PIL
Pipeline Infrastructure Limited

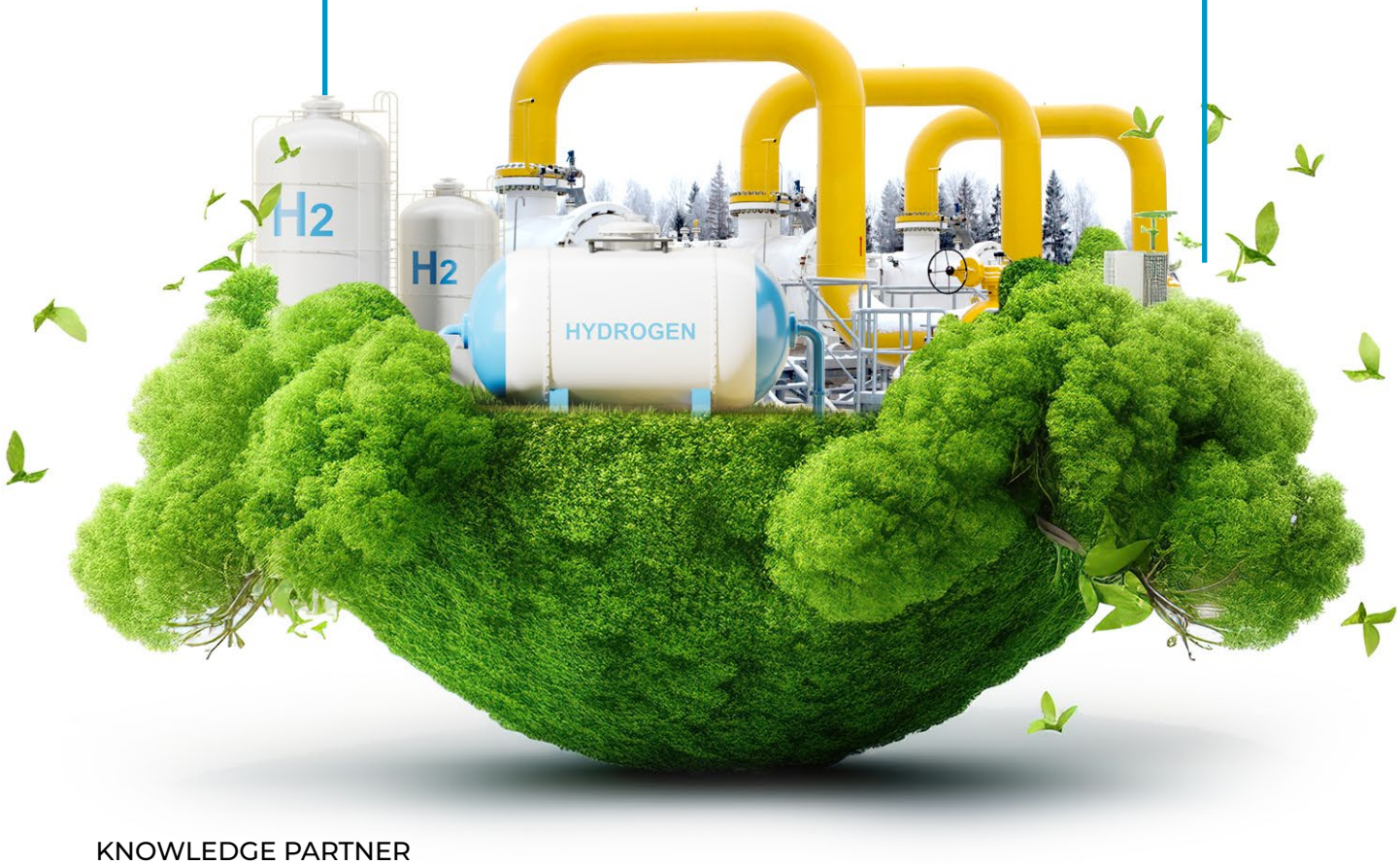
PRESENTS

ANNUAL GAS FORUM

IN ASSOCIATION WITH

ET Energyworld

INDIA'S PATHWAYS TO A LOW EMISSION FUTURE



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INTRODUCTION

The impact of climate change have been visible now more than ever. This fact has been substantiated by several industrial and scientific body reports, as well as the physical impact being observed across the globe. As a result, energy transition has become the need of the hour.

At the recently concluded COP28, the call for nations to "transition away from fossil fuels" marked a historic moment, signaling a collective resolve to embrace change. Concurrently, strides were made to reconcile hydrocarbons, with a particular focus on gas, with sustainability objectives, acknowledging their persistent significance in the energy landscape. On December 2nd, 2023, 118 countries signed the renewable energy pledge at the COP28 to triple the world's renewables capacity to 11,000 GW by 2030, helping reduce reliance on fossil fuels. There were also additional pledges to double energy efficiency by 2030 and double nuclear capacity by 2050.

Amidst this growing urgency for energy transition, it's also widely recognized that changes in the energy mix and thus emissions reduction, would not follow a linear trajectory across all nations. While all geographies are working towards this common goal, like the European Union forming the Green Deal and the United States, setting up the Inflation Reduction Act (IRA), each nation will have to design its own pathway. The level of economic growth, impact of climate calamities and resource availability have distinctively increased the gap between the needs and action trajectories of Global North and Global South.

KEY OUTCOMES OF COP28

118

COUNTRIES THAT SIGNED THE RENEWABLE ENERGY PLEDGE

3X

TRIPLE WORLD'S RENEWABLES CAPACITY TO 11,000 GW BY 2030

2X

DOUBLE ENERGY EFFICIENCY BY 2030

2X

DOUBLE NUCLEAR CAPACITY BY 2050

As the 5th largest economy in the world and 3rd largest greenhouse gas emitter, India will play a pivotal role in the global movement towards limiting emissions rise to 1.5ºC as compared to the pre-industrial levels.

While dealing with the trilemma of energy security, affordability and sustainability, India is working towards revamping its energy mix, of which Natural Gas is an important element.

