India Gas Market Report

Outlook to 2030

International Energy Agency

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Abstract

India's dynamic economic growth, coupled with rapid urbanisation and industrialisation, is set to significantly transform its entire energy market, including natural gas, in the coming years. This report, based on extensive dialogues with key Indian stakeholders, provides the International Energy Agency's (IEA) comprehensive analysis of this evolving landscape. As India aims to transition towards a gas-based economy and reduce its dependence on oil imports, the report offers a detailed forecast and strategic insights through 2030. The analysis reveals an anticipated transformative shift in the natural gas landscape, driven by favourable global market conditions, expansion of gas pipeline infrastructure and improvements in domestic production. These factors are expected to support a strong increase in natural gas consumption.

Strategic opportunities and policy interventions could further boost gas consumption beyond the forecasted trajectory by 2030. The report explores the potential for LNG use in heavy-duty transport, greater utilisation of the power generation fleet, and accelerated infrastructure development in the residential, commercial, and transport sectors to drive additional demand. It also examines the untapped potential of India's compressed biogas (CBG) production and the expected growth in LNG imports to bridge the gap left by marginal domestic production increases. Additionally, the report outlines policy options for the Indian government to enhance the role of natural gas within the national energy mix in the coming years.

Acknowledgements, contributors and credits

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Akos Losz, Lead Gas Market Analyst, and Carole Etienne, Gas Market Analyst, led the analysis and were the principal authors of the report, with significant assistance from Omkar Kajrolkar. Valuable comments and feedback were provided by senior management and colleagues within the IEA, including Ana Alcalde-Bascones, Eren Cam, Ilias Atigui, Toril Bosoni, Marc Casanovas-Simo, Tim Gould, Ciaran Healy, Hugh Hopewell, Nicholas Howarth, Kavita Jadhav, Martin Kueppers, David Martin, Apostolos Petropoulos, Yutaka Shirakawa, Siddharth Singh, Anthony Vautrin and Peter Zeniewski. Special thanks to Nicolas Coent, from the Energy Data Centre team, for his expert assistance with the data. Alay Patel acted as a research consultant and played a key role in the preparation of the Report, especially during the mission in Delhi. All data and projections are the work of the IEA, unless otherwise noted.

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Table of contents

Executive summary

The history of gas in India's energy system has a mixed track record, with periods of rapid expansion followed by episodes of decline. After steep demand declines in the wake of the 2022 global energy crisis, total gas consumption in India in 2023 was only slightly higher than in 2011. However, this report – grounded in comprehensive data analysis and extensive consultations with Indian stakeholders – argues that gas use in India has reached an inflection point and is on course to increase substantially between 2023 and 2030. This growth is driven by three major trends: the rapid expansion of India's gas infrastructure, a rebound in domestic natural gas production (which is generally cheaper than imported LNG) and an expected easing of global gas market conditions. Supportive government policies have further paved the way for increased natural gas consumption through 2030.

India's natural gas consumption is forecast to increase by nearly 60% by 2030, driven by robust growth in city gas distribution, industrial demand, and power generation. Since 2000, India's natural gas consumption more than doubled, exceeding 65 bcm/yr by 2023. Between 2023 and 2030, gas consumption is projected to grow by nearly 60%, reaching 103 bcm/yr by the end of the forecast period, bringing India roughly on par with the current gas consumption of Saudi Arabia. The city gas distribution (CGD) sector is expected to lead this growth, supported by the rapid expansion of compressed natural gas (CNG) infrastructure and the cost advantage of gas over liquid fuels for small industrial users. Heavy industrial and manufacturing sectors, such as iron and steel production, are also driving demand, collectively adding around 15 bcm/yr during this period. Gas use in oil refining is expected to increase by more than 4 bcm/yr as more refineries get connected to the grid. Growth prospects in the petrochemical and fertiliser sectors remain more limited, as no new gas-based capacity additions are foreseen within our forecast horizon. Gas demand in the power generation sector is projected to reach nearly 15 bcm/yr by 2030, driven by a recovery in large gas-fired power plants and the rapid expansion of gas use in captive power plants.

Targeted strategies and policy interventions could boost gas consumption beyond the forecasted trajectory to around 120 bcm/yr by 2030, close to the current gas consumption of the entire continent of South America. Incremental growth in this accelerated demand trajectory, which requires additional policy support in each category, could come from higher utilisation of India's stranded gas-fired power plants, faster adoption of LNG in heavy-duty transport, and more rapid expansion of India's CGD infrastructure, combined with the replacement of LPG with natural gas in the commercial segment. In total, this accelerated uptake of natural gas across the residential, commercial, transport and electricity sectors could add another 15 bcm/yr of gas demand by 2030.

India's domestic gas production, which met 50% of demand in 2023, is expected to grow only moderately through 2030. After nearly a decade of decline and stagnation, India's domestic gas production has seen a resurgence. In 2023, total net gas production reached 35 bcm, meeting about half of the country's gas demand. This growth is primarily driven by the deepwater fields in the Krishna-Godavari basin, which now account for nearly 25% of India's total production. Between 2024 and 2030, only moderate growth is expected, supported by increasing onshore production from coal bed methane (CBM) and discovered small fields (DSF). Offshore production will also rise with additional supplies from ONGC's deepwater KG-D5 project. However, overall growth will be tempered by plateauing output from the KG-D6 fields and declining production from legacy assets like ONGC's Mumbai offshore fields, leaving production in 2030 (at just under 38 bcm) only around 8% higher than 2023 levels.

India's compressed biogas (CBG) production potential remains largely untapped, with annual output expected to reach 0.8 bcm by 2030. India's CBG potential is estimated at approximately 87 bcm/yr, while the installed capacity currently represents less than 1% of this potential. The government has introduced several policy initiatives to support CBG production. As of September 2024, approximately 90 CBG plants were operational, with an additional 508 plants under various stages of development. By 2030, CBG production could reach 0.8 bcm/yr. However, challenges such as land availability, limited offtake, seasonal biomass supply and inadequate logistics continue to hinder the consistent availability and commercial viability of CBG production. The government has provided financial support for pipeline connectivity for CBG plants, biomass aggregation machinery, and byproducts offtake to address these challenges and build a robust CBG ecosystem by 2030.

India's LNG imports are set to more than double between 2023 and 2030, driven by steady demand growth and a much slower rise in domestic production. Between 2013 and 2023, India's LNG imports increased by 70%, and reached 36 bcm in 2024, matching the previous record set in 2020 and cementing the country's position as the fourth-largest LNG importer globally. Looking ahead, India's LNG demand is projected to grow steadily, reaching 64 bcm/yr by 2030. This represents an annual average growth rate of 11% for the 2023-2030 period, twice the average rate observed in the previous ten years. As domestic natural gas production is projected to see only marginal growth until 2030, LNG imports are expected to meet an increasing share of India's future gas demand. The rapid rise in LNG requirements necessitates additional LNG import capacity in the second half of the decade. The gap between contracted LNG supply and projected LNG requirements is set to widen significantly after 2028, leaving India more exposed to the volatility of the spot LNG market unless additional LNG contracts are secured in the coming years.

Chapter 1. Introduction

Global gas market trends

The global gas and LNG markets have experienced significant turbulence in recent years, driven by geopolitical events and shifting supply-demand dynamics. The 2022 gas supply shock, combined with a surge in post-pandemic energy demand in Europe and Asia, created a perfect storm that strained the global gas market balance. As a result, gas prices spiked, leading to significant demand declines, a reconfiguration of global LNG flows, and a reassessment of energy security policies worldwide.

Following the gas supply shock of 2022, natural gas markets moved towards a gradual rebalancing in 2023, driven by timely policy interventions, market adjustments in response to high gas prices and favourable weather conditions. Throughout 2023, market fundamentals continued to ease, leading to a fragile stabilisation in supply and demand dynamics.

By the first quarter of 2024, gas prices had fallen nearly 50% below the average in 2021, the last year before the 2022 energy crisis, reflecting a more balanced market environment despite limited LNG supply growth and shipping constraints via the Panama Canal and the Red Sea. This trend continued throughout the first half of 2024, although European and Asian spot prices remained well above their historical averages observed in the 2016-2020 period. Tighter market fundamentals, combined with perceived supply risks amid geopolitical tensions, drove up natural gas prices again in the second half of the year. In 2024, natural gas demand grew by an estimated 2.8% y-o-y (or 115 bcm); Asia, led by China and India, accounted for nearly 45% of the incremental demand. From a sectoral perspective, global gas consumption growth was largely supported by industry and energy own use, accounting for about 45% of the incremental gas demand during the year. Meanwhile, global LNG supply saw only modest growth in 2024, increasing by less than 2.5%.

Looking ahead, the substantial increase in LNG production and export capacity, mainly from Qatar and the USA, with close to 270 bcm/yr of new capacity coming online between 2024 and 2030, is poised to reshape the market. This surge in LNG supply is anticipated to outpace demand growth, resulting in more comfortable supply and demand balances and easing market tensions. However, regional price disparities may persist due to varying demand dynamics and infrastructure constraints.

Energy use and gas market trends in India

Driven by rapid economic development, urbanisation and industrialisation, India, the world's most populous country, is experiencing significant growth in energy demand. Primary energy consumption increased 2.4-fold between 2000 and 2022, with about 70% of demand still being met by coal and oil. From a greenhouse gas (GHG) and local air pollution perspective, this increased energy consumption poses significant challenges.

India's energy-related GHG emissions have grown rapidly since the turn of the century, making it the world's third largest GHG emitter. However, India has committed to clear climate goals, including achieving net zero emissions by 2070. As part of its updated Nationally Determined Contributions (NDCs) under the Paris Agreement, India has committed to reducing the carbon intensity of its GDP by 45% by 2030 compared to 2005 levels and cutting total projected carbon emissions by one billion metric tons over the same period. These efforts are part of India's broader strategy to transition to a low-carbon economy, which includes increasing renewable energy capacity, enhancing energy efficiency and promoting sustainable urbanisation. Despite these commitments, balancing economic growth with environmental sustainability remains an ongoing challenge for India, as it is for any other country committed to the energy transition.

Air quality remains a significant concern, with many regions experiencing levels of pollution that exceed national and international standards. The government has implemented various measures to combat air pollution, such as enforcing stricter emissions standards in industry and the transport sector, promoting sustainable agricultural practices, transitioning to cleaner energy sources, regulating construction and demolition activities, and enhancing waste management practices. However, the effectiveness of these measures is often hampered by enforcement challenges and the sheer scale of the pollution problem. Improving air quality is crucial for public health and aligns with India's broader environmental and climate goals.

Natural gas can play an important role in the early stages of India’s extended decarbonisation journey, as it can simultaneously contribute to meeting rapidly rising energy demand, reducing local air pollution and mitigating GHG emissions in India’s coal-dominated energy system.

The Government of India has set a highly ambitious target to increase the share of natural gas in the country's energy mix to 15% by 2030, up from the 2022 level

of 6.4%.[1] This target provides a clear growth signal for India's natural gas sector and has set the direction for a range of supportive government policies aimed at increasing gas use in India's energy economy.

Such policies have focused on expanding natural gas infrastructure, including transport and distribution pipelines, compressed natural gas and LNG filling stations, and LNG import terminals to improve access to natural gas across the country. Targeted policies and incentives have also been introduced or proposed to encourage natural gas adoption in specific sectors, including industry, power generation and transportation. Meanwhile, market reforms have taken cautious steps towards greater gas market competition and market-based pricing, trying to strike a delicate balance between incentivising greater domestic production and ensuring affordable natural gas supply to India's price-sensitive consumers.

Inter-fuel competition is particularly strong in India, with natural gas vying against coal, oil and renewables in several gas-consuming sectors. This means that even small changes in global gas prices can significantly impact domestic consumption patterns. This price sensitivity underscores the need for competitive pricing to enable natural gas adoption.

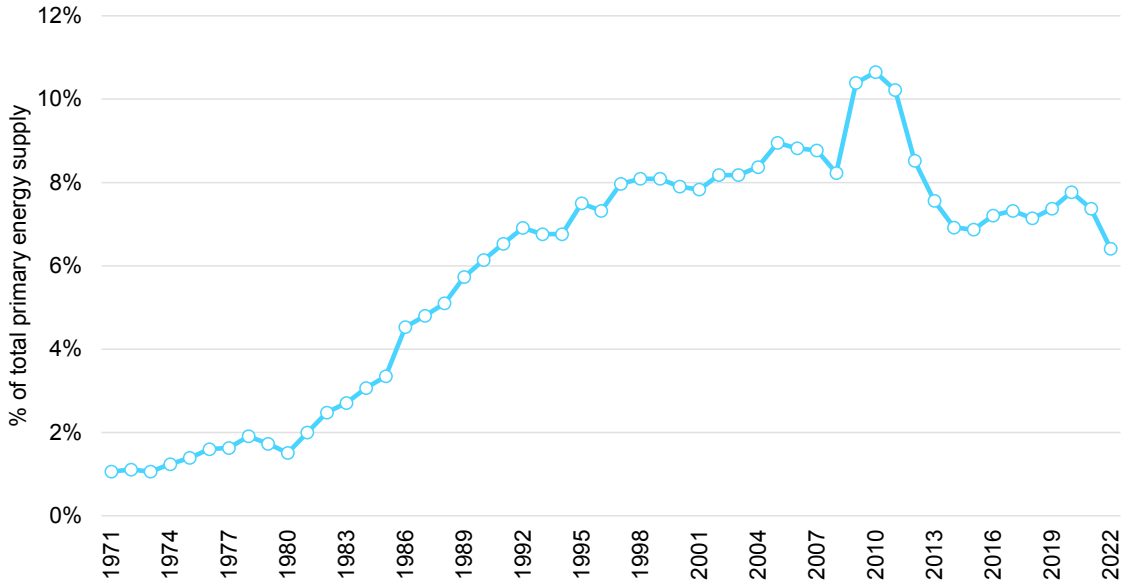
The push for a greater share of natural gas is a key part of India's strategy to reduce its reliance on coal and oil, which currently dominate the energy landscape, and to mitigate GHG emissions in line with the country's 2070 net zero target. Greater natural gas use also supports the integration of India's rapidly expanding wind and solar capacities, further reinforcing the role of gas in the country's energy transition.

However, achieving a 15% primary energy share for natural gas by 2030 (equivalent to 500 mcm/d or 182.5 bcm/yr, according to government estimates), appears challenging. Despite rapid energy demand growth, India's natural gas consumption has not kept pace. While primary energy consumption expanded by nearly 60% between 2010 and 2022, natural gas uptake remained slow, as India's development pathway prioritised affordability and energy security. As a result, natural gas accounted for about 6.4% of India's primary energy consumption in 2022.[2]

[1] This share is calculated based on an adjusted IEA primary energy balance, which follows the methodology of India's Ministry of Statistics and Programme Implementation and excludes biofuels and waste from primary energy supply. In contrast, the IEA's standard methodology, which follows the United Nations' International Recommendations for Energy Statistics, includes biofuels and waste in the primary energy balance. As a result, the IEA's World Energy Balances dataset reports a lower 5.1% share for gas in India's primary energy mix in 2022.

[2] The corresponding share is 5.1% when biofuels and waste are also included in the primary energy balance.

Share of natural gas in primary energy mix in India, 1971-2022



Note: Total energy supply excludes biofuels and waste in this graph.
Source: IEA (2024), World Energy Balances (database).

Several factors have contributed to this shortfall. First, the high cost of imported LNG has limited the competitiveness of natural gas compared to cheaper alternatives, especially coal. Second, infrastructure development, including pipelines and LNG terminals, has not kept pace with potential demand. The resulting bottlenecks and connectivity issues have constrained the adoption of natural gas in sectors where the economic and environmental case for switching to gas have been compelling, such as transportation, small industrial and commercial applications, and refining.

Moreover, while the regulatory environment and policy support have improved, challenges in implementation and enforcement persist. The industrial and power sectors, which are critical to increasing natural gas consumption, continue to rely heavily on coal due to its lower cost and established supply chains, which is further exacerbated by uneven and generally higher taxation on natural gas relative to competing fuels.

To achieve India's goal of becoming a gas-based economy and reducing its dependence on oil imports, strengthening the regulatory framework and ensuring consistent policy support will be essential. The government's commitment to these efforts will be pivotal in driving growth in the natural gas sector and reducing energy-related GHG emissions by replacing coal and liquid fuels with gas in the energy mix.

Gujarat: **A model for India's gas-based economy**

Gujarat was an early adopter of natural gas in India and the state's transition to a gas-based economy has served as an inspiration (and a potential template) for the Indian government's goal of developing a gas-based economy nationwide. With natural gas accounting for 25% of its energy mix, the case of Gujarat demonstrates that with the right combination of supply availability, infrastructure development and policy support, gas can play a significant role in the energy economy in India. Gujarat's experience with natural gas adoption is particularly significant in the context of the Government of India's target to increase the share of natural gas in the national energy mix to 15% by 2030.

Gujarat's natural gas market development began in 1972 with the Vadodara Municipal Corporation initiating local gas distribution. This early start was bolstered by the establishment of the Gujarat State Petroleum Corporation (GSPC) in 1979, which played a crucial role in developing the state's gas infrastructure. The formation of GSPC's subsidiary, Gujarat Gas Limited (GGL), in 1980 further accelerated the growth of the natural gas market by focusing on city gas distribution. All these entities are state-owned, contributing significantly to the development of the region's gas supply chain.

One of the key factors behind Gujarat's wider natural gas use is its extensive gas infrastructure. The state's proximity to Qatar, India's first and biggest LNG supplier, and the presence of several onshore and offshore legacy gas fields in and around Gujarat created favourable conditions for downstream gas and LNG infrastructure investments. The state boasts a well-developed network of LNG terminals, including India's first operational terminal at Dahej, commissioned in 2004, and subsequent terminals at Hazira and Mundra. These facilities, supported by a comprehensive pipeline network managed by Gujarat State Petronet Limited (GSPL), ensure reliable supply and distribution of natural gas across the state. Gujarat's LNG terminals account for about 60% (38 bcm/yr) of India's total LNG import capacity. The Dahej terminal alone has a capacity of 24 bcm/yr. The state has the most extensive gas pipeline network in India, with over 5 850 km of main lines, accounting for 25% of the country's pipelines. The state also leads the country in the number of CNG stations (accounting for over 1 000 or 14% of India's total) and piped natural gas (PNG) connections for domestic, commercial, and industrial use (totalling close to 3.5 million or 25% of the national total).

