Gas Conclave

Join Us To Pave The Way To A Green Future

Indian Oil Corporation Limited

Bringing Energy to Life

Contents

सत्यमेव जयते

Message by Shri Dharmendra Pradhan

Hon'ble Minister of State (IC), Ministry of Petroleum and Natural Gas, Government of India

MESSAGE

The Indian economy is poised to take off on a higher trajectory of macroeconomic growth and socio-economic development in an environmentally sustainable manner. To successfully attain these objectives, equitable access to adequate and affordable energy is essential. As a green fuel of the century, the role of natural gas in India's energy mix is critical.

The challenges which the sector is grappling with are well recognized. The Government has committed itself to the growth of the gas sector in the country. Revisiting the domestic gas pricing policy was a first step in this direction and efforts are ongoing for policy formulation in the areas of gas production, gas pooling, infrastructure development, city gas distribution etc. to promote a conducive investment climate to ensure that the industry is benefitted and that investments in this sector are attracted and sustained.

This IndianOil Gas Conclave provides a platform for all stakeholders to come together to deliberate on various relevant issues and come out with innovative solutions to help that sector gain momentum growth.

(Dharmendra Pradhan)

सत्यमेव जयते

Message by Shri K. D. Tripathi

Secretary, Ministry of Petroleum and Natural Gas, Government of India

MESSAGE

Prospects for growth of the Indian economy are optimistic and energy continues to be the prime driver underpinning this growth. Gas, which is undoubtedly preferred to oil because of lower carbon content per unit of heat, more gas availability and lower cost in calorific terms, is fast replacing the conventional fossils fuels in the global energy basket. Hence, developing a clean and green fuel based economy, by reworking the energy mix and expanding the natural gas usage, holds the key for sustained growth in India.

A series of specific measures aimed at increasing domestic gas production and developing adequate infrastructure facilities for meeting the growing demand of natural gas have been undertaken by the Government, in the recent past. The enabling environment so created, would undoubtedly, provide an impetus to growth of this sector.

This Gas Conclave organised by IndianOil is an excellent forum for the industry to brainstorm and dwell upon innovative ideas to tackle challenges, explore opportunities and carve out a road map to determine modalities for taking the growth of the gas sector on an upward trajectory.

I wish the Gas Conclave all the success.

(K.D. Tripathi)

Message by Shri B. Ashok

Chairman

Indian Oil Corporation Ltd.

MESSAGE

The growth of India's gas sector is intertwined with the nation's development. The key to the growth of the sector lies in ensuring sustainable supply and affordability of gas for the end-consumers. To achieve this, there is a need for synergistic growth across the gas value chain, be it exploration & production, gas sourcing, transmission and distribution, or infrastructure development to meet the growth in demand.

While the challenges confronting the sector are enormous, a collaborative and integrated approach by all the stakeholders will go a long-way in creating a vibrant gas market.

The 2nd edition of IndianOil Gas Conclave seeks to stimulate discussions on such approaches for achieving the growth of the gas sector.

B Ashok
Chairman,
IndianOil

Natural Gas - Global Perspective & Indian Scenario

Over the years, concerns on the increasing carbon levels owing to usage of fossil fuels have been growing. The recently held Paris Conference (COP21) was successful in establishing binding commitments by all nations to make "nationally determined contributions" (NDCs), and to pursue domestic measures aimed at achieving them.

