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**On The future of energy and
resource security in the
United Arab Emirates**

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Yousef Nazzal

Views presented in this working paper are those of the authors and do not necessarily represent views of Zayed University

On The future of energy and resource security in the United Arab Emirates

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Abstract

The UAE is making notable progress in diversifying its economy through tourism, trade, and manufacturing. However, in the near term, oil, natural gas, and associated industries will continue to account for the majority of economic activity. Rising gas demand from power stations and industrial users such as petrochemical makers and steel manufacturers has turned the UAE into a net gas importer in the past decade, triggering multi-billion dollar investments into nuclear power and renewables. This paper looks into the patterns of energy production and consumption in the UAE in the context the changing nature of global energy markets. The paper will analyze current and proposed national energy initiatives, and assess their impacts on the future of the country. The research analyzed a wide range of statistics obtained from various sources to highlight the current situation and predicts some future scenarios. The study also adhered SWOT analyses of the energy scene in UAE and examined the impact of some external factors. The demand for electricity in the UAE, which is almost exclusively generated from natural gas-fired power plants, is set to rise at a rate of about 9 percent per annum through to 2020.

Keyword: Energy, resource security, UAE.

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1. Introduction:

The United Arab Emirates (UAE) a federation of the seven emirates of Abu Dhabi, Ajman, Al Fujayrah, Dubai, Ras al Khaymah, Sharjah, and Umm al Qaywayn (Figure-Map), relies on its vast oil and natural gas resources to sustain its economy. Together with the hydrocarbon economy, the UAE is evolving as one of the world's significant financial centers and a major trading hub in the Middle East. Patent and strategic investments in non-energy sectors, such as infrastructure and

technology, continue to give the UAE preventive means against oil price declines and global economic stagnation. Recovering oil prices and robust trade growth have supported the UAE's economy, and International Monetary Fund (IMF) data indicate that UAE GDP grew by 4.3% in 2012, and the trend continues to be healthy at the moment.

In many countries renewable energy already has a significant market share and has developed along different lines in different countries. Many other studies have handled energy resources in the other part of the world, such as Foley & others (2010), Dassisti and Carnimeo (2012), Lipp J (2007), and Brennan and Others (1996). The UAE, which is the second largest Arab economy, the country has also options, plans, initiatives and strategies to develop a diversified and efficient energy portfolio by including unconventional resources that will sustain future economic growth and extend the country's position as a reliable supplier of crude oil to global markets (UAE 2015). The present paper will describe and analyze those options and strategies in the context of the mixed news of alternating low hydrocarbon in the global market. For UAE economic growth, unconventional energy sources are important and central to future economic development and growth. Hence, the paper will describe its role in the planned future energy mix of UAE. Given this backdrop in the global conventional energy market, SWOT analysis on the energy sector at the current juncture will have several advantages.

The main objective from this study is to assess the current status, and examine the future energy mix in the UAE as well as describe SWOT analyses. Identification of SWOTs is vital because they can advise on planning steps to achieve goals (Chen et al. 2014; Chermack and Bernadette 2007). Often, the decision-makers should evaluate if the objective is attainable, given the SWOTs. Assume it is objective is not attainable, then a different objective must be decided on and the process repeated. Users of SWOT analysis need to ask and answer questions that generate meaningful information for each category (strengths, weaknesses, opportunities, and threats) to make the analysis useful and find their competitive advantage (Nadine and Richter 2007; Terrados et al. 2007). A SWOT analysis is a structured planning method used to evaluate the strengths, weaknesses, opportunities, and threats involved in a project or in a business venture (Chen et al. 2014; Chermack and Bernadette 2007).

2. Methodology

The literature review is the most effective way of gathering information's in this kind of studies. The same methodology was used in similar studies in the past. Lewis and Wier [2007] used the literature review methodology to examine the vital roles of national and sub national policies in providing the support to develop a successful wind turbine manufacturing companies. Cherni and Kentish [2007] examined the effectiveness of the RE policy and legislation implemented in China. Mitchell and Connor [2008] examined the Renewable Energy policy in the UK between 1990 and 2003. SWOT analyses was also used by Iglinski et. Al, 2015 in similar studies, Applying these approaches (analysis of literature, statistics and analytics) to the current research required extensive study and analysis of the policies currently employed in UAE, as well as describe their SWOT status.

A SWOT analysis can be carried out for a product, place, industry, or person. It involves specifying the objective of the business venture or project and identifying the internal and external factors that are favorable and unfavorable to achieve that objective. In this study, we adopted and amended the questions of Iglinski et. Al, 2015. The degree to which the internal environment of the firm matches with the external environment is expressed by the concept of strategic fit (Iglinski et. Al, 2015):

- Strengths characteristics of the business or project that give it an advantage over others,
- Weaknesses characteristics that place the business or project at a disadvantage relative to others,
- Opportunities elements that the project could exploit to its advantage,
- Threats elements in the environment that could cause trouble for the business or project (Fig. 1) (Nadine and Richter 2007; Terrados et al. 2007).

