The reasons of the UAE's implementation of a nuclear program

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by

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i Abstract

This thesis examines the interaction of energy policies and future plans of the UAE in nuclear energy while focusing on examining the reasons the UAE is implementing a nuclear energy program by primarily looking into the environmental, economical and political reasons. The n environmental reasons which were to find a reliable alternative energy source that can adhere to the country's rising energy demand with less consequences on the environment. Whilst the economical reasons as were stated by the government of the United Arab Emirates were to support the development of industrial and modern sectors by creating business and investment opportunities that will stimulates the growth of the economy in accordance with the UAE Centennial 2071governemnt plan. The UAE's political stance were to advance its national interests by forming nuclear alliances and strengthening its international relations. The UAE has transformed to embrace renewable, and particularly, nuclear energy as well as several other initiatives that aimed at preserving the environment, supporting the economic growth and advancing its political position. The UAE has become the regional leader in taking steps to shift its policies regarding the energy sector and environmental conservation as well as gaining economic and political strength through its nuclear program. This research will continue to build on available literature on energy policy and nuclear energy using a qualitative approach methodology.

Indexing Terms: nuclear power, nuclear energy, United Arab Emirates

ii Declaration

I declare that the work in this thesis was carried out in accordance with the regulations of Khalifa University of Science and Technology. The work is entirely my own except where indicated by special reference in the text. Any views expressed in the thesis are those of the author and in no way represent those of Khalifa University of Science and Technology. No part of the thesis has been presented to any other university for any degree.

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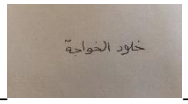
Author Signature: ___  _____

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iv Acknowledgment

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v **Contents**

Chapter One: Introduction

1.1 Defining nuclear energy

In examination of the UAE's plan to pursue a nuclear energy program and the soon to be run plants, this research paper looks into the utility of nuclear energy for the country in terms of its economic, environmental and political costs and benefits and examines the reasons that have led the UAE into choosing to enter the world of nuclear energy and its following significances, while the other Gulf Cooperation Council (GCC) countries have not opted for the same future energy plan.

To begin with, a proper scientific definition of nuclear energy must be made. Nuclear energy refers to the energy derived from a nucleus of an atom. The atom is the smallest part of a matter that takes part in a reaction (Doeden, 2015, p 14). Inside an atom, there are two constituent particles namely, the proton and neutrons. Nuclear energy is the force that joins the protons and neutrons together. So far, nuclear fission and nuclear fusion are ways used to produce energy or electricity using nuclear energy. In the process of nuclear fusion, the atoms involved in it are fused or combined jointly to form a single large atom. For example, the sun produces such energy. On the other hand, nuclear fission involves the splitting of a single atom into a smaller particle of atoms hence releasing energy in the process. Nuclear power plants utilize this reaction to produce electricity (Doeden, 2015, p 26).

Nuclear energy has many uses such as weapon making, medicine application, environment conservation technology and electricity production that is widely utilized. Uranium is commonly used in nuclear power plants. In splitting of uranium nuclei into small fragments, the fission results in the production of energy and additional neutrons. These addition neutrons cause a chain of reaction that causes the other uranium nuclei to split into fragment hence causing additional energy production. Therefore, even a small amount of uranium can produce a lot of energy, which can be converted into electricity, while causing no pollution to the environment. However, it should be noted that nuclear fission process always produces a radioactive waste that is harmful to human life and the environment if it is not properly stored or disposed.

1.2 Countries with nuclear energy

Historically, the first commercial nuclear power plant base initiated it first operation in the 1950s. Currently, there are thirty-one countries that have built over 435 commercial nuclear power stations capable of producing a total capacity of 375000MWe. It is also recorded that nuclear energy provides 11% of the world's electricity (Kerr, 2011, p 254). Many are involved in the development of nuclear power energy as well. These countries that possess nuclear plants/energy use this nuclear technology for producing electricity, building nuclear weapons, driving of large ships and it is used in the movement of electric trains and other large engines. However, many countries that possess nuclear energy and technology do not have nuclear weapons as they chose to pursue the perceived economic and environmental benefits of the technology and not its harmful uses such as making nuclear weapons. The table below shows the number of nuclear power plants found in different countries and the capacity of electricity net output produced by this nuclear power plants.

Table 1: Countries with operating nuclear power plants, planned plants and capacity of electricity net output (*Nuclear energy cooperation with foreign countries: Issues for Congress*. Congressional Research Service, Library of Congress)

Country	Number of nuclear power plant in operation	Electric.net output MW	Number of nuclear power plants that are still under construction
United State of America	99	98639	5
France	58	63130	1
Japan	43	40290	2
China	27	23025	24
Korea Republic	24	21667	4
India	21	5308	6
Canada	19	13500	_
United Kingdom	16	9373	_
Ukraine	15	13107	2
Sweden	10	9651	_
Germany	9	12074	_

Belgium	7	5921	_
Spain	7	7121	_
Czech Republic	6	3904	_
Switzerland	5	3333	_
Finland	4	2752	1
Hungary	4	1889	_
Slovakia	4	1814	2
Argentina	3	1627	1
Pakistan	3	690	2
Brazil	2	1884	1
Bulgaria	2	1926	_
Mexico	2	1330	_
Roman	2	1300	_
South Africa	2	1860	_
Armenia	1	375	_
Iran Islamic republic	1	915	_
Netherlands	1	482	_
Slovenia	1	688	_
United Arab Emirates	_	_	5
Total countries that have nuclear power plant 31	**Total number of operational nuclear power plant worldwide 435**	**Total amount of electricity produced by nuclear energy worldwide 375000MWe**	**The total number of nuclear power plants that are still under construction worldwide 67**

The UAE is currently constructing five nuclear power stations that will produce and provide 25 percent of the UAE's electricity requirements. So far, France, Ukraine, Slovakia, Hungary, Belgium, Switzerland, Sweden, Czech Republic, Slovenia, Finland, Armenia, Bulgaria and South Korea rely on nuclear energy to supply at least one-quarter of their full electricity consumption (Kerr, 2011, p 145). A country is considered super or superior based on the capacity of nuclear energy it produces, as I mentioned earlier, it gives access to the elite club

in the world. For instance, one of the reasons the United States of America is considered the superpower nation of the world is due to the high level of nuclear energy technology it possesses. Nuclear energy technologies include several fields such as research, medical application, weapon application, conservation applications and infrastructure uses of nuclear energy, as well as the fact it attracts lucrative economic opportunities and investments as well as creating many jobs.

Nuclear energy can be fatal however, if it is not well managed and the systems are not checked regularly according to the highest standards. Therefore, many factors are considered before setting up a new nuclear plant, which the UAE have gone carefully through which will be discussed later in the chapters. It is also important to mention that all operations of a nuclear power plant are closely monitored by the Nuclear Regulatory Commission, which is an independent agency in the US whose mission is to regulate reactors, materials and waste. The agency's job is also to prevent accidents from occurring and to avoid having nations misusing it through inhuman or illegal acts such as creating and manufacturing nuclear weapons that may threaten the security of the region a country is in and the world, as well as the threat of nuclear energy falling into the hands of terrorist organizations. And for any country that is planning to build a nuclear power plant, it has to consider the following rudimentary factors; the country must have a good economy and have a large capital base. This is mainly because construction and maintenance of nuclear power plants are highly costly. For example, the construction of Braidwood, Byron, and Clinton nuclear power in the United States were all constructed behind schedule and cost billions of dollars but the US managed to complete it. Secondly, the method of waste management, transportation and storage should be reliable and continuous or else it would lead to severe negative effects on the environment and human lives. This is because waste produced from a nuclear plant is very toxic to both human and the environment due to radioactive components that take years to dissolve. Therefore, before setting up a plant, the government should specify a certain place which is remote from the city and heavily populated areas along with the proper procedures implemented. As well as having a proper emergency contingency plan in case of an accident. One of the most important components in a plant is the cooling mechanism in case of an overheating incidence. For example, this was effective during the great East Japan Earthquake that was weighed at magnitude 9.0 and caused panic at the Fukushima nuclear power plant, due to the high risks of hazard in the plant, but, the situation has been managed. The safety of workers and the neighbouring resident community should be considered to be

the priority due to the fatal radioactive emissions/waste from the plant if ever occurred. Many countries whom have built nuclear plants have situated them far away from the public and populated areas and have invested heavily on the safety of employees and workers inside the plants, including the UAE, who has built the four plants in Barakah which is about 50 Kilometers from Ruwais, a town that is located in the Western Region which is about 250 kilometres from Abu Dhabi.

1.3 The UAE's energy profile

The UAE depends largely on oil as a main source of income to support the economy, it led to oil being a vital and central segment of the daily life, and oil became of such importance and priority that oil exporting movements increased massively within the UAE waters and it became a vital route to in and out oil carrying ships. With the UAE ranking at number 6 in the total oil production in the world with 3,471,000 million barrels a day and ranking number 7 in the world based on oil reserves of about 97,800 MMbbl, it is considered to be one of the richest countries in the world (*United Arab Emirates energy policy, laws and regulations handbook*. 2015) However, through concerted efforts, the UAE has begun to change over the past period of years to be noticeably making the notable improvement in diversifying its economy through trade, tourism, oil, natural gas and manufacturing that will continue to account for its economic activity potential. The UAE has a gross domestic product per capita of $ 48,158 and it was ranked number eleven in 2011 as the best promising economy of the world (Sergeant, 2015, p 89).

