

Skill Gap Study for Hydrocarbon Sector - 2025 and 2030

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Executive Summary

Background and introduction

India is the third largest consumer of Oil and Gas in the world. One-third of India's energy demand is met by the sector and given the growth trajectory of India's robust economic growth the demand for oil and gas is only expected to rise. Despite the COVID-19 induced slow down, the consumption of oil and petroleum products in India has grown at a CAGR of 3% in the last decade. In future, India's share in the global energy consumption basket is expected to grow two-fold by 2035.

India's hydrocarbon reserves are of the order of 41.87 million tons, of which over 75% are yet to discovered and harnessed. Having said that, India's consumption patterns have surpassed the production yield, and currently more than 85% of the oil demand of the country is met by imports. India's energy scenario is only expected to expand, given rising industrial levels and dynamic demographic factors. India's has rolled many efforts to increase the energy availability and reach in the country and the figure below presents a snapshot of the same.

Figure 1 Key drivers to propel growth for India's oil and gas sector

- Achieve refining capacity of 400-500 MMTPA by 2030 (from 251 MMTPA as of May 2022).
- Expanding the reach of fuel retailing by increasing the number of petrol/diesel retail outlets in the country.
- Ensuring access to clean cooking fuel through LPG coverage of 100% households in India.
- Increasing network of CNG retail outlets and PNG access for households through the city gas distribution network - 11 rounds of CGD have been commissioned with an intended coverage of 98% of the population.
- Increasing the natural gas and petroleum product pipeline network - multiple projects to add 20,000 kms of pipelines are being commissioned.
- Digitisation of processes along the hydrocarbon sector value chain for operational excellence and risk minimisation.
- Policy initiatives:
 - ▶ Push towards a gas-based economy. GOI aims to increase a share of natural gas in the energy basket from 6% to 15% by 2030.
 - ▶ Ease in entry policy and complete deregulation of petrol and diesel with the new marketing guidelines.
 - ▶ Increased use alternates and less polluting energy sources, like compressed biogas and other biofuels (such as ethanol).
 - ▶ Increasing domestic production to lower import dependency through Discovered Small Field Policy (DSF), Hydrocarbon Exploration Licensing Policy (HELP), Open Acreage License Policy (OALP), Incentivising Production from Ageing Field etc., aimed investment and participation of oil and gas companies for crude production.
 - ▶ 100% Foreign Direct Investment (FDI) in upstream and private sector refining projects.

Objectives of the study

Given the socio-economic significance of the sector for the country and its ongoing economic growth, the oil and gas sector will need to ensure availability of skilled and trained human resources to further the various developmental plans that are in the pipeline. Therefore, the Hydrocarbon Sector Skill Council, commissioned this study to estimate the industry demand for human resources in the sector till 2030. It also aimed to assess the supply-side imperative and get an insight into the

perspectives and the aspirations of the youth with respect to being employed in the oil and gas sector.

The study was conducted to assess the key value streams in the sector with highest manpower demand creation potential (with a focus on blue collared manpower demand) and suggest training and skilling models to address the talent needs. The results are aimed to highlight the job role specific manpower requirement, primarily for level 1 to level 6 job roles as per the National Skills

Qualification Framework (NSQF). This information will enable the planning and implementation of

skilling programs to ensure availability of pool of adequately training workforce for the sector.

Approach for the skill gap study

The study analyses the potential for employment generation till 2030 in the Oil and Gas sector across key activities along the value chain. The analysis has been done with a subsector lens to focus on the critical aspects in upstream, midstream and downstream segments that have the highest potential for creating incremental manpower demand.

The study undertook a consultative and participatory approach, engaging and interacting with key industry members, collecting data (both primary and secondary) and congregating factors through rigorous analysis to address project objectives. The project employed a **mix method design with a pragmatic blend of primary and secondary data analysis.**

Figure 2 Approach and key considerations for demand and supply side assessment

Demand side assessment
<ul style="list-style-type: none"> ▶ Extensive demand-side assessment was carried out to conduct industry landscape assessment by leveraging Industry diagnostic and intelligence reports, MoPNG annual reports and PIB announcements, Data and statistics by PNRGB, PPAC, DGH etc. ▶ Current and future projects were identified across the value chain such as greenfield and brownfield projects across refineries, processing plants natural gas and petroleum product pipelines, retail network, oil and gas production etc. ▶ Extensive SME interactions through surveys, focus group discussions and interviews, were held with industry members (accounting for ~80% market share) to design workforce estimation models to estimate demand by 2025 and 2030. ▶ Industry validations and inputs were sought to ensure that the estimations were in line market sense.
Supply side assessment
<ul style="list-style-type: none"> ▶ Assessment of existing training and skilling models and intuitional network for offering training to youth for oil and gas roles. ▶ Assessment of the youth aspiration to assess the perception of willingness and challenges.
Triangulated inputs to create list of recommendations
<ul style="list-style-type: none"> ▶ Suggest training and skilling intervention models to address workforce availability for roles with niche skill requirements and those roles that create workforce requirements at scale and speed. ▶ Recommend training areas and new skill requirements to meet the future projects and new diversified business areas of the oil and gas sector

Outcome of the skill gap study

Given the structure of the industry all the key activities across the entire value chain were categorized across - upstream, midstream and downstream to estimate the workforce demand. Growth in the Oil and Gas sector entails development of new or enhancement of existing infrastructure, which also involves engagement of construction services and manpower.

Therefore, workforce demand in the oil and gas sector can be categorised as:

- ▶ Construction workforce (usually required in high numbers for specific period).
- ▶ Operations and maintenance workforce: Core Oil and gas roles, permanent roles, (exception of disruptions such as technology, change of business, product phase out etc).

Various value chain segments in the Oil and Gas value chain may differ by how labour intensive each activity is.

- ▶ The ones that are labour intensive are more critical from perspective of creating demand for skilled workforce at scale.
- ▶ Further, some segments' actual growth is subject to variety of conditions, and their manpower demand thereof is relatively harder to estimate given the conditionality of its future projects (e.g., Upstream). On the other hand, there are some segments in the Oil and Gas value chain whose growth can be estimated with a relatively higher degree of probability based on industry inputs/forecasts and government policy directions, therefore the related workforce demand from such activities

also can be better estimated for future manpower planning.

- ▶ A combination of both the factors, i.e., extent of labour engagement and potential of forecasting of future growth of a segment, can help us to identify the areas that will most definitely need a pool of skilled talent to support the future projects.

A snapshot of the key value stream activities, key inputs and job roles across each and estimation of workforce demand is given below, as assessed from industry landscape studies and industry interactions. The demand estimation numbers pertain to the time period till 2030.

Figure 3 Snapshot of skill gap assessment - key value chain elements, key job roles and demand imperatives

Potential of incremental manpower in Upstream	
Key industry imperative	<ul style="list-style-type: none"> ▶ Decreasing production levels and increasing import dependency since 2012 ▶ 37% decrease in the number of exploratory wells drilled in the last 10 years ▶ Drivers for growth and future projects over the next 10-20 years <ul style="list-style-type: none"> ▶ 26 new field development plans have been approved during 2019-20 ▶ More than 75 unmonetized small fields with discoveries belonging to national oil companies will be auctioned out ▶ Contracts for exploration blocks signed across Madhya Pradesh, Gujarat and Maharashtra ▶ Occurrences of oil and gas reserves in Kutch district of Gujarat, Cauvery basin (Tamil Nadu), Mahanadi basin (Odisha), Hugli basin (West Bengal), and offshore location in Bay of Bengal, on eastern Continental Shelf to be explored, appraised and developed of future production
Key states in focus where existing manpower is engaged	Key states in focus where incremental manpower maybe engaged
<ul style="list-style-type: none"> ▶ Andhra Pradesh ▶ Arunachal Pradesh ▶ Assam ▶ Gujarat ▶ Rajasthan ▶ Tamil Nadu ▶ Tripura 	<ul style="list-style-type: none"> ▶ Gujarat ▶ Tamil Nadu ▶ Odisha ▶ West Bengal
<p>Indian PSUs have also invested heavily in exploration and production projects across 20+ countries such as Azerbaijan, Bangladesh, Colombia, Iran, Libya, Mozambique, Myanmar, Russia, South Sudan, Syria , UAE, Vietnam, Venezuela, Canada, USA, Oman etc.</p>	
Industry inputs for additional manpower demand	
<ul style="list-style-type: none"> ▶ Demand for manpower in the upstream segment is characterised by highly probabilistic variables such as viability assessment of new discoveries, nature of field, number of wells/quanta of drilling works and other factors that may be encountered as the development commences. ▶ Upstream manpower in large numbers is primarily required at 2 phases - field development phase and production phase. Additionally, some manpower is also engaged at the exploration phase for drilling of exploratory wells to determine the field viability, however these would require manpower with higher and complex technical skills ▶ Engineering and construction during field development is the segment that generates maximum manpower demand relative to the drilling and production phases. ▶ The manpower planning dynamics in the upstream segment are defined by new discoveries and successful field development, both of which are probabilistic in nature. As per industry inputs, not all discoveries and exploration projects can be put through production due to lack of commercial viability, which may be determined at any point before the field starts yielding. 	
Key high volume roles during E&P	

- ▶ Offshore underwater welder
- ▶ Toolpusher
- ▶ Platform roustabout
- ▶ Derrickman
- ▶ rotary drill operators
- ▶ Production operator (Rig zone)
- ▶ Junior well testing technician
- ▶ PSV mechanic
- ▶ Scaffolder

Potential of incremental manpower in Midstream

- ▶ Estimated incremental demand for operations and maintenance manpower for midstream pipelines: ~5000+.

Workforce drivers: ▶ 20+ natural gas pipeline projects are underway for laying of 16,000 kms of additional pipeline
 ▶ Majority pipeline projects are aimed for completion by 2025

Focus states where new pipelines are being commissioned

▶ Andhra Pradesh	▶ Madhya Pradesh	▶ Rajasthan
▶ Gujarat	▶ Maharashtra	▶ Tamil Nadu
▶ Jharkhand	▶ Odisha	▶ Telangana
		▶ West Bengal

Key job roles

- ▶ Operator - Hydrocarbon Pipeline / Technician (Site/Inspection)
- ▶ Industrial Technician Electrician (Oil & Gas)
- ▶ Industrial Technician Mechanical (Oil & Gas)
- ▶ Industrial Technician Instrumentation (Oil & Gas)
- ▶ SS Tubing Technician
- ▶ Fire Safety Technician (Oil & Gas)

- ▶ Estimated incremental demand for operations and maintenance manpower at LNG terminals: ~2,600.

Workforce drivers: ▶ ~6 new LNG terminals to be commissioned over the next few years

Focus states where new LNG terminals will be commissioned

- ▶ Odisha
- ▶ Maharashtra
- ▶ Gujarat
- ▶ Puducherry
- ▶ Gujarat

Key job roles (key blue collared high volume job roles)

- ▶ Operator LNG Storage and Loading
- ▶ Engineering Assistant Electrical /Gas Turbine Generator Operator

Potential of incremental manpower in Downstream

- ▶ The downstream sector includes the refining of petroleum crude oil and the processing and purifying of raw natural gas, as well as the marketing and distribution of products derived from crude oil and natural gas.

- ▶ Estimated incremental demand for operations and maintenance manpower for refineries: ~30,000.

Workforce drivers: ▶ 3 new refineries planned /underway to add more than 70 MMTPA capacity by 2030
 ▶ Multiple brownfield field projects planned /underway for adding more than 30 MMTPA capacity

Focus states where new refineries are to be set up (Asia's largest refinery to be setup +brownfield projects)

- ▶ Maharashtra
- ▶ Tamil Nadu
- ▶ Rajasthan
- ▶ Gujarat
- ▶ Andhra Pradesh
- ▶ Haryana
- ▶ Assam
- ▶ Uttar Pradesh

Key job roles (key blue collared high volume job roles)

- ▶ Draftsman - Civil
- ▶ Draftsman - Electrical/Instrumentation
- ▶ Draftsman - Mechanical
- ▶ Engineering Assistant Mechanical Maintenance
- ▶ Engineering Assistant Production
- ▶ Engineering assistant Maintenance (Instrumentation)
- ▶ Engineering assistant P&U electrical maintenance
- ▶ Engineering assistant P&U Operations (BOE)
- ▶ Operator refinery



In addition to the above there are some value chain streams that were assessed to identify their key job roles, but it was observed that they create minimal manpower demand periodically, owing to increasing automation and technological factors or due to limited expansion projects. Some of these

segments are: natural gas processing, fractionation and liquefaction plants, crude oil pipelines, bottling plants, storage depots/terminals stations etc. These value chain segments have been covered in the report by highlighting the core job roles across these value chain segments .

Summary of recommendations

In the context of the manpower demand estimates, the recommendations envisage to highlight the key areas and models of skilling that can be explored. The recommendations cover both the conventional

areas of demand creation and also highlight areas of skilling and related job roles that will come to the fore as the sector diversifies, along with new value streams and newer ways of working.

Skilling strategy for large scale construction projects in the Oil and Gas sector

- ▶ Construction roles, accounts for over 80% of the manpower demand that a project entails.
- ▶ Given the scale of manpower required for a construction project, short term skilling,

courses under public funded schemes are well suited to leverage their capacity for training the manpower for upcoming construction projects in the oil and gas sector.

Skilling strategy for Oil and Gas roles with low to medium manpower demand / niche skills/technical knowledge

- ▶ Large scale refinery and pipelines projects can leverage institutional network of ITIs and SDIs for training in technical and niche roles.
- ▶ The ITI and SDI ecosystem can also be leveraged for the upstream manpower demand. Since demand for manpower in upstream is subject to various preconditions pertaining to viability and commercial

suitability analysis, it is recommended that periodic industry consultations are held to record the demand for such job roles.

- ▶ Industry and academia collaborations design effective hiring strategy leveraging ITI ecosystem and provide an avenue of regional employment to the local youth.

Skilling strategy for Oil and Gas roles with high manpower demand

- ▶ Certain job roles, specifically in the downstream segment for retail and marketing have large scale demands for manpower for increasing the reach of petroleum products across the country.

- ▶ For these role short term training courses run under public schemes are suggested to train at scale and speed.

Skilling, reskilling and new training imperatives

The report also highlights training imperatives that need to be addressed given the sector trajectory going forward:

- ▶ Skilling and training of youth for job roles to support the influx of automation and digitization of processes.
- ▶ Skilling to enable migration to other countries that have core oil and gas-based economies.
- ▶ Skilling for job roles that will become pertinent as the oil and gas companies in India continue to diversify into renewable energy sector, alternate fuels such as compressed biogas, ethanol etc., LNG, etc.

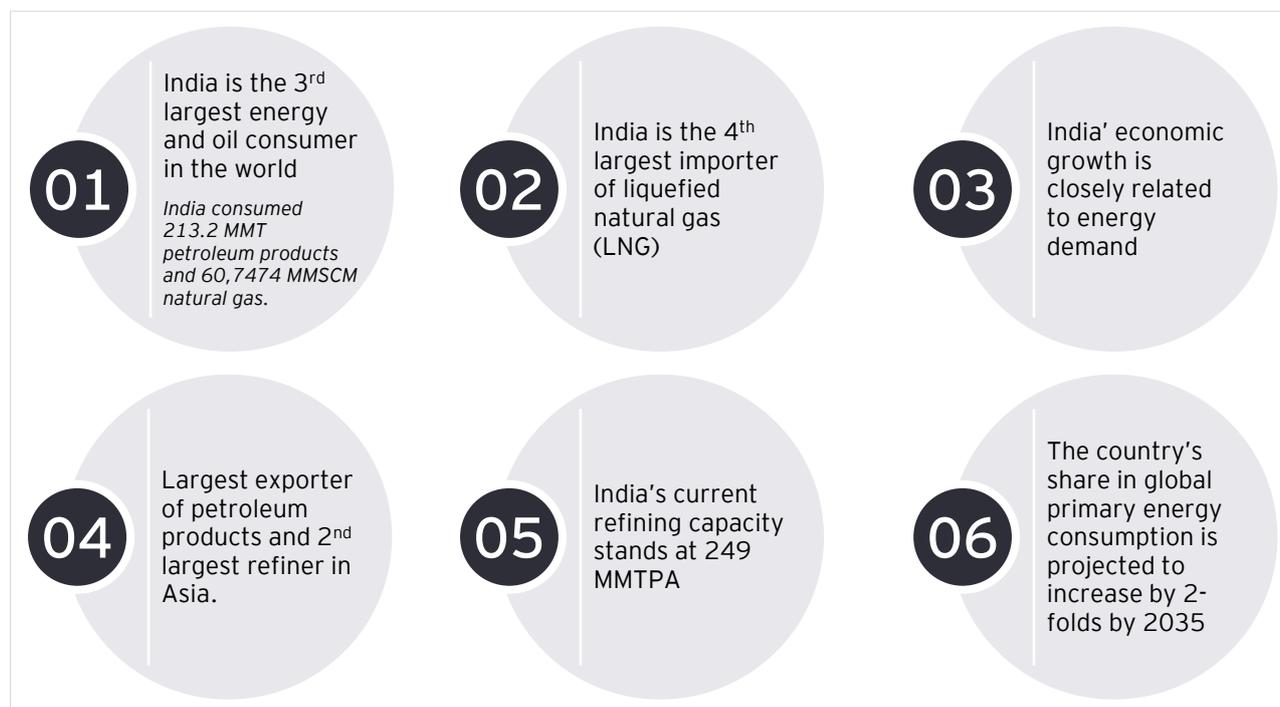
1 Overview of the Oil and Gas Industry in India

1.1 Indian Hydrocarbon Sector Overview

The Oil and Gas industry has always been significant for the Indian economy, since more than one-third of India's energy requirements are being met by the hydrocarbon sector¹. India is also one of the largest consumers of Oil and Gas in the world and its primary energy consumption has doubled in the last two decades. Despite the increase in the overall demand, the country's per capita Oil and Gas consumption is still lower than other nations. This is an indicator of *low availability and affordability of energy, particularly natural gas*². As per the country's economic survey 2018-19³,

India's per capita energy consumption was only one-third of the global average. The survey also highlighted that with a population that accounts for 18% of the world population, *India consumes only 6% of the world's primary energy.* India's per capita energy consumption equals 0.6 tons of oil equivalent (toe) as compared to the global per capita average of 1.8 tone.⁴ This indicates a huge potential for higher energy demand in the future signifying tremendous growth in the sector fuelled by rising economy and rising levels of income.

Figure 4: Indian Hydrocarbon Sector Highlights



Source: Invest India (Oil and Gas ready reckoner)⁵

¹ Ministry of Petroleum and Natural Gas, 2017, Hydrocarbon Vision Document for Northeast India. Accessed from <http://petroleum.nic.in/sites/default/files/visiondoc2030.pdf>

² CR Prasad, 2016, Make in India-Oil and Gas Sector. Indian National Academy of Engineers. Accessed from <https://www.inae.in/storage/2018/12/Feb-2016-Make-in-India-Oil-and-Gas-Sector-by-Dr-CR-Prasad.pdf>

³ Ministry of Finance (GOI), 2019, India needs to increase its per capita energy consumption at least 2.5 times to increase its Real Per Capita GDP by \$5000 per capita to enter the

Upper-middle Income Group. Press Information Bureau. Accessed from <https://pib.gov.in/Pressreleaseshare.aspx?PRID=1577011>

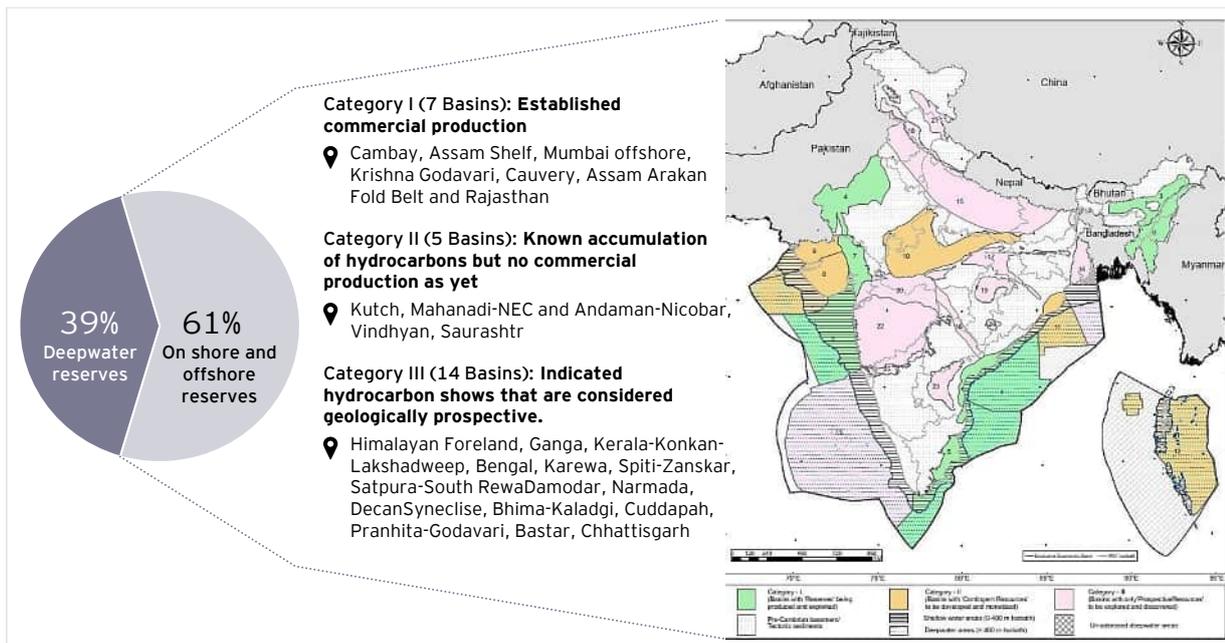
⁴ Press Information Bureau (2019), India need to increase its per capita energy consumption at least 2.5 times to increase its Real Per Capita GDP by \$5000 per capita to enter the Upper-middle Income Group. Accessed from <https://pib.gov.in/Pressreleaseshare.aspx?PRID=1577011>

⁵ Accessed from <https://www.investindia.gov.in/sector/oil-gas> as on 30th May 2022

As per the Ministry of Petroleum and Natural Gas (2020-21)⁶, the estimated total volume of India's conventional hydrocarbon resources.⁷ from 26 sedimentary basins is estimated to be around 41.87 billion tonnes of oil equivalent across 3.36 million square kilometres. Of this land and offshore (shallow water) basins make up more than 61 % of the reserve (2.04 m sq. km) and deep waters reserves are 39 % of the total (1.32 m sq.km).

Broadly Indian sedimentary basins have been divided into three categories based on their degree of prospective as presently known. The categories are however subject to change basis, new discoveries, or advent of new technology. A category III basin can be upgraded to II in case there is a discovery or Category II to I if discoveries are developed for commercial production.

Figure 5: Sedimentary basins in India and their categorization as per prospective



Source: India's Hydrocarbon Outlook, 2018-19

- ▶ Category I consists of 7 basins which are commercially producing crude. These are in Cambay, Assam Shelf, Mumbai offshore, Krishna Godavari, Cauvery, Assam Arakan Fold Belt and Rajasthan. Category I basins have 85% of total hydrocarbons assessed and 98% of total discovered in place of which around 40% have been discovered.⁸
- ▶ Category II consists of 5 basins which have discoveries but are yet to be monetized and developed for commercial production. These

are located at Kutch, Mahanadi-NEC, and Andaman-Nicobar, Vindhyan, Saurashtra.

- ▶ Category III consists of 14 basins have indicated presence of hydrocarbon but are yet to have a discovery. These are located at Himalayan Foreland, Ganga, Kerala-Konkan-Lakshadweep, Bengal, Karewa, Spiti-Zanskar, Satpura-South RewaDamodar, Narmada, DecanSyncline, Bhima-Kaladgi, Cuddapah, Pranhita-Godavari, Bastar, Chhattisgarh.

⁶ Ministry of Petroleum and Natural Gas, 2021, Annual Report 2020-21. Accessed from <https://mopng.gov.in/files/TableManagements/MoPNG-Annual-Report-combined.pdf>

⁷ Note: Conventional oil is a category that includes crude oil - and natural gas and its condensates. Crude oil production in 2011 stood at approximately 70 million barrels per day. Unconventional oil consists of a wider variety of liquid sources

including oil sands, extra heavy oil, gas to liquids and other liquids - International Energy Agency

⁸ Directorate General of Hydrocarbon (DGH), 2021. Hydrocarbon Prospectivity, Indian Sedimentary Basins. Accessed from https://online.dghindia.org/oalp/Files/pdf/OALP5_MUMBAI_Overview_of_Prospectivity_of_Indian_Sedimentary_Basins.pdf

Hydrocarbon reserve position

- ▶ Hydrocarbon assessment survey was conducted for the 26 basins in India in 2017 and the results yielded reserves capacity in India to the order of 41.87 billion tons.
- ▶ However, about 75% of total prognosticated resources are under "yet to discover" category.
- ▶ As on 1st April 2018 in-place hydrocarbon volume.⁹ of 10.9 billion tonnes of oil and oil

Crude supply and consumption

Oil is one of the key sources for energy in India. It is the second largest source of the total primary energy supply (TPES) after coal and largest in its total final consumption (TFS) of the country. The demand for oil in the country has been increasing robustly to become the third largest oil consuming country in the world.

In the last decade, India's domestic production of oil has remained relatively stable at an average of 862 thousand barrels per day (KB/d), and an annual average growth of 0.3%. Demand for oil over the same period has grown by over 50%. Increase in demand for gasoline and diesel for transport and liquified petroleum gas for residential purposed have been majorly responsible for this growth spurt in demand. The forecasts are in line the with the prevailing trends of oil demand,

Oil supply

According to the Indian Petroleum and Natural Gas Statistics report 2017- 18, India's proven reserves of crude oil and condensate as of April 2018 were around 595 Mt (around 4.4 billion barrels), which could potentially sustain production for about 14 years at current levels.

Location-wise, oil production in India comes primarily from Andhra Pradesh, Arunachal

equivalent gas has been established through exploration by Oil and Gas companies.

- ▶ Out of 10.9 billion ton of oil and oil equivalent gas of in-place volumes, the ultimate reserves which can be produced are about 4.23 billion tons oil and oil equivalent gas. The balance recoverable reserves are of the order of 1.56 billion tons of oil and oil equivalent gas.¹⁰.

and India is expected to surpass China in the mid-2020s and become the leader of oil demand growth.¹¹

India's production of oil however has not been able to keep pace with the increase in India's domestic demand and consumption. Between 2020-21 itself, petroleum consumption in India witnessed an increase of 81%, while comparing the consumption in the month of April of the two years¹². Continued strong growth in demand against falling domestic production has resulted in high dependency of India on imports of crude oil. During 2020-21, India consumed 194 MMT (estimated) of petroleum products while only 30.5 MMT was produced in India.¹³ This posits a challenge for India to harness and build its crude oil reserves to reduce its import dependencies.

Pradesh, Assam, Gujarat, Rajasthan and Tamil Nadu. Of which Rajasthan, Assam, and Gujarat together account for more than 96% of the total outputs. In addition, since ages Mumbai High fields also contribute to the major proportion of the production.¹⁴

India relies heavily on on crude oil imports, as domestic production is not enough to meet the

⁹ In-place hydrocarbon - is the amount of crude oil first estimated to be in a reservoir

¹⁰ Annual Report (2021), Ministry of Petroleum and Natural Gas.

¹¹ International Energy Agency, 2020, India 2020 Energy Policy Review. Accessed from <https://www.iea.org/reports/india-2020>

¹² Petroleum Planning & Analysis Cell, 2021, Snapshot of India's Oil & Gas data April 2021. Ministry of Petroleum & Natural Gas. Accessed from <https://www.ppac.gov.in/WriteReadData/Reports/202105190844562205768SnapshotofIndiasOil&GasdataApril2021.pdf>

¹³ Same as above

¹⁴ Ministry of Petroleum & Natural Gas (MoPNG), 2018, Indian Petroleum and Natural Gas Statistics 2017-18. Accessed from http://petroleum.nic.in/sites/default/files/ipngstat_0.pdf

country's soaring demand. During 2017-18, India recorded an increase of 3.04% in the quantity of crude oil imports as compared to its imports in 2016-17.¹⁵ Of the global crude oil imports, India in 2016 accounted for 10 % of the share and is only behind USA and China among the top oil importing countries.¹⁶ Approximately 58% of India's imported

Oil consumption

Between 2014 and 19, the oil consumption in India grew at a rate of 5.19% CAGR.¹⁸ India's oil demand has risen strongly since 2008, with average demand growth close to 160 kilo barrel per day to reach 4.4 million barrel per day in 2017, which already represents 5% of global consumption. India's oil demand is expected to reach around 6 mb/d by 2024, representing 3.9% growth per annum, well ahead of the global average of 1.2%.

While oil is a key energy source for all the sectors of the economy, the key sectors for domestic oil consumption are .¹⁹

- ▶ **Transport:** In the transport sector, road transport specifically accounts for 41% of the total oil consumption in 2017 and the fastest growing sector for oil demand. This demand for

crude oil came from middle eastern countries, mostly Saudi Arabia and Iraq. The second-largest source of oil imports is Africa (19%), with most of the crude oil coming from Nigeria.¹⁷ In terms of supply of by products from oil refinement, diesel dominates domestic oil refining outputs, followed by motor spirit.

oil in the transport sector also covers aircraft fuel and fuel for railways.

- ▶ **Building and construction:** The buildings sector, including both residential and commercial, accounted for 19% of total oil demand.
- ▶ **Residential sector/Non-industrial** - In the residential sector, LPG accounts for a dominant share at around four-fifths of demand, mostly for used cooking, and kerosene for the remaining one-fifth, for heating.
- ▶ **Industry and petrochemical** - Industry is the third-largest oil-consuming sector at 12% of total demand followed by the booming petrochemical sector at 9%.

