



# PETROTECH-2019

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Greater Noida, Delhi - NCR, India

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## Shaping the New Energy World through Innovation & Collaboration

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Theme Session

Unlocking gas potential - New business models

Knowledge Partner: McKinsey & Company





# Unlocking gas potential - New business models



# Executive Summary

Efficient, easy to transport and with a high calorific value, natural gas could play an important role in a clean energy future for India. The country is already home to 22 of the world's 50 most polluted cities<sup>1</sup>. Realizing the perils in this scenario, and committed to protecting the environment, the Indian government has announced the aspiration to increase its share of natural gas in the overall energy consumption mix to 15 percent<sup>2</sup>, compared to the 2017 figure of 6.2 percent<sup>3</sup>, as one of its important initiatives for a more sustainable future<sup>4</sup>.

Robust and proactive efforts to boost the use of natural gas could help India march towards meeting this aspiration. These could also be some of the most important levers to help the country reduce its carbon footprint by 33 to 35 percent from its 2005 levels<sup>5</sup>, fulfilling its commitment to the United Nations Framework Convention on Climate Change (2015)<sup>6</sup>.

## THE DECLINING SHARE OF GAS IN INDIA'S ENERGY MIX

While India aspires to increase the share of natural gas in its energy basket, the share of gas in India's primary energy mix has been dropping, from 10 percent in 2010 to 6.2 percent in 2017 (Exhibit A)<sup>7</sup>. The total gas consumption has reduced from 162 mmscmd in FY 2011 to 145 mmscmd in FY 2018 (Exhibit B).

<sup>1</sup> "22 of the world's most polluted cities are in India", Shashank Bengali, *LA Times*, 12 May 2016, <https://www.latimes.com/world/asia/la-fg-india-polluted-cities-20160512-snap-story.html>

<sup>2</sup> "On road to a gas-based economy?", MP Sukumaran Nair, *The Hindu Business Line*, 18 December 2018, <https://www.thehindubusinessline.com/opinion/on-road-to-a-gas-based-economy/article25765361.ece>

<sup>3</sup> *BP Energy Outlook*, 2018 edition, <https://www.bp.com/content/dam/bp/en/corporate/pdf/energy-economics/energy-outlook/bp-energy-outlook-2018.pdf>

<sup>4</sup> "On road to a gas-based economy?", MP Sukumaran Nair, *The Hindu Business Line*, 18 December 2018, <https://www.thehindubusinessline.com/opinion/on-road-to-a-gas-based-economy/article25765361.ece>

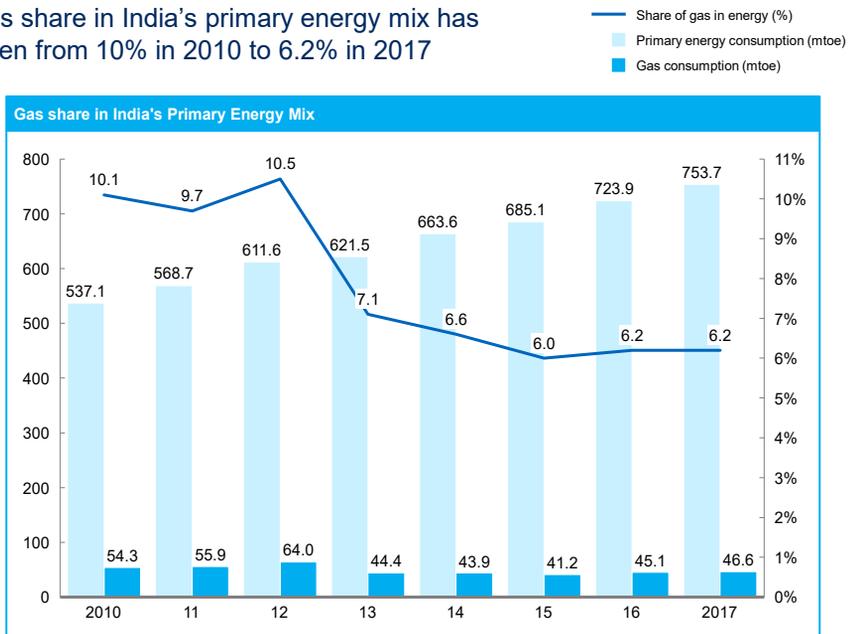
<sup>5</sup> "National Electricity Plan, Ministry of Power", Government of India, January 2018, [http://www.cea.nic.in/reports/committee/nep/nep\\_jan\\_2018.pdf](http://www.cea.nic.in/reports/committee/nep/nep_jan_2018.pdf)

<sup>6</sup> "US and India step up cooperation on climate change", United Nations Framework Convention on Climate Change, 26 January 2015, <https://unfccc.int/news/us-and-india-step-up-cooperation-on-climate-change>

<sup>7</sup> *BP Energy Outlook*, 2018 edition, <https://www.bp.com/content/dam/bp/en/corporate/pdf/energy-economics/energy-outlook/bp-energy-outlook-2018.pdf>

EXHIBIT A

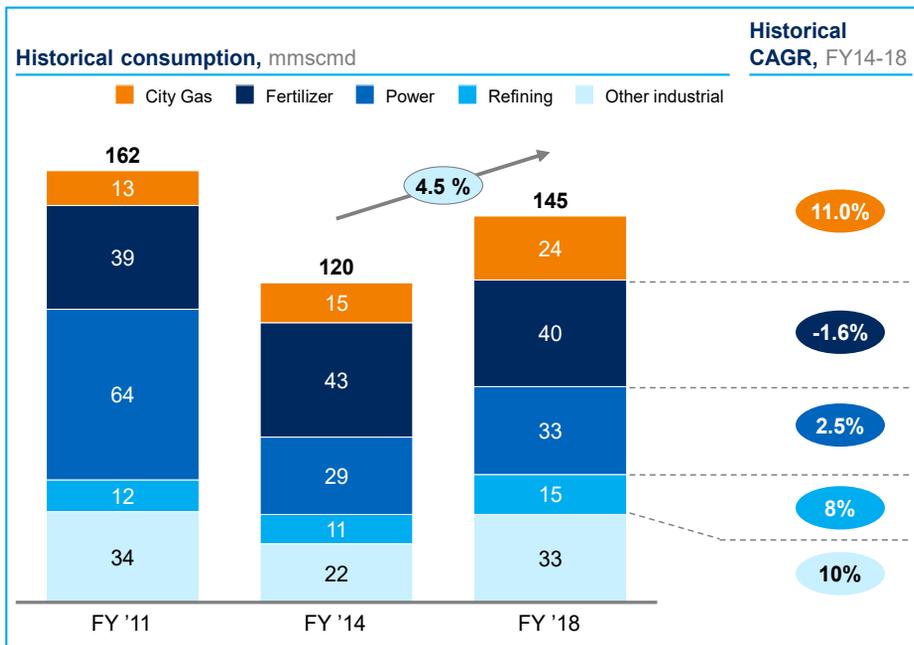
Gas share in India's primary energy mix has fallen from 10% in 2010 to 6.2% in 2017



SOURCE: BP outlook 2018

EXHIBIT B

Evolution of natural gas consumption in India

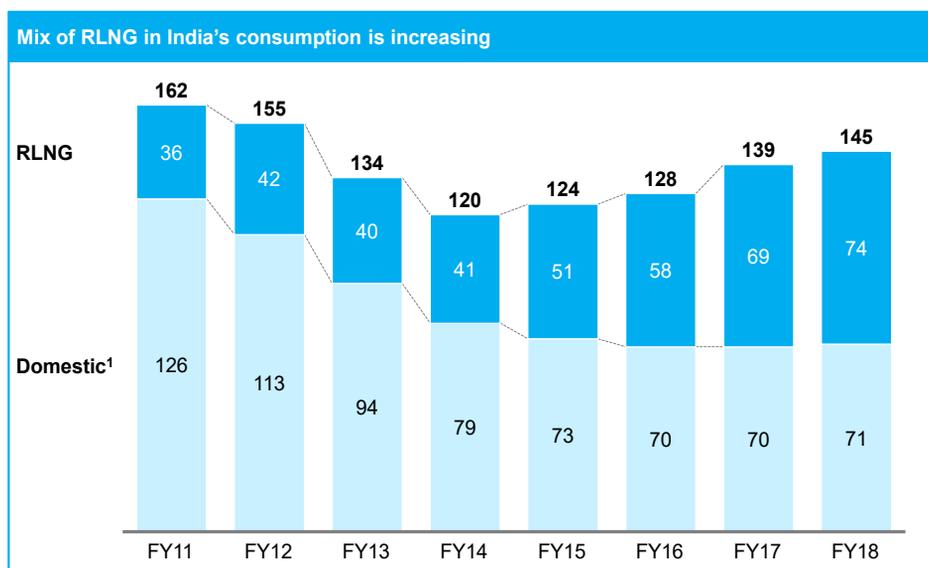


SOURCE: Analysis based on data from MOPNG, WoodMac UDT, UDI, Expert interviews, Fertecon Ammonia Outlook, IHS

Multiple challenges have affected the growth of gas in India. A drop in domestic production has led to domestic gas being replaced by more expensive, imported Liquefied Natural Gas (LNG) (Exhibit C), which is costly versus the alternative fuels used in many sectors. This has restricted gas consumption despite high latent demand. A constrained outlook for consumption is limiting investments and prompting the postponement of infrastructure development projects. This has caused a logjam for the gas market.

## EXHIBIT C

Import dependence on RLNG has been increasing given domestic production has declined



SOURCE: Analysis based on data from GAIL investor presentation, Expert discussions

### Falling domestic production is largely responsible for a decreased share

The domestic production of natural gas has reduced by 46 percent since 2011, falling from 126 mmscmd in FY 2011 to 71 mmscmd in FY 2018<sup>8</sup>. FY18 saw a minor uplift, but this was insufficient to even meet the growth in consumption in the same year, resulting in higher imports in FY 2018 (Exhibit C).

<sup>8</sup> "Investors' presentation", GAIL India Ltd., April 2018, [http://www.gailonline.com/pdf/InvestorsZone/Analyst\\_Presentation/Investors%20Presentation\(ND%20Road%20show\)%20April%202018.pdf](http://www.gailonline.com/pdf/InvestorsZone/Analyst_Presentation/Investors%20Presentation(ND%20Road%20show)%20April%202018.pdf)

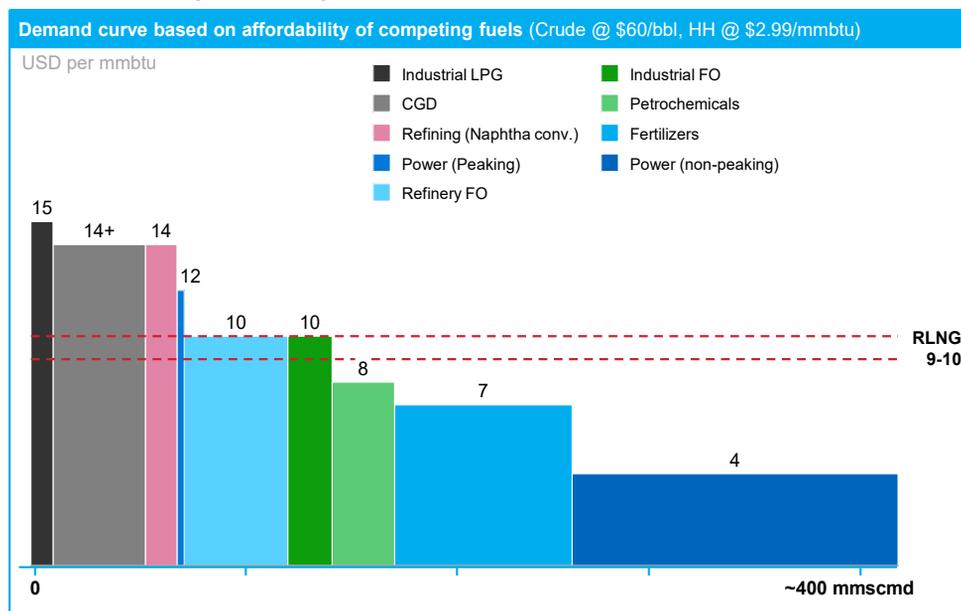
## Imported LNG is not viable for most sectors

In many key consumer segments, LNG is not a commercially viable alternative to cheaper (if polluting) fuels like coal, furnace oil (FO), pet coke and naphtha. As an example, gas-based power plants operated at a capacity utilization or plant load factor (PLF) of about 23 percent on a national average<sup>9</sup>, but 31 gas-based power plants—a total capacity of 14,305 megawatts—struggled or were stranded at nil to very low capacity utilization in 2018<sup>10</sup>.

