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LNG – GLOBAL CHALLENGES & OPPORTUNITIES AND IMPERATIVES FOR INDIA

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LNG – GLOBAL CHALLENGES & OPPORTUNITIES AND IMPERATIVES FOR INDIA

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FOREWORD

The last two decades have seen substantial economic growth in India coupled with increased energy consumption to drive a fast growing economy. Given India's future growth aspirations, it is clear that access to abundant and economically viable energy will be critical to sustaining the momentum of this growth. India has few indigenous energy resources apart from coal and will necessarily have to diversify its fuel mix and look to global energy markets for its energy needs. Liquefied Natural Gas (LNG) can be a long term solution to India's needs given that it is a proven and commercially viable energy source.

While the LNG industry is nearly half a century old, India is a newcomer to the party since it missed the first round of LNG trade growth. While LNG usage has risen dramatically in the country, it has done so in an unplanned manner; Indian companies have, by and large, not taken advantage of the flexibility afforded by evolving mechanisms in LNG contracting, shipping and infrastructure to finalise favourable terms of trade. In the Indian context, LNG is associated with spot cargoes and carries connotations of ad–hoc supplies at exorbitant rates. This is unfortunate because other nations, in particular the Asian JKT (Japan, Korea, and Taiwan) trio, have shown that a country can have a viable development model driven by LNG, as long as there is sufficient foresight and planning.

The structural deficiencies of India's domestic energy sources make it clear that India will need to rely on steady LNG imports, causing Indian firms to look aggressively for LNG capacities in existing, expanding and upcoming LNG projects. Pricing mechanisms and contracting structures too are evolving to accommodate new price discovery models and more equitable distribution of risks.

Thus, while there is substantial opportunity for LNG in India's energy mix, there is also a concomitant need to create the necessary physical infrastructure and provide regulatory clarity to ensure that the LNG opportunity is realised. To achieve this, suppliers, marketers, consumers and regulators will all have to work together to ensure that the emerging Indian LNG ecosystem delivers what it is meant to: availability at viable prices.

Through this report, we aim to present a 'call for action' for industry as well as for the policy makers, to ensure that a vibrant LNG ecosystem is created which can fuel the Indian economic growth engine into the future.

METHODOLOGY AND APPROACH

The global LNG market is dynamic and constantly evolving amidst the interplay of changing demand patterns, prices of competing fuels, supply capacities and diverse market structures and regulatory mechanisms across countries. This is reflected in the substantial volatility observed in prices and costs incurred across the value chain, which can vary with time and geography. In this paper, we have frequently given ranges for LNG prices and CAPEX figures to reflect this inherent volatility. While care has been taken to ensure that these figures reflect the best and latest publicly available information that can be applicable to a variety of situations, nevertheless, it is recommended that the inherent variability of these figures be kept in mind while reading this report. The emphasis of this study has been to draw inferences and associated imperatives for the Indian LNG sector from long term structural trends disregarding the periodic distortions caused by large spikes that are a characteristic of this industry.

CONTENTS

EXECUTIVE SUMMARY

Energy security has assumed strategic importance for countries across the world. As countries try to reduce their dependence on oil, natural gas has emerged as a cleaner and commercially viable option. LNG has played a crucial role in the globalization of natural gas by providing an affordable means of transporting it over long distances.

LNG at present contributes 2.4 percent to the world's fuel mix. Asia is the largest consumer of LNG, with strong traditional consumers in Japan, Korea and Taiwan and emerging powerhouses in China and India. The rapid commercial exploitation of shale gas has reduced the dependence of North America on LNG imports and can potentially transform the region into a net exporter. The economic downturn and the availability of Russian piped gas have contributed to the slow growth of LNG in Europe. Future growth in LNG consumption is expected to be driven by China, India and niche markets in Latin America and the Middle East. The current LNG supply base is limited to 17 nations with Qatar cornering 33 percent of the market share; however the supply base is bound to broaden as new suppliers, particularly in East Africa, come to the fore. Moreover, substantial additional capacity is expected to come from Australia in the medium term when a number of projects that are currently in the development stage go on–stream. Thus, the global LNG market is expected to be supply constrained only until 2017, after which supply is expected to exceed demand.

LNG has become important towards satisfying India's growing energy needs. Natural gas has become increasingly crucial to India's energy security driven by increased demand due to a growing economy, a need to diversify from traditional sources of energy and compliance to more stringent environmental norms. Power, fertilizer, city gas distribution and refineries are the biggest consumers of natural gas. However, India's domestic reserves of natural gas and planned pipeline imports are unlikely to suffice for its requirement; imported LNG will be critical to overcome the structural gap between gas demand and domestic production. This is borne out by the rapidly increasing LNG consumption in the country which currently stands at 41.60 MMSCMD, almost 32 percent of the total natural gas consumption. The demand for LNG is determined by its cost competitiveness with respect to the alternative fuels, mainly coal, oil based fuels and domestic natural gas in key end use sectors. India's relatively abundant coal reserves make it cheaper for base load power generation than natural gas. Similarly, preferential allocation of domestic gas at low prices to priority sectors like power and fertilizer

limit the addressable market for LNG, though the overall size of the opportunity still remains large. There still remains substantial demand from other consuming sectors like refineries, city gas distribution, and iron & steel that are under–served by domestic gas. This dynamic will be substantially altered if the recommendations of the Rangarajan Committee are accepted and prices of domestic gas are increased substantially, boosting the competitiveness of LNG.

India's natural gas demand is expected to far outstrip its domestic and pipeline gas supply. This gap, projected to be ~131.00 MMTPA by 2029–30, represents a huge opportunity for LNG suppliers and energy companies looking to enter this sector. However, in order to tap this opportunity, significant long term planning and actions need to be undertaken to develop a robust and vibrant domestic LNG market. These actions span the length of the LNG value chain, right from tying up with new sources and long term contracts, to developing re–gasification infrastructure (land based or floating) for additional supplies, to developing viable pricing and contracting structures, so as to provide a compelling value proposition to end consumers. These actions will also need to be supplemented with the creation of requisite capabilities in oil and gas companies and the establishment of a clear and enabling regulatory framework that encourages competition, while at the same time assures investors of fair returns.

INTRODUCTION TO LNG

Energy has played a critical role in the economic development of human civilisation and will continue to do so for the foreseeable future. Today, access to reliable and abundant energy supplies is so intrinsic to the health of modern societies that national policies are built on the foundation of 'energy security' — tacitly equating control over energy with the physical defence of territory. Indeed, in an environment of burgeoning energy requirements with limited availability, the quest for reliable supply has become the next great human endeavour – encompassing technological, political and social dimensions. The history of liquefied natural gas (LNG) is an apt illustration of this monumental quest and, as illustrated in this paper, is very much work in progress, making it one of the most exciting and promising avenues of the evolving global energy landscape.

For nearly a century, the energy revolution brought about by the commercial exploitation of crude oil, held sway over the global energy landscape. However, this status quo was shattered by the oil crisis of 1973, when for the first time the assumption of endless supply at cheap prices was challenged, and the world economy sputtered. The crisis of 1973 held seminal lessons for global politics as nations were exposed to the risk of over–dependence on one fuel. Energy diversification became the slogan of the coming decades: to reduce dependence on crude oil and ensure that the energy mix would comprise a healthy combination of different sources.

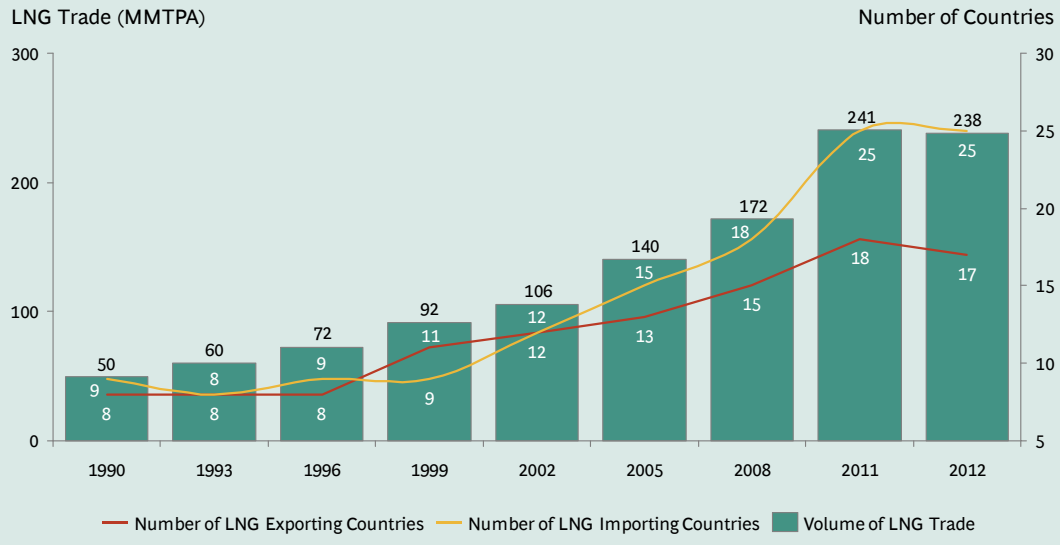
Natural gas became the beneficiary of this trend as countries realised the utility of a fuel that had until then been flared as a waste product during crude oil extraction. Over the next few decades, extraction became more viable, enabling commercialisation of natural gas in a number of applications as a substitute to coal and crude oil derivatives.

There are several advantages of natural gas over traditional fossil fuels like oil and coal. It is the cleanest burning fossil fuel. The combustion of natural gas produces 60–90 percent less emissions of hydrocarbons in the atmosphere as compared to oil. No soot or ash is left behind after combustion, thus reducing pollution levels further. Natural gas infrastructure, once established, is convenient and economical. The gas can be piped directly to the customer facility, eliminating the need for regular deliveries as is the case with oil, leading to a more reliable supply.

The primary challenge to greater commercialisation of natural gas lies in its transportation. The low density of natural gas makes it more costly to contain and transport than either oil or coal. The primary mode of transportation of natural gas used to be through pipelines, which limited it to areas where it could be served by pipelines. The breakthrough came in the form of LNG which allowed countries with limited or no feasibility of pipelines to receive supplies from distant sources at viable prices.

Commercial trade in LNG commenced in 1964 when the United Kingdom imported LNG cargos from Algeria. Post the 1973 oil crisis, LNG gained momentum with Japan, Korea and Taiwan (JKT countries) increasing their imports of LNG to support their growing economies. As shown in figure 2.1, in the last 20 years, LNG trade has evolved from intra–regional status to achieve worldwide growth at 10 percent a year and stood at 237.70 MMTPA in 2012. LNG contributes ~10 percent share in natural gas production and ~32 percent of the total international gas trade.

