Shale gas
Key considerations for India
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The surging shale gas production in the US and the possibility of replicating this success worldwide holds the potential to revolutionize the global energy market in the future. Recent technological advancements in hydraulic fracturing and horizontal drilling have made shale gas operations economically viable. The widely dispersed shale gas reserves represent the strong potential of shale gas to emerge as a major alternative source of energy globally. According to the US Energy Information Administration (EIA), it is estimated that the top 33 countries, including the US, are estimated to have around 6,622 trillion cubic feet (tcf) of technically recoverable shale gas resources. To put this in perspective, the global natural gas consumption was 113.8 tcf in 2011. The reserves are likely to increase as more regions are explored and evaluated. Based on current reserve estimates and consumption, shale gas reserves could potentially satisfy global gas requirements for the next six decades.

Is shale gas emerging as the next game changer globally?

Shale gas revolution transforming the US energy market

The unlocking of huge domestic shale reserves has transformed the US energy market. The exponential rise in natural gas production in the country has reduced the country’s reliance on imported gas, particularly liquefied natural gas (LNG) imports, to meet its requirements. According to the EIA, the US holds 862 tcf of technically recoverable shale gas reserves. Shale gas production has increased from 99.2 million metric standard cubic meters per day (mmscmd) in 2007 to 409.3 mmscmd in 2010. The share of shale gas in the country’s overall natural gas production has increased from 5.2% (2007) to 19.9% (2010). As a result, the country’s gas imports have declined from 353.4 mmscmd in 2007 to 287 mmscmd in 2010, while the decrease in LNG imports has been even more significant. LNG imports have declined from 59.1 mmscmd in 2007 to 33 mmscmd in 2010. Further, the US has overtaken Russia as the world’s largest natural gas producer.

Natural gas prices in the US are at record lows as the surge in shale gas production coupled with lower demand has resulted in oversupply and record high gas inventories. The average price of gas at the Henry Hub has reduced from US$8.8 per mmbtu in 2008 to around US$2.9 per mmbtu in July 2012. Natural gas prices in the country have diverged from crude oil prices and gas prices index in other parts of the world. Oil and gas prices in the US have been moving in different directions since 2009, resulting in an increase in the oil-to-gas price ratio (Chart 1). Similarly, gas prices in the US are prevailing at a substantial discount to gas prices prevailing in Europe and LNG prices in the Asia-Pacific region, as they are still aligned to crude oil prices. (Chart 2)
The shale gas revolution has contributed to the growth of the US economy by increasing the competitiveness of the gas-consuming industries along with creating employment and revenue opportunities for state and federal government.

- **Growth of gas-based power plants:** Abundant and assured supplies of cheap gas have led to the expansion of gas-based power plants in the country. In the last decade, electricity generated from gas-based plants has increased by more than 50% as power generators substituted coal with gas.8

- **Drop in electricity prices:** Since 2008, wholesale electricity prices has slumped in excess of 50%, resulting in lower electricity costs for residential and industrial customers.9

- **Lower feedstock costs:** US-based chemical and petrochemical manufacturers who use gas as a feedstock have amply benefitted from the decline in input costs. This has given them a competitive edge over players from other regions. In the previous decade, high feedstock prices resulted in many companies moving their operations to the Middle East and Asia. However, the trend has now reversed with many companies, including Exxon Mobil, Dow Chemical and Chevron Phillips Chemical, increasing their investments in the US chemical and petrochemical industry.10

- **Job creation:** The increase in shale gas operations is creating various new job avenues across the country. The shale gas industry is estimated to have provided employment to more than 601,000 workers across the value chain in 2010.11

- **Key source of government revenues:** The shale gas industry is emerging as an important source of government revenues. In 2010, the industry is estimated to have contributed around US$18.6 billion in taxes, including US$9.6 billion in federal taxes and US$8.8 billion in state and local taxes.12

This revolution has transformed the country’s outlook for energy supplies and has even dramatically altered the trade flow outlook of the global gas market. By 2030, shale gas is projected to account for around 46% of the country’s total gas production.13 From being a major importer of LNG a few years back, the US is projected to emerge as an exporter over the next few years. For instance, the EIA had estimated in its Annual Energy Outlook 2006 the US LNG imports to reach almost 334.5 mmscmd by 203014. However, in the latest 2012 outlook, the agency estimates that the country is expected to export 47.6 mmscmd of LNG by 2030.15

Currently, the regulator has approved only one export terminal (Cheniere’s Sabine Pass terminal). While a number of new LNG export terminals have been envisioned, their commissioning is subject to government approval.
Surge in shale gas activities worldwide

The shale gas success story in the US has resulted in heightened speculation over the potential for shale gas to transform energy markets in other regions. According to the latest estimates by the EIA, Poland (187 tcf) has the largest technically recoverable shale resources in Europe, while China (1,275 tcf), South Africa (485 tcf) and Argentina (774 tcf) lead the resource base in Asia, Africa and South America, respectively. The US, which given its experience of shale gas production, probably has the most accurately estimated resources and accounts for 13% of the global total. Shale gas exploration is currently underway across the globe, with Argentina, Poland and the UK leading the way. Although there is immense potential for developing shale gas reserves worldwide, environmental and social concerns could impact growth prospects.

