



Gas in 2020: A Perspective

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McKinsey & Company

Executive Summary

INTRODUCTION

The world over, climate change concerns are dominating the agendas of governments and businesses. And the emphasis on clean energy has amplified. Gas with its inherent environment-friendly nature is assuming greater significance. Gas consumption could rise by 2.7 per cent¹ year-on-year for the next twelve years. During this time, Asia will be the fastest growing consumption market as it witnesses rapid economic growth, and India will continue to be the third largest consumer in Asia. To discuss each of these developments and their implications this document is organised in four sections:

- The rise of natural gas
- Asia: The fastest growing consumption market
- India: Asia's third largest market
- Implications

THE RISE OF NATURAL GAS

In recent years, the need to meet the world's growing energy demand has been eclipsed by rising oil prices and the perils of climate change. In this scenario, the role of natural gas – a relatively abundant and clean fuel has attained new significance. In isolation, the sheer volumes of gas reserves² and resources³ are sufficient to meet the global growth in consumption. Based on 2006 estimates, gas has a reserve–

to–production ratio of 61 years and a resource–to–production ratio of 133 years. In contrast, oil has a reserve–to–production ratio of 40 years and a resource–to–production ratio of 60 years.

Our analyses suggest that between 2005 and 2020, global consumption of natural gas is likely to grow at a compounded annual growth rate of about 2.7 per cent from about 2600 BCM in 2005 to around 3900 BCM in 2020. Rapid economic growth will make Asia the fastest growing region in the world as consumption accelerates by 5.8 per cent year-on-year from 2005 to 2020. However, adoption of renewable energy resources and the resulting energy efficiency could impact gas consumption significantly. For example, in North America consumption by power producers could swing by 50 per cent on either side of the base case depending on the growth in the share of renewable energy resources and the quantum of gain from efficiency related initiatives.

As regional demand and supply imbalances increase, LNG and international pipelines will become even more important. If supply constraints do not exist LNG and international pipelines are likely to account for 23 to 24 per cent or approximately 955 BCM of natural gas flows by 2020, as compared to 15 per cent in 2005. A detailed comparison of specific demand and supply scenarios in different regions supports this view. For instance, by 2020, North America and Europe will face a shortfall of about 510 to 520 BCM while North and West Africa will have a surplus of 235 BCM.

In the short to medium⁴ term, flow constraints will create a mismatch between demand and supply of natural gas.

1 Based on McKinsey's proprietary global gas model using 2006 supply estimates and McKinsey Global Institute Report - Curbing Global Energy Demand Growth: The Energy Productivity Opportunity 2007

2 Reserves are technologically and economically mineable

3 Resources are demonstrated, not mineable at present for technological or economical reasons

4 Short to medium term refers to the next three to seven years i.e., 2012-2015

Gas flows will be constrained by two key factors, in the short to medium term

- *Uncertainty around availability of gas for export from key producing centres:* Gas exporting countries in the Middle East and in Asia are using additional quantities of indigenous gas to meet growing domestic demand while politics and unrest in Nigeria has affected availability of gas for exports. Even, Qatar, a large producer of gas will not be able to step-up supplies due to liquefaction capacity constraints and the moratorium⁵ on additional exploration activities till 2010. Further, there could be a delay in the availability of Russian supplies to Europe; if so some of the LNG contracted to Europe may not be diverted to Asia or North America to meet their needs.
- *Delays in the build-outs of additional LNG and pipeline infrastructure:* By 2020, an additional 320 to 325 BCM of liquefaction capacity will be needed in addition to the existing 225 BCM, and another 140 to 145 BCM of international pipeline capacity will be required over the existing 220 BCM. Executing such large scale projects is going to be no easy task.
 - Significant uncertainty clouds the implementation of liquefaction projects in Australia, Iran, Nigeria, and Qatar. Delays in the build-outs of liquefaction capacities are a result of several factors. Overheated engineering, procurement and construction (EPC) markets, technical issues, uncertainty in achieving financial closure – an outcome of rising costs, lags in project execution, and geopolitical issues, are notable amongst others. Further, in the last two to three years alone, the cost and time of building land based liquefaction terminals has risen by 20 to 50 per cent. Closing deals with the National Oil Companies (NOCs) has also become increasingly difficult. And, most liquefaction capacities

