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# The Rise of Renewable Energy in the MENA Region: An Investigation into the Policies Governing Energy Resources

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This paper explores the various policies and legislative frameworks regarding renewable energy in place throughout the Middle East and North Africa (MENA), with a specific focus on two representative countries: Egypt and the United Arab Emirates. Through compiling information from past literature covering renewable energy policies in general, the history of hydrocarbons in the Middle East, and the steadily growing presence of renewables in the area, and combining that information with primary research through meetings and interviews with individuals throughout the different stages of the renewable energy market, this paper arrives at recommendations regarding the future of renewable energy production and policies in the MENA region. Overall, the recommendations this paper presents based on its findings determine that MENA governments must begin by eliminating pre-existing fuel subsidies and reducing their international energy-related financial burdens to allow the private sector to fully penetrate the market. In general, the governments must take steps towards achieving higher efficiency in the renewable energy market, be it through the legislative framework, infrastructure, or financial framework to achieve the lowest Levelized Cost of Energy possible and to grow into a possible energy hub in the future.

**Keywords**

renewable energy, Middle East and North Africa, Egypt, U.A.E., clean energy, fossil fuels, energy policy, sustainability, social impact

**Disciplines**

Arabic Studies | Business | Energy and Utilities Law | Environmental Law | Environmental Sciences | Government Contracts | Natural Resources Law | Oil, Gas, and Mineral Law

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## An Investigation into the Policies Governing Energy Resources

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## Abstract

This paper explores the various policies and legislative frameworks regarding renewable energy in place throughout the Middle East and North Africa (MENA), with a specific focus on two representative countries: Egypt and the United Arab Emirates. Through compiling information from past literature covering renewable energy policies in general, the history of hydrocarbons in the Middle East, and the steadily growing presence of renewables in the area, and combining that information with primary research through meetings and interviews with individuals throughout the different stages of the renewable energy market, this paper arrives at recommendations regarding the future of renewable energy production and policies in the MENA region. Overall, the recommendations this paper presents based on its findings determine that MENA governments must begin by eliminating pre-existing fuel subsidies and reducing their international energy-related financial burdens to allow the private sector to fully penetrate the market. In general, the governments must take steps towards achieving higher efficiency in the renewable energy market, be it through the legislative framework, infrastructure, or financial framework to achieve the lowest Levelized Cost of Energy possible and to grow into a possible energy hub in the future.



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# I. Introduction

The Middle East and North Africa (MENA) have long been known as geographical areas rich in non-renewable energy resources, including crude oil and natural gas, among others. Nevertheless, over the past decades, various countries in the region have been developing different renewable energy resources to complement the abundance of natural resources, to make up for their gradually diminishing energy reserves. Although the presence of renewable energy resources continues to grow and develop, it remains nearly negligible in comparison to the non-renewable resources available in this area. However, all across MENA, governmental policies and corporate actions have been shifting to accommodate and encourage this change of focus.

This study will address the subject of changing governmental and corporate policies and attitudes regarding renewable and non-renewable energy resources, with a specific focus on Egypt and the United Arab Emirates (UAE). It will begin by discussing the background of the presence of non-renewable and renewable energy resources in the region, as well as the policies, rules, incentives, and projects in place to manage the different energy resources in the two countries listed above, and will finish by presenting recommendations for future direction regarding their respective energy resources.

To provide a brief background of the two countries on which the case study will be conducted, Egypt is the country linking North Africa and the Middle East geographically. It has a total area of 390,121 square miles, and a population of over 95 million. It has vast desert lands, is bordered to the north by the Mediterranean Sea, to the east by the Red Sea, and is crossed by the Nile River from south, in Upper Egypt, to north, spilling out into the Mediterranean at the Nile Delta. Regarding the United Arab Emirates, it is situated at the southeast end of the Arabian Peninsula, with wide coastal areas on the Arabian Gulf. It sits on an area of 32,300 square miles, and is populated by over 9.6 million people. Both countries are considered Arab countries, and belong to the MENA region.

## II. Research Goals

The purpose of this study is to suggest future governmental and corporate policy changes to encourage the rise of renewable energy resources without sacrificing the benefits of non-renewable energy resources to the MENA region. These recommendations will be constructed through an assessment of previous policies, as well as current governmental and corporate plans to be implemented regarding energy resources. Thus, this study intends to describe current laws, policies, and corporate actions in place to promote renewable energy resource usage, then present recommendations on methods to ameliorate the various energy profiles through improving the policies implemented by each of the respective countries to achieve a more efficient and cost-effective energy balance and legislation.

# III. Non-Renewable Energy in the MENA Region

## a. Background

May 26th, 1908: the original discovery of oil in southwestern Iran, the consequences of which slowly snowballed as oil was discovered under the surfaces of Bahrain, Kuwait, Qatar, Saudi Arabia, the United Arab Emirates, and many more countries throughout the Middle East and North Africa region (Owen, 2008).[1] The Middle East is one of the, if not the, richest geographical areas in oil and natural gas reserves worldwide. Slowly but surely it has extracted copious amounts of fossil fuels from these reserves, as well as refined them and exported them to bring in significant revenues to these various countries' economies. These energy sources constitute an integral part of the economies and national GDPs of the countries of the MENA region, and the significance of oil to the MENA region continues to grow as the Gulf states produce an increasing share of the world's total oil supply. At the end of 2011, oil reserves in the MENA region equated to 56% of global proven oil reserves, or 860 billion barrels out of a total of 1532 billion barrels of reserves worldwide.[2]

Similarly, the existence of natural gas in the MENA region is bountiful, with the end of 2011 showing reserves of 88 trillion cubic meters out of a world total of 208 trillion cubic meters.[3] This 42% share of natural reserves only continues to grow, as the region discovers newer reserves, such as the off-shore reserves in the eastern Mediterranean Sea, as well as more efficient methods of extracting and refining them. From establishing pipelines connecting countries globally to extracting natural gas, turning it into Liquefied Natural Gas, and exporting it, the MENA region has a presence unlike no other in the space and constitutes a major power player worldwide.

This all begs the question: why would these countries abandon their rich oil and natural gas reserves, and shift to a new source of energy which can be employed and utilized nearly worldwide?

