas/%c3%89mirats-rabesnis/topics/%c3%89nergie/%c3%89lectricit%c3%a9/ Electricity-net-generation ; Date de vue) 18/06/2020).

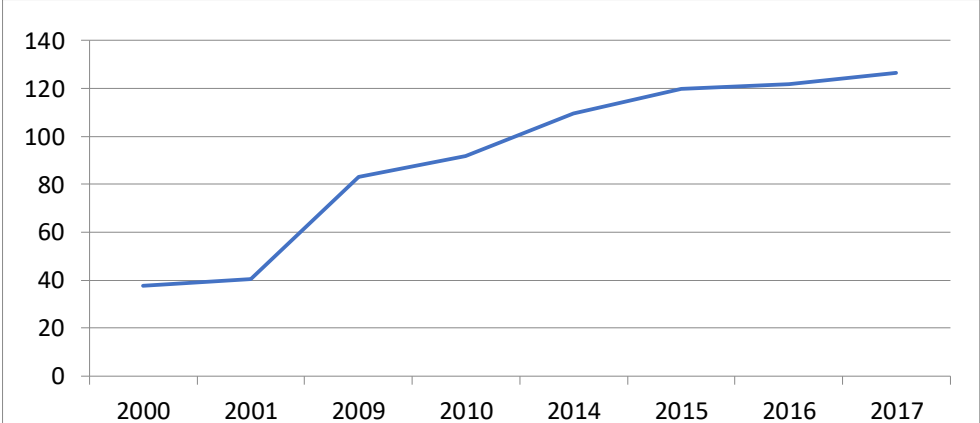
The production of electricity generated from solar energy during the past eight years amounted to one million 346 thousand and 151 megawatt hours, equivalent to 1315 gigawatt hours. The United Arab Emirates (UAE) is building the world's largest concentrated solar power plant, capable of generating 700 megawatts. During daylight, solar power will provide cheap electricity, and at night, the UAE will use stored solar heat to generate electricity. (The conversation; 2020).

The commercial sector accounted for the largest percentage of consumption of electricity generated from solar energy by 49.3%, followed by household consumption by 24.4%, and industrial consumption by 12.3%

Production of electrical energy from other sources:

In this element, we focused on electricity production, considering that Emirates uses several types of renewable energy for the production of electricity, especially with the high consumption of energy due to the dry desert climate, which combines high temperatures and high humidity, where more than 65% of energy consumption meets two main requirements: water provision and cooling (i.e. air conditioning).

Figure (07): Production of electrical energy from other sources during the period (2000-2017) billion kilowatts/hour



Source : Knoema(2020) Émirats arabes unis – **Production nette d’électricité thermique**

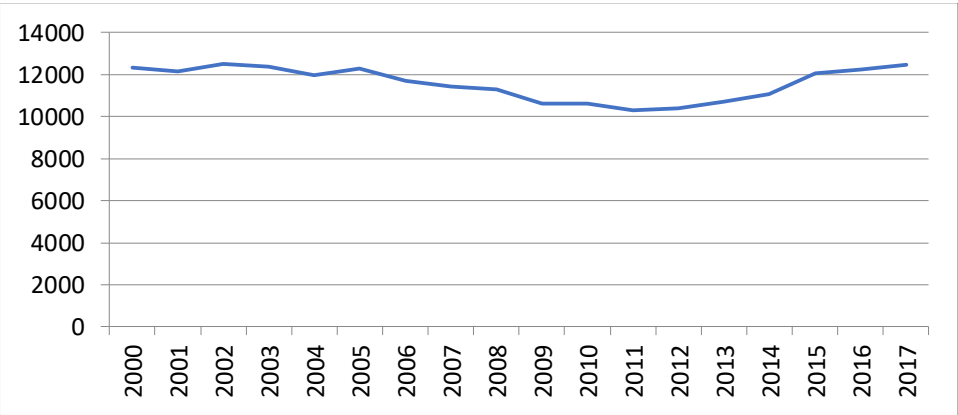
“ ; Disponible sur le site : knoema.fr/atlas/%c3%89mirats-rabes/nis/topics/%c3%89nergie/%c3%89lectricit%c3%a9/Electricity-net-generation ; Date de vue (18/06/2020).

Rising the development of electric power production at the beginning of the 21st century, producing 57.06 billion kWh in 2005, rising significantly during 2013 and 2016, registering 99.86 and 121.84 billion kWh, respectively. However, among the challenges of renewable energy in the UAE:

- The overall awareness and uptake of renewable technologies on the distributed generation is still low. The deployment of renewable energy varies significantly between emirates;
- The penetration of clean energy use in the transport sector remains low. New incentive packages have been launched by the local governments, which shall facilitate the electrification of the **Total net electricity** transport sector. (The official portal of the SDG in the UAE).

