



# REPORT ON INDIA GAS INFRASTRUCTURE

Strategies to accelerate to a Gas Based Economy

October 4, 2017 - New Delhi



Knowledge Partner





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# Foreword



In a developing country like India facing the challenge of eradicating poverty, accelerating industrial development, modernising the agrarian economy and meeting the needs of a rapidly growing urban economy, the demand for energy will continue to rise. India has no option but to tap into all sources of energy including hydro, thermal, nuclear, renewable and gas. Natural gas is an important source of clean energy. Given India's commitments to reduce carbon emission and ensure that non-fossil fuels account for 40% of energy supplies, natural gas becomes an important source of energy.

Moving towards a gas based economy and putting in place the necessary infrastructure should go hand in hand. We have to evaluate the demand / supply scenario viz-a-viz supply options, transportation costs, geo political realities and evolve a holistic approach that looks at the entire value chain from well to the burner.

The report on “India Gas Infrastructure: Strategies to accelerate to a Gas-Based Economy” jointly prepared by FICCI & Ceresta Business Consulting looks at these issues and suggests a way forward.

We hope that this report will set the context for the deliberations and enable us to implement the action points identified during the Conference.

**Dr. Sanjaya Baru**  
Secretary General  
FICCI

# Foreword



Indian economy is on a growth path energised by pragmatic policies and strategies by the government coupled with efforts to integrate with major countries of the world. The thrust by the government towards Infrastructure development and Investment into India, has truly given an impetus to the Energy Sector. Indian natural gas sector is facing one of the major challenges in recent years in terms of lower quantum and sluggish growth in domestic gas production, challenges of under-utilisation of regasification and transmission pipeline infrastructure and global oil and gas market dynamics. Government has kept an ambitious target of increasing the share of gas in energy basket from the current 6-7% to 15% in the next 4-5 years. This calls for an innovative approach in evolving a long-term road map for stepping gas consumption in the country. Developing gas infrastructure like Regasification terminals, transmission pipelines and distribution network, though important, is only one aspect of the strategy. Real challenge lies in the integration of the value chain in terms of multiple supply options, multiple infrastructure and demand side management.

In this Knowledge Paper prepared by Ceresta Business Consulting, the main theme is focused on "**Strategies for acceleration towards a Gas Economy**". The paper covers the theme in three major heads:

- Indian Gas Market Scenario - Developing a Market for Gas Economy
- Gas Infrastructure - Need for an Integrated Strategy
- Acceleration towards a Gas Economy: A Strategic Road Map

Some of the key issues identified are the need for development of multiple supply including domestic and LNG resources, Integrated Energy Planning covering Power, Coal, Gas and Renewable Energy, planned Infrastructure Development and effective utilisation, focused development of anchor sectors like power, realistic assessment of demand, need for a robust regulatory structure and policy support

and interventions to provide the initial momentum. The challenges and roadmap discussed at the end provides specific pointers for development of the gas sector and the need for long term thinking and implementable strategy is what is needed at this juncture.

The paper attempts to initiate a strategic thought process that is required for providing the much needed momentum to gas sector in India. It discusses a no. of strategic steps that are needed to bring in the necessary momentum to the sector. We welcome suggestions and dialogue on the paper because we believe that is the best way evolve an effective strategy for moving towards a gas based economy.

**S. Ravishankar**

Chief Executive Officer

Ceresta Business Consulting





# Knowledge Paper

## Strategies for acceleration towards a Gas Economy

### Introduction

India's population is expected to surpass China as the world's largest by 2022, reaching approximately 1.4 billion people, creating greater demand for energy. In the context of this growing demand for energy and the country's commitment to low carbon energy use, India has the potential to be a much larger producer and consumer of natural gas. Indian economy has long been plagued by lack of a strategic energy roadmap in effectively changing the energy mix of the country, which is still heavily tilted towards coal and oil. Major social, economic and political factors have influenced India's policies towards optimizing the energy mix. An objective review of the period from 2000 to 2015, would show the country's constant struggle in stepping up natural gas production and enhancing its usage. The prospects of increasing natural gas production was short-lived when the expected production with KG-D6 fields of Reliance had declined dramatically and the announced gas finds of GSPC and ONGC did not materialize. Adding to these challenges, uncertainty in gas pricing policy and high prices of oil and LNG in global markets during 2011-2014 had effectively crippled the natural gas sector and the industries that were dependent on natural gas. For example, more than 14000 MW power capacity was rendered stranded due to decline in natural gas production. At the same time, already created gas pipeline infrastructure was getting underutilized due to the above reasons and therefore, fresh investments were really not forthcoming. Indeed, Indian government has taken a no. of initiatives across all fronts to address these multitude of issues. Some of the major initiatives of government undertaken in the last two years and targets are listed below:

- Domestic Gas Pricing Policy based on global hub gas prices / Gas pricing Policy for Deep Water / Ultra DW fields
- Subsidy scheme for revival of stranded power plants based on R-LNG (withdrawn in Budget 2017)
- Hydrocarbon Exploration Licensing Policy 2016 (HELP)
- Discovered Small Fields (DSF) Bidding round
- Open Acreage Licensing Policy (OALP) - National Data Repository (NDR)
- LNG Price Re-negotiation with Qatar and Australia and Revised Formula to reflect current market conditions
- Series of steps to integrate with the world both in terms of Investment and LNG supply

- Viability Gap Funding (VGP) - for creating Pipeline infrastructure in the East to North Corridor
- Target to reach 1 crore households with Piped Natural Gas (PNG) supply
- Stepping up share of Natural Gas in Primary Energy Mix from 6% to 15% by 2022

Coupled with these policies and actions, major thrust to Renewable Energy target to 175000 MW by 2022, stepping up coal production to 1 Billion Tonnes in 5 years and plans for creation of LNG terminals in East Coast, do indicate definite prospects for growth of energy sector in India. Delving deeper, it is also important to note that the various targets for power, gas and coal may be competing with each other and a lack of an integrated approach may stifle growth and result in significant shortfall in targets because targets have to be looked at, in the context of realistic demand as well as the economic viability of the investments.

The proportion of natural gas in India's energy mix at 6% remains small though it is comparable to similar emerging economies like Brazil, China, and South Africa. But in terms of actual usage of gas, India's consumption is still lower. Despite India's plans to double the proportion of natural gas consumption in energy mix by 2022, achieving this goal would require major upstream, midstream, and downstream investments as well as the continued will to enact policies and action plans to decrease the reliance on coal and oil, increase usage of gas to replace polluting fuels (eg..Diesel), increase the share of renewable energy along with gas based power to meet peak and intermittent demand and provide necessary need based infrastructure investment support.

Despite some slowdown in GDP growth in last two years, Indian economy is on a long-term growth path energised by pragmatic policies and strategies launched by the government. The key is to evolve a strategic road map and roll out a timebound implementation plan which would call for an innovative approach. The thrust by the government towards Infrastructure development and Investment into India, has truly given an impetus to the Energy Sector. Developing gas infrastructure like Regasification terminals, transmission pipelines and distribution network, though important, is only one aspect of the strategy. Real challenge lies in the integration of the value chain in terms of supply options, realistic demand estimation, enabling gas usage in key sectors of growth and infrastructure creation.

## SECTION 1

# Indian Gas Market Scenario - Developing a Market for Gas Economy









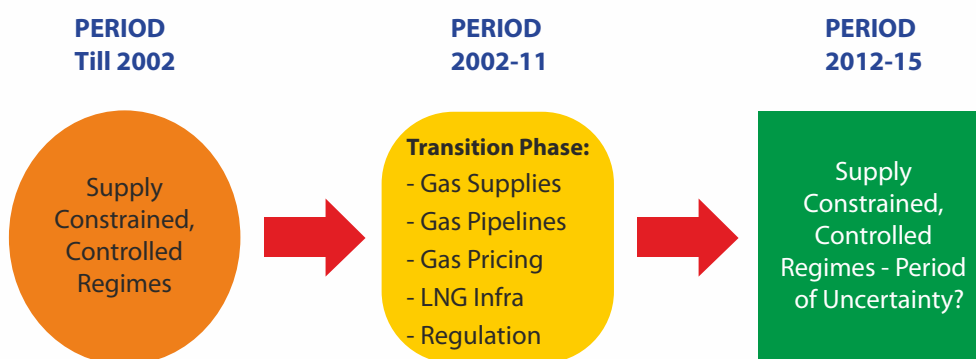
# Section 1

## Indian Gas Market Scenario - Developing a Market for Gas Economy

### 1.1 Indian Gas Market: Historical Overview

The period of 2000 to 2004 was a period of optimism for Indian gas market with world class gas find in KG Basin, setting up of LNG Re-gasification terminal and commencement of LNG Supply, successful operation of city gas distribution projects and its positive impact on environment, plans to set up a Regulator given the emergence of gas economy and related infrastructure development. The period after that (2004 -2011) truly the marked the beginning of the gas era in the country with successful commencement and operation of the LNG terminal, expansion of transmission pipeline network in the north-western corridor and new network in the east-west corridor, setting up of the regulator (Petroleum and Natural Gas Regulatory Board) and authorisation of new pipelines and geographical areas for CGD Network, substantial jump in gas production from KG Basin and increased supply of gas to many end use sectors. During this period, government announced a Gas Allocation Policy prescribing a customer-wise allocation for the gas that was being produced from KG Basin. The following period 2011 - 2015 saw the unprecedented decline of gas production from KG basin from a high of about 60 MMSCMD to a very low level of around 10 MMSCMD. The gas production forecasts from other finds in the KG basin also failed to materialize. With declining gas production from the traditional fields of ONGC, the country saw a period continuous fall in gas production for 5 years and the government's decision not to pursue any new gas based power projects, in the light of stranded power projects to the tune of around 14000 MW. Effectively, a period of uncertainty has ensued, which the current government is trying to put an end to, by announcing a no. of policies to attract investment and step up production.

