



Natural Gas

Navigating towards cleaner tomorrow

Emerging Opportunities in India



LCNG station



Compressed Bio-Gas Plant
(SATAT)



PNG at Home



CNG Station



Employment Generation



LNG Propelled Marine Vehicle



सत्यमेव जयते

प्रधान मंत्री
Prime Minister

MESSAGE

It is a pleasure to learn that the Ministry of Petroleum and Natural Gas is organising a national conclave on the theme "Emerging Opportunities in Natural Gas Sector".

Energy is the key driver of growth across the various sectors of the economy. India's energy future has four pillars- energy access, energy efficiency, energy sustainability and energy security. Our government believes in an integrated approach for energy planning and our energy agenda is inclusive.

Natural gas is vital for the expanding energy requirements of the nation besides being an enabler in providing solutions to the environmental challenges. We are focusing on all the dimensions of gas economy to ensure easy access of natural gas to people. Nationwide Gas Grid, City Gas Distribution (CGD) and gas import terminals are part of our efforts towards strengthening the infrastructure.

The conclave will provide the participants an opportunity to hold in-depth discussions on the opportunities and challenges in expanding the coverage and will come out with a roadmap to accelerate the adoption of natural gas as a popular alternative fuel.

I wish the deliberations at the national conclave all success.

(Narendra Modi)

New Delhi

पौष 30, शक संवत् 1941
20th January, 2020



मंत्री, पेट्रोलियम एवं प्राकृतिक गैस; इस्पात मंत्रालय
Minister, Petroleum and Natural Gas; Steel Ministry

MESSAGE

As we begin the new decade, we have an opportunity to re-examine India's energy scenario and prepare the roadmap for the coming years. It is in this backdrop that the National Conclave on "*Emerging Opportunities in Natural Gas Sector in India*" being organized by the Ministry of Petroleum and Natural Gas gains special significance.

Natural Gas is an environment friendly conventional fuel available today, and hence can play a critical role in India's transition towards a low carbon clean fuel based economy. Since 2014 and onward, the country under leadership and guidance of Hon'ble Prime Minister Shri Narendra Modi is consistently taking initiatives to achieve the Government's vision to usher a gas-based economy. One of the primary initiatives in this regard has been the rapid expansion of gas infrastructure including National Gas Grid, Liquefied Natural Gas (LNG) import terminals and City Gas Distribution (CGD) Network in the country. The upcoming infrastructure will facilitate in creating robust gas ecosystem with multi-fold increase in investments as well as employment opportunities across skilled, semi-skilled and un-skilled areas. Expansion of large infrastructure projects will also ramp-up 'Make in India' opportunities for manufacturing sector across India, in-turn, boosting the state economy.

Further, technological advancements are also creating new opportunities of commercial activities across gas value chain. The use of LNG directly for long distance transport, inland waterways, cold storage, etc. is also being explored. We have also launched the Sustainable Alternative Towards Affordable Transportation (SATAT) scheme which encourages entrepreneurs to set up Compressed Bio-Gas plants, and contribute towards increasing household income of farmers.

This booklet provides succinct information about various aspects of the Natural Gas value chain and highlights key emerging opportunities across gas value chain for all stakeholders. I urge all to explore and capture these opportunities in support of the vision of Government to usher in a gas based economy, leading to sustainable benefit to state and its people.

Dharmendra Pradhan

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Socio-Economic Benefits

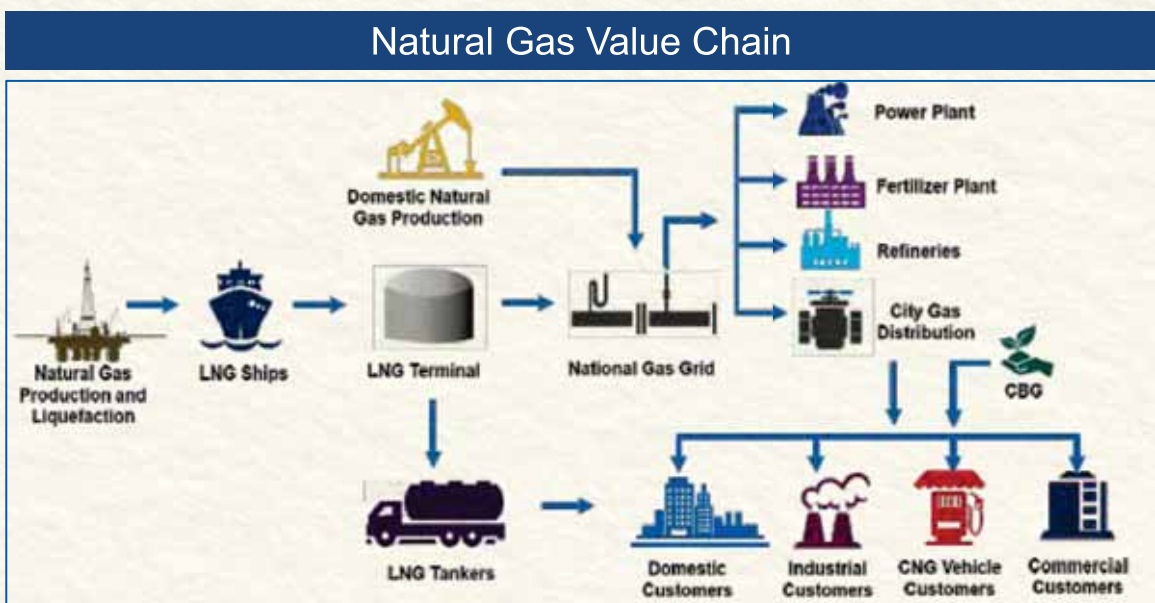


1.Introduction

1.1 Natural Gas Value Chain



- ❖ Natural Gas is the cleanest burning fossil fuel produced from oil and gas wells.
- ❖ Natural Gas upon cooling to -162°C becomes liquid, and is called Liquefied Natural Gas (LNG). Upon liquefaction, the volume reduces by 600 times.
- ❖ In FY 2019, ~53 percent of India's annual consumption of Natural Gas was met by domestically produced gas. Remaining ~47 percent was imported as Liquefied Natural Gas (LNG)*.
- ❖ LNG is stored in LNG regasification terminals where it is re-gasified to gaseous form.
- ❖ The domestically produced Natural Gas and re-gasified Natural Gas is transported to consumers through Natural Gas pipelines.
- ❖ City Gas Distribution (CGD) network is an interconnected network of pipelines in a geographical area for supply of Natural Gas as fuel to domestic households, industries and commercial establishments through Piped Natural Gas (PNG) connections.
- ❖ The CGD network is also used to supply Natural Gas to retail outlets situated in a specified city or district, where it is further compressed before filling into vehicles as Compressed Natural Gas (CNG).

