

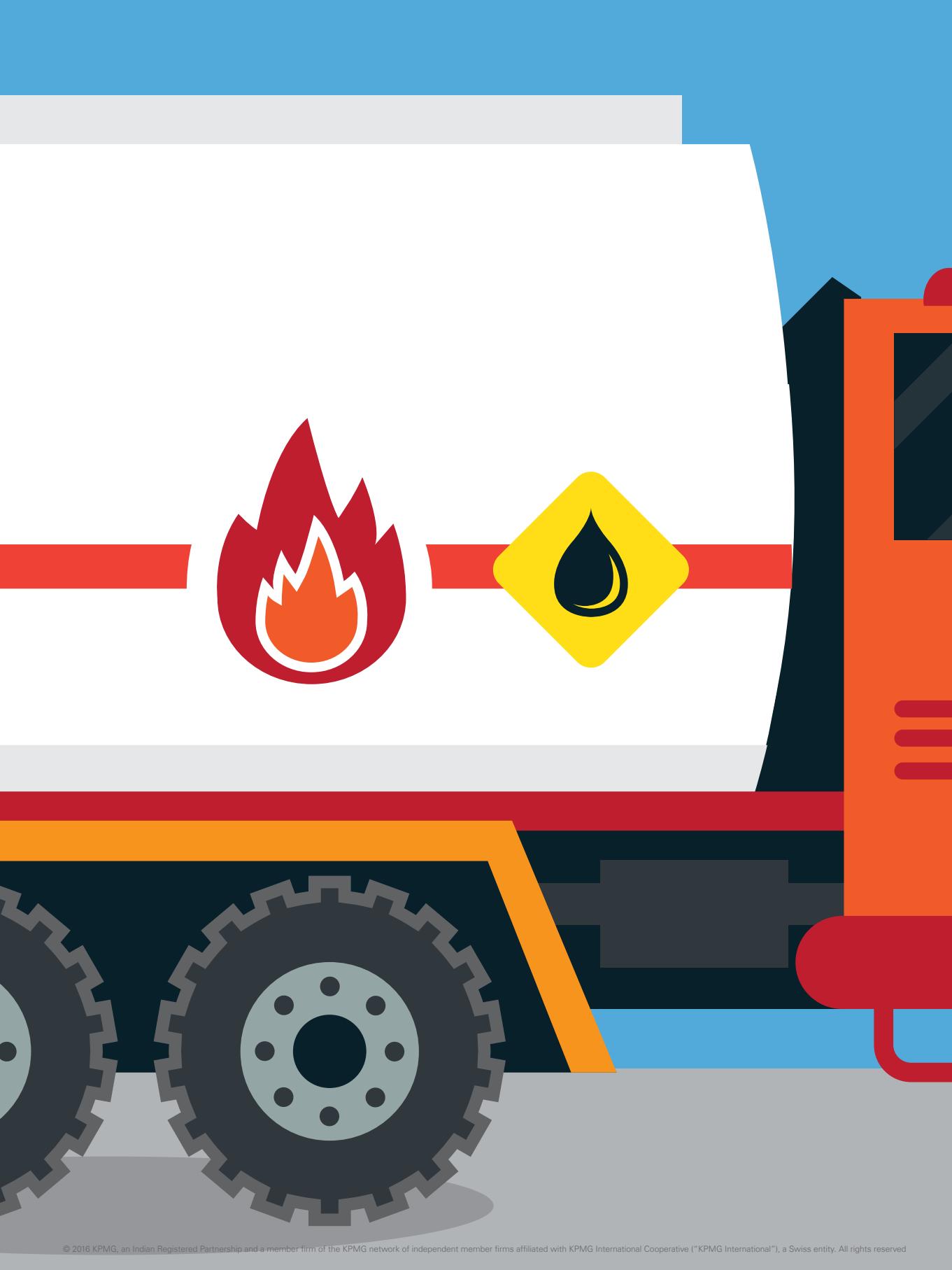
# Natural gas

**The road towards a  
cleaner and prosperous  
future**



<b>Natural gas</b>	<b>01</b>
A key component of the clean energy future	
<b>Global gas markets</b>	<b>05</b>
Key developments	
<b>The Indian context</b>	<b>17</b>
A rising demand for natural gas	
<b>Infrastructure development</b>	<b>21</b>
Critical for the growth of gas markets	
<b>Small scale LNG technologies</b>	<b>27</b>
A game changer	
<b>Policy and regulations in India</b>	<b>31</b>
The need for reforms	
<b>Competitive gas markets</b>	<b>35</b>
Their role in transforming India's energy landscape	
<b>Future outlook</b>	<b>39</b>
India moving towards a natural gas era	







# Foreword

India's decadal energy consumption growth rate in 2015 has outstripped that of China for the first time in 15 years<sup>4</sup>, indicative of the anticipated ascendancy of India as an economic heavyweight in times to come. However, this growth has been uneven when it comes to the distribution of resources. At the top of the consumption chart is oil, which has grown by an astounding 8.1 per cent compared with 4.4 per cent in the previous year. Coal has grown by 4.8 per cent. Renewable energy by 13.7 per cent and nuclear by 9.8 per cent, albeit both over relatively small bases<sup>4</sup>. In contrast, the growth of the consumption of key clean energy resources such natural gas in the energy basket has actually shrunk. Natural gas has fallen below the previous year consumption, but has since shown signs of recovery. Though the growth of oil consumption in a fast developing economy is expected, if India becomes excessively reliant on oil and coal, the ability to react to global

economic and environmental realities becomes that much more doubtful. In October 2016, Government of India ratified the Paris Agreement and aims to reduce the country's carbon emissions intensity by up to 35 per cent<sup>1</sup> from 2005 levels by 2030. Hence it becomes all the more essential to build a well-diversified fuel basket for India with much higher contributions of natural gas. The contribution has dipped from a high of 12 per cent five years ago to only 6.5 per cent at present, and in contrast to the global average of 23.8 per cent<sup>4</sup>.

India's gas sector is in relatively early stages of development and should be expected to grow strongly at this time.

The Petrotech series of International Oil and Gas Conference and Exhibition is a biennial platform for national and international experts in the oil and gas industry to exchange views and share knowledge, expertise and experiences. Held for over two decades with growing participation,

Petrotech-2016 is the 12th edition of the flagship event of the bustling Indian hydrocarbon sector. KPMG is privileged to be the knowledge partner for the plenary session on natural gas of the event.

The plenary session on natural gas is expected to be attended by various industry stakeholders including policymakers and regulators. In order to enable the discussions, KPMG has prepared this background paper titled 'Natural gas: The road towards a cleaner and prosperous future' covering the emerging trends and key developments in global gas markets, emerging small scale LNG technologies and challenges and opportunities for the gas industry. The paper also throws light on the policy and regulatory reforms needed to foster the growth of the Indian gas industry. We sincerely hope that this paper which sets out the theme for discussion during the plenary session provides an insightful overview.



**Anish De**

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Strategy and Operations, Infrastructure,  
Government and Health  
KPMG in India

1. India, Climate Action Tracker, <http://climateactiontracker.org/countries/India.html>, accessed on 17 November 2016

# Natural gas



**A key component of the  
clean energy future**

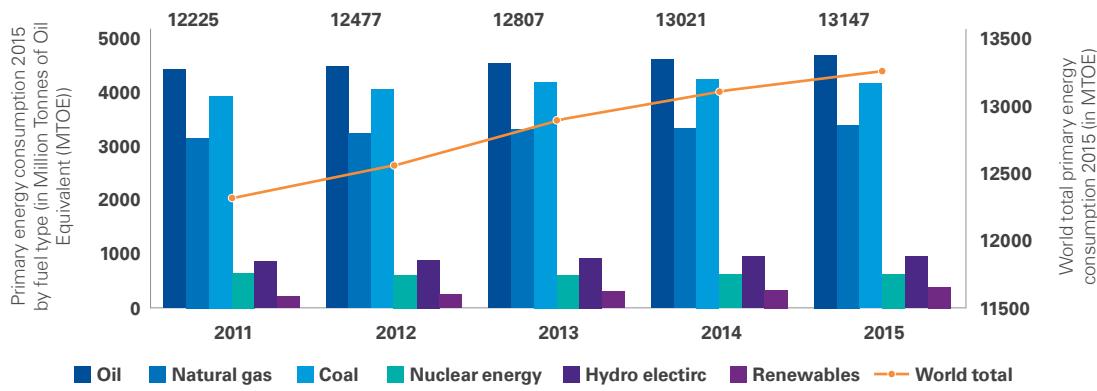


According to International Energy Agency (IEA) 2016 outlook, global natural gas demand is expected to rise by 1.5 per cent per year by the end of the forecast period, compared to 2 per cent projection in the 2015 outlook<sup>2</sup>. Although growth in the primary energy demand of the world economy has been slower (Compound annual growth rate (CAGR) of 1.8 per cent

during 2011-15<sup>3</sup>), the share of gas in the energy mix is still expected to increase in light of the environmental imperative to reduce the carbon emissions. With a continuous increase in share of primary energy consumption over the last half century from 15 per cent<sup>3</sup> in 1965 to nearly 25 per cent<sup>3</sup> today, natural gas is poised to play an important role in the global energy system.

Pledges to reduce global greenhouse gas (GHG) emissions have been made in the twenty-first session of the Conference of the Parties (COP21)<sup>3</sup> to mark a beginning to build a cleaner and sustainable energy ecosystem. The flexibility of natural gas as a fuel, together with its energy security and environmental attributes makes it an attractive fuel option.

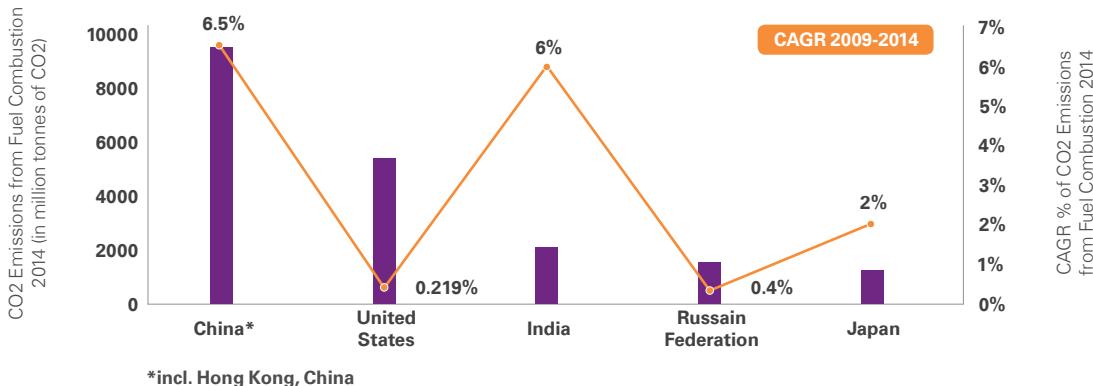
## World Primary Energy Consumption (By Fuel Type)



**Source:** Statistical Review of World Energy 2016 – data workbook, BP <http://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html>, accessed on 14-Oct-2016

2. IEA sees major shifts in global gas trade over next five years, International Energy Agency, <https://www.iea.org/newsroom/news/2016/june/iea-sees-major-shifts-in-global-gas-trade-over-next-five-years.html>, accessed on 20 Oct 2016
3. COP 21, United Nations Framework Convention on Climate Change, [http://unfccc.int/meetings/paris\\_nov\\_2015/session/9057.php](http://unfccc.int/meetings/paris_nov_2015/session/9057.php), accessed on 23 Oct 2016

## CO2 Emissions from Fuel Combustion 2014



Source: CO2 emissions from fuel combustion Highlights, International Energy Agency Energy, 2016

The natural gas share in world primary energy consumption saw CAGR of 1.8 per cent during 2011-15 compared to 1.5 per cent of oil and 1.4 per cent of coal<sup>4</sup> during the same period. China is the largest contributor to CO2 emissions arising from fuel combustion followed by U.S. and India in 2014<sup>5</sup>.