Given this background, Pipeline Infrastructure Limited (PIL) is organizing a conference of key Natural Gas industry stakeholders on the theme

India's Pathways to a Low Emissions Future

To set the context for this conference, this paper outlines themes that will be central to the conference discussions and how the sessions will be structured. The discussions will give a comprehensive overview of the global energy markets, the role of Natural Gas and green alternatives, the state of India's Natural Gas infrastructure, the feasibility of Hydrogen Blending, and strategies for fostering gas demand across sectors to fortify India's journey toward an emission-resilient future.

The first theme for the conference, "Global Energy Markets Outlook: Implications for India's Energy Transition" will cast a spotlight on the external forces shaping India's energy landscape. With a keen eye on the ebb and flow of fossil fuel prices, the ascendance of renewable energy, and the geopolitical currents influencing global energy markets, this theme will set the stage for a comprehensive understanding of the external factors that will influence India's journey towards a low emission future.

Next, focusing on India, **the second theme will cover "The Role of Natural Gas and Green Alternatives in India's Sustainable Future".** As India aims to use Natural Gas as a transition fuel in its emissions reduction journey, the discussions in this theme will describe the possibilities inherent in the adoption of Natural Gas and green alternatives. From the current state of Natural Gas consumption to the evolving landscape of renewable energy sources, this theme endeavors to highlight the possibilities for India to have an energy basket having an optimal mix of various fuels for a sustainable future thereby steering India towards a cleaner energy paradigm.

However, the realization of these possibilities hinges on the resilience of India's energy infrastructure. **The third theme, "Enhancing India's Natural Gas Infrastructure for a Sustainable Tomorrow,"** takes center stage in dissecting the current state of the country's Natural Gas infrastructure. By identifying bottlenecks, proposing strategies for expansion, and highlighting the pivotal role of infrastructure in enabling a sustainable energy future, this theme weaves a narrative of the critical need for robust infrastructure to support India's low-emission transition.

As the canvas of possibilities unfolds, **the conference will venture into unexplored yet promising territory with the fourth theme, "Hydrogen Blending in Natural Gas Pipeline Networks".** Hydrogen, hailed as a material clean energy and net-zero technology, is being evaluated globally for its viability as a blend with Natural Gas. Most of the talk today is around the production of Hydrogen, however how swiftly it can reach the consumption centres will determine its quick adoption as a fuel. Different nations across the globe have initiated a review of their existing Natural Gas pipeline networks and developed a roadmap for the transportation of Hydrogen through blending in Natural Gas networks. Technological advancements, regulatory landscapes, and potential challenges are examined to discern whether Hydrogen

Blending is not just a theoretical concept but a pragmatic step towards a low emission future.

The concluding theme, "Fostering Gas Demand Across Sectors for India's Emission-Resilient Future," circles back to the heart of the matter – how to increase the adoption and integration of multiple cleaner energy sources into the diverse sectors of the Indian economy. By exploring strategies for fostering gas demand in industries, transportation, and households, this theme underscores the need for a holistic approach that permeates every key sector for demand.

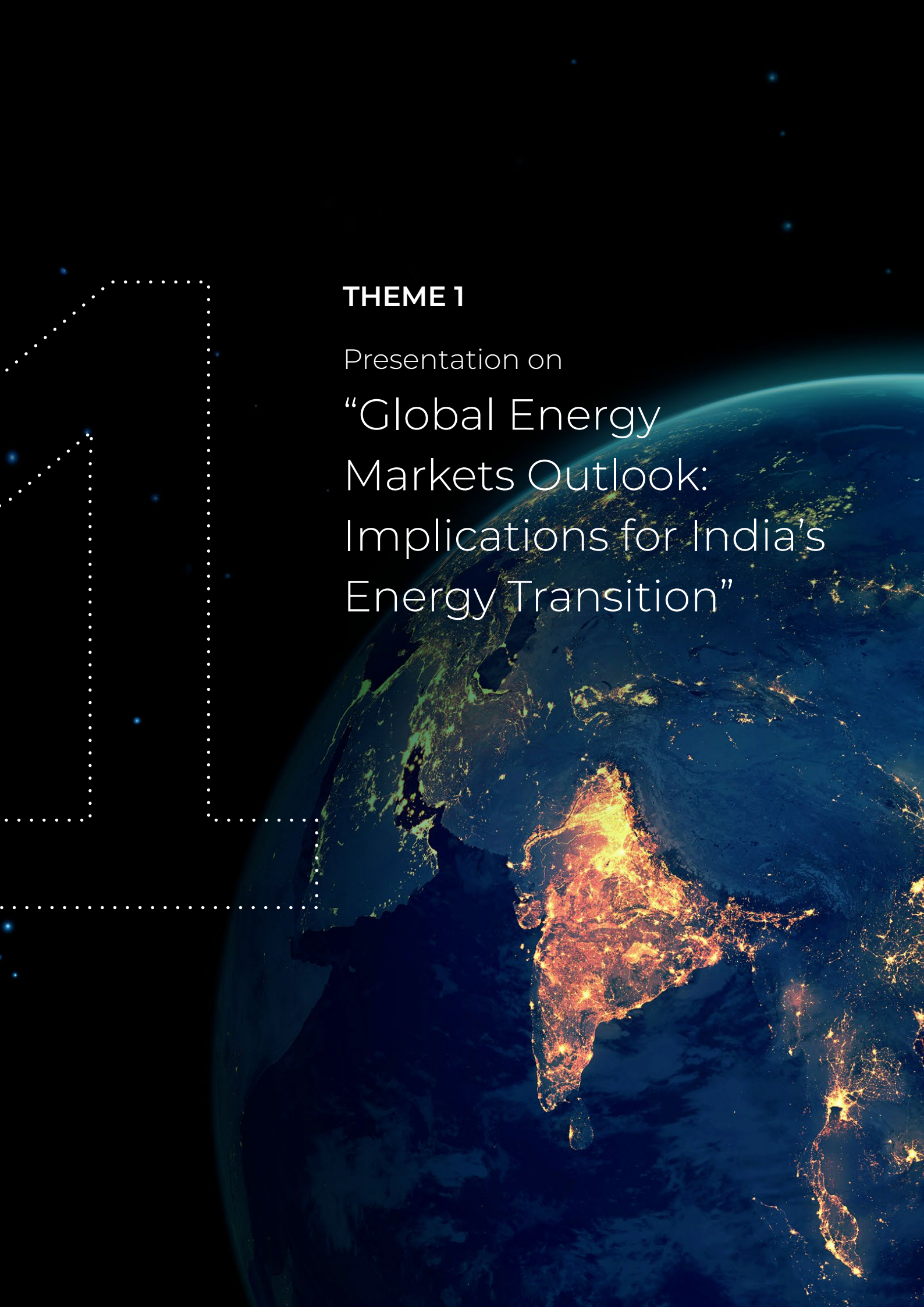
In a nutshell, this conference endeavors to convey the depth and complexity of India's journey towards high economic growth, low emission future and the role gas can play. The themes delineated in this scene-setting paper are the threads that will weave through the conference with the goal of identifying actionable business, technology, and policy solutions to accelerate contribution of gas in India’s future energy mix.