Additionally, the UAE ranks steadily amongst the top ten countries that produces the most barrel of crude oil worldwide. The government has invested heavily in enhanced crude oil recovery techniques that will increase oil production. The UAE's government is hoping to increase the extraction of oil to 3.5 million barrels per day in the next couple of years to come (Sergeant, 2015, p 98). This was notably perceived when it approached 3 million barrels per day of oil extraction in the year 2012. It is also recorded that almost 95 percent of the UAE`s crude oil are exported to Asian markets mainly in Japan.

The UAE has also a vast reserve of natural gas that is approximated to be 215 trillion cube feet of gas. As it may be also known, the UAE generates electricity in high capacity. The electricity is produced mainly from natural gases. But the plan of building a nuclear power

plant will significantly improve electricity production and reduce reliance on gas. In 2013, the electricity produced in UAE reached more than 27 gigawatts (GW). 110 billion kilowatts is produced using natural gas(United Arab Emirates energy policy, laws and regulations handbook. 2015). The nuclear power plant being currently constructed is expected to boost electricity production by 5.6 GW. So far, the UAE is planning to invest in other renewable energy technologies that will at least improve their power generation by 7 percent (Sergeant, 2015, p 105). For instance, a structured solar technology is on the way to trap sunlight energy that will boost electricity production as well.

In 2014, the electricity consumption in UAE was 103 terawatt-hours. Moreover, in 2020 it is expected that the gross domestic electricity consumption will be 141 terawatt-hours, which is one of the ways in which the nuclear program will be used for.
The table below shows the increased energy and electricity consumption in the UAE from the years 2004-2015.

Figure 2: Table 2: Countries with operating nuclear power plants, planned plants and capacity of electricity net output (Energy and Electricity report. Federal Competitiveness and Statistics Authority UAE)

Years	Energy consumed by UAE (MW)	Energy Production of UAE (MW)	Electricity consumed in UAE (MW)
2004	510	1907	49
2007	601	2074	70.5
2008	680	2100	75.8
2009	693	1963	79.5
2010	723	2015	83.0
2012	769	2211	83.8
2015	838.21	2299.44	141.0

From the statistics shown above, it is clear that the energy consumed in UAE is increasing by 9% annually. Alternatively, the rate of electricity consumption is increasing by 4% annually. This makes the demand for energy in the UAE very high. The rate of electricity consumed in UAE is considered to be one of the highest in the world as it has increased from 18.7 (billion kWh) in the year 2000 to 85.17 (billion kWh) in 2014.

1.4 Overview of the GCC countries energy usage

The Gulf Cooperation Council (GCC) is an alliance formed by the six Gulf States to strengthen the economic, political and military interests of the region. In 1981, the union was established in Abu Dhabi between the Arab Gulf countries. Using its vast energy resources and rich investment arms, the GCC has been able to use this advantage as its bargain chip with the other parts of the world. Over the past decade, the GCC has tried to diversify its economy using different sectors such as tourism, trade and construction. As the oil and gas reserves begin to be exhausted, alternative energy sources must be incorporated. Additionally, they have gone further trying to initiate a common monetary council that will oversee the formation of a common GCC currency which was supposed to be called Khaleeji. This strategy was announced by Kuwait, Qatar and Saudi Arabia in the year 2009, but did not happen to be implemented.

The GCC incorporates the variety of economies that has vital renewable energy potential. For instance, Saudi Arabia is planning to set up massive renewable energy strategies that will increase its energy production by 54GW toward the end of 2032 (World Bank, 2012, p 34). These renewable energy programmes include wind resource and solar energy. Overall, energy is affordable to all citizen of the GCC. For example, in Qatar electricity is free. In Saudi Arabia, the price for a customer is 3.2 cents/kWh while that of industrial use is 2000kWh per month. In Bahrain, it charges the customer less than 0.8 cents/kWh per month using its energy at 2000kWh per month. In comparison with the rest of the world like China that charges its citizen 9 cents/kWh, European Union who charges 25 cents/kWh, and Brazil that charges 28 cents/kWh, South Africa that charges 8 cents/kWh and United State that charges 12cents/kWh; it's clear that the GCC nations energy/electricity are considered affordable (World Bank, 2012, p 67). Also, when electricity prices are low, it encourages investments opportunities and development of infrastructure.

However, GCC nations have the highest per capita rate of carbon dioxide emission in the world. This is due to its continuous use of fossil fuel. For instance, it has been recorded that the GCC emits almost 42 tons of carbon dioxide per year that is above the standard world average set at 4.6 tons (OECD stats). The GCC is currently planning to set a power grid that produces a capacity of 8000MW and save its member states over $6 billion. The power grid will be linked to nuclear energy and other renewable energy sources such as the wind and solar energy.

1.5 Research aims and hypothesis

This research aims at building on the current available literature on the reasons behind the UAE's implementation of a nuclear energy program. It studies the link between obtaining nuclear energy and its usage for advancing economic, environmental and political advantages and goals.

1.6 Research question

What are the reasons the UAE implemented a nuclear program?

1.7 Significance of the problem

The topic of the UAE's reasons for the implementation of a nuclear energy program has still not been widely discussed in the literature although it is considered an important topic among researchers and the media.

Simultaneously, the topic of energy is very important because it is used for economic benefit, environmental benefit, future state security and job opportunity. Energy is very significant in the economy by influencing investment and building of infrastructures. Moreover, energy technologies and programs developed in the United States are traded overseas hence providing a boost to the country`s trade businesses. The advantage of using the renewable source of energy is that it does not end or is depleted speedily. Therefore, the future of continuous energy use is assured, especially in the case of the UAE where the population and energy consumption is on constant rise. In the environment sector, some renewable energy technologies have a low impact on the environment than other conventional energy technologies.

Even though the topic of energy has been positively portrayed at a different level, there are still many issues raised against it. For instance, the controversial topic of energy is explained as the following; the effect on the global energy policy will be the increased substitution by alternative fuels, and this is likely to spur a clean energy revolution which we are beginning to slowly witness in my areas around the world. This means a better approach to the issue of global warming contributed to by the increased use of carbon-based fuels. This will bring a new platform for trade through new clean energy initiative that will replace the fossil fuels sometime in the future. The action will likely affect the global oil prices and the reduction in imports of the country is likely to increase the countries savings on energy. These savings can

bring about trade balance and hence, the imposed tariffs will act as solution and gateway to research on alternative fuel and clean energy (Epstein, 2014, p 345).

As the population of our planet continues to grow so does the demand for energy, conservation, and renewable energy efforts will offset the increased demand to a certain point but the reality is fossil fuels are current, and in the foreseeable future, the most abundant energy source we have access to. While it is an agreeable fact that many countries have programs and policies in place to promote the consumption of clean and renewable energy, the evidence shows that we may not see a sizeable shift away from oil and gas for decades. There are profound economic and technological reasons behind the persistence of fossil fuels. It is through the strain at higher commodity prices that the country stakeholders in the energy sector will increase their innovativeness and creativity. This can further impact on the quality of innovations if the imposed oil tariff is permanent.

The implication will be evident in the global demand and the price of oil with the intentional disruption of the imports. This comes with associated direct and indirect costs, direct costs will simply add to the additional costs that prevent the stakeholder in the oil market from operating freely like; tariffs, excise duty and taxes exemption among the member states. Initially, the imposition of tariffs is a way of shielding the domestic oil producers and reduces the reliance on oil imports –which will consequently harm the UAE's economy- but this is detrimental to the global development agenda. The U.S is currently enjoying the monopoly in the world oil market because of its large scale imports; this makes U.S a major player in the international oil market.

Moreover, over the last decade, the OPEC has exercised an active monopoly and to the present it is still a significant player in the oil business. OPEC shut off oil supply and that led to some minor efforts to change the ways. Fuel efficiency became a buzzword as it was witnessed the birth of smaller cars and the less of muscle machines. 40 years later cars get much better mileage, so much so that states are looking for ways to replace the lost revenue from gas taxes. Fossil fuel companies have fought that change each and every step of the way. Clean air, fuel mileage and efforts to reduce carbon footprints aren't really in their vocabulary because it cuts into their bottom line and if you owned a business why would you actively participate in its demise.

Companies exploit resources and markets for profit - that is the nature of business in the world today. For an example from the US, Exxon Mobil, argues in their report *The Outlook for Energy: A View to 2040* that, the global consumption of renewable forms of energy will grow significantly in the coming decades, but oil will be the leading global fuel while natural gas will become second and coal the third in ranking. Based on this ExxonMobil expects to invest approximately $185 billion in energy projects primarily in the oil and gas industry. The organization control and regulation of the oil market are significant (Epstein, 2014, p 408). It should be noted that the expert's point of concern is the uncompetitive operation of the world market. This means that the recent oil price increase can be reversed through some form of restriction and regulation. Thus, the limit in terms of oil import tariffs is likely to influence the world oil price to the benefit of the UAE consumers.

As mentioned earlier, the UAE has been witnessing increased energy demand as well as negative tolls on the environment and changes to the politics of oil and its prices. The major electricity consumption in UAE is used for the desalination of water. This creates the need for more capacity of electricity demand to be high. UAE independently announced that it will venture in nuclear energy programme in April 2008 in close consultation with the international atomic energy agency. It agreed to the bid of $20 billion for the construction of four commercial nuclear power plants using the South Korean Consortium. The plants that are still under construction have the total capability of producing 5.6 GWe of energy. The Emirates Nuclear Energy Corporation (ENEC) funded $100 million towards the implementation of nuclear power plant setting. ENEC has signed a contract worth $ 3 billion dollars with suppliers of Uranium that will provide Barakah with this resource. These suppliers are UK-based Rio Tinto, Canada-based Uranium One, Russia Techsnabexport and France`s Areva (Int'L, B. P. U, 2015, p 375).