In order to define the strengths and weaknesses, the authors adopted and modified the following questions of Iglinski et. Al, 2015:

- (1) What are the natural conditions for the development of a given type of energy option (EOP)
- (2) Does the development of a given type of EOP generate a lot of interest among investors/local authorities?

- (3) What is the current level of knowledge of UAE citizens about a given type of EOP?
- (4) How high are the investment costs?
- (5) How long does the investment process last?
- (6) What is the profitability of various EOP? Is it possible to have subsidies in the form of green certificates?
- (7) Is the generated energy from renewable cheaper than energy from fossil fuel?
- (8) How does a given type of EOP impact on the environment?

In order to define the opportunities and threats, the authors considered the following questions:

- (1) Will the research conducted at a laboratory/technical level lead to higher efficiency and lower price of energy generation from a given type of EOP?
- (2) Can the installation be easily connected to the current power grid network?
- (3) Will the construction of an installation still cause public opposition/opposition from environmental groups in the future?
- (4) Will the development of a given type of certain EOP generate new jobs?
- (5) Is there an opportunity to develop mini-installations and micro-installations?
- (6) Will the development of a given type of certain EOP lead to the economic growth?
- (7) Will the current grand initiatives have a positive impact on the development of certain EOP?

The SWOT analysis was conducted using the information provided by the MOE, literature sources data, the strategy for the development of renewable energy sources as well as legal acts and regulations. Recommendations on how to quicker develop a particular renewable energy sector have been added to this paper.

3.Results and Discussions:

3.1 Status of Fossil Fuel in UAE

The pressure on UAE fossil fuel resources comes from the local internal demands and from the desire to international commitments of OPEC. Oil reserves in the United Arab Emirates are about 98 billion barrels (15.6×10^9 m³). Abu Dhabi Emirate has most of the oil with 92 billion barrels (14.6×10^9 m³) while Dubai has 4 billion barrels (640×10^6 m³) and Sharjah has 1.5 billion barrels (240×10^6 m³). Most of the oil is in the Zakum field which is the third largest in the Middle East with an estimated 66 billion barrels (10.5×10^9 m³). The UAE produces about 2.9 million barrels per day (460×10^3 m³/d) of total oil liquids, but has stated its intention to increase this to 5 million barrels per day (790×10^3 m³/d) by 2014. The UAE's reserves-to-production is about 93 years. "United Arab Emirates Oil" (2007) (Fig. 1, 2 & 3). The likelihood of further major oil discoveries is low, but the UAE uses enhanced oil recovery (EOR) techniques to increase the extraction rates of the country's mature oil fields. Continued higher oil prices will help increase the commercial viability of EOR. USEIA (2007). (Fig. 4) & (Table 1).

Natural gas use in the UAE is rising. While the country is a member of the Gas Exporting Countries Forum (GECF), domestic demand is likely to draw heavily on the UAE's potentially-exportable natural gas resources. Presently, the country both imports and exports liquefied natural gas (LNG) and shares international natural gas pipelines with Qatar and Oman. The UAE is also one of the world's leaders in the use of natural gas in EOR techniques, but with natural gas demand rising, the government plans to expand into other EOR techniques to divert the gas volumes for domestic consumption. USEIA (2007), (Fig. 3). The United Arab Emirates was the first country in the Middle East to export liquefied natural gas (LNG), and has exported more than 250 billion cubic feet of LNG annually, almost exclusively to Asia, (Fig 8). Despite steadily increasing production, the UAE became a net importer of natural gas in 2008. Consumption in the UAE grew by an average of more than 5% per year between 2003 and 2012, which was only partially met by domestic production.

In the UAE, Natural gas imports grew from just 7 Bcf in 2003 to 662 Bcf in 2012, while exports remained relatively flat through the entire period, rising by just 30 Bcf over the same period. BP Statistical Review of World Energy, (2014). In terms of natural gas, the UAE has decided to diversify its sources of natural gas, which would be about 70% to three different sources,

the primary source of natural gas produced locally and increase this production through the development of gas fields such as Project Company fort, and the second source of compressed gas importer Using pipeline company "Dolphin", while the third source is the import of liquefied natural gas, as state-owned port in Dubai card import three million tons per year, and conducted the study for the establishment of the port of Fujairah in the last card of nine million tonnes per annum, US Energy Information administration (2007). The UAE boosted imports from neighboring Qatar via the Dolphin Gas Project's pipeline over the past several years. The pipeline runs from Qatar to Oman via the UAE and is one of the principal points of entry for the UAE's natural gas imports.