Figure 2.1 | Growth in global LNG trade volumes

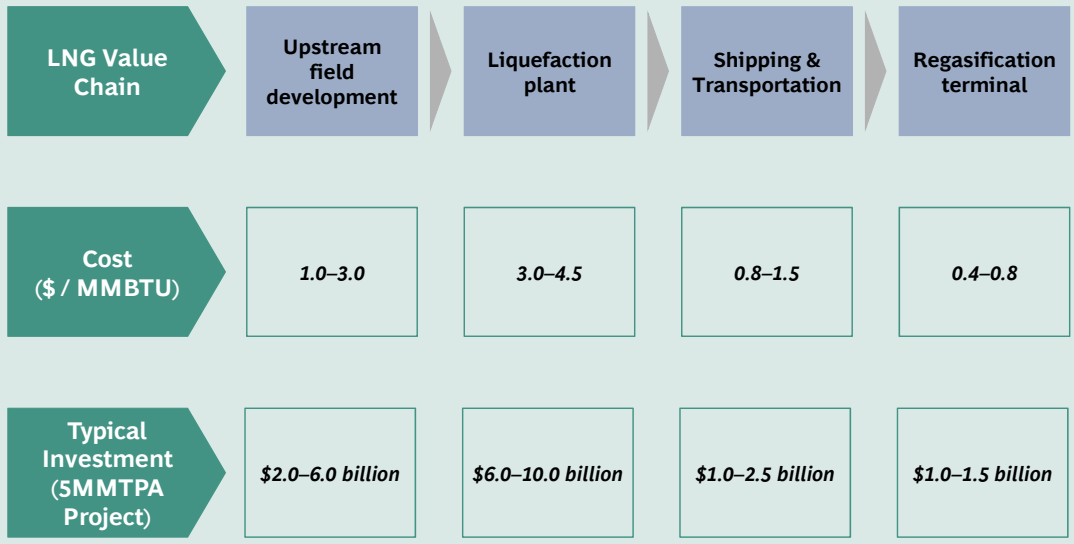


Source: World LNG Report – 2013, IEA, PFC Energy

2.1 Characteristics of LNG: Overall Value Chain and Cost Structure

An LNG project typically requires investment across four links: field development, liquefaction, tanker transportation and regasification. As shown in figure 2.2, LNG production has some fixed costs over and beyond the cost of raw natural gas. Liquefaction adds ~US$ 4.00/MMBTU while shipping and regasification add another US$ 1.50/MMBTU.

Figure 2.2 | Economics of LNG production



Source: Oxford Institute for Energy Studies, InvestorVillage, BCG Analysis

In comparison with pipeline transport, LNG is viable over large distances. Pipeline costs rise linearly with distance, whereas LNG has a higher threshold cost but a much lower increase in cost with distance. LNG transportation is more economical than pipelines over a distance of 2,500 km.

2.2 Commercialisation of LNG: Contract Structures and Risk Sharing

Commercialisation of LNG involves contracts between the buyer, seller and the shipper. Field development and liquefaction at the seller's end and receipt and regasification at the buyer's end are outside the scope of the contract. The key contracts in LNG trade are:

- Gas Sales Contract: This includes 'Sale and Purchase Agreement' for long term contracts and 'Confirmation Notice' for spot sales.
- Gas Transportation Contract: Tankers used for transportation may be owned by the buyer, seller or independent shippers and are usually contracted for the life of the contract.

Sale and Purchase Agreement (SPA)

A Sale and Purchase Agreement works on the principle that 'the buyer takes the volume risk and the seller takes the price risk'. The key clauses include:

Price: LNG prices are typically indexed to a base, for example, oil, gas hub etc. The SPA determines the indexation and price formula for arriving at the price.

Contract Volume (Annual Contracted Quantity): Determines the volume to be delivered during the contract. Contracts work on a take–or–pay basis: if the buyer takes less than the minimum volume agreed, she must pay for the difference. The seller takes the responsibility for providing the minimum contracted volume.

Contract Duration: The typical contract duration is 20 years.

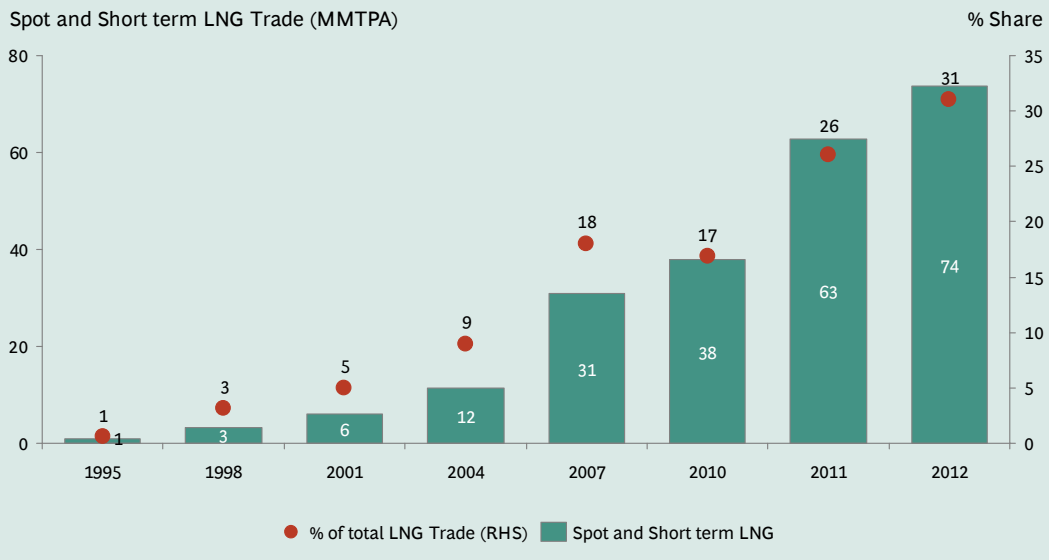
Delivery Point: The destination and the transfer of title (DES or FOB) are established. A contract may have a destination restriction clause restricting the buyer from reselling any surpluses at its end.

Price Review: This establishes the triggers, review periods, and reference markets to allow for a price review in case market conditions change.

Spot Contracts

Spot contracts are used to cater to demand fluctuations which cannot be adjusted in long term contracts. These contracts are applicable only for an individual sale or for a very short duration. As shown in figure 2.3, the spot market has grown from less than 10 percent to 31 percent of the global LNG trade over the past 10 years and stands at 74.00 MMTPA. This increase has been driven by fluctuations in demand, increased competition between exporters, and growth in the LNG fleet.

Figure 2.3 | Growth in global spot and short term trade



Source: World LNG Report – 2013, Waterborne LNG Reports, US DOE, PFC Energy Global LNG Service

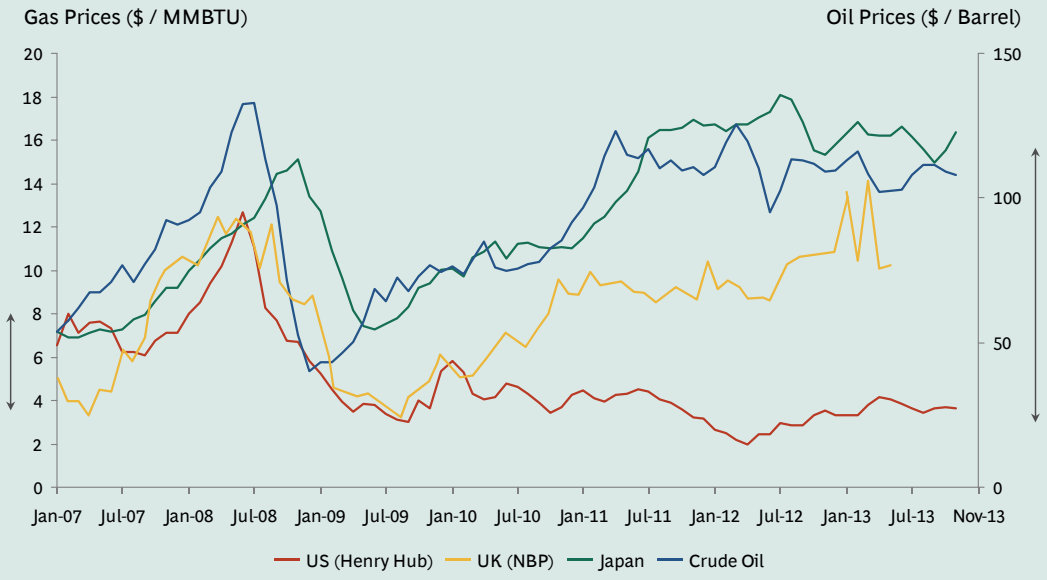
2.3 Commercialisation of LNG: Price Indexation

Gas markets across the world can be grouped into two:

- Gas–on–Gas markets: Liberal markets with volatile prices indexed to a gas hub rather than other energy sources. Examples are the United States, United Kingdom, Belgium, and Canada.
- Oil linked price markets: Gas prices movements linked directly to oil prices or a basket of alternative energy sources (especially oil based products and coal); for example, the JKT countries, Continental Europe, and SE Asia.

Figure 2.4 shows the price movements in these markets in recent years. Post 2008, there has been increased divergence between the oil–linked and gas–hub prices. Moreover, the oil–gas price coupling has weakened over the past five years.

Figure 2.4 | Global gas prices movement



Source: World LNG Report – 2013, Cedigaz, GIIGNL, Waterborne LNG Reports, US DOE, PFC Energy Global LNG Service, Bloomberg

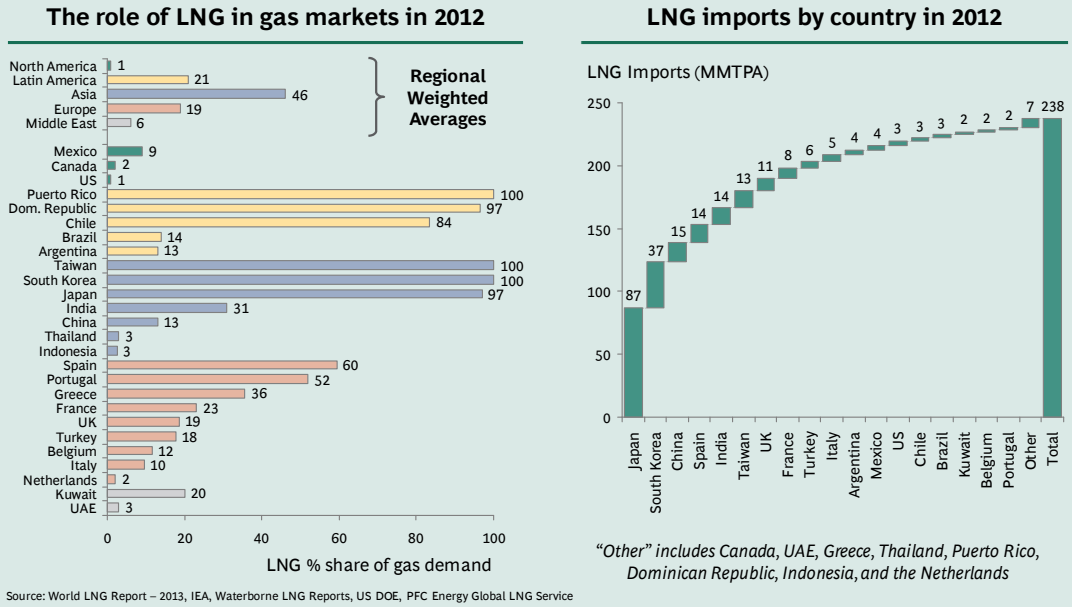
GLOBAL LNG SCENARIO

LNG trade has evolved from intra-regional status to a substantial contributor to the world's energy mix. Today, LNG contributes to 2.4 percent of the world's fuel mix. This section examines the current state of the LNG industry and its future in the coming decades.