The high price of LNG makes it economically unviable for many important end-use segments. As a result, although latent demand in India is estimated to be over 400 mmscmd, consumption is limited to 145 mmscmd (Exhibit D).

### EXHIBIT D

The low affordability of RLNG, compared to other fuels, has been one of the barriers to growth in gas consumption in India



SOURCE: Analysis based on data from Expert discussions

## Lack of infrastructure in some areas

<sup>9</sup> "PLF of gas-fired power plants likely to decline further: Ind-Ra", *The Hindu Business Line*, 8 January 2018, <https://www.thehindubusinessline.com/economy/plf-of-gas-fired-power-plants-likely-to-decline-further-indra/article9901660.ece>

<sup>10</sup> "Lack of gas, high cost 'stranded' more than half of India's gas-based power plants", Kiran Pandey, *DownToEarth*, January 18, 2019, <https://www.downtoearth.org.in/news/energy/lack-of-gas-high-cost-stranded-more-than-half-of-india-s-gas-ased-power-plants-62854>

Multiple pipeline and infrastructure projects awarded by the Petroleum and Natural Gas Regulatory Board (PNGRB) have not achieved financial closure<sup>11</sup>. For example, financial closure issues with the Surat-Paradip pipeline led to the PNGRB cancelling the license for the project in 2018<sup>12</sup>. Delays often occur on account of the outlook on insufficient capacity utilization, resulting from a slow consumption offtake. This means that many areas of potential demand remain unconnected. In many geographical areas, City Gas Distribution (CGD) expansion has been slow due to delays in securing multiple clearances and post bidding financial challenges for some of the new CGD entities<sup>13</sup>.

## UNLOCKING INDIA'S GAS POTENTIAL: ASPIRING FOR A 15% SHARE IN THE ENERGY MIX

It is estimated that "Business as Usual" (BAU) would result in a very minor increase in the gas share in the energy mix, i.e., to about 7 percent by 2030<sup>14</sup>. Concerted, discontinuous actions across sectors could help propel Indian gas consumption closer to its 15 percent aspiration.

### Business-as-usual scenario

As per projections, in a BAU scenario, gas could form less than 7 percent of India's expected total energy mix by 2030<sup>15</sup>. In this scenario, India's gas consumption could grow at around 5 percent to reach 270 mmscmd by FY 2030 (Exhibit E).

The highest contributors to this growth could be CGD (automotive and domestic consumption) and refining, while fertilizers, power and other industrials could make up the rest.

<sup>11</sup> "Natural gas shortage hits pipeline projects", Siddhartha P Saikia, *Financial Express*, 15 April 2015, <https://www.financialexpress.com/economy/natural-gas-shortage-hits-pipeline-projects/63776/>

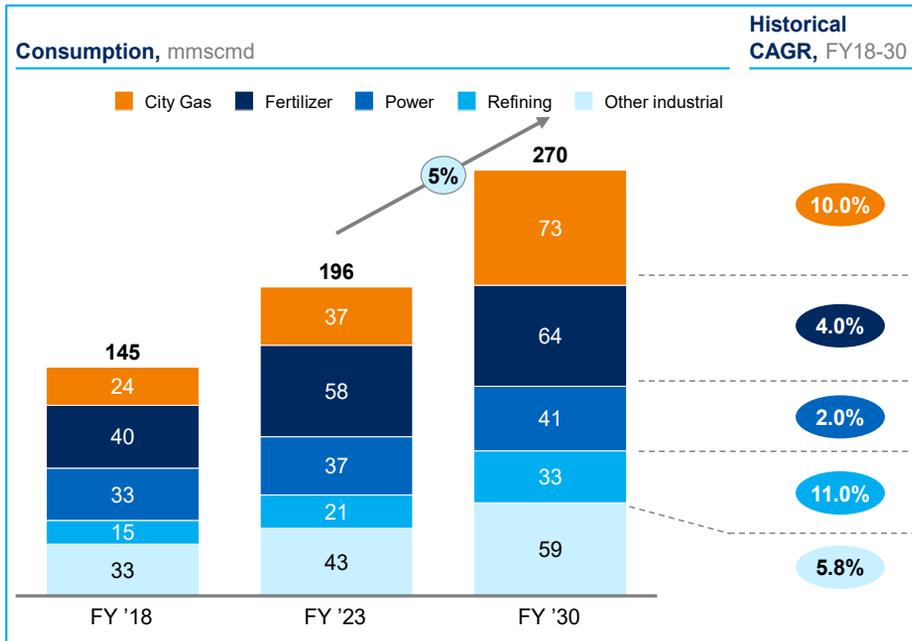
<sup>12</sup> <https://economictimes.indiatimes.com/industry/energy/oil-gas>

<sup>13</sup> "New board member for PNGRB; Eighth CGD bidding round delayed due to lack of quorum", Bilal Abdi, *The Economic Times*, 27 July 2017, <https://energy.economictimes.indiatimes.com/news/oil-and-gas/new-board-member-for-pngrb-eighth-cgd-bidding-round-delayed-due-to-lack-of-quorum/59791726>

<sup>14</sup> *Transforming energy to transform India*, McKinsey & Company, 2016

<sup>15</sup> "Investors' presentation", GAIL India Ltd., April 2018, [http://www.gailonline.com/pdf/InvestorsZone/Analyst\\_Presentation/Investors%20Presentation\(ND%20Road%20show\)%20April%202018.pdf](http://www.gailonline.com/pdf/InvestorsZone/Analyst_Presentation/Investors%20Presentation(ND%20Road%20show)%20April%202018.pdf)

In a BAU scenario, India’s gas consumption could grow by 5% till 2030



SOURCE: Analysis based on data from MOPNG, WoodMac UDT, UDI, Expert interviews, Fertecon Ammonia Outlook, IHS.

### Discontinuous shifts could spur gas consumption

Boosting the share of gas in the primary energy mix to a 15 percent target could mean growing gas consumption to 550 to 600 mmscmd by 2030—an additional increase of 280 to 330 mmscmd. While this seems like a stretch goal for 2030, five focus areas could support India to move towards achieving this aspiration.

### Power

In energy consumption terms, India’s gas-based power is 3 percent of the total power consumption<sup>16</sup>. If existing plants could run at 50 percent PLF, and if the entire 4 GW gas-based power plant capacity that is under construction comes online in the long run again to achieve a 50 percent PLF, the power sector could generate around 29 mmscmd of additional gas demand over BAU<sup>17</sup>.

<sup>16</sup> "National Electricity Plan, Ministry of Power", Government of India, January 2018, [http://www.cea.nic.in/reports/committee/nep/nep\\_jan\\_2018.pdf](http://www.cea.nic.in/reports/committee/nep/nep_jan_2018.pdf)

<sup>17</sup> Analysis based on data from the "National Electricity Plan, Ministry of Power", Government of India, January 2018, [http://www.cea.nic.in/reports/committee/nep/nep\\_jan\\_2018.pdf](http://www.cea.nic.in/reports/committee/nep/nep_jan_2018.pdf)

## Transportation

A determined push to improve the availability and use of Compressed Natural Gas (CNG) and LNG for transportation could be an important enabler for higher gas consumption. If half the fleet vehicles in India shift to CNG and 10 percent of the trucks and inter-city buses adopt LNG as fuel, the sector could generate around 82 mmscmd of additional gas demand over BAU<sup>18</sup>.

## Cooking: Replacing LPG

Over 88.5 percent of households in India got LPG connections in 2018, accounting for around 25 mtpa of LPG demand<sup>19</sup>. A push to grow the CGD network over the next 10 years, with the aim of replacing 60 percent of only urban LPG demand with Piped Natural Gas (PNG), could increase India's natural gas consumption by 61 mmscmd<sup>20</sup> over BAU.

## Replacing FO across industries

If natural gas replaces up to 50 percent of FO, superior kerosene oil, light diesel oil and the low sulphur heavy stock (LSHS) consumed by industries, gas consumption could increase by 19 mmscmd<sup>15</sup>.

## Mixed feedstock for petrochemicals

India's petrochemical industry consumed around 10.3 mtpa of naphtha in 2017<sup>21</sup>. It is estimated that India's petrochemicals capacity will grow by 3 to 4 percent year on year<sup>22</sup>. If 33 percent of this capacity was to be gas based (gas-based plants or mixed feed), it could add 4 mmscmd of gas consumption by 2030<sup>23</sup>.

## ACTIONS THAT COULD DRIVE GROWTH

Discontinuous shifts in the power, transportation, city gas and petrochemicals sectors could help India bridge the gap between aspirations and projections in the BAU scenario. Actions to improve viability, boost domestic production,

<sup>18</sup> Analysis based on data from SIAM, IHS and Petroleum Planning & Analysis Cell (PPAC)

<sup>19</sup> "LPG penetration in Northeast to cross 80 per cent by March 2019", Press Trust of India, *The Economic Times*, 16 October 2018, <https://economictimes.indiatimes.com/industry/energy/oil-gas/lpg-penetration-in-northeast-to-cross-80-per-cent-by-march-2019/articleshow/66237109.cms>

<sup>20</sup> Analysis based on data from PPAC

<sup>21</sup> Sector-wise Consumption (End use) of Naphtha from 2010-11 to 2016-17, <https://data.gov.in/resources/sector-wise-consumption-end-use-naphtha-2010-11-2016-17>

<sup>22</sup> Ethylene and propylene capacity

<sup>23</sup> Analysis based on data from ICIS, IHS and PPAC

support infrastructure-building and technology interventions could help make these discontinuous shifts.

### Improving the economic viability of natural gas in India

The economic viability of natural gas could stimulate gas demand across all sectors. Efforts are already underway to increase domestic production by accelerating the development of discovered fields, including many small fields considered unviable till now. There has also been a concerted push to increase exploration activity through an easier to administer licensing regime. Bringing this gas to market sooner through faster approvals and infrastructure development could be considered.

Making transnational pipelines a reality (land and sub-sea) and reducing the domestic transportation cost through a unified tariff mechanism could be considered to help drive down transportation cost. Some other actions that could be initiated or accelerated include introducing contracting mechanisms to reduce take-or-pay risk for buyers while protecting the interests of sellers, creating a win-win price for additional domestic gas for suppliers and consuming sectors, and creating a gas exchange to improve liquidity.

### Supporting the development of natural gas infrastructure

The rapid completion of the National Gas Grid with innovative funding mechanisms could be considered to help connect demand centres that would remain unconnected beyond the current network and ongoing builds.