Table (3) : Shows the top-10 countries with proved natural gas reserves, 2013

3.2 Consumption:

The UAE is witnessing unprecedented socio-economic growth which put pressure on the available energy resources. The rapid economic growth and the increase in population has led to an annual increase in the consumption of electricity, 6% and this rate is large compared to the average global growth. 35% of electricity consumption goes to the residential sector, and about 31% go for the commercial sector, what makes these two sectors the largest consumer in the state, noting that the per capita consumption of energy in the state is three times the normal average, and this of course as a result of waste and lack of rationalization in the consumption of electricity and water. And increase the cost of electricity on the state to 35 billion dirhams annually, where that provide 10% of consumption provides a 3.5 billion dirhams a year. In the near future, the UAE energy pie will have 68% to 70% natural gas and 25% nuclear energy and solar energy from 5% to 7% of the total electrical energy.

Most of the UAE's electricity is generated using gas-fed thermal generation, and plans to integrate the seven Emirates' gas distribution networks (for example, through the Dolphin Pipeline project) should help alleviate some of the peak-demand shortfalls experienced in the past. These issues are exacerbated by ongoing subsidy programs that keep domestic prices artificially low, and contribute to wasteful energy practices. Privatization of the electricity sectors in the seven Emirates is little more than a rumor at this time. Federal Competitiveness and statistics Authority 2016. Another complication comes from the fact that UAE has one of the highest rates of per capita petroleum consumption in the world. The UAE is both a major exporter and consumer of petroleum

and petroleum products. The U.S. Energy Information Administration (EIA) estimates that the UAE exported more than 2.5 million bbl/d of crude oil in 2012, with the vast majority going to markets in Asia. In addition to being a major global petroleum exporter, the UAE domestic market relies heavily on petroleum and petroleum products to meet energy demand. Most of the UAE's petroleum imports are of residual fuel oil, with limited imports of motor gasoline and diesel fuel. The UAE had the seventh-highest per capita petroleum consumption in the world, and the country consumed nearly 620,000 bbl/d in 2012. Middle East Economic Survey, (January 3, 2014). (Fig. 5).

The United Arab Emirates plans to boost domestic natural gas production over the next several years to help meet growing internal demand. Much of the growth could come from the country's large sour (high sulfur) gas deposits, (Fig 6). The UAE holds the seventh-largest proved reserves of natural gas in the world, at just over 215 trillion cubic feet (Tcf) (Table 3). Despite its large endowment, the UAE became a net importer of natural gas in 2008. This phenomenon is a product of two things: (1) the UAE re-injected approximately 26% of gross natural gas production from 2003 to 2012 into its oil fields as part of EOR techniques, (Fig 2) and (2) the country's inefficient and rapidly-expanding electricity grid—already taxed by the swift economic and demographic growth of recent decades—relies on electricity from natural gas-fired facilities. BP Statistical Review of World Energy, (2014).

3. 3 Strategies to meet internal and external demands

Although some reports indicated that UAE appeared unlikely to meet a 3-million-barrel-per-day crude oil production target by the end of 2013, and it may push back a longer-term 3.5 million barrel per day target until the end of the decade. The UAE spend in raising its production capacity to 3.5 million barrels of oil a day by 2017. With this spending came some management actions which were taken and will be described in subsequent sections.

3.3.1 Strategies and initiatives in the fossil fuel fronts

With limited prospects for major discoveries, production increases in the UAE will come almost exclusively from the use of EOR techniques in Abu Dhabi's existing oil fields. Middle East Economic Survey, (April 11, 2014). One region that may help the UAE boost production is the Zakum petroleum system, which IHS reports may contain over 65 billion barrels of recoverable

oil. ZADCO owned by ADNOC (60% share), ExxonMobil (28%), and the Japan Oil Development Company (JODCO; 12%) manages production from UAE's Upper Zakum field, which currently produces about 550,000 bbl/d. In July 2012, ZADCO awarded an \$800-million engineering, procurement, and construction contract to Abu Dhabi's National Petroleum Construction Company along with French firm Technip with the goal of expanding production to 750,000 bbl/d by 2016. Production from the Lower Zakum field operated by the Abu Dhabi Marine Operating Company (ADMA-OPCO) should also increase, with production eventually reaching 425,000 bbl/d, increasing from the 300,000 bbl/d it currently produces. Middle East Economic Survey, (January 23, 2015).

ADCO—which oversees onshore operations in the Emirate plans to increase production in the Bu Hasa, Bab, and SAS fields over the coming years, with increases expected to approach 200,000 bbl/d as soon as 2014. Smaller offshore fields like the Nasr, Umm Lulu, and Umm Shaif are also the targets of increased investments. ADMA-OPCO is seeking to boost production levels at the Umm Shaif field to 280,000 bbl/d and is attempting to bring the combined production of the Nasr and Umm Lulu fields up to 170,000 bbl/d as soon as 2018. In June 2013, ADMA-OPCO awarded a contract for full field development at the Umm Lulu field. ADMA-OPCO also hopes to significantly increase recovery rates at its fields, where the average rate is currently around 35%, according to industry sources. Exploration and production in the other Emirates is limited, with reserves nearly exhausted and the cost of recovery continuing to climb. (Table 2).