3.1 LNG Demand

The development of LNG has driven the globalisation of natural gas, connecting far flung sources to distant markets. Today ~24 percent of the global energy supply is provided by natural gas. LNG trade at 237.70 MMTPA contributes to 32 percent of the total natural gas trade in the world. Figure 3.1 shows the status of LNG demand in the world.

Figure 3.1 | Global LNG demand



LNG consumption across continents varies with the availability of domestic gas, total energy consumption and the viability of cross border pipelines. Table 1 shows the contribution of natural gas and LNG in the energy mix of different continents.

Table 1 | Share of LNG in energy mix of continents (2012)

Country	Share of natural gas in fuel mix	Share of LNG in fuel mix
North America	30%	0.3%
Europe	33%	6.0%
Asia Pacific	11%	5.0%
Latin America	22%	5.0%
Middle East	49%	3.0%

Source: IEA, World LNG Report – 2013, BCG Analysis

Asia has emerged as the pre–eminent market for LNG. LNG contributes to 46 percent of the total natural gas consumption in Asia. Table 2 shows the share of LNG in the energy mix of key countries in Asia. Japan and South Korea together account for nearly 52 percent of the total LNG imports in the world. Isolated geography and scarcity of domestic natural gas have made these countries ideal for LNG imports. Post the Fukushima nuclear disaster, LNG's share in Japan's energy mix has jumped from 29 percent to 48 percent. China and India are also increasing their dependence on natural gas with LNG contributing ~15 percent and 30 percent of the natural gas consumption (2 percent and 3 percent of the energy mix respectively).

Table 2 | Share of LNG in Asian energy mix (2012)

Country	Share of LNG in fuel mix
Japan	48%
Korea	11%
Taiwan	11%
China	2%
India	3%
Asia	5%

Source: IEA, World LNG Report – 2013, BCG Analysis

LNG contributes 21 percent of the total natural gas consumption in Latin America. Table 3 depicts the share of LNG in the fuel mix of key Latin American countries. The LNG demand in Latin America has almost tripled, with Brazil and Chile

driving the growth. Chile plans to use LNG to replace fuel oil, diesel and Argentinean pipeline imports.

Table 3 | Share of LNG in Latin American energy mix (2012)

Country	Share of LNG in fuel mix
Brazil	1.5%
Chile	7.0%
Argentina	8.0%
Latin America	5.0%

Source: IEA, World LNG Report – 2013, BCG Analysis

Mexico is the biggest user of LNG in North America, but the region as a whole depends marginally on LNG (1 percent share in natural gas consumption). The discovery of shale gas in USA has fundamentally altered the natural gas scenario in the country. Unconventional sources already account for 60 percent of United States' natural gas consumption. Export contracts signed by Cheniere in the Sabine Pass LNG terminal have consolidated United States as a net LNG exporter. Table 4 shows the share of LNG in the fuel mix of key North American countries.

Table 4 | Share of LNG in North American energy mix (2012)

Country	Share of LNG in fuel mix
Mexico	0.3%
Canada	0.6%
United States of America	3.6%
North America	0.3%

Source: IEA, World LNG Report – 2013, BCG Analysis

LNG contributes 19 percent of the total natural gas consumption in Europe and 6 percent of its total energy mix. Significant variation exists in LNG dependence within Europe. Spain uses LNG to meet 60 percent of its gas demand, whereas Italy is only 10 percent dependent. However, continued economic downturn and increase in piped gas from Russia have hampered the growth of LNG in European markets. Table 5 shows the share of LNG in key European countries.

Table 5 | Share of LNG in European energy mix (2012)

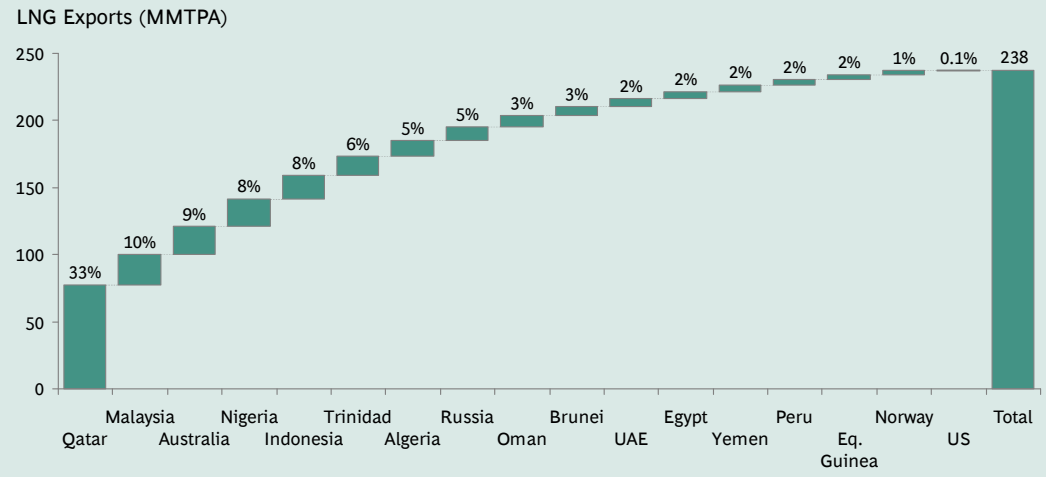
Country	Share of LNG in fuel mix
Spain	12.0%
Portugal	10.0%
UK	7.0%
Turkey	6.0%
Greece	5.0%
France	4.0%
Italy	4.0%
Belgium	3.0%
Netherlands	0.7%
Europe	6.0%

Source: IEA, World LNG Report – 2013, BCG Analysis

3.2 LNG Supply

Global LNG supply is limited to 17 countries with the top five countries (Qatar, Malaysia, Australia, Nigeria and Indonesia) contributing 67 percent of the total supply. Figure 3.2 shows LNG exporters with their market share in 2012.

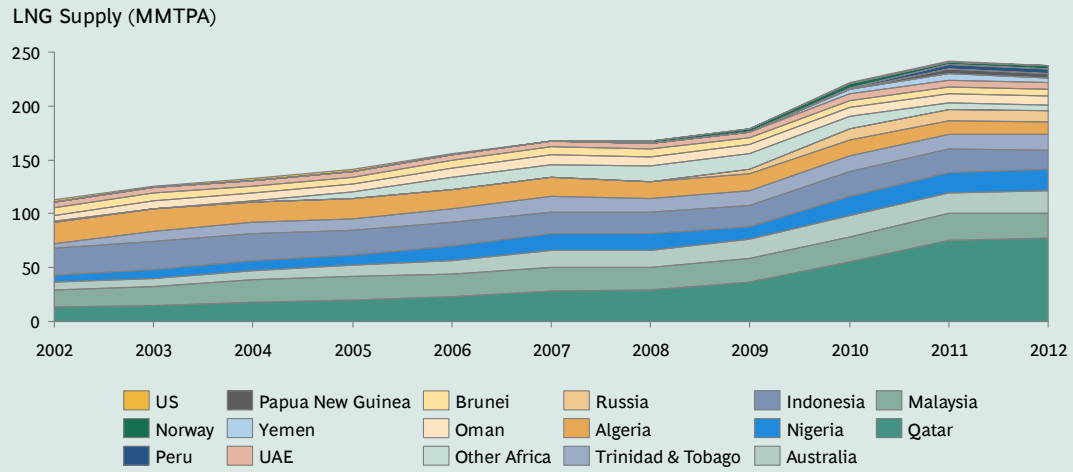
Figure 3.2 | Global LNG supply (2012)



Source: World LNG Report – 2013, Waterborne LNG Reports, US DOE, PFC Energy Global LNG Service

Figure 3.3 shows the trend of LNG exports by country. Qatar has emerged as the pre–eminent global LNG supplier, investing heavily in liquefaction capacities over the past decade and increasing its share of global LNG supply from 11 percent to 33 percent from 2003 to 2013. Traditional suppliers like Malaysia, Indonesia and Algeria have struggled to increase output. In addition, the past decade saw increasing supply diversity as new countries established liquefaction capacities and legacy suppliers have increased capacity by developing new projects.

Figure 3.3 | Evolution of global LNG supply

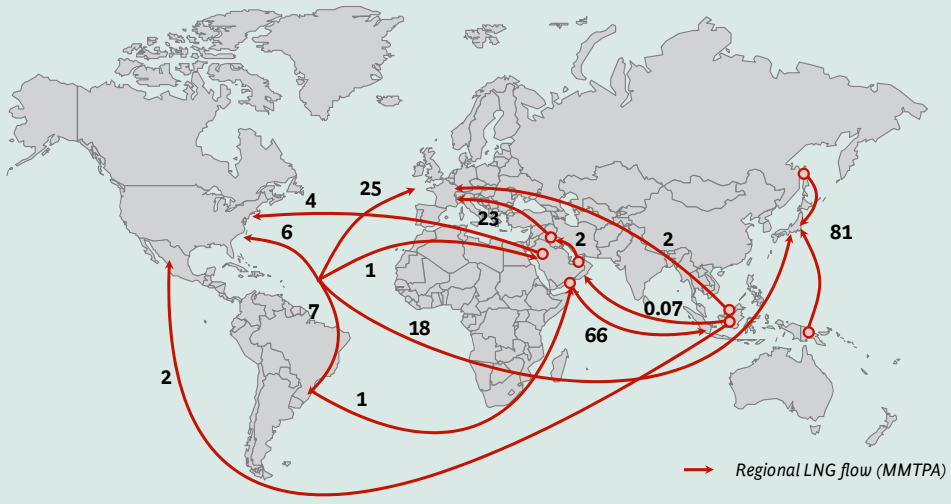


Source: Zeus Virtual Energy Library, Wood Mackenzie, Stream

3.3 Status of the Global LNG Industry

Global trade witnessed its first decline after 30 years as it fell by 1.6 percent from 241.50 MMTPA in 2011 to 237.70 MMTPA in 2012. The contraction in supply was mainly caused by supply side issues in South–East Asia (low feedstock availability) and domestic and political challenges in the Middle East and North Africa region. Figure 3.4 shows key LNG trades between countries in 2012. Europe remains a key export destination for North African countries accounting for ~50 percent of their exports. Qatar has become the predominant supplier for Asian markets, supplying ~30 percent of their total imports. Trinidad is the key supplier for the Americas with 50 percent of the market share.

Figure 3.4 | Key LNG trade routes (2012)



Source: IEA Medium Term Natural Gas Market Report 2013

71 percent of the world's LNG is consumed in the Asia–Pacific region. Trade flow between the Middle East and Asia Pacific saw the maximum increase from 2000 to 2012, growing from 15.30 MMTPA to 54.30 MMTPA. The spread between European and Asian prices has led to Qatari volumes re–directed eastward. A similar price differential has resulted in North American volumes getting diverted towards South America. The emergence of new LNG players in the United States, Canada, and East Africa has the potential to alter the supply position of the market in the coming years.

The spot and short–term LNG market reached 73.50 MMTPA in 2012 amounting to 31 percent of the total volumes. Qatar and Nigeria account for almost half the exports in the spot market while Japan, Korea and India together account for 61 percent of the imports. Spot markets have been boosted by the use of divertible options in flexible contracts that allow companies to engage in arbitrage.

