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Research Article

NATURAL GAS: A BRIDGE TO SUSTAINABLE FUTURE (A CASE OF QATAR)

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Abstract

This study has a particular emphasis on the natural gas industry, thus this study intends to investigate the role of Qatar in the strategic shift of energy such as hydrocarbons to the clean and green alternatives. The primary objective of this study was to examine and analyse contributions of Qatar natural gas business with the Global Sustainable Development Goals (SDG's) meanwhile considering the factors of economy, policy and environment. The study has used a two-step organized technique. The first step involves a thorough analysis of the literature comprised of background information regarding international obligations of Qatar, environmental objectives, and economic diversification. In the second step, the study has conducted a PESTLE analysis to assess the prospective contribution to the global energy transition as well as its existing standing as a significant producer of natural gas. Additionally, the study analysis also considers the factors of global economy, policy and legislative frameworks. Qatar is diversifying its income sources by prioritizing investments in research, science, and technology, and renewable energy initiatives. The country's National Vision 2030 includes sustainability objectives to address environmental issues related to natural gas extraction. Qatar supports renewable energy projects and a green economy by aligning with international agreements like the Paris Agreement. This highlights Qatar's potential impact on the global energy landscape and places it as a major player in energy dynamics. Understanding Qatar's strategy for balancing environmental protection and economic expansion offers valuable advice for resource-rich countries transitioning to sustainable energy.

Keywords: Natural gas production, Energy transition, Global energy dynamics, Hydrocarbon revenues, Qatar gas production.

INTRODUCTION

Since the industrial revolution, greenhouse gas (GHG) emissions have been increasing, and in the last few decades. The resulting rise in emissions has contributed to increasing temperatures and climate change, with significant repercussions on the environment, human health, and economy. The longer we hesitate to take decisive action to reduce emissions consistently, the worse the economic and social effects are predicted. Due to the severity of the issue, the Paris Agreement was adopted in 2015 with the goal of keeping global warming to less than 2°C and continuing efforts to keep temperature increases to 1.5°C. In order to reduce their greenhouse gas emissions, nations are also required under the Paris Agreement to formulate and announce their nation-ally determined contributions, or NDCs. The NDCs represent the nations' pledges to cut emissions, which may be accomplished in a number of ways, including by switching to cleaner energy sources, decarbonizing the economy, and improving energy efficiency (Al-Noaimi *et al.,* 2023). Producer economies, also referred to as "hydrocarbon-dependent rentier states," are nations (countries) worldwide, mostly in the Middle East that are intrinsically reliant on the extraction and export of fossil fuels. These states are major producers of natural gas and/or oil, accounting for at least one-third of their overall exports of products; the export money they receive from these sources makes for at least one-third of their nation's fiscal income (IEA, 2018). Oil and gas extraction accounts for more than 60% of exports and government revenue in nations like Nigeria, Saudi Arabia, Kuwait, Iraq, and Qatar(Mohammed *et al.,* 2022). Some of the largest exporters of oil, natural gas, and solid minerals worldwide are found in the Middle East and North Africa (MENA) as discussed above.

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However, approximately 59% of the world's proved oil reserves, 45% of the world's proven natural gas reserves, and 30% of the world's mineral reserves are found in the MENA area (Olawuyi, 2021). Moreover, historically significant producers of oil and gas have included Algeria, Egypt, Libya, and the Gulf states (Bahrain, Iran, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates, UAE). Similar to this, mineral resources including bauxite, cobalt, diamond, gold, lithium, phosphate, potash, rhodium, silver, iron ore, zinc, and platinum-group metals have drawn large investment and revenue to Egypt, Morocco, Jordan, and Tunisia. As a result, the production and supply of extractives worldwide have historically been dominated by the MENA area, offering enough opportunity for the extractive sector to stimulate social and economic growth in a number of MENA nations that are low- to middle-income (Olawuyi, 2021). Fossil fuel extraction must be phased out within a generation in order to facilitate the global energy transition, according to academics and activist groups. Worldwide energy transitions have worldwide economic, social, and political ramifications. They also have distributional effects on various groups of actors, such as employees of coal-mining corporations, oil and gas facilities, investment firms, and economies that export energy. It is very difficult for countries to change if they depend more heavily on energy supplies, jobs, public income, corporate profits, and legacy (Showkath, 2021). The shift is not just an option, but also a must for meeting environmental impact reduction targets and attaining global sustainability over the next 20 years (Hassan *et al.,* 2023). The idea of gradually decreasing the use of fossil fuels instead of completely eliminating them is at the core of this shift (Olujobi *et al.,* 2023). Reducing the amount of energy used is a sensible strategy that takes into account the world's present reliance on fossil fuels and the difficulties that come with making a sudden change (Kalair *et al.,* 2021). This strategy is especially important for economies that rely