## b. United Arab Emirates

The United Arab Emirates is home to bountiful reserves of oil and natural gas which it has been able to extract, refine, utilize, and monetize for decades and decades. Similar to its fellow Arabian Gulf states, the UAE has been able to benefit greatly from its rich resources: in 2012, oil and gas accounted for approximately 42% of its national GDP, while revenues from hydrocarbon exports reached 80% of total government revenue.[4] Focusing on crude oil, in 2015

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[1] Prof. Owen, E. Roger, 2008. One Hundred Years of Middle Eastern Oil. Brandeis University.
[2] Khatib, Hisham, 2013. Oil and Natural Gas Prospects: Middle East and North Africa. Energy Policy 64, 2014, pp. 71-77.
[3] Khatib, Hisham, 2013. Oil and Natural Gas Prospects: Middle East and North Africa. Energy Policy 64, 2014, pp. 71-77.
[4] Khondaker, A.N., et al., 2016. Greenhouse Gas Emissions from Energy Sector in the United Arab Emirates – An Overview. Renewable and Sustainable Energy Reviews Volume 59, June 2016, pp. 1317-1325.

the UAE possessed 5.8% of the world's total oil reserves, deeming it the country with the 7th largest oil reserves. Furthermore, it was the 4th largest producer of oil, producing 3.65 million barrels daily, or 4% of the world's total production.[5] As evidenced by the UAE's output of 154,189,000 tons of crude oil in 2016, it maintains a prominent position among the members of the Organization of the Petroleum Exporting Countries (OPEC). Altogether, this oil only makes up 16% of its total primary energy supply.[6]

The majority of the UAE's total primary energy supply comes from natural gas, which amounts to 81.5%. It produced a total of 2,301,573 Terajoules (TJ) in 2016, due to its abundant oil reserves.[7] In fact, the UAE possessed 2.9% of the world's total proven gas reserves at the time, deeming its reserves the world's 7th largest.[8] This natural gas, which is an integral part of the UAE's energy supply and production, is used primarily in the industrial sector. In addition, it is deemed a transition fuel to a carbon-free future due to its less harmful impact on the environment.[9] In general, this indicates that natural gas burns cleaner, so its combustion releases negligible amounts of sulfur, mercury, and particulates, as well as emitting 50-60% less carbon dioxide ($CO_2$) than alternatives such as coal.[10] Nevertheless, just like its fellow Gulf countries, the UAE is dependent to a great extent on its hydrocarbon energy sources, which will likely run out in the decades to come.

### c. Egypt

Besides the Gulf states' abundance of oil and natural gas, North African countries have also historically been able to extract and utilize large reserves of fossil fuels that are present under their surfaces. Egypt, for one, has made discoveries of large oil reserves in its western and southern deserts. With the 6th largest proven oil reserves in Africa, Egypt's oil production reached 35.6 million tons/year in 2016. Its large reserves in the Western Desert and the Gulf of Suez have landed it a spot as a member of the Organization of the Arab Petroleum Exporting Countries (OAPEC).[11] Overall, this has led to oil constituting 44% of its total primary energy

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[5] Juaidi, Adel et al., 2016. An Overview of Energy Balance Compared to Sustainable Energy in United Arab Emirates. Renewable and Sustainable Energy Reviews 55, 2016, pp. 1195-1209.
[6] International Energy Agency. https://www.iea.org/statistics/?country=UAE&year=2016&category=Energy%20supply&indicator=TPESbySource&mode=chart&dataTable=BALANCES
[7] International Energy Agency. https://www.iea.org/statistics/?country=UAE&year=2016&category=Energy%20supply&indicator=NatGasProd&mode=chart&dataTable=GAS
[8] Juaidi, Adel et al., 2016. An Overview of Energy Balance Compared to Sustainable Energy in United Arab Emirates. Renewable and Sustainable Energy Reviews 55, 2016, pp. 1195-1209.
[9] Poon, Chun Yu Jonathan, 2015. The Post-Fossil Subsidy Age of the United Arab Emirates. Renewable Energy Focus Volume 16, Number 5–6 December 2015.

[10] Union of Concerned Scientists, https://www.ucsusa.org/clean-energy/coal-and-other-fossil-fuels/environmental-impacts-of-natural-gas
[11] World Energy, 2016. https://www.worldenergy.org/data/resources/country/egypt/oil/

supply in 2016, based on total production of 32,835,000 tons of crude oil.[12] On the consumer side, the Egyptian government had been providing large fuel subsidies which it has nearly eliminated under the terms of the loan it was granted by International Monetary Fund.[13]

Furthermore, over the years Egypt has discovered plentiful reserves of natural gas across the country, 87% of which are present in the Mediterranean Sea. With more than 40 producing wells over that area, the Mediterranean reserves contributed on average around 58.1% of Egypt's total annual natural gas production from 2010-2017. Combined with reserves in the Western Desert and the Nile Delta, they made up 97% of Egypt's total gas production in 2017.[14] In addition, natural gas made up 52% of Egypt's total primary energy supply in 2016, based on production levels of 1,381,636 TJ.[15] These statistics not only serve as an indication of the abundance of Egyptian natural gas reserves, they doubly act as a cautionary alert, displaying Egypt and the MENA region's strong reliance on finite sources of energy.

[12] International Energy Agency. https://www.iea.org/statistics/?country=EGYPT&year=2016&category=Energy%20supply&indicator=TPESbySource&mode=chart&dataTable=BALANCES
[13] Werr, Patrick et al. Reuters, 6 April 2019. https://www.reuters.com/article/us-egypt-economy-imf/egypt-to-slash-fuel-subsidies-as-it-nears-end-of-imf-program-idUSKCN1RI032
[14] Hussein, Amina & El Baz, Mahinaz, 2018. Egypt's Natural Gas: Bright Prospects. Egypt Oil and Gas Newspaper, October 2018, Issue 142.
[15] International Energy Agency. https://www.iea.org/statistics/?country=EGYPT&year=2016&category=Energy%20supply&indicator=NatGasProd&mode=chart&dataTable=GAS

# IV. Renewable Energy in the MENA Region

## a. Why Renewable Energy?

Demand for energy in the MENA region is steadily growing because of an increase in population, large levels of industrialization, and several other factors. Based off of the World Bank's estimates, primary energy demand in the region is forecasted to increase consistently at a rate of 1.9% per year until 2035.[16] This increasing need for energy is coupled with dwindling reserves of hydrocarbons or fossil fuels within the area, and also worldwide.[17] As these finite resources diminish, countries want to reduce how much of their oil and gas exports they divert to domestic use, and limit quantities of any fuel they do import, since their exports generate large revenues and energy imports are extremely expensive.

In addition, the most evident reason for the gradual shift to renewable and clean energy is the environment. Protecting the environment from the harmful effects of climate change which are only aggravated by the excessive use of fossil fuels worldwide has become a large priority for many nations across the globe, including many MENA countries. Thus, several MENA countries want to reduce the harmful effects of greenhouse gas emissions on the global environment. This has led to many Middle Eastern and North African countries accelerating their shift to renewable energy resources to combat these factors and continue on the path to economic growth and prosperity. Achieving these two goals in tandem is the ultimate target for many of those involved.