¹⁵ Same as 9, MoPNG

¹⁶ The World Factbook, Crude oil - imports is the total amount of crude oil imported, in barrels per day (bbl/day). Central Intelligence Agency). Accessed from <https://www.cia.gov/library/publications/the-world-factbook/rankorder/2243rank.html>

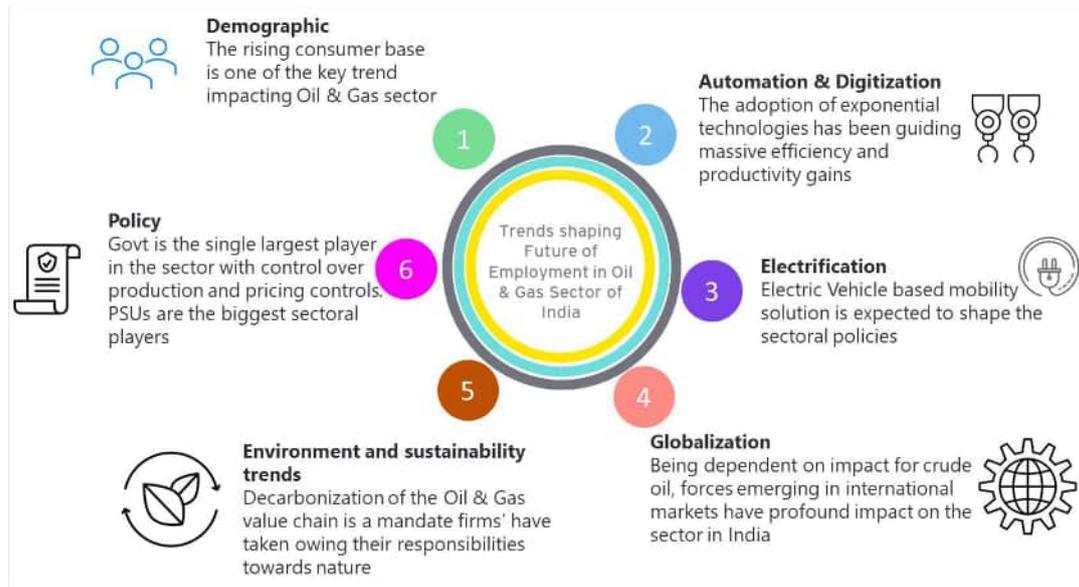
¹⁷ US Energy Information Administration, 2016, Country Analysis Brief: India. Accessed from https://www.eia.gov/international/content/analysis/countries_long/India/india.pdf

¹⁸ Invest India, 2020, Oil and Gas. Accessed from <https://www.investindia.gov.in/sector/oil-gas>

¹⁹ Same as 15, IEA

1.2 Key trends in the industry

Figure 6: Key emerging trends in the Oil and Gas sector impacting demand and consumption patterns



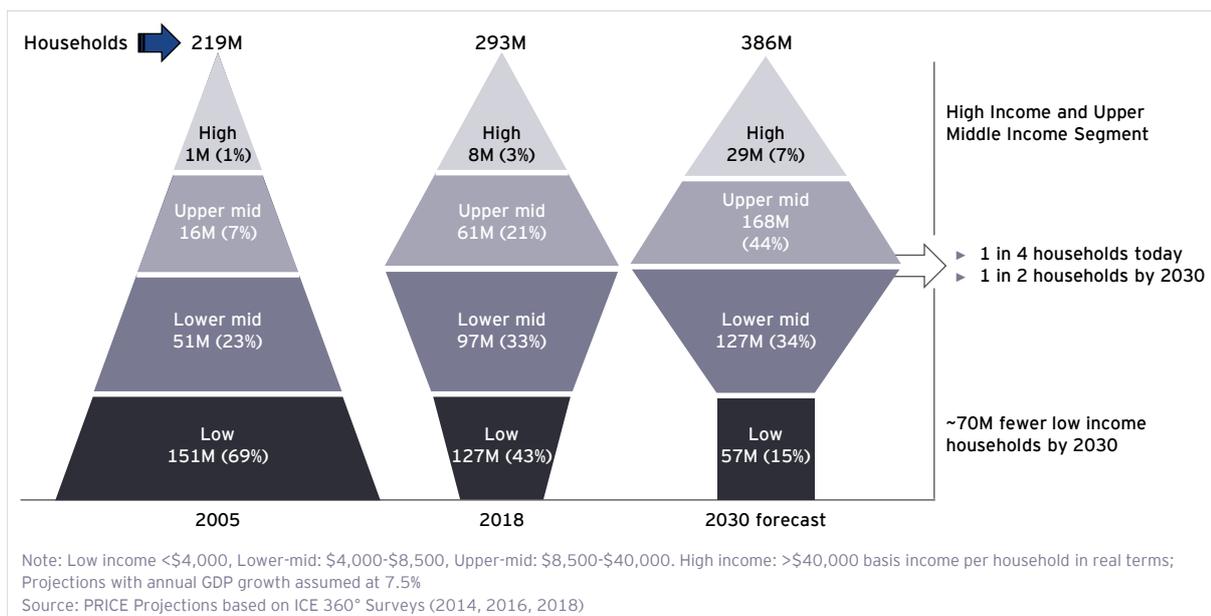
Demographic

Increasing demand for energy demand due to economic and demographic factors

Indian market will continue to see increased demand for Oil and Gas products. The demographic shift of the Indian population towards the middle class will propel the growth of the sector. Further, a large contingent of urban inhabitants also

increases demand for energy consumption. However, in long term the expanding size of middle class will be one of the key trends shaping the sector.

Figure 7 Evolution of the household-income profile in India



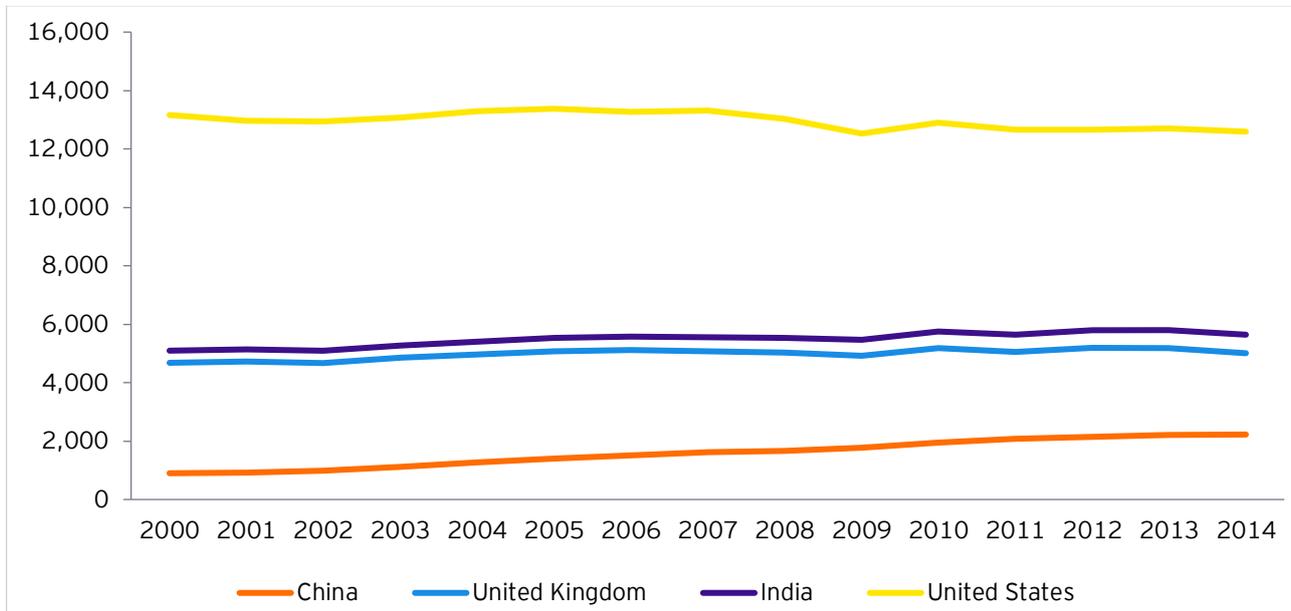
Source: Future of Consumption in Fast-Growth Consumer Markets: INDIA

(http://www3.weforum.org/docs/WEF_Future_of_Consumption_Fast-Growth_Consumers_markets_India_report_2019.pdf)

Further, the per capita energy consumption in India although has increased over the years is minuscule compared to the developed economies. This suggests that India's rising population and

especially expanding middle class presents a large consumer base for increasing energy consumption in India.

Figure 8: Per capital energy consumption of India compared to some other economies (kg of oil equivalent per capita)



Source: World Bank²⁰

Expanding the reach of fuel retailing

- ▶ Government is encouraging global players to participate in India's retail growth story.
- ▶ There are currently over 80,000 fuel retail outlets in India²¹. Further, due to increase in sale of automobiles and new roads being constructed, the number of retail outlets will be on the rise. In 2019, the PSU oil marketing companies advertised to invite applications for setting up 78,000 new retail outlets in the country²².
- ▶ There is an ease in the entry policy and complete deregulation of petrol and diesel with the new marketing guidelines provided by the Ministry of Petroleum and Natural Gas (MoP&NG).

Expansion of City Gas Distribution Network (CGDN)

- ▶ Natural Gas is emerging as the preferred fuel of the future in view of it being environment friendly, economically attractive and desirable as feedstock for petrochemicals. Currently, the natural gas consumption in India stands at 6.7% of the primary energy consumption and government is targeting to increase it to 15% by 2030²³.

²⁰ <https://data.worldbank.org/indicator/EG.USE.PCAP.KG.OE?end=2015&start=2000>

²¹ PIB (2022). Accessed from <https://pib.gov.in/PressReleaseFramePage.aspx?PRID=1811901>

²² PIB (2019). Accessed from <https://pib.gov.in/PressReleasePage.aspx?PRID=1565856>

²³ PIB (2022). Accessed from <https://pib.gov.in/newsite/pmreleases.aspx?mincode=20>

- ▶ With the objective to providing impetus to the natural gas in the country, Government of India is promoting CGDN in a big way.
- ▶ Till date 11 CGD commissioning rounds have been announced. After the 11th round

commissioning, and on successful completion of assigned targets, over 88% coverage of geographical area and 98% coverage of population will be achieved, spanning over 600 districts²⁴.

Automation and digitization

Emergence of Oil Field Services and Equipment (OFSE) domain²⁵

- ▶ Over the next 10 years, investments worth US\$102B are expected in upstream equipment and services.
- ▶ Due to policy reforms, additional investment opportunities of US\$40B in field developments have been unlocked.
- ▶ Drilling and drilling-related services are likely to account for 35-40% of the total spend followed by oilfield equipment with 18-20% and completion and stimulation equipment and services with 18-20%.

Digital transformation in Oil and Gas

- ▶ Digital innovation and transformation can help drive excellence and maximize value in the Oil and Gas sector by increasing oil production and recovery, reducing operational costs and minimizing risk.
- ▶ Hydrocarbon value chain facets such as refinery processes (digital refineries), pipeline monitoring (intelligent pipelines), fuel quality, asset management, fuel supply chain, enterprise planning, are at the brink of witnessing transformation digital influx.

Upgradation in refining and petrochemicals

- ▶ Massive engineering, procurement and construction projects are being planned for the Oil and Gas sector to achieve refining capacity of 400-500 MT 2030.²⁶

Electrification

Development of electric vehicles as a new mobility solution

- ▶ Electric vehicles have emerged as a promising alternative to IC engine-based mobility solutions. All the major automobile players have aggressively launched several EV models.

Passenger EV sales jumped from 450,000 in 2015 to 2.1 million in 2019
The global passenger EV fleet size to reach 54 million by 2040
Globally Evs comprise 2.7% of the new car sales. This number will rise to 58% by 2040
Current size of global EV fleet is estimated to be 8.5 million (2020) and is expected to reach 116 million 2040

Source: *Electric Vehicle Outlook 2020, Bloomberg NEF (BNEF)*. <https://about.bnef.com/electric-vehicle-outlook/>

²⁴ PIB (2022). Accessed from <https://pib.gov.in/PressReleaseDetailm.aspx?PRID=1846990>

²⁵ The Evolving Energy Landscape in India | Opportunities for investments (2018).

²⁶ <https://www.ibef.org/industry/oil-gas-india>

- ▶ Indian EV market too will see an expansion in the future. The EV market in India is expected to reach US\$206 billion by 2030.
- ▶ The Indian EV market is also evolving fast as close to 3,20,000 vehicles were sold in 2021, up 168% YoY²⁷.
- ▶ Ongoing electric vehicle adoption in India is based on the Paris agreement to reduce carbon emissions, to improve the air quality in urban areas and reduce oil imports.
- ▶ To support this growth, retail outlets are increasingly offering EV charging facility. In January 2022, over 1500 retail outlets in the country had EV charging facilities.²⁸
- ▶ For the EV sector in India, falling lithium-ion battery prices is the major driving force. Lithium-ion battery pack prices fell by 87% between 2010 and 2019, with the volume-weighted average hitting \$156/kWh.
- ▶ Underlying material prices will play a larger role in the future, but the introduction of new chemistries, new manufacturing techniques and simplified pack designs is expected to keep prices falling.

Globalization

Increase in the prices for oil and gas products due to global political and economic environment

- ▶ The Oil and Gas industry is strongly influenced by the geopolitical context. The capping on the oil production by OPEC has been a major cause for the increase in oil global oil prices.
- ▶ The increase in oil prices beyond 60 US\$ per barrel had adversely impacted the price of petrol and diesel in India.
- ▶ During 2021-21, India's import dependency on crude was more than 85%²⁹, therefore even an increase of USD 10 increases India's import bills substantially and impact of the same is felt through the value chain and realised by the end consumer while paying of higher retail prices in the economy.
- ▶ To mitigate such price shocks, the Government has also taken more proactive policy measures to increase the levels of the domestic production crude oil and gas.

Environmental and sustainability

Demand for sustainable energy alternatives

The demand for changing the global energy matrix and search for sustainable energy alternatives is intense and will become even more complex in the near future. There is a growing impetus for reducing the consumption of fossil fuels to mitigate the effects of climate change. India has seen some major investments in solar energy projects. However, solar, and other alternative sources have not completely proven their economic feasibility, still showing higher costs than oil and gas as well as

insufficient scale to justify their supply on a national level.

India has been investing heavily in alternative sources of energy. For instance, solar energy installed capacity of India has consistently increased over the last five years, currently stands at ~50 GW³⁰. India achieved its total non-fossil based installed energy capacity of 157.32 GW which is 40.1% of the total installed electricity capacity³¹.

²⁷ IBEF (2022). Accessed from <https://www.ibef.org/blogs/electric-vehicles-market-in-india>

²⁸ PIB (2022). Accessed from <https://pib.gov.in/newsite/pmreleases.aspx?mincode=20>

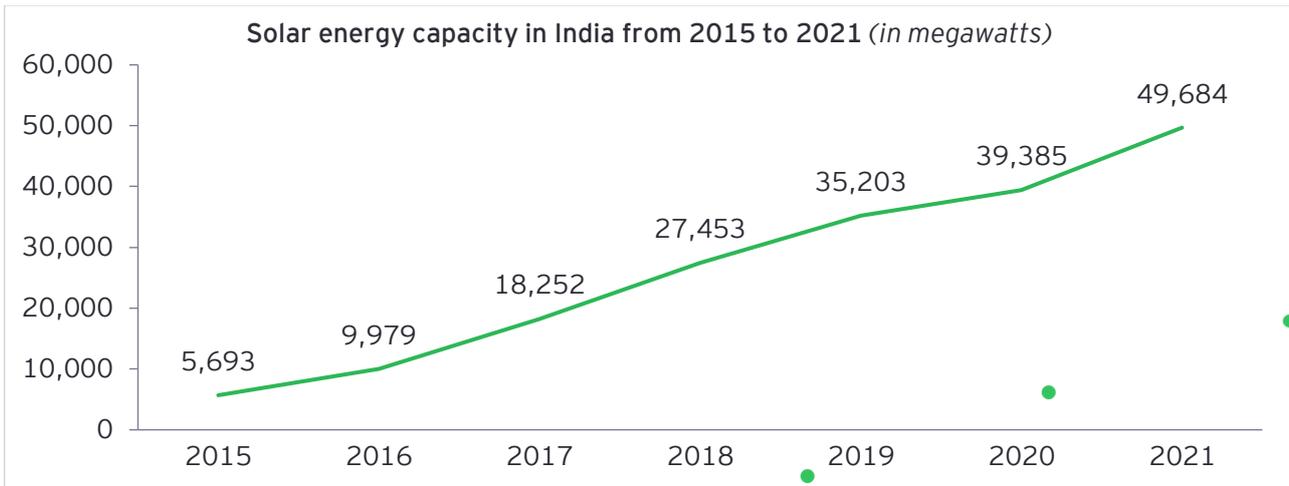
²⁹ PPAC (2022). Accessed from <https://www.ppac.gov.in/WriteReadData/Reports/202206290>

442188531469SnapshotofIndiasOilandGasdataMay2022uploadRev.pdf

³⁰ IBEF (2021). Accessed from: <https://www.ibef.org/industry/renewable-energy>

³¹ PIB. Accessed from <https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1785808>

Figure 9: Trend in installed solar energy capacity in India



Source: MNRE

Emergence of biofuels:

- ▶ A national policy on biofuels is already in place to boost the biofuel program of India.
- ▶ With the objective of increase the ethanol mixing, the government enhanced the procurement price of Ethanol to promote Ethanol supply in the year 2019-20.
- ▶ Allowed production of Ethanol from sugar and sugar syrup.
- ▶ Ethanol blending in petrol -20% by 2025-26 (NITI Aayog).
- ▶ 12 Biofuel refineries are planned to be opened with an investment of US\$1.5 billion³².

Policy

Discovered Small Field Policy (DSF)

Introduced for fast-track monetization of un-monetized small fields/discoveries of National Oil Companies.

- ▶ In August 2018, GoI approved the DSF Policy Bid Round-II. Through this, 59 discovered small fields / un-monetized discoveries estimated to have 194.65 MMT (O+OEG) in place, were offered for bidding.

Hydrocarbon Exploration Licensing Policy (HELP)

HELP (March 2016) provides a uniform licensing system to cover hydrocarbons such as oil, gas, coal bed methane etc. under a single licensing framework.

- ▶ Under HELP, contracts are awarded based on 'biddable revenue sharing'.
- ▶ Contractors will have full marketing and pricing freedom for crude oil and natural gas to be sold at arm's length basis, through a transparent and competitive bidding process.
- ▶ For production enhancement, bringing new technology and capital, NOCs will be allowed to induct private sector partners.
- ▶ For category I basins, the weightage in revenue-share has been reduced from 50% to 30%.

³² Economic Diplomacy Division, Ministry of External Affairs. Accessed from <https://indbiz.gov.in/sector/oil-and-natural-gas/>

- ▶ For Category II and III basins, revenue-sharing has been done away with and allotment of

basins is based solely on the exploration work program.

Open Acreage License Policy (OALP)

OALP allows a bidder to apply to the Government, seeking exploration of any block not already

covered by exploration. There is freedom to transfer/exit blocks.

Incentivising Production from Ageing Fields

The upstream regulator Directorate General of Hydrocarbons (DGH) has proposed a draft 'Policy Framework to Promote and Incentivise Enhanced Recovery Methods' to boost oil and gas output from existing fields using Enhanced Recovery (ER) techniques.

- ▶ The proposed incentive includes a 50% waiver of oil cess on gross oil production for EOR (and other unconventional oil production projects).

PAHAL - Direct benefit transfer in LPG (DBTL) subsidy

Largest subsidy transfer scheme across the globe. More than 26.29 crore of LPG consumers joined:

cash given - INR 1,31,814 crore (31st March 2020)³³.

Ujjwala Yojna

A social movement to improve women's health by giving them freedom from sooty kitchens and

hazards of collecting firewood. One crore ujjwala connections were provided till January 2022³⁴.

National Data Repository (NDR)

An integrated repository of Exploration and Production (E&P) data of Indian sedimentary basins. Its main objective is to provide reliable exploration and production data for India with provisions for seamless access and online data management.

- ▶ As on 31st October 2018, surface coverage of 28,485 LKM, out of 48,243 LKM, has been achieved under 2D Seismic data acquisition under the National Seismic Programme.

Coal Bed Methane Policy

Coalbed Methane (CBM), an unconventional source of natural gas, is now considered an alternative source for augmenting India's energy resources.

- ▶ India has the 5th largest proven coal reserves in the world, and thus holds significant prospects for exploration and exploitation of CBM.

- ▶ The prognosticated CBM resources in the country are about 92 TCF (2600 BCM) in 12 states of India³⁵.

³³ MoPNG (2020). PAHAL (Pratyaksh Hanstantrit Labh. Accessed from <https://mopng.gov.in/en/marketing/pahal>
34 PIB (2022). Accessed from <https://static.pib.gov.in/WriteReadData/specificdocs/documents/2022/apr/doc202242447301.pdf>

³⁵ Director General of Hydrocarbons. Accessed from <https://dghindia.gov.in/index.php/page?pageld=38>

Floating Regasification Storage Units

The Union Ministry of Shipping has issued guidelines for the setting up of floating storage

regasification units (FSRUs) for handling liquefied natural gas (LNG) cargo at major port trusts.

1.3 Hydrocarbon sector value chain

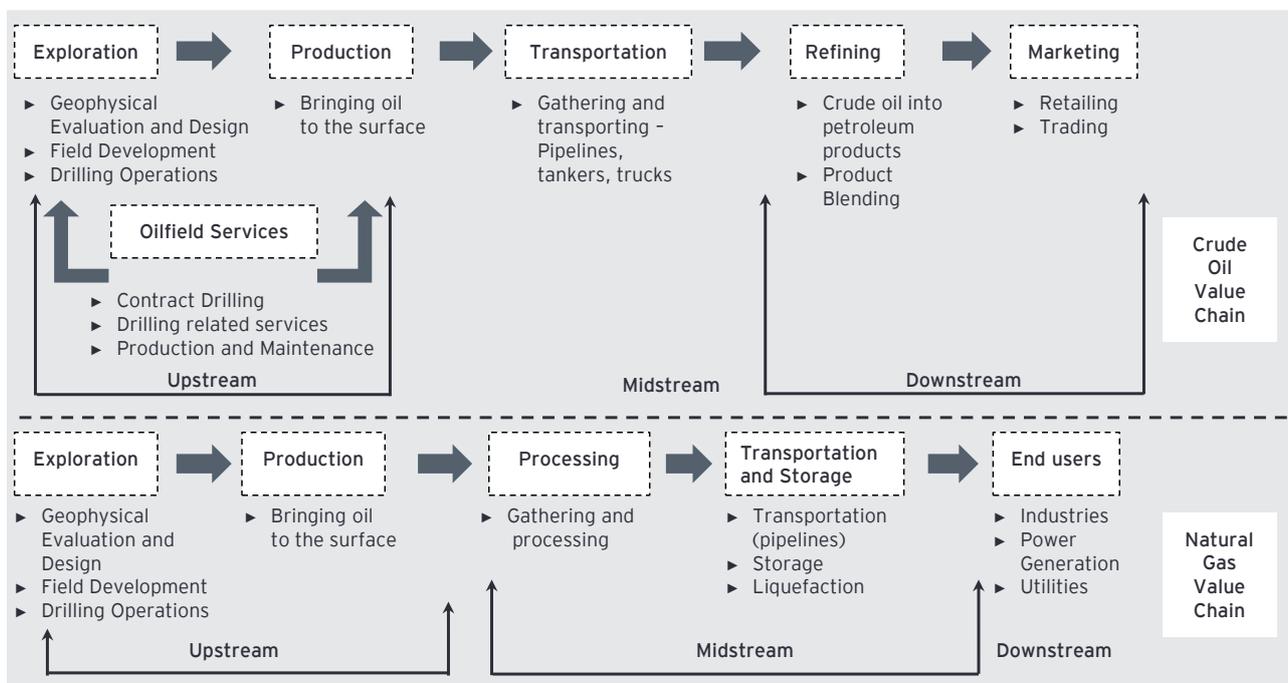
From a sector perspective, the Oil and Gas sector is broadly divided into three major segments, but Construction and Services also constitute a major part of this study:

- ▶ **Upstream:** Comprises of activities pertaining to exploration, recovery and production of oil and gas.

- ▶ **Midstream:** Processes, stores, markets, and transports commodities such as crude oil, natural gas, natural gas liquids (liquefied natural gas such as ethane, propane and butane) and Sulphur.

- ▶ **Downstream:** Refers to the refining of crude oil and the selling and distribution of natural gas and products derived from crude oil.

Figure 10: Various segments of the Oil and Gas Value Chain



Upstream

Oil and gas exploration in India dates to the 19th century when production commenced at Digboi in Assam. Since then, oil companies have added substantial hydrocarbon reserves, acquired production technical knowhow, and made large investments to manage complex reservoirs of the Indian sedimentary basins. The upstream is sometimes known as the exploration and production (E&P) sector and includes searching for potential underground or underwater crude oil and natural gas fields, drilling exploratory wells, and subsequently drilling and operating the wells that

recover and bring the crude oil or raw natural gas to the surface. Exploration is carried on onshore and offshore fields.

- ▶ Historically, in India exploration was carried forth by NOCs (National Oil Companies); *Oil and Natural Gas Corporation (ONGC) and Oil India*

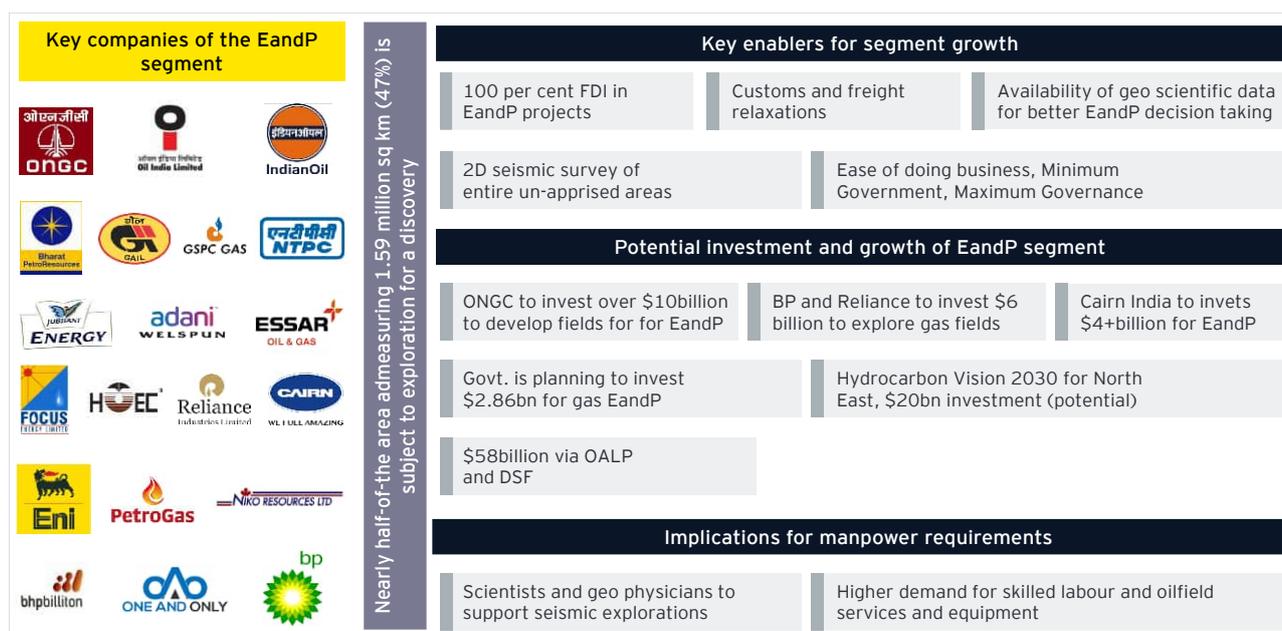
Ltd (OIL) through a nomination regime³⁶. However, with the coming of new licensing policies such as NELP³⁷ and HELP, the sector has opened to private sector participation and allows for 100% FDI.

- ▶ As on March 2020, as per Directorate General of Hydrocarbon, there were 41 companies (7 PSUs, 17 private, 17 foreign) who had carried out upstream activities for oil exploration.
 - ▶ ONGC is the largest domestic producer of crude oil and condensate in the country.
 - ▶ During FY 2019-20, out of total oil production of 32.17 MMT, ONGC produced 20.62 MMT and OIL produced 3107 TMT oil³⁸.
 - ▶ During 2019-20, total natural gas produced was 32.043 BMC. Of this,

ONGC's share was 24,177 MMSCM and OIL's share was 2,708 MMSCM.

- ▶ Apart from ONGC and OIL, other NOCs, and private companies (domestic and international) participated in the production of oil and gas through the product sharing contracts and joint ventures
- ▶ Many upstream oil companies are also making biddings to acquire a portion of the oil fields in other countries, e.g., ONGC Videsh an international arm of ONGC has acquired stakes in oil fields located in Russia, UAE, Vietnam, Azerbaijan, Myanmar, Brazil, Colombia, Venezuela and Sudan³⁹.

Figure 11: Highlights of the upstream subsector in India



Source: Invest India, IBEF, Make in India, DHGIndia

³⁶ Till the end of 1970s, Indian E&P industry was dominated by the two National Oil Companies (NOCs) ONGC and OIL to whom Petroleum Exploration Licenses (PEL) were granted on nomination basis. - Directorate General of Hydrocarbon

³⁷ New Exploration Licensing Policy (NELP) - Government introduced healthy competition and public participation by introducing NELP for exploration & production of oil & gas in the country. Under NELP, blocks were awarded to Indian, private and foreign companies through International Competitive Bidding process where NOCs, viz. ONGC and OIL, were competing on equal footing. NELP not only accelerated

the quest for hydrocarbon exploration, but also brought state-of-the-art technology and efficiency of operations/management to the country.

³⁸ India's Hydrocarbon Outlook: 2019-20

³⁹ Care Ratings, 2018, Exploration & Production of Crude Oil: Drilling for the Black Gold. Accessed from ratings.com/upload/News Files/Studies/Exploration & Production of crude oil.pdf

Midstream segment for oil and gas

The midstream sector involves the transportation (by pipeline, rail, barge, oil tanker or truck), storage, and wholesale distribution of crude or refined petroleum products. Pipelines and other transport systems can be used to move crude oil from production sites to refineries and deliver various refined products to downstream distributors. Crude oil and Natural gas pipeline networks aggregate crude oil and gas and deliver it to downstream customers, such as local utilities.

