The Arab Gulf States Institute in Washington

Building bridges of understanding


# Enhancing Gas Security: An Economic Imperative for the Gulf Arab States

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The Arab Gulf States Institute in Washington (AGSIW), launched in 2015, is an independent, nonprofit institution dedicated to increasing the understanding and appreciation of the social, economic, and political diversity of the Gulf Arab states. Through expert research, analysis, exchanges, and public discussion, the institute seeks to encourage thoughtful debate and inform decision makers shaping U.S. policy regarding this critical geostrategic region.



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## About the Author

Diane Munro is a non-resident fellow at the Arab Gulf States Institute in Washington where she specializes in international oil markets and geopolitical issues driving OPEC and Gulf Cooperation Council energy policies. Formerly, she served with the Paris-based International Energy Agency, where her work centered on developing global oil market forecasts, policy analysis of IEA and OPEC member countries, and energy security strategies such as IEA simulations and war-gaming exercises among member countries in the event of major oil supply disruptions. Munro has written on energy issues for more than 30 years, with her work published by Bloomberg, Middle East Economic Survey, Reuters, Al-Hayat, Energy Compass, and Petroleum Intelligence Weekly. In addition, she has worked as a consultant for a wide range of companies including Wood Mackenzie, BP, and Arthur Andersen. Previously, she was president and editor-in-chief of The Oil Daily Co, now known as Energy Intelligence Group.

# Executive Summary

Natural gas will play a critical role in driving economic expansion and diversification for the Gulf Arab states in coming decades. Yet, despite the enormous resources of natural gas, almost all countries in the region, with the exception of Qatar, will struggle to meet growing supply needs. Straining supplies further, gas is being prioritized for use in electricity generation in an effort to divert more valuable crude oil to export markets to maximize revenue, a critical priority in the major producing countries.

The Gulf Arab states are casting a wide net in their pursuit of gas-supply security, with increased use of renewable sources also a central policy initiative. State energy companies are sharpening their focus on developing domestic natural gas production, but some countries are having more success than others developing these technically challenging reserves. As a result, rapidly expanding demand is forecast to outpace planned production increases for the major gas consuming countries in the region.

In an effort to mitigate supply deficits, a number of countries will increasingly turn to imports of liquefied natural gas or embark on joint ventures to acquire gas assets outside their borders. Indeed, the pursuit of natural gas security will dominate the energy landscape of the Gulf Arab states through the next decade.

# Introduction

Gulf Cooperation Council members' per capita natural gas demand ranks among the highest in the world, but domestic production has lagged behind the growth in consumption and the supply shortage is expected to persist, and even widen, for some countries. Against a backdrop of robust gas demand, the need to curb the use of oil for burning in power plants, and planned expansions of energy intensive industries, Gulf Arab states are prioritizing plans to meet their strategic needs to achieve gas security.

Given each country's diverse natural gas supply and demand profiles, governments are exploring a wide range of options to reach a balance in their energy mix. In the past, efforts to diversify economies were fueled by low-cost associated gas produced as a byproduct of more valuable crude oil production. The associated gas, with its relatively inexpensive gathering and processing costs, has provided a competitive advantage for expansion of gas-intensive export industries, such as petrochemicals, aluminum, and fertilizer, but it has also led to a rapid acceleration in demand growth. Price subsidies for natural gas have also led to wasteful and inefficient use in electricity consumption.

The oil price crash in mid-2014 and corresponding plunge in oil revenue, however, made government-supported subsidies untenable. GCC states are implementing energy pricing reforms but in a staged approach to lessen the impact of higher prices for both residential and industrial consumers over the next several years. The gradual rise in domestic prices will partially temper growth rates in gas consumption but, nonetheless, the region's demographics and industrialization will combine to eclipse the savings in demand from reduced subsidies.

Aside from Qatar, much of the region's nonassociated natural gas reserves are relatively underdeveloped because they are technically challenging and expensive to produce. Now, however, companies are deploying the latest technology in an effort to monetize their massive nonassociated gas reserves, including shale gas fields. However, there are limits to what can be achieved given the complex quality of the gas. For Saudi Arabia, the United Arab Emirates, Kuwait, and Bahrain gas deficits will worsen in the coming decade as demand outpaces domestic production.

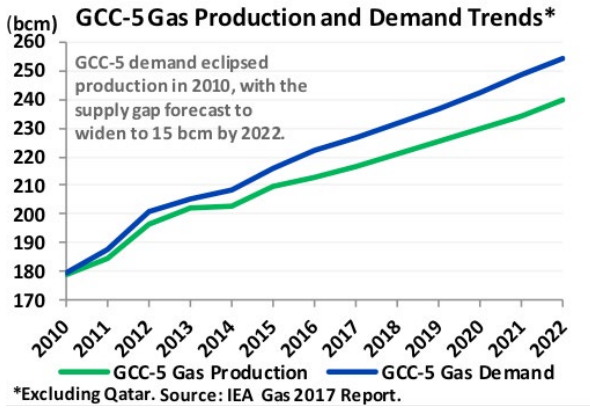
*In an effort to mitigate domestic gas supply shortages, states are increasingly turning to imports of liquefied natural gas from the international market.*

In an effort to mitigate domestic gas supply shortages, states are increasingly turning to imports of liquefied natural gas from the international market.[1] The UAE and Kuwait are already importers and will see volumes increase in coming years while Bahrain will import its first LNG cargo in 2019, when its new receiving terminal is completed. Saudi Arabia is weighing LNG options, including joint venture opportunities to secure foreign supplies.

Renewable and nuclear energy will play an increasingly important role in the future, but natural gas will remain the primary source for power generation and new energy-intensive industrial projects, making it a powerful engine of economic growth for the Gulf Arab states.

## GCC States Pursue New Gas Strategies

GCC natural gas demand more than doubled from 2000-17, fueled by the rapid expansion of energy-intensive industries and surging residential electricity consumption buttressed by growing populations. Demand in the GCC states is forecast to rise by an additional 15 percent by 2022, to 327 billion cubic meters per year (bcm/y), according to data from the International Energy Agency's (IEA) Gas 2017 report.[2] GCC production also more than doubled between 2000 and 2017, to 393 bcm/y. However, Qatar accounts for more than 45 percent of the group's total production and complicated political relationships among some of the Gulf countries has meant that Doha exports the bulk of its supplies to international markets rather than to some of its neighbors with a natural gas deficit.




Excluding gas-rich Qatar, demand from the remaining five GCC members collectively surpassed production levels in 2010 and the

1 Liquefied natural gas is cooled to a liquid for shipping in special tankers and then transformed back to its gaseous state at special regasification terminals at its destination before being piped to distribution companies, industrial consumers, and power plants, among others. The volume of natural gas in its liquid state is about 600 times smaller than its gaseous state, which enables buyers to import a large quantity of supplies by tanker.

2 International Energy Agency, *Gas 2017* (Paris: International Energy Agency, July 2017).

supply deficit has steadily worsened. By 2017, the gas supply gap for the GCC-5 averaged approximately 10 bcm/y and is forecast to post a near 50 percent increase to 15 bcm/y by 2022, according to the IEA.

The six GCC states hold just over 20 percent of global supplies, at an estimated 1.5 trillion cubic feet (tcf), but, with the exception of Qatar, development has lagged far behind demand. Qatar sits on a massive 60 percent of the region's reserves, followed by Saudi Arabia at 20 percent and the UAE at 15 percent. At the same time, excluding Qatar, as much as 60-70 percent of the region's gas supply comes from associated gas produced in tandem with crude oil deposits rather than nonassociated gas fields, so volumes are capped by oil production levels. Additionally, with the exception of Saudi Arabia, other countries also use the associated gas production for reinjection into oil fields to increase pressure and maintain flow rates of production, limiting the amount available for use in the domestic market.

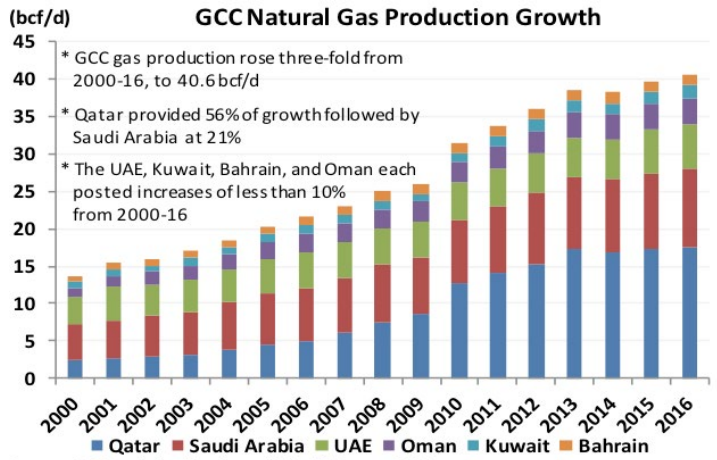
**World Gas Reserves (In tcf)**

| | Estimated Reserves | Share of GCC | Share of World |
|---|---|---|---|
| Qatar | 858 | 58.6% | 13.0% |
| Saudi Arabia | 298 | 20.3% | 4.5% |
| UAE | 215 | 14.7% | 3.3% |
| Kuwait | 63 | 4.3% | 1.0% |
| Oman | 25 | 1.7% | 0.4% |
| Bahrain | 6 | 0.4% | 0.1% |
| **GCC Total** | **1,464** | **100%** | **22.2%** |
| Iran | **1,183** | ... | 18.0% |
| Russia | **1,140** | ... | 17.3% |
| Turkmenistan | **617** | ... | 9.4% |
| United States | **308** | ... | 4.7% |
| Rest of World | **1,877** | ... | 28.5% |
| **Total World** | **6,589** | | **100%** |

Source: BP Statistical Review of World Energy 2017.

GCC natural gas production rose three-fold between 2000 and 2016, rising from just 13.7 billion cubic feet per day (bcf/d) to 40.6 bcf/d, according to the BP 2017 annual statistical review.[3] Qatar provided a staggering 56 percent of the growth, reaching 17.5 bcf/d by 2016. Saudi Arabia captured 21 percent of the growth, almost doubling natural gas production over the period, from 5.7 bcf/d to 10.7 bcf/d. Combined, Qatar and Saudi Arabia produced almost 70 percent of the GCC states' total gas supplies by 2016. The UAE's market share was 15 percent followed by Oman with 8 percent, while both Kuwait and Bahrain supplied just 4 percent each.