This document outlines the above themes in some detail as a scene setter for the conference discussion.

THEME 1

Presentation on

“Global Energy Markets Outlook: Implications for India’s Energy Transition”



At present, this decade represents a period of unparalleled uncertainty for global energy markets. From the energy systems being impacted by the pandemic at the beginning of this decade to energy price spike in 2021 to geopolitical tensions impacting the energy supply, the first few years of this decade have seen unprecedented challenges along with the burgeoning need to reduce Greenhouse Gas Emissions.

S&P Global scenarios provide a good reference to understand this situation and answer the questions on the evolving geopolitical landscape and global balance of power, the new security paradigm, and the role of developing Asia in global decarbonization. Given different assumptions, S&P Global annually releases three scenarios and two net-zero cases describing where the global energy mix and emissions will be heading. While the base scenario, i.e., **Inflections,** forecasts the global energy outlook based on current situations, **Discord** showcases a dismantled world where there's no consensus of policies or directions and **Green Rules** presents a greener and cleaner world where all nations together work towards achieving a low-emissions future.

The 2023 edition of the S&P scenarios shows that, at present, fossil fuels still constitute 80% share of primary energy demand. This demand for fossils will rebound through the 2020s and peak on or before 2040 for all scenarios and cases. By 2050, the share of fossil fuels is expected to fall to 57% in Inflections (base scenario) and up to 39% in the Green Rules. Amongst the fossil fuels, Natural Gas will retain a key share of primary energy in the Inflections, Green Rules, Discord and ACCS outlooks playing a central role in many countries' power grids across all outlooks, as a source of baseload power in developed countries over the short to medium term and in developing countries over the medium to longer term.