The UAE has decided to spend in raising its production capacity to 3.5 million barrels of oil a day by 2017. The future of energy and resource security in the United Arab Emirates", that the energy of local refineries will rise from 707 thousand barrels per day to 1.0001 million bpd during 2017, and the strategic outlook of the state to maintain its position as one of the largest exporting countries Petroleum in the world." The march of the UAE in the field of oil industry and its global role and weight in the pose of the Organization of Petroleum Exporting Countries "OPEC", stressing that the state owns 4% of the world's oil reserves and about 3.5% of global gas reserves. Facts Global Energy, Gas Insights, (2014),

3.3.1 Strategies and initiatives in the unconventional sources of energy

The UAE enjoys reasonable renewable energy resources, with an average vertical solar irradiance of 2120kWh/m²/year and an average monthly wind speed of 4.2–5.3 m/s in coastal

areas. The UAE is also recognized for its commitment to the global carbon agenda and has planned to reduce its CO₂ emissions by 30% by 2030. With the above drivers in mind, the announcement of the country's aims to attract AED367b (€77.45b) of investment in alternative and sustainable energy projects by 2020 was no surprise. Both Abu Dhabi and Dubai are targeting the generation of 7% and 5% respectively of total power demand from renewable sources by 2030 (Abu Ali, 2012).

According to statistics from MOE, 2015, power generation in the UAE will increase by more than 1.5 gigawatts in 2017/18, enough to power around 150,000 homes. The State of Energy Report in the UAE 2015, prepared by the Dubai Carbon Centre of Excellence and the United Nations, highlights energy projects across the UAE focusing on energy diversification and government policy. The report reveals that the UAE will increase power generation with a mix of energy sources from natural gas to solar and nuclear power. From 2008 to 2012, national power demand grew 37 per cent, the trend of increase is continuing until 2017. Abu Dhabi increased its power-generating capacity by 43.6 per cent and Dubai increased capacity 44.5 per cent. The UAE's energy demand is growing at about 9 per cent a year.

Nuclear. In 2009, the UAE awarded a \$20 billion contract to the Korea Electric Power Corporation (KEPCO) to construct four nuclear reactors, and in 2012 the licenses were approved for KEPCO to begin construction on the first two 1,400-megawatt reactors. The first reactor is scheduled to come on-line in 2017, with the others expected to be completed by 2020. Upon completion of the first reactor, the UAE will become the second country in the region (after Iran) to have a domestic nuclear program. The site is located 300 kilometres west of Abu Dhabi. The UAE expects the second unit to follow in 2018 and units three and four will come online in 2019 and 2020, respectively.

Solar and wind. UAE announced plans to develop the Sir Bani Yas wind farm—with a target capacity of 28.8 megawatts (MW)—and the Shams 1 concentrated solar power (CSP) plant (100 MW capacity) over the next several years, and should continue to help the UAE find new ways to diversify its energy mix. Federal Competitiveness and statistics Authority 2016. Dubai has another major clean energy projects are expected to feed electricity into the grid in the near futures. The second phase in the Mohamed bin Rashid Al Maktoum Solar Park will generate 100 megawatts of solar photovoltaic (PV) power.

Geothermal, Masdar City in UAE is proposing to build the Gulf's first geothermal energy facility. The US\$11 billion project will be partially built by the Icelandic company Reykjavik Geothermal. The company has also been awarded a US\$1.6 million contract to export its geothermal know-how to Masdar City. When complete, the geothermal project will be used to power the city's 5 MW air conditioning system.

Hydrogen Power Abu Dhabi (HPAD), HPAD is a 60/40 joint venture between Masdar and BP to construct the world's first commercial-scale hydrogen-fuelled power plant utilising fossil fuel feedstock and CCS. The project will require a total capital investment (excluding CO² transportation and storage) of about AED 7 billion (US\$2 billion). This project will take natural gas from the grid and convert it to hydrogen and CO². The hydrogen power plant will generate approximately 400 MW of low-carbon electricity, and could provide more than 5 per cent of all Abu Dhabi's current power generation.

3.4 SWOT analysis:

3.4.1 Strength:

- 1- UAE government committed to develop further the renewable energy strategies.
- 2- The UAE developed the legal frameworks, and based on legal frameworks The UAE has announced that it aims to produce 7 per cent of electricity from renewable sources by 2020, and the creation of Masdar, the UAE's multi billion dollar investment company signals the Emirate's strong determination to lead in the clean-technology market plus the other projects such as, Shams 1 solar project, Hydrogen Power Abu Dhabi (HPAD), MBM Solar Holding Inc., Dubai - Solar power plant
- 3- Infrastructures and industrial base in the UAE is developing.
- 4- Availability of locations very attractive for both solar & wind energy in UAE.
- 5- UAE shows the most political stability in the region.
- 6- UAE one of the most engorging investment and giving incentives to the private sector in the world.
- 7- UAE government provide land for renewable energy.
- 8- Existence of several Universities providing programs in engineering related to RE plus several research centers active in research related to RE specially Masdar.
- 9- UAE already got several pilot projects , they are in place and successful.