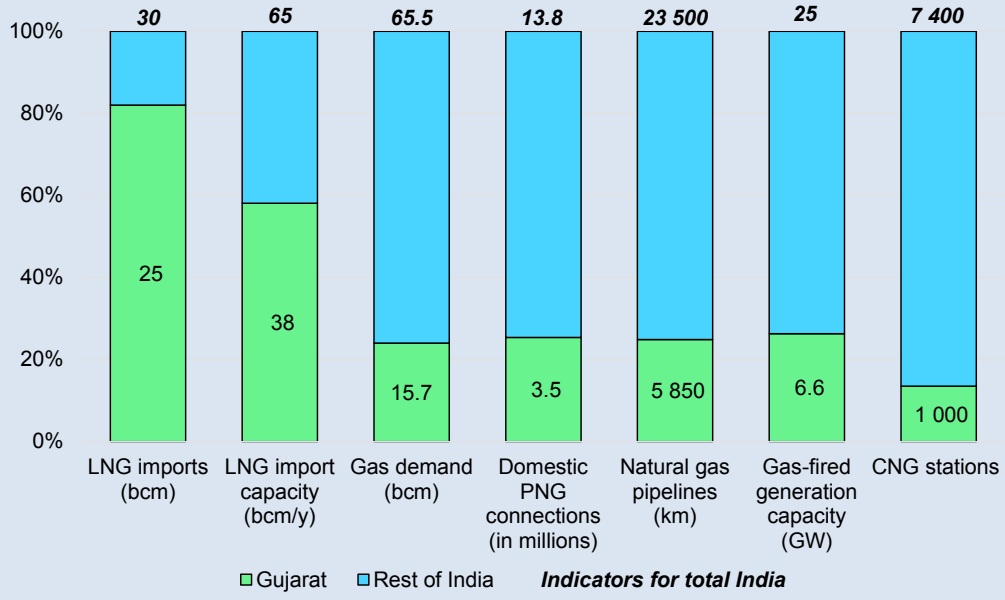
Gujarat's state-level policies have also played a crucial role in promoting natural gas. The Gujarat Gas (Regulation of Transmission, Supply and Distribution) Act of 2001 and the LNG Terminal Policy of 2012 created a favourable environment for investment and development. These policies facilitated the establishment of gas-based industries and promoted the use of natural gas in various sectors, including power generation, industrial applications, and city gas distribution. The creation of Special Economic Zones (SEZs) in Gujarat also played a significant role in

attracting investments and promoting industrial growth. SEZs offer economic incentives and infrastructure support, making them attractive destinations for businesses. This move has further bolstered Gujarat's position as a leading natural gas-based state within the Indian economy.

Gujarat's state entities, including GSPC, GSPL, GGL and Sabarmati Gas Limited (SGL), were established decades ago and have progressively developed an extensive, integrated gas infrastructure. Additionally, Gujarat adopted a collaborative approach with state-owned companies like Petronet LNG and international companies like Shell and BG Group (later acquired by Shell), fostering investments to develop and expand this infrastructure.

With nearly 25% of India's total consumption, Gujarat's demand for natural gas is spread across many sectors. The industrial sector, including manufacturing and various other industrial applications, consumes more than 40% of India's total industrial gas consumption. The city gas distribution (CGD) sector, which includes residential and commercial users, accounts for 33% of India's total CGD consumption. The cumulative installed capacity of gas-fired power plants in the state stands at 6 600 MW, representing 26% of India's total installed capacity of gas-fired power plants. This diverse demand was created and sustained because consumers had access to a well-developed infrastructure that ensured a reliable supply of natural gas.

Key indicators for Gujarat state compared to all of India, 2023



Source: IEA analysis based on data from PPAC Oil & Gas Snapshot of States, Volume: 2024-25, Edition: II (April-September).

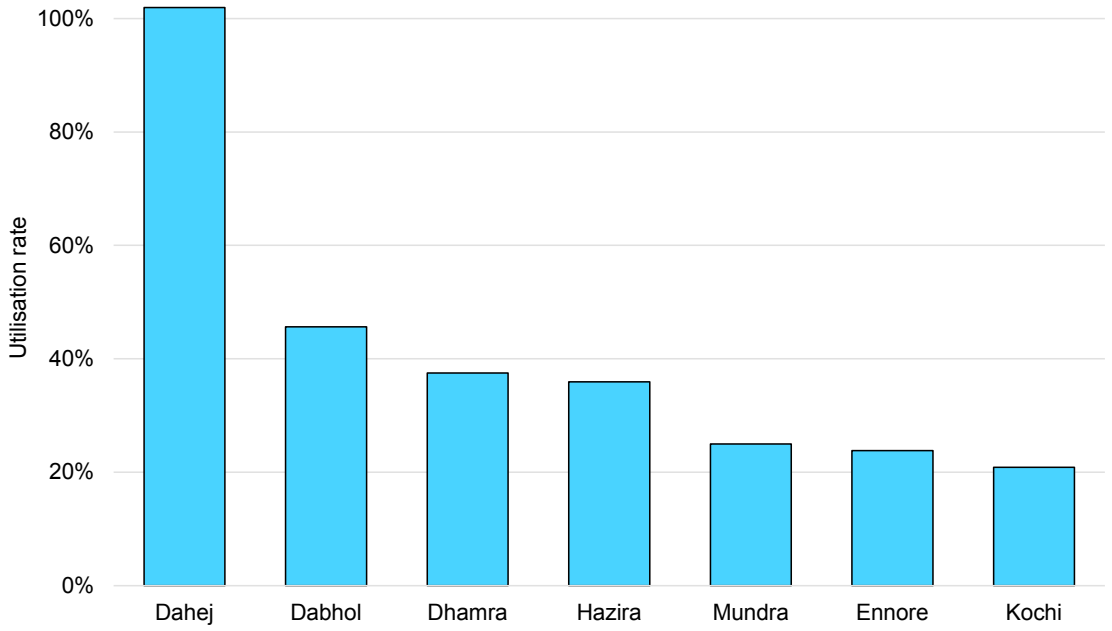
Chapter 2. Gas infrastructure

While successive policy documents have targeted a more prominent role for gas in India's energy economy, infrastructure bottlenecks and downstream connectivity issues presented key obstacles to materially increasing the share of gas in the energy mix over the past decade. The buildout of India's domestic gas infrastructure has accelerated markedly in recent years, but gaps remain between government goals and progress in key areas, such as the rollout of CGD networks to residential users. The regulatory framework for India's gas infrastructure could also be improved further with additional gas market reforms.

LNG infrastructure

India's LNG regasification capacity has expanded by 90% over the last decade, with four new terminals coming online since 2019. At the end of 2024, the country had a total nameplate regasification capacity of 65 bcm/yr spread across seven terminals in Dahej, Hazira, Dabhol, Kochi, Ennore, Mundra, and Dhamra. A new terminal in Chhara with an additional 6.8 bcm/yr nameplate capacity is expected to enter commercial service in 2025.

Utilisation rates of LNG import terminals in India, 2024



Note: The Dabhol terminal utilisation rate is calculated on the basis of its effective capacity of 4 bcm/yr (instead of 6.8 bcm/yr), due to the lack of breakwater facilities, which makes the terminal inoperable during the monsoon season.
Source: IEA analysis based on data from ICIS LNG Edge.

Utilisation rates vary by terminal, with the Dahej terminal operating at full capacity, while newer terminals like Dhamra are still ramping up operations. This difference in utilisation rates stems not only from the varying stages of operational maturity, but also from the development of connecting infrastructure. Established terminals like Dahej benefit from well-developed pipeline networks and stable demand, whereas newer facilities are still integrating into the national grid and building their customer base. The Kochi terminal in Kerala on the southwestern coast of India, for example, has been operating significantly below its nameplate capacity due to insufficient end-use demand connected to the facility. Meanwhile, the effective capacity of the Dabhol terminal in Maharashtra on the western coast of India has been limited to about 60% of its nameplate capacity due to the absence of breakwater facilities, restricting operations during the monsoon season.

To meet projected demand, India plans to further expand its LNG infrastructure. Several new terminals are under construction or in the planning stages, with the potential to add nearly 40 bcm/yr of regasification capacity by 2030. This expansion is expected to align with the projected increase in LNG demand, ensuring that infrastructure constraints do not hinder growth.

LNG import terminals in India

Terminal	Status	Nameplate capacity (bcm/yr)	Storage capacity (m^3 LNG)	Start-up year	State
Dahej	Operational	23.8	1 104 000	2004	Gujarat
Hazira	Operational	7.1	320 000	2005	Gujarat
Dabhol	Operational	6.8	480 000	2013	Maharashtra
Kochi	Operational	6.8	310 000	2013	Kerala
Ennore	Operational	6.8	360 000	2019	Tamil Nadu
Mundra	Operational	6.8	320 000	2020	Gujarat
Dhamra	Operational	6.8	360 000	2023	Odisha
Total operational		***65***	***3 254 000***		
Chhara	Commissioning in progress	6.8	200 000	Expected in 2025	Gujarat
Jafrabad FSRU	Under construction	6.8	180 000	Expected in 2025	Gujarat
Jaigarh FSRU	Under construction	5.4	145 000	Expected in 2026	Maharashtra
Total under construction		***19***	***525 000***		
Gopalpur	Planned	5.4			Odisha
Dahej expansion	Planned	6.8			Gujarat
Dabhol expansion	Planned	6.8			Maharashtra
Total planned		***19***			

Note: The effective capacity of the Dabhol terminal is limited to 4 bcm/yr due to the absence of breakwater facilities, which makes the terminal inoperable during the monsoon season. The Kochi terminal has been operating significantly below its nameplate capacity due to insufficient end-use demand linked to the facility.

Source: IEA analysis based on data from ICIS LNG Edge, IGU, GIIGNL and PNGRB.

Transmission pipelines

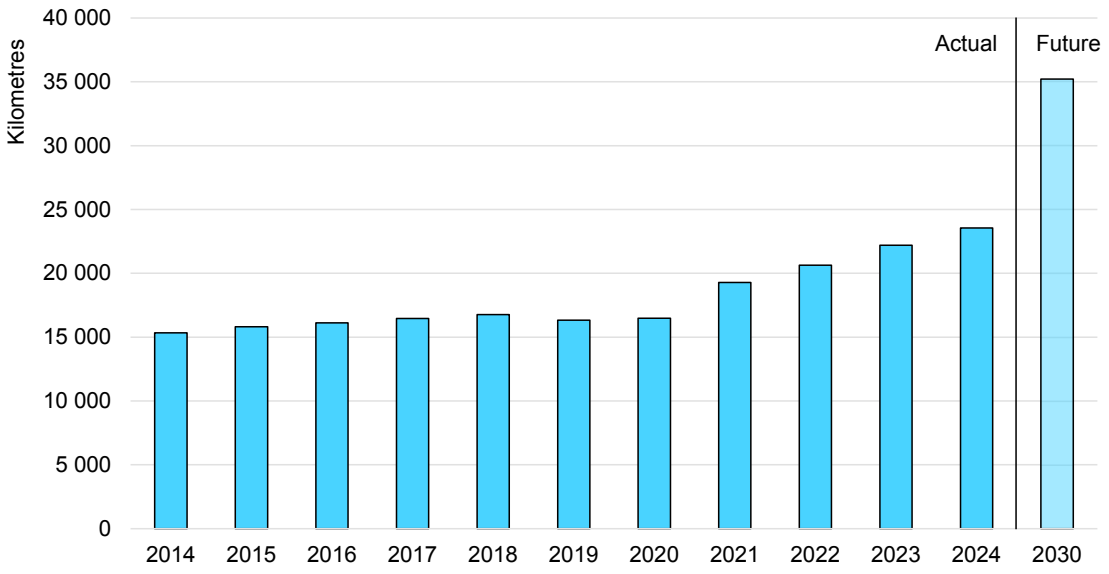
India's gas transmission pipeline network is a critical component of its energy infrastructure, facilitating the efficient and safe transport of natural gas across the country. As of mid-2024, India had approximately 23 500 km of operational natural gas pipelines, with plans to expand this network significantly. The PNGRB (Petroleum and Natural Gas Regulatory Board) has approved approximately 33 600 km of natural gas pipeline network across the country to create a national gas grid, under the “One Nation, One Gas Grid” initiative. With the completion of all under construction pipelines, including tie-in lines, dedicated pipeline projects, and sub-transmission lines, the total length of India’s high-pressure gas grid is expected to reach 35 200 km towards the end of the decade.

Historically, the majority of India’s domestic gas pipeline network has been developed and operated by state-owned entities. The Indian government has made notable steps towards liberalising the domestic gas market. However, progress towards the unbundling of transport and marketing operations has been slow and tentative, highlighting the need for a more effective market structure to ensure fair competition and efficiency in the gas sector.

Insufficient domestic pipeline connectivity was recognised early on as a key obstacle to building a gas-based economy nationwide in India. Between 2014 and 2020, the Government of India made efforts to expand the domestic gas transmission grid, but the buildout only accelerated markedly in the 2020-2024 period, when India’s gas transmission network expanded by more than 7 000 km (40%). This notable growth was driven by an uptick in new project approvals by PNGRB, the launch of a capacity booking portal by GAIL (Gas Authority of India Limited) to facilitate third-party access, the introduction of a simplified pipeline tariff structure, the commissioning of three new LNG import terminals (Ennore, Mundra, Dhamra) and the expansion of one existing project (Dahej) requiring pipeline connections and the expansion of the domestic gas grid to India’s underserved northeastern states in recent years (most notably through the 3 500 km Jagdishpur-Haldia-Bokaro-Dhamra Natural Gas Pipeline system).

This outlook anticipates the length of the domestic gas transmission grid to reach around 35 000 km by 2030, more than doubling the size of the network between 2020 and 2030. The largest additions are expected to come from the inauguration of the Mumbai-Nagpur-Jharsuguda pipeline (around 1 750 km) and the North East Natural Gas Grid (around 1 650 km).

Length of the domestic gas transmission pipeline network in India, 2014-2030



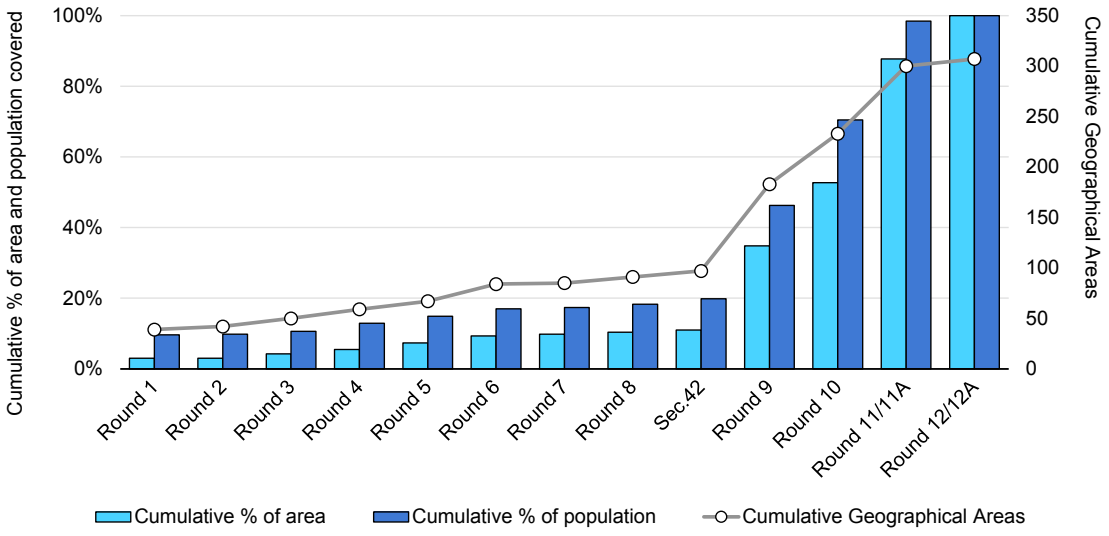
Note: Pipeline length on 30 June of each year or closest date available.
Source: IEA analysis based on data from PPAC.

City gas distribution

Under the Petroleum and Natural Gas Regulatory Board (PNGRB) Act of 2006, the PNGRB organises competitive bidding rounds and grants licences to companies to develop a city gas distribution network within a specified geographical area (GA). Bidders are required to commit to a minimum work programme (MWP) over a period, which typically ranges between 8-10 years to provide domestic PNG connections, set up CNG filling stations and lay a certain quantity of steel pipes. Authorised entities enjoy marketing exclusivity for a period of 8 years (extendable up to 10 years for entities meeting the quoted work programme) and infrastructure exclusivity for a period of 25 years in their respective geographical areas (GA).

As of 2024, India had allocated licences for 307 GAs in 12 bid rounds, covering most of India's population and territory.

Geographical coverage of CGD connections in India by bidding round, 2008-2024

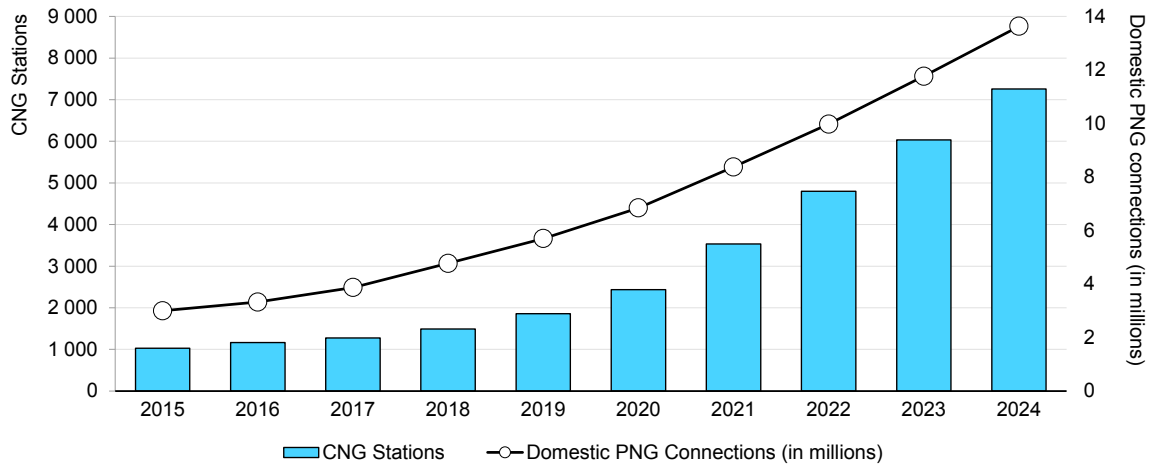


Source: IEA analysis based on data from PNGRB.

The current rollout of India's CGD network is focused on the 210 GAs allocated under the 9th (April 2018), 10th (November 2018), 11th (September 2021 and January 2022) and 12th (March 2024) bid rounds. Under the already awarded bidding rounds, CGD companies have committed to connect 126 million pipeline gas users across the residential, commercial and small industrial sectors, and are expected to add more than 18 300 CNG stations to India's distribution grid by 2032. Based on the interim targets under the most recent bid rounds, the Indian government expects 120 million pipeline gas connections and 17 500 CNG stations by 2030.

At the end of 2024, India had just under 14 million pipeline gas connections and approximately 7 400 CNG stations. Annual additions of PNG connections averaged 1.6 million in the 2020-2024 period and never exceeded 2 million to date. The corresponding expansion rate for the CNG station network averaged just over 1 000 stations per year between 2020 and 2024 and the maximum yearly increase was 1 400 stations in 2022. To hit the 2030 targets, the rollout of PNG connections would need to accelerate more than ten-fold (to nearly 18 million connections per year) between 2025-2030 relative to the 2020-2024 average and the expansion of the CNG station network had to expand 60% faster through 2030 (adding more than 1 700 units each year) than in the 2020-2024 period.