## b. Types of Renewable Energy

### i. Solar

Solar energy is the most widely used in the MENA region, due to the plethora of sun rays that hit its surface each day. The solar energy is transformed into utilizable energy through various methods and mechanisms. The primary method present throughout the region uses photovoltaic (PV) cells, which face the sun and pivot in 2 or 4 directions. The PV surface of the solar panels channels the energy through the structure to a transformer, which then feeds the energy into the larger electrical grid that the panels are connected to. This is known as an on-grid system. The main pitfall of this system is its inability to function at night, as it cannot store the solar energy it processes without some additional storage such as batteries, pumped hydropower or XYZ. There are also off-grid systems, which rely mainly on battery storage technology; however, these are extremely expensive and difficult to apply on a large scale.[18]

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[16] Anderson, Kerry Boyd, 06 February 2019. Arab News, http://www.arabnews.com/node/1448021

[17] Shafiee, Shahriar, & Topal, Erkan, 27 September 2008. When Will Fossil Fuel Reserves be Diminished? Energy Policy, Vol 37, Issue 1, January 2009, pp. 181-189.

[18] Ossama, Mohamed & Khedr, Omar. Personal Interview. "Solar Renewable Energy in Egypt: A Case Study of Benban Solar Park." 15 July 2019.

Solar power is also employed thermally: it is used to boil water, which can be channeled into heating systems or used to turn generators to provide electricity. This second application has been termed Concentrated Solar Power (CSP). A CSP system employs mirrors to concentrate sun rays, which are then used to heat up a fluid until it evaporates. The steam it produces is used to turn turbines and general electricity – a method which is applied on a large-scale solar plant. The most attractive aspect of CSP systems is how they can be equipped with molten salts, which can store the heat to allow electricity generation even after sunset.[19]

Besides these utility-focused applications of solar energy, it can also be employed in a more residential or commercial aspect, with small-scale projects. These methods of application have become more popular in the recent years, as environmentally-conscious individuals and businesses set up solar panels on their roofs to reduce the amount of fossil fuel-generated energy they consume.[20] Many countries have incentive systems set in place to encourage this individual action, through subsidies or reductions in electricity prices and tranches.

Overall, the main disadvantages of solar energy are that it requires a significant area of land to harness enough solar power, its dependence on weather conditions, and the fact that it only exists for half or two-thirds of the day.[21] In addition, the practical aspect of regulating solar power plants is complicated due to the varying hours of sunlight, and the dust that collect on the surface of the PV cells which must be cleaned and maintained regularly. However, innovations in the industry are slowly working to combat these obstacles.[22] Regardless, solar power is an excellent energy source that is extremely attractive in a bright and sunny area like the MENA region.

### ii. Wind

The second most widespread source of renewable energy in the MENA region is wind power, mainly due to the large expanses of desert land where winds can reach high speeds.[23] The majority of wind energy applications in the MENA region are on a large scale – there are rarely any occurrences of standalone wind turbines used for residential or commercial reasons. In general, wind turbines operate with a simple mechanism: the wind turns the rotor blades, which in turn rotate a shaft, which spins an electric generator to create electricity.[24] Recently, innovations in the field have led to the average capacity of an onshore wind turbine increasing to 2MW. Moreover, one of the unique qualities of wind turbines is that as wind speed increases, the output increases proportionally to the cube of the wind speed.[25]

The main benefit of wind energy is that it’s available 24 hours of the day, unless weather conditions are unfavorable or wind is intermittent. Furthermore, its upkeep and maintenance costs are fairly low; however, it requires a large initial investment due to the high cost of the

[19] International Renewable Energy Agency, https://www.irena.org/solar
[20] EnergySage. https://www.energysage.com/solar/
[21] U.S. Energy Information Administration, https://www.eia.gov/energyexplained/solar/
[22] Ossama, Mohamed & Khedr, Omar. Personal Interview. “Solar Renewable Energy in Egypt: A Case Study of Benban Solar Park.” 15 July 2019.
[23] Mortensen, NG et al. Wind Atlas for Egypt, 2006.
[24] U.S. Department of Energy, https://www.energy.gov/eere/wind/how-do-wind-turbines-work
[25] International Renewable Energy Agency, https://www.irena.org/wind

machinery.[26] Compared to solar energy, it requires a higher initial capital expenditure but lower operating expenditure due to the reduced need for regular cleaning and maintenance. Overall, its benefits as a source of renewable energy far outweigh its costs.

### iii. Hydropower

Hydropower is one of the oldest existing forms of renewable energy; it was used by farmers in eras such as Ancient Greece to spin wheels and create power for grinding grains or conducting similar farming jobs.[27] Today, hydroelectric plants exist in three main forms: impoundment, diversion or run-of-river, and pumped storage. Impoundment facilities, the most common type, incorporate the use of dams and reservoirs, which channel the water to spin turbines to activate electric generators. Diversion or run-of-river facilities are installed in rivers or canals through which rivers are channeled, and operate using the same mechanism without impeding the flow of water. Finally, pumped storage facilities operate like a battery, where energy generated by other alternative sources is used to pump water to a reservoir at a higher elevation, which is later released to the lower reservoir to generate electricity by turning a turbine.[28]

Large hydropower plants are more prominent in the MENA region than their smaller-scale counterparts, due to the existence of large dams such as the Egyptian High Dam or Aswan Dam. Much of the hydropower infrastructure in the area has existed for decades, and makes up a significant portion of the renewable energy portfolio mix of several MENA countries. It is environmentally-friendly, although many believe that smaller scale projects are safer for the environment because they don't interfere with the natural flow of the earth's waters.[29]

### iv. Others

In the MENA region, besides solar, wind, and hydroelectric power, nuclear energy and bioenergy – energy from living organisms – are the main other forms of renewable energy used. However, they are still not as prominent as other alternative or clean energy sources in the region, and don't make up a significant part of their energy mix.

## c. Renewable Energy Schemes and Terms

There are several schemes that national governments may employ to encourage investment in and employment of renewable or clean energy. Some of these schemes are used to encourage commercial or residential projects, while the majority describe different incentives or contract types between a government body and another entity involved in the renewable energy production process.

### i. Levelized Cost of Energy

[26] Wind Energy Development, http://windeis.anl.gov/guide/basics/
[27] U.S. Department of Energy, https://www.energy.gov/articles/top-10-things-you-didnt-know-about-hydropower
[28] U.S. Department of Energy, https://www.energy.gov/eere/water/types-hydropower-plants
[29] International Renewable Energy Agency, https://www.irena.org/hydropower

Before proceeding it is necessary to discuss a term known as the Levelized Cost of Energy, or LCOE.[30] Fundamentally, the LCOE of a project is a measure of its lifetime costs, from start to finish, at its present value, divided by the total amount of energy produced over the lifetime of the project. It is used because it allows one to make an informed decision on the general cost of a project and compare projects of different durations, initial capital outlays, risk, capacities, etc. because it normalizes these variables and includes them in the final number – the LCOE. In general, the initial capital cost and capacity factors have the largest impact on the LCOE, but other factors are still extremely relevant.[31]

### ii. Feed-in Tariff

Feed-in tariffs, or FIT, are essentially a fixed price per unit of energy paid to a power producer for the generation of electricity that is fed into the larger electric grid. The price is cost- and output-based, and therefore changes with different types of renewable energy technologies and projects, different sizes and capacities, and at different points in time. Nevertheless, it is usually above the LCOE to provide an incentive for parties to invest in the aforementioned projects. FIT are generally used for longer-term projects, in the range of 15-25 years, and provide compensation rates that are above retail pricing to encourage investors and individuals to take on renewable energy projects.[32]

The main advantage of FIT is that they provide some level of transparency for the investor, as the price level is laid out for decades into the future, along with forecasts of the energy and electricity to be produced. This also vastly reduces the level of risk of the investment. Since the FIT are cost- and output-based, they create an additional incentive for the investors or producers taking on the project to make it as efficient as possible and to generate as much electricity as they can, to reap the rewards. For governments, FIT are extremely attractive because they provide a mechanism to rapidly stimulate the growth and development of their national renewable energy market.