- 10- UAE provide adequate funding for research in RE.
- 11- The UAE is also recognized for its commitment to the global carbon agenda and has planned to reduce its CO2 emissions by 30% by 2030.
- 12- Transparency e.g. to avoid concerns about their use of nuclear technologies, the UAE sought and received International Atomic Energy Agency (IAEA) approval for its nuclear project, and committed itself to forgoing the domestic enrichment and reprocessing of nuclear fuel by signing a law that banned that practice within the country. In addition, the UAE signed a nuclear cooperation agreement with the United States in 2009, and it is a signatory of the Nuclear Non-Proliferation Treaty.
- 13- The legal system, e.g. the Federal Law Regarding the Peaceful Uses of Nuclear Energy was signed. It provides for the development of a system of licensing and control of nuclear material, as well as establishing the Federal Authority of Nuclear Regulation (FANR). FANR is an independent entity charged with overseeing the regulation of the whole of the UAE's nuclear energy sector as well as appointing the regulator's board.

3.4.2 Opportunity:

- 1- UAE provide adequate funding for RE.
- 2- The investment climate in the UAE very open and attractive.
- 3- The U.A.E. is a promising renewables market.
- 4- There is strong government support for the industry
- 5- There is a trend towards increased participation of the private sector in the U.A.E.'s energy sector.
- 6- Much of Abu Dhabi's existing electricity and water production capacity was installed by private developers.
- 7- The U.A.E. has implemented an auction mechanism to support the deployment of large scale renewable energy projects.
- 8- The UAE open an opportunity for small-scale deployment is the solar rooftop market.
- 9- Another opportunity is the replacement of out of dates generators in off-grid settings.

3.4.3 Weakness:

- 1- The initial cost to the RE is still high in compared with conventional technology.
- 2- UAE may consider a small market by the large investing RE companies.

- 3- Some of the RE technologies are still not deployed and are still expensive.
- 4- Professional expertise needs more attention from the energy sector.
- 5- Lack of awareness among public and consumers about the importance of RE.
- 6- Electricity for households and agriculture still depends on fossil fuels.
- 7- Results of applied research in RE still not considered to be commercialize.

3.4.4 Threat:

- 1- REs is still perceived as uncertain and risky by local & foreign investors.
- 2- Impact from global energy market e.g. In January 2016, the OPEC Reference Basket (ORB) reached its lowest level (\$22.48/barrel) since the price decline that started in the second half of 2014. It has since shown a general upward trend and over the past couple of months it has fluctuated in the range of \$40–45/b. On the supply side, non-OPEC production has contracted this year, while demand remains relatively healthy at around 1.2 million barrels per day (mb/d).
- 3- Global behavior of oil stocks, volatility and challenges
- 4- Un precise foresights and predictions
- 10- Fossil fuel market will continue to alternate e.g. OPEC provides an increasing share, approaching 50 percent of global production by 2040 – a level not seen since the 1970s – while unconventional production more than doubles between 2015 and 2040

4. Conclusion:

Despite holding some of the largest deposits of hydrocarbons in the world, the UAE is planning to diversify its energy mix beyond hydrocarbon-based electricity generation, including nuclear and renewable-energy technologies. This will the future economic risks of being largely exposed to fuel prices. Internally, energy waste and inefficiencies are one of the major challenges. Diversifying the energy pie of UAE to increase the low to moderate utilization of unconventional and renewable energy resources is needed but comes with many technical and policy challenges. The status quo of high income and low energy prices has created some inefficiencies, adding pressures on hydrocarbon resources and the environment "A general change in habits would help drive the region's competitiveness and boost efficiencies in the longer term. *Al Mazrouei, 2015.* On the hydrocarbon front, the sector is very advanced and there lots of deployed initiatives and technologies bring the oil fields into its potential and enhance the production further

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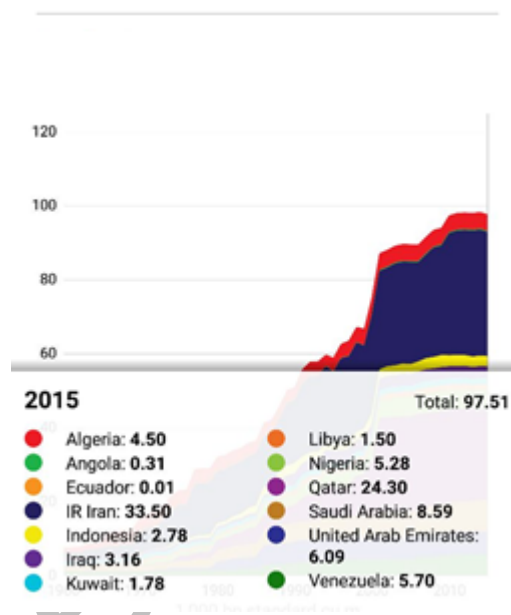
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Fig. (1) OPEC members proven natural gas reserves.