Faster completion of the remaining CGD bidding, increasing the number of CNG refuelling stations and introducing LNG fuelling terminals along highways to facilitate LNG as trucking fuel are some infrastructure-related initiatives that could be considered.

### Considering some more policy initiatives to bolster gas consumption

Downstream sector reforms such as differential pricing for peak power demand and supporting the creation of an ancillary market in the power sector, awareness campaigns to promote the use of gas-based appliances like air-conditioners, heaters, geysers, etc., for PNG connected homes and CNG corridors could also spur gas demand.

Promoting the conversion of FO-based, LSHS-based and naphtha-based plants to gas, and a policy push to facilitate LNG vehicles on highways and CNG vehicles in urban centres might be some other initiatives that could be considered.

## Pushing technologies that realize the potential of gas

The government and industry could consider collaborating to develop new technologies to aid the consumption of gas. Some initiatives could be developed and evaluated such as working on specialized tanks that use adsorbed natural gas to help expand the CNG fuelling network, promoting the development of LNG-based vehicles and better LNG supply infrastructure, and encouraging research on better CNG engines and tanks.

□ □ □

A strategic and concerted push across high-potential areas could help stimulate a rise in the overall consumption of natural gas. This could enhance self-sufficiency and help increase the presence of this clean, environment-friendly fuel in India's energy mix.



# The declining share of gas in India's energy mix

Natural gas is one of the cleanest fuels compared to other hydrocarbon-based fuels, making it one of the preferred energy sources across the world. It ranks third after oil and coal as a global energy source; it accounts for 24 percent of the world's primary energy needs; and its biggest use (up to 40 percent) is to produce power or electricity<sup>24</sup>.

Already home to 22 of the world's 50 most polluted cities, India aspires to drastically reduce its carbon footprint by 35 percent below 2005 levels, as a part of its commitment to the United Nations Framework Convention on Climate Change<sup>25</sup>. The country is also working towards transforming into a gas-based economy, with a 15 percent gas share in its energy mix<sup>26</sup>.

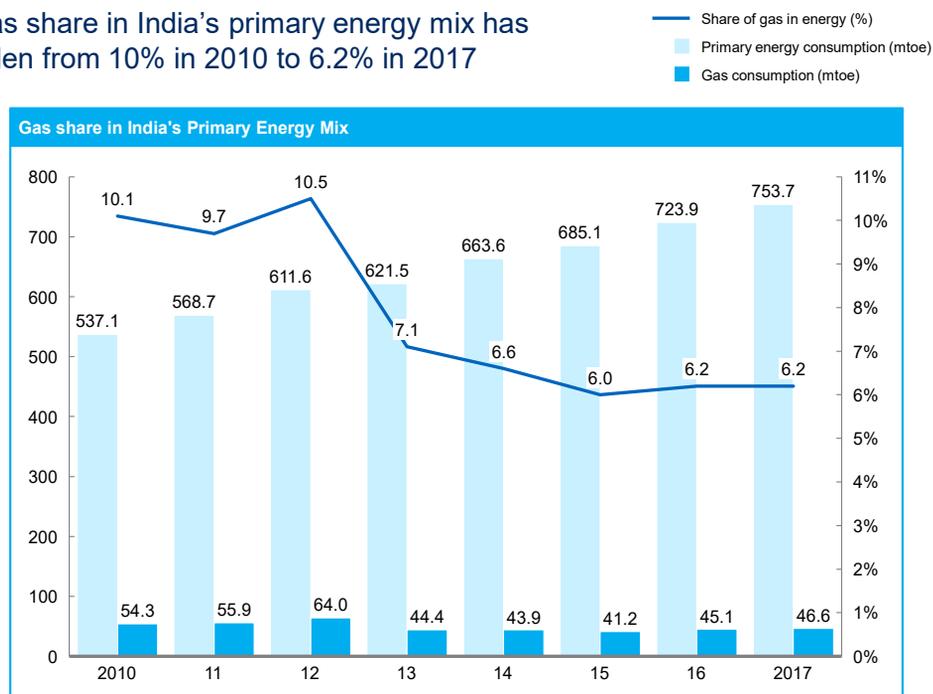
Natural gas plays a critical role in this scenario. Its declining share in the primary energy mix from 10 percent in 2010 to 6.2 percent in 2017 (Exhibit 1), when the aspiration is to boost consumption, calls for a close examination of the root causes. The drop has been mainly due to the reduced supply of domestic gas and unaffordability of imported Regasified Liquefied Natural Gas (RLNG).

<sup>24</sup> *BP Energy Outlook*, 2018 edition, <https://www.bp.com/content/dam/bp/en/corporate/pdf/energy-economics/energy-outlook/bp-energy-outlook-2018.pdf>

<sup>25</sup> "National Electricity Plan", Ministry of Power, Government of India, January 2018, [http://www.cea.nic.in/reports/committee/nep/nep\\_jan\\_2018.pdf](http://www.cea.nic.in/reports/committee/nep/nep_jan_2018.pdf)

<sup>26</sup> "PM Modi sees India's gas usage rising 2.5 times by 2030", *Financial Express*, 23 November 2018, <https://www.financialexpress.com/market/commodities/indias-gas-usage-to-rise-2-5-times-by-2030-modi/1390788/>

## Gas share in India's primary energy mix has fallen from 10% in 2010 to 6.2% in 2017



SOURCE: BP outlook 2018

In India, domestically produced gas (also called Administrative Price Mechanism or APM gas) is limited and cheaper as its pricing is government administered. APM gas is produced by entities that were awarded gas fields prior to the Production Sharing Contract (PSC) regime. The gas discovered under New Domestic Natural Gas Pricing is non-APM/free-to-market gas<sup>27</sup>. The price for this gas is determined based on the benchmarks of several global natural gas hubs.

To meet excess gas demand, India imports RLNG<sup>28</sup>, getting its supply primarily from Qatar, Australia, the US and now Russia<sup>29</sup>. Over the last five years, RLNG

<sup>27</sup> "Allocation and pricing of gas", *Nineteenth report from the Standing Committee on Petroleum & Natural Gas (2013-14) at the Fifteenth Lok Sabha*, Ministry of Petroleum & Natural Gas, 10 December 2013, <http://www.indiaenvironmentportal.org.in/files/file/allocation%20and%20pricing%20of%20gas.pdf>

<sup>28</sup> Natural Gas is transported in liquefied form through specialized carriers to R-LNG terminals where it is reconverted to a gaseous state.

<sup>29</sup> "India begins importing LNG from Russia", *The Economic Times*, 4 June 2018, <https://economictimes.indiatimes.com/industry/energy/oil-gas/india-begins-importing-lng-from-russia/articleshow/64449583.cms>

has grown from 30 to 50 percent of the total gas supply in the country—India imported around 73 mmscmd of RLNG last year<sup>30</sup>.

## Historical consumption

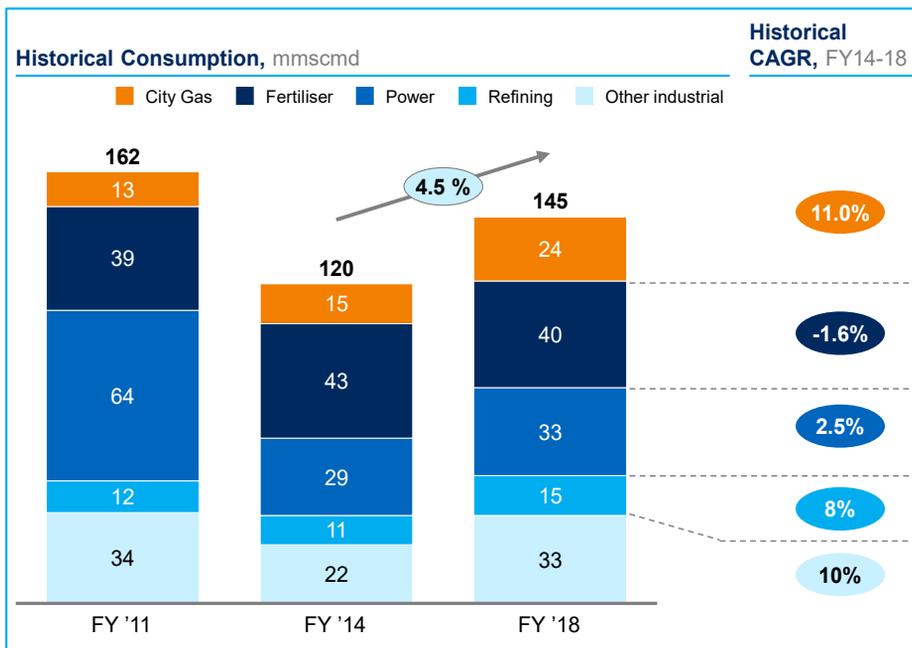
India's gas consumption has reduced from 162 mmscmd in FY 2011 to around 145 mmscmd in FY 2018 (Exhibit 2). The government allocates domestic gas to sectors prioritized by national importance, with the following being key end-use consumption segments:

- CGD—This mainly comprises CNG for vehicles, and PNG for cooking, heating purposes, commercial and industrial usage in cities.
- Fertilizers—Natural gas is used as feedstock for urea and ammonia production.
- Power—Gas-based power plants use natural gas to make electricity through cogeneration, gas turbines and steam turbines.
- Refining—Refineries use natural gas as feedstock to produce hydrogen.
- Industries—Natural gas has a broad range of other uses in industries as a source of both heat and power, and as an input for producing plastics and chemicals. It is also used to manufacture petrochemicals, glass, steel, ceramics and other products.

The power and fertilizer industries constitute half of all demand for natural gas due to their scale, different policy interventions and their social impact. However, the consumption of gas by the power sector has shown low growth and the share of fertilizers has decreased gradually in the past seven to eight years (Exhibit 2).

<sup>30</sup>“Investors' presentation”, GAIL India Ltd., April 2018, [http://www.gailonline.com/pdf/InvestorsZone/Analyst\\_Presentation/Investors%20Presentation\(ND%20Road%20show\)%20April%2018.pdf](http://www.gailonline.com/pdf/InvestorsZone/Analyst_Presentation/Investors%20Presentation(ND%20Road%20show)%20April%2018.pdf)

Evolution of natural gas consumption in India



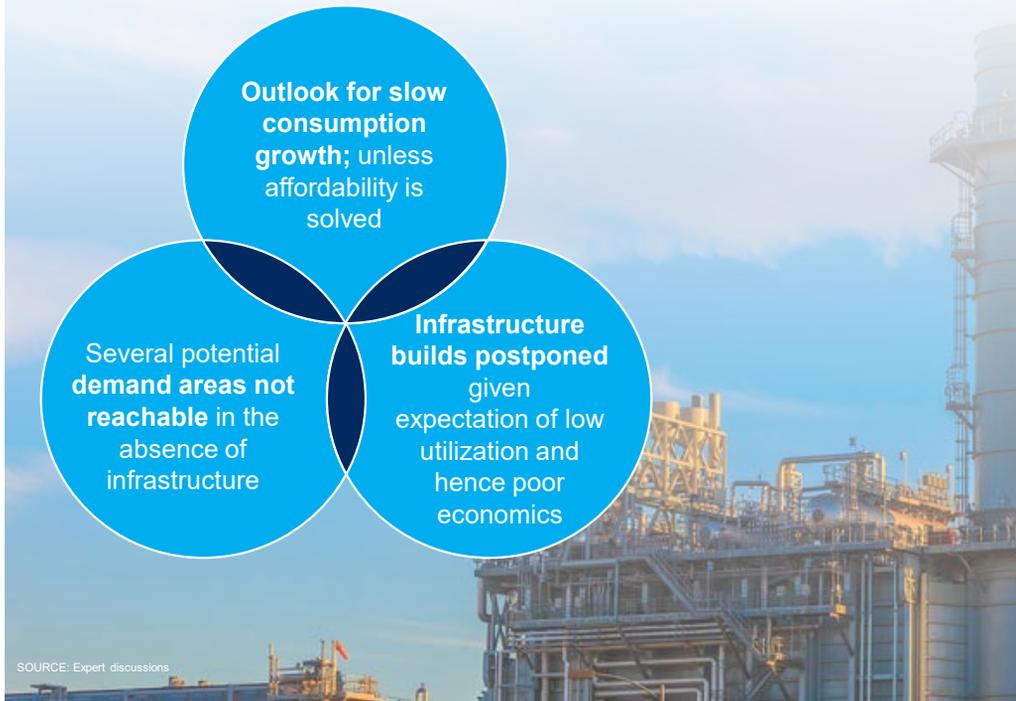
SOURCE: Analysis based on data from MOPNG, WoodMac UDT, UDI, Expert interviews, Fertecon Ammonia Outlook, IHS.

