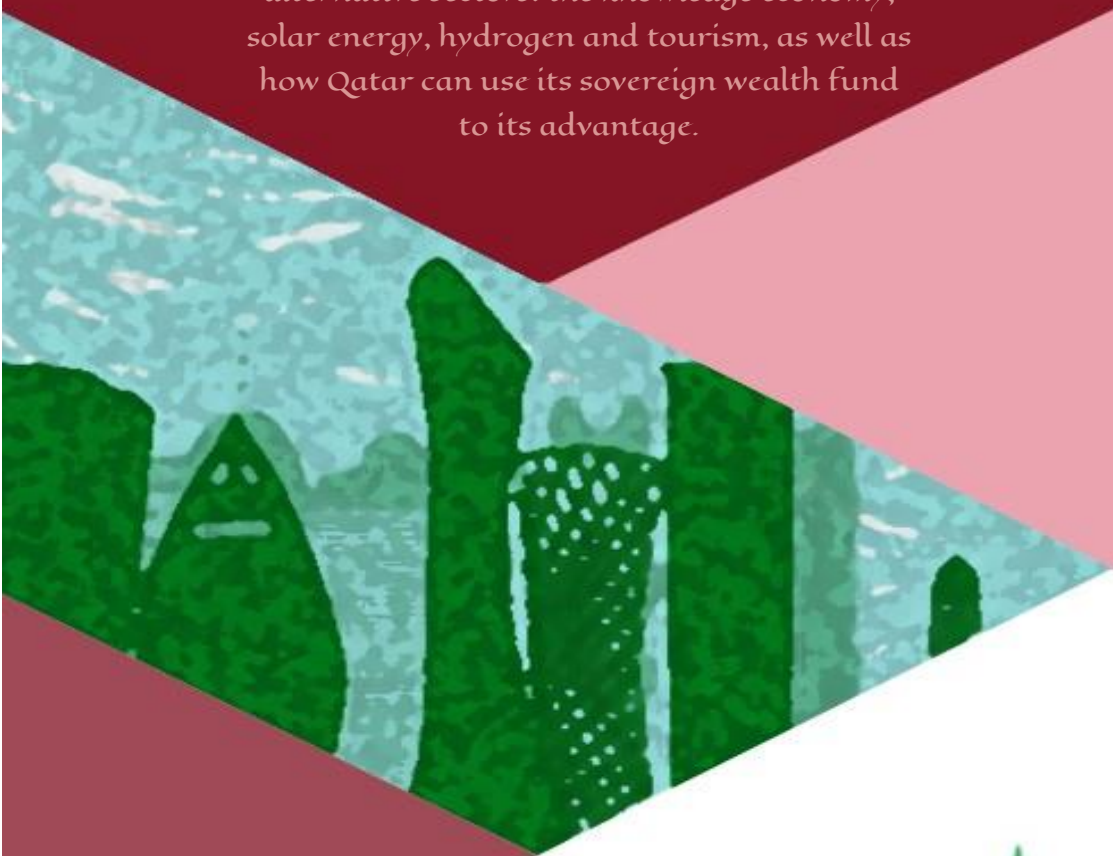
QATAR

Beyond the Fossil Fuel Age

The age of oil and gas is coming to an end. So, what can help Qatar maintain its future prosperity and wellbeing? This comprehensive analysis by the progressive, environmental organization-LINGO- will highlight potential alternative sectors: the knowledge economy, solar energy, hydrogen and tourism, as well as how Qatar can use its sovereign wealth fund to its advantage.



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Alhussein Elrayah & Kjell Kühne. LINGO. Leave It In The Ground Initiative. 2021. https://www.leave-it-in-the-ground.org/

Introduction

For decades, Qatar's economy has depended mostly on the export and production of fossil fuels. Oil was discovered in the 1940s, but it was the discovery of fossil gas[1] in the 1990s which truly advanced its economic prospects. Qatar has an estimated 25 trillion cubic meters of proved fossil gas reserves, the third highest in the world (OPEC 2020). Fossil gas helped it grow from an inconsequential peninsula dependent on the pearl diving industry into a high-income economy with strong trading ties with the world's great powers (Bohra and Shah 2019).

