Greater Role of Natural Gas in the Energy Transition

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The pathway to a low carbon future primarily depends on a nation's availability of energy resources, economic growth, government policies, pattern of land usage, energy diplomacy, affordability and a gradual energy transition towards cleaner fuels. In such transitions, an old energy economy shifts to a newer energy economy by switching from old fossil fuel generations to more efficient technologies, thereby increasing the energy productivity; developing alternative fuels, such as renewables and more importantly, producing and using natural gas more responsibly.

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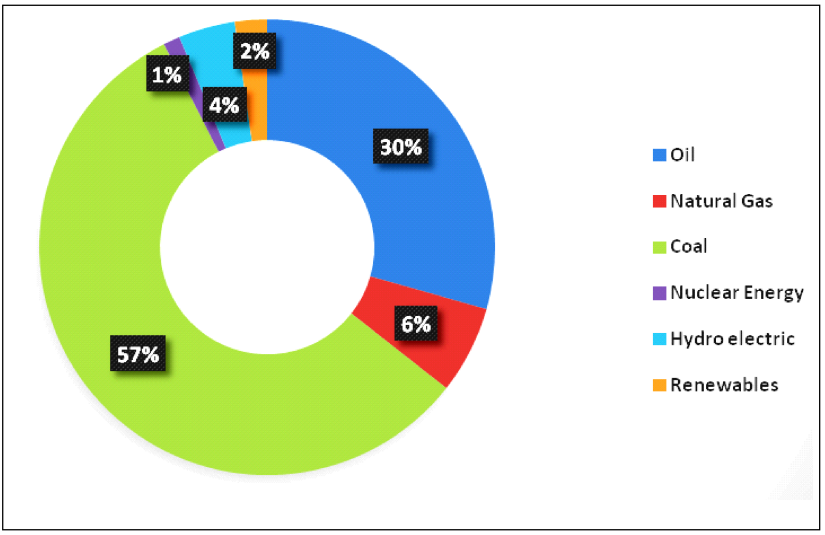
Therefore, the role of natural gas in energy transition becomes more crucial, which can go beyond just being a bridge fuel to clean energy for sustainable future. Natural gas is already preferred over wood, coal and crude oil due to its inherent features, such as its ability to be easily transported and stored, its combustion efficiency, convenience and flexibility of use and most importantly, its carbon emission factor. Its future can be sustainably extended if new energy economies find cost effective ways to abate the methane emissions that are generated from oil and gas operations. There are 76 million tonnes (mt) of oil and gas related methane emissions, more than half of which is stemmed from natural gas operations.[1] More than half of the methane leakage from natural gas comes from upstream operations, such as drilling sites and gas processing plants, with the remainder coming from downstream operations, like pipeline and storage systems.[2]

However, according to WEO 2017, it is technically possible to reduce global methane emissions from oil and gas operations by roughly 75% and by 40-50%, just by implementing approaches that have no net costs. It argues that the value of the captured methane is higher than the cost of the abatement measures.[3] Such methane emissions, which occurs at any stage during production, processing and transport of oil and gas, can be detected, measured and avoided through digital technologies.[4]

So far, the share of natural gas in the global energy mix has not increased to an extent that it can fight climate change, primarily due to the failure of replication of shale gas boom of the US to other shale-rich countries[5] and poor reserve-replacement ratio, such as in China. In addition, lack of sufficient new gas fields coming up despite fast aging gas fields across the world have resulted in fall in gas infrastructure investments.

However, the surge in recent LNG exports emerging from shale boom of the US and increased unconventional gas production from Australia is changing the natural gas outlook of the world. As a consequence of these developments in the LNG markets, natural gas prices have fallen significantly, stimulating LNG markets to shift from seller to buyer, empowering the latter in changing the existing rules of LNG trade.

Such a paradigm shift in global LNG trade has made India the fourth-largest LNG importer in 2016 due to the resulting increase in LNG imports. Consequently, Petronet LNG (PLL) has successfully renegotiated with a couple of LNG suppliers, namely RasGas of Qatar and Australian subsidiary of Exxon Mobil Corporation. These efforts have encouraged the Gas Authority of India Limited (GAIL) to discuss renegotiation with the US and Russia for sourcing up to 5.8 million tonnes (mt) and 2.5 mt of LNG respectively.[6]



Source: BP Statistical Review of World Energy, 2017.