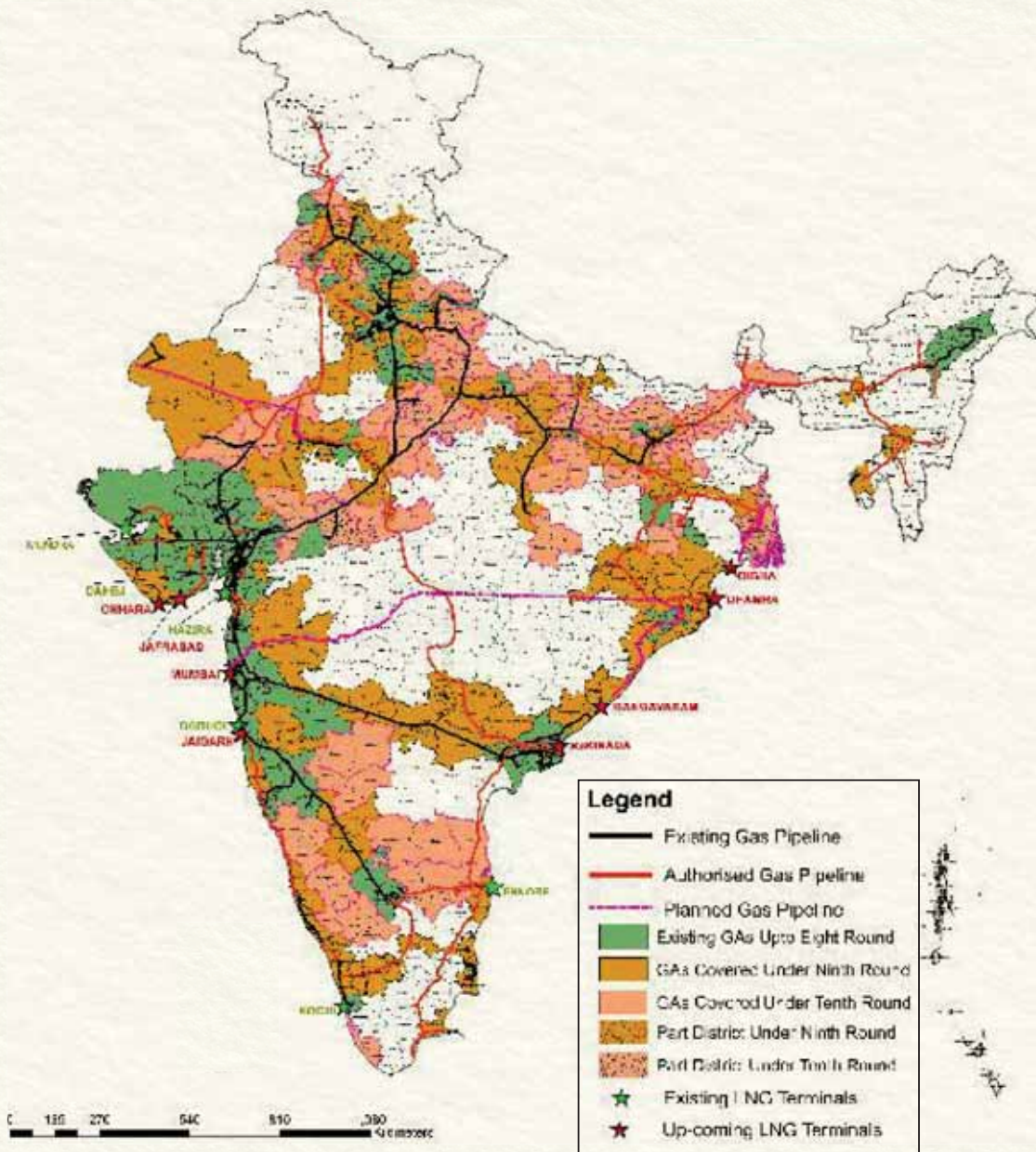


*Source: Petroleum Planning and Analysis Cell – Ready Reckoner November 2019

1.2 Natural Gas Infrastructure



- ❖ The Ministry of Petroleum and Natural Gas (MoPNG) along with Petroleum and Natural Gas Regulatory Board (PNGRB) is focused on development of Natural Gas infrastructure within the country.
- ❖ The existing Natural Gas infrastructure is depicted in the map* below:



*Source: Petroleum and Natural Gas Regulatory Board

1.3 Snapshot of CGD Sector



- ❖ As on October 1st, 2019, there are around **55 lakh domestic household connections** and around **1,838 CNG stations** in the country.*
- ❖ Under the PNGRB Act 2006, PNGRB grants authorization for development of CGD network in specified Geographical Areas (GAs), spread over Municipal limits/City/District (s). Coverage of CGD network has been expanded to **232 GAs, spread over 407 districts across 27 States/UTs**. It has potential to make gas accessible to **70 percent** of Country's population.**
- ❖ The **investment** across the CGD sector is estimated to be around **INR 90,000 crore in next 5-7 years**.
- ❖ This will lead to direct and indirect **employment generation for around 3.5-4 lakh people[#]** across India.
- ❖ It would also facilitate access to clean and **affordable energy to over 4 crore households by 2027[#]** and hence contribute towards betterment of the health and environment.
- ❖ The expansion of the Natural Gas infrastructure and CGD sector in particular will lead to various opportunities across Natural Gas value chain.

Source: *Petroleum Planning and Analysis Cell – Ready Reckoner November 2019

**Petroleum and Natural Gas Regulatory Board

[#]GAIL (India) Ltd.



2. Opportunities

2 Opportunities



- ❖ In India, demand of Natural Gas is on an upswing. A number of nationwide initiatives like Make in India, Swachh Bharat, and Smart Cities would spur the growth of economic activities in the country and would push for greater demand of gas in the economy.
- ❖ This will lead to various opportunities across various segments as below.

| | |
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2.1 CNG for Intracity Buses



Overview

- ❖ The transport sector and particularly the road transport contributes maximum in the production of CO₂ emissions.
- ❖ Among all the oil consuming sectors, **CO₂ emissions from transport sector are increasing** at more than 6 percent per annum*.
- ❖ At COP21 Paris Convention, India has committed to **reduce greenhouse gas emission intensity of its GDP by 33-35 percent** below 2005 levels by 2030.
- ❖ CNG has many advantages which makes it a preferred fuel.
 - ❑ CNG has **lower CO₂ emissions** as compared to diesel and petrol.
 - ❑ CNG has higher octane rating and has **efficiency advantage** over diesel and petrol.
 - ❑ Being cheaper than diesel and petrol, CNG is a **cost effective** fuel.
 - ❑ CNG is a **safer fuel** and is less likely to auto-ignite on a hot surface.

Global References

- ❖ **China** – It has the **world's largest Natural Gas Vehicle (NGV) fleet** of 6 million vehicles approximately (3.7 percent of the country's total vehicles).
- ❖ **Europe** – **Natural gas buses and trucks are forecasted to have a market share of 33 percent and 25 percent respectively by 2030.** Today, over 1.4 million Natural Gas Vehicles (NGVs) are plying on European roads and are expected to reach 13 million by 2030. As of September 2019 these NGVs are supported by 3,665 CNG stations and 214 LNG stations#.