Multiple challenges have affected the growth of gas in India

Several challenges are affecting the growth of the gas market in India. Domestic production has almost halved since 2011<sup>31</sup>, and LNG has not been able to replenish the domestic gas shortfall due to price affordability. Falling consumption and low pipeline utilization have delayed the construction of new pipelines, leaving some potential demand centres unconnected, and further impacting consumption growth. This has resulted in a logjam (Exhibit 3).

<sup>31</sup> "Investors' presentation", GAIL India Ltd., April 2018, [http://www.gailonline.com/pdf/InvestorsZone/Analyst\\_Presentation/Investors%20Presentation\(ND%20Road%20show\)%20April%202018.pdf](http://www.gailonline.com/pdf/InvestorsZone/Analyst_Presentation/Investors%20Presentation(ND%20Road%20show)%20April%202018.pdf)

India's gas market continues to be in a logjam

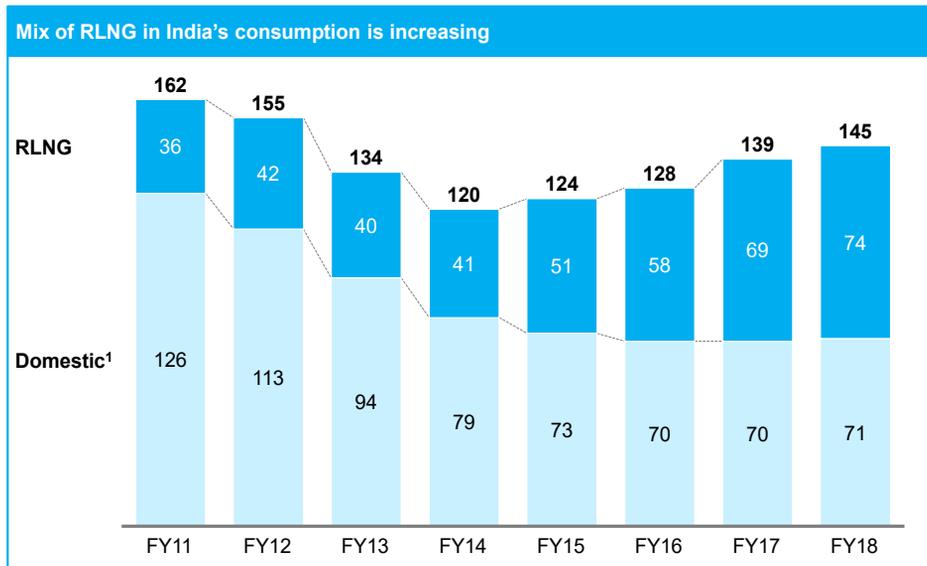


The main reasons for the constrained growth of India's gas economy are:

- **Fall in domestic production** from 126 mmscmd in FY 2011 to around 71 mmscmd in FY 2018 and the absence of any major new domestic sources of gas (Exhibit 4). While FY 18 witnessed a minor uplift due to the relative increase in domestic production in that year, it was not enough to meet even that year's growth in demand<sup>32</sup>.

<sup>32</sup> "Investors' presentation", GAIL India Ltd., April 2018, [http://www.gailonline.com/pdf/InvestorsZone/Analyst\\_Presentation/Investors%20Presentation\(ND%20Roa%20show\)%20April%2018.pdf](http://www.gailonline.com/pdf/InvestorsZone/Analyst_Presentation/Investors%20Presentation(ND%20Roa%20show)%20April%2018.pdf)

Import dependence on RLNG has been increasing given domestic production has declined

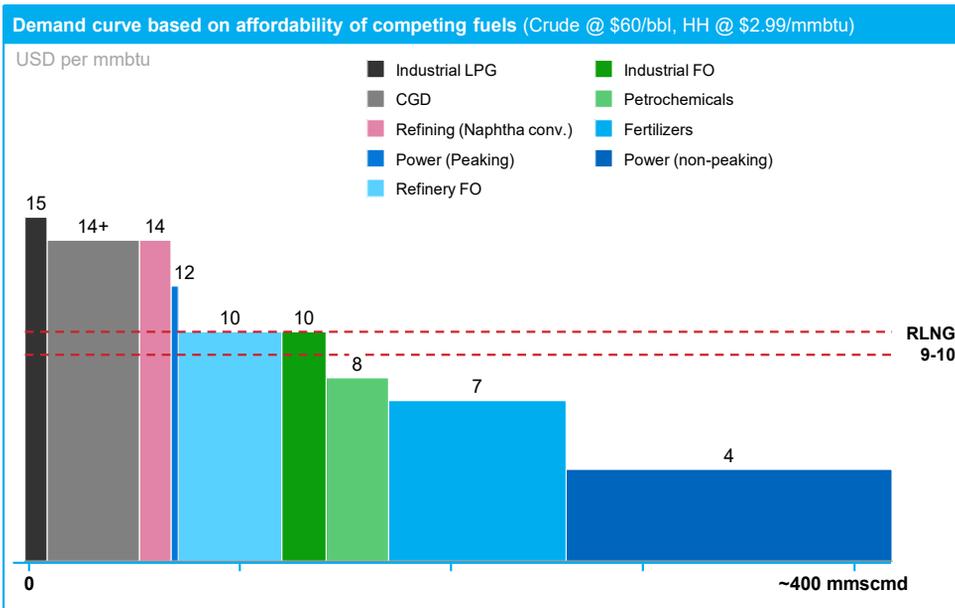


SOURCE: Analysis based on data from GAIL investor presentation, Expert discussions

- With domestic supply falling, **LNG imports have increased**. But imported LNG is not a commercially viable alternative for many key consumer segments, given competition from polluting but cheaper fuels like coal, FO, pet coke and naphtha. Gas-based power plants have a PLF of about 23 percent on a national average, but in 2018, several entities struggled or were stranded at nil to very low capacity utilization<sup>33</sup>. The contribution of natural gas to India's power generation mix dropped from a peak of 11 percent in 2010–11 to 4 percent in 2016–17<sup>34</sup>. The total demand for gas in India is more than 400 mmscmd but the actual consumption is only 145 mmscmd. Also, important sectors like fertilizers and petrochemicals struggle to afford the high RLNG price of USD 9 to 10 per mmbtu (Exhibit 5).

<sup>33</sup> "National Electricity Plan", Ministry of Power, Government of India, January 2018, [http://www.cea.nic.in/reports/committee/nep/nep\\_jan\\_2018.pdf](http://www.cea.nic.in/reports/committee/nep/nep_jan_2018.pdf)

The low affordability of RLNG, compared to other fuels, has been one of the barriers to growth in gas consumption in India



SOURCE: Analysis based on data from Expert discussions

- There is a **lack of infrastructure** in several areas possessing demand potential. Many areas remain unconnected due to postponements in the financial closure of pipeline projects driven by low consumption offtake. Delays in securing multiple clearances and financial challenges post the bidding process have obstructed the timely implementation of CGD expansion plans.



# Unlocking India's gas potential: Aspiring for a 15 percent share in the energy mix

The Indian government has announced its aspiration to increase the share of natural gas in its overall energy consumption to 15 percent<sup>35</sup> from the 2017 figure of 6.2 percent<sup>36</sup>. Strategic shifts across multiple sectors could push Indian gas consumption even closer to this aspiration.

The government is already taking various proactive measures towards this goal. It has launched many investor-friendly policy initiatives and reforms to boost the domestic supply of gas. Recent years have seen path-breaking developments such as ensuring utmost priority in allocating domestic gas to PNG and CNG sectors, bi-annual price revisions for domestic gas, and pricing and marketing freedom for producers with respect to Coal Bed Methane (CBM) and difficult areas of gas production<sup>37</sup>.

The upstream sector has taken additional measures under the Hydrocarbon Exploration and Licensing Policy (HELP), as has the downstream sector, such as fertilizers, which successfully introduced the price-pooling mechanism. The Government of India has also, for the very first time, enabled the implementation of the capital-intensive trunk pipeline project through comprehensive measures such as granting 40 percent funding for the natural gas pipeline project<sup>38</sup>, and synchronizing downstream projects under the fertilizer sector and CGD networks to ensure the pipeline infrastructure is utilized from the commissioning stage itself<sup>39</sup>. Highlights of some of these policies include:

<sup>35</sup> "On road to a gas-based economy?", MP Sukumaran Nair, *The Hindu Business Line*, 18 December 2018, <https://www.thehindubusinessline.com/opinion/on-road-to-a-gas-based-economy/article25765361.ece>

<sup>36</sup> *BP Energy Outlook*, 2018 edition, <https://www.bp.com/content/dam/bp/en/corporate/pdf/energy-economics/energy-outlook/bp-energy-outlook-2018.pdf>

<sup>37</sup> Expert discussions

<sup>38</sup> "Govt to fund 40% of Jagdishpur-Haldia and Bokaro-Dhamra gas pipeline project", Debjoy Sengupta, *The Economic Times*, 21 September 2016, <https://economictimes.indiatimes.com/industry/energy/oil-gas/govt-to-fund-40-of-jagdishpur-haldia-and-bokaro-dhamra-gas-pipeline-project/articleshow/54451036.cms>

<sup>39</sup> "About natural gas", Ministry of Petroleum and Natural Gas, <http://petroleum.nic.in/natural-gas/about-natural-gas>

- **HELP:** The new licensing regime addresses the administrative issues of the previous PSC regime, while also providing pricing and marketing freedom for produced gas<sup>40</sup>.
- **Open Acreage Licensing Policy (OALP):** The Ministry of Petroleum & Natural Gas announced this new policy for oil and gas exploration that allows bidders to carve out the areas they want to explore for drilling<sup>41</sup>.
- **Marginal Field Policy (MFP):** Cabinet-approved, this policy aims to bring marginal fields to production at the earliest to augment the domestic production of oil and gas<sup>42</sup>.

The Pradhan Mantri Urja Ganga Project has already initiated work on the 3,200-km gas pipeline network for eastern India and the 1,500-km network in the Northeast that will connect 294 districts to the CGD grid, bringing half of the country into the CGD network<sup>43</sup>. Significant viability-gap funding has been provided to link eastern India to the gas grid.

A new pricing regime has been introduced for gas produced from deep-water and HPHT (High Pressure, High Temperature) fields to make these projects more viable<sup>44</sup>. These steps could help the country's gas economy make progress towards its 15 percent aspiration.