Development of nonassociated gas fields has been marginal in most of the Gulf Arab states, in large part due to its highly corrosive, sulfur-laden quality that requires expensive and complex technology to produce. However, a pivotal policy shift toward increasing non-oil industrial growth as part of national economic diversification plans has now triggered renewed efforts to monetize stranded gas assets. State-run energy companies are



Source: BP Statistical Review of World Energy 2017.

3 BP, *BP Statistical Review of World Energy June 2017* (BP, June 2017).

devoting substantially more resources and capital expenditures to nonassociated natural gas projects in a bid to close the supply gap. Saudi Arabia, the UAE, Kuwait, Oman, and Bahrain are working with oil and gas service companies and joint venture partners with experience and advanced technologies to help develop their complex gas reserves. Drilling activity of gas wells in the GCC states reached an all-time high in February, according to Baker Hughes.[4] Nonetheless, complex sour quality issues, logistical hurdles, and project economics will continue to constrain the growth of nonassociated natural gas fields, especially post 2020.

One potential area of new supplies is tight, or shale, gas reserves. Oman successfully started production from the massive Khazzan gas field utilizing horizontal drilling and hydraulic fracturing to extract gas from the tight reserves in September 2017. Saudi Arabia has also embarked on its own shale gas revolution with the planned start-up of small production volumes imminent.[5] However, a scarcity of water and logistical issues may limit the growth of tight gas in the kingdom, and elsewhere in the region. Indeed, assessing the potential of shale gas in the Gulf is still in the early stages, and, therefore a meaningful contribution to overall supplies is not expected in the medium term.

*As the largest gas consumer in the region, Saudi Arabia must confront an array of formidable supply challenges that will undoubtedly require it to look outside its borders and embrace LNG imports in the near future.*

Against the backdrop of rising gas demand and domestic production constraints, LNG imports have been a critical source of additional supplies for some countries and volumes are forecast to increase into the next decade. Plans are moving apace for new LNG import infrastructure to meet future demand, with the Arab Petroleum Investments Corporation (Apicorp), the Saudi investment bank, estimating that Middle East countries will need to invest $10.3 billion in LNG-importing facilities over the medium term to meet surging gas demand.[6] In contrast to permanent LNG terminals, reduced costs for building floating storage and regasification units are providing a flexible and economically competitive option for imports.

Relatively attractive pricing in global LNG markets is also driving some countries to increase imports, with the UAE buying a spot cargo of LNG from as far as the United States. Kuwait, the first Gulf state to turn to LNG, is building a new import terminal and in late 2017 signed a massive contract with Shell for long-term supplies. As the largest gas consumer in the region, Saudi Arabia must confront an array of formidable supply challenges that will undoubtedly require it to look outside its borders and embrace LNG imports in the near future. Aramco is assessing its needs for LNG imports and, in a major policy reversal, appears ready to forge a new joint venture partnership for foreign gas supplies with international companies.

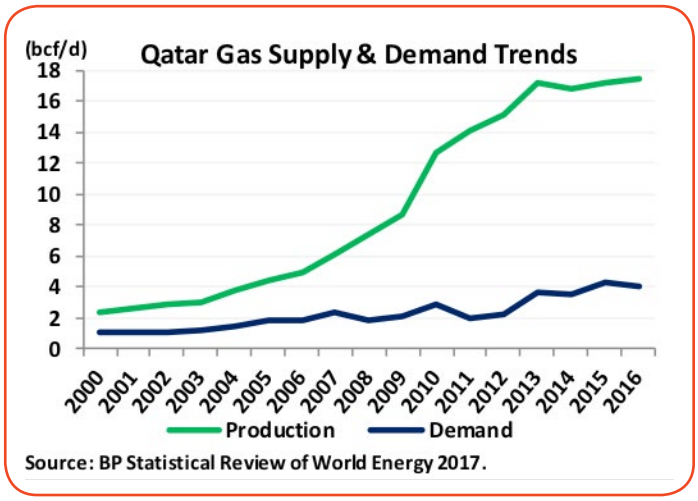
4 "International Rig Count," Baker Hughes, March 7, 2018.

5 Wael Mahdi and Bruce Stanley, "The Next Entrant in the Shale Revolution? OPEC's Saudi Arabia," *Bloomberg*, March 7, 2018.

6 "MENA: LNG's Top Growth Target," *Arab Petroleum Investments Corporation*, August 2016.

# Qatar: Global LNG Exporter with Limited Regional Markets

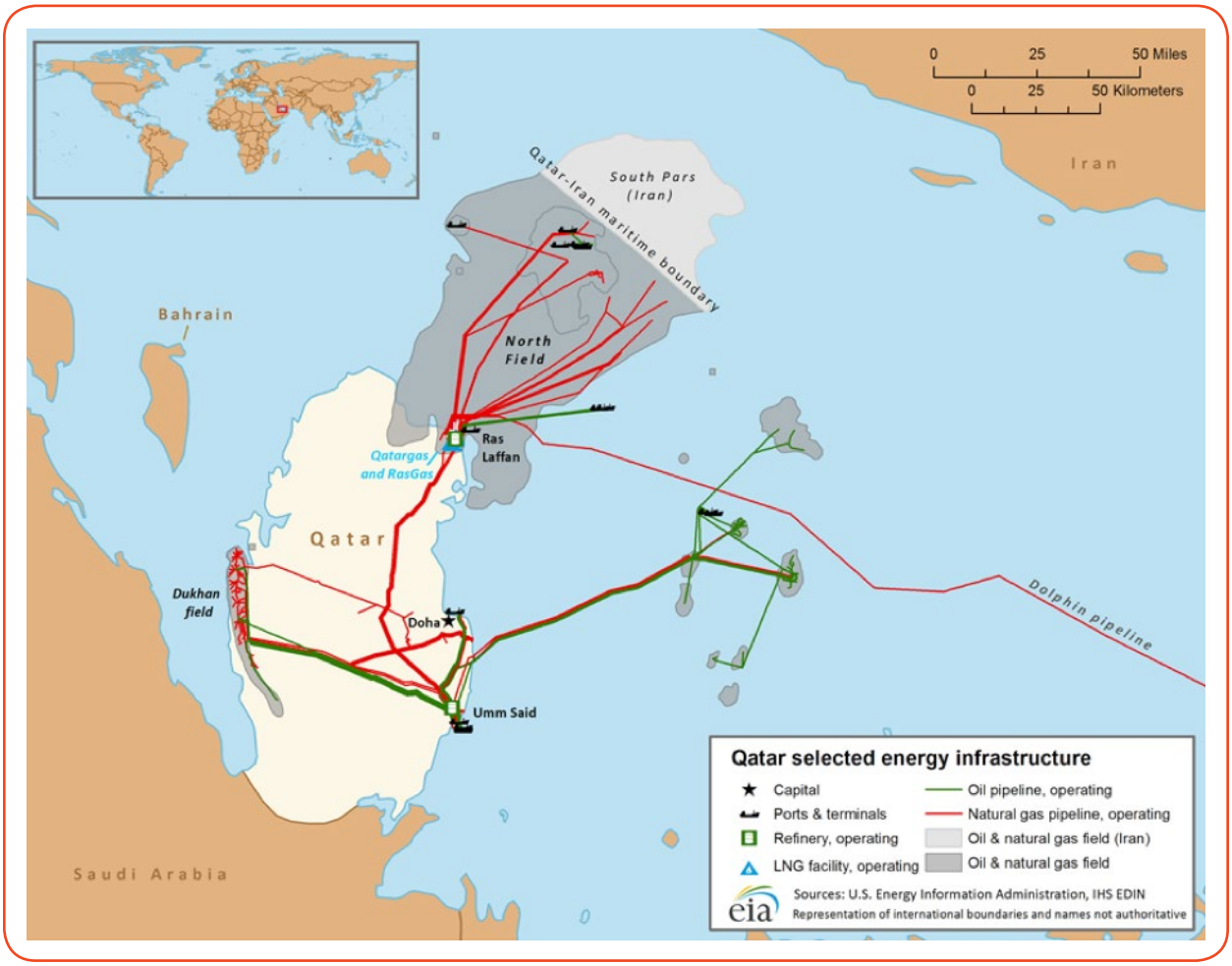
Qatar is the exception among the GCC countries with its massive gas production and LNG facilities giving the country a distinct advantage over its neighbors. Qatar holds the world's third largest stock of reserves and is the largest LNG exporter. Qatar's prized North Field, which is shared with Iran where it is called South Pars, is the world's largest offshore gas field with recoverable reserves of more than 900 tcf. Qatar lifted a 12-year moratorium on development at the North Field in April 2017 and plans to raise its LNG exports over 77 million tons (mt) to 100 mt by 2024. The decision to lift the moratorium reflects the country's efforts to maintain its competitive market position as Australia, the United States, and Russia all increase LNG export capacity over the next several years.[7]




The political complexities of the Gulf region, however, have meant that the imports of Qatari gas by neighboring countries have been limited and previous talk of increasing gas supplies to fellow GCC members to offset growing supply imbalances is not currently an option. The diplomatic crisis that erupted in June 2017 and ensuing embargo against Qatar led by Saudi Arabia, the UAE, Bahrain, and Egypt has not affected existing gas exports to neighboring countries. Qatar continues to export approximately 2 bcf/d of gas via the Dolphin pipeline, with the UAE taking the bulk of the supplies and Oman smaller amounts. The pipeline is owned by Abu Dhabi-based Dolphin Energy, a joint venture between Mubadala Investment with a 51 percent stake, and U.S. Occidental Petroleum and French Total each with 24.5 percent. Qatari LNG exports to Kuwait, which along with Oman is not party to the embargo, also have not been affected. Qatar exported 77.2 mt of LNG in 2016, more than 30 percent of a total global supply of 258 mt, according to the International Gas Union.[8]

