



Qatar

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National Energy Introduction

Energy Policies

Qatar is a desert country located in the Middle East as a peninsula in the Persian (or Arabian) Gulf. In 1977, a decree law was enacted to preserve oil resources by setting technology norms and industry standards for production [1]. This law was set out to protect the environment and reduce the risk to human life [1]. Law No. 30 of 2002 was set in motion by 2003 to maintain the environmental quality, avoid damaging effects from man-made error, sustainable developments moving forward, and protection of public health as well as wildlife [1]. The country is subject to extreme heat, and therefore many energy policies center around air conditioning. Policies enacted in 2009 and 2013 set standards and parameters for energy production for the purposes of air conditioning [1].

Trends in Generation Technologies (Fig. 1)

Domestic Resources

The country of Qatar is abundant in oil and natural gas both onshore and offshore. The countries resources are so vast that they have little purpose to depend on other countries for energy production.

History of Energy

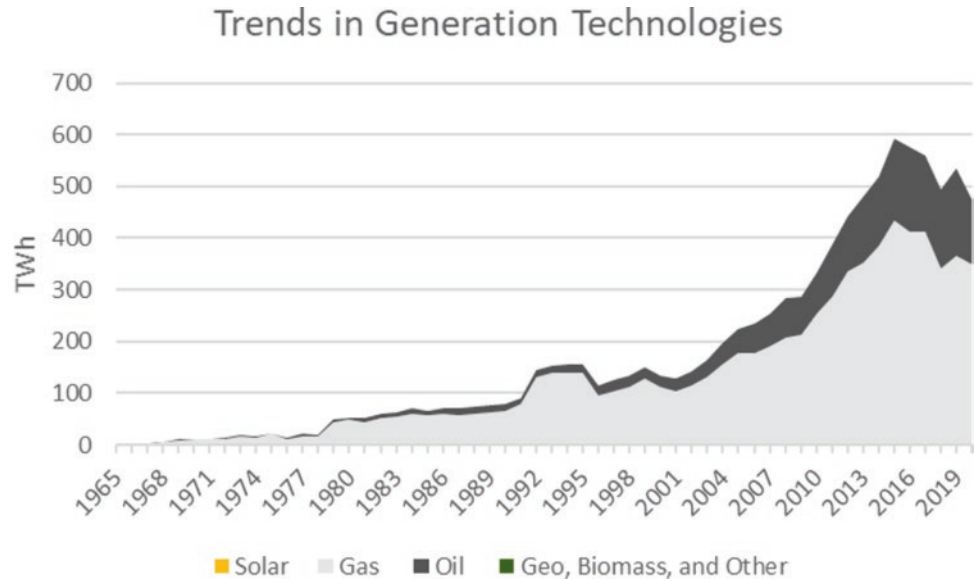
Before oil was developed in Qatar, the country's economy was largely based on underdeveloped agriculture [2]. In 1931, Anglo-Persian Oil Co. did a geological survey and discovered oil potential [2]. By 1935, that same company was granted a concession for development [2]. The license for the concession was transferred to Qatar's Petroleum Development in association with Iraq's Petroleum Co; however, Anglo-Persian was still a shareholder [2]. Dukhan No. 1 was the first to strike oil on one of the first well explorations in 1938 [2]. Two other wells were erected in the area, however, World War II forced all three wells to stop resulting a production drop-off of 40,000 barrels per day at the time [2].

At the end of 1947, oil production was restarted, and by 1949 the country opened up to further exploration including offshore ventures [2]. The third offshore field, Bul Hanine, was discovered in 1970 and was producing by 1972 [2]. By Decree No. 72 of 1980, Qatar General Petroleum Corporation (QGPC), created in 1974, was merged with the Qatar Petroleum Producing Authority and took over all the counties shareholdings across the various oil companies in operation within their borders [2]. Most of Qatar's natural gas production is in conjunction with their oil wells [2]. Qatar's oil and natural gas sectors are overseen by the state-owned organization Qatar Petroleum (QP) [3].

In December 2003, Qatar climbed the ranks to one of the key players of the global economy in oil and natural gas revenue [4]. In 2013, Qatar was the fourth largest dry natural gas producer in the world [3]. Much of the country's economy relies on their energy sector with 49% of government revenue coming from hydrocarbon sales in 2014 [3]. A discussion lecture given in February 2014 informed the public that Qatar's unique ability to supply 100% of its power from natural gas has allowed the country to use the oil production as a way to drive revenue [5]. The same session observed the necessity for renewables due to the fact that reserves will eventually deplete and as they do the countries revenue will also causing financial hardship [2].