⁵ In 2005, Qatar Petroleum capped further gas development beyond the 260 BCM per year of liquefaction capacity. The moratorium was to be reviewed in 2007, but this has been pushed back to 2010

have utilisation rates of about 90 per cent across regions. Such high cumulative utilisation rates provide limited flexibility to manage seasonal variations or to conduct preventive maintenance. Therefore, liquefaction capacity is likely to remain a bottleneck in the short to medium term.

- Setbacks in pipeline construction resulting from geopolitical tensions are also likely to slow down pipeline build-outs, as evidenced in the Iran-Pakistan-India pipeline project and South Stream pipeline project.

Flow constraints will become increasingly evident in the next three to seven years, highlighting the urgency to complete pipeline and liquefaction projects.

Gas prices are likely to remain high in the short to medium term, as they will remain linked to oil

Despite different pricing mechanisms, natural gas prices in Europe, North America, and Asia will continue to be linked to oil prices. In Europe and Asia, the pricing formula in long term contracts will to a large extent remain linked to oil products. In the US the prices on Henry Hub⁶ will be set by the switching costs between residual fuel oil and distillate. Given oil prices are expected to remain high, gas prices will also be high.

- **Europe:** European suppliers have a strong economic rationale to maintain a tight link to oil in long term contracts. Likewise, utility companies will support high prices through the contractual oil link, as gas is the marginal fuel and gas prices set power tariffs i.e., higher gas prices mean higher power prices.
- **North America:** Prices will continue to be set by switching costs – the ability of some power producers to use crude products i.e., residual fuel oil or distillate instead of gas. Divertible LNG cargoes that can be sent to either North America

⁶ Henry Hub is the pricing point for natural gas in the US

or Europe will strengthen the linkage to residual oil. Even if gas prices drop below the residual oil-linked price, the floor will be set by coal prices that have been rising globally.

- **Asia:** Buyers in Asia will continue to keep long term contract prices linked to the Japanese Crude Cocktail (JCC) because of the widespread use and acceptance of JCC as an index.

Regardless of different pricing mechanisms, the price differential between contracts in the Atlantic and Pacific basins is likely to narrow. Much of this will be led by the expiry of Japanese contracts in the coming years (e.g., about 19 per cent of Japanese contracts will expire by December 2010, and 30 per cent by 2015). These contracts are likely to be replaced by those that will have a stronger linear correlation with oil prices as evidenced in the recent contracts executed by Asian countries. And this trend is likely to continue. Prices in Asia will rise and move closer to those in the Atlantic basin. What's more, at prevailing prices LNG producers have the opportunity to supply to both the Pacific and Atlantic basins for similar netbacks.

Trading volumes in the short term will increase but will be a relatively smaller portion of total volumes. Increases in short term trading volumes will result from diversion of cargoes from Europe to either the US or Asia. This will be a natural outcome of over contracting by Europe for the next few years. In addition, LNG suppliers are willing to keep a part of their liquefaction capacity for the short term market as opposed to selling it completely as part of long term contracts.

Thus in the short term price linkages between the Henry Hub, European spot markets and the Atlantic and Pacific basins will strengthen.

Demand and supply situation could improve by 2020

As long as crude oil prices remain in excess of US\$ 60 per barrel, even at the current over-heated capital cost of US\$ 1000 to 1200 per tonne of liquefaction capacity, gas prices will incentivise suppliers to invest in the required LNG and pipeline capacities with an internal rate of return (IRR) of 13 to 22 per cent. Unless unforeseen geopolitical developments or construction related environmental issues crop up, additional liquefaction capacity should come on-stream to address flow constraints and related supply gaps in the long term.

In the next section, we examine the Asian gas market in detail to learn more about the growth of consumption in Asia, its outcomes, and the subsequent implications and challenges.