significantly on the fossil fuel sector, since a rapid change might have serious negative effects on the economy. Presently, while comprehending the global energy transition, it has been observed that it is important initially to demonstrate the current energy landscape which is characterized by its reliance on heavy hydrocarbons (Davies & Simmons, 2021). Therefore, this study describes the existing energy matrix while exploring the leading role of coal and oil along with the emergence of natural gas, and the emerging influence of the renewable energy resources. Thus this study has its scope to answer the research question of How can natural gas serve as a transitional fuel in the global energy shift from heavy hydrocarbons to cleaner alternatives, including energy sources and what role do major natural gas producers like Qatar play in facilitating this transition? By following the objectives to answer this question, the study has its focus on:

1. To evaluate through PESTLE analysis, Qatar's current position as a major natural gas producer and its potential role as a facilitator in the global energy transition, considering economic, environmental, and policy aspects.
2. To examine the feasibility and implications of Qatar's involvement in phasing out versus phasing down fossil fuels, emphasizing the use of natural gas as a transitional fuel.
3. To investigate how Qatar can leverage its natural gas resources to balance economic growth with environmental stewardship and contribute to a sustainable energy future.

This study is also aimed at analyzing the role of Qatar in the strategic transition of energy from the heavy hydrocarbons to cleaner alternatives, with a specific emphasis on the natural gas sector of the country and its contributions to achieve the global sustainable development goals.

METHODS AND MATERIALS

The research method of this study is based on the two step procedure, consisting of (i) a comprehensive literature review and (ii) to evaluate through PESTLE analysis the current position of Qatar being a major player of producing the natural gas throughout the world and its potential role in offering the facilities in the global energy transition by considering the factors and aspects of global economy, policy and environment. The literature research was done by searching of the scientific data bases such as Scopus, Web of Science, Emerald, Schimago. Initially, the scientific data bases were searched using the general terms like “major gas producers”; “hydrocarbons”; “energy transition”; “cleaner alternatives” by the keywords, abstracts and also title. The larger number of publications can be found while search with these terms and most of the studies were not even directly relevant to the title, research question, and objectives of this study and were not considered therefore. Thus, the research process was more refined to select the related publications in the area of energy transition in Qatar or Middle east region, hence more than 7,000 results of the recent studies appeared from which the best of the studies were also screened and synthesis by their title, keywords and abstract.