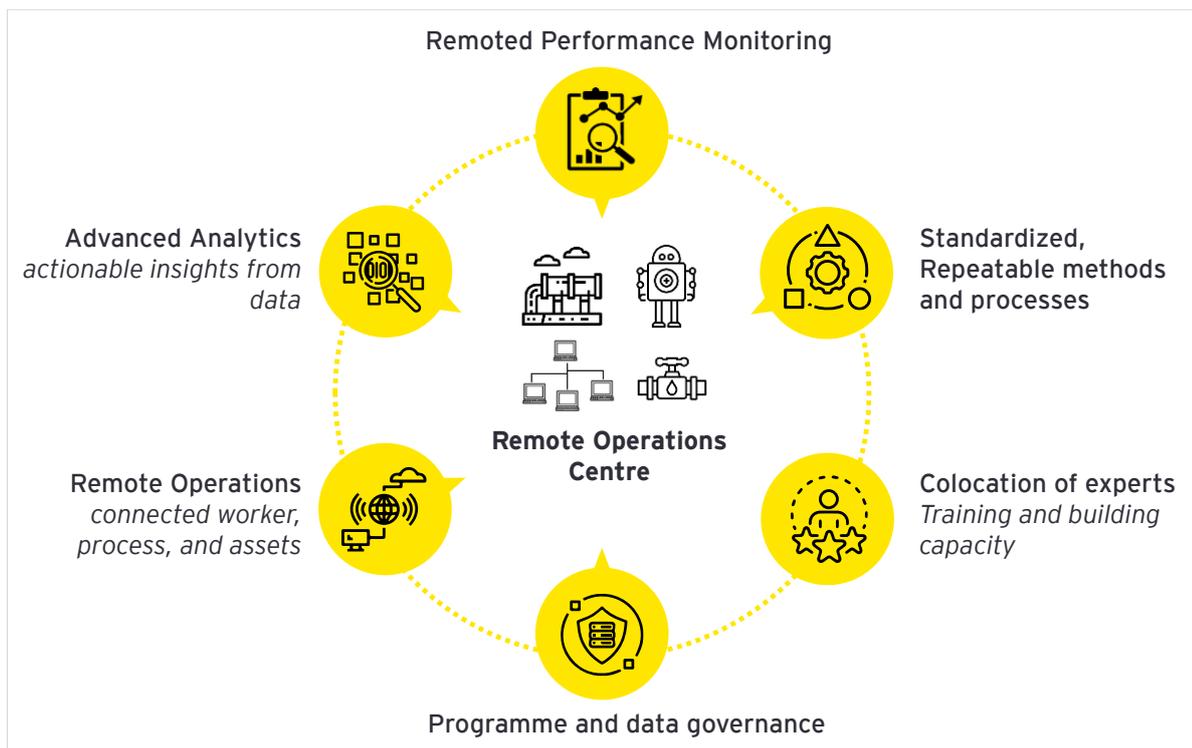
- ▶ The country currently has a crude oil pipeline network of 10,419 Kms with a capacity utilization of 68 percentage. The total crude oil transportation capacity stands at 157.74 MTPA⁴⁰.
- ▶ India has an extensive gas pipeline network with a total pipeline length of 19,487 kms as of April 2021. In addition, to the existing gas pipeline, 16,478 kms of pipelines is in different stages of installation.

Digitization enabling the remote monitoring of pipeline operations

Pipeline operators need to leverage emerging technologies to deliver major performance improvements and maximize value across their networks. By taking advantage of operations (OT)

and information technology (IT) convergence to implement virtual pipeline assets, they can realize breakthrough improvements in integrity, safety, compliance and operational efficiency.

Figure 12: Key activities of remote operations centre



⁴⁰ Annual Report, MoPNG 2020.

Downstream segment of oil and gas

The downstream sector commonly refers to the refining of crude oil, processing and purification of raw natural gas, as well as the marketing and distribution of products derived from crude oil and natural gas. The downstream sector touches consumers through products such as gasoline or petrol, kerosene, jet fuel, diesel oil, heating oil, fuel oil, lubricants, waxes, asphalt, natural gas, and liquefied petroleum gas (LPG) as well as hundreds of petrochemicals.

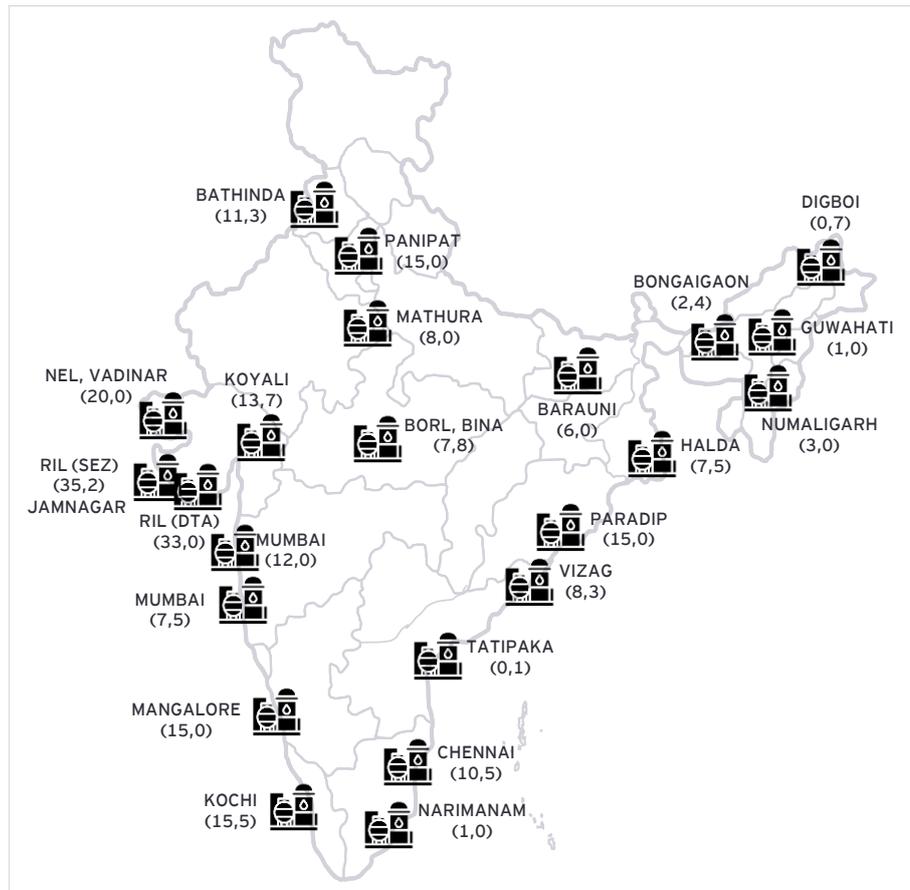
Crude processing at refineries

Refineries are the start point of the downstream subsector of the hydrocarbon sector. Refineries process the crude products by removing the impurities and converting the oil and gas to products for the public, such as gasoline, jet fuel, heating etc.

India's refining journey started in the early 1900s and it has come to establish itself as a global refining hub on the back of major refining capacity

There are **23 refineries in the country with an installed capacity of 249.9 MTPA** as on May 2021⁴¹, of which:

- ▶ 18 are owned by public organizations Indian Oil Corporation Ltd (IOCL), Hindustan Petroleum Corporation Ltd (HPCL), Bharat Petroleum Corporation Ltd (BPCL), Chennai Petroleum Corporation Ltd (CPCL), Numaligarh Refinery Ltd (NRL), Mangalore Refinery and Petrochemicals Ltd (MRPL) and Oil and Natural Gas Commission (ONGC).
- ▶ 3 are owned by private organizations - Reliance India Limited (RIL) and Nayara Energy Limited (NEL).



additions involving massive investments over the last few decades.

India is the 3rd largest consumer of the crude oil and petroleum products in the world, and its oil demand is only projects to grow at a CAGR of 4% till 2030. At the same time India is also the second largest exporter of petroleum products in Asia.

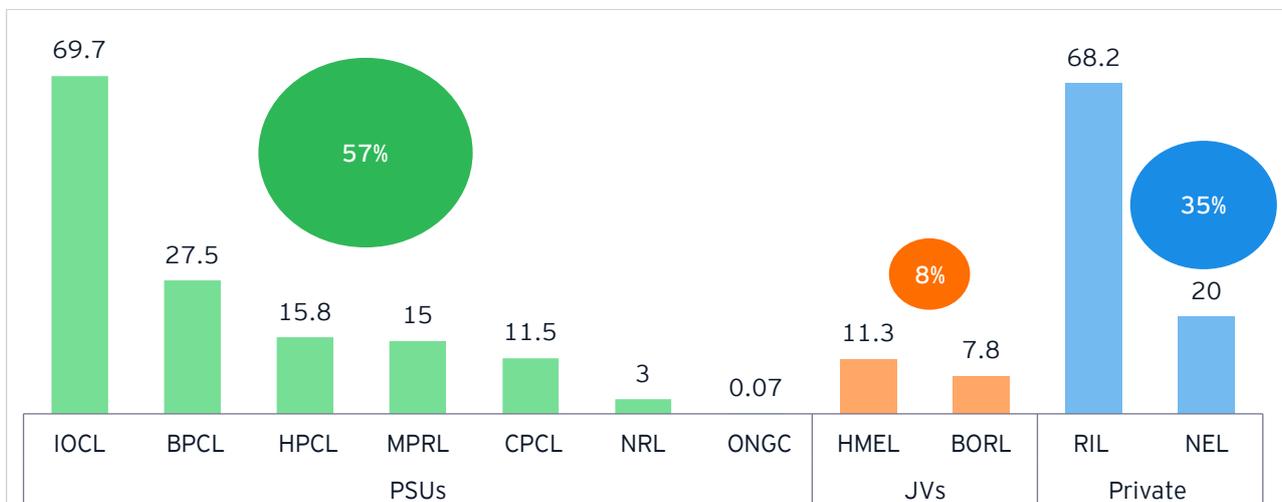
Figure 13 : Refineries in India



⁴¹ Petroleum Planning & Analysis Cell (2021), PPAC's Snapshot of India's Oil & Gas data.

- ▶ 2 are owned in Joint Venture partnership by Bharat Oman Refinery Ltd (BORL) HPCL Mittal Energy Ltd (HMEL). BORL is a joint venture between BPCL and Oman Oil refinery and HMEL is a joint venture between HPCL and Mittal Energy Limited.

Figure 14: Refinery capacity (MMTPA) in India by ownership

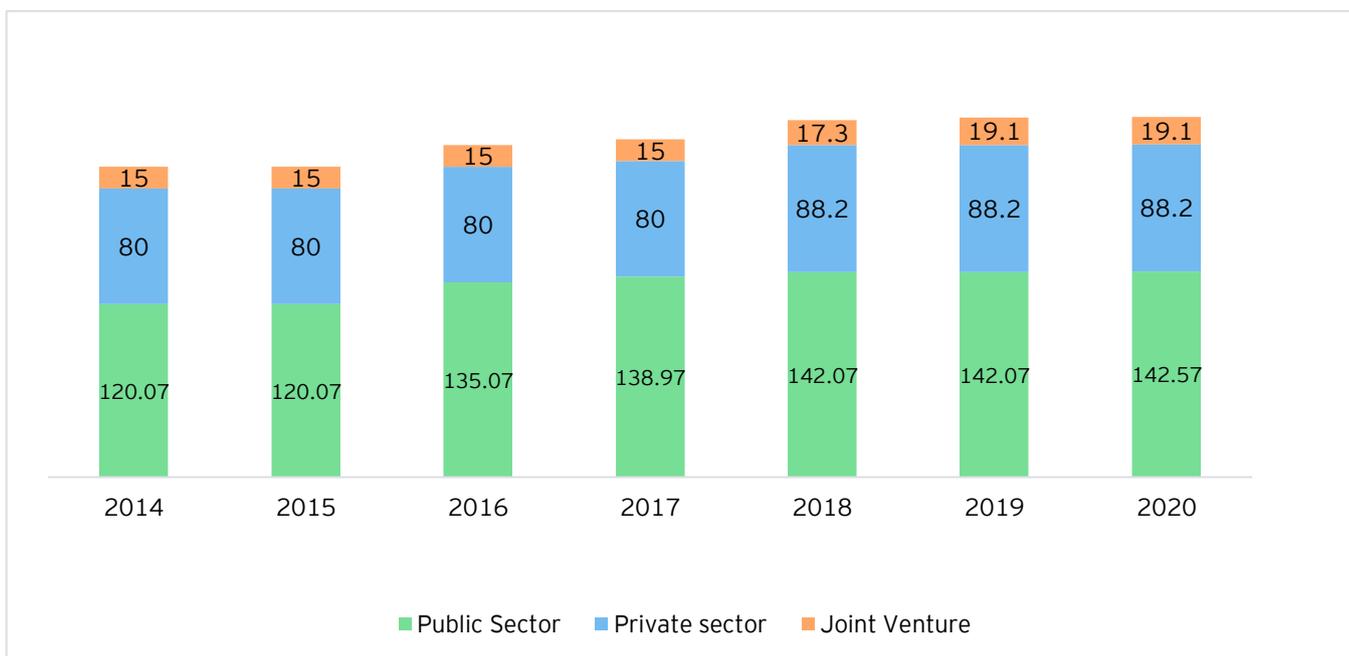


Source: PPAC Ready Reckoner, April 20021

India's has witnessed an increase of more than 15% since 2014 for its total refining capacity due

various investment led improvement projects across its refineries.

Figure 15: Trends in refining capacity in India



Source: Indian Petroleum and Natural Gas Statistics (IPNG), 2019-20

- ▶ Despite India's import crude oil dependency of crude oil, it has managed to build its processing capacity to become the net exporter of petroleum products. India has emerged as the

largest exporter of petroleum products in Asia since August 2009.

- ▶ India's retail oil market is largely dominated by the state-owned refining and marketing companies Indian Oil, Hindustan Petroleum and

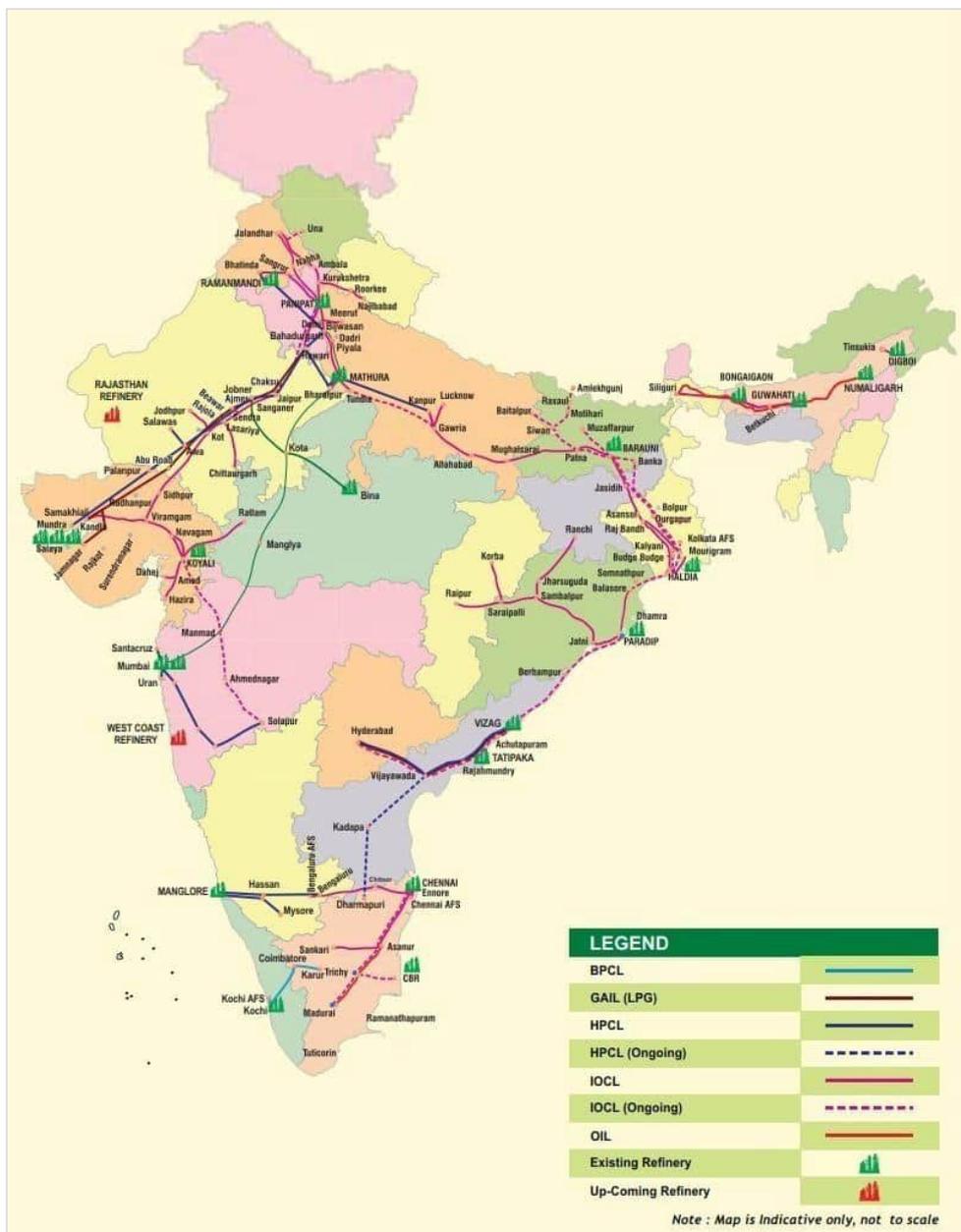
Bharat Petroleum, who own around 90% of India's fuel stations.

Distribution of refined products

The other key segment of the downstream segment includes the distribution of the refined petroleum products: petrol, diesel, LPG etc. India’s network of petroleum product pipeline currently spreads across 18,000 kms with carrying capacity of 112 MMTPA. The petroleum product pipeline network

across the country is established primarily by IOCL, HPCL, BPCL, GAIL, Oil India and Petronet, of which more than 50% of the network lies under the ownership of IOCL alone. The sector is undergoing a major expansion with projected plans for addition of over 8000 kms of product pipeline length.

Figure 16: Refineries and petroleum products pipelines



Source: PNGRB

Retail and marketing

Post refining of crude oil, the downstream segment includes the retailing of the petroleum products such as petrol, diesel, LPG. Retailing includes both B2B and B2C retailing. Currently, public and private sector players operate a total of over 80,000 retail outlets and of the total retail outlets more than 80% is operated by public sector enterprises like IOCL, HPCL, BPCL. The Government has extensive plan for a major expansion in the fuel retailing in the country with plans for the opening of addition of over 78,000⁴² fuel outlets. The opening of new fuel outlets will

immensely help in providing fuel access to remote areas.

LPG retailing has been a major thrust area towards inclusive development and providing access to clean fuel especially to citizens in rural and tribal areas. As of January 2021, there are more than 28 crore households in India with an LPG coverage of 99.8% through a network of more than 24,000 LPG distributors⁴³. It is projected that an additional 1.3 - 1.5 crore new LPG connects will be added in the coming years.

City gas distribution network

City gas distribution network is the key downstream segment witnessing rapid expansion and growth. During July 2021, the CGD network had over 79 lakh domestic connections, 32,000 commercial connections and 12,000 industrial connections⁴⁴. The 8th, 9th, and 10th round of CGD distribution provided a major impetus to the sector

and leading to major employment generation. Further the 11th round CGD bidding round has also been announced and approximately 88% of the country's area has been authorized for development of CGD Network to provide access of natural gas to approximately 98% of country's population.



⁴² Ibid.

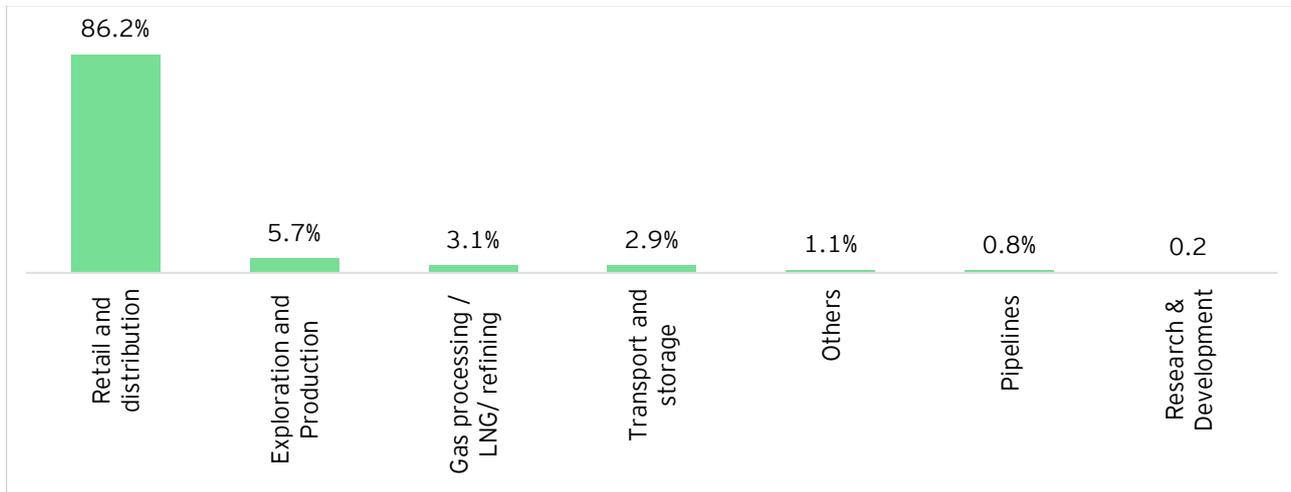
⁴³ PPAC (2021). LPG Profile. Accessed from <https://www.ppac.gov.in/WriteReadData/Reports/202102150402082513713WebVersion1.1.2021.pdf>

⁴⁴ PPAC (2021). Accessed from <https://www.ppac.gov.in/WriteReadData/userfiles/file/Snapsh ot%20of%20Indias%20Oil%20Gas%20data%20February%202021.pdf>

1.4 Manpower in the Hydrocarbon sector

- ▶ The estimated number of people employed in the Oil and Gas sector across the key value streams is estimated to be more than 10 lakh including direct hires contract employees, third party/dealership employees etc.

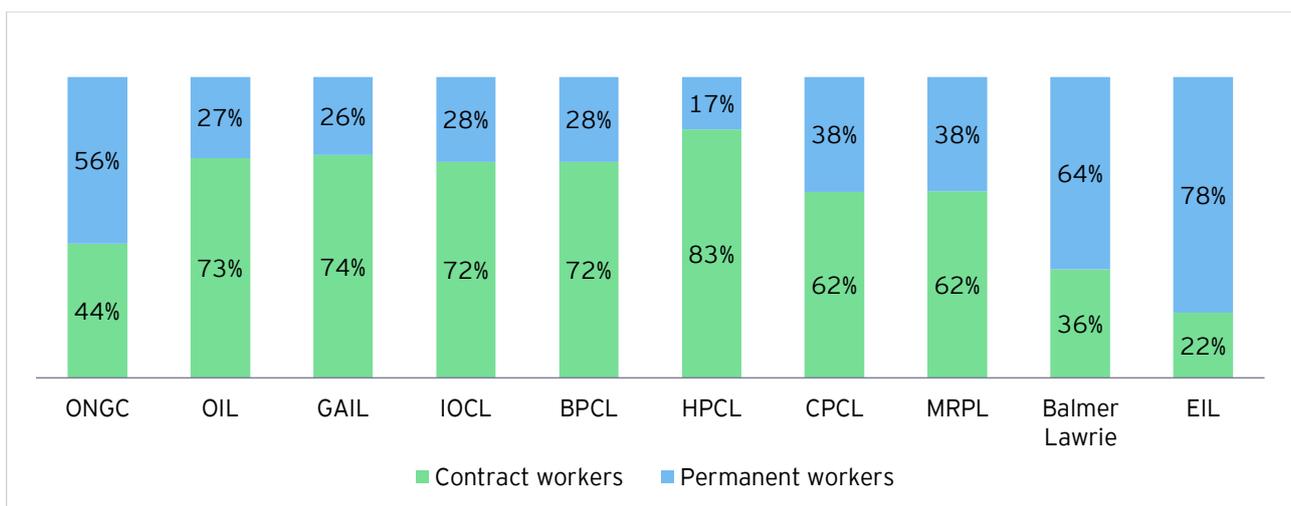
Figure 17: Distribution of manpower across various value streams of Hydrocarbon sector



Source: Analysis based on industry inputs

- ▶ The workforce is both made up of permanent employees and contractual employees that are engaged for various brownfield projects or even as a part of regular operations staff. Analysis of the employee profile across the central public sector enterprises revealed that more than 50% of the workforce was contractual in nature.

Figure 18: Nature of employment of manpower across Oil and Gas central PSEs



Source: Annual Reports of Oil and Gas CPSEs for 2020-21.⁴⁵

⁴⁵ Numaligarh Refinery Ltd. (NRL) has 900+ on roll employees, the number of contract workers maybe a part of Oil India, hence has not been taken separately

- ▶ The workforce in the sector may be categorized as Clerical, Workmen, Supervisory and Executive/Managerial - across the Exploration and Production (E&P), Marketing, Refining and Pipeline and research and development segments.

Figure 19: Nature of employment of manpower across Oil and Gas central PSUs

Manpower category	Executive/Managerial	Supervisory	Clerical	Workmen
ONGC	65.0%	5.5%	1.8%	27.7%
OIL	22.5%	11.1%	8.7%	57.6%
GAIL	80.2%	6.1%	12.5%	1.3%
IOCL	51.6%	10.9%	5.0%	32.5%
BPCL	49.8%	NA	11.8%	38.4%
HPCL	58.6%	NA	11.7%	29.7%
CPCL	11.9%	36.8%	3.4%	47.9%
MRPL	42.8%	5.5%	NA	51.7%
NRL	50.7%	NA	4.4%	44.9%
Balmer Lawrie	42.3%	18.9%	6.9%	31.9%
EIL	92.2%	3.8%	4.0%	0.0%
Total	55.6%	6.9%	5.9%	31.6%

Source: Sector and Category-wise Manpower Employed in Oil and Gas CPSEs.⁴⁶

- ▶ Assessment of the workforce across various age groups also highlighted that the average manpower of the CPSEs were aged around 43 years and the proportion of the manpower across the age groups were as follows:

Table 1: Age distribution of manpower across Oil and Gas central PSUs

18-30 years	31-40 years	41-50 years	Above 50 years
24%	21%	14%	41%

Source: Analysis based on annual reports of PSUs



⁴⁶ Source: Data.gov.in. Accessed from <https://visualize.data.gov.in/?inst=8b508bcb-1160-402d-8573-3e48f24d57b8&vid=98560#>



2

Approach and Methodology for Skill Gap Analysis in the Oil and Gas Sector

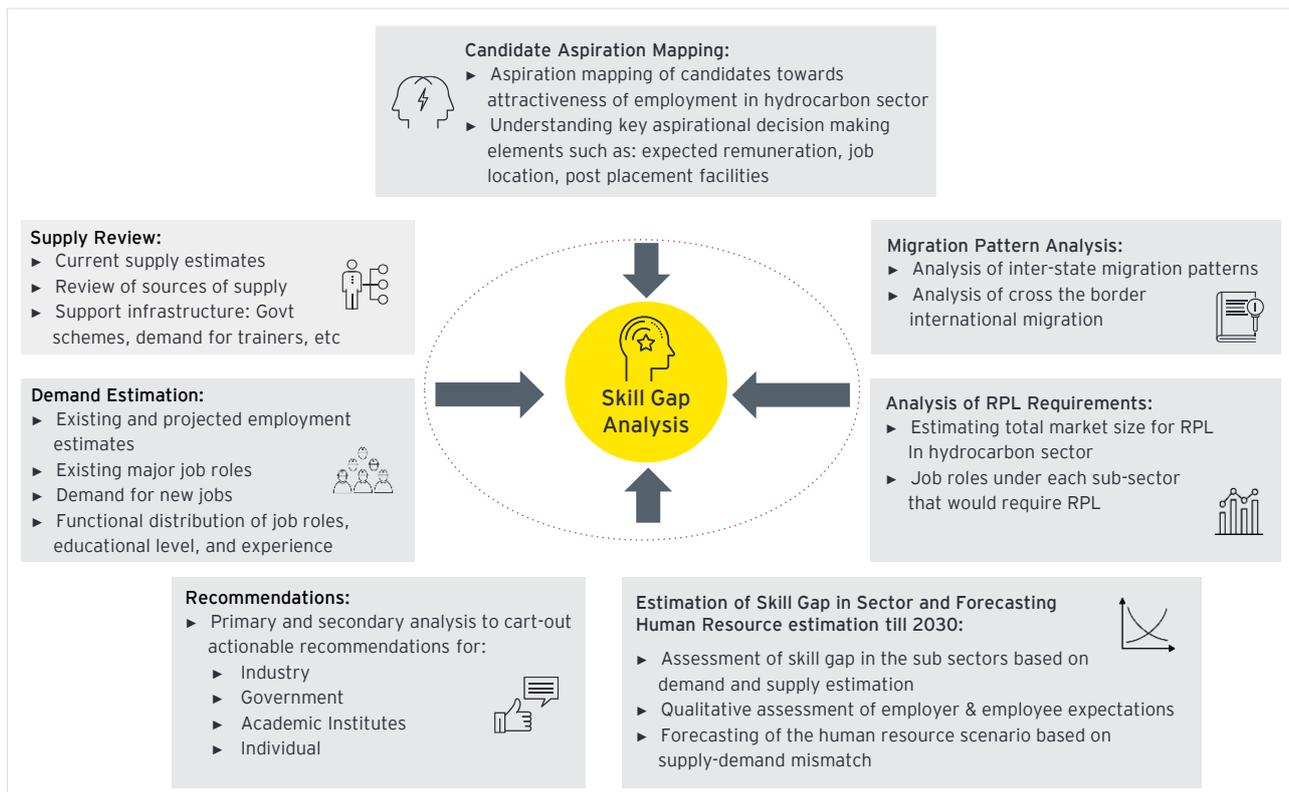
2 Approach and Methodology for Skill Gap Analysis in the Oil and Gas sector

2.1 Approach for Skill Gap Analysis

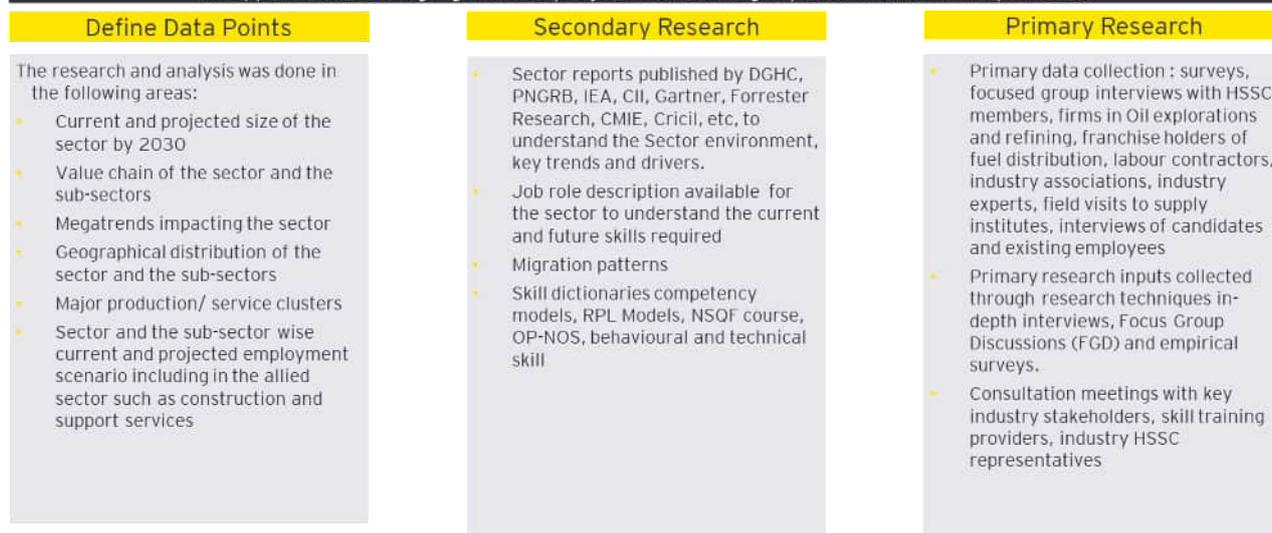
The study analyses the potential for employment generation till 2030 in the Oil and Gas sector across key activities along the value chain. The analysis has been done with a subsector lens to focus on the critical aspects in upstream, midstream and downstream segments that have the highest potential for creating incremental manpower demand. The results are aimed to highlight the job role specific manpower requirement, primarily for level 1 to level 6 job roles as per the National Skills Qualification Framework (NSQF).

