

HISTORY OF INITIAL ENERGY AND WATER NETWORK DEVELOPMENT IN QATAR

Mohd. Jassim ZAMAN¹, Marek OLESZ²

1. Texas A&M University
tel.: +48 514844541 e-mail: mk1004089@qu.edu.qa
2. Gdańsk University of Technology
tel.: +48 3471820 e-mail: marek.olesz@pg.edu.pl

Abstract: Qatar: A country which had to be associated with neighboring countries like UAE or Saudi Arabia for people to know about it, stands proud today due to the ample production and exporting of Black Gold. A country with almost no vegetation or suitable weather to harvest crops, turned from being heavily dependent on trading Pearls to exporting natural oil and gas to all over the globe. The paper outlines in details the history of the development of Energy sector in the State of Qatar. Being under British protection around the Arabian sea and Ottoman Empire from Land, there was not much of interest in this region. However, the scenario changed drastically after the discovery of Oil in 1938. Being able to produce and export the oil in huge quantity, it took Qatar less than 40 years to transform its energy sector totally. The paper describes these post oil discovery developments in the energy sector of the State of Qatar and links History to the Present.

Keywords: Black Gold, Energy, Export, Pearl, Qatar.

1. INTRODUCTION

Energy is important in day to day life. In physics, energy is the quantitative property that must be transferred to an object in order to perform work on, or to heat, the object. Energy is a conserved quantity; the law of conservation of energy states that energy can be converted in form, but not created or destroyed. The paper illustrates the initial development of Energy in the State of Qatar and how it initially came over the scarcity of energy in the hot and arid Arabian Peninsula.

1.1. Geographical background

Qatar is a trivial peninsula in the Persian Gulf covering an area of roughly 11 000 km² as well as a number of small offshore islands. Its maximum length is about 180 km along the north-south axis, while the east-west width is 85 km at its broadest point. It is limited by the Persian Gulf on all sides except in the south where it touches the eastern province of Saudi Arabia [1].

2. HISTORY OF THE ENERGY SECTOR DEVELOPMENT OF QATAR

Being a peninsula, the means of energy in the Middle eastern region and Qatar was basically by depending on the coal energy that were traded from the eastern part of the world and ottoman empire. With little oasis and almost no access to fresh water, energy development was crucial for the sustenance of life in Qatar.



Fig. 1. Qatar's Map

Before the world war one, the economy of Qatar was based on earnings from trading Pearls which were abundant in the region. However, with the introduction of artificially cultured pearls by Japan, the market for trading collapsed and Qatar had to look for newer means to sustain its economy which would provide for its energy consumptions.

To understand the development of Energy sector in Qatar, it is necessary to look in to the history of Qatar's natural recourses as they contribute to the development of sectors not limited to only energy, but all other sectors.

The energy sector of Qatar is mainly focused on fossil fuel and can be categorized into two points. These are crude oil and natural gas.

2.1. Discovery of crude oil and development

Qatar's investigation of the oil market began around 1923, Qatar's first oil discovery was made in late 1930s with oil deposits found in Dukhan (North western) field. Interest was awakened in the oil potential of Qatar in 1931, when the Anglo-Persian Oil Co. (Now British Petroleum) began carrying out a detailed geological survey of the country.

In 1935, the company was granted a concession to explore for oil. The license was subsequently transferred to Petroleum Development (Qatar), associated with the Iraq Petroleum Co. in which Anglo-Persian Company was a shareholder. Petroleum Development, which was later renamed the Qatar Petroleum Company (QPC), struck oil near the village of Dukhan after the first exploration well. Dukhan No. 1 was under service in October 1938.

Two more wells were drilled in the same structure, but the second World war made it necessary to plug all three, when initial production operations had taken output to the 40,000 b/d level. Operations were not resumed until the end of 1947. The first shipment was made from the new terminal at Umm Said (south of Qatar) in December 1949. In the same year, further exploration licenses covering offshore areas were also granted [3].