7 Diane Munro, "Qatar Moves to Ensure LNG Dominance," *Arab Gulf States Institute in Washington*, April 17, 2017.

8 International Gas Union, *2017 World LNG Report* (Barcelona: International Gas Union, April 5, 2017).




## Saudi Arabia: Multitrack Strategy to Increase Gas Supplies

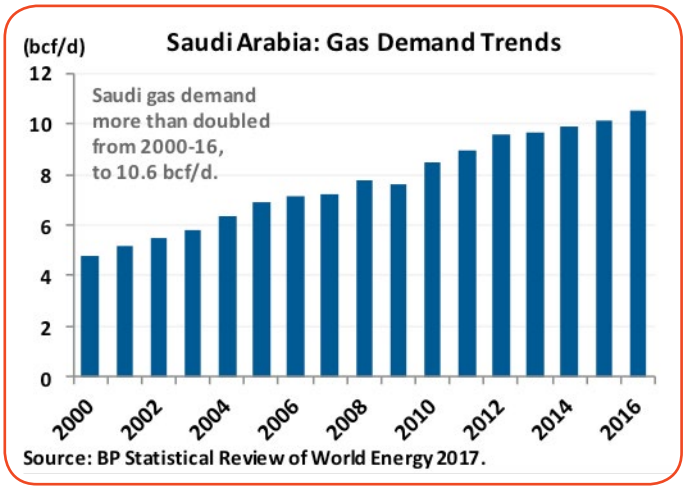
Saudi Arabia has made natural gas security a national priority, committing tens of billions of dollars to exploration, development, and production. Project developments are underway across the country, from the offshore Gulf, to the deepwater areas of the Red Sea, to shale gas drilling sites in the north. Saudi Arabia has made a sizable investment in its gas sector over the last decade resulting in a near 50 percent increase in production since 2006, reaching 12 bcf/d in 2016, according to Saudi Aramco.[9] Gas production has largely kept pace with growth in consumption over the years but that is expected to change in 2020, with the expansion of new energy-intensive industries and rising demand from the power sector.

The government's National Transformation Program has targeted an increase in natural gas production to 17.8 bcf/d by 2020 in a bid to replace oil with gas at electricity plants and as a feedstock in the kingdom's industrial base, including its growing petrochemical industry.[10] The initiative also calls for the country to raise the share of gas in electricity generation from

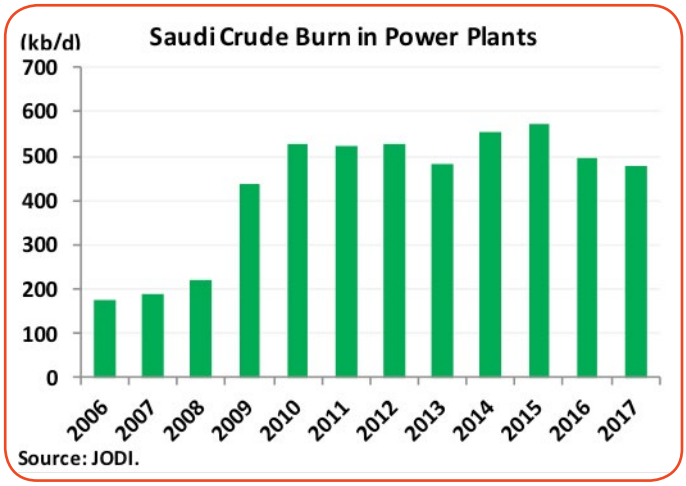
9 "2011 Annual Review," *Saudi Aramco*, July 12, 2012; "Facts & Figures 2016," *Saudi Aramco*, July 20, 2017.

10 "National Transformation Program 2020," *Kingdom of Saudi Arabia*, June 6, 2016.

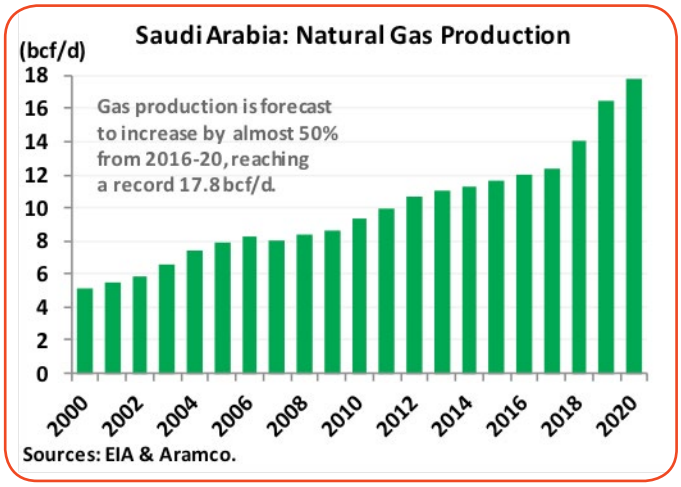
50-70 percent by 2030. Electricity generation capacity was estimated at around 82 gigawatts (GW) as of 2017 with investments of $21 billion needed to raise capacity to 92 GW by 2022 to meet demand for air conditioning, water desalination, industrial use, and other domestic needs, according to a new report by Apicorp. However, the forecast is substantially lower than it was last year due to the government's recent steep increase in electricity prices of 250 percent, which is expected to reduce growth in power demand to just 1.5-2 percent over the next five years.[11]




Plans to increase the use of natural gas to replace crude burned for power generation is a critical financial imperative. Start-up of new gas production over the past several years was behind the drop in crude burned at power plants from a record 570,000 barrels per day (kb/d) in 2015 to 475 kb/d in 2017. During the peak cooling months of June through August, crude burned reached over 900 kb/d in recent years but fell to just 680 kb/d in June 2017 and volumes are forecast to decline further in 2018 on planned increases in gas production. Based on a rough estimate of $65 per barrel for crude oil, every 100 kb/d saved equals approximately $2.4 billion a year.




The kingdom sits on the world's sixth largest gas reserves at 298 tcf, which is equal to 77 years of supply based on current demand estimates.[12] However, almost 70 percent of the reserves are located with associated oil fields, and therefore are constrained by crude production levels. After decades of treating nonassociated gas projects as a low priority, a steady supply of gas is expected to come online by 2020, all of which will be consumed by rising domestic demand. However, post-2020 no new megaprojects are in the pipeline. Moreover, developing additional gas supplies will




11 "MENA Power Investment: Reforms Slowing Demand Growth," *APICORP Energy Research* Vol. 03 No. 07, April 2018.

12 BP, *BP Statistical Review of World Energy June 2017* (BP, June 2017).

become increasingly more challenging in the coming decade due to the complex geology and high sulfur content of undeveloped fields. By 2026, Saudi Arabia hopes to have more than doubled production to 23 bcf/d but reaching that target will be extremely challenging.

## Aramco Casting a Wide Net

Saudi Arabia is casting about for joint ventures to secure access to gas supplies post-2020, when demand is once again expected to overtake production. In a sharp departure from past policy that focused solely on developing domestic gas supplies, Saudi Aramco is seeking to buy a stake in an ongoing foreign LNG venture, which would provide the company with a steady stream equity offtake to meet rising demand in the kingdom.

*Saudi Aramco is seeking to buy a stake in an ongoing foreign LNG venture, which would provide the company with a steady stream equity offtake to meet rising demand in the kingdom.*

"Aramco is drawing a very wide net," according to Saudi Arabia's Minister of Energy, Industry, and Mineral Resources Khalid al-Falih.[13] Saudi Aramco is reportedly seeking an investment bank to act in an advisory role to identify potential natural gas asset acquisitions.[14] In late 2017, U.S. and Russian government officials were actively courting Saudi Arabia as a potential joint venture partner in LNG projects but, after months of speculation, so far there has been no formal announcement about new projects.[15]

However, the kingdom is moving forward with plans to work with Royal Dutch Shell on gas joint ventures. During the official visit of Saudi Crown Prince Mohammed bin Salman to London in early March, a memorandum of understanding with Royal Dutch Shell was signed that could include natural gas projects inside the kingdom as well as Aramco taking a stake in one of the international major's many LNG projects.[16] In 2015, Shell bowed out of the South Rub al-Khali Co. joint venture with Aramco in the Rub al-Khali desert, or the Empty Quarter, due to ongoing concerns over the economic and operational viability of production from the Kidan gas field. Gas from the Kidan field has a high hydrogen sulfide content, which would require a large treatment plant and a costly pipeline network to move the gas from the remote location. At the time, Shell said a minimum price of $6 per million British thermal units (/MBtu) was required to make it commercially feasible but Saudi officials reportedly countered that the price was too high. Whether the two companies will try to resurrect the project under new terms was not disclosed.

13 Javier Blas, Yousef Gamal El-Din, and Vivian Nereim, "Saudi Aramco Embarks on Global Hunt for Natural Gas Supplies," *Bloomberg*, December 20, 2017.

14 Matthew Martin and Archana Narayanan, "Saudi Aramco Seeking Adviser for Global Gas Acquisitions," *Bloomberg*, January 3, 2018.

15 Wael Mahdi and Elena Mazneva, "Russia, Saudis May Go Beyond Oil Alliance With LNG Project," *Bloomberg*, February 14, 2018.

16 "Saudi Aramco Signs Preliminary Gas Deal with Shell," *Reuters*, March 8, 2018.

## Saudis Lead GCC with Nonassociated Gas Projects

The country's nonassociated gas expansion program is designed to help supply gas to meet growing demand on power and desalination plants; it also is aimed at fueling growth of industries, including refining, petrochemicals, steel, cement, ammonia, and solvents, among others. Plans are in place to raise gas production 20 percent by 2022. Saudi Aramco started production from its first nonassociated gas from the offshore Karan field in 2012; since then Aramco has undertaken other major nonassociated gas projects after years of neglect. Between November 2014 and August 2017, the value of the kingdom's gas projects rose by 26 percent, from $18.6 billion to $24.3 billion.[17]

The second major nonassociated gas development to be brought online was the massive 2.5 bcf/d Wasit Gas Plant in 2016, which processes high-sulfur gas from the offshore Arabiyah and Hasbah fields. The Wasit gas facility in the Gulf helps power the Jubail Industrial City, but also enabled Aramco to reverse the relentless rise in the burning of valuable crude oil in power plants during the peak summer demand season.