Volatility in gas prices decreased in 2012 as compared to 2011. Strong growth in unconventional gas production depressed prices in Henry Hub, USA which averaged US$ 2.75/MMBTU in 2012. European oil–linked prices remained essentially flat with an average of ~US$ 11.65/MMBTU while prices in Japan were the most volatile, with the second half of the year 2012 witnessing fluctuations in the range of US$ 14.50–17.50/MMBTU. The average import price in Japan, however, remained at US$ 16.00/MMBTU level in 2012.

Only one liquefaction project came online in 2012 taking the global capacity to 281.00 MMTPA. Angola LNG is the next major addition to the market. Global regasification capacity, however, continued to grow in 2012 – to 642.00 MMTPA — due to the increasing demand for gas. The floating regasification market has reached 32.00 MMTPA of import capacity, spread across seven countries. The global LNG fleet consists of 362 vessels of all types with a combined capacity of 40.00 MMTPA.

3.4 Evolution of the Global LNG Market: Outlook (2014–2030)

Demand Outlook

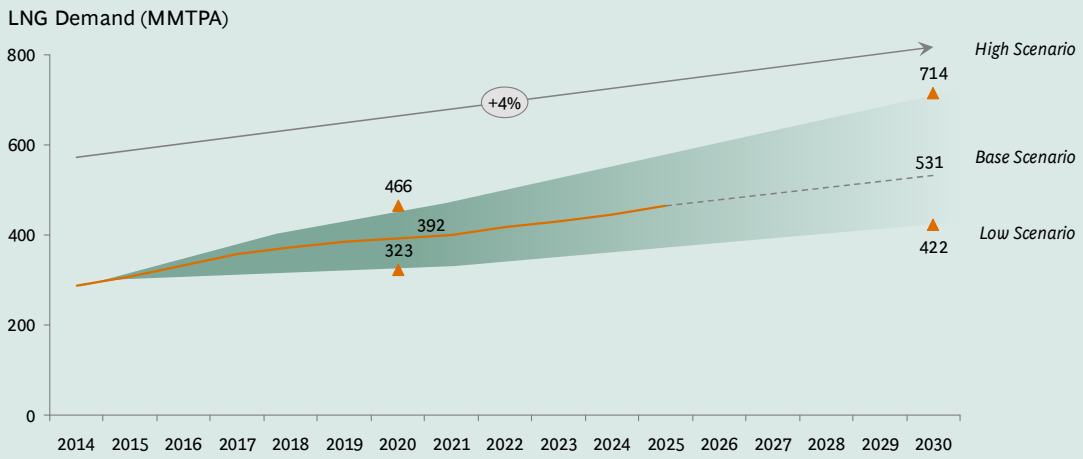
Despite the recent economic slowdown that severely impacted LNG demand during 2009–11, we expect the long term demand in the base case to increase at 4 percent per annum to reach 531.00 MMTPA by 2030. The global demand outlook for LNG primarily depends on the following factors:

- Global economic growth: Higher economic growth leads to higher gas demand and consequently higher demand for LNG.
- Development of domestic production and pipelines: Rapid development in domestic gas production and trans–national pipelines would lead to lowering of LNG demand.

- Development of LNG infrastructure: LNG demand is constrained by the development of liquefaction plants, regasification terminals and price regulations.
- Global energy policy: A shift towards renewable / nuclear energy in the future will lead to lower LNG demand.

Figure 3.5 projects the global demand for LNG under three scenarios with different combinations of the above factors. The base case scenario with expected developments in the above factors i.e. global economic growth of three percent; expected development in pipelines, domestic gas and regasification plants; and reduction in coal dependence of Asia, projects a global LNG demand of 531.00 MMTPA. The optimistic scenario assumes global growth picking up to four percent; limited development of pipeline infrastructure and domestic production in China and India; price deregulation in niche markets; and a continued, aggressive policy against nuclear energy in Japan. This scenario predicts a global LNG demand of 714.00 MMTPA. However, continued global economic downturn, increase in production from unconventional sources, finalising of key pipelines and an energy policy shift towards nuclear energy can limit the LNG demand to 422.00 MMTPA by 2030.

Figure 3.5 | Global LNG demand projections between 2014 and 2030



Source: Cedigaz, WoodMackenzie, BCG Analysis

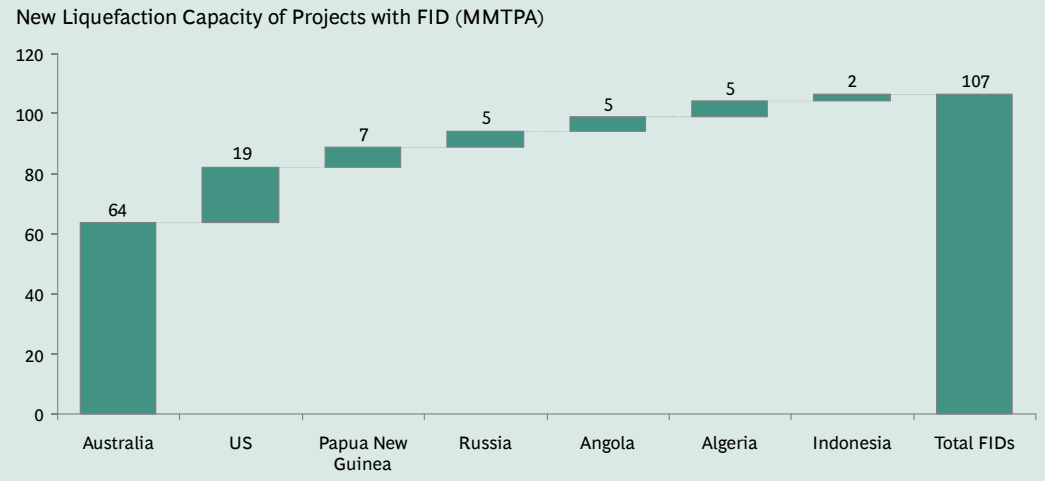
Japan, South Korea and Taiwan are expected to remain the backbone of the gas market. The imports from Japan may decrease if and when it restarts its nuclear programme. New demand centres of China, India, the Middle East and South America are expected to drive growth. China's latest five year plan to gasify its economy calls for a rise in the gas share in its energy mix from four percent in 2010 to eight percent by 2015 with a longer term goal of 10 percent by 2020. By 2020, China is expected to import 37.00–59.00 MMTPA of natural gas with LNG demand potential of 15.00–37.00 MMTPA. Similarly, for India the share of natural gas is expected to rise from 11 percent in 2010 to 20 percent in 2025. The demand for

LNG in India is expected to be ~75.00 MMTPA by 2020. The discovery of shale gas has reduced imports from the United States. Shale gas already contributes to 24 percent of the United States' natural gas supply, and LNG imports have decreased by 17.5 percent from 2007. The trend is likely to continue, with United States becoming an exporter of natural gas. European markets continue to be depressed due to the economic slowdown. As Russia expands eastward, Europe may get increasingly dependent on gas pipelines rather than on LNG.

Supply Outlook

The global LNG supply is expected to reach 415.00 MMTPA by 2020. 107.00 MMTPA of additional capacity is in the FID stage competing to come online by 2020. Figure 3.6 shows the major liquefaction projects with FID taken between 2009 and 2013 that may come online by 2020. Australia is expected to have the major share of added capacity with a total of 64.00 MMTPA projects in FID.

Figure 3.6 | Upcoming LNG projects



Source: Company Data, Broker Reports, Press Search, GIIGNL, BCG Analysis

Further supply diversification is expected from projects starting in East Africa, Europe and North America. Overall 30.00 MMTPA of capacity is in a FEED completed stage while 49.00 MMTPA capacity is in FEED stage taking total global project pipeline to 185.00 MMTPA. Key projects expected to start before 2020 are:

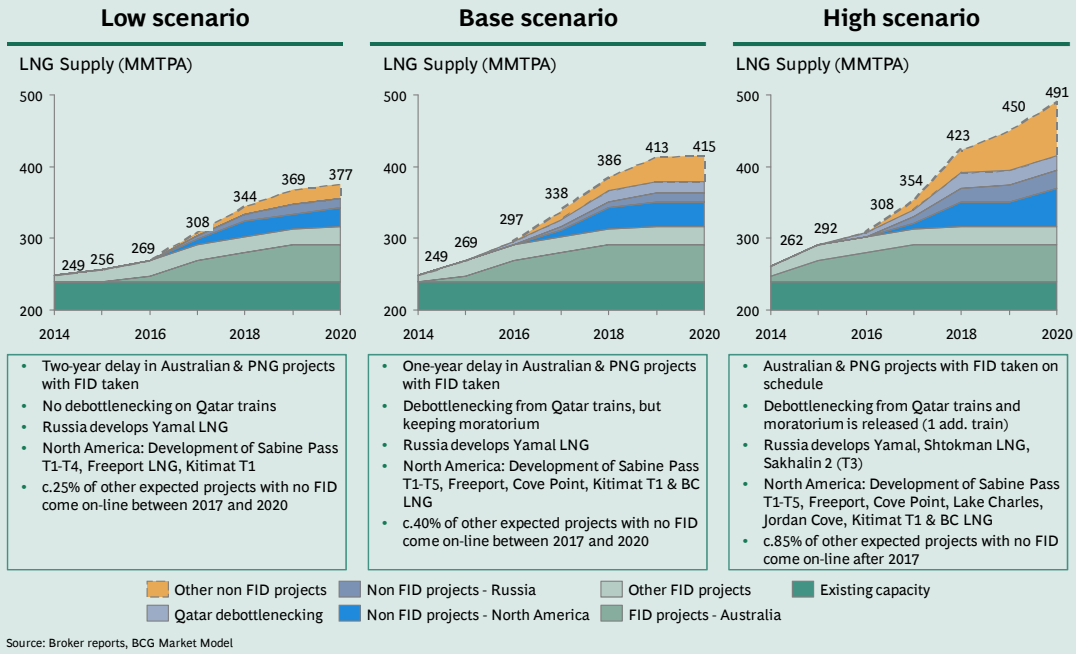
- **North America:** Sabine Pass T5–6, Freeport LNG, Cove Point LNG, Lake Charles, Jordan Cove, Kitimat LNG, BC LNG.
- **Australia & Asia–Pacific**: Pluto T2–3, Arrow Energy, Fisherman's Landing, PNG LNG T3, Liquid Niugini.
- **East Africa**: Mozambique LNG T1–2, Tanzania LNG.
- **West Africa**: EG LNG T2, Cameroon LNG.
- **Russia**: Yamal, Shtokman LNG, Sakhalin 2.
- **Europe**: Cyprus LNG.

The global supply outlook for the next decade depends primarily on the following factors:

- **United States & Canada Exports:** Development of export potential of United States' shale gas reserves. Expected impact of ~26.00 MMTPA.
- **Australia Exports:** Delay in under–construction projects in Australia and realisation of non FID pipeline projects. Expected impact of 22.00 MMTPA.
- **Qatar Debottlenecking:** Additional capacity released due to debottlenecking of Qatar trains. Expected impact of 22.00 MMTPA.
- **Other New Supply Countries:** Development in export capacity of Russia, Iran and East Africa. Expected impact of 11.00 MMTPA considering only Russian exports come online before 2020.
- **Viability of Existing Assets:** Continued viability of Egypt and Brunei. Expected impact of 11.00 MMTPA.