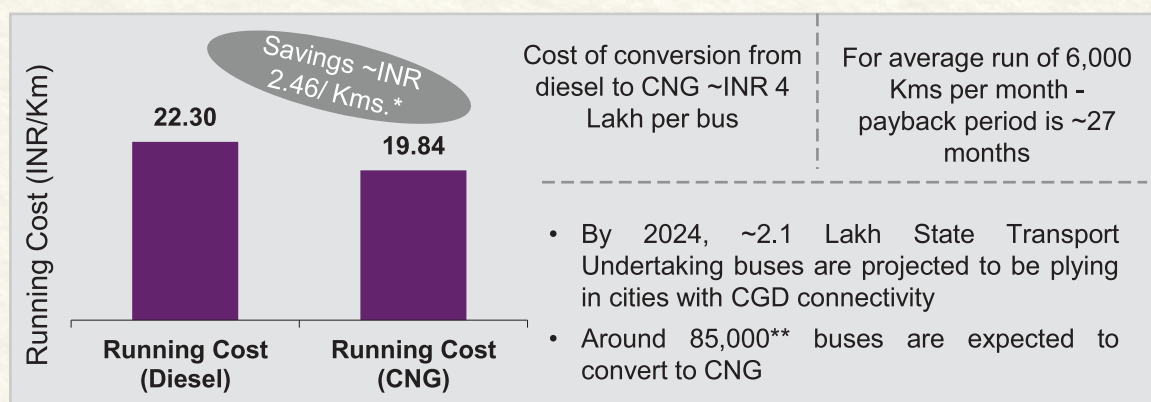
2.1 CNG for Intracity Buses



Benefit and opportunities for the country

- ❖ **Cost Effectiveness:** Natural Gas (as CNG) being cheaper as compared to diesel would help in reduction of operating cost for the State Transport Undertakings (STUs).
- ❖ **Lower Maintenance Costs:** Since CNG is a clean fuel, CNG buses require significantly less maintenance as compared to diesel buses.
- ❖ **Improved Vehicle Performance:** Natural Gas engines are superior in performance because Natural Gas has comparatively higher octane rating, as compared to diesel.

Comparative Assessment of Diesel and CNG Bus[#]



Net Savings[#]
(For ~85,000 buses)
~INR 5,690+ crore

=

INR 9,020+ crore
Running cost savings
(2020-24)

—

INR 3,330+ crore
Incremental/
Conversion cost



Support Required

- Policy support from the states for induction of CNG based bus fleet in respective STUs.
- Facilitate establishing of CNG infrastructure within STU depots.
- Rationalization of road taxes & registration charges by the states for CNG vehicles, as they can be classified as green vehicles.

Assumptions

*Price of Diesel and CNG considered – INR 66.9 / Litre and INR 53.58/Kg respectively

*Diesel mileage – Bus – 3 Kms/ Litre, CNG mileage – Bus – 2.7 Kms/Kg

** Assuming a conversion of ~40 percent over next 4 years

Source: #GAIL (India) Ltd.

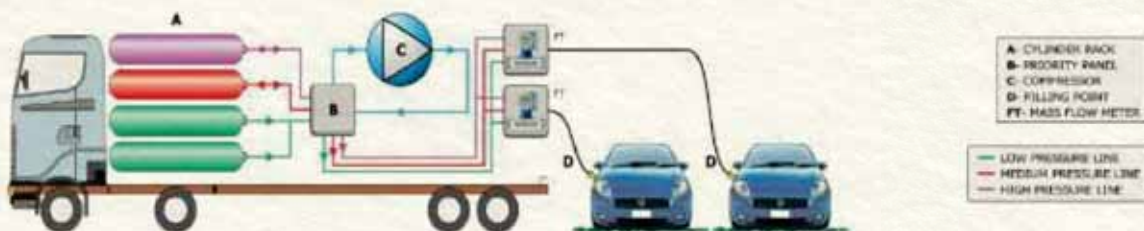
2.2 Mobile Refueling Units



Overview

- ❖ The Mobile Refueling Unit (MRU) system contains all the necessary working components of fixed stations, and depending on the design, could supply LNG, CNG or both. Hence MRU is a cost effective solution to the existing gap in infrastructure for CNG distribution.
- ❖ MRUs can be used effectively in areas with land constraints and for faster cost effective deployment of CNG dispensing infrastructure in new Geographical Areas.
- ❖ With the growing demand for natural gas fueling, the MRUs can be deployed immediately and operationalized in a few days as compared to months taken by traditional CNG stations thereby accelerating the development of CNG ecosystem.

A Typical Mobile Refueling Unit Setup



Global References

- ❖ **Mobile LNG/CNG refueling station** - It is a completely pre-fabricated and transportable LNG/CNG refueling unit. *Spain, Germany and France* have exhibited considerable success in implementation of such mobile systems.
- ❖ **LNG Blue Corridors projects** – This project has 14 LNG stations being developed by 27 participants from 11 countries namely *Spain, Netherlands, Portugal, Italy, Belgium, Croatia, UK, France, Germany, Slovenia and Sweden*.
- ❖ **Virtual Pipelines** – This concept is used to serve customers beyond the gas grid like multiple remote communities, mines, railways, buses, trucking and power generation users. These are essentially **plug-and-play systems**, “**re-deployable CNG In a Box**” for trucks and buses at various fueling stations.



2.2 Mobile Refueling Units

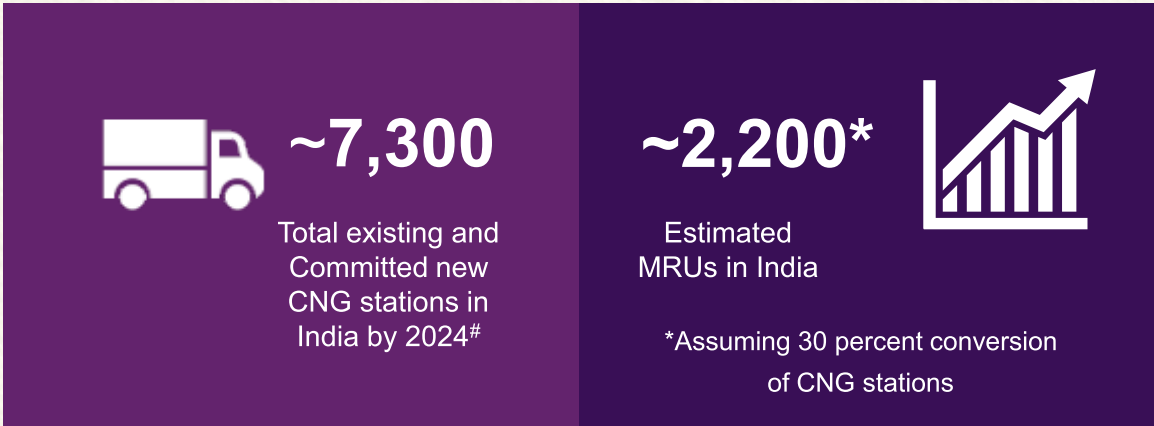



Benefits and Opportunities for the Country

- ❖ The MRUs may be used for a wide range of applications such as standby units for maintenance shut down, filling vehicles in remote project sites, and to serve as peak shaving during high demand periods.

