

GCC: Europe's Best Hope to Meet Their Energy Goals

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Abstract

With increased tensions with Russia and the ambitious energy goals set at the Paris Climate Accord, Europe is scrambling to find new sources of low-emissions energy. The Gulf States (GCC) are Europe's best hope to meet their energy goals in the medium to long-term while simultaneously tapering their reliance on Russian natural gas in the short-term. There are five main reasons to support this assertion: 1) GCC have among the highest concentrations of solar radiation and considerable potential for wind. 2) Their political systems lend themselves well to quick development and limited bureaucracy. 3) GCC are desperate to diversify their economies which have historically relied on fossil fuels exclusively. 4) GCC are wealthy and can afford to develop the necessary infrastructure 5) GCC are capable of filling in the supply gap in natural gas caused by the Ukraine crisis. These assertions will be tested in three main case studies: Oman, Qatar, and Saudi Arabia.

A handwritten signature in black ink, appearing to read "Paul Holshouser", written over a horizontal line.

Faculty Advisor Signature

April 28, 2022

Date

Paul Holshouser
Faculty Advisor Printed Name

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By: Jack Morningstar

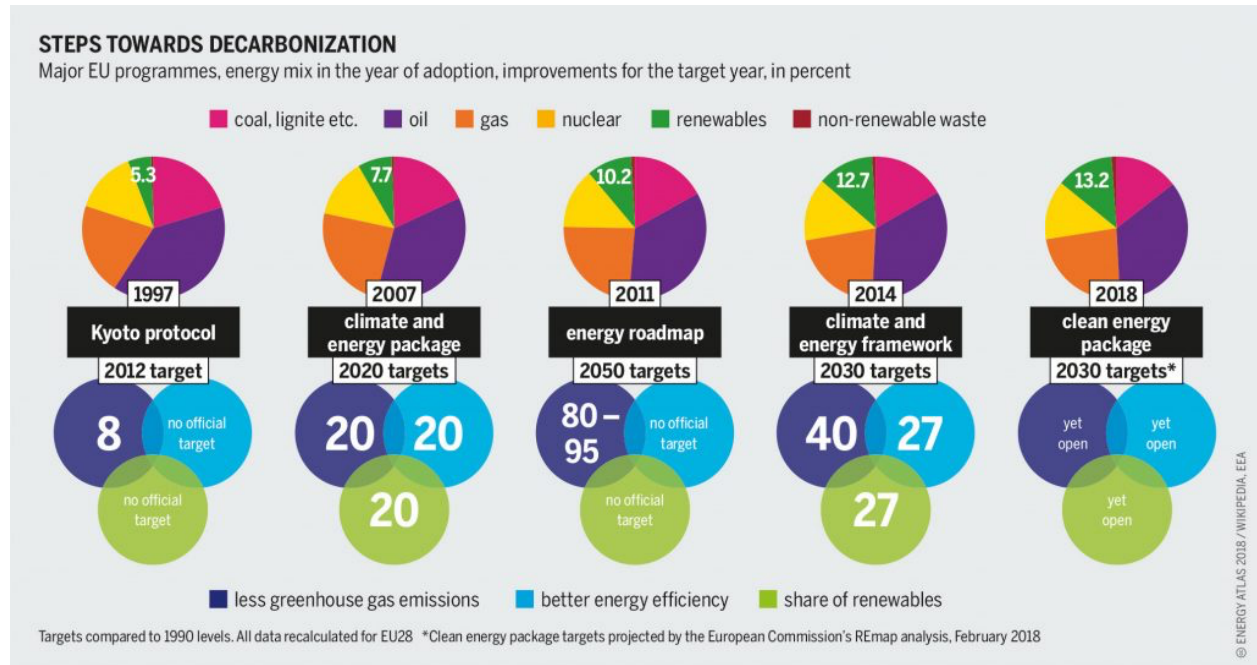
Advised by Paul Holshouser

Abstract

With increased tensions with Russia and the ambitious energy goals set at the Paris Climate Accord, Europe is scrambling to find new sources of low-emissions energy. The Gulf States (GCC) are Europe's best hope to meet their energy goals in the medium to long-term while simultaneously tapering their reliance on Russian natural gas in the short-term. There are five main reasons to support this assertion: 1) GCC have among the highest concentrations of solar radiation and considerable potential for wind. 2) Their political systems lend themselves well to quick development and limited bureaucracy. 3) GCC are desperate to diversify their economies which have historically relied on fossil fuels exclusively. 4) GCC are wealthy and can afford to develop the necessary infrastructure 5) GCC are capable of filling in the supply gap in natural gas caused by the Ukraine crisis. These assertions will be tested in three main case studies: Oman, Qatar, and Saudi Arabia.