Comprehensive Literature

One of the primary global producers to greenhouse gas (GHG) emissions is the transportation industry. The worldwide aviation sector contributes around 2% of human-induced CO2 emissions as stated by (Bicer & Dincer, 2018). The transportation industry was responsible for 24 percent of the world's total carbon emissions in 2016, reported by the International Energy Agency (IEA). As per the United Nations Conference on Trade and Development, 80 to 90% of items get transported using marine routes. Roughly one third of the increasing global seaborne trade is made up of the shipment of hydrocarbons. By 2022, traded natural gas is predicted to account for 28% of the world's gas supply, up from a reported 25% in 2017 (Al-Enazi *et al.,* 2021). The demand for natural gas is anticipated to increase to over 300 BCM between 2017 and 2022, with a 1.6% compound annual growth rate forecast in natural gas transactions. It is anticipated that the Asian market would account for around half of this expansion, adding an extra 132 BCM to its distillation capacity each year during 2017 and 2022(McKinsey, 2019). The transportation industry accounts for around 56% of the world's use of liquid fuels (such petroleum), which is predicted to exceed 132 EJ by 2040.Therefore, in order to lessen the negative effects that the oil and gas supply chains have on the environment, a number of strategies have been put forth. These strategies include decreased combustion, optimization of processes, and the use of clean fuels, all of which have been thoroughly examined in fuel-using industries like the aviation sector for more than 20 years (Al-Enazi *et al.,* 2021). Policymakers' focus has started to diverge toward alternatives like fossil fuels due to increasing concerns about energy security, the environment, and the economy. Hydrogen possesses the ability to drastically alter the global energy future, according to a growing number of politicians and energy specialists worldwide. Since hydrogen energy technology has the potential to facilitate the transition to a sustainable energy future for the transportation sector, the United Nations Energy Program is also keeping up to date on its developments. Currently, over 70 million tons of pure hydrogen are needed annually (Al-Enazi *et al.,* 2021). Additionally, petroleum and coal have always been the primary sources of energy used worldwide for transportation, industry, and the production of electricity. Their relative availability, high energy density, and until recently low cost have solidified their status as main energy sources (León & Scipio-Cimetta, 2022). However, a reassessment of these fossil fuels' long-term sustainability has been necessitated by their environmental costs, particularly their significant carbon emissions and contribution to air pollution. By 2020, coal accounted for 35% of global electrical production. These numbers for fossil fuels with higher emissions are due to their low cost, which makes energy available for countries with lower incomes. However, between 2019 and 2020, the yearly average reduction in coal was 3.2% (León & Scipio-Cimetta, 2022).

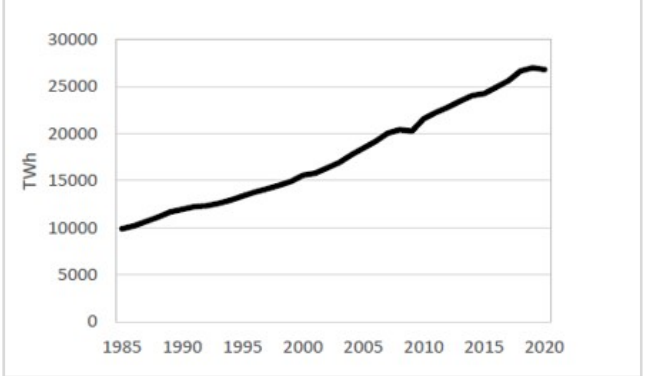

Figure I. Total world electricity generation. Source:(León & Scipio-Cimetta, 2022)

Furthermore, around the early years of the 21st century, natural gas surpassed nuclear and hydroelectric power in terms of its percentage of the electricity mix. This may have happened as a result of the restrictions these forms of energy have and the realization that natural gas could be useful as a transition fuel to greener energy sources. It should be highlighted, nonetheless, that natural gas and coal have grown at comparable rates. The percentage of natural gas reached 23% in 2020, followed by hydroelectricity (16%), renewable energy (12%), and nuclear (10%). Subsequently electricity production has been a major factor in the rise in natural gas usage worldwide(León & Scipio-Cimetta, 2022). This increase has been made possible by the establishment of contemporary combined-cycle plants with gas turbines to accommodate the increasing demand for electricity and by the conversion of older thermal plants that used heavy fuel oil and coal to comply with modern energy regulations.