ASIA: FASTEST GROWING CONSUMPTION MARKET

As in other regions, energy and energy infrastructure will play a critical role in shaping the economic destiny of Asia. It is well recognised that accelerated economic growth and subsequent industrialisation have boosted the region's demand for all energy resources.

Our analyses suggest that gas consumption in Asia will rise from approximately 340 BCM in 2005 to about 785 BCM in 2020, growing at 5.8 per cent year-on-year.

If current indigenous production levels are maintained and all signed contracts are honoured, Asia could have a gas deficit of 415 BCM by 2020. As a result, the region has to significantly increase its indigenous production and secure adequate LNG and international piped supplies.

Despite the structural differences across various Asian countries – Japan, Korea, China and India, they will compete fiercely for LNG and piped gas supplies. It is necessary to understand how the region's heterogeneous economies are likely

to respond in the short to medium term flow constrained environment and their subsequent impact on the global gas market.

- **Japan & Korea:** Resource-short countries like Japan and Korea have traditionally relied heavily on long term LNG contracts, to meet domestic demand. As a result, both countries will aggressively try to renew expiring contracts, albeit at higher prices. This trend has been observed in recently negotiated contracts.
- **China:** China has access to enormous coal reserves. Yet, growth in natural gas consumption in China will be the highest in the world, at a compounded rate of around 10.4 per cent as compared to world gas consumption at 2.7 per cent during the next twelve years. In real terms, consumption will rise from 45 BCM in 2005 to about 200 BCM by 2020, thereby increasing the share of natural gas in the country's energy mix from 3 per cent to 7 per cent. Growth will occur, despite the focus on coal and coal-based technologies in power generation. It will result mainly from the increase in consumption by households. To facilitate this growth in natural gas consumption, the government has undertaken several important steps – (i) partially lifted caps on natural gas prices; (ii) permitted foreign participation in the supply of city gas, and in exploration and production; and (iii) encouraged the set-up of regasification terminals.
- **India:** Gas consumption in India has grown at 8 per cent from 1997 and 2007. Consequently, India's share in the Asian consumption mix has risen from 8.6 per cent to 10.1 per cent in the last decade. In 2007, India was the third largest natural gas consumer in Asia with an annual consumption of 45 BCM. Looking ahead, demand for natural gas will come from various consumers like fertiliser producers, city gas distributors, industrial gas distributors and peaking power producers amongst others. Our analyses suggest that India's total demand could be 115 to 135 BCM by 2020.

Recent gas finds along with the fact that only 20 per cent of India's sedimentary basins have been relatively well explored instill confidence that indigenous gas

could play an important role in the short to medium term. For this, the country needs to significantly accelerate its exploration, and production efforts. Further, India should also prioritise the construction of international pipelines. If either of these measures are not acted upon, LNG imports could jump to 40 to 90 BCM by 2020⁷. The next section discusses our perspective on the Indian gas market in detail.

- **Malaysia & Indonesia:** Asia's two largest exporters – Malaysia and Indonesia have substantial gas reserves. But growing domestic demand, stagnating production, and investment delays are constraining their export potential. Indonesia expects domestic consumption to rise from 46 per cent of the total volume of indigenous gas to 70 per cent by 2010. This coupled with the Malaysian government's drive to promote the use of clean fuels for domestic purposes will boost consumption of indigenous gas. These shifts in consumption patterns will reduce global supply by 10 to 15 BCM in the medium to long term i.e. from 2015 to 2020.

A combined view of individual country responses reveals that in addition to the acceleration in indigenous production, the competition for gas imports will intensify in the short to medium term.

In the next section, we discuss the future of gas consumption in India with an emphasis on demand drivers and supply imperatives.

INDIA: ASIA'S THIRD LARGEST MARKET

Growing importance of gas in India

Growing at 8 per cent between 1997 and 2007, gas consumption in India has outpaced that in Asia. Its share in the country's energy basket has increased from 6.4 per cent in 1997 to 8.6 per cent in 2007. Steep growth in demand coupled with

⁷ This is in addition to 17 BCM secured via long term contracts

insufficient indigenous production has triggered the demand for LNG. The share of LNG in India's gas consumption mix has jumped from marginal levels in 2002 to 22 per cent in 2007. Recent gas finds and the fact that only 20 per cent of India's sedimentary basins have been well explored instill confidence that indigenous gas supply could increase in the short to medium term.