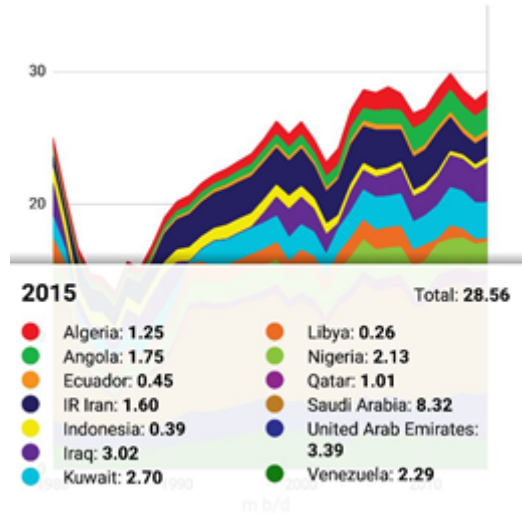


Fig. (2): OPEC members exports of crude oil & petroleum products.

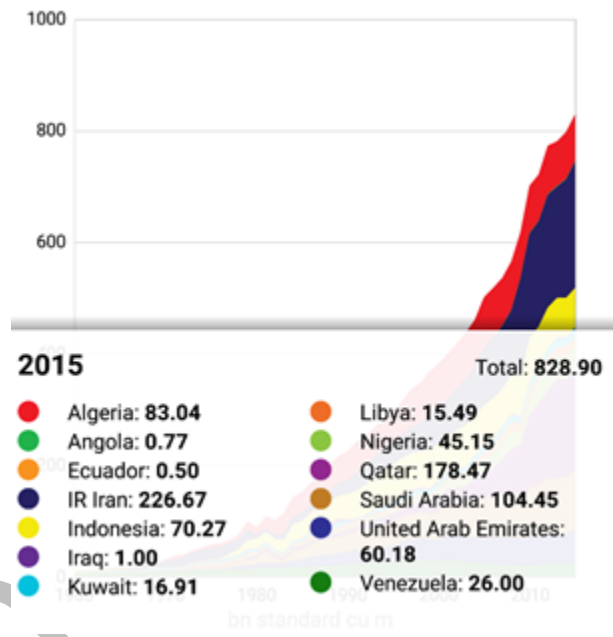


Fig. (3): OPEC members marketed production of natural gas.

Oil (million barrels)

Proved reserves, 2013	Total oil supply (thousand bbl/d), 2012	Total petroleum consumption, 2012	Reserves-to-production ratio
97,800	3,213	618	95

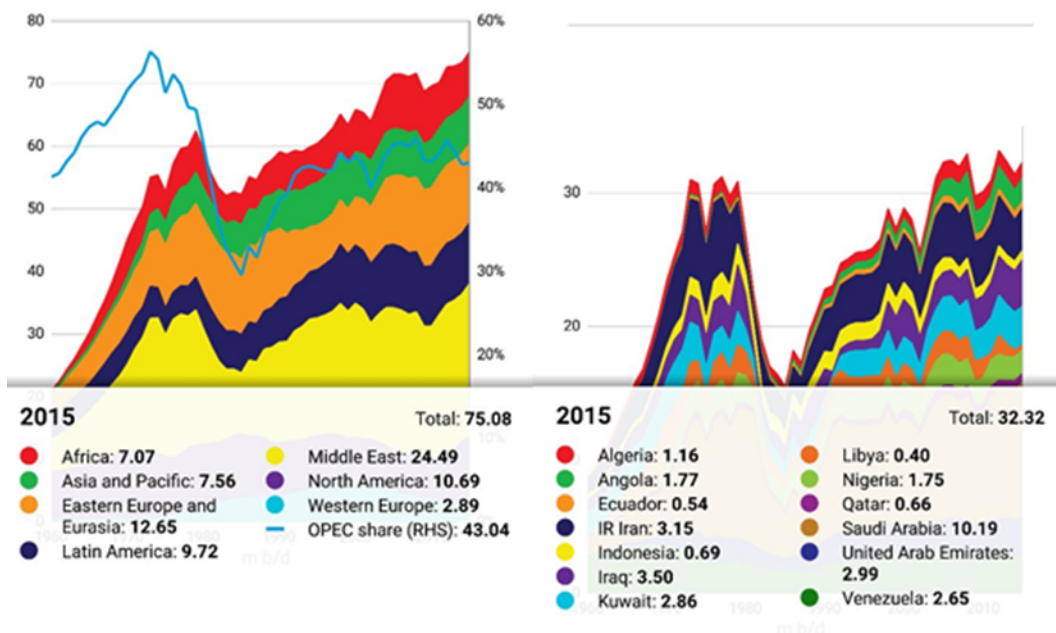
Natural Gas (billion cubic feet)

Proved reserves, 2013	Dry natural gas production, 2012	Dry natural gas consumption, 2012	Reserves-to-production ratio
215,025	1,854	2,235	116

Electricity

Generating capacity, 2011 (gigawatts)	Electricity generation, 2011 (billion kilowatthours)	Electricity consumption, 2011 (billion kilowatthours)	Distribution losses, 2011 (billion kilowatthours)
26.1	97.9	82.5	7.2

Source: U.S. Energy Information Administration (2014)



(a)

(b)

Fig. (4): Shows a: world crude oil production, b : OPEC members crude oil production.