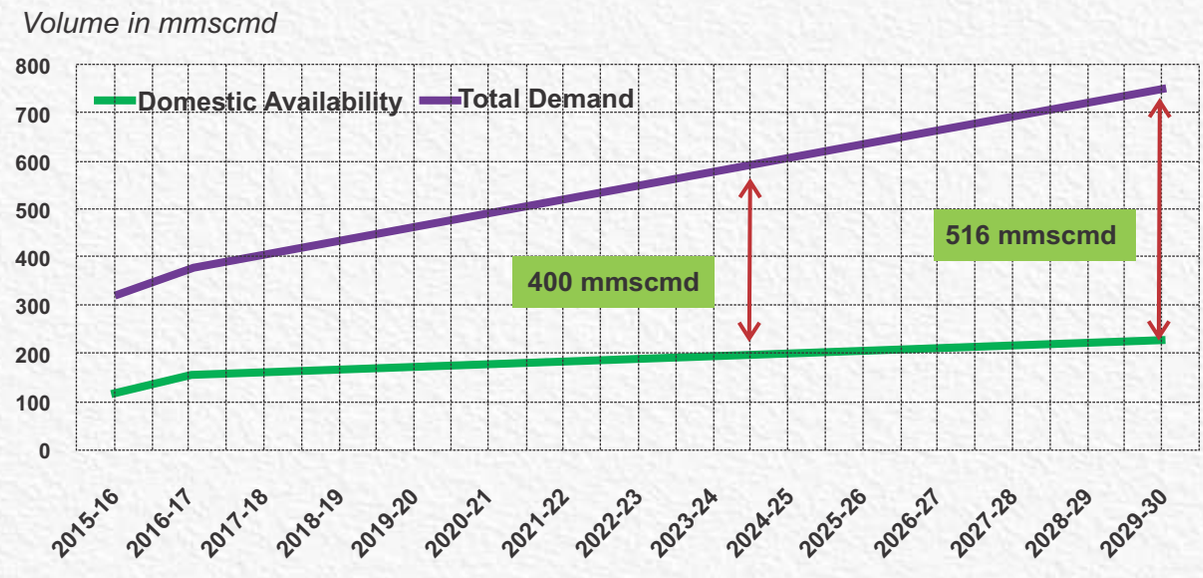
There has been a strong movement towards stricter legislations across the world for cleaner liquid fuels and adoption of natural gas, especially in the transport sector. Natural gas, with its clear advantages, is emerging as the favoured fuel in many countries. This aspect, coupled with the fact that natural gas reserves are likely to last much longer than liquid fuels, is driving the demand for natural gas in the world. From 1980 to 2015, the share of oil has dropped from 44.94% to 32.82% in the world's primary energy demand, while share of natural gas has increased from 19.53 % to 24.16%.

This shift has primarily been driven by economical and environmental factors. Although fossil fuels will continue to remain the dominant source of world's energy, the shift towards lower-carbon fuels will continue to be a key growth driver of natural gas consumption, which is expected to be the fastest growing fossil fuel during the next two decades.

At the present rate of production, the natural gas reserves are expected to last more than oil reserves. The success of shale gas has been instrumental in this increased supply of gas. Notwithstanding the current low prices, which have adversely impacted many shale projects, the share of shale gas production in total gas production is expected to increase from the 11% in 2014 to 24% by the year 2035, mainly driven by production in North America and significantly in Asia Pacific.

The growth of gas consumption, specially in gas importing countries was, however, impacted by the high import prices during 2013-14. The subsequent oil price crash and related gas price plunge has helped achieve better affordability of gas imports, resulting in higher consumption. On the other hand, this has impacted several planned E&P projects around the world. The rebalancing in energy market is expected to play out in the coming years with gas prices expected to remain low in the short term.

As the economic growth shifts towards the developing world, the energy demand is also expected to grow to support this. The non-OECD countries are expected to account for 90% of the global increase in primary energy consumption in the next three decades. Among them, China, India and ASEAN members will account for 55%. As per projections of BP, India will account for more than a quarter of the growth in global energy demand during 2025-35.