### 2015 Paris Agreement - Adopted under COP21<sup>6</sup>

- Global effort to combat climate change through emission reduction targets
- Countries are formulating long-term low greenhouse gas emission development strategies to achieve targets
- 110 parties of 197 parties to the convention have ratified the Paris Agreement which entered into force on 4 November 2016<sup>7</sup>

Natural gas is gaining prominence as a clean-energy option globally

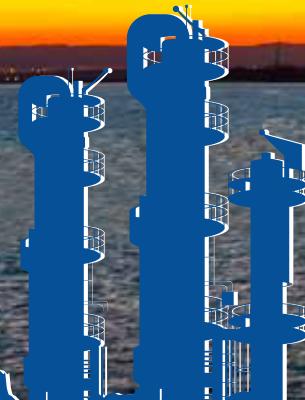
4. Statistical Review of World Energy 2016 – data workbook, BP, <http://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html>, accessed on 14-Oct-2016
5. IEA Statistics – CO2 Emissions from fuel combustion highlights, International Energy Agency, 2016
6. The Paris Agreement, United Nations Framework Convention on Climate Change, [http://unfccc.int/paris\\_agreement/items/9485.php](http://unfccc.int/paris_agreement/items/9485.php), accessed on 16 Nov 2016
7. Paris Agreement - Status of Ratification, United Nations Framework Convention on Climate Change, [http://unfccc.int/paris\\_agreement/items/9444.php](http://unfccc.int/paris_agreement/items/9444.php), accessed on 16 Nov 2016



# Global gas markets

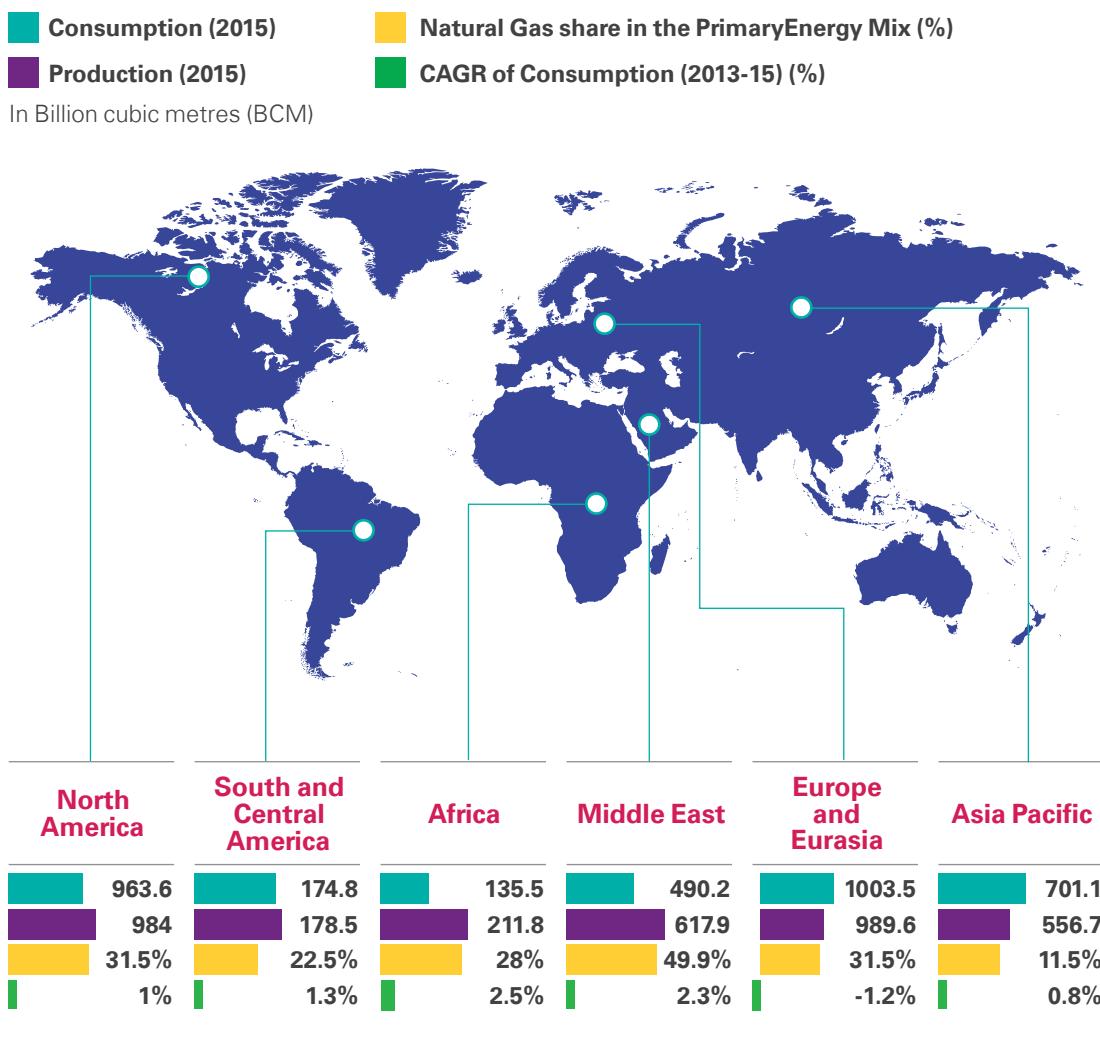


## Key developments

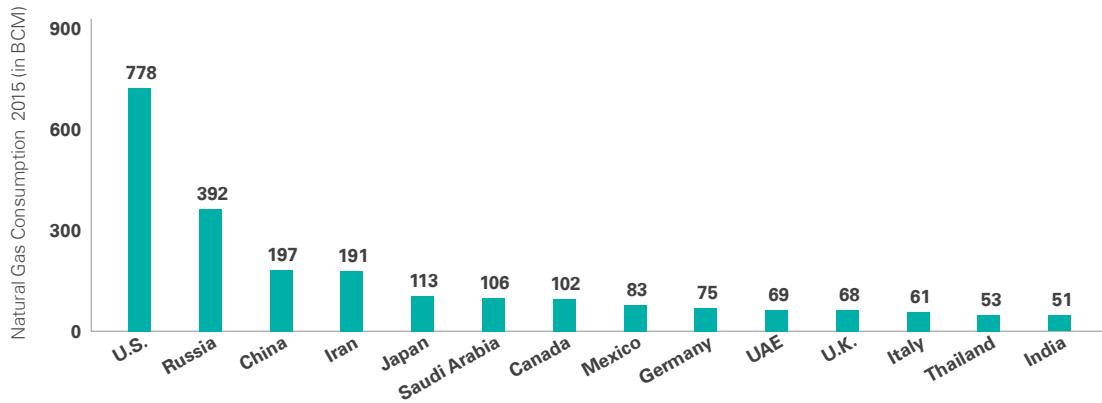


## Global gas markets - Quick snapshot

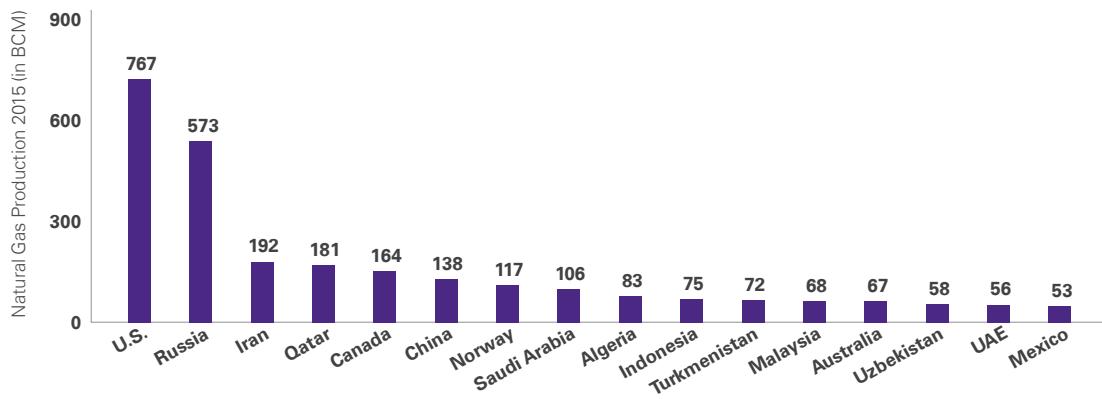
Global gas markets are facing several challenges such as low oil prices, increasing competition and glutted energy demand. Traditionally, gas markets have been largely regional, predominantly functioning as sellers markets mostly traded through pipelines via long-term oil linked contracts. However, with the emergence of new supply sources (unconventional resources, in particular) and new re-gasification markets in the last few years, the Liquefied natural gas (LNG) market is poised to grow despite the slowdown in gas demand in mature gas markets. A stronger buyer market could drive the expansion of the global gas trade in the long run.



**Source:** Statistical Review of World Energy 2016 – data workbook, BP; <http://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html>, accessed on 14-Oct-2016



**Source:** Statistical Review of World Energy 2016 – data workbook, BP <http://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html>, accessed on 14-Oct-2016

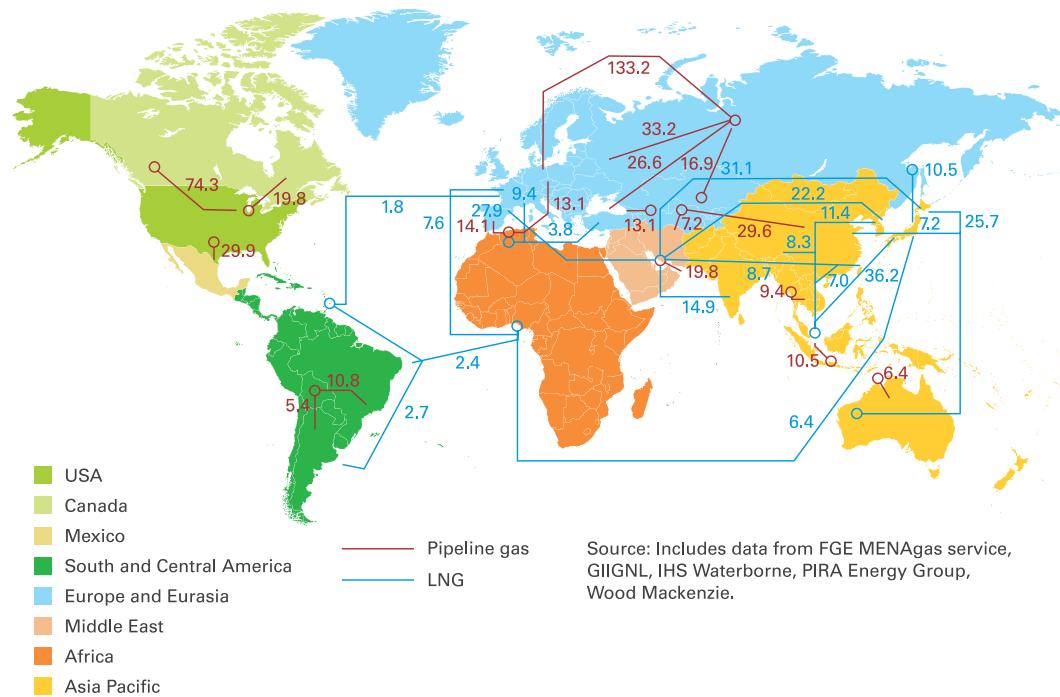


**Source:** Statistical Review of World Energy 2016 – data workbook, BP <http://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html>, accessed on 14-Oct-2016

U.S., Russia, Iran and Qatar are the top natural gas producers and together contribute to 48.7 per cent of global gas production in 2015 worldwide

## Global gas markets - Trade patterns

### Major trade flows in 2015 (In BCM)



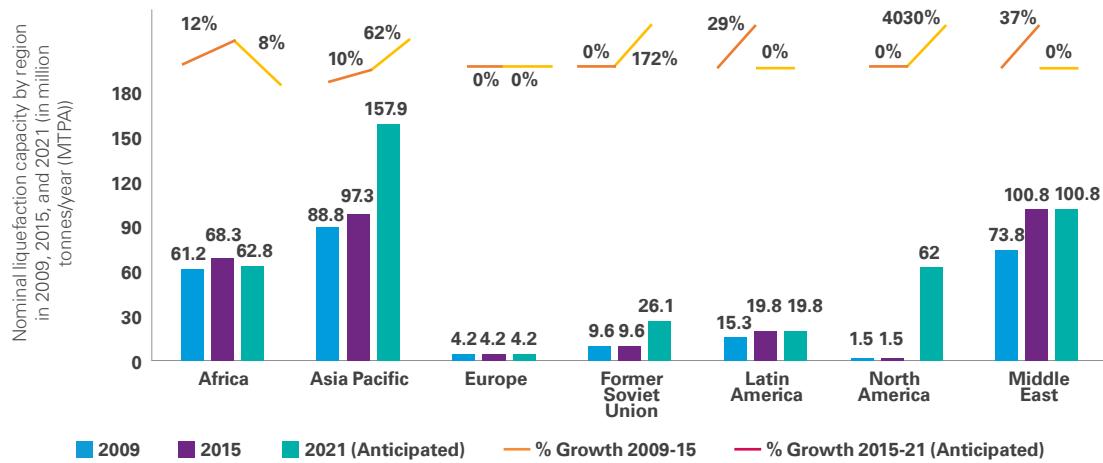
**Source:** Statistical Review of World Energy 2016 – data workbook, BP <http://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html>, accessed on 22-Oct-2016

Asia Pacific Region accounts for the majority (70.5 per cent) of LNG imports from top exporters such as Qatar and Australia.