Growth of domestic PNG connections and CNG stations in India, 2015-2024



Note: Data reported as of September annually.
Source: IEA analysis based on data from PNGRB.

Underground gas storage

India currently lacks underground gas storage (UGS) facilities and has only limited LNG storage capacity, equivalent to around 1.9 bcm. In July 2023, the PNGRB proposed developing strategic gas reserves to enhance energy security and mitigate price volatility. In November 2023, the Indian Ministry of Petroleum and Natural Gas (MoPNG) instructed ONGC, Oil India and GAIL to conduct a feasibility study for strategic gas stocks with a capacity of 3-4 bcm. The report will evaluate costs, potential locations, timelines and business models. The initial UGS capacity of up to 4 bcm is estimated to cost USD 1-2 billion, with construction expected to take 3-4 years following project approval. Potential sites are being considered in western and northeastern India, using depleted fields or salt caverns.

India's primary motivation for exploring underground storage options stems from the extreme price volatility experienced in 2022 and the resulting curtailments of gas supply to price-sensitive users (especially in the power, oil refining, and CNG sectors) during the peak of the 2022-23 energy crisis. A number of European countries (including Italy, Hungary, Bulgaria, Spain, Latvia, Germany, Austria and Czechia) have developed strategic gas reserves to provide backup during gas supply emergencies and India's recent experience with building strategic petroleum reserves offers a suitable template for creating strategic gas stocks. However, strategic reserves represent only one of many gas reserve mechanisms and flexibility options available to net importing countries.[3] Given the relatively

[3] More information about this can be found in this IEA commentary: Secure gas and LNG value chains call for greater international co-operation.

high cost, long lead-time and limited use of strategic stocks during the 2022-23 energy crisis in Europe, India could explore a broader range of solutions to mitigate the economic impact of future price shocks. In addition, several other factors can justify investment in UGS, including price arbitrage opportunities from the seasonal price spread between summer and winter, and the ability to ensure quick gas availability for gas-fired power plants to ramp up rapidly in response to electricity system needs and price fluctuations.

Regulatory issues

The PNGRB regulates access to gas transport and distribution networks, transmission tariffs and the authorisation of companies involved in gas transport, distribution, storage, and LNG trade.

In principle, India's gas transmission network has been open to regulated non-discriminatory third-party access (TPA) since the adoption of the PNGRB Act of 2006. To further facilitate this, GAIL set up an online capacity booking platform in 2018 to provide transparent open access to its pipelines to third parties. However, the unbundling of transport and marketing operations, which was first initiated in 2019, is yet to materialise. International experience in the European Union and other mature gas markets shows that the unbundling of supply and transmission activities is a key prerequisite to a well-functioning gas market. However, in most liberalised gas markets, including EU member states, the development of legacy pipeline infrastructure preceded the market liberalisation process, and was overseen by national monopolies under state control. Given the highly capital-intensive nature and low returns associated with gas transmission infrastructure development, an extended timeline for separating transmission activities in India may also be appropriate. In the longer term, the unbundling of transport and marketing operations and establishing an independent gas transmission system operator (TSO) in India would likely enhance competition, improve market flexibility and increase the utilisation of the domestic gas transmission grid, which averaged only around 40% in the 2015-2023 period.

The introduction of a unified pipeline tariff system in April 2023 removed one key barrier to greater gas penetration, especially in remote areas, which are located far from gas supply sources and LNG terminals. The unified tariff policy will apply to 21 pipelines representing 90% of operational and under construction transmission capacity. Prior to the reform, customers in the country's interior faced cumulative pipeline tariffs due to the addition of multiple transit zones and tariffs, often leading to high costs for long-distance pipeline gas transport.

In October 2024, the PNGRB took steps to remove the exclusivity rights of six CGD operators in 73 districts and reclassify these areas as common carrier networks open to third parties on a non-discriminatory basis. Similar attempts in

the past faced legal challenges, but a pending amendment to the PNGRB Act of 2006 could give the regulator more authority to revoke exclusivity rights and enforce open access to the distribution grid if CGD operators fail to meet MWP requirements. Opening India's distribution network to third-party access would reduce CGD companies' profits, discourage investment and potentially lead to additional delays in the buildout of the CGD network. On the other hand, it could increase competition in one of India's most dynamic end-use sectors, lower prices for consumers and ultimately lead to higher gas penetration in India's energy mix. How this balances out would to a large extent depend on the tariffs that the network operators can charge network users.

Chapter 3. Gas pricing in India

Gas pricing in India is a multifaceted system influenced by various factors, including international benchmarks, domestic production and government policies.

India employs two primary gas pricing mechanisms: the Administered Price Mechanism (APM) and prices determined by market forces. The APM applies to gas from older onshore fields allocated to public sector companies, with prices set by the Petroleum Planning & Analysis Cell (PPAC). In contrast, the price of gas from newer fields and imported LNG is determined, to varying degrees, by market forces.

Historically, APM gas prices were based on a formula considering the weighted average of gas prices in Canada, the United States, the European Union and Russia. This approach often led to significant price volatility. Between the October 2020-March 2021 and October 2022-March 2023 cycles, for example, the regulated domestic price jumped from USD 1.79 to 9.16/MBtu.

Following the recommendations of the Kirit Parikh Committee, the government revised the APM pricing mechanism in April 2023 to better reflect market conditions and simultaneously ensure fair pricing for both producers and consumers. The new mechanism links the APM gas price to 10% of the monthly average of the Indian Crude Basket,[4] with a USD 4/MBtu price floor and a USD 6.5/MBtu ceiling price for gas production from ONGC's and Oil India's nomination gas fields to protect against extreme market fluctuations. Since the introduction of the new formula in 2023, the APM gas price has remained at the maximum level of USD 6.5/MBtu. Gas produced from new wells or well interventions in nomination fields is allowed a 20% premium over the APM price.

To incentivise exploration and production in challenging environments, the Indian government grants marketing and pricing freedom for natural gas extracted from high pressure/high temperature (HP/HT) fields in deepwater and ultra-deepwater areas. This policy, effective for discoveries commencing commercial production from 1 January 2016, allows producers to set market-driven prices, subject to a ceiling determined biannually based on the landed price of alternative fuels. The ceiling price in USD/MBtu (on a gross calorific value [GCV] basis) is to be the lowest of the (i) landed price of imported fuel oil, (ii) weighted average landed price

[4] The Indian Crude Basket is a weighted average of the prices of two types of crude oil: sour crude from Oman and Dubai (78.5%), and sweet crude from Brent (21.5%). This basket serves as an indicator of the price of crude oil imports for India and is used by the government to monitor and manage domestic pricing issues.

of imported substitute fuels (0.3 x price of coal + 0.4 x price of fuel oil + 0.3 x price of naphtha) and (iii) the landed price of imported LNG. As of the second half of FY 24-25, the ceiling price from these challenging fields is set at USD 10.16/MBtu, reflecting a 3% increase from the previous period.

Operators in fields under the Discovered Small Field (DSF) Policy, Hydrocarbon Exploration and Licensing Policy (HELP), and all coal bed methane (CBM) blocks have full autonomy over natural gas marketing and pricing. Similarly, operators in blocks under the New Exploration Licensing Policy (NELP), pre-NELP and nomination regimes enjoy marketing and pricing freedom if their field development plans were approved after 28 February 2019. Additionally, natural gas discoveries in northeastern basins that commenced production after 1 July 2018, also qualify for similar autonomy.

Snapshot of consolidated upstream gas pricing regimes in India

Domestic gas price with ceiling (APM) - Calculated monthly	• Since April 2023, linked to 10% of the Indian crude oil basket* • A floor of USD 4/MBtu and ceiling of USD 6.5/MBtu applies (ceiling to be adjusted upwards by USD 0.25/MBtu periodically) • Applies to nomination fields of ONGC and Oil India, NELP and pre-NELP contracts which required government approval
HP/HT- deepwater price ceiling with marketing freedom	• Introduced in January 2016 • Pegged to the price of alternative imported fuels • Applies to deepwater and HP/HT fields which were not producing as of 1 Jan 2016 • Examples include Reliance-BP's KG-D6 fields (R Cluster, Satellites Cluster, MJ) and ONGC's KG-D5
Marketing and pricing freedom	• Applies to fields and blocks licensed under the DSF/HELP regime and all CBM blocks • Also applies to NELP/pre-NELP, nomination blocks where field development plans were approved after 28 Feb 2019, and discoveries in northeastern basins which started producing after 1 July 2018

* The Indian Crude Basket is a weighted average of crude oil prices from Oman, Dubai, and Brent crude. It indicates the cost of India's crude oil imports and is used for domestic pricing decisions.

Source: IEA analysis based on data from PPAC.

We estimate that approximately 64% of India's domestic gas supply in 2024 was priced as per APM. Additionally, 29% fell under the HP/HT-deepwater price ceiling and 7% enjoyed full pricing and marketing freedom. For comparison, in 2020, 85% of the gas was priced as per APM, indicating a clear shift towards higher-priced gas as new volumes came online in recent years. This shift presents a challenge

for the government as it seeks to balance consumer needs with the need to incentivise upstream investment.

The allocation mechanism for domestic gas

The allocation of domestic natural gas to certain end users is not market-based but follows an allocation policy for priority sectors. The Ministry of Petroleum and Natural Gas (MoPNG) manages this process, considering several key factors. First, sectoral priorities are established, with the government prioritising sectors critical to economic development and public welfare. Second, the process assesses demand across various sectors alongside the available supply of domestic gas. Finally, specific government guidelines and policies provide direction for the overall allocation process.

As of the end of 2024, the allocation of domestic gas to piped natural gas (PNG) for domestic use and compressed natural gas (CNG) for transport has been given top priority. This ensures that these segments will continue to receive their allocated gas supply without any reductions. Additionally, gas is also allocated to gas-fired plants in the power generation sector, urea producers in the fertiliser sector and for the production of liquefied petroleum gas (LPG).

Between May 2023 and November 2024, the share of APM gas allocated to CGD networks fell significantly from 96% to around 40%, due to a reduction in supplies of low-priced natural gas from domestic fields like Mumbai High and Bassein. This led to city gas retailers adjusting CNG prices by INR (Indian rupees) 2-3 per kg, making CNG less competitive compared to diesel.

To address these temporary issues, the MoPNG issued an order on 31 December 2024 to reallocate approximately 0.5 bcm/yr of gas from LPG production to city gas entities. Additionally, the government mandated a pro-rata allocation of gas from new wells and designated ONGC's Ramnad field exclusively for the city gas sector. These measures, which underscore the importance of the CGD sector to the government, aim to stabilise CNG prices and ensure a more reliable supply for India’s urban gas consumers.

When domestic gas supply is insufficient to meet demand, consumers have to rely on regasified liquefied natural gas (RLNG). This imported gas is procured under open general licenses and is subject to market prices. The average imported LNG price was approximately USD 12/MBtu in 2024, reflecting an 11% decrease from the previous year. Since the establishment of the Indian Gas Exchange (IGX), market participants in India have access to an alternative market-based price discovery mechanism that provides clear price signals driven by the fundamentals of supply and demand.

The role of the Indian Gas Exchange (IGX) in gas price discovery

The IGX, established in 2020 under the regulatory framework of the PNGRB, is India's first automated, national-level natural gas exchange. Initially limited to trading regasified LNG, the platform aims to evolve into a transparent, cost-reflective and uniform pricing mechanism for the entire Indian gas market.

Currently, the IGX operates across 15 delivery points, comprising 4 LNG terminals, 3 pipeline interconnection points, and 8 domestic gas field landfall points. These points are grouped into 6 gas hubs. The exchange supports delivery-based trading through 7 contract types: intraday, day-ahead, daily, weekly, weekday, fortnightly and monthly, allowing trades for up to two consecutive years.

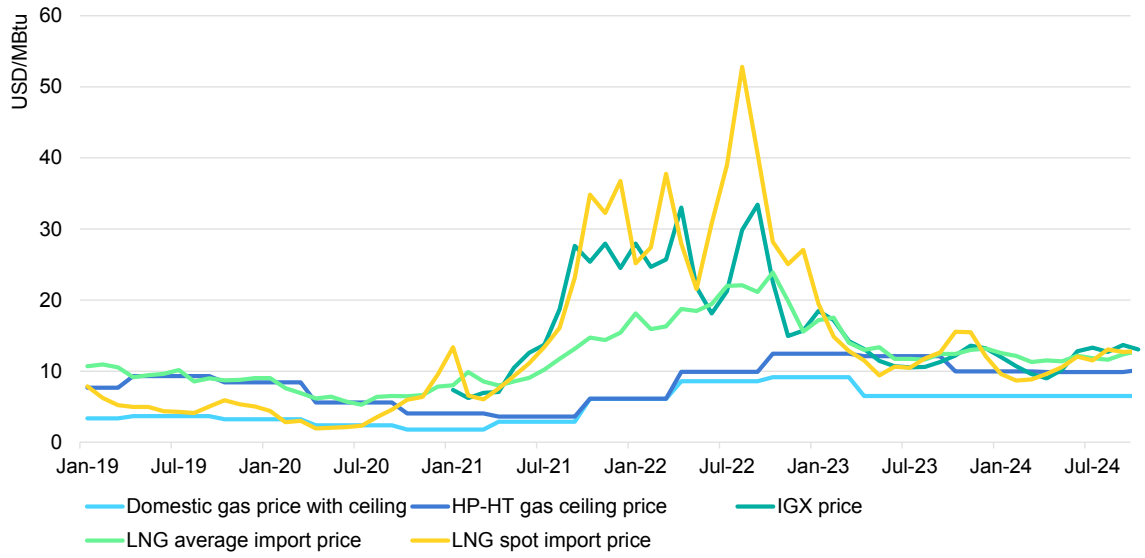
For IGX to serve as a reliable price reference point, certain conditions must be met. These include (1) the presence of multiple buyers and sellers across an unbundled gas value chain with transparent third-party access to infrastructure; (2) market liquidity allowing for the buying and selling of gas multiple times before final delivery and consumption; and (3) market depth, namely the availability of gas for both spot transactions and futures contracts. This enables market participants to manage risks, including by hedging future production or consumption.

Despite its promise, India's gas market is still in the early stages of development and faces challenges typical of emerging markets. These include a limited number of gas supply sources, insufficient (though rapidly growing) gas infrastructure, no underground gas storage facilities and a domestic market dominated by long-term bilateral contracts with restrictive delivery and resale conditions.

The evolution of gas hubs in mature markets like the United States (Henry Hub) and Europe (National Balancing Point [United Kingdom] and Title Transfer Facility [Netherlands]) offers valuable lessons. These hubs required over a decade to mature and often relied on strong government intervention to limit the market power of incumbents. Similarly, India’s power sector exchange, established in 2008, has grown significantly but still accounts for only 7% of the country’s total electricity supply.

The IGX will require sustained efforts to overcome these challenges and develop into a robust and mature gas trading platform capable of shaping India’s energy market transformation.

Evolution of prices under the various regimes in India, January 2019-October 2024



Note: IGX has been operating as a gas exchange since December 2020.
Source: IEA analysis based on data from PPAC, IGX, ICIS LNG Edge.

Inter-fuel competition

Natural gas faces economic competition with alternative fuels in several sectors, including power generation (with coal), road transport (with diesel, gasoline and EVs), and residential, commercial and small industrial users within the CGD sector (mainly with LPG).

End-user gas prices are dependent on the source of gas (imported RLNG vs. domestic natural gas), tariffs and state taxes. The price of domestic natural gas can vary depending on the pricing regime the producing field falls under. In 2024, this price ranged between USD 6.5 and 9.9/MBtu.

Another important variable is taxation. While coal, electricity and LPG fall under the goods and services tax regime (GST) regime, natural gas, diesel and gasoline do not. Natural gas remains outside the scope of GST and is subject to various legacy taxes, including customs duties (ranging from 2.5 to 14%), central excise duty (0 to 14%), state value-added taxes (which vary by state, from 3% in Maharashtra to as high as 25% in Chhattisgarh) and a central sales tax. When a fuel is subject to GST, it enables consumers to benefit from input tax credit (ITC), which allows them to claim credit for the GST paid on purchases (inward supplies) against their GST liability on sales (outward supplies). This mechanism reduces the overall tax burden on consumers and enhances cost efficiency, making fuels under GST more attractive for commercial use.

Power sector

Gas-fired power plant utilisation rates have remained very low, ranging from 12-16% between 2022 and 2024 on an annual basis. A key reason for this is the lack of affordable domestic gas, which forces reliance on higher-priced imported LNG, making gas-fired power generation uncompetitive, especially against coal-based power plants. This situation applies to existing assets, with no current plans to invest in new gas-fired power plants. Economic studies show that at a RLNG price of USD 14/MBtu, the cost of generating electricity from gas would be in the range of INR 12-18/kWh. At a RLNG price of USD 8/MBtu, the generation cost would still be in the range of INR 8-11/kWh. In comparison, the cost of generating electricity from coal is estimated at INR 4/kWh by the National Thermal Power Corporation (NTPC) for its own power plants. This analysis may vary depending on the location of the power plants, both for coal and gas, as plants located near the domestic production site or close to the ports where coal or LNG are imported can benefit from reduced transportation costs.

We estimate that input gas prices would have to be below USD 6/MBtu for gas-fired generation to be able to compete against coal-based power plants. For context, the cheapest domestically produced gas available in India is currently priced at USD 6.5/MBtu.

However, it is essential to consider the external costs associated with different fuel types, such as health impacts from air pollution and carbon emissions. Coal-based power generation contributes significantly to air pollution, leading to respiratory and cardiovascular diseases, and emits large amounts of CO_2. By incorporating these externalities into fuel prices (e.g., through a robust carbon price signal), the true cost of coal power becomes apparent. This adjustment could make natural gas more competitive in the merit order, as it produces fewer pollutants and lower carbon emissions compared to coal. Reflecting these external costs in fuel pricing would not only promote cleaner energy sources but also improve public health and support climate goals.

Transport

CNG prices are highly competitive when compared to gasoline and diesel. However, state levies significantly influence the final prices of gasoline and diesel, as they do for CNG. A comparison of Delhi over the past two years, which has a relatively higher CNG penetration, shows that CNG prices (on an energy equivalency basis) are around 40% lower than gasoline and diesel prices, which also have a high tax component. For instance, the average CNG price for H1 2024 was INR 1.4/MJ, compared to INR 2.91/MJ for gasoline and INR 2.32/MJ for diesel. Similar differentials can be observed in other prominent cities like Mumbai and Ahmedabad.