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Fig. 1 Qatar trends in generation technologies [2]



Breakdown of Energy Generation “Mix”

Energy Generation Mix

Electricity production in 2016 was up to 39.78 billion kWh with country consumption at 37.24 billion kWh [6]. The total installed capacity of Qatar as of 2016 was 8.796 million kW where 100% was generated from fossil fuels [6]. Figure 2 is the combination of energy generation within Qatar in the units of gigawatt-hours (GWh).

Energy Generation Mix

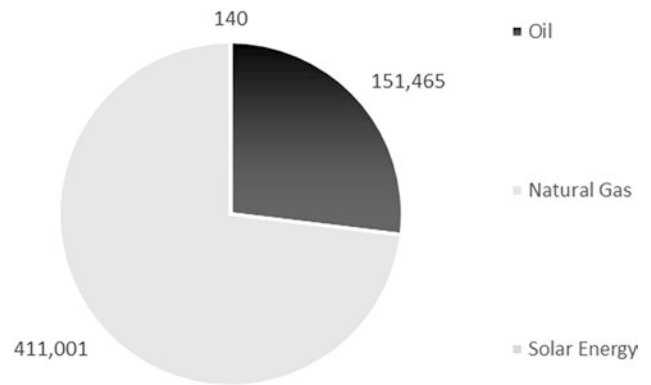


Fig. 2 Energy generation mix

Energy Consumption Mix

Figure 3 is the consumption distribution of fuel within Qatar rated in GWh.

Table 1 is the numerical summary of the generation and fuel data to be described in detail below.

Fuel Consumption Mix

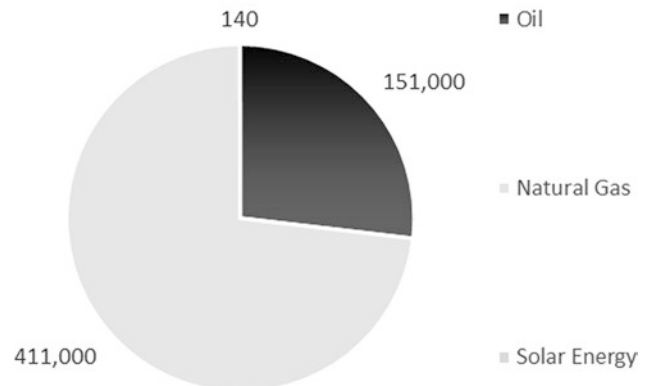


Fig. 3 Fuel consumption mix

Fossil Fuels

Oil

Being a large producer of oil, Qatar only uses approximately 277,000 bbl/day (as of 2016) generating about 151 TWh from oil in 2019 [6, 7]. Current production of crude oil is around 1.464 million bbl/day with 1.15 million bbl/day being exported [6]. Refined oil production was at 273,800 bbl/day as of 2015 with exports at 485,00 bbl/day and imports of 12,300 bbl/day [6].

Qatar has nine major oil fields: Al Shaheen, Dukhan, Idd al-Shargi, Bul Hanine, Maydan Mahzam, AlKaheleej, Al Rayyan, Al-Karkara, and El-Bunduq [3]. The fields consist

Table 1 Fuel breakdown

Fuel	Quantity	Installed capacity (MW)	Energy production (GWh)	Energy consumption (GWh)	Imports (GWh)	Exports (GWh)
Oil	9	2661.68	151,465.1862	151,000	20.8977	465.1862
Coal	NA	NA	NA	NA	NA	NA
Natural gas	28 (lines)	2716	411,001.3055	411,000	0	1.30548
Nuclear	NA	NA	NA	NA	NA	NA
Solar energy	1	7.39	140	140	NA	NA
Wind	NA	NA	NA	NA	NA	NA
Hydro	NA	NA	NA	NA	NA	NA
Ocean	NA	NA	NA	NA	NA	NA
Geothermal	NA	NA	NA	NA	NA	NA
Bio-energy	NA	NA	NA	NA	NA	NA

Table 2 Oil fields of Qatar [3]