In May 1960 and with a few months, an even more capable discovery was made 11 miles to the north-east, named Maydan Mahzam. A third offshore field, Bui Hanine, was discovered in 1970 and that came on stream in 1972. The Qatar General Petroleum Corporation (QGPC) was created in 1974 and, in accordance with Decree No. 72 of 1980, was subsequently merged with the Qatar Petroleum Producing Authority [3]. In December 1974, the government decided to acquire all the remaining shares in these two companies. The creation of QGPC (Qatar general Petroleum Company) stemmed from these developments and it took over all the state's shareholdings.

Qatar built up a theoretical production capacity of 650,000 b/d during the 1970s, but output never attained that level. The all-time high was recorded in 1973, when production averaged 570,300 b/d. The new structures and technologies helped raise onshore production capacity by 70,000 b/d and boost total capacity to 550,000 b/d by 1993.

Qatar was originally allocated a quota of 300,000 b/d in 1982, but that was cut to 280,000 b/d in late 1984, when output amounted to 290,000 b/d. The situation changed radically in 1986 when OPEC abandoned its official pricing structure and its production quota system. Qatar stepped up output to 340,000 b/d in the first seven months of the year, but brought it back down to 280,000 b/d from September 1 1986, when the quota system was reestablished and production averaged 313,600 b/d.

Qatar's production quota was raised in two stages in 1987 to 285,000 b/d for the first half of the year and 299,000 b/d for the second half. Qatar was assigned an increased quota of 312,000 b/d for the first half of the year, which was raised to 329,000 b/d for the third quarter and 346,000 b/d for the fourth quarter (an average of 324,750 b/d for the year).

For the first half of 1990, Qatar's production quota was raised to 371,000 b/d, approaching the country's actual extraction rate at the end of 1989.

Qatar's oil reserves have not been substantially re-evaluated since 1984, when a new official estimate of proven reserves was published, putting them at 4.5 billion barrels as against 3.33 billion barrels before. Assuming an average 500,000 barrels per day the reserves should have lasted approximately 25 years from 1990 i.e. say till 2015 [3].

However, again due to newer technologies, the oil and gas that was deemed to be unusable and un- extractable are being able to be used up. In addition, newer oil and gas fields have been discovered which promises another decade's worth of reserve for Qatar. Qatar's reserves are almost equally divided between onshore and offshore fields. The field has an estimated production capacity at present of 250,000 b/d, although its current rate of output is well below that. The bigger offshore field is Bui Hanine, the last of the three to be discovered, which has recoverable reserves of about 1.1 billion barrels. Idd Al-Shargi, discovered in 1960, has reserves estimated at around 350 million barrels, while Maydan Mahzam, discovered in 1965, contains an estimated 830 million barrels of recoverable reserves.

2.2. Discovery of natural gas and development

Qatar's recoverable reserves of natural gas are officially estimated at 156 trillion cu. ft., representing about 4.1% of the world total and 12% of total OPEC gas reserves. Almost all Qatar's reserves are concentrated in the colossal North Field which is probably the largest non-associated gas field in the world. It covers an area of some 6,000 sq.km, lies under relatively shallow water to the northeast of the Qatari peninsula, and its reserves in place are estimated at 156 trillion cu.ft. are considered recoverable. Recently this figure was raised to 250 trillion cu.ft [4]. Depending on the rate of extraction, the North Field could have a productive life of between 115 and 200 years, compared to a maximum of 30 years for Qatar's known oil resources. The development of the North Field is a gigantic project that will dwarf all other hydrocarbon developments in the Gulf region.

With the discovery of crude oil and Natural Gas, it was easier for Qatar to quickly adapt to changes and bring new technologies to develop its energy sector. From the early 1900's to the late 1940's, no information is available about the status of the supply of water and electricity in Qatar. Records as seen that Qatar's first Oil Well in Dukhan started production in 1940 and first oil shipment was exported in 1949. These are indicators that large permanent communities may have been established around that period needing sustained water and electricity for survival and industry.