The hydrocarbon industry not only involves the export of oil and gas, but also the export of industrial products made up of fossil fuels, especially petrochemicals, which it produces domestically. Hydrocarbons account for more than 50% of its GDP and 90% of its exports. (OPEC 2020; US-Qatar Business Council "Economics").

In addition to exports, Qatar produces more than 90% of its electricity and water needs through fossil fuels, via a system of power plants. The combustion of fossil gas produces electricity. This combustion also allows the thermal desalination of salt water to form freshwater, since the country has no freshwater sources of its own (Bohra and Shah 2019).

There are currently three main threats to the Gulf state's hydrocarbon-dominant economic and energy model. Firstly, global efforts at decarbonization and the shift towards renewables will mean that fossil fuels will be in less demand. Second, the use of fossil fuels at current levels through the 2020s is projected to worsen global climate change. Carbon emissions must be cut by 45% between 2010 and 2030 in order to limit global warming to 1.5 C^{o}, as outlined by the Intergovernmental Panel on Climate Change (IPCC 2018). If warming exceeds this limit, this is projected to cause more extreme shifts in climate. This potential climate change catastrophe will specifically affect Qatar primarily in the areas of water and food security (Meltzer, Hultman and Langley 2014). Third, even supposing that Qatar continues to exploit its hydrocarbon reserves at current rates, both oil and gas are projected to run out some time in the 21st century (Bohra and Shah 2019). Fossil fuels are limited resources so will not be able to sustain Qatar's economy.

Therefore, economic diversification is key to the continued prosperity of Qatar and reducing the effects of shifts in global climate.

The analysis will first explore the latest scholarship surrounding alternatives to fossil fuels. This will start with the knowledge economy, followed by solar energy, hydrogen and tourism. For each option, its advantages and disadvantages will be outlined. The end of will highlight how Qatar could use its significant

[1] Although more commonly referred to as 'natural gas', the alternative term 'fossil gas' is a much more accurate description, as the fuel is composed of fossils and therefore a significant contributor to greenhouse gas emissions. The word 'natural' can help underplay these harmful effects.

sovereign wealth fund to finance its potentially expensive transition.

Potential Replacements of Hydrocarbons

1. The Knowledge Economy

Advantages

The main strength Qatar has is that its government- which dominates all sectors of the economy- **has shown significant interest** in transitioning Qatar to a knowledge economy. This interest is evidenced by Qatar 2030 and Qatar's National Development Strategy of 2018. These plans have served as a blueprint for the state to carry out new education, ICT and innovation initiatives (Hassen 2020).

In terms of education, Qatar has made significant efforts since the 1990s **to attract highly-skilled workers and educators** to the country to begin building the knowledge economy. The most significant of these efforts has undoubtedly been the establishment of Education City, a collection of top university institutions and think tanks from the US. This has been a great step for the country's domestic workforce to train in world-class education facilities and can provide the opportunity for Qatar's workforce to become internationally competitive in terms of their skills. (Hassen 2020).

These educational achievements have made Qatar take **positive steps in the area of innovation.** Other than the Qatar Foundation, since the 1990s, Qatar has opened a number of research institutions which includes: Qatar Science and Technology Park, Qatar Computing Research Institute, and Qatar Environment and Energy Research Institute (Hassen 2020). This can help educate the workforce but also attract skilled workers from abroad.

In terms of ICT, Qatar has made substantial **investments in new, foreign technologies and products.** This has been especially high since 2004 and has accelerated since the decade building up to the 2022 World Cup (Hassen 2020). This has resulted in Qatar being ranked 40th out of 175 countries in 2020 in the area of fixed broadband and 2nd in the world with regards to the area of internet access in the Network Readiness Index, which measures a country's ability to benefit from new technology. In sum, this has made Qatar a country where learners and workers have significant and consistent access to the world's most advanced technologies (Hassen 2020).