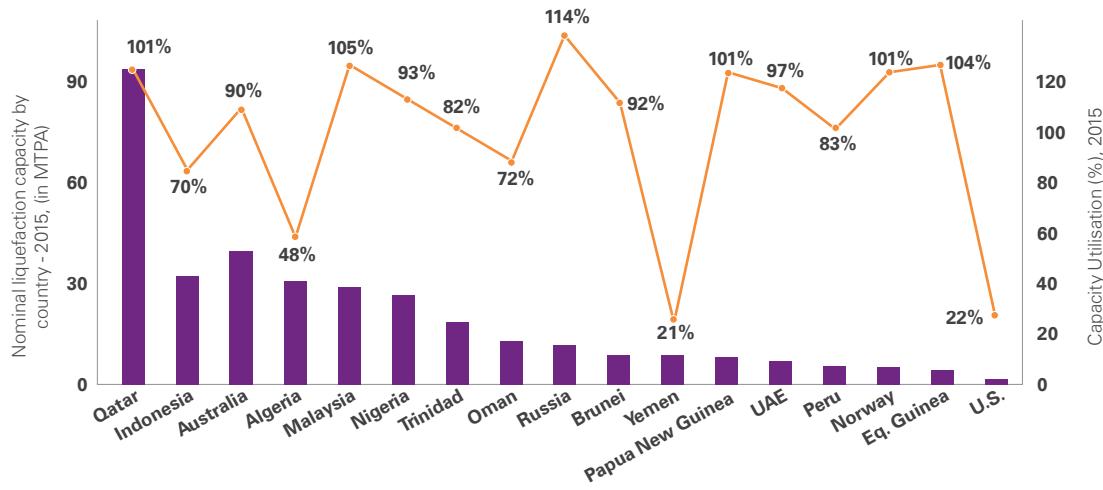
Russia leads in pipeline gas exports (27.4 per cent) with Germany being the major importer of natural gas through pipelines.

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## Global gas markets – LNG liquefaction capacity



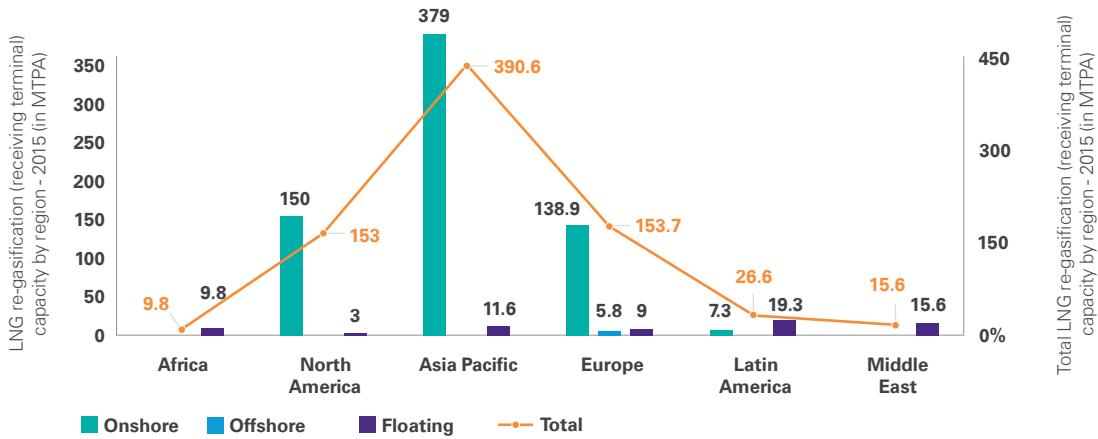
Source: IGU 2016 World LNG Report, LNG 18 Conference & Exhibition Edition, International Gas Union, April 2016



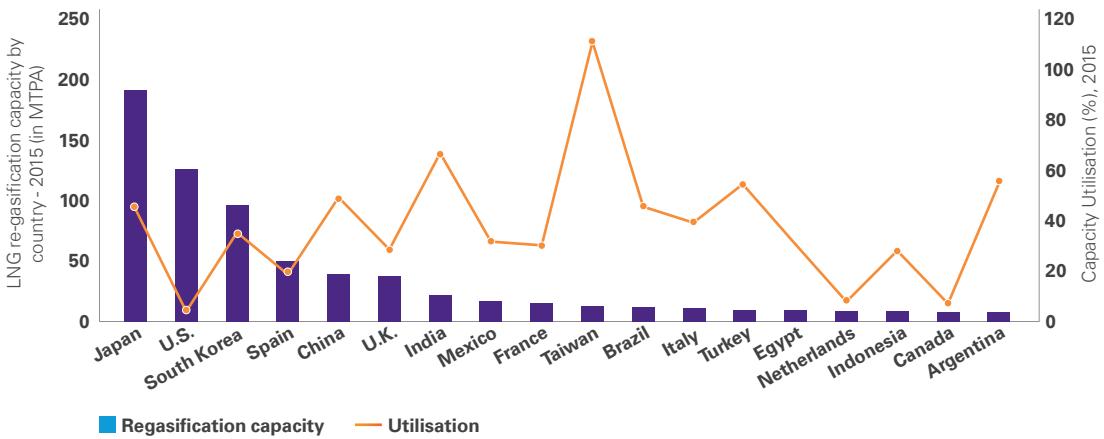
Source: IGU 2016 World LNG Report, LNG 18 Conference & Exhibition Edition, International Gas Union, April 2016

- About 60 per cent<sup>8</sup> of the global liquefaction capacity is in Qatar, Australia, Malaysia, Indonesia and Nigeria
- 141.5 MTPA<sup>7</sup> of the global liquefaction capacity is under construction; a majority is in the U.S. followed by Australia
- There are 890 MTPA<sup>7</sup> of proposed liquefaction projects globally as of January 2016, of which North America has made a large number of new liquefaction project announcements
- Large gas discoveries in East Africa have led to many new liquefaction project proposals
- 96 MTPA<sup>7</sup> of liquefaction projects proposed in Asia-pacific region, many are post-2020 opportunities
- 171 MTPA<sup>7</sup> of floating liquefaction (FLNG) project proposals have emerged – near-shore barge, purpose-built and conversions. The U.S., Canada and Australia account for a major share of the proposed projects.

## Global gas markets – LNG re-gasification capacity



Source: IGU 2016 World LNG Report, LNG 18 Conference & Exhibition Edition, International Gas Union, April 2016



Source: IGU 2016 World LNG Report, LNG 18 Conference & Exhibition Edition, International Gas Union, April 2016

8. IGU 2016 World LNG Report, LNG 18 Conference & Exhibition Edition, International Gas Union, April 2016

- Global LNG receiving capacity as on 2015 was about 750 MTPA<sup>7</sup>
- Asia-Pacific region accounted for the largest re-gasification capacities over the last few years now. Japan, South Korea and rising importers including China and India are the key players in the region<sup>7</sup>

- Japan continues to be the largest importer in terms of both capacity and actual imports comprising of 26 per cent<sup>7</sup> of the total re-gasification capacity in 2015
- China has been one of the fastest growing market with respect to regasification capacity with ~29 MTPA<sup>7</sup>

of under-construction re-gasification capacity due in 2016 and 2017. But challenges in reducing competitiveness of gas over coal may pose challenges in natural gas demand growth and re-gasification capacity additions.

## Global gas markets - Key developments in various gas markets

### U.S. and Canada



- Overall natural gas demand in Canada is expected to see modest growth given the low pricing regime<sup>9</sup>
- Rising oil sands production fuelled by natural gas and gas consumed for cogeneration to act as key drivers to demand growth in Canada<sup>10</sup>

- Shale-LNG Breakthrough - By 2019, the U.S. is expected to have liquefaction capacity equivalent to about 12 per cent<sup>11</sup> of its 2015 natural gas production
- U.S. aims to achieve cuts in energy-based GHG emissions through the Clean Power Plan<sup>12</sup> to reduce carbon emissions

- from power plants, investing in renewables and transformation in fuel standards in the transport sector
- Innovation in drilling technology is revamping the size and economics of the U.S. and Canadian gas resource base.

### Europe and U.K.



- Low oil prices, high winter temperatures, steady LNG supply and increasing pipeline imports put downward pressure on the European hub prices<sup>13</sup>

- Rigorous efforts to reduce environmental consequences of power generation can facilitate significant avenues for natural gas as a fuel

- Significant policy emphasis on increasing the consumption of natural gas in road and marine transportation

9. Canadian Energy Dynamics: Highlights of 2015 - Energy Market Analysis, National Energy Board, <https://www.neb-one.gc.ca/rg/ntgrtd/mrkt/dnmc/2015/indexeng.html?pdisable=true>, accessed on 20 October 2016

10. Canada's Energy Future 2016: Energy Supply and Demand Projections to 2040, National Energy Board, <https://www.neb-one.gc.ca/rg/ntgrtd/ftr/2016/indexeng.html>, accessed on 20 October 2016

11. International Energy Outlook 2016, U.S Energy Information Administration, May 2016, accessed on 10 November 2016

12. The Clean Power Plan: A Climate Game Changer, Union of Concerned Scientists, <http://www.ucsusa.org/our-work/global-warming/reduce-emissions/what-is-the-clean-power-plan#.WCwCt7J97cc>, accessed on 16 November 2016

13. Quarterly Report Energy on European Gas Markets, European Commission, 2015, accessed on 10 November 2016



## Asia (China, Japan, Korea, Taiwan and India)

- Under China's Energy Development Strategy Action Plan for 2014-2020, natural gas is targeted to make up at least 10 per cent<sup>14</sup> of energy consumption by 2020
- LNG growth in China is facing competition from piped natural gas supplies from Russia into China
- With the decoupling of oil and gas prices, Japan is likely to benefit by optimising LNG transactions
- Asian countries are enabling the shift towards regional trading hubs to set natural gas prices that better reflect regional market dynamics<sup>15</sup>
- New emerging Asian buyers are increasingly entering with demand that is price sensitive, shorter term and requiring more contractual flexibility<sup>16</sup>
- Imports in India and Taiwan, the fourth and fifth-largest LNG importers, respectively, increased slightly in 2015<sup>17</sup>
- Most of the incremental demand is expected to come of this region particularly with the addition of new LNG markets such as Pakistan and Bangladesh.

## Global gas markets - LNG supply outlook<sup>18</sup>

- Major uncertainties arise over the future supply of LNG in the short term as the number of projects proposed far exceeds the number needed to meet demand. It is likely that not all of these projects shall come to market as their economic viability may be questioned in the current context due to various political reasons and market dynamics.
- Globalisation is also introducing some new suppliers with very different business models: U.S. shale-to-LNG; floating LNG; and trading aggregators. The rise of more flexible trading shows a combination of commercial innovation, a more diverse and liquid market, and new technology in the form of floating storage and re-gasification.
- However, the launch of many projects in the recent years has set forth a strong LNG outlook for the near future. Expectations in Asian demand surge and high prices are key drivers for a bright outlook.