Introduction

Europe faces a daunting challenge ahead, caught in the balancing act of meeting its ambitious emissions goals while also tapering its reliance on Russian natural gas. Several thousand miles east, the gulf states grapple with an economy built almost exclusively on fossil fuels in a world that is scrambling to pivot to renewables. These dynamics create a fertile ground for strategic partnerships between the West and the Arabian Peninsula.



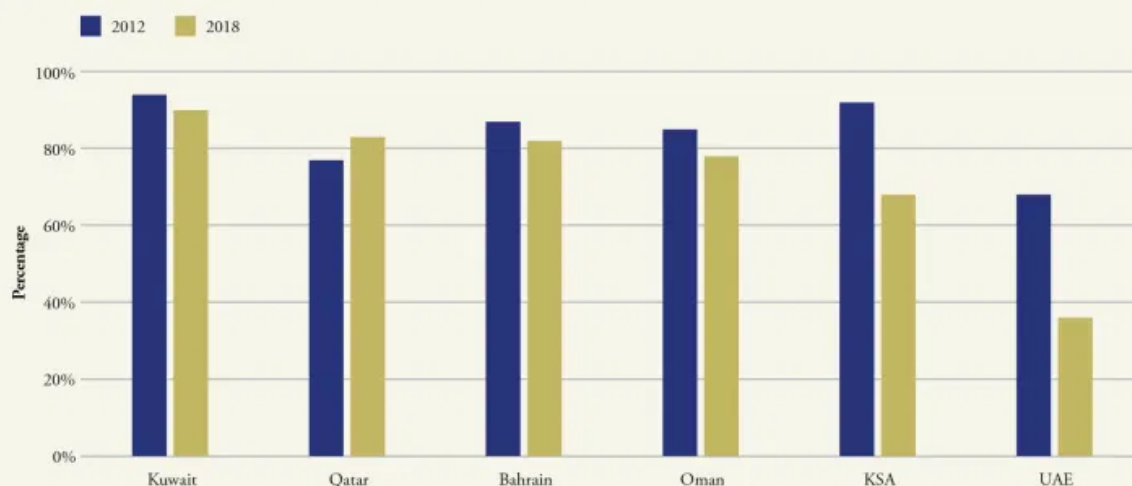
Despite their reputation as the world's leading petroleum exporters, the Gulf States' oil-rich soil is fertile ground for the future of renewables. There are several factors that give the Arabian Peninsula a competitive advantage as a global resource for green energy. The most crucial reason is that it has among the highest levels of solar radiation on the planet. According to the World Resources Institute, Saudi Arabia, the UAE, Oman, and Yemen all rank among the highest countries in terms of solar energy potential (Appendix).

The political dynamics in the Gulf States' position them well to develop their renewable infrastructure expeditiously. Developers in the west have to navigate through a lot of bureaucracy, often just to find their project dead on the table. If a company wants to build a solar farm in a state like Arizona, for instance, they may face a lot of backlash from locals who don't want to see their landscape adulated by thousands of acres of black plates. One of the benefits of

the GCC systems is that if a renewable project gets approval, it happens and, if the government wishes, quickly.

Additionally, the economic implications of shifting energy demands mean that the Gulf States must seize their renewable energy opportunity. According to the Brookings Institute, “ unless GCC countries undertake substantial fiscal and economic reforms, they will deplete their conserved wealth by 2034.” Countries like Saudi Arabia, the UAE, and Oman are extraordinarily wealthy, yet among the least diversified economies in the world. Oman for instance gets more than 80% of its GDP from Hydrocarbon and Saudi Arabia is almost at 70% (Kabbani).

Figure 4: Hydrocarbon Revenues (Share of Total Revenues)



Source: World Bank Group, “Economic Diversification for a Sustainable and Resilient GCC,” 54–59.

Obviously, the tide has shifted due to the conflict in Ukraine, but when oil prices dropped to below zero during the pandemic, the Gulf States’ reality—that their economies can’t exclusively rely exclusively on fossil fuels forever—became much more real.