Figure 1: Primary Energy Mix of India (2016)
(Million tonnes of oil equivalent)

These developments have further encouraged the government to formulate a strategy to increase the share of natural gas in India's energy mix from 6% at present to 15% (Figure 1) over the medium period, in line with India's commitment at the Paris meeting on climate change.[7]

India, being a new energy economy is under an energy transition. Having the lowest electricity per capita and with an aim to provide access to electricity and clean cooking fuel to all its citizens, it relies heavily on the fossil fuels (Figure 1). However, such energy transition should incorporate steps to improve its energy productivity, which can help reduce its energy import bills, greenhouse gas emissions, including methane emissions to meet its emissions reduction commitments, boost domestic production, increase uptake of renewable energy and improve energy security, while simultaneously improving its resilience to energy prices. In this regard productive use of natural gas to meet basic energy needs, and improving its productivity will help to fight climate change and local air pollution. Therefore, instead of getting lost to energy debates of fossil fuels and renewables, energy productivity should be the key factor shaping the current phase of energy transition, as India needs all the sources of energy it can lay its hands on, as emphasized by Petroleum Minister, Dharmendra Pradhan, who stated that:

> Energy is a multi-dimensional commodity and all the fuels — including coal, petrol, diesel, gas and renewables – will have a part to play in the

> country's energy growth…. Given the market size we have and consumption pattern, we need multiple sources of energy.[8]

Interestingly, a statement by the World Bank during the recent Paris Summit on stopping funding of oil and gas after 2019, says:

> In exceptional circumstances, consideration will be given to financing upstream gas in the poorest countries where there is a clear benefit in terms of energy access for the poor and the project fits within the countries' Paris Agreement commitments….[9]

The above statement reflects India's current energy conditions which could support its cause for accessing clean energy and electricity to all, wherein around 830 million Indians are still devoid of clean cooking facilities and per capita electricity consumption is only at 1075 kWh (2015-16).[10]

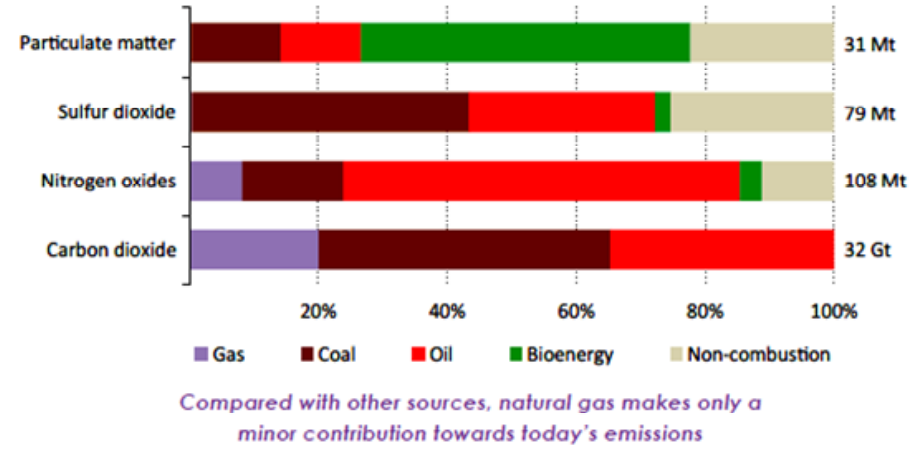
The Government's push for LPG, a petroleum product, for poor families and its deeper penetration in rural areas as a replacement of the polluting cow dung and firewood is a strong case in favour of energy access to the poor. While this initiative releases Liquefied Petroleum Gas (LPG) to be supplied to rural consumers, it also benefits urban consumers, through the expansion of a city gas distribution (CGD) network via piped natural gas (PNG) supplies, again reiterating a stronger environmental case for natural gas. Therefore, the promotion of clean cooking access with LPG including free connections to the rural poor through Pradhan Mantri Ujjwala Yojana, which further helps in the expansion of natural gas in urban areas, and thereby contributing towards the Paris Climate commitments, makes a stronger case for cleaner fossil fuels.

Environmental Case for Natural Gas

Besides offering a cleaner option through PNG, natural gas also brings in the flexibility needed in energy systems by replacing coal and oil while being a good fit for the rise of variable renewables, such as wind and solar PV.[11] Consistent fall in cost of renewables have resulted in its increased demand, making it a cost competitive resource. However, with the intermittent nature of both wind and sun, these energy resources need a baseload supply to support them. Natural gas with its all inherent benefits and availability on demand makes it a viable option, particularly in power generation. This makes natural gas and renewables complementary and this can further help in reducing reliance on coal and oil.