**Figure 1: Indian Gas Sector - Journey from 2000 to 2015**



As one can see from Fig.1, Indian gas sector has moved on from a supply constrained, controlled regime through a vibrant phase of emerging gas economy (2002-11) before getting back to a period of constrained supply and controlled regime, rather quickly. It is also important to note that the current policies and strategies of government are being made in the context of the recent developments, which would involve a multi-pronged strategy of stepping up gas production from existing fields under production or exploration, policies to attract investments in fields and policy prescription and regulatory certainty to bring about a conducive climate for growth.

## 1.2 Natural Gas market: Review of Production and LNG import Trends

Table 1 provides an overview of natural gas production / consumption and import trends in India.

**Table 1: Natural Gas Consumption in India ( 2008 - 2017)**

(in BCM)							
Year	2008-09	2009-10	2010-11	2011-12	2013-14	2015-16	2016-17
<b>Net Gas Production</b>	31.75	46.49	51.23	46.45	34.57	31.14	30.85
<b>LNG import</b>	10.54	11.82	12.89	15.41	17.73	21.31	24.69
<b>Total Gas Consumption (BCM)</b>	42.29	58.31	64.12	61.87	52.30	52.45	55.53
<b>Total Gas Consumption (MMSCMD)</b>	115.9	159.7	175.7	169.5	143.3	143.7	152.1

Note: Gas Consumption includes Internal Consumption also  
Source: PPAC

As can be seen, the production of natural gas in India showed a substantial jump 31.75 BCM in 2008-09 to 51.23 BCM in 2010-11. There has been continuous decline since then over the next 4 years to a level of 30.85 BCM in 2016-17. Overall Gas Consumption during the period showed a substantial increase between 2008-09 and 2010-11 (115.9 MMSCMD to 175.7 MMSCMD) and declined thereafter considerably to a level of 143.7 MMSCMD in 2015-16. Last year (2016-17), gas consumption showed a minor reversal of trend going up to 152 MMSCMD primarily contributed by increase in LNG Consumption.

During the same period, LNG imports which was around 8-9 MMTPA during 2008-2010 period moved up to around 13 - 14 MMTPA during in 2012-15 and subsequently jumped to 19.1 MMTPA in 2016-17 driven by spot purchases and government scheme for RLNG supply to Power Sector. The growth was also contributed in substantial part by sustained downtrend in global LNG prices. A snapshot of LNG import trends are presented in Table 2.

**Table 2: LNG Import Trend in India (2008 - 2017)**

Year	2008-09	2009-10	2011-12	2013-14	2014-15	2015-16	2016-17
<b>Total LNG Imports (Long Term, ST / Spot) in MMT</b>	7.96	8.92	11.63	13.38	13.99	16.08	19.10
<b>Total LNG Imports (Long Term, ST / Spot) in MMSCMD</b>	28.2	31.6	41.2	47.4	49.5	56.9	67.6

Source: PPAC

Mirroring the trend in fall in domestic production and reduced domestic gas supply to consumers, the share of LNG has increased from 25% in 2008-09 to 45% in 2016-17. Overall gas consumption was impacted substantially due to fall in domestic production and the consistently higher prices of LNG prevalent in global markets till 2014. It is also interesting to note that LNG share in gas consumption which was 25% in 2008-09 has actually fallen to around 20-21% during the period 2009 - 2011 before moving up again to 25% in 2011-12 mirroring the rise and fall of domestic gas production and overall gas consumption in the country. From 2012-13 onwards, the share of LNG in total gas consumption has shot up considerably driven by gas demand, falling global LNG prices and government scheme for reviving stranded gas based power projects through R-LNG supply.

Since late 2014, announcement of new gas pricing policy in India, changing global market dynamics and continuous fall in oil and LNG prices, government scheme to revive stranded gas based power projects and government's thrust to increase domestic gas production and expand city gas distribution are some of the key factors, which have provided some traction to the hitherto struggling Indian gas sector.

### 1.3 Gas Demand vs Supply: A Reality Check - Understanding end user sector dynamics

Doing a reality check and making a realistic assessment of gas supply and demand is an important step to understand the ground realities and plan for accelerating gas usage in future. While India is pursuing multiple strategies of enhancing domestic gas production and creating LNG import infrastructure, it would also be important to make an informed assessment of the demand for gas in various sectors and its sensitivity to gas price.

#### 1.3.1. Natural Gas - Supply Side Scenario

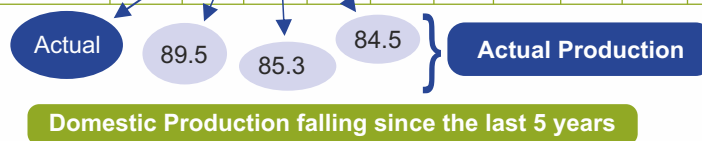
On the supply side, in the past, various supply projections have consistently fallen short of the target due to some important reasons:

- Falling production from the prospective KG D6 fields
- Falling production from traditional producing fields
- No supply in horizon from announcement of new finds I KG basin

Table 3 gives one of the projections made in 2013 by industry sources for the following years till 2025 and what was actually produced during 2014 to 2017.

**Table 3: Natural Gas Supply: Forecast vs Actual in recent years**

Sr.No.	Source	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25
1	ONGC- Nominated Including Marginal fields	63	65	70	76	82	82	82	77	72	68	64	60
2	OIL nominated	7	8	8	8	8	8	8	8	8	8	8	8
3	ONGC KG-Basin/Mahanadi	-	-	2	6	13	15	15	15	15	15	15	15
4	RIL-KGD6/NEC/Others	14	15	19	24	30	45	45	45	55	58	58	58
5	GSPC KG Basin	-	-	2	4	8	8	8	8	8	8	8	8
6	PMT+Others+CBM	10	12	14	17	17	17	17	17	17	20	20	20
7	New Prospects (Under exploration)	-	-	-	-	-	2	7	7	11	18	25	25
	<b>Total</b>	<b>94</b>	<b>100</b>	<b>115</b>	<b>135</b>	<b>158</b>	<b>177</b>	<b>182</b>	<b>177</b>	<b>186</b>	<b>195</b>	<b>198</b>	<b>194</b>



Source: Ceresta Analysis / Industry Reports

The Forecasts done in 2013 expected additional supplies from small and marginal fields of ONGC, production from new finds from KG Basin and revival of production from KG D6. Except the production from small and marginal fields of ONGC, none of the other forecasts have fructified while there has been a fall from the nominated fields of ONGC. Therefore, the actual production has consistently fallen short of the forecasts of 2013. In fact, gas production has consistently fallen during the last five years. The Government has taken a realistic view of the situation and hence put together a strategy to increase domestic production of gas over the next 5 to 10 years. The analysis of 2013 Production Forecast vs actual production is brought out here to emphasize the fact that forecasts need to be accompanied by a strategic roadmap and implementable action plan to accomplish the targets.

Having said that, there have been revisions in forecast in supply, to reflect the current production challenges - both industry forecasts and by government - which is presented below:

**Table 4: Domestic Gas Supply Forecast 2016-2020**

Forecast (MMSCMD)	20015-16 (Actual)	2016-17	2017-18	2018-19	2019-20
Industry Forecast 1		100.3	96.6	99.3	111
Industry Forecast 2		102	114	131	158
MOPNG Plan		97.4	106.3	138.3	152
<b>Gas Supply Forecast (Average)</b>	<b>85.0</b>	<b>99.9</b>	<b>105.6</b>	<b>122.9</b>	<b>140.3</b>

Source: Industry Estimates / Presentations



There are definite plans to increase gas supply in the near term by about 60% to 70% from the current levels. While such a near term target, accompanied by a roll out plan, is very much necessary, a long term view on increasing supply is also the need of the hour.

In the light of the fact that government has set an ambitious target of enhancing share of natural gas in the energy mix from the current 6-7% to 15% in the next 5 years, it is important to take a holistic and integrated view of supply and demand side factors and evolve a strategic roadmap.

For accelerating towards a gas based economy, the concerns of dwindling domestic gas production needs to be addressed on priority. Specifically, on the supply side, the major focus areas that need to be considered at a strategic level for stepping up oil and gas production, from an overall energy security perspective, can be summarized as follows:

- Production Enhancement and Optimization should be taken up in existing producing fields to step up production in the near term on a regular basis.
- Development of existing discovered fields and discovering new resources in on-land, deep water and ultra-deep water areas would be very important
- Development of strategies for development and production of small, marginal and isolated fields which hold huge potential but not developed due to lack of infrastructure and monetisation hurdles.
- Special emphasis to be given for evolving a strategy and policy framework for development of unconventional resources like Shale gas, Coal Bed Methane and others.
- Strategic investments in Oil and Gas assets globally and bringing in equity oil and gas into India.