However, FIT have one large pitfall. The fixed price, which is the essence of the mechanism, is difficult to set so as to attract investors but not overcompensate, or create windfall profits. Thus, there are countless cases where the FIT's tariff is set incorrectly, and creates unnecessary costs for investors or governments. In addition, over time the actual cost of renewable energy technologies has been diminishing, although the price of FIT agreements made in the past has not changed. This creates a large discrepancy between market prices of electricity and set tariffs, which hinders the integration of the electricity market and the achievement of a free market with various private players.

### iii. Build-Own-Operate(-Transfer)

The Build-Own-Operate (BOO) model is used in many industries, as its principle is quite simple. It is based on an agreement between a private sector player and a government electric

[30] U.S. Department of Energy, https://www.energy.gov/sites/prod/files/2015/08/f25/LCOE.pdf
[31] U.S. Department of Energy, https://www.energy.gov/sites/prod/files/2015/08/f25/LCOE.pdf
[32] U.S. Energy Information Administration, https://www.eia.gov/todayinenergy/detail.php?id=11471

utility where the private sector builds the power production facility, owns it for a specific period of time, operates it, and sells the electricity to the government for a specific set price. All the terms are described in the Power Purchase Agreement (PPA) between the two entities, including the lifetime of the project and contract, the price for the electricity, the size, and other such factors. The price is based on the calculated LCOE, and the bidder with the lowest price wins the tender.[33]

There exists another mechanism known as the Build-Own-Operate-Transfer (BOOT) model, which is a variant of the BOO model. However, with BOOT, the ownership of the power production facility is transferred to the government power utility at the end of the contract, rather than just being disassembled.

The benefits of BOO mechanisms are that they are one of the easiest ways to integrate the private sector into the renewable energy space, as well as the flexibility of what to do with the power production facility after the lifecycle of the project has ended. Unfortunately, the mechanism does carry a main disadvantage for the buyer: the inflexibility that comes with its commitment to purchase the power produced by the private sector.

### iv. Independent Power Producer

An Independent Power Producer (IPP) is essentially a private entity which develops, constructs, operates, or owns a renewable energy facility in this case. In a BOO or BOOT model, the private sector player is an IPP, but it can also be a private company which builds its own renewable energy facility to supply its business or factories with electricity. Thus, it is possible for an IPP to sign a PPA with a government entity as the buyer, but it is in no way a necessity.[34]

### v. Engineering, Procurement, and Construction

Also implemented in other industries, an Engineering, Procurement, and Construction (EPC) mechanism is where a private sector company, known as the contractor, signs an agreement with a government power utility to design, procure, and construct a power production facility. After the project is completed according to the temporal, size-related, cost-related, and other terms, it is handed over to the original owner, or the government electric facility in the case of renewable energy projects. Normally, companies bid on the EPC contracts and the company offering the most favorable terms, or in this case the lowest cost of construction, is chosen to sign the agreement. It is beneficial as it integrates the design and construction stages and solidifies a total price for the project, although it can be more expensive for the owner as the contractor takes on the full risk and responsibility of constructing the project and so requests a higher price.[35]

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[33] El Deib, Amgad. Assistant Professor, Renewable Energy Engineering Department, University of Science and Technology at Zewail City. Personal Interview. “Renewable Energy Schemes and Policies.” 17 May 2019.
[34] El Deib, Amgad. Assistant Professor, Renewable Energy Engineering Department, University of Science and Technology at Zewail City. Personal Interview. “Renewable Energy Schemes and Policies.” 17 May 2019.
[35] El Deib, Amgad. Assistant Professor, Renewable Energy Engineering Department, University of Science and Technology at Zewail City. Personal Interview. “Renewable Energy Schemes and Policies.” 17 May 2019.

### vi. Net Metering

Net metering is a residential- and consumer-focused mechanism which greatly raises awareness about and incentivizes households and businesses to employ renewable energy (mainly solar energy) in their day-to-day lives. Under this billing mechanisms, consumers or business install PV cells on their roofs to generate electricity, which they use for their daily needs. This is in turn connected to the country-wide electric grid, and any excess electricity generated is fed back into the grid to provide credit for future electric bills. Essentially, the household or business is only billed for the net amount of electricity they use. This system greatly encourages private investment and incentivizes individuals to incorporate renewable energy in their daily lives, thus raising awareness.[36]

## d. Egypt

Starting in 2002, Egypt became one of the first countries of the MENA region to take steps towards a future that incorporates renewable energy. Although the nation is rich in oil and more prominently natural gas, it also is one of the nations which receives the most sunlight on its surface worldwide, as well as high wind speeds that can reach up to 13.8m/s.[37] Over time, it has continued to develop nation-wide policies and projects to further encourage and promote the development of renewable energy products on both a large utility scale and a smaller commercial or residential scale. After renaming the Ministry of Electricity to the Ministry of Electricity and Renewable Energy (MOEE), Egypt began taking tangible steps towards their renewable energy future. In addition, its ratification of the Paris Climate Change Agreement on June 29th, 2017 signified its dedication to the following goals.[38]

The larger legislative and policy framework was all laid out in Egypt's Vision 2030, with its goal of a sustainable, diversified, and internationally competitive economy which is balanced across sectors.[39] To further highlight the integral role and goal of renewable energy, in 2015 the MOEE also released the Integrated Sustainable Energy Strategy to 2035, or the ISES 2035, which details the country's aims for its developing energy sector and its firm focus on the renewable energy space, as well as sustainable development as a whole.[40] Within the ISES 2035, the Ministry described its first goal of supplying 20% of Egypt's generated electricity from renewable sources by 2022, with wind constituting 12%, hydroelectric at 5.8%, and solar at 2.2%, and with the private sector taking up 67% of the renewable energy market. Its ultimate goal by 2035 is to generate 42% of Egypt's total generated electricity using renewable energy sources, with the nation's total energy mix also including 16% coal and 3.3% nuclear energy. In keeping with these targets, the Egyptian private and public sectors have already initiated a

[36] El Deib, Amgad. Assistant Professor, Renewable Energy Engineering Department, University of Science and Technology at Zewail City. Personal Interview. "Renewable Energy Schemes and Policies." 17 May 2019.
[37] S. M. Essa, Khaled & Mubarak, Fawzia, March 2006. Survey and Assessment of Wind-speed and Windpower in Egypt, including Air Density Variation. Wind Engineering, Vol. 30, No. 2, 2006.
[38] UN Treaty Collection, https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXVII-7-d&chapter=27&clang=_en
[39] IRENA, 2018. Renewable Energy Outlook: Egypt. International Renewable Energy Agency, Abu Dhabi.
[40] IRENA, 2018. Renewable Energy Outlook: Egypt. International Renewable Energy Agency, Abu Dhabi.

paradigm shift towards their clean energy goals, through instituting various projects across the country.