A BAU scenario would result in a very minor increase in the share of gas in the energy mix. Concerted, discontinuous actions may be needed in multiple sectors to take Indian gas consumption closer to its 15 percent aspiration.

## BUSINESS-AS-USUAL SCENARIO

The availability of gas from domestic sources as well as LNG imports could determine gas consumption in the future. Additional domestic production could

<sup>40</sup> "From NELP TO HELP: Can a new policy transform the oil and gas exploration and production sector in India?", *Financial Express*, 24 October 2016, <https://www.financialexpress.com/market/commodities/from-nelp-to-help-can-a-new-policy-transform-the-oil-and-gas-exploration-and-production-sector-in-india/428346/>

<sup>41</sup> About Open Acreage Licensing Policy, <http://online.dghindia.org/oalp>

<sup>42</sup> "Policy for marginal fields of ONGC and OIL: Major expansion of role of private sector in oil and gas", Press Information Bureau, Ministry of Petroleum and Natural Gas, Government of India, 2 September 2015, <http://pib.nic.in/newsite/PrintRelease.aspx?relid=126552>

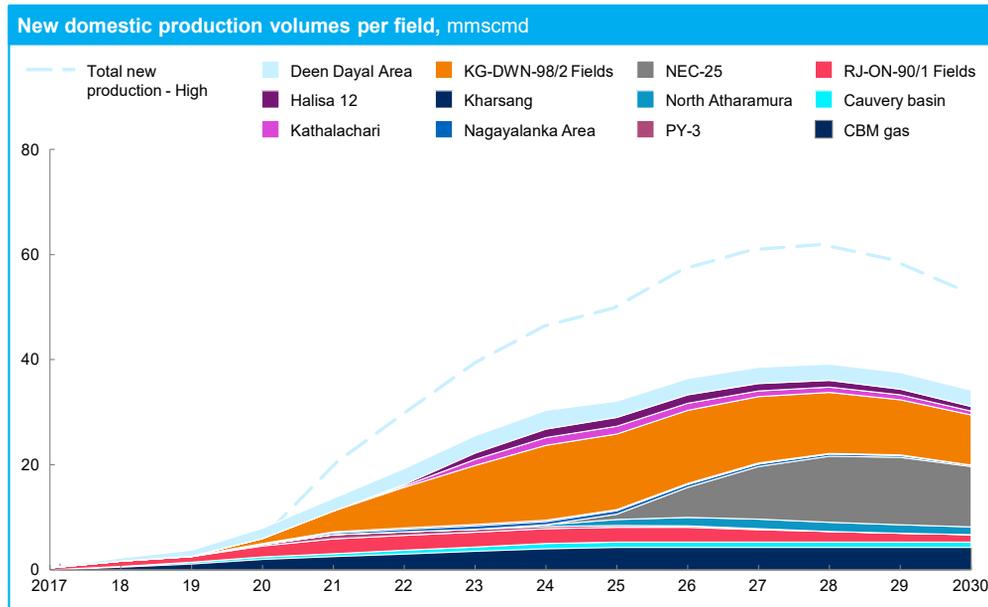
<sup>43</sup> "48 months, 48 major achievements: Foundation of a new India", Ministry of Petroleum and Natural Gas, Government of India, <http://petroleum.nic.in/MOPNG-EBOOK/2018/MoPNG-48-Months-Booklet-ENGLISH.pdf>

<sup>44</sup> "Major policy initiatives to give a boost to petroleum and hydrocarbon sector", Press Information Bureau, Cabinet, Government of India, 10 March 2016, <http://pib.nic.in/newsite/printrelease.aspx?relid=137661>

be around 35 to 55 mmscmd in the next 10 to 12 years (Exhibit 6). Gas from the KG-DWN-98/2 and NEC-25 fields could contribute to 60 percent of this incremental production<sup>45</sup>.

EXHIBIT 6

Additional domestic production of 35-55 mmscmd is expected in the next 10-12 years

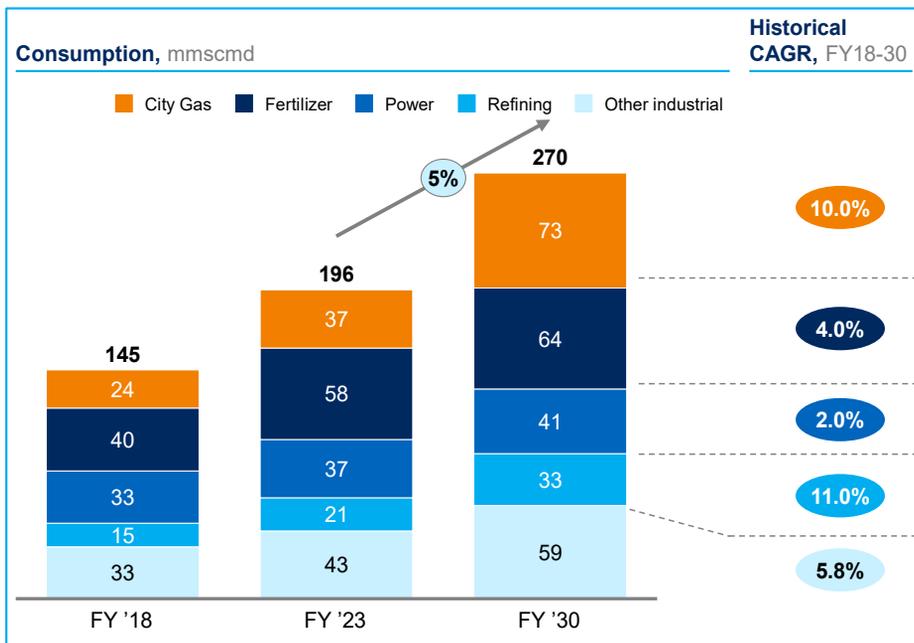


SOURCE: Analysis based on Expert discussions

The BAU growth in gas consumption could be around 5.1 percent, taking India’s gas demand to 270 mmscmd by 2030—this is under 7 percent of the total energy mix in India (Exhibit 7). The greatest contributors to this growth are likely to be CGD (automotive and domestic consumption) and refining, with fertilizers, power and other industrials making up the rest.

<sup>45</sup> WoodMac UDT

In a BAU scenario, India’s gas consumption could grow by 5% till 2030



SOURCE: Analysis based on data from MOPNG, WoodMac UDT, UDI, Expert interviews, Fertecon Ammonia Outlook, IHS.

### City gas

CGD is set to take centre stage as a priority sector, with several programs and initiatives being announced to bolster city gas demand. The expected growth in consumption under this category is around 10 percent between FY 2018 and FY 2030 (Exhibit 8) under a BAU scenario.

- At present, 31 companies are developing CGD networks across 81 geographical locations in 21 states and union territories, supplying clean cooking fuel in the form of PNG to about 4 mn households<sup>46</sup>. The government has plans to provide 10 mn PNG connections<sup>47</sup>. Central

<sup>46</sup> "City gas distribution to see big investments", Kalpana Pathak, *Live Mint*, 3 December 2018, <https://www.livemint.com/Industry/Amwfjm4m0s4EhyclgWt9CO/City-gas-distribution-to-see-big-investments.html>

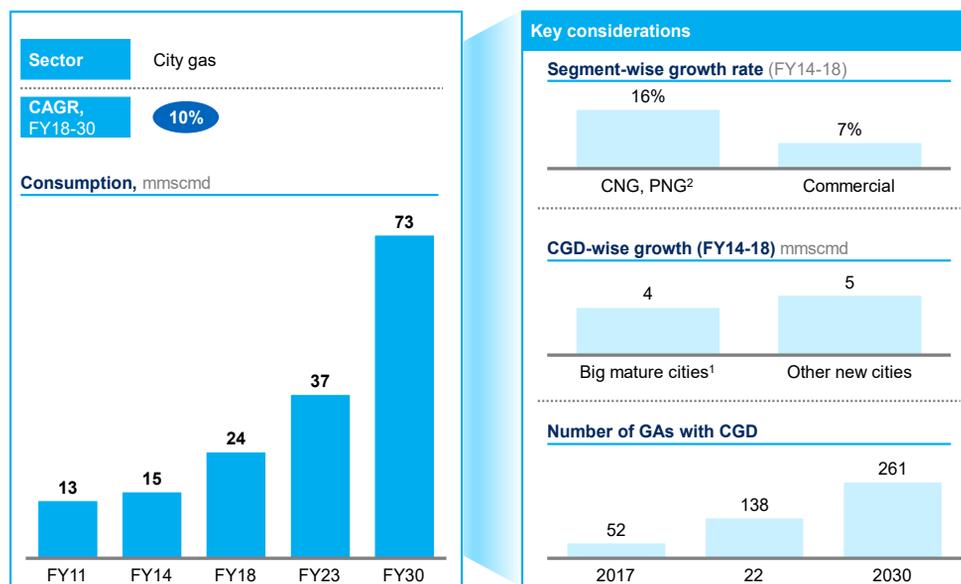
<sup>47</sup> "City gas distribution to see big investments", Kalpana Pathak, *Live Mint*, 3 December 2018, <https://www.livemint.com/Industry/Amwfjm4m0s4EhyclgWt9CO/City-gas-distribution-to-see-big-investments.html>

Government has also introduced stringent emission levels for vehicles and plans to develop green corridors to reduce India's carbon footprint.

- There are about 60,000 fuel retail stations and around 1,500 CNG stations across India, with 10,000 CNG stations expected in the next 10 years<sup>48</sup>.

## EXHIBIT 8

In a BAU scenario, India's CGD gas consumption could grow by 10% till 2030



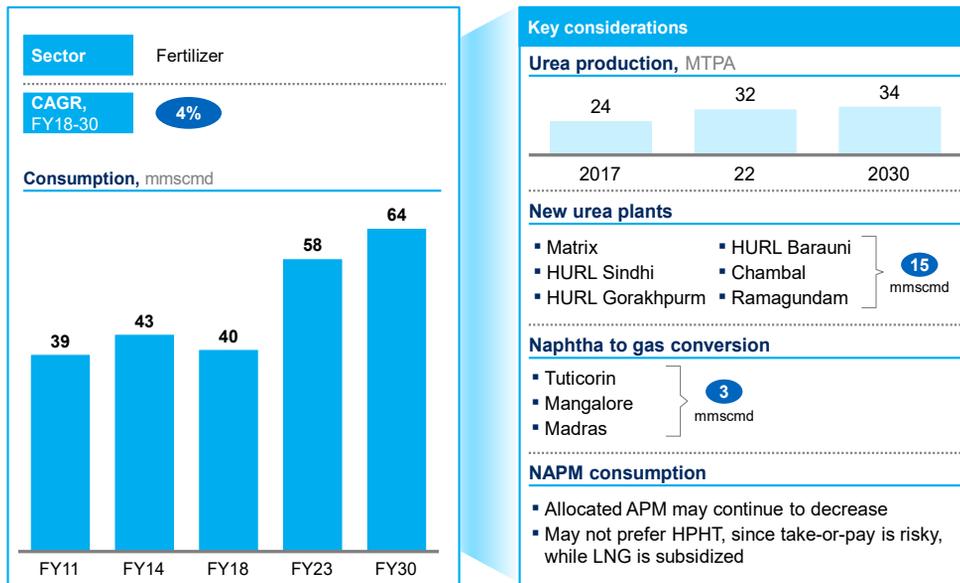
<sup>1</sup> FY14 to FY18 growth: Delhi (1.1) + Mumbai (0.5) + Gujarat (0.6) + Lucknow, Agra (1.8); <sup>2</sup> CNG mainly used for vehicles, PNG used for household use like cooking  
SOURCE: Analysis based on data from PGNRB, PPAC and Expert discussions

## Fertilizer

Urea plants (new and revived) meant for import substitution could initially (till FY 23) cause a spike in the gas demand linked to fertilizers (Exhibit 9). The BAU scenario has an expected growth rate of around 4 percent between FY 18 and FY 30. The growth in gas consumption in fertilizers is set to slow down due to the limited growth potential of urea consumption. This sector is unlikely to prefer HPHT as the take-or-pay aspect is risky while LNG is subsidized.