Figure 3.7 shows the global LNG supply situation under different scenarios of the above factors. Projections after 2020 are speculative and not included in the analysis.

Figure 3.7 | Global LNG supply 2014–2020

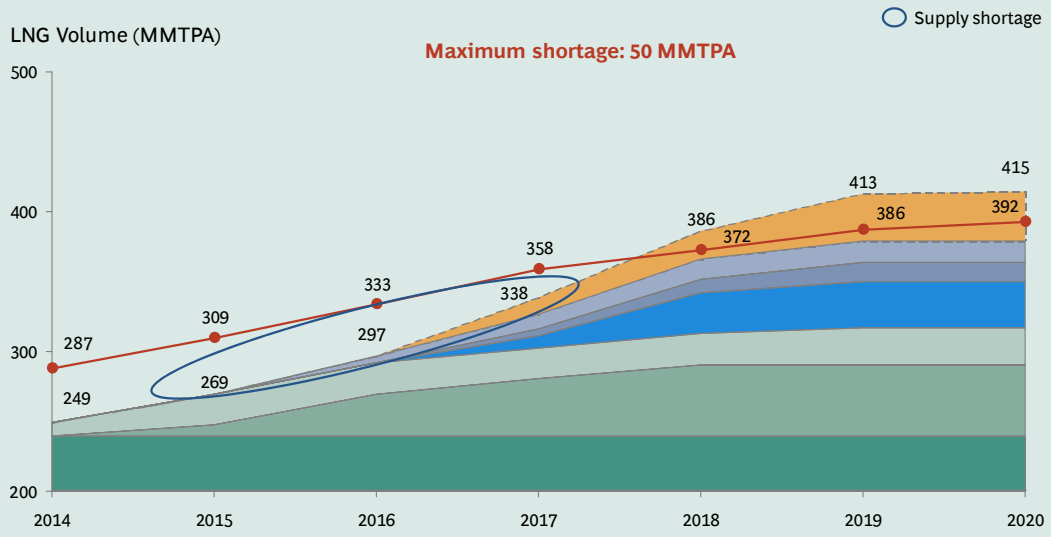


Source: Broker reports, BCG Market Model

Price Outlook

As shown in figure 3.8, market tightness till 2017 is expected to sustain LNG prices over the short term. However, as the supply situation improves, prices are expected to go down.

Figure 3.8 | LNG supply–demand balance (2014–2020)



Source: Company Data, Broker Reports, Press Search, BCG Analysis

Another trend visible in LNG pricing is the increasing decoupling of oil–gas indexation. It can be attributed to the following factors:

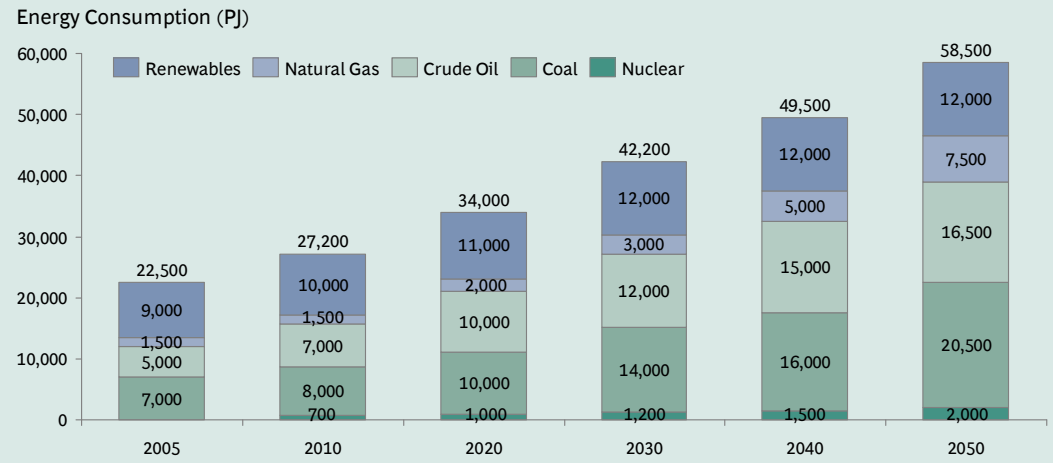
- Demand uncertainty has made buyers averse towards committing to long term 'take or pay' contracts. Increased competitiveness due to new suppliers joining the market has further made it a buyers' market.
- The increase in crude oil prices post 2008 has weakened the link between oil and gas prices and has led to arbitrage opportunities between the oil linked Asian market and the gas linked North American market.
- Natural gas has developed into a significant energy source and subjecting it to traditional price indexation as an oil substitute is getting outdated. Gas hubs like Henry Hub in the United States, and NPB in the United Kingdom provide a much better indicator of the gas market and provide for gas–on–gas competition rather than traditional gas–oil competition for indexation.

Moving forward, the prices are expected to decouple from the oil based indices and shift towards more accurate gas market indicators like gas hubs.

INDIAN LNG SCENARIO

At present, India is the world's fourth largest consumer of energy, consuming ~660.00 MTOE per year, driven primarily by an increase in energy consumption in tandem with the rapid economic growth of the last few decades. On a per capita basis however, India's average consumption is 0.80 MTOE, substantially lower than the global average of 1.80 and far below the consumption norms in developed economies. In the economic development lifecycle, India is currently at the 'take off' stage and will need to sustain rapid rates of growth for the coming few decades to improve the living standards of its citizens. Thus, there is substantial room for further growth in energy consumption as shown in figure 4.1. India's energy demand is expected to increase to 1,120.00 MTOE by 2031–32.

Figure 4.1 | India energy mix



Source: Energy Statistics – 2013 Ministry of Statistics and Planning

As a consequence of this exponential demand, India's drive to achieve energy security will face substantial challenges. In an admission of the scale of this challenge, the 12th five–year plan has identified diversification of the country's fuel mix as one of the most critical milestones towards energy security. India has historically been a coal and oil dominated economy, with both sectors accounting for ~80 percent of primary energy consumption. Despite having the fifth largest supply of coal, India's coal supply is beset with problems. India's cheapest coal reserves lie in the exact same places as the country's remaining forests that are inhabited by a large number of tribal people. Inadequate transport infrastructure compounds the problem. In terms of oil, India is dependent on imports for up to

75 percent of consumption; given the paucity of domestic reserves this situation is likely to worsen, with 80 percent of oil coming from imports by 2016–17. With oil prices now stubbornly greater than US$ 100.00/barrel and concerns around available reserves, India's economic growth needs to be delinked from oil.

Natural gas is the economy's great white hope. As a fuel, gas is underrepresented in India's energy mix, accounting for a mere ~12 percent of primary energy consumption, well below the world average of 23 percent. The Planning Commission has an ambitious target of increasing the share of natural gas to 20 percent from the current levels by 2025.

The bulk of this shift towards a gas economy will come from four consuming sectors: power, fertilizers, industrial (petrochemicals, refining, steel etc) and City Gas Distribution (CGD). It is estimated that by 2029–30, these four sectors will account for 746 MMSCMD of gas demand. The capacity of domestic gas production to serve this demand is limited and there is substantial uncertainty around trans–national pipelines. By implication, LNG will play a critical part in establishing the foundation of India's aspirational gas economy, and by extension, its energy security endeavour. In this section, we will investigate the gas demand and supply in detail and identify the LNG opportunity.

4.1. India LNG Market: Current Scenario

Demand

The total natural gas consumption in India in 2012–13 was 127.80 MMSCMD. RLNG contributed 41.60 MMSCMD (~32 percent) of the total gas supply. Table 6 shows the sector wise natural gas consumption in India for 2012–13. The total natural gas consumption in India has been 100 MMSCMD (April–November 2013).

Table 6 | India LNG consumption (2012-13)

Sector	Domestic Gas (MMSCMD)	RLNG (MMSCMD)	Total consumption
Fertilizers	30.4	5.8	36.2
Power	31.0	8.4	39.4
CGD/ CNG	6.7	7.3	14.0
Refineries	2.0	8.6	10.7
Shrinkage for liquid extraction – LPG etc.	6.0	0.4	6.4
Petrochemicals	3.5	1.4	4.9
Sponge iron/ Steel	1.1	3.5	4.6
Court mandated customers	1.0	2.9	3.9
Small consumers (< 50,000 SCMD)	2.4	0.0	2.4
Other users	0.8	3.3	4.0
Internal consumption in pipelines	1.5	0.0	1.5
Total	**86.4**	**41.6**	**127.8**

Source: "Vision 2030" Natural Gas Infrastructure in India

Refineries are the largest consumers of LNG in India (20.8 percent). Natural gas is used in refineries as a cheaper substitute for naphtha used in the production of hydrogen. The fertilizer sector accounts for 20.1 percent of LNG consumption; where it is used as a cheaper and more efficient alternative for naphtha. City gas distribution is the third largest consumer of LNG with a 17.6 percent share. LNG is increasingly being used as a substitute for domestic LPG and as a cheaper fuel for transport in cities. The power sector accounts for 14 percent of LNG consumption, primarily for peak–load generation. Due to government allocation policies, the power and fertilizer sectors get the major share of their demand from domestic supply. However, LNG is the primary source of fuel for CGD, refineries and sponge iron.

Supply

As of December 2013, LNG re–gasification capacity in the country is 21.10 MMTPA (10.00 MMTPA at Dahej, 3.60 MMTPA at Hazira, 5.00 MMTPA at Dabhol and 2.50 MMTPA at Kochi). 7.50 MMTPA of LNG is sourced through a long term contract with RasGas, Qatar and 1.44 MMTPA is imported from Exxon Mobil's Gorgon Venture in Australia. The remaining demand of ~5.70 MMTPA is sourced from spot markets.

Table 7 shows the key exporters of LNG to India. Qatar is the largest exporter of LNG to India contributing 80 percent (10.89 MMTPA) of the total supply.

Table 7 | India LNG import profile (2012-13)

Country	Imports (MMTPA)	% share
Algeria	0.4	3%
Egypt	0.6	4%
Nigeria	1.4	10%
Qatar	10.9	80%
Yemen	0.4	3%
Total	**13.7**	**100%**

Source: World LNG Report – 2013

4.2. India LNG Market: Future Outlook

4.2.1. Demand Outlook

The LNG demand outlook depends on two major factors: growth in the demand for natural gas and relative preference for LNG over domestic gas (gas–on–gas

competition). This section attempts to project the LNG demand on the basis of natural gas demand projections and the evolution of gas–on–gas competition.