KEY DATA POINTS

80%

FOSSIL FUELS' SHARE OF PRIMARY ENERGY DEMAND GLOBALLY

80%

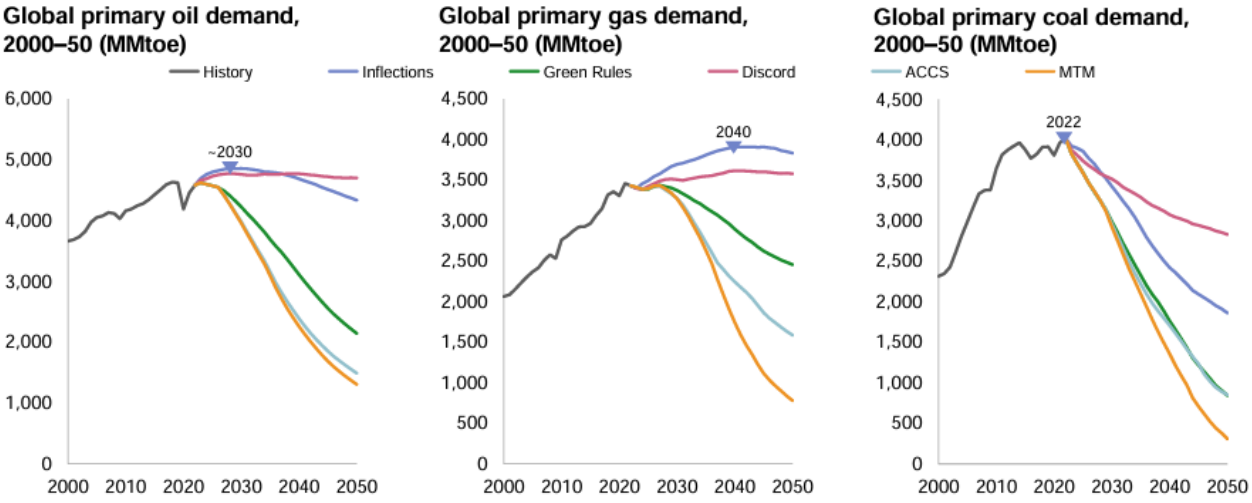
INDIA'S PRIMARY ENERGY CONSUMPTION DEPENDANT ON FOSSIL FUELS

50%

FOSSIL FUEL SOURCE OF ENERGY POWERED BY COAL IN INDIA

2X

DOUBLING OF PRIMARY ENERGY DEMAND IN INDIA BY 2050

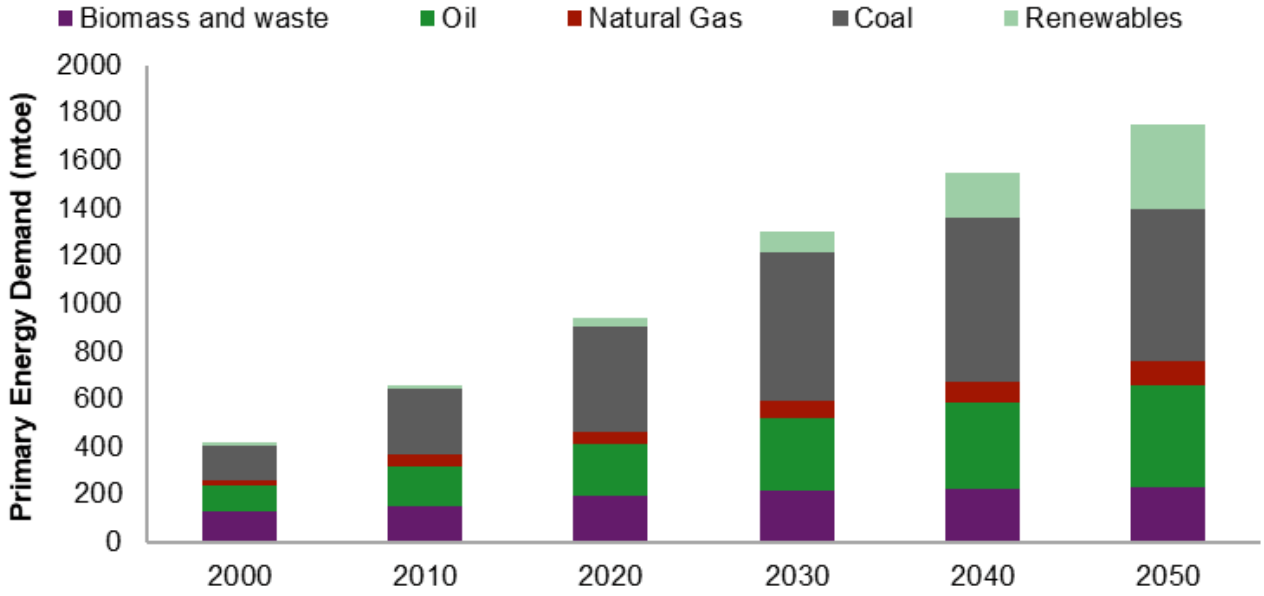


Data compiled July 2023.
Source: S&P Global Commodity Insights.

Compared to the global outlook, India has been a front runner in increasing the use of renewables, but also a major user of fossil fuels given its rapid energy demand growth. Currently, India's primary energy consumption is nearly 80% dependent on fossil fuels, with approximately 50% attributed to coal.

Given the projected economic growth, India's primary energy demand is expected to double by 2050 with fossil fuels still being foundational to the energy mix, comprising ~67% of the primary energy mix. In this mix, the share of gas is expected to rise towards 10% in the Green Rules Scenario.

India Energy Demand to Double by 2050



Data compiled Dec. 18, 2023.
Source: S&P Global Commodity Insights.

Securing reliable, affordable, and sustainable energy supplies will remain India's focus of India through 2050. To move towards a lower emission future, the Indian government has set forward its decarbonization goals:

Reaching net-zero emissions by 2070

Reducing the emissions intensity of GDP by 45% relative to 2005 levels by 2030

Achieving 500 GW of fossil fuel–free generating capacity by 2030

Reducing total projected carbon emissions by 1 billion metric tons by 2030

Meeting 50% of energy requirements from renewable energy sources by 2030

During the conference, this presentation will focus on answering the following questions:

- How do the current trends in global energy markets impact India's energy transition, and what key factors should be considered in navigating this dynamic landscape?
- Given the geopolitical uncertainties and market fluctuations in the global energy sector, how can India strategically position itself to leverage opportunities and mitigate risks in the pursuit of a more sustainable and diversified energy mix?

THEME 2

Panel discussion on

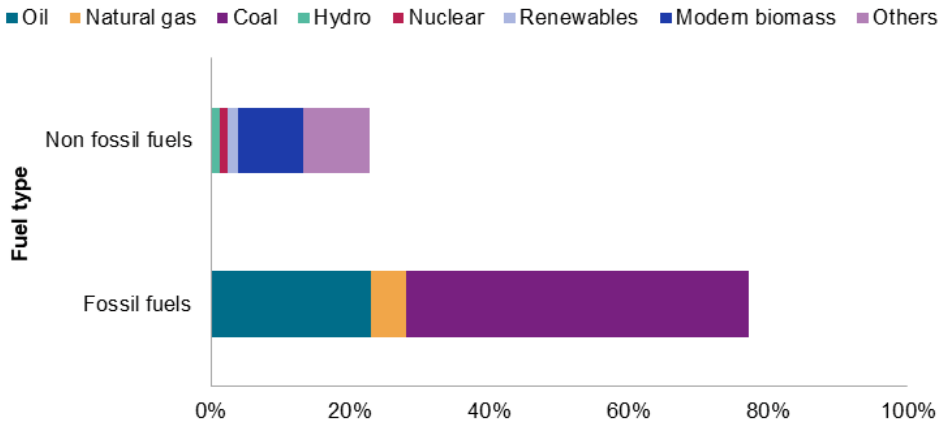
“The Role of Natural Gas and Green Alternatives in India’s Sustainable Future”

The first global stocktake that concluded at COP28, emphasized the role of transition fuels in moving towards a low-emission world. In India, Natural Gas is progressively gaining significance as a transition fuel and thus becoming a vital energy source. Ranking as the third most utilized fuel in the country's energy portfolio, it stands out as the cleanest and least carbon-emitting fossil fuel.

At present, Natural Gas accounts for 6% share in India's energy mix. Notably, there has been a surge in both the production and consumption of gas in India. LNG imports into the country have consistently risen, playing a crucial role in overall gas consumption.

In 2020, during the COVID-19 pandemic and subsequent restrictions affecting domestic production, the share of LNG imports reached its peak at 53%. As of 2022, with a resurgence in domestic production, the import share declined to 44%.

In 2022, gas had 6% share in India's primary energy mix



Note:
Renewables include solar, wind, geothermal, and tide/wave/ocean energy. Others include solid waste, traditional biomass (used in the domestic sectors; includes charcoal, wood, bagasse), ambient heat, and net trade of electricity, Hydrogen and heat.

Data compiled Dec. 18, 2023.

Source:
S&P Global
Commodity Insights.