Further, though emissions from the combustion of natural gas is much lower than coal and oil, it also emits 50-60% less carbon dioxide (CO_2) when combusted

in a new efficient natural gas power plant compared with emissions from a typical new coal plant. Similarly, under smog conditions, the use of CNG in transport has an edge over other air pollutants (Figure 2), like sulfur dioxide (SO_2), mercury, particulate matter, and to some extent even nitrogen oxide (NO_x), found in petrol and diesel. It also performs better on other pollution parameters such as carbon monoxide and non-methane hydrocarbons and regarded considered safe and clean as Euro-VI emission standards for petrol and diesel that are yet to be implemented in India.[12]



Source: IEA, WEO 2017.

Figure 2: Share of Natural Gas in Total Energy-Related Emissions of Selected Air Pollutants and CO_2, 2015

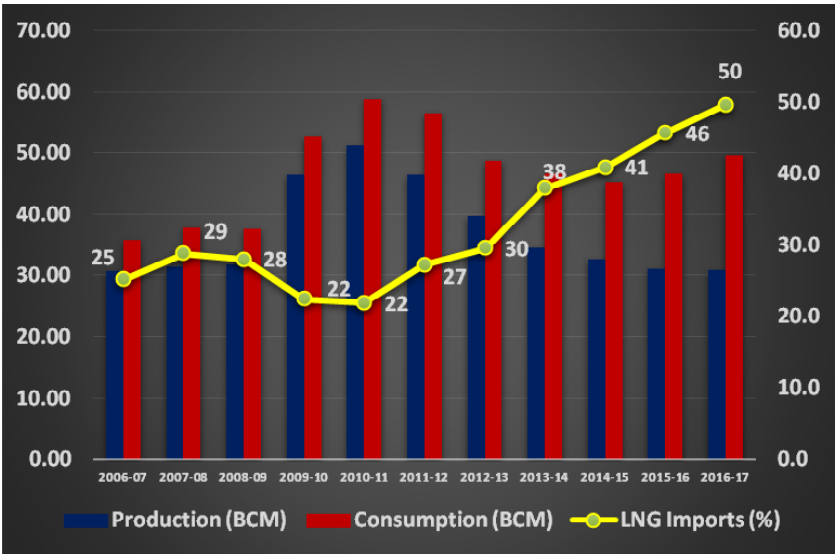
Thus, given the enormous economic and environmental benefits that can be derived from natural gas, it becomes important to create new gas demands and accordingly make viable investment decisions for gas infrastructure that is more strategically planned, across the natural gas value chain. In this regard the emergence of new technology as seen with the introduction of floating liquefied natural gas (FLNG), compressed natural gas (CNG), liquefied natural gas (LNG) trucks and floating regassified storage units (FSRU) complements well with the new global gas order. The new gas order[13] offers a greater diversity on the supply side due to the doubling of global liquefaction sites, competitive price formation of different gas supply sources, a tendency towards shorter contract duration, and an increased spot trading and contractual flexibility. All these conditions have enabled increased volume of global natural gas trade by reduction

in initial capital investments, bringing about a more flexible LNG trade with the possibility of future relocation, particularly, with respect to FLNG and FSRU.

A Move towards a Gas-based Economy

Possibilities of curbing methane emissions in the future and the new gas order are great enablers and contributors for India to increase its natural gas share in energy mix. Its robust growing population, projected to be the largest in the 2020s and its urbanization growth, which is expected to increase from 31% in 2012 to 51% in 2047 could make India one of the largest contributor to global energy demand with a 30% share. This could push its energy demand up by a 1000 million tonnes of oil equivalent (mtoe) between now and 2040.[14] It is further projected that in the next 25 years global natural gas use would increase by 45%,[15] with industrial demand leading the growth, wherein LNG would cover 60% of the long-distance gas trade by 2040.[16] Given 140 billion cubic meters (BCM) of LNG trade capacity still under construction,[17] gas markets would remain well supplied over the next few years creating more opportunities for India's LNG imports.

During the medium-term, gas demand could grow at 1.6% per year by 2022, wherein 90% of such demand would be coming from developing economies, like China and India. For instance, India, which currently leads the growth in gas demand in Asia, could have its gas demand increasing from 55 bcm in 2016 to 80 bcm by 2022.[18]



Source: Petroleum Planning & Analysis Cell (PPAC)

Figure 3: Demand-Supply Dynamics of Natural Gas

Despite historically being a part of India's primary energy fuel, natural gas has struggled to play a prominent role in India's energy basket. Though the share of natural gas in India's energy basket has steadily increased from 2005 until 2010 to reach 11%,[19] it fell afterwards, primarily due to a fall in the gas production in Krishna Godavari (KG-D6) blocks, comprising of DI-D2 and MA fields. Thereafter, factors like expected complexity of reservoirs and a lack of new discoveries led to its further fall. Subsequently, India's total natural gas consumption came down from 55.7 MTOE in 2010 to 45.1 in 2016, registering a fall of 19%. This scenario prompted the government to increase its LNG imports (Figure 3).

