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RENEWABLE ENERGY FOR SUSTAINABLE DEVELOPMENT IN MIDDLE EAST

ВІДНОВЛЮВАЛЬНА ЕНЕРГЕТИКА ЯК ЧИННИК СТАЛОГО РОЗВИТКУ КРАЇН БЛИЗЬКОГО СХОДУ

ВОЗОБНОВЛЯЕМАЯ ЭНЕРГЕТИКА КАК ФАКТОР УСТОЙЧИВОГО РАЗВИТИЯ СТРАН БЛИЖНЕГО ВОСТОКА

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Abstract. *Improving energy efficiency is one of the main ways to reduce energy pollution that leads to economic development, increasing energy access and better life. That can result in reducing fossil fuel use and growing clean energy supplies. The Gulf countries have as many renewable resources as hydrocarbons like sunshine, considerable wind resources, and geothermal. The economy of the Middle east deeplydepends on fossil fuel export. Declining fossil fuel supplies and rising energy prices are driving global energy supplies to renewables energies. Although the Middle East region, due to its special geographical features, has significant potential for the growth of renewable energy sources, they have not been developed yet. It overviews the energy situation and sustainability, economic potential of renewable energy, policies for energy systems over the recent decades in six resource-rich countries in the middle east. In addition, along with renewable energy technologies, possible ways to solve current environmental problems are recognized. The methodology of this work is PESTLE analysis of these countries' energy status*

to develop a long-term mechanism for sustainable and secure energy for the Middle East based on Political, Economic, Social, Technological, Legal, Environmental. Also, it identifies challenges that restrict the development of renewable energy technologies in the Middle East. By analyzing the status of energy in recent decades, the importance of implementation of effective energy policies to develop sustainable energy can be realized.

Key words: *energy source, sustainable future, renewable, effective policy, resource-rich countries.*

Анотація. *Підвищення енергоефективності є одним з основних способів зменшення забруднення, економічного розвитку, покращення рівня добробуту населення. Використання заходів енергоефективності може призвести до зменшення використання викопного палива та збільшення обсягів чистого енергопостачання. Країни Перської затоки активно використовують такі відновлювані ресурси, як сонячне світло, ресурси вітру та геотермальні ресурси.В той же час, економіка Близького Сходу глибоко залежить від експортувикопного палива. Зменшення поставок викопного палива та зростання цін на енергію обумовлюють потребу в глобальному енергопостачанні відновлюваних джерел енергії. Хоча регіон Близького Сходу через свої особливі географічні характеристики має значний потенціал для зростання відновлюваних джерел енергії, вони залишаються недостатньо розвиненими. В статті здійснено огляд енергетичної ситуації, оцінено економічний потенціал відновлюваної енергетики, політику щодо енергетичних систем протягом останніхдесятиліть у шести багатих ресурсами країнах Близького Сходу. Крім того, поряд із технологіями відновлюваної енергетики визнаються можливі шляхи вирішення поточних екологічних проблем. Методологією цієї роботи є PESTLE- аналіз енергетичного стану цих країн для розробки довгострокового механізму стійкої та безпечної енергетики на Близькому Сході на основі аналізу політичної, економічної, соціальної, технологічної, правової, екологічної ситуації в регіонах. Крім того, автори визначили проблеми, які обмежують розвиток технологій відновлюваної енергетики на Близькому Сході. Аналіз стану енергетичного забезпечення дає можливість усвідомити важливість впровадження ефективної енергетичної політики для розвитку сталої енергетики.*

Ключові слова: *енергетичні ресурси, сталий розвиток, відновлювальні джерела енергії, ефективна політика, багаті на енергетичні ресурси країни.*