In addition to price competitiveness, it is crucial to consider the external costs associated with fuel use, particularly the impact on public health due to low air quality in urban areas. The use of diesel in transport, particularly in vehicles without particulate filters or those not compliant with the latest environmental regulations, contributes significantly to urban air pollution, leading to a series of adverse health impacts in India's major cities. By contrast, CNG produces up to 80% less NO_x and 99% less particulate matter than diesel vehicles. Therefore, the use of CNG in the transport sector not only offers economic benefits but could also help mitigate the adverse health effects associated with poor air quality.

Residential and commercial

In the residential and commercial sector, PNG competes against LPG for cooking and water heating, as well as for heating or cooling in small commercial units and in small industries connected to the distribution grid.

As per the minimum work programme submitted by CGD entities, the Government of India has an ambitious target to increase the number of household connections from less than 14 million at the end of 2024 to around 126 million by 2032.

Unlike in transport, the price difference between PNG and LPG is far narrower. In mid-2024 in Mumbai, the price of a 14.2 kg LPG cylinder worked out to be INR 1.23/MJ as compared to the PNG price of INR 1.2/MJ. However, the cost of building PNG infrastructure is significant, particularly when contrasted with the more straightforward delivery of LPG via cylinders. Consequently, the adoption of PNG for residential purposes is likely to face substantial challenges. This is further compounded by the relatively low potential consumption in Indian households, which primarily use gas for cooking and water heating, with no demand for space heating.

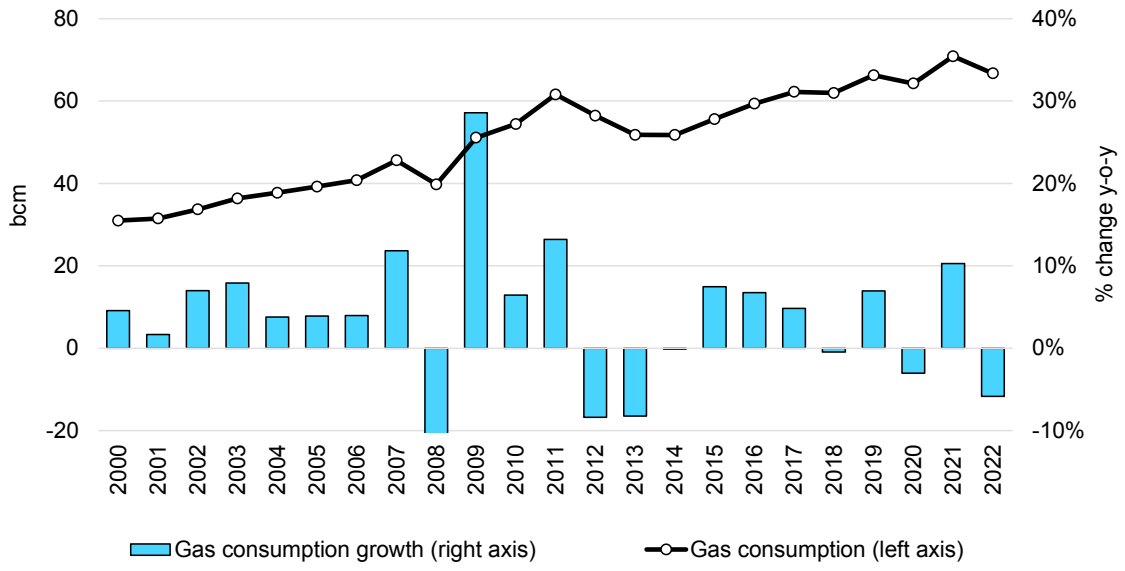
The situation is further complicated as the government has also provided subsidised LPG cylinders to over 100 million beneficiaries under the Pradhan Mantri Ujjwala Yojana (PMUY) initiative launched in 2016. This programme offers financial assistance to cover the cost of the LPG connection, including the first refills and a stove, aimed at promoting clean cooking in rural areas and helping low-income families mitigate indoor pollution and avoid the associated health risks.

In India, small and medium-sized enterprises (SMEs) connected to the natural gas distribution grid (PNG sector) have the flexibility to switch between LPG and PNG based on price fluctuations. This adaptability is facilitated by short contract durations, often spanning one month or less, allowing SMEs to optimise their fuel costs effectively.

Chapter 4. Gas demand outlook

India's natural gas consumption more than doubled since 2000, reaching over 65 bcm by 2023, comparable to that of the United Kingdom. India's growth path was highly uneven in the last two decades. Between 2000 and 2011, domestic gas use expanded rapidly, driven by a production boom in the deepwater Krishna-Godavari basin that provided affordable gas for the domestic market. However, this production peak was short-lived, and consumption declined sharply after 2011, entering a prolonged slump that persisted through much of the decade.

Total natural gas demand and annual growth rate in India, 2000-2022



Note: Data reported on a fiscal year basis.
Source: IEA (2024), Natural Gas Information.

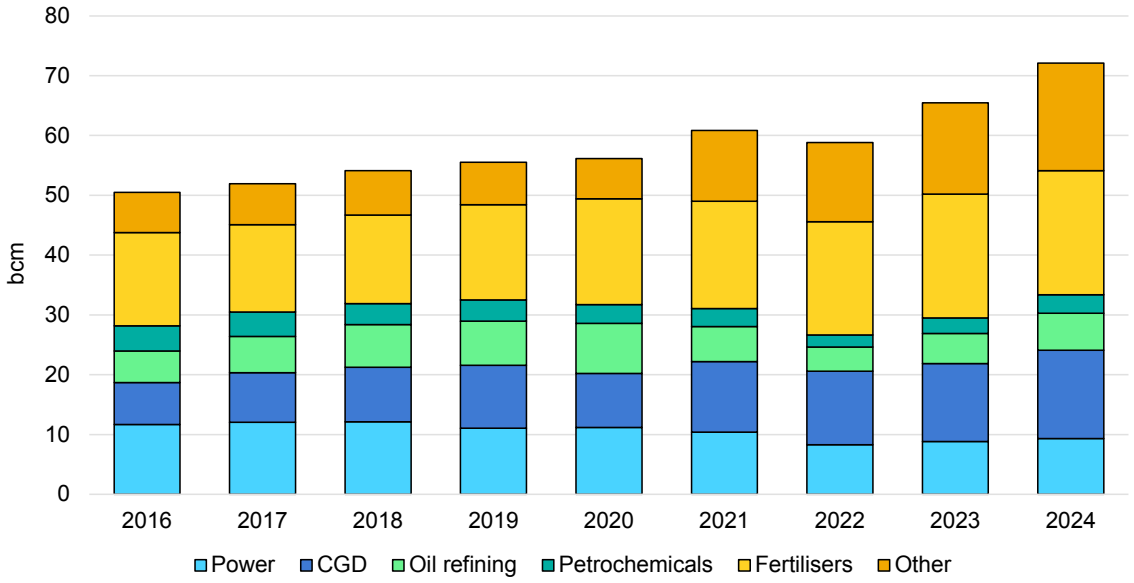
A modest recovery began around 2015, supported by low LNG import prices and government efforts to promote a gas-based economy. While the 2020 Covid-19 pandemic and the 2022 energy crisis temporarily disrupted demand, India's gas consumption rebounded strongly, achieving double-digit growth in both 2023 and 2024.

Sectoral trends

Between 2016 and 2023, India's sector-wise natural gas consumption increased by 30% (15 bcm/yr). The city gas segment (up 86%), fertiliser production (up 33%)

and other industries (up 127%) saw rapid consumption growth during this period as the low-pressure distribution grid was built out, and urea producers and a host of industrial users converted from liquid fuels to natural gas. Meanwhile, gas use in the power generation (down 24%), oil refining (down 5%), and petrochemical (down 39%) sectors declined over time as high gas and LNG prices pushed these price-sensitive industries to switch to alternative fuels.

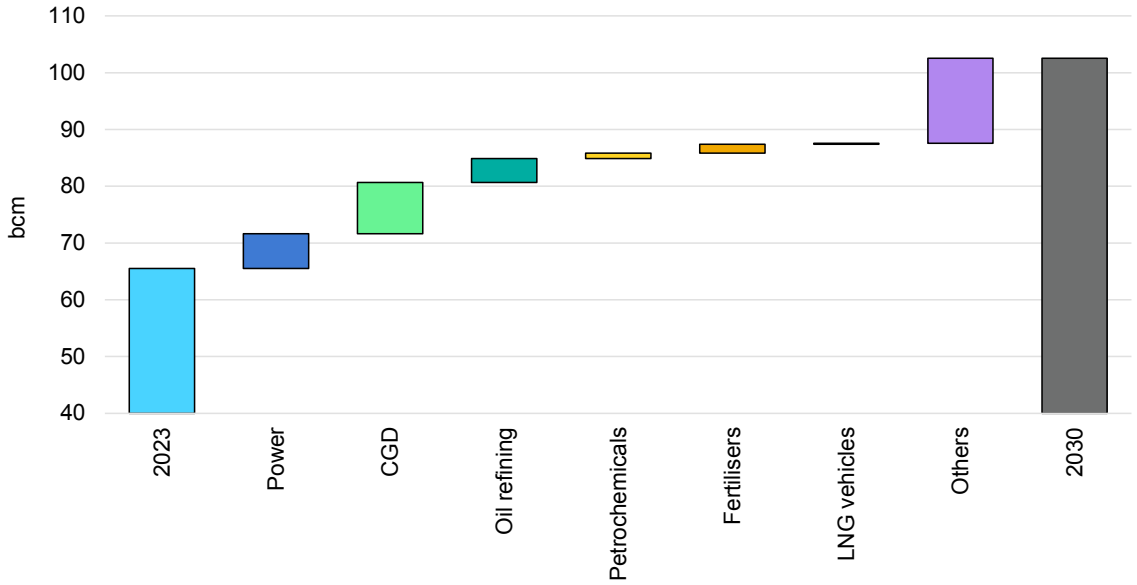
Annual natural gas consumption by sector in India, 2016-2024



Note: Data reported on a calendar year basis.
Source: IEA analysis based on PPAC data.

Between 2023 and 2030, gas consumption is projected to grow by nearly 60% (37 bcm/yr), reaching 103 bcm/yr by the end of the forecast period. The CGD sector is expected to lead this growth, supported by the rapid expansion of CNG infrastructure and the cost advantage of gas over liquid fuels for small industrial users, creating a strong foundation for further gas penetration. Heavy industrial and manufacturing sectors grouped under the “other” category, such as iron and steel, are also driving demand, collectively adding around 15 bcm/yr during this period thanks to improved pipeline connectivity and robust industrial growth. Gas use in oil refining is expected to increase by more than 4 bcm/yr (+84%) as more refineries are connected to the grid and refinery runs increase at existing plants that are already running on gas. Growth prospects in the petrochemical and fertiliser sectors remain more limited, as no new gas-based capacity additions are foreseen within the 2030 forecast horizon. The power generation sector is projected to grow at a healthy 8% annual average rate between 2023 and 2030, driven by a recovery in large gas-fired power plants following the 2022 slump and rapid expansion of gas use in captive power plants.

Natural gas demand outlook in India, 2023-2030

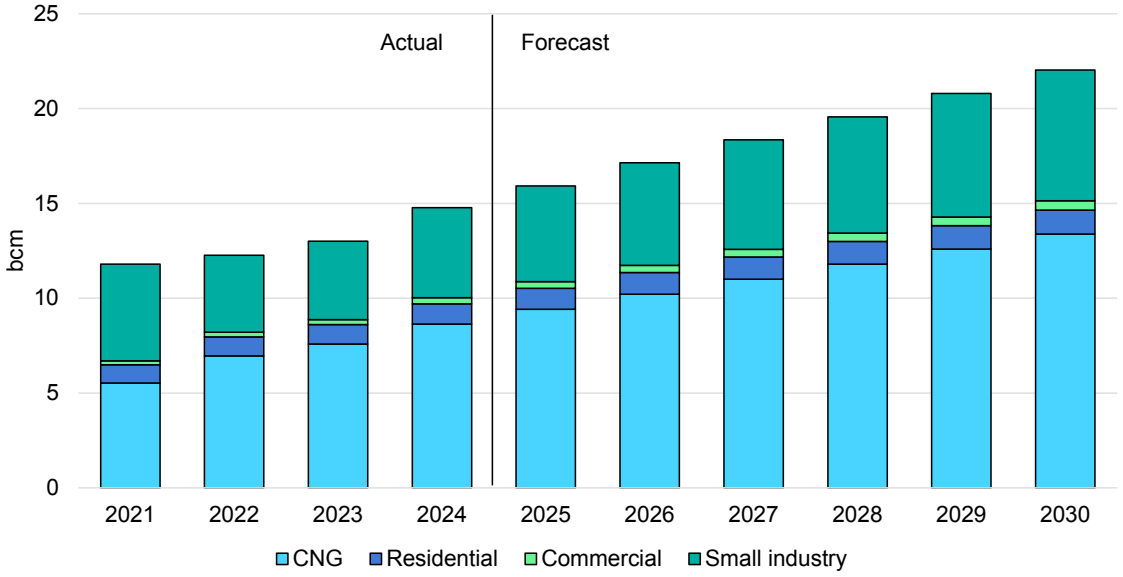


City gas distribution

India's city gas sector includes four traditional end-use segments – residential, commercial, small industries, and CNG for vehicles – and a nascent new one, LNG for heavy-duty transport. As of 2023, CNG was the dominant segment, accounting for nearly 60% of CGD consumption. Residential and commercial users together accounted for only about 10% of CGD demand, while small industries connected to the low-pressure distribution grid contributed a little over 30% to CGD gas use.

Between 2023 and 2030, city gas demand is expected to increase by close to 70% (9 bcm/yr), achieving a CAGR of almost 8%. Most of the growth will come from the CNG sector (5.8 bcm/yr) and small industries (2.8 bcm/yr), with residential and commercial users adding approximately 0.5 bcm/yr through 2030.

Natural gas demand in the city gas distribution sector in India, 2021-2030



Note: Data reported on a calendar year basis.
Source: IEA analysis based on PPAC data.

The strong overall growth in the CGD sector is driven by the ongoing rollout of CNG filling stations and distribution grids, and supportive government policies towards the CGD sector and LNG use in transport.

The winners of the PNGRB's last four bid rounds have collectively committed to increase the number connections to CGD networks by more than ten-fold (to reach 120 million) and the number of CNG stations by threefold (to 17 500) between 2023 and 2030. While these targets are challenging, even a partial delivery would drive rapid gas demand growth in the city gas sector.

The government has implemented several measures to promote the use of CNG and PNG across the country. These include reallocating the cheapest (APM-priced) domestic gas from power and other non-priority sectors to CNG and residential city gas users and ensuring preferential treatment for CNG and residential PNG consumers in the distribution of high pressure / high temperature (HP/HT) gas, which is subject to a price ceiling.

Compressed natural gas

India has become one of the world's largest markets for CNG in the transport sector, with around 7.7 million CNG-fuelled vehicles on the road in 2024. These vehicles are primarily three-wheelers, passenger cars and buses, many of which serve shared mobility purposes, such as taxis or public transport.

The rapid expansion of CNG infrastructure has been a key driver of this growth. Significant investments by both the government and private sector have focused on

increasing accessibility and convenience for consumers by establishing new refuelling stations, expanding existing networks and building a robust pipeline infrastructure for efficient distribution. Since 2019, the number of CNG stations in India has quadrupled, with over 7 000 operational stations as of mid-2024. These stations are predominantly located in the western and northern regions, with Gujarat and Maharashtra leading, followed by Uttar Pradesh, Delhi and Haryana. However, the distribution remains uneven, with these five states accounting for 56% of all CNG stations nationwide.

Retail prices for CNG were 30-60% lower than gasoline prices between 2020 and 2023, partly due to the priority allocation of cheap APM-priced gas to the CNG sector. In October 2024, due to a reduction in supplies of low-priced natural gas from domestic fields like Mumbai High and Bassein, the Indian government reduced the allocation of APM gas to the CGD segment by 20%, narrowing – though not eliminating – the price advantage of CNG over competing fuels. To address these temporary issues, the MoPNG ordered on 31 December 2024 to reallocate 0.5 bcm of gas per year from LPG to city gas retailers, in order to ensure a reliable supply for CNG and to stabilise prices.

By 2023, natural gas consumption in the CNG segment reached 7.6 bcm/yr, a nearly 40% increase from 2021. Between 2023 and 2030, CNG consumption is expected to grow by more than 75%, surpassing 13 bcm/yr by the end of the decade. This growth is driven by the continued expansion of the CNG filling station network, the sustained cost advantage of CNG at the pump and ongoing concerns about urban air pollution, to which the transport sector remains a major contributor in India's cities.

Residential demand

Gas use in the residential sector is limited to cooking and water heating in India. Expanding access to clean cooking has been a longstanding government priority, as traditional biomass use poses a serious public health challenge. Access to clean fuels like natural gas or LPG is especially limited in rural areas, home to two-thirds of India's households. In urban areas, LPG dominates as the main cooking fuel, followed by electricity and PNG.

PNG offers several advantages over LPG, including convenience (no need for cylinder booking, storage or handling), higher energy content per unit, and improved safety. However, its cost depends on various factors, such as procurement costs, state taxes, tariffs, subsidies, connection fees and distribution expenses.

Between 2019 and 2023, the number of residential PNG connections more than doubled to over 11 million, representing annual consumption of about 1 bcm. Residential gas use is heavily concentrated in five states – Gujarat, Maharashtra, Delhi, Haryana and Uttar Pradesh – which account for over 80% of all PNG connections.

If city gas companies fully implement their MWP commitments from recent bid rounds, India could achieve 120 million residential PNG connections by 2030. However, progress has lagged significantly behind targets. Consequently, this outlook anticipates only around 22 million residential connections by 2030, with total residential gas consumption reaching approximately 1.3 bcm/yr.

Commercial demand

PNG has emerged as the preferred fuel source for various commercial establishments and public services, including restaurants, hotels, hospitals, dairies, bakeries, offices, shopping malls and educational institutions, where gas can offer significant cost and convenience benefits relative to oil and coal, respectively. Gas use in this segment encompasses cooking, water heating, air conditioning, space heating, steam production and power generation.

At the end of 2023, India had about 40 000 commercial PNG connections delivering 0.3 bcm to end users annually. The number of connections is expected to reach 65 000 by 2030, pushing gas consumption to 0.5 bcm/yr by the end of the decade (at a CAGR of 9%).

Small industries

Industries consuming less than 50 000 cubic meters of gas per day can access natural gas through the CGD network. Pipeline gas is widely used in industrial applications such as chemicals production, food processing, textile mills, ceramics and glass manufacturing. It powers equipment including boilers, furnaces, ovens, kilns and industrial kitchens.

Natural gas offers several advantages for industrial use, including a reliable supply that ensures uninterrupted operations and environmental benefits. Natural gas emits 20-30% less CO_2 than liquid fuels and, unlike coal, it produces minimal particulate matter and SO_x emissions. These attributes are particularly significant in India, where the Central Pollution Control Board classifies nearly 70 industrial areas as critically or severely polluted. Further extension of the CGD network could pave the way for additional pollution control efforts and facilitate fuel switching to natural gas.