Waste disposal is managed through a dual track radioactive waste management programme. So far, the G7 countries have signed a memorandum of understanding with the UAE on its nuclear energy strategies. The public are also engaged in the construction of nuclear power plant.

The UAE has considered several renewable energy sources that can replace fossil fuels, such as solar, wind and primarily nuclear energy, all of which have their own advantages and disadvantages for the UAE. Besides environmental benefits, there are several other reasons

why the UAE has opted for nuclear energy mainly and minimized the role of other renewable energy sources such as solar or wind.

Regarding that, it is clear that UAE has plans of initiating a nuclear energy program and that massive construction plans have already taken place. From the world nuclear news, it was reported that international officials from the Nuclear Regulatory Commission have tested the UAE`s response mechanism in case of any incidence of an accident at the first nuclear power station. On March 15, 2015, the ENEC applied for an operating license for its two plants at Barakah (World Nuclear News, 2015, p 1).

The topic of energy is significant because it changes the living condition of many hence improving the economy of many people. It has been noted that oil rich countries are prone to violence and negative radicalization extremism. For example, Iraq, Libya, Afghanistan, Syria, and Sudan that are faced with civil war. This act of war is instigated by interests of controlling the oil funds, and in the case of these countries, obtaining nuclear energy will not be happening in the near future and will face strong opposition.

Nuclear power begets strong political influence and power: it will help the UAE join the small exclusive nuclear club for countries that possess it such as USA and France. It will strengthen the UAE's position in the Middle East and the Gulf especially since it would be the first to implement and use nuclear energy—Saudi Arabia, Qatar, Jordan and Egypt have announced plans to use nuclear energy as well and signed deals but are still in the early stages. Nuclear energy will bring economic benefits with it as it would create many jobs and encourage new technology and science studies and research. It is important to study the reasons the UAE is implementing a nuclear energy program because this initiative will have vast political, economic, environmental and regional implications to it on the future and understanding the reasons why the UAE has chosen to develop and implement a nuclear program will reaffirm its diplomatic and peaceful path towards the nuclear program as well as affirming its position on economic diversity and energy sustainability. This particular topic of the reasons that led the UAE to implement a nuclear program have not been extensively explored nor is the topic of the UAE's diplomatic and peaceful approach towards its development and implementation of nuclear energy. Further exploring this research topic will help in promoting the UAE's methods and strategies regarding the energy and nuclear fields

and correct any misconceptions around the world especially considering the geostrategic location of the UAE.

Chapter Two: Literature Review

The UAE occupies a position of strategic importance resulting from the geographical location and the availability of natural energy sources such as oil and natural gas. In the recent years, the UAE has commenced a nuclear energy program to enhance the natural sources of energy. The main objective of this literature review is to analyze past literature regarding the main aspects of the nuclear energy debate and the connection between past research and the implementation of the nuclear program by the UAE today. It further reviews research on the highlights of the previous studies. The main sources of the literature reviewed includes major books, published articles, think tank researches and online government documents with content written about the UAE and its goals to have nuclear energy.

Over the years, nuclear energy in the region appeared to be an unlikely set-up for the GCC states. This is because the GCC countries traditionally depended on fossil fuels and natural gas that is found in abundance. However, in late 2000s, several states in the region declared their intent to begin nuclear energy programs for peaceful purposes (The Government of the United Arab Emirates, 2008). Egypt, Saudi Arabia and Turkey were the first states to commence the relevant research and exploration to determine the capacity to begin the projects. Among the countries in the Middle East, Saudi Arabia, UAE and Qatar lacked the nuclear expertise to commence the program despite their financial ability to fund such projects. Egypt is a relatively poor state, but it possesses remarkable nuclear expertise if compared to other states in the Middle East. Today, only Iran has an operational nuclear power plant (IAEA, 2011). UAE, Turkey and Saudi Arabia have made significant progress in the construction of their respective nuclear power plants. The rest of the states are stuck in the research phase which was announced years ago. The research studies done on the status of the nuclear energy programs in the Middle East countries considered the aspect of safety narrowly. At the international level, a study by Bernards and Buggy (1990) considered the cause and effect relationship and offered opposing perspectives on nuclear power. The study concentrated more on concerns regarding safety.

The UAE and the Middle East countries overall have recently shown significant progress in nuclear energy development among the countries whose nuclear power exploration is new. UAE is especially spearheading its nuclear energy development to newcomer countries in a regional scale. Iran commissioned its first power reactor in 2011 whereas the UAE commenced its construction of the first nuclear power plant in July 2012. The UAE is

considered the most ambitious in exploiting the nuclear energy by projecting the completion of a nuclear power plant by 2017. Some researchers believe that such an ambition is not achievable. This is attributed to the lack of expertise for the construction of the anticipated 20 energy reactors across the UAE and Middle East Countries. Additionally, the projects rely heavily on advanced technological, financial and organizational solutions. These studies done on development of the nuclear energy programs were comprehensive in the highlighting of the need for experts, advanced technologies and experienced personnel especially for states that are new to this field. The findings of the research regarding construction of nuclear power plants covered the need for foreign aid conclusively, which may not be the case for the UAE.

According to Christopher and Paul (2010), the decision to develop civilian nuclear energy in the UAE was fueled by the need for future energy. The research study determined that the national consumption of electricity energy was projected to increase to an excess of 40,000 megawatts by the year 2020 –as was mentioned in the introduction. This was attributed to the projected cumulative growth of approximately 9% from 2007 to 2020 (Government of the United Arab Emirates, 2008). As such, the demand for energy in 2020 will surpass the supply given the current capacity. Additionally, the natural gas, burning of liquids and coal-fired power generation were considered non-viable options and needed to be focused on export businesses. This is because of the environmental concerns that came along with the burning of crude oil and mining of natural gas. Environmental consequences included, warmer weather and heat waves which causes diseases and tiredness. It also damages the crops and fields as water evaporates faster from the soil which adds to the already existing problem of food shortage and water shortage as the need to use more water grows. Extinction of animals which has become evident around the world and is evidently increasing too in the case of the UAE in the past 20 years such as extinction of the Arabian leopard, tahr, sand gazelle, houbara and Arabian oryx. As well as types of mangrove trees that has become extinct. Another sign of environmental degradation is the *"*detergent*"* called hydroxyl that naturally exists in the atmosphere, this detergents job is to clean the air from gases such as CO^2 and methane, but due to the rapid and increasing operation of burning oil and gas, it is not functioning in the way that it should. Scientists believe this could be as severe of a problem as ozone depletion. So using fossil fuel is not just adding polluting gases into the atmosphere, it is changing the way it was naturally made to eliminate harmful gases by itself

Consequently, the UAE concluded that there is a need for nuclear energy owing to its renewable aspect and generation capacity that would suffice the demand for energy by the year 2020 and future years to come. The study on the need for additional energy, especially in UAE indicated the dire need for additional energy for the country in the future. The UAE is found to have ever growing demand for more energy each year with minimal guarantee of meeting the demand using fossil fuels and natural gas. The strength of the research on the need for better sources of energy proves the need for the commencement of the nuclear energy program.

Many countries today continue using oil and gas as the main source of energy. However, some countries seek to have nuclear energy to augment their electricity energy needs. The increased demand for electricity has led to increase in electricity prices in many countries today. For example, Italy's electricity prices are currently at 45% above the EU average. Other countries such as the UAE, Serbia, Croatia and Albania have also turned towards nuclear energy problems in order to reduce the overreliance on electricity produced from hydro power plants. These countries also seek the nuclear energy in order to reduce importation of electricity that contributes to high expenses to the country's imports. Countries such as Belarus and Finland seek nuclear energy in order to gain energy independence. Relying on imported electricity leaves the countries dependent on other sovereign states. Economically, countries seek nuclear energy in order to gain power security and secure the industries and other important energy-oriented sectors in the economy. The need for governments to control their own power in order to increase industrial production is important in improving the economy. Additionally, energy security helps in reducing the risks of importing of energy and being versatile in the energy sources used within the state. Politically, countries seek nuclear energy to improve inter-country relations and promote unity in regions. Various countries have been brought together by the need for nuclear energy and are working towards collaborating in the nuclear programs. Such collaborations helps in improving the relations between nations as both parties profit from it.

According to the Government of the United Arab Emirates (2008) the GCC states collectively agreed and signed the quest to establish civilian nuclear energy in their respective states. All the member states of GCC began the nuclear projects independently with their own private implementation plans. However, out of all the six member countries of the GCC, only Saudi Arabia and UAE have made tangible steps in the development of nuclear energy

(IAEA, 2011). This is attributed to required specifics in the GCC with the need for advanced technology and innovative financial solutions for the Nuclear energy projects. Additionally, the exponential growth of energy demand in the country prompted the government to implement better sources of energy as compared to the natural gas and oil whose volumes could not meet the future demands. There is limited existing information on research regarding the inactivity of a majority of the GCC states on nuclear program commencement. The existing studies did not elaborate why these states are stuck on the research phase and the absence of tangible progress in the implementation of the commissioned plans.