The data was collected based on the broad value chain of each sub-sector based on the discussions with stakeholders from the industry. The study undertook a consultative and participatory approach, engaging and interacting with key industry members, collecting data (both primary and secondary) and congregating factors through rigorous analysis to address project objectives. The project employed a **mix method design with a pragmatic blend of primary and secondary data analysis** and the overall approach has the following components:

Figure 20: Approach for Skill Gap analysis of the Oil and Gas Sector



To support the above highlighted study objectives, following key mechanisms was implemented



2.2 Methodology for Skill Gap Analysis

The skill gap analysis has the following core components which entailed customized methodology for each, described below - industry

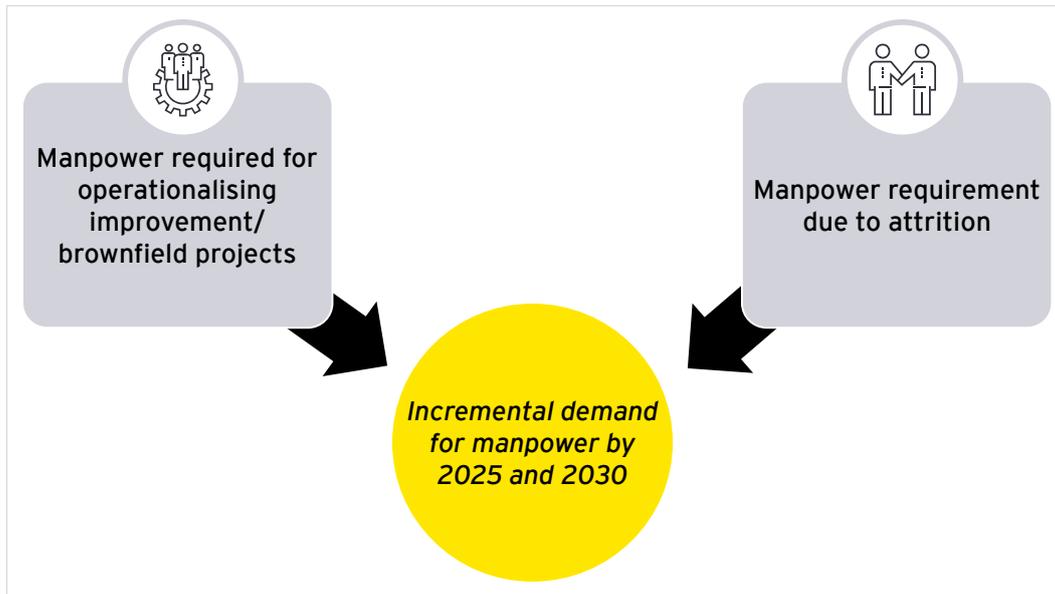
demand, supply review and youth aspiration assessment.

2.2.1 Estimation of Industry Demand

- ▶ Given the structure of the industry all the key activities across the entire value chain were categorized across - upstream, midstream and downstream.
- ▶ Extensive industry landscaping based on stakeholder interactions and secondary information analyses (based on government reports and data repository, annual reports and public information published by Oil and Gas industries) has been carried out to understand the key trends - regarding future projects and downsizing/expansion plans across the various National Oil Companies and private companies in the sector
- ▶ Subject matter experts across the value chain were consulted to identify the key manpower

- ▶ deployment patterns in the industry, especially the ones that concerned the entry level manpower across NSQF level 1 and NSQF level 6, in labour intensive manpower segments
- ▶ Based on SME discussions with experts from the sector, it was noted that a typical career lifecycle of a resource pans between 20-30 years, indicating that in a year about 1/30th to 1/20th of the workforce is getting replaced. Manpower demand estimated under the study also accounts for additional manpower demand created due to attritions and retirements. As indicated, an attrition rate of 3-5% has been considered and factored in.

Figure 21: Sources of incremental manpower demand (Oil and Gas Jobs)



- ▶ Growth in the Oil and Gas sector entails development of new or enhancement of existing infrastructure, which involves engagement of construction services and manpower. While not all the of the segments and activities in Oil and Gas sector are labour intensive at the operations stage, the construction stage does entail involvement of the manpower (not core oil and gas roles) in high numbers but for short period of time
- ▶ The following figure enlists the various segments and activities of the value chain in the oil and gas sector. The figure aims to covers all key segments, across activities with varied levels of labour involvement for both current and incremental (considering continuation of current operations and greenfield/brownfield projects).

Figure 22: Key activities in the Oil and Gas value chain and potential for incremental manpower demand that have been captured in the report

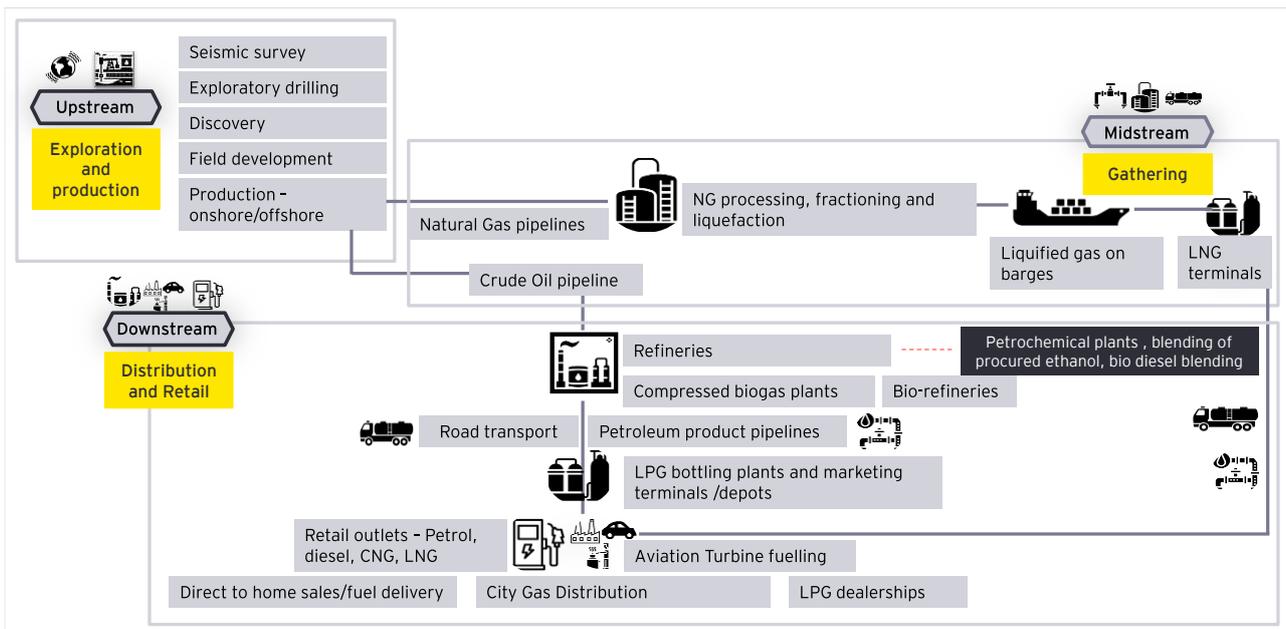


Table 2 Value chain activities and varied levels of skills and quantum of incremental manpower demand

Value chain activities upstream				
Seismic survey	Discovery	Exploratory drilling	Field development	Production onshore/offshore -
<ul style="list-style-type: none"> ▶ Technical and advanced skills required for geophysical assessment 		<ul style="list-style-type: none"> ▶ Incremental demand determined by successful discoveries that can be commercialized 		
Value chain activities midstream				
Operations of natural gas pipelines	Operations of crude oil pipeline	LNG terminals	NG processing	
<ul style="list-style-type: none"> ▶ High/medium demand due to multiple ongoing expansion projects 	<ul style="list-style-type: none"> ▶ Low incremental demand due to limited expansion/new pipeline projects 	<ul style="list-style-type: none"> ▶ Low manpower engagement ▶ Largely automated process 	<ul style="list-style-type: none"> ▶ Low manpower engagement ▶ Largely automated process 	
Value chain activities downstream				
Oil refining, compressed biogas plants	Bottling plants, marketing / storage terminals, stockiest locations		Road transport ⁴⁷	
<ul style="list-style-type: none"> ▶ High/medium incremental demand due to multiple ongoing expansion projects 	<ul style="list-style-type: none"> ▶ Low incremental demand due limited expansion projects ▶ High level of mechanisation and advanced infrastructure with low manpower involvements ▶ LPG bottling plants: LPG demand limited/saturated due to PNG connections, plants also are under-utilized, thus future expansion unlikely ▶ Marketing locations: Increase in consumption or product demand is often met by capacity expansion across existing facilities which doesn't always create any additional demand for oil and gas roles 		<ul style="list-style-type: none"> ▶ High demand due to increase in consumption/marketing networks. Since, driver requirement is only 1-2 per new vehicle the incremental manpower maybe low to medium 	
Petroleum product pipelines, CGD pipelines	Retailing- petrol, diesel, LNG, CNG, ATF ⁴⁸ , LDO/SKO ⁴⁹ LPG/PNG distribution			
High incremental demand due to multiple ongoing expansion projects				
Outcomes of demand side analysis				
<ul style="list-style-type: none"> ▶ Growth in business operations across both greenfield and brownfield projects ▶ Sub-sector wise employment demand accounting to traditional investment as well as new investments by companies diversifying ▶ High demand job roles sub-sector wise 				

Source: Premise based on industry interactions

⁴⁷ Including door to door delivery, delivery to industrial customers, retail outlets, mid to downstream movement

⁴⁸ Minimal incremental manpower required, subject to development of new airports

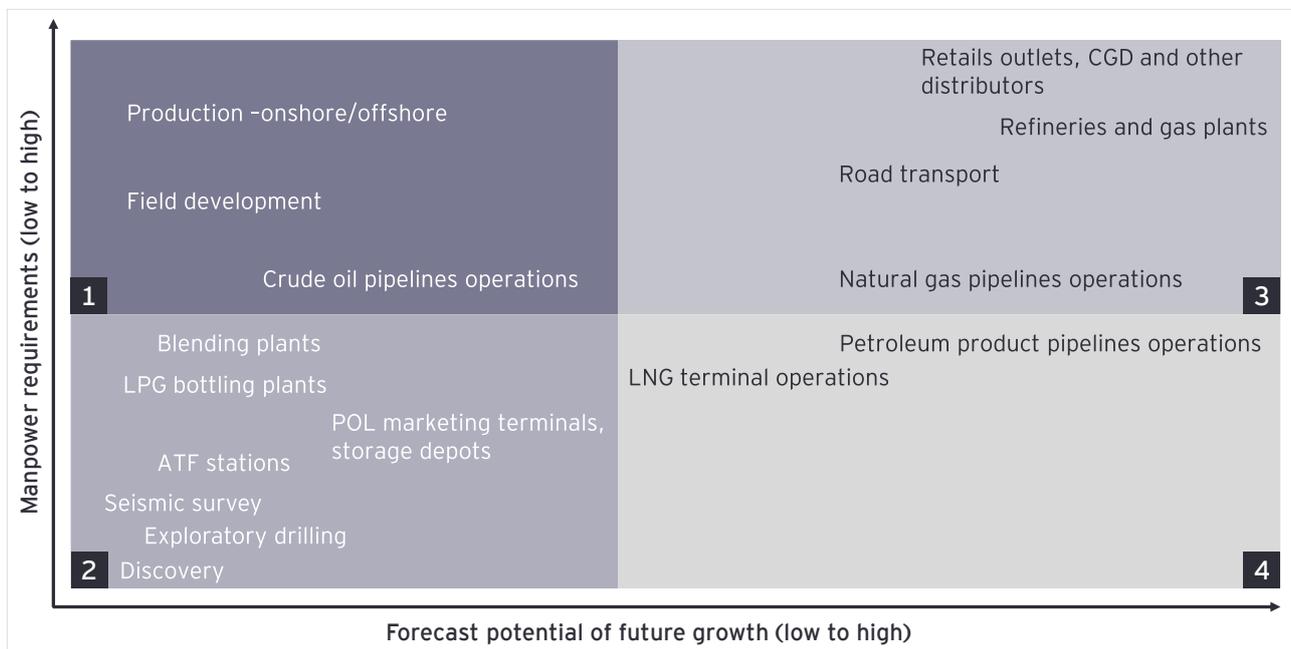
⁴⁹ Limited number of new allocations being done



Value chain activities in focus:

- ▶ Based on industry inputs and as represented above, there are many segments in the Oil and Gas value chain and may differ by how labour intensive each activity is. The ones that are labour intensive are more critical from a perspective of creating demand for skilled manpower at scale.
- ▶ Further, some segments' actual growth is subject to variety of conditions, and their manpower demand thereof is relatively harder to estimate given the conditionality of its future projects.
- ▶ On the other hand, there are some segments in the Oil and Gas value chain whose growth can be estimated with a greater degree of ease based on industry inputs/forecasts and government and policy directions, therefore the related manpower demand from such activities also can be better estimated for future manpower planning.

Figure 23: Identifying the critical Oil and Gas value activities with high potential of creating demand for incremental manpower



Source: Analysis based on industry interactions

- ▶ A combination of both the factors, i.e., extent of labour engagement and potential of forecasting of future growth of a segment, can help us to identify the areas that will most definitely need a pool of skilled talent to support the future projects. With reference to the above representation, the activities largely represented in quadrant number 3, are the most significant ones given their future growth projects that are being planned and they also employ a significant amount of manpower across the existing and new projects.

2.2.2 Supply side review

Supply side analysis primarily focussed on identifying the existing supply source (formal and non-formal education, training institutes, public and private).

The steps undertaken for supply analysis are:

- ▶ Training trend analysis for courses that are relevant for the oil and gas sector across ITIs

and funded programs for long term and short-term training ecosystem.

- ▶ Identification of job roles that can be leveraged for training the manpower for oil and gas roles.
- ▶ Identification of institutions which can be explored for forging partnerships for training support in terms of infrastructure, faculty, curriculum development, training of trainers etc.

Outcomes of supply side analysis

- ▶ Extensive data base of training institutes of all kinds and its seating capacity
- ▶ Extensive list of courses and trades for which courses are offered

2.2.3 Candidate Aspiration Mapping

Candidate aspiration survey primarily was based on the data collected through the survey of candidates at SDIs and ITIs/ technical educational institutes in the districts hosting the refineries.

Responses were collected from more than 500 candidates. The location/districts of the ITIs were chosen to carry out this survey since it has been observed that within India the cluster around refineries and have allowed major activities pertaining to hydrocarbon sector. As a result, the youth in these locations are expected to be highly aware about the employment potential in hydrocarbon sector. This is also due to the fact that these refineries have come up because of heavy capital investments, promoting economic incentives for the local communities due to forward and backward linkages. Objective of this analysis are listed as:

- ▶ To understand the aspirations of the youth vis-à-vis education and employment
- ▶ How best their aspirations can be met through intervention in the educational institutes
- ▶ Gaps in the objectives and needs of youth and the industry
- ▶ Their perspective on the future demands and skill gap

The questions covered the key following aspects: Candidate location, age profile and gender, Perception about working in Oil and Gas industry or in other sectors of energy, expected remuneration, reason to enrol in SDI, willingness to gain further skills in the sector, perspective of willingness for employment in the sector etc.





3

Manpower Analysis for Upstream

3 Manpower Analysis for Upstream

3.1 Key activities in the Exploration and Production Project Lifecycle

The upstream segment, that is also known as the Exploration and Production segment, encompasses survey and searching of crude assets, viability

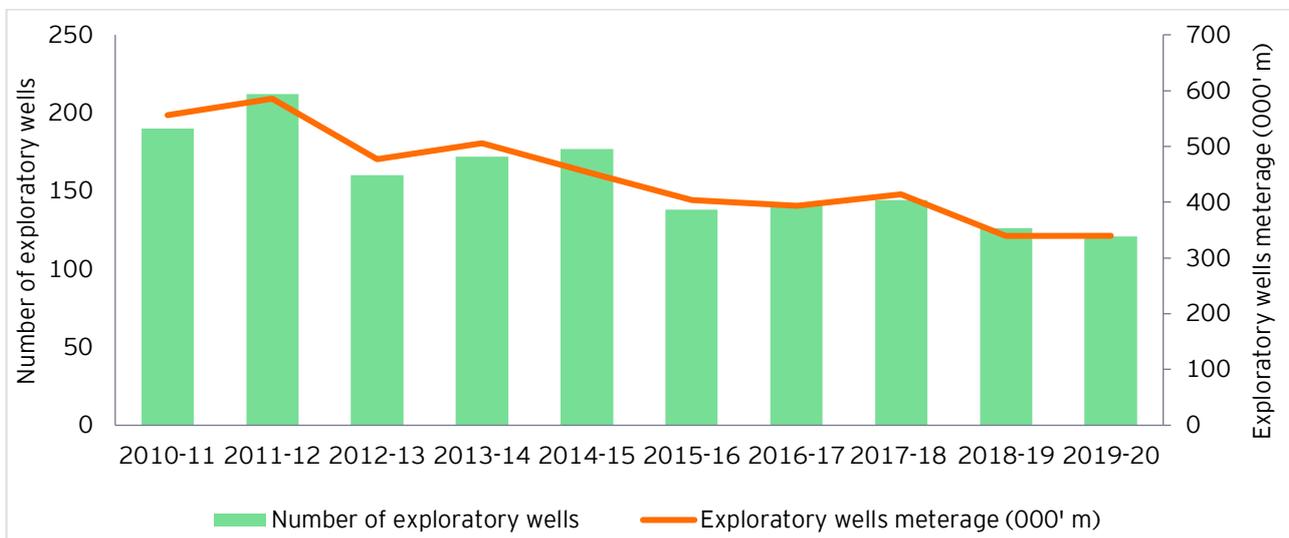
assessment of discoveries, development of drilling plan and infrastructure and production of crude oil and gas.

Exploration and appraisal

Exploration	Appraisal
<ul style="list-style-type: none"> ▶ Acquiring licences for undertaking geophysical surveys at oil and gas fields. ▶ Ascertain if the field has potential for future development for crude production using seismic activities for presence of crude is assessed by using 2D, 3D and 4D GIS tools at both onshore and offshore locations. ▶ India's present seismic belt consists of both onshore and offshore fields. 	<ul style="list-style-type: none"> ▶ Assess the commercial and practical viability of a discovered site. ▶ Drilling of exploratory wells are drilled to test hydrocarbon sample quality, temperature and pressure measurement, flow rates, reservoir age etc. ▶ A combined function of these results determines if further development and production would take place at a certain field.

The goal of the exploration is to identify and locate a prospect, to quantify the reserve of hydrocarbon, to validate the results of the initial geophysical hypotheses and ascertain the potential for return on investment and estimated production life.

Figure 24: Year wise exploratory wells drilled - DGH



▶ Over the last few years, though number of contracts have been awarded to Indian and foreign Oil and Gas companies for exploring India's crude potential, the number of new

wells dug every year has come down substantially resulting in a slowdown in rate of new discoveries.

Field development for production

- ▶ The development stage takes place after the appraisal and exploration of the oil and gas fields and precedes the production stage and involves high capital investment. This entails the following:
 - ▶ Estimation of volume of the reserve through 3D models of the sub surface.
 - ▶ Selection of the onshore or offshore platforms based on production volumes expected, calculating the required investments, operating costs, economic feasibility.
- ▶ Defining the front-end engineering and design using simulation and construction programs.
- ▶ Construction of the platforms for drilling of production wells.
- ▶ Design the crude transport model.
- ▶ Costs and duration of the development phase depends on the location of the field, the size and complexity of the facilities, and the number of wells needed to achieve the production and economic targets, which may take up to 5-10 years.

Production

- ▶ Production phase aims to recover the reservoir oil and gas to the surface for their further processing and refinement. A hydrocarbon reserve may continue to yield for a period of 15-30 years or more depending on the scale and maturity of the reserve.
- ▶ India's production is concentrated at few geographical zones.

Figure 25 Domestic crude oil production - 2019-20

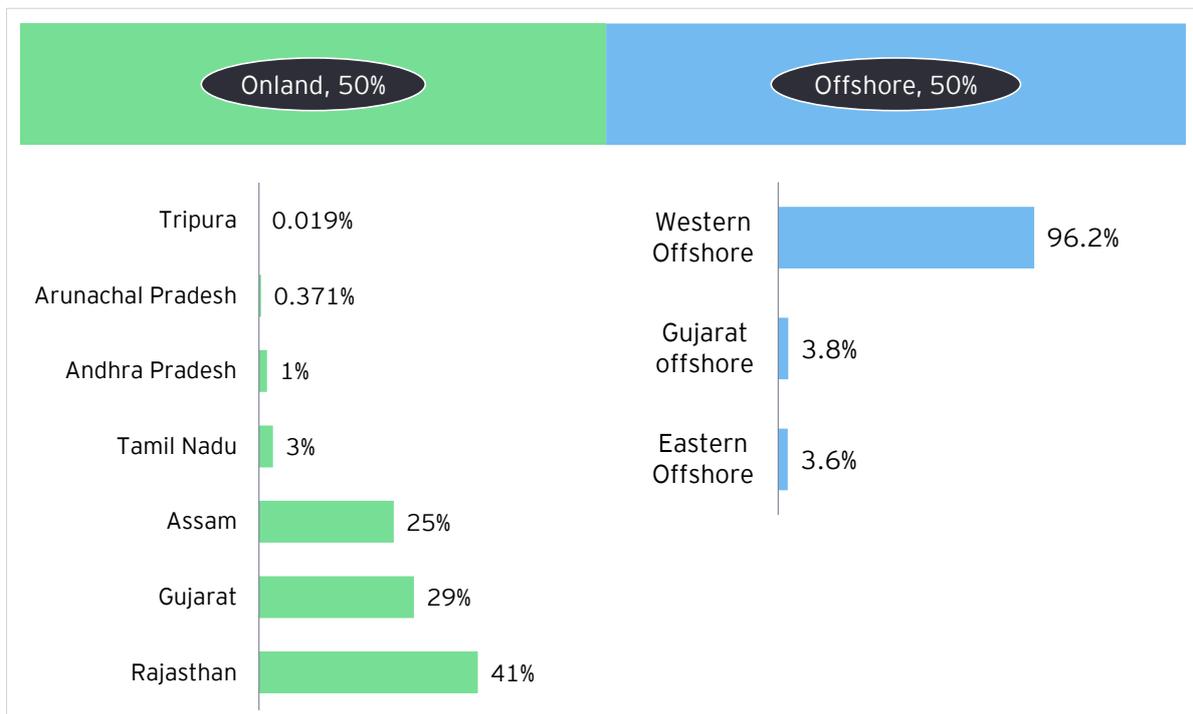
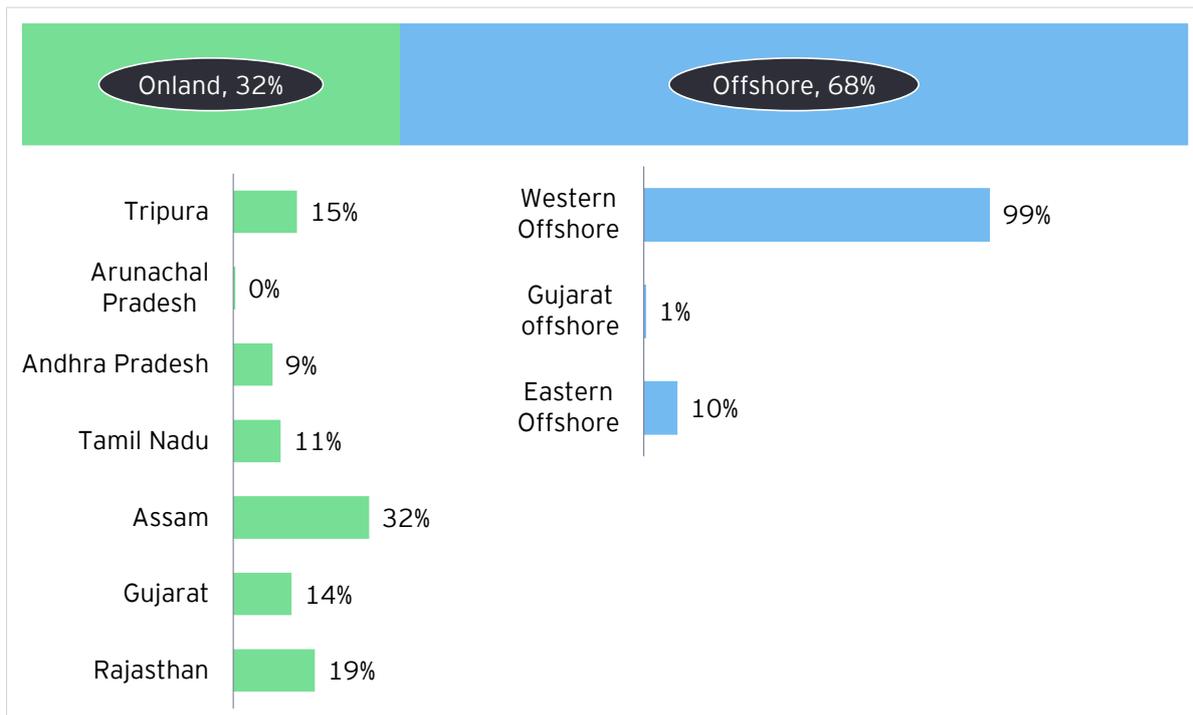


Figure 26: Domestic natural gas production - 2019-20



Source: MoPNG Annual Report 2020-21

Additionally, there are well service companies that provide specialized equipment and services for supporting the exploration and production companies across construction, maintenance and monitoring of infrastructure in proven oilfields.

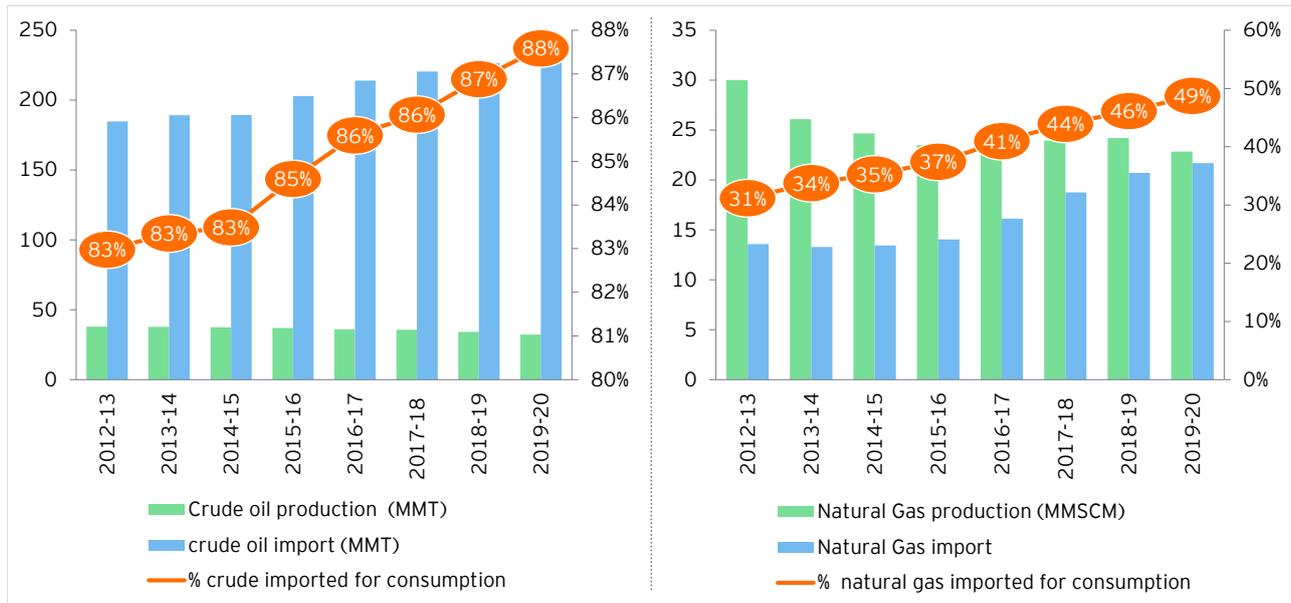
Industry trends show that India's oil and gas production have declined during the last decade in India. There are many reasons attributing this:

- ▶ One being that India has consistently followed the principle of strategic exploitation of energy resources with the aim of future conservation leading to stagnation of production.
- ▶ The companies are also faced with the challenge of dry wells, wherein the drilling operations are not yielding the expected results due to this dry well challenge have failed to improve its oil production.