There are many projects in development that suggest that the Gulf States, and the rest of the world, are taking the Arabian Peninsula's green energy potential seriously. These projects include developments on solar, wind, and green-hydrogen fronts. These endeavors will be analyzed on a country by country basis in the analysis section. Suffice to say that every gulf state has established considerable momentum in its efforts to develop green energy platforms.

GCC also has the potential to help Europe stay on track with their emissions goals by filling in the supply gap caused by Europe's tapering their Russian supply. As will be discussed in the analysis, Qatar has a huge supply of LNG, and is not a member of OPEC. A longer-term strategic partnership should be pursued with Qatar specifically. The other OPEC member states are less likely to be reliable partners as they are eager to stay in good relations with Russia due to their involvement in OPEC+.

Naturally there are some risks associated with doing business in GCC and working with renewables in general. The Arabian Peninsula suffers political strife, although considerably less than many of its neighbors to the north. Tensions between Saudi Arabia and Iran have resulted in instability on the peninsula. Yemen, which has the world's highest concentration of solar radiation is filled with untappable potential as a proxy war between Iran and Saudi Arabia has ravaged the country precipitating a humanitarian crisis and jeopardizing any investment potential in Yemen itself. However, the conflict in Yemen is for the most part sealed within the country's borders, and the likelihood that it would spill over into other GCC is relatively low.

Another concern is intramural fighting among the GCC. The Iran/Saudi conflict bled over into the Qatari border a few years ago as well. Qatar, emboldened by an unimaginable influx of natural gas wealth, decided to make friends with many of Saudi Arabia's enemies including the west, Iran, and free press. Saudi Arabia responded by manufacturing a crisis as an excuse to besiege Qatar's only land border, blocking many critical resources from entry. Things have since settled, however, but this tension may continue to cramp the countries' spirit of collaboration in the future.

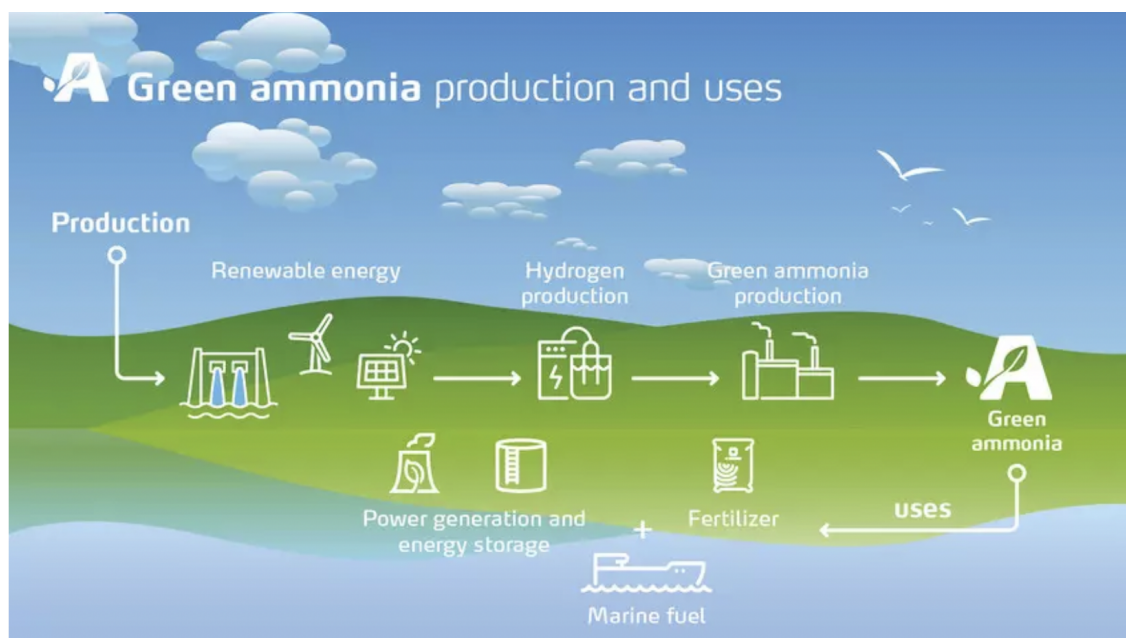
Another potential worry is the misalignment of world views between the west and GCC, most so with Saudi Arabia. This is an important consideration because Europe's energy dependence on Russia, two regions with diametrically opposed worldviews, is what's fueling the current energy crisis. One could argue that it would be ill-advised to create a new dependency with a country(s) that, like Russia, has historically shown a disregard for human rights and a hostility towards basic democratic institutions. Although it seems like a distant memory in the midst of Russia's invasion of Ukraine, the murder of Jamal Khashoggi, perpetrated by the Saudi Government, shook the world and prompted the west to re-evaluate their economic investments in the region—although, it never really stopped them from procuring Saudi oil. The aftermath was a total humiliation for the crown prince Muhammed Bin Salman who was and continues to be desperate for foreign investment and international recognition as the regional hegemon amidst tensions with Iran. Up until recently one might have argued that those motivations could be channeled to disincentivize such atrocities from happening in the future. However, tensions from Khashoggi's killing were resurrected recently when National Security Advisor brought up the murder in a meeting with the crown prince which ended in a shouting match. Muhammed Bin