## Westward Gas Flows Underway

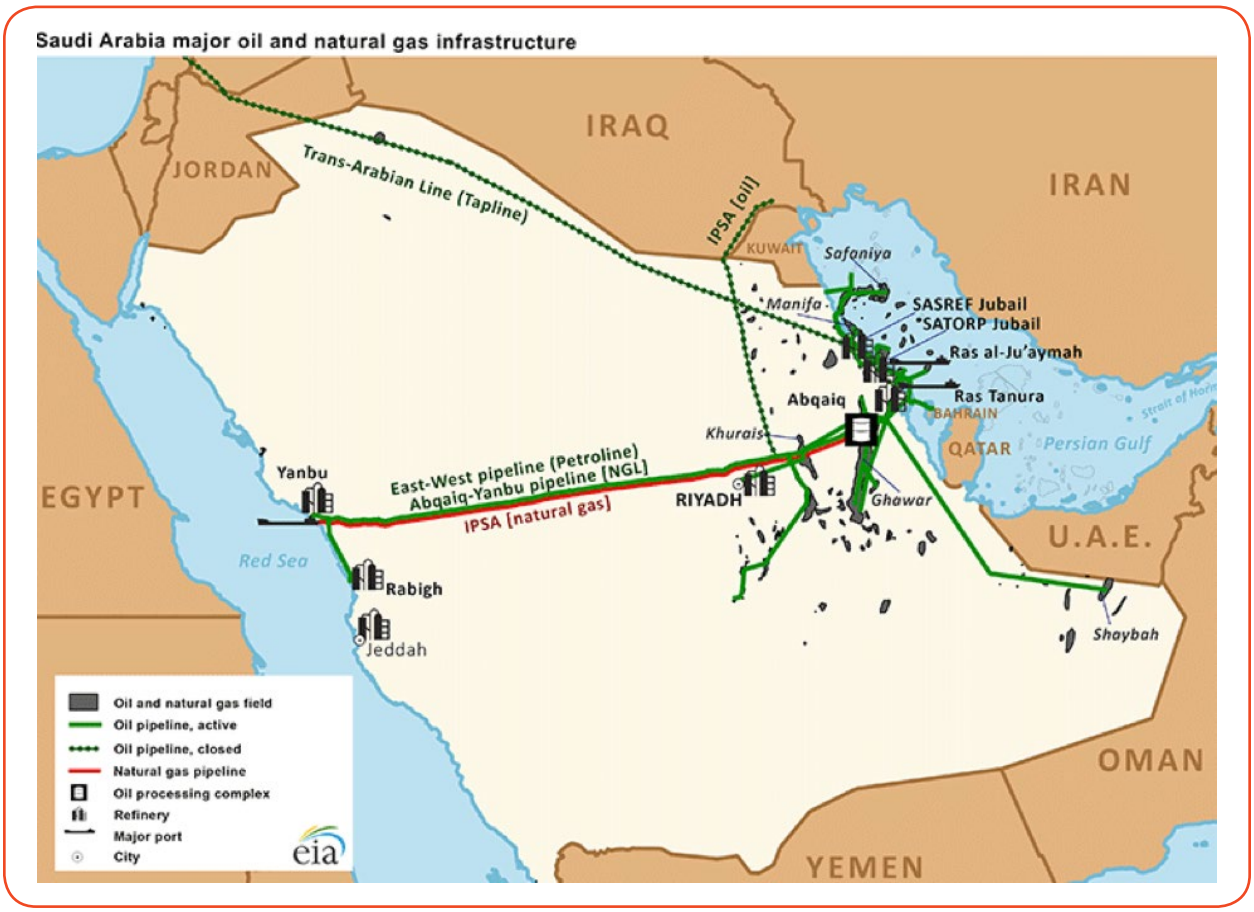
Saudi Arabia is midway through expanding its master gas system, which was originally built in 1975 as a gas-gathering pipeline network and processing facilities for almost all the associated gas produced with oil production and provided the foundation for the kingdom's electricity and industry sectors. The $1.5 billion Master Gas System Expansion is designed to increase the country's gas network to the western region of the country for industrial and power generation use, including the King Abdullah Economic City[18] and the Petro Rabigh-2 power plant. It is a two phase project, with the first tranche planned to raise capacity to 9.6 bcf/d in 2018. The second phase of the expansion will increase capacity by an additional 2.9 bcf/d, to 12.5 bcf/d, by 2020. The plan includes the installation of almost 620 miles of 56-inch diameter pipelines linking the eastern and western coasts of the country.[19]

As part of the second phase, the mega $13 billion grassroots nonassociated Fadhili gas facility in the Eastern Province was launched in late 2016. The 2.5 bcf/d Fadhili project will be a major addition to the kingdom's master gas system and will handle gas from both onshore and offshore fields. The plant will process 2 bcf/d of nonassociated gas from the Hasbah field and 500 mcf/d of associated gas from the onshore Khursaniyah oil field. Fadhili is forecast to be fully operational by the end of 2019. The new Wasit and Fadhili facilities are key pillars of the kingdom's Master Gas System Expansion and are designed to add just over 5 bcf/d of gas processing capacity by the end of the decade. Beyond 2020, however, there are no mega developments planned. A number of contracts were awarded at the end of 2017 for smaller projects to expand gas production but the contribution to overall supply post-2020 appears modest.

17 "Opportunities in the Energy Sector of the Kingdom of Saudi Arabia," *Shearman & Sterling*, December 2017.

18 Fahd Al-Rasheed, "Learn from the Past, Build for the Future: Saudi Arabia's New City on the Red Sea," *McKinsey*, August 2016.

19 "Saudi Aramco Receives Bids for Contracts in Gas Expansion Drive," *Reuters*, August 23, 2017.




## Saudi Shale Revolution?

Saudi Aramco has been aggressively pursuing development of its shale and tight gas reserves, which could play an important role to meet its target of 23 bcf/d by mid-decade. Production of unconventional natural gas in the North Arabia Basin is reportedly imminent, though Aramco has provided few details. Saudi Arabia has significant shale gas reserves, estimated at 645 tcf, which is roughly twice the size of U.S. tight gas reserves.

Meanwhile, shale gas at the Jafurah field could rival the massive Eagle Ford formation in Texas. The Jafurah field is located between Ghawar, the world's largest oil field, and the Gulf, with pipeline networks and existing infrastructure needed to produce unconventional gas already in place. However, despite the promising reports on Jafurah, like other shale reserves in the kingdom, the development costs are steep and Aramco is working on bringing the costs down, according to Khalid Al-Abdulqader, Aramco's general manager of unconventional resources.[20]

While the potential for shale gas development may be significant, the reserves are plagued by a number of potential problems including high costs due to the depth, scarcity of water needed for the fracking process, lack of infrastructure to support production, and remoteness

20 Wael Mahdi and Bruce Stanley, "The Next Entrant in the Shale Revolution? OPEC's Saudi Arabia," *Bloomberg*, March 7, 2018.

of many of the basins from end-user centers. Shale gas may prove an important contributor to meet higher production targets but advances in technology needed to lower development costs are likely necessary over the next decade.

## Aramco Sharpens its Focus on LNG

Saudi Aramco is actively exploring opportunities with a number of international companies for LNG supplies to fill a looming supply gap, which in itself is a seismic shift in policy. Close to home, it could pipe gas from Bahrain's new LNG facility when it starts up in 2019. However, Aramco is also looking further afield to invest in foreign LNG projects in the United States and Russia, but the geographic logistics with the latter make it a less attractive alternative. Falih has said Aramco is also interested in importing natural gas from areas closer to the kingdom, such as the Mediterranean Sea and East Africa.

That said, it appears that the most advanced discussions for an equity stake in an existing LNG project have involved U.S. producers of shale gas. Aramco held initial talks with Tellurian Inc., a Houston-based company focused on LNG production with a major export terminal in Louisiana expected to be online by 2022. Aramco is also reportedly considering acquiring assets in two giant U.S. oil-and-gas basins in the Permian and Eagle Ford plays.[21]

Going outside the country for gas supplies now may also be a pragmatic solution as the country aims to reassure investors ahead of the Aramco initial public offering that the country is reducing its high level of burning valuable crude in power generation and to deliver increased oil export revenue to the company. Saudi Arabia currently does not have infrastructure in place to import LNG but deploying a new floating storage and regasification unit would provide a relatively attractive option. Judging by the high-level discussions with U.S. firms that have taken place, Aramco may be prepared to make some major decisions on securing an LNG stake with a U.S. company or arranging LNG import facilities in the very near term.

# UAE: Pivot to Expanding Natural Gas Production

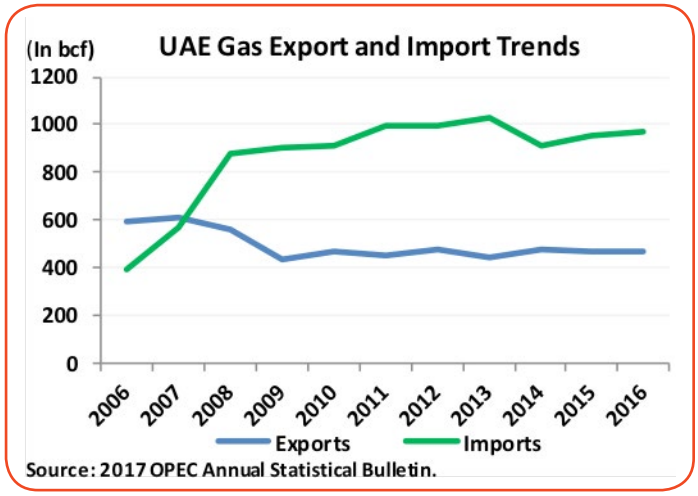
The UAE is both an importer and exporter of natural gas but the rapid rise in domestic demand over the past decade has created an increasingly unbalanced market. Economic and demographic growth have sent domestic consumption soaring, rising by a steep 65 percent, to 6.9 bcf/d, from 2006-16. By contrast, domestic gas production rose by a much smaller 25 percent, to 5.9 bcf/d, over the same period.[22] The country depends almost 100 percent on natural gas for power generation, with gas imports via pipeline from Qatar and LNG cargoes filling a widening supply gap. Abu Dhabi and Dubai have been importing LNG for several years and Sharjah has plans to start in 2019. Abu Dhabi controls around 95 percent of the UAE's crude and natural gas reserves, with the remaining modest share held by Dubai, Sharjah, and Ras Al Khaimah.