Source:PNGRB Vision 2030 Report

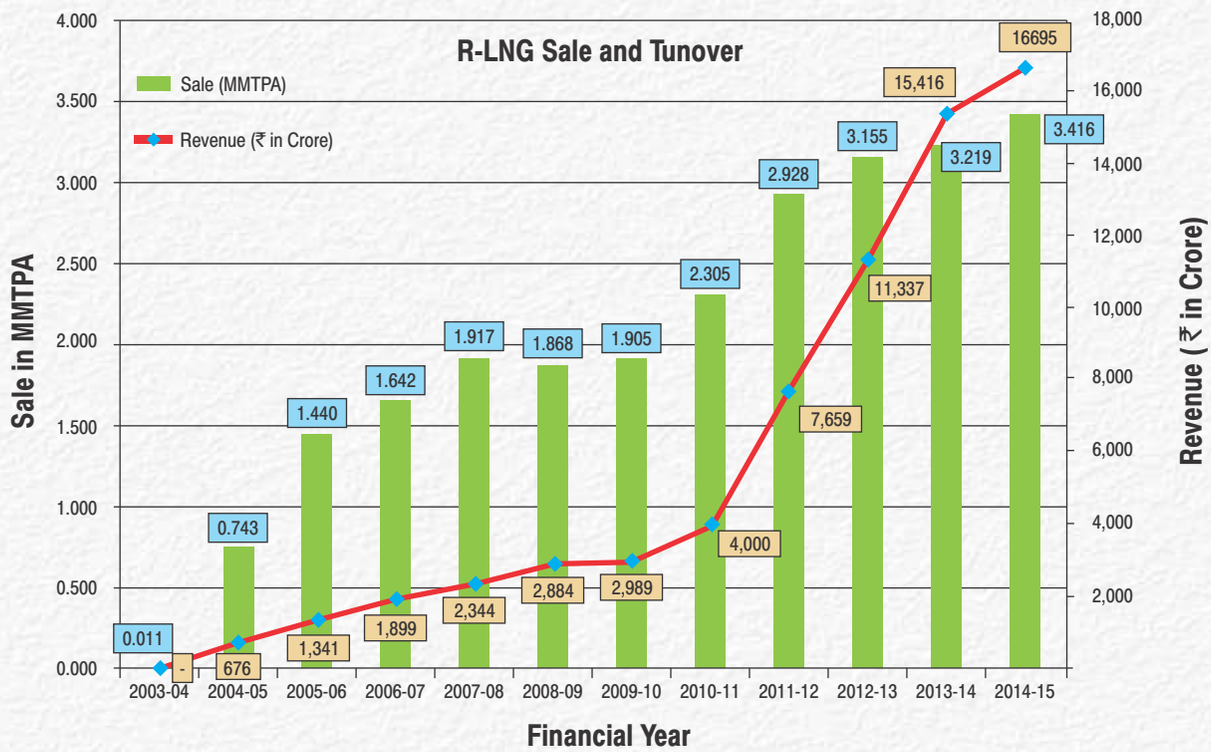
Meeting the growing energy demand of India is a huge challenge and natural gas is poised to play a very important role in all sectors of the economy. Over the past three decades, natural gas consumption in India grew at a CAGR of 9.1%. This growth has however, reduced to 4.7% over the past decade primarily owing to slowing domestic gas production and inadequate infrastructure. The total consumption of natural gas in India during 2014-15 was 116.78 mmscmd against a net domestic production of 73.93 mmscmd. The corresponding consumption and production during 2013-14 was 121.13 mmscmd and 80.02 mmscmd. The stagnating production is a continuing challenge requiring policy initiative that are likely in near future.

International Energy Agency, in its India Energy Outlook, 2015, has projected India's domestic gas production to reach a level of 162 mmscmd by 2030. PNGRB, on the other hand, has projected this to be 230 mmscmd. The demand by then is expected to be in excess of 700 mmscmd. Hence, India will need to increasingly depend on imported LNG to meet its growing energy demands. Augmenting natural gas transmission and distribution infrastructure in the country will be critical in ensuring that market growth meets required shift in energy mix. This will also ensure viability of the many LNG import terminals with announced capacities of over 80 MMTPA on both the coasts of India.

IndianOil and Natural Gas

IndianOil started its journey as a natural gas marketer in 2004 with the commissioning of the first LNG import terminal in India at Dahej by Petronet LNG Limited (PLL). IndianOil was one of the promoters of PLL, which was formed by the Government of India for setting up LNG import terminals and importing LNG into India to meet the increasing demand of natural gas in the country. Being a promoter of PLL, IndianOil holds marketing rights for a third of LNG being imported by PLL on long term basis at all its present and future terminals.

Over the years, IndianOil has steadily grown its natural gas customer base by leveraging its inherent strengths and widespread reach across the country. Beginning at a modest level, the sales have increased to 3.42 MMTPA (million metric tonnes per annum) i.e., 12.31 MMSCMD (million standard cubic meters per day) with a revenue of ₹ 16,695 crore for FY 2014-15. In 2015-16, sales are expected to reach 3.65 MMT (13.14 MMSCMD).