According to Tausher, (2009) the UAE released a policy document showing interest in engaging in the development of nuclear energy in 2008. The decision was considered as the best source of energy because of its contribution to the economy and future energy security. The construction of the first nuclear power plant in the UAE began in 2009 and projected to be operational by 2017. However, the UAE requires significant help from foreign governments and time to follow through on the nonproliferation pledges made in 2008. The UAE pledged to follow the Nuclear Suppliers Group's export control guidelines, and worked towards preventing export of sensitive technologies to Iran (Bryan, 2009). The UAE further faces capacity-building challenges in several areas afar from exporting regulations. The country needs noteworthy commitment to training local and regional experts and its foreign partners. According to IAEA (2011), the UAE progress on developing nuclear energy is favorable and the speed is commendable. The research on the progress of the nuclear power program in UAE is comprehensive. The research studies have shown tangible progress in the construction of the power plant, the commitment to follow nonproliferation pledges and outsourcing of experts.

Furthermore, Khaleej Times (2015), representing opinions on UAE's nuclear program speaks positively about the program. The newspaper applauds the move by Emirates Nuclear Energy Corporation (ENEC) to award contracts for construction to many UAE companies to help in the building of the country's nuclear power plants. According to the newspaper, this move is aimed at establishing a supply chain for the local nuclear energy industry, which will influence the country's economy positively. This is in line with the country's intention to engage in the search for nuclear energy to not only deal with energy needs but also create a new industrial sector and diversify its strategy. The newspaper said that by July 2015, UAE's

Barakah Nuclear Power Plant was 48% complete, and one of its units will be complete by 2017.

Vick (2015), in his article in *Time*, adds a unique opinion on UAE's nuclear power program. He groups the UAE together with other Middle Eastern countries and talks about their interest in nuclear power as a race, such as the arms race. Vick records a commentator who believes that Middle Eastern countries are seeking for nuclear power as an option to make a step towards nuclear weaponry. The commentator also believes that there could be a prestige element in the search for nuclear power by Middle Eastern countries including the GCC states. This factor manifests when one considers whether or not the neighbors of the country of interest have nuclear power. Vick also believes that these countries have other reasons as to why they are seeking for nuclear power. For example, Jordan could be driven by the fact that it has no liquid form and has limited water resources while Saudi Arabia and UAE may be pushed by the fact that they lose potential export revenue by burning oil domestically to get electricity. Israel, Egypt, Jordan, Iran and Saudi Arabia are the Middle Eastern countries that have been identified as having nuclear energy.

Different from the angles adopted by Khaleej (2015) and Vick (2015), Kumetat (2015) provides the view of public stakeholders on the issue of the UAE's pursuit of nuclear power. One particular stakeholder that Kumetat interviewed took several issues with how the UAE nuclear energy program was rolled out. Firstly, the program planners did not invite the contribution of the people at the grass roots. The respondent was not convinced that the UAE needed nuclear energy. According to him, nuclear energy is generated by uranium, and since uranium resources are scarce, the energy does not seem sustainable. Another issue that this local respondent took issue with is the fact that nuclear reactors are bombs waiting that can blow up any minute; hence, the fear of a nuclear disaster. Lastly, the respondent lamented the long time in which nuclear waste stays toxic. He worried that this waste would affect the lives of the UAE's future generations.

Dirioz and Reimold (2014) are in support of Vick (2015) that there were multiple suspicions as to what led the UAE to pursue nuclear energy. Dirioz and Reimold argue that the suspicions could actually have been compounded by the fact that the UAE took an interest in nuclear energy when it was losing popularity, especially with the Fukushima Daiichi accident of 2011. According to these researchers, there were economic, geopolitical, and security

vulnerabilities that could have led to the UAE to seeking for nuclear energy. Besides all these vulnerabilities, the researchers propose that the UAE wanted to set the pace for other countries, especially in the region on issues of transparency and foreign assistance in regards to the acquisition of nuclear energy.

Adding to that, most countries pursue nuclear energy for its reliable power output capabilities or for military and political intimidation. The difference between these two reasons is usually the mentality of the leaders in control of the states. For instance, the government in the UAE is primarily concerned with business and advancing the economy; therefore, they see this technology as a means to strengthen their economy by making it an alternative power source. Also, the leadership realizes that the oil which they rely upon for export and their commercial domestic use is an extinguishable resource as mentioned earlier. On the other hand, rulers in authoritarian states, such as North Korea, see nuclear technology as a tool of aggression. Obviously, the UAE and Saudi Arabia would never use nuclear technology to produce weapons of mass destruction as they are business-oriented countries. Moreover, although the UAE is the 8th largest oil producing nation in the world, the petroleum it generates is not a viable option to use in its industries (Jongeun, 2015). From an environmental and commercial perspective, one cannot blot out the fact that oil is an extreme pollutant. That characteristic of the resource coupled with its inherent bulkiness makes petroleum not ideal for business. Hence, an alternative energy source must be found.

Also, oil producing states such as the UAE and Saudi Arabia derive most of their political clout from trading the vast petroleum reserves they have. Fortunately for these countries, the resource is the most traded commodity in the world. Hence, for these nations the more oil they are able to export the better; nuclear power allows them to free up more petroleum for this purpose.

Additionally, Arab Islamic countries located in the East have been rocked recently with revolutions and caos, which then became breeding grounds for terrorists (Malek, 2015). However, countries like Saudi Arabia and the UAE have remained intact to such upheavals. Besides, these states use their nuclear energy producing capabilities to prove to their international partners that they are not power hungry, and that is why the UAE does not have a program to manufacture weapons-grade atomic energy. Consequently, nuclear technology is not a security matter for such nations.

Basically, the use of reactors to produce electricity will strengthen the economies of these countries. For example, it is predicted that by 2020, a quarter of the UAE's energy needs will be met by atomic power (Nakhle, 2016). Ideally, the first reactor in Saudi Arabia is set to produce 5.6 gigawatts, which will sustain 15% of the state's power needs.

Also, the Gulf Cooperation Council sanctioned a study on the peaceful use of nuclear energy ("Nuclear power in the UAE", 2016). Essentially, this move was meant to show the global community that the GCC member states only intend to use the technology for non-military purposes. As a result of that study, the international community supported the move by the Gulf Cooperation Council to embrace atomic energy.

Whereas a number of nations view Nuclear power as a means to ensure their military might, the UAE has made no attempt to weaponize this technology. Instead, the country's goal is to improve its commercial interests and society in general.

In conclusion, this review has touched on several issues pertinent to the UAE's nuclear power program. Khaleej Times (2015) considered the economic benefits of the program while Vick considered the varying reasons why the country would want to have nuclear energy. Kumetat (2015) showed that different stakeholders could hold divergent views on program and Dirioz and Reimold (2014) emphasized the fact that there were geopolitical reasons that led to UAE's move.

The materials used in this research were chosen based on its relevancy to the UAE's case and from the most reliable updated government sources, online journals and official websites. It included a lot of reviews and discussion on the topic of energy from a theotrical framework. Many sources that were used were from the relevant nuclear entities in the UAE which provided a strong basis for developing the reasons of the UAE's implementation as well as the governments direction. Journals and online think tank articles were gathered from the Khalifa University library and databases.

Chapter Three: Research Methodology

3.1 Research methodology and methods

The data collected for this comparative research was done through review of secondary information published on books, online journals, official websites, case studies, and official online articles discussing the UAE's implementation of nuclear energy. There was no interview done to collect data on the topic because interviews could provide biased information. This research used different methods of data collection such as the use of different web sources that are referenced in the reference part of this document.

During analysis, the data from secondary sources will be examined analytically in five distinct steps. First, processing and recording the collected data will be done immediately. At this stage, the information that stood out, time, and date details will be put down. Other observations and highlights from official websites will be put separately. While doing this, the focus of the study will be on why UAE is implementing nuclear energy, while also considering reasons as to why other GCC countries are not doing so. This data processing will be done through labeling and coding of all data by recognizing similarities, noting differences, and cataloging information patterns relevant to the case.

Secondly, data analysis will begin as soon as the first data is collected and reviewed. The data will be analyzed and processed for the themes or patterns exhibited. This will help in creating a platform to group the data obtained. Consequently, the main information and patterns being passed by various grouped data will be explored later on. This will happen to all groups of data set for this research. In effect, related information from books, journals, and official websites will be put together for coherence. Final analysis will be done to all sources depending on the kind of information they contain on the concerned topic. Principally, the study only requires qualitative data to come up with conclusion on the concerns raised by the study questions which is the reasons for implementing a nuclear program in the UAE (Yakovlev, Klebanov, & Gaile, 2013).

The third step in this analysis will be information reduction and transformation of raw data. Putting the collected and filtered data in groups will enhance the prospected analysis. Due to the fact that qualitative studies normally produce a wealth of information or data, data

reduction will be done through a process that identifies and focuses only on meaningful information that answers the study question. In this context, data collected from the mentioned secondary materials will be compared with one another to identify which group of sources provides relevant and updated information on the study topic. This will ensure that the data collected only focus on the topic and gives no room for biasness (Axinn & Pearce, 2006). In case there are some statistics involved, they can be grouped for analysis using basic software/s such as Microsoft Excel to give synthesized information on the UAE's nuclear energy project.

The fourth step will be the identification of meaningful information patterns and themes regarding the UAE's adoption of nuclear energy in contrary to other GCC countries (Dey, 2016). In this regard, data will be grouped into the meaningful patterns and themes observed during collection. Because this was a review of secondary data with already synthesized information, the process will be done through two ways comprising content analysis and thematic analysis. The analysis done will depend of on the nature of research questions and type of data collected. Nonetheless, this study will prefer content analysis where it will code data for certain words or information, identify the prevailing patterns, and interpret meanings used.