- ▶ Additionally, most of India's crude oil production comes from aging wells that have become less productive over time. The output of these aging wells is declining faster than the rate of new wells. India is heavily dependent on a few specific locations for its crude production for years now - Barmer district of Rajasthan, Gulf of Khambhat (Gujarat), Mumbai High Sea, Godavari-Krishna Basin and in Assam.
- ▶ Declining production from old and marginal fields.

Lack of new oil discoveries in India coupled with a long lead time to begin production from discovered wells has led to marginally declining/flattened production curve of crude oil and gas and increasing dependency on import of crude products to address the domestic energy needs.

Figure 27: Increasing import dependency for meeting domestic demand for crude oil and natural gas



Source: Petroleum Planning and Analysis Cell (2021).

Oil and Gas companies and the Government are striving to make India favourable for production of crude.

Drivers for growth and future projects

- ▶ 26 new field development plans have been approved during 2019-20.
- ▶ More than 75 unmonetized small fields with discoveries belonging to national oil companies will be auctioned out to private and foreign entities.⁵⁰
- ▶ Time bound monetization of small fields under discovered small field policy to boost domestic production of oil and gas.
- ▶ Enhanced Oil Recovery/Improved Oil Recovery (EOR/IOR) methods to be adopted for small and marginal producing nomination fields operated by National Oil Companies (NOCs).
- ▶ Occurrences of oil and gas reserves in Kutch district of Gujarat, Cauvery basin (Tamil Nadu), Mahanadi basin (Odisha), Hugli basin (West Bengal), and offshore location in Bay of Bengal, on eastern Continental Shelf to be explored, appraised and developed of future production
- ▶ Investment in international oil fields - Indian oil and gas companies have invested in 55 overseas assets across 25 countries.
- ▶ India's hydrocarbon Vision 2025 aims to establish 100% appraisal of the Indian sedimentary basins.
- ▶ Enhance policy frameworks to support investment and efficient monetisation of assets.
- ▶ Establishment of national data repository now provides access to lakhs of kms of geoscientific data that will enable the investors to make informed decisions.
- ▶ There are also efforts to digitally transform the upstream exploration and production landscape to enhance accuracy, agility and versatility of operations. From the digital standpoint, intervenes are being proposed for the following⁵¹

⁵⁰ PIB (2021), Discovered Small Field Bid Round-III launched; Shri Dharmendra Pradhan calls for adopting innovative ways for early resource monetization.

⁵¹ MoPNG (2021), Digitalization Roadmap for Indian Exploration and Production (E&P) Industry. Accessed from https://mopng.gov.in/files/uploads/India_EP_Digital_Roadmap_June_2021_final.pdf

Figure 28: Excerpt from MoPNG's Vision Paper on Digitalization Roadmap for Indian

1 Transforming unstructured/ legacy data into meaningful information	12 Integrated data management platform for drill planning	23 Artificial Lift performance surveillance & failure prediction	34 AR/VR assisted safety training
2 Multi-client model in seismic survey, enabled through cloud system	13 Real time operation centre (ROTC) for drilling to foster collaboration	24 Drone-based surveillance of upstream/midstream assets and infrastructure	35 Managing environment impact during operations planning
3 Cloud-based seismic data collection, processing, & interpretation	14 Data-driven reservoir operations management	25 Predictive maintenance for compressors, pumps, and other surface equipment	36 Electronic barrier using image analytics and AI based alerts
4 Cloud hosted exploration portfolio: From regional to basing to play level	15 Big-data driven polymer dosage optimization in Chemical EOR Technique	26 Full scale asset simulation on cloud	37 Intelligent Permit To Work
5 Real-time data transmission and analysis - Field to Desktop	16 Integrated field operations (Integrated view of field performance from sub-surface, wells, & facilities)	27 Efficient Asset management through Operator driven reliability	38 Energy monitoring and optimization
6 ML driven sub-surface characterization and interpretation models	17 Integrated Asset Modelling in field development: Subsurface and surface digital twin	28 Integrated shutdown, turnaround, and outage management	39 Developing a common O&M and project spares platform
7 Digital Twin for integrated well planning and management	18 Automated selection and workflow for well workover	29 Analytics driven spare part inventory optimization	40 Developing a common Emergency Response Platform
8 Digitally driven Integrated Field Development Planning	19 Well testing automation and data management	30 Reliability centered maintenance and performance management	41 Developing a joint Operator-Supplier Cooperation Model
9 Digitally enabled Exploration Portfolio Management	20 ML based prediction of well choking	31 Virtual cloning of physical asset using digital engineering twin	42 National Data Lake and Data service CoE powered by NDR and Open Community
10 Digital Capital Project management for integrated schedule & interface management	21 Pipeline integrity management (leak detection & anomaly identification)	32 CCTV based surveillance monitoring	
11 Advanced Analytics based Frac design optimization	22 Non-contact Magnetometry diagnostic of pipelines	33 Wearables based tracking of workers	

- ▶ Accelerating exploration and geophysical study through the use of machine learning for data interpretation.
- ▶ Fast tracking field development for greenfield and brownfield projects through the use of integrated modelling techniques and preparing digital twins of assets.
- ▶ Enhancing production and recovery by deploying automation. Use of data analytics also helps enhance yield by supporting improved well designs. Further real time data, advanced data modelling helps optimize production and enables predictive maintenance.

Demand for manpower in the upstream segment is characterised by highly probabilistic variables such as viability assessment of new discoveries, nature of field, number of wells/quantas of drilling works and other factors that may be encountered as the development commences.

- ▶ Upstream manpower in large numbers is primarily required at 2 phases - field development phase and production phase. Additionally, some manpower is also engaged at the exploration phase for drilling of exploratory wells to determine the field viability.
- ▶ Engineering and construction during field development is the segment that generates maximum manpower demand relative to the drilling and production phases.
- ▶ The manpower planning dynamics in the upstream segment are defined by new discoveries and successful field development, both of which are probabilistic in nature. As per industry inputs, not all discoveries can be put through production due to lack of commercial viability, which may be determined at any point before the field starts yielding.

3.2 Key job roles across various stages of upstream activities

Exploration (1-5 years) and appraisal (4-10 years)

► Exploration

Once an Oil and Gas company is given a licence for an Exploration and Production a certain location, the exploration experts with their teams begin gathering geophysical and sub surface data, through surveys and exploratory drilling. The key techniques deployed at this stage:

- Geological surveys to assess, analyse and collect information from rock samples for potential areas with hydrocarbons
- Seismic survey to assess potential of presence of oil and gas before drilling exploratory wells. This method primarily deploys sound energy and can draw 2D, 3D and 4D images of the subsurface rock layers
- This is followed by drilling of a few exploratory wells to testify the geoscientific information

► Appraisal

- Basis the results of the seismic study during the exploration stage, the field is

assessed to decide if further production is viable at the field. During appraisal, more wells are drilled to collect information and samples from the reservoir and other seismic survey to better understand the hydrocarbon discovery.

- Minimum manpower, to the order of 50-100 maybe engaged at a certain field to drill the exploratory wells. However, manpower demand for appraisal is probabilistic in nature and the exact location and number of manpower required for appraisal of a field is a function of affirmative geophysical information and characteristics of the field (acreage, terrain etc).
- **Locations in focus for appraisal projects:** Appraisal of discovered small fields in Assam, Tripura, Gujarat, Rajasthan, Andhra Pradesh, Tamil Nadu, Cambay offshore, Kutch offshore, Krishan Godavari offshore, Mumbai offshore and Mahanadi and other large discoveries under various exploration regimes

Table 3: Key job roles in the exploration and appraisal phase

Development Geoscience	Exploration Geoscience	Operations Geoscience	Geotechnical Support and Seismic Processing	Land Seismic Unit	Well Drilling
Development Geoscience Manager	Geoscience Manager	Operations Team Leader	E&P Data Manager	Chief Surveyor	Drilling Operations Supervisor
Development Geology Advisor	Exploration Geoscience Manager	Operations Geoscience Manager	Senior Data Management/ Application Geoscientist	Geo-physicist	Drilling Engineering Supervisor
Development Geophysics Advisor	Exploration Geology Advisor	Operations Geology Advisor	Data Management and Software Support Officer	Party Chief	Drilling Application and Data Management Engineer
Development Team Leader	Exploration Geophysics Advisor	Operations Geophysics Advisor	Seismic Processing Lead	Observer	Drilling Fluids Specialist

Development Geoscience	Exploration Geoscience	Operations Geoscience	Geotechnical Support and Seismic Processing	Land Seismic Unit	Well Drilling
Lead Development Geologist	Exploration Team Leader	Lead Operations Geologist	Processing Geophysicist		Drilling Engineer
Lead Development Geophysicist	Lead Exploration Geologist	Lead Operations Geophysicist	Subsurface Data management Engineer		Drilling Supervisor
Senior Development Geologist	Lead Exploration Geophysicist	Senior Operations Geologist	Geotechnical Graphic Designer (GIS-CAD)		Driller
Senior Development Geophysicist	Senior Exploration Geologist	Senior Operations Geophysicist	Geotechnical Graphics Supervisor (GIS-CAD)		Assistant Driller
Development Geologist	Senior Exploration Geophysicist	Operations Geologist			
Development Geophysicist	Exploration Geologist	Operations Geophysicist			
	Exploration Geophysicist	Senior Wellsite Geologist			
		Wellsite Geologist			
		Senior Petro-physicist			
		Petro-physicist			
		Mud Logger			
		Formation Pressure Engineer			
		Hydrogeologist			
		QC Geophysicist			
Geophysicist					
Geologist					
Petro physicist					
Senior Technician - Geophysicist/ Geologist/Petro physicist					
Technician - Geophysicist					
Technician - Geologist					
Technician - Petro physicist					

Projects and design	Structure and fabrication (HUC commissioning)	Pipeline/piping	Well drilling (drilling, completion testing, rig management)
Engineering manager	Structural designer	Pipeline designer	Rig superintendent
Civil/structural engineer (offshore)	Structural senior draughtsman	Senior pipeline draughtsman	Drilling operations supervisor
Civil/structural engineer (onshore)	Structural draughtsman	Pipeline draughtsman	Drilling engineering supervisor
Offshore installation manager (OIM)	Junior structural draughtsman	Junior pipeline draughtsman	Drilling application and data management engineer
Instrument engineer	Senior structural engineer	Senior pipeline engineer	Drilling fluids specialist
Mechanical engineer	structural engineer	Pipeline engineer	Drilling engineer
Process engineer	Construction supervisor	Pipeline construction superintendent	Drilling supervisor
Electrical engineer	Senior fabrication workshop supervisor	Pipeline construction manager	Driller
CAD engineer	Structural fabricator	Pipeline constructor	Assistant driller
Draftsman	Structural fitter	Senior pipeline fitter	OAC assistant driller
	Heavy equipment operator	Pipeline fitter	Senior drilling technician
	Land surveyor	Junior pipeline fitter	Drilling technician
	Painter	Helper	Junior drilling technician
	Plumber		Well completion and intervention manager
	Quantity surveyor		Well completion supervisor
	Offshore underwater welder		Well intervention supervisor
	Carpenter		Well services supervisor
			Well superintendent
			Senior well completion engineer
			Senior well intervention engineer
			Well completion engineer
			Well intervention engineer
			Senior well completion technician
			Well completion technician
			Junior well completion technician
			Well testing manager
			Well testing supervisor
			Well testing engineer
			Senior well testing technician
			Well testing technician
			Junior well testing technician



			Pumpman
			Junior pumpman
			Derrickman
			Lead roughneck
			Rotary drill operators
			Roughneck
			Platform roustabout
			Toolpusher
			Rig mechanic
			Mudman

Field Development (4-10 years) and Production (15-20 years)⁵²

- ▶ Development activities and processes involves environmental impact, geophysics, geology, reservoir and production engineering, infrastructure, well design and construction, completion design, surface facilities, economics and risk assessment.
- ▶ This phase of the upstream segment primarily entails engineering and construction jobs at large scale to set up production platforms, drilling of one or multiple wells, setting up processing units, control stations and pipelines.
- ▶ In case of offshore oil rig platforms, much of the structure is prefabricated and installed at an offshore oil rig site.
- ▶ Currently 26 field development plans across Category 1 basins have been approved during 2019-20 which have the potential of creating manpower demand when they begin the development works, however timelines for the same are yet to be clarified. Further, the number of manpower required to develop the fields will be decided by capacity of fields, number of wells to be drilled etc.
- ▶ Further during the production stage, the drilling for oil and gas and other hydrocarbons can take place in two modes: offshore and onshore.
- ▶ In the Development and Production areas, the key activities cover drilling, pipeline, structural, mechanical, piping, instrumentation and control, material and corrosion, process, process safety, hook-up and commissioning (HUC), quality control, document management, platform operations and maintenance and storage and distribution etc.

Table 4: Key job roles for field development of a new reservoir site

Table 5: Key job roles for production of oil and natural gas for a new hydrocarbon reservoir site

Procurement and production		
Mechanical engineering	Storage and distribution / gas processing	Offshore production
Maintenance turnaround engineer	Control room operator storage and loading oil	Maintenance supervisor offshore

⁵² Including wellsite operations

Procurement and production		
Mechanical engineering	Storage and distribution / gas processing	Offshore production
Maintenance planning engineer	Operator storage and loading oil	Mechanical senior technician offshore
Predictive maintenance engineer	Senior operator storage and loading oil	Mechanical technician offshore
Contracts engineer	Operations supervisor storage and loading oil	Electrical senior technician offshore
Mechanical supervisor	Control room operator gas production	Electrical technician offshore
Maintenance planner	Operator gas production	Instrument and control senior technician offshore
Static equipment senior technician	Senior operator gas production	Instrument and control technician offshore
Static equipment technician	Operations supervisor gas production	Operations supervisor offshore oil production
Rotating equipment senior technician	Health and safety	Senior operator offshore oil production
Rotating equipment technician	Manager quality, health, safety and environment department	Operator offshore oil production
Senior condition monitoring technician	HSE coordinator (on FPSO)	Control room operator offshore oil production
Mechanical senior technician	Safety manager	Operation supervisor offshore gas production
Mechanical technician	Safety engineer	Senior operator offshore gas production
Car mechanic	Senior safety engineer	Operator offshore gas production
Heavy equipment mechanic	Trainee safety engineer	Control room operator offshore gas production
Instrumentation and control	Plant safety officer	Production superintendent
Analyzer senior technician	Offshore safety officer	Production supervisor
Instrument and control technician	Fire fighter	Lead production operator
Senior automation technician	QA/QC	Production operator (rig zone)
Senior metering technician	Quality control manager	Control room operator
Automation technician	Senior QAQC engineer	Laboratory technician
Instrument and control senior technician		Offshore installations manager (OIM)
Instrument and control supervisor		Marine offshore manager (FPSO)
Automation and metering specialist		Marine operations coordinator
Instrument technician (metering)		Marine superintendent
Telecom/SCADA technician		Marine technical lead
Production engineering		Port captain
Production engineering manager		Maintenance superintendent

Procurement and production		
Mechanical engineering	Storage and distribution / gas processing	Offshore production
Senior production engineer		Maintenance supervisor (FSO)
Production engineer		Mechanical supervisor
Production support supervisor		Electrical supervisor
Production data assistant		Instrument and control supervisor
Permit coordinator		Engine room supervisor
Operations support		Instrument technician
Production analyst		Storekeeper
Radio operator		Inspection technician
Laboratory technician		Mechanical technician
Facilities and project		Electrical technician
Facility planning superintendent		Maintenance planner
Facilities engineer		Control system technician
Surface facilities integrity engineer		PSV mechanic
Subsea and well integrity management engineer		Metering technician
Subsea engineer		Marine superintendent
Planning engineer		Cargo supervisor
Project engineer		Cargo technician
Integrity engineer		Crane operator
Asset integrity management coordinator		Pumpman
		Crane operator assistant
		Boatswain (bosun)
		Able seaman
		Scaffolder
		Roustabout
		Underwater repairs and installation
		Diving operations manager
		Diving operations supervisor
		Underwater inspection manger
		Underwater inspection supervisor
		Entry level diver
		Offshore underwater welder



4

Manpower Analysis for Midstream

4 Manpower Analysis for Midstream

In a bid to meet the rising consumption of oil and gas, the pipeline capacities are being expanded and new pipeline projects are being commissioned. India plans to invest US\$60 billion by 2024 to expand and upgrade its pipeline infrastructure⁵³. Ministry of Petroleum and Natural Gas with the objective of promoting the growth of the sector and meet the increasing demand of oil and gas has launched the New Exploration Licencing policy (NELP) and Open Acreage Licencing Policy (OALP) 2017.

As we know, a majority of the Oil and Gas requirement in the country is met through imports. The imported oil and gas are received at the ports situated at the eastern and western coasts. The oil and gas produced internally and imported needs to be transported to the downstream segment of the Oil and Gas industry.

The midstream Oil and Gas segment mainly comprises of storing and transporting oil and gas. Pipelines have been the preferred mode of transportation for oil and gas amongst the available options. Pipeline is the most preferred mode of oil and gas transport. The preference for pipeline can be seen from the fact that more than 70% of the transportation of crude oil and products in the US, and 97% of oil in Canada is transported through pipeline⁵⁴. Transportation through pipeline has multiple benefits among them economic and environmental are the key. It is economically superior due to low operational cost which is almost negligible. Financial analysis of the

pipeline installation and operations phase suggests that key financial investment is required in the installation and design phase; in comparison the operations and maintenance phase require relatively little investment. The pipeline is also safe and does not get impacted by adverse economic, social and environmental accidents.

Further, the impetus towards environmental sustainability has also promoted the transportation of oil and gas through pipelines. Pipelines are environmentally safe, and the carbon footprint is significantly less compared to other modes of transportation. The low operations and maintenance activities of pipelines makes them environmentally green.

The products carried in liquid pipelines include a wide range of materials. Crude oil systems gather production from onshore and offshore fields, while transmission lines transport crude to terminals, interconnection points, and refineries. The crude oil transported is both domestic origin and imported. Also carried by pipeline are liquefied petroleum fuels such as liquefied natural gas (LNG) liquefied petroleum gas (LPG) and propane, all of which are gases at standard temperature and pressure but easily liquefied with the application of pressure.

The oil and gas pipelines are primarily classified into two streams:

- ▶ Midstream gas pipeline
- ▶ Midstream crude oil pipeline

⁵³ Thomson Reuters (2019), India investing \$60 billion gas grid to link up nation by 2024. Accessed from : India investing \$60 billion gas grid to link up nation by 2024 | Reuters

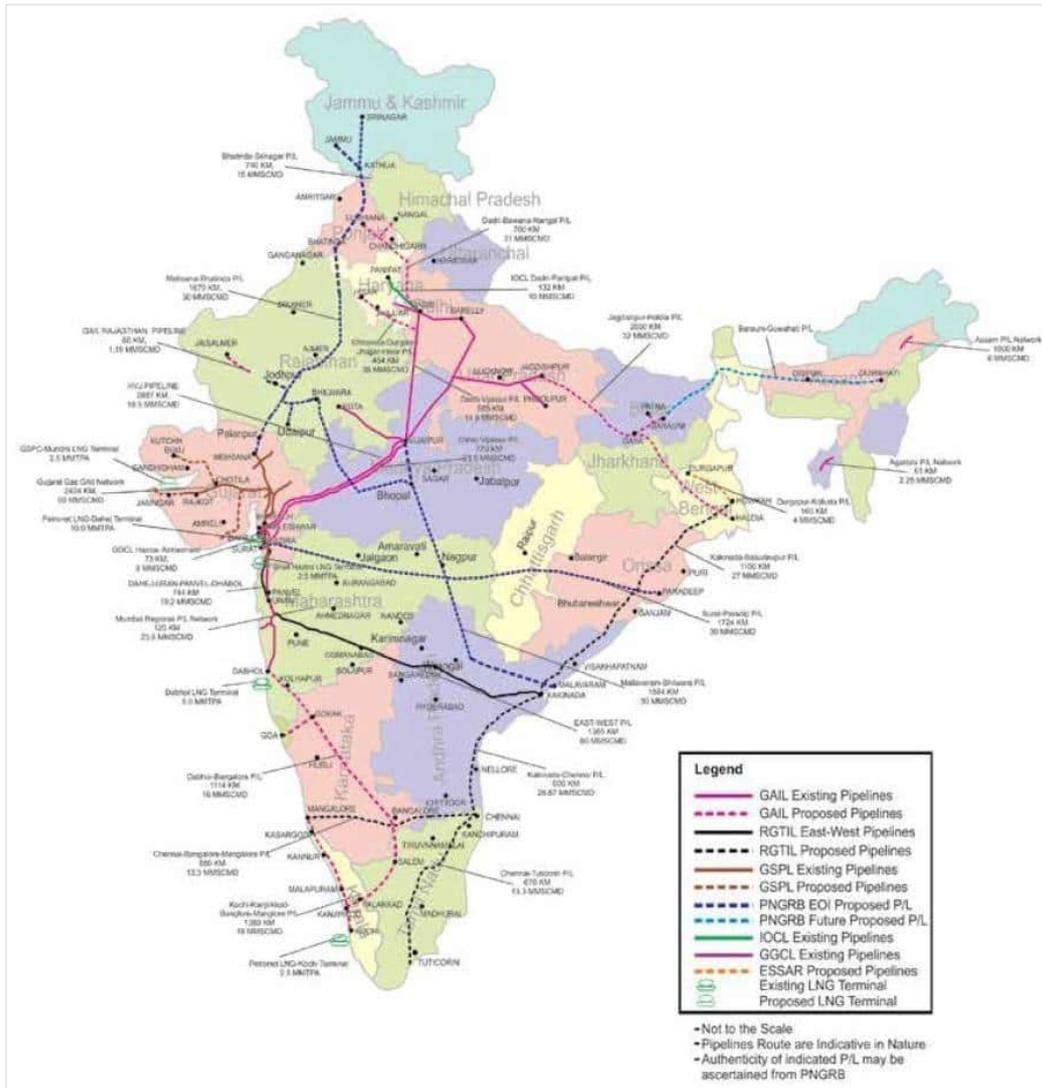
⁵⁴ https://www.assochem.org/latest_publication_img/1622832032.pdf

4.1 Midstream Gas Pipelines

India has an extensive gas pipeline network with a **total operational pipeline length of over 21,000⁵⁵ kms**. In addition, to the existing gas pipeline, **16,478 kms of pipelines is in different stages of installation**. Among the different firms, Gas

Authority of India Limited (GAIL) has the highest share with 70% of the total natural gas pipeline operated by it. Company wise ownership of natural gas pipeline is presented below.

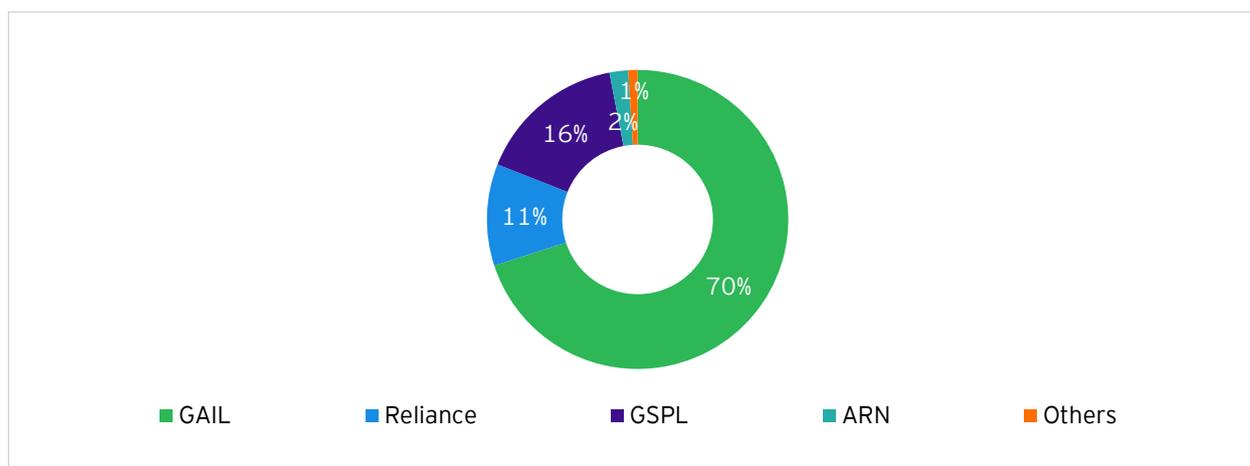
Figure 29: Key natural gas pipelines in different stages of development



Source: PNGRB <https://www.pngrb.gov.in/eng-web/annualReports.html>

⁵⁵ PNGRB (2022). Accessed from <https://pngrb.gov.in/eng-web/data-bank.html#ngpl-1>

Figure 30: Company wise ownership of natural gas pipeline



Manpower demand estimations for commissioning and operations of natural gas pipelines

Design and Installation Phase

As per industry inputs, it is estimated that over 5,000 manpower has the potential of being engaged to construct natural gas pipeline length of over 16,000 kms

Majority of the employment involved in the natural gas pipeline gets generated in the design and installation phase in the construction and laying of the pipeline. The manpower estimates for the design and installation phase has been done based on the ongoing and approved pipelines projects as informed on PNGRB website. As a majority of the

pipelines highlighted by PNGRB are already ongoing, most of the manpower demand is expected to be in the coming years 2022-2025. The estimated manpower demand figures are provided in the figure below. The manpower has been estimated based on the pipeline length. The pipeline projects have been classified in different classes such as 0-100 kms, 100-500 kms, 500-1000 kms and so on. The manpower estimation methodology has assumed increasing manpower requirement for pipeline projects with larger lengths.

Table 6: Key job roles where employment is expected be generated in gas pipeline design and installation phase

Job roles	Manpower demand (2022-2025)
1. Gas Cutter	440
2. Assembly Operator	440
3. Structural Welder	440
4. Machinist	357
5. Electrician	265
6. Operator	265
7. Pipe welder	440
8. Fire Stewart	260
9. Driller	97
10. Rigger	440
11. Grinder	260
12. Blaster	186
13. Painter	186

14. Pipe Fitter	440
15. Wireman	186
16. Concrete and Excavation Worker	182
17. Roof Setter	182
18. Laboratory and Field Technician	182
Total	5,248

Source: Analysis based on industry inputs

In addition to the above job roles, significant employment during the construction phase gets generated for labourers which include jobs such as **as Flagman, General Labourer, Jackhammer man, Measure man, and Specialized Labourer.**

Based on the geographical distribution of the ongoing and approved pipelines projects, the key states with the intensity of the manpower requirement are highlighted below:

Table 7: States in focus for new natural gas pipelines

State	Intensity of new pipeline installation activities
Andhra Pradesh	High
Gujarat	High
Jharkhand	High
Madhya Pradesh	High
Maharashtra	High
Odisha	High
Rajasthan	High
Tamil Nadu	High
Telangana	High
West Bengal	High
Assam	Medium
Bihar	Medium
Chhattisgarh	Medium
Haryana	Medium
Karnataka	Medium
Kerala	Low
Uttar Pradesh	Low

Source: Analysis based on industry inputs

Operations and maintenance phase

As per industry inputs, it is estimated that over 3,400 manpower (blue collared) has the potential of being engaged for operations and maintenance of midstream pipelines

Post the installation of the gas pipeline, the pipeline is handed over to the Gas company who operate and maintain the pipeline. During the operations and maintenance phase majority of the employment gets created at the Pumping Stations,

Valve Manifolds and Supervisory Control and Data Acquisition (SCADA) Systems. However, the employment getting generated in this phase is significantly small as compared to the installation phase.

The estimation methodology considers the manpower required for the operations and maintenance of the pipelines. In addition to the manpower required, a yearly manpower attrition



rate of 3-5% is considered to arrive at the aggregated estimates. The attrition figure has been

assumed based on the average sectoral attrition rates in the mid-stream.

Table 8: State wise incremental demand for manpower by 2030 for operations and maintenance of new and existing natural gas pipelines

States	Incremental manpower demand		
	by 2025 ⁵⁶	2025-2030 ⁵⁷	2025 - 2030 ⁵⁸
Grand Total	336 - 560	3029	420-700
Andhra Pradesh	21- 35	317	26 - 44
Assam	6 - 10	24	8 - 13
Bihar	12 - 20		15 - 25
Chhattisgarh		39	
Gujarat	94 - 157	43	118 - 197
Haryana	7 - 12	87	9 - 14
Jammu and Kashmir	3 - 5	75	4 - 6
Jharkhand		85	
Karnataka	7 - 12	95	9 - 15
Kerala	8 - 13	66	10 - 17
Madhya Pradesh	38 - 64	168	48 - 80
Maharashtra	50 - 83	352	62 - 103
NCR	18 - 30	27	22 - 37
NE states		350	
Odisha		363	
Rajasthan	14 - 24	360	18 - 30
Tamil Nadu	10 - 16	166	12 - 20
Telangana	12 - 20	183	15 - 25
Tripura	6 - 11		8 - 13
Uttar Pradesh	29 - 49	92	36 - 61
West Bengal		134	

Source: Analysis based on industry inputs.