KEY DATA POINTS

6%
CURRENT SHARE OF NATURAL GAS IN INDIA'S ENERGY MIX

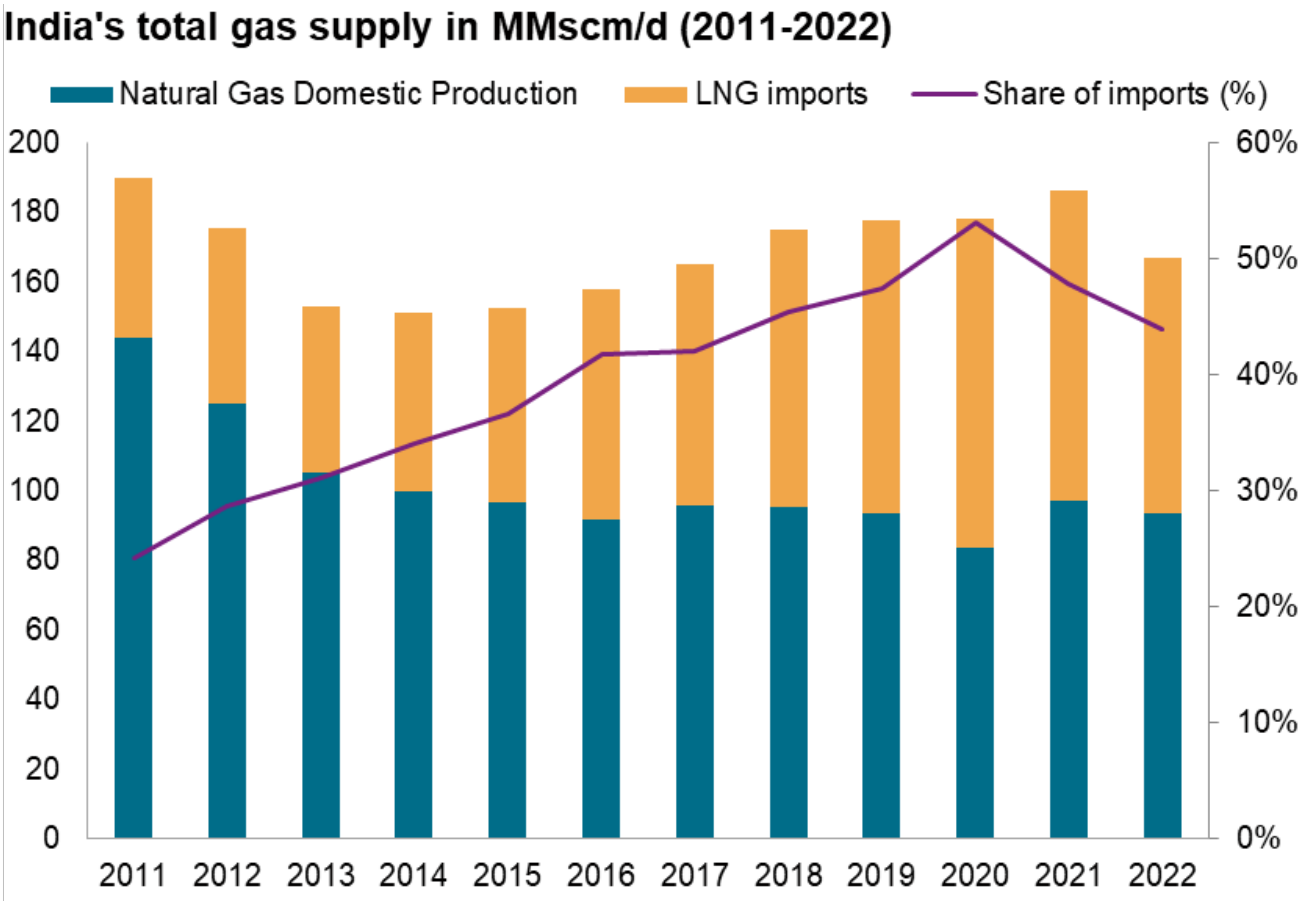
53%
SHARE OF LNG IMPORTS IN INDIA DURING THE 2020 COVID-19 PANDEMIC

44%
IMPORT SHARE OF LNG AS OF 2022

15%
TARGETTED SHARE OF NATURAL GAS IN INDIA'S ENERGY MIX BY 2030

Commissioning of production from MJ fields and upcoming production from ONGC assets in the KG basin are expected to boost India's domestic production in the coming years; however, constraints in capacity indicate that domestic production is likely to peak by 2026-27. Consequently, a substantial reliance on LNG imports is anticipated to remain as a prominent feature of India's gas industry, in the longer-term.

India's gas consumption relies significantly on urea manufacturing, transportation (CNG), industries, refineries, city gas distribution, and the power sector. The government's emphasis on cleaner energy sources has spurred increased demand for Natural Gas across industrial, transportation and residential sectors. However, the growth in gas consumption in crucial sectors is sluggish, raising concerns about the feasibility of achieving the long-targeted 15% share of gas in the energy mix by 2030.



For facilitating the transition, the Govt of India has introduced three major reforms recently:

1. Unified tariff for interconnected Natural Gas pipelines
2. Linked domestic gas price for APM fields to crude oil, thus putting a price ceiling
3. Setting priority order for domestic gas allocation

Additionally, India is currently in the process of establishing a carbon market, further encouraging the adoption of cleaner fuels.

Beyond its conventional applications, Natural Gas plays a valuable role in Hydrogen production, often hailed as the fuel of the future due to its emission-free combustion. With the introduction of the National Hydrogen Mission, Natural Gas combined with Carbon, Capture and Storage (CCS) will play a critical role in the production of blue Hydrogen in India. Moreover, biogas presents an alternative to traditional Natural Gas usage by being used as Compressed Bio Gas (CBG).

In its G20 Presidency, India also launched the Global Biofuel Alliance, which aims to promote facilitating cooperation and intensifying the use of sustainable biofuels. As the global push for phasing out fossil fuels gains momentum, the pivotal question remains: will these alternatives and diversified applications replace or complement Natural Gas in India's envisioned energy landscape of the future?