Key Benefits of Mobile Refueling Units

- It is an efficient solution for market seeding since it is cheaper and faster to deploy
- Reduction in Service cost (O&M expense) of CNG stations
- It is an effective solution for Transporters, Taxi aggregators, School vans etc.
- Help in congestion management at existing CNG stations
- Help in increasing geographical reach to areas with Ltd. pipeline connectivity (hilly terrains etc.)



- 
Support Required
- Promotion of MRUs through an expeditious approval process by PESO and respective state administration by waving of DM NOC.
 - MRUs may be considered as CNG Stations for the purpose of committed work program by PNGRB.

Source: #Indraprastha Gas Ltd.

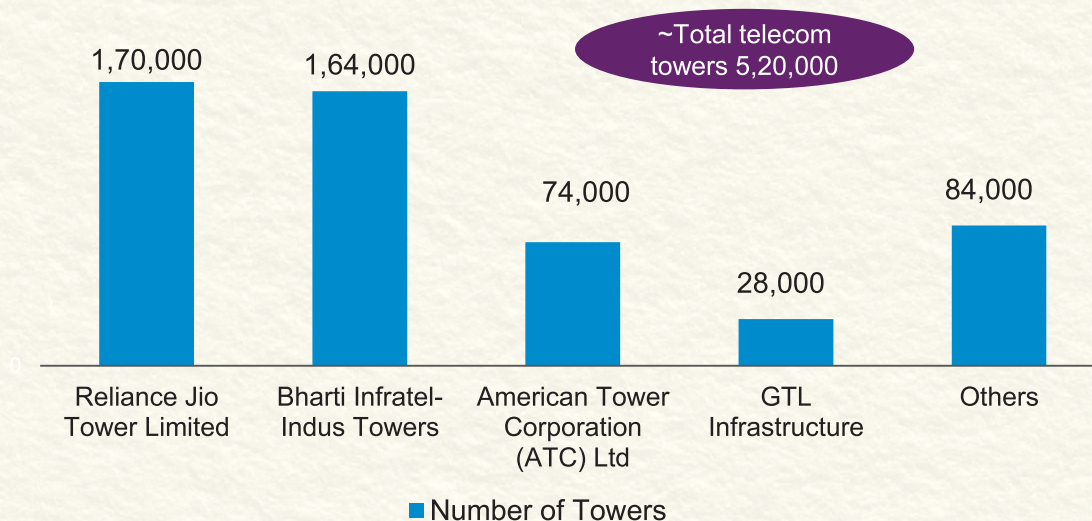
2.3 Gas Generators in Telecom Service Towers



Overview

- ❖ Telecom towers are located all over the country and draw primary and backup energy from a myriad of conventional sources.
- ❖ There are over 5.20 Lakh telecom towers in the country.
- ❖ Majority of the telecom towers use diesel generators for power back up. The diesel generators are highly polluting sources of power backup.
- ❖ Natural Gas based generators provide an environment friendly alternative, at a lower cost as against the diesel based generators.

Key Players in the Telecom Tower Market*



National Scenario

- ❖ **65 percent** of telecom tower sites **use diesel generator sets as primary source** of power backup.
- ❖ **15 percent** of sites **use diesel generator sets as base load** and such instances are mostly found in remote areas.
- ❖ **20 percent** of sites **use other sources of energy** like solar power UPS etc.
- ❖ **Commonly used** genset capacities are **25KVA (80 percent), 125KVA (15 percent)** and others 5 percent.



2.3 Gas Generators in Telecom Service Towers



Benefit and Opportunities for the Country

❖ The majority of the towers in the country could benefit from connectivity of CGD pipeline, while the others can use solar power till further development.

| <u>Opportunity in India</u> | <u>Cost Benefit Analysis</u> |
|---|---|
| <ul style="list-style-type: none">• Addressable market for conversion to gas generators is estimated to be ~1.8 lakh towers.• The market is expected to grow at a CAGR of 3 percent over the next 4-5 years.• Assuming 20 percent of existing and upcoming telecom towers use gas generator as back-up fuel, the total realizable potential is estimated to be around 32,070 towers. | <ul style="list-style-type: none">• The cost of retrofitting a 25KVA DG set is ~INR 3 lakhs, while the cost of a new 25KVA Gas based generator set is ~INR 5 lakhs*.• The cost of retrofitting a 125KVA DG set is ~INR 6 lakhs, while the cost of a new 125KVA Gas based generator set is ~INR 13 lakhs*.• For an average outage of 4 hours per day, annual consumption of 5,760 litre of diesel may be replaced by Natural Gas.• Total annual diesel savings for 32,070 towers is estimated to be 184.7 million litre (0.18 percent of India's diesel consumption). |

| Particulars | Payback (Retrofit) | Payback (New) |
|-------------|--------------------|---------------|
| 25 KVA | ~12 Months | ~20 Months |
| 125 KVA | ~5 Months | ~10 Months |

| | |
|---|--|
|  Support Required | <ul style="list-style-type: none">• State Pollution Boards to promote the conversion of DG sets installed for telecom towers to Natural Gas fueled generators.• Consider telecom towers powered by Natural Gas generators as White Category Industries for environmental clearance. |
|---|--|

Source: *Indraprastha Gas Ltd.

2.4 Vendor Development for Equipment and Spares for CGD Sector



Overview

- ❖ Domestic **PNG and CNG segments have grown at a CAGR of 15.1* percent and 14.4* percent respectively** from FY 2015 to FY 2019 and are further expected to grow in years to come.
- ❖ By 2027, PNG connections and CNG stations would increase to ~4.9 crore and 10,000 respectively#.
- ❖ Currently, India has Ltd. capacity to meet the estimated demand for equipment and spares related to CGD sector. This provides opportunities for setting up of new facilities and expansion of existing capacities in the country.

Key Equipment in CGD Sector

Online / Booster
Compressor

CNG
Dispensers

CNG Cascade

CNG Kit-
Retrofitting

PNG
Mechanical /
Smart Meters

Steel Pipes

Regulators /
Valves and
fittings

PE / GI / Cu
pipes and
fittings

Global References

- ❖ **Natural Gas filling stations are increasing** globally, **particularly in Asia-Pacific**, due to increasing focus on using Natural Gas as a fuel for transportation.
- ❖ **Countries in Asia-Pacific** such as China, New Zealand, Japan, South Korea and Australia **constitute the world's largest and fastest-growing meter market**.
- ❖ United Kingdom (UK), to increase collaboration and facilitate knowledge sharing among Natural Gas stakeholders, has introduced a **“Supplier Development Programme”**. The programme is helping to improve the competitiveness of local businesses in the Natural Gas sector.