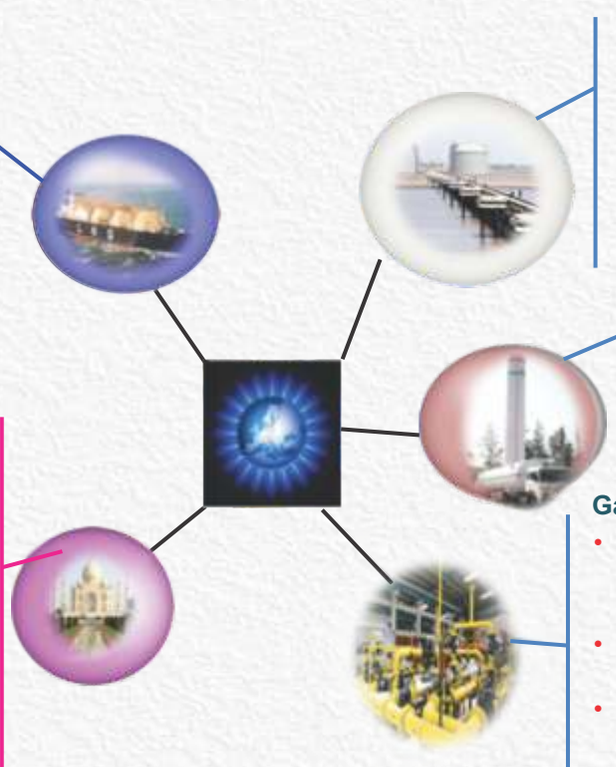


IndianOil in Natural Gas

IndianOil has envisioned to become a major player in the domestic natural gas sector having significant presence in the entire supply chain and has already taken steps to enhance its share in LNG sourcing, LNG import terminals, natural gas pipelines, city gas distribution networks and LNG supply by road tankers.

Major initiatives in these areas are given below in brief.

Gas Business - IndianOil's Portfolio



Gas Marketing

- Co-Promoter of Petronet LNG Ltd. (PLL) - 30% marketing rights at Dahej & Kochi Terminals.
- Sale of 3.42 MMT in 2014-15

LNG Import

- 9 spot cargoes Imported in 2015-16
- Setting up 5 MMTPA LNG terminal at Ennore by 2018-19

LNG at Doorstep

Pioneers in India
Also the largest.

City Gas Distribution

- Operating CGDs in Agra & Lucknow;
- Projects under execution through JVs in Allahabad, Daman, Chandigarh, Ernakulam, Panipat, Dharwad & Udhamsingh Nagar

Gas Pipelines

- Owns & operate Dadri Panipat pipeline since 2010
- Developing additional 4,000 kms in consortium
- Developing 1175 kms Ennore-Nagapattinam-Tuticorin-Bengaluru Pipeline

With 23 mmscmd demand of refineries, IndianOil itself is a large consumer of natural gas

Gas Sourcing

In 2012, IndianOil successfully partnered Oil India Ltd. for a 30% stake in Carizzo Oil & Gas's Niobrara shale asset in Colorado, USA for $ 8.52 million. In May 2014, IndianOil signed a deal with Pacific NorthWest LNG to buy 10% stake in shale-gas assets and a linked LNG project in British Columbia, Canada for which IndianOil will be investing $4 billion. The Canadian asset will produce about 20 MMTPA of LNG for 25 years starting in 2018. An additional 0.7 MMTPA LNG on FOB basis for 20 years has been tied up from Mitsubishi's Cameron Project, USA from where delivery is expected to start from Q1, 2018.

A LNG train
B Power generation equipment
C Storage and maintenance buildings
D Natural gas metering station
E Flare stack
F Prince Rupert Gas Transmission pipeline
G LNG carrier berths
H LNG carrier
I Trestle
J Suspension bridge
K LNG storage tank
L Materials offloading facility
M Security checkpoint
N Administrative buildings
O Lelu Island Bridge

Perspective view of LNG terminal of Pacific North West in British Columbia, Canada

IndianOil has signed 11 Master Sales & Purchase Agreements (MSPAs) with various international suppliers for spot LNG purchase. MSPAs are under discussion with other international suppliers for Short Term/ Spot purchases.

Starting from procurement of 1st LNG spot Cargo on its own in June'15, IndianOil has successfully imported 9 LNG spot cargoes till March '16.