Аннотация: *Повышение энергоэффективности является одним из основных способов уменьшения загрязнения, экономического развития, улучшения уровня благосостояния населения. Использование мер энергоэффективности может привести к уменьшению использования ископаемого топлива и увеличению объемов чистого энергоснабжения. СтраныПерсидского залива активно используют такие возобновляемые ресурсы, как солнечный свет, ресурсы ветра и геотермальные ресурсы. В то же время экономика Ближнего Востока глубоко зависит от экспорта ископаемого топлива. Уменьшение поставок ископаемого топлива и роста цен на энергию обусловливают потребность в глобальном энергоснабжении возобновляемых источников энергии. Хотя регион Ближнего Востока через свои особые географические характеристики имеет значительный потенциал для роста возобновляемых источников энергии, они остаются недостаточно развитыми. В статье сделан обзор энергетической ситуации, оценены экономический потенциал возобновляемой энергетики, политика в отношении энергетических систем в течение последних десятилетий в шести богатых ресурсами странах. Ближнего Востока. Кроме того, наряду с технологиями возобновляемой энергетики признаются возможные пути решения текущих экологических проблем. Методологией этой работы является PESTLE-анализ энергетического состояния этих стран для разработки долгосрочного механизма устойчивой и безопасной энергетики на Ближнем Востоке на основе анализа политической, экономической, социальной, технологической, правовой, экологической ситуации в регионах. Кроме того, авторы*

определили проблемы, которые ограничивают развитие технологий возобновляемой энергетики на Ближнем Востоке. Анализ энергетического обеспечения дает возможность осознать важность внедрения эффективной энергетической политики для развития устойчивой энергетики.

Ключевые слова: *энергетические ресурсы, устойчивое развитие, возобновляемые источники энергии, эффективная политика, богатые энергетическими ресурсами страны.*

Introduction. The Middle East countries, whose economies depend on hydrocarbons for their energy supply and domestic consumption, are consuming huge amounts of natural resources domestically. Their rapid economic growth, identified by population explosion, significant industrialization, and growth in Gross Domestic Product (GDP) makes them large consumers of energy. With energy production around 2.7 times as large as its demand, and reaching 2040 Mtoe in 2018, the Middle East had the highest energy self-sufficiency ratio in the world. The region produced 14% of global energy in 2018, and more specifically 33% of global oil and 16% of the world's gas. The Middle East's global share of natural gas production had more than tripled since 1993. Saudi Arabia was still by far the largest oil producer in the region in 2018with 39%, followed by Iraq and Iran, with 15.5% and 14% respectively (IEA: 2020). Demand for electricity is soaring; it has nearly doubled during the last decade and will continue to grow inexorably by seven to eight percent annually for several years to come (Imen: 2012). Such rapid growth of energy needs is making pressure on the GCC's hydrocarbon resources, a significant lack of which, and inefficient use or damage to the environment refers to the fact that we should not be too dependent on fossil resources. Since most of the energy used in the region is provided by fossil fuels, any alternative way must respond to promoting renewable energy solutions to protect the environment while maintaining development. The GCC countries (Saudi Arabia, Kuwait, the United Arab Emirates, Qatar, Oman, and Bahrain) significantly meet the demand for primary energy, electricity generation and CO2 emissions in the Middle East. Consequently, it is critical to know how the development of their energy systemscan affect the energy future of the region. so, the purpose of this article is to study andcompare the CO2 emissions in GCC countries, which are known as the biggest polluters and what is their role in the future sustainable development of the Middle East's energy system. The first section of this paper looks an overview of natural resources, energy production and consumption. the second section is about renewableenergy development in these countries and the last one is PESTLE analysis of renewable energy with consideration of energy trends and CO2 emissions in the MiddleEast.

The purpose of the article is to evaluate the effect of renewable energy development on Carbon emission reduction in the middle east region over the recent decades and how the middle east can shift to a sustainable future by sustainable energy and lower emission. It overviews the energy situation and sustainability, economic potential of renewable energy, policies for energy systems over the recent decades in six resource-rich countries in the middle east.

Literature review. Historical energy trends have shown that rapid growth in energy consumption in GCC countries is expected in the next few years. In addition, rapidly growing domestic energy needs could potentially notably limit their ability to export to the world market in the future. All these factors can lead to an increase in the region's overall share of global CO2 emissions. Addressing these issues will require considerable input from governments, stakeholders, society, and politicians. The problem of renewable energies in its broadest sense was explored by authors. The mainlimitation of this article is the study of energy trends without much emphasis on the policies associated with these trends. In addition, the six key PESTLE factors discussed in this article can be expanded to include other parameters, such as energy managementpolicy, fuel prices, and the efficiency of available renewable energy technologies. However, in the works of these authors, the analysis in the review section showed thatin these countries, renewable energy targets are part of the future energy agenda. However, emission trends have shown that there is a gap in the relevant energy policy,which is closely linked to climate goals. In addition, the relationship between

energy demand management and the Establishment of renewable energy technology will have a strong effect on reducing CO2 emissions in the future. Such trends show that the development of energy transition policies aimed at reducing carbon emissions is the main to attain climate goals in these countries. Finally, a coherent policy is needed to lay the groundwork for an appropriate energy development strategy and to implementthe planned renewable energy targets.