Source: *Petroleum Planning and Analysis Cell

#GAIL (India) Ltd.

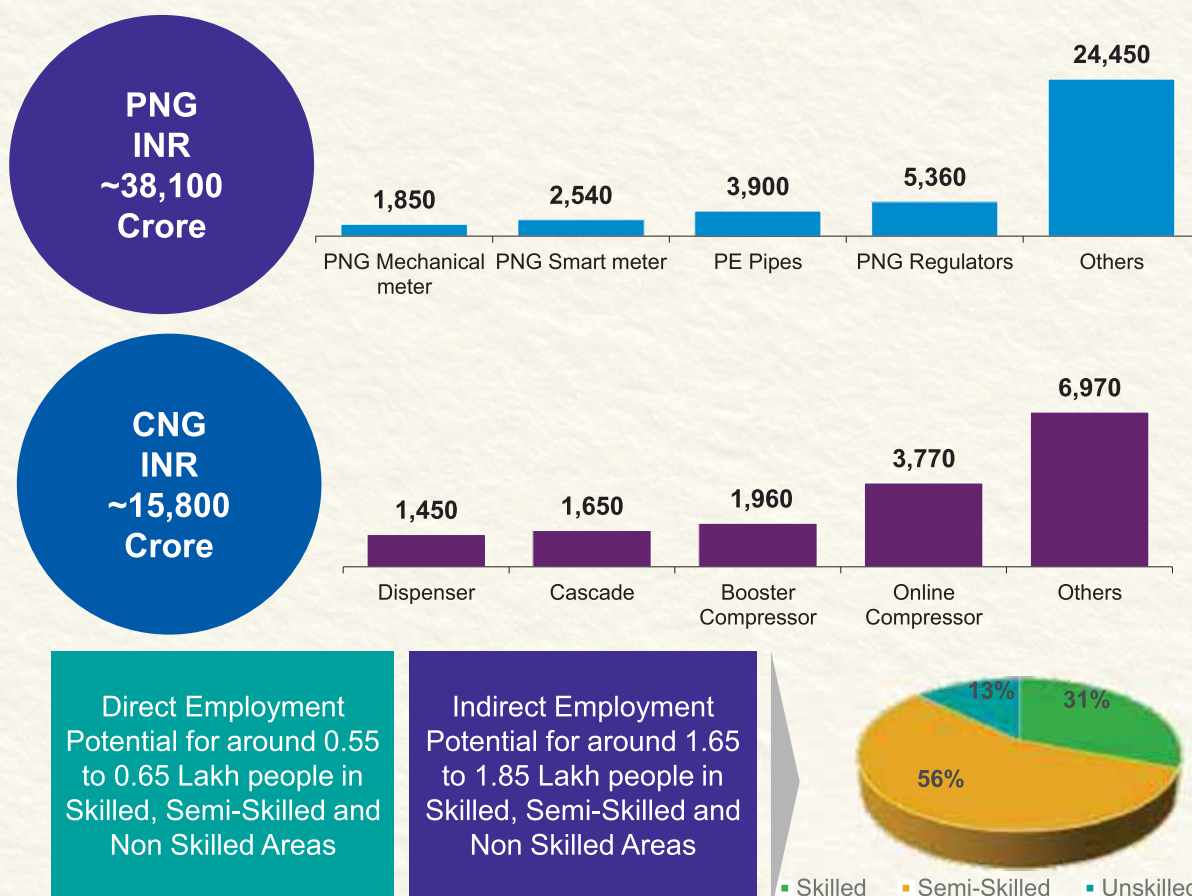
2.4 Vendor Development for Equipment and Spares for CGD Sector



Benefit and opportunities for the country

- ❖ Massive opportunities to build and expand the manufacturing of various PNG and CNG related equipment for meeting the demand within the country.
- ❖ Augmentation/ creation of the manufacturing facilities under “Make in India” campaign will create direct and indirect employment opportunities within the country.

Estimated market size (2024) (INR Crore)#



Support
Required

- States to promote development of manufacturing units for the CGD sector.
- Skill sets required in the CGD sector to be promoted in State ITIs.

Source: #GAIL (India) Ltd.

Others in PNG include GI pipes, isolation valves, copper pipes, Appliance valves etc.

Others in CNG include piping and fittings, fire fighting systems, electrical and instrumentation

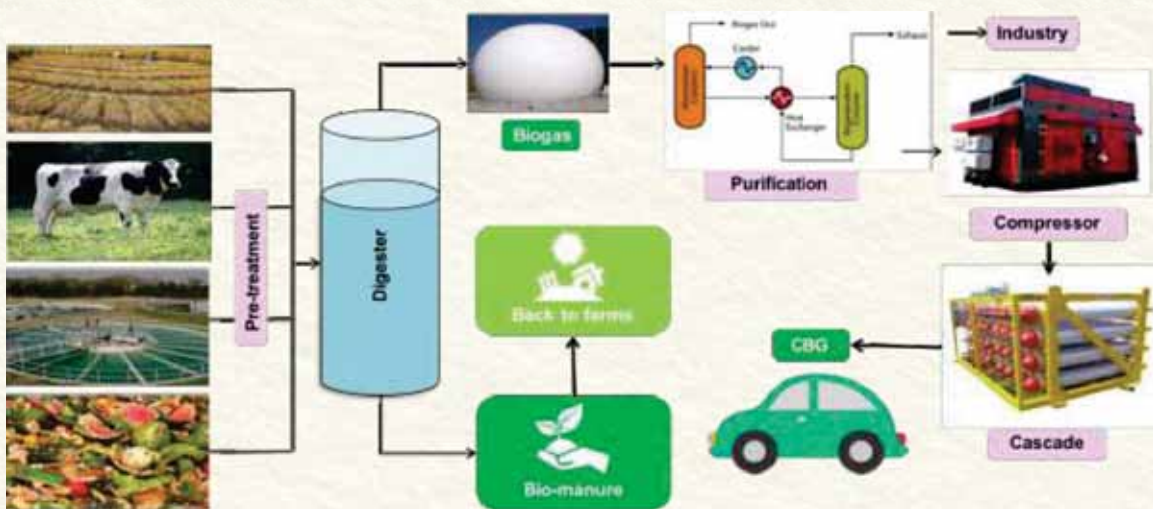
2.5 Compressed Bio-Gas (SATAT Scheme)



Overview

- ❖ Bio-Gas is produced naturally through a process of anaerobic decomposition from waste / bio-mass sources like agriculture residue, cattle dung, sugarcane press mud, municipal solid waste, sewage treatment plant waste, etc.
- ❖ Bio-Gas is similar to the commercially available natural gas in its composition and energy potential.
- ❖ Given the abundance of biomass in the country, Compressed Bio-Gas (CBG) has the potential to replace CNG in automotive, industrial and commercial uses.
- ❖ The production process of Bio-Gas also generates Bio-Manure which has a potential to replace fertilizers used by farmers.