14. China's Natural Gas: Uncertainty for Markets, Congressional Research Service, May 2016, accessed on 14 November 2016

15. Natural gas prices in Asia mainly linked to crude oil, but use of spot indexes increases, U.S. Energy Information Administration, <http://www.eia.gov/todayinenergy/detail.php?id=23132>, accessed on 10 November 2016

16. Gas, LNG portfolio and contract optimization proposition, KPMG Global Energy Institute, March 2016, accessed on 1 November 2016

17. As Japan and South Korea import less LNG, other Asian countries begin to import more, U.S. Energy Information Administration, <http://www.eia.gov/todayinenergy/detail.php?id=27652>, accessed on 10 November 2016

18. Uncharted waters: LNG supply in a transforming industry, 2016, KPMG International, February 2016



## U.S.

- As of July 2014, the Department of Energy received 43 applications for permission to export LNG, from 34 proposed terminal projects<sup>17</sup>
- Seven of these projects<sup>17</sup> have received Federal Energy Regulatory Commission (FERC) permission to export to non-FTA (non-Free Trade Agreement) countries
- Free-trade negotiations with the EU (Transatlantic Trade and Investment Partnership) and with a group of Asian countries (Trans-Pacific Partnership) may widen the circle of FTA buyers
- A long list of projects exporting shale gas is at various stages of approval, including some conversions of existing import facilities.
- The U.S. business model is heavily influenced by commercial capabilities: tolling facilities, Henry Hub pricing and a possible relaxation of destination restrictions to permit flexibility in marketing and delivery.

## Australia



- Australian capacity is likely to grow from just under 30 MTPA to approximately 75 MTPA in 2020<sup>17</sup>
- 2016 has been a big year for Australian LNG. The successful startup of BG's Queensland Curtis LNG and
- the introduction of feed-gas to Australia-Pacific LNG and Gladstone LNG has sped up online-supply expectations<sup>17</sup>.

## Qatar



- The world's largest LNG supplier (77 MTPA exports in 2015)<sup>7</sup>
- Qatar's output could rise modestly by removing bottlenecks, to 80 MTPA by 2018<sup>18</sup>.
- Further expansion of Qatari LNG looks unlikely at the moment, as the moratorium on further development of the North Field continues.

## Others

- Algeria has been hit by a shortfall in domestic production, in part due to internal instability and rising internal gas demand. The total supply in Algeria has dipped by more than 3.5 MTPA in 2015. Production is estimated to be 19.0 MTPA in 2017.
- Indonesian upstream developments have waned and a lack of investment into
- Bontang LNG has prompted Indonesia's LNG supply to drop in 2015 to 17.5 MTPA<sup>17</sup>
- Nigeria, Trinidad and Malaysia are likely to continue to produce a steady output of LNG
- Angola's (5.2 MTPA<sup>7</sup> in 2015) domestic production is offline for repairs.
- Giant deep-water finds in Mozambique and
- Tanzania are slated for LNG development. They appear cost-competitive, and well placed to supply Asia.
- Though primarily a pipeline exporter, Russia's giant, low-cost resources and desire to expand customers beyond its European base making LNG a viable option.

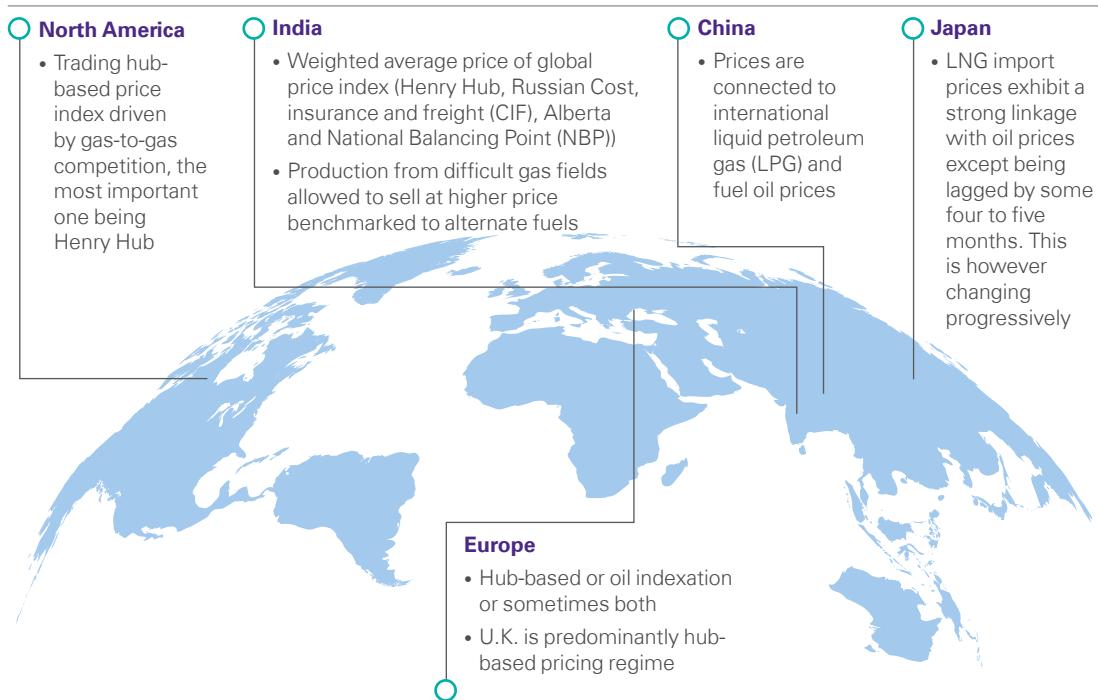
## Key challenges anticipated in the future LNG supply<sup>17</sup>

	Proven Resource Base	Upstream gas cost	Capital cost	Political/ regulatory support	Location maturity	Environmental Sensitivity
U.S.	●	●	●	●	●	●
Canada	●	●	●	●	●	●
Middle East	●	●	●	●	●	●
Russia	●	●	●	●	●	●
Southeast Asia	●	●	●	●	●	●
East Africa	●	●	●	●	●	●

● Critical   ● Important   ● Less critical

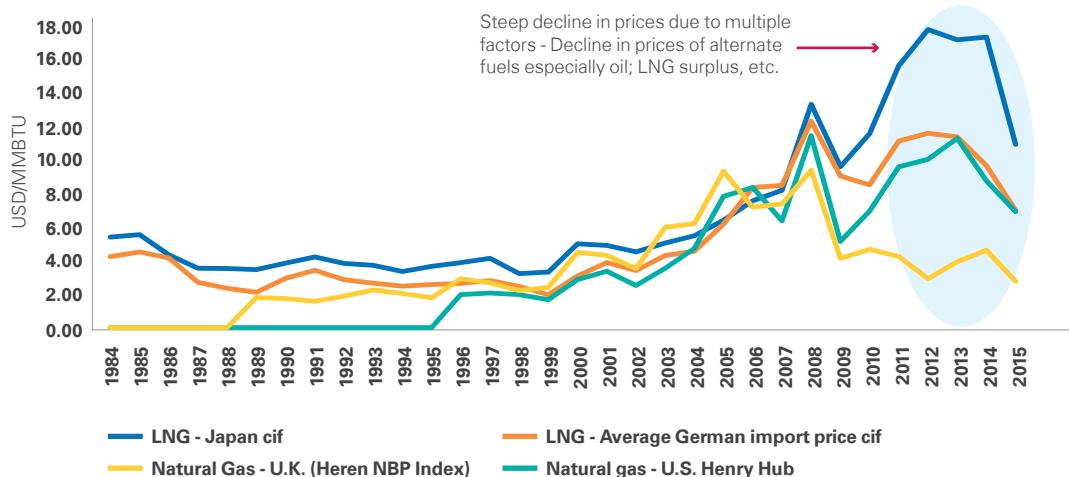
## Global gas markets - Gas pricing dynamics

Gas pricing primarily is driven by local and regional factors rather than global ones. Hence, there are wide disparities in the regional gas prices all over the world. While some regional prices are determined by the demand and supply forces, others have their regional reference prices linked to crude or oil products prices referred to as oil-linked prices.



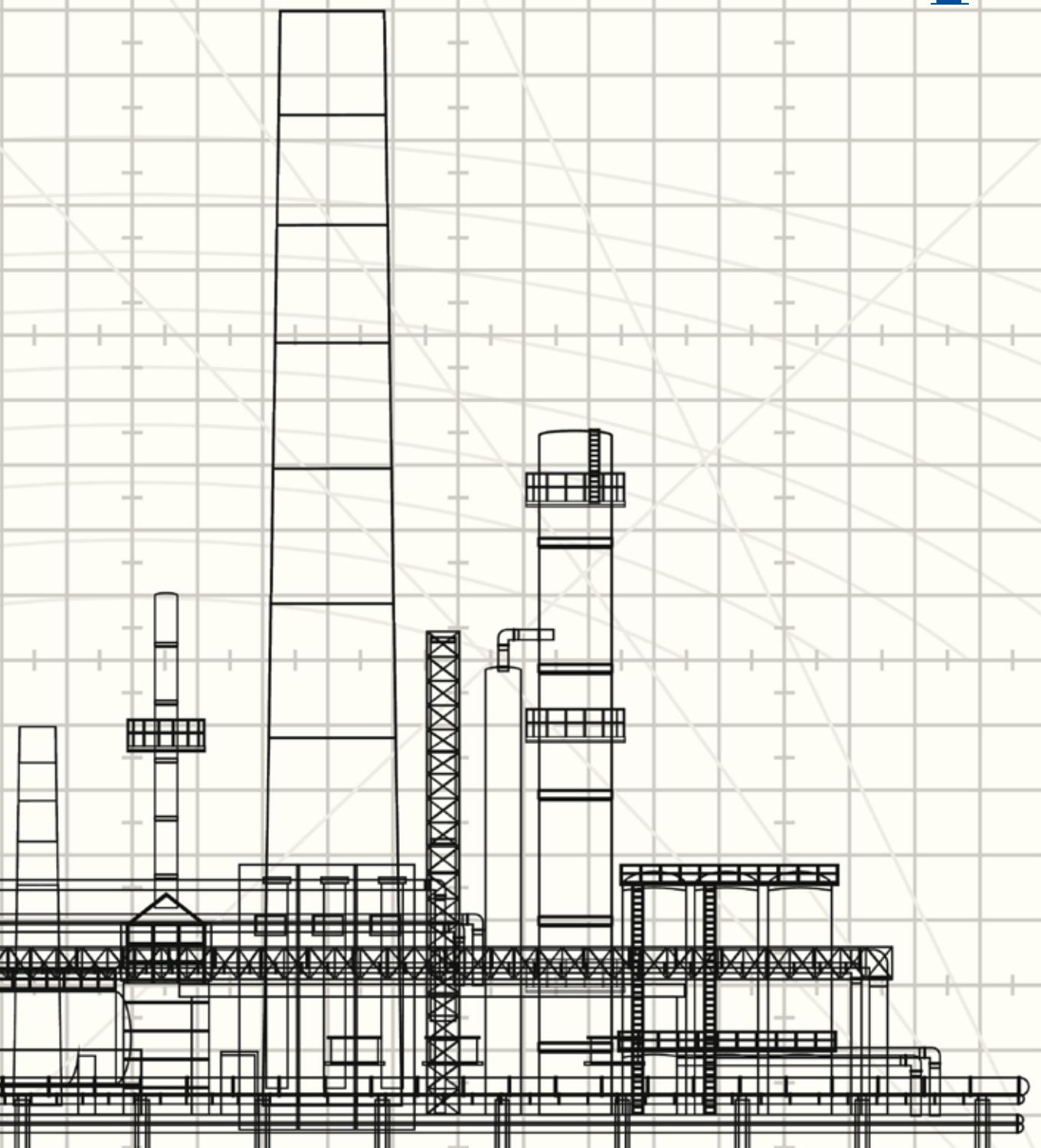
Source: The Impact of Lower Gas and Oil Prices on Global Gas and LNG Markets; The Oxford Institute for Energy Studies, July 2015, Natural Gas Pricing Reform in China: Getting Closer to a Market System?, Tsinghua- MIT, July 2015; KPMG in India Analysis 2016 based on Market research

## Trends in Global Gas Prices



Source: Monthly Report on Natural Gas September, 2016, Petroleum Planning & Analysis Cell, September 2016

Slow changes in pricing structures have started taking shape in the past couple of years. Of late, many Asian long term contracts increasingly use hybrid-pricing structures (linked to hub prices and oil indexed). There is clearly an emerging need for Asian countries to develop a trading-based pricing regime that reflects the true regional and local market dynamics.