Main results of the research.

1. Natural Resources. The availability of fossil fuels is evaluated based on existing reserves of oil and gas in GCC countries. The GCC countries have considerable conventional resources: KSA has the world's largest oil reserves of 259.9 billion barrels, Kuwait has 101.5 billion barrels, the UAE has 97.8, and Qatar 25.4 billion barrels. The table below shows the scores given for each country based on its ranking. In terms of existing natural gas reserves, Qatar ranks 3rd in the world with 899 trillion cubic feet (TCF), and UAE ranks 7th with 210 TCF (CIA: 2011).

Table 1: The GCC countries energy reserve ranks and RE-readiness scores

	Proven Oil and Gas Reserves						
	Rank 1-16	16-32	32-48	48-64	64-80	80-96	Rank >96
Allocated score	1	2	3	4	5	6	7
Country	Oil rank	Score	Gas rank		Score	Average score	
Bahrain	66	5	55		4	4.5	
KSA	1	1	4		1	1	
Kuwait	6	1	20		2	1.5	
Oman	23	2	26		2	2	
Qatar	12	1	3		1	1	
UAE	7	1	7		1	1	

The Middle East holds about 78% of the world's proven crude oil reserves, putting the region at the forefront of the global oil market. Saudi Arabia is the largest oil producer and exporter in the Middle East, with oil reserves for about 16 percent ofthe world. As a result, its economy is largely oil-based, with oil revenues accounting for about 90% of total national income and about 50% of its GDP (Mezghani: 2017). For Kuwait, oil is an essential component of its energy supply system. At the end of 2012, Kuwait's total proven crude oil reserves accounted for 8% of world oil reserves (Ramadhan: 2012).

a. *Energy Production.* The composition of energy production differs between the four countries in terms of fuel type and its share in total primary energy production. In general, the contribution of renewable resources is comparatively small compared to fossil fuels. The UAE, has two main sources of energy: oil and natural gas, other sources like coal and solar energy contribute slightly (less than 0.1%). (BP Statistical: 2016). AE is planning to adopt clean technology such as Carbon Capture and Storage (CCS) to continue using coal in the future. Also for the UAE, coal is mostly supplied through imports with a 2.5% share of the country's primary energy (IEA: 2016). With oil reserves about 16% of the world, Saudi Arabia is the largest oil producer and exporter in the Middle East. As a result, the country's economy is largely oil-based, since oil revenues accounting for about 90% of total national income and about 50% of GDP (Mezghani: 2017). Oil production in Saudi Arabia and Kuwait have been growing at an average annual rate of 1.5 percent, while the UAE grew at an annual rate of 2 percent. According to recent surveys of gas reserves in the Middle East, Saudi Arabia, the UAE, and Kuwait are among the largest natural gas reserves, accounting for about 63% of the total region. In 2012, Saudi Arabia was recognized as the world's largest producer of petroleum liquids (Bahgat: 2016). Consequently, oil has been supplying more

than 50% of Saudi Arabia's primary energy production since 1980. For Oman in 2012, about 86% of the government revenue came from the hydrocarbons sector and about 40 % of Oman's GDP comes from Oil and gas revenues, which shows the high dependence on the hydrocarbons sector. Looking into the energy balance of Oman, it is noticed that natural gas is the main energy source, as it accounts for 73% of the Total Primary Energy Supply (TPES) and the rest 27% comes from crude oil (Almulla: 2015). Bahrain is also a small producer of natural gas; it produced 446 billion cubic feet of dry natural gas in 2011. Despite the fact Bahrain is the smallest producer of hydrocarbons among the GCC countries, the Total Primary Energy Supply (TPES) in 2010 was about 9457 ktoe, it is mainly supplied by natural gas 85% and the rest comes from crude oil (Almulla: 2015).

b. *Energy Consumption.* For Kuwait, its domestic natural gas consumption has always equaled production. However, in the last years, Kuwait's natural gas demand has surpassed domestic consumption due to surging demands from electricity generation during the summer months (Abdul Hamid: 2016). Saudi Arabia is ranked as the world's sixth-largest oil consumer with total energy consumption higher than the global average (Alyousef: 2012). Over the past two decades, the country's per capita energy consumption has been rising, reaching four times higher than the world average in 2014 (IEA: 2015). The UAE has fewer reserves than Kuwait, but its total oil production and consumption are extremely higher than Kuwait. While the total population of UAE represents only 0.1% of the global population, the country consumes around 0.8% of the world's total oil consumption (Sgouridis: 2016).