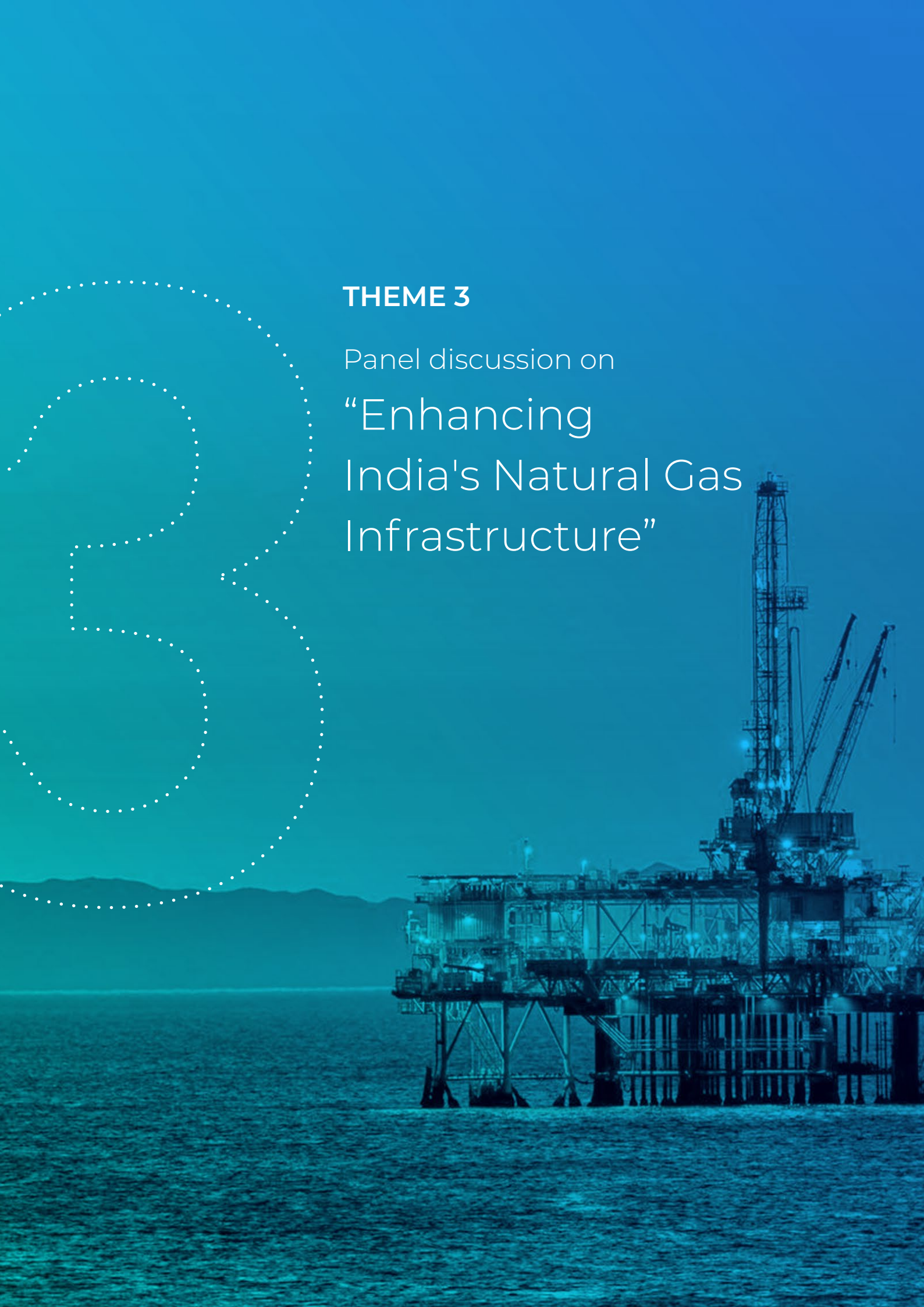
This panel discussion will aim to answer the following questions:

- What are the distinct roles Natural Gas can play in achieving India's energy security and sustainability goals in the coming decades?
- What is the potential of green or renewable gases, including Hydrogen and Biogas, to complement conventional Natural Gas in India's energy transition?
- What are some of the initiatives for restraining use of polluting fuels (Carbon tax, pricing, etc.) and promoting use of cleaner fuels?

THEME 3

Panel discussion on

“Enhancing India's Natural Gas Infrastructure”



As of October 31, 2023, there were 6,088 Compressed Natural Gas (CNG) stations in 267 Geographical Areas (GAs) operated by 51 CGD entities. India's Natural Gas infrastructure is currently limited in its ability to function at its full potential.

The pipeline network is not extensive enough to transport gas across the country efficiently, resulting in a regional imbalance of access. Additionally, storage facilities and import terminals need expansion and modernization to accommodate the increasing demand for Natural Gas. At present, LNG terminals are expected to remain underutilized by almost 30% to 40% due to lack of pipeline infrastructure and a shortage in demand. Limited Natural Gas infrastructure has been one of the contributing factors towards low consumption and the development of gas infrastructure in the Eastern part of Indian is expected to provide the backbone of unlocking further gas demand.

While city gas distribution is one of the fastest growing sectors, over 500 million people still do not have access to clean cooking fuel. There is a need to increase the reach of piped Natural Gas to households. Improvement in the Natural Gas supply is the key to fueling its demand in India. Recognizing the need for infrastructure development to facilitate the move towards the target of 15% share of Natural Gas in India's energy mix, the Indian government has created a National Gas Grid and has envisioned a total of 33,764 km of pipeline network. Also, the 12th CGD bid round, recently floated by PNGRB, aims at covering 100% geographical area of the nation.