These five focus areas are described briefly below:

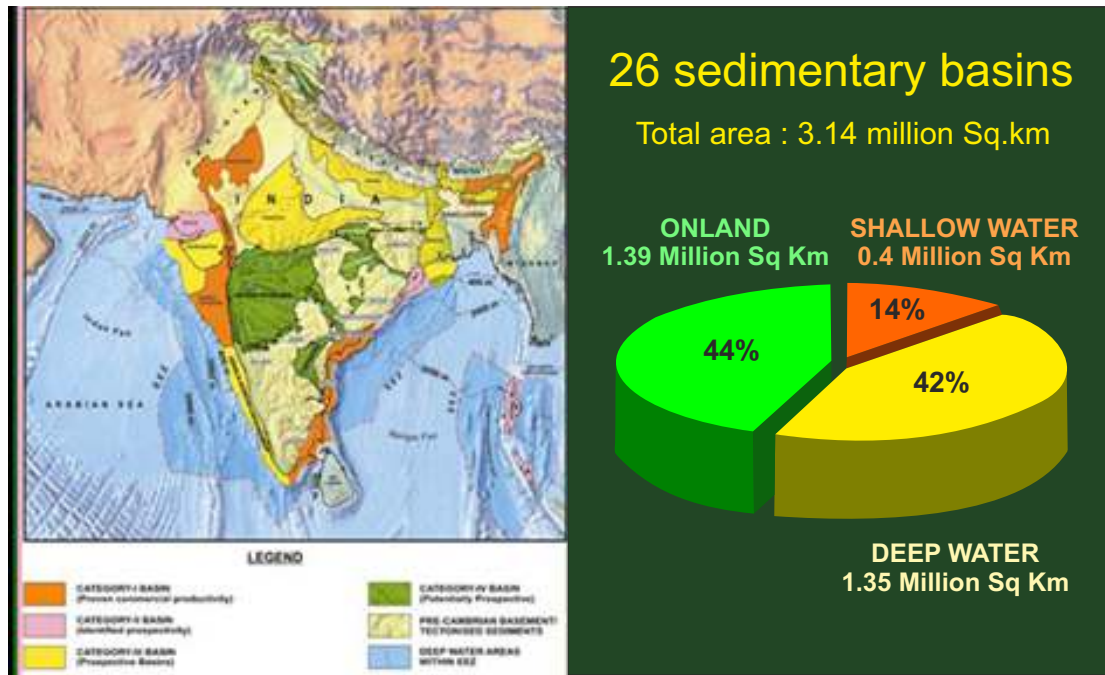
### **Focus Area 1: Increase production and recovery of existing fields**

According to the MOPNG the estimated hydrocarbon resources in India as on 1.4.2014 were 28.1 billion tonnes (oil & oil equivalent of gas). India's production has not increased significantly in recent years. While oil imports have been increasing because of stagnant domestic production, gas production increased significantly during 2010-12 period due to KG D6 field production but declined substantially thereafter due to fall in production from KG D6. As of today, more than half of India's current domestic oil production is from maturing fields or fields in declining stages of production. From peak levels of oil and gas production in 2010, the production has declined by 2.3% and 38% respectively for oil and gas till 2014. Average recovery rates of Indian fields are 25%-40%, while state of art developments globally has witnessed recovery rates of up to 55% or more. Production Optimization, Enhanced Recovery technologies (EOR and IOR) & Development of adjacent Field are some of the strategic options which can be taken up to quickly increase production and recovery in the short to medium term.

## Focus Area 2: Development of discovered fields and discovery / development of new prospects

India has 26 sedimentary basins covering 3.14 million sq km of area. About 44 % of India's total sedimentary basin area is on-land, covering an area of 1.39 mn sq km, and balance 56 percent covering 1.75 mn sq km is offshore, including deep-water of 1.35 mn sq km and 0.4 Mn Sq Km of shallow water. Only 22 % of the total area falls under the category "Moderately to well explored". Exploration efforts have been initiated in 44 % of the area and the balance 34 % remains poorly to completely unexplored. (See Fig 2)

**Fig.2: India's Exploration Landscape**



Since 1993, the Government of India has signed Production Sharing Contracts (PSCs) for 28 exploration blocks under Pre-NELP rounds. Out of this, 11 blocks have already been relinquished or surrendered. Major hydrocarbon discoveries made in the pre-NELP blocks are in the Gulf of Cambay by Cairn Energy, Gujarat State Petroleum Corporation (GSPC) and Essar.

Out of the 360 blocks which have been offered in the nine rounds of NELP till date only 148 are active blocks in various stages of exploration, appraisal, development or production, 106 have been relinquished and 106 blocks have not been awarded due to lack of participation. Furthermore, while 128 hydrocarbon discoveries were made in 42 blocks, production has been limited to 11 fields in 4 blocks (as per data of DGH in mid-2014).

**Development of major deep-water gas discoveries and other discoveries:** 11 major gas fields with a resource base of around 3 billion tonnes oil equivalent of gas have been discovered of which only KG-D6 is under production. The other blocks have not yet started

production due to various geological issues, sub-optimal developments and lack of government policy support in the past in terms of pricing etc. Moreover, KG D6 the production from has also declined over the years from 60 MMSCMD in 2010-11 to 11 MMSCMD by 2014-15 due to geological complexities reported by the developer. Bringing these blocks to production can add up to 15 to 20% of current production in the next 10 years.

One of the steps taken by government is on the policy front in terms of introducing revenue sharing model to minimize complexities in administering PSC model. It is also recommended that more efforts need to be put to bring the existing discoveries and development into production.

Over 75% of India's sedimentary basin is yet to be properly or fully explored and this calls for increased exploration focus through new exploration licensing rounds. The remaining estimated potential in these basins is around 28 billion tonnes with 12 billion tonnes of recoverable resources according to DGH and other studies. While these resources are unlikely to add production in the next 6- 7 years, they will be critical to add and grow production significantly by 2030. Discovering the full potential of Indian basins can help India bridge the supply-demand gap in energy requirements in the long term.

### **Focus Area 3: Development and Production of isolated, small and marginal fields**

As defined earlier, Small and Marginal fields are remotely located and hold limited reserves. Majority of these were allocated to National Oil Companies (NOCs) before the licensing rounds on a nomination basis in the past. ONGC held about 165 marginal fields (79 offshore and 86 onshore). These fields have ultimate total reserves of about 350 MMTOE. ONGC had developed a comprehensive plan to develop these fields and during the last 6 - 7 years, there has been a major thrust on this development. ONGC has brought to monetisation by adopting a strategy of clustering and other technological interventions. Given the challenges of the task and the time factor involved, Government had announced a new Discovered Small Fields Bidding round in 2016 for 69 fields, relinquished by ONGC and OIL, in order to give a thrust to development of these fields through large scale private participation.

### **Focus Area 4: Increase focus on unconventional sources of energy**

To meet our growing energy needs, there is a need to tap into additional non-conventional sources of gas such as shale gas, coal bed methane, coal gasification, gas hydrates etc. which require significant R&D effort.

India has estimated technically recoverable shale gas resources of 96 tcf. The KG basin has the highest reserves of about 27 - 28 tcf followed by the Cambay basin with reserves of close to 20 tcf. Currently development of shale resources are being undertaken only by state entities ONGC and OIL under the current policy. A positive step towards unlocking India's shale potential is ONGC's plan to drill 30 shale gas exploratory wells. Conoco Philips would provide technological support to ONGC.

Keeping in mind the critical role played by niche and independent players in the Shale industry in the US, it's important to encourage private players (local, international, small and big) to develop shale in existing acreages and also obtain new leases for shale development. Shale resources can help ramp-up the much required domestic gas production. But the lack of appropriate geological data on shale and multiple and wide-ranging estimates of potential has been major drawback. Unless there is clarity on these factors, it is difficult to project how much shale will add to future production.

On the CBM front, India has a proven CBM reserve of 92 tcf. While a large number of private developers like Reliance, Cairn India, ONGC, GEECL and Essar have invested in the exploration and production of CBM, multiple issues in most of the 33 awarded blocks have hampered developments of these blocks. E.g. Essar has 5 blocks with a capacity of 10 tcf. Its Raniganj asset produces about 0.6 mmscmd of CBM, significantly lower than its estimated peak production. Reliance, which has discovered CBM in Sohagpur in MP almost 7 years back, has not yet started production. Infrastructure connectivity issues, poor reserve assessment data and pricing issue in the past, have led to the current situation. Besides, resolving land acquisition issues and delay in clearances can also enable CBM to reach some level significance in term of its contribution to gas production.

### **Focus Area 5: Invest and develop / secure Hydrocarbon assets abroad**

India is currently and will continue to be dependent on crude oil and gas imports. Besides importing oil and LNG, India, like other major oil import countries like China, Korea etc., has been making efforts to secure exploration and production assets overseas. Over the last five years, Chinese NOCs have invested over USD 90 billion to secure resources globally vs. USD 10 billion by the Indian NOCs. While OVL, the overseas arm of ONGC was established in 1989 with this very purpose, India has lagged behind China and Korea in its quest for securing resources globally. In the recent past, India has lost to Chinese and Korean companies in a number of strategic acquisitions across the world e.g. Nigeria, Kazakhstan and Russia.

While Oil and Natural Gas Corporation (ONGC) through its wholly owned subsidiary ONGC Videsh Limited (OVL), has taken the lead in acquiring oil and gas assets abroad, there is significant room for increasing our global footprint. Currently OVL is a non-operator in most of its international blocks with moderate to limited stakes. Moreover, Improved coordination of Indian NOCs and the Government can enable India to acquire key global assets. Developing a strategic plan and identifying focus areas at a national level will help optimize efforts. A consortium involving all key PSUs would ensure focus and enable increased bargaining power to acquire resources globally.