# The Indian context



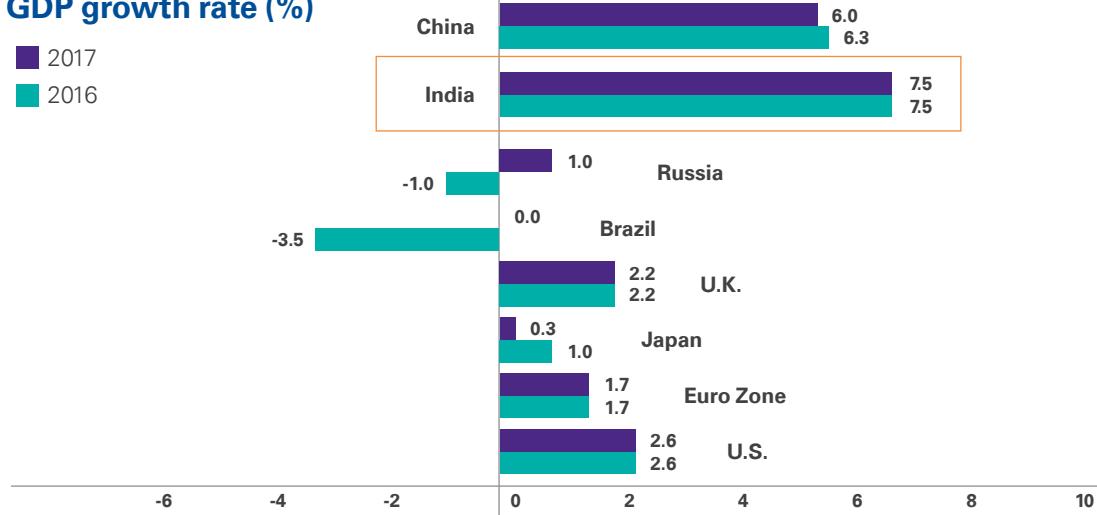
**A rising demand  
for natural gas**



## The Indian Context - A rising demand for natural gas

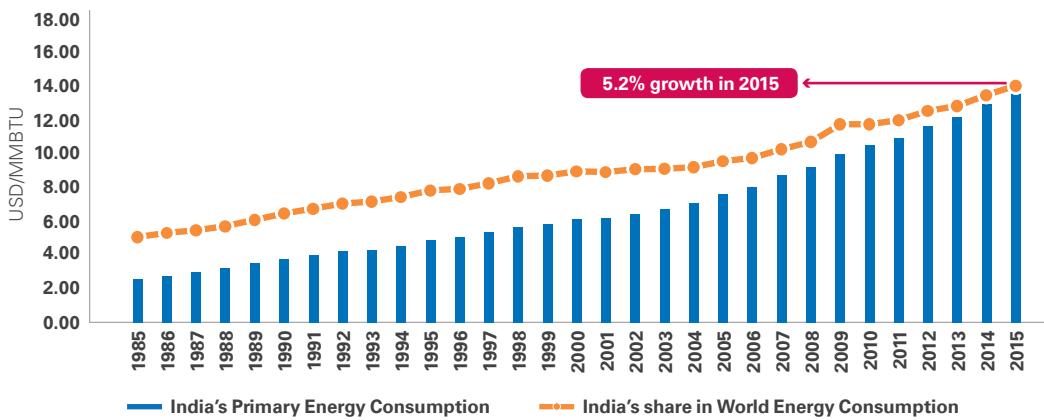
### India: A bright spot amidst a bleak global economic outlook

#### GDP growth rate (%)



Source: The Impact of Lower Gas and Oil Prices on Global Gas and LNG Markets; The Oxford Institute for Energy Studies, July 2015, Natural Gas Pricing Reform in China: Getting Closer to a Market System?, Tsinghua- MIT, July 2015; KPMG in India Analysis 2016 based on Market research

### International Monetary Fund (IMF) foresees India to retain the status of one of the fastest-growing large economy in the foreseeable future<sup>19</sup>

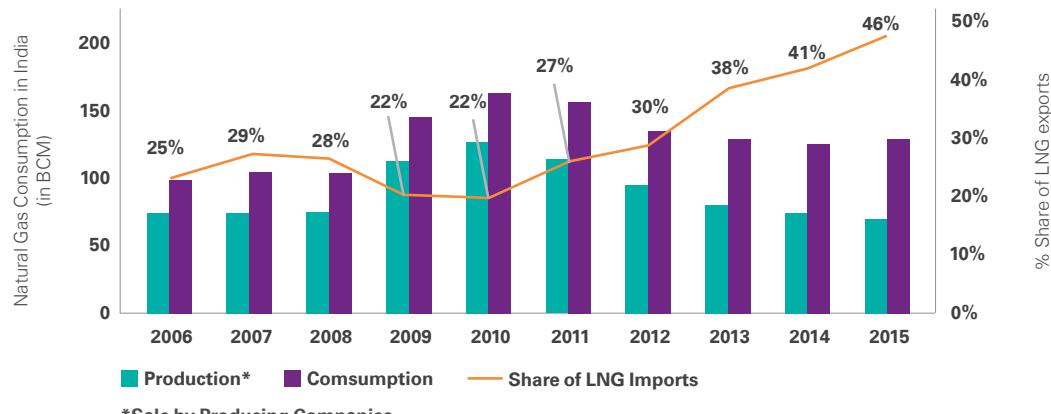


Source: Statistical Review of World Energy 2016 – data workbook, BP <http://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html>, accessed on 14-Oct-2016

19. IMF expects India to retain world's fastest growing economy, Economic Times, <http://economictimes.indiatimes.com/news/economy/indicators/imf-expects-india-to-retain-worlds-fastest-growing-economy-tag/articleshow/49245651.cms>, accessed on November 10, 2016

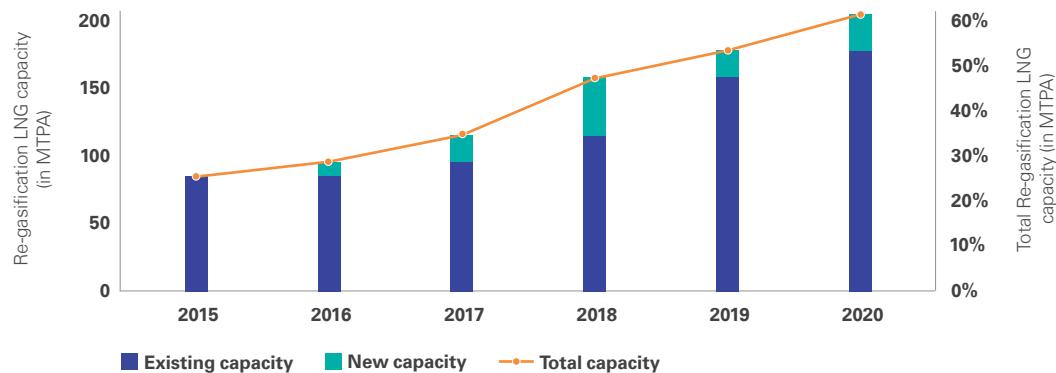
## Indian gas market- Quick snapshot

### Declining domestic gas availability and rising LNG dependency



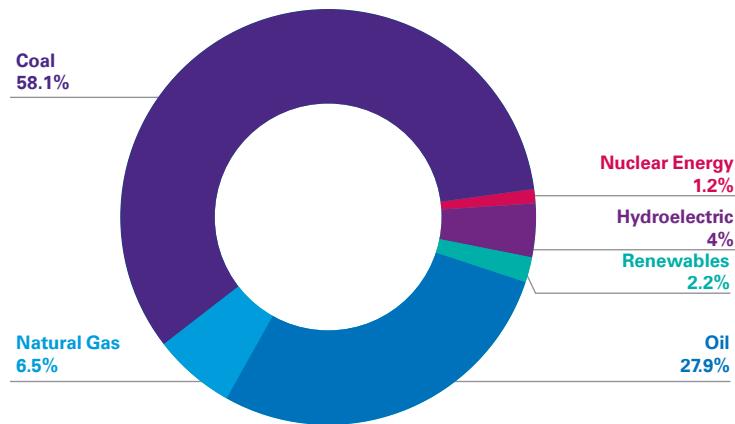
Source: Gas Consumption, Petroleum Planning & Analysis Cell, [http://ppac.org.in/content/152\\_1\\_Consumption.aspx](http://ppac.org.in/content/152_1_Consumption.aspx), accessed on 10 November 2016

### Substantial additions in re-gasification capacity expected by 2020-21



Source: Monthly Report on Natural Gas September, 2016, Petroleum Planning & Analysis Cell, September 2016

## Primary Energy Mix of India (2015)

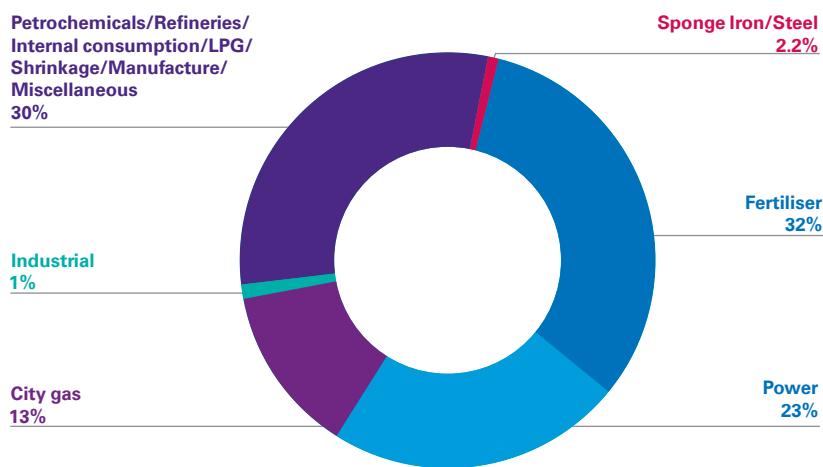


**Source:** Statistical Review of World Energy 2016 – data workbook, BP <http://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html>, accessed on 14-Oct-2016

### The power and fertiliser sector dominate the current consumption (~60 per cent)-

However, city gas distribution and industrial use are likely to emerge a key driver for the incremental demand

#### Segment-wise gas consumption (2015)



**Source:** Monthly Report on Natural Gas September, 2016, Petroleum Planning & Analysis Cell, September 2016

- Natural gas accounts for 7 per cent<sup>3</sup> share in the primary energy mix
- Growth of gas demand in the priority sectors has outpaced the growth in domestic production and thus, the

- priority sector remains largely supply deficit due to their inability to switch to expensive re-gasified LNG
- Refineries (Petrochemical) and City gas distribution (CGD) have the highest share

in overall LNG consumption (~35 per cent)<sup>20</sup>

- As per Industry projections, re-gasification capacity is likely to reach around 52 MTPA by 2020-21<sup>21</sup>.

