Gulf Research Centre Cambridge

Knowledge for All

Transforming GCC's Oil and Gas Industry in the 21st Century: Opportunities and Challenges

Vijo Varkey Theeyattuparampil and Ali Vezvaei

August 2014

GRM PAPERS

This paper was presented at a workshop titled

"Challenges Facing the GCC Oil and Gas Industry"

organized as part of the

Gulf Research Meeting (GRM) 2013

in Cambridge, UK,

by the Gulf Research Centre Cambridge.

GRM PAPER

Transforming GCC's Oil and Gas Industry in the 21st Century: Opportunities and Challenges

Vijo Varkey Theeyattuparampil and Ali Vezvaei

Introduction

For many decades, the energy industry, particularly oil and gas, has been the mainstay of the GCC countries. Presently, the GCC is home to 81 percent and 25 percent of the world's oil and gas reserves, respectively.[1] The National Oil Companies (NOCs) have invested in infrastructure development for exploration, production, refining, and distribution of crude oil and natural gas. Improved recovery of crude oil by steam and chemical flooding has promoted the use of Enhanced Oil Recovery (EOR) techniques that have helped sustain oil production. However, GCC countries such as Kuwait, UAE, Saudi Arabia, and Oman have been experiencing severe shortages of conventional natural gas and rely on Qatar to meet their peak summer demands.

In the downstream industry, GCC countries like Saudi Arabia and Qatar have focused on developing the petrochemical industry. Other GCC countries have followed similar strategies. In the coming years, the GCC region is expected to be a major producer of hydrocarbon by-products including chemicals, plastics and fertilizers. With the global population expected to touch nine billion by 2050, the demand for energy will only rise and the GCC is set to play a pivotal role in meeting these demands.

1. BP Statistical Review of World Energy, available at: <http://www.bp.com/en/global/corporate/about-bp/statistical-review-of-world-energy-2013.html> (accessed June 28, 2013).

Looking at the long term, the GCC countries have made national commitments to raise their oil production targets by 2020 and beyond as well as to be a leading supplier of high-value downstream products. However, a number of challenges may potentially undermine these efforts. For example, existing reservoirs are becoming hard-to-recover reservoirs, while natural gas, water and power are required in large amounts to meet both industrial and domestic demands.

To overcome these challenges, the region is increasingly relying on foreign expertise and technologies. Joint collaborations and partnerships between technology firms, International Oil Companies (IOCs) and NOCs have become the go-to solutions for deploying state-of-the-art technologies in the GCC. For pursuing these technology deployment goals, it would require both strategic planning and focus. At the same time, environmental and regulatory oversight is necessary to ensure safe and reliable operations at all times.

In this paper, we first outline the challenges facing the oil and gas industry. Then a SWOT assessment facing the GCC's oil and gas industry is presented. Subsequently, key recommendations in the form of opportunities for the oil and gas industry are outlined. This is particularly aimed at political decision makers and energy industry executives. In conclusion, we lay out the future research prospects stemming from this study.

Challenges

Listed below are a summary of challenges facing the oil and gas industry:

Depleting oil wells: Production in the oilfields in the GCC countries started around the 1950s. Over time, the natural pressure in these reservoirs declined which impacted the production curve. With ambitious production targets set for 2020 by the GCC countries, the challenge will be to sustain and raise oil production levels. EOR techniques like water, nitrogen and natural gas injection are currently being implemented to stimulate these reservoirs. However, the scarcity of water and natural gas in the GCC countries remains a growing challenge.