The fifth step will be data display, conclusion drawing, and verification. After identification of themes and content patterns regarding the UAE's implementation of nuclear energy, the obtained information will be assembled, organized, and compressed into a display to facilitate conclusion results. Consequently, the study will use graphics, tables, or textual displays to present the information obtained. According to Pawar (2004), conclusion and verification of the obtained information will form the last step of this qualitative data analysis.

Limitations

This research has looked through a large amount of literature and sources but had some limits in the data collection in regards to including interviews due to necessary security permissions and other time limits, hence it wasn't applied in this research.

In overall, data analysis will provide a reasonable level of significance because the used methodology is a valid approach in a comparative study on energy security. It has focused

more on why UAE is adopting nuclear energy and the history and energy profile of the UAE. Secondary data analysis for this qualitative study will involve gathering and analyzing information from different sources such as books, online journals, official websites, case studies, and online articles. Information attained from the study will then be labeled and coded by recognizing similarities, filtering differences, and tagging information patterns relevant to the case. To remain focused on the study topic, the developed statement of purpose will define the main objective of this study and create a relevant research design.

Chapter Four: Results

4.1 Renewable energy sources and energy security

"We have to strike a balance of responsibility between our duty to update other sources of energy, protecting our environment and ensuring a proper legacy for the next generation"
His Highness Sheikh Mohammed Bin Zayed Al Nahyan- Crown Prince of Abu Dhabi and Deputy Supreme Commander of the UAE Armed Forces at the opening ceremony of the World Future Energy Summit 2009. (CPC, 2017)

Energy security lies in the rising global demand for different energy sources because of increased urbanization and industrial manufacturing for example as well as population increase, the UAE's population reached 9,267,000 in mid of 2016 (The World Fact book,2016) which has made energy security a topic of priority in many government agendas in fear of destructive consequences in the future. There are also other factors that threaten energy security and shape future energy policies such as the dread of diminishing energy resources as consumption increases, constant instability conditions in the oil-rich countries such as the UAE, and possible threats caused by oil and gas developments on the environment and its degradation. Energy security is achieved when all energy demands of all parties of the state are met including the military, society and the economy. Which is especially particular in the 21st century where depending on technology in all means of transportation and communication has become inevitable, all of which are run by nonrenewable energy resources. Countries with poor energy resources might be inclined to follow the exporting states foreign policies or it could be in a compromising situation. But even if a state has enough energy resources on its own, it cannot exclude itself from the other states foreign/energy policies as the case is that it usually exports to them, hence, depending on them for revenue. This can be the case in the UAE. The foreign states could agree on not importing oil and gas from a Gulf state for any particular reason, which would eventually harm the economy of the state and cause massive economic losses. The UAE's current contribution of oil to the GDP is at 30% (Mayenkar, 2016).

Achieving energy stability in the main can be identified as the absence of a challenge to the states status quo which is nearly impossible at the current time considering the region's political and economical tensions and constant bids for war especially with Iran's detrimental

foreign policy with its illegitimate nuclear programs and plants and the war in Syria, as well as the depletion of the natural energy resources available which calls for a need to start implementing other energy resources.

4.2 The different types of renewable energy resources

There are several renewable energy sources that can be adopted by the UAE, all of which differ in their advantages and disadvantages; however, choosing and implementing one of them is based on economic, environmental and political reasons which will be further discussed in the next chapter.

Renewable energy sources vary from wind power, solar power, water power (which would hardly be considered in the UAE because of its geographical location and the scarcity of water resources) and nuclear energy- which can be debated as a non-renewable energy source. There are other renewable sources such as bio-fuels but this type of energy is usually rejected, as the ones mentioned above are considered the most efficient and effective. A brief summary of the renewable energy sources would help in understanding the direction of which might be the most suitable and reasons of why did the UAE start implementing alternative energy sources and considered different energy policies to achieve energy security and diversion in energy.

Firstly, wind energy is "Energy received from the movement of the wind across the earth. This energy is a result of the heating of our oceans, earth, and atmosphere by the sun." The wind is then captured and its kinetic energy is transformed into mechanical or electrical power by the use of wind turbines which are made of steel. It can produce energy up to 5,600 MW enough to provide energy for many houses. Wind energy is clean and renewable but the problem is that strong winds does not occur very often in the Gulf countries, and it occasionally is not strong winds which would lead to the need of having another energy source to rely on for providing electricity for houses for example or else most of the time it would not be working efficiently as it mainly depends on strength of the wind. In some ways, wind energy cannot be looked at as an efficient and reliable source especially in the case of the Gulf countries weather and on the long term of the foreseen increase in energy demand in the countries especially in the case of the Gulf where increases are exceptionally high. Another disadvantage of wind turbines is that they are huge in its sizes and need massive spaces of land to be placed far from each other, especially far from people's houses as wind

turbines make loud noises when working. Another solution that can be suggested is to have wind turbines built in the sea, in order to have it far from people's houses and not consume massive spaces of land that could be used for something else that would not disrupt the city's landscape. "Offshore wind farms are about twice as expensive as land-based ones", and wind turbines may disrupt local fishermen's activities and businesses which in the case of Gulf states, can damage local fisherman businesses where many depend on fishing as a main source of income.

Solar energy is thought to be the most convenient as an energy source because of the UAE and Gulf countries weather. Solar energy is "the energy received by the earth from the sun. This energy is in the form of solar radiation, which makes the production of solar electricity possible." Solar energy is renewable, clean and necessary for life as it helps grow plants and food, provide day light, heat and energy. By using Photovoltaic's (PVs) cells that convert solar radiation into electrical power; energy is produced. The advantages of solar energy is that it is free, easy to obtain, it does not cause pollution such as carbon dioxide, nor produce waste and is perfect for a climate like the Gulf countries where sunlight is available for about 8 hours a day. Implementing solar energy may have some disadvantages such as; solar panels and stations consume massive amounts of land in order to produce reasonable efficient energy which may be placed in the desserts. Nonetheless, if solar panels are to be placed in the desert, there would be the burden of having to maintain the voltaic panels clean with water, due to the desert's nature of sand storms and dusty wind which can be considered as a disadvantage as water resources is scarce in the UAE and Gulf states and water desalination is highly costly.

Nuclear energy has received the biggest share of media attention and controversy in the past years because of its many applicable civilian and military purposes. Nuclear is "the energy released by a nuclear reaction; either through nuclear fission or nuclear fusion such energy used as a power source". Nuclear energy was mainly used to generate electricity and power for other reasons such as warships. Nuclear energy advantages is that firstly it does not cause pollution; as in emitting harmful carbon dioxide gases in the atmosphere and when generated can produce energy a million times more than other sources could produce such as fossil fuels or wind energy. Nuclear plants do not consume or need large amounts of land and space unlike solar panels for example. Another thing is that nuclear energy is the most reliable when compared with wind or solar energy, as nuclear plants operate on their own as long as

uranium and the processes are combined and working. While wind and solar energy production depend essentially on the weather in order to produce energy or the right amount of energy. Disadvantages of nuclear are leakage and explosion that can be very dangerous and is considered as the most lethal between all other side effects of renewable energy resources.

4.2.1 Gaining international and domestic support by engaging local and international entities

The UAE aimed at gaining international support from the world community and domestic support from the society by ensuring it created a role model for developing peaceful nuclear energy. Working towards building a strong basis for the country's future growth, the UAE involved the international community with complete transparency and cooperation in developing the policy and foundation for the peaceful nuclear energy program. This further contributed to advancing the UAE's aims for reasons of implementing a nuclear program as it advanced the UAE's position in the world politically and economically (ENEC,2016). By doing so, the UAE worked towards having has a successful management system that ensures that all the nuclear programs are monitored as a unit. In the same breath, health, quality, security, and environmental issues are integrated into the management standards (Russell & Markaz, 2007). The aim of this management system is to incorporate safety issues in the decision-making process. The UAE's nuclear program is under the watch of local and international entities which ensure that all the safety standards are adhered to. Federal Authority for Nuclear Regulation (FANR), the International Atomic Energy Agency (IAEA), the Emirates Nuclear Energy Corporation (ENEC), and the International Advisory Board (IAB) are among the most crucial entities in UAE affecting the national policy regarding the nuclear energy (Wilde, 2011).

Federal Authority for Nuclear Regulation (FANR)

FANR is the sole authority for licensing and inspection within the UAE. This body was established in 2009 in agreement with the federal law. Both the policy of the UAE on Potential Development of Peaceful Nuclear Energy and the UAE nuclear law emphasized that the establishment of a vigilant, independent, and efficient regulatory body was the cornerstone of a secure nuclear program (Apikyan & Diamond, 2010). FANR is the only authority responsible for inspecting and licensing those who own nuclear technologies or

radiation technologies. Moreover, the institution determines all the issues that relate to the control and supervision of the nuclear sector insofar as nuclear safety, radiation protection, and security are concerned (Banks & Ebinger, 2011). Furthermore, the FANR enforces the regulations of relevant international treaties and conventions. (FANR, 2016)

Emirates Nuclear Energy Corporation (ENEC)

While FANR is a regulatory body, the ENEC is responsible for delivering safe, clean, efficient, and reliable nuclear energy to the UAE (Ramady, 2012). The corporation has formed in international partnerships with experts around the world to deliver nuclear programs with the highest international standards. Furthermore, the corporation is also investing in the best technologies available. As mentioned by Low (2012), nuclear energy sustainability does not only depend on the new technology but also on the preparedness of graduates who studied nuclear science. In this regard, ENEC has partnered with academic institutions to promote the study of engineering sciences. By the same token, ENEC is responsible for educating masses on the importance of nuclear energy as well as developing roads, utility, and telecommunication projects near nuclear plants (Sovacool & Valentine, 2012).