By 2023, small industrial users with CGD connections numbered around 18 000, collectively consuming slightly over 4 bcm of gas annually. This segment is expected to grow at an average rate of 8% per year, reaching nearly 7 bcm/yr by 2030. However, small industrial users are highly price-sensitive, with many retaining the flexibility to switch to alternative fuels if gas becomes economically less viable.

For instance, between 2021 and 2024, the number of CGD connections for industrial users increased by 50%, but actual gas consumption declined by about

7% during the same period. This decline was particularly pronounced in 2022, at the peak of the global energy crisis, when gas use in the small industrial segment dropped by 20% due to high prices.

LNG for transport

India relies heavily on diesel-powered road transport, with trucks transporting nearly 70% of goods and contributing 35-40% of total road transport emissions. Rising economic activity and the expansion of the highway network are expected to drive a sharp increase in freight transport demand in the coming years.

Recognising LNG's potential as a cleaner alternative to diesel for long-haul trucks, the Government of India amended the Central Motor Vehicles Rules in 2017 to include LNG as a transport fuel. Further amendments in 2018 introduced codes to support the establishment of LNG fuelling infrastructure. A key clarification by the PNGRB in 2020 confirmed that entities could set up LNG stations in any geographical area, removing LNG from the exclusive rights of CGD companies and opening up the segment to third-party participation. These measures aimed to resolve ambiguities and catalyse the nationwide development of LNG dispensing stations.

To support the transition, the government launched initiatives to expand LNG infrastructure. In November 2020, the foundation was laid for 50 LNG fuelling stations along national highways and the Golden Quadrilateral connecting Delhi, Mumbai, Chennai and Kolkata. Public sector entities including IOCL, BPCL, HPCL, GAIL, Petronet LNG and Gujarat Gas were mandated by the government to develop this initial phase. Plans are underway to establish LNG stations every 200-300 km along the Golden Quadrilateral and invest INR 100 billion (USD 1.2 billion) to develop 1 000 LNG stations through public and private sector collaboration.

A draft policy document by the MoPNG proposed converting up to a third of India’s 7 million heavy-duty vehicles to LNG within five to seven years. It also suggested allocating 0.18 bcm/yr of APM gas for LNG trucks over an initial three-year period to support the development of a 50 000-strong LNG truck fleet.

However, these goals – beyond the 50 initial pilot LNG stations – remain highly ambitious and converting diesel trucks to LNG purely on economic grounds is currently unattractive for fleet operators. In 2023, India had only 645 operational LNG trucks, consuming a negligible 0.03 bcm of LNG annually. Without additional fiscal support and infrastructure investment, this outlook expects India’s LNG truck fleet to reach only 5 000 vehicles by 2030, in line with NITI Aayog’s estimates of the number of trucks that the first 50 LNG stations can support. This would result in annual gas consumption of slightly over 0.2 bcm for LNG trucking by the end of the forecast period.

Fertilisers

Fertiliser production is India's largest gas-consuming sector, accounting for nearly a third (21 bcm) of the country's total gas demand in 2023. Natural gas is used as a feedstock for ammonia-based urea production, which is viewed by the government as vital for the country's agricultural sector and food security.

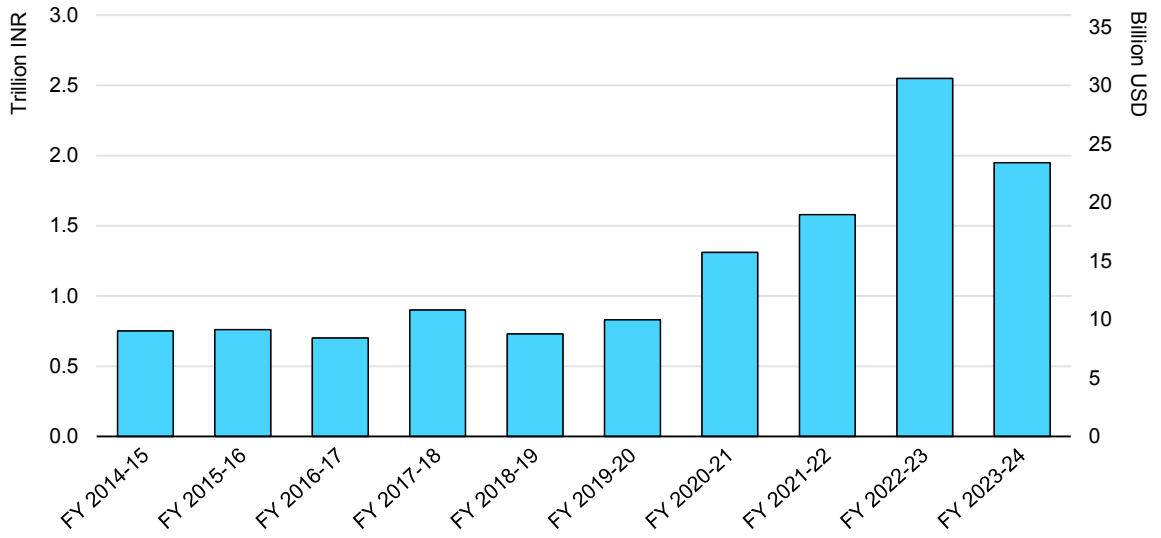
Domestic gas allocations to the fertiliser sector have steadily declined, falling to approximately 3 bcm/yr by 2023. As a result, reliance on imported LNG has surged, covering 85% of the sector's gas needs in 2023, up from less than 50% in 2016.

Urea is sold to farmers at a highly subsidised price of INR 242 (USD 2.9) per 45-kg bag. To cover the gap between market prices and this discounted rate, the government provides significant subsidies to urea producers and importers. This presents a substantial fiscal burden for the budget. In FY 2022-23, urea subsidies peaked at INR 2.5 trillion (USD 31 billion) due to surging global energy and fertiliser prices. However, as long as India's fertiliser subsidy scheme is in place, gas demand in the fertiliser sector remains insensitive to price fluctuations, despite the sector's increasingly heavy reliance on imported LNG.

Between 2018 and 2023, gas consumption in the fertiliser sector grew by 40%, reaching nearly 21 bcm in 2023, at an average annual increase of 7%. This expansion was driven by the conversion of India's last naphtha-based fertiliser plants (operated by Madras Fertilizers, SPIC, and Mangalore Chemicals & Fertilizers) to natural gas, the restart of four previously idled plants (Ramagundam, Gorakhpur, Sindri, Barauni) using natural gas feedstock and the commissioning of a major greenfield project (Matix Fertilisers).

Between 2023 and 2030, gas demand in India's fertiliser sector is projected to grow at a modest CAGR of around 1%, driven by increased activity at existing plants. No new greenfield fertiliser projects using natural gas are expected within the 2030 forecast horizon. A recently announced gas-based urea plant in Namrup (Assam) was included in the 2025 Union Budget but had no clear timeline at the time of writing and is likely to contribute to fertiliser sector gas demand only after 2030. Meanwhile, the upcoming Talcher plant in Odisha state will rely on coal gasification technology and use coal as its feedstock.

Fertiliser subsidies in India, FY 2014-15 – FY 2023-24



Note: The right-hand axis has been included to make converting currencies easier. It is based on the average exchange rate seen in 2024 (1 Indian Rupee = 0.012 US Dollar).
Source: IEA analysis based on data from India Budget.

Power generation

At the end of 2023, India had 24 GW of installed gas-fired power plant capacity, but these plants generated only 29 TWh of electricity, reflecting a low average load factor of 14%. Average annual utilisation rates for the fleet fluctuated between 12% and 25% from 2019 to 2024, largely influenced by imported LNG price trends. But even during record-low gas prices in 2020, average load factors (at 25%) remained very low by international standards.

The underutilised gas-fired capacity in India is due to two main factors. First, as of the end of 2023, nearly half (11.3 GW) of the installed capacity remained idle due to limited gas availability. Many of these stranded plants were built in the mid-2000s in anticipation of a significant gas production boom from the Krishna-Godavari basin, which proved short-lived, and priority access to low-cost domestic gas, which was reallocated to the city gas distribution sector in 2013.

Second, gas-fired power plants face competitiveness challenges. Without priority access to low-cost APM gas, direct subsidies or a robust carbon pricing mechanism, these plants struggle against coal-fired generators, which benefit from lower fuel costs and more favourable taxation. As a result, most non-stranded gas-fired plants operate as marginal units with relatively low utilisation rates.

In 2023, the power generation sector consumed 8.8 bcm of natural gas. Of this, 6.8 bcm was used by main-activity power producers and 2 bcm by captive

generators. By 2030, natural gas consumption in the sector is projected to reach 15 bcm, a nearly 70% increase.

About one-third of this projected growth will come from main-activity power plants, where load factors are expected to recover to an average of 18%, similar to 2019-2023 levels. This recovery is supported by expected declining LNG prices towards the end of the decade and the introduction of a high-price day-ahead electricity market in 2023. This new market allows gas-fired power plants using imported LNG to sell electricity at up to INR 50/kWh (or USD 0.6/kWh) on the Indian Energy Exchange, significantly above the INR 10/kWh (or USD 0.12/kWh) cap for other generators, enabling greater participation of stranded gas plants to meet peak demand. Flexible gas-fired generators could receive further support from the government's draft National Electricity Policy (NEP), which aims to increase the share of India's power consumption traded on the spot market to 25% by 2030 (from less than 8% today), and the recently introduced Late Payment Surcharge Rules, which require thermal generators to sell surplus power on the spot market.

The remaining growth is expected to come from captive generators, driven by rising overall electricity demand, improved economics of gas relative to liquid fuels, and local restrictions on coal and other polluting fuels in industrial areas near urban centres.

Oil refining

Over the past two decades, India has established itself as a major oil refining hub and exporter of refined petroleum products to the rest of the world. Between 2006 and 2023, the country's oil refining capacity more than doubled to 5.8 MMbbl/d, making India the fourth-largest oil refiner in the world. In the 2024-2030 period, distillation capacity is projected to grow by an additional 1 MMbbl/d, with most new capacity coming online between 2025 and 2027. This expansion is primarily driven by public sector undertakings (PSUs) to meet rising domestic demand and increase petrochemical output at integrated plants.

Natural gas is widely used in refinery operations, serving as fuel for process heaters, boilers, cogeneration plants and as feedstock for hydrogen production. In 2023, India's oil refineries consumed 5.1 bcm of natural gas, a 24% increase from the previous year. However, gas consumption has fluctuated significantly in recent years, peaking at 8.4 bcm in 2020 before falling to under 4.1 bcm in 2022 due to record high spot LNG prices. A subsequent recovery saw consumption increase by about 1 bcm in both 2023 and 2024, aided by rising domestic gas production and improved gas connectivity, which boosted domestic gas allocation to the oil refining sector from 22% (1.3 bcm) in 2021 to 38% (1.9 bcm) by 2023.

Between 2023 and 2030, gas consumption in the oil refining sector is projected to grow at nearly 9% annually, reaching more than 9 bcm/yr by 2030. This increase

will be driven by higher refinery runs at existing units that already use natural gas, and the addition of several new projects and capacity expansions in coming years. Key developments include new refineries at Barmer and Nagapattinam, as well as expansion projects at the Vizag 2, Numaligarh, Panipat, Koyali and Barauni refineries – all of which will be connected to the national gas grid by the second half of the decade.

Petrochemicals

India's demand for petrochemical products is rapidly growing, fuelled by urbanisation, rising incomes and infrastructure expansion. To meet this demand, the country is boosting production capacity with major projects, including a new polyethylene unit at HPCL-Mittal Energy's Bathinda refinery, polyethylene and polypropylene plants at HPCL's Rajasthan refinery and GAIL's polypropylene facility under construction in Usar. The "Make in India" initiative supports this growth by driving investment and infrastructure development.

Natural gas consumption in the petrochemical sector reached 2.6 bcm in 2023, a 27% increase from the low point of 2.0 bcm in 2022, caused by high LNG prices and LNG supply disruptions from Gazprom Marketing and Trading, which was taken over by the German government in that year. However, consumption in 2023 remained about 25% below the 2017-2021 average of 3.5 bcm/yr, as operators have increasingly relied on ethane and NGL-based feedstocks in recent years. New petrochemical projects often use dual natural gas and naphtha crackers and prefer to use naphtha from integrated oil refining operations when it is available. Companies like Reliance Industries, Petronet and GAIL are also expanding the use of imported ethane and NGLs as feedstock for their petrochemical plants.

Incremental gas demand growth is limited to recovering activity at existing gas-connected facilities. This is projected to drive petrochemical sector gas demand to around 3.5 bcm/yr by 2030, representing a 5% annual increase from 2023.

Other sectors

About a quarter (15 bcm) of India's sector-wise natural gas consumption in 2023 came from various sectors collectively classified as "other", including iron and steel production, large manufacturing industries, agriculture, and gas used in oil and gas operations and pipeline transport. Approximately two-thirds of this other demand is estimated to come from sub-sectors classified by the International Energy Agency as industry. The remaining share is a mix of energy own use, pipeline transport, agriculture-related consumption and on-site generation not classified elsewhere.

Between 2023 and 2030, total gas consumption in these "other" sectors is projected to double, reaching over 30 bcm/yr by the end of the forecast period. About 95% of this increase is set to come from industrial activities. The remaining

growth is driven by gas use for pipeline transport, fuelled by the rapid expansion of India's gas transmission and distribution networks.

Sponge iron and steel

Natural gas-based direct reduced iron (DRI) is preferred for its lower emissions and superior quality compared to traditional coal-based steel production methods. However, limited access to affordable domestic natural gas and the high cost of LNG imports have hindered its adoption in India. As of 2023, only three natural gas-based DRI units operated in the country, accounting for less than 20% of total steel production. Sponge iron and steel production consumed 1.1 bcm of natural gas in 2023, largely relying on LNG imports.

The European Union's Carbon Border Adjustment Mechanism (CBAM), which is set to take full effect in January 2026, has prompted Indian steelmakers to advocate increased domestic gas allocations, price subsidies, and infrastructure investment to adopt cleaner production methods and reduce the steel industry's reliance on coal. Gas consumption in the sponge iron and steel segment is projected to grow at an annual average rate of 8%, reaching close to 2 bcm/yr by 2030.

Agriculture (tea plantations)

India is a major tea producer, accounting for over 20% of global tea production in 2023, with Assam and West Bengal being the leading producing states. The tea industry relies heavily on thermal energy from coal, firewood and natural gas during the withering and drying processes. In 2023, the sector consumed an estimated 0.1 bcm of natural gas.

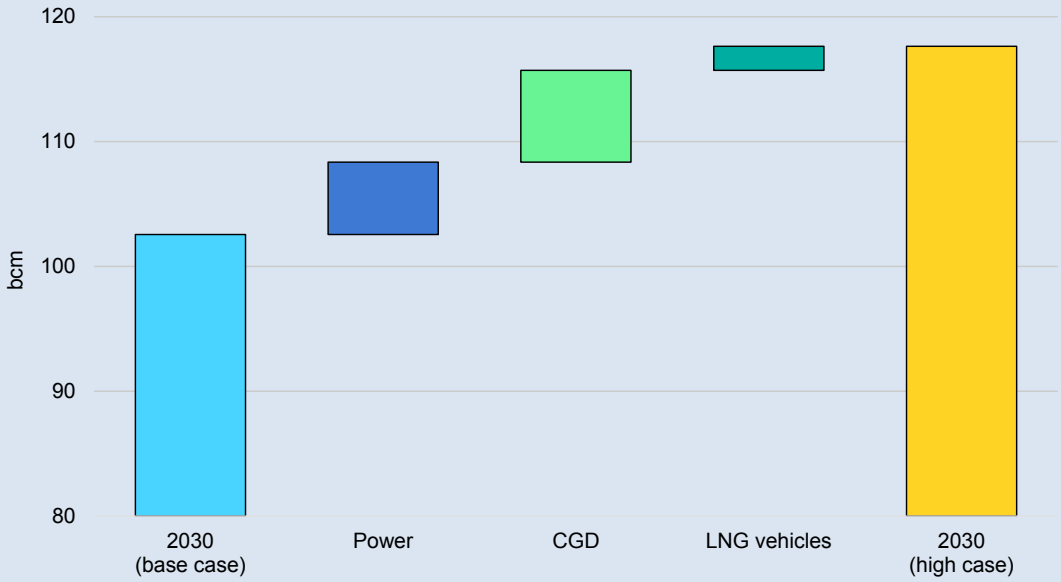
To support the energy transition, the government has introduced measures such as the Northeast Gas Subsidy. However, limited gas availability in the main tea-producing regions remains a challenge. The Northeast Gas Grid, expected to be operational by 2026, aims to improve natural gas access in India's northeastern states, enabling its broader adoption and reducing reliance on traditional fuels. Despite these developments, the tea production sector's gas consumption is expected to remain modest, reaching 0.2 bcm in 2030.

Potential levers for higher gas demand in India by 2030

Based on current policy and market trends, India's total natural gas consumption is projected to reach 103 bcm/yr by 2030, a nearly 60% increase from 2023 levels. This represents a nearly 7% annual average growth rate between 2023 and 2030, far in excess of the previous five years' CAGR of less than 2%. Nevertheless, this projected demand falls short of the Indian government's targeted consumption level of 500 mmscmd (182.5 bcm/yr) by 2030.

This analysis presents a number of areas where additional policy support – coupled with improved infrastructure and a lower LNG price environment – can unlock higher natural gas demand over the forecast horizon, boosting total consumption by 15 bcm/yr to nearly 120 bcm/yr by 2030.

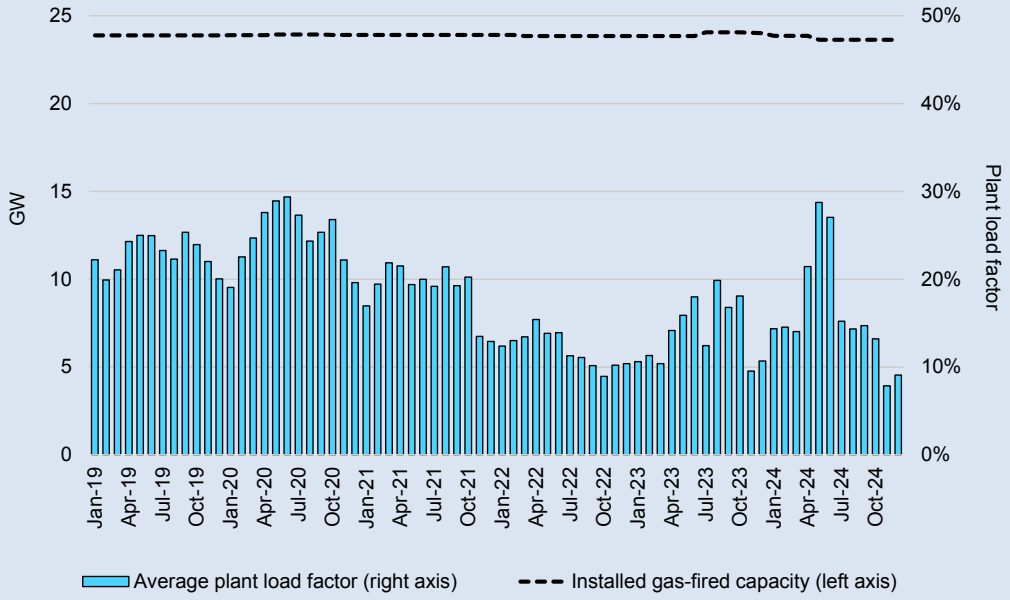
Potential levers to achieve higher gas consumption in India by 2030



Power generation

Although challenges persist for India's stranded gas-fired power plants, the fleet has demonstrated its ability to operate at load factors near 30% under favourable market conditions or government mandates. In mid-2020, for example, the collapse of global LNG spot prices during the Covid-19 pandemic spurred a sharp rise in gas-fired generation, with load factors reaching 25-30% between March and November. Similarly, in Q2 2024, plant load factors surged 20-30% when the Ministry of Power invoked Section 11 of the Electricity Act of 2003, requiring available gas plants to operate at full capacity from May to June to meet surging power demand during a prolonged heat wave and drought.