20. Monthly Report on Natural Gas September, 2016, Petroleum Planning & Analysis Cell, September 2016

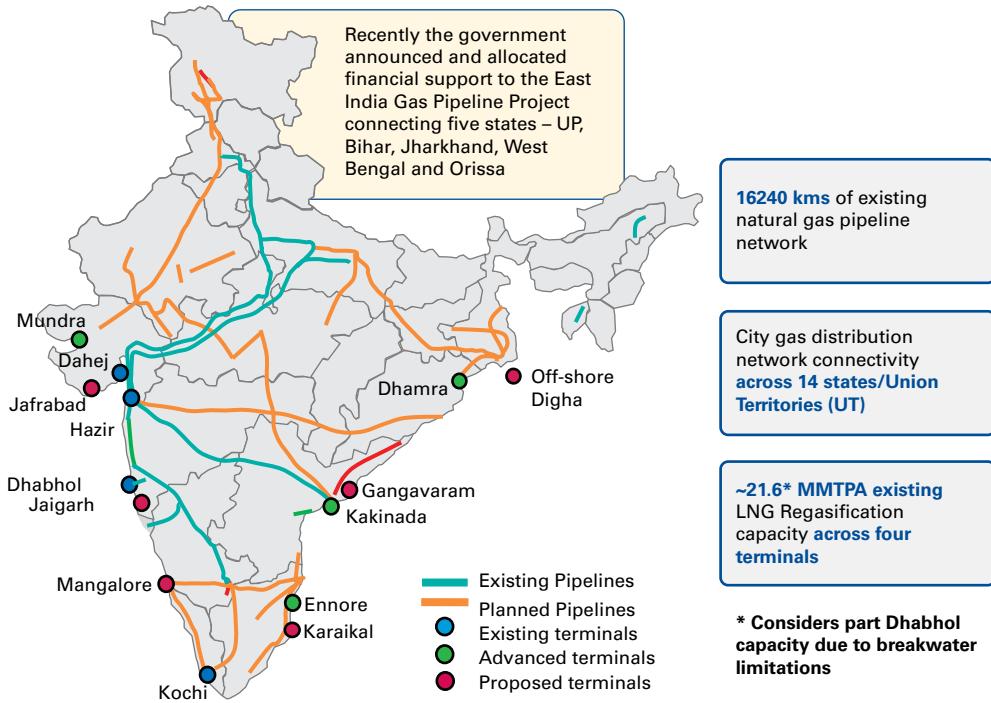
21. KPMG in India Analysis 2016 based on Market Research

# Infrastructure development



**Critical for the growth  
of gas markets**

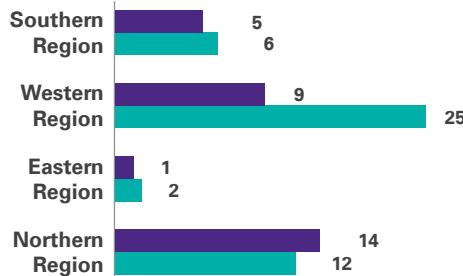




**Source:** Snapshot of India's Oil and Gas data - September 2016, Petroleum Planning and Analysis Cell, September 2016; Media Reports; City Gas Distribution Networks in India, Petroleum & Natural Gas Regulatory Board, 7 October 2016; KPMG in India Analysis 2016 based on Market Research

## City gas distribution infrastructure

**2015**



- Geographical areas covered - Under development
- Geographical areas covered - In operation

**Source:** Petroleum& Natural Gas Regulatory Board, October 2016  
 City Gas Distribution (CGD Network), Pipeline and City Gas Distribution, Petroleum Planning & Analysis Cell, March 2016

- Access to the current natural gas transmission and distribution pipeline network is limited to a few regions
- Natural gas pipeline density (0.0049 km/ km<sup>2</sup>)<sup>20</sup> in India is amongst the lowest globally for major countries
- Limited access to the larger consumer base due to the lack of interconnectivity of national/regional pipelines
- High market risk involved in gas infrastructure projects.



Over 1080 Compressed natural gas (CNG) stations caters to ~26 lakhs of CNG vehicles accounting for 2155 TMT of sales



Existing 65 Geographical areas operated by 20 CGD Companies

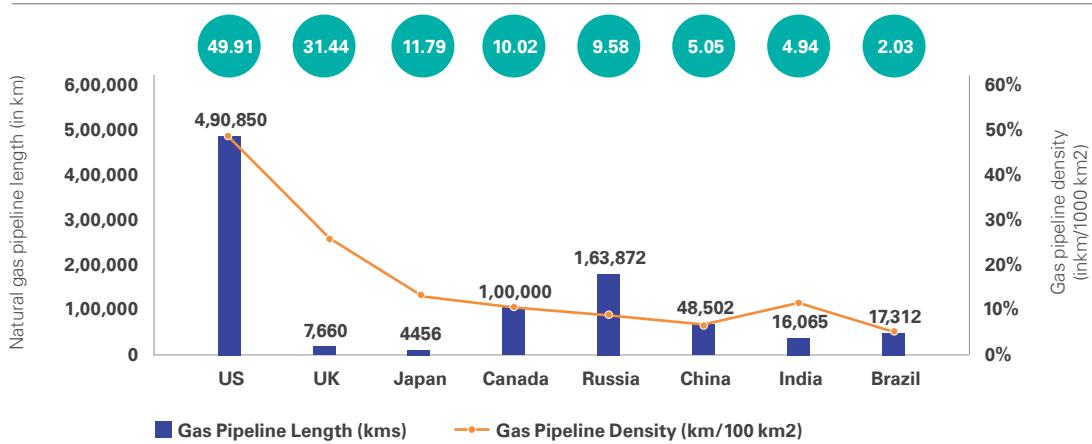


31.6 Lakh households, 23304 commercial and 6225 industrial consumers connected

**Source:** City Gas Distribution Networks in India,

Adequate gas infrastructure creation is critical for accelerating the growth of the gas sector

India has inadequate infrastructure that results in a larger user base not having access to gas as a fuel option. Robust gas infrastructure is essential to unlock the huge potential of gas as an efficient and reliable energy supply option for the country. India scores relatively low in terms of natural gas transmission pipeline density.

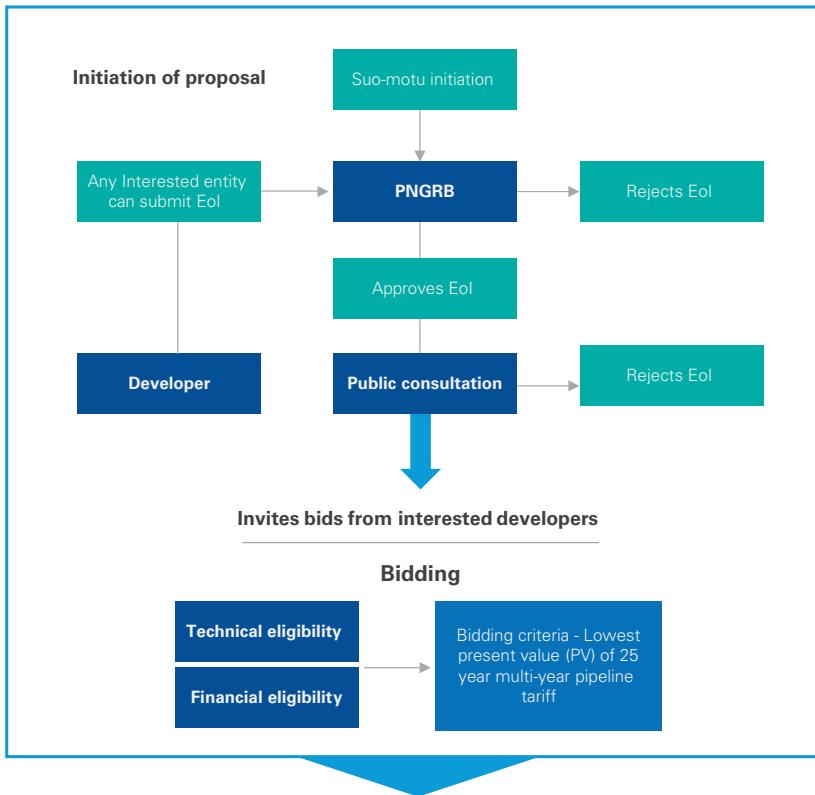


**Source:** Field Listing :: Pipelines, The World Factbook, Central Intelligence Agency, <https://www.cia.gov/library/publications/the-world-factbook/fields/2117.html>, accessed on 1 November 2016; Our Company, National Grid, <http://www2.nationalgrid.com/UK/Our-company/>, accessed on November 1 2016; Natural Gas Pipelines Network in India, Data Bank, Petroleum & Natural Gas Regulatory Board, <http://www.pngrb.gov.in/data-bank.html> , accessed on 10 November 2016; KPMG in India Analysis 2016 based on Market Research

Infrastructure needs to precede demand to enable the growth of end-use of natural gas - This is critical to meet India's energy security and regional development objectives



## Current development model



## Key challenges and risks

- 1 Lack of integrated **infrastructure development plan**
- 2 **No prior capacity allocation** - high market risk/ uncertainty
- 3 **Current bid parameters** -  
No flexibility to switch to new tariff mechanism
- 4 Multi-ownership and multi - operator environment -  
**No single system operator**

Current risk allocation framework is highly skewed leading to the under-recovery of revenues and developers bearing most of the market/volume risk



# Small scale LNG technologies



**A game changer**



Traditionally, natural gas has been used for heating, power generation and industrial purposes and its use in the transport segment has been limited and localised as compared to the overall global trade. The emergence of shale gas in North America and Canada coupled with the global slowdown in consumption has tipped the supply demand balance resulting in fluctuating oil and gas prices. Also, low oil

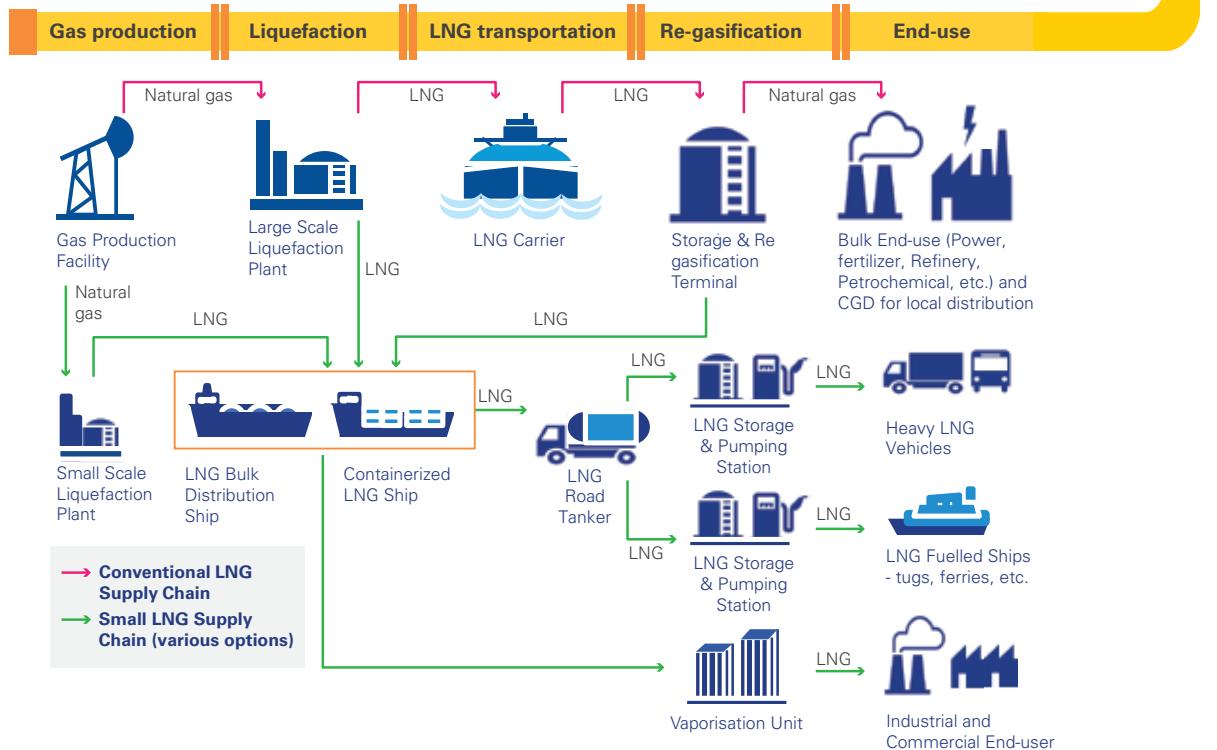
prices in last few years have led to the softening of LNG prices especially in Asia and some parts of Europe.

Natural gas despite its cost advantages and low emissions over alternate fossil fuels, finds limited use in many geographies due to gaps in LNG re-gasification, pipelines and distribution infrastructure.

The small scale LNG supply chain is an innovative and cost

efficient way of getting gas to end users that have localised, flexible or geographically scattered gas requirements which may not be served through a pipeline-based system. These technologies are not only available today but also find commercial implementation in new user segments such as rail, road and marine transportation.

### Typical small scale LNG supply chain



Source: KPMG in India Analysis 2016 based on Market Research

Adoption of small scale LNG technologies can enable India to scale up its gas consumption



## Small scale LNG technologies – Increased policy emphasis

Despite the significant growth in global gas markets, the transportation segment (marine, road and rail) remain largely dependent on oil. However, with advent of small scale LNG technologies, natural gas is poised to displace petroleum fuels substantially. There are strong market indicators already as large corporate fleets in North America and Europe are switching to LNG-based vehicles.

The European Union, under Directives 2014/94/EU, has emphasised the development of refuelling network for LNG vehicles and ships. EU has also initiated a financial support programme to motivate the use of cleaner fuels under which it is providing support to various projects that will enable development of transnational European infrastructure in energy (TEN-E) and transport (TEN-T)<sup>22</sup>.

In order to establish LNG as a real alternative for medium and long distance transport – first as a complementary fuel and later as an reliable substitute to diesel, the 'LNG Blue Corridors'<sup>23</sup> project was planned in 2013 which set goal to build about 14 LNG or Liquefied-to-Compressed Natural Gas (L-CNG) stations along identified corridors and about 100 LNG Heavy Duty Vehicles.