### i. Development of Projects

The Egyptian Electricity Holding Company (EEHC), a government-owned holding company formally established in 2000, and its subsidiaries are responsible for electricity production, distribution, and transmission throughout Egypt.[41] Between 2002 and 2003, the EEHC signed three 20-year long PPAs with IPPs, generating a total capacity of about 2.5GW.[42] Providing a more historical background of other renewable energy policies within Egypt, in September 2014 a FIT system was launched which provided incentives and support for renewable energy projects, both wind and solar, with capacities not exceeding 50MW. This was used to promote Egypt's goal to reach 2300MW of PV capacity, along with 2000MW of wind.[43] In 2017, the FIT policy was amended after conflicts regarding financing and arbitration.[44] Moving forward, the state-owned New and Renewable Energy Authority (NREA), which oversaw the FIT system, cut tariffs by more than 40%, extended the capacity limit to 100MW, and allowed international arbitration.[45]

As time went on, the Egyptian MOEE began establishing and promoting projects to reach its goals stated in the ISES 2035. With wind making up the largest portion of Egypt's renewable energy target, there have been several wind energy projects throughout the country. One of the largest global energy companies, Siemens, signed a contract in June 2015 to generate 16.4GW of electric capacity, including 2,000MW of wind energy.[46] Furthermore, on July 24th, 2018, a 580MW wind farm containing 300 turbines was inaugurated at Gabal El Zeit, which is currently the largest wind farm in the MENA region. This wind farm, contrary to the Siemens model, is publicly owned by NREA rather than the private sector. It was divided into 3 phases, with the

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[41] EEHC, http://www.eehc.gov.eg/eehcportal/Eng/

[42] International Trade Administration, 9 September 2019, https://www.export.gov/article?id=Egypt-Renewable-Energy

[43] International Energy Agency, https://www.iea.org/policiesandmeasures/pams/egypt/name-131470-en.php?s=dHlwZT1yZSZzdGF0dXM9T2s,&return=PG5hdiBpZD0iYnJlYWRjcnVtYiI-PGEgaHJlZj0iLyI-SW50ZXJuYXRpb25hbCBFbmVyZ3kgQWdlbmN5Jnp3bmo7PC9hPjxzcGFuPiAmZ3Q7IDwvc3Bhbj48YSBocmVmPSIvcG9saWNpZXNhbmRtZWFzdXJlcy8iPlBvbGljaWVzIGFuZCBNZWFzdXJlczwvYT48c3Bhbj4gJmd0OyA8L3NwYW4-PGEgaHJlZj0iL3BvbGljaWVzYW5kbWVhc3VyZXMvcmVuZXdhYmxlZW5lcmd5LyI-UmVuZXdhYmxlIEVuZXJneTwvYT48c3BhbiBjbGFzcz0ibGFzdCI-PC9zcGFuPjwvbmF2Pg,,&s=dHlwZT1yZSZzdGF0dXM9T2s,&return=PG5hdiBpZD0iYnJlYWRjcnVtYiI-PGEgaHJlZj0iLyI-SW50ZXJuYXRpb25hbCBFbmVyZ3kgQWdlbmN5Jnp3bmo7PC9hPjxzcGFuPiAmZ3Q7IDwvc3Bhbj48YSBocmVmPSIvcG9saWNpZXNhbmRtZWFzdXJlcy8iPlBvbGljaWVzIGFuZCBNZWFzdXJlczwvYT48c3Bhbj4gJmd0OyA8L3NwYW4-PGEgaHJlZj0iL3BvbGljaWVzYW5kbWVhc3VyZXMvcmVuZXdhYmxlZW5lcmd5LyI-UmVuZXdhYmxlIEVuZXJneTwvYT48c3BhbiBjbGFzcz0ibGFzdCI-PC9zcGFuPjwvbmF2Pg,,

[44] Ossama, Mohamed & Khedr, Omar. TAQA Arabia. Personal Interview. "Solar Renewable Energy in Egypt: A Case Study of Benban Solar Park." 15 July 2019.

[45] Hafez, Tamer, September 2017, American Chamber of Commerce in Egypt, https://www.amcham.org.eg/publications/business-monthly/issues/261/September-2017/3638/egypt-pulls-the-plug-on-the-feed-in-tariff

[46] Developing Renewable Energy Projects: A Guide to Achieving Success in the Middle East. PWC, Third Edition, January 2016, https://www.pwc.com/m1/en/publications/documents/eversheds-pwc-developing-renewable-energy-projects.pdf

first consisting of 120 turbines which produced 240MW, the second containing 110 turbines generating 220MW, and the third having 60 turbines producing 120MW of wind energy.[47] Near the Gulf of Zeit area, two additional wind farms are being developed by a private consortium made up of Orascom Construction, Engie, and Toyota Tsusho Corporation to generate a total capacity of 250MW in the Gulf of Suez and 500MW in Ras Ghareb. The first 250MW wind farm will be based on an EPC as well as ownership and operation model for a 20-year period, with the state-owned Egyptian Electricity Transmission Company (EETC) buying the generated power at 22 cents/kWh.[48] The second 500MW farm will be based on a BOO model, with the EETC again as the off-taker of the produced energy.[49] With a LCOE of 38 cents/kWh, the consortium presented the most competitive bid for the wind farm.[50]

On the other hand, Egypt also has a large presence of solar energy production facilities in its renewable energy arsenal. The first utility-scale renewable field in Egypt was established in 2007, when Orascom Construction was awarded an EPC contract from the MOEE and NREA to construct and install the Kuraymat Solar Power Field, which generates a total of 150MW of electricity.[51,52] In more recent years, the country established the largest solar energy station in the world at Benban in Awsan. The Benban Solar Park is set to contain 40 solar power plants and generate 1650MW of solar energy.[53] It is divided into plots of land, where producers bid for individual (or several) plots, and win a bid based on their LCOE. Benban operates on a FIT scheme, distributed between companies under the first FIT policy and those under the second.[54] Egypt has also established several other solar energy stations across the country, including a 26MW station at Kom Ombo in Aswan, a 20MW station to be constructed in Hurghada, and 3 other 50MW stations to be constructed, such as one in Zaafarana. For the Kom Ombo project, the EETC signed a BOO deal with ACWA Power, a Saudi Arabian company, in which it will purchase the electricity produced at $0.0275/kWh, an extremely low tariff which began paving the way for future EETC projects.[55] Egypt has also introduced a net metering policy, established in 2013 and amended in 2017 to allow households to generate their own electricity through solar energy and to receive compensation if they generate excess electricity than their usage and it is fed back into the grid.[56]

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[47] Sustainable Development United Nations, https://sustainabledevelopment.un.org/partnership/?p=29586

[48] Africa Energy Portal, 24 July 2019, https://africa-energy-portal.org/news/egypt-orascom-engie-and-toyota-will-connect-their-wind-farm-end-2019

[49] Maptalent, https://www.maptalent.com/article/orascom-consortium-to-build-new-wind-farm-in-egypt

[50] El Degwy, Khaled. Chairman of Ras Ghareb Wind Energy Company, Department of Concessions, Orascom Construction. Phone Interview. "Solar and Wind Energy in Egypt". 19 August 2019.