Within ENEC, there is another board known as the Nuclear Safety Review Board (NSRB). This board encompasses international professionals who report directly to the CEO. Even though the NSRB provides an advanced oversight of safety, security, risks, and gaps to excellence, its main focus is nuclear safety. In the same vein, the board can offer advice concerning regulation, quality, engineering, operations, education, international treaties as well as law and training (Oceania Editorial Board, 2012).

The International Advisory Board (IAB)

The IAB is responsible for conducting frequent assessments of the UAE nuclear energy program. The IAB reports to the leadership of the nation directly. When the IAB was established, it was meant to provide the energy program with seasoned experts who would bring in knowledge and experience, which are the two components that are essential in the development of a nuclear plant (Stulberg & Fuhrmann, 2013). Among the experts are internationally recognized individuals who have a wealth of experience in the fields of non-proliferation, safety, and security as well as human resources. The board reviews the progress that the UAE is making regarding safety, transparency, sustainability, non-proliferation, and

sustainability on a semi-annual basis. As a result, board members can make suggestions regarding the improvements that can be made.

The IAB has nine members who are chosen from a crop of the world recognized experts in regulatory affairs, no-proliferation, nuclear science, reactor-operations, human resource development, and waste management (Cordesman, 2001) Semi-annually, the board issues regular reports suggesting the potential areas for improvement. These reports are made public to ensure transparency and to enable the domestic and international stakeholders the opportunity to monitor the program's performance against the highest international standards.

International Atomic Energy Agency (IAEA)

The IAEA agency's functions are more like those of OPEC. The agency is based on a solid foundation of international agreements concluded between and with states. This agency provides protection and security for nuclear plants of member states (Cohen, 2010). One of the agency's main function is to administer safeguards designed to ensure that all the raw materials, equipment, and confidential information are made available at the agency's request (IAEA, 2015). Recently, the IAEA has been conducting frequent checks at the Iranian nuclear plant to ensure the peaceful nature of Iran's nuclear program, and thereby the security of other states. The United Arab Emirates is also a signatory of the IAEA, and all the local entities regulating the UAE nuclear program are under its governing.

4.3 The UAE's energy policy

"Rapid changes requires us to prepare future generations with new tools and knowledge, and different skills that enable them to succeed in a world that we will be very different from the times we live in today"

His Highness Sheikh Mohammed Bin Rashid Al Maktoum Vice-President and Prime Minister of the UAE and Ruler of Dubai during the launch of Five-Decade Government Plan 'UAE Centennial 2071' (UAE Cabinet,2017)

The UAE is considered one of the top ten producers in the world of oil and gas, ranking at number 8 in the world (Monthly energy review, 2016), and such valuable commodity will always be integrated with environmental, political and energy policy concerns. It is also OPEC's second largest crude producer of oil after Saudi Arabia. The environment in the

UAE has been through drastic changes, which can be seen as both good and bad. It has been transformed from a desert to a green island and oil as many would argue was the blessing that allowed this great transformation and the economy has been affected as well as the UAE depends on oil exports as a source of income, which is over 30% of the total country's GDP. Since the UAE depends on oil heavily as a source of income, it led to it being a vital and central segment of the daily life, and oil became of such importance and priority that oil exporting movements increased massively within UAE waters and it became a vital route to in and out oil carrying ships. With the UAE holding 8.1 % of the world's oil reserves that would have dragged some drawbacks as well such as the other negative and income generating matters such as pollution and concerns regarding the diversity of energy and income resources the country is dependent on. Hence, the UAE's direction towards energy security was by implementing energy policies that would include initiatives and plans of alternative sources of energy being brought to the country but mainly adopting nuclear energy as the alternative.

4.3.1 IRENA

According to the official website of IRENA, "*The International Renewable Energy Agency (IRENA) is an intergovernmental organisation that supports countries in their transition to a sustainable energy future, and serves as the principal platform for international co-operation, a centre of excellence, and a repository of policy, technology, resource and financial knowledge on renewable energy. IRENA promotes the widespread adoption and sustainable use of all forms of renewable energy, including bioenergy, geothermal, hydropower, ocean, solar and wind energy, in the pursuit of sustainable development, energy access, energy security and low-carbon economic growth and prosperity."* (IRENA,2016) The UAE was chosen to be the headquarters of the agency partially because of the UAE's standard international policies on environmental preservation and participation in Kyoto Protocol (UAE ratified it in 2005). The hosting of IRENA has opened many doors for new job opportunities and create awareness on environmental preservation and renewable energy and draw attention to other GCC countries and Arab countries in general, because similar to the UAE's situation, a large part of the other GCC countries income depends on oil exports which could guide them as well towards a change in energy policy changes as well. IRENA is an agency that aims at using renewable energy, clean energy for developing countries and providing it to all people. Since the demand for energy is increasing with the number of

people worldwide, a project like this would have been inevitable. IRENA plans to make the most of wind, ocean and solar energies to be put in use. As well as nuclear energy for it can produce large amounts of energy with little harm to the environment if proper procedures were followed. IRENA aims at triggering more research projects within the UAE that would prove to be beneficial for its sustainable future.

4.3.2 The UAE and nuclear energy

"Energy is a key component of the UAE Centennial Plan 2071, and safe nuclear energy will play an important and vital role,… Barakah Nuclear Energy Plant is a national strategic project in which 60% of the employees are Emiratis and 20% are women, and it will provide quality jobs in the fields of engineering and advanced technology in order to contribute to the development of our industrial and modern sectors, benefiting generations to come"
His Highness Sheikh Mohammed Bin Rashid Al Maktoum Vice-President and Prime Minister of the UAE and Ruler of Dubai during the UAE Cabinet meeting at Barakah Nuclear Energy Plant on the 9th April 2017.
Nuclear energy and its usage has with no doubt been the focus of many governments due to its civilian and military applications. However, unlike what might other countries use their nuclear potentials for, the UAE's goals are completely not detrimental and consider the nuclear option to be an important part of its new future energy policy.

The UAE has decided to buy the nuclear energy as a ready commodity instead of producing it in the country, where the UAE has signed an agreement with Korea in 2009 for an exchange in technology and information on peaceful uses of the nuclear energy. The UAE has established several official government sectors that are mainly concerned with the nuclear sector such as The Federal Authority for Nuclear Regulation (FANR) and The Emirates Nuclear Energy Corporation (ENEC). FANR acts as the UAE's safe regulator for future nuclear programs and studies any decision to be made concerning it. Also, the UAE has signed a non-proliferation agreement with the International Atomic Energy Agency (IAEA) in 2009 in a move to direct its energy focus to nuclear—IAEA is an international organization that calls for peaceful use of nuclear energy. The Ministry of Presidential Affairs has also announced the establishment of the International Advisory Board (IAB) which includes several international experienced figures in the sector of nuclear energy who would offer their advice and experience on keeping safety in implementing nuclear energy in the

country. All of the mentioned above are indicators of new energy policy directions for the UAE and perhaps later on for the GCC states. Which will all be further discussed later on in this chapter.

The UAE has opted for nuclear energy for several other reasons other than its environmental benefit and energy production which will be further discussed in the next chapter. Nuclear energy provides the country with *"The three P's: Power, prestige and politics".* It will help the UAE join the elite exclusive nuclear club with powerful countries such as USA, France and Russia. Nuclear energy will help in advancing the UAE's position over matters in the Middle East and especially the GCC as well give it an international status that will boost its position. The UAE's plan consists of finding alternative energy sources other than its oil reserves which at some point will run out as mentioned earlier. Other than that, the UAE's local demand on oil is expected to rise by 17% which would mean more oil would be used locally and less oil barrels would be sold outside and exported. The UAE's plan is to curb the oil and energy demand increase by substituting the oil which is depended on heavily for generating electricity, running cars and factories, into using an alternative energy source such as nuclear plants that would generate more energy than oil and gas. By doing so, the UAE would have one of the main income sources to be assured from decreasing.

The UAE has become one of the leading countries not just regionally but internationally as well in developing new energy policies and initiatives as increased regional tensions begin to affect economic and political aspects of neighboring countries, alternative energy resources must be implemented, and according to Suhail Mohammed Al-Mazrouei, the energy minister, 7% of the UAE's energy generation will be from diverse renewable energy resources and 25% of the country's power from nuclear energy. All of which to keep up with the rising demand for food, water, energy security and environmental protection. (ENEC, 2016)

4.4 Climate change and security

Future conflicts in the world will be over natural and energy resources, as climate change is becoming one of the priorities in the countries agendas as one of the most critical issues that need to be addressed immediately, climate change and environmental deterioration has already begun shaping the countries policies and many have begun implementing new sources of energy. Gulf countries have become extremely reliable on oil and gas as a main

source of income and as a source of energy; hence, many initiatives have started to take place around the Gulf countries that's main goal is to re-consider the energy policies, its sustainability and the future of energy in renewable sources of energy and as a way to preserve the environment. On the other hand, such possible renewable energy initiatives will also create many jobs, encourage new technology and science studies and research to be brought to the countries while solving the environmental degradation situation, which will discussed further in the next chapter. Because of climate change and environmental deterioration, the policies regarding the security of the country have slowly shifted from being very military focused to being energy and environmentally focused. The Gulf countries change of policies regarding energy sector security will prove to be beneficial on the long run as more countries worldwide adopt renewable energy sources, the demand on oil and gas from the Middle East might decrease. Knowing that current energy sources would not last as much as it is hoped it will and the impact it has had on the environment, such critical issues of renewable energy will need to be addressed in the Gulf countries as they all share similarly the same fate regarding dependence on oil and gas and the need for alternative energy sources as the environment deteriorates.