To promote a gas-based and clean fuel economy, the Indian government has taken several initiatives across the natural gas value chain. Efforts have been made to increase domestic exploration and production of natural gas from both, the conventional and non-conventional gas sources, including, shale gas and gas hydrates. Besides, new facilities, including, LNG terminals and FSRUs are being built up to import LNG. These facilities would be connected to the existing network of the natural gas grid of 16,000 km length, which is planned to be extended further up to around 30,000 km in the next five years. Finally, to make the gas molecules reach their final and wider consumer base, the city gas distribution (CGD)[20] network is strengthened alongside with the introduction of small scale LNG (SSLNG) to meet the increasing gas demand in niche markets. These initiatives are elaborated as follows:

1. To increase domestic gas exploration and production.
2. To increase LNG imports.
3. To develop a National Gas Grid and CGD Network.
4. To boost Gas Demand in Power and Fertilizer Sectors.

1. **To Increase Domestic Gas Exploration and Production:** Out of 26 sedimentary basins covering an area of 3.14 million sq. km, 48% are yet to be appraised, which accounts for an area of 1.502 million sq. km. with an assessment of only 15 sedimentary basins since 1990. To appraise the remaining areas, MoPNG has formulated a plan to conduct 2D seismic surveys in all 26 sedimentary basins of India by ONGC and OIL.

   In this regard, on March 10, 2016, government also approved Hydrocarbon Exploration Licensing Policy with the following features:

   - to provide a simple and easy to administer revenue sharing model;[21]

- to provide marketing and pricing freedom for difficult areas such as, High Pressure High Temperature reservoirs and Deepwater and Ultra Deepwater areas;[22]
- to introduce open acreage policy,[23] wherein exploration is permitted throughout the contract period, governed by a single license for exploration and production of all forms of hydrocarbon without having to obtain separate approvals and going through new bidding rounds;
- to reduce the royalty rates for offshore fields[24] while extending of Production Sharing Contracts.[25]

Further, to facilitate unconventional gas production, such as shale to private players, government is now planning to change the definition of 'Petroleum' in the Petroleum and Natural Gas Rules, 1959 and the production sharing contracts to allow the private exploration companies exploit shale,[26]thereby providing a level playing field with National Oil Companies (NOC) in their onland Petroleum Exploration License (PEL)/Petroleum Mining Lease (PML) blocks awarded under the nomination regimes.[27]

2. **To Increase LNG Imports:** Noting that LNG would play a central role in India's natural gas share increase, India has planned to accelerate its cheaper LNG imports and expand its LNG capacities to meet the rising gas demand until some new discoveries are found. India's current capacity of LNG import terminals permits it to handle about 30 million metric tonnes per annum (MMTPA) from four operational terminals (Table 1) comprising of just 30% of the total current gas consumption. Government has planned to expand LNG import capacity to 47.5 MMTPA.[28] In this regard the eastern part of India with gas pipeline network and LNG terminals is being developed along the Dhamra port.[29]

Table 1: LNG Terminals (Operational)

Sl. No.	*Name of terminal*	*Promoters*	*Capacity (MMTPA)*	*Capacity Utilization (%) (Apr-Sep 2017)*
1.	Dahej (Gujarat)	Petronet LNG Ltd. (PLL)	15 MMTRA	101.7
2.	Hazira (Gujarat)	Hazira LNG Pvt. Ltd. (HLPL)	5 MMTPA	56.5
3.	Dabhol (Maharashtra)	Ratnagiri Gas Power Pvt. Ltd. (RGPPL-JV of GAIL & NTPC)	1-69 MMTPA presently without breakwater to be increased to 5 MMTPA	13.8
4.	Kochi (Kerala)	Petronet LNG Ltd. (PLL)	5 MMTPA	13.8

Source: PPAC, Ready Reckoner, November 2017.

Further, three LNG projects of 15 MTPA are targeted to be completed by 2019 and based on the number of announced project proposals, India's total regasification capacity can reach up to 103 MTPA by 2020.[30] These terminals would be instrumental in meeting the incremental gas demands of India.