IndianOil imported first Spot LNG Cargo from M/s Excelerate (USA). The LNG Tanker loaded from Bonny Terminal, Nigeria and berthed at Dahej on 11-12 June 2015.

Unloading operations at Dahej LNG Terminal

LNG Import Terminals

IndianOil has 30% marketing rights of all longterm LNG imported by PLL. Thus, a capacity of 2.25 MMTPA at PLL's Dahej LNG Terminal is already available.

Additionally, 1.5 MMTPA capacity for 20 years has been booked at the said terminal upon its expansion from 10 to 15 MMTPA by the end of 2016. Similarly, a capacity of 0.44 MMTPA of longterm LNG is booked at Kochi LNG Terminal.

Dahej LNG Terminal at night

IndianOil, through its Joint Venture Company (JVC), IndianOil LNG Pvt. Ltd. (IOLPL), is setting up a 5 MMTPA LNG Terminal at Kamarajar Port, Ennore (outskirts of Chennai) in Tamil Nadu. The LNG Terminal is scheduled to be commissioned in 2018-19. The Terminal will be expanded to 10.0 MMTPA in future.

Location of LNG Project Site at Kamarajar Port, Ennore

Aerial view of LNG Project Site in Kamarajar Port, Ennore in the state of Tamil Nadu

A Concession Agreement for taking 130 acres of port land and waterfront on lease for 30 years for this Project has been executed with Kamarajar Port Ltd.

Major EPCC contracts for execution of the project have been awarded and the construction activities have started at the site in August 2015.

Ennore LNG Terminal - Site Overview

Ennore LNG Terminal - Tank Piling Work in progress

Interim funding of the project has been arranged through subscription of Compulsory Convertible Debentures. The process of debt syndication for arranging the debt for the project has also started.

The Government of Tamil Nadu has granted fiscal incentives for the LNG Terminal Project. IndianOil has also signed a Memorandum of Understanding & Heads of Agreement with Tamil Nadu Industrial Development Corporation (TIDCO) for co-operation and participation in setting up the terminal and related infrastructure at Kamarajar Port. TIDCO will take around 5% equity in the project.

Meanwhile, discussions are going on with various international oil/ gas companies for inducting them as strategic/ equity partners. IndianOil will remain the lead shareholder in the JVC after induction of strategic/ equity partners.

In addition, IndianOil is in discussions for booking capacities in other LNG terminals being set up in the country to augment its RLNG market share.

Natural Gas Pipelines

IndianOil is operating a 132 km natural gas pipeline from Dadri (Uttar Pradesh) to Panipat-Haryana since 2010. This pipeline, with a capacity of 9.5 mmscmd, is supplying natural gas to IndianOil's refinery at Panipat and to other customers in the area.

View of the IndianOil Gas Station at Panipat, Haryana

IndianOil has also entered into partnership with Gujarat State Petroleum Corporation Ltd., Bharat Petroleum Corporation Ltd. and Hindustan Petroleum Corporation Ltd. to lay three cross-country pipelines of approximately 4,100 km (Mallavaram-Bhopal-Bhilwara-Vijaipur, Mehsana-Bhatinda, Bhatinda-Jammu-Srinagar), which are expected to be commissioned by 2017-18. These pipelines will be passing through the States of Gujarat, Rajasthan, Haryana, Punjab, J&K, Andhra Pradesh, Telangana, Maharashtra and Madhya Pradesh.

In addition, IndianOil has been authorised in December 2015 by the Petroleum and Natural Gas Regulatory Board (PNGRB) for developing the Ennore-Nagapattinam-Tuticorin gas pipeline with spur lines to Bengaluru and Madurai. This pipeline is approximately 1,175 km long with a capacity of 85 mmscmd and would evacuate the LNG imported at Ennore Terminal for distribution in the States of Tamil Nadu, Andhra Pradesh, Karnataka and the Union Territory of Puducherry.

City Gas Station, Green Gas Ltd., Lucknow

View of CNG station set up by Green Gas Ltd in Lucknow

City Gas Distribution

IndianOil operates City Gas Distribution (CGD) network & through its Joint Venture Company **Green Gas Ltd. i**n Uttar Pradesh for the cities of Agra and Lucknow.