Disadvantages

One of Qatar's significant weaknesses is that its **current education system cannot domestically produce** and therefore effectively sustain an internationally competitive workforce. Qatari nationals have low interest and performance in the STEM fields, which as the building blocks of careers in an engineering-dominated knowledge economy, is a huge issue. In a 2016 study, 70% of Qatari students performed poorly in the area of STEM and reading (Hassen 2020). This lack of performance is also coupled by a lack of interest, which is caused by government incentive structures. Despite Qatar's government investments, the public sector remains the dominant employer for nationals with high-paying jobs subsidized by hydrocarbons. As such, nationals, from the primary school level of education, show more interest in these jobs. This means that Qatar Foundation and other research institutions are dominated by expatriates, with few Qataris qualified to attend those universities (Hassen 2020).

This poor attainment in education means that a **workforce in the knowledge economy is lacking for nationals**. Currently, efforts at the knowledge economy- the largest sector of which is engineering-, like education in the STEM fields, is dominated by expatriates. While many public sector jobs are subsidized by hydrocarbons, in the future, this could be not the case due to a rising population and limited hydrocarbons, so the main option seems to be an educated, internationally competitive workforce. (Hassen 2020).

These poor achievements in education and workforce means that Qatar is **far from being internationally competitive in the area of innovation.** Most institutions rely on research and development from abroad. For instance, in 2014, only 10% of ICT enterprises invested in research and development and this has continued to be the case (Hassen 2020). This is significant since this lack of innovation capacity means that Qatar cannot adequately conduct research domestically to provide itself a comparative advantage in innovative, new technologies. As such, unlike countries like Taiwan and Singapore in the past, it has not actively managed to improve on its unfamiliarity with technological innovation. This public sector dominance mentioned earlier also has the added disadvantage of making the entrepreneurship sector having a low number of new ideas. Most entrepreneurs are part-timers. They tend to have a main full-time job is in the public sector since the economic risks are too high to become a full-time entrepreneur (Hassen 2020).

Qatar has also been lacking in the area of teamwork with **little collaboration between the major stakeholders** in the knowledge economy. This means that, as seen before in the areas of education, workforce and innovation, Qatar's progress has been very slow, and according to studies, not proportionate to its high levels of investment (Hassen 2020). Despite the

Qatar 2030 Strategy, in practice, The Qatar Development Bank, Qatar Foundation and Qatar Science and Technology Park have not been working much together to progress in the areas of education and innovation, with no clear joint objectives for how they will work together (Hassen 2020). This low rate of collaboration remains a threat to Qatar achieving its aspirations to become an internationally competitive knowledge economy.

2. Solar Energy

Advantages

First, Qatar has been **making progress in the area of solar energy** and has acknowledged its importance. In the Qatar National Vision 2030, the government outlined it aimed to use 20% of its electricity needs using solar energy (Bohra and Shah 2019).

Solar energy seems to be the most suitable option compared to other sources of renewable energy since **Qatar has a very suitable climate for its efficient generation.** The Middle East and North Africa (MENA) has very intense and long sunshine hours, with about 3000 hours of sunshine per year. (Olawuyi 2020). Qatar specifically has average sunshine hours of approximately 8 hours per day with a global horizontal irradiance of 2130 kWh per m^2 per year. It also has the added advantage of being a spacious country with large uninhabited spaces of desert to build solar panels (Zafar 2018).

This is coupled with fact that **solar energy equipment has now become significantly cheaper** than in the past. Solar energy installations are now competitive with gas installation costs and researchers project that solar energy's costs will reduce over time (Van Renssen 2020). While existing installing solar panels will have a higher cost than keeping existing gas infrastructure, Qatar can fund these projects using its vast sovereign wealth fund (SWF) (Mas'ud 2018). The potential of SWFs will be further explored later in this paper.

Another advantage is that Qatar's optimal geographical position to produce solar energy means that it has **been involved in a number of foreign partnerships and expertise** in recent years to help build its first few solar energy projects (Mas'ud 2018). This positive investment environment for solar energy in the MENA specifically is evidenced by the increasing number of international solar collaborations in the region. For instance, the UAE's Masdar Initiative, has led to the establishment of Siwa Solar PV Plant in Egypt, the Baynouna

Solar Energy Project in Jordan and several solar projects in Afghanistan (Mas'ud 2018).