Table 9: Key job roles involved in the operations and maintenance of gas pipelines

Job Roles	by 2025 ⁵⁹	2025-2030 ⁶⁰	2025 - 2030 ⁶¹
Total	336 - 560	3029	420-700
Industrial Technician Electrician (Oil and Gas)	69 - 115	605	86 - 144
Industrial Technician Mechanical (Oil and Gas)	69 - 115	605	86 - 144
Industrial Technician Instrumentation (Oil and Gas)	40 - 67	348	50 - 84

⁵⁶ Replacement manpower for retirement and attrition. Replacement rate - 3% to 5%

⁵⁷ New project manpower

⁵⁸ Replacement manpower for retirement and attrition (replacement rate - 3% to 5%)

⁵⁹ Replacement manpower for retirement and attrition. Replacement rate - 3% to 5%

⁶⁰ New project manpower

⁶¹ Replacement manpower for retirement and attrition (replacement rate - 3% to 5%)

Job Roles	by 2025 ⁵⁹	2025-2030 ⁶⁰	2025 - 2030 ⁶¹
SS Tubing Technician	16 - 26	158	19 - 32
Fire Safety Technician (Oil and Gas)	68 -113	609	85-1141
Operator - Hydrocarbon Pipeline / Technician (Site/Inspection)	74 - 124	704	93 - 155

Source: Analysis based on industry inputs. .

In addition to the blue collared job roles that have been identified for manpower demand creation, some other critical job roles (either supervisory, niche skills needed or minimally required) for operations and maintenance of natural gas pipelines are as follows⁶² :

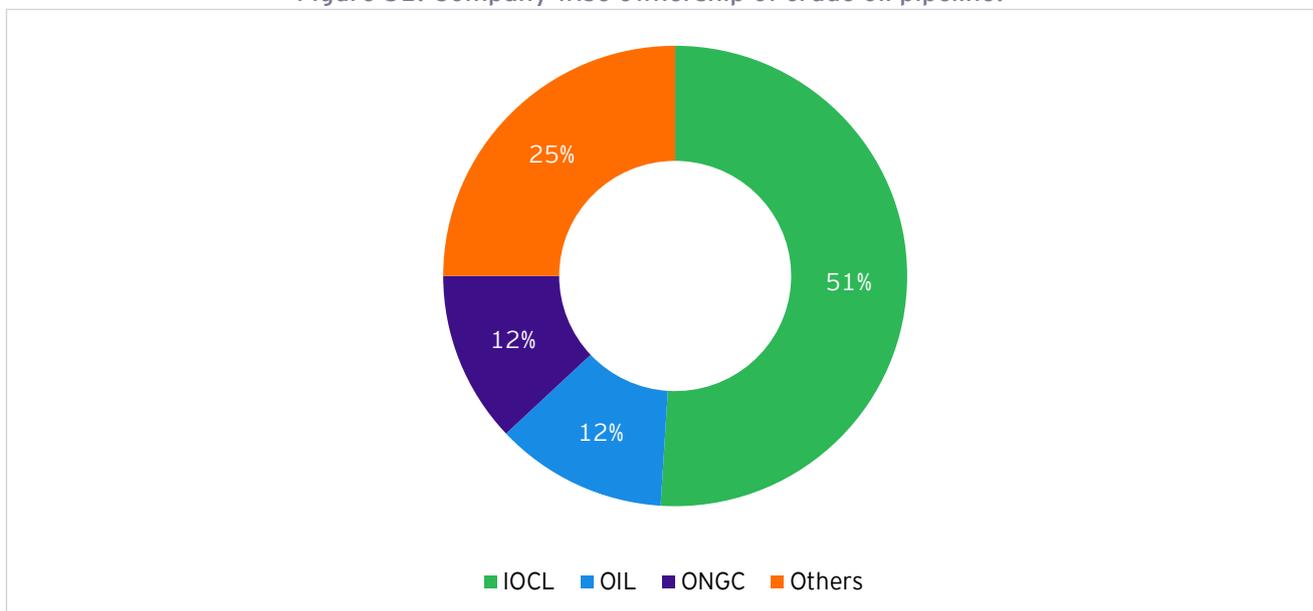
- ▶ Chief Engineer
- ▶ Team Leader Operations
- ▶ Team Leader Maintenance
- ▶ Planning Specialist
- ▶ Team Leader - Main Control Centre
- ▶ Chief Engineer - Main Control Centre
- ▶ Engineer - Main Control Centre
- ▶ Engineer - Metering
- ▶ Operator- Telecom and SCADA (subject to level of automation)
- ▶ Technician - Turbo Compressor
- ▶ Technician - Heavy Machinery
- ▶ Technician - Main Control Room

4.2 Midstream Crude Oil Pipeline

The crude oil pipeline is used for transportation of crude oil from exploration sites and imported oil terminals to refineries. As of April 2020, India

operated a total crude oil petrol pipeline of 10,419 kms.

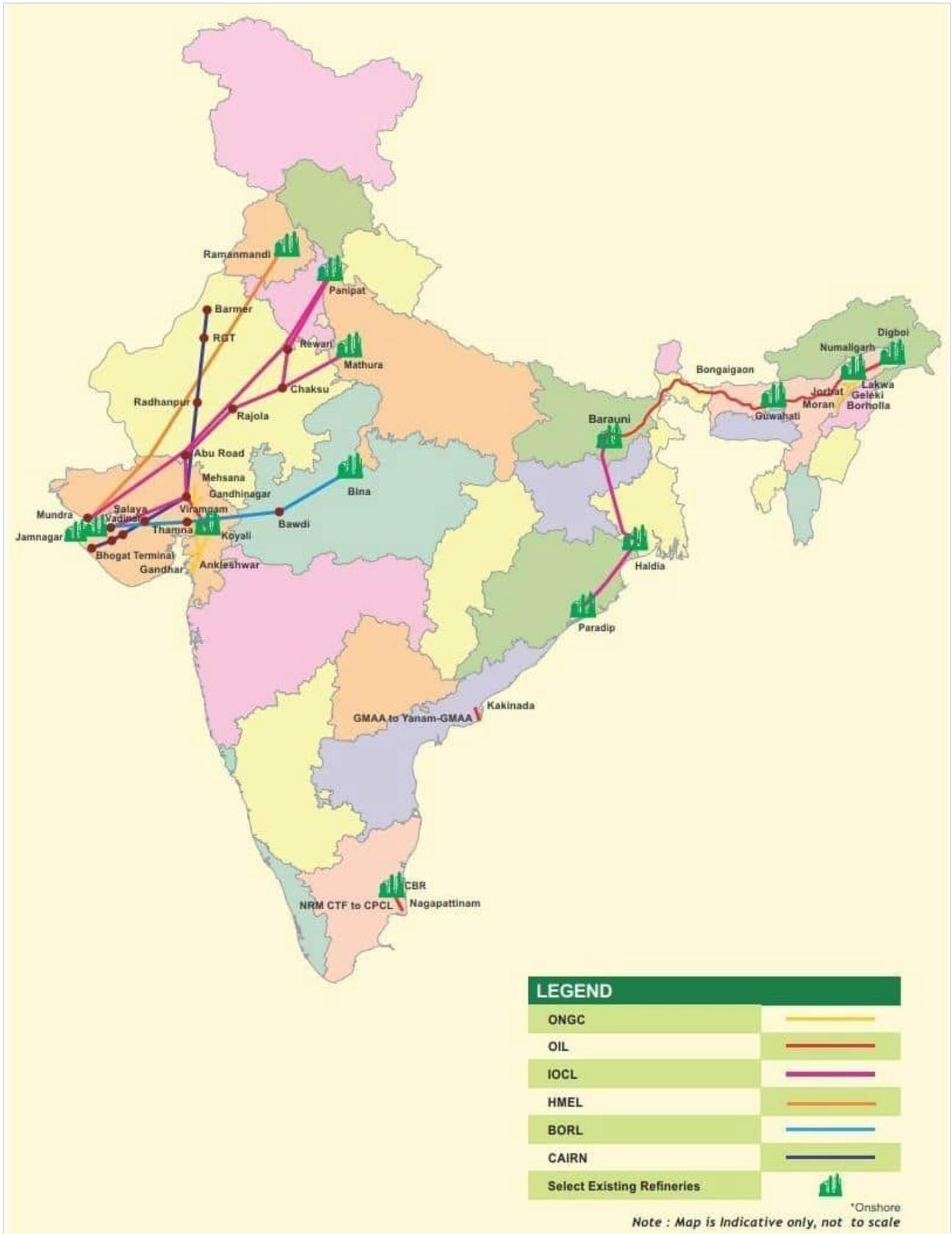
Figure 31: Company wise ownership of crude oil pipeline.



⁶² Basis literature review of global competency frameworks across USA, Singapore and Malaysia.

Sources : <https://ihrdc.com/competency-management/competency-content-2/>, https://www.mogsc.org/files/editor_files/files/CTWG/134%20-%20OCCUPATIONAL%20ANALYSIS%20-%20OIL%20%26%20GAS%20INDUSTRY.PDF

Figure 32: Crude oil pipeline network of India



As can be seen, a majority of the crude oil pipelines are originating on the western coast of Gujarat and primarily moves across the states of Gujarat, Rajasthan, Uttar Pradesh, Madhya Pradesh, Haryana, and Punjab. These pipeline network on

the western side have been developed to carry the imported crude to the refineries. The other major crude oil network runs from the domestic oil fields in Assam.

The crude oil pipeline network requires manpower in two phases:

Design and installation phase

Design and installation of the crude oil pipeline generates majority of the employment in this stream. During the installation phase significant numbers of construction jobs gets generated. In addition, pipeline construction also employs manufacturers, service workers, engineers, surveyors, occupational health and safety professionals, managers, teamsters, etc.

Key activities in the pipeline construction phase includes:

- ▶ Clearing/grading/levelling/bulldozing
- ▶ Digging of earthen drain

- ▶ Installation of row boundary posts
- ▶ Trenching (ditching)
- ▶ Laying of the pipeline
- ▶ Welding of pipe joints
- ▶ Coating of field joints
- ▶ Repairing of damaged coating
- ▶ Lowering pipe into trenches
- ▶ Backfill and dress trench
- ▶ Testing
- ▶ Valve assembling
- ▶ Painting

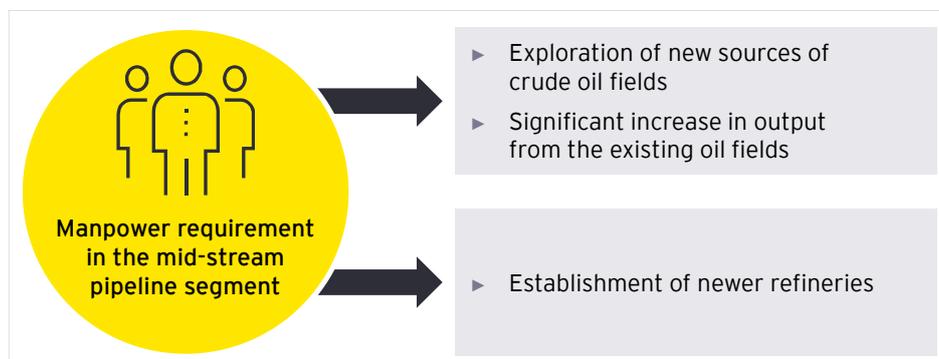
Construction job roles

The manpower requirement in midstream crude pipeline segment is a function of two variables:

- ▶ **Domestic crude oil production and associated demand for new pipelines** to transport the crude to the refineries. In addition to the existing crude oil pipelines; new discovery of any oil field or enhancement of

production from existing oil fields can lead to demand for new crude oil pipelines. However, both these decisions are strategic and have long term planning horizon. Given the limited production from domestic oil fields and the production increase may only lead to increase in requirement of pipeline.

Figure 33: Factors for capacity enhancement of midstream pipeline



- ▶ Import of crude oil is the other major driver of demand for newer pipelines. Pipelines are the preferred mode for transporting crude oil from ports to the refineries. Increase in imports can be accommodated with the existing pipeline

networks through pressure or flow interventions. However, establishment of newer refineries or substantial increase in import can create a case for establishment of newer pipelines.

- ▶ Manpower requirement for crude oil pipeline as a function of the operationalization of newer oil fields or establishment of newer refineries.
- ▶ Currently, there is limited visibility on the operationalization of newer oil fields, therefore the manpower requirement in design and installation of newer pipelines will be limited.
- ▶ As per the current planning three newer refineries are expected. These three refineries are in early stage of development and the plans for any pipeline to these refineries have not been developed yet. Therefore, the manpower demand for pipeline due to newer refineries is also limited.

Operation and maintenance roles

Post the labour-intensive installation phase, operations and maintenance are low manpower intensive phases. The key job roles in these phases mainly involve running the flow lines, pumping

stations, and SCADA systems. The key installations in the midstream crude pipeline segment which requires manpower deployed in the operations and maintenance phase includes:

Table 10 Key crude oil pipeline segment for operations and maintenance

Installations	Features
Flowlines	Flowlines are part of a crude gathering system in production areas to move produced oil from individual wells to a storage area. Flowlines are generally small-diameter pipelines operating at relatively low pressure.
Crude Trunk Lines	The crude trunk lines are the long-distance trunk lines used to transport the crude oil from storage points to refineries. Crude trunk lines operate at higher pressures than flowlines and could vary in size from 6 inches in diameter to as large as 4 feet.
Pumping Stations	The trunk lines have pumping stations at regular distance throughout its length to maintain the pipeline pressure and assist the smooth transportation of the crude oil.
Valve Manifolds	Valves are installed at strategic locations along the mainline pipe to control flows and pressures within the pipe and to isolate pipe segments in the event of upset or emergency conditions. Regardless of design, all valves require regular monitoring and maintenance.
Pigging Stations	Pipeline have started incorporating the use of pigs, depending on the nature and quality (purity) of the materials being transported. Pigs can be designed to clean accumulated sludge and debris off the inside walls of a pipe, or to monitor the pipe for conditions such as corrosion.
Supervisory Control and Data Acquisition (SCADA) Systems	Pipelines are monitored and operated using sophisticated SCADA systems. SCADA systems regulate pressure and flow by monitoring and controlling pump operation and the positions of valves. SCADA systems also perform a variety of additional functions including alarm processing, leak detection, hydraulic analysis, pump station monitoring, throughput analysis, and other functions deemed critical to the safe operation of the pipeline.

Crude pipeline operations and maintenance phase requires little manpower mainly to operate flowlines, pumping stations and SCADA systems. Manpower skilling and reskilling for the mid-

stream operations and maintenance can be carried-out at the respective locations as per demand.

Summary – Manpower Demand Analysis for Midstream Pipelines	
Incremental demand for operations of new pipelines (natural gas) – 3029	
Incremental demand till 2025 for operations and maintenance – 336 - 560	Incremental demand from 2025 till 2030 for operations and maintenance of pipelines (new and existing) – 3,449 3,729
States in focus	Andhra Pradesh, Gujarat, Jharkhand, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Telangana, West Bengal

4.3 Natural gas processing, fractioning and liquefaction plants

The natural gas that is produced from rocks is called *feed gas* and further needs to be treated to ensure that impurities, water and oil is separated from it. This separation usually happens at the production site itself or transported to a nearby facility for the treatment and processing.

Once the gas is separated from water and oil it is put through a fractioning process in the processing plant to remove other components, such as ethane, propane, butane, isobutane, and natural gasoline, also known as natural gas liquids.

Now, while natural gas is plentiful, and it is the cleanest-burning fossil fuel, transporting the gas for long distances by pipeline can be expensive and dangerous given its characteristic of being a low-

density element. As a solution, the natural gas (methane with traces of ethane) is subsequently cooled down to freezing temperatures and turned to liquid in the plant for further transportation to farther places and storage using barges and pipelines. The liquefaction process also can take place at the production site itself or at separate facility. Many a time common processing and liquefaction facility serve to treat the natural gas produced from multiple sites. The LNG is kept in insulated tanks until it is ready for loading into a specially designed LNG ship/carrier or barges.

Based on industry consultations, it was realised that the processes at the facilities are largely automated, and technology driven with then supervision and surveillance manpower required.

Table 11: The key job roles required for gas processing, fractioning and liquefaction plants

Storage and distribution /gas processing
Control room operator storage
Operator storage
Senior operator storage
Operations supervisor storage
Control room operator gas production
Operator gas production
Senior operator gas production
Operations supervisor gas production

4.4 LNG terminals

Followed by extraction/production and liquefaction, the LNG is transported to location for further distribution to end users. LNG that is received from storage barges is re-gasified at the LNG terminals and then transported via pipelines to

customers, providing energy for homes and industry.

The key processes that take place at the LNG terminals are - unloading from the floating vessel



carrying the LNG to onshore terminal and then its operations at the regasification plant unit in the at the receiving LNG terminal.

India is the world's fourth largest importer of Liquefied natural gas (LNG) and the dependency on

imports has only been increasing due to decline in domestic production and increase in consumption.

Currently the LNG terminals operational in India are highlighted below. The total capacity at these LNG stations is 39.2 MMTPA⁶³.

Table 12: List of existing LNG terminals in India

Terminal	State	Promoters	Capacity (MMTPA)
Dahej	Gujarat	Petronet LNG Ltd.	17.5
Hazira	Gujarat	SHELL	5
Kochi	Kerala	Petronet LNG Ltd.	5
Dhabol	Maharashtra	GAIL (KLPL)	1.7
Mundra	Gujarat	GSPC LNG Ltd	5
Ennore	Tamil Nadu	IndianOil LNG Pvt. Ltd	5

Source: MoPNG

Manpower demand estimations for commissioning and operations of LNG terminals

Design and installation phase

Based on industry inputs, it is estimated that over 2,600 manpower has the potential of being engaged for the construction of new LNG capacity⁶⁴.

In addition to the existing LNG capacity, additional capacity of more than 20 MMTPA through multiple LNG terminals is underway.

Table 13 List new LNG terminals that are in development stage

Terminal	State	Promoters	Capacity (MMTPA)
Dhamra	Odisha	Adani LNG Pvt Ltd	5
Dhabol Expansion	Maharashtra	GAIL(KLPL)	3.3
Jaigarh	Maharashtra	H-Energy	4
Jafrabad	Gujarat	Swan Energy	5
Karaikal	Puducherry	AG&P	1
Chhara	Gujarat	HSEPL	5

Additionally, an LNG terminal is also being planned on the east coast, for which technical and commercial feasibility assessment is underway

The new LNG projects that are in the pipeline are currently in their construction phase, with most of the projects expected to be completed by 2022-2023. This manpower, however, would not be entirely incremental since the construction

projects have been underway a few years. Additionally, in the case of LNG terminals, which is a relatively new segment in India, especially the ones with floating and regasification units, critical and large-scale infrastructure and terminal units

⁶³ MOPNG Annual Report 2020-21

⁶⁴ Reference: http://environmentclearance.nic.in/auth/FORM_A_PDF.aspx?c at_id=IA/OR/MIS/38482/2016&pid=found

are imported from other countries for assembly and installation at the terminals.

Operations and Maintenance Phase

Approximately, 2300 additional manpower maybe required for operations and maintenance of 6 new LNG terminals that are being planned and commissioned

LNG operations include high degree of complexity and automation resulting in creation of technical jobs at a relatively limited scale.

Based on industry inputs and secondary resource, volume of jobs in the LNG segment, existing and future are as follows:

- ▶ It is estimated that across 6 of the existing LNG terminals, approximately 2700 manpower has been engaged, across company executive staff and sourced manpower for shipping LNG, outsourcing jetty management, and security.
- ▶ For the new LNG terminals, based on estimates, approximately 2300 additional manpower maybe required.⁶⁵

Table 14 Key job roles and processes at LNG terminals

Department	Job Role
Terminal Head - Operations and Management	
LNG Operations	Chief Manager Operations
Shipping and Marine Logistics	Chief Manager (Shipping And Marine Logistics)
Hr/Fire/Security	Chief Manager (Hr/Fire/Security)
Maintenance	Chief Manager Maintenance
LNG Operations	LNG Operations Supervisor
LNG Operations	Operator LNG Production
LNG Operations	Control Room Operator LNG Production
LNG Operations	Control Room Officer LNG Production
LNG Operations	Operations Supervisor Inlet Receiving LNG
LNG Operations	Senior Operator Inlet Receiving LNG
LNG Operations	Operator Inlet Receiving LNG
LNG Operations	Operations Supervisor LNG Storage and Loading
LNG Operations	Senior Operator LNG Storage and Loading
LNG Operations	Operator LNG Storage and Loading
LNG Operations	Control Room Operator Storage and Loading LNG
Quality Control	Quality Control Officers
Quality Control	Chemist/Analyst
Shipping and Marine Logistics	Shipping and Marine Logistics Supervisor
Shipping and Marine Logistics	Shipping Officer
Shipping and Marine Logistics	Logistics Officer

⁶⁵ Hazira LNG terminal Environmental Assessment Report, Dahej LNG terminal manpower plan, Page 17

Dahej Environment Assessment Report Phase 2 (increasing of 5 MMTPA capacity)



Department	Job Role
Shipping and Marine Logistics	Shipping Coordinator
Shipping and Marine Logistics	Logistics Coordinator
Gas Turbine Generator /Electrical Operations	Gas Turbine Generator/Electrical Operations Supervisor
Gas Turbine Generator/Electrical Operations	Gas Turbine Generator/Electrical Operations Engineer
Gas Turbine Generator/Electrical Operations	Engineering Assistant Electrical /Gas Turbine Generator Operator
Terminal Maintenance - Mechanical	Mechanical Maintenance Supervisors
Terminal Maintenance - Mechanical	Mechanical Maintenance Engineer/ Planner
Terminal Maintenance- Mechanical	Engineering Assistant Mechanical Maintenance
Terminal Maintenance Civil	Civil Maintenance Engineers
Terminal Maintenance Instrumentation	Maintenance Instrumentation Supervisor
Terminal Maintenance - Instrumentation	Maintenance Instrumentation Engineer
Terminal Maintenance - Instrumentation	Engineering Assistant Maintenance (Instrumentation)
Health and Safety	HS&E Manager
Health and Safety	HS&E Engineer
Health and Safety	HS&E Operator
Health and Safety	Fire Safety Engineer (Oil and Gas)
Health and Safety	Fire Safety Technician (Oil and Gas)
Health and Safety	Security Staff
Materials and Contract Officers	Manager C and P
Materials and Contract Officers	Officers Materials
Materials and Contract Officers	Commercial Supervisor
Materials and Contract Officers	Officer Commercial
Support Roles	Materials Assistant
Support Roles	HR Officers (HR/Fire/Security)
Support Roles	HR Staff
Support Roles	Admin Officer
Support Roles	Admin Staff
Support Roles	Finance Officer
Support Roles	Information System (Is Department)



5

Manpower Analysis for Downstream

5 Manpower Analysis for Downstream

The downstream sector includes the refining of petroleum crude oil and the processing and purifying of raw natural gas, as well as the marketing and distribution of products derived from crude oil and natural gas. To assess the

manpower demand in downstream in the next 10 years, the key value chain activities were identified and main brownfield and green field projects across the same were mapped.

Key component	Key factors for creating manpower demand till 2030
Crude processing at refineries	<ul style="list-style-type: none"> ▶ 3 new refineries planned /underway to add more than 70 MMTPA capacity by 2030 ▶ Multiple brownfield field projects planned /underway for adding more than 30 MMTPA capacity ▶ 5,000+ compressed biogas plants being added to increased use of clean energy
Distribution of refined products	<ul style="list-style-type: none"> ▶ Over 9,000kms of product pipeline length to be added ▶ Capacity to be augmented by 200 MMTPA by 2025 ▶ Increasing fuel demand to add increase demand for road vehicles ▶ Storage and packaging through bottling plants, marketing terminals, tank farms etc
Retail and marketing	<ul style="list-style-type: none"> ▶ ~55,000 retail outlets have been allocated to 13+ states ▶ 1.80 cr LPG connections need to be provided to ensure 100% household coverage by LPG ▶ Retail of air turbine fuels to increase ▶ Direct to home retail network and mobile dispensers to received increased impetus
City Gas Distribution	<ul style="list-style-type: none"> ▶ Project for 9th and 10th CGD round are underway <ul style="list-style-type: none"> ▶ 42 lakh PNG connections to be provided ▶ More than 8,000 CNG stations to be established ▶ 11th CGD round has been announced

5.1 Refineries

Industry snapshot

Indian refining sector's growth is imperative not only to address the domestic consumption needs but to also maintain its position as a net exporter of petroleum products, as it contributes substantially to the ex-chequer. The refineries to remain commercially viable and environmentally progressive, have undertaken various advancement and modernization projects to optimize their performance and strive to continue its capacity enhancement.

Refinery capacity is increased by both greenfield and brownfield projects. The capacity enhancement projects of the refineries could range from installation of various process units for upgradation of refinery for yield improvement, catalysts development for refining processes using

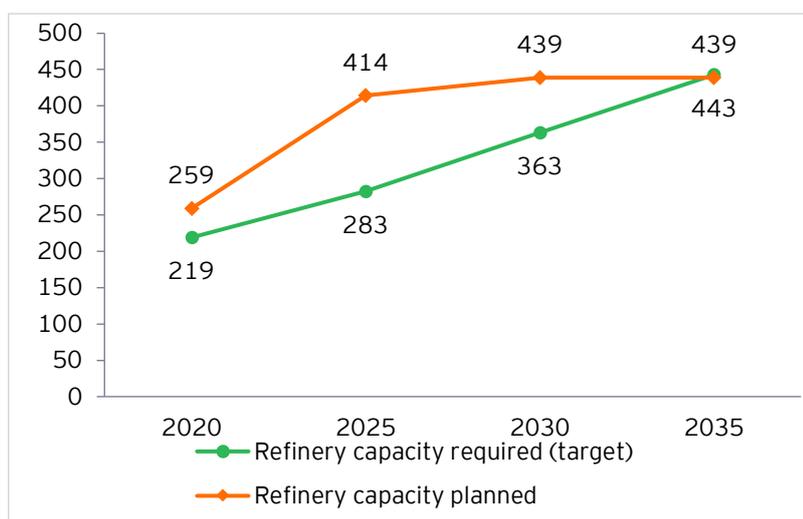
quality upgradation technologies, modernization of process modules for production of specific fuels to installation of turbines, generators, boilers, treatments plants, petrochemical unit etc.

For instance, in 2016-17, the refinery capacity of the country experienced a steep increase in capacity due to the establishment of IOCL's refinery in Paradip. More recently, the year 2017-18 witnessed a significant rise in the refining capacity owing to augmentation efforts at Kochi (BPCL), Bhatinda (HMEL) and Jamnagar (RIL) refineries.

Massive engineering, procurement and construction projects are being planned for the Oil and Gas sector to achieve refining capacity 450-500 MT by 2030⁶⁶ to cater to rising domestic demand and also address export needs

India's refining capacity is more than 249 MMTPA, which exceeds the domestic petroleum consumption by 16%. However, the consumption of petroleum products is projected to rise to a 335 million tonnes per annum by 2030 and to 472 million tonnes by 2040 according to government estimates. The refineries will hence need to enhance their capacity in tandem with the increasing consumption demand and maintain a surplus of 25% for exports as the current trend.

Figure 35: Refining capacity expansion plans in India to meet petroleum products demand.⁶⁷



India's peak oil demand is expected to be achieved during the 2030 and 2040, which would require a number of brownfield refinery augmentation programs as well as significantly increasing the total refining capacity through green field projects by 2025 through debottlenecking of existing assets, expansion of existing refineries and greenfield refinery projects to meet the domestic and export demands.

Figure 34 FIPI's report on India's expanding demand for petroleum products and fuel sources

increasing population and urbanization of households, and strong demand from energy consuming sectors will increase demand for petroleum products till 2040



Key petroleum products such as aviation turbine fuel, LPG, motor spirits set to increase by 6%, 2%, 6.5% till 2040



The petrochemical and fertiliser industry posed to rise by 110% sector by 2040



Primary energy demand of India is projected to more than double by 2040, leading increase in overall demand for fuel sources

Refineries need to configured with the growing need for fuels and petroleum products and insulate the growing sectors

Table 15: Upcoming/ongoing refinery capacity expansion projects in India

New refineries to be established in India	Timelines
Cauvery Basin Refinery, Nagappattinam, 9 MMTPA	48 months (<i>clearances awaited</i>)
Barmer Refinery, Rajasthan, 9 MMTPA	Expected operations by 2025. ⁶⁸
Ratnagiri Refinery, Maharashtra, 60 MMPTA	Land clearance and project approvals awaited
Key refinery projects - brownfield projects. ^{69, 70}	Timelines
▶ Panipat refinery, Haryana, increasing the capacity by 10 MMTPA	By 2025

⁶⁶ Ministry of Petroleum and Natural Gas (2020)

⁶⁷ Source: Federation of Indian Petroleum Industry (FIPI), 2018. India Energy & Oil demand Outlook.

⁶⁸ Source: <https://www.offshore-technology.com/marketdata/barmer-refinery-india/#:~:text=The%20integrated%20refinery%20will%20be,to>

⁶⁹ MoPNG, Annual Report 2020-21

⁷⁰ locl.com

<ul style="list-style-type: none"> ▶ Koyali refinery, Gujarat increasing the capacity by 4.30 MMTPA ▶ Baruni refinery, Bihar, increasing the capacity by 3 MMTPA ▶ Assam refineries increasing the capacity by a total of 0.55 MMTPA ▶ Mathura refinery, UP increasing capacity to by 1.20 MMTPA 	
Vadinar refinery in Gujarat set to increase its refining capacity by 26 mmtpa	2024
Jamnagar Refinery in Gujarat set to increase its capacity by 7.50 MMTPA	2025
Numaligarh refinery, Assam, to increase capacity by 6 MMTPA	2024
Mumbai refinery, Maharashtra to augment its capacity by 2 MMTPA	36 months projects. ⁷¹
Modernization and expansion project at its Visakh refinery to augment its capacity by 6.7 MMTPA	Advance stage of project completion

Source: Annual Report MoPNG 2020-21, Annual Reports refinery entity

Manpower demand estimations for commissioning, improvement and operations of refineries

As per estimates based on industry inputs, refinery greenfield and brownfield projects may require approximately more than 3,00,000⁷² manpower for construction, engineering and operations and maintenance services till 2030.