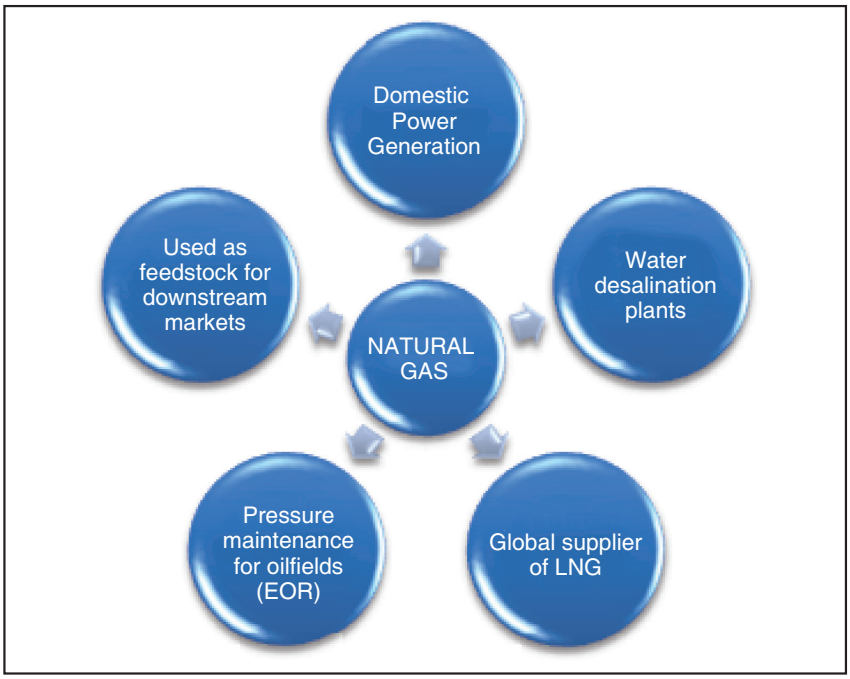
Heavy oil recovery: The presence of large amounts of heavy oil in Kuwait and Oman is an opportunity that comes with high recovery cost. Using advanced steam flooding techniques to produce heavy oil requires large quantities of steam. As a highly viscous fluid, a key concern is the high energy ratio required for extraction, recovery, production, and processing of heavy oil. During the lifetime of the field development, mitigating technical and cost risks is a challenge. This adds to the operating cost for heavy oil development. The added impact to the environment, particularly air, land

and water, would have to be estimated at the time of oilfield appraisal, which in turn would help minimize the CO_2 emissions.

Natural gas shortage: The GCC countries have been largely dependent on natural gas for their power generation and water desalination. At the same time, they use natural gas to maintain reservoir pressure for sustaining oil production. Gas is also used as the feedstock for the downstream hydrocarbon industry. Barring Qatar, the rest of the GCC countries are experiencing natural gas shortages. As a result, remote locations in these countries have experienced power outages particularly during peak summer. Supply constraint of natural gas feedstock can, therefore, hinder both commercial and industry related developments.

In the GCC, natural gas is found mainly in associated forms which are limited by the oil barrels produced. The region is also home to large quantities of sour gas which contains hydrogen sulfide (H_2S), which is highly corrosive and toxic in nature. Prior sulfur removal is essential to prevent corrosion in pipelines and rotating equipments. This further adds to the cost of natural gas production. Globally, the GCC countries have locked in long-term LNG contracts with countries in Asia and the Far East as well as other high-growth markets such as Latin America and Africa. Therefore, apart from taking care of the domestic needs for gas, international contracts also have to be met. Figure 1 provides a schematic representation of why natural gas is an important commodity in the GCC countries.

Figure 1: Use of natural gas in the GCC region



Absence of a robust decision-making process for technology selection by the NOCs: In evaluating a technical bid and ensuring that the right technology is selected for a project, NOCs have to take into account the upfront capital investment. This influences their decision-making process, wherein projects are awarded based on the lowest bid. A robust decision-making model that takes into account technical capability of the organization, life-time operating cost of the technology, and life-cycle CO_2 emissions is currently not adhered to. Therefore, the CAPEX-based approach adopted by the NOCs and Engineering, Procurement and Construction (EPC) companies requires reevaluation and assessment.

Absence of incentives to promote research and manufacturing centers: At present, international oil and gas companies are finding it hard to set up their local manufacturing centers and research hubs in the GCC region. Among the main reasons is the lack of funding and insufficient local incentives to promote such activities. These incentives could include consortium agreements between NOCs and international companies, cost-sharing mechanism for setting up technology centers of excellence, and attractive financing schemes.