<sup>48</sup> "10,000 CNG stations to be set up in 10 years: Pradhan", *The Economic Times*, 7 September 2018, <https://economictimes.indiatimes.com/industry/energy/oil-gas/10000-cng-stations-to-be-set-up-in-10-years-pradhan/articleshow/65713474.cms>

In a BAU scenario, India's Fertilizer sector gas consumption could grow by 4% till 2030



SOURCE: Analysis based on data from Fertecon Ammonia Outlook, Expert discussions

## Power

Of the total installed capacity of 345 GW in India at present, a capacity of around 25 GW (~ 7.5 percent) is gas-based. A total capacity of 21,048 MW links to the main pipeline/gas grid and 2,989 MW links to isolated gas fields. Of the connected grid, the capacity of 8,042 MW is predominantly APM-gas based. While the normative gas requirement to operate the existing power plants at 90 percent PLF is about 117 mmscmd, only 29.59 mmscmd of gas was supplied to these gas-based power plants in 2016–17. The gas grid connected capacity had received 20.22 mmscmd gas during the year 2016–17 and achieved an average PLF of around 19 percent only; gas-based capacity connected with isolated gas fields received 9.37 mmscmd gas and achieved a PLF of 50.43 percent<sup>49</sup>.

The average PLF of gas-based capacity in the country in 2016–17 was thus about 22.86 percent<sup>50</sup>. The lack of economically viable gas has led to around 15 GW of

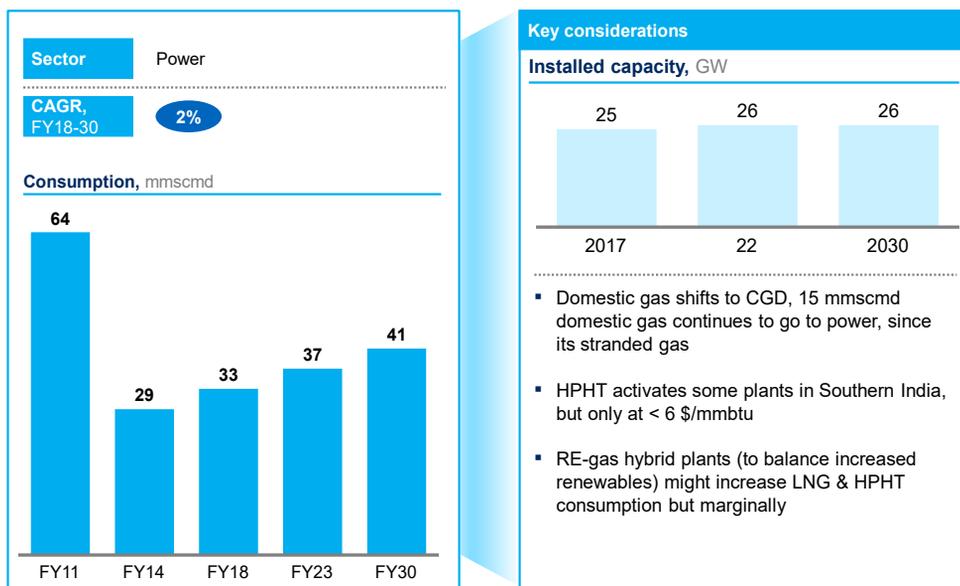
<sup>49</sup> "National Electricity Plan", Ministry of Power, Government of India, January 2018, [http://www.cea.nic.in/reports/committee/nep/nep\\_jan\\_2018.pdf](http://www.cea.nic.in/reports/committee/nep/nep_jan_2018.pdf)

<sup>50</sup> "National Electricity Plan", Ministry of Power, Government of India, January 2018, [http://www.cea.nic.in/reports/committee/nep/nep\\_jan\\_2018.pdf](http://www.cea.nic.in/reports/committee/nep/nep_jan_2018.pdf)

gas-based power plants being stranded<sup>51</sup>—most are private sector gas-based plants or plants commissioned without any gas allocation. The expected growth rate of gas to the power sector would be around 2 percent between FY18 and FY30 in the BAU scenario (Exhibit 10).

## EXHIBIT 10

In a BAU scenario, India's Power sector gas consumption could grow by 2% till 2030



SOURCE: Analysis based on data from UDI, Expert Discussions

This growth could be characterized as follows:

- Domestic gas would shift to city gas. However, 15 mmscmd of domestic gas would continue to go to the power sector.
- HPHT could activate some plants in Southern India but only at less than USD 6/mmbtu.
- RE-gas hybrid plants (to balance increased renewables) might marginally increase LNG and HPHT consumption.

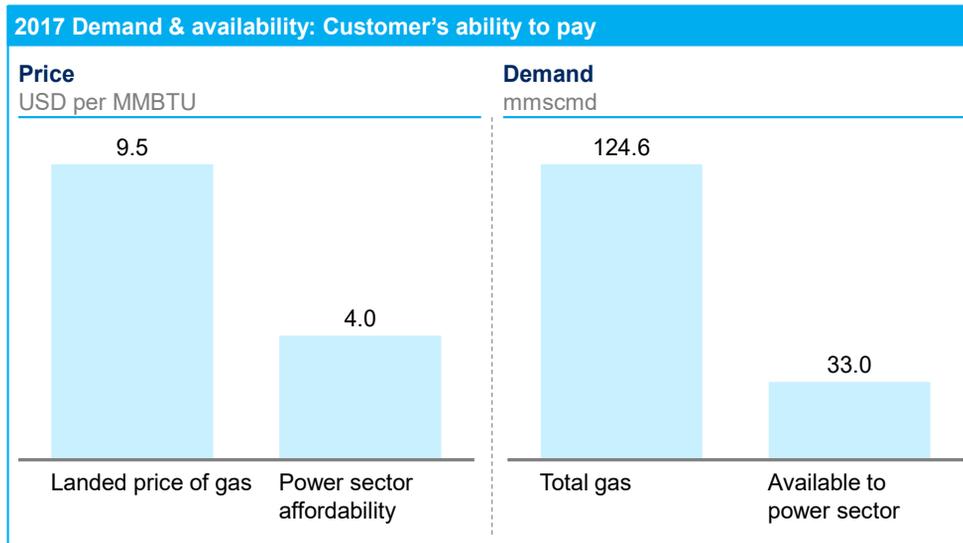
Gas-based power generation in India is unlikely to increase as the sector cannot afford the gas landed price of USD 9.5 per mmbtu (Exhibit 11). At the current

<sup>51</sup> "Panel suggests measures to tackle crisis in stressed thermal power projects", Rohit Pathania, *DownToEarth*, 26 November 2018, <https://www.downtoearth.org.in/news/energy/panel-suggests-measures-o-tackle-crisis-in-stressed-thermal-power-projects-62255>

LNG price, the landed power price would be around INR 7.25 per unit, which is beyond the average power purchase cost in India<sup>52</sup>.

## EXHIBIT 11

Gas-based generation in India is unlikely to increase as the sector cannot afford gas landed price of USD 9.5 per mmbtu



SOURCE: Analysis based on data from Expert discussions

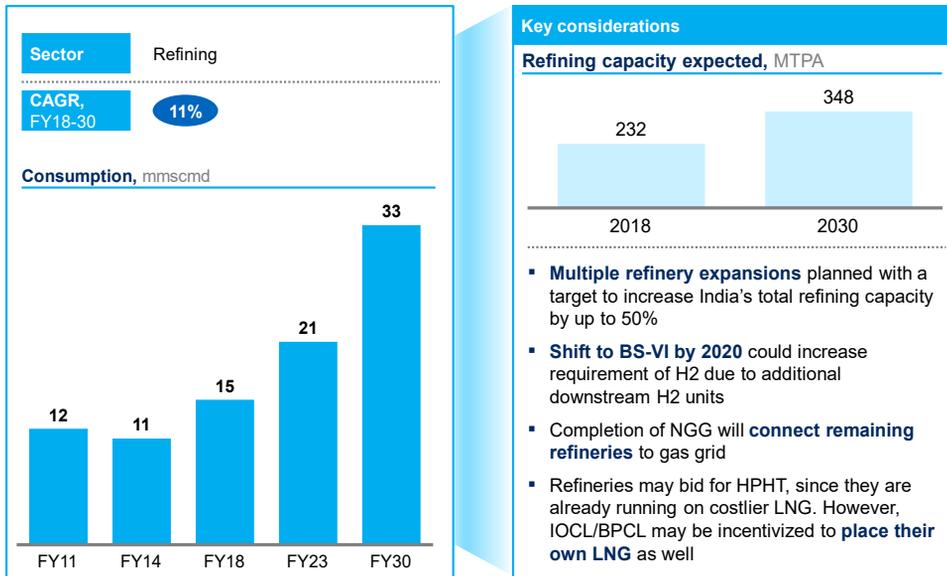
## Refining

Gas consumption could grow at a CAGR of around 11 percent between FY 18 and FY 30 in the BAU scenario (Exhibit 12).

- Multiple refinery expansions are planned to increase India's total refining capacity by nearly 50 percent.
- A shift to BS-VI norms by 2020 could increase the requirement for hydrogen due to additional downstream H<sub>2</sub> units.
- The completion of the National Gas Grid could connect the remaining refineries to the gas grid.
- Refineries may bid for HPHT since they are already functioning on costlier LNG. However, National Oil Companies may be incentivized to place their own LNG infrastructure.

<sup>52</sup> Analysis based on data from the "National Electricity Plan, Ministry of Power", Government of India, January 2018, [http://www.cea.nic.in/reports/committee/nep/nep\\_jan\\_2018.pdf](http://www.cea.nic.in/reports/committee/nep/nep_jan_2018.pdf)

In a BAU scenario, India's Refining sector's gas consumption could grow by 11% till 2030



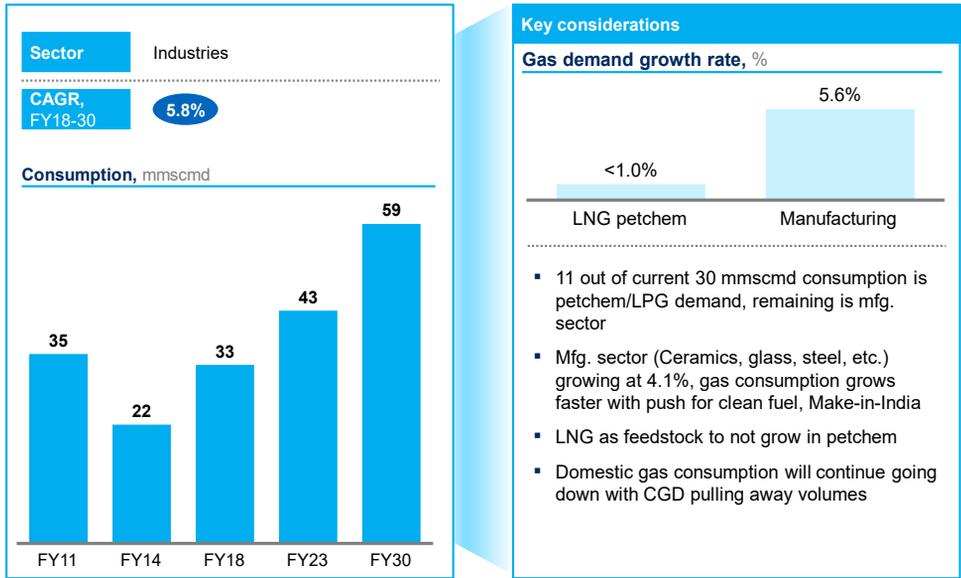
SOURCE: Analysis based on data from McKinsey Refinery Database, Expert discussions

## Other industries

Gas consumption under this category is expected to grow at a rate of around 5.8 percent between FY 18 and FY 30 in the BAU scenario (Exhibit 13).