Demand will increase three-to-four fold by 2020

Detailed bottom-up analyses suggest that rapid economic growth will continue to stimulate India's appetite for energy. Demand for gas will rise by 9 to 10 per cent per year to about 115 to 135 BCM by 2020. Several consumers will trigger this growth – most notable being fertiliser producers, city gas distributors, industrial gas distributors and peaking power producers.

- *Based on switching costs, gas consumption in certain sectors could grow substantially:* At the current domestic prices, gas is an economical fuel compared to its substitutes. For example, at a crude price of US\$ 50 per barrel, the captive power sector that uses diesel as fuel can buy around 17 BCM at a favourable switching cost of US\$ 9 per mmbtu; while the city gas distribution (CGD) sector with a demand of around 17 BCM has a switching cost of US\$ 7 per mmbtu; and fertiliser plants using naphtha could consume around 15 BCM at a switching cost of US\$ 10 per mmbtu.
- *Gas could play a major role in fulfilling India's peaking power requirement:* To meet its power deficit of about 140 GW at peak in 2017⁸, India will need to build 55 GW of additional peaking capacity. Hydro plants can satisfy 20 to 30 GW of peak power demand by 2017. The balance will need to be produced by alternatives like gas. The expected tariff of peaking power in excess of Rs. 5.50/KWhr could support a gas price of around US\$ 12 per mmbtu.

⁸ Based on the Planning Commission's eleventh and twelfth plan estimates

Additional supply of 70 to 90 BCM will be needed by 2020

By 2020, India needs a total of 115 to 135 BCM of natural gas supply i.e., 70 to 90 BCM of additional supply over 35 BCM of indigenous production and 10 BCM of LNG in 2007⁹, to meet expected demand. The status of current projects indicates that indigenous production would increase to 55 BCM by 2012. But in the longer term, indigenous gas alone may not be able to fulfill India's consumption needs. Pipelines could play an important role in bridging this gap. The Iran-Pakistan-India (IPI) project (32 BCM) and Myanmar-India pipeline (12 BCM) could provide 40 to 45 BCM of gas. If pipeline projects are delayed and not enough is done to accelerate indigenous production, India will need LNG imports between 40 to 90 BCM by 2020. For gas to gain a meaningful share in India's energy basket, several actions are required:

- *Expedite indigenous production:* During the last decade, India has made numerous gas discoveries, some of them substantial by even global standards. Yet, a significant upside exists as only 20 per cent of India's sedimentary basins have been well explored. This warrants a concerted effort to explore and to develop domestic gas resources. India should aspire to produce 70 to 90 BCM of indigenous gas by 2020 instead of the projected 55 BCM by 2012.
- *De-bottleneck key projects:* Measures to expedite construction of large international pipeline projects like the Myanmar-India pipeline and even the politically difficult IPI pipeline are needed. If either one of these does not materialise, India will have to invest substantially in LNG, which may not be as economical as piped or indigenous gas. In addition, building domestic pipeline infrastructure like trunk pipeline capacities e.g., Kakinada to Mumbai, Kakinada to Chennai and providing easy access to producers is essential.
- *Explore CNG as a feasible alternative to both LNG and international pipelines:* Two factors favour this – (i) India's proximity to the Middle East provides it with easy access to CNG; and (ii) costs are competitive as compared to those of LNG, for

⁹ Published estimates

distances between 500 and 2000 kilometres. Further, it has certain inherent advantages. It is not constrained by geopolitics, and it provides suppliers with the flexibility to develop smaller, less capital intensive fields in a relatively shorter span of time.

The next section outlines the implications for the various players.

IMPLICATIONS

Increasing flow constraints, rising prices, and intensifying competition will pose significant challenges for the gas industry. Stakeholders will need to act on multiple fronts.