China has the world’s largest shale reserves, accounting for almost 20% of the global reserves and approximately 92% of the reserves in Asia. The Chinese Government has been taking concrete steps in harnessing its huge shale gas potential. It plans to produce 18 mmscmd of shale gas annually by 2015 and increase production to between 164 mmscmd and 274 mmscmd by the end of 2020.17 In order to develop technical expertise, Chinese NOCs have been aggressively participating in shale gas activities in the US through stake purchases and forming joint ventures.

Is shale gas emerging as the next game changer globally?

Figure 1: Global shale gas reserves distribution

Source: US Energy Information Administration

Exploration is currently in progress in several countries in Europe, including Austria, Germany, Hungary, Ireland, Poland, Sweden and the UK. Nearly 57% of the estimated shale reserves in Europe are concentrated in two countries – Poland and France. The need to reduce the region’s dependence on Russian gas supplies and meeting carbon emission targets are the main drivers contributing to shale gas development in the region. However, environmental concerns over hydraulic fracturing have led some European countries to rethink their strategy on developing shale gas reserves. While countries such as France and Bulgaria have banned hydraulic fracturing, others such as the Czech Republic have imposed a temporary moratorium until new legislations are put in place.

Argentina accounts for 63% of the reserves in South America. The Argentinean Government is encouraging investments in the shale gas industry to offset the declining conventional oil and gas production in the country and reduce its dependence on imported gas from Bolivia.
Why does India need shale gas?

The unlocking of domestic shale gas reserves could help India meet its growing energy demand, besides reducing its dependence on expensive energy imports. In addition, the development of the domestic shale gas industry could boost the economy. However, this emerging industry will have to be promoted by balancing economic benefits with environmental and social issues.

Huge unmet gas demand to persist

India’s natural gas market continues to be in a state of deficit, with demand far exceeding the supplies. In FY12, around 38% of the gas demand was unmet. As a result, the dependence on LNG imports has increased and there has been an underutilization of gas-consuming industries, particularly in the power and fertilizer sectors. For instance, the average plant load factor (PLF) of gas-based power plants has declined from 66% in FY11 to 59% in FY12. Additionally, the existing gas-based units have to rely on expensive alternative fuels such as naphtha, diesel, furnace oil and LNG to meet demand. The gas shortage problem has been aggravated by dwindling production levels in the KG-D6 block. Therefore, the construction of new gas-based units, particularly in the power sector, which were allocated supplies from the block has been stalled.
According to the Government of India’s projections, the shortage of gas supplies is likely to continue during FY13–FY22. It is estimated to average around 72 mmscmd per annum. While the deficit as a percentage of demand is likely to decrease from 38.2% in FY12 to 12.4% in FY22, the country’s dependence on imported gas is likely to increase considerably. The share of imported gas in India’s total gas supplies is likely to increase from 22.5% in FY12 to 54.2% in FY22. Out of this, LNG is likely to account for a major share, with LNG imports increasing from 38.5 mmscmd in FY12 to 258 mmscmd in FY22. This high dependence on imported gas could have significant implications on India’s energy security and the overall trade deficit of the country.

Although the global LNG liquefaction capacity is projected to increase significantly over the next few years, gas prices under new LNG supply contracts are likely to remain high given the forecast of high crude oil prices. The sourcing of fresh LNG supplies at competitive rates has been a challenge on account of the intensifying competition among Asian companies. Competition is likely to further intensify due to an increased Japanese appetite for LNG for power generation after the shutdown of most of the country’s nuclear power plants along with China’s plans to augment its LNG imports. LNG supply projections for India depend upon the timely commissioning of the proposed LNG terminals (Ennore, Mundra, Paradip, Vizag, Mangalore and Dhamra). Additionally, the supply estimates assume the commencement of gas supplies from the Turkmenistan-Afghanistan-Pakistan-India (TAPI) pipeline in FY18.