- Of the current 33 mmscmd consumption, 11 mmscmd goes to the petrochemical/LPG industry and the remaining to the manufacturing sector.
- The manufacturing sector (e.g., ceramics, glass, steel) is growing at a rate of 4.1 percent. Gas consumption will grow slightly faster with the push for clean fuel.
- Almost stagnant demand growth is expected for LNG as feedstock for petrochemical plants.

In a BAU scenario, India's Industrial sector's gas consumption could grow by 5.8% till 2030



SOURCE: Analysis based on data from MOPNG statistics, Expert discussions

## DISCONTINUOUS SHIFTS COULD SPUR GAS CONSUMPTION

A concerted push in specific sectors such as power, transportation, cooking and petrochemicals could boost gas consumption to 550 to 600 mmscmd, an increase of 280 to 300 mmscmd. This could possibly expand the share of gas to the targeted 15 percent of the primary energy mix.

### Power

Gas is a prime contributor to electricity generation worldwide (32 percent in the USA<sup>53</sup> and 36 percent in the UK<sup>54</sup>). The demand for natural gas to generate power will continue to rise globally in and beyond 2019. This could be due to low

<sup>53</sup> U.S. Energy Information Administration, 16 May 2018, [https://www.eia.gov/energyexplained/?page=us\\_energy\\_home](https://www.eia.gov/energyexplained/?page=us_energy_home)

<sup>54</sup> BP Energy Outlook, 2018 edition, <https://www.bp.com/content/dam/bp/en/corporate/pdf/energy-economics/energy-outlook/bp-energy-outlook-2018.pdf>

gas prices, the ongoing retirement of coal power plants and the burgeoning supply of gas. As the demand for renewable energy sweeps the globe, natural gas is set to emerge as the fastest growing source of power given its ramp-up and ramp-down capability to complement renewables in sustaining the grid. Besides, gas-based capacity minimizes the need for other sources of power generation during peak demand—such as diesel generators, which are not only costlier but also cause pollution.

The installed capacity for gas-based power in India is 7.5 percent of the total installed capacity, while in energy terms, it was only 3 percent in 2018<sup>55</sup>. The existing gas-based power plant capacity had only enough gas to run at 23 percent of the total generation capacity in 2018<sup>56</sup>. Another 4 GW is under construction and 14 GW is deferred capacity<sup>57</sup>. If the existing plants could run at 50 percent PLF, and the under-construction plants could come online in the long run, again achieving 50 percent PLF, the power sector could generate around 29 mmscmd of additional gas demand over the BAU scenario<sup>58</sup>.

## Transportation

A World Health Organization study listed 14 Indian cities among the world's 20 most polluted<sup>59</sup>. These levels of pollution widen India's gap to the COP21 target to keep global temperature rise under 2-degrees Celsius. India could therefore benefit significantly from efforts to decrease pollution and control transport emissions. One alternative lies in boosting the use of natural gas consumption for mobility.

The strong need for alternative cleaner fuel segments to grow and the regulatory/policy push provided by the government/the Ministry of Petroleum and Natural Gas/PNGRB for city or local gas distribution projects have helped immensely to drive natural gas penetration in the future via CGD networks, RLNG terminals and gas pipelines<sup>60</sup>.

<sup>55</sup> "Growth of electricity sector in India from 1947-2018", Central Electricity Authority, Ministry of Power, Government of India, June 2018, [http://www.cea.nic.in/reports/others/planning/pdm/growth\\_2018.pdf](http://www.cea.nic.in/reports/others/planning/pdm/growth_2018.pdf)

<sup>56</sup> "Gas power stations", [http://indiaenergy.gov.in/iess/supply\\_gaspower.php](http://indiaenergy.gov.in/iess/supply_gaspower.php)

<sup>57</sup> National Electricity Plan, Ministry of Power", Government of India, January 2018, [http://www.cea.nic.in/reports/committee/nep/nep\\_jan\\_2018.pdf](http://www.cea.nic.in/reports/committee/nep/nep_jan_2018.pdf)

<sup>58</sup> Analysis based on data from the National Electricity Plan, Government of India, 2018

<sup>59</sup> "India To Ply Long-Distance CNG Buses On Four Routes By February", Bhanvi Arora, *BloombergQuint*, 21 December 2018, <https://www.bloombergquint.com/business/india-to-ply-long-distance-cng-buses-on-four-routes-by-february#gs.Mwblj1DR>

<sup>60</sup> "City Gas Distribution (CGD) Sector in India: Analysing 86 Geographical Areas notified under PNGRB Round IX Bidding (2018)—Unlocking a Multimillion Dollar Opportunity—ResearchAndMarkets.com",

The government has invested INR 70,000 cr<sup>61</sup> to set up CGD networks which could help expand the network of CNG stations from 1,500 stations (82 percent of which are in Delhi, Mumbai and Gujarat) to 10,000. This investment is expected to increase to INR 1.1 lakh cr in the next 10 years<sup>62</sup>. India's largest LNG importer, Petronet LNG, is setting up 20 LNG stations at petrol pumps on highways along the west coast that connect Delhi with Thiruvananthapuram via Mumbai and Bengaluru<sup>63</sup>.

If at least half of the 4 wheeler fleet vehicles in India were to shift to CNG and 10 percent of all trucks and inter-city buses were to adopt LNG as fuel, the sector could expect to generate an additional gas demand of around 82 mmscmd over the BAU scenario<sup>64</sup>. In China, a total of 96,000 LNG vehicles were produced in 2017, up from 19,600 in 2016. The Chinese government imposed a ban in 2017 on the use of diesel trucks to transport coal at northern ports in provinces like Hebei and Shandong, and in the city of Tianjin<sup>65</sup>.

### Cooking: Replacing LPG

Most Indian households cook using polluting energy sources such as LPG and kerosene, which contribute to the PM 2.5 pollution in the country<sup>66</sup>. To replace LPG and kerosene with a cleaner fuel, the government has been promoting the growth of infrastructure for PNG, a cleaner cooking fuel. The CGD network is being developed to provide PNG to over 4 mn households, with plans to soon extend this to 10 mn households<sup>67</sup>.

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*BusinessWire*, 13 June 2018, <https://www.businesswire.com/news/home/20180613006224/en/City-Gas-Distribution-CGD-Sector-India-Analysing>

<sup>61</sup> "10,000 CNG stations to be set up in 10 years: Pradhan", *The Economic Times*, 7 September 2018, <https://economictimes.indiatimes.com/industry/energy/oil-gas/10000-cng-stations-to-be-set-up-in-10-years-pradhan/articleshow/65713474.cms>

<sup>62</sup> "City gas distribution to see big investments", Kalpana Pathak, *Live Mint*, 3 December 2018, <https://www.livemint.com/Industry/Amwfjm4m0s4EhycLgWt9CO/City-gas-distribution-to-see-big-investments.html>

<sup>63</sup> "Indian CVs and LNG", *CV Commercial Vehicle*, 23 April 2018, <http://commercialvehicle.in/indian-cvs-and-lng/>

<sup>64</sup> Analysis based on data from SIAM, IHS and PPAC

<sup>65</sup> "Natural gas truck demand to rise", Zheng Xin, *China Daily*, 6 July 2017, <http://www.chinadaily.com.cn/a/201807/06/WS5b3eeefca3103349141e1268.html>

<sup>66</sup> "India's battle with air pollution is getting serious", *Swarajya*, 31 January 2019, <https://swarajyamag.com/videos/indias-battle-with-air-pollution-is-getting-serious>

<sup>67</sup> "City gas distribution to see big investments", Kalpana Pathak, *Live Mint*, 3 December 2018, <https://www.livemint.com/Industry/Amwfjm4m0s4EhycLgWt9CO/City-gas-distribution-to-see-big-investments.html>

Under the Pradhan Mantri Ujjwala Yojana, the government has set up LPG connections for more than 88.5 percent households in 2018, accounting for around 25 MTPA of LPG demand<sup>68</sup>. Assuming a steady growth rate of 2.6 percent, the requirement could go up to around 33 MTPA by 2030. Effectively developing the CGD network in the next 10 years could help PNG to replace 60 percent of the LPG demand in urban India. That could increase India's natural gas consumption by 61 mmscmd, with natural gas substituting the LPG demand for cooking<sup>69</sup>. Expediting the current CGD infrastructure build-out will help to make this conversion a reality.

## Replacing FO across industries

Secondary particles contribute to 25 to 30 percent of pollution in the winter<sup>70</sup>. Industries across the board, including fertilizers, ceramics, cement, glass etc., use pet coke and FO in their manufacturing processes, which release sulphur dioxide and other secondary particles well beyond the prescribed limits for a city like Delhi. The Supreme Court therefore imposed a ban on using pet coke and FO on 24 October 2017<sup>71</sup> in Delhi-NCR. This ban is expected to show positive results in a year or two. If it is deemed a success, the scope could even be extended to the whole country in the next five to 10 years.

The rising implementation of CGD could prompt a significant increase in PNG across FO-using industries in India. Besides helping to control pollution levels, natural gas could also be an economically preferable alternative to FO, superior kerosene oil, light diesel oil and LSHS. Replacing at least 50 percent of these fuels with natural gas could increase the gas requirement to around 19 mmscmd by 2030<sup>72</sup>. A focused regulatory push aimed at reducing the adverse environmental effects of these polluting fuels could help to enable this conversion.

<sup>68</sup> "LPG penetration in Northeast to cross 80 per cent by March 2019", Press Trust of India, *The Economic Times*, 16 October 2018, <https://economictimes.indiatimes.com/industry/energy/oil-gas/lpg-penetration-in-northeast-to-cross-80-per-cent-by-march-2019/articleshow/66237109.cms>

<sup>69</sup> Analysis based on data from PPAC

<sup>70</sup> "Use of pet coke and furnace oil in industries", *Business Standard*, 23 December 2017, [https://www.business-standard.com/article/news-cm/use-of-pet-coke-and-furnace-oil-in-industries-117122300117\\_1.html](https://www.business-standard.com/article/news-cm/use-of-pet-coke-and-furnace-oil-in-industries-117122300117_1.html)

<sup>71</sup> "Use of pet coke and furnace oil in industries", *Business Standard*, 23 December 2017, [https://www.business-standard.com/article/news-cm/use-of-pet-coke-and-furnace-oil-in-industries-117122300117\\_1.html](https://www.business-standard.com/article/news-cm/use-of-pet-coke-and-furnace-oil-in-industries-117122300117_1.html)

<sup>72</sup> Analysis based on PPAC data

## Mixed feedstock for petrochemicals

In India, naphtha is predominantly used in the petrochemicals industry, accounting for 78 percent of the country's consumption<sup>73</sup>. It is a major feedstock in the industry, along with natural gas. It is a product of the crude oil distillation process, and so international crude oil price fluctuations directly affect naphtha prices. While crude prices are at an all-time low, the cyclical nature of prices indicates that they might rise soon.