Fig. 2. Ras Abu Aboud Power Station in early Years

The energy sector which deals with electricity in Qatar is named as KAHRAMAA, which is an Arabic word that translates to Electricity and Qatar.

The first diesel powered electricity station was built in Mushaireb (near the capital, Doha). The power station was named Ras Abu Aboud power Station. The station began operation in 1963 using steam turbines [5]. The steam for the operation of the turbines were found collected from the desalination plant which was also in Ras Abu Aboud as it is near to the sea. The salt water from the Arabian sea was heated up to 450 degrees Celsius and the steam from it was used to run the turbines for producing electricity. The desalinated water was stored in ground reservoirs and water towers situated along different parts of the country. For places where no towers were established water tankers were used to supply the consumers and all users of water.

The steam turbines having output of 30 MW, were initially designed and made in England, but within a year were replaced by Siemens, and today the turbines output is 200 MW. The output voltage of the turbine was 10.5 kV, which was sent to the substation where a transformer of rating 10.5/132 kV, stepped up and transmitted it to different areas. Until 1980 most of the grid was over head and were

132 kV cables. By 1986, it can be said that except the High voltage cables, the entire grid system was done underground.



Fig. 3. Water Storage Tank in Al Ghanem area

Few major in house companies supplied cables for this massive upgrade of infrastructures. One of the most prominent name in this sector is Elsewedy Cables, which is a joint venture between a Qatari and Egyptian businessman. Within 3 years, 1966, Ras Abu Aboud power station was upgraded to work on Gas instead of Steam, due to the abundance and discovery of Natural Gas. The power station on steam had a capacity of 30 MW, which later was upgraded to 200 MW with the installation of further steam turbines.

In early 1980's Power and Water were still separate businesses (now called KAHRAMAA). Works to lay down thousands of meters of water mains began in the year 1982. Between 1982 and 1996, about 1.17 million meters of water distribution network mains were in place. A growing demand for electricity saw the introduction of Satellite power stations, which are basically turbines that run on crude oil instead of steam, in Al Sailiyah, Doha Super South and Al Wajbah. German companies, Fischer and Eubanks begin construction of new power infrastructures and prior to these the British's established and dug wells as they were in a fight against ARAMCO to discover oil and win rights over the middle east. From the late 1980's to early 1990's, oil prices slumped on the world market leading to less oil revenue, decreasing the investments in the development of the country infrastructure projects, and resulted to instability in the electricity system.

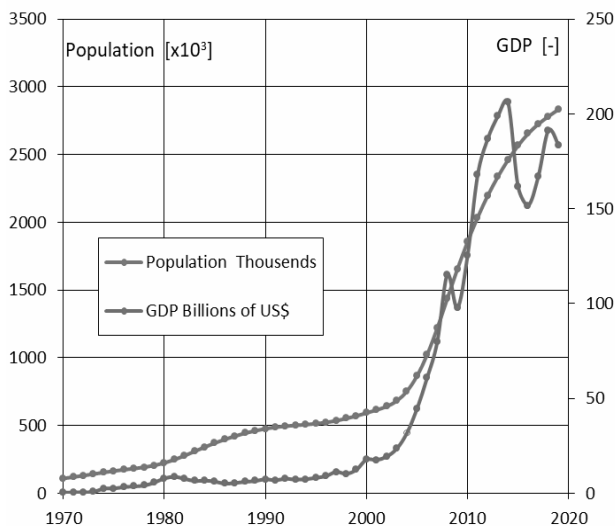


Fig. 4. The increase of population vs GDP in Qatar

As mentioned above, Qatar and surrounding areas have the least access to fresh ground water due to its geographical location. This imposed great pressure on the production and distribution of Electricity and Water around the country for the ever growing population (Fig.4). For instance, the population of Qatar in 1971 was only 120,000. This quickly increased when the oil and gas industry boomed. The population became 615,000 in 2001. However, with the massive developments carried within Qatar to host the Asian Games in 2006, a large number of skilled and unskilled labor force was brought to Qatar. The population just after 10 years stood at 2 million [6].