Table (1) : UAE summary energy statistics

Table (2) : Shows Oil production at selected UAE fields and planned increases, 2012

Field name	Production (bbl/d)	Planned increases (year)
Bu Hasa	550,000	
Sahil, Asab, and Shah (SAS)	430,000	200,000 (2014)
Murban Bab	360,000	
Bida al-Qemzan	225,000	75,000 (2016)
Upper Zakum	500,000	250,000 (2016)
Lower Zakum	300,000	125,000 (TBD)
Umm Shaif	230,000	50,000 (2018)
Al-Dabbiya, Rumaitha, and Shanayel	100,000	none reported
Satah	20,000	100,000 (2017)

Source: U.S. Energy Information Administration, (2012).

United Arab Emirates petroleum consumption, 2003-2012

thousand barrels per day

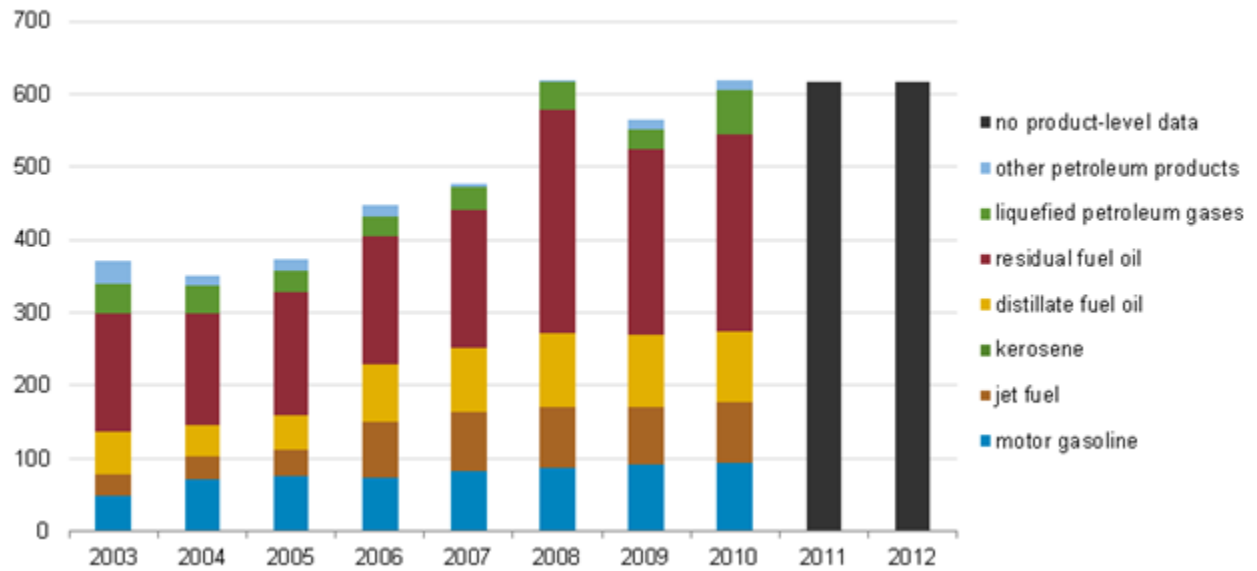


Fig. (5) : Shows UAE total oil supply and total petroleum consumption, 2003-2012.(Source: US energy Information Administration, 2012)

United Arab Emirates dry natural gas production, 1980-2012

billion cubic feet

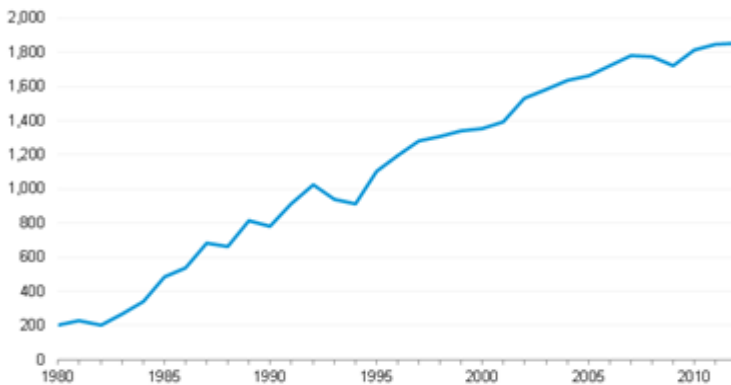


Fig. (6) : UAE dry gas production to the period between 1980-2012. .(Source: US energy Information Administration, 2012)

Table (3) : Shows the top-10 countries with proved natural gas reserves, 2013

Country	Trillion cubic feet
Russia	1,688
Iran	1,187
Qatar	890
United States	334*
Saudi Arabia	288
Turkmenistan	265
United Arab Emirates	215
Venezuela	195
Nigeria	182
Algeria	159

*2012 data

Source: U.S. Energy Information Administration, (2013).