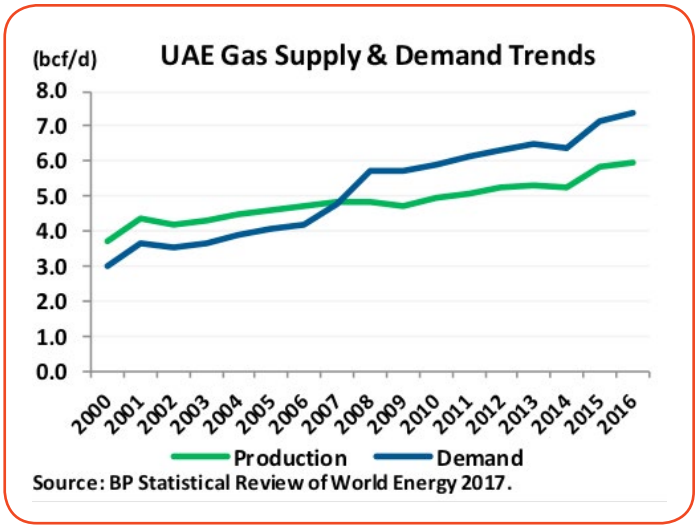
21 Sarah McFarlane and Summer Said, "Tables Turned: Saudi Arabia Hunts for Oil Assets in the U.S.," *The Wall Street Journal*, December 20, 2017.

22 "Annual Statistical Bulletin," OPEC, June 13, 2017.

The UAE was an early exporter of LNG with shipments to Japan starting in 1977. Just over 20 percent of the UAE's gas production is exported under long-term contracts. The associated natural gas output from Abu Dhabi's crude oil production was surplus to demand for decades due to its relatively small population and limited industrial activity. LNG exports provide substantial revenue since the contract prices are linked to much higher international market levels, especially compared to heavily subsidized domestic prices. For the UAE, it is far more financially advantageous to import gas from Qatar given its exceptionally low price of an estimated $1.61/MBtu compared to international LNG prices of $5.50-6.00/MBtu.

The rapid growth in domestic demand eclipsed gas production a decade ago, turning the country into a net gas importer in 2008. The start-up of the Dolphin pipeline provided additional gas supplies from Qatar, which now account for almost one-third of the UAE's domestic gas consumption. The Dolphin pipeline carries gas from Qatar's North Field via a 226-mile pipeline to Abu Dhabi's massive Taweelah electricity and water desalination plants, then runs on to the northern emirates before ending in Oman. With the volume of gas imports from Qatar capped by operational limitations, the UAE started augmenting its needs with imports of LNG in 2016. Combined pipeline and LNG imports provided just over 40 percent of consumption in the past 10 years.




Compounding the gas supply shortfall, Abu Dhabi uses an estimated 25-30 percent of its associated gas production for reinjection at its maturing oil fields to maintain flow rates, which is an exceptionally high level relative to other producers in the region. Gas reinjection for enhanced oil recovery is critical to maintaining output levels at its major fields, which otherwise would rapidly decline. In an effort to reduce the demand for reinjection, the Abu Dhabi National Oil Company is developing new technologies for carbon capture and as an alternative to reinjection of natural gas through a new company, Al Reyadah, set up in 2016. Originally a joint venture between Masdar and ADNOC, the latter assumed full ownership in January.[23] Al Reyadah currently supplies carbon dioxide for injection into

23 "ADNOC Acquires Remaining 49% Share of CCUS Pioneer Al Reyadah," Abu Dhabi National Oil Company, January 14, 2018.

oil reservoirs in place of natural gas at the small onshore Habshan oil field.[24] ADNOC plans a sixfold increase in the use of carbon dioxide for enhanced oil recovery over the next 10 years, which should reduce gas use for reinjection.[25]

## Gas Fuels the Future

The UAE's natural gas demand is forecast to rise steadily in the coming decade, more than doubling to 78.3 bcm in 2022 from 2000 levels, according the IEA's 2017 report on gas markets.[26] Reducing the share of gas used in the power sector to 70 percent by 2030 is a primary goal for the government, with a combination of nuclear and renewable energy forecast to provide a larger share of the mix.

While the country has been a champion of renewables, near term, nuclear energy will help meet higher demand needs. The start-up of two reactors at the Barakah nuclear power plant in 2018, combined with two more reactors expected to come online two years later, will provide at least 10 percent of power generation by 2020 and 15 percent by 2022. Nuclear energy is expected to help reduce the share of gas in the power mix from 98 percent in 2017 to 67 percent in 2021. Solar energy is expected to provide another 5 percent by 2020. The savings in gas use in the power sector will primarily be redirected toward the industry sector, where demand is forecast to rise by around 23 percent, to 36 bcm, from 2016-22, according to the IEA's forecast. While reduced gas burn for electricity will play an important role in balancing domestic natural gas markets, more supplies will be needed to meet growing demand from the petrochemical, steel, and aluminum industries, among other sectors.

## Mastering Sour Gas Development

Ambitious plans to increase production from its underdeveloped, technically challenging natural gas reserves are a key plank in achieving energy security and are paramount to the government's strategy for economic diversification and industrial development. As part of its new smart growth strategy, ANDOC increased capital spending to $109 billion in November 2017, with the bulk of spending allocated for development of its gas reserves. Indeed, the cost of gas production will rise sharply as supplies of cheaper associated gas are overtaken by development of more expensive and complex production of sour gas from nonassociated fields.

*As part of its new smart growth strategy, ANDOC increased capital spending to $109 billion in November 2017, with the bulk of spending allocated for development of its gas reserves.*

24 Jennifer Gnana, "Abu Dhabi Explores Capturing More CO2 to Help in Oil Production," *The National*, December 7, 2017.

25 "ADNOC to Expand Carbon Capture, Use & Storage Technology to Reduce Environmental Footprint and Enhance Oil Recovery," Abu Dhabi National Oil Company, January 17, 2018.

26 International Energy Agency, *Gas 2017* (Paris: International Energy Agency, July 2017).

In the past, the UAE has faced multiple setbacks in its efforts to develop its sulfur-heavy, sour gas reserves. Sour gas is highly toxic and corrosive, which makes it more expensive and technically challenging to process. Government efforts to reduce price subsidies and raise natural gas prices toward international levels in the last few years may be behind renewed interest in several gas projects.

The country's first nonassociated sour gas development, Shah, was delayed for years due to concerns by potential partners that the project would not be profitable based on the contract terms offered. ConocoPhillips signed a contract in 2008 only to withdraw in 2010 over the project's economics. ADNOC finally signed a contract for the $10 billion Shah gas field with U.S.-based Occidental in early 2011, with the company taking a 40 percent stake in a 30-year contract in a new joint venture company called Al Hosn Gas. The Shah gas project started in 2016 and processes 1 bcf/d of the sour gas. Al Hosn has plans to increase output by 50 percent.

Abu Dhabi's gas development plans had another setback after Shell withdrew from the country's second gas project, the $10 billion ultra-sour gas Bab project. Shell was awarded the Bab contract in 2013 but withdrew in January 2016 over cost and technical concerns. The collapse in both oil and gas prices in mid-2014 triggered spending cuts across the industry with companies reassessing the viability of projects undertaken during the much higher price environment. ADNOC is continuing to pursue options to develop the Bab gas project, which may include the China National Petroleum Corporation. ADNOC signed a framework agreement with the China National Petroleum Corporation in November 2017 on potential collaboration for a number of projects, including the Bab sour gas development.[27]

Under pressure to raise production levels, ADNOC is going forward on its own with the development of the $20 billion offshore ultra-sour gas project in the Hail, Ghasha, and Dalma fields, known collectively as the North-West Area. The three fields, which lie in relatively shallow water southwest of Abu Dhabi, are estimated to hold trillions of cubic feet of recoverable gas and are projected to meet 20 percent of the UAE's gas demand by the second half of the next decade.[28] The project is expected to produce more than 1 bcf/d. ADNOC awarded Front End Engineering Design contracts in January, selecting Bechtel UK for Hail and Ghasha and TechnipFMC UAE for Dalma.[29]