4.5 Environmental degradation and climate change

Environmental degradation and climate change have been prominent in the making of future policies of the region in recent years and countries have already begun implementing new energy policies. Environmental degradation signs may include, warm winters, early springs, heat waves, damages to crops and plants, diseases, extinction of animals and sea level rise. All of which would have a very harmful impact on the region. Gulf countries are now including energy security in their government agendas, and the vision of the future of the states has changed to include; environmental preservation along with alternative energy sources. As more threats may be arising in the near future other than energy such as demographic imbalances, food, water and disturbed regional conditions that always could have a possibility of affecting other states as well, energy security and its environmental impact could have the longest impact on the states. More broadly, following the steps of some European countries such as France, which intends at making 76% of its electricity use come from nuclear energy, as after the 1973 events and the price rise of oil from the Middle East, France decided to look at other ways of energy sources as it is poor in natural resources and wanted to avoid an energy crisis by depending mostly on their own means and not on oil

from the Middle East. (Why the French like nuclear energy, Jon Palfreman). Also, Denmark generates 19% of its electricity from wind power and intends to increase that percentage in the future. – This could increase pressure on other developed countries to start being more environment friendly and use less oil as a source of energy. Huge dependence on foreign oil from Western countries such as the US or Europe on the Middle East is starting to make many countries cringe, as they believe that the Middle East is an 'unstable' region and future problems might occur especially with the neighboring country being Iran and its nuclear plans and bids on war (not to undermine the current peace talks with the US) as well as the war in Syria and Iraq and instabilities in other states—. Hence, the Western states change in energy policies could be because of two reasons; the first is the increasing deterioration of the environment worldwide, hence, Western states are shifting towards clean and renewable energy resources in order to better preserve the environment, and second, because of the increased instabilities and conflicts in the Middle East region case in point, the Gulf, that may threaten the flow of oil to the west and could be considered as an unstable source. Because of foreign energy policies changing, that has taken an impact on the region as well, and the Gulf states must keep up with the worldwide energy change and demand by enforcing new set of policies regarding renewable and clean energy implementation and research and development in order to ensure stability in its states and preserve security.

4.6 The UAE and the rising energy demand

The growing population of the UAE is increasing and so is the energy demand in electricity generation, water desalination plants and transportation. As well as increased urbanization and industrial manufacturing (look appendix). Thus, diverse energy sources will need to be implemented, especially since the UAE depends on exports for a large percentage of its income, which is why the UAE should reduce its reliance on it, instead of increased consumption of it. A planned and efficient transition to non-fossil fuels energy sources is needed in the circumstances of increased population and energy demands. The more oil and gas are used domestically, the less the exports will be sold. Another reason is shifting the mode of people consuming and relying on low cost hydrocarbons mainly to shifting into the new means of green energy which maybe of higher cost but rewarding as well.

4.7 Modernization and technology

Investing in research and development in sources of renewable energy will lead to new scientific discoveries and improvements within the country, new business opportunities and careers— energy sector is usually labor intensive. An example from the region would be the King Abdullah for Atomic and Renewable Energy in 2010 and Masdar for research and development in Abu Dhabi. Having alternative energy options is important to start a slow but steady shift to new modern ways of providing energy and diversifying it, while focusing on exporting oil and gas and keeping it as one of the main sources of revenue while adopting new methods of generating energy security internally. Adopting new energy sources will help in diversifying the economy and creating more jobs while drawing in new investment opportunities. Hence, investing in alternative energy sources and in this case nuclear energy in specific, can be the solution to another existing problem.

4.8 Renewable energy power generation is becoming more cost effective

Research and developments in improved technologies in renewable energy sources have increased and many companies worldwide are competing on prices and implementation operations, for example there are yearly exhibitions on emerging clean energy companies and technologies. The costs have dropped in comparison to fossil fuel generation as an increasing number of countries drive towards clean energy and alternative energy sources. The Gulf region hold the potentials needed for renewable energy such as the capitals, available land usage to develop solar power plants and regular strong sunlight for it. The solar capability in the UAE is limitless. Adding to that, investments in renewable energy will offer new research & development opportunities in the country in terms of best exploiting the lands and capital for the near future. Investing in early stages in renewable energy will stimulate and encourage more companies internally and externally to participate in this process, and it is likely that the other GCC countries will follow in the steps of the UAE in terms of implementing a nuclear program.

4.8 Over dependence on oil and gas is not sustainable

It is evident that there has been some change of policies in the energy sector worldwide which have come to consider environmental protection and preservation, as well as reducing the dependence on imports of oils and gas from the Middle East region. And as there is increased pressure from the world community to start phasing out fossil fuels and start

depending on renewable energy sources, this may decrease the demand on imports of oil and gas from the UAE and which will affect its income dependence on the revenues, which calls for another reason to start implementing and investing in alternative energy sources before any further outcomes could happen to the revenue of the country. Also, with the increased instabilities in the area of Middle East (for example the war in Syria and Iran's illegitimate nuclear program), many countries could be re-considering their importing plans for oil and gas as we witness further instabilities in neighboring countries of the GCC that could affect the production lines and security. As being one of the world's biggest consumers and producers of oil and gas, it is important to diversify the energy sources to achieve energy security.

In the recent years, it is evident that there has been a resilient focus on energy and environmentally focused policies as the reasons leading to it and the impact has become more evident by the day and as governments have recognized that climate change will not only have an environmental impact, but a social, economic and political impact as well on the state and its people. For example, in case of droughts, high sea-level rise, floods or storms, etc. the country will be severely harmed economically and socially, thus, it is expected that countries should act on the situation and provide effective measures as well as long term solutions for both environmental threats and energy security.

As climate change and the environmental threats have become a priority in the governments agendas, and especially in the case of the region where it could have the highest impact as it will increase the instabilities and is considered as a global challenge, governments should decide its energy policies and integrate change to achieve energy security and state security with regard to the previous mentioned obstacles. The UAE must start implementing strategies to ensure steady transition of change in policies regarding energy and environmental deterioration. And in regards to that, the UAE has reached a milestone in implementing a nuclear program.

Chapter Five: Discussion and conclusion

As seen from the previous chapters, the UAE's reasons for implementing a nuclear program were due to changes in the energy policy of the country, as a committed non-proliferation state, the UAE is committed to continue to establish and develop its nuclear program in order to advance its political, economical and environmental goals as was explained in the previous chapters. Furthermore, this chapter will further study the different drivers that motivated the development of nuclear energy and its implementation.

5.1 The Economic drivers

In 2013, most of the electricity produced in the UAE (110 billion kilowatt-hours) was by means of natural gas (EIA, 2015). The demand for electricity in the country went up to 105 billion kilowatt-hours in 2013, which makes it one of the top consumers of electricity globally (EIA, 2015). According to a 2013 report from the Emirates News Agency, the consumption of electricity in the UAE would grow by about 50% by 2020 (EIA, 2015). The ongoing nuclear project is expected to add a minimum of 5.6 GW to the national grid (EIA, 2015). Renewable energy would only supply around 6% of the needed amount (WNA, 2015).

Consequently, the emission of carbon dioxide has risen to higher levels of about 94,163,000 tons in 2012 as compared to about 60,809,000 tons in 1990 (AlFarra & Abu-Hijleh, 2012). Use of fossil fuels is the main agent for higher pollution of the environment caused by carbon dioxide (AlFarra & Abu-Hijleh, 2012). As such, the UAE decided to keep Kyoto protocol by incorporating use of nuclear energy so as to lessen the production of CO_2 (AlFarra & Abu-Hijleh, 2012).

5.1.1 Growing Demand for Electricity

The increase in population has led to a higher consumption of electricity in the UAE than in the 1980s (Aboul-Enein et al., 2016). Between 2000 and 2010, the consumption of electricity was noted to be growing by 9% which was quite high as compared to other countries (Aboul-Enein et al., 2016). High percentage of electricity generated in the UAE is through natural gas which accounts for 97%; the remaining 3% is oil deposits (Aboul-Enein et al., 2016). Thus, it was a requirement for the UAE to increase energy security by venturing into nuclear energy (Aboul-Enein et al., 2016).

5.1.2 Investment Opportunities

There has been increase in the need for new investments in the electricity sector due to high consumption of electricity from the population (Dirioz & Reimold, 2014). Economic development facilitated an increase in the population numbers (commonly non-Emiratis) to look for settlement in the UAE (Dirioz & Reimold, 2014). High population opened opportunities for investors in different sectors like desalination of sewage which requires energy, water and other infrastructure (Dirioz & Reimold, 2014).

5.1.3 Job opportunities

Nuclear power plants provide employment in operation, construction and generation of power (Nuclear Energy Institute [NEI], 2014a). According to the research, the Emirates Nuclear Energy Corporation (ENEC) indicates that nuclear projects will create jobs for about 900 to 1,000 staff in 2016; another 1,400 opportunities will be available by 2017 (Banks, Massy, & Ebinger, 2012). When the first nuclear plant is commissioned up to the last one, 2,200 workers will be hired by 2020 (Banks, Massy, & Ebinger, 2012).

ENEC conducted an evaluation which indicated that few of the staff who will be hired are nuclear engineers (Banks, Massy, & Ebinger, 2012). The rest of the staffs will be mechanical, electrical and other engineers from various fields (Banks, Massy, &, Ebinger, 2012). ENEC will hire various professionals as a way of building capacity and attracting operational team players (Banks, Massy, & Ebinger, 2012).