Salman ended the meeting saying that he never wants the topic brought up again and that the US could forget about its request to boost oil production to replace Russian supply (Said). Whether this argument was an isolated tiff or an omen for a non-cooperative future remains to be seen.

Forced labor is another humanitarian concern that should be considered while entertaining prospects of EU/GCC energy partnerships. Qatar came under scrutiny during the leadup to the FIFA world cup, which was hosted in a stadium built by migrant workers. It brought to light numerous abuses and problematic immigration systems in the country that some argue are indicative of systemic exploitation. Amnesty International reports that the ‘Kafala’ system in Qatar which allows employers in Qatar to sponsor immigrant visas —and “until recently prevented workers from changing jobs or even leaving the country without their employer’s permission – traps migrant workers in a cycle of abuse,” (Amnesty). European leaders may have to weigh the potential moral hazards that come with procuring goods that could be produced using forced labor and contributing financially to Russia which may pose an existential threat to Europe and the world. Despite the concerns surrounding GCC labor sourcing, global outrage seemed to fizzle out just in time to enjoy a soccer tournament. Therefore, it’s likely to be a concern during an energy crisis. Additionally, Qatar has made an effort in recent years to improve its dicey record on labor regulation with a slate of reforms which includes abolishing the Kafala system. According to Michael Page, the deputy Middle East Director at Human Rights Watch, “Qatar’s new labor reforms are some of the most significant to date and could, if carried out effectively, considerably improve migrant workers’ living and work conditions,” (Human Rights Watch). It’s clear that Qatar is responsive to public opinion and economic

leverage, which should be interpreted auspiciously as the EU gauges long-term energy partnerships with Qatar and other GCC.

Another concern is with green energy itself, although it's less significant in the analysis since these are problems that will need to be addressed regardless of which regions the west gets their clean energy from. Despite all of the solar and wind energy potential on the Arabian Peninsula, there question remains of how to transport that energy westward. One potential workaround is converting the solar and wind energy into a transferable form. As will be discussed in the analysis, green hydrogen is the most likely solution. Essentially, the solar power is used to create hydrogen which is then converted into ammonia which is transportable and can be used as an energy source itself or converted back into hydrogen post-transport. Ammonia is quickly gaining traction in discussions surrounding green energy because it is energy dense and relatively economical to produce. According to the World Economic Forum, Ammonia is nine times as energy dense as Li-Ion batteries and three times the energy density as compressed hydrogen. There are massive efforts to quickly develop green hydrogen and ammonia infrastructure. The Green Hydrogen Catapult Initiative endeavors to increase green hydrogen production by a factor of fifty by 2026. This would enable green hydrogen to reach prices that are competitive with fossil fuel alternatives (Holsether). The process of green hydrogen to ammonia conversion can be visualized below:



Another potential workaround is a carbon credit system. If GCC countries power their grids mostly with green energy, that frees up their oil and natural gas reserves to send elsewhere. In addition to purchasing the oil and natural gas from GCC, the west can also purchase carbon credits from GCC from their clean energy grid and apply them to their own energy quotas. This process, although clever, obfuscates who really contributes what and how much. One might argue that GCC would be using green energy to power their grids regardless if they could sell the credits or not, so is it really proper for entities like the EU to take those credits? A discussion on the topic is warranted.