In addition to gas infrastructure development, India's LNG importers are actively involved in renegotiating their long-term LNG contracts, commensurate with low global gas prices. In this regard RasGas and Petronet LNG (PLL) have renegotiated their long-term contracts resulting in a significant fall in the Free-on-Board (FOB) price of RasGas LNG from around $12.5/MBTU to $6.5-7/MBTU boost to RasGas LNG's demand and helping India's LNG imports to become cheaper by almost half.

PLL has once again successfully renegotiated the pricing for its 20-year, 1.5 MMTPA Gorgon LNG contract with Exxon Mobil, which they have signed with the Australian subsidiary of Exxon Mobil Corporation.[31] With reduction in slope from 14.5% (FOB) to 13.9% (delivered ex-ship), by including shipping cost in oil indexation itself, the cost of imported LNG is now expected to come down by almost $1.4/mBtu to $7.6/mBtu, assuming Brent price of $55 a barrel.

Encouraged with PLL's LNG trade renegotiations, GAIL too has attempted to renegotiate its contract with the US and Russia. However, its efforts have not come to fruition yet. While GAIL continues to discuss renegotiation of its LNG to be sourced from the US to the tune of 5.8 million tones, (mt) its upcoming LNG imports from Gazprom[32] for 2.5 mt would remain same as already agreed in 2012, thereby nullifying any benefits that GAIL could have accrued due to the fall in the global gas prices.

3. To Develop National Gas Grid and CGD Network

(a) ***National Gas Grid:*** To strengthen natural gas infrastructure, government has targeted to increase gas pipeline network to about 30,000 km in next 5 years, from existing 15,486.13-km,[33] while also fixing regional imbalances in the gas grid, particularly in the eastern part of India, particularly through viable gas funding (VGF) as approved by Cabinet Committee of Economic Affairs in September 2016 for the development of Jagdishpur- Haldia and Bokaro-Dhamra Gas Pipeline (JHBDPL) projects to strengthen the eastern part of the gas pipeline network.[34]

(b) ***City Gas Distribution:*** To expand this network, government has set a target to Oil and Gas Public Sector Undertakings (PSUs) to achieve one crore PNG connections by 2019, from existing 37,02,095[35] domestic PNG connections recorded till July 1, 2017. To reach this target, the government is now mulling to replace all LPG connections in Smart Cities with PNG connections.[36] PNG connections for industrial and commercial segments as on June 1, 2017 were recorded at 6,875 and 24,602 respectively, covering 13 states.[37]

In case of CNG network, India has so far covered 15 states having a total number of 31,75,685 CNG vehicles, served by only 1,237 CNG stations.[38] For holistic expansion of the CGD network, government has pitched for inter-ministerial support.[39]

4. To Boost Gas Demand in Power and Fertilizer Sectors

Fertilizer and power sectors are the major gas consumers in the Indian gas market with a combined gas consumption share of about 55% of the total gas consumption in the month of October 2017.[40] Given, the scale of their operations, policy interventions and social impact, natural gas demand in these sectors is expected to rise further.

(a) ***Power Sector***: Despite the growth potential of the gas power sector, factors like affordability and reliability continues to play a big role as evident from discontinuation of the Power System Development Fund (PSDF) initiative that was started in March 2015 to revive the stranded gas based capacity of 14305 MW after state government withdrew from it. Under this scheme, while state governments were required to forego some taxes, gas transporters and import terminals had offered discounts on charges of their services[41]. However, the Association of Power Producers are in favour of continuation of the scheme for two more years as they are ready to pay premium.[42]

(b) ***Fertilizer Sector:*** In this sector, natural gas is used as a feedstock and fuel for the production of fertilizers. Consumption of gas in fertilizers is driven by the consumption of urea, wherein 90% of urea manufacturing capacities is gas-based, while the rest is based on naphtha. Increased use of natural gas in the fertilizer sector was driven by rising price of oil price-linked naphtha. Thus, to reduce dependence on naphtha there was a constant push by the government to convert all urea manufacturing capacities to gas-based.

However, this sector is unable to raise the production of fertilizer due to prevailing fertilizer subsidy resulting in its increased imports. Due to overconsumption of urea, subsidies have also contributed to soil degradation and environmental damage due to imbalanced use of fertilizers. Consequently, many Indian States have deviated from the ideal ratio of nitrogen (N), phosphorus (P) and potassium (K) of around 4:2:1, such as in Haryana, Punjab and Rajasthan, the NPK consumption ratio reached a whopping 61:19:1, 62:19.1 and 45:17:1 respectively.[43]

According to the Secretary, Department of Fertilizers, "the cost of urea production is 16,000 to 17,000/MT. The farmers are provided urea at 5,360/MT after reducing 5,360 from 17,000, the rest amount is given as subsidy to the companies."[44] This price of 5,360/MT (USD86 at an exchange rate of Rs.62/USD) is very low price compared not only to the global urea price of $300/MT but also very low compared to $362/MT in Pakistan, $207/MT in Bangladesh and $265/MT in China45. For 2017-18, subsidies on fertilizer is pegged at 70,000 crore, making it the second largest subsidy bill after food, earmarked at 1,45,338.60 crore.