2. Renewable Energy. The gradual decline in fossil fuel reserves, coupled with rising energy prices, will shift global energy to more renewable sources over the next decade. Under these conditions, renewable energies show a great capacity to meet much of the growing energy demand. The Middle East has considerable potential for renewable energy development due to its geographical and environmental characteristics, especially solar and wind energy. Although the region has the greatest potential for renewable energy, especially solar energy, renewable energy is not yet developed and accounts for only about 5% of the Middle East primary energy supply mix (IEA, 2016).

a. *Solar Energy.* GCC countries receive significant solar radiation, with KSA having the highest resource potential. On average, the global solar radiation for solar PV is close to 2,083 ($kWh/m^2/year$) and the direct solar radiation for CSP is about 2,208 ($kWh/m^2/year$) in the region.

b. Wind energy. The Gulf region has moderate wind energy potential. The countries of this country have an average wind speed of about 6 meters per second with wind potential, which is very different among them. Full load hours per year, which indicates the number of hours a wind turbine operates at full capacity for local wind speeds, is low compared to other countries. If the full wind load hours are reduced, the cost per unit of generation will increase. The KSA recorded full loading hours in 1,789 per year, which is the highest in the GCC countries, with the UAE having the lowest loading hours per year at 1,176.

Table 2: Solar and wind potential in the GCC countries (Alnaser: 2011;Ferroukhi: 2013; ACVL: 2011).

Country	PV Global solar radiation kWh/m^2/year	CSP Direct normal solar radiation (kWh/m^2/year)	Solar energy (kWh/m^2)/ Score	Wind speed (m/s)	Hours of full load per year	Score
Bahrain	2160	2050	5.1	5 – 6	1,360	**5.5**
Kuwait	1900	2100	5.9	5 - 5.5	1,605	**5.2**
Oman	2050	2200	5.4	4 -6	1,463	**5**
Qatar	2140	2200	5.2	5 -7	1,421	**6**
KSA	2130	2500	5.6	2.5-4.5	1,789	**3.5**
UAE	2120	2200	5.4	3.5-4.5	1,176	**4**
Average	**2083**	**2208**				

Generally, the GCC countries have considerable solar and wind resources. UAE and KSA reached lower scores due to their lack of wind resources.

c. *Electrification Rate.* The GCC countries have the highest electricity rates in the world (Kuwait and the UAE 100%, KSA 99%, Bahrain 99.4%, Qatar 98.7%, and Oman 98%). The Gulf region has high reliability (reduced load / limited blackout) of electricity suppliers. The only exception is during peak summer days, which experience some disadvantages. Kuwait and the UAE have 100% electrification rates and the best quality of electricitysupply. Saudi Arabia's electricity consumption is nearly 256 TWh/y, the highest consumption of all Gulf Cooperation Council (GCC) countries (SP Statistical: 2016). In the UAE, electricity consumption has increased exponentially in the last decades. With large reliance on hydrocarbon resources for energy supply, the country has set three targets; 27% of Renewable Energy Technologies (RETs) by 2020, 30% by 2030 and recently 50% from renewables by 2050 (IRENA: 2015).