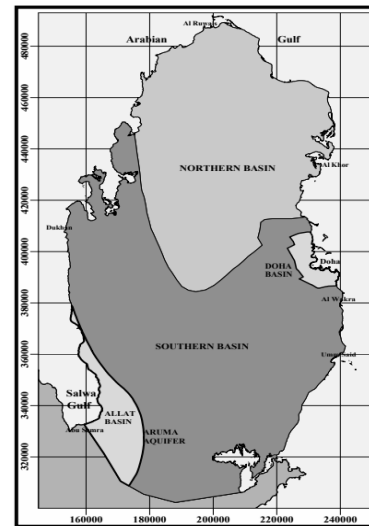


Fig. 5. Ground water Basin in the State of Qatar

The total ground water produced in Qatar is around 60 Mm^3 /year and the consumption is 250 Mm^3 /year [7]. To cater this quick increase in population, KAHRAMAA awarded projects in 2008 worth USD 30bn to develop the electricity and water sector.

The water made available for usage for agriculture, beautification, home and industrial usage mainly comes from these sources [8]: Abstraction of Fresh and Saline groundwater, Seawater Desalination, Re-use of treated sewage effluent.

Figure 5, shows the water basins in the State of Qatar, however, to conserve the natural resources and due to the fact that due to tectonic plate faults some basins have salinity which does not allow the water to be used normally. Therefore, most of the water consumed in various sectors in Qatar are supplied by KAHRAMAA. In 2000 the water production was around 0.44 million m^3 /day, which escalated to 1.48 million m^3 /day in 2011 [8].

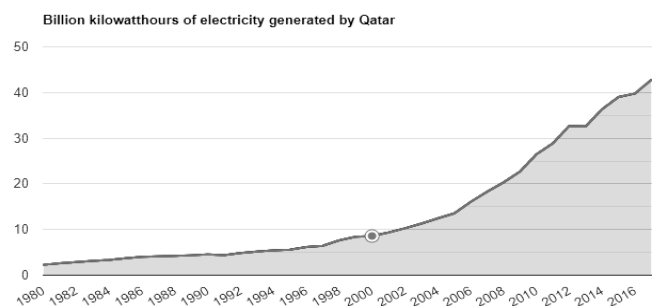


Fig. 6. Generation of Electricity from 1980 to 2016

In the year 1971, the production of electricity was approx. 9 billion kilowatts-hours., and this figure jumped quickly to around 25 billion kilowatts-hours. in 10 years, 2010. Figure 6, illustrates the electricity production in the State of Qatar, which came from fossil fuels [8]. As of 2020, the electricity production has reached 50 billion kilowatts-hours.

3. CONCLUSION

Crude oil is termed as Black Gold. Being successful in trading this Black Gold to all the other parts of the world, Qatar has grown stronger in terms of economy very quickly. With better economy is it possible to look for other sources to sustain the daily minimum energy required for life in Qatar. To mention, this was not possible in the past, since the climate is dry and temperatures soars up to 50 degrees Celsius during summer. Lack of mountainous regions or rivers, did not allow Qatar to look for hydroelectricity either. Recently, new deals and agreements have been signed by the concerning bodies to establish Solar Power Plants that will ease the load on the use of fossil fuels. With advancements to research and development done in house and around the globe, different solutions are being taken by Qatar to upgrade its energy system from the old ways of harvesting them. For instance, in 1963 there was only one power station in Qatar, that produced and serviced for the small amount of people in this Arabian Peninsula. Currently, there are 9 Power Plants in Qatar and it also shares its supply to neighboring countries. Among the other noteworthy improvements and upgrades in the energy sector, these are worth highlighting:

- The production of electricity and desalination of water are outsourced leaving KAHRAMAA to focus on transmission and distribution.
- Speed pumps are installed to by-pass small water towers so water is pumped directly from reservoir to homes.
- KAHRAMAA begins pumping water 24 hours continuously from June, 2008.
- KAHRAMAA enters into agreements with electricity and water supplies for increased volumes and capacity.
- KAHRAMAA signs deal with foreign companies to set up an 800MW Solar Power Plant worth QR 1.7bn.