Natural gas, on the other hand is cheaper than naphtha<sup>74</sup>. The other advantage of using natural gas is the lower emission of NO<sub>x</sub> and SO<sub>x</sub>. The advantages of natural gas could encourage Indian companies to move to a gas-based chemistry for cracking and producing olefins—the major input for most petrochemicals.

The Indian petrochemicals industry consumed around 10.3 mtpa<sup>75</sup> of naphtha in 2017 and is expected to grow at 4 to 5 percent. It is estimated that the country's petrochemicals capacity<sup>76</sup> could grow by 3 to 4 percent year on year. If 33 percent of this capacity was gas based (gas-based plants or mixed feed), it could create an additional 4 mmscmd of consumption by 2030<sup>77</sup>.

<sup>73</sup> Indian Petroleum & Natural Gas, Ministry of Petroleum and Natural Gas, 2017-18

<sup>74</sup> "Naphtha Faces Competition from Abundant Natural Gas Liquids, IHS Markit Says", *Oil and Gas 360*, 16 February 2017, <https://www.oilandgas360.com/naphtha-faces-competition-from-abundant-natural-gas-liquids-ihs-markit-says/>

<sup>75</sup> Sector-wise Consumption (End use) of Naphtha from 2010-11 to 2016-17, <https://data.gov.in/resources/sector-wise-consumption-end-use-naphtha-2010-11-2016-17>

<sup>76</sup> Ethylene and propylene capacity

<sup>77</sup> Analysis based on data from ICIS, IHS and PPAC

# Actions that could drive growth

India could propel itself towards achieving its aspiration of a 15 percent gas share in the energy mix with various stakeholders taking concerted actions across multiple sectors, primarily power, transportation, city gas and petrochemicals. These actions could focus on improving the economic viability of gas, encouraging the development of necessary infrastructure, steps to boost gas consumption and promoting technologies that help to tap the potential of gas.

## Improving the economic viability of natural gas in India

While multiple initiatives to improve the economic viability of natural gas are already underway, there is potential to consider some more:

- **Increasing domestic production:** The current push for this could provide more affordable gas to several priority sectors. Prices could drop because of savings in liquefaction, seaborne freight and regasification compared to imported LNG. There are already steps underway to accelerate the development of discovered fields, including many small fields that were earlier considered unviable. There is also a joint push to increase exploration activity through an easier-to-administer licensing regime. Bringing this gas to market through faster approvals and infrastructure development could be considered. Alternative gas pricing models could be explored to increase the economic viability of discovered fields and to accelerate their development.
- **Making transnational pipelines a reality:** There could be a concerted focus on reducing the transportation cost of imported gas to make it economically viable. International pipeline projects such as the Iran–Pakistan–India, Myanmar–Bangladesh–India, Oman–India, Turkmenistan–Afghanistan–Pakistan–India and Bangladesh–India could be revisited, and sub-sea pipelines could also be considered. Technologies like transportation in CNG form, that could be viable from countries in India’s vicinity, could also be evaluated for viability and feasibility.
- **Reducing domestic transport costs:** A unified tariff mechanism, that is already in the works, could be one of the steps to reduce domestic pipeline tariffs, especially for regions that get connected through multiple pipelines.
- **Alternate contracting methods:** The evaluation of different contracting mechanisms that reduce take-or-pay risk for buyers, creating a portfolio of gas from different sources and linking price to different markers, could be considered to develop a win-win situation for sellers and buyers.

- **Innovative pricing mechanisms for additional domestic gas:** This could be evaluated to ensure viability for both producers and consumers, further enhancing the attractiveness of natural gas.
- **Improving the liquidity of gas markets:** Setting up a gas exchange for some part of the gas market is already under evaluation. Starting with only a part of the gas market, possibly spot, could be considered to improve liquidity.

## Supporting the development of natural gas infrastructure

Efforts to make natural gas more widely available could help boost consumption. Some initiatives could be considered in this direction:

- **Rapid completion of the National Gas Grid and CGD networks with innovative funding mechanisms:** Even after the completion of the ongoing pipeline builds, there are many demand centres that would be unconnected to the National Gas Grid. Given viability and utilization challenges mentioned previously in this paper, innovative funding mechanisms could be evaluated. For CGD, accelerating the bidding of remaining districts, setting up single window clearances and improving the execution speed of network build-out could be considered.
- **Setting up new CNG refuelling stations:** The reported shortage of refuelling infrastructure for gas-based vehicles is considered to be one reason for slower conversion to CNG vehicles<sup>78</sup>. Approvals towards setting these up is considered to be an important reason—this could be possibly overcome through single window clearances.
- **Considering setting up of LNG fuelling terminals along important highways:** This could help establish LNG as a fuel source for trucks. For example, a large Russian natural gas company is constructing six cryogenic filling stations along the M-11 highway connecting Moscow and St. Petersburg, part of the North–South and Europe–China international transit routes<sup>79</sup>. Select highways in India could be considered for cryogenic filling stations as well.
- **Encouraging gas demand for industrial use:** Several actions could be considered to do this such as increasing the reach of natural gas through

<sup>78</sup> "As capital waits for more CNG stations, queues at existing ones get longer", *The Indian Express*, 1 February 2019, <https://indianexpress.com/article/cities/delhi/as-capital-waits-for-more-cng-stations-queues-at-existing-ones-get-longer-2778618/>

<sup>79</sup> <https://www.lngworldnews.com>

laying steel/polyethylene pipelines to connect new consumers in existing clusters, e.g., Agra and Firozabad, adding spur lines or using truck-based transportation to new clusters to expand current gas clusters by promoting the development of new industries, which are typically LPG-based, such as ceramics or tiles and glass, around existing clusters like Bulandshahr and Firozabad.

- **Going beyond pipelines:** Trucks are already being used to reach LNG demand centres where scale does not permit pipeline builds. Other countries have used inland waterways and railways. A developed East Asian country has been transporting LNG by railroad since 2000, and a North American country started doing so in 2016<sup>80</sup>. These options could help India supply gas to customers who can afford LNG but do not have pipeline connectivity.

### Considering some more policy initiatives to bolster gas consumption

Policy support could help to shape and promote the demand for natural gas in the country. The following initiatives might be useful:

- **Downstream sector reforms in select sectors:** This may include differential pricing for peak power demand that might increase the affordability of the power sector.
- **Policy to facilitate LNG vehicles on highways and CNG in urban centres:** A policy thrust could encourage CNG consumption across all public transportation vehicles and even cab-aggregator services. One example is the MoU between GAIL Gas and Uber in 2018—where GAIL Gas agreed to provide free CNG to the first 500 cars joining the program (capped at a maximum of INR 10,000 per car) and Uber agreed to provide a joining award of INR 10,000 to each of the first 500 CNG vehicles driving with the platform<sup>81</sup>. Focused regulatory initiatives to promote LNG as a cleaner fuel could also be considered.
- **Promoting the use of gas-based appliances like air-conditioners, heaters, geysers:** Mass awareness campaigns could be run to bring about mindset shifts and to spread awareness about the cost effectiveness of PNG over LPG, e.g., the #Gas4India campaign. Other states could also draw inspiration from Gujarat, which is set to become India's first completely

<sup>80</sup> Expert interviews

<sup>81</sup> "Uber, GAIL Gas to promote CNG fleet", Sanjay Dutta, *The Times of India*, 20 June 2018, <https://timesofindia.indiatimes.com/business/india-business/uber-gail-gas-to-promote-cng-fleet/articleshow/64671046.cms>

covered piped gas state<sup>82</sup>. The government could also promote CNG among a target segment of customers seeking to switch vehicles as different regulations take effect, e.g., BS-VI emission norms, ban of diesel vehicles over 10 years old in Delhi, etc. CNG could also be positioned and marketed as a cost-effective and cleaner alternative to electric vehicles until the latter technology matures. Underserved SMEs could be covered through a stronger outreach team or by incentivizing natural gas usage.

- **Promoting the conversion of FO-based, LSHS-based plants and naphtha-based petrochemical plants to gas:** These could benefit the environment.
- **Creating an ancillary market in the power sector:** The presence of such a market could boost demand for flexible fuel sources such as natural gas.
- **Establishing a new gas-focused fund:** For example, the Power Sector Development Fund helps, to some extent, to absorb the current gas landed cost and power sector affordability gap of around USD 5 per mmbtu<sup>83</sup>.
- **Providing public utility status to CGD:** While working with states, this measure could help rationalize taxes.
- **Planning CNG corridors:** The government could plan these corridors along major and busy national highways such as Noida–Agra Delhi–Jaipur and Mumbai–Pune.
- **Extending the ambit of the goods and services tax (GST) to natural gas:** This could help contain production costs and make it price competitive.
- **Removing custom duty on imported LNG:** This may make it more price competitive, boosting the use of gas.

### Pushing technologies that realize the potential of gas

Encouraging the availability and uptake of enabling technologies could help to promote the use of gas. Some initiatives that could be considered are:

- **Encouraging the domestic auto industry to produce CNG-dedicated vehicles:** One of the largest Middle Eastern countries, for example, invested significantly in natural gas cars in the wake of sanctions

<sup>82</sup> "Gujarat to become 1st state with 100 percent piped gas network", Press Trust of India, *The Economic Times*, 13 June 2018, <https://economictimes.indiatimes.com/industry/energy/oil-gas/gujarat-to-become-1st-state-with-100-piped-gas-network/articleshow/64575951.cms>

<sup>83</sup> Expert interviews

for its nuclear program. This investment, over the past decade, was so significant that the number of dual-fuel cars increased from 1,500 in 2006 to 2.95 mn in 2013<sup>84</sup>.

- **Incentivizing private sector players:** This could encourage them to focus on developing LNG-based vehicles and LNG-supply infrastructure. For example, a Swedish multinational automobile company introduced the new LNG-based trucks that are Euro-6 compliant in 2017. These have the same performance, drivability and fuel consumption as the company's diesel-powered models<sup>85</sup>.
- **Focusing on technological investments to commercialize natural gas as a fuel:** There could be a concerted focus in India on developing better CNG engines, CNG tanks, etc. For example, a major Middle Eastern country's Research Institute of Petroleum Industry, in partnership with a university, have piloted a project to indigenize special compressed natural gas tanks which could help expand the CNG fuelling network. CNG is typically compressed to 220 bar for use in vehicles—the new technology (Adsorbed Natural Gas or ANG), can not only reduce the pressure to 35 bar, it can also increase the tank's total storage capacity by 40 percent. The ANG system thus creates a low pressure, conformable CNG storage solution for full-scale and affordable natural gas vehicle hybrid development<sup>86</sup>.

□ □ □

To drive the growth of gas in India, it is important to acknowledge the market's unique regional characteristics—large geographic spread, lack of seasonal (summer/winter) demand swings that offer differential pricing options, dearth of economically viable pipeline gas imports from other countries and limited domestic supply resources. Implementing key initiatives in line with the nature of the economy could help the government to resolve implementation issues. These initiatives could contribute towards building a vibrant, mature and significantly larger gas market in India.

<sup>84</sup> <https://www.ft.com/content/ad19885c-58bd-11e2-99e6-00144feab49a>

<sup>85</sup> <https://ngtnews.com>

<sup>86</sup> "Special tanks to help expand CNG network", *Financial Tribune*, 9 June 2018, <https://financialtribune.com/articles/energy/87724/special-tanks-to-help-expand-cng-network>







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