CO2 Emissions. Increasing global energy demand, most of which is met by fossil fuels, is resulting in increasing CO2 emissions. In 2012, a total of 35.6 billion tons of CO2 emissions were generated worldwide, which is 2.6% more than the previous year, mostly because of increased fossil fuel combustion. CO2 emissions in Kuwait are between the highest in the world. CO2 emissions in Kuwait per capita grew at a rate of 1.13% annually to reach 39 metric tons in 2010, compared to a world average of 4.54 tons and the U.S. of 18 tons (Alotaibi: 2011). Between 1995 and 2015, Saudi Arabia's CO2 emissions increased by 5.2 percent annually. In addition, Saudi Arabia's share of global CO2 emissions increased from 0.7 percent in 1990 to 1.4 percent in 2015 (Bahgat: 2016). The UAE is among the world's largest emissions per capita from fossil fuel combustion. Since 1980, per capita emissions have grown by an average of 1.3 percent per year, reaching 44 tons in 2010. However, the country's absolute pollution rate corresponds to 0.7% of CO2 emissions worldwide.

3. PESTLE analysis. PESTLE analysis includes six main categories: Political and legal (political changes or improvement that would have an impact on energy policies, trades, and energy supply), Economical (economic factors like income level, international trade, and taxes), social (social factors like population, consumption behavior, and lifestyle), Technological (new technologies that can affect the development of energy systems, and efficiency) and Environment (including factors of natural systems such as wind and water).

a. Technological. Bahrain; Population and economic growth have led to a very high estimated annual energy growth rate of 10% in Bahrain. In 2008, the total installed power generation capacity

was 2,780 megawatts (MW) (IEA: 2012). It is expected that a total capacity of 6,500 MW will be required by 2030 to meet the projected demand (Gelil: 2013). Bahrain has installed three wind turbines at its World Trade Center, which supply 13% of the building's energy needs. The country has a solar energy street lighting pilot project implemented by the Electricity and Water Authority (EWA). In July 2011, Bahrain signed a contract with German consulting engineers Fitchner to prepare a techno-commercial feasibility study for solar and wind energy sources (MEW: 2012).

Kingdom of Saudi Arabia; The KSA's rapid economic growth is closely linked to its per capita energy consumption which has increased by more than 30% since 2010(Alyousef: 2012). KSA made the first step in the region in the 1970s with the establishment of King Abdulaziz Science and Technology City (KACST) and the funding of R&D projects, including renewable energy. In 2009, KAUST was established to make the country a major energy research center and develop renewable and sustainable technologies through collaboration with global scientific institutions. In April 2010, the King Abdullah City for Atomic and Renewable Energy (KA-CARE) was founded by a Royal order to contribute towards sustainable development through the implementation of nuclear power plants and renewable energy projects to diversify energy supply and minimize CO2 emissions. In April 2011, KSA announced that it would invest $ 100 billion in renewable and nuclear energy to reduce its dependence on crude oil and generate 7-10% electricity generation from RETs by 2020 (Bachellerie: 2012).

Kuwait. In 1958, the first power plant with a capacity of 15 MW was installed. The total installed capacity by 2008 has reached 11.6 GW. It is expected that by 2020, a capacity of 23 GW will be needed to meet the projected demand for electricity (Bachellerie: 2012). This country is rich in solar energy. Kuwait has set a goal of generating renewable energy production, which aims to generate 10% of its electricity from sustainable sources by 2020 (Times: 2011). Several pilot projects in wind, solar PV, and solar thermal technologies have been completed by the KISR. Some of these projects are: solar heating and cooking with different thermal storage configurations, thermal and electricity application projects including Kuwait English School (Salwa) with a daily electricity load of 80 kWh. the solar power plant at Sulaibia complex with56 power production of 125 kW.

Oman. In 2010, the total peak of electricity demand in Oman was 3,856 MW, an increase of 46.4% since 2005. The peak of demand is expected to grow at an annual rate of 8% and is projected to reach about 6,600 MW by 2018 (Al-Badi: 2013). The Oman Electricity Regulatory Authority (AER) has drawn up a roadmap for thedevelopment of renewable energy projects. AER published a report in 2008 entitled "Study of Renewable Energy Sources, Oman". This study recommends several RET pilot projects: 1) 10 kW off-grid solar PV/diesel hybrid system; 2) 20 kW grid-connected solar PV system; and 3) 10 MW grid connected wind power farm (AERO, 2008).

Qatar. In the year 2000, the country's peak electricity demand was only 1,800 MW, this figure reached 8,000 MW by the year 2011. Electricity demand growth in recent years has been about 5.1% (Alnaser, 2011). Qatar's electricity generation is projected to continue at an annual growth rate of 2.9% by 2030. The country's primary energy demand is projected to grow at an average rate of 5.2% per year. The Qatar National Food Security Program (QNFSP) recently launched a solar resource assessment project. The project is to be carried out by the German Aerospace Center (DLR) to identify the country's most desirable areas for solar energy projects.