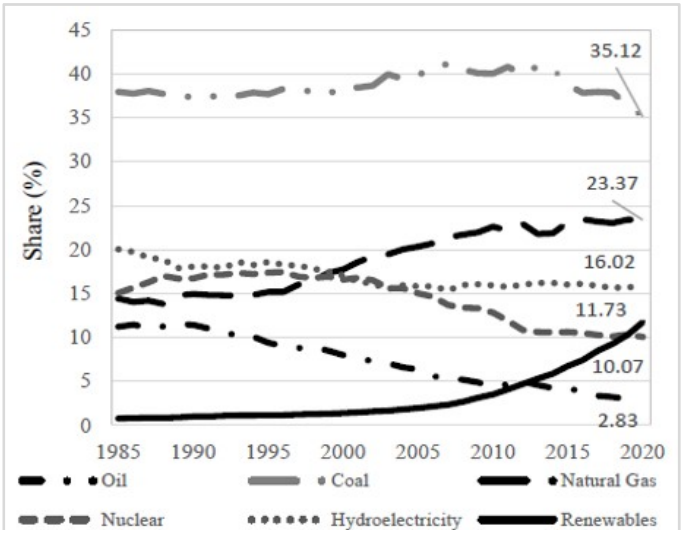

Figure 2. Electricity generation by type of source. Source: (León & Scipio-Cimetta, 2022)

In an attempt to balance the dream of a decarbonized energy and power system with predictions of fuel use continuing, the gas industry has begun to embrace the concept of environmentally friendly natural gas. Increased use of bio methane from organic compounds or integration of hydrogen produced from natural gas mixed with CCUS (blue hydrogen) or from water using renewable power (green hydrogen) into current natural gas networks are two ways to achieve this. Certain routes may provide large-scale decarbonization, even in industries with low adoption rates, but they may also prolong the life of current natural gas networks. According to a renewable energy economics perspective, none of these routes are very simple, and success is by no means assured(León & Scipio-Cimetta, 2022).

The gas industry has been arguing for the past ten or so years that gas can play a significant role in the current energy transition as a bridging fuel, mainly by replacing more polluting coal and some oil in the energy system. The environmental advantages of gas as a transition fuel are highlighted by a few success stories, such as the complete replacement of coal-fired power by a mix of gas and renewables in the US and the UK, and the more recent coal-to-gas switching in China due to policy. According to a recent estimate from the IEA, between 2010 and 2018, coal-to-gas switching prevented over 500 millions of tons of CO2 emissions globally. This is almost equal to the entire energy-related emissions of all the nations in Central America during that time (Elkind, 2019). However, specific quantity of CO2 emissions of different fuels can be comprehended from the figure 3 below.

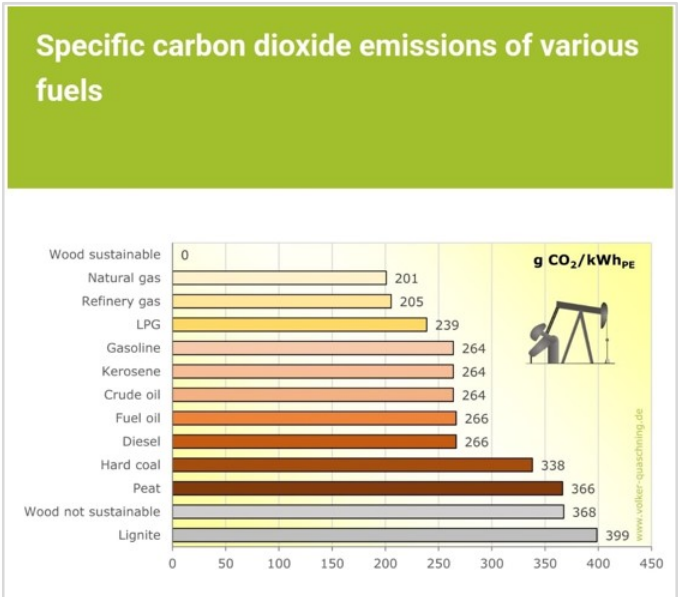

Figure 3. CO_2 emissions of different fuels

The figure 3 and 4. Elaborates the quantity of CO2 emissions by the combustion of different kinds of fuels, showing evidently less quantity of emissions generated by the combustion of natural gas up to 201g/CO2/kWhPE. Whereas, the combustion of wood with 368 g/CO2/kWhPE is very obvious and not sustainable option to use as a fuel because it contains higher value of organic material since it is made from it, that degrades the natural environment and causes air pollution in to the atmosphere.