One last solution with longer development horizons is extending the grid systemically through the Arabian Peninsula, and from there to Europe. There are discussions of constructing underwater power lines through the Mediterranean, although the most likely projects will connect Northern Africa and southern Europe. These endeavors are unlikely to materialize in the

short and medium-term, however, and the most promising prospects for pipelines will run north-south across the Mediterranean from north Africa to southern Europe—not particularly relevant to this thesis

Analysis

Oman

It's safe to say that Oman has benefited tremendously from oil revenues over the past few decades. After Sultan Qaboos bin Said deposed his father in 1970, he prioritized using oil revenues to modernize Oman's economy and infrastructure. He also made an effort to open the sultanate to the rest of the world. Although a member of the GCC, it falls less under the Saudi sphere of influence than states like the UAE. It remained neutral, for instance, in Saudi's vendetta against Qatar and it decisively side-stepped involvement in the war in Yemen.

Oman is an interesting case study because its economy's reliance on hydrocarbons is pronounced even amongst the world's largest producers. Over 80% of its GDP comes from fossil fuels directly, and the current administration seems to be in a hurry to diversify their economy.

Perhaps Oman's most ambitious project to date has been the Ibri 2 solar field. It was developed by Saudi-owned ACWA with the Gulf Investment Corporation, and spearheaded by CEO Yahyah Al-Rawahi who I had the privilege to speak with. The field was marketed to produce 500 megawatts of energy; although Al-Rawahi asserts it's capable of producing much more than that. In fact, the government has recently requested moving the plant to maximum capacity to

minimize domestic use of petroleum so they can export it and take advantage of inflated oil prices.

Al-Rawahi feels optimistic that the sultanate is moving in the right direction with respect to clean energy development: “When oil prices were high, we were complacent. [Oman] never thought that it needed to diversify... they were talking about it, but there were no real efforts that you could see from the top...when oil prices declined—before COVID but COVID made it worse—the government started feeling the pressure. Then they realized that they needed to stop talking about diversification and actually start doing it. A lot of initiatives took place, Ibris being one of them. [Now] we have many more renewable projects in the pipeline including two solar, two wind all in the next five years.”

Oman’s biggest problem might not even be low oil prices, but rather supply. Out of all the GCC states, “Bahrain and Oman are in the most precarious position, with reserves expected to run out within the next decade for Bahrain and within 25 years for Oman.” (Brookings)

Despite the sultanate’s theoretical ability to expedite prioritized projects, Al Rawahi says that there’s a lot of bureaucracy to navigate in order to get a project approved. Creating a bid usually involves a coordinated effort to comply with conflicting regulations and standards from multiple government agencies. Additionally, competition against other developers makes any given project’s margins razor thin. Despite Oman's solar-rich land availability, not all of it’s available for solar projects and sometimes the land that the government grants is difficult to develop a

solar field on. This can partly be attributed to the nomadic Bedouin population to whom the desert has a very practical and cultural significance.

However, as the Omani government continues to elevate green energy as a priority, there is hope that the bureaucracy will start to diminish. Al Rawahi also noted that the Omani authority announced that all future energy projects are going to be renewable. They will no longer be adding infrastructure in their hydrocarbon sector. Additionally, gulf corporations have proven that once renewable projects are approved, the development process itself is quick. Ibris 2, a 1.5 million panel plant, was impressively completed in 13 months.

There remains the question of how this solar energy will make travel thousands of miles to Europe. Oman has an answer to that question as well: green hydrogen. Well, hydrogen that's converted to ammonia. Mr. Salim Sabani is the lead on several projects for ACWA including a hydrogen plant that is currently under construction. He explained, "the way to do it now is to mix [hydrogen] with nitrogen from air. And then you get the ammonia. Ammonia, which is a liquid. It actually has the highest energy content. It can be used as energy, as fuel. It can be used as fertilizer." Ammonia is essentially a transportable version of hydrogen. Once it's delivered to its desired destination, the ammonia can be used as a fuel source itself or be converted back into hydrogen.

According to Sabani, the potential for this technology is not a matter of when: "it is already happening. One major project in Saudi is with an American company called Air Products. They are the world leader in hydrogen consumption. They manage the industrial part, industrial gasses

and then you have ACWA Power, which is our parent company. They are the leader in this region for renewable electricity. So the combination of the two created a project in Saudi called Neom; that's their first milestone or mega-projects already in construction and that will be partly Saudi consumption and partly to export to Europe. So it's already happening.”