United Arab Emirates. Power generation in the UAE is almost entirely dependent on fossil fuels, with natural gas accounting for 98% of the total installed capacity in 2009 (WDI, 2011). Low energy costs and high rates of economic and population growth have led to a significant increase in the country's energy consumption over the past decades. The Emirate of Abu Dhabi has established one of the world's most comprehensive clean energy initiatives through the Masdar Initiative. It has set a target of 7% of electricity generating capacity from renewable energy by 2020. The Abu Dhabi Climate Change Policy Plan proposes that Abu Dhabi will generate electricity by 10% from renewable energy by 2030 (Harder, 2011). The UAE Solar Atlas has been commissioned to provide

valuable technical data for setting up solar energy projects in the country. The UAE Solar Atlas is the outcome of the agreement signed between Masdar Institute and IRENA. Dubai has set a target of 5% renewable energy generating capacity by 2030 (1000 MW).

Innovation and R&D. Creating a strong R&D sector for the knowledge economy will help GCC countries achieve their sustainable development goals. The percentage of GDP cost forresearch and development in the GCC countries is very low compared to the global average. Kuwait spent about 0.1% and KSA about 0.08% of GDP on R&D in 2009, while the global average was about 2.1% (WDI, 2011).

b. Environmental. A policy for climate protection and energy security should include efforts to diversify energy composition, including the use of low-carbon options. Climate changemitigation policies that target renewable energy or demand-side efficiency options have benefits of less primary energy use as well as supply diversification (Mondal: 2010; Shrestha: 2010). All the GCC countries have ratified the Kyoto Protocol and arecommitted to sustainable development. The Kyoto Protocol was successfully extended for 2nd commitment periods of 8 years (2012 to 2020) in the COP18 meeting in Doha,Qatar. The Dubai Supreme Council of Energy and Dubai Carbon Center for Excellenceare developing a strategy to cut CO2 emissions. The strategy sets its effort to cut Dubai's CO2 emissions by 1.5 million tons per year. Growing energy consumption hasled to increased carbon dioxide emissions. average. Regarding the average growth rate,Kuwait is the fastest, growing at an average of 3% annually, followed by the UAE (0.93%) and Saudi Arabia (0.72%).

c. Economical. The macroeconomic environment reflects the ability of the government and private sector to support and invest in the development of renewable energy projects. For example, high-interest rates and inflation will discourage investment. The GCC countries have a very strong macroeconomic environment. A number of factors, such as government budget, gross national savings, inflation, interest rates, government debt, and credit ratings, are used to determine readiness scores for the macroeconomic environment factor. Macroeconomic data of the GCC countries, global ranking (2011- 2012), and readiness scores are presented in Table 3. Kuwait receives the highest scoreof 6.6 followed by Oman at 6.5 on macroeconomic environment.

Table 3: Macroeconomic indicators, world ranks, and competitiveness scores(WEF: 2011).

Country	Budget balance (% GDP) [Rank]	National savings (% GDP) [Rank]	Inflation (%) [Rank]	Interest rate (%) [Rank]	Debt (% of GDP [Rank]	Credit rating (1-100) [Rank]	Overall score
Bahrain	-7.8	34.4	2 [1]	6.0	32	68.1 [40]	5.1
KSA	7.7 [8]	35.2 [14]	5.4	6.0	10.8 [10]	75 [32]	6.1
Kuwait	17.5 [2]	40.4 [9]	4.1 [75]	0.5 [2]	10.5 [9]	76.2 [29]	6.6
Oman	75 [9]	41.4 [8]	3.3	3.5	5.9 [4]	71.8	6.5
Qatar	11.4 [4]	49.4	-2.4 [102]	4.4	17.8	79	6.4
UAE	3.3 [12]	26.4	0.9 [1]	3.0	21.0	75.3	6.1

d. Social. Consumer and social awareness are usually the result of capacity-building effortsin renewable energy sources and technologies. NGOs, professional associations, and related public organizations may organize exhibitions, seminars, and media awareness campaigns to raise consumer awareness. This factor is usually measured through surveys. The results are generally presented in published reports such as "Gulf Cooperation Council 2020: Resources for the Future." (EIU, 2010). This factor is assessed qualitatively from a range of consumer social awareness and "very good" andeventually translates to scales from 1 to 7. Many initiatives have been taken to raise awareness in the GCC countries. Social awareness of the need for clean energy development has been assessed with a good score of 4.66 for KSA and UAE. Bahrain, Kuwait, Oman, and Qatar receive a fair score of 2.33 on consumer and social awareness.