Talent crunch: The GCC region faces difficulty in hiring highly-qualified talent for both the upstream and downstream industries, including geologists, engineers, project planners, management, and marketing personnel. Recruiting high-skilled laborers in the GCC region with necessary skill-sets has been a perennial challenge. The region has relied on foreign nationals who have international experience in the oil and gas industry. At the same time, in the global oil and gas industry several experienced but aging experts have retired. This challenge has a spillover effect in the GCC region.

Additionally, the lack of career development plans for employees working for the regional oil and gas industry has also caused high attrition rates in those organizations. These qualified people then seek opportunities elsewhere, even in non-hydrocarbon sectors. Therefore, the culture of grooming talent has to take root in the regional NOCs.

Oil - and gas-based subsidies encourage excessive use of natural resources: Presently, Qatar, the UAE, Kuwait, and Saudi Arabia rank among the highest in per capita consumption and per capita CO_2 emissions. Brown (2012) explains that in 2010, Kuwait's fossil fuel subsidies were recorded to be one of the highest on a per capita basis with $2,800 spent per person, while the UAE and Qatar recorded a spending close to $2,500 per person. These subsidies lower the costs of electricity and water for consumers, encouraging excessive consumption of non-renewable commodities. Minimizing the consumption would require the gradual removal of subsidies for water

and power. Table 1 indicates the generation cost of gasoline, diesel and electricity prices in the GCC countries in comparison to the North American market.

Table 1: Gasoline, diesel and electricity prices in the GCC and US (May 2013)

	Gasoline ($/Liter)	Diesel ($/Liter)	Electricity ($cents/kWh)
Saudi Arabia	0.21	0.09	6.9
Qatar	0.25	0.25	2.7
Bahrain	0.27	0.17	4.2
Kuwait	0.30	0.27	0.7
Oman	0.40	0.48	7.8
UAE*	0.48	0.67	4.0
US	0.96	1.014	11.92

Source: "Monthly Newsletter: June 2013," available at: <http://www.manaarco.com/images/presentations/Manaar%20Newsletter%20June%202013.pdf> (accessed June 28, 2013).

Shale gas renaissance in North America: Hydraulic fracturing and horizontal drilling techniques have enabled the US and other countries to unlock large reserves of natural gas. In fact, the US has turned from being a natural gas importer to exporter. Consequently, regions like North America can be expected to reduce their reliance on GCC's natural gas. At the same time, surplus natural gas feedstock has led to the development of petrochemical industries in North America. In the future, regions such as Europe and South America would also have alternate options to obtain natural gas and their reliance on the GCC, particularly Qatar, may come down. By leading the race for natural gas, the US could pose a threat to Qatar, Saudi Arabia, and UAE in the production of petrochemical products.

Flare gas management: Flaring is the process of burning natural gas that cannot be processed or sold. These flared gases contain toxins that are poisonous and harmful to the ecosystems and human habitats, leading to environmental degradation. Qatar, Kuwait, Saudi Arabia, and UAE have made aggressive commitments to reduce their flaring to <2% and more in the coming years. Figure 2 provides a schematic representation of the challenges experienced in GCC's oil and gas industry:

Figure 2: Challenges for GCC's oil and gas industry

Opportunities

While there are several challenges facing the oil and gas industry, there are also concomitant opportunities.

- The GCC has adopted a wait-and-see approach regarding shale gas development in North America. However, adopting pilot projects from early on to explore and produce gas from shale rocks with assistance from IOCs and independent operators could pave the way for the GCC countries to get a headstart on a potential gas bonanza. Additionally, this success can add to the existing reserves of natural gas in the GCC. Besides, natural gas can be replaced by renewable energy like solar energy for power generation which can be used for oilfield operations. This has high potential in the GCC which receives high solar irradiation. Such technologies can allow the freeing up of natural gas for energy-intensive industries such as petrochemicals, cement and aluminum.