Gas-fired generation capacity and average plant load factor in India, 2019-2024



Source: IEA analysis based on data from Central Electricity Authority.

In the past, the Indian government introduced various initiatives to support stranded gas-fired power plants. Between 2015 and 2017, the government organised reverse auctions to subsidise LNG purchases for stranded gas plants using India's Power System Development Fund. In 2019-2020, two separate schemes were proposed to revive 4 000 MW of stranded gas-fired capacity: one aimed to procure 2 000 MW of gas-fired capacity through an online auction, while the other sought to bundle 2 000 MW of gas-based power with an equivalent amount of solar capacity. However, these plans were shelved in mid-2020 as low LNG prices temporarily revived gas-fired generation without additional support.

India's gas-fired power plants could sustainably operate at average utilisation rates of 30%, but achieving this would likely require targeted support schemes, a strong carbon price signal, of some combination of both. Reaching this higher load factor could generate an incremental gas demand of approximately 5.8 bcm/yr by 2030 compared to the projected demand at an 18% load factor.

LNG in heavy-duty transport

LNG use in heavy-duty transport presents further upside potential for gas demand. A detailed 2024 study by NITI Aayog estimated that, with the right incentives, India could have 50 000 LNG-fuelled trucks on its roads by 2030, ten times as much as expected in our forecast. Potential incentives to achieve this include road toll

exemptions for LNG vehicles, public sector procurement programmes, reduced fuel taxes on LNG, domestic gas allocation for LNG vehicles and corporate fuel efficiency standards for heavy-duty vehicle (HDV) manufacturers. The accelerated adoption of LNG-fuelled HDVs could generate an additional gas demand of approximately 2 bcm/yr by 2030.

City gas distribution

The accelerated expansion of city gas distribution (CGD) infrastructure and targeted incentives could significantly boost India's natural gas demand by 2030. Under the current forecast, India is expected to add approximately 1.5 million new residential gas connections per year between 2025 and 2030, in line with the pace observed during 2020-2023. This would result in about 22 million household connections by 2030. Similarly, the number of CNG filling stations is projected to grow by the 2020-2023 average rate of 1 000 per year during third period, reaching just over 13 000 stations by 2030.

However, with stricter enforcement of minimum work programme commitments and sustained domestic gas allocation to the residential and transport sectors, this rollout could be significantly accelerated. The annual addition of new household connections could double, reaching to 31 million by 2030, while the deployment rate of new CNG stations could grow by 75%, achieving the government's target of 17 500 stations by the end of the forecast period. These developments could add an incremental 3.8 bcm/yr of natural gas demand by 2030.

In the commercial sector, where LPG is widely used despite often being costlier and less convenient than piped natural gas, the transition to gas could further drive demand. With the continued rollout of CGD infrastructure and incentives supporting fuel conversion, commercial LPG use could be entirely replaced by natural gas by 2030, adding another 3.6 bcm/yr of demand. In total, this accelerated uptake of natural gas across the residential, transport and commercial sectors could add another 7.4 bcm/yr of gas demand by 2030.

Chapter 5. Domestic gas production outlook

India's upstream sector is dominated by the state-owned ONGC, Oil India and private companies led by Reliance Industries (in partnership with BP). Total net gas production stood at 35 bcm in 2023. Domestic supplies meet around 50% of the country's gas demand.

State-owned ONGC and Oil India are the leading operators in the key Mumbai offshore, Assam, Tripura and Cambay basins. A significant portion of their production comes from nomination blocks awarded to these companies. Nomination blocks are specific areas granted to national oil companies without competitive bidding, primarily before the implementation of the New Exploration Licensing Policy (NELP). While many of these fields have been producing for decades, the companies have effectively managed decline rates. We estimate that in 2024, nomination blocks across all basins accounted for more than 60% of India's gas production.

Natural gas production through 2030

Historically, the Mumbai offshore and the Assam, Tripura and Cambay onshore basins have been major contributors to gas production in the country. Some of the fields in these basins have been producing gas since the 1960s.

In the early-2000s, Reliance discovered the Dhirubhai 1 and 3 gas fields in the KG-D6 block of the deepwater Krishna-Godavari basin. However, production from the KG-D6 fields peaked at less than 70 mcm/d during 2010 due to reservoir issues before heading into terminal decline, falling short of the planned peak of 88 mcm/d. India's total gas production peaked at around 50 bcm in 2010 but declined 40% over the following six years.

To boost domestic gas production, the government has provided several incentives since 2016, including a seven-year royalty holiday for deepwater and ultra-deepwater blocks, concessional royalty rates and fiscal incentives for the early monetisation of fields. Additionally, the government has streamlined various project approval processes to improve the ease of doing business in the gas sector.

In 2016, key changes to gas pricing for undeveloped deepwater and high pressure-high temperature fields enabled the second phase of Reliance's and BP's KG-D6 project and ONGC's KG-D5 Cluster 2 development to reach final

investment decisions (FID). These projects have progressively come online and ramped up production since 2020.

After nearly a decade of decline and stagnation, domestic gas production returned to growth in 2021. This growth is underpinned by production from the Reliance-BP deepwater fields located in the KG-D6 block off India's east coast. The three fields – R Cluster, Satellites Cluster, and MJ – are expected to produce a combined 85 bcm over their lifetime. These fields accounted for nearly 25% of India's total net production of 36 bcm in 2024. As a result, India's total gas production has increased by nearly 30% between 2020 and 2024.

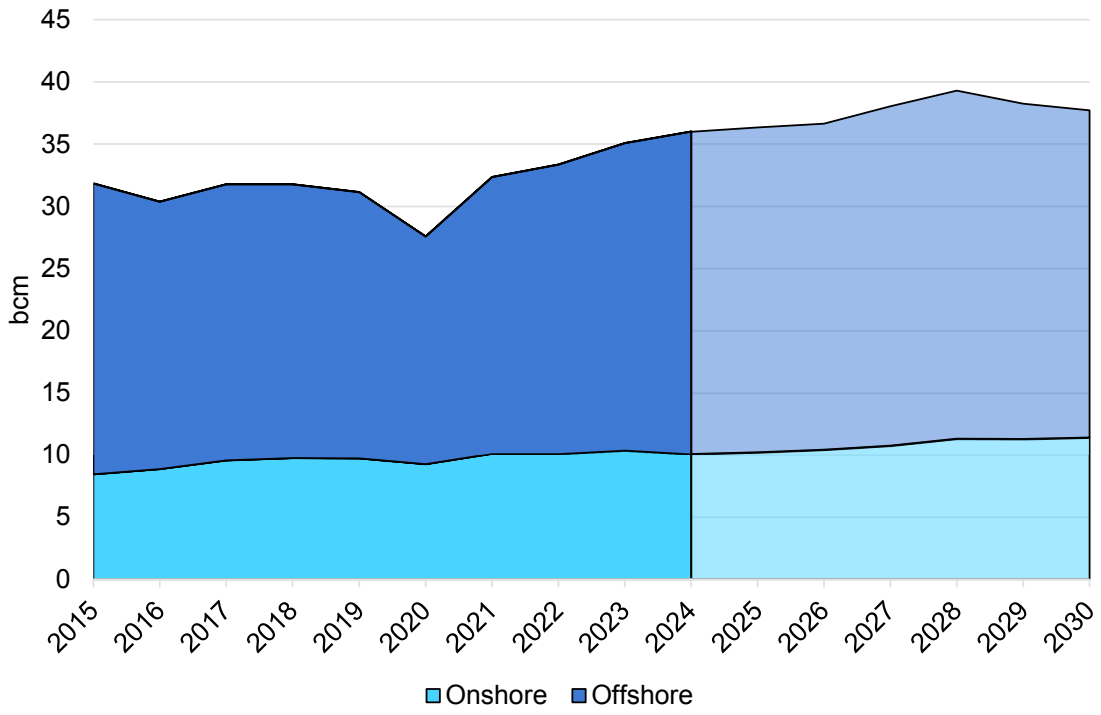
Growing output from CBM projects, which were granted full marketing and pricing freedom, has also marginally contributed to India's production recovery since 2020, although total CBM production remained under 1 bcm in 2024.

In 2024, the government introduced a 20% increase in gas prices for new wells and workovers in legacy fields supplying APM-priced gas to priority sectors. While this policy is contributing to increased investments by national oil companies operating these fields, the incremental supplies are only expected to offset base declines in coming years.

The pipeline of major gas field development projects remains limited. Between 2024 and 2030, we expect only moderate growth in domestic gas production. This growth will be driven by increasing onshore production from CBM and discovered small fields. Key CBM projects include Reliance's, Essar's, ONGC's and GEECL's developments in West Bengal, Jharkhand and Madhya Pradesh, where drilling continues for further ramp up. Additionally, several DSF projects, particularly in the Mumbai offshore basin, are anticipated to come online by early 2028.

Offshore production is set to increase thanks to additional supplies from ONGC's deepwater KG-D5 project between 2025 and 2030. However, offshore (and overall) gas supply growth will be tempered by plateauing output from the KG-D6 fields and declining production from legacy assets like ONGC's Mumbai offshore fields.

Annual natural gas production in India, 2015-2030



Note: Data reported on a calendar year basis.
Source: IEA analysis based on PPAC data.

Upside potential for domestic natural gas production

Further growth in domestic gas production is possible if demand can be unlocked in India's relatively disconnected northeastern region. In recent years, the Assam and Tripura basins have contributed nearly 47% of India's onshore production and 13% of its total gas supply. According to the Directorate General of Hydrocarbons (DGH), these basins hold a combined risked undiscovered in-place hydrocarbon resource potential of 1 874 MMtoe. India's national oil companies are well-positioned to increase supply from these basins, contingent on further economic and infrastructure-led development unlocking regional demand. However, significant supply growth in the northeast is unlikely to materialise before 2030.

Additionally, in early January 2025, ONGC selected BP as a technical service provider to increase oil and gas output from the Mumbai High fields over a 10-year period. The initiative targets a 60% increase in oil and gas production relative to the current baseline. If successful, this development could provide further upside to our production forecast in the latter part of the decade, with material contributions expected only after 2030.

Further growth in domestic production can be unlocked through additional fiscal and gas pricing reforms. Transitioning to complete pricing freedom for all fields –

as recommended by the government-appointed Kirit Parekh Committee in 2022 – would be the most potent incentive. At present, not all fields benefit from full marketing and pricing freedom. Gradually extending this to all projects would encourage incumbents to increase output and allow market dynamics to match supply and demand more effectively.

Diversifying the operator mix could also enhance India's long-term production prospects. For over a decade, exploration activity has been dominated by a handful of experienced companies, with limited participation from international explorers. This lack of diversity has contributed to the absence of large-scale oil and gas discoveries. According to the DGH, India's unrisked in-place hydrocarbons potential stands at 41 billion toe. Engaging a broader set of operators, including international exploration and production companies, could unlock a greater share of this untapped resource potential.

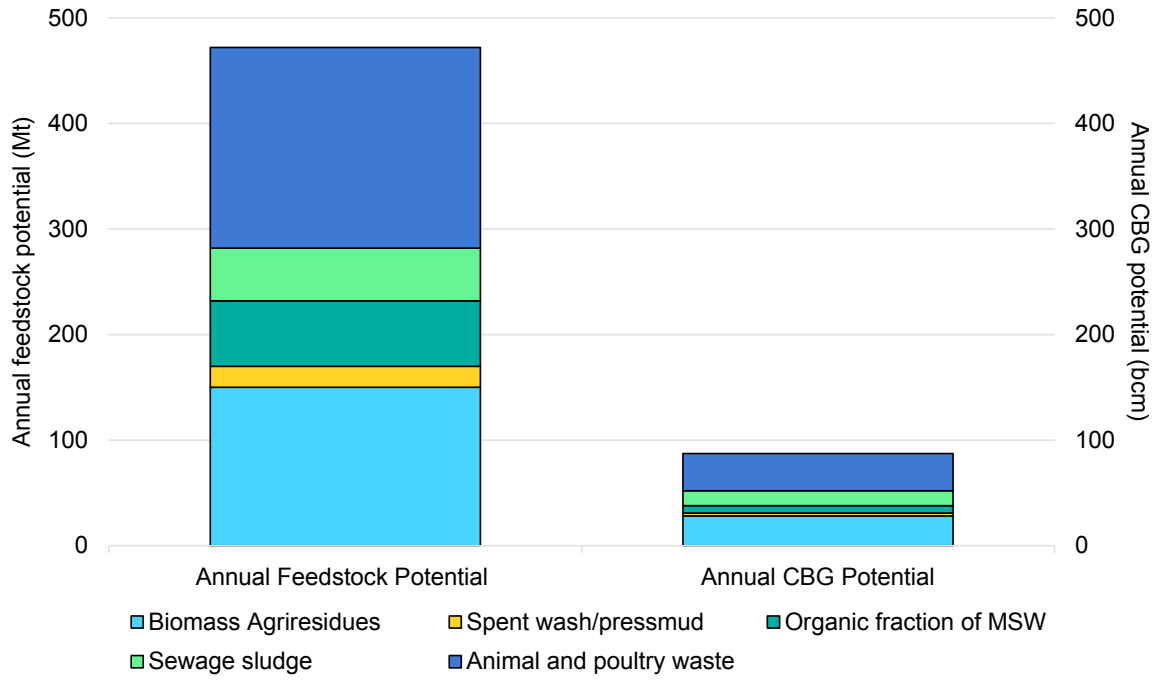
Improved fiscal terms are critical to reviving interest in India's deepwater prospects. The 2016 Hydrocarbon Exploration and Licensing Policy (HELP) was introduced to streamline approval processes, simplify fiscal terms, and reinvigorate licensing and exploration activity. Under HELP, the Open Acreage Licensing Programme (OALP) replaced traditional bid rounds with semi-annual Expressions of Interest (EOI) rounds in January and July, offering companies frequent opportunities to bid on available blocks. By mid-2024, 144 blocks covering approximately 243 000 km² had been awarded, though international companies have largely avoided participation, favouring other countries with more attractive terms.

However, India's deepwater potential is proven, with both Reliance and ONGC producing from the Krishna-Godavari basin, despite operational challenges. The KG basin alone holds an estimated risked undiscovered in-place potential of 2 796 MMtoe. Extending the attractive fiscal terms currently available for undeveloped and undiscovered acreage to new exploration prospects in deepwater blocks within already producing and under-development basins could reignite operator interest and accelerate the development of these established plays.

Compressed biogas supply outlook

Biogas production has a more than 100-year history in India, building on the country's large agricultural sector, which currently accounts for an 18% share of the country's GDP and more than 45% of overall employment. The Government of India has recently taken a renewed interest in the biogas sector and introduced policies to accelerate investments in compressed biogas (CBG) production. India's CBG potential is estimated at approximately 87 bcm/yr, while the installed capacity currently stands at less than 1% of this potential.

Estimation of annual feedstock and potential CBG production in India



Source: IEA analysis based on data from Ministry of New and Renewable Energy.

Policy initiatives to support CBG production

GOBARdhan scheme

The Galvanising Organic Bio-Agro Resources Dhan (GOBARdhan) initiative is a multi-ministerial programme aimed at converting biodegradable waste, including cattle dung, agricultural residues, and biomass, into valuable resources such as CBG and organic manure. It promotes a circular economy through a collaborative "whole of government" approach, integrating schemes like the Waste to Energy scheme by the Ministry of New and Renewable Energy and the Sustainable Alternative Towards Affordable Transportation (SATAT) initiative by the Ministry of Petroleum and Natural Gas.

Projects producing more than 10 cubic meters per day of CBG are eligible for funding under the GOBARdhan scheme. The 2023 Union Budget bolstered this initiative by announcing the establishment of 500 new "waste-to-wealth" plants with an INR 100 billion (USD 1.2 billion) investment.

SATAT initiatives

The SATAT initiative, launched in 2018, promotes CBG production from biomass waste to enhance energy security and sustainability. SATAT focuses on extracting

economic value from various biomass waste streams, including municipal solid waste, agricultural residue and sugar industry byproducts. The initiative encourages the establishment of CBG production plants by independent entrepreneurs. These plants convert biomass into CBG, which is then distributed to fuel stations in cylinders.

To ensure the viability of these plants, oil and gas companies have committed to offtake CBG at a set minimum price for the first ten years of operation. This provides a stable market and revenue stream for producers. This initiative aims to help reduce greenhouse gas emissions, lower fossil fuel dependency, and create jobs in rural areas.

CBG-CGD synchronisation scheme

Since 2021, the MoPNG has issued a series of policy guidelines for the synchronisation of CBG with CGD network requirements. GAIL has been mandated to implement this scheme, ensuring the supply of CBG mixed with domestic gas at a Uniform Base Price (UBP) to CGD entities for use in the CNG and residential PNG segments of CGD networks.[5]

CBG, compressed to 200-250 bars, can be supplied via cascades for sale at retail outlets or injected into distribution pipelines at pressures specified by the respective CGD entities. To participate in the scheme, CBG producers must sign an agreement with GAIL to sell their CBG and enter a tripartite agreement with GAIL and the local CGD entity for the supply of CBG.

GAIL's model has offtakes through both retail outlets and pipeline injection, but CBG-CGD synchronisation has been achieved in only a few cities. On-ground implementation remains limited, with companies primarily selling biogas through their own retail outlets to maximise value generation.

CBG obligations

In a significant step to promote the adoption of CBG in India, the National Biofuels Coordination Committee (NBCC) approved the phase-wise mandatory selling of CBG with CNG and PNG in the city gas distribution sector in November 2023.

Under this directive, obligations are set at 1%, 3% and 4% of total CNG and PNG consumption for the 2025-26, 2026-27 and 2027-28 fiscal years, respectively. From FY 2028-29 onwards, the target will increase to 5%.