[51] El Degwy, Khaled. Chairman of Ras Ghareb Wind Energy Company, Department of Concessions, Orascom Construction. Phone Interview. "Solar and Wind Energy in Egypt". 19 August 2019.

[52] Orascom Construction, http://www.orascom.com/our-capabilities/case-studies/kuraymat-solar-power-field/

[53] Raven, Andrew. International Finance Corporation, October 2017. https://www.ifc.org/wps/wcm/connect/news_ext_content/ifc_external_corporate_site/news+and+events/news/cm-stories/benban-solar-park-egypt

[54] The Economist, 26 March 2018, https://www.eiu.com/industry/article/36561387/benban-puts-egypt-on-the-solar-power-map/2018-03-26

[55] Enterprise, 14 May 2019, https://enterprise.press/stories/2019/05/14/acwa-submits-lowest-price-in-egyptian-electricity-transmission-cos-200-mw-kom-ombo-solar-plant-tender/

[56] Egyptian Electric Utility and Consumer Protection Regulatory Agency, Periodic Book Release on 13 March 2017.

In addition, Egypt has also developed renewable energy projects which target hydroelectric energy generation. There are two main projects which provide the majority of Egypt's hydroelectric capacity. The Aswan Dam, the first major hydropower project, was inaugurated in 1971 to serve a primary function of flood and irrigation control.[57] Nevertheless, a hydropower complex was simultaneously built to harness the Nile River's power to generate electricity, specifically more than 2600MW today.[58] The second main project is the Moussa Water Springs, or Oyun Moussa, which is a 2640MW power station announced on July 3rd, 2018 to feed all of Sinai with electricity.[59] Overall, Egypt has strongly developed its renewable energy sector, mainly through solar and wind energy, and will continue to do so vis-à-vis its ISES 2035.

### ii. Main Programs and Policies

There has been a strong trend throughout Egypt's renewable energy history of IPPs establishing renewable energy projects, through BOO schemes. The FIT program was relatively strong when it began; however, the government phased it out due to how expensive it was and how much of a financial burden it signified. The vast majority of the IPP contracts signed have addressed the government or a state-owned entity as the off-taker of the generated energy, a trend that the Egyptian government is looking to reduce in the future. The private sector is slowly entering the renewable energy space, but will be unable to fully penetrate the market until Egypt completely eliminates its fuel subsidies, which it is very close to achieving. Furthermore, the NREA has been targeting raising awareness of renewable energy across Egypt as well as encouraging its private use through the Net Metering system.

## e. United Arab Emirates

The UAE has been, and continues to be, one of the most prominent presences in the renewable energy sphere within MENA and globally. It has developed strong energy legislation along with several campaigns and policies to raise awareness and encourage the integration of private entities, households, and businesses within the renewables space. As a result of their continuing efforts, in 2009 Abu Dhabi was chosen to permanently host the International Renewable Energy Agency's (IRENA) headquarters. Currently located in Masdar City in Abu Dhabi, the establishment of IRENA's headquarters signified a major milestone, as it was the first instance in which a developing country hosts a major international organization.[60]

Moving forward, in February 2016 the UAE solidified its position in the global renewable energy arena by creating the Ministry of Climate Change and the Environment, which preceded it ratifying the Paris Climate Change Agreement in September of that year.[61] This was a step among many within the government's initiatives and policies which work towards a future

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[57] Water Technology, https://www.water-technology.net/projects/aswan-high-dam-nile-sudan-egypt/
[58] ABB, Press Release 26 October 2011, https://new.abb.com/news/detail/13340/abb-to-automate-generation-at-iconic-aswan-hydropower-plants-in-egypt
[59] Reda, Lolwa. Egypt Today, 4 July 2018. https://www.egypttoday.com/Article/3/53310/Bring-on-the-coal-Egypt%E2%80%99s-journey-to-becoming-regional-energy
[60] Al Lawati, Abbas, 29 June 2009, https://gulfnews.com/uae/environment/uae-to-host-irena-hq-1.73103
[61] UN Treaty Collection, https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXVII-7-d&chapter=27&clang=_en

strong in renewables, such as the UAE Vision 2021, the UAE Energy Strategy 2050, the Dubai Clean Energy Strategy 2050, and the Abu Dhabi Economic Vision 2030.[62] For instance, one of the UAE Vision 2021's 4 elements consists of creating a sustainable environment and infrastructure to promote healthy, quality life throughout the country, which can partly be achieved by increasing the contribution of clean energy to the UAE's energy mix to 27% in 2021, from 0.23% in 2015.[63] With its other plans, it has implemented a more direct approach to achieving a diversified energy mix with a large contribution of clean energy. Overall, the UAE has established and continues to establish various renewable energy projects, mainly focused on solar energy, to develop the country, help the environment, and shift global perspectives from non-renewable energy sources.

### i. Development of Projects

Launched in 2017, the UAE's Energy Strategy 2050 set an environmental goal of 44% clean, renewable energy, 38% natural gas, 12% clean coal, and 6% nuclear energy for the country by 2050.[64] Slowly but surely, its investments and policies in its renewable energy sector have pushed it closer to achieving this goal. All in all, the goals of the UAE and its emirates that are described in their visions for the future fuse together through their actions and outcomes. One of the most significant historical steps in this field was the creation of Masdar City in Abu Dhabi, which completed its first project in 2009; the Masdar City 10MW Solar Photovoltaic Plant produces 17,564 MWh of electricity per year as the first renewable energy endeavor in the UAE and the largest in the MENA region at its time. It was also the first in the country to be connected and fed into the electrical grid, and now reduces 15,000 tons of carbon emissions annually.[65] Masdar City continues to establish large projects such as Shams 1, which was launched in 2013 as the largest renewable energy project in the MENA region at the time. With a capacity of 100MW generated by CSP, Shams 1 was one of the major steps towards Abu Dhabi's goal of renewable energy constituting 7% of its energy portfolio by 2020, and a large leap towards the UAE's energy future.[66]