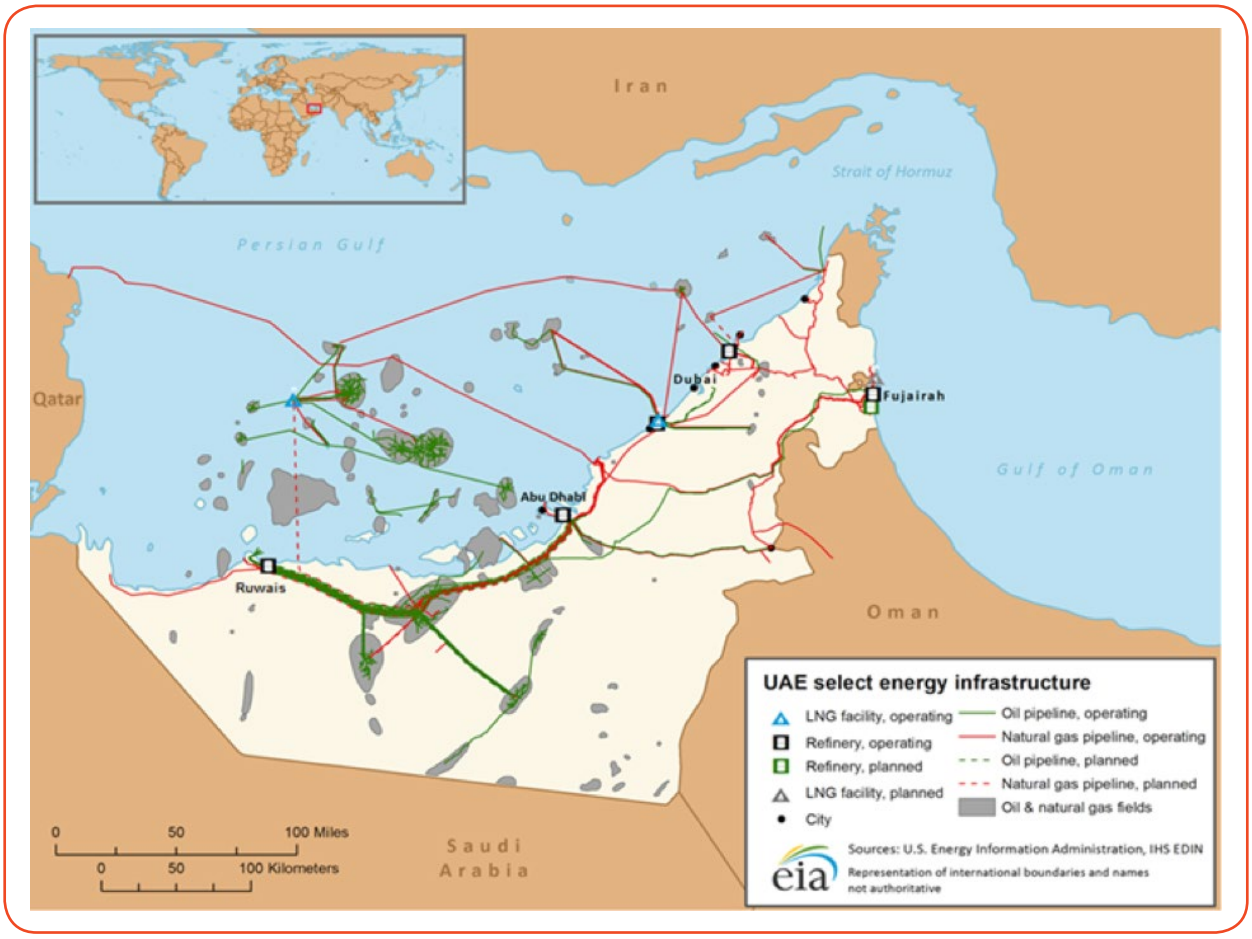
In its first ever oil and gas exploration bidding round, ADNOC announced on April 10 that it is offering six blocks for international tender. The blocks on offer reportedly hold multiple billion barrels of oil and trillions of cubic feet of natural gas, with bids due by October and contract awards expected by the end of 2018.[30] ADNOC will hold a 60 percent share in all projects.

27 "ADNOC Signs a Deal to Expand CNPC Partnership," *Pipeline Oil & Gas Magazine*, November 15, 2017.

28 "ADNOC's Sour Gas Hail, Ghasha and Dalma Project Takes Critical Next Step," Abu Dhabi National Oil Company, January 9, 2018.

29 "ADNOC hands out FEED awards for sour gas mega project," *Offshore Energy Today*, January 9, 2018.

30 Mahmoud Kassem, "Adnoc Offers First Competitive Bidding for Oil and Gas Concessions," *The National*, April 10, 2018.




Germany's Wintershall is also hoping to expand its gas operations in Abu Dhabi. The company, along with its partners ADNOC and Austria's OMV, tested two wells in the western sour gas field of Shuwaihat and sees potential for the development. Wintershall may deepen its business ties in the UAE through its parent company BASF, the world's largest chemicals firm, as the country continues to expand its petrochemicals business.[31]

## Shale Gas Could Double Reserves

ADNOC is reportedly exploring opportunities for shale gas production but as yet has no commercial developments underway. However, Abu Dhabi's sovereign fund Mubadala Development Company has made a small investment with private equity in U.S. shale operations. "The objective is to understand the dynamics of this business, the technical side, and the financial side—in particular the cost,"[32] said Musabbeh Al Kaabi, chief executive of Mubadala's petroleum and petrochemicals business.

31 Jennifer Gnana, "Parent Company BASF Said to be Seeking Petrochemicals Tie-Ups in the Emirate," *The National*, January 30, 2018.

32 Fahd Al-Rasheed, "Learn from the Past, Build for the Future: Saudi Arabia's New City on the Red Sea," *McKinsey*, August 2016; Sarah McFarlane and Summer Said, "Tables Turned: Saudi Arabia Hunts for Oil Assets in the U.S.," *The Wall Street Journal*, December 20, 2017.

In a detailed study of the country's potential shale reserves, the U.S. Energy Information Administration reported that the country's Rub al-Khali basin holds three significant tight oil and gas formations.[33] Potential technical recoverable tight gas reserves estimates by the Energy Information Administration are currently not included in the UAE's reported proved reserves of 214 tcf, which would almost double the country's resources.

## LNG Plays a Key Balancing Role

Imports of LNG play a critical role in offsetting the country's gas deficit. Dubai was the first emirate to import LNG via a floating storage and regasification unit in 2010 followed by Abu Dhabi with the installation of floating import facilities at Ruwais in 2016. These units are much cheaper and faster to install than onshore regasification facilities, which has hastened the growth of LNG imports. The UAE currently has 1.46 bcf/d of LNG import capacity with plans to expand volumes over the next several years. The floating LNG import facility at Jebel Ali in Dubai is currently being upgraded, which will bring total UAE liquefaction capacity to around 1.6 bcf/d by the end of 2018. Sharjah plans to inaugurate a 500 mcf/d floating storage and regasification unit at the end of 2019.

*The UAE currently has 1.46 bcf/d of LNG import capacity with plans to expand volumes over the next several years.*

LNG enables the UAE to increase gas supplies during the peak demand summer months and at the same time take advantage of relatively cheaper import prices following the wave of new supplies from the United States hitting the markets in 2017. Houston-based Cheniere Energy began exporting to Dubai in 2017 and volumes are poised to grow this year. At the end of 2017, U.S. Secretary of Energy Rick Perry met with UAE Energy Minister Suhail Mohamed Faraj Al Mazrouei during a goodwill tour to promote new U.S. LNG supplies.[34]

The various plans to better manage the country's natural gas resources, from reducing use in the power sector to curbing reinjection at oil fields, and to increasing domestic production, may eventually help close the supply gap, but imports of LNG will continue to play a key balancing role in the short and medium term.

# Kuwait: LNG Remains Critical to Offset Gas Supply Shortages

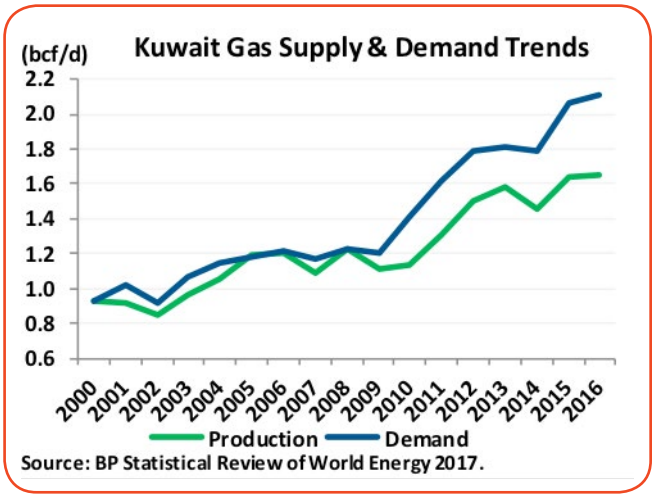
Kuwait has struggled with natural gas supply shortages for almost a decade as runaway demand has far outpaced domestic production. Lengthy delays in developing its own gas reserves forced the country to turn to imports of LNG to offset supply deficits, with volumes steadily increasingly over the years. Kuwait's domestic demand is fueled by a power sector straining to meet electricity and water desalination needs. The country's gas supplies are also used as a feedstock in petrochemical production, as well as for reinjection in enhanced

33 U.S. Department of Energy, *Technically Recoverable Shale Oil and Shale Gas Resources: United Arab Emirates* (Washington, DC: U.S. Department of Energy, September 2015).

34 Anthony Dipaola, Tracy Alloway, and Mahmoud Habboush, "U.S. Ready to Ship More Gas to Middle East," *Bloomberg*, December 6, 2017.

oil recovery projects to maintain oil production levels at the country's mature fields. Natural gas consumption has doubled from 2000-16, to 2.1 bcf/d, according to BP. By contrast, gas production averaged a significantly lower 1.65 bcf/d in 2016.

Kuwait's gas supply shortages have led to chronic power interruptions over the years. Forecast higher demand will require $15 billion of investment to expand current power generation capacity of around 17 GW to 24 GW by 2022.[35] The planned new capacity will require substantial natural gas supplies, further straining the system. Kuwait is plagued by regular blackouts and brownouts during peak demand periods, with the problem so acute at times that the government has been forced to shut down operations at its refineries and petrochemical plants to free up gas supplies for electricity generation to cool homes and businesses.[36] Indeed, the power shortfall poses a significant risk to the country's plans for large infrastructure projects and acceleration of economic diversification, underscoring the critical importance of increased gas supplies to fuel additional electricity generation capacity.




## Political Power Plays

Ambitious plans to develop its northern Jurassic nonassociated sour gas fields have been consistently derailed by Kuwait's intransigent Parliament, whose approval is required for sanctioning oil and gas projects. Kuwait's broad-based political governing system, anchored by an executive branch led by the ruling Al Sabah family and an elected Parliament, is unique for the region but has also led to a more complex and difficult decision-making process. Political discord between the Parliament and executive branch have derailed negotiations with international companies for decades, and continue to undermine the country's oil and gas outlook. Royal Dutch Shell signed a technical service agreement in 2010 to develop the Jurassic gas fields but the contract was suspended following a protracted parliamentary inquest into alleged irregularities.

*Political discord between the Parliament and executive branch have derailed negotiations with international companies for decades, and continue to undermine the country's oil and gas outlook.*

As a result, Kuwait's efforts to boost nonassociated production have floundered. Relatively unattractive terms offered to international companies for development of the high-cost nonassociated sour gas reserves have also hampered development. Production averaged 1.65 bcf/d in 2016, according to BP's 2017 statistical review.[37] Of that, approximately 80-90 percent is associated gas output linked to oil production levels.