22. TEN-T Innovation & New Technologies, European Commission , <http://ec.europa.eu/transport/infrastructure/tentec/tentec-portal/site/en/innovation.html> , accessed on 30 October 2016

23. LNG Blue Corridors Project Fact Sheet, European Commission, January 2016

# Well-proven and commercially available small scale LNG technologies

## Small scale LNG tankers

- Typical capacity ranges from 10000 - 15000 m3
- Designed for offshore, rivers, ports and inter-island and loading and receiving terminals
- Unloading needs specialised facilities.

## Containerised LNG tankers

- Houses interconnected ISO tanks
- Typical capacity ranges from 5000-7000 m3
- Highly flexible and suited for small distributed applications
- Easy to move further through rail or road.

## Small scale liquefaction plants

- Typical Liquefaction capacity <0.5 MMTPA
- Regional supply directly to end-users in isolated geographies or for direct replacement of liquid fuel.

- Effective technology for monetisation of small or marginal gas fields

## LNG-fuelled heavy vehicles

- Dual fuel engine technologies are well proven and commercial available
- Allows medium - heavy duty vehicles (buses, trucks, etc.) to use diesel 100 per cent when natural gas is not available
- First LNG-fuelled bus in India was launched in Kerala during November 2016.

**Source:** Country's first LNG-fuelled bus rolls out in Kerala, ET EnergyWorld, EconomicTimes, <http://energy.economictimes.indiatimes.com/news/oil-and-gas/country-s-first-lng-fuelled-bus-rolls-out-in-kerala/56323349>, accessed on 12 November 2016; Small-Scale LNG: Developments in Distribution & Bunkering Solutions, Platts, [https://www.platts.com/m.platts.content/productservices/conferenceandevents/2013/pc322/presentations/larry\\_bowling.pdf](https://www.platts.com/m.platts.content/productservices/conferenceandevents/2013/pc322/presentations/larry_bowling.pdf), accessed on 10 November 2016; IGU 2016 World LNG Report, LNG 18 Conference & Exhibition Edition, International Gas Union; April 2016; KPMG in India Analysis based on Market Research.

# Policy and regulations in India



## The need for reforms



Issues	Key perspectives
<b>Multiple regulatory bodies and regulations for various energy segments</b>	<p><b>Indian Context</b></p> <ul style="list-style-type: none"> <li>Unlike many other countries India does not have a unified regulatory body responsible for energy policy and regulatory related matters. This results in lack of coordination in the policy and regulatory environment for various sub-sectors viz. coal, oil and gas and electricity.</li> </ul> <p><b>Leading industry practices</b></p> <ul style="list-style-type: none"> <li>Many developed countries (U.S., U.K., Germany and France etc.) and also many developing countries have a unified energy regulator that ensures coherency in the regulations and effective governance of the energy sector.</li> </ul>
<b>Lack of a centralised gas network planning</b>	<p><b>Indian Context</b></p> <ul style="list-style-type: none"> <li>Under the current regulatory framework, the new pipeline corridors are identified through the Expression of interest (EoI) route from interested developers (private or public sector). However, this approach results in an incoherent development of networks.</li> </ul> <p><b>Leading industry practices</b></p> <ul style="list-style-type: none"> <li>Typically, a central agency is responsible for the long-term integrated planning of gas infrastructure and such plans precede the auctions/ implementation of projects. This enables the development of infrastructure in an integrated and effective manner. Alternatively, few countries such as Germany adopts a collaborative approach wherein integrated network plan is developed by the 14 transmission network owners/ operators through a robust and structured consultation process.</li> </ul>
<b>Competitive market based pricing and Lack of liquidity/ markets</b>	<p><b>Indian Context</b></p> <ul style="list-style-type: none"> <li>Largely driven by long to medium term supplies (Domestic and RLNG) until last few years wherein the share of spot/ short term RLNG supplies has increased</li> <li>Spot trade is limited to few regions and the supply chain largely is dominated by bilateral trades.</li> </ul> <p><b>Leading industry practices</b></p> <ul style="list-style-type: none"> <li>Globally, Gas exchanges such ICE, Powernext, European Energy Exchange (EEX), APXEndex, Australian Energy Market Operator (AEMO) etc. have played a critical role in establishing a transparent market mechanism for physical trading, gas-to-gas competition and price formation.</li> </ul>

Issues	Key perspectives
<b>Lack of policy stipulations for use of cleaner fuels</b>	<p><b>Indian Context</b></p> <ul style="list-style-type: none"> <li>Fuel quality and vehicle emission standards in India lag international leaders by more than a decade, and India is at risk of falling behind other developing countries namely China, Brazil, South Africa, etc. The government has recently set an ambitious target for vehicular segments however, the industrial-based pollution needs to be addressed effectively as well.</li> </ul>
<b>Packaging of pipeline tariffs and Central system operator</b>	<p><b>Indian Context</b></p> <ul style="list-style-type: none"> <li>The current structure of pipeline tariffs results in severe artificial cost distortions for consumers (on account of its additive nature when gas is being transported through multi-owned pipelines). Further, there is clearly an emerging need for unified system operators to ensure the seamless and efficient operation of the national grid.</li> </ul> <p><b>Leading industry practices</b></p> <ul style="list-style-type: none"> <li>Under the Third party package<sup>25</sup> of EU energy reforms, the regulatory framework makes setting up of an independent transmission system operator (TSO) and entry-exit system obligatory (does away with contract paths-based tariffs).</li> <li>In the U.K., Ofgem establishes cost allowances and efficiency targets; these elements are the basis for setting the allowed revenue collected through transportation capacity and commodity charges<sup>26</sup>.</li> </ul>

24. Natural Gas Vehicles – Securing a sustainable transport future for India, Knowledge Paper, Asia Pacific Natural Gas Vehicles Association (ANGVA) – 5th International Biennial Conference & Exhibition, India, November 2013

25. Monthly Report on Natural Gas September, 2016,

Petroleum Planning & Analysis Cell, September 2016

26. KPMG in India Analysis 2016 based on Market Research

Issues	Key perspectives
<b>Volume risk involved in pipeline development under current bidding mechanism</b>	<p><b>Indian Context</b></p> <ul style="list-style-type: none"> <li>Under the current bidding mechanism the interested entities are required to bid for pipeline tariffs and compression charges in case of distribution networks and for pipeline tariffs in case of transportation networks. The revenue recovery across the life of the asset happens at the quoted tariff during the bids</li> <li>As the recovery is dependent on the actual volume built up of the networks, developers are exposed to significant market risk which is beyond their reasonable control and the extant regulation does not provide any provision of adjustment of tariffs later. This has severely impacted the investments in gas infrastructure as a result no significant progress is made on ground despite the several authorisations issued.</li> </ul> <p><b>Leading industry practices</b></p> <ul style="list-style-type: none"> <li>Many countries including developing markets such as Brazil adopt an 'Open season' or 'pre-auction capacity booking' among prospective shippers on a non-discriminatory basis. This enables them to reduce the volume risk of the proposed pipeline project and provides other benefits such as the finalisation of the technical specifications of the project such as capacity, sizes, points for injection, withdrawals, etc.</li> <li>Typically, regulations across many gas markets allow developers to adjust or 'clawback' the tariff assumptions periodically during each review period.</li> </ul>

# Competitive gas markets



**Their role in transforming  
India's energy landscape**



## What issues can competitive gas markets help address?

Indian gas markets, historically, have been developed along supply centres, however, with new planned pipelines, a stronger gas market is evolving. While gas markets have been traditionally dependent on domestic supply, LNG has acquired a significant share in the total gas consumption in the last decade. With market multi sources, multi prices, growing pipeline and distribution networks, and a competitive price environment, a conducive environment has emerged for setting up of competitive energy markets. International experience suggests that a neutral physical trading platform has been the founding block for most of the liberalised markets.

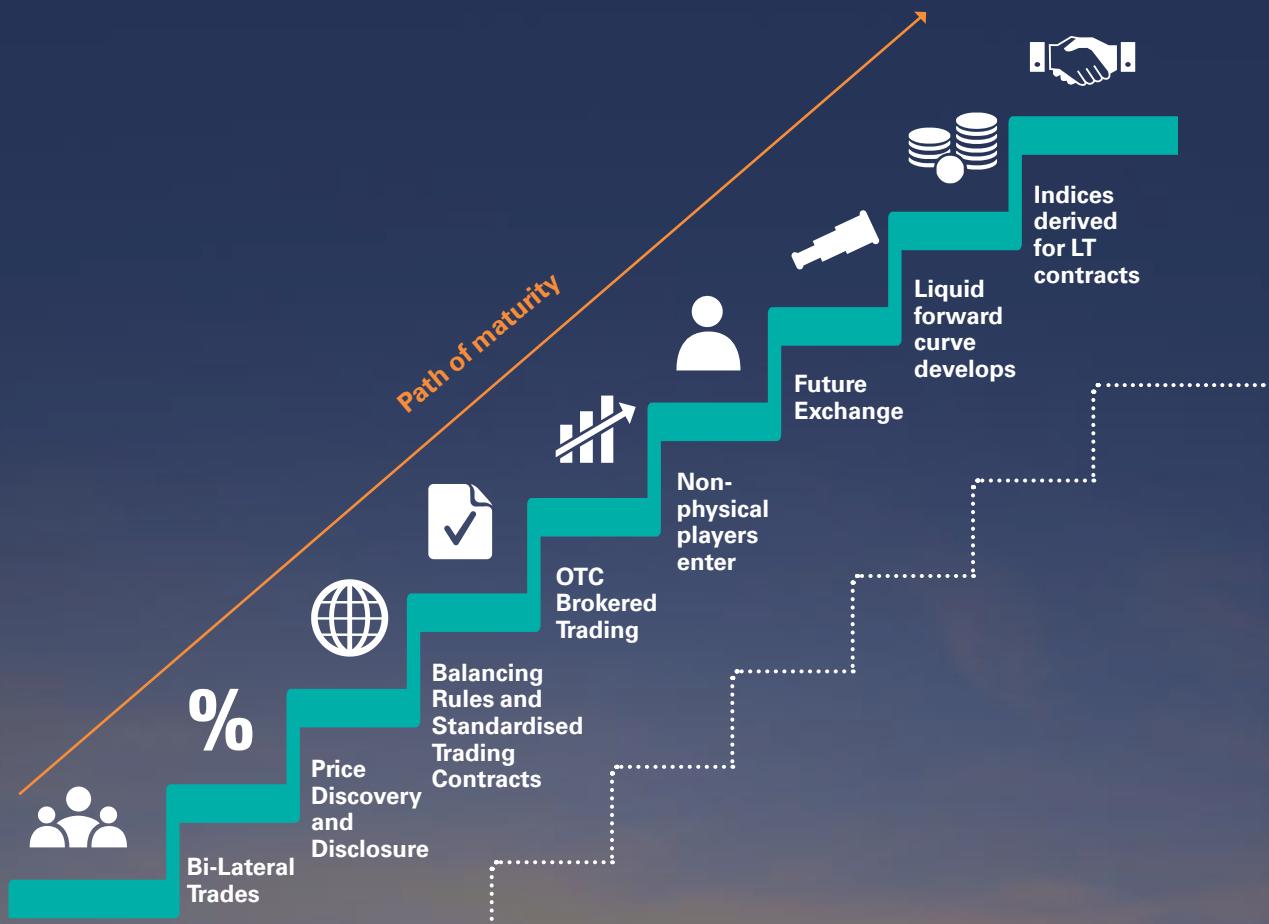


Source: KPMG in India Analysis 2016 based on Market Research and Industry Interactions.

## Key advantages of a competitive gas market

- Emergence of a liquid market
- Emergence of a reference point for gas pricing
- Ability of consumers to source gas from various suppliers
- Provide sourcing options to small consumers
- Facilitate deeper markets and last mile connectivity
- Enable Suppliers to access a wider base of consumers while managing credit risk effectively.