The refinery projects in the pipeline are set to generate employment for the youth over the next

10 years at both construction phase and for post development operations. Based on inputs from various organizations leading these refinery projects and based on assessment of secondary inputs, the following manpower demand (blue collared) may be foreseen for the sector.

Construction job roles

Based on benchmarks from similar refinery projects in India, the greenfield and the brownfield projects across the refineries will

- ▶ construction manpower has already been planned for engagement for the ongoing brownfield projects and the Barmer greenfield refinery. These projects are slated for completion by 2025. Hence this manpower would not be treated as incremental manpower demand.
- ▶ Further, the Nagapattinum refinery is expected to have the potential of creating 20,000 jobs during the construction stage⁷⁵ (peak numbers, dynamics and clearance factors.

create more than 2,70,000 jobs⁷³ during the construction phase of the projects.

- ▶ Of which, almost 1,00,000⁷⁴ though actual deployed numbers will vary during the phases of the project).
- ▶ Expected to be Asia's largest refinery, the Ratnagiri refinery and petrochemical complex was planned for commissioning and had the potential to create construction jobs of more than 1,50,000 during the peak phases⁷⁶. However, the project is yet to be initiated for commissioning and therefore the actual number of jobs it may create, may change owing to final commissioning

⁷¹ Environment clearance waited for the project

⁷² Includes estimated construction manpower numbers for proposed Ratnagiri refinery, however the same may change since the actual scale and location of the project is yet to be finalised

⁷³ Includes estimated construction manpower numbers for proposed Ratnagiri refinery, however this number may change subject to final project location, scale etc.

⁷⁴ Estimated based on industry inputs and project details provided for environmental clearance reports

⁷⁵ Industry inputs from CPCL officials

⁷⁶ NS Energy. Accessed from : <https://www.nsenergybusiness.com/projects/ratnagiri-oil-refinery/>

Operations and Maintenance roles

Based on industry consultations and past project benchmarks of refinery projects, over 30,000 new operations and maintenance jobs are estimated to be created as a result of greenfield and brownfield refinery projects and vacancies from retirement and attrition. 90% of this demand will be created during 2025-2030 after the ongoing projects are completed.

The core technical job roles within a refinery are generated across:

- ▶ **Production and Quality Control Department** comprising of chemical engineering experts, assistants and technicians. This is the most critical department in a refinery and entails the highest proportion of technical jobs.
- ▶ **Power and Utilities Department** comprising of electrical engineering experts, assistants and technicians
- ▶ **Maintenance Department** comprising of mechanical engineering experts, assistants and technicians.
- ▶ **Instrumentation Department** comprising of electronics engineering experts, assistants and technicians.
- ▶ **Inspection Department** comprising of metallurgical experts.
- ▶ **Central engineering and technical services** comprising of a common pool interdisciplinary expert.
- ▶ **Health and Safety department** including health officers and fire safety team.

Table 16: State wise incremental demand for manpower by 2025 and 2030

State	District, city	Incremental manpower demand		
		by 2025 ⁷⁷	2025-2030 ⁷⁸	2025 - 2030 ⁷⁹
Grand total		~3,800 - 6,300	~30,000	~4700 - 7900
Andhra Pradesh	Visakhapatnam	169 -281	424	211 -352
	East Godavari	121- 201		151 - 252
Assam	Bongaigaon	121- 201		151 - 252
	Golaghat	121- 201	424	151 - 252
Assam	Tinsukhia	121- 201		151 - 252
	Kamrup Metropolitan	121- 201	106	151 - 252
Bihar	Begusarai	121- 201	212	151 - 252
Gujarat	Jamnagar	601-1002	424	751 -1,252
	Vadodara	169 -281	424	211 -352
	Devbhoomi Dwarka	301-502	2,000	376 - 627
Haryana	Panipat	169 -281	424	211 -352
Karnataka	Dakshina Kannada	169 -281		211 -352
Kerala	Kochi	169 -281		211 -352
Madhya Pradesh	Bina	169 -281		211 -352
Maharashtra	Ratnagiri		21,517	
	Mumbai	169 -281		211 -352

⁷⁷ Replacement manpower for retirement and attrition. Replacement rate - 3% to 5%

⁷⁸ New project manpower

⁷⁹ Replacement manpower for retirement and attrition (replacement rate - 3% to 5%)

	Mumbai	169 -281	212	211 -352
Odisha	Jagatsinghpur	169 -281		211 -352
Punjab	Bhatinda	169 -281		211 -352
Rajasthan	Barmer		2,008	
Tamil Nadu	Nagapattinam		2,008	
Tamil Nadu	Chennai	169 -281		211 -352
Uttar Pradesh	Mathura	169 -281	53	211 -352
West Bengal	Purba Medinipur	169 -281		211 -352

Source: Analysis based on industry inputs. .

Table 17: Job role wise incremental demand for manpower by 2025 and 2030

Department	Job role	Incremental manpower demand		
		by 2025 ⁸⁰	2025-2030 ⁸¹	2025 - 2030 ⁸²
Grand total		~3,800 - 6,300	~30,000	~4700 - 7900
Refinery Production	Engineering Assistant Production	665 -1109	5856	832 - 1386
Refinery Production	Technician Chemical - Refinery	1039 -1732	8767	1299 - 2165
P&U electrical maintenance	Engineering assistant P&U electrical maintenance	275 -459	2047	344 - 574
P&U electrical maintenance	P&U electrical maintenance Engineer	89 - 148	869	111 - 185
P&U operations	Engineering assistant P&U Operations (BOE)	166-277	1109	208 - 346
P&U operations	P&U Operations Engineers	62-104	454	78 - 130
P&U operations	P&U Operations Engineers (BOE)	67-111	491	83 - 139
Quality Control	chemist/analyst	93 -154	696	116 - 193
Quality Control	Quality Control Officers	68 - 114	565	85 - 142
Refinery Maintenance - Instrumentation	Engineering assistant Maintenance (Instrumentation)	117 -195	937	147 - 244
Refinery Maintenance - Instrumentation	Maintenance (Instrumentation) Engineer	85 -141	674	106 - 176
Refinery Maintenance - Mechanical	Engineering Assistant Mechanical Maintenance	287 -479	1851	359 - 598
Refinery Maintenance - Mechanical	Mechanical Maintenance Engineer	142 -236	990	177 - 295
Civil Maintenance	Civil Maintenance Engineers	41 -68	273	51 - 85
Engineering Services Refinery	Civil Engineers/Process Engineers	9 -15	67	11 - 18
Engineering Services Refinery	Draftsman - Civil	4-7	9	5 - 8

⁸⁰ Replacement manpower for retirement and attrition. Replacement rate - 3% to 5%

⁸¹ New project manpower

⁸² Replacement manpower for retirement and attrition (replacement rate - 3% to 5%)

Department	Job role	Incremental manpower demand		
		by 2025 ⁸⁰	2025-2030 ⁸¹	2025 - 2030 ⁸²
Engineering Services Refinery	Draftsman - Electrical/Instrumentation	4-7	9	5 - 8
Engineering Services Refinery	Draftsman - Mechanical	4-7	9	5 - 8
Engineering Services Refinery	Maintenance (Instrumentation) Engineer	9-15	67	11 - 18
Engineering Services Refinery	Maintenance (Mechanical)Engineer	9-15	67	11 - 18
Engineering Services Refinery	P&U Operations Engineers	9-15	67	11 - 18
Technical Services (Chemical)/Process Improvement	Chemical Engineers/Process Improvement Engineer	79 - 132	527	99 - 165
Health and Safety	Fire Safety Engineer (Oil and Gas)	30-50	377	37 - 62
Health and Safety	Fire Safety Technician (Oil and Gas)	104-173	924	129 - 216
Health and Safety	HS&E Engineer	8-14	55	10 - 17
Materials and Contract Officers	Civil Engineers/Process Engineers	17-28	114	21 - 35
Materials and Contract Officers	Maintenance (Instrumentation) Engineer	17-28	114	21 - 35
Materials and Contract Officers	Maintenance (Mechanical)Engineer	17-28	114	21 - 35
Materials and Contract Officers	P&U Operations Engineers	17-28	114	21 - 35
Support roles	Finance	90 -150	600	112 - 187
Support roles	HR Officers	98 - 164	654	123 - 204
Support roles	Information system (IS department)	22 - 36	145	27 - 45
Support roles	Inspection Engineer (Metallurgy engineer)	49 - 82	405	61 - 102
Support roles	Materials Assistant	33 - 55	218	41-68

Source: Analysis based on industry inputs. .

- ▶ Ratnagiri Refinery and Petrochemicals Limited's 60 MMTPA capacity green field refinery will be set up in Ratnagiri, Maharashtra (location finalisation is underway). Driving an investment of over INR 3 lakh crores, it is slated to become the world's largest single location refinery complex, with state-of-the-art technology and 50 interconnected units.
 - ▶ This project alone would lead to direct employment during the construction phase of over 1,50,000 persons.
- ▶ Once commissioned would contribute to employment of nearly 20,000 persons besides lakhs of indirect employment.
 - ▶ Out of the 20,000 operations jobs thus to be created, more than 13,000 are estimated to be blue collared job roles, to support the engineers and other highly skilled manpower.
- ▶ The Nagapattinam refinery being set up in Tamil Nadu with the planned capacity of 9 MMTPA is ready to begin construction operations.

- ▶ Will generate approximately 20,000 jobs across 48 months of its commissioning phase.
- ▶ Once established the refinery is projected to generate over 1500 jobs for its operations, of which around 1100 jobs are estimated to be blue collared job roles.
- ▶ The Barmer refinery with a target capacity of 9 MMTPA is on its last leg of completion and will start its operations by 2025. During its commissioning phase, more 40,000 jobs were created.
 - ▶ Once established it will lead to the employment of over 1,500 manpower of which 50% are estimated to be blue collared roles.

The brownfield projects across Panipat, Koyali, Baruni, Guwahati, Bongaigon, Mathura, Vadinar, Jamnagar, Numaligarh, Mumbai and Visak refineries would create additional 4,700 jobs, of which more than 2800 jobs are estimated to be blue collared.

- ▶ As per industry inputs, for every engineer/officer cadre personnel, an associated demand for technicians/ assistant technicians is created.
- ▶ The demand for incremental manpower also considers a replacement rate of the manpower in the range of 3-5% on account of retirements and attritions.

Summary - Manpower Demand Analysis for refineries	
Incremental demand for construction - 2,70,000 (incl. Ratnagiri refinery construction jobs)	
Manpower for new refineries - ~25,000	
Incremental demand till 2025 for operations and maintenance at existing refineries and new project ~4200 - 6700	Incremental demand from 2025 till 2030 for operations and maintenance at existing refineries and for new projects ~34,000 - 37,000
States in focus	Maharashtra, Gujarat, Tamil Nadu, Rajasthan, Assam, Andhra Pradesh

Impact of modernization of the refineries on demand for blue collared job roles

The new refineries are being set up using state-of-the-art technology with modern equipment conforming to the latest standards, to ensure high yield quality and optimum process efficiency while adopting environmentally friendly practices.

The existing refineries through their various improvement and enhancement projects are proactively taking steps to improve the overall efficiency through use of latest generation catalysts, instrumentation and control system.

- ▶ Adoption of modern technologies, performance improvement programs and energy consumption measures have helped Indian refineries in increasing distillate yield and reduction of specific energy consumption.

- ▶ On the *process optimization front, refinery operation modernization* could include - *robotic process automation, automated/consolidated refinery control rooms, operator training systems, drone led quality inspections, sensor technologies, corrosion detection through technology led inspection tool* and other Industry4.0 technologies, which tends to have an impact of the scale of engagement of manpower in the refineries for the entry level job roles.
- ▶ This also had led to a conservative incremental demand for manpower across refineries for operations and maintenance.

Petrochemical plants/blending units

While refineries primarily deal with refining of crude products such as oil and gas, further down the value chain, divulging into an allied industry, petrochemical plants use the refined products from the refineries as feedstock to produce inputs for not just energy industry but also other industries such as plastic, rubber etc.

However, it is envisaged that the refineries may see integration with the petro-chem industry, hence it will also be useful to take view of the key job roles that are deployed at petrochemical plants.

Table 18: Key job roles for petrochemical industry for petrochemical plants

Key job roles at petrochemical plants
Petrochemical engineering Reliability Manager Power distribution Technician
Petrochemical Operation Production Manager Manufacturing Expert Operations Shift Supervisor Shift Supervisor Board Operator Production Operator (Shift)
Petrochemical maintenance Maintenance Supervisor Maintenance Coordinator Planner - Scheduler Mechanical Maintenance Technician Mechanical Maintenance - Millwright Mechanical Maintenance - Pipefitters Mechanical Maintenance - Machinist Predictive Maintenance Analyst Predictive Maintenance Technician
Petrochemical Process Control Technology Process Control Technology Engineer Process Control Technology Senior Supervisor Process Control Technology Technician
Petrochemical Logistics Material Handler - Barge Dock Material Handler - Main Tank Farm
Petrochemical Quality Control Petrochemical Quality Officer Petrochemical Assistant Chemist Petrochemical Lab Supervisor Petrochemical Lab Technician

Source: industry inputs

5.2 Petroleum product pipelines

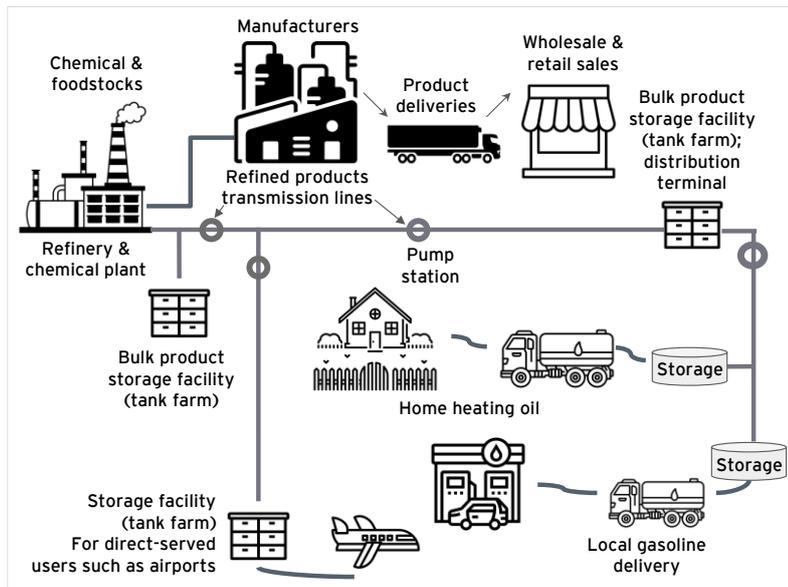


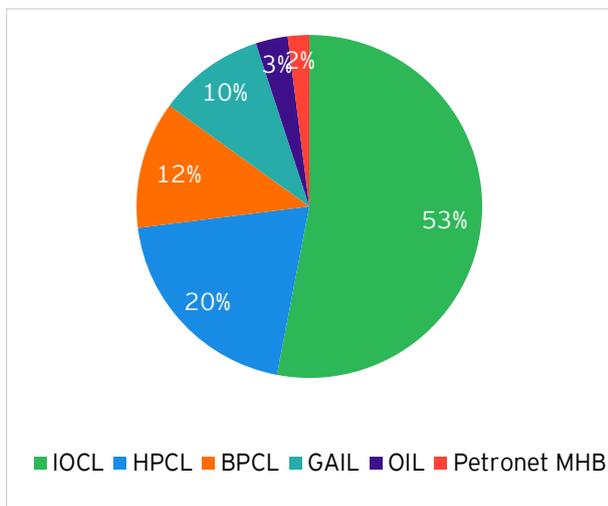
Figure 36: Network for distribution of refined products

With the burgeoning demand for energy fuels in the country, the imperative of a robust business to business and business to customer distribution system for petroleum products is only highlighted. The product pipelines and roadways (also transportation through railways) are significant for movement and distribution of refined products (kerosene, aviation turbine fuel, high speed diesel, light diesel oil, LPG, motor spirit, naphtha, lube oil etc) from the refineries to the market, storage

depots, industries and retail outlets. However, pipelines are considered the most cost effective, energy efficient, safe and environment friendly mode of transportation of petroleum products. They also ease the overburdened rail and road infrastructure and minimize the environmental impacts arising out of rail and road transportation.

Industry snapshot

Figure 37: Company wise ownership of petroleum product pipeline in India



India's network of petroleum product pipeline currently spreads across 18,000 kms with carrying capacity of 115 MMTPA⁸³. The petroleum product pipeline network across the country is established primarily by IOCL, HPCL, BPCL, GAIL, Oil India and Petronet, of which more than 50% of the network lies under the ownership of IOCL alone.

The petroleum product pipeline network is linked to the geographical distribution of refineries in India, primarily transverses in the eastern, western and southern coastal regions of India and a few landlocked areas in north and north eastern regions.

India's demand for petroleum products is projected to reach 439 MMTPA by 2035 and as per industry inputs the product pipeline capacity should at least be 75% of the product demand, that is

approximately 329 MMPTA installed capacity of product pipelines⁸⁴. If India is aiming to achieve the product pipeline capacity of 329 MMTPA before

⁸³PPAC (May 2022), Abridged Ready Reckoner May 2022. Accessed from <https://www.ppac.gov.in/WriteReadData/Reports/2022062>

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⁸⁴ As quoted by Shri KK Jha (2011), Director - Pipelines. Indian Oil Corporation Ltd.

2035, it will have to substantially increase its pipeline network capacity across the country.

India currently has a petroleum product pipeline network of over 18,000⁸⁵ kms across the country and further over 8000 kms are planned to be commissioned.

As per industry feedback, many plans for pipeline capacity and network augmentation and have been

planned and 8,000 kms of pipeline is in the process of being added across the country to increase the product distribution capacity. The pipeline projects could vary from establishment of new pipelines, increasing the length of current pipelines or augmenting the capacity of the pipelines.

Manpower demand estimations for commissioning, operations and maintenance of petroleum product pipelines

Construction job roles

- ▶ At the commissioning stage skilled/semi-skilled and unskilled manpower is primary engaged for - survey and mapping, pipeline staging, ditching, bending, pipe coating, lowering, ditch backfilling, testing and grading.
- ▶ As indicated, almost 8,000 kms of new pipeline length is being commissioned/soon to be commissioned. These pipeline projects are currently underway and are planned for completion by 2025 or earlier over the next few years.
- ▶ As per industry inputs, **approximately 14,000 manpower across various job roles would have been engaged/is currently engaged** in Andhra Pradesh, Bihar, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Telangana, Uttar Pradesh and West Bengal to undertake pipeline commissioning tasks for various projects.
- ▶ However, since these projects have already been tendered and begun work in some cases, it is assumed that manpower for construction of pipelines has already been identified/engaged.
- ▶ A pipeline job, ranging from laying of 100-1,000 kms of pipeline would entail the engagement of 200 to 3,000 manpower across multiple roles.

Table 19: Key job roles for pipelines construction for laying 8,000 kms length

Approximately more than 14,000 manpower across 28 key construction job roles engaged for commissioning of petroleum product pipelines							
Concrete and Mason Worker	2,538	Insulators	623	Radiography operator	174	Bar bender	84
Drivers	1,639	Structural Welder	312	Gas Cutter	172	Assembly Operator	75
Operator (Heavy Duty Eqpt)	1,559	HDD driller	270	Electrician	164	Wireman	30
Rigger	1,247	OFC splicer	234	Mechanics	164	Painter	22
Welder	1,103	OFC Blower	234	Blaster	156		
Grinder	1,091	Cathodic Protection	220	Laboratory and Field Technician	156		
Fitter	813	Surveyors	215	HDD tracker	145		

⁸⁵ PPAC (May 2022), Abridged Ready Reckoner May 2022. Accessed from <https://www.ppac.gov.in/WriteReadData/Reports/202206250>

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Operator (Light Duty eqpt)	779	Machinist	191	Carpenter	84		
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Source: Analysis based on industry inputs

Operation and maintenance roles

At the operations and maintenance stage skilled/semi-skilled and unskilled manpower is primarily engaged for - physical monitoring, inspection, repairs, pressure monitoring, pigging, security, waste management, leak detection, cathodic protection and awareness and sensitisation of the surrounding population.

- ▶ The 8,000 kms of pipeline is being commissioned across 15 ongoing pipeline projects in the country at varying phases of completion, which will generate demand for operations and maintenance manpower in a phased manner.
- ▶ **Demand for 1,770 incremental manpower for operations and maintenance of this new 8,000 kms petroleum product pipeline length, will be generated across all skill categories up till 2030.**
- ▶ Additionally, for the existing pipeline network of over 19,000 kms, more than 4,600 blue collared manpower are currently engaged across multiple states. Assuming that each year due to attrition and retirement, around 3-5% of the manpower will need to be replaced.

Table 20: State wise incremental demand for manpower by 2030 for operations and maintenance of new and existing petroleum pipelines

States	Incremental manpower demand		
	by 2025 ⁸⁶	2025-2030 ⁸⁷	2025 - 2030 ⁸⁸
Grand Total	~559-930	1770	699- 1165
Gujarat	98 - 163	333	122 - 203
West Bengal	46 - 77	57	58 - 95
Rajasthan	46 - 76		57- 95
Haryana	44 - 73		55 - 91
Bihar	41 - 68	167	51 - 85
Odisha	34 - 56	57	42 - 71
Assam	34 - 56		42- 70
Tamil Nadu	31 - 51	164	38- 64
Uttar Pradesh	28 - 46	281	35 - 58
Karnataka	26 - 43	57	32 - 54
Delhi	25 - 41		31 - 52
Maharashtra	21 - 35	167	27 - 44
Punjab	21 - 35		26 - 43
Andhra Pradesh	17 - 28	224	21 - 36
Telangana	17 - 28	83	21 - 36
Chhattisgarh	10 - 17		13 - 21

⁸⁶ Replacement manpower for retirement and attrition. Replacement rate - 3% to 5%

⁸⁷ New project manpower

⁸⁸ Replacement manpower for retirement and attrition (replacement rate - 3% to 5%)

Jharkhand	10 - 17		13 - 21
Madhya Pradesh	7 - 12	123	9 - 15
Kerala	5 - 9	57	6 - 11

Source: Analysis based on industry inputs. .

Table 21: Job role wise incremental demand for manpower by 2030 for operations and maintenance of petroleum pipelines (new and existing)

Job role	Incremental manpower demand		
	by 2025 ⁸⁹	2025-2030 ⁹⁰	2025 - 2030 ⁹¹
Grand Total	~559-932	1770	~699- 1165
DGR guards/line inspection personnel	385-642	1191	482-803
Operator - Hydrocarbon Pipeline	99-165	332	124-207
Industrial Technician Electrician (Oil and Gas)	24-41	83	31-51
Industrial Technician Mechanical (Oil and Gas)	24-41	83	31-51
Industrial Technician Instrumentation (Oil and Gas)	24-41	83	31-51

Source: Analysis based on industry inputs.

In addition to the blue collared job roles that have been identified for manpower demand creation, some other critical job roles (either supervisory, niche skills needed or minimally required) for operations and maintenance of natural gas pipelines are as follows:⁹²:

- ▶ Chief Engineer
- ▶ Team Leader Operations
- ▶ Team Leader Maintenance
- ▶ Planning Specialist
- ▶ Team Leader - Main Control Centre
- ▶ Chief Engineer - Main Control Centre
- ▶ Engineer - Main Control Centre
- ▶ Engineer - Metering
- ▶ Operator- Telecom and SCADA (subject to level of automation)
- ▶ Technician - Turbo Compressor
- ▶ Technician - Heavy Machinery
- ▶ Technician - Main Control Room

Summary - manpower demand analysis for petroleum product pipelines	
14,000 manpower engaged/planned for engagement for construction of new pipelines	
Incremental demand till 2025 across existing pipelines for operations and maintenance - ~559-932	Incremental demand from 2025 to 2030 for operations and maintenance 2,760 - 3,142
Manpower for new pipelines - 1,770	
States in focus	Gujarat, Uttar Pradesh, Andhra Pradesh Bihar, Maharashtra, Tamil Nadu, West Bengal

⁸⁹ Replacement manpower for retirement and attrition. Replacement rate - 3% to 5%

⁹⁰ New project manpower

⁹¹ Replacement manpower for retirement and attrition (replacement rate - 3% to 5%) + new project manpower

⁹² Basis literature review of global competency frameworks across USA, Singapore and Malaysia.

Sources : <https://ihrdc.com/competency-management/competency-content-2/>,
https://www.mogsc.org/files/editor_files/files/CTWG/134%20-%20OCCUPATIONAL%20ANALYSIS%20-%20OIL%20%26%20GAS%20INDUSTRY.PDF

Leading pipeline operators are leveraging digital enablers to address the challenges of managing an increasingly complex pipeline network

With the coming of the industry 4.0 and continuous research and development in the country, technology led pipeline operations poses a high chance of making some manual roles redundant. This necessitates, periodic industry inputs about latest status of technology integration and accordingly functional skills required for manpower in the sector. For the instance, the following technology is extensively being used in the countries elsewhere and have a high potential for the Indian hydrocarbon ecosystem too:

- ▶ Use of **robotic technology** for the repair and inspection of operations pipelines could directly impact jobs involve on-foot/physical inspection of pipelines for detecting damages.
- ▶ Leak detection technology integrating with **GPS synchronized** ultrasonic transmitter - pressure sensor is a further a technology that over the period of next years.
- ▶ **AR/VR wearables to improve field safety and productivity** - this enables to enhance real-time inspection/maintenance/field service compliance and experts and technical staff can assist multiple pipeline control centres and physical inspection at the same time.
- ▶ **Autonomous remote operations with Industrial Internet of Things (IIoT)** enables a provision to start, stop, or reset machine remotely. It also supports continuous monitoring and operation of pumping station from the 'integrated command and control centre.
- ▶ **Use of drone technology** for inspection to determine any damage or corrosion and to provide data for structural integrity and visual and infrared photography," as well as for "pipeline inspection, corrosion checks, security checks, and maintenance issues.

5.3 Road transport distribution network in Oil and Gas sector

Manpower demand estimations for drivers to operate the road transport network for movement of oil and gas across the country

Road network is also used to distribute the refined products from their processing and manufacturing source to the end customer, bulk storage locations and the retail/marketing units. For the distribution network for the consumer products, primarily *bulk tanker trucks* are used for transportation/storage

of large quantities of petroleum products and LPG cylinders. In addition, smaller trucks are also used for *delivering packed LPG* to the customers. The drivers appointed for these trucks must be well trained in driving skills as well as in handling of flammable and hazardous materials.

Table 22: Incremental demand for drivers for distribution of refined products through road network

Drivers engaged in 2020-2021		Drivers required by 2025		Drivers required by 2030	
Driver - Packed LPG	Driver - Bulk tanker truck	Driver - Packed LPG	Driver - Bulk tanker truck	Driver - Packed LPG	Driver - Bulk tanker truck
27,300	86,016	30,700	89,600	33,000	94,211
Incremental demand for drivers by 2025 and 2030		3,400	3,584	2,300	4,611
Factors that may lead to increase in demand for locomotive drivers			Factors that may lead to decrease in demand for locomotive drivers		
<ul style="list-style-type: none"> ▶ Increase in demand of petroleum products across industries ▶ Increase in network of retail outlets 			<ul style="list-style-type: none"> ▶ Development of rail routes along the distribution routes 		

Source : Industry inputs.

Transport of crude and other petroleum and gas products using railways and marine logistics

- ▶ In addition, the crude and petroleum products are often transported and stored by railways and marine routes.
- ▶ While the main locomotive in these transport methods is manned by professionals trained for rail and marine driving and engineering, the following blue collared manpower is required in

the value chain for some operational and logistical tasks:

- ▶ Operations Supervisor Storage and Loading Oil
- ▶ Operator Storage and Loading Oil
- ▶ Senior Operator Storage and Loading Oil
- ▶ Storekeeper for oil and gas product

5.4 Sales and distribution - petrol / diesel retail outlets

Retail marketing of petroleum products in India is done by the Public Sector Oil Marketing Companies (OMCs) i.e., Indian Oil Corporation Ltd (IOCL), Hindustan Petroleum Corporation Ltd (HPCL), Bharat Petroleum Corporation Ltd. (BPCL) and Private Companies such as Reliance, Essar, Shell, etc. The retail of the refined products may be

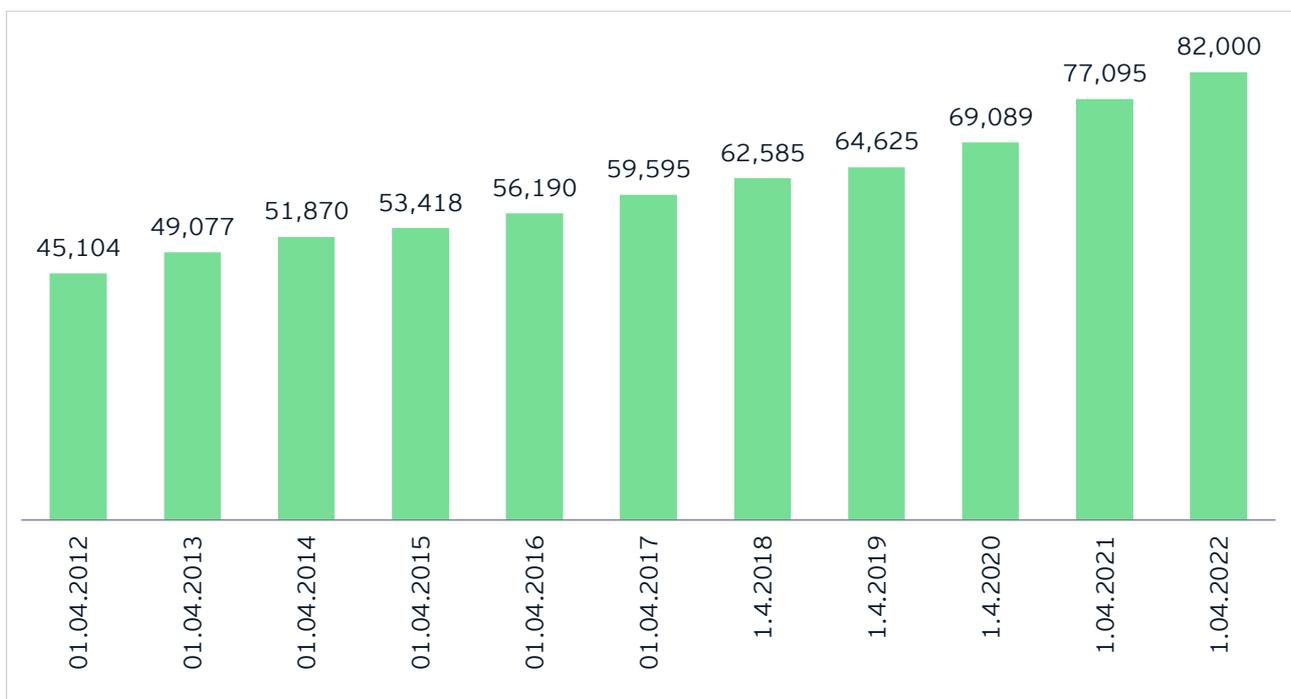
undertaken in business to business (b2b) form, for sale of products to industries and commercial units and in business to customer (b2c) form, for sale of products directly to the customer through packed LPG and petrol and diesel dispensing stations, referred to as retail outlets.