Thus, to rationalize fertilizer subsidies, while also increasing the domestic production and reducing imports, the government has introduced a 'gas price pooling scheme' w.e.f. July 1, 2015[46] and planned to roll out direct benefit transfer for fertilizers from March 2018.

Under this gas price-pooling scheme, the domestic gas is being pooled with RLNG to provide natural gas at uniform delivered price to all national gas grid connected urea manufacturing plants for the purpose of manufacturing of urea.[47]

In case of direct benefit transfer in fertilizer sector, government would pay fertilizer subsidies directly to manufacturers only after sale of soil nutrients via point of sale devices at retail level, helping the government to reduce its subsidies by up to 20% through plugging diversion and leakages.[48]

Challenges and A Way Out

One of the biggest reasons for the failure of the natural gas sector to expand in India was the lack of a natural gas infrastructure coupled with very high LNG prices as consistent fall in India's domestic production of natural gas never created a scenario which could have rebooted the share of gas in its energy mix. While the global gas market was rocked by massive investments in new LNG

supply and subdued demand growth, pulling gas prices down drastically, it is only now that the long-awaited demand response to such prices have started to happen. This is reflected with the changes in LNG market dynamics wherein demand from countries like China and India have started to shoot up.

India, for instance, went for big gas reforms across the NGVC where efforts were made, not only to provide incentives to domestic gas producers but also to attract investments from private companies, besides its engagement through natural gas diplomacy with LNG exporters through renegotiations. However, there is a need to work on a few more aspects of the gas reforms which can help optimise India's domestic natural gas production and demand, which so far has been constrained due to supply bottlenecks. The following are the key determinants which can help increase the share of gas in India's energy mix.

1. ***Gas Pricing –*** The biggest determinant for India's gas demand for the government would be to focus on price transparency and relooking at current disposition of the gas pricing mechanism, which is still resulting in shortfall of investments in an upstream gas sector. The hardest hit from the new gas pricing mechanism is ONGC and OIL which are finding it difficult to start production from domestic fields. Notably, after the fourth consecutive cut, the domestic gas prices, which recorded at $2.5/million British thermal unit (mBtu) in October 2016, went even below the average cost of producing natural gas for Oil & Natural Gas Corporation (ONGC) and Oil India Limited (OIL), hampering their profitability and making their upstream business completely unviable.[49] The recent increase in domestic gas prices as a result of increased global oil price have not brought cheer for NOCs. While, the current gas price for domestic natural gas for the period from October 2017 to March 2018 is $2.89 per mBtu, the price for gas from difficult gas fields from Deepwater, Ultra Deepwater and High Pressure-High Temperature area is around $6.3 per mBtu. However, the price of $2.89 per mBtu is not sufficient enough for ONGC to produce gas from shallow waters of KG basin, as the same is unviable and affecting ONGC's investment plans. This is because block KG- OWN-2004/1 is not being considered as a difficult field thereby not qualifying for higher rates.[50] It may be noted that without offering higher prices for this field to ONGC, government would still end up paying $6-7 per mmbtu to domestic consumers if it imports LNG at the prevailing low global LNG prices. Government would do well to consider these scenarios and revisit the current gas pricing formula. Setting up a floor price of around $3.5-4 per mBtu could be a way out, as suggested by experts.[51]