Field	Capacity (thousand barrels per day)	Primary operator	Comments
Al Shaheen	300	Maersk	Maersk began work on \$2.5 billion drilling program in 2013 to maintain output at 300,000 bbl/day
Dukhan	225	Qatar Petroleum	ExxonMobil-led development plan likely to conclude in 2014
Idd al-Shargi	100	Occidental	Occidental Petroleum investing \$3 billion to maintain production of 100,000 bbl/day through use of enhanced oil recovery techniques
Bul Hanine	45	Qatar Petroleum	Total to invest \$6 billion to double capacity to 90,000 bbl/day by 2017
Maydan Mahzam	22	Qatar Petroleum	–
Al-Kahaleej	19	Total	–
Al Rayyan	8	Occidental	–
Al-Karkara	7	Qatar Petroleum Development Company	–
El-Bunduq	6.5	Bunduq Oil Company	Operated jointly with United Arab Emirates
total	732.5		

of both onshore and offshore wells producing up to 300,000 bbl/day [3] (Table 2).

As of a January 2018 survey, there were 25.24 billion bbl of proven crude oil reserves [6].

Coal

As of a 2019 report, Qatar did not have any coal production or generation [7]. Coal has not been as abundant or accessible in Qatar as oil and natural gas, so there is little to no incentive to develop in this sector.

Natural Gas

Qatar's consumption of natural gas in 2017 was 39.9 billion cubic meter producing 411 TWh of electricity by 2019 [6, 7]. The country has no need to import natural gas due to their abundance of it, however they did export about 126.5 billion cubic meter in 2017 [6].

On- and off-shore fields typically in conjunction with their oil production facilities.

As of a 2018 survey, Qatar had 24.07 trillion cubic meter of natural gas proven reserves [6].

Nuclear Energy

There are no current plans for Qatar to develop nuclear power plants.

Renewable Energy Generation

Approximately 1% of Qatar's installed energy generating capacity is from renewable resources [6].

Photovoltaics (PV)

Currently, Qatar has a small amount of solar power installed but not of a substantial capacity as of yet.

Qatar's new solar production goals for 2030 are broken down into two phases: 2021 will be the launch of 350 MW of capacity to be completed in 2022 with a grand total of 700 MW of capacity [8].

Wind

As of this writing, Qatar has no installed wind generator fields.

While the country does not have wind farms at this time, there is huge potential for such generation. Given a mean wind speed of 5.06 m/s, Qatar could save 6.813 tons of CO₂ with the addition of a 17 MW capacity wind farm [9].

Hydro

Qatar currently does not have any notable hydroelectric plants and no plans of one have been found.

Ocean

Qatar currently does not have any notable ocean power plants and no plans of one have been found.

Geothermal

Qatar currently does not have any notable geothermal plants and no plans of one have been found.

Biomass

Qatar currently does not have any notable biomass plants and no plans of one have been found.

Biofuels

Qatar currently does not have any notable biofuel plants and no plans of one have been found.

Energy Storage Technologies

Country's Current Implementation of Energy Storage Techniques

As of a report in August of 2020, Qatar General Electricity and Water Corporation commissioned their first ever large-scale battery storage system [10]. A 1 MW and 4 MWh Tesla battery storage system is to be grid connected mainly to meet growing energy demands for the summer months, a US\$2.75 million investment [10].

Country's Future Storage Direction

Qatar has good global relations and has access to growing technologies of today.