Compressed Bio Gas Value Chain



Global References

- ❖ Globally, **Germany is the world leader** in usage of bio-gas with ~8,980 Bio-Gas plants and produces around 10 billion cubic meter (BCM) Bio-Gas annually (2018).
- ❖ Germany plans to **replace 10 percent of the total consumption of natural gas with CBG across the country by 2030.**
- ❖ In **France**, as on March 31, 2019, there were **63 Bio-Gas units producing electricity, with total installed capacity was 460 MW.**

2.5 Compressed Bio-Gas (SATAT Scheme)



Opportunity and Benefits to the Country

- ❖ Sustainable Alternative Towards Affordable Transportation (SATAT) was launched on 01.10.2018 by the Govt. of India. The scheme offers an opportunity to entrepreneurs to set up compressed Bio-Gas (CBG) plants.
- ❖ Under the SATAT scheme, total 5,000 CBG plants have been envisaged by 2023, which will produce around 15 MMT of CBG per annum.

Potential in the Country

- It has been estimated that there are six major sources from which CBG can be synthesized in India – Recoverable Cattle Dung, Bagasse, Agri residue, Sewage Treatment Plant, Municipal Solid Waste and Spent Wash/Press Mud.
- The total CBG potential in India has been estimated to be ~62 MMT. 5,000 CBG plants with production capacity of 15 MMT has been envisaged by 2025 with an investment potential of INR 1.75 lakh Crore, and direct employment to 75,000 people.

Benefit to the Country

- As per international carbon accounting standards, CBG has 'zero' associated Carbon emissions.
- Reduction in emissions due to crop burning.
- Reduction in landfill emissions due to municipal and sewage waste.
- Opportunity for budding entrepreneurs to set up new CBG plants thereby generating employment opportunities for locals.

- ❖ The investment required for a **CBG plant is approximately INR 15-50 Cr**, depending upon the capacity of the plant, feedstock type and technology used.
- ❖ Based on the revenue generated from the sale of CBG, it has been estimated that the **breakeven for the initial investment can be reached in 4-6 years**.



Support
Required

- **Policy support for developing Biomass supply chain for Biofuel projects.**
- **Inclusion of CBG Plants in White Category Industries for Environmental Clearance.**
- **Policy support to facilitate use of CNG and Bio-manure in Smart cities, large Municipal Corporations, Sugar industries.**

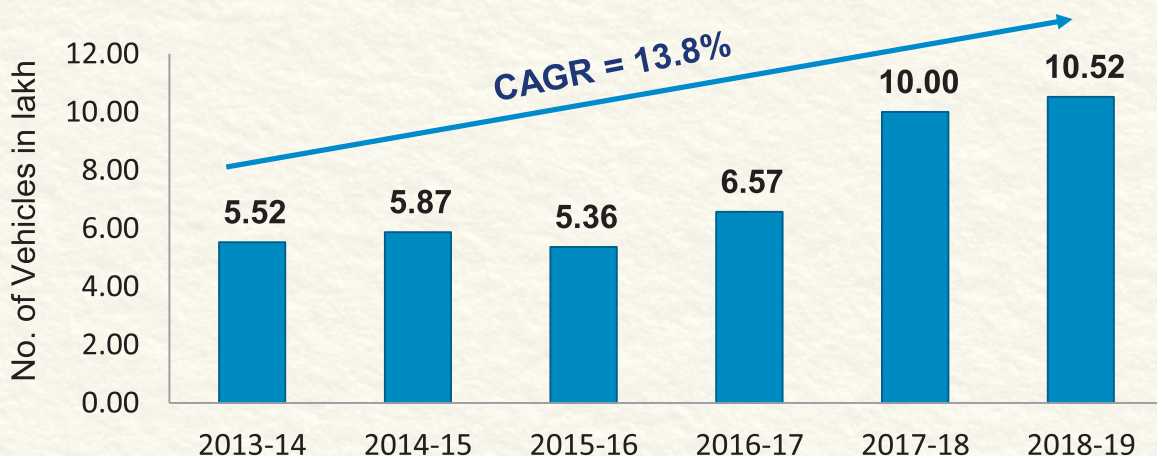
2.6 LNG in Long Distance Transport



Overview

- ❖ In 2018, India registered sales of over 1 million units of commercial vehicles of which 40 percent were medium and heavy commercial vehicles.
- ❖ Number of commercial vehicles in India is expected to increase by ~4 times by 2040; whereas globally the growth is expected to be ~2 times*.
- ❖ LNG has been gaining prominence globally as an environment friendly transport fuel.

Commercial Vehicle Sales and Growth in India (FY14-FY19)[#]



Global References

- ❖ **China** has more than **2,30,000 LNG trucks** and around **3,000 filling stations** (CNG and LNG) as of 2017.
- ❖ **In Europe over 6,000 LNG fueled trucks** are supported by **214 LNG filling stations**.
- ❖ **USA has 1,000 operational LNG transit buses** along with **144 filling stations**.

Sources: *India Brand Equity Foundation (IBEF)

[#]Ministry of Commerce and Industry, Secondary Research

2.6 LNG in Long Distance Transport



Benefit and Opportunities for the Country

- ❖ LNG is approximately 15 percent to 25 percent cheaper than diesel, which will lead to savings in the operating cost for the State Road Transport Undertakings in the country.
- ❖ LNG is a Euro VI compliant fuel and necessary amendments have been done in the Central Motor Vehicle Rules to recognize LNG as a auto fuel like CNG.
- ❖ Since the range (Km. travel) of an LNG truck is notably more, the frequency of refilling reduces significantly which would need fewer fueling stations.

Opportunity in India

- By 2024, India is estimated to have total ~1 Crore buses & trucks.
- Assuming a conservative conversion to LNG vehicles of **~1 percent** the potential opportunity for LNG buses and trucks is **estimated to be around ~1 lakh buses and trucks.**



Cost Benefit Analysis

- The incremental investment of procuring new LNG bus/truck over Diesel bus/truck is ~INR 9 lakh.*
- Per km savings on operating cost @INR 3.1 per km, amounting to INR 3.4 lakh# per annum.
- The payback period for the incremental investment on new LNG bus/truck ~2.7 years.#



Total savings worth ~INR 42 lakh per bus/truck over the service life of vehicle #

Total savings for 1 lakh vehicles is estimated to be ~INR 3,436 Crore per annum#



**Support
Required**

- Promoting usage of LNG in long distance buses under STUs.
- PNGRB support in facilitating the setting up of LNG refueling station across the country.
- Rationalization of import duty on LNG bus/trucks treating them at par with Electric Vehicles.