[5] Uniform Base Price is a standardised rate across India at which GAIL supplies CBG to CGD entities. Charges for compression is paid to the producer, making it attractive to pressurise gas to up to 250 bars for injection.

This policy is designed to stimulate demand for CBG while reducing India's dependence on imported LNG. The government has underscored that non-compliance with the targets may result in penalties, potentially affecting the financial and operational performance of CGD companies.

Challenges for CBG adoption

Limited offtake

Currently, oil marketing companies procure CBG on a "best endeavour" basis, meaning they are expected to make reasonable efforts to purchase the product, but are not legally obligated to do so. This creates challenges for plant owners who face the risk of unsold inventory. The implementation of initiatives like SATAT and the CBG-CGD synchronisation scheme remains limited, with companies primarily selling biogas through their own retail outlets to maximise value. Expanding CGD networks and linking them to CBG plants can address these issues by creating a reliable market for CBG, reducing transport losses, and minimising unsold inventory costs.

To facilitate this, the Government of India has introduced the Development of Pipeline Infrastructure scheme to create links between CBG plants and CGD networks, with a financial outlay of INR 9.9 billion (USD 0.12 billion) for FY 2024-25 and FY 2025-26. This initiative aims to ensure the full offtake of CBG through cost-effective transportation and to maximise the utilisation of the CBG produced.

Stability of feedstock supply

Ensuring a stable supply of CBG in India faces several challenges, including seasonal biomass availability and inadequate logistics. Agricultural residues, abundant after the harvest period, become scarce at other times, necessitating efficient storage and reliable supply chains to maintain year-round CBG production. The widespread practice of burning agricultural residues, such as stubble, significantly contributes to air pollution in India, particularly in northern regions like Punjab and Haryana. Additionally, pressmud, a byproduct of the sugar industry, is often burned or dumped in landfills. Around 50% of municipal solid waste ends up in landfills, too, with 45-55% of it being organic matter suitable for biogas production.

These agricultural residues, along with pressmud and organic municipal solid waste, can be used as feedstock for CBG plants. However, inadequate transport and distribution infrastructure hinder the consistent availability of feedstock, necessitating investments in networks, storage and processing facilities. Furthermore, inefficient waste segregation contaminates biogas feedstock, damaging equipment and reducing production quality.

While the government's financial incentives and policy support are favourable for prospective CBG producers, long-term infrastructure development is essential for a stable CBG supply. To improve waste segregation, the government can offer tax incentives, run education campaigns, impose penalties and implement public-private partnerships with performance-based contracts.

Cost of land

The high cost of land can be a barrier to establishing biogas production units in rural areas. Access to affordable land can significantly enhance CBG production in India by reducing initial capital investment, particularly for small and medium-sized enterprises. Lower land costs can facilitate the establishment of CBG plants in rural areas rich in organic waste, such as agricultural residues and livestock manure. This not only reduces the cost of CBG production but also supports decentralised production, lowers logistical costs and promotes local energy generation.

State governments can drive the growth of the CBG sector by offering public land at affordable rates to biogas producers or providing other incentives for land acquisition, thereby attracting investment.

Policy hurdles at state level

A key obstacle to CBG development is the uneven implementation of policies at the state level. Despite significant potential, most states lack clear policies and incentives for CBG production. Currently, only Uttar Pradesh, Haryana, Bihar, and Gujarat have bioenergy policies that actively support CBG, while states like Karnataka, Madhya Pradesh, and Maharashtra focus primarily on electricity generation from biogas rather than biomethane.

To address this, more state governments could consider establishing and enforcing comprehensive policies that prioritise CBG. This includes streamlining regulatory approvals, providing financial incentives, land assistance, and developing necessary infrastructure. Collaboration between central and state authorities is crucial to accelerating the growth of the CBG sector.

Marketing challenges for the CBG byproduct

Fermented organic manure (FOM) is a byproduct of the CBG production process, that can be sold as organic fertiliser, representing a vital supplementary revenue stream for CBG producers. However, these producers have faced significant hurdles in meeting the government's quality standards for FOM, including requirements related to moisture content, carbon-to-nitrogen ratio and pH levels. Additionally, market demand for FOM from the farmers and fertiliser companies has been undermined by the widespread availability of subsidised chemical fertilisers such as urea, and limited awareness by farmers.

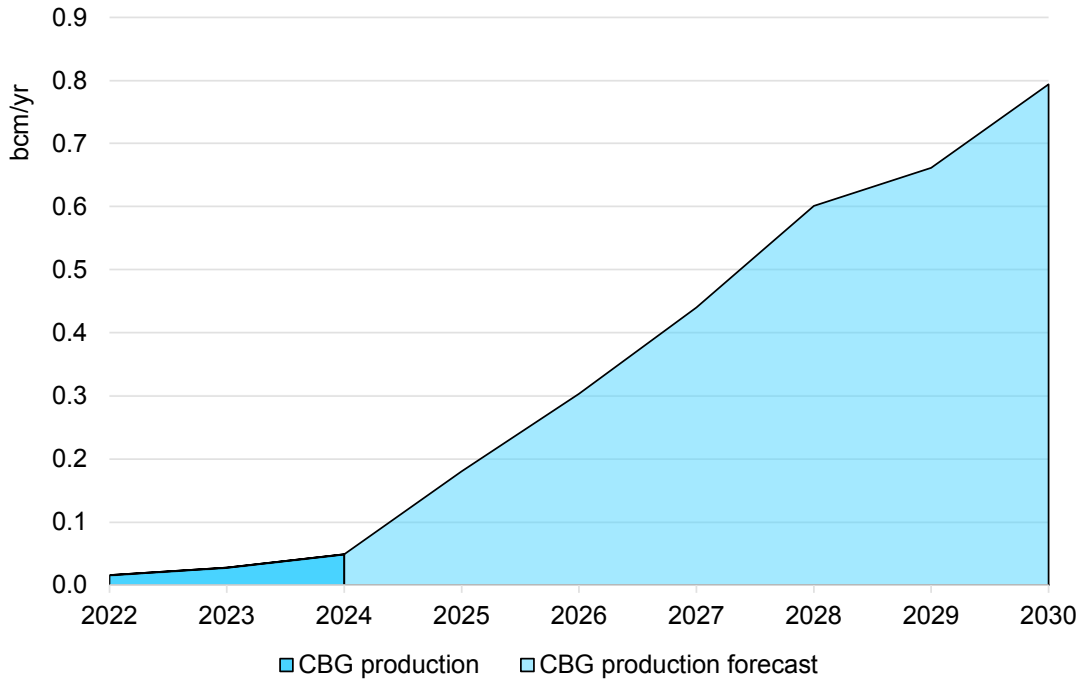
To address these challenges, the Department of Agriculture and Farmers Welfare amended the fertiliser quality criteria in 2023. These amendments relaxed requirements for moisture content, carbon-to-nitrogen ratio and acceptable pH levels, making it easier for CBM producers to market their FOM byproduct as fertiliser. Furthermore, the Market Development Assistance (MDA) scheme, introduced in 2023, provides a financial incentive of INR 1 500 (or USD 18.2) per metric ton to boost FOM sales and promote organic farming.

CBG supply outlook to 2030

As of September 2024, approximately 90 CBG plants were operational in India, with 77 of them falling under the SATAT and CBG-CGD Synchronisation schemes. An additional 508 plants are in various stages of development, with about 150 currently under construction, indicating significant growth potential in the coming years. According to the GOBARdhan portal, Maharashtra, Madhya Pradesh, Bihar, and Tamil Nadu account for around 58% of the operational CBG plants.

In 2024, CBG production reached only 0.05 bcm. Key obstacles include the commercial viability of large-scale projects, as well as challenges related to land availability, access to desired feedstocks, offtake agreements, and the sale and distribution of FOM. By 2030, CBG production is projected to reach 0.8 bcm/yr, at a capacity utilisation rate of 50%.

Annual CBG production in India, 2022-2030



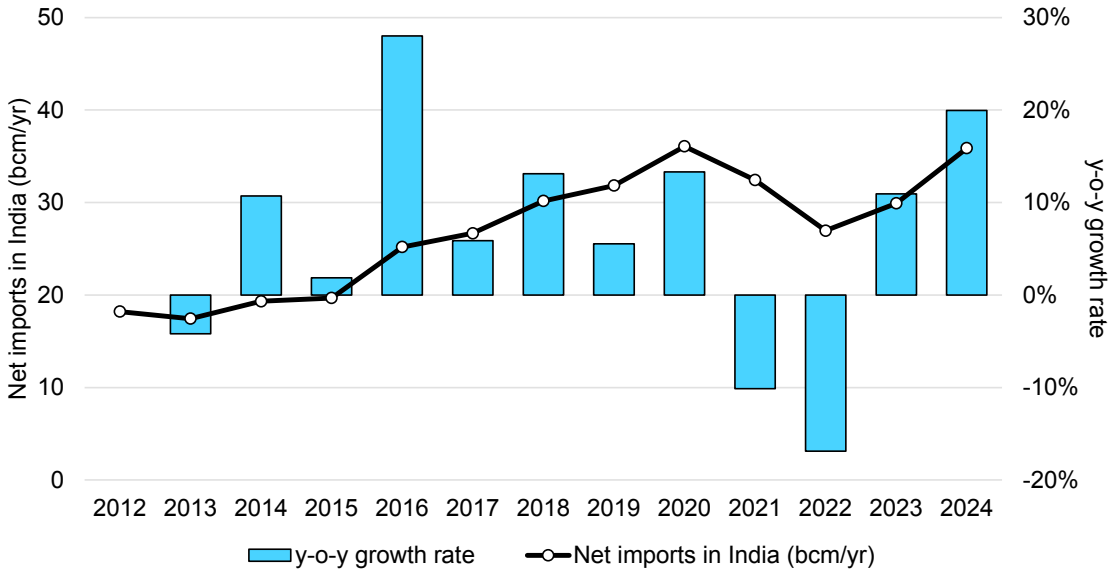
Source: IEA analysis based on PPAC data.

Chapter 6. LNG demand outlook to 2030

Recent trends in LNG imports

In 2024, India imported a record 36 bcm of LNG, maintaining its position as the fourth-largest LNG importer globally, following China, Japan and Korea. India's LNG imports have doubled since 2013, with an average annual growth rate of nearly 8%. However, this average conceals significant yearly fluctuations. The highest annual growth rate was observed in 2016, with a 28% increase, driven by historically low spot LNG prices and subsidies from the Power System Development Fund to support natural gas-fired power plants. In 2024, LNG imports grew by nearly 20% y-o-y, marking it the second-highest annual growth rate of the past decade. Conversely, 2022 saw an unprecedented 17% decline during the global energy crisis, as record high energy prices squeezed demand.

Net LNG imports and y-o-y growth rate in India, 2012-2024



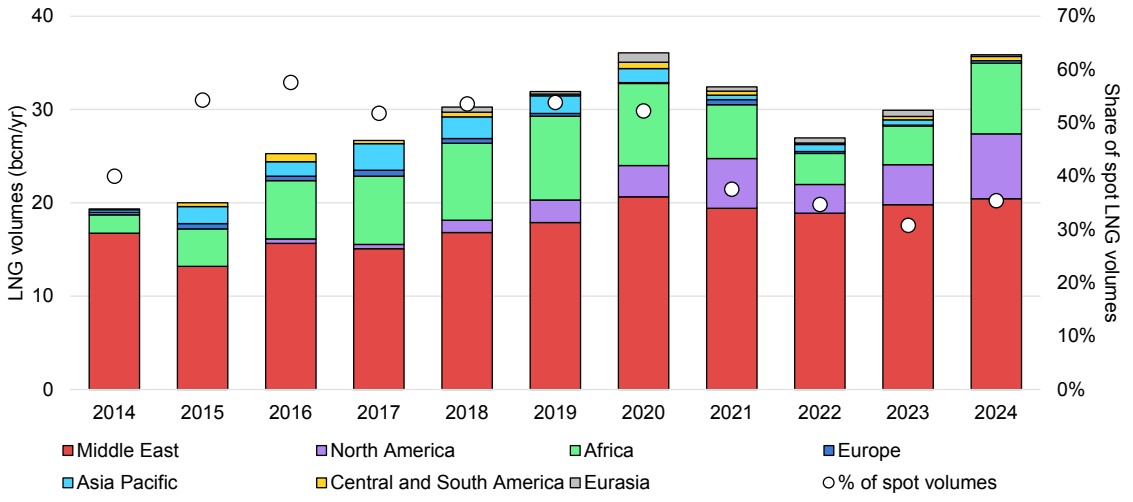
Source: IEA analysis based on data from ICIS LNG Edge.

The proportion of spot purchases in the Indian LNG supply fluctuates over time, influenced by various factors, with price being the primary driver. While spot market transactions provide greater flexibility compared to long-term contracts, they are also more susceptible to volatility. Since 2022, under a higher price

environment, spot LNG imports in India have accounted for approximately 35% of total LNG imports, a decrease from over 50% in the preceding five years. In 2024, Indian companies secured over 13 bcm/yr in new long-term LNG contracts. This continued commitment to long-term agreements is crucial for enhancing the security of supply, as it ensures a stable and predictable flow of natural gas, mitigating the risks associated with volatile spot market prices and potential supply disruptions.

India's LNG imports are sourced from a wide range of countries, and the diversity of these sources has increased over time. In 2014, Qatar was by far the largest supplier, accounting for 82% (16 bcm) of total LNG imports, followed by Nigeria with 9% (1.8 bcm) and Yemen with 3% (0.6 bcm). By 2024, Qatar remained the largest supplier, but its share had decreased to 42% (15 bcm), followed by the United States at 19% (7 bcm) and the United Arab Emirates at 11% (4 bcm). Diversifying supply sources has enabled India to mitigate risks associated with supply disruptions and price volatility, while also creating more opportunities for optimisation.

LNG imports by source and share of spot LNG supply in India, 2014-2024



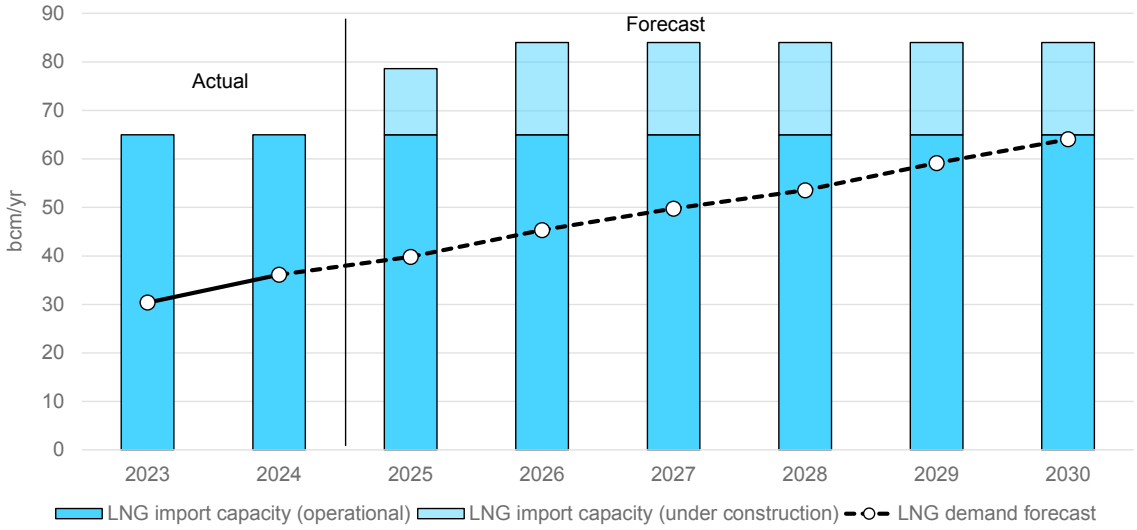
Source: IEA analysis based on data from ICIS LNG Edge.

Outlook for LNG demand through 2030

Looking ahead, India's LNG demand is projected to grow steadily, reaching 64 bcm/yr by 2030. This represents an annual growth rate of approximately 11% for the 2023-2030 period. As India's domestic natural gas production is projected to see only marginal growth until 2030, the increasing reliance on LNG imports will be crucial to bridging the gap and ensuring that the country meets its future gas demand.

This growth will be supported by both existing and future long-term contracts and increased spot market purchases. The balance between contractual commitments and spot requirements will be critical in ensuring supply security and cost-effectiveness. The rapid increase in LNG requirements necessitates additional LNG import capacity in the second half of the decade.

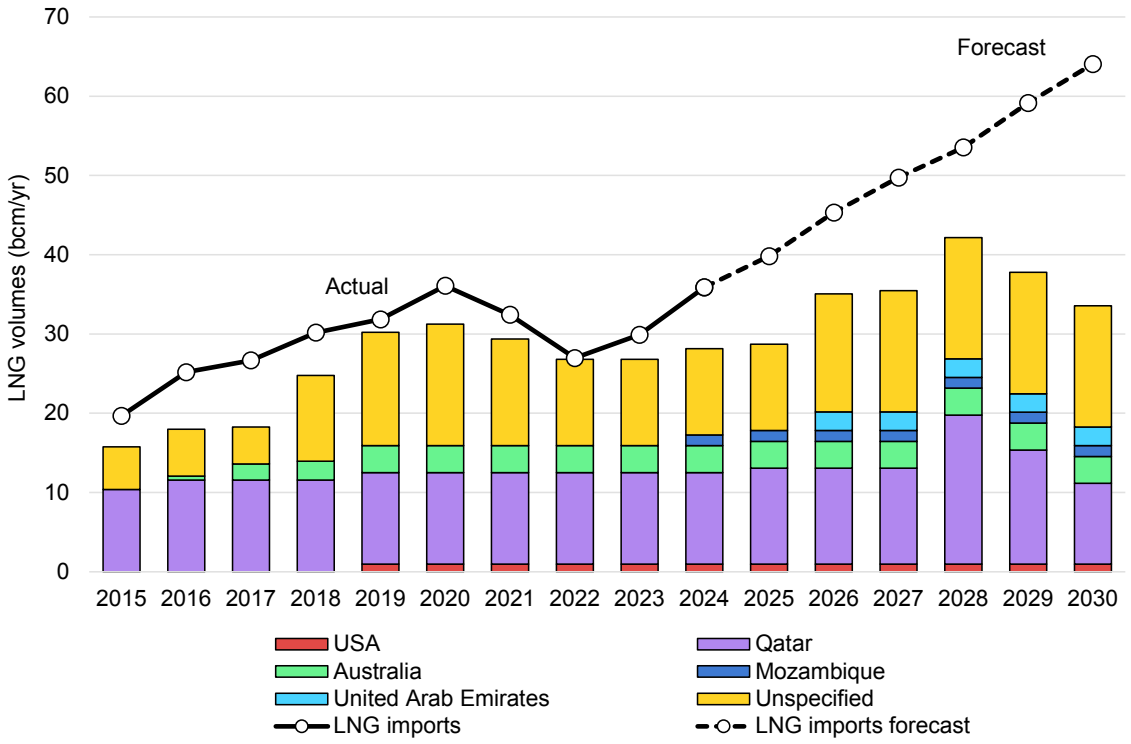
LNG demand forecast and import capacity in India, 2023-2030



Source: IEA analysis based on data from ICIS LNG Edge.