Disadvantages

Qatar's most significant challenge - similar to the knowledge economy- **is having significant institutional deficiencies.** Qatar has no agency tasked specifically to implement renewable energy goals. Poor coordination between Qatar's main stakeholders for implementing these goals, such as the Ministry of Finance and Ministry of Interior, means that progress has been generally slow as these ministries have many priorities, and renewable energy can often be put low on that list (Olawuyi 2020). With just one renewable energy agency, the central priority for this institution could allow for faster implementation of more solar initiatives in the country. This is evidenced by Australia's success in this area. The country has a dedicated renewable energy agency in the form of the Australian Renewable Energy Agency (ARENA) (Olawuyi 2020). This has helped remove slow bureaucracies with differing priorities and could provide a blueprint for Qatar to more adequately implement solar energy projects.

This lack of institutional focus on renewable energy may also contribute to the country **lagging behind in the area of research and development of renewable energy technologies**, as highlighted before in the knowledge economy section (Hassen 2020). This R&D capability's weakness could potentially hamper the effectiveness of solar PV panels as they can be damaged by prolonged exposure to high temperatures and, to prevent this, experts highlight that these panels may need to be adapted by researchers to the specific environment (Mas'ud 2018).

3. Hydrogen

Advantages

Hydrogen, specifically 'green' hydrogen- created through the electrolysis of water using renewable energy- **could provide a great opportunity for Qatar to continue the export of energy.** As highlighted in the previous section, Qatar has significant potential for solar energy due to its favorable sunny environment. Researchers have highlighted how solar energy from the sunny MENA can be converted to hydrogen, transported to less sunny areas of the world- like Europe- and using a fuel cell, can be used as a reliable source of power (van Renssen 2020). Studies show that this is much more efficient than using power from a solar panel placed in a relatively cloudier country like the Netherlands. Europe offers a great opportunity as a market since it is aiming for climate neutrality by 2040 and there is growing interest in green hydrogen in the area. It is also very suitable in sectors of Europe that are energy intensive, like the

steel and chemicals industries (van Renssen 2020).

It is useful to note that green hydrogen has two other variants: 'blue' hydrogen, which is produced from fossil gas combined with carbon capture and storage, and 'grey' hydrogen, which is made from fossil gas and is the most used out of the three variants. Out of the three, green hydrogen is the most expensive, around twice as expensive as the other two today (Van Renssen 2020). However, there is a great opportunity that **renewable energy costs are projected to become lower** and more research can help blue hydrogen become used today, replacing the significant uses of grey and blue hydrogen in the future (Buffet 2020).

A potential blueprint for blue hydrogen's use is in the **relationship between Australia and Japan.** Japan has been using grey and blue hydrogen for decades, which is imported from Australia. The Land Down Under, which has long sunshine hours like Qatar, is now working with a decarbonizing Japan to transition to the cleaner variant of blue hydrogen. This could prove to be a model Qatar, Europe and other countries could emulate and even surpass (van Renssen 2020).

Disadvantages

One of the biggest dangers that arise from this is **the risk of the hyping 'blue' hydrogen which could harm the decarbonization efforts of Qatar.** As highlighted before, both grey and blue hydrogen are produced using natural gas, but blue hydrogen, is specifically advocated for by many in the fossil fuel industry as a new clean energy. However, unlike green hydrogen which produces no emissions, blue hydrogen's production will lead to the release of greenhouse gases (van Renssen 2020). Concerns among the literature mainly refer to methane leakage in the production of this variant. Methane is a gas which is projected to cause around half the world's global warming between 2020 and 2040 (van Renssen 2020). As such, continuing the production of blue hydrogen could make Qatar continue to produce more carbon emissions; not in line with the 2015 Paris Agreement and could risk worsening the world's climate catastrophe (Buffet 2020). In addition, any support of blue hydrogen on the basis of carbon capture and storage (CCS) is overly optimistic, since carbon capture has proven to be never entirely efficient in capturing and storing greenhouse gas emissions (van Renssen 2020).

Other experts point to all the colors of hydrogen as a problem. **They argue that they are too inefficient to bring any economic benefits to producing countries.** An expert in energy studies based in Brussels, Professor Samuele Furfari, highlights how it would be much more efficient to use renewable energy directly than use hydrogen which is an unnecessary extra step that wastes energy (van Renssen 2020). It is estimated that if the world would replace grey and blue hydrogen use today with green hydrogen, the amount of energy used to produce it would be even more

than the amount of electricity Europe currently produces in one year. While this is a valid critique for domestic needs, it is possible that, as highlighted in the 'Advantages' section, green hydrogen could prove to be more efficient if exported from Qatar to countries with significantly lower levels of sunlight (van Renssen 2020).