Assumptions

#Price of Diesel and LNG considered – INR 66.9 / Litre and INR 56 /Kg respectively

#Diesel mileage – bus/truck – 4 Kms/ Litre, LNG mileage – Bus/truck – 4 Kms/Kg

#Assuming a bus/ truck runs for 300 Kms per day

Source: *Industry interactions, Secondary Research, Indian Oil Corp. Ltd.

2.7 LNG as fuel in Inland Waterways



Overview

- ❖ India has about 14,500 km of navigable inland waterways which comprise of rivers, canals, backwaters and creeks.
- ❖ Globally, domestic waterways are found to be a cost effective as well as environment friendly means of transportation.
- ❖ There are 111 officially notified Inland National Waterways (NWs) in India identified for the purpose of inland water transport, out of which 5 major ones are operational.
- ❖ LNG can serve as an efficient eco friendly fuel for transportation on these waterways.
- ❖ The *International Maritime Organization has mandated a cap of 0.5 percent Sulphur on marine fuels, to be implemented by 2020*. This has provided impetus to LNG as a marine fuel from the international marine community.

Top five Major Inland National Water Ways

| Waterway | Length (KM) | State Served |
|---|-------------|---|
| NW-1: Ganga (Haldia to Allahabad) | 1,620 | UP, Bihar, Jharkhand & WB |
| NW-2: Brahmaputra (Dhubri to Sadiya) | 891 | Assam, WB, Meghalaya, Arunachal Pradesh |
| NW-3: West Coast Canal (Kollam to Kottapuram) | 205 | Kerala |
| NW-4: Godavari, Krishna & Canals (Kakinada to Puduchery) | 1,078 | Andhra Pradesh, Tamil Nadu, Puducherry |
| NW-5: Brahmani, Delta Canals, ECC (Goenkhali to Talcher) | 588 | Odisha, WB |

Global References

- ❖ In July 2019, Europe's first inland-waterway LNG bunker vessel performed its first bunkering operation in Netherlands with LNG-powered container ships.
- ❖ In June 2019, a Netherlands based Co. opened the first shore-to-ship LNG bunkering facility in Germany on the Rhine River, making LNG available to inland shipping.

2.7 LNG as fuel in Inland Waterways



Benefit and Opportunities for the Country

- ❖ LNG is approximately 15 percent to 25 percent cheaper than diesel, which will lead to savings in the operating cost for the shipping companies.
- ❖ LNG has potential to address insistent requirement of a clean and environment friendly fuel because of its low level of harmful emissions.

Opportunity in India

- Freight transportation by waterways is highly under-utilized in India, as compared to developed countries.
- Inland Water Transport is relatively a cheaper mode of transport as compared to Railways or Roads.
- Several projects are being implemented by the Inland Waterways Authority of India (IWAI) to develop requisite infrastructure along the waterways.



Cost Benefit Analysis

- The incremental cost for retro-fitment to dual fuel (60 percent LNG and 40 percent Diesel vessel)* is expected to be around ~INR 1.5 crore and ~INR 4 crore* for 100 percent LNG retro-fitment.
- Average annual savings on operating cost amounts to ~INR 38.5 lakh due to cheaper LNG as compared to diesel.



For a retrofitted dual fuel vessel, the payback period comes out to be 3 years and 10 months.

For a retrofitted (100 percent LNG vessel), the payback period comes out to be 6 years and 2 months.



**Support
Required**

- States with Inland Waterways to promote usage of LNG for cargo boats/ships.
- Policy support from the states for providing necessary land and allied infrastructure to set up LNG bunkering en-route Inland Waterways.

Source: *Primary data from industry stakeholder consultations

2.8 LNG Bunkering in Fishing/Sea-going Vessels



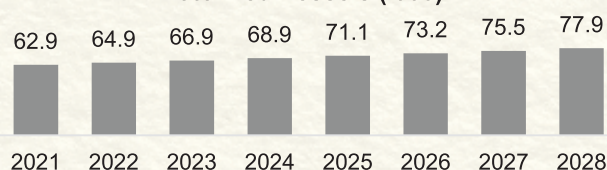
Overview

- ❖ LNG bunkering pertains to use of LNG as a fuel in shipping vessels.
- ❖ There is a huge opportunity for India in LNG bunkering owing to the vast coastline.
- ❖ While the sea going vessels will take time for conversion, LNG bunkering in fishing vessels appears to be low hanging opportunity to tap on.
- ❖ India is the second largest producer of fish and fish products in the world. The fishing sector in India has a fairly large vessel count of ~2,60,000 vessels. Trend of using dual-fuel systems (LNG & Diesel) in fishing vessels is being explored globally.

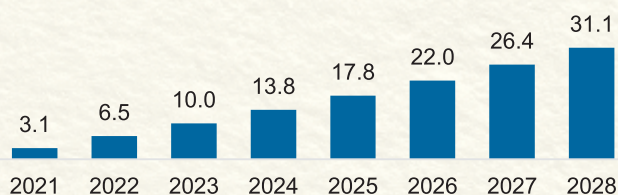
Huge Bunkering Potential Along the Coast Line

Potential for all LNG bunkering in Fishing vessels[#]

Estimated Market Size – Mechanized & Motorized Vessels ('000)



Estimated Market Size – LNG Fishing Vessels ('000)



Total coastline of 7,517 km
(9 States & 4 UTs)



Global References

- ❖ LNG bunkering in fishing vessels has been noted to be used across **Europe, North America, Panama Canal, Dominican Republic and Asia.**
- ❖ Dual fuel operations is preferred due to space limitation for LNG storage & HSD as back up option – **Globally 69 percent of Vessels operating on LNG are on dual fuel mode.**

2.8 LNG Bunkering in Fishing/Sea-going Vessels



Benefit and Opportunities for the Country

- ❖ India being home to large number of fishing vessels can play a significant role through use of LNG in fishing vessels to lower the carbon footprint.
- ❖ Further, the cost advantage of LNG as compared to diesel leads to substantial savings.

Opportunity in India

- Addressable market for conversion to LNG is estimated to be **~69,000 fishing vessels by 2024.**
- The market is expected to be growing with a CAGR of ~3 percent[#] over the next 4-5 years.
- Assuming a 20 percent conversion to LNG vessels, the potential opportunity for LNG fishing vessels is **estimated to be ~13,800 LNG vessels.**



Cost Benefit Analysis

- The incremental cost for an LNG shipping vessel is expected to cost around ~INR 15 lakhs (for a 450 liter tank capacity and other fittings)*.
- Average annual savings on operating cost amounts to ~INR 8 lakhs due to cheaper LNG as compared to diesel.
- The payback period for a fishing vessel is hence estimated to be ~2-3 years.



Total savings worth ~INR 96 lakh per vessel over the service life of vessel[^]

Total savings for 13,800 vessels is estimated to be ~INR 1,069 Crore per annum



**Support
Required**

- States to promote LNG in fishing vessels.
- Policy support for setting up infrastructure for LNG refueling and bunkering at fishing harbors and ports.