KEY DATA POINTS

6088

COMPRESSED NATURAL GAS STATIONS IN INDIA AS OF OCT'23

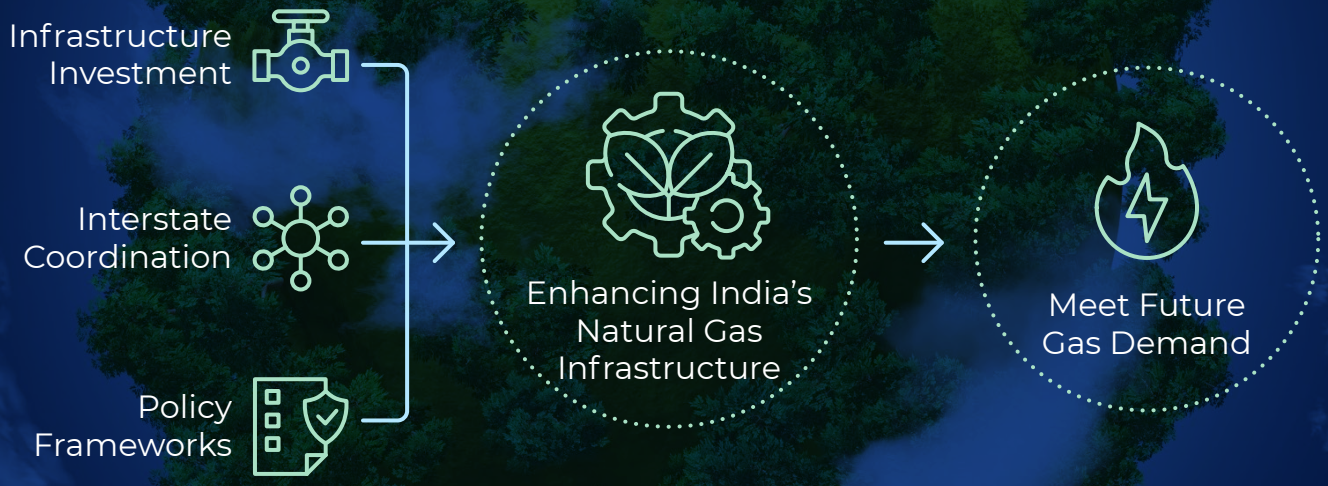
30%-40%

RATE OF UNDERUTILISATION OF LNG TERMINALS DUE TO LACK OF PIPELINE INFRASTRUCTURE & SHORTAGE IN DEMAND

15%

TARGETTED SHARE OF NATURAL GAS IN INDIA'S ENERGY MIX BY 2030

Along with more such policy led initiatives, there's also a need to encourage public-private partnerships for providing infrastructure investment, investment in research and development and technological innovations. At the same time, improving interstate coordination would help streamline gas transportation and distribution.



This panel discussion will focus on answering these key questions:

- In what ways can India's Natural Gas infrastructure (Pipelines, CGD, LNG terminals, etc.) be expanded and improved to meet growing demands and ensure a reliable supply?
- How to bring more investments/private sector participation in Gas infrastructure development in India?

THEME 4

Presentation on

“Hydrogen Blending with Natural Gas”

As the world moves towards cleaner fuels, the current imperative is the integration of Green Hydrogen for two primary reasons. The first pertains to ensuring energy security by establishing a dependable, long-term supply. The second reason involves the pursuit of decarbonization, aiming for a sustainable and environmentally friendly fuel source.

As highlighted in the 2022 report titled **"Global Hydrogen Trade to Meet the 1.5ºC Climate Goal: Part II[1]"** by the International Renewable Energy Agency (Irena), blending 20% Hydrogen in gas could result in a 7% reduction in CO emissions, albeit with a significant rise in energy costs.

Testing for blended fuel has also started in India

At present, NTPC is running a pilot project at its Kawas township in Surat to make Green Hydrogen Blending a viable future fuel option. Currently, being tested at 5% blending, the project aims to increase the blending level to 10% and at the same time make the blended PNG more economical than LPG. Similarly, Adani Total Gas Limited (ATGL) have also planned to introduce 8% blended gas in its Ahmedabad CGD network during next year.

Pipeline Infrastructure Limited (PIL) has conducted a pilot study for blending various percentages of Hydrogen in its transmission Network. The initial desktop study has been encouraging with possibility of 8-10% Hydrogen blend in Natural Gas without any major modifications and possibility of higher percentage blend with some modifications. The next step is to conduct field studies by adopting learnings of similar studies done in UK and Europe.

KEY DATA POINTS

7%

REDUCTION IN CO EMISSIONS AS A RESULT OF BLENDING 20% HYDROGEN IN GAS

5%

HYDROGEN BLENDING RATIO CURRENTLY BEING TESTED BY NTPC

8-10%

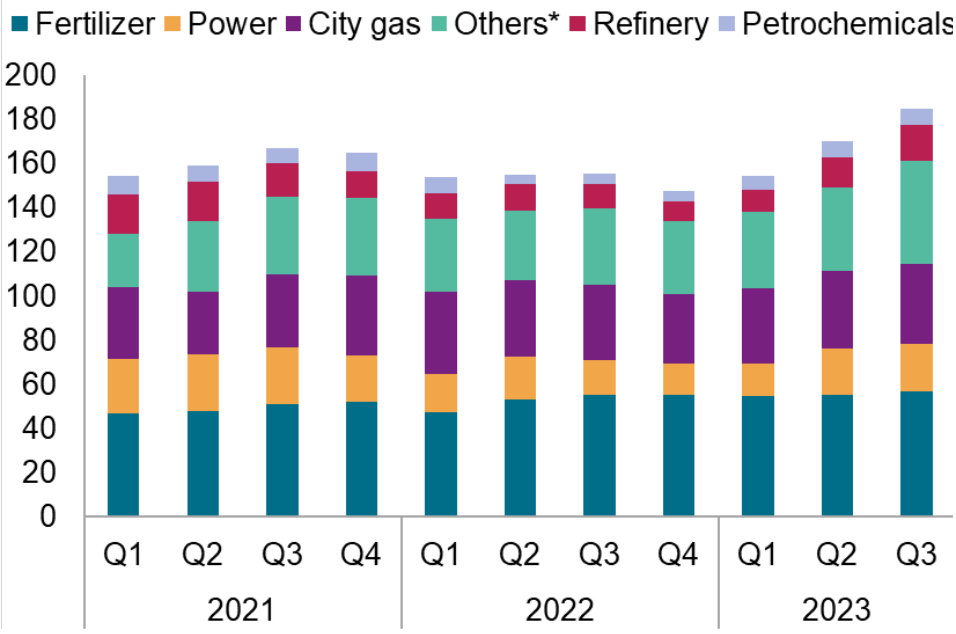
HYDROGEN BLENDING RATIO USED BY PIL FOR CONDUCTING A PILOT STUDY IN ITS TRANSMISSION NETWORK

[1] https://www.irena.org/publications/2022/Apr/Global-hydrogen-trade-Part-II

While these pilot projects have started, the work is still at a very nascent stage. At present, the pressing priority is to increase the scale and feasibility of these initiatives to make it a viable reality. There is an opportunity for India to develop Hydrogen Blending initiatives, like the EU Hydrogen Backbone, on the back of the National Hydrogen Mission.