Renewable energy consumption:

Figure (08): Average per capita of electricity consumption in the Emirates during the period (2000-2017) kWh



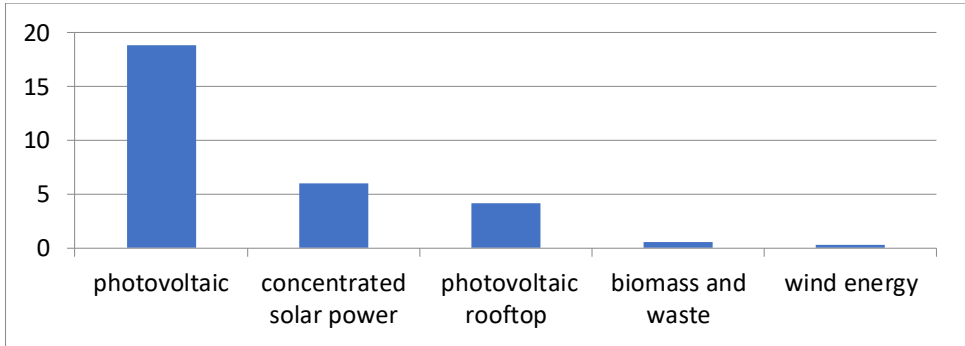
Source: Prepared by the researcher based on World Bank statistics.

The average per capita consumption of electricity in Emirates increased at an increasing pace from 12314, 05 kWh in 2000 to 12279, 91 kWh in 2005 to 12058, 36 kWh and 12458, 25 kWh during the years 2015 and 2017 respectively.

4. STRATEGY FOR THE DEVELOPMENT OF RENEWABLE ENERGIES IN EMIRATES:

Renewable energy is now economically attractive in the United Arab Emirates (UAE). In fact, a 10% share of renewable energy in the total energy mix could generate annual savings of USD 1.9 billion by 2030 based on avoidance of fossil fuel consumption. (Irena; 2015).

Figure (09): Estimated capacity of renewable energy in the United Arab Emirates in 2030, by type (in 1,000 megawatts)



Source: statista (2020): **Estimated capacity of renewable energy in the United Arab Emirates in 2030**; available at: <https://www.statista.com/statistics/958464/uae-estimated-renewable-energy-capacity-by-type/#statisticContainer>; .visited :(.2020/09/16) .

Regarding the renewables mix, currently projects worth of about 1 billion USD are under execution .This portfolio of investments includes the following projects in Abu Dhabi by 2030:

- 100 MW PV plant (Nour I project)
- 28.8 MW wind plant approved (Sir Bani Yas project)
- The following projects are under way for Dubai by 2030
- 1000 MW Mohammad Bin Rashid Al Maktoum Solar Park

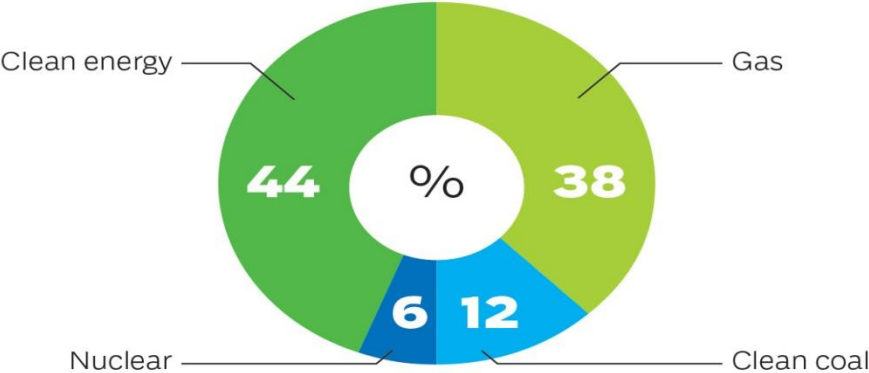
The trend is obviously moving into a sustainable direction. When we look at the energy consumption trend in the UAE, we see that this is growing annually. A major factor explaining the consumption growth is the growth in population size in the UAE. We see that the Electricity consumption grew by $(71 \text{ b kWh} - 64 \text{ b kWh}) / (64 \text{ b kWh}) = 11\%$ over 5 years. Roughly extrapolating to 2030 (assuming continuing population growth, assuming other electricity use like electric cars as none), this means that UAE will face another 30% increase on electricity use. (Energy Dubai; 2014).

Also the UAE Energy Strategy 2050 aims to provide a mix of renewable, nuclear and clean fossil energy to ensure a balance between economic needs and environmental objectives, and the energy mix by strategy includes clean coal, gas, nuclear, solar, wind and biofuels (United, official gateway to the UAE government, 2019):

- 44% of clean energy;
- 38% of gas;
- 12% of clean coal;
- 6% of nuclear power.

Figure (10): United Arab Emirates 2050 energy goals

UAE 2050 energy goals



Source: Dubai Media Office

©Gulf News

Source: Gulfnews (2017) **UAE Energy Plan for 2050 to achieve balance between energy production and consumption**; available at : <https://gulfnews.com/business/energy/uae-energy-plan-for-2050-to-achieve-balance-between-energy-production-and-consumption-1.1959893> ; .visited :(.2020/09/16) .