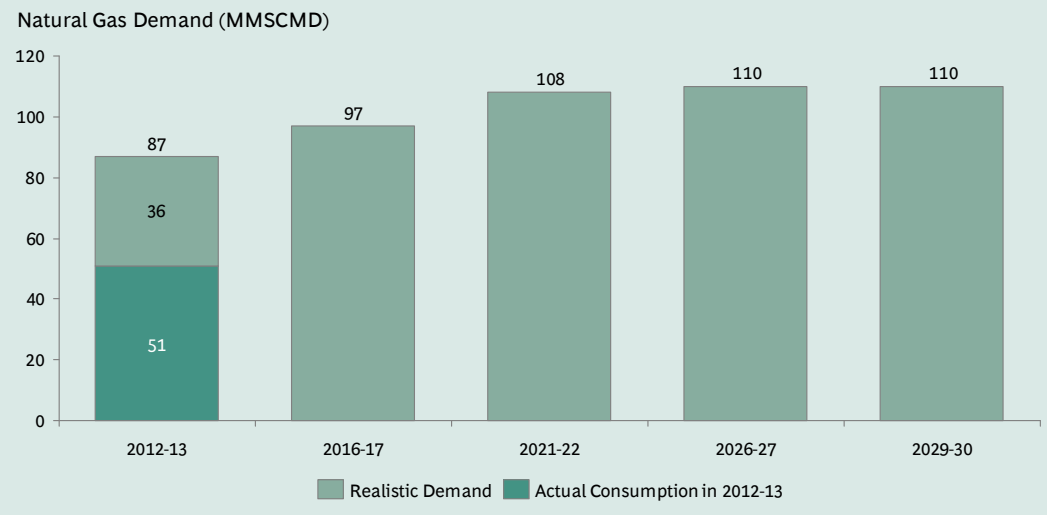
4.2.1.1. Natural Gas Demand Outlook

Gas demand in India is primarily driven by the fertilizer and power sectors, city gas distribution, and industrial sector. This section assesses the potential for LNG demand in these important sectors:

Natural Gas Demand: Fertilizer Sector

Urea is the most widely used fertilizer in India as the soil needs replenishment of nitrogen. Urea prices are regulated with the government subsidising the difference between the cost of production and the regulated price in the form of fertilizer bonds. Gas based plants are more efficient and have lower capital investment costs compared to naphtha and fuel–oil based urea plants. Hence, in an effort to limit the subsidy outflow, the government has mandated that all urea plants are to convert to natural gas, making fertilizer segment a captive gas customer. Additionally, greater emphasis on food security and increasing import prices of urea has made the government adopt a policy to obtain self–sufficiency in the production of urea. Figure 4.2 shows the projected increase in natural gas demand in the fertilizer sector until 2030.

Figure 4.2 | Realistic gas demand from fertilizer sector



Source: "Vision 2030" Natural Gas Infrastructure in India

Natural Gas Demand: Power Sector

Gas faces significant competition from coal in power generation. As shown in Table 8, the cost of power generation from domestic coal is significantly cheaper than that from natural gas. Also, as coal mines are completely state–owned, fuel linkages for domestic coal are easily provided to both public and private

generation companies through government policy. Gas, increasingly produced by the private sector, lacks such linkages and has to depend on government allocation. Given the current coal prices, it is difficult for gas to compete with coal for base load generation.

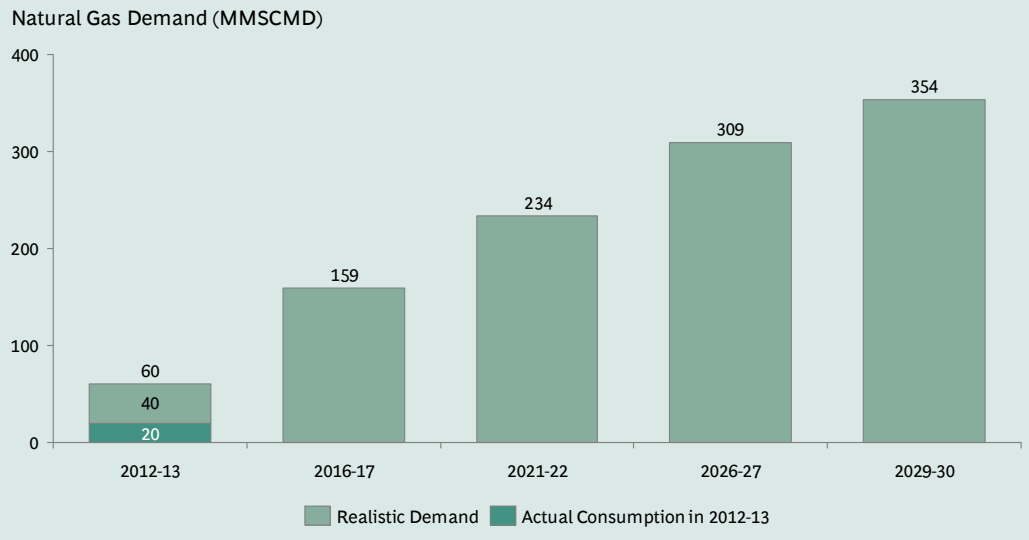
The continued power deficit in India, however, allows gas to bridge the gap in peak load generation. The increase in merchant and captive power plants also represents an opportunity for gas demand. Electricity exchanges allow captive / merchant power plants to trade power with consumers with lower price sensitivity. Going forward, power sector reforms, constraints in domestic coal development and rising costs of imported coal are expected to increase the demand for natural gas. Figure 4.3 shows the demand projection for natural gas in the power sector.

Table 8 | Cost of generating power from different fuels

Fuel	Power generation cost (Rs. / kWh)
LNG	4.1 – 4.5
NELP Gas	3.1 – 3.4
Domestic Coal	2.2 – 2.7
Imported Coal	3.2 – 3.8

Source: Central Electricity Regulatory Commission, BCG Analysis

Figure 4.3 | Realistic gas demand from power sector



Source: "Vision 2030" Natural Gas Infrastructure in India

Natural Gas Demand: City Gas Distribution

City gas distribution comprises two consuming sectors: transport and household.

In the transport sector, natural gas is used as a substitute for petrol and diesel. India imports over 75 percent of its oil requirement. In order to reduce the import bill, the government has encouraged public transport move to CNG. As shown in Table 9, CNG fuelled vehicles are much less expensive than petrol and diesel fuelled vehicles. As a result, with increasing reach of natural gas private vehicles are also converting to CNG. The gradual deregulation of diesel prices is expected to further accelerate natural gas demand in the transportation sector.

Table 9 | Fuel cost comparison in the transport sector

	CNG	Petrol	Diesel
Price Rs./litre or Kg in Rs.	45.6	71.5	53.8
Average Km/litre or Kg			
Car	18.0	16.0	–
Auto–rickshaw	25.0	35.0	–
Bus	3.5	–	3.5
Fuel Cost – Rs./Km			
Car	2.5	4.5	–
Auto–rickshaw	1.8	2.0	–
Bus	13.0	–	15.4

Note: Based on retail prices in Delhi
Source: The Oxford Institute for Energy Studies, BCG Analysis

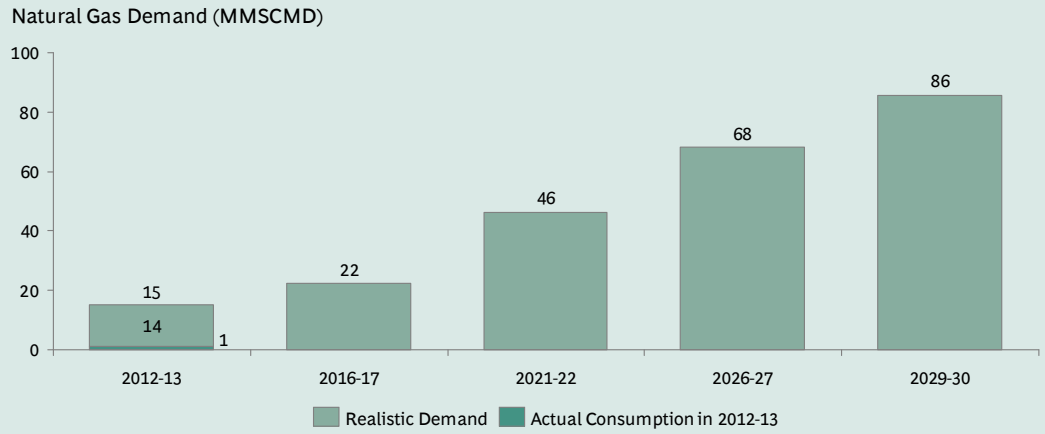
In the household sector, PNG can be used as a substitute for LPG. Substituting PNG for LPG in the household sector leads to additional cost of roughly Rs. 2.00 per kg in equivalent terms. However, there is significant opportunity cost of not shifting to PNG related to environmental externalities in terms of:

- Costs of Delivery: LPG is largely transported through gas cylinders in India. PNG infrastructure requires an initial investment in terms of gas pipelines but does not have the recurring cost of transportation.
- Government Subsidy: Household LPG is heavily subsidised in India. Conversion from LPG to PNG will substantially reduce the subsidy bill.

Recent order by Gujarat High court has directed the government of India to allot natural gas for domestic and vehicular usage at the same rate to the city of Ahmedabad at which it is supplied to Delhi and Mumbai. This is expected to increase the demand in hitherto untapped customers in Mumbai and Delhi.

Figure 4.4 shows the projected natural gas demand for this sector up to 2030.

Figure 4.4 | Realistic gas demand from CGD sector

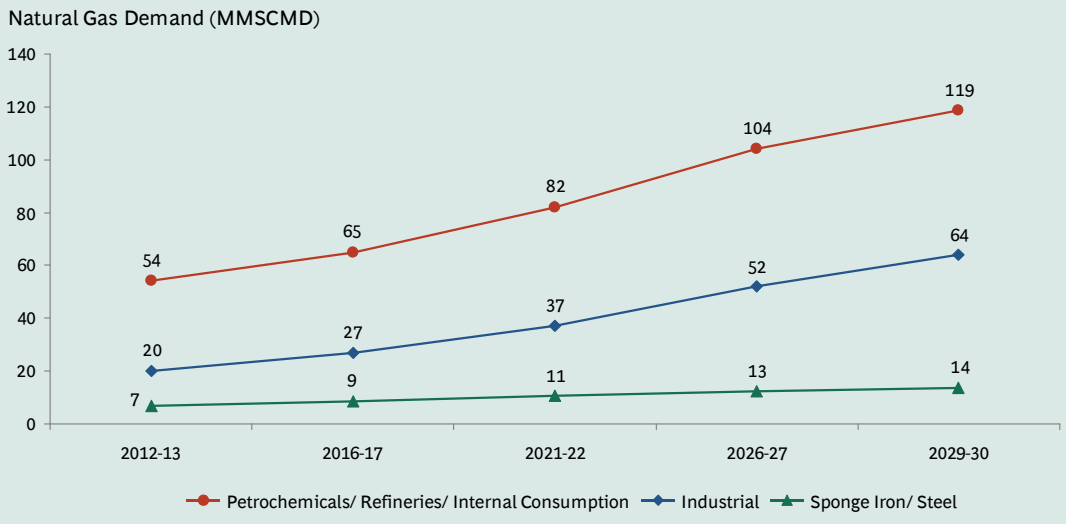


Source: "Vision 2030" Natural Gas Infrastructure in India

Other Consuming Sectors

The industrial sector is crucial to LNG demand due to its high affordability. Natural gas demand by the petrochemical sector is expected to grow at a CAGR of 5 percent till 2029–30. Natural gas is a cheaper alternative to naphtha used in hydrogen production in oil refineries. Besides, natural gas is cleaner and is expected to allow expansion in refineries, which is currently held up due to environmental norms. Figure 4.5 shows the natural gas demand projection in refineries and other consuming sectors.