In Dubai, under the Clean Energy Strategy the emirate aims to satisfy 7% of its needs by 2020 and 25% by 2030 using clean energy. It has created the Dubai Green Fund, a $27.2 billion clean energy fund, and has utilized it in the creation and installment of several renewable energy projects. Nevertheless, within Dubai's wide arsenal of energy projects one stands out prominently. The Mohammed bin Rashid Al Maktoum (MBR) Solar Park is the largest solar park in the world, forecasted to grow to a capacity of 1,000MW by 2020 and to 5,000MW by 2030. It was built under an IPP model, with the Dubai Electricity and Water Authority (DEWA) as the buyer in the PPA. The MBR Solar Park has set record-low tariffs with its second phase, buying electricity from the winning bidder at 5.89 cents per kWh, due to an extremely low

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[62] U.A.E. Cabinet, https://uaecabinet.ae/en/details/prime-ministers-initiatives/vision-2021
[63] U.A.E. Cabinet, https://uaecabinet.ae/en/details/prime-ministers-initiatives/vision-2021
[64] U.A.E. Government, https://government.ae/en/information-and-services/environment-and-energy/water-and-energy/energy-
[65] Masdar, https://masdar.ae/en/masdar-clean-energy/projects/masdar-city-solar-photovoltaic-plant
[66] Masdar, https://masdar.ae/en/masdar-clean-energy/projects/shams-1

LCOE. In its third phase, it went on to break that record with a winning bid of 2.99 cents per kWh from a consortium of companies led by Masdar for an 800MW plant.[67]

On a more small-scale basis, Dubai has come up with an important initiative to promote residential and commercial solar power use. This net metering system, known as the Shams Dubai Initiative, was set up by DEWA to promote independent solar energy utilization. It encourages households to set up solar PV panels and connect them to the DEWA grid. The electricity generated is primarily used for the household, and any excess is fed into the grid and is deducted from the future energy bills of the household.[68]

Aside from solar energy, the main form present in the UAE, there have also been several large initiatives with other types of clean energy. First of all, also in Dubai, DEWA has begun installing a 250MW hydroelectric plant at the Hatta Dam in the Hajar Mountains through a contract with France's EDF Group. It will operate on a pumped storage system, where water will be pumped up to a reservoir 300m above the dam using cheap solar power, and then will fall to generate electricity by spinning turbines during peak-load hours.[69] Besides renewable energy, the UAE is also installing other clean energy projects such as the 2400MW Hassyan Clean Coal Project in Dubai, which is being built on a BOO basis using an IPP framework between DEWA and a consortium led by ACWA Power, a Saudi Arabian company.[70] Unfortunately, the UAE is somewhat limited to solar energy and a portion of hydroelectric energy due to the slower wind speeds in that area of the world. In the future, an addition of geothermal energy would be a possibility.

### ii. Main Programs and Policies

Concerning renewable energy projects specifically, the UAE has seen a trend of BOO and IPP large-scale projects. The renewable energy efforts have been concentrated in Dubai and Abu Dhabi, the Emirati capital, with commitments to purchase the generated electricity coming from DEWA and ADWEA, the Abu Dhabi Water and Electricity Authority. Along with Net Metering, these signify the main initiatives that the UAE has used to raise awareness about clean energy and to encourage the involvement of households and the private sector in the shift towards a more sustainable future with reliance on renewable energy sources.

This presents a large financial burden on the government and its state-owned companies, that must be eliminated in the future. In addition, one of the main policies present not only in the UAE but throughout the Gulf region as a whole is substantial electricity subsidies, which lower electricity prices from traditional sources for the population as a whole to make it more affordable and to raise the quality of life.[71] Overall, the UAE's policies aim towards encouraging

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[67] Masdar, https://masdar.ae/en/masdar-clean-energy/projects/mohammed-bin-rashid-al-maktoum-solar-park-phase-3

[68] Enerray, 22 June 2019, https://www.enerray.com/blog/shams-dubai-increasing-solar-power-in-dubai/

[69] Bridge, Sam, 27 July 2018, Arabian Business, https://www.arabianbusiness.com/energy/400888-dubais-dewa-says-hatta-hydropower-project-studies-completed

[70] Power Technology, https://www.power-technology.com/projects/hassyan-clean-coal-project-dubai/

[71] Kumar, Ashwani, 14 November 2018, Khaleej Times, https://www.khaleejtimes.com/uae-must-end-subsidy-to-avoid-slipping-into/-hole

the private sector in the renewable energy space, but come with a large financial burden for the country itself.

## f. Looking towards the Future

### i. Problems and Complications

Although the countries of MENA are taking significant tangible steps towards diversifying their energy portfolios and increasing their footprint in the renewable energy world which have been widely successful, there are several problems that appear as trends across many MENA countries. First of all, the lack of stable regulation, strategic coherence, and strong longstanding legislation and policy has been a major obstacle for many governments. Only recently have countries such as Egypt and the UAE emerged with organized long-term strategies which lay out their goals for the future as well as tangible paths to achieving them. Nevertheless, this is an obstacle still present in many countries due to the lack of efficient bureaucratic systems.[72] Increasing transparency and streamlining the bureaucratic process to increase its efficiency should be two main goals for all MENA countries, even though several of them, including the UAE and Egypt, have begun taking steps towards achieving that target.

Moreover, reaching a balance between national government projects and the promotion of private players in the renewable energy market has been difficult to strike. The previous and current government projects have necessitated large loans from local and international institutions, which must be paid back from the profits reaped from the various energy projects they have installed.[73] Therefore, it is risky for them to allow too many private players into the arena as they may limit the profitability of these government projects and hinder them from repaying their loans. It is extremely difficult for these governments to strike the right balance since they have prodigious financial burdens they need to satisfy, so they are unable and unwilling to completely transfer the market over to the private players until these burdens are repaid. Simultaneously, the respective governments want to avoid increasing their financial burdens, and thus want to shift the renewable energy market to one that operates solely on an IPP model without government influence or intervention. Overall, the renewable energy market will be at its most efficient level when the private sector is free to enter and leave with low legislative and regulative barriers, and when there is no skew in either demand or supply. If governments are unable to break out of this constricting cycle, the renewable energy market in the MENA region may never fully prosper.

Another additional financial burden on governments which greatly affects electricity prices and thus the pricing of various renewable projects is the extensive electricity subsidies implemented throughout the region. These subsidies artificially reduce electricity prices from

[72] Lilliestam, Johan & Patt, Anthony, 2015. Barriers, Risks and Policies for Renewables in the Gulf States. Energies 2015, 8, 8263-8285 https://www.mdpi.com/1996-1073/8/8/8263
[73] Ossama, Mohamed & Khedr, Omar. TAQA Arabia. Personal Interview. “Solar Renewable Energy in Egypt: A Case Study of Benban Solar Park.” 15 July 2019.

hydrocarbon sources such as oil, which is slightly more expensive, and gas.[74] In reality, prices of wind and solar energy based on their LCOE today are cheaper than actual prices of electricity from traditional sources. However, this feeds into the above cycle as governments are unable to eliminate subsidies since this action will result in an increase in electricity prices, so large institutional consumers will replace their government-supplied electricity with electricity sourced from IPPs. This will in turn lead to the government being unable to satisfy its financial burdens and commitments, which will turn into a financial crisis for several MENA countries.