^{*}Source: Primary data from industry stakeholders, vendors and suppliers; [#]State Fisheries Department

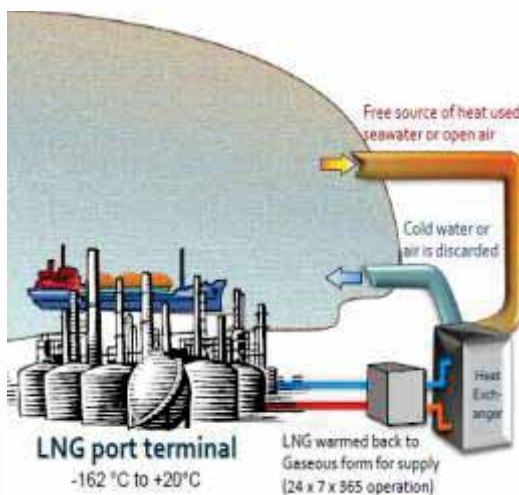
2.9 LNG for Cold Warehouse



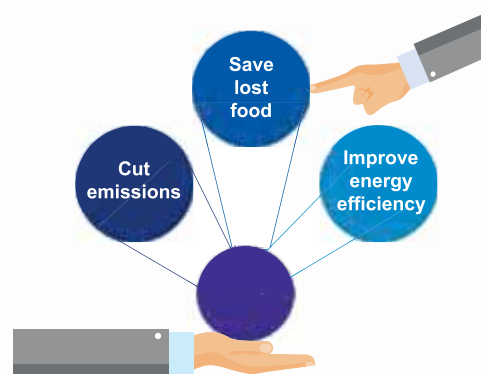
Overview

- ❖ Currently in India, lack of cold and frozen supply chain leads to loss of fruits and vegetables worth thousands of Crore annually. It is estimated that ~16 percent of the total food grain, fruits, vegetables and fishes produced in India, is wasted annually due to lack of cold warehouse facilities.
- ❖ The cold energy used for regasification of LNG, which otherwise is discarded into sea or air can be utilized in the cold storages.
- ❖ These cold warehouse can act as an in-transit warehouse which can help in increasing the life of perishable goods to be exported.
- ❖ Further, it can help in planning the export of perishable goods well in advance.

Potential Solution for Saving Wastage of Food



Offers an opportunity to



Global References

- ❖ Japan, the third largest importer of LNG worldwide, has made the most progress in utilizing the LNG cold energy till now.
- ❖ Across US and Russia cold chains have been setup near LNG terminals for storing food grains, fishes & meats.

2.9 LNG for Cold Warehouse



Benefit and Opportunities for the Country

- ❖ The usage of the waste energy for cold warehouse will serve to enable the country in ensuring food security by avoiding wastage of food.
- ❖ Further, the usage of waste energy also leads to increasing efficiency thereby helping to generate additional revenue.

Total export

Export of perishable goods from States with LNG terminals[#]

~4 MMT



New cold warehouse capacity*

Cold Warehouse Capacity estimated from 15 percent utilization of available & upcoming LNG Re-gas capacity

0.39 MMT



New cold warehouse capacity

Cold warehouse capacity met by new capacity[#]

10%



The total investment required for the same is estimated to be INR 945 Cr

Savings

Food wastage avoided per year (people equivalent)

7.6 lacs



Support Required

Encourage PPP models for successful implementation of LNG based cold warehouses.

**Cold warehouse capacity that can be created from 1MMTPA LNG is~0.05 MMT*

Sources: International Journal of Agriculture and Food Science Technology, National Center for Cold Chain Development, [#]GAIL (India) Ltd.; Secondary Research, Analysis of available data

2.10 Inclusion of Natural Gas in GST regime



Overview

- ❖ Currently Natural Gas is taxed under the VAT regime with VAT varying from 3 percent to 20 percent across states, while most downstream products are taxed under the GST regime.
- ❖ As Natural Gas is not under the ambit of GST, there is no input tax credit available. Further, the downstream industries are not able to claim benefit of tax credit of VAT paid on purchases of Natural Gas which is available for alternate fuels/feedstocks.
- ❖ Cost of imported LNG is adversely affected by GST as regasification activities (which forms around 12 percent to 15 percent of total cost of RLNG) attract GST and tax credit of the same is not available against sale of RLNG.
- ❖ Companies are forced to accommodate such tax costs in final selling price of Natural Gas which increases the cost of industrial inputs for end consumers.

Benefits of inclusion of Natural Gas in GST Regime

Results into increase in State Domestic Product and socio-economic development owing to increased economic activities



Increase in economic activity will lead to employment opportunities in the country



Lead to improved investor confidence and attract more investment in natural gas infrastructure in the country



Positive impact on environment and health due to reduction in carbon emissions across major cities



Global References

- ❖ Argentina, Brazil, China, European Union, Indonesia, Mozambique, Nigeria, Norway, Russia, UAE, UK follow the VAT regimes while Australia and Canada follow GST regime.
- ❖ All the countries across the world have **uniform taxation** structures within their respective geographies.
- ❖ **Tax credits are available** across products and industries, in all regimes.



Support
Required

Inclusion of Natural Gas in GST to enable transition towards a gas based economy hence contributing towards the socio economic development of the country.



3.Socio-Economic Benefits



3.1

Opportunity Wise – Socio-Economic Benefits

| Opportunity | Investment (INR Crore) 2024 | Employment Numbers* |
|---|--------------------------------|------------------------|
| CNG for Intracity Buses | 3,330 | 10,000 |
| Gas Generators in Telecom Service Towers | 1,240 | 3,500 |
| Vendor Development in Equipment and Spares | 53,900 | 2,56,200 |
| Compressed Bio-gas (SATAT Scheme) | 1,75,000 | 75,000 |
| LNG in Long Distance Transport | 40,500 | 45,000 |
| LNG Bunkering in Fishing Vessels | 2,800 | 7,500 |
| LNG for Cold Warehouse | 945 | 2,800 |
| Total | 2,77,715 | 4,00,000 |

*Includes both direct and indirect employment over next 5-7 years



3.2

Overall Socio-Economic Benefits

1



Investment

Investment opportunity of around **INR 2.8 lakh Crore** has been estimated due to the various opportunities in the Natural Gas value chain over next 5-7 years.

2



Employment

Capitalizing on the opportunities will boost direct and indirect employment, particularly in the **CGD, CBG and transport sector**.

Employment for **4.0 lakh manpower** is expected to be generated in the country due to investment in the Natural Gas value chain.

3



Environment

Promoting use of Natural Gas in Automobiles, Industries, Commercial units and households will reduce air pollution significantly as Natural Gas is one of the cleanest fuel. Considering the health cost associated due to the rising levels of air pollution, **Natural Gas is going to be the future of fossil fuel.**

| CGD Companies | Contact Details |
|------------------------------------|---|
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पेट्रोलियम एवं प्राकृतिक गैस मंत्रालय
Ministry of Petroleum and Natural Gas



GAIL (India) Limited



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