The gap between contracted LNG supply and projected LNG requirements is set to widen significantly after 2028, leaving India increasingly exposed to the volatility of the spot LNG market unless additional LNG contracts are secured in the coming years.

Total LNG imports and volumes under long-term contracts by source and by calendar year in India, 2015-2030



Note: This chart reflects LNG volumes from contracts active as of December 2024, excluding potential future contracts. The graph includes volumes from Mozambique LNG, which are not being delivered due to the project's suspension under a force majeure notice, awaiting further developments.

Source: IEA analysis based on market announcements as of December 2024 and data from ICIS LNG Edge.

Chapter 7. Policy options to increase the role of gas in India's energy mix

Natural gas has the potential to meet rapidly rising energy demand, reduce local air pollution and mitigate GHG emissions in India's coal-dominated energy system. The Government of India has set ambitious goals to increase the share of gas in the energy mix and develop a gas-based economy. However, natural gas has historically faced challenges in India's energy system due to its cost disadvantage relative to coal and renewables, periods of high LNG prices, underperformance in upstream production, and insufficient downstream infrastructure.

In recent years, the Indian government has taken significant steps to overcome these obstacles, creating conditions for an accelerated uptake of gas in the energy mix. Targeted policy efforts in seven key areas could help further address these challenges and bolster the role of gas in India's energy economy by 2030.

1. Increasing domestic supply

Historically, few major economies have successfully developed gas-based economies and well-functioning, competitive gas markets without access to abundant gas supplies supported by significant domestic production. India, where approximately half of total gas supply is sourced from domestic fields, is no exception.

However, India faces the challenge of balancing the maximisation of production – primarily from high-cost deepwater areas – with the need to keep gas affordable for its price-sensitive end users. The resulting multi-tier pricing system, with much of the production still subject to price caps, has inevitably constrained production growth. However, the anticipated easing of global gas market conditions in the latter half of the decade provides an opportunity for the government to implement full gas pricing freedom within the forecast horizon.

Transition to gas pricing freedom for all fields

Gradually extending gas pricing freedom to all fields, as recommended by the Kirit Parekh Committee in 2022, could stimulate greater investment in the upstream sector and improve the long-term availability of gas for India's consumers. A phased approach is advisable to protect consumers from price volatility during the

transition. Initial measures could include lifting the price ceiling on deepwater and ultra-deepwater HP/HT projects and allowing upstream producers to sell a larger portion of their domestic production freely on the Indian Gas Exchange (IGX) than is currently permitted.

2. Developing domestic infrastructure and improving infrastructure access

The simultaneous buildout of gas transmission, distribution and LNG import infrastructure in recent years has been a key enabler of rapid gas consumption growth in 2023 and 2024, and continuing infrastructure development is a key prerequisite for further natural gas growth in the years ahead. However, utilisation rates in key parts of the gas supply chain remain low and the rollout of specific projects has suffered significant delays. To address these challenges, the government could further strengthen planning and approval processes and increase non-discriminatory third-party access to infrastructure.

Stricter enforcement of minimum work programmes

The buildout of India's CGD network has lagged significantly behind MWP commitments in recent years, leaving the number of PNG connections far below the targeted numbers. While addressing other structural factors that prevent a more rapid buildout remains essential, stricter enforcement of these commitments – and the possibility of revoking exclusivity rights if an operator fails to meet its commitments – could accelerate the ramp-up of city gas infrastructure. However, such stringency should be coupled with additional incentives and regulatory support in order not to discourage investment in CGD networks.

Prioritise last-mile connectivity in downstream infrastructure

With CGD licenses granted nationwide, some operators have faced challenges related to last-mile connectivity, including high network expansion costs, difficulties in securing investment, and a slow pace of pipeline development. Addressing these issues and extending the transmission grid to reach all authorised geographical areas is a precondition to the successful buildout of distribution networks, especially in rural and remote areas.

Improve the planning process for gas infrastructure

India could enhance the transparency and efficiency of planning for its domestic gas transmission grid by developing a national gas grid masterplan and implementing a rolling planning process, similar to the EU's ten-year network development plans, which are updated every two years. Such initiatives would enable market participants to better understand the timelines for planned transmission projects, facilitating more informed and coordinated decision-making and strategic planning.

Ensure effective, non-discriminatory third-party access to infrastructure

Implementing a transparent access regime has the potential to ensure that all market participants can utilise the infrastructure on equal terms, promoting competition and efficiency in the gas market to the benefit of consumers. Extending non-discriminatory third-party access to more of the country's LNG import facilities – coupled with transparent reporting requirements on available capacities, tariff structures, and other charges – could improve terminal utilisation rates and ensure adequate supply at a time when India is expected to require growing volumes of LNG imports to meet rising demand. Further facilitating regulated third-party access to transmission infrastructure could also increase competition and improve the utilisation of the domestic gas transmission grid. Opening CGD networks to non-discriminatory third-party access after the end of the marketing exclusivity period would bring similar benefits to the distribution grid.

Assess and evaluate further transmission infrastructure tariff reforms

Adopting a single entry-exit tariff model could simplify the tariff structure by decoupling tariffs from physical delivery points, thereby creating a unified national market with a virtual hub.[6] This model could potentially enhance market liquidity and efficiency. However, given India's vast area and the potential for pipeline congestion, multiple entry-exit zones might better align with the country's physical and logistical realities. A careful analysis of the benefits and drawbacks of each model, including through an open stakeholder consultation process, is essential to determine the most suitable approach.

3. Increasing gas market competition

International experience shows that the unbundling of supply and transmission activities and establishing independent gas transmission system operators (TSOs) are key prerequisites to a well-functioning gas market.

Unbundling of transport and marketing operations

Acknowledging India's unique challenges and the different market in which deregulation and unbundling took place in mature natural gas markets across Europe and North America, it is appropriate to plan for the unbundling of India's main transmission pipeline operators on an extended timescale. In the longer term, however, the legal separation of transport on the one hand and marketing and sales operations on the other hand could enhance market competition, increase flexibility, and improve infrastructure utilisation, ultimately supporting a

[6] An entry-exit tariff model is a gas network access system that allows network users to book capacity rights independently at entry and exit points, rather than along specific contractual paths. This model creates gas transport through zones, providing more flexibility and non-discriminatory access to the network. The independence of entry and exit capacities is often supported by a virtual balancing or trading point, where network users can buy or sell gas.

greater role for gas in India's energy mix. Interim steps towards eventual unbundling could include the standardisation of gas sales agreements (GSAs) and gas transmission agreements (GTAs), which are currently not harmonised across India's main pipeline operators, and the strict enforcement of a code of conduct for the main operators to ensure an arms-length approach to capacity allocation, particularly to affiliated companies.

Create independent gas transmission system operator(s)

A related requirement for any competitive, well-functioning gas market is the creation of one or more independent transmission system operators, which can ensure that infrastructure access is provided fairly, transparently and in a non-discriminatory manner.

Increase transparency on available capacities and pipeline tariffs

To enhance transparency in India's gas sector, electronic bulletin boards could be established to provide real-time, publicly accessible information on pipeline operations. These boards could display details such as pipeline capacity data, tariffs and daily capacity availability, ensuring equitable access for all stakeholders. Such real-time information on contract and common carrier capacity data could facilitate capacity trading, improve market efficiency and increase competition over time.

Continue promoting a transparent and efficient gas trading platform

The establishment of the Indian Gas Exchange (IGX) marks a significant step for India's gas market, fostering competition, transparency and efficient price discovery. The trading platform benefits both consumers and producers by ensuring fair and competitive gas prices and hedging opportunities. Efforts should be continued to attract more participants and to increase volumes, including the trading of additional domestic gas, CBG and green certificates.

4. Levelling the playing field for gas across the economy

Owing more to the historical evolution of the energy sector than to intentional design, natural gas faces disparities and unequal treatment in a number of end-use segments vis-à-vis competing fuels in India. Addressing these disparities could support greater adoption of gas at the expense of other more polluting fossil fuels.

Harmonise the taxation system for competing fuels

A collaborative approach to establishing a unified tax regime for all competing fuels can help create a level playing field. The inclusion of natural gas under India's goods and services tax (GST) would eliminate its unequal – and often

unfavourable – tax treatment compared to coal and LPG. However, this reform would lead to a loss of VAT revenues currently collected by state governments on natural gas.

Adjusting the tax structure to support the use of gas as a transport fuel, similar to the favourable tax treatment for electric vehicles, could encourage its adoption and reduce emissions compared to diesel and gasoline vehicles.

Revising import duties on natural gas to align with those applied to crude oil and rationalising the GST on compressed natural gas (CNG) vehicles to reflect their lifecycle environmental advantages over diesel could further promote gas use in the transportation sector. These measures would enhance the competitiveness of natural gas and incentivise cleaner fuel use in India.

Implement revenue-neutral carbon pricing

A strong carbon price signal could help offset the cost disadvantage of natural gas, especially against coal, by incorporating the externality cost of higher emissions into fuel use decisions. A revenue-neutral approach can keep the overall cost to consumers stable by redistributing revenues from carbon pricing through tax reductions or direct rebates. This mechanism encourages the adoption of cleaner energy sources without increasing the overall financial burden on consumers. Ideally, such a framework should be phased in gradually, account for lifecycle emissions, and encompass all fuel types. Similar revenue-neutral carbon taxes and levies are already in use in a handful of countries and sub-national entities, including Mexico, Switzerland and British-Columbia.

5. Providing targeted support in potential growth sectors

While government policies aimed at supporting gas should primarily focus on removing market distortions, targeted support schemes in at least two otherwise struggling end-use sectors may be justified.

Kick-start LNG use in heavy-duty transport

Heavy-duty transport is a hard-to-abate sector, and LNG offers an economically and environmentally attractive alternative to diesel fuel. However, without an established ecosystem, LNG in transport faces a chicken-and-egg problem, necessitating policy support during the early stages of deployment. Potential incentives include public sector procurement for LNG-powered commercial vehicles and mining trucks, reduced fuel taxes and road tolls, domestic gas allocation for LNG vehicles, and corporate fuel efficiency standards for manufacturers of heavy-duty trucks.

Leverage India's stranded gas-fired capacity

Using more of India's underused gas-fired generation capacity could complement intermittent renewable generation, enabling faster deployment of solar and wind capacity, while also displacing coal to reduce GHG emissions and air pollution. Bundled solar and gas-fired capacity auctions, as proposed in 2019-2020, could support the balancing role of stranded gas plants.

Additionally, implementing peaking power tariffs and expanding the high-price day-ahead electricity market on the India Energy Exchange (IEX) could incentivise gas-fired power use, complementing renewables and ensuring grid stability. Introducing dynamic price flexibility – both short-term and seasonal – along with mechanisms to enable load-shifting, would further benefit flexible grid resources. This approach would likely support gas alongside other solutions like batteries and demand-side response.

Accelerating coal-to-gas switching could also be achieved by strengthening energy-saving targets for coal power plants under the Perform, Achieve, and Trade (PAT) scheme and broadening the Carbon Credit Trading Scheme (CCTS) to include thermal power plants. Incorporating both energy efficiency and CO_2 emission reductions into these frameworks will create stronger incentives for fuel switching, as natural gas plants offer higher efficiency and lower emissions compared to coal.

6. Ensuring gas supply security

Given India's growing reliance on imported LNG, declining contract coverage post-2028, and recent experiences with sharp demand swings due to price spikes and extreme weather events, the country would benefit from a more strategic approach to managing gas supply security.

Evaluate strategic gas storage alongside other gas reserve mechanisms

The extreme price volatility during the 2022-23 energy crisis led to gas supply curtailments in India's price-sensitive sectors and prompted the government to explore the feasibility of strategic underground storage to enhance energy security and mitigate price volatility. However, strategic gas reserves are just one of many gas reserve mechanisms and flexibility options, and given their high cost, long lead times, and limited use during energy crises in other countries, they may not be the most optimal solution for India. Therefore, the government could consider a broader range of alternatives, including expanded LNG storage capacity, flexible commercial arrangements, and policy-based mechanisms, such as Japan's strategic buffer LNG framework, alongside strategic gas reserves.

Rethink LNG contracting strategy in light of market trends and growing LNG requirements

The global LNG market is expected to ease significantly later in the decade, while India's exposure to spot market dynamics is set to increase after 2028 with the expiration of legacy LNG contracts. In light of these trends, India's LNG contracting strategy should adapt to ensure long-term gas supply security and mitigate market risks. Key strategies may include requiring state-controlled importers to ensure that all new LNG contracts are destination flexible (at least within India) and exploring joint LNG procurement for smaller city gas companies to help them negotiate better terms. Leveraging a period of lower international prices in the latter half of the decade could also provide an opportunity to lock in favourable LNG contracts.

7. Reducing emissions along the gas value chain

Compressed biogas production is a good match for India's vast agricultural base and its ambitions to boost domestic gas supply while meeting long-term decarbonisation goals. It also addresses waste management issues by converting organic waste into valuable resources. The Indian government has provided commendable support to CBG, but the sector's early stage of development suggests that additional policy measures could further accelerate its growth and establish it as a key energy source.

In parallel, efforts to mitigate methane emissions across the natural gas value chain could extend natural gas's role in India's energy transition and prepare the country to navigate international carbon pricing mechanisms like the EU's Carbon Border Adjustment Mechanism (CBAM).

Provide support for compressed biogas production

Offering public land at affordable rates to biogas producers or providing other incentives for land acquisition could help facilitate the establishment of CBG plants in rural areas.

Establishing a transparent and robust National Registry to track CBG production and document green certificates could facilitate trade growth. Book-and-claim systems, supported by Guarantees of Origin or other green certifications, could foster market expansion as the gas grid develops. Including sustainability and GHG performance data in certificates is recommended to encourage the use of sustainable feedstocks and efficient biogas plants.

During the early phases of the CBG obligation, when CBG must be sold alongside natural gas for CNG and PNG, supply may lag behind demand. In such cases, introducing compliance waivers (which allow obligated parties to flexibly meet their requirements by purchasing them) could be beneficial. Additionally, improved

coordination between state and national policy tools can enhance access to funding programmes and streamline permitting processes. Adopting a one-stop-shop approach could further support these efforts.

Reduce methane emissions along the natural gas value chain

India is the world's fifth-largest source of energy-related methane emissions. Although the vast majority (about 80%) of these emissions result from coal and bioenergy use, India nonetheless added 0.5 million tons of natural gas-related methane emissions to the atmosphere in 2023. Another 0.6 million tons were emitted from oil fields in India. Developing a comprehensive strategy to monitor, mitigate and capture these emissions could not only add the equivalent of up to 1.6 bcm to India's annual gas supply but also ensure that natural gas remains a viable transition fuel throughout the forecast period. Additionally, such efforts could help India comply with international carbon pricing mechanisms, such as the EU's CBAM, which taxes carbon emissions embedded in imported goods, thereby allowing Indian exporters to remain competitive in markets with stringent carbon regulations.

Annex

Abbreviations and acronyms

ACE	Association for CGD Entities
APM	Administered Price Mechanism
ATGL	Adani Total Gas Limited
BPCL	Bharat Petroleum Corporation Limited
CAGR	Compound annual growth rate
CBAM	Carbon Border Adjustment Mechanism
CBG	Compressed biogas
CBM	Coal bed methane
CCTS	Carbon credit trading scheme
CGD	City gas distribution
CNG	Compressed natural gas
CO_2	Carbon dioxide
DGH	Directorate General of Hydrocarbons
DRI	Direct reduced iron
DSF	Discovered small field
EMS	Energy Markets and Security Directorate
EOI	Expression of interest
EU	European Union
EV	Electric vehicle
FID	Final investment decision
FOM	Fermented organic manure
FSRU	Floating storage regasification unit
FY	Fiscal year
GA	Geographical area
GAIL	Gas Authority of India Limited
GCP	Gas, Coal and Power Markets Division
GCV	Gross calorific value
GDP	Gross domestic product
GEECL	Great Eastern Energy Corporation Limited
GGL	Gujarat Gas Limited
GHG	Greenhouse gas
GOBARdhan	Galvanising Organic Bio-Agro Resources Dhan
GSA	Gas sales agreement
GSPC	Gujarat State Petroleum Corporation Limited
GSPL	Gujarat State Petronet Limited
GST	Goods and services tax
GTA	Gas transmission agreement

HDV	Heavy-duty vehicle
HELP	Hydrocarbon Exploration and Licensing Policy
HP/HT	High pressure/high temperature
HPCL	Hindustan Petroleum Corporation Limited
IBA	Indian Biogas Association
IEA	International Energy Agency
IEX	Indian Energy Exchange
IFGE	Indian federation of green energy
IGL	Indraprastha Gas Limited
IGX	Indian Gas Exchange
INR	Indian rupee
IOCL	Indian Oil Corporation Limited
ITC	Input tax credit
KG	Krishna Godavari
LNG	Liquefied natural gas
LPG	Liquefied petroleum gas
MDA	Market Development Assistance
MGL	Mahanagar Gas Limited
MoPNG	Ministry of Petroleum and Natural Gas
MWP	Minimum work programme
NBCC	National Biofuels Coordination Committee
NDC	Nationally Determined Contributions
NELP	New Exploration Licensing Policy
NEP	National Electricity Policy
NGL	Natural gas liquids
NITI Aayog	National Institution for Transforming India Commission
NO_x	Nitrogen oxides
NTPC	National Thermal Power Corporation
OALP	Open Acreage Licensing Programme
OIL	Oil India Limited
ONGC	Oil and Natural Gas Corporation Limited
PAT	Perform, Achieve, and Trade
PM	Particulate matter
PMUY	Pradhan Mantri Ujjwala Yojana
PNG	Piped natural gas
PNGRB	Petroleum and Natural Gas Regulatory Board
PPAC	Petroleum Planning and Analysis Cell
PSU	Public sector undertaking
RIL	Reliance Industries Limited
RLNG	Regasified liquefied natural gas
SATAT	Sustainable Alternative Towards Affordable Transportation
SEZ	Special Economic Zone
SGL	Sabarmati Gas Limited
SME	Small and medium-sized enterprise
SO_x	Sulphur oxides

SPIC	Southern Petrochemical Industries Corporation Limited
TPA	Third-party access
TSO	Transmission system operator
UBP	Uniform base price
UGS	Underground gas storage
USA	United States of America
USD	United States dollar
VAT	Value-added tax

Glossary

bbl/d	barrels per day
bcm	billion cubic meters
bcm/yr	billion cubic meters per year
GW	gigawatt
kWh	kilowatt-hour
MBtu	million British thermal units
MJ	megajoule
MMbbl/d	million barrels per day
MMtoe	million metric ton of oil equivalent
MW	megawatt
toe	tonne of oil equivalent
TWh	terawatt-hour
y-o-y	year-on-year

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