Fuel	Emissions in g CO_2/kWh_{PE}	Emissions in g CO_2/MJ_{PE}
Wood[1)]	0	0
Wood[2),3)]	367.6	102.1
Lignite[3)]	398.7	110.8
... Lusatia[3)]	399.6	111.0
... Central Germany[3)]	371.6	103.2
... Rhineland[3)]	407.3	113.1
Peat[3)]	366.5	101.8
Hard coal[3)]	338.2	93.9
Gasoline[3)]	263.	73.3
Fuel oil[3)]	266.5	74.0
Diesel[3)]	266.5	74.0
Crude oil[3)]	263.9	73.3
Kerosene[3)]	263.9	73.3
Liquid petroleum gas[3)]	238.8	66.3
Natural Gas[3)]	200.8	55.8

Figure 4. Direct CO_2 emissions from various fuels

Using natural gas offers society a chance to move toward a sustainable energy future in light of worries about climate change and an increasing need for cleaner energy according to the ("Energy Transition in Remote Areas Natural Gas as a Bridge to Renewables," 2023). It acts as a first step in obtaining a more environmentally friendly source of energy that strikes an appropriate equilibrium between the requirement for sustainable power production and reducing its negative effects. Global reserves of natural gas can be found, and advances in methods for drilling have made it easier to extract. Natural gas, given its abundant supply and widespread availability, presents a practical choice for meeting the growing worldwide energy needs while being a more environmentally considerate fuel option. In comparison to coal and oil, natural gas produces far less greenhouse gas emissions. It is essential for lowering carbon dioxide emissions, which is what the fight against climate change is all about. Using natural gas as a transitioning energy source can assist countries in achieving their goals for reducing emissions. It is now essential for the entire world to shift away from reliance on fossil fuels and toward cleaner energy. The focus has moved to realizing the promise of clean energy in isolated and remote areas as technology develops and renewable energy sources evolve into increasingly efficient. However, these remote areas have also been confronted by several challenges Due to their physical position or infrastructural constraints, such as islands, rural areas, and isolated communities often have limited access to conventional energy sources. In many places, generating electricity only from fossil fuels not only degrades the environment but also presents financial difficulties. Fossil fuels may be extremely expensive to transport and store, which restricts the expansion and development of the local economies.

Moreover, many authors like Gürsan in their study also argued that the concept of bridging the gap thorough natural gas transitioning is still a temporary option because the natural gas also emits some of the amount of CO2. Parties involved in the matter policymakers, scientists, NGOs, and the general public become divided by the complexity and unpredictability of the problem. According to one perspective, natural gas can assist in addressing the present issues with renewable energy. Authors also explained that there would be possible direct and indirect effects of natural gas as a transition fuel such as its redirection of investment of coal hence it would have a significant growth potential (Gürsan & de Gooyert, 2021).

However, the direct effects could be possible with the replacement of coal which can reduce the annual emissions throughout the world. Several experts have noted the crowding-out effect as one of the significant indirect consequences of natural gas. Crowding out occurs when investments in an emerging technology (renewables) are diverted by a transitional technology like (natural gas). Due to the associated establishment of the fossil fuel infrastructure, investments in natural gas have the potential to crowd out investments in renewable energy sources and encourage further investments in alternative fossil fuels. If gas use results in an indirect extension of the fossil fuel infrastructure, any direct environmental gains may be offset. If natural gas is used to supplement other fossil fuels rather than to replace them, its role as a transition fuel may be compromised (Gürsan & de Gooyert, 2021). Nevertheless, this study has aimed at enlighlighting the benefits of the natural gas transitioning therefore, this study has further discussed the PESTEL analysis factors in the context of Qatar and its current situation as a great producer of natural gas below in section 3.1.

PESTLE Analysis of Qatar's Current Position as a Major Natural Gas Producer

Political Factors: The political stability of Qatar has always been a talk of town throughout the world since ages due to its success as a major natural gas production industrial sector. The Qatari government has its firm belief on the strong leadership and clean and clear energy policies that has provided a conductive environment for the energy sector. Moreover, Qatar's political landscape also has influence on its potential role in the global energy transition because the government's commitment to the Paris Agreement and other international records that also demonstrates a willingness to participate in global efforts to combat the climate change. Additionally, Qatar's diplomatic ties and collaborations within the geopolitical sphere plays a key role in order to shape its position as a contributor to the global energy transition.