35 "MENA Power Investment: Reforms Slowing Demand Growth," *Apicorp Energy Research* Vol. 03 No. 07, April 2018.

36 "Soaring Demand Leads to Power Cuts," *The Economist*, July 21, 2016.

37 BP, BP Statistical Review of World Energy June 2017 (BP, June 2017).

## A Window of Opportunity Closing?

A political détente between the country's Parliament and executive branch paved the way for the award of contracts with international companies in 2016, enabling the start-up of new gas production from the giant Jurassic Non-Associated Gas Reserves in the northern region in early 2018.[38] However, plans for the much-needed second phase of the project are now on hold after tenders were inexplicably cancelled in late 2017.[39] The $3.6 billion project is reportedly being redesigned into smaller contract packages, but, so far, there has been no official comment.

After years of delay, Kuwait awarded contracts for early development of nonassociated gas fields in the north of the country in September 2016. Kuwait commissioned two of the three gas projects in the north in January with the final facility expected mid-year. Early production from the Umm Niqa and Al-Sabriya fields was launched first followed by West Al-Rawdatain while the East Al-Rawdatain project is expected in the summer. The three projects, with two gathering centers, will add 300 mcf/d in 2018, bringing total northern production to 500 mcf/d for the year. State-owned Kuwait Petroleum Corporation announced plans to raise production to 1 bcf/d by 2020 and to 2.5 bcf/d by 2040, but these targets appear unreachable now.[40]

Kuwait's only other potential nonassociated natural gas field prospect is the offshore Dorra field in the Partitioned Neutral Zone that it shares with Saudi Arabia and Iran. However, Kuwait and Saudi Arabia's plans for production of 500-800 mcf/d in the area controlled by the two countries were abandoned due to disagreements over resource allocation, among other issues.[41]

## LNG and Pipeline Imports Fill the Breach

Kuwait was the first GCC country to start importing LNG to meet surging domestic demand, receiving supplies from Qatar starting in 2010 via its Mina Al Ahmadi floating terminal. Kuwait has sidestepped involvement in the current diplomatic row among GCC members Saudi Arabia and the UAE with Doha and has continued to import LNG cargoes from Qatar, which, as noted, is also true of the UAE. However, with no end in sight to the diplomatic rift, Kuwait may opt to diversify its LNG import slate.

*Kuwait was the first GCC country to start importing LNG to meet surging domestic demand, receiving supplies from Qatar starting in 2010 via its Mina Al Ahmadi floating terminal.*

In a de facto acknowledgement that its domestic gas production is woefully inadequate to meet rising demand, Kuwait is building a permanent LNG facility, the $3.3 billion Al-Zour LNG Import Terminal Project, which is due for completion by the end of 2020.The new terminal will raise LNG import capacity from 0.8 bcf/d to 3 bcf/d by 2020. Kuwait Petroleum Corporation signed a 15-year

38 Diane Munro, "Kuwait's Political Détente Improves Prospects for its Energy Industry," *Arab Gulf States Institute in Washington*, July 29, 2016.

39 A Saleh, "MP Slams Minister for Offering 14 Tenders Simultaneously," *Kuwait Times*, November 1, 2017.

40 Fareed Rahman, "Kuwait to Invest $112b to Boost Oil and Gas Production," *Gulf News*, January 12, 2018.

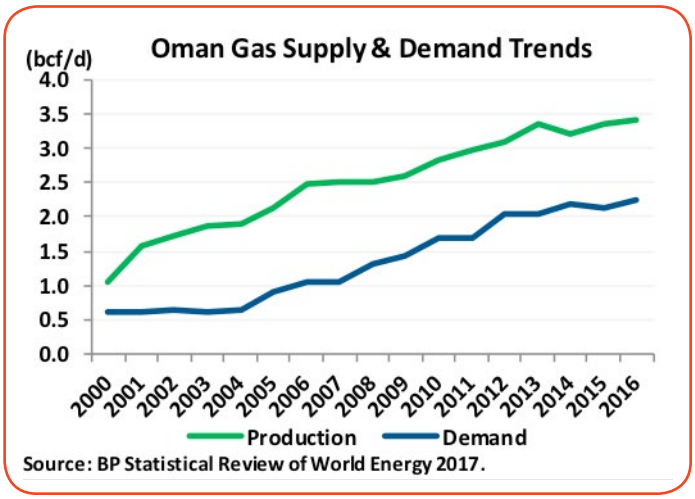
41 "Kuwait Country Brief," *U.S. Energy Information Administration*, November 2, 2016.

agreement at the end of 2017 to import LNG from Shell starting in 2020. Kuwait has a five-year agreement with Golar LNG that expires in 2019 for a 760 mcf/d floating LNG vessel, which will be replaced with its permanent land-based LNG terminal. Kuwait imported 3.49 million metric tons of LNG in 2016, according to the International Group of Liquefied Natural Gas Importers.[42]

Kuwait is also in negotiations with Iraq to import gas via pipeline with initial volumes starting at 50 mcf/d and gradually building to 200 mcf/d.[43] For cash-strapped Iraq, the gas pipeline exports will enable it to pay off reparations long owed to Kuwait. Baghdad still owes the last tranche of the $52.4 billion reparations bill but has struggled to make payments following the decline in oil prices in mid-2014 and the high cost of its war with militants from the Islamic State in Iraq and the Levant. Negotiations have reportedly faced multiple setbacks, and it is unclear if a final agreement will be reached. Kuwait is asking for a relatively low contract price of less than $3/MBtu, but Iraq has argued that the price is less than half what Kuwait pays for importing gas from Iran. In addition, the plan includes building a new petrochemical plant to monetize the gas flows but both countries are lobbying to have the plant built on their territory.

## Oman: Promising Gas Outlook Anchors Economy

Oman was one of the first GCC countries to recognize the importance of offering attractive contract terms for exploration and production sharing agreements in order to partner with international companies that had the experience and technologies needed to tap into its massive tight gas reserves. Oman's natural gas production peaked in 2013, but after several years of decline, Oman's fortunes significantly improved in late 2017 following the commissioning of the BP-led Khazzan gas project, one of the largest unconventional tight gas reservoirs in the Middle East. The Khazzan gas development will be a major source of gas supply for decades and has revived Oman's LNG exports.[44]




New Khazzan production will help meet the country's rising domestic gas demand, which has steadily climbed since 2004, posting a fourfold increase by 2016 to 2.25 bcf/d. Oman's ambitious plans to develop its petrochemical sector and new industrial centers along the coast are expected to increase the pace of gas demand growth in coming years. Mega industrial projects along the coast are central to the country's economic diversification plans, which will require significant natural gas supplies.

42 "The LNG Industry, 2017 GIIGNL Annual Report," *Groupe International des Importateurs de Gaz Naturel Liquéfié*, 2017.

43 "Iraq Looks to Kuwait Gas Pipeline to Pay Off Reparations," *Reuters*, November 22, 2017.

44 Gerald Butt, "Oman LNG Back in Top Gear," *Petroleum Economist*, November 22, 2017.

The Duqm development project, which includes a major petrochemical complex, new refinery, and large oil storage depot, is strategically located outside the Strait of Hormuz off the Arabian Sea and Indian Ocean and is expected to play a major role in the country's economic expansion.[45] Previously scattered with remote fishing villages, Oman hopes the Duqm development along the coast will transform the country into a major maritime hub at the intersection of East-West shipping routes with its proximity to sea lanes serving Asia, Africa, and Europe. Increasing gas production is critical to realizing these ambitions. A gas pipeline sending new Khazzan gas production to the Duqm Special Economic Zone, located halfway between Muscat and Salalah, is slated for completion in late-2019. Alongside use as an industrial feedstock, gas will be directed for use at a desalination plant at Duqm.

## Gas Riches Set to Increase

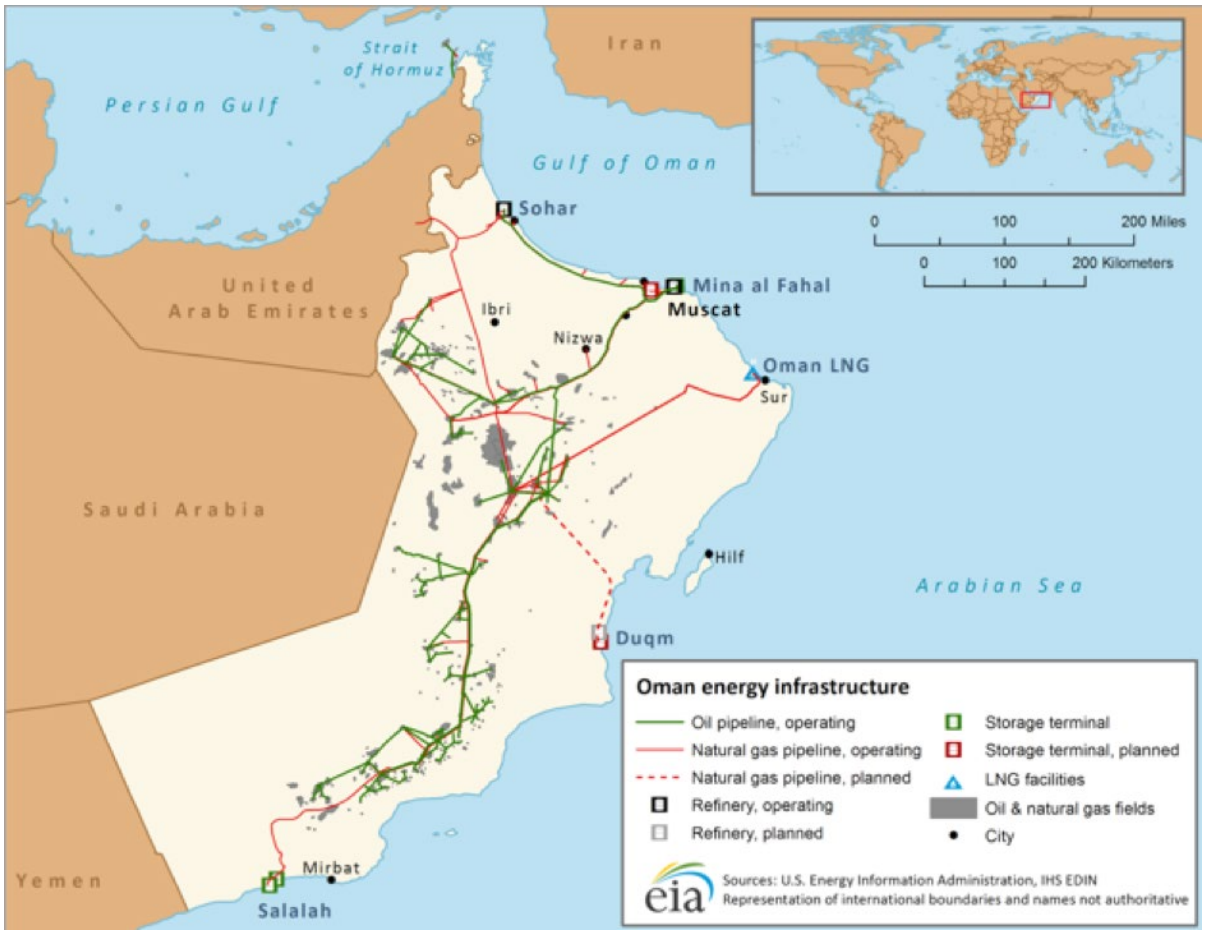
The first phase of the Khazzan gas project added 1 bcf/d of production and development of the second phase, which received final approval in late 2017, will add a third gas train to handle 500 mcf/d. The BP-led project will add the equivalent of 40 percent of the country's current production when it reaches its forecast production of 1.5 bcf/d in 2020. The Khazzan field, a tight gas formation that requires horizontal drilling and hydraulic fracturing, holds an estimated 10.5 tcf of recoverable natural gas reserves.