2. ***Investments in Gas Infrastructure:*** According to CRISIL Research, India needs an investment of $10 billion (65, 000 crores), of which 30,000 crores is needed for gas pipeline of around 9,000 km.[52] Rising air-quality concerns over the last few years have been instrumental to push for gas-fueled vehicles to include LNG-fueled busses and trains. This not only needs an expansion of CNG gas infrastructure but also strategic LNG infrastructure installation such as national highways to fuel LNG-run fleets. Reliance Industries have shown interest in setting up LNG retail outlets along with Royal Dutch Shell and PLL.[53] Furthermore, there are both environmental and economic factors to boost small scale LNG (SSLNG)[54] business in India as this has the potential to spur the demand for Micro, Small & Medium Enterprises, pushing for Industrial demand for natural gas. India's large coastal metropolitan areas and industrial hubs offer a great potential to LNG markets necessitating infrastructure development.
3. ***Bringing Natural Gas under GST:*** Government is now trying to include natural gas under the new goods and services tax (GST) at the next GST Council meeting in January 2018 as this would help increase gas demand for city gas distribution expansion plans. Similarly, bringing LNG under GST would help increase the usage of LNG for industries and transport fuel, particularly for long haul busses, trucks, etc.
4. ***Resetting Gas Pipeline Diplomacy:*** India has so far pursued several cross-border gas pipelines, such as, Iran-Pakistan-India (IPI), TAPI, Myanmar-Bangladesh-India (MBI) and Oman-India Natural Gas Pipeline (Now Middle East to India Deepwater Pipeline/MEIDP). India is also looking to bring Russian gas from Siberia to India via Myanmar through gas swap arrangements. However, none of these have come to fruition so far with only the TAPI pipeline moving at some pace. This is due to ever changing geopolitical environment which has come into play in directing India's strategy towards gas pipeline diplomacy, which now needs to be revisited with some plausible outcome.

   In this regard, strengthening relations with Iran would be beneficial for India to explore several opportunities that it offers resulting from its gas production. MEIDP and LNG imports from Iran are some options which need to be considered more seriously, particularly after the successful inauguration of Chabahar Port, jointly developed by India, Iran and Afghanistan. MEIDP Iran-India gas pipeline can bring cheaper LNG to India which could cost around $5-5.50 per mBtu.[55]

Thus, addressing all the above challenges can create tremendous opportunities for India to expand its share of natural gas in its energy mix while tapping LNG markets and finding ways to abate methane emissions. It is the holistic and integrated approach towards gas-based economy that would strengthen India's natural gas sector in a more sustained manner.

Notes

1. International Energy Agency, *World Energy Outlook 2017*.
2. Union of Concerned Scientists, "The climate risks of natural gas" https://www.ucsusa.org/clean-energy/coal-and-other-fossil-fuels/infographic-natural-gas-fugitive-methane-emissions#.WjuhzN-WbIU
3. *Ibid,* p. 399.
4. IEA. *Digitalization & Energy.* 2017. p. 70.
5. n. 1.
6. PTI, "India to renegotiate LNG rate with US, Russia", *Livemint*, 04 October 2017.
7. PIB, "India's Intended Nationally Determined Contribution is Balanced and Comprehensive: Environment Minister", MoEF, 02 October 2015.
8. Bilal Abdi, "Oil Minister Pradhan calls for umbrella policy to synergise energy ministries", *ET Energy World,* https://energy.economictimes.indiatimes.com/news/oil-and-gas/oil-minister-pradhan-calls-for-umbrella-policy-to-synergise-energy-ministries/61832525
9. News Wires, "World Bank to stop funding oil, gas projects from 2019", *France24*, 12 December 2017.
10. Rakesh Dubbuddu, "India's Per Capita Electricity Consumption lowest among BRICS nations", *Factly,* 10 May 2016.
11. Tim Gould and Christophe McGlade, "The Environmental Case For Natural Gas", 23 October 2017, https://www.iea.org/newsroom/news/2017/october/commentary-the-environmental-case-for-natural-gas.html
12. TNN, "CNG is safe, as clean as Euro-VI compliant diesel", *Times of India*, 11 August 2015.
13. n. 1, p. 367.
14. *Ibid.,* p. 64.
15. *Ibid,* p. 333.
16. *Ibid.*
17. *Ibid.*
18. IEA, *GAS 2017: Analysis and Forecasts to 2022,* p. 11.
19. *BP Statistical Review of World Energy, 2011*, http://www.bp.com/content/dam/bp-country/de_de/PDFs/brochures/statistical_review_of_world_energy_full_report_2011.pdf
20. City or local natural gas distribution network" means an interconnected network of gas pipelines and the associated equipments used for transporting natural gas from a bulk supply high pressure transmission main to the medium pressure distribution grid and subsequently to the service pipes supplying natural gas to domestic, industrial or commercial premises and CNG stations situated in a specified geographical area. [Section 2(i) of PNGRB Act 2006]
21. MoPNG, Model Revenue Sharing Contract, *Hydrocarbon Exploration & Licensing Policy, 2017*, http://182.19.5.116/HELP/Content/files/oalp/2_Model_RSC.pdf