Economic Factors: The economic aspects are the most important in terms of energy transformation and transitions currently all over the world. Evidence from many nations shows their accountability for environmental and social governance to switch towards the energy efficient power generation options like China, Japan, UK USA, Europe, Australia (Zhao *et al.,* 2022). In similar means, the natural gas sector of Qatar has been a driven force behind the prosperity of the country by its abundancy of natural gas resource supplies which has fueled the economic growth within the country while providing a competitive revenue growth stream (Tok, 2020). However, economic considerations are also evolving with a global push towards a sustainable energy. Qatar must diversify its economy to lessen its reliance on income from fossil fuels. Qatar's position in the global energy transition will be influenced by the economic viability of switching to cleaner energy sources and the growth of new sectors. Qatar's capacity to strike a balance between environmental sustainability and economic growth will depend heavily on its ability to maintain economic stability and draw in investments for renewable energy projects.

Social Factors: Social considerations include the expectations and attitudes of the international world as well as the people of Qatar. Social acceptance and support are necessary locally for the changes brought about by the energy transition, including possible economic restructuring and employment transfers. Qatar's standing as a global leader in social responsibility including community involvement and corporate social responsibility will have an impact on its function as a facilitator. Supporting Qatar's efforts in the global energy transition will require raising public awareness and educating people about the advantages of sustainable energy techniques (Grey, 2021).

Technological Factors: Innovations in technology are essential to Qatar's role as an energy transition intermediary. By funding the development of technology linked to the production and use of natural gas, Qatar has demonstrated its commitment to innovation (Ben Hassan, 2022). It will be essential to adopt and develop greener technology, such carbon capture and storage. Furthermore, Qatar's ability to embrace and integrate green energy sources into its renewable energy environments will have an impact on its collaborative function.

It will be necessary to work with international technology executives and foster an inventive culture in order to want to stay at the center of technological advancements in the energy sector.

Legal Factors: The international agreements and laws that Qatar officially works under impact its involvement within the global energy revolution. It is essential to abide with environmental rules and accords, such as those specified in the Paris Agreement. Qatar's legislative framework, which includes energy rules and regulations, will determine how simple it is to transition to more environmentally friendly energy sources. Qatar's participation in globally recognized regulatory organisations and adherence to evolving legal standards will play a significant role in determining its position as an intermediary in the global shift to cleaner energy (Al-Sarihi and Mansouri, 2022).

Environmental Factors: Qatar offers environmental concerns first priority in the global energy transition. The impact of natural gas production on the environment in particular, water usage and emissions is being examined more and more. Qatar must continue to be dedicated to mitigating these impacts by the adoption of sustainable practices, such making investments in green technology and renewable energy. The ability of the country to balance economic interests with environmental preservation will determine its legitimacy and effectiveness as a global energy transition facilitator (Al Meraikhi, 2021). Furthermore, careful observation will be kept on Qatar's commitment to international efforts to tackle climate change, as evidenced by its environmental sustainability goals, Qatar National Strategy for the Environment and Climate Change 2021 and National Vision 2030.