Table 2: SWOT assessment of GCC's oil and gas industry

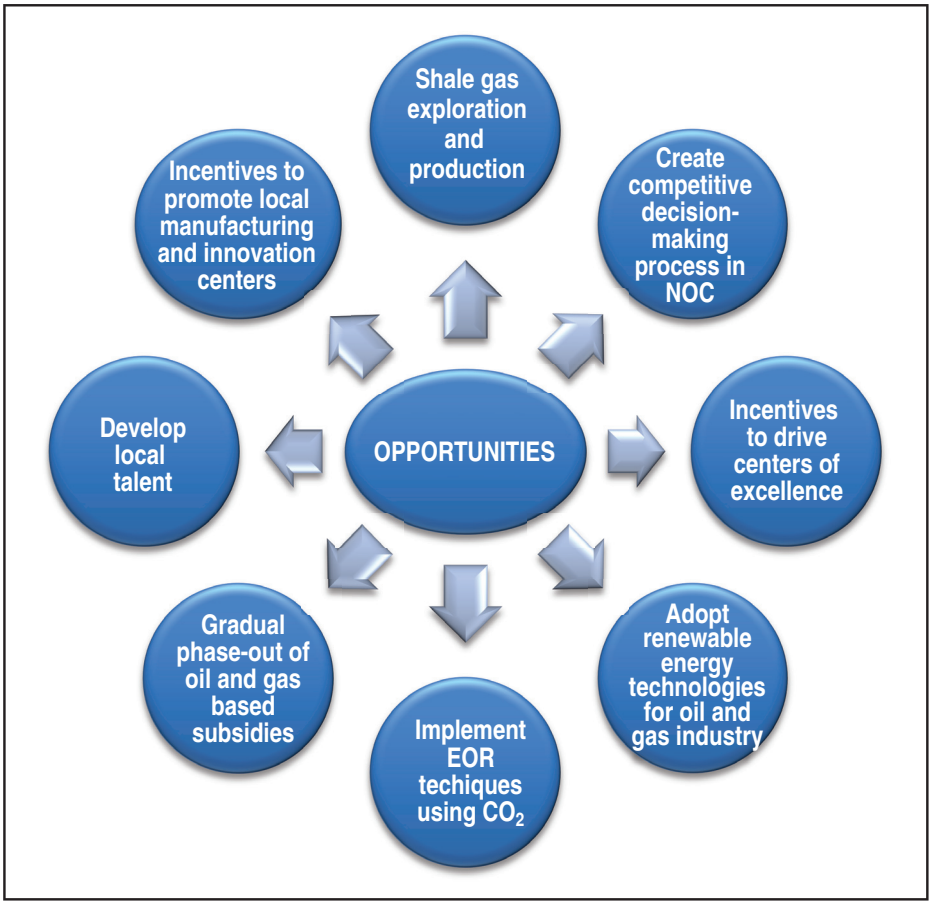
Strengths	Weaknesses
- Hub for hydrocarbon reserves - Has financial strength and political support to undertake large up stream and downstream projects. - The NOCs welcome the expertise in technologies from IOCs and leading technology firms - The GCC aims to be a leader in producing petrochemical products and thereby strengthening the downstream market	- Talent crunch may slow down NOCs ability to be a leader in technology and innovations. - NOCs have often based decisions on upfront capital cost for awarding projects, rather than focusing on technology life-cycle costs and CO_2 emissions generated from the projects - Lack of sufficient incentives in the GCC to set up technology, innovation and manufacturing centers for leading technology oil and gas companies. - The GCC has adopted a 'wait-and-see' approach for exploring oil and gas from shale formations - Availability of large amounts of sour gas with high percentage of Hydrogen Sulfide makes the gas economically unattractive for natural gas production, thus raising the unit costs of natural gas production - Few research institutions focusing on technology innovations in the oil and gas industry
Opportunities	**Threats**
- The NOCs are positioning themselves to be integrated providers in up stream and downstream markets. E.g., production of oil, gas and petrochemicals products - Potential for EOR using CO_2 in mature oilfields - Exploration and production potential for shale oil and gas production - Research institutions can help forge collaborations and partnerships with NOCs and technology companies to explore new avenues of research	- Global shale gas development could in future hamper demand for gas from the GCC, particularly Qatar. - New upstream technologies could allow shale oil and oil sands to be produced economically thereby destabilizing GCC's position as leading crude oil exporter Demand for gas in the GCC is outstripping supply and this can undermine the growth of petrochemical industries