Figure 4.5 | Realistic gas demand from other consuming sectors

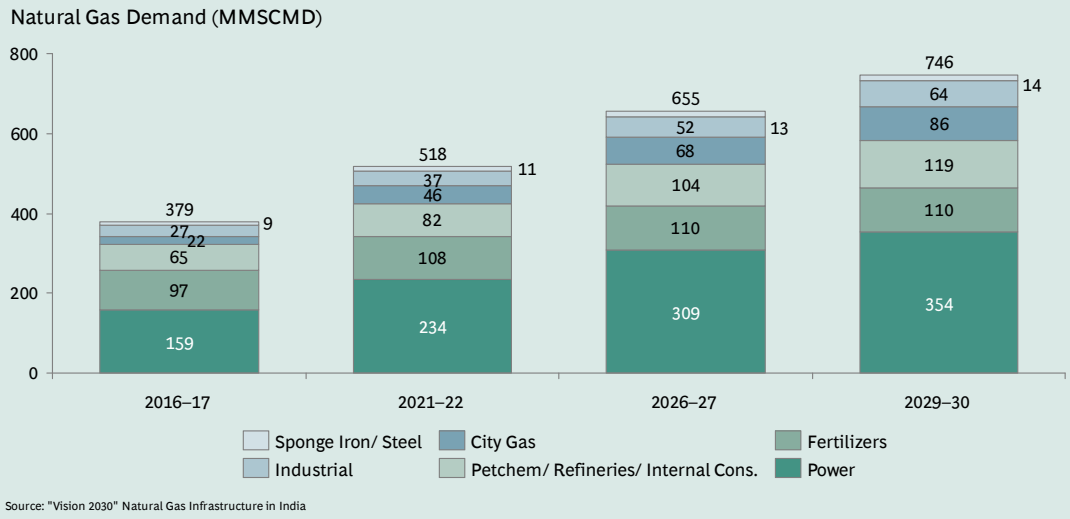


Note: Data for 2012-13 represents realistic demand. Actual consumption is 5.12 MMSCMD for Petrochemicals, 5.12 MMSCMD for steel and 10.24 MMSCMD for industrial
Source: "Vision 2030" Natural Gas Infrastructure in India

Natural Gas: Consolidated Demand

Natural gas in India is expected to register a healthy growth in the years to come. Figure 4.6 shows the consolidated demand growth trajectory till 2029–30. The contribution of the power sector is expected to increase from 36 percent to 47 percent over the projection period. The share of the fertilizer sector is expected to drop from 25 percent to 15 percent of the total demand (due to higher growth in other sectors). CGD is expected to register the fastest growth in the use of natural gas and contribute 11 percent to the total demand by 2030.

Figure 4.6 | Consolidated natural gas demand



Source: "Vision 2030" Natural Gas Infrastructure in India

4.2.1.2. Gas–on–Gas competition

While the overall LNG opportunity in India is expected to be robust, gas suppliers, marketers and consumers will need to understand the dynamics of the domestic gas vs. LNG competition that plays out across different end usage segments. For LNG suppliers in particular, the inherent economics of certain segments will make LNG usage unviable and reduce the addressable demand. The key determinants of this anticipated gas–on–gas competition are:

Price: India follows a differential pricing mechanism for natural gas:

- **Administered Pricing Mechanism (APM)**: Applied for domestic gas production by national oil companies and joint ventures under the discovered field exploration policy set by the government.
- **RLNG Pricing:** Prices are determined on the basis of long term and short term contracts and spot purchases.
- **NELP Gas:** Private players are allowed price discovery but the final value has to be approved by the government.

Table 10 shows the prevailing gas prices in India for different gas sources. LNG has had a price disadvantage as compared to the other regimes that are controlled by the government. Moreover, India's dependence on expensive spot LNG for bulk of the demand has deteriorated LNG prospects. However, the latest policy decision by government to increase APM prices to US$ 8.4/MMBTU is expected to make LNG more competitive with domestic gas in India.

Table 10 | Prevailing gas prices in India (2013)

	Source	Regime	Price ($ / MMBTU)
1	**APM Gas**	APM	4.20
2	**Panna–Mukta–Tapti fields**	Discovered Fields	4.60 – 5.65
3	**Ravva field**	Discovered Fields	3.50 – 4.30
4	**Lakshmi and Gauri fields**	Discovered Fields	4.60 – 4.75
5	**Hazira field**	NELP	4.65
6	**D–6**	NELP	4.20
7	**LNG (Spot Prices)**	Imported Gas	9.00 – 20.60
8	**LNG (Long Term Contract Prices)**	Imported Gas	6.24 – 13.28

Source: The Oxford Institute for Energy Studies

Allocation Policies: Gas markets are not fully liberalised in India with the government allocating gas to different consuming sectors. The order of priority has been fixed as fertilizers, power, CGD and petrochemicals. A major portion of APM gas is allocated to the power and fertilizers sectors. For these sectors, the price of gas is kept at a 'pass–through' cost. LNG has struggled to compete with APM gas in these sectors due to its higher cost. On the other hand, the industrial sector and CGD have a higher demand for LNG due to lower allocation of APM gas and higher affordability.

Switching Viability: Gas demand in different sectors is dependent on the switching viability of the traditional primary fuel of the sector. Gas has struggled to compete with coal in the power sector and in sponge iron / steel production due to higher costs. The fertilizer sector is a captive gas customer owing to a government mandate to convert all urea plants to gas. Refineries also have a preference for natural gas to lower costs and reduce environmental impact. Gas plants are cheaper and more efficient than traditional naphtha based plants. In the CGD sector, LNG provides a cheaper and more efficient solution to LPG, petrol and diesel.

The above factors have resulted in different price sensitivity for gas consumption for different sectors. Currently, there is limited gas–on–gas competition as LNG prices, being oil linked are higher than domestic APM gas, thereby limiting its feasibility to a few sectors that are less price sensitive or are currently not served by domestic gas.

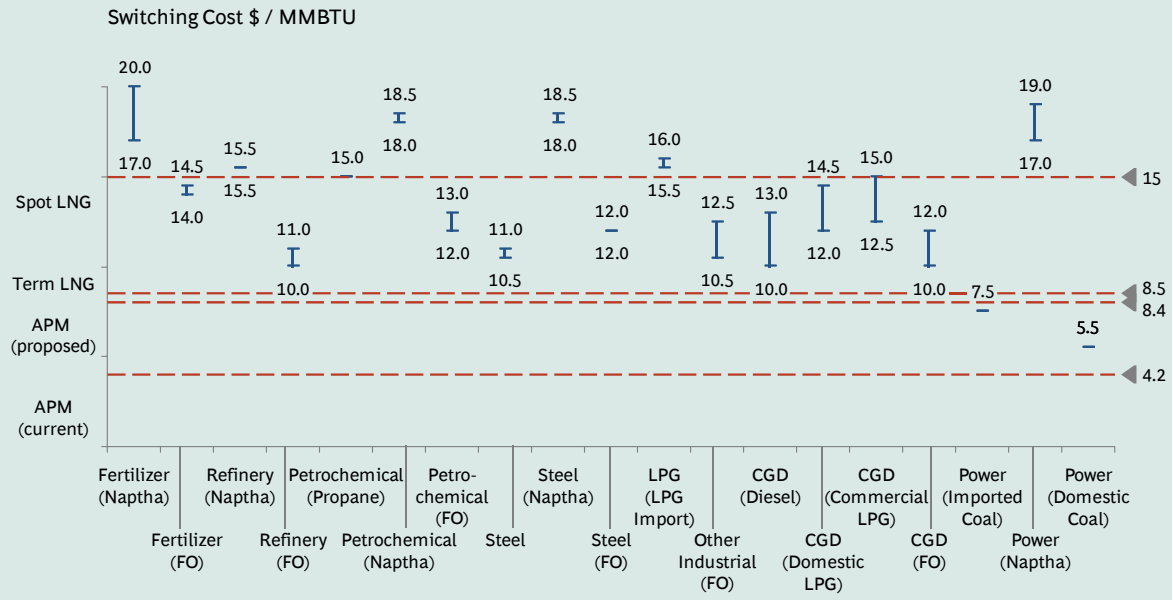
At a price greater than US$ 15.00/MMBTU, the gas market is limited to plants in fertilizer, power, steel and refineries which are switching from naphtha. In this segment, gas is the cheaper and more efficient alternative.

At a price of US$ 12.00–15.00/MMBTU, gas is primarily used as a substitute for fuel oil. It replaces fuel oil in fertilizers, petrochemicals, and steel. At these prices gas is also affordable as a replacement for LPG in the CGD sector.

At a price range of US$ 10.00–12.00/MMBTU, gas is mainly affordable for refineries replacing fuel oil, and in the CGD sector replacing diesel.

LNG is currently not competitive in the price band below US$ 8.00/MMBTU. This sector primarily constitutes steel plants running on coal, and power and fertilizer plants with allocated APM gas. The switching cost of the above mentioned sectors varies from US$ 6.00–8.00/MMBTU, a price which may not be matched by either term or spot LNG. LNG can become the second priority fuel for these sectors in case sufficient domestic gas is not available to service demand. However, this competitive dynamic can be substantially transformed if the recommendations of the Rangarajan Committee are adopted which will raise the price of administered pricing mechanism gas to US$ 8.40/MMBTU. At these price levels, term LNG can become competitive with domestic gas even in fertilizers and power production. In such a scenario, customers will have real freedom of choice; oil and gas companies that can conclude term contracts at US$ 8.00–10.00/MMBTU can corner a much larger share of the market. Figure 4.7 shows the switching costs for different sectors.

Figure 4.7 | Switching cost for gas in different sectors



Note: Alternate fuel mentioned in brackets.
Source: Company data, MoPNG, Infraline, Annual Reports, BCG Analysis

4.2.2. Supply Outlook

4.2.2.1. Domestic Gas and Pipeline Supply

India's natural gas reserves are limited. As of April 2012, India has 1330.26 billion cubic metres of confirmed natural gas reserves. Development of unconventional sources of gas has been scarce in India due to lack of data, low intensity of exploration, pricing regulatory policy, and lack of domestic infrastructure and expertise. Hence, domestic production of natural gas is unlikely to keep pace with the increasing demand. Based on current projections, domestic production is expected to reach 230.00 MMSCMD by 2029–30 against a projected demand of 746.00 MMSCMD. Moreover, domestic production has been concentrated in the western and southern regions of the country. In the absence of substantial pipeline infrastructure, the eastern and northern regions are perennially gas–starved.

The Turkmenistan–Afghanistan–Pakistan–India (TAPI) pipeline is expected to get completed by 2017. However, given the geo–political situation and the financial uncertainty surrounding the pipeline, the actual start may get delayed. When fully operational, the expected supply from TAPI pipeline is 30.00 MMSCMD.

Table 11 shows the consolidated gas supply projections from domestic gas and transnational pipelines and the expected demand supply gap.

Table 11 | Consolidated natural gas supply projection

Source	2016–17	2021–22	2026–27	2029–30
Domestic Sources	156.7	181.6	210.6	230.1
Gas Imports (Cross border Pipelines)	0.0	30.0	30.0	30.0
Total Supply (MMSCMD)	**156.7**	**211.6**	**240.6**	**260.1**
Total Demand (MMSCMD)	**378.7**	**517.7**	**655.4**	**746**
Gap (MMSCMD)	**222**	**306.1**	**414.8**	**485.9**
Gap (MMTPA) (LNG Opportunity)	**59.9**	**82.6**	**112.0**	**131.2**

Source: "Vision 2030" Natural Gas Infrastructure in India

4.2.2.2. The LNG opportunity

As seen previously, the country's natural gas demand is expected to outpace its domestic and pipeline supply. By 2029–30, the gap is expected to reach 130 MMTPA. LNG imports represent the only viable option to bridge this gap.