Feasibility and Implications of Qatar's Involvement in Natural Gas

Qatar is one of the GCC's leading exporters of natural gas. Since the 1990s, Qatar has worked closely with technology suppliers, investors, and potential natural gas consumers to design and implement carefully constructed policies that have allowed the country to undergo a dramatic transformation into a flourishing economy powered by natural gas. From around $6 billion in the late 1980s to over $146 billion in 2020, Qatar's GDP grew. In order to build on its previous transformational achievements and take into account its future goals, partners, competitors, and dangers, Qatar urgently needs a national strategy for hydrogen that outlines its vision, long-term aims, and immediate to mid-term measures. Using both qualitative and quantitative models, this approach should take into consideration the global hydrogen market in a number of potential scenarios (Hjeij *et al.,* 2022). The possibility of eliminating fossil fuels entails a significant shift in infrastructure and the economy toward renewable energy, which might improve Qatar's standing as a sustainability leader internationally. This path, meanwhile, can provide financial difficulties and need for cautious labor transition management. Conversely, a phase-down approach that prioritizes the ongoing usage of natural gas provides economic stability and is consistent with Qatar's existing position as a significant producer of natural gas. Although this strategy makes the transition easier, it necessitates large investments in greener technology and strikes a compromise between preserving energy security and moving toward a completely renewable energy source. Thorough impact assessments, stakeholder participation, and an adaptable policy framework should all be part of the decision-making process in order to guarantee a strategic and adaptive approach when managing the intricate interactions between policy, the environment, and the economy. The topic of discussion has shifted from whether or not to even use renewable energy sources to whether or not to surpass current goals. According to the survey, even in gas-rich nations like Qatar, the most affordable grid-scale solar 44 PV projects in the area were now less expensive than new gas-fired power generation (Mohmmad *et al.,* 2022). Oil exploration and exporting have emerged as one of the major economic sectors in Qatar throughout the 1970s. Developments in technology have enabled the production and transportation of LNG both technically and economically possible, nearly two decades since the discovery of vast natural gas reserves. The increasing demand for gas has created a chance to turn natural gas into financial success. Qatar is a prominent energy provider, exporting 80% of its output and providing more than one-fifth (22 %, or 77.8 million tonnes) of LNG to the world market (IGU, 2020). Reserves will endure for an additional 138 years at the present rate of natural gas production as explained in (Mohammed *et al.,* 2022). Due to its structural reliance on oil and gas leasing options and its exposure to unpredictable commodity prices, the government of Qatar has been expanding its sources of income via the development of knowledge-based sectors and a service-based economy. Over the past 20 years, a few of these small-scale economic changes have changed the composition of the GDP. Between 2000 and 2019, the non-oil GDP grew from 40% to 66% (QCB, 2020). Even with the shift in the structure of the GDP, Qatar's reliance on hydrocarbon earnings is still significant, and the price of oil affects other industries like real estate and construction.

According to the report, Qatar's transition to a low-carbon economy is based on a methodical change in the composition and structure of the economy that supports the growth of new businesses while allowing for the safe demise and reorganization of unnecessary ones.Presently, Qatar is actively and diligently formulating policies to facilitate a transition towards a carbon-free future, in addition to expert feedback from the Delphi research as stated by authors like Mohammad et al. (2022) in their findings. Moreover, since the 1990s, Qatar has worked closely with technology suppliers, investors, and potential natural gas consumers to design and implement carefully constructed policies that have allowed the country to undergo a dramatic transformation into a thriving economy fueled by natural gas. From around $6 billion in the late 1980s to over $146 billion in 2020, Qatar's GDP grew. In order to build on its previous transformational achievements and take into account its future goals, partners, competitors, and dangers, Qatar urgently needs a national strategy for hydrogen that outlines its vision, long-term aims, and immediate to mid-term measures. Using both qualitative and quantitative models, this approach should take into consideration the global hydrogen market in a number of potential scenarios a described by (Hjeij *et al.,* 2022).

According to Hjeij et al. (2022), Qatar's economy demonstrates persistent global leadership in terms of GDP per capita. At now, the main driver of its economy is the production and export of natural gas, accounting for over 85% of its total exports. With the third-largest natural gas reserves in the world, Qatar has emerged as a global leader in LNG production and export since its inception in 1996. When it