4. Tourism

Before getting into the analysis, it is important to note that this sector especially has been affected by the global restrictions in the wake of the COVID-19 pandemic after March 2020, and due to 2021's increase in tourist numbers, this analysis will assume that tourist numbers will recover to approximate normal levels in the future (Hilal 2020).

Advantages

Qatar has three main geographical advantages that make it an ideal tourist destination. First, its climate is warm in the winter. Second, it is close to Europe, a region with large numbers of people who can afford to travel, and the Gulf State is therefore given an advantage compared to some of its further, potential competitors (Hilal 2020). Third, Qatar is a peninsula with abundant coastlines, surrounded by the Arabian Gulf on three sides. This gives it a great advantage in terms of sea and beach-related tourism (Hilal 2020).

Augmenting these geographical advantages is **a sophisticated system of infrastructure connecting it to the world**, particularly in the area of aviation (Hilal 2020). The country's Qatar Airways is one of the Gulf's three major airlines (the other two being Etihad Airways and Emirates Airways), which allows it to promote the Qatari tourism industry to travelers (Hilal 2020). In addition to aviation externally, Qatar ranks highly in terms of its internal road quality (which particularly helps attract tourists from nearby Gulf countries), low crime rates and a high-quality telecommunication infrastructure (Karolak 2018).

Also, multiple studies (Mansfled and Winckler 2007; International Tourism 2019) have found that **the tourism sector is easier to compete for countries which have historically not been competitive**. This is because it involves lower costs of training a domestic workforce and operating it when compared to the aforementioned knowledge economy with its high training costs (Hilal 2020). Second, the market for tourism is huge with 1.5 billion tourist arrivals. In 2019, the Middle East even became the fastest growing region for the arrival of international tourists (Hilal 2020). Hilal's (2020) study found that tourism is generally a sector which employs a larger proportion of a country's workforce when compared to the hydrocarbon industry (Hilal 2020). As such, tourism also promotes economic diversification further

as it increases employment and therefore sustains the growth of other sectors. For Doha, the increase of tourist arrivals in recent decades has caused the transportation and the construction sectors in particular to grow considerably (Hilal 2020).

Another advantage is that **the government has already taken steps to take advantage of Qatar's strengths by focusing on investing in created rather than inherited resources** (Karolak 2018). Tourism scholars Larry Dwyer and Chulwon Kim (2003) find that countries have two types of resources which they can make use of for their tourism sector: these are 'inherited' (such as naturally occurring landscapes and historical sites) and 'created' (tourist sites created from scratch, such as events, shopping centers etc.,). While Qatar is home to a rich, ancient culture, it has no inherited resources which can compete with others in the region- such as the Giza Pyramids in Egypt- with only one UNESCO World Heritage Site. It has no diversity in terms of its 'inherited' natural landscapes (mainly deserts and beaches) that allow it to compete effectively with more established countries in the international tourist industry (Karolak 2018). It is therefore a positive that over the past 20 years, that Qatar has invested in created resources, which includes the Museum of Islamic Art, Arab Museum of Modern Art, Education City (Weber 2017) and attracted some of the most iconic luxury hotel brands in the world- including Hilton, Rotana and Sheraton (Karolak 2018). In its diversification efforts, it has already outlined its plans of diversification in the National Vision Strategy 2030. Magdalena Karolak (2018), an Associate Professor at the UAE's Zayed University, found that Qatar's ability to invest high amounts of money (as a result of its vast hydrocarbon revenues and SWFs) in sophisticated and extravagant superstructures, gives it more potential to become internationally competitive. Dubai, the entity with the highest annual tourist numbers in the Gulf, is clearly a model for this, as it has promoted itself as a center of the most extravagant buildings and events. Examples of these include Burj Khalifa -the tallest building in the world-, hosting the prestigious Expo 2020 exhibition, building the largest indoor shopping center in the world, the largest manmade marina and ski slope, and creating an artificial palm-shaped island (Jumeriah Island) (Karolak 2018). These unique superstructures have allowed Dubai to become internationally competitive and the clear leader in the Gulf region (Karolak 2018).