Oman is also developing the Rabab Harweel Integrated Project, which is targeting production of 6 million cubic meters per day (mcm/d) at a cost $1.25 billion and is expected online in 2019. The Yibal Khuff project will add a further 5 mcm/d of associated gas and 10,000 b/d of oil at a cost of $900 million in 2020.

## LNG Exports Revived

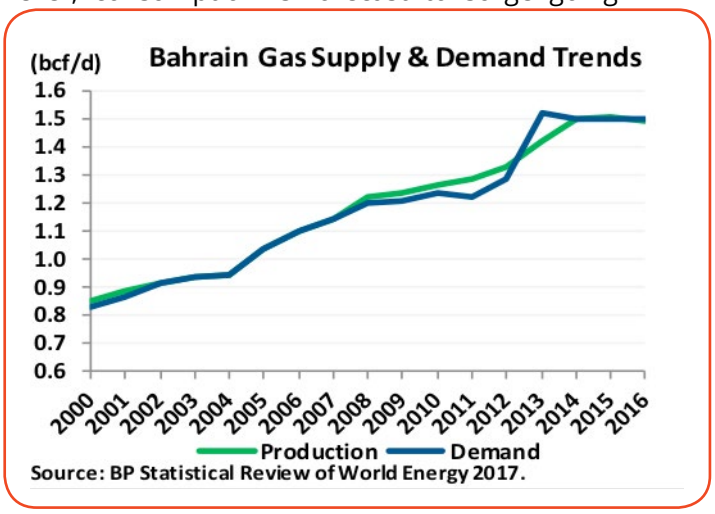
Apart from Qatar, Oman is the only net gas exporter in the GCC states, with revenue earned from gas sales a major income source for the government. In 2016, Oman imported around 200 mcf/d from Qatar through the Dolphin pipeline but exported a substantially higher 1.1 bcf/d of LNG. Oman's exports of LNG edged lower in 2015-16 due to demand-side supply constraints, with the country's three trains at its Qalhat terminal near Sur operating at only 80 percent of capacity. Oman exported 8.12 million tons (mt/y) in 2016. The start-up of the Khazzan field in September 2017 enabled the country to boost exports to the facility's nameplate capacity of 10.4 mt/y. After limiting contracts for several years, Oman signed a new seven-year contract with BP for the sale of 1.1 mt/y in January.

45 Diane Munro, "Cutting-Edge Technology Boosts Oman's Oil and Gas Production," *Arab Gulf States Institute in Washington*, July 5, 2016.




## Bahrain: LNG to Close Gas Supply Gap

Bahrain has managed to maintain a relative balance between its domestic gas production and demand needs in recent years. However, consumption is forecast to surge going forward, fueled by significant expansion projects at industrial plants. With its comparatively much lower oil and gas resources than its neighbors, Bahrain has focused on developing its industrial and manufacturing sectors to fuel its economy.[46] The country currently uses all of its 1.5 bcf/d of gas production to meet demand from its industrial and power sector, as well as for reinjection into its aging oil fields. About 40 percent of the country's demand is driven by industrial needs, with Aluminum Bahrain accounting




46 Pummy Kaul, "Industrial Sector's Share in Bahrain GDP to Hit 20pc," *Trade Arabia*, May 7, 2018.

for nearly half of demand. The aluminum smelter is one of the largest in the world with its own gas-fired plant. An existing expansion project due for completion by 2019 will increase demand for natural gas by more than 40 percent.[47] Aluminum Bahrain accounts for 12 percent of the kingdom's gross domestic product. Bapco's Sitra oil refinery is also a large consumer of gas, and demand is expected to more than double following completion of expansion of the plant's capacity in 2022.[48]

## Tight Gas Production Holds Promise

Bahrain has ambitious plans to develop new tight gas discoveries but there are considerable challenges that need to be overcome to develop the technically complex and costly projects. Bahrain unveiled its largest ever find in the offshore Khalij al-Bahrain Basin on April 1, with preliminary assessments of at least 80 billion barrels of tight oil and 10-20 tcf of natural gas in place. However, it is too early to judge if the find will be economic, not least because it would be the first major offshore tight oil and gas development in the world and will require securing a best-in-class joint venture partner.[49] If the project receives the green light, the industry typically can only develop a small fraction of the initial estimated discovered resources, suggesting potentially 5 percent of the initial estimated tight gas could be developed, or 1-2 tcf. That compares with Bahrain's current estimated proved gas reserves of 6 tcf, according to data from the 2017 BP Statistical Review of World Energy.[50]

Bahrain is also hoping to develop tight gas reserves beneath the onshore Bahrain Field discovered in 2017.[51] The government said it is planning to start development this year but so far has not reached any agreements with potential partners. Discussions are taking place with a number of service firms such as Halliburton and Schlumberger. However, the terms on offer are considered unattractive. Bahrain is asking companies to share upfront capital costs, which is unusual for fixed-fee contracts. The new onshore and offshore gas discoveries hold enormous promise, but Bahrain may need to reconsider its contract terms if it expects to lure international companies with advanced technologies and extensive experience in tight gas projects. Given the considerable challenges that still need to be addressed, the earliest any new gas production would come online is in the second half of the next decade.

## New LNG Import Terminal to Meet Higher Industrial Demand

To offset the projected supply gap, Bahrain will start importing LNG in 2019 when its new offshore terminal is completed. The Bahrain LNG Import Terminal is located in the Hidd industrial area of the Khalifa bin Salman port on Muharraq Island. The facility will have an initial capacity of 400 mcf/d with the option to expand to 800 mcf/d. The facility will not only meet forecast demand but could potentially enable the country to act as a re-export hub for

47 "Alba Approves Line 6 Expansion Project which Will Make it the World's Largest Single Site Smelter," Aluminium Bahrain, June 10, 2015.

48 "Bahrain's Refinery Expansion, LNG Terminal Sees Big Spending," *Pipeline Oil & Gas Magazine*, March 4, 2018.

49 Diane Munro, "Bahrain Sees Windfall in Offshore Oil Strike, but Choppy Waters Lie Ahead," *Arab Gulf States Institute in Washington*, April 10, 2018.

50 BP, BP Statistical Review of World Energy June 2017 (BP, June 2017).

51 Jennifer Gnana, "Bahrain to Start Tight Gas Development this Year," *The National*, January 13, 2018.

its neighbors, including Saudi Arabia. The terminal project is a public-private partnership and is jointly owned by Noga Holding, the investment and development arm of the National Oil and Gas Authority, and a consortium consisting of Teekay LNG Partners, the Gulf Investment Corporation, and Samsung. The partnership enabled Bahrain to tap into the extensive LNG expertise of its private partners as well as secure financing from a syndicate of banks.[52]

## Conclusion: The Golden Age of LNG Imports

Gulf Arab states are spending billions of dollars to develop domestic natural gas resources to meet burgeoning demand from the power sector and fuel ambitious gas-intensive industrialization projects that are a major plank of their long-term economic visions. Projects focusing on development of sour or tight gas fields will yield new supplies unimaginable just a decade ago. Advanced technologies have effectively provided a new tool box to develop the region's notoriously complex and difficult gas resources, though success is not assured.

Oman, Abu Dhabi, Saudi Arabia, and Bahrain are all pioneering technically challenging fields, whether tapping into ultra-sour offshore gas or tight gas. Oman and Saudi Arabia will both post significant increases from 2016 levels while the outlook is less certain for Abu Dhabi, Kuwait, and Bahrain.

Aside from Oman, which will see its role as a net exporter increase, these efforts nonetheless will fall short of meeting projected demand for Saudi Arabia, the UAE, Kuwait, and Bahrain, with LNG critical to bridge the supply gap. Security of supply, however, no longer means that gas resources have to lie within national borders. The global LNG trade is forecast to expand by 50 percent by 2020 with a wave of new projects from Australia, the United States, and Russia coming online over the next several years, offering an increasingly more competitive market for importers, including the GCC states.

Whether through increasing imports of LNG via short- or long-term contracts, joint ventures with international exporters, or even the outright purchase of a majority stake in a foreign gas producer, the Gulf Arab states have an array of options to secure gas supplies that did not exist even a few years ago. As a result, the region is poised to be a major force of growth in global LNG markets.

52 "Bahrain LNG: A Game Changer for the Kingdom," *Apicorp Energy Research*, Vol. 02 No. 08, June 2017.

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