Governments and regulators in gas-short countries

On the domestic front governments and regulators need to:

- *Make gas a meaningful part of the power portfolio:* Despite short term flow constraints, emphasis on natural gas as a key constituent in the country's power generation mix is a must. More so, because unlike coal and oil, natural gas has two distinct advantages – (i) it is relatively abundant and; (ii) it is clean. Indigenous gas, piped gas and CNG could be viable options to make natural gas available at affordable prices in China and India.
- *Ensure attractiveness for suppliers:* To attract imports and to encourage domestic exploration and production, it is essential for governments to allow domestic prices to align with global prices. At a minimum, they should encourage domestic users willing to pay international prices to import LNG and piped gas. This will help develop local gas markets and infrastructure. In addition, they should craft energy policies that provide attractive returns on investments and in effect enhance

investor confidence. This calls for supporting a competitive price regime, and articulating a minimum threshold for capacity utilisation for a given duration.

- *Create demand centres:* LNG will always be attracted to concentrated demand centres. Regulators need to encourage the formation of consortia and industrial parks that import bulk supplies.

On the international front governments must:

- *Collaborate with resource-rich countries:* Increased collaboration with targeted gas-rich countries is imperative to ensure supply is augmented. Governments in gas-short countries are increasingly bypassing International Oil Companies (IOCs) and working directly with governments of gas-rich countries and their NOCs. For example, Chinese NOCs have bought stakes in gas fields in Africa in collaboration with the respective governments.
- *Support establishment of an Asian gas trading mechanism:* Unlike Europe and North America, Asia lacks financial tools to manage price and volume risks resulting from gas trades. Seeking agreement on a regional gas price index and ensuring liquidity by reserving a small share of LNG for spot purchases will be a good start. However, given the significant differences across various Asian countries, making this work will require significant international collaboration and efforts to build trust.

Natural gas buyers in gas-short countries

In order to secure additional supplies at competitive prices, buyers in gas-short countries should:

- *Adopt creative approaches to seek gas supply:* In the short term, buyers should explore partnerships with over-contracted European buyers and suppliers to Europe, willing to divert their planned cargoes – in periods when the cargoes are not needed in Europe e.g., during the first half of 2007 cargoes were diverted to the U.S. because of mild weather conditions in Europe. In the longer term, they should aggressively target second and third horizon resource holders.
- *Work with regulators and governments to facilitate gas supply:* Companies in gas-short countries must lobby with their governments and regulators to ensure infrastructure investments are made to attract supply.

Resource owners and providers

To play a strategic role in developing the global gas market, resource owners and providers must:

- *Provide clarity on national energy policies:* Resource-rich countries need to outline their future consumption requirements and subsequent export potential. This will help streamline contracting between the resource owners and gas buyers.
- *De-bottleneck projects:* Continuous delays in infrastructure build-outs ultimately undermine the market. In the current scenario, adopting the mindset “supply creates its own demand” might be appropriate. Execution of large-scale infrastructure projects e.g., pipelines and terminals should be expedited. Gas will fail to gain its rightful place in the world’s energy basket if any of this is not done.

International Oil Corporations

Despite an increasingly challenging environment, in which resources are largely nationalised, and technologies are easily accessible, IOCs should continue to work through host governments and NOCs of gas-rich countries to retain their stake in the natural gas market. In particular, they should:

- Adopt technologies such as floating liquefaction and develop appropriate business models. Given their broader global portfolio, IOCs can do this more easily than NOCs.
- Continue their work with NOCs and host governments by sharing their expertise in technology, project management, etc.
- Assist ‘new’ demand countries to develop their markets by working with host governments and by investing in infrastructure to stimulate local demand.

Technology developers and investors

Developments in technology such as floating liquefaction and CNG can unlock significant new resource pools – in particular smaller gas fields, offshore resources, and resources in troubled regions. This could help alleviate short term flow constraints. Today’s flow constrained environment calls for strong commitment from technology developers and investors to advance resources in this area.

Switching from gas substitutes to natural gas is an important step towards building a clean and green world. Unleashing the potential of this fuel, to bridge the demand and supply gap warrants immediate as well as long term interventions from stakeholders. Undoubtedly, the use of natural gas holds the promise of a better tomorrow.