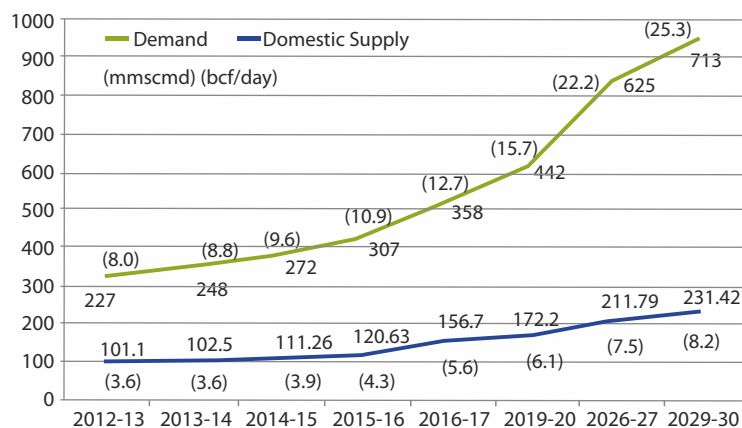
While strategies have to be pursued across all the focus areas detailed above, in the past two years, government has indeed taken a no. of initiatives to step of gas production. Policies like Hydrocarbon Exploration Licensing Policy (HELP), Discovered Small Fields Bidding round, Gas Pricing Policy for Deep Water and Ultra-deep Water fields and Open Acreage Licensing Policy in the Upstream Sector show the long term thinking of the government.



### 1.3.2 Natural Gas - Demand Side Dynamics

While it is a well-documented fact that India's gas demand is much higher than the total gas supply in the country (domestic + imported), it is also to be clearly understood that the various sectors of demand for gas, have different demand dynamics and sensitivity to prices. According to Vision 2030 document prepared by PNGRB a few years ago, the demand - supply gap has been enormous in the Indian gas sector, in spite of the optimistic supply forecast made at that time. Just to recap, the figures are presented below in Figure 3.

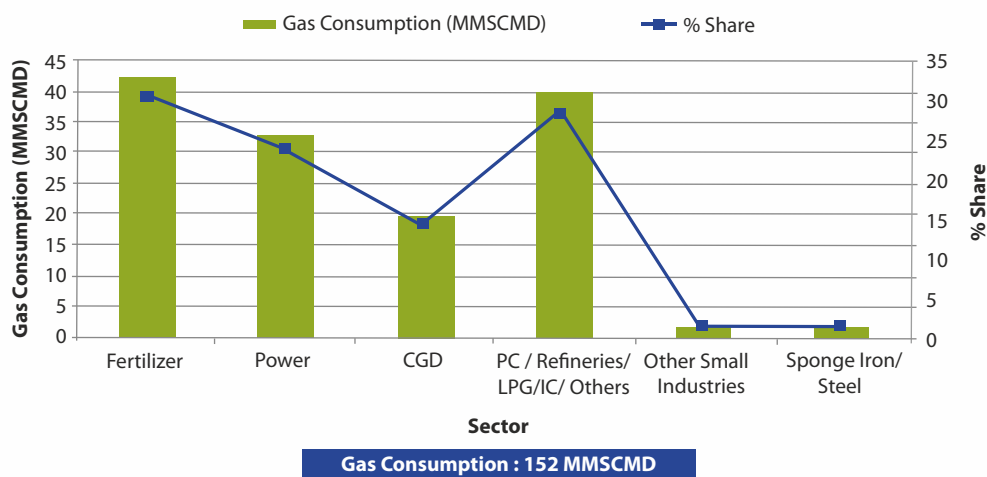
**Figure 3: Natural Gas Demand - Supply Forecast 2030**



Source: Vision 2030 – Gas Infrastructure In India - PNGRB

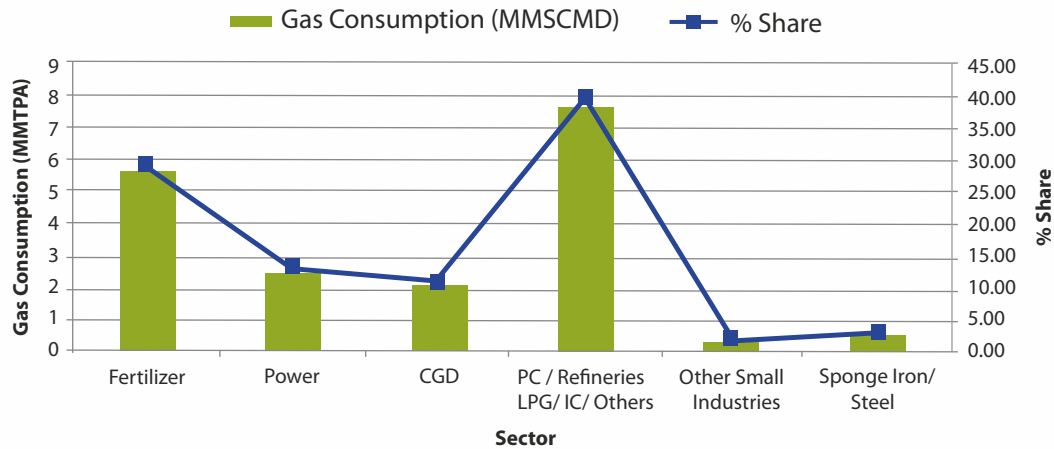
The demand figures above represent the unconstrained demand across sectors. In India, gas pricing has been a key issue and the price sensitivity of major anchor sectors like Power and Fertilizer sectors has been eloquently discussed in various forums and reports. Indeed, it is a fact. The sectoral dynamics of gas demand is an important aspect that has to be delved deeper. The sector-wise consumption of Gas (Domestic gas and LNG) is presented below (See Figure 4 and 5):

**Figure 4: Sector-wise Gas Consumption (2016-17)**



Source: PPAC, Ceresta Analysis

**Figure 5: Sector-wise LNG Consumption (2016-17)**



**Estimated LNG Consumption (2016-17) : 19.1 MMTPA**

Source: PPAC, Ceresta Analysis

From Figure 4 on sectoral gas consumption, it can be inferred that Fertilizer and Power sectors still dominate with a combined share of about 57%. It is important to note here that about 4-5 years ago, the two sectors had a share of almost 70% with power sector taking a share of about 40%. During the intervening period, the share of power sector has fallen significantly, because of fall in production and therefore stoppage of allocation of KG D6 gas to the sector. Fertilizer has indeed maintained its share since that sector retained its priority sector allocation. High priced LNG has never been an option for power sector and hence its share fell along with domestic supply fall. In fact, more than 14000 MW of new gas based power plants were rendered stranded by lack of domestic gas supply. The introduction of a government reverse bidding subsidy scheme for supply of LNG to these stranded power plants to make them operational at 35% PLF did revive some of these plants for two years. With the withdrawal of that scheme in this year's budget, the impact needs to be seen. Already, in the last few months of this FY 2017-18, LNG imports have shown some decline. Effectively, power sector is an effective non-consumer of gas, if domestic gas is not made available or there is no special government scheme for supply of R-LNG to the sector. As far as fertilizer plants are concerned, most of the existing plants have converted to gas and they continue to get gas supply. But in terms of future growth for gas demand, the sector has limited potential and hence any new LNG terminal operators do not look at it as a major anchor barring some scope for revival of a couple of plants.

To summarize, the falling domestic supply and increasing imports of LNG into the country had brought down the overall share of the two traditionally anchor sectors - Power and Fertilizers. One of the major gainers during the last 5 years has been the City Gas Distribution (CGD) sector has grown from 7 - 8% share before 2010 to 15 - 16% currently, supported by both expanding network, favourable economics, environment friendliness and government thrust through policy interventions. With renewed thrust of government to reach out to one crore households in 5 years, the sector is gaining traction and considered to be an important

growth sector in the coming years. But in terms of gas consumption, it will be slow because Piped Natural Gas Supply (PNG) to households, has a low share in terms of quantum of supply though it may be large in terms of absolute numbers. CNG and Industrial / Commercial segments will hold the key here.

The major gainers in the last few years when LNG supply shot up, were the other sectors led by Refinery, Petrochemicals, Steel & Sponge Iron and other industries. In terms of overall gas consumption, these sectors have gone up beyond 30% share. When it comes to LNG consumption, its share has shot up beyond 40%. Fertilizer and CGD sectors are other important sectors of LNG consumption.

Talking about realistic demand assessment, it is a fact that sectoral gas demand is in the context of gas price. While unconstrained demand can be very high in India, the actual demand at different price points are more relevant from the perspective of an infrastructure developer. Table 5 provides a matrix of price and sectoral affordability with an indicative demand composition.

**Table 5: Indian Natural Gas Demand - Affordability Matrix**

Delivered Cost Range (US\$ / MMBTU)	Consumption Sectors	Estimated Demand Composition %
US\$ 10 -14	LPG, Refinery - Feedstock, Petrochemicals, Diesel Back-up Power, Peak Power	40 - 45%
US\$ 7.5 - US\$10	Fertilizer, CGD, Industrial / Commercial	
US\$ 5.5 - 7.5	CGD - Transport / Domestic, Refinery Fuel, Industry Fuel	55 - 60 %
<US\$ 5.5	Base Power	

Source: Ceresta Price – Demand Framework

Effectively one can see that power sector is completely going out of LNG usage given that the base power is highly sensitive to gas price and any price of gas above US\$ 5.5 / MMBTU makes it challenging for gas based power to compete with coal based power. With renewable power prices also coming down in recent years, competitiveness of gas based power faces a test and therefore, a specifically focussed strategy on power sector to make gas usage viable or acceptable is what is required. Here both Environment and Economics will come into play. The affordability matrix (Table 5) provides a pointer that the effective demand would be in the range of 45 to 55% of the generally projected unconstrained demand.