22. MoPNG, "Marketing including pricing freedom for the gas to be produced from Discoveries in Deepwater, Ultra Deepwater and High Pressure-High Temperature areas", 21 March 2016, http://petroleum.nic.in/sites/default/files/mkt_freedom.pdf
23. MoPNG, "Notification on 'Modalities of Operationalization of Open Acreage Licensing Policy under HELP'", http://petroleum.nic.in/sites/default/files/oalp_modalities.pdf
24. MoPNG, "A presentation on recent policy decision", http://petroleum.nic.in/sites/default/files/imppolicy.pdf
25. PIB, "Policy for the Grant of Extension to the Production Sharing Contracts signed by Government awarding small, medium sized and discovered fields to private/Joint Ventures", http://pib.nic.in/newsite/PrintRelease.aspx?relid=137637
26. Sanjeev Choudhary, "Definition change may let private exploration companies exploit shale", *The Economic Times,* 11 December 2017.
27. PIB, "Shale Gas Exploration", Ministry of Petroleum & Natural Gas, 25 November 2015.
28. Choudhary, Sanjeev. 'Government mulls doubling LNG import terminal capacity', *The Economic Times,* 06 June 2016.
29. PTI, "LNG Terminal ground breaking ceremony held in Dhamra port in Odisha", *The Hindu,* 08 July 2017.
30. International Gas Union, "IGU 2017 World LNG Report", https://www.igu.org/sites/default/files/103419-World_IGU_Report_no%20crops.pdf
31. Bilal Abdi, "Renegotiation of Gorgon LNG contract could pave the way for other deals: ICRA", *Energy World,* 02 October 2017.
32. Rajesh Kumar Singh and Debjit Chakraborty, "GAIL Delivered Setback in Bid to Renegotiate Gazprom LNG Deal", *Bloomberg,* 27 November 2017.
33. Rajya Sabha, "Unstarred Question No. 2043 – Expansion of Gas Grid Network" asked by M.P. Veerendra Kumar to Dharmendra Pradhan, Minister of State in MoPNG on 02 August 2017.
34. PIB, "Cabinet approves Capital Grant to GAIL for development of Gas Infrastructure in Eastern part of the country", CCEA, 21 September 2016.
35. PPAC, "Ready Reckoner – Snapshot of India's Oil & Gas data", July 2017.
36. Dipak Kumar Dashi, "Govt wants to replace LPG with PNG in smart cities", *Times of India*, 13 November 2015, http://timesofindia.indiatimes.com/india/Govt-wants-to-replace-LPG-with-PNG-in-smart-cities/articleshow/49762703.cms
37. n. 34, p. 17.
38. *Ibid.*
39. Lok Sabha Secretariat, 'PNG Network', answer to starred question no. 217, 31 July 2017, Krishnan Narayanswamy Ramchandran, MoPNG, http://164.100.47.194/Loksabha/Questions/QResult15.aspx?qref=55543&lsno=16
40. n. 34.
41. Sarita Singh, "Subsidised imported gas scheme scrapped", *The Economic Times,* 03 April 2017.
42. *Ibid.*
43. Ashok Gulati and Pritha Banerjee, "Rationalising Fertiliser Subsidy in India: Key Issues and Policy Options", Working Paper 307, ICRIER, August 2015, p. 25.
44. Lok Sabha Secretariat, "Demand for Grants – 2017-18", Ministry of Chemicals and Fertilizers, March 2017.
45. n. 43, p. 28.

46. PIB, "Pooling of Gas in Fertilizer (Urea) Sector", CCEA, 31 March 2015, http://pib.nic.in/newsite/PrintRelease.aspx?relid=117888
47. *Ibid.*
48. PTI, "From June, fertiliser companies to get subsidy after PoS retail sale", *Livemint*, 03 April 2017.
49. PTI, "ONGC, Oil India making losses on natural gas production: Officials", *Livemint,* 02 October 2016.
50. PTI, "ONGC pushes for higher gas price to produce KG basin, Kutch discoveries", *The Asian Age*, 26 November 2017.
51. Saurabh Kumar, "Set floor price for domestic gas: Experts", *Financial Express,* 28 November 2017.
52. M. Allirajan, "India's gas targets will need $10 billion investments, Crisil says", *The Times of India,* 22 December 2016.
53. Kalpana Pathak, "Reliance may set up LNG retail outlets, charging points for electric vehicles", *LIvemint*, 17 July 2017.
54. International Gas Union defines small scale liquefaction and regasification facilities as plants having a capacity of less than 1 million tonnes per annum
55. PTI, "Undersea Iran-India gas pipeline can bring cheaper LNG to India", *Livemint*, 05 September 2017.