- o A comprehensive evaluation model for selecting the right technology during project selection could be adopted by the NOCs and the EPCs in the GCC. When factoring in technology costs, life-time environmental emissions as well as technology performance, and a robust framework considering various aspects would help in selecting the right technology for project execution. Such frameworks are currently in use in countries such as Norway and Australia.
- o Monetizing value of low-quality fuels such as natural gas containing H2S and high CO_2 content can help generate power. IOCs and international firms have innovative technologies for monetizing the value of low-quality fuels. NOCs could seek the support of IOCs and leading technology firms

to work together to monetize their existing reserves of natural gas. Research collaborations to find solutions for sour gas management could vastly help in economizing low-quality natural gas.

- Unlocking new reserves of oil through EOR technique: A large number of oilfields in the GCC have reached their "peak oil" era. The time is ripe for these mature oil fields to adopt tertiary recovery. Tertiary recovery method has been used in the Permian Basin of West Texas, US, for over 40 years and has been successful in enhancing the oil properties. By use of these techniques, recovering 5-15 percent of Original Oil in Place (OOIP) would mean realizing the NOCs targets of 2020 and beyond. Additionally, by use of wasteful CO_2 captured from industrial sources, high purity CO_2 can be obtained using carbon capture techniques. Ideally, these projects should be executed on a pilot scale before deploying them as a commercial-scale project.
- The GCC countries could introduce incentives for IOCs and technology firms to set up knowledge hubs. This would encourage development of research hubs and innovation centers. In addition, these centers of excellence can generate value for the GCC countries in less tangible ways. This includes employing and training local citizens, developing technologies in collaboration with NOCs, and, sharing best practices and techniques.
- Program initiatives like gradual phase-out of fossil fuel subsidies and energy efficiency measures by GCC governments could help limit the excessive consumption of fossil fuels. Figure 3 depicts a schematic representation of the opportunities for GCC's oil and gas industry.

Figure 3: Opportunities for GCC's oil and gas industry



Future Research

The analysis allowed us to identify challenges and opportunities in the GCC oil and gas industry. As an extension of this research, an in-depth assessment of the challenges and opportunities could be carried out using interview and survey techniques. The qualitative research would provide a clearer understanding of the regional NOCs and their work process. Additionally, their working relationship and business models when dealing with the IOCs and technology firms could also be well understood through this research. Such studies can contribute to gaining a comprehensive understanding of the existing promoters and impediments for the regional NOCs.

About the Authors

Vijo Varkey Theeyattuparampil is an Engineering Manager with Siemens Energy. He graduated with a Masters in Operations Research and Industrial Engineering from the University of Texas at Austin and obtained his second Masters in Engineering Systems and Management from the Masdar Institute of Science and Technology, UAE. His research interests include sustainability in the oil and gas industry and carbon mitigation technologies.

Ali Vezvaei is currently the President of Linde Engineering in MENA, and oversees the company's ongoing and new operations and projects. He also sits on the Board of Linde Engineering Middle East, Linde Arabian Contracting and Linde Engineering Saudi Arabia. Prior to this, Vezvaei was the global Senior Vice President of Siemens Oil and Gas. Vezvaei has also served as Vice President of Siemens Oil & Gas in charge of Strategy and Mergers & Acquisitions. He has held several global and regional senior management positions in Energy, Oil, Gas and petrochemical sectors. His research interest includes efficiency and sustainability in oil and gas and petrochemical industries, future technologies like Subsea, Enhanced Oil Recovery and unconventional gas. He holds a B.Sc. in Mechanical Engineering.

Gulf Research Centre Cambridge
Knowledge for All

www.grc.net