e. Political & Legal. Reliable and effective renewable energy policies are essential to attract investors.It is important to have a realistic target based on long-term planning to integrate large-scale renewable energy projects into the power sector. Large RET projects provide economies of scale and favorable planning environments, which facilitate project development financing (E&Y: 2012). Lack of long-term planning based on technical and economic feasibility leads to lack of clarity and stability of policy over the long term, prevents investment and development of renewable energy projects (WEF: 2011). RET development goals should ideally be based on technical and economic modeling of renewable energy potential for a given country. These goals are a guide for investors and entrepreneurs to develop their future strategy and business plans to invest in the development of RETs. Renewable energy production targets must be specific, measurable, achievable, reasonable, and time-bound. Policy mechanisms arefurther broken down into regulations, fiscal incentives, and finance (including finance for R&D). The policy mechanisms are identified by the Renewable Energy Policy Network for 21st Century (REN21: 2012). Institutional regulatory challenges are diverse in terms of their impact on energy production. Some of these challenges affectthe energy industry in general and some affect renewable energy projects specifically.Regulators need to create an environment that avoids or minimizes investors' risk in RET projects. The most common institutional regulatory challenges are (WEF: 2011): The absence of long-term planning; Many overlapping relevant authorities; Lack of coordination between relevant authorities; Complex permitting procedures; Lack of stakeholder involvement in decision-making. Most of the GCC countries lack a specific regulatory authority that is specifically responsible for RET projects. The existence of such an authority could simplify the permitting and approval process, ensure standardization of projects, and thereby ensuring higher project quality and increased administrative efficiency. For example, Qatar has no dedicated legal or regulatory framework for the deployment of clean energy projects yet. The Sustainable Environmental Management Program in Kuwait was started in 2003 to establish an environmental database. So far, there is no dedicated law on sustainable energy use or uptake in Kuwait. According to the country-specific surveys, KSA and UAE have better legislation and harmonization between stakeholders as well as an adequate regulatory enforcement for RET deployment. These benefits are reflected in their scores, as shown in the following table. The scores are given based on seven sub-factors that contribute more regulatory assurance and each sub-factor receives one point out of a total of 7 points.

Table 4: The GCC countries regulatory framework scores

Country	Bahrain	KSA	Kuwait	Oman	Qatar	UAE
Clear legislation	0.25	1	0.25	0.5	0.5	1
Timely implementation of legislation	0.25	0.25	0.25	0.25	0.25	0.25
Harmonization between stakeholders and good coordination	0.25	1	0.25	0.5	0.25	1
Transparency and clear communication from NRA	0.25	0.5	0.25	0.5	0.25	0.5
Comprehensive guidance of legislative requirements	0.25	0.5	0.25	0.25	0.25	0.5
Adequate NRA enforcement	0.25	1	0.25	0.25	0.5	1
Clear and consistent permitting procedures and fair competition as well as adequate appeals processes	0.25	0.5	0.25	0	0.25	0.5
Score	1.75	4.75	1.75	2.25	2.25	4.75

Conclusions

The purpose of this paper is to investigate the trend of energy and CO2 emissionsin the GCC countries to better understand the status of their energy systems to reach sustainable energy in the region. The challenges in these countries are due to the largereserves of fossil fuels that have led to huge fossil fuel consumption. energy consumption and electricity demand have been growing rapidly in recent years. Geographical proximity, also the similarity in climatic conditions and the structure of their policies can let them work together to improve renewable energy development. Developing energy policies and a regulatory framework that are commensurate with reducing carbon emissions is important to achieving climate goals in the Middle East. Finally, a consistent policy is essential to lay the groundwork for an appropriate energy development strategy and to implement planned renewable goals. Also, it is necessaryto have a realistic target based on long-term planning to integrate large-scale renewableenergy projects into the power sector.

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