IndianOil is also setting up new CGD network through its Joint venture Company **IndianOil-Adani Gas Pvt. Ltd.** in Allahabad, Chandigarh, Panipat, Daman, Ernakulam, Udhamsingh Nagar & Dharwad.

Odourising unit Ernakulam CGD project - City Gas Station

IndianOil plans to participate in all future rounds of CGD bidding called by the PNGRB. Additionally, IndianOil also aims to increase its presence in other parts of the country through strategic tie-ups whenever and wherever such opportunities arise.

LNG at the Doorstep

IndianOil pioneered supplying natural gas in liquefied form, i.e. LNG to the end-users in the country in 2007. The "LNG at the Doorstep" initiative has benefited bulk users located away from gas pipelines by enabling them to store LNG and use natural gas as per their convenience. The supply of LNG is done using cryogenic road transportation, unloading into cryogenic storage tanks at the customer's premises and using ambient air vaporisers for onsite regassification of LNG for the cleanest natural gas supply to the end use equipments for heating, power generation and other applications.

TATA Prima truck under trial run with LNG fuelled by IndianOil

At present, IndianOil is supplying LNG through road tankers from Dahej LNG Terminal. Supplies will commence from Kochi Terminal also. LNG tanker loading facilities would also be set up at upcoming Ennore and other LNG terminals.

Drilling work for steel pipe, Chandigarh CGD project

IndianOil is the market leader in supply of LNG at the Doorstep. In 2015-16, sales of over 20 TMT is expected to be achieved with plans to cross 100 TMTPA supplies by 2020.

Other initiatives of IndianOil in LNG at the Doorstep segment include the following :

- **Development of LNG as automobile fuel (LNG on Board):** IndianOil collaborated with TATA Motors Limited for the successful trial of Tata Prima truck operating on LNG as fuel with the approval of the Ministry of Road Transport & Highways and the Central Institute of Road Transport. The LNG was dispensed into the fuel tank of the truck using mobile dispensing technique by IndianOil. The LNG fuelled truck has successfully covered more than 8,000 km of trial run. This development will lead to introduction of long haulage trucks in India using clean fuel without frequent re-filling.
- **L-CNG :** IndianOil plans to set up off pipeline Compressed Natural Gas (CNG) stations using LNG. The LNG will be pressurized using booster pumps and passed through a vaporiser to convert to CNG before dispensing. Such L-CNG stations can be built anywhere without any need of pipeline connectivity.
- **LNG as fuel in locomotives of Indian Railways :** Indian Railways has commenced development activities of LNG fired locomotives supported by IndianOil.

LNG storage and regas facilities at customer's premise with LNG trucks waiting for unloading

Natural Gas

➔ **Chemical Composition:**

Methane: 85% Min; Ethane : 9.2% Max.; Propane: 3% Max; Butane: 2% Max.; Pentane: 0.25% Max.; Nitrogen: 1.25% Max.; Sulphur: 10 ppm Max.

➔ **LNG Properties :**

- ★ Liquifies at a temperature of minus 161º C; Maintained as cryogenic liquid.
- ★ Clear, colourless and odourless.
- ★ Density - Less than half of water (0.45 Kg/l).
- ★ High Purity - No moisture, sulphur etc.

➔ **Safety Aspects:**

- ★ LNG vapors are lighter than air – quickly dissipates up in the atmosphere, if spilled.
- ★ Higher Flammability range - 5 to 15%
- ★ Non-toxic, non-corrosive and non- carcinogenic.
- ★ Stored and transported at low pressure.
- ★ High auto-ignition temperature
- ★ Does not contaminate water or soil

Natural Gas and LNG Conversions	billion cubic metres NG	billion cubic feet NG	million tonnes oil equivalent	million tonnes LNG	trillion British thermal Units	million barrels oil equivalent
1 billion cubic metres NG	1	35.3	0.90	0.74	35.7	6.60
1 billion cubic feet NG	0.028	1	0.025	0.021	1.01	0.19
1 million tonnes oil equivalent	1.11	39.2	1	0.82	39.7	7.33
1 million tonnes LNG	1.36	48.0	1.22	1	48.6	8.97
1 trillion British thermal units	0.028	0.99	0.025	0.021	1	0.18
1 million barrels oil equivalent	0.15	5.35	0.14	0.11	5.41	1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