- KAHRAMAA partners with Qatari Dior, responsible for the Urban development around the newly founded Islands Namely Pearl Qatar and Lusail for setting up 10 new electric vehicle charging stations around the area.
- KAHRAMAA wins two prestigious Global Sustainability awards on September, 2020.

ACKNOWLEDGMENT

This publication was made possible by NPRP grant [10-0101-170085] from the Qatar National Research Fund (a member of Qatar Foundation). The statements made herein are solely the responsibility of the authors.

4. REFERENCES

1. Crystal J., Anthony J.: Qatar, Retrieved September 16, 2020, from <https://www.britannica.com/place/Qatar>.
2. Achu U.: Qatar. The Energy Year, The Energy Year, 12 Dec. 2019, theenergyyear.com/market/qatar/.
3. Sorkhabi R., et al.: The Qatar Oil Discoveries, GEOExPro, Vol. 7, No. 1, 2010, from www.geoexpro.com/articles/2010/01/the-qatar-oil-discoveries.
4. Cochrane P.: Supertanker state: How Qatar Is Gambling Its Future on Global Gas Dominance, Middle East Eye French edition, 2 July 2020, from www.middleeasteye.net/news/qatar-gas-lng-market-oil-prices-dominance.
5. Qatar General Electricity & Water Corporation - المؤسسة العامة القطرية للكهرباء والماء, Retrieved September 16, 2020, from <https://www.km.qa/AboutUs/Pages/History.aspx>.
6. Global Petrol Prices: Qatar, Energy mix for electricity generation, 2016, June/July, Retrieved October 07, 2020, https://www.globalpetrolprices.com/energy_mix.php?countryId=144.
7. Alhaj M., Mohammed S., Darwish M., Hassan A., Al-Ghamdi S. G.: A review of Qatar's water resources, consumption and virtual water trade, Desalination and Water Treatment, 90, 2017, pp. 70-85.
8. Ministry of Development Planning and Statistics, Water Statics in the State of Qatar in 2015, 2015, November/December, Retrieved October 08, 2020, from <https://www.psa.gov.qa/en/statistics/Statistical%20Releases/Environmental/Water/2015/Water-Statistics-2015-En.pdf>

POCZĄTKI ROZWOJU SYSTEMU ENERGETYCZNEGO I ZAOPATRZENIA W WODĘ W KATARZE

W sąsiedztwie Kataru znajdują się Zjednoczone Emiraty Arabskie i Arabia Saudyjska. Warunki pogodowe uniemożliwiają w tej części świata produkcję rolną, więc import produktów żywnościowych w przeszłości umożliwiał handel perłami, który obecnie zastąpiły ropa naftowa i gaz skroplony. Artykuł zawiera wiadomości dotyczące rozwoju sektora energetycznego oraz systemów zaopatrywania w wodę w Katarze po odkryciu ropy, które miało miejsce w 1938 roku. Wytwarzanie energii elektrycznej opiera się na wykorzystywaniu surowców naturalnych, do których należą złoża ropy i gazu (4,1% zasobów światowych, 12% OECD). Pierwsza elektrownia konwencjonalna powstała w Mushaireb w pobliżu Doha stolicy Kataru. Uruchomiona w 1963 zawierała generatory napędzane silnikami Diesla. Wytwarzaną energię wykorzystywano do produkcji wody pitnej w pobliskim przedsiębiorstwie odsalającym wodę morską. Napięcie z układu generacyjnego o wartości 10,3 kV transformowano na poziom 132 kV i przesyłano do dalszych miejsc, początkowo poprzez linię napowietrzną, a potem kablową. Elektrownię tę w kolejnych latach rozbudowywano, aż do osiągnięcia obecnej mocy około 210 MW.

Słowa kluczowe: czarne złoto, energia, eksport, perły, Katar.