Disadvantages

However, **Qatar still lags behind Abu Dhabi and Dubai – the two leading entities in the Gulf-** in the tourism sector (Karolak 2018). So far, the reality is Qatar has not been able to become as competitive as the UAE (where Dubai and Abu Dhabi are located). In the UAE, tourism was 8.4 per cent of GDP while in Qatar it was 6.6 per cent of GDP (Karolak 2018). Hilal (2020) describes the current situation as a "competition between these countries for

the same product." Qatar lags behind because it has low number of world-famous tourist attractions. The only sites with international renown are the Museum of Islamic Art, Souq Waqif- a traditional market-, Education City (Weber 2017) and the World Cup 2022 stadiums. It is important to note that the UAE – mostly Dubai and Abu Dhabi- are the main competitors for Qatar in terms of its branding – due to their focus on superstructures. Other GCC countries either (1) have not been able to compete with Qatar due to lower government funds (Bahrain, Kuwait), (2) already have a tourism industry based on a diverse natural environment rather than superstructures (Oman) or (3) depend significantly on religious tourists coming to the Holy Cities of Mecca and Medina (Saudi Arabia). (Karolak 2018)

Qatar also lacks a domestic, sustainable tourism workforce due to its dual-labor market model. This model is comprised of two distinct divisions. The first is a private sector with relatively lower salaries dominated by foreign workers, which most of the tourism industry depends on. The second is a public sector where most nationals work, with high salaries subsidized by hydrocarbon revenues, leaving the tourism industry with a small proportion of nationals (Hilal 2020). This subsidization of the public sector for nationals' jobs means that the public sector is viewed with prestige and good working conditions, and private sector jobs in the tourism industry, with its significant interaction with guests, viewed with disdain (Al Suwaidi 2020).

The Importance of Sovereign Wealth Funds

From the analysis presented earlier, it is clear that the transition may entail significant costs. As such, the sovereign wealth fund (SWF) of Qatar, the Qatar Investment Authority (QIA), could prove to be an essential component of funding these transitions (Olawuyi 2020).

Qatar's hydrocarbon industry has helped it to amass vast surplus revenues, providing it with one of the largest sovereign wealth funds in world. To decarbonize in line with the Paris Agreement and other global climate goals, it could be helpful to use the QIA to invest in solar technology, the knowledge economy, hydrogen and tourism (Olawuyi 2020). This could potentially give Qatar an extra edge to become a truly competitive economy in these sectors. For instance, the Abu Dhabi Oil Company used its sovereign wealth fund to build the Al Reyadah Facility, the first carbon capture, utilization and storage (CCUS) unit in the region, which aimed to capture carbon dioxide from the fossil fuel industry (Olawuyi 2020).

Qatar has also shown an interest in this. Its Qatar Investment Authority is one of the One Planet Sovereign Wealth (SWF) Fund Working Group's founding members (Olawuyi 2020). This group's main aim is to fund decarbonization projects and help in the achievement of the sustainable development goals around the world in order to prevent a climate catastrophe. Yet it is important to note that, currently, the QIA mainly invests in the fossil fuel industry and must therefore ensure it shifts its funding further towards economic diversification efforts (Olawuyi 2020).

Conclusion

Qatar's rich resources means it has a variety of options to pursue in the diversification and decarbonization of its economy. Knowledge-based economic models, solar power production, the export of this solar power using hydrogen and tourism could provide opportunities for Qatar to advance in these respects (Olawuyi 2020). The paper has aimed to provide suggestions for how Qatar can effectively transition from fossil fuels, using current and past data on Qatar, as well as past precedents. As such, it is hoped that this paper can help provide ideas for stakeholders in Qatar's carbon transition.

There are many interesting questions which can be useful for further exploration. What other sectors can Qatar diversify to in order to replace its hydrocarbon dependence? How can one ensure that the transition is smooth and not plagued by crises? How will future generations view the age of fossil fuels and how can future education systems keep up with a carbon transition?

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