Saudi Arabia

Saudi Arabia has among the highest solar energy potential in the world—ranked third according to the World Resources Institute. Many projects are underway to realize that potential and Saudi Arabia is well-positioned to become a strategic partner for green energy exports in the medium to long-term. Saudi Arabia, like Oman, is currently processing the consequences of having a dangerously undiversified economy. More than 90% of its GDP comes from hydrocarbon or oil and gas related industries. Additionally, the Kingdom faces a considerably high youth unemployment rate at around 40% (Kabbani). The current administration is spearheading a massive project called “Vision 2030” with the purpose of quickly pivoting the Kingdom’s reliance on fossil fuels and injecting fuel into the economy. Under the plan “the Kingdom would take advantage of its place in the Arab and Islamic worlds, transform itself into a global investment giant, and establish itself as a hub for Europe, Asia, and Africa... Aramco would grow from an oil company to an energy conglomerate... There would be recycling, e-government, and renewable energy,” (Hubbard 67). Muhammed Bin Salman, who is functionally the Saudi head-of-state, has spoken extensively about his concern about the kingdom’s “oil addiction” that demanded an intervention (Hubbard 68). With his administration's approval, renewable development contracts have been distributed with unprecedented urgency.

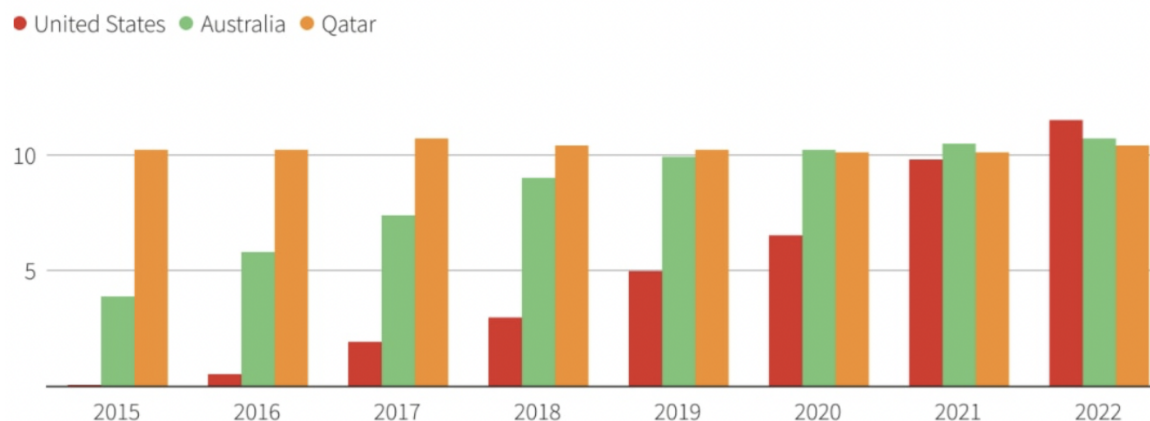
Despite Saudi Arabia's eagerness to diversify their economy, their current financial situation from decades of hydrocarbon extraction positions them well to rapidly finance and develop alternative economic endeavors. According to the World Bank, Saudi Arabia has generated \$700 billion in GDP in 2020. These kinds of financial capabilities are critical to get projects like Neom, which could be considered the crown jewel of the Vision 2030 project, off the ground. Neom is a city under construction on the Saudi Red Sea coast and it will eventually be home to one of the most ambitious green hydrogen projects in the world. Neom, partnering with ACWA and Air Products, has plans to start construction on their hydrogen plants in 2026 (Ellis). In order for green hydrogen to be considered "green" it needs to be manufactured using green energy sources like wind and solar. Saudi Arabia has many renewable projects in development, like those in Oman, in development to meet the demands of its developing hydrogen infrastructure. The Kingdom of Saudi Arabia has ambitions to build 58.7 GW of renewable energy by 2030 ("Saudi Arabia Makes Next Solar Move"). To put that number into perspective, each gigawatt of energy is capable of powering 750,000 homes, meaning that 58.7 GW can power roughly 44 million homes (Dellinger). The largest contract to date is a 1,500 MW solar farm called Sudair, another project involving ACWA. According to the company, "Sudair PV IPP will be capable of powering 185,000 homes and offsetting nearly 2.9 million tons of emissions per year (Sudair PV IPP)."