**Advantages of shale gas**

Given the state of the supply deficit and heavy reliance on imports, it becomes imperative for India to harness all its energy resources, including shale gas, appropriately. The unlocking of domestic shale gas can help India meet its growing energy demand, besides reducing its dependence on expensive energy imports and the energy import bill. Taking a note from the impact of shale gas development in the US, the development of the sector can help increase economic activity in the country, thereby boosting government revenues and creating new jobs. Additional gas supplies can also spur investments in associated downstream segments, which cater to significant latent gas demand in the country. A case in point is Gujarat where the development of gas infrastructure led to the application of gas in new sectors such as industrial and commercial establishments in the ceramics, glass, chemicals, textiles, pharmaceuticals and diamond industries, among others. With some degree of intervention from the judiciary and local state governments, the household and automobile segments have the potential to further boost city gas demand as well.

Initially, the prices of shale gas may not be economically viable for industries, such as power and fertilizers, where the prices of end products are regulated or price hikes are difficult to pass on to customers. However, it could be a viable alternative for meeting the needs of peak and captive power units and other sectors such as transportation, refineries and steel where it can substitute expensive liquid fuels. During FY13–FY22, gas demand from these sectors is estimated to increase at a CAGR of 7.6%, accounting for around 30% of the total gas demand in the country.
Section 03

Key capabilities required to develop the domestic shale gas industry

In order to replicate the shale gas experience of the US, the country will need strong service and infrastructure capabilities along with a favorable regulatory regime, which not only promotes E&P activities, but also addresses environmental and social concerns. The prerequisites for developing the domestic shale gas industry include:

- **Supportive regulatory policies**: There is need to have a favorable regulatory framework, which will incentivize companies to invest in shale gas activities. A liberal fiscal regime can be considered for shale gas operations as the industry is still in its infancy stage of development and the cost of operations are expected to be higher than conventional oil and gas operations. The need for a favorable pricing mechanism for shale gas operations has surfaced due to the initial high costs of production. The International Energy Agency (IEA) estimates shale gas production costs between US$3/mmbtu and US$7/mmbtu in North America. Production costs in India are likely to be higher, given the relatively unknown geological terrain, water disposal costs, inadequate domestic service industry and other expenses. Gas gathering and processing costs are also likely to be on the higher side. However, operational costs have substantially reduced in the US with the application of new and advanced technology. For instance, breakeven costs have reduced by around 40% during the past few years and a similar trend could be expected in India, with the implementation of advanced technology.

Western Australia has reduced its royalty rate to increase shale gas exploration activities. In addition, under an exploration incentive scheme, companies receive subsidies for arranging drilling and hydraulic fracturing equipment. Other countries such as Algeria, Poland and China are currently in the process of framing new regulatory policies, which includes quicker land approvals and tax-free imports of equipment.
The Government of Argentina has introduced a “Gas Plus” program, under which gas produced from unconventional sources, can be sold at higher prices.

- **Promote the development of service capabilities**
  The inadequate oilfield service sector capacity and suitable equipment are potential bottlenecks preventing the faster development of shale gas in the country. This is one of the challenges that India will need to address to develop its unconventional resource potential. The service level intensity for shale gas development is typically higher than that of conventional oil and gas activities. In the US, the domestic service industry played a pivotal role in supporting the country’s shale industry. In comparison, there is a shortage of critical oilfield equipment in India. Moreover, equipment imported from other countries will have to be modified to suit local conditions due to differences in terrain. The geological characteristics of shale gas plays vary across regions. Therefore, the exact replication of technologies and techniques employed in the US may be not possible in India. As such, there is a need to foster an environment, which is conducive for investment in development of high-specification equipment required to conduct shale gas operations. With many oilfield service companies looking to export the techniques they have used successfully in North America to international markets, the Government of India can encourage their participation in India. For instance, China-based Anton Oilfield Services recently offered Schlumberger a 20% stake, which will enable the latter to consolidate its presence in China.

- **Address environmental concerns:**
  Before initiating shale gas development in the country, it is necessary to learn the lessons from studies underway on the environmental and public health impact of shale gas development in the US and use them to shape appropriate regulation. With the increase in shale gas production brought about by the application of hydraulic fracturing “commonly termed as fraccing” techniques, there has been a corresponding increase in concerns about the potential impact of the process on public health, drinking water and the environment. The issue has become increasingly contentious in the US, which has had several years of shale gas production experience, largely pertaining to the parameters against which the impact needs to be assessed. In response to raised public concerns, various studies are underway on the environmental and public health impact of shale gas development in the US. Many states in the US are deliberating to impose a moratorium on drilling activities until the results of the study are released and robust measures are implemented. Currently, most...
countries in Europe appear to be adopting a “wait and see” approach on the issue. Even South Africa, with significant shale gas reserves, has suspended drilling activities in the region. The extensive use of water, especially in water-deficient countries such as India, may put severe pressure on water supplies. The efficient disposal of waste-water from drilling operations is likely to be another debatable issue. Moreover, the exploitation of shale reserves in ecologically sensitive areas may lead to public opposition.