Recently, PNGRB has also partnered with the World Bank to draft a roadmap for Hydrogen Blending in India, showcasing the support of Indian policymakers.

Sectoral gas demand (MMscm/d)



Note:
*Others includes sectors like internal consumption for pipeline system, agriculture (tea plantation), industrial, manufacturing, LPG shrinkage, sponge iron and Miscellaneous.

Data compiled Dec. 18, 2023.

Source:
S&P Global
Commodity Insights.
https://www.energy.gov/

This presentation will center around the following points:

- Is Hydrogen Blending a reality?
- Blending of Hydrogen in Transmission and Distribution Network
- Progress made by UK and European Nations in this space

THEME 5

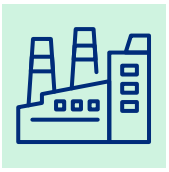
Panel discussion on

“Fostering Gas Demand Across Sectors for India’s Emission Resilient Future”

According to the S&P Global Commodity Insights, India exhibited the highest-ever gas demand in the third quarter of 2023, growing by 17% year over year owing to increased LNG imports and deepwater gas production. Gas demand across all sectors continued to exhibit robust growth.

CGD sector

In the third quarter of 2023, gas demand from this sector increased by 6% year over year. The demand outlook remains robust as downstream infrastructure expansion continues rapidly, and the government reforms favored more domestic gas allocation to this segment. Furthermore, residential demand also increased as piped Natural Gas connections grew by 18% in August 2023 year over year, nearing 12 million, and consumers are opting for piped Natural Gas as an economical alternative to expensive LPG cooking gas.



Industrial sector

In the third quarter of 2023, gas intake of the industrial sector grew by 36% year over year to 46.73 MMscm/d owing to increased deepwater gas production, stable LNG prices and strong gas-based sponge iron production.

Fertilizer sector

Gas demand from the fertilizer sector grew by 3% year over year. The growth rate was attributed to the addition of gas-based ammonia and urea plant in Barauni (October 2022) and Sindri (November 2022).

KEY DATA POINTS

6%	36%	3%	49%	40%
YoY INCREASE IN GAS DEMAND IN CGD SECTOR IN Q3'2023	YoY INCREASE IN GAS DEMAND IN INDUSTRIAL SECTOR IN Q3'2023	YoY INCREASE IN GAS DEMAND IN FERTILIZER SECTOR	YoY INCREASE IN GAS DEMAND FROM REFINERY SECTOR	YoY INCREASE IN GAS DEMAND FROM PETROCHEMICAL SECTOR

Refinery and petrochemical sector

Gas demand from the refinery and petrochemical sectors increased by 49% and 40% year over year, respectively, owing to relatively lower LNG spot prices and sustained domestic gas supply. With improved pipeline connectivity and the commissioning of the Dhamra LNG terminal, IOCL eastern refineries have shown an increase in gas offtake.

This reflects that the continued expansion of downstream infrastructure, growing residential connections, and flourishing industrial activities suggest a robust trajectory for gas consumption. With the fertilizer, refinery, and petrochemical sectors also witnessing substantial growth, the future appears dynamic and resilient, marked by sustained domestic supply, improved connectivity, and competitive pricing in the LNG market.

To conclude the conference, the discussions in this panel will explore answers to the following questions:

- How can the gas industry actively collaborate with various sectors in India to foster increased demand and promote a more emission-resilient future for the nation?
- What specific strategies and innovations within the gas sector can be implemented to address environmental concerns effectively and contribute to sustainable development across diverse sectors?
- What regulatory frameworks and policy measures should be explored or enhanced to encourage the adoption of Natural Gas across different industries in India, ensuring a balanced approach between economic growth and environmental sustainability?

As we stand on the cusp of this conference, the themes outlined in this paper provide a glimpse into the multidimensional landscape of India's journey towards a low emission future. By unraveling the intricacies of Natural Gas, green alternatives, infrastructure enhancement, Hydrogen Blending, and sectoral integration, we embark on a collective exploration to shape a sustainable and resilient tomorrow for India. The conference promises to be a crucible of ideas, igniting the spark of innovation that will propel India towards a greener, cleaner future.

About PIL

Pipeline Infrastructure Limited (PIL) owns and operates a 48 - inch diameter pipeline with an overall network length of 1480 km, including spur and dedicated pipelines. India's first bi-directional pipeline traverses 5 states across the peninsular region from Kakinada in the East to Bharuch in the West. PIL acts as the vital link in supplying clean and green energy across the country in a safe, sustainable, and reliable manner. With a design capacity of 85mmscmd, it commenced operations in 2009 to transport record gas off the East Coast. The above-ground facility of the PIL pipeline includes 10 compressor stations with a total installed power of 900+ MW.

About ET Energyworld

Energy constitutes 6-7% of India's GDP, making it a significant sector in the country's economy. The Indian energy market is among the world's top five and is rapidly growing. ETEnergyworld keeps industry leaders informed with the latest developments, curated news, and tailored analyses.

With a commitment to staying at the forefront of the ever-evolving energy sector, ETEnergyworld not only reports extensively on the industry but also organizes major events both domestically and internationally, with a primary focus on the energy domain. Additionally, we provide customized digital and on-ground solutions, empowering brands to select options that align precisely with their requirements.

S&P Global Commodity Insights

S&P Global Commodity Insights is a division of S&P Global. For more than 100 years, we've been a trusted connector that brings together thought leaders, market participants, governments, and regulators to co-create solutions that lead to progress. Vital to navigating Energy Transition, S&P Global Commodity Insights' coverage includes oil and gas, power, chemicals, metals, agriculture, and shipping.