Saudi Arabia, along with the other OPEC states, likely won't provide much assistance in meeting Europe's energy needs in the short term. First of all, the majority of the energy that Europe formerly received from Russia was Natural Gas, which Saudi Arabia doesn't have a huge supply

of. There is the possibility of using their oil to replace the supply gap in Russian natural gas, but using oil will be antithetical to Europe's green energy goals and the OPEC states have all signaled that they won't be increasing supply to maintain good rapport with Russia, a member of OPEC+, and a collaborator of global oil price-fixing. Their value added to Europe's energy goals will come in the form of carbon credits and transport of renewable sources via hydrogen and ammonia (Appendix).

Qatar

Qatar plays a different role in this energy paradigm. Thanks to the discovery of natural gas reserves, Qatar was plucked out of relative economic obsolescence and made one of the world's wealthiest countries. This Gulf State has the potential to remedy Europe's energy supplies in the short-medium term since the infrastructure to transport liquified natural gas is much more established than alternatives such as solar and green hydrogen. As referenced in the figure below, Qatar is among the top three exporters of liquified natural gas which is indicative of its capability to produce and scale at a significant level. Furthermore, Qatar's exit from OPEC/+ makes it less prone to appeasing Russian interests when it comes to supply increases. In addition to its Natural Gas supply, it also is looking beyond hydrocarbons to safeguard their economy with a portfolio of numerous renewable projects.



Note: 2021 and 2022 figures are estimates

Sources: U.S. EIA, International Gas Union, Goldman Sachs

Even with Qatar's enormous amount of natural gas infrastructure, it will still may be a challenge to increase capacity to compensate for the gap from Europe's Russian supply. There are some indications, however, to be optimistic. Qatari natural gas suppliers are putting out feelers to potential buyers to see if it will make sense to build six new liquefaction plants that would increase the state's capacity to produce LNG by 40%. Although the solution would not be immediate, the plants would be expected to be producing by 2026.

Qatar has also expressed that it supports its European partners in ways that the other Gulf States haven't. As much as Europe's focus has been on increasing LNG supply from alternate sources, it's also playing a game of defense trying to make sure that supplies from Russian collaborators don't decrease either. Under current contracts between the EU and Qatar for instance, LNG are divertable, meaning that Qatar could sell supplies previously dedicated to the EU elsewhere to take advantage of higher energy prices. However, As the crisis in Ukraine escalated and precipitated a secondary energy crisis in Europe, the CEO of Qatar Energy said "We're not going to divert [contracts] and will keep them in Europe, even if there is financial gain for us to divert

away, we would not do that...That's in solidarity with what's going on in Europe" (Anderson). This assurance is critical to ensuring that the energy crisis in Europe doesn't continue to spiral, and it's not one being offered by any other GCC.

Qatar's potential to help the EU meet its energy goals transcends beyond the supply of hydrocarbons. Like Saudi Arabia and Oman, Qatar is working diligently to wean off its fossil fuel addiction to ensure the long-term health of its economy. Qatar may be in an even more precarious situation than the other gulf states as more than 90% of its exports are carbon-based. This GCC has increased focus on developing several economic sectors such as sports and tourism, but the potential for renewables may eclipse other opportunities for economic diversification (Kabbani).

On the solar front, Qatar is on the cusp of completing its first large-scale solar plant which will be capable of producing 800MW once it reaches its full capacity this year. According to Total Energies, which is developing the plant: "It will represent around 10% of electricity peak demand of the country and will reduce the CO2 emissions of Qatar by 26 million tons during the life of the project." Although it's Qatar's first solar project of this scale, it keeps pace with the ambitions of its GCC counterparts.