- **Address social concerns:** The availability of land is not a major challenge in the US, given its vast open spaces; however it may be a vital issue in countries such as India, where population density is relatively higher. The physical footprint related to shale gas activities is considerably larger than that of the exploitation of conventional oil and gas. The typical well pad needs to be large enough to contain the drilling rig equipment, wastewater ponds, storage and pipeline infrastructure and facilities for staff and contractors.

To reduce environmental impact, many companies in the US are implementing new techniques such as advanced well designs and equipment to reduce fracs per well, multiple layers of steel casing to prevent water contamination, closed-loop drilling to minimize water usage and discharge of toxic waste.

- **Overcome talent shortfall:** The Indian oil and gas industry is facing a dearth of talent, which could delay projects and impact production. According to Ernst & Young’s estimates, approximately 50% of the current oil and gas workforce has more than 20 years of experience and the majority of them may retire within the next five to ten years. The attrition levels are high, as 7% of the current workforce may leave the industry in the next five years. To address these issues, there is a need for significant efforts to attract new talent.

To reduce the usage of land, companies must be encouraged to develop superpads in areas where population density is high. This multi-well pad system enables the drilling of multiple wells from a single location. Although this may push operational costs, it will reduce the geographical footprint of operations and help win public acceptance.

The Polish Ministry of Environment and the State Mining Authority organize specific training programs for a better understanding of shale gas operations.
Shale gas prospects of India

According to estimates by EIA, India has 63 tcf of recoverable shale gas reserves. However, there has been a recent downward revision in the estimates. India’s shale reserve estimates pale in comparison to global standards; however limited exploration has been carried out so far. It is quite possible that similar to the US, India’s shale gas reserve potential could be upgraded with further exploratory drilling.

The Cambay, Krishna Godavari, Cauvery and the Damodar Valley are the most prospective sedimentary basins for carrying out shale gas activities in the country. The Cambay basin in Gujarat is the largest basin in the country, spread across 20,000 gross square miles, with a prospective area of 1,940 square miles. Around 20 tcf of gas has been classified as technically recoverable reserves in the basin. It is estimated that the Krishna Godavari basin, located in eastern India, holds the largest shale gas reserves in the country. It extends over 7,800 square miles in gross area, with a prospective area of around 4,340 square miles. The basin encloses a series of organically rich shales, containing around 27 tcf of technically recoverable gas.30

Latest developments

The Government of India, along with Indian companies, is undertaking various initiatives to accelerate the development of shale gas reserves in the country. India is likely to launch the bidding for shale gas exploration toward the end of 2013.31 As a part of this initiative, the government has set up a multi-organizational team (MOT) comprising the Directorate General of Hydrocarbons (DGH), Oil and Natural Gas Corporation (ONGC), Oil India Limited (OIL), and GAIL (India) Limited for analyzing the existing data set and suggesting a methodology for shale gas development in the country.32 Further, in April 2012, the DGH submitted its draft policy on exploitation of shale gas to the Ministry of Petroleum and Natural Gas (MoPNG).33

ONGC and OIL are aggressively implementing pilot projects to assess the shale gas potential in the country. In addition, Reliance Industries Limited (RIL) and GAIL have entered the US shale industry to gain technical expertise and may apply that expertise in developing shale gas reserves in India.

• In January 2011, ONGC discovered shale gas in its first pilot shale gas drilling venture in the Damodar basin. Further, the company plans to explore shale gas potential in other promising basins in the country.24

Appendix
To gain expertise in this emerging industry, the company signed an agreement with ConocoPhillips in March 2012, for cooperation in the exploration and development of shale gas resources in India and other regions. Under the first phase of the agreement, both the companies plan to explore Damodar, Cambay, KG and Kaveri basins.35

OIL has hired Schlumberger to conduct a feasibility study of shale gas potential in the Assam-Arakan and Rajasthan basins.36

RIL has signed three upstream joint ventures (Chevron, Pioneer Natural Resource and Carrizo Oil & Gas) and a midstream JV (Pioneer) for carrying out operations in the US. RIL has invested a total of US$4.09 billion and achieved production of 22.1 billion cubic feet equivalent in 1Q13.37

GAIL signed an agreement with Carrizo Oil & Gas to acquire a 20% stake in the latter’s Eagle Ford acreage for US$95 million38, GAIL has also signed a 20-year agreement with Cheniere Energy for the supply of 3.5 million tonnes per year of LNG39.

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