As the nuclear energy facilities will produce hundreds of jobs during its decades of operation, it will have an important economic benefit as it will continuously stimulate the creation of jobs locally in many different fields of specialty.

5.1.4 Business opportunities

The production of nuclear electricity can help to increase local consumption of electricity and the excess may be sold to other countries experiencing power shortages (Dirioz & Reimold, 2014). One of the agreements among GCC member countries was to foster peace among them through the use of nuclear energy. Thus, it is achieved by selling excessive nuclear power to the rest of GCC countries (Dirioz & Reimold, 2014). Korea Electric Power Co. (KEPCO) and ENEC have signed a contract that is valued at about $20 billion to construct,

commission and fuel four reactors; another $20 billion are expected for project maintenance in the next 60 years (WNA, 2015).

5.1.5 Developing the country's Economy

The level of economic development of a specific country may also influence the need for nuclear power plants (Fuhrmann, 2012). Rising consumption of energy necessitates the need for nuclear energy; thereby, establishing nuclear reactors can help in meeting energy demands from the population (Fuhrmann, 2012). The use of natural gas has been predicted to be more expensive in the future and the pollution of the environment has been high in the energy sector of the UAE (Emirates Nuclear Energy Corporation [ENEC], 2009). Consequently, sale of excess electricity is going to increase the annual GDP.

5.1.6 Profitability of Nuclear Energy Trade and Operation in Other Countries

The majority of countries that have implemented nuclear energy like Japan, UK, Hungary and Spain have seen an increase in their annual GDP (Omri & Chaibi, 2014). It is estimated that when the consumption of nuclear power increases by 1%, GDP will consequently increase within a specific range, for example, a range of 0.173% (Finland) to 0.429% (UK) (Omri & Chaibi, 2014). In the USA, nuclear industry is a long-term source of employment and economic growth (NEI, 2014a). The USA has got 100 nuclear stations that produce around $40-$50 billion annually in electricity sales and provide jobs for more than 100,000 employees in the nuclear sector (NIE, 2014a).

For instance, Exelon nuclear power plant in Illinois, USA, generated about 100 million megawatts in 2013 which is about 48% of the total electricity generated that year in the country (Nuclear Energy Institute [NEI], 2014b). Additionally, the Exelon plant provides about 5,900 jobs to full time employees and cheap electricity to Illinois residents (NEI, 2014b). Locals are given priority in employment with about 30% of jobs being preserved for them (NEI, 2014b). Exelon plants generated about $5.4 billion in 2013, and the output on state was estimated to be $8.9 billion (NEI, 2014b). It is clear that by 2030, complete economic output will be approximately $11.4 billion. As per 2015, Exelon was predicted to contribute about $6 billion to Illinois and this figure is set to increase to $7.8 billion by 2030 (NEI, 2014b).

5.2 The Environmental drivers

Over 45 countries initiated and launched nuclear power programs that ranged from sophisticated economies to representatives of developing nations (Emerging Nuclear Energy Countries,2016). Among the front runners in this process are such countries as the UAE, Vietnam, Turkey, Poland and Belarus. The United Arab Emirates government strategy in creating and developing peaceful nuclear energy lies in the need for electricity as mentioned earlier in order to meet the risen demands. Due to fact UAE region is rich in fossil fuels, it has helped develop the country as it is, but at the same time cased difficulties in energy sector. Such outcomes of highly developed and industrialized societies as one of UAE as poisoning of air and water, destroying the ozone layer and provoking global warming are the main reasons to imply more environmental-oriented ways for gaining energy such as nuclear one.

The government being an institution that has absolute responsibility for its keeping and using. Nuclear industry was not evolved in the UAE locally, it has combined all experience collected internationally. This basis is essential due to the fact the sophisticated institutional approach nuclear energy requires. Moreover, it ensures the highest operational standards of this process to be implemented.

Gas that is used in UAE for producing electricity is mostly taken with a help of import. At the same time, the demand for electricity in the country is growing each year for about 9% (“Emerging Nuclear Energy Countries”, 2016). The amount of energy and resources used by the UAE’s population is proportional to negative consequences caused by the their usage. Due to fact the inevitable depletion of the oil and gas, nuclear energy became an appropriate option to imply in this case. This approach has already proven itself of being environmentally promising. Nuclear power can create a significant contribution to the basis of future energy security and the country’s economy. Destroying of ozone layer over the territories of the most industrialized and developed regions, as well as poisoned water and air does not create appropriate conditions for sustainable living for next generations. Moreover, people all over the world are fighting against global warning which is considered being the most topical topic dedicated to modern ecology and its future state. Nuclear energy can prevent degradations of environment in the world, as it is not harmful for water, air and the environment. During the production of nuclear energy, no carbon emissions are produced, unlike what happens with

burning oil and gas. Thus, not producing any greenhouse gases and reducing the amount of carbon emissions in the UAE.

Due to fact alternative sources of energy produce high amount of energy, they have to deal with numerous resources gained from the planet. The usage of such particular types of energy sometimes becomes a reason for oil spills, as well as extinction of trees that are essential for atmosphere, animals and people. Nuclear energy can change this influence and perform the needed energy for the future of the planet and sustainable growth for the country.

The government of UAE provides projections and evaluations that help to determine the amount of resources that are needed to satisfy the risen demands among people. The results of such projects show that the expected volumes of gas will be insufficient for complete covering. If to consider some alternative ways for gaining energy that have been considered, burning fuels is one of the most effective ones. However, despite its logistically viability, burning diesel and crude has deliberately high costs. Moreover, it is also known as the factor of degradation in the environmental performance. Another popular alternative way to gain energy in UAE is coal-burning generation (Dirioz & Reimold, 2014). It is economically more beneficial, but can result in negative environmental performance. Considering such alternative sources of energy as wind and solar are able to produce only a small amount of limited energy that is almost useless in conditions of technological development and global demand.

Due to fact UAE experiences rich fossil fuels and increased productivity connected mostly with the processes of globalization and technological progress, more energy is now needed. However, producing more energy causes a lot of resources to be used and ecology to be ruined. For example, destroying of ozone layer, poisoning water and air as well as activities that result is popularization of global warming are the main reasons that provoked UAE for using alternative methods of gaining energy and supplying people. In order to get more energy for the risen demands, such alternative resources as solar, wind, coal- and fuel-burning are usually used. Nevertheless, modern society cares about ecological consequences it can cause. The methods listed above are not safe for the future of our planet; however, nuclear energy can prevent degradation of environment, changes of climate and different kinds of pollution.

Climate change and environmental degradation has begun shaping the regional security and especially the UAE, it has directed the UAE into investing in renewable energy to guarantee their energy security along with achieving sustainability and diversity in the energy sector. The following research done will explore the reasons to why investing in renewable energy is needed for the UAE and why a change of energy policy is ought to be implemented.

5.3 The political drivers

The UAE has dealt with complete transparency and cooperation with the international community regarding its nuclear program and has adhered to the international agreements and laws in regards to developing its nuclear program. To continue its position as a strong diplomatic and peaceful state, it has followed the highest standards of non-proliferation agreements. The safety and security of the state will be strongly improved with the development of a nuclear program as it advances energy security and diversification in the energy sources and economy. The correlation between the development of a nuclear energy program and gaining political power is strong as it requires extensive cooperation and efforts from the local and international community to develop and implement a program and policy of such magnitude. Naturally, forming alliances based on mutual interests will occur as the development of the program continues to prosper for decades to come bringing mutal interest and benefits. Considering the geo-political location of the UAE and the recent political circumstances, being a leader in implementing the nuclear program and first in the GCC, it can be expected that it will increase the collaboration between the GCC states with the UAE to follow its steps in developing a nuclear program by stressing the economic and environmental benefits of the program, hence giving the UAE a stronger standing position. The nuclear program will ensure long term sustainability for the energy and economic sector especially, which all pours in the safety and security of the country.

In conclusion, This thesis examined the interaction of energy policies and future plans of the UAE in nuclear energy while focusing on examining the reasons the UAE is implementing a nuclear energy program by primarily looking into the environmental, economical and political reasons. The environmental reasons which were to find a reliable alternative energy source that can adhere to the country’s rising energy demand with less consequences on the environment. Whilst the economical reasons as were stated by the government of the United Arab Emirates were to support the development of industrial and modern sectors by creating

business and investment opportunities that will stimulates the growth of the economy in accordance with the UAE Centennial 2071governemnt plan. The UAE's political stance were to advance its national interests by forming nuclear alliances and strengthening its international relations.

The UAE has transformed to embrace renewable, and particularly, nuclear energy as well as several other initiatives that aimed at preserving the environment, supporting the economic growth and advancing its political position. The UAE has become the regional leader and role model in taking steps to shift its policies regarding the energy sector and environmental conservation as well as gaining economic and political strength through its nuclear program.

5.4 Reflections

This thesis has educated me on the energy policy of the UAE and the environmental, economic and political benefits of the nuclear program and its advantages to the country for decades to come. Hopefully, this research will contribute to the available literature on energy policy and nuclear energy in the UAE and continue to be expanded.

For future reference, each of the reasons for the UAE's implementation of a nuclear program should be explored separately while taking into consideration its impact on the region considering the geostrategic location of the UAE. This research will hopefully help in establishing a strong basis for future researches on the UAE's nuclear program and the association between implementing a nuclear program and the development of the country economically, environmentally and politically.

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