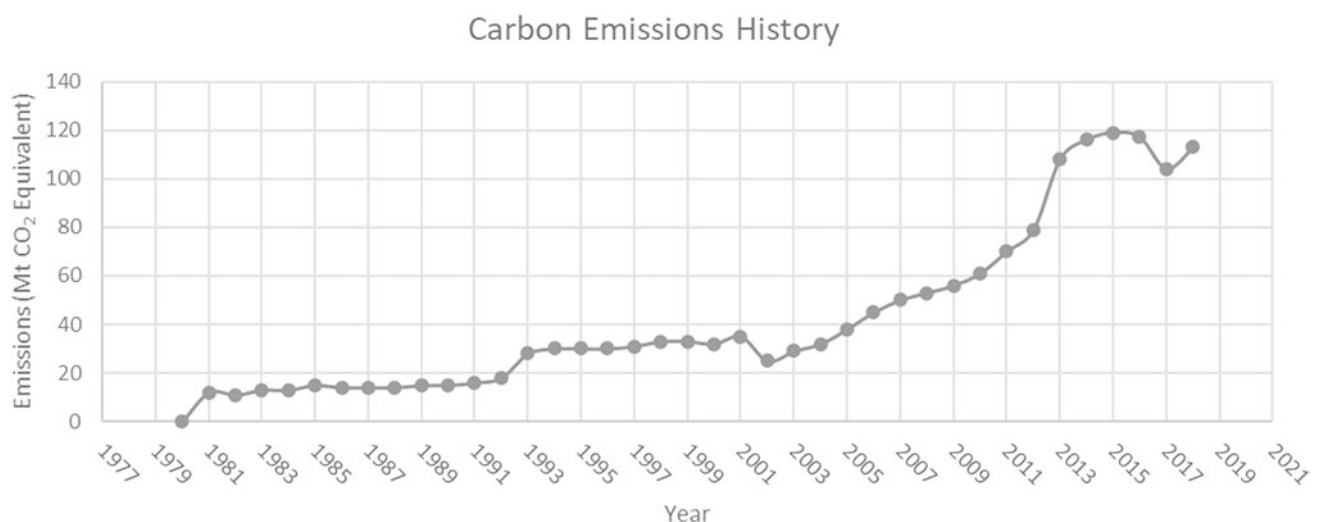


Fig. 4 Carbon emissions history: EIA CO₂ emissions data from 1980 to 2018 [11]

Carbon Footprint

Most Recent Carbon Output

The most recent record of carbon emissions was at 105 Mt of CO₂ equivalent [11].

Historical Trends of Carbon Footprint

Figure 4 is Qatar's carbon emissions history from 1980 to 2018 from EIA data. The emissions data includes coal, coke, consumed natural gas, petroleum, and other liquids [11]. It is worth noting that while coal and coke are included, the record shows no carbon emissions from these sources, this is due to coal not being mined or used in Qatar according to current records [11].

Types and Main Sources of Pollutants

The main source of pollutants is from the oil and natural gas fields and their production. Natural gas has a greater impact on pollutants due to its use for power generation throughout the country. Aside from CO₂ pollutants, dust storms also wreak havoc on the country which leads into air quality.

Air Quality

Due to the abovementioned pollutants and according to the International Association for Medical Assistance to Travellers (IAMAT), Qatar's air quality is dubbed unsafe with an average concentration of PM_{2.5} of 91 µg/m³ [12]. For perspective, PM_{2.5} are inhalable pollutants of approximately 2.5 µm or smaller, and the recommended levels are within 10 µg/m³ [12].

Energy Resiliency

Climate and Natural Disasters

As stated in the Pollutants section earlier, Qatar is plagued with dust storms. This could pose a problem with the implementation of renewables and especially with their solar farm plans. For solar fields to work with the best efficiency, they should be clear of debris, however, a dust storm would cover the panels with dust at least in part and would therefore require regular maintenance.

Due to Qatar's geographical location and terrain, heat is a constant hindrance on electrical demand. With the increase of temperatures and change in weather patterns, the tempera-

ture is ever increasing the demand on power for air conditioning and water desalination [13]. Typically, 80% of energy production goes toward cooling through the year [13]. Energy consumption is foreseen to increase up to 30% resulting in an increase of carbon emissions, which could worsen the situation [13].

Grid Resiliency

The abundance of natural gas and crude oil allows generating units to be highly resilient, there are few blackouts since the release of 1000 MW to the grid in 2009 [14].

Geopolitical Circumstances

Reliance on Foreign Fossil Fuels

Due to Qatar's abundance of oil and natural gas, the country does not require dependency on other countries for fuel resources. However, the country does acquire technological support from other well-developed countries to create energy diversity [8].

A large portion of Qatar's revenue is acquired through their energy sector, mainly in the export of crude oil. The country is endowed with an abundant supply of crude oil and ships it across the globe making Qatar a friend to most of the world. Nevertheless, the country is looking to diversify their energy production and revenue so as not to become dependent upon a diminishing resource.

Relations with Global Community/ Socioeconomic Influence

Qatar is working in pace with the United Nations sustainability goals and is making such strides as to diversify their energy profile to include solar energy and other natural, environmentally-friendly resources [15]. The country is committed to being the first host to prepare a carbon-free World Cup Championship for 2022 [15].

Qatar is focused on meeting the world energy and sustainability goals and to meet the needs of their people.

Education

Qatar has extensive higher education curriculums for environmental and energy research such as contained within its infamous Education City, a campus spanning 12 km² and the College of the North Atlantic-Qatar [16]. Qatar is currently growing their energy education system as they start their