On a global basis, in many cases there is a need for gas-generated electricity to satisfy a country's base load.[75] Since most renewable energy sources rely on weather conditions, there have been instances where changes in these conditions hinder the generation of enough electricity to satisfy the country's base load.[76] Therefore, there always needs to be a guaranteed source of electricity. As innovations in the field have progressed, basic storage solutions such as molten salts in CSP have developed; however, they only provide a solution for a few hours. There is a need for affordable, large-scale battery storage to eliminate the reliance on gas or oil to guarantee the satisfaction of a country's base load.

Finally, a main problem is the mismatch between demand and supply. MENA countries have actually reached a level of electricity generation which far surpasses the electricity demand coming from the population and industry. Thus, many countries have begun trying to export the excess energy they produce to avoid a problem of oversupply. If not, it will lead to a crisis for investors in and lenders to renewable energy projects. In addition, it also creates a restriction on how far the various energy initiatives can go before they run out of buyers.

Regarding different mechanisms, after having spoken to representatives from IPPs who have built their own renewable energy projects while contracted with the government, the different schemes such as FIT, BOO, EPC, and others don't create much of a difference for the private players. Most private players' motivations lie in the profitability of the project as well as the general goal of diversifying energy portfolios and the global shift to renewable energy.

### ii. Recommendations

In the long-term, the most guaranteed path towards energy efficiency and sustainability is the exit of the public sector from the renewable energy space. The government must find other sources to satisfy its financial commitments and begin to eliminate its electricity subsidies, so as to encourage a free market and eliminate the skew between demand and supply. As soon as the government withdraws from the space, there will be a dip in prices due to surplus supply, as the government had committed to purchasing most of the electricity generated by private producers. However, MENA countries in general have begun to develop a solution to that problem.

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[74] El Degwy, Khaled. Chairman of Ras Ghareb Wind Energy Company, Department of Concessions, Orascom Construction. Phone Interview. "Solar and Wind Energy in Egypt". 19 August 2019.
[75] El Degwy, Khaled. Chairman of Ras Ghareb Wind Energy Company, Department of Concessions, Orascom Construction. Phone Interview. "Solar and Wind Energy in Egypt". 19 August 2019.
[76] El Degwy, Khaled. Chairman of Ras Ghareb Wind Energy Company, Department of Concessions, Orascom Construction. Phone Interview. "Solar and Wind Energy in Egypt". 19 August 2019.

The MENA region aims to act as a global energy hub, not just as a source of hydrocarbons but also as a source of electricity generated by renewable energy sources. This is where the mismatch between demand and supply turns into an advantage for the MENA countries: all of this surplus energy can now be exported to other countries around the world, to develop the economy as well as provide clean energy and sustainably grow GDP. In addition, some of the excess capacity stems from older assets and facilities that have a very low level of efficiency, and thus must be decommissioned to move forward and create more space for private players to enter the market. All in all, this will only serve to further grow demand, and as demand grows more private players will enter the market, stimulating the shift away from nationalization.

Furthermore, governments must undoubtedly work to create a more efficient bureaucratic system. Although the legal framework is relatively sound and theoretically encourages private players to enter the market, many consumers are still afraid of the risk of unknown future policy changes (such as a reduction in subsidies), instability of regulations, and difficulty of obtaining permits or other such bureaucratic matters. Thus, there must be a heightened level of transparency and ease of processing requests and communicating regulations and policy changes and goals.

Striking a balance between government involvement in encouraging private players and achieving a free market state is extremely difficult, but it is the best course of action for the MENA region to achieve prosperous economic development, become a global energy hub, and encourage sustainable energy and growth locally and worldwide.

## V. Conclusion

The MENA region possesses a large global footprint due to its strong presence in the energy arena. Historically it has provided the majority of hydrocarbon energy in use worldwide – yet recently, several of its countries have begun the transition to a renewable energy-based economy, with emphasis on developing into a global energy hub due to their abundant resources and favorable geographic location. A few of its countries may have taken the lead from Germany with its successful renewable energy policies; however, they have developed their own path and policies to a renewable energy-rich future, based on the individual strengths and needs of each respective nation.

After assessing the situation and presenting recommendations, it is evident that there are many obstacles which may hinder the MENA nations from achieving their targets. Nevertheless, the long-term policies and legislative framework they have set in place will allow them to reach their goals, as long as they follow it and do not stray from the path they themselves have outlined. With strong adherence to their legislation and policies, as well as additional policies and adjustments to address the complications presented, it is likely that the MENA region will develop into an energy hub which encompasses renewable, non-renewable, and clean energy overall.

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International Energy Agency, https://www.iea.org/policiesandmeasures/pams/egypt/name-131470-en.php?s=dHlwZT1yZSZzdGF0dXM9T2s,&return=PG5hdiBpZD0iYnJlYWRjcnVtYiI-PGEgaHJlZj0iLyI-SW50ZXJuYXRpb25hbCBFbmVyZ3kgQWdlbmN5Jnp3bmo7PC9hPjxzcGFuPiAmZ3Q7IDwvc3Bhbj48YSBocmVmPSIvcG9saWNpZXNhbmRtZWFzdXJlcy8iPlBvbGljaWVzIGFuZCBNZWFzdXJlczwvYT48c3Bhbj4gJmd0OyA8L3NwYW4-PGEgaHJlZj0iL3BvbGljaWVzYW5kbWVhc3VyZXMvcmVuZXdhYmxlZW5lcmd5LyI-UmVuZXdhYmxlIEVuZXJneTwvYT48c3BhbiBjbGFzcz0ibGFzdCI-PC9zcGFuPjwvbmF2Pg,,&s=dHlwZT1yZSZzdGF0dXM9T2s,&return=PG5hdiBpZD0iYnJlYWRjcnVtYiI-PGEgaHJlZj0iLyI-SW50ZXJuYXRpb25hbCBFbmVyZ3kgQWdlbmN5Jnp3bmo7PC9hPjxzcGFuPiAmZ3Q7IDwvc3Bhbj48YSBocmVmPSIvcG9saWNpZXNhbmRtZWFzdXJlcy8iPlBvbGljaWVzIGFuZCBNZWFzdXJlczwvYT48c3Bhbj4gJmd0OyA8L3NwYW4-PGEgaHJlZj0iL3BvbGljaWVzYW5kbWVhc3VyZXMvcmVuZXdhYmxlZW5lcmd5LyI-UmVuZXdhYmxlIEVuZXJneTwvYT48c3BhbiBjbGFzcz0ibGFzdCI-PC9zcGFuPjwvbmF2Pg,,

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