### 1.4 Future of Gas Based Power Development: A Strategic Challenge

As had seen earlier, one of the major sectors that got affected by the falling domestic gas production, is the Power Sector, wherein about 14305 MW is stranded due to non-availability of gas. At the same time, India has also committed to progressive reduction in Carbon

emission through various strategies which include Renewable Energy and use of cleaner fuels. In this context, integrating natural gas in India's Energy Portfolio is one of the keys to a cleaner future.

#### **1.4.1 Key Highlights of Indian Energy Scenario:**

- 60% of power generation capacity based on coal. Failing PLF of Coal Based power plants over the last 5-7 years due to domestic shortage of coal supply. Besides, historically, the sector had also faced challenges of logistics, port handling capacity, high ash content and pollution. Government has taken firm steps to step up coal production which has shown a fair growth trend in the last two years.
- Very low PLF of existing gas fired power plants (<30%) due to low gas supply (shortage)
- Stranded gas based capacity of 14305 MW due to non-availability of gas.
- Dramatic price drop in the global Oil & Gas/LNG industry since late 2014 and more competitive prices of LNG supplies to India. Oil prices have fallen from a level of USD 100-120 / BBL during the period 2012 - 2014 to around USD 50 / BBL in recent months ( oil prices touched a low of below USD 30 / BBL as well during 2016). LNG prices have fallen from a consistently high level of above USD 15 / mmbtu to below USD 7 / mmbtu during the same period.
- Low penetration of Renewable Power in India so far and therefore renewed government thrust to enhancing RE Capacity. There is also continuous fall in Solar CAPEX and tariffs, with Solar Power Tariff moving towards grid parity

This section attempts to assess the current situation in the power sector in India, identify the issues and challenges, review the government plans and targets and arrive at various strategic options for expanding natural gas based generation. Evolving such a strategy requires review of the key aspects of coal based power, diesel power and solar power. A brief review of the various power generation modes are detailed below:

#### **1.4.2 Coal Power: Critical Aspects**

- Coal has been in short supply in recent years and Coal India has been unable to fulfil the commitment as per the Fuel Supply Agreement. In the last two years, government has taken steps to increase coal production in India which has indeed resulted in positive effects. The government has kept a target of enhancing coal production to 1 Billion Tonnes by 2022.
- Government's ambitious plan to create RE capacity would be a major challenge to coal based generation
- Coal based Power PLF has come down significantly over the years
- Coal is less efficient and more polluting (High Ash Content)



- Coal Logistics - Rail Wagons availability for inland transport has been a challenge historically and with more coal available domestically, the challenges could be more.
- Technology Challenge due to high ash content of domestic coal

If Government's plan of alternate energy sources progresses, annual capacity addition of coal based generation may be lesser than renewable addition by 2020. Coal share in power generation is expected to come down. Gas has an important role to play here as a cleaner fuel option.

### 1.4.3 Diesel power: Critical Aspects

One of the studies undertaken on diesel based back up power in Delhi NCR brings out the high cost level of back-up power. Some of the major findings of various studies done during 2011 to 2013 in Gurgaon / Manesar is given below:

- Expensive Back-up Power at **Rs.16 to 20 / KWH (Diesel based)**
- Average Power Outage: **2.7 hours to 4 Hours; 13 - 20 % Power supply** is based on back-up diesel power
- High Paying Capacity of Industrial / Commercial / Consumers given that they use high cost back up power
- Willingness of Consumers to share the additional cost burden of zero load shedding (Reliability Surcharge to Discoms)
- Affordable Segments - Domestic (Urban), Commercial, HT Industry and LT Industry

Such studies in past have clearly established the challenges of regular power outage, need for reliable power and customer's willingness to pay for reliable power. Given the thrust on pollution reduction, gas is the best option to replace diesel through various technologies for distributed generation.

### 1.4.4 Solar Power: Critical Aspects

There is major thrust on Solar Power by Government for creating a capacity of 100000 MW in next 5 to 7 years. Even more conservative reports have predicted addition of 43000 MW solar power in next five years. A target of 175000 MW has been set by government for RE. Creating large RE Capacity must be planned through integrated back- up power planning given the challenges of solar and wind power.

### Key Challenges in implementing large scale Solar / Renewables

- Hurdles can be in the form of Grid Connection / transmission constraints
- Integration of Diurnal Power into the grid with peak load management capability
- Challenges in enforcement of Renewable Energy Purchase Obligations (RPO), given the weak finances of the State SEBs

- Inability of the State Discoms to absorb high cost electricity - so large scale of absorption of Solar power is a serious concern though the recent bids have received tariff bids of below Rs.3 / Kwh
- Financing, Land Acquisition, limited domestic manufacturing capability and reliability of baseline data
- Solar Power Cost might have come down but its intermittency / infirmity is a serious issue. Using back-up power to mitigate this issue, costs are quite high (eg Diesel Power)
- Intermittency of solar / wind power is reported to impact power generation by 20 - 30 % in different states where they are installed.
- Balancing the grid in such situation is a major challenge and therefore load shedding is resorted to.

As can be seen, Integration with grid, intermittency and peak load management are going to be major challenges in Solar / Renewable Power. This would need Integrated Planning - Natural Gas needs to part of such Planning to take India towards 24x7 Reliable, Cleaner and Efficient Power.

#### 1.4.5 Gas based Power Generation - The Current Challenge

Currently, there is about 27000 MW of gas base generation capacity in the country. Of the total capacity, 9845 MW is the operational capacity which is currently getting gas allocation and it is operating at an average PLF of less than 35%. This is a serious cause for concern. Even steeper challenge is the fact that there is a capacity of 14305 MW which is stranded and non-operational due to non-availability of gas. Table 5 gives an overview:

**Table 6 : Gas based Power – Current Scenario**

<b>Current Gas based power capacity grid connected including just commissioned / to be commissioned plants</b>	<b>27123</b>
<b>Stranded gas based power Capacity ( MW) – Non Operational</b>	<b>14305</b>
<b>Existing Operational Gas based Power Plants (operating at less than 35% PLF)</b>	<b>9845</b>

Source: CEA, Industry Sources

In the context of the above, it is quite clear that for any strategy to enhance natural gas usage in the energy mix to succeed, focussing on strategies to enhance gas usage in existing plants is the first step and it can add substantial volumes to gas usage.

For accelerating gas usage and increasing gas share in energy mix to 15%, power sector needs to be part of the scheme of things and importantly, natural gas has to form an important part of the portfolio in India's energy planning. In the context of the above, the following 4 strategies are proposed for expanding natural gas usage in power sector:

**Strategy 1:** Reviving stranded gas based power capacity of 14305 MW and reach a PLF of 60% over a specified period of time

**Strategy 2:** Increasing PLF of existing gas based power stations from less than 35% to reach 60% PLF in the next 3 years

**Strategy 3:** Replacing diesel based back up power/ peak power demand in industrial/ commercial establishments with gas based power across major load centres, in a phased manner

**Strategy 4:** Creating gas based capacities to support intermittency/ black outs associated with solar generation capacities. All new / existing commercial solar PV capacities to be supported by addl. 30% of gas based generation.

The four strategies are presented below briefly in the 4 exhibits:

**Exhibit 1**

**Strategy 1 : Reviving stranded gas based power capacity of 14305 MW and reach a PLF of 60%**

- **Target PLF : 60% in 4 years (by 2019-20)**
- **Domestic Gas / LNG Availability has been an issue**
- **Many projects located in South India / AP wherein LNG could not reach from West Coast**

**Strategy Proposed :**

**Near term** : Gas Pooling Mechanism to be decided by government. Plan LNG supply to all grid connected stranded plants at competitive prices in line with prevalent global prices

**Medium Term** : Introduce a efficient Swap Mechanism and enable Gas Swapping without the incidence of multiple taxation to the extent it is feasible

**Long Term** : Set up the planned FSRU terminal at Kakinada / Land based terminal. Increase domestic gas supply.

**Gas Requirement to meet the target : 34.3 MMSCMD**

### Exhibit 2

#### Strategy 2 : Increasing PLF of existing gas based power stations from less than 35% to reach 60% PLF

- Target PLF : 60% in 4 years (2019-20)
- Existing Operating Power Plant Capacity : 9845 MW
- Existing Operating plants on grid with dwindling gas supply over the years – leading to continuous reduction in PLF

#### Strategy Proposed :

- Near term** : Gas Pooling Mechanism to be decided by government. Plan LNG supply to all operating plants at competitive prices in line with prevalent global prices
- Medium Term** : Plan LNG supply through existing unutilized / underutilized capacities / to be commissioned terminals, to achieve the target PLF
- Long Term** : Set up the planned LNG terminals / FSRU which have shown some progress towards Agreements / FID

**Gas Requirement to meet the target : 10.94 MMSCMD**

### Exhibit 3

#### Strategy 3 : Replacing diesel based back up power/ peak power demand in industrial/ commercial establishments with gas based power across major load centres, in a phased manner

- Estimated Diesel based back-up Power Generation in Industrial / commercial areas (fairly larger scale engines)- 2014: 7000 MW
- High cost diesel power at Rs 16 – 20 / Unit – 6 hours / day of diesel power usage (25% - no grid power)
- Major cause of pollution in major cities
- Efficient Gas Engines of various capacities – can produce back up gas based power at 17 – 30% lower cost according to gas / LNG prices