However, realisation of this potential depends on two factors: LNG long–term contracts and regasification capacity.

Long Term Contracts

Currently, India imports ~9.00 MMTPA of its LNG demand through long term contracts. Recent, acceleration in signing long term contracts has led to a total capacity of 29.00 MMTPA. Table 12 shows the current long term contracts for LNG imports. However, there is still a shortfall of ~100.00 MMTPA that needs to be filled to tap the LNG opportunity. Spot markets are much more expensive than term LNG and given the pricing regime, LNG sourced from spot markets is rendered uncompetitive in several sectors. Post 2017, global markets are expected to be in a situation of oversupply. India must take advantage of this situation to secure more long term contracts.

Regasification Capacity

LNG supply is constrained by installed re–gasification capacity. India is in the process of ramping up its re–gasification capacity across all terminals. The capacity of Dahej is expected to reach 15.00 MMTPA by 2015–16 while Hazira capacity is expected to reach 10.00 MMTPA. The capacity of Kochi terminal is being augmented to 5.00 MMTPA while regasification terminals are being constructed at Mundra (5.00 MMTPA), Ennore (5.00 MMTPA), Kakinada and Gangavaram. ONGC with its consortium partners BPCL and Japanese conglomerate Mitsui is carrying out a feasibility study for a terminal of 2.00–3.00 MMTPA capacity, expandable to 5.00 MMTPA at New Mangalore.

Table 12 | India LNG long term contracts

Importer	Exporter	Volume (MMTPA)	Term (Year)	Export Start Year	Contract Signing Year
Gujarat State Petroleum Corp.	BG Group	2.5	20	2015	2013
Gujarat State Petroleum Corp.	Gazprom	2.5	20	2016	2011
Petronet LNG	Ras Laffan Liquefied Natural Gas Co. Ltd	5.0	25	2004	N/A
Petronet LNG	Ras Laffan Liquefied Natural Gas Co. Ltd	2.5	25	2009	N/A
Petronet LNG	Exxon Mobil Corporation	1.5	20	2015	2009
Petronet LNG	Gazprom	2.5	25	N/A	2011
Petronet LNG	United LNG LP's	4.0	20	2017	2013
Gail India	Ras Laffan Liquefied Natural Gas Co. Ltd				
Gail India	Sabine Pass Liquefaction Company	3.5		2017/18	N/A
Gail India	Gazprom	2.5	20	2018/19	N/A
Gail India	US Dominion Cove Point	2.3		2018/20	N/A
Total		**28.8**			

Source: Press search.

Table 13 details the expected capacity addition in regasification plants. Considering 70 percent capacity utilisation, a further 70.00 MMTPA of regasification capacity, equivalent to ten new terminals will be required to completely tap the LNG opportunity.

Table 13 | Development of regasification terminals

	12th plan		13th plan		
MMTPA	**2012–13**	**2016–17**	**2021–22**	**2026–27**	**2029–30**
Dahej	10	15	15	15	15
HLPL Hazira	3.6	10	10	10	10
Dabhol	5	5	5	5	5
Kochi	2.5	5	10	10	10
Ennore	0	5	5	5	5
Mundra	0	5	10	10	10
Kakinada (FSRU)	0	5	5	5	5
Gangavaram	0	3	3	3	3
East Coast terminals (1)	0	2.5	5	10	10
West Coast terminal (1)	0	0	5	10	10
Total capacity (MMTPA)	**21.1**	**55.5**	**73.0**	**83.0**	**83.0**
Total capacity (MMTPA) (70% utilization)	**14.8**	**38.8**	**51.1**	**58.1**	**58.1**

Source: "Vision 2030" Natural Gas Infrastructure in India

INDIAN LNG SECTOR: THE WAY FORWARD

The preceding analysis clearly demonstrates that LNG will have a significant role to play in India's energy future and will provide a lucrative business opportunity for LNG suppliers, international and domestic gas marketers and other stakeholders in the LNG value chain. However, while the demand for LNG exists, more work remains to be done to create a smooth and well functioning market for LNG. The key elements for realising the full LNG potential of the Indian market are:

- Sourcing
- Contracting
- Physical Infrastructure
- Downstream Ecosystem
- Regulations

5.1 Sourcing

In keeping with the theme of energy security, tying up LNG supplies will be the critical first step in ensuring LNG availability in the country. India's gas shortfall is due to a structural deficiency between domestic production and demand and not a result of frictional mismatches caused by unsynchronised production dips or demand spikes. This means that there will be a steady and large requirement of LNG that is best served through firm long term contracts that remove supply–uncertainty for downstream users and reduce risks in capacity investments. Currently, though, only 58 percent of India's LNG is supplied under long term contracts, while the country has been consistently importing 5.00–6.00 MMTPA under spot purchases. This reflects an inability to lock in supplies sufficiently early leaving end users victim to the vagaries of availability and price movements.

Additionally, India's current supply base has significant scope for diversification. Our current long term contracts are with Qatar, Australia, Russia and the United States. India is absent from the export portfolio of major suppliers like Algeria, Indonesia, and Malaysia which together account for 22 percent of the global supply. Some of this can be explained on account of being a late mover in the LNG space; however, Indian companies need to systematically identify uncommitted

capacities either in existing projects in these countries or in planned expansions, and move to broaden the supply base. Additionally, Indian companies will need to keep a close watch on developments in frontier LNG supply regions like East Africa, and ensure they are not left behind in the next round of the great LNG 'gold rush'.

5.2 Contracting

It is imperative for LNG suppliers and marketers to understand the commercial viability of LNG in different end user segments to ensure that they avoid the pitfalls associated with 'irrational exuberance'. LNG for the sake of LNG will not be a winning strategy in India; there has to be a clearly defined value proposition for LNG in terms of economic feasibility for end use sectors. There are definite sectors where LNG is unlikely to be viable (e.g. base load power generation). Similarly, the affordability of LNG varies greatly across segments; some will absorb gas even upwards of US$ 15.00/MMBTU. Thus, suppliers and gas marketers will carefully need to construct and constantly optimise their LNG contract portfolios to cater to the price points that can be absorbed in the market. Marketing companies will need to become not just suppliers but also traders of gas contracts to ensure that they can respond quickly and effectively to price signals in the market

5.3 Physical Infrastructure

Establishing sufficient regasification capacity will be a pre–requisite for satisfying the projected LNG opportunity of 130.00 MMTPA by 2030. At present, India has four regasification terminals at Dahej, Hazira, Dhabhol and Kochi with a combined capacity of 21.10 MMTPA. The capacity is likely to increase to 58.00 MMTPA by 2030 with the planned expansions of existing terminals and the commissioning of terminals under construction. This will still leave an additional requirement of 70.00 MMTPA of regasification capacity (at 70 percent capacity utilization), requiring ~10 terminals at a capex of US$ 10.00 billion. Similarly, realizing the true potential of the gas economy would require establishing the critical pipeline links that connect the eastern and northern parts of the country to gas supplies.

5.4 Downstream Ecosystem

The LNG ecosystem primarily comprises of regasification terminal operators, marketers and end users. The interactions between them determine how smoothly the LNG supply chain operates. Oil and Gas companies have traditionally been aggregators in industries where buyers and/or suppliers are fragmented and cannot easily finalise contracts. In the LNG industry, the supply side is significantly consolidated at present, while the demand side spans a spectrum ranging from big standalone customers like power generation plants to smaller consumers like city gas distribution companies. Going forward, with more countries looking to enter the liquefaction space, the supply side will also get more fragmented. Oil and Gas companies can take the lead in scanning the supplier landscape, especially among

new projects coming online and establishing term contracts with them to supply medium to small size customers who are unlikely to establish supply contracts themselves. Additionally, oil and gas companies should also take the lead in coordinating spot supplies in response to periodic demand–supply mismatches. To accomplish these roles however, oil and gas companies will have to build up sophisticated portfolio management and trading capabilities.

Currently, no large end customer in India has a direct long term contract with an LNG supplier, in contrast to a number of Japanese, Korean and European firms (power plants, city gas firms etc.) that have long term fuel supply arrangements with LNG producers. Customers with steady and large scale requirements for gas can explore the option of concluding long term supply arrangements directly with LNG suppliers either independently or as part of a consortium. Firms can also explore the option of taking a direct equity stake in an LNG project like a number of Korean and Japanese firms have done, which will provide greater security of supply though needing greater upfront investment. Alternatively, IPP developers can look to provide an equity stake to suppliers in their power projects though the attractiveness of this option in the context of the Indian power sector (exemplified by the experience of the Dabhol Power Company) may be limited to merchant power.

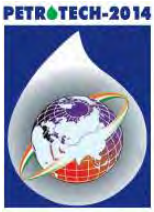
Currently, LNG regasification terminals in India are established by oil and gas companies that have integrated backward by owning and operating physical assets. This model, with a limited number of oil and gas companies, is adequate for the current nascent state of the industry; if the number of oil and gas companies has to increase in the future, it may become necessary to have regasification terminals operated on a tolling basis by Transmission System Operators (TSOs) without gas marketing interests. Companies looking to establish such regasification terminals will have to scrutinise carefully the business case of such an opportunity and assess the risk of capacity utilisation reducing to unviable levels in case the marketing companies fail to supply adequate gas. Project and budget management during the construction phase will be critical success factors for such TSOs.

5.5 Regulations

Regulatory clarity will be critical for attracting investments in various aspects of the LNG value chain. One of the most important issues on which the industry is currently awaiting clarity is the status of regasification terminals as open access infrastructure. At present, there is uncertainty whether regasification terminals will be designated as mid–stream assets and be subject to conditions of mandatory open access, or be designated as up–stream assets and be exempt from these conditions. In addition, there is a lack of clarity whether open access will imply regulated tariffs for regasification. The business case of upcoming terminals will hinge on the decisions taken in this regard; the sooner there is clarity on the same, the better will it be for all stakeholders in the LNG ecosystem.

CONCLUSION

In conclusion, there exists a substantial business opportunity for LNG in the coming decades driven by India's innate energy requirements to fuel its economic development, coupled with the lack of domestic resources to satiate this demand. However, this demand is sensitive to the economics of end user segments; hence the supply of LNG has to take into account the price sensitivity of customers in order to offer them a viable business proposition. India is a late entrant to the LNG space and needs urgently to create the infrastructure and ecosystem to enable firms interested in this space to compete on an equal footing with established players in the globalised LNG marketplace. Securing access to new LNG supplies; creating contracts that distribute risks equitably and ensure viability for end users; and developing the physical infrastructure as well an enabling regulatory landscape are critical interconnected links in the creation of a robust LNG supply and commercialisation chain. Shortcomings in any of these will make LNG a non–starter and leave behind a legacy of failed investments and stranded assets. It is imperative for all stakeholders involved to work in a constructive manner, mindful of the imperatives that govern different parts of the value chain to ensure that the true potential of LNG in this country is realised.



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NOTE TO THE READER

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