In what is coming we will try to show the most important projects that the UAE has undertaken in order to develop renewable energy by type:

Table No. (01) The most important renewable energy production projects in the Emirates

Headquarters	Production capacity	project
Nuclear plants in The Barakah area of Abu Dhabi	1400 MW per unit	The United Arab Emirates' Peaceful Nuclear Program Project
Nuclear plants in The Barakah area of Abu Dhabi	100 MW	Shams Station Project 1
Dubai	2400 MW	Hassian complex
Sir Bani Yas Island	850 kw of power in one hour	Wind power station
Dubai	Treating 2000 metric tons of solid waste per day in the first stage, to produce 60 megawatts of energy.	Convert solid waste into energy

Source: the official portal of the United Arab Emirates government and U.S UAE Business council

Nuclear Energy: Nuclear energy has emerged as an ideal option for the UAE as it uses in technology as safe, friendly, and capable of producing large quantities of electricity. In addition, Nuclear energy will contribute to the diversification of energy supplies in the country, ensure support for economic development, and provide many job opportunities

for the citizens of the country. By 2020, the four nuclear power units are expected to provide about a quarter of the country's electricity needs and reduce about 12 million tons of carbon emissions each year. The Emirates aims to produce 25% of the energy produced by 2021 from nuclear power sources. (World nuclear organization; 2020).

Solar power: Solar energy is classified as the most attractive renewable energy source in Emirates, solar energy is the second source of electricity produced in the country, and Masdar initiative is based on Abu Dhabi's economic vision 2030 to provide new sources of income and strengthen existing economic sectors. Shams station is considered one of the largest projects to produce concentrated solar power, and aims to provide 7% of Abu Dhabi's renewable energy needs. (Government portal; 2020).

Energy production with clean coal technology: The Dubai Clean Energy Strategy 2050 aims to use clean coal as part of the energy mix in Dubai to produce electricity. The UAE has started implementing projects for energy production with clean coal technology, in accordance with an integrated energy strategy in Dubai until 2030, according to which the proportion of renewable energy use will reach in the field of electricity generation to five percent. In addition to 12% for nuclear energy, 12% for clean coal and the rest is 71% of natural gas. (Clean coal centre; 2018)

Wind energy generation: With the aim of diversifying the Emirates clean energy sources, Masdar Company has built the first wind turbine to generate electricity, and the plant will operate the desalination plant for use in agriculture and feeding the island's endemic animals. (Asia Wind).

Waste conversion: The goal of the waste conversion project is to make Dubai the most sustainable and intelligent city by 2021 to achieve the national agenda by reducing landfills by 75% by 2021, and saving wasteland in landfills, as well as protecting the environment from methane released from landfills. (Government portal; 2020).

Results:

In an attempt to answer the problem and evaluate the hypotheses, we concluded:

- Renewable energies are one of the alternative sources on which they are depended on in order to find solutions to the problem of depletion of conventional energy, the characteristics that characterize them make them energy that blends economic, social and environmental interests, and this proves the validity of the first hypothesis;

The Emirates has chosen solar energy because, according to the solar radiation map, solar energy in the UAE is very available, as the radiation energy in the Emirates ranges between 2100 to 2400 kilowatt hours per square meter annually. This amount of energy is quite impressive if it is used optimally. (The official portal of the government of the United Arab Emirates, 2019).

5. CONCLUSION:

Renewable energies are one of the alternative sources on which it depends in order to find solutions to the problem of the depletion of non-renewable energies, as well as problems related to the environment;

As for the reality and prospects **for the development and use of renewable energies in the Emirates economy**, we summarize them in the following table:

Recently discovered oil in Emirates although the discovery of oil globally was in 1853.

- The Emirates are seeking to pursue economic diversification policies and expand the productive base to increase reliance on non-oil sectors by enhancing their contribution to GDP;
- Emirates have established a sovereign fund with the aim of fortifying economies from fluctuations in the oil markets. It aims to ensure a future source of wealth from current revenues from oil and gas sales;
- the Emirati experience are followed not only in the amount of oil revenues that it saves to future generations as much as it can be emulated in its investment in its infrastructure in order to achieve growth, it provides other non-oil sectors with opportunities for growth and employment;
- According to the Economic Competitiveness Report issued by the World Economic Forum for the year 2018, The UAE ranked first regionally and 27 globally in global competitiveness, and ranked first globally in the macroeconomic stability axis. And sixth globally in the technological readiness axis, while it ranked within the top ten in 19 sub-indicators out of 100 indicators of economic competitiveness, and in the first place globally in four sub-indicators; the percentage of broadband penetration on mobile devices, the rate of electricity delivery, the rate of inflation change annually, and the dynamics of the domestic market, which indicates a marked improvement in the performance of the Emirates during the year 2018 compared to Alvarth year.(Klaus Schwab;2019);
- The Emirates economy has become increasingly diversified, but oil and gas remain the mainstay of the economy, but the Emirates intends to rely on alternative energy sources in the future to secure its energy needs. International standards will be applied in the fields of energy, water, infrastructure, waste management, and recycling and energy buildings;
- The strategy of Emirates aims to finally abandon oil by 2050 and make renewable energy the ultimate alternative.

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