#### Proposed Strategy:

- Introduce gas in NCR or any pilot : Undertake a quick assessment of diesel back-up in NCR and current infrastructure status / need and Introduce gas based generation ( Gas Engines ) in a phased manner in 3 years. May require mandatory compliance order for phasing out diesel in such applications
- Undertake a study in other major industrial locations / load centres and assess gas requirement / infrastructure and prepare a roll out plan

**Gas Requirement to meet the target : 7.78 MMSCMD**



#### Exhibit 4

**Strategy 4 : Creating gas based capacities to support intermittency/ black outs associated with solar generation capacities. All new / existing commercial solar PV capacities to be supported by addl. 30 % of gas based generation**

- **Solar Capacity Targeted by 2020 ( Conservative) : 43000 MW**
- **Key issue of Peak Demand Management / Intermittency**
- **Grid Connectivity / transmission constraints**

**Proposed Strategy:**

- Create gas capacity of 15% to 30% of proposed solar capacity of 43000 MW by 2020. Gas capacity needed would be : 6500 to 12900 MW.
- Gas capacity to operate at the required level to meet the peak demand management loads and power intermittency and specific locational power shortages. Gas based capacity to operate at 50% PLF
- Current stations' capacity and locations to be taken into consideration

**Gas Requirement to meet the target : 7.78 MMSCMD**

A summary of gas requirement for the 4 strategies is given below:

**Table 7: Portfolio Strategy for Power - Summary**

<b>Table 7: Proposed Energy Portfolio Strategy – Summary (Based on Emission Reduction and enabling accelerated gas usage )</b>	
<b>Solar Capacity Target 2020</b>	<b>43000 MW</b>
<b>Natural Gas Requirement</b>	
<b>Strategy 1</b> : Reviving stranded gas based power capacity of 14305 MW and reach a PLF of 60%	<b>34.30 MMSCMD</b>
<b>Strategy 2</b> : Increasing PLF of existing gas based power stations from less than 30% to reach 70% PLF	<b>10.94 MMSCMD</b>
<b>Strategy 3</b> : Replacing diesel based back up power/ peak power demand in industrial/ commercial establishments with gas based power across major load centres	<b>7.78 MMSCMD</b>
<b>Strategy 4</b> : Creating gas based capacities to support intermittency/ black outs associated with solar generation capacities. All new/existing commercial solar PV capacities to be supported by addl. 30 % of gas based generation.	<b>13 to 25.80 MMSCMD</b>
<b>Total additional Natural Gas required for the proposed strategy</b>	<b>66 to 78.82 MMSCMD</b>
<b>Operating Existing / Stranded Capacity at 60 % and Diesel Replacement alone can provide a gas demand of 53 MMSCMD</b>	

Such a strategy would also require a brief assessment of impact of the proposed strategy on power pricing, natural gas and LNG planning for the power sector under the proposed strategy and the affordability issues. Furthermore, we have to also undertake a more focused study on Distributed Generation evaluation in major centres as well as possible gas for Smart Cities. Regional level gas supply Infrastructure also needs to be studied and feasibility and creation of new transmission and distribution network need to be assessed.

## SECTION 2

# Gas Infrastructure – Need for an Integrated Strategy







## Section 2

### Gas Infrastructure – Need for an Integrated Strategy

#### 2.1 Gas Transmission and Distribution Pipeline Infrastructure - Status, Challenges and Future Plans

Indian natural gas sector is facing one of the major challenges in recent years in terms of lower quantum and sluggish growth in domestic gas production, challenges of under-utilisation of regasification and transmission pipeline infrastructure and global oil and gas market dynamics. Though gas industry in India has witnessed growth in terms of demand and infrastructure in the last decade, the growth has still remained limited to few regions and the pipeline and distribution infrastructure has remained confined to a few states in the West - North belt and erstwhile Andhra Pradesh in South. Some pragmatic policies and strategies by the government coupled with efforts to integrate with major countries of the world, coupled with the thrust by the government towards infrastructure development and investment, has truly given a growth impetus to the energy sector. This section review the current status of Gas Transmission Pipeline infrastructure, Gas Distribution Infrastructure and LNG regasification Infrastructure and the future plans along with the prospects and challenges.

#### 2.2 India Gas Transmission Infrastructure

India's Gas Transmission Infrastructure has been growing since the striking of the first long term LNG deal in late 1990s and supply of gas from new sources during the period 2001-2010. Additional arterial pipeline network on the HVJ corridor and the East - West corridor and the regional network in the Mumbai and Gujarat regions provided the necessary impetus to growth. The city gas distribution infrastructure also grew along these corridors and regions. As discussed earlier, the fall in domestic production and challenges of using high priced LNG had posed major challenges and the Pipeline utilization has dropped significantly since then. Table 8 shows the current status of gas transmission pipeline network and the capacity utilization:

**Table 8: India Gas Pipeline Infrastructure - An Overview**

S. No.	Pipeline Owner	Length (KM)	% Share
1	GAIL	11077	68.60%
2	RGTEL	1480	9.16%
3	GSPL	2612	16.17%
4	AGCL/OIL/DNPL	817	5.05%
5	IOCL	140	0.87%
6	ONGC	24	0.15%
	<b>TOTAL</b>	<b>16150</b>	<b>100.00%</b>

India Pipeline Infrastructure space is dominated by GAIL with a 68.6% share followed by RGTIL and GSPL with a combined share of about 25%. The three companies, amongst them, garner a dominant share of about 94%. One of the major challenges faced by these companies is the utilization of the pipeline infrastructure due to gas supply constraint in the country. All the three major players operate at lower capacity utilisation with GAIL operating at 43%, RGTIL at 21% and GSPL at a higher level of 59%. GSPL has been one of the success stories of the decade with a reasonably higher capacity utilisation since it is a state network and the created much earlier under the Gujarat Gas Act. Given the locational advantage, the state had the easiest access to both domestic and LNG sources. Most importantly, the state government played an important role to giving a thrust in expanding the network across the state.

**Table 9: India Gas Pipeline Infrastructure: Capacity Utilisation - 2016 - 17**

S. No.	Transporter	Length(KM)	Design Capacity (MMSCMD)	Average Flow (MMSCMD)	%Capacity Utilization 2016-17
1	GAIL	11077	242	104	43
2	RGTIL	1480	80	17	21
3	GSPL	2612	43	25.3	59
4	AGCL/OIL/DNPL	817	3	2.3	77
5	IOCL	140	10	4.3	43
6	ONGC	24	6	3.8	63
	<b>TOTAL</b>	<b>16150</b>	<b>384</b>	<b>156.7</b>	<b>41%</b>

In transmission pipeline segment, one of major enablers of growth and capacity utilization is the government policy and regulation besides regular access to multiple sources of gas and demand centres across the network. Regulations are expected to provide a fair and level playing field for operators while ensuring that the customers get regular supply at reasonable prices. At the same time, the regulation must facilitate investment and expansion of network by serious players keeping the economic viability in view. When such growth enablers are stifled, it has a direct impact on the pipeline capacity creation as well as utilisation. This issue is well brought out by the low capacity utilization of the existing pipeline network. Furthermore, such a status of current network would definitely have a negative impact on upcoming pipelines. Though government laid out ambitious plan to double the pipeline network and Indian pipeline companies have obtained authorisation for a no. of pipelines through PNGRB, the progress of construction of these pipelines has been very tardy, as reflected by the data provided in Table 11.

The data reflect that only Shadol- Phulpur has shown significant progress. All other pipelines have shown very little progress or no progress at all, as on March 2017. The pipeline which is currently showing speedier progress in recent months is the Jagdishpur - Haldia - Bokaro - Dhamra Pipeline (JHBDPL) given the thrust given by government for setting up City Gas

Networks in a no. of cities in the corridor in few of the states besides provision of Viability Gap Funding (VGF). With just 523 KM of construction out of the planned 13281 KM of pipeline network, it is a great cause for concern. Unless there is renewed government support and integrated planning to enable higher gas supply and pipeline capacity utilisation, there would be mounting challenges which would render this planned expansion, a Pipe Dream.

**Table 11: India Gas Pipeline Infrastructure under execution (March 2017)**

NETWORK/REGION	Entity	Length in Kms	Design Capacity (mmscmd)	Status of Pipeline laid (Km)
Kochi - Koottanad - Bangaluru - Mangalore	GAIL(India) Ltd.	1063	16	55
Dabhol -Bangaluru (DBPL)	GAIL(India) Ltd.	315	16	77
Surat - Paradip	GAIL(India) Ltd.		2112	750
Jagdishpur- Haldia-Bokaro-Dhamra (JHBDPL) (Phase-1 (755 KM), 7.44 MMSCMD capacity	GAIL(India) Ltd.	2539	32	87
Mallavaram – Bhilwada	GSPC India Transco Ltd.	2042	78	0
Mehsana - Bhatinda	GSPC India Gasnet Ltd.	2052	77	0
Bhatinda –Srinagar	GSPC India Gasnet Ltd.	725	42	0
Kakinada -Vizag- Srikakulam	A P Gas Distribution Corporation	391	90	0
Shadol-Phulpur	Reliance Gas Pipelines Ltd.	312	4	304
Ennore- Nellore	Gas Transmission India Pvt. Ltd.	250	36	0
Ennore- Thiruvallur-Bengaluru-Puducherry-Nagapattinam-Madurai-Tuticorin	Indian Oil Corporation Ltd.	1385	85	0
Jaigarh-Manglore	H-Energy Pvt. Ltd.	635	17	0
<b>Total</b>		<b>13821</b>	<b>568</b>	<b>523</b>

## 2.3 India Gas Distribution Infrastructure

The City Gas Distribution (CGD) sector has been a growing sector in the last decade and in terms of % share in gas portfolio, CGD has shot up from less than 5% before 2005 to about 15% in 2017. In terms of potential, this sector offers a major growth area. An overview of the Piped Natural Gas (PNG) and Compressed Natural gas (CNG) sectors is given in Table 12 and 13.