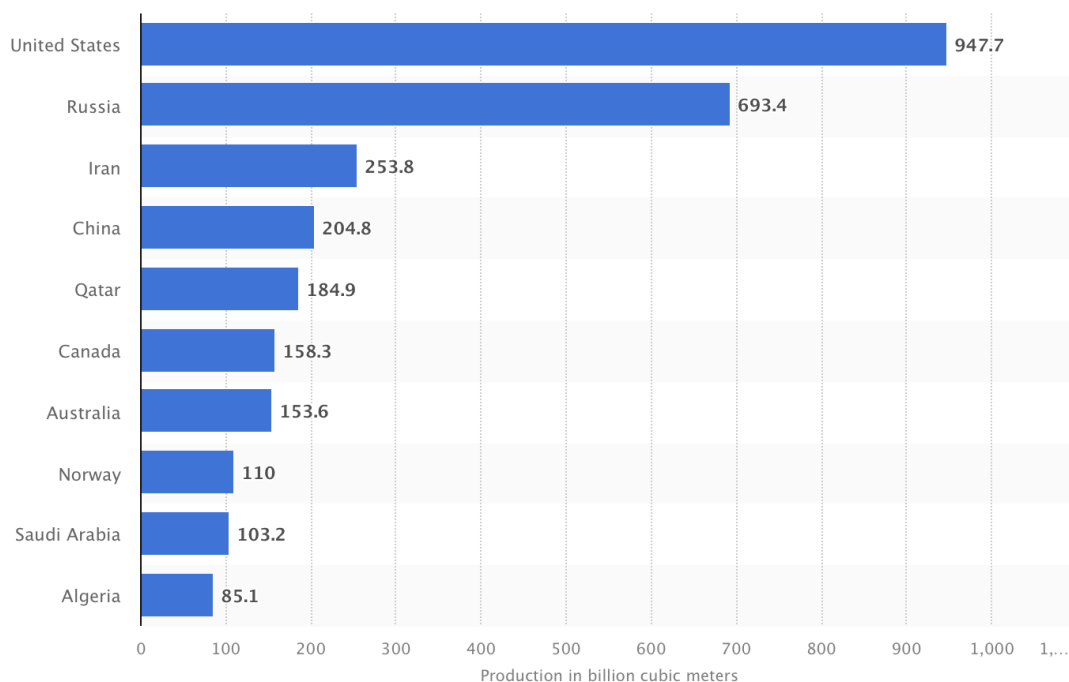
Conclusion

Although there are risks associated with increased investment in the GCC energy sector, most can be mitigated. The reality is that the EU faces a massive challenge managing an energy crisis while also trying to meet their ambitious energy goals. It is critical that the EU works to establish

business partnerships to build up solar, green hydrogen, and ammonia infrastructure in GCC to meet long-term energy goals. It will also be critical to work with Qatar to maximize LNG supplies to meet their energy needs and goals in the short-medium term.

Appendix (1)

Top Countries Natural Gas Production Worldwide



Saudi Arabia significantly increased its renewable energy targets and long term visibility

Planned Capacity (GW)



- Increased 5-Year Target**
- Extended visibility to 2030**
- Optimized the energy mix**
- Manufacturing capacity of 200GW by 2030**

VISION 2030
Saudi Vision 2030
National Renewable Energy Program

البرنامج الوطني للطاقة المتجددة
National Renewable Energy Program

THE FOUR AMMONIAS

The ammonia industry has informally adopted a color scheme to describe the carbon intensity of the different methods for making ammonia. The system also applies to hydrogen.

Gray

Also called brown ammonia, this is conventional ammonia that has been made the same way for 100 years. The Haber-Bosch process, responsible for nearly all of the world's 180 million t of annual ammonia production, reacts hydrogen and atmospheric nitrogen. The hydrogen often comes from the steam reformation of methane, a process that emits CO₂.



Blue

Blue ammonia is conventional ammonia for which by-product CO₂ has been captured and stored, reducing climate impact compared with gray ammonia. Many fertilizer makers have embarked on such projects in recent years. Blue ammonia is controversial and in need of industry standards. Using CO₂ for enhanced oil recovery, for example, isn't as environmentally beneficial as injecting it into the ground permanently.



Green

Green ammonia is made with hydrogen that comes from water electrolysis powered by alternative energy. Projects abound, though most are on a modest scale of tens of thousands of tons, an order of magnitude smaller than a typical ammonia plant. A massive project in Saudi Arabia, however, aims to make more than 1 million metric tons of ammonia per year.



Turquoise

This process uses pyrolysis to convert methane into pure carbon and hydrogen, which is reacted with nitrogen to make ammonia. The industry thinks of turquoise ammonia as somewhere between green and blue. A prominent project is Monolith Materials' carbon black plant in Nebraska.



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