Top 10 natural gas reinjecting countries, 2011

billion cubic feet

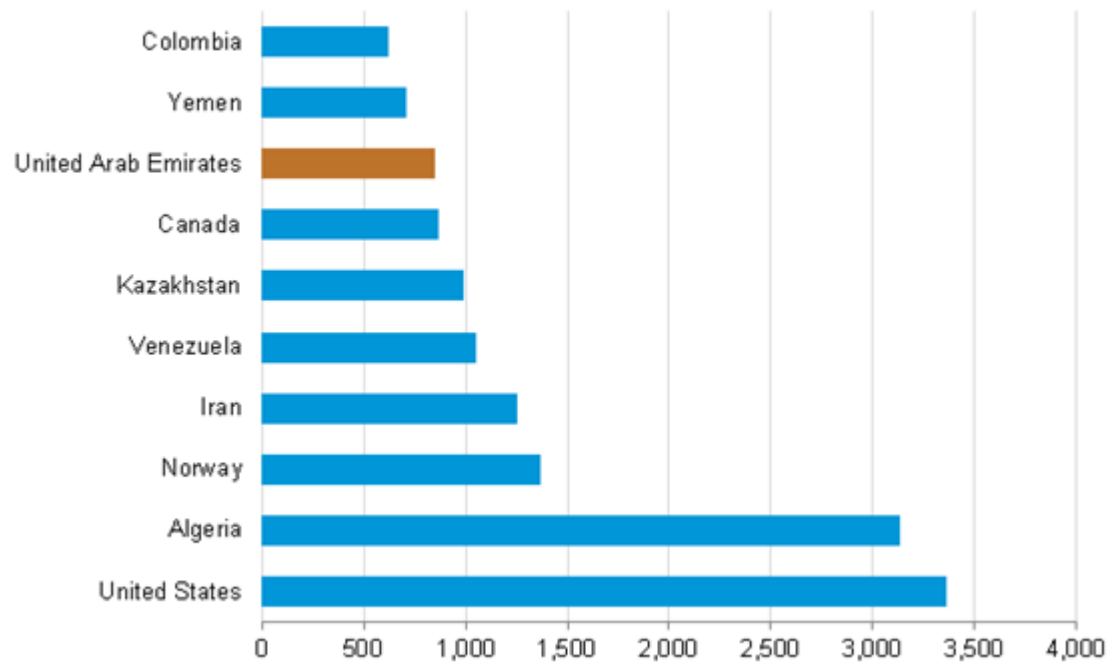


Fig. (7); The figure shows the top 10 natural gas reinjecting countries in 2011, (Source: U.S. Energy Information Administration, 2011).

. [BP Statistical Review of World Energy](#), (2014).

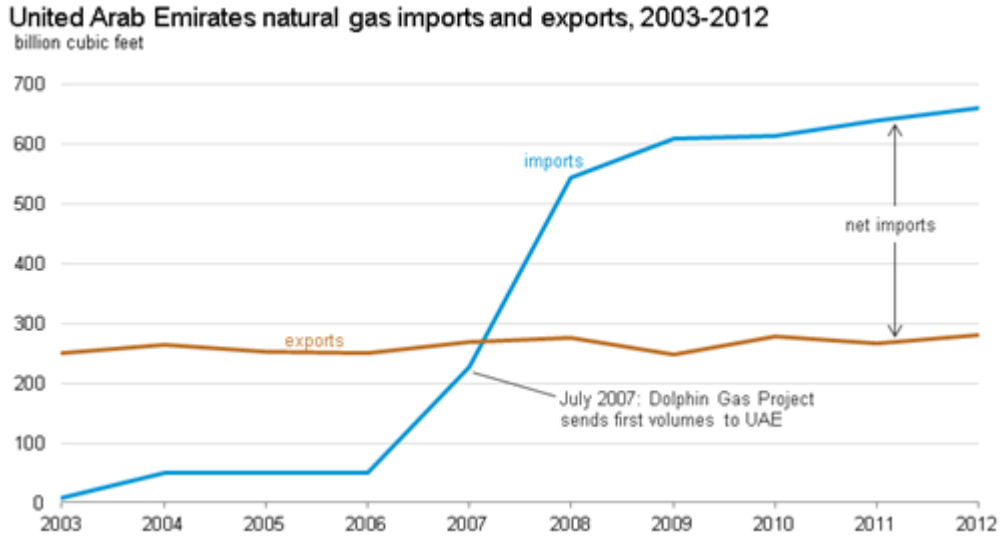


Fig. (8) : UAE natural gas import & exports in the period between 2003-2012, (Source: U.S. Energy Information Administration, 2011).



Fig. (9) : Shows Electric power consumption (kWh) in the UAE to the period between 1998-2010. **(Source:** <http://www.tradingeconomics.com/united-arab-emirates/electric-power-consumption-kwh-wb-data.html>).**)**

unedited draft