**Table 12: Piped Natural Gas (PNG) Overview**

No. of States Covered	No. of Cities GAS covered	No. of Companies	No. of Connections		
			Domestic	Commercial	Industrial
14	61	21	35.86 Million	21990	6670

**Table 13: Compressed Natural gas (CNG) Consumption**

No. of States Covered	No. of Companies	Consumption('000MT)		
		2014-15	2015-16	2016-17
12	20	2037	2155	2365

In PNG, though 61 Geographical Areas (GAs) are covered in 14 states, 97.6% of the connections are confined to just 5 states - Delhi NCR, Gujarat, Maharashtra, Uttar Pradesh and Haryana. In CNG sector, four states - Delhi NCR, Gujarat, Maharashtra and UP - garner a share of 92% of total consumption though 20 companies operate in 12 states. This brings us to the point regarding the volume growth of this sector and efforts that are required to be undertaken in other cities / states other than the 4-5 consumption centres.

Three major issues pose a major challenge for the growth and expansion of PNG and CNG in other states. One is the availability of Gas and the second is development of infrastructure. The third major factor is the demand for PNG and CNG in these states. In the case of developed cities, CNG and Industrial / Commercial PNG Consumers form the major share of gas consumption. Domestic PNG, though large in terms of nos., consumption very limited volumes.

For addressing pollution issue, major thrust has been given by the government in major cities. In case of Delhi and Mumbai, the SC order mandating CNG usage gave the necessary impetus. For promoting CNG in other states, similar government mandate needs to be done, especially in metro, capital and other developed cities. This is also important from the pollution control perspective. Also a thrust to usage of CNG and PNG by government can step up volumes and make it viable for CGD developers.

With government plans to reach 1 crore households in 5 years and expand to more than 100 GAs, it is important that policy and appropriate regulatory structures are in place to enable growth in the sector.

## 2.4 LNG Re-gasification Infrastructure: Market Dynamics and Strategic Implications

LNG supply has been on a growth trajectory as discussed in an earlier section. To recapitulate, India's imports of LNG is on the increase since 2010-11 from a level of 35.32 MMSCMD (approx.10.1 MMTPA) to 67.64 MMSCMD (19.32 MMTPA approx.) in 2016 -17. In terms of % share, from a level of 20%, LNG share has increased 44.5 % during the same period. While the share had further jumped in April 2017 to 47.06%, it has actually come down during May 2017, primarily contributed by drop in LNG consumption by power sector due to withdrawal of subsidy scheme for power sector during the 2017-18 budget. Under this scheme, power sector was consuming almost 9 MMSCMD of LNG. Another important factor to note is that there was significant jump in LNG imports in the last two years (between 2014-15 and 2016-

17) from 50.78 MMSCMD to 67.64 MMSCMD, an increase of 16.86 MMSCMD (4.8 MMTPA), with increased consumption of Spot and Short Term LNG due to global fall in LNG prices and driven by power sector consumption.

### India's long-term LNG Deals

India currently has a long term deal of 8.5 MMTPA with Qatar which is operational since 2004. In addition, India has four major LNG long term deals in pipeline, which are most likely to come in the next 2-4 years:

- Australia Gorgon LNG: 1.44 MMTPA with a price formula of 14.85% of Brent Crude (FOB) likely to commence in 2017-18. It has recently been re-negotiated given the current market conditions.
- US Sabine Pass LNG from Cheniere: 3.5 MMTPA at a price formula of 115% HH + \$3 / mmbtu (FOB) - Commencement of supply in 2018/19.
- US Dominion Cove Point: 2.3 MMTPA which is a Tolling Agreement wherein India will buy gas at HH price and supply to terminal and would pay a liquefaction charge of \$3 / mmbtu to the terminal operator - Supply in 2019/20
- Russia Gazprom Marketing: 2.5 MMTPA at 13.5% of Crude price (yet to be firmed up due to delays in timing and source of supply and under discussion)

India's committed supply is 7.24 MMTPA from Australia and USA which is due for delivery between 2017 and 2019/20.

In terms of LNG re-gasification infrastructure, India has an existing capacity of 15 MMTPA in Dahej, 5 MMTPA in Hazira, 5 MMTPA in Dabhol and 5 MMTPA in Kochi, totalling to 30 MMTPA. Of the existing capacity, Dahej and Hazira are well utilized whereas Kochi has remained almost unutilized due to lack of pipeline connectivity to demand centres in the states of Kerala, Tamil Nadu and Karnataka. Dabhol experiences seasonal utilization due to lack of breakwater facility though it has pipeline connectivity.

In terms of expansion, there are major plans for expanding the LNG terminal capacities in the country. In the case of new LNG terminals, no. of companies are planning to set up capacities, especially on the east coast. The existing and planned terminals with forecasted timelines based on Industry and company reports are presented in Table 14:



**Table 14: India Regasification Capacity Forecast**

Terminal	Company	2015	2016	2017	2018	2019	2020
Dahej (Existing)	Petronet LNG Ltd.	12.5	15	15	15	15	20
Hazira (Existing)	Shell/Total	5	5	5	5	5	5
Dabhol (Existing)	RGPPL	5	5	5	5	5	5
Kochi (Existing)	Petronet LNG Ltd.	5	5	5	5	5	5
Mundra	GSPC/Adani	0	0	0	5	5	10
Ennore	Indian Oil Corporation	0	0	0	5	5	5
Digha	H-Energy	0	0	0	0	0	4
Jaigarh	H-Energy	0	0	0	0	0	4
Dhamra	Adani - IOC - GAIL	0	0	0	0	0	0
Pipavav	Swan Energy	0	0	0	3	3	5
Kakinada	GAIL/APGDC /Shell	0	0	0	0	0	3.5
<b>Total</b>		<b>27.5</b>	<b>30</b>	<b>30</b>	<b>43</b>	<b>43</b>	<b>66.5</b>

If all the terminals come as per schedule, it is expected that the regasification capacity in the country will more than double from the current 30 MMTPA to 66.5 MMTPA by 2020. Given the market conditions in the gas market, many of the planned terminals are already unduly delayed and it is not very certain how many terminals would come up in the next three years.

From the table above, a quick account of each of the terminals are given below:

- PLL's Dahej Terminal and Shell's Hazira terminals are the fully operating terminals. Dahej terminal has expanded from 10 MMTPA to 15 MMTPA in the last four years and operates at a very high capacity utilisation. So is the Hazira Terminal. Since these two terminals are connected to an arterial pipeline network with many major customers along the pipeline, they are fairly well utilized.
- The Dabhol terminal still does not have breakwater facility and hence its capacity utilization has only been seasonal for the last few years.
- PLL's Kochi terminal has negligible utilisation since its commissioning in 2013 because there is no Pipeline network to the markets because of problems of land acquisition and some demand side issues.
- GSPC / Adani's Mundhra terminal of 5 MMTPA capacity on the west coast is on the verge of completion and must be commissioned by early 2018. In terms of customer tie-up or capacity booking, it is still uncertain though there is pipeline connectivity in the region. GSPC / Adani is looking to make it a tolling terminal.

- IOC's Ennore terminal is also under construction and is expected to be commissioned by 2018 end. IOC has also got a pipeline authorisation in the southern region. But in terms of customer tie-up, it is not done yet expect its own refinery and Madras Fertilizers. Again, IOC has not yet tied up LNG supply.
- H-Energy terminals at Digha in east Coast and Jaigarh in West coast are FSRU terminals and the company has also got authorisation for two pipelines. Here the major challenge is the customer tie-up. H-Energy's terminal in Digha competes with the other planned terminal in Dhamra by Adani / IOC / GAIL as there is certain overlap of customer segments.
- The Dhamra terminal is in initial stage and is being planned based on anchor demand of the three refineries of IOC and planned pipeline linkage of GAIL.
- Swan Energy's Pipavav is an FSRU terminal and it is reported to have tied up some portion of its capacity.
- GAIL's Kakinada terminal is still in an uncertain stage as it is under planning for the last 4 years.

From the above it is clear that 4 -5 terminals might see the light of the day but the demand and customer tie-ups are in an uncertain zone. The uncertainty of LNG demand can be summarized as below:

- What is actual demand and who are the anchor customers - none of the terminals are able to ascertain and lock up demand. All new terminals are looking to sectors like Refinery, Petrochemicals and CGD as their main demand base because of challenges associated with Power and Fertilizer sectors.
- Power sector was supported by a subsidy scheme but the moment it is withdrawn, the demand for LNG is expected to fall in that sector.
- Indian customers are unwilling to sign in long term contracts for LNG given the dynamic market conditions and prevalence of low oil and LNG spot prices. Given the uncertain global oil and gas markets, Indian customers are well informed and unwilling to commit to long term contracts
- In some cases, the pipeline infrastructure is unavailable and therefore no connectivity to markets.