came to entering the natural gas (NG) market and LNG supply chains, Qatar was a trailblazer. This led to a significant change in the global energy landscape. It is currently among the world's top exporters of greener energy. As part of its Second National Development Strategy 2018–2022, Qatar has already made investments in the renewable energy sector and set goals to raise the proportion of renewable energy in the energy mix (QSNDS, 2018). It has promised to construct an 800-MW large-scale solar power plant (Peninsula, 2020) in order to maintain its natural gas resources, cut carbon emissions, and meet their pledge to hosting the 2022 World Cup in a carbon-neutral manner. The establishment of cost-effective integrated H2 production systems that take advantage of Qatar's natural gas resources is necessary to create optimal H2 supply chains in the country. The planned H2 supply chain network in Qatar will naturally complement the current natural gas supply chain, rather than operating in isolation. Furthermore, it is anticipated that the connection between these two supply chains would assist H2 in overcoming its high manufacturing costs and technical performance obstacles, such as energy efficiency. If H2 is shown to be a realistic and feasible fuel for small, heavy vehicles and the shipping industry in Qatar, this presents a significant potential for the nation to decarbonize its energy and industrial sectors and significantly lower its greenhouse gas emissions (Eljack, 2021). Qatar will therefore have better air quality and the residents will be free from airborne contaminants. The manufacture of value-added goods in Qatar using green or blue H2 will significantly boost the country's industrial portfolio. The initiative will create the best supply chains for these value-added goods, which include methanol, GTL, and other petrochemicals, which may be produced using H2 as an intermediary. Moreover, in order to encourage hydrogen (H2) to play a larger part in the global energy mix and have a stronger impact, smart policies and investments are required. This calculated move will assist Qatar in taking the lead in becoming into the world's HUB for H2. It has the potential to become the global H2 hub (Eljack, 2021).

Possibilities for Qatar to leverage Natural Gas Resources

Qatar has an ideal opportunity to leverage its energy resources to advance sustainable energy futures and achieve a balance among protecting the environment and economic progress because of its substantial natural gas reserves (Van, 2019). In recent years, the country has worked to align its policies with the goals of global sustainability and diversify its energy mix. Qatar is adopting a strategy that combines natural gas with more environmentally friendly technologies, such as carbon capture and storage, or CCS (Lau *et al.,* 2021). Natural gas production and consumption generate carbon emissions, which may be collected and stored via CCS, significantly reducing the harmful environmental consequences of fossil fuels. Furthermore, Qatar has assumed the lead in providing money for research and development (R&D) initiatives aimed at enhancing the efficiency and sustainability of natural gas production (Meza, 2021). Projects driven by technology and collaborations with international partners concentrate on innovations that can further mitigate the environmental effects of the whole natural gas value chain, particularly extraction to consumption (Basile *et al.,* 2021). By placing a high priority on technical development, Qatar hopes to both satisfy its economic needs and establish itself as a leader in the global adoption of greener energy technology. Beyond technology innovation, Qatar is investigating natural gas's potential as a transitional fuel within the larger framework of its energy transformation. Frequently seen as a more environmentally friendly substitute for conventional fossil fuels, natural gas may be instrumental in mitigating carbon emissions while shifting towards an entirely renewable energy system. Qatar is committed to striking a balance between environmental responsibility and economic progress, which is why it places a strategic priority on natural gas as a bridging fuel (Wright, 2022). Qatar actively participates in international partnerships and collaborations to advance sustainable energy practices, demonstrating the extent of its efforts beyond national boundaries. The nation's involvement in international forums and initiatives facilitates the sharing of best practices, expertise, and the implementation of policies that support the development of sustainable energy in the future. Being one of the world's leading producers of natural gas puts Qatar in a unique position to influence the global energy scene and demonstrate its dedication to both environmental sustainability and economic growth (Sarrakh *et al.,* 2022).

Conclusion

Qatar's ability to impact environmental and economic factors makes it an ideal facilitator of the global energy transition. Qatar, a significant exporter of natural gas, may aid in the shift by encouraging the use of natural gas as a cleaner-burning substitute for coal and oil. Furthermore, the nation's partnerships with foreign partners and investments in renewable energy projects put it in a position to support the advancement and use of sustainable energy technology. Qatar is among the 25 percent of nations where the agriculture sector is the source of the lowest emissions as GHG emissions are trending downward, it looks like Qatar has already passed the tipping point and appearing to be on the stage of decreasing the environmental degradation impact. Utilizing its economic might and geopolitical clout, the preservation of the environment and balancing social and economic development are two of the key principles of the Qatar National Vision 2030. Qatar can promote worldwide climate objectives.

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