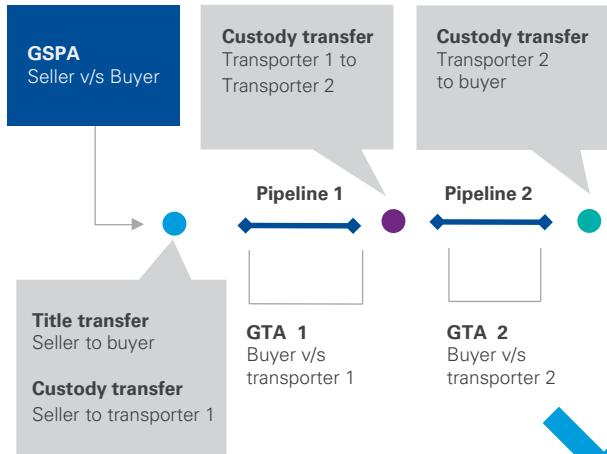
## Evolution path typically followed by gas markets<sup>27</sup>



34. Evolution of Gas Hubs in the U.K. and Netherlands, Patrick Heather Consultancy Limited (PHCL) and KPMG, January 2016

## Competitive gas markets – Key attributes to fulfil India's endeavours

Current state - Mostly Bilateral Contracts



- Landfall point of gas
- Interconnected point
- Customer gate

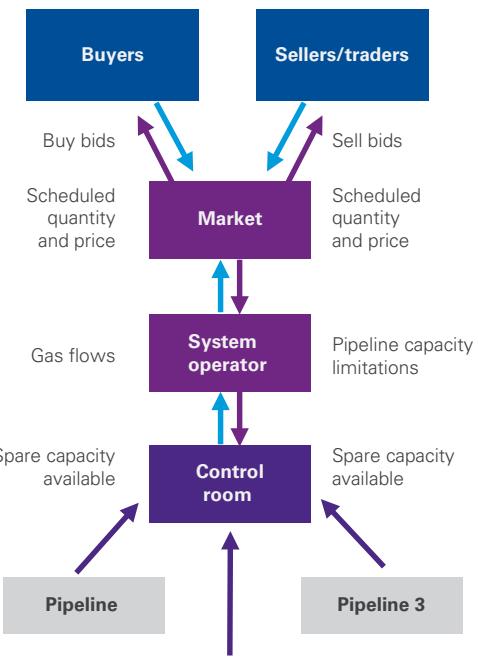
**GSPA** - Gas Sales & Purchase Agreement  
**GTA** - Gas Transmission Agreement

### Key attributes for competitive gas markets:

- Adequate network capacity
- Integration of networks
- Access to infrastructure
- Sufficient number of market players
- Financing platform

For the **market to open up and efficiently function**, it is necessary to build a framework encompassing the necessary set of **structural requirements to support the development** of a competitive natural gas market.

Desired state - exchange - based trading



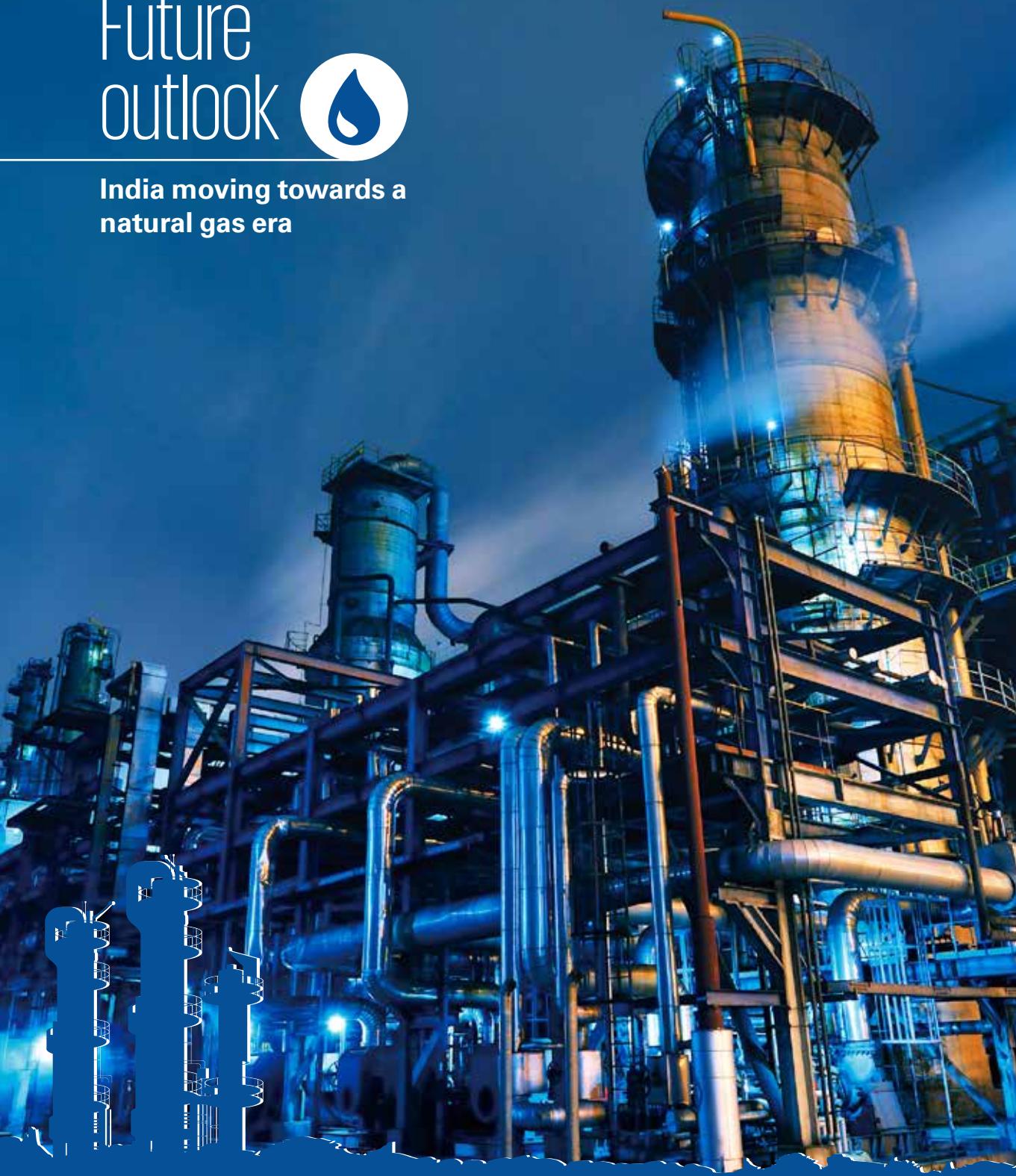
**Source:** KPMG in India Analysis 2016 based on Market Research and Industry Interactions

For a transparent and competitive market to develop it is necessary to have a physical trading platform (or hub) that provides flexibility of access to end consumers and enables price formation

# Future outlook



**India moving towards a natural gas era**



Economic growth and increasing populations worldwide herald a rise in the world's energy demand in the long run. High growth economies such as India and China are likely to need energy in proportion to their rapidly expanding energy demand, which can simultaneously improve the local environment while reducing global emissions. This growth in energy in the near future is likely to be met by hydrocarbon fuels. In another significant global effort to combat climate change, 110 parties<sup>28</sup> ratified the COP21 agreement to meet the stipulated emission reduction targets. With its low carbon emissions among various fossil fuels, natural gas presents a potential solution to the world's energy demand in a clean and sustainable way.

Natural gas can be utilised for a variety of purposes in the residential, commercial, industrial and power generation sector. However, despite its immense potential, natural gas could not adequately replace oil in the transport sector (road, rail and marine) as the conventional gas value chain was largely structured for industrial consumption and electricity generation. However, with the advent of small scale LNG technologies along with backbone of robust conventional LNG value chain, natural gas is poised to transform the fuel dynamics of the transport sector in the near future. Also, natural gas can enable the integration of renewable energy sources into

the power system due to its flexibility. With India seeking to add 175 GW<sup>29</sup> of renewable energy capacity by 2022, natural gas could play a critical role in providing the balance of power to renewables and enabling the integration of renewable energy sources into the grid.

Given the myriad benefits of natural gas across various consumer sectors, India needs to adopt a sustainable energy policy with a larger role for natural gas as it is appropriately placed to meet many of the short-term energy challenges that India faces today.

The Government of India has undertaken significant reforms and initiatives in a very short time to promote natural gas. Its efforts include:

- Adopting a simple and investment-friendly regulatory regime for enhancing domestic E&P activities<sup>30</sup>
- Increasing prices for gas production from deepwater, ultra-deepwater, high pressure and high temperature fields<sup>31</sup>
- Providing full marketing and pricing freedom to new gas fields<sup>2</sup>
- Giving financial support to the 2540 km long East India gas pipeline project<sup>32</sup>
- According priority to the residential and transport segment for the allocation of domestic gas by diverting non-core sector supplies<sup>33</sup>
- Adopting Bharat Standard (BS) VI emission norms for vehicles by 2020<sup>34</sup>.

28. Paris Agreement - Status of Ratification, United Nations Framework Convention on Climate Change, [http://unfccc.int/paris\\_agreement/items/9444.php](http://unfccc.int/paris_agreement/items/9444.php), accessed on 16 Nov 2016
29. Report on the expert group on 175 GW RE in 2022, National Institution for Transforming India, December 2015
30. HELP, Resolution, Ministry of Petroleum and Natural gas, March 2016
31. Decision on Marketing including Pricing freedom for the gas to be produced from Discoveries in High Pressure-High Temperature, Deepwater and Ultra Deepwater Areas, Press Information Bureau, <http://pib.nic.in/newsite/PrintRelease.aspx?relid=137642>, accessed on 16 November 2016
32. Cabinet approves Capital Grant to GAIL for development of Gas Infrastructure in Eastern part of the country, Press Information Bureau, <http://pib.nic.in/newsite/PrintRelease.aspx?relid=150960>, accessed on 16 November 2016
33. Revised guidelines for allocation/supply of domestic natural gas to CGD entities for CNG (transport) and PNG (domestic) segments, Ministry of Petroleum and Natural gas, <http://petroleum.nic.in/docs/revcnpng.pdf>, accessed on 16 November 2016
34. Bharat Stage VI emission norms: Two-wheeler prices to up , Economic Times, <http://timesofindia.indiatimes.com/business/india-business/Bharat-Stage-VI-emission-norms-Two-wheeler-prices-to-up/articleshow/52401603.cms>, accessed on 16 November 2016

In the backdrop of these reforms however, there are still several policy, regulatory, structural and market reforms that are needed for the development of vibrant gas markets and infrastructure that can enable the growth of gas in the overall energy consumption basket. In our view, the following should be the key elements of the future roadmap for the sector:

- **Policy and regulatory reforms to foster competitive gas markets**

For the growth of the gas industry, it is essential to move towards a market-based ecosystem that ensures fair and flexible terms of access to infrastructure, competition in supply and affordability for end users. Measures such as the unbundling of marketing and transportation activities, standardised commercial terms of access for network capacity, formation of independent system operator for pipeline networks and the formation of gas trading hubs would be desired to foster competition and development of vibrant gas markets.

- **Expansion of the gas infrastructure**

Adequate gas infrastructure is the key pre-requisite for making natural gas available to a larger base of consumer across the country which currently is limited to few regions (predominantly northern and western India). In our view, the following initiatives can help transform the existing framework for gas infrastructure development to encourage greater private public participation

- Appropriate regulatory reforms for licensing and tariff determination of pipeline and city gas distribution projects to lower the market (or volume) risk of such projects. Regulatory provisions such as 'open season' or 'pre-auction capacity booking' for the licensing of projects and 'claw back' or 'true up' provision for tariff determination may be adopted in line with global practices
- Government funding support (or Viability Gap Funding) for the development of new

pipeline and distribution networks

- Long-term integrated planning and development of pipeline and distribution networks in a cohesive manner.

- **Incentivising the use of clean fuels and technologies**

There is a clear need to incentivise the use of clean fuels and technologies to accelerate the adoption of clean fuels in various end-use segments. While the government has set very ambitious targets for stringent emission norms for vehicles, there is clearly a need to fast track the adoption of clean fuel by providing incentives such as grants or rebates, soft loans, state tax credits, etc. for the use of NGVs as is the case for many markets around the world.

In conclusion, as India moves forward to a natural gas era, it remains to be seen how the country leverages this environment-friendly energy to its full potential.

35. Natural Gas Vehicles – Securing a sustainable transport future for India, Knowledge Paper, Asia Pacific Natural Gas Vehicles Association (ANGVA) – 5th International Biennial Conference & Exhibition, India, November 2013



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