## 2.5 Transnational Pipeline Infrastructure

- India has been, both in the past and currently, evaluating a no. of options of gas supply through Transnational pipelines
  - Turkmenistan - Afghanistan - Pakistan - India Pipeline (TAPI)

- Iran - Pakistan - India Pipeline (IPI)
  - Iran - India Pipeline (with Oman Link)
  - Russia - India Pipeline via Iran / Middle East
- In case of TAPI, though GSPA was signed 4 years ago, the commercial terms were yet to be frozen. Of late, TAPI has been going through a major issue of security concerns of passing through Pakistan
  - IPI has been formally shelved by the government due to security considerations
  - Russia - India pipeline Pre-Feasibility presented highlighted both technical and commercial challenges in terms of higher price of Gas though an option of routing via Middle East is being considered.
  - Iran - India Pipeline has been found to be the most technically and economically viable alternative. India has taken a clear stand on bilateral relations with Iran that certain of its strategic investments in upstream - Farzad B Block and Port and logistics have to be honoured by Iran along with adherence to principles of peace in the region.

Given the challenges faced by LNG terminal investors in tying up demand for LNG in India, the transnational pipelines would really face major challenges because of the huge investment involved and the price and market competition faced by them in Indian gas markets. Recent reports indicate the Middle East India Deepwater Pipeline (MEIDP) does offer a competitive pricing option.

## SECTION 3

# Acceleration towards a Gas Economy: A Strategic Road Map







## Section 3

# Acceleration towards a Gas Economy: A Strategic Road Map

Based on the foregoing analysis about the current status, issues and forecast of the Indian Gas Infrastructure sector, it is quite clear that the sector would need an integrated planning in the context of the overall development of the Indian Energy Sector and evolving a clear strategy for enhancing gas usage in the current and new areas of gas consumption. This in turn would require development of a robust and extensive gas transmission and distribution infrastructure. This section brings out the key challenges of developing such a robust and extensive infrastructure and also provides key pointers for the road ahead.

### 3.1 Challenges for developing Gas Infrastructure in India

- Demand side challenges and need for assessment of realistic demand under the current market conditions and pricing regimes. The realistic demand assessment needs to look at the sectoral dynamics for each of the potential consumption sectors to enable development of a strategy for creation and utilisation of infrastructure. As we had seen earlier, power sector has remained out of focus for gas supply for many years and Fertilizer sector provides minimum scope for growth. That leaves us with the other sectors like CGD, Refinery, Petrochemicals and Industries as the only potential demand sectors and therefore, a objective and detailed assessment of demand is needed.
- Gas Infrastructure development would need an integrated planning to enable better utilisation and economic viability. Due to lack of integrated approach, the development of the sector has remained lopsided.
- Under-utilisation / non-utilisation of the already created pipeline and LNG infrastructure - As we had seen earlier, overall capacity utilisation of the transmission pipeline in India is 41% with certain arterial pipelines like Dabhol - Bangalore Pipeline and east - west pipeline remaining significantly under-utilised. LNG regasification terminals at Dabhol and Kochi are also facing gross under-utilisation.
- Global Market dynamics in the last 3 years have posed a no. of market related challenges - vanishing of premium in gas indexed contracts vis-à-vis oil indexed contracts due to steep fall in oil prices and reluctance of end use customers to enter into long term agreements. Also slow development of infrastructure and uncertainty are also forcing customers to adopt a more cautious strategy.
- Many recently bid-out and awarded pipelines and CGD GAs have not progressed at all in spite of PNGRB stipulated timelines, due to various market related challenges though the developers have gone ahead with bidding and won the authorization. This has put the whole system of bidding and authorization under serious question.

- Given the under-utilisation and viability issues with the pipeline and CGD infrastructure, developers are constrained and they are unwilling to commit and create new infrastructure. Three major challenges here are the economic viability, customer tie-up of anchor demand and no visibility of assured gas supply. Here gas Supply, Pricing and Infrastructure hold the key in getting the development process going.
- Though global experience has shown that infrastructure development often precedes gas demand / usage, lack of integrated planning across the value chain right from gas supply and demand tie-ups has rendered the gas sector development skewed and slow.
- Lack of integrated energy planning is another major challenges, which generally has maximum impact on the gas sector. As we have seen, the gas sector plans are often de-linked from the power and coal sector planning process. For example, marketability of gas based power has always been a challenge vis-à-vis coal based power. Also government's plan to step up coal production to 1 Billion MT while simultaneously targeting creation of 175 GW of Renewable Energy and increasing gas usage from 6% to 15% over the same period, may pit each of these sectors against each other if no integrated planning is in place.
- Long term development of infrastructure will require a strong regulatory structure as experienced in major global gas markets. This is another challenge in India. The regulatory body has to be a key enabler for growth, with clear responsibilities of oversight rather than that of a controller. The regulatory body has to be fully equipped and staffed with clear roles and responsibilities. For most part of last decade, India has faced regulator related challenges in the all the above areas discussed.
- Gas markets are generally developed based on four major pillars - 4 A's.
  - Availability (Commodity)
  - Accessibility (Infrastructure)
  - Affordability (Price and Economics)
  - Acceptability (Minimal Uncertainty)

In India, these 4 A's have been posing a major constraint for many years now and need to be addressed.

- Long term development and targeted development has been a major challenge.
  - Regulations envisaged open access and unbundling over a period of time but has not come through for years, contributed also by constrained gas sector development.
  - Gas pricing had gone long periods of uncertainty till 2014.
  - Planned Infrastructure development and moving towards a market based pricing

which were in the government's agenda in the past, have not progressed as envisaged.

### 3.2 Road Ahead - Steps towards building a gas Based Economy

One of the fundamental requirement for building a gas based economy is integrated planning, institutional strengthening, stable and robust regulatory structure and key policy initiatives to support investment and drive growth. This section lists down some specific steps and pointers on various aspects of infrastructure in order to accelerate towards a gas based economy.

- Government Policy to incentivize upstream players for increasing production from existing, mature fields through strategies like EOR etc. To encourage investments in EOR and enhancing production, government can consider suitable financial incentives and tax breaks.
- More sectoral focused gas pricing strategy with the current trend of increasing LNG usage in the country. Power sector is a case in point, wherein any strategy of gas supply must look at entire chain to enable dispatchability of gas based power.
- Alternate strategies to reach out to larger section of gas industries and users through technologies like LNG by road, LCNG, LNG as transportation fuel etc, which have been gaining traction worldwide.
- Encouraging FSRU investments given its advantage of faster implementation time, lower investment cost and flexibility. Globally, FSRUs are growing more rapidly in recent years.
- Making new upstream investments attractive through multiple / differential pricing methods besides marketing and pricing freedom. Government has already announced marketing freedom and market based pricing under HELP.
- A more structured planning for introducing Renewable Energy along with environment friendly natural gas. The usage of such power need to be encouraged and where required, mandated through purchase obligations.
- Detailed study and phased approach to introduce gas based power to replace diesel as back-up power in various industrial and residential clusters. Greater penetration of gas pipeline and distribution infrastructure, usage of efficient gas engines and distributed power technologies must be introduced in a planned manner.
- While reviewing the current authorisation procedure for CGD, the focus should be on bringing serious players in to the fold. Unreasonable bidding and non-implementation of CGD due to poor economic viability have to be curbed through a well planned and efficient mechanism of authorisation.
- Strategies like selective Viability Gap Funding (VGF), suitable commercial intervention in power sector and policy support to CGD development must continue in order to give the

necessary momentum to the gas sector and gas based industries.

The strategies proposed above are the macro level strategies, to enable the industry to gain initial momentum. More specific road map to be drawn up and implemented as proposed below:

- Clear Roadmap for accelerated development for pipeline and CGD infrastructure along with Regasification Terminal development on the supply side. This would require a simultaneous strategy to step up capacity utilisation through a planned gas sourcing strategy.
- Utilisation of existing gas infrastructure and creation of a national level network would need a special focus on developing domestic gas supply sources. A fair share of domestic gas supply as part of overall gas portfolio is very important in the current market scenario.
- Realistic assessment of demand for various sectors is another key factor. Given the fact that LNG has taken a significant share in the overall gas portfolio and is set to increase further and with the domestic resource development taking time to develop, it would be prudent to plan the overall development, economics and usage based on fair share of LNG in the portfolio.
- In the background of current global market conditions and Indian gas markets discussed earlier, three important steps are necessary:
  - Increased role of government in development of infrastructure through some measures of budgetary support and VGF
  - Policy reforms to enable gas usage in key sectors like power through appropriate government intervention
  - Overall revamp of the existing regulatory regime and creating of a more proactive regulator
- Specific steps for Policy and Regulatory arena
  - Integrated planning for creation of National Gas Grid
  - Standard network access code with defined principles of Third Party Access (TPA) and system integration among various operators of pipeline network.
  - Enabling environment for creating and operating the National gas Grid while simultaneously planning time-bound transition towards a market based pricing mechanism, unbundling and TPA / Open Access.
  - Review of current process of authorisation and development of an appropriate model for authorisation and development of infrastructure. A robust structure and regulatory mechanism will effectively contribute to dispute resolution
  - Overall, there is a need to introduce and sustain a consistent, reliable and transparent regulatory regime







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## **Contact Us:**

FICCI Hydrocarbons Division

Federation of Indian Chamber of Commerce and Industry

Federation House, 1, Tansen Marg, New Delhi – 110 001

T: +91-11-23487583 / 23487384

E: [vivek.pandit@ficci.com](mailto:vivek.pandit@ficci.com) / [v.vaidhyanathan@ficci.com](mailto:v.vaidhyanathan@ficci.com) / [mahima.tyagi@ficci.com](mailto:mahima.tyagi@ficci.com)

W: [www.ficci.in](http://www.ficci.in)