Industry snapshot

Retail outlets are the backbone of the Indian automobile industry serving motor fuel to more than 29 crore vehicles across commercial and personal use category and this number has been

growing at almost 10% every year. To address the fuelling needs of this vehicles in India, the network of retail outlets has also been increasing steadily each year.

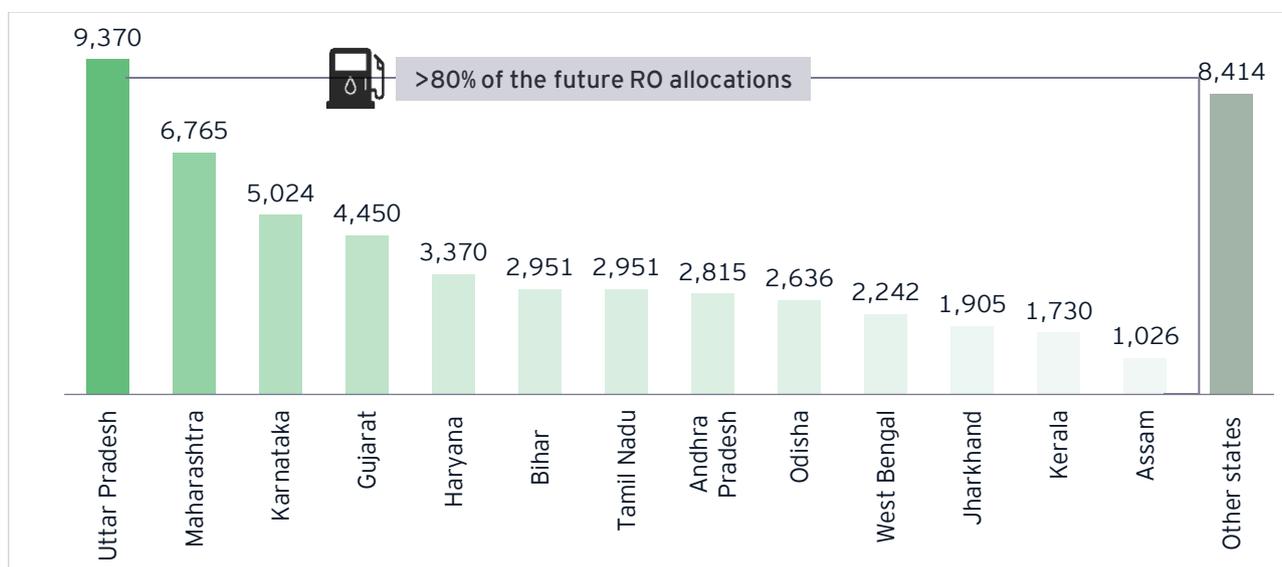
Figure 38: Growth of retail outlets in India



Source : Petroleum Planning and Analysis Cell. Accessed from <https://www.ppac.gov.in/WriteReadData/userfiles/file/Statewise%20Retail%20Outlets.xls>

The Government of India plans to establish over 80,000⁹³. ROs across the country over the course of the next few years. Of which, over 55,000 ROs have been allocated to various RO owners across the country.

Figure 39: 84% of the ROs have been allocated across 13 states



Source: Petrol Pump Dealer Chayan (2019)

To ascertain total manpower required, manpower requirements at a single RO was surveyed through field visits and industry inputs. An RO could be set up as a rural RO or a regular RO (at highways and urban/city regions). Based on trend

assessment of aggregate level distribution of the ROs across rural and regular category, it was observed, rural ROs typically accounted for ~30% of the total ROs in a year.

Table 23: Estimated manpower model for petrol diesel retail outlets

Job Roles	Number of manpower per role at an RO (regular)	Number of manpower per role at an RO (rural)
Retail outlet Dispenser Operator - Petrol/diesel	5-8	1-2
Retail Outlet Manager - Petrol/diesel	1	1 (also usually the owner of the RO)
Gas Attendant (Air Boys)	1	1
Pollution Check Attendant	1 ⁹⁴	-
Security Guard	1-2	-

Source: Based on field survey/industry inputs

⁹³ PIB (2019). Accessed from <https://pib.gov.in/PressReleasePage.aspx?PRID=1565856>

Additionally, 55,000 RO were allocated through Petrol Pump Dealer Chayan in 2018. Basis industry feedback, it was observed after the initial allotment, it takes around 2-3 years for the RO owners to start the operations after land acquisition, clearances, fuel supply establishment and construction of the RO.

⁹⁴ Pollution check attendant is not a mandatory requirement for ROs. However, some states are working on state level guidelines to have pollution check facilities to be made available at all the petrol pumps in the future. As per industry inputs, it is assumed that close to 20% of the ROs are likely to offer pollution check facility

Manpower demand for establishing the ROs in the country maybe assessed in two case scenarios - as per the prevailing growth rates of new RO establishment across the states and based on the ROs recently allocated .

Case A - Realistic scenario: The current CAGR considered as rate of increase of ROs across the states. Approximately, 48,000 ROs can be estimated to be established by 2030.

Table 24: State wise incremental manpower for new RO's - Case A

State	Manpower for new ROs_Case A (Estimated minimum requirements)	
	By 2025	By 2030
Grand total	~1,00,000	~2,15,000
Andaman & Nicobar	21	45
Andhra Pradesh	5,400	11,000
Arunachal Pradesh	200	400
Assam	1,400	3,000
Bihar	4,200	8,900
Chandigarh	76	161
Chhattisgarh	2,400	5,000
Dadra & Nagar Haveli and Daman & Diu	80	100
Delhi	650	1,400
Goa	161	330
Gujarat	6,900	14,500
Haryana	4,500	9,600
Himachal Pradesh	743	1,500
Jammu & Kashmir	728	1,530
Jharkhand	2,000	4,200
Karnataka	7,300	15,500
Kerala	3,200	6,700
Madhya Pradesh	6,600	14,000
Maharashtra	9,400	19,900
Manipur	211	400
Meghalaya	314	600
Mizoram	73	150
Nagaland	158	300
Odisha	2,700	5,800
Puducherry	229	400
Punjab	5,000	10,600
Rajasthan	7,500	15,900
Sikkim	75	159
Tamil Nadu	8,500	18,000
Telangana	4,800	10,000
Tripura	124	261
Uttar Pradesh	12,000	26,000
Uttarakhand	900	1,900

State	Manpower for new ROs_Case A (Estimated minimum requirements)	
	By 2025	By 2030
West Bengal	3,600	7,700

Source: Analysis based on industry trend analysis.

Table 25: Job role wise incremental manpower for new ROs - Case A

Job role	Manpower for new ROs_Case A (Estimated minimum requirements)	
	By 2025	By 2030
Grand total	~1,00,000	~2,15,000
Retail outlet Dispenser Operator - Petrol/diesel	59,000	1,25,000
Retail Outlet Manager - Petrol/diesel	15,000	32,000
Gas Attendant (Air Boys)	15,000	32,000
Pollution Check Attendant	2000	4000
Security Guard	10,000	23,000

Source: Analysis based on industry trend analysis.

Case B - Optimistic scenario: The 13 states achieve the state level allocated target (out of 47,235) till 2030

Table 26: State wise incremental manpower for new RO's - Case B

State	Manpower for new ROs_Case B (Estimated minimum requirements)	
	By 2025	By 2030
Grand total	~1,38,000	~1,73,000
Andhra Pradesh	8,300	10,300
Assam	3,000	3,700
Bihar	8,700	10,800
Gujarat	13,000	16,400
Haryana	9,900	12,400
Jharkhand	5,600	7,000
Karnataka	14,800	18,500
Kerala	5,100	6,300
Maharashtra	19,900	24,900
Odisha	7,700	9,700
Tamil Nadu	8,700	10,800
Uttar Pradesh	27,650	34,500
West Bengal	6,600	8,270

Source: Analysis based on retail outlet allocation announcement.

Table 27: Job role wise incremental manpower for new ROs - Case B

Job role	Manpower for new ROs_Case B (Estimated minimum requirements)	
	By 2025	By 2030
Grand total	~1,38,000	~1,73,000
Retail outlet Dispenser Operator - Petrol/diesel	79,700	99,700

Retail Outlet Manager - Petrol/diesel	20,900	26,000
Gas Attendant (Air Boys)	20,900	26,000
Pollution Check Attendant	2,900	3,000
Security Guard	14,600	18,300

Source: Analysis based on retail outlet allocation announcement.

Note:

- ▶ For Case B, state wise manpower demand analysis has been done for 47,235 retail outlets, basis state wise allocation details. For the remaining 8,414 ROs that have been allocated across other states, another 55,000 manpower would be required.
- ▶ The existing ROs across the country also have a potential of generating incremental demand for manpower, due to attrition and retirement of existing manpower. There were over 80,000 retail outlets in India, as of March 2022. Assuming they all continue to function, ⁹⁵ incremental manpower requirement could be created as follows:
 - ▶ Approximately 70,000 to 1,00,000 retail outlet workers are employed with rural ROs, and can potentially create demand for 8,000 - 14,000 manpower by 2025 and 11,000 - 18,000 manpower by 2030 on account of retirement and attrition.
 - ▶ Approximately, 4,00,000 - 10,00,000 retail outlet workers are employed with regular retail outlets (urban and highways), and can potentially create demand for 55,000 - 94,000 manpower by 2025 and 70,000 - 1,00,000 manpower by 2030 on account of retirement and attrition.

Key considerations for RO network expansion

On discussion with industry, it was noted that RO expansion plans are also governed by the following factors and maybe considered while working out a future case scenario:

- ▶ The number and location of ROs is primarily governed by availability of land and obtaining the necessary clearance thereof.
- ▶ Another factor that governs the establishment and sustainability of the ROs is throughput, or per pump sale of petrol and diesel, that is further impacted by density of ROs around. Large number of ROs impacts the throughput of the RO and impacts the commercial viability.
- ▶ In addition, vehicular traffic in a region plays an important role in deciding the RO locations. Vehicular traffic in a region over a time may get impacted by spurts of new economic development (like setting up of industries) leading to increase in income levels of the local population.
 - ▶ The demand for motor fuel is also function of development of new roads and highways increasing the motor traffic in region.
 - ▶ Further, the advent of Electrical Vehicles in the Indian market will also impact the demand for conventional motor spirit. Although, conventional petrol/diesel driven vehicles will continue to maintain majority, it may face some competition from clean energy driven vehicles.
 - ▶ As India's energy basket diversifies, it will have a definite impact on the scape and diversity of the ROs. While this is expected to pan out majorly post 2030-2035, but in the future ROs could function as diversified multifuel energy stations - covering liquids, CNG, Ethanol, EV charging, LNG, Hydrogen. the manpower thereof, those who will be employed at ROs

⁹⁵ Retail outlets closures may happen to due break-even challenges, low throughput values, road/highway construction

after 2030 time period, will need to be empowered with the skills that are required to handle the varied fuels and substances.

Summary - Manpower Demand Analysis for retail outlets (rural and regular retail outlets)	
Manpower demand till 2025 across for new retail outlets ~1,00,000 - ~1,38,000	Incremental demand from 2025 to 2030 across new retail outlets - ~1,73,000 - ~2,15,00
Incremental manpower demand for existing ROs till 2025 ~ 65,000 - ~1,00,000	Incremental manpower demand for existing ROs till from 2025 to 2030 - ~ 81,500- 1,36,500
States in focus (new ROs planned)	Uttar Pradesh, Maharashtra, Karnataka, Gujarat, Haryana, Bihar, Tamil Nadu, Andhra Pradesh, Odisha, West Bengal, Jharkhand, Kerala, Assam



5.5 Storage and marketing infrastructure - bottling plants, marketing terminals, stockiest locations

LPG bottling plants

LPG bottling plant is a plant where LPG is put into bottles for storage and further dispatch. The plant has the facility to receive bulk LPG by pipeline from a reliable source or any area.

Currently, India has 212 bottling plants⁹⁶ in the country to address the LPG services across the country.

- ▶ The key operations that need manpower engagement are:
 - ▶ Loading and unloading of licensed railway wagons /tankers and road tankers
 - ▶ LPG bottling in cylinders - valve operations, pump operations,
 - ▶ Fire safety operations
- ▶ Limited demand for additional/expansion of LPG bottling plant units in the country:
 - ▶ Bottling plants used to require 30-40 personnel based on its capacity. However,

as per industry inputs, the operations at a bottling plants are getting automated with sophisticated machinery that runs on autopilot mode, hence reducing the requirement of manpower in such plants.

- ▶ The plants are running at 60% automated operations at the moment and are expected to be 100% automated within a few years.
- ▶ Additionally, it has been observed that the bottling plants are not functioning at their full capacity, therefore providing room to accommodate opportunities to address increased demand within the existing network of bottling plants.
- ▶ Additionally, with increasing network of PNG connections for households through City Gas Distribution Network, the demand for LPG for domestic use has been gradually decreasing.

⁹⁶ MoPNG Annual Report 2020-21

Table 28: Key job roles at bottling plants

Job Roles at bottling plants
1. Bottling Plant location in-charge
2. Deputy location in-charge
3. Maintenance Officer
4. Operations officer
5. Safety officer
6. Dispatch and Receipt officer
7. Engineering Assistant - Operations
Blue collared operators - Storage tank operations, stock management, product assessment, valve change, maintenance, receiving and dispatch coordination with tank lorry
Security staff
Loading and unloading operator (LPG Plant)
Support staff (clerical)

Source: Industry inputs

Marketing terminals /depots / stockist locations

Supply chain nodes such as terminal / depots, lube blending / small can filling plants, are intermediaries that connect petroleum product refineries in various parts with consumption centres.

- ▶ Much like LPG bottling plants, these locations receive products / inputs in bulk through pipelines, railway tank wagons and road tank trucks.; keep them in safe custody and transfer them to market friendly packages through specially designed filling systems. Most of these nodes are equipped with automated

systems ensuring fail-safe, efficient and user-friendly operations.

- ▶ As on April 2020, there were 306 POL terminal/depots across the country. As per industry inputs, terminals could employ manpower across the job roles similar to those in an LPG bottling plant. This segment is also not manpower intensive with more operations that are being automated. Increasing consumption or product demand is often met by capacity expansion such facilities which does not always create any additional demand for oil and gas roles.

Table 29: Key job roles at storage locations for and oil and gas products

Job Roles at marketing terminals and other storage locations
Terminal/Depot location in-charge
Deputy location in-charge
Maintenance Officer
Operations officer
Safety officer
Dispatch and Receipt officer
Engineering Assistant - Operations
POL Storage and Terminal Operator - Storage tank operations, stock management, product assessment, valve change, maintenance, pump house operations, receiving and dispatch coordination with tank lorry
Security staff

Loading and unloading operator
Support staff (clerical)

Source: industry inputs

5.6 Sales and distribution - Domestic LPG distribution centres

Industry snapshot

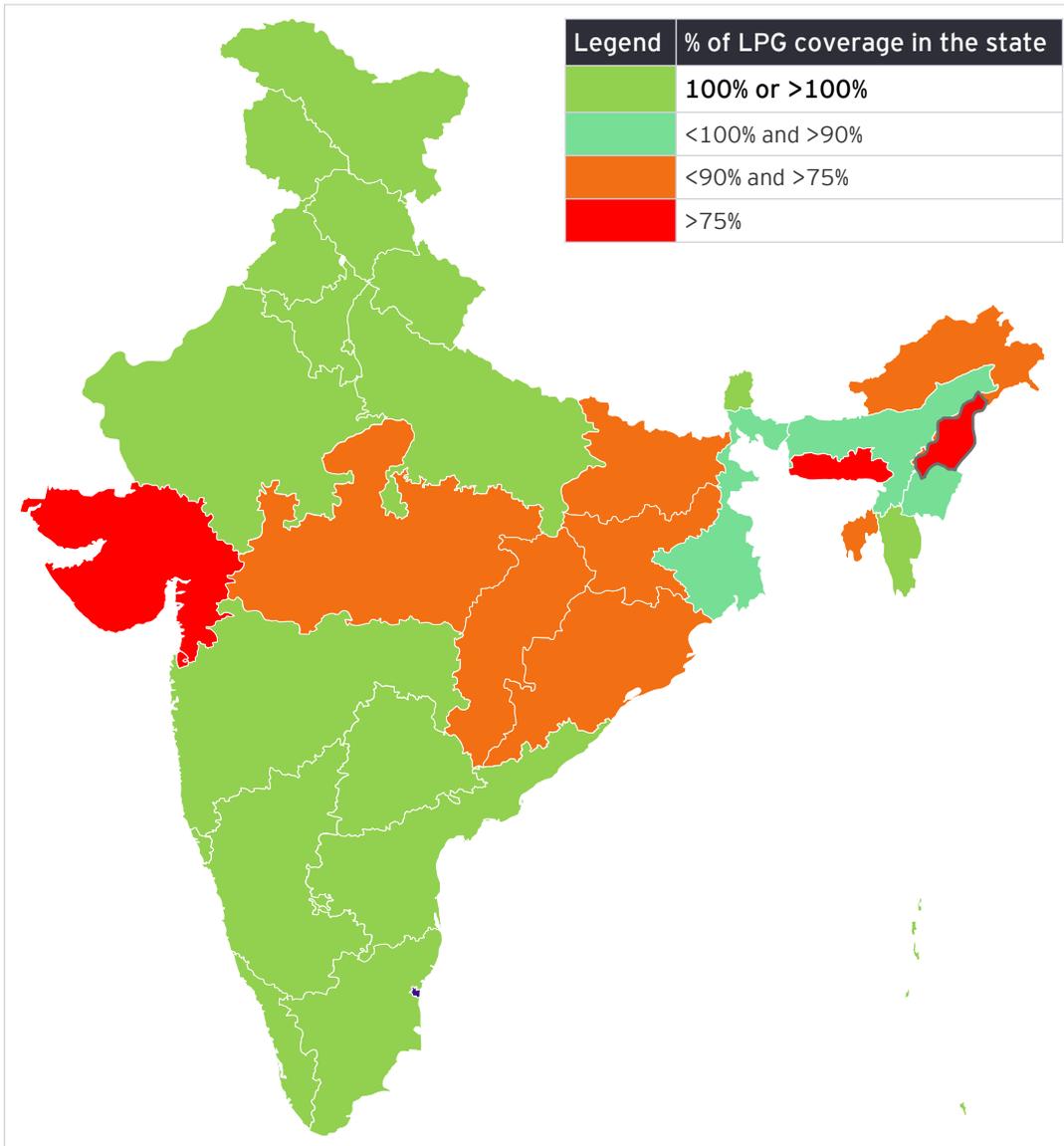
As on 01.01.2021, the National LPG coverage is 99.5% as a result of Government's sustained efforts to ensure that all households have access to clean cooking fuel. Social support schemes such as Pradhan Mantri Ujjwala Yojana (PMUY) and LPG subsidy schemes has promoted usage of LPG across the country especially in rural households.

Increasing the reach of petroleum products including LPG across the country has been an important business activity of Oil Marketing Companies. OMCs are engaged in appointing new

LPG Distributors as a continuous business process and providing accessibility of LPG to households.

While India has achieved close to 100% national coverage for LPG, there are a few states that have more than 100% coverage of LPG (more connections than households). More than 10 states have less than 80% coverage of LPG in the state which will be focus states to establish the distribution of LPG network over the next few years.

Figure 40: States and LPG coverage in India



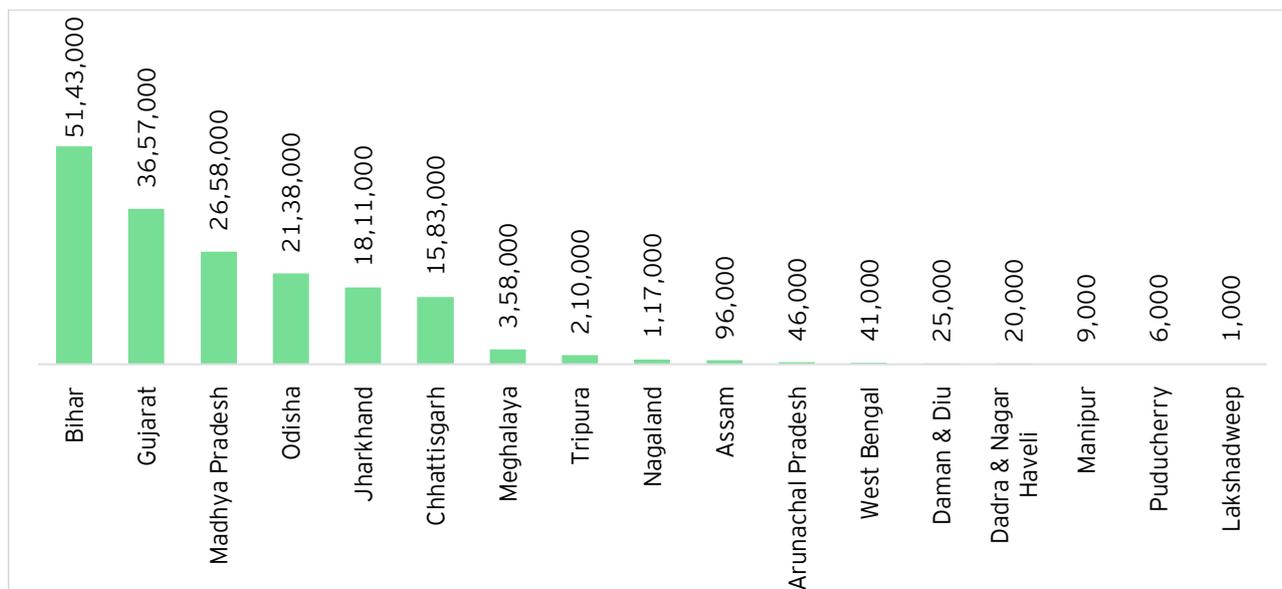
100% or more than 100%		Less than 75%
▶ Goa	▶ Maharashtra	▶ Nagaland
▶ Punjab	▶ Sikkim	▶ Meghalaya
▶ Jammu and Kashmir	▶ Andhra Pradesh	▶ Daman and Diu
▶ Delhi	▶ Tamil Nadu	▶ Gujarat
▶ Haryana	<90% and >75%	
▶ Himachal Pradesh	▶ Madhya Pradesh	
▶ Telangana	▶ Dadra and Nagar Haveli	
▶ Uttarakhand	▶ Arunachal Pradesh	
▶ Andaman and Nicobar Islands	▶ Odisha	
▶ Mizoram	▶ Tripura	
▶ Kerala	▶ Chhattisgarh	
▶ Rajasthan	▶ Jharkhand	
▶ Karnataka	▶ Bihar	
▶ Uttar Pradesh	▶ Lakshadweep	
▶ Chandigarh		

Manpower demand to ensure 100% domestic LPG coverage across the country

There are more than 30 crore households in India with an LPG coverage of 99.8%⁹⁷ through a network of more than 25,000 LPG distributors⁹⁸. The following states, however, are yet to reach

100% LPG coverage and would require an increased distributor network to ensure access of LPG to all the remaining households.

Figure 41: Additional households across the states to receive LPG connections



Source: Analysis based on household coverage as of April 2021.

Table 30: Mapping job roles for LPG dealership centres

Job Roles	Number of manpower per role at an LPG distribution centres ⁹⁹
LPG Delivery personnel	10
LPG Distributor Supervisor	1
LPG Mechanic	2
LPG Dealership staff - Handling and storekeeping	3

Table 31: Job role wise manpower demand for new LPG dealerships in the country across states

States	Number of distributors needed	LPG Delivery personnel	LPG Distributor Supervisor	LPG Mechanic	LPG Dealership staff -	Total
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⁹⁷ LPG Profile- Data on LPG Marketing (Jan 2021), PPAC
⁹⁸ PPAC (May 2022), Abridged Ready Reckoner May 2022. Accessed from <https://www.ppac.gov.in/WriteReadData/Reports/202206250444183656498SnapshotofIndiasOilandGasdataMay2022upload.pdf>

⁹⁹ Based on average number of connections provided by 1 LPG distributor the following estimates provide total number of new LPG distributors across the country and the corresponding manpower needed for operations

					Handling and storekeeping	
Bihar	550	5,496	550	1,099	1,649	8,794
Gujarat	338	3,377	338	675	1,013	5,403
Madhya Pradesh	264	2,642	264	528	793	4,227
Odisha	230	2,298	230	460	689	3,676
Jharkhand	180	1,796	180	359	539	2,874
Chhattisgarh	159	1,589	159	318	477	2,542
Meghalaya	69	690	69	138	207	1,104
Nagaland	35	346	35	69	104	553
Tripura	21	213	21	43	64	341
Arunachal Pradesh	14	138	14	28	41	220
Assam	8	77	8	15	23	123
West Bengal	3	27	3	5	8	44
Manipur	2	15	2	3	5	25
Daman and Diu	1	11	1	2	3	18
Lakshadweep	1	10	1	2	3	16
Puducherry	1	10	1	2	3	16
Lakshadweep	1	10	1	2	3	16
Dadra and Nagar Haveli	1	6	1	1	2	10
Total	1,875	18,751	1,875	3,750	5,625	~30,000

Source: Analysis based on industry inputs and field survey.

- ▶ Out of a total of 30,000 manpower estimated for over the next few years, 67% of the demand is for LPG cylinder delivery men.
- ▶ The demand of 30,000 manpower will be realized between 2022-2025, as per past rate of increase of dealerships in the country.

Additionally, it is estimated that about 4,00,00 manpower is currently working with dealership networks across the country. Assuming a 3-5% replacement rate on account of attrition and retirement, 11,287 - 18,812 manpower per year would be required additionally for the existing dealerships.

Table 32 Estimated additional manpower requirement at existing LPG distribution centres across states

state	Number of distributors	Existing manpower	Incremental manpower	
			by 2025 ¹⁰⁰	2025-2030 ¹⁰¹
Total	25,083	~4,00,000	~48,000 - 80,000	~60,000 - 1,00,332
Uttar Pradesh	4,126	66,016	7,921 - 13,203	9,902 - 16,504
Maharashtra	2,206	35,296	4,235 - 7,059	5,294 - 8,824
Bihar	1,993	31,888	3,826 - 6,377	4,783 - 7,972
Tamil Nadu	1,632	26,112	3,133 - 5,222	3,916 - 6,528
West Bengal	1,529	24,464	2,935 - 4,892	3,669 - 6,116
Madhya Pradesh	1,528	24,448	2,933 - 4,889	3,667 - 6,112
Rajasthan	1,385	22,160	2,659 - 4,432	3,324 - 5,540

¹⁰⁰ Replacement manpower for retirement and attrition. Replacement rate - 3% to 5%

¹⁰¹ Replacement manpower for retirement and attrition. Replacement rate - 3% to 5%

state	Number of distributors	Existing manpower	Incremental manpower	
			by 2025 ¹⁰⁰	2025-2030 ¹⁰¹
Karnataka	1,261	20,176	2,421 - 4,035	3,026 - 5,044
Andhra Pradesh	1,062	16,992	2,039 - 3,398	2,548 - 4,248
Gujarat	1,006	16,096	1,931 - 3,219	2,414 - 4,024
Odisha	955	15,280	1,833 - 3,056	2,292 - 3,820
Punjab	857	13,712	1,645 - 2,742	2,056 - 3,428
Telangana	785	12,560	1,507 - 2,512	1,884 - 3,140
Kerala	691	11,056	1,326 - 2,211	1,658 - 2,764
Haryana	623	9,968	1,196 - 1,993	1,495 - 2,492
Assam	590	9,440	1,132 - 1,888	1,416 - 2,360
Jharkhand	572	9,152	1,098 - 1,830	1,372 - 2,288
Chhattisgarh	534	8,544	1,025 - 1,708	1,281 - 2,136
Delhi	321	5,136	616 - 1,027	770 - 1,284
Uttarakhand	314	5,024	602 - 1,004	753 - 1,256
Jammu and Kashmir	287	4,592	551 - 918	688 - 1,148
Himachal Pradesh	206	3,296	395 - 659	494 - 824
Manipur	101	1,616	193 - 323	242 - 404
Arunachal Pradesh	85	1,360	163 - 272	204 - 340
Nagaland	83	1,328	159 - 265	199 - 332
Tripura	77	1,232	147 - 246	184 - 308
Meghalaya	64	1,024	122 - 204	153 - 256
Mizoram	59	944	113 - 188	141 - 236
Goa	55	880	105 - 176	132 - 220
Puducherry	28	448	53 - 89	67 - 112
Chandigarh	26	416	49 - 83	62 - 104
Sikkim	26	416	49 - 83	62 - 104
Andaman and Nicobar Islands	9	144	17 - 28	21 - 36
Dadra and Nagar Haveli	3	48	5 - 9	7 - 12
Daman and Diu	3	48	5 - 9	7 - 12
Lakshadweep	1	16	1 - 3	2 - 4

Source: Analysis based on industry inputs.

Table 33 Estimated additional manpower requirement at existing LPG distribution centres across job roles

Job roles	Existing manpower	Incremental manpower	
		by 2025 ¹⁰²	2025-2030 ¹⁰³
Total	~4,00,000	~48,000 - 80,000	~60,000 - 1,00,332
LPG Distributor Supervisor	25,083	3,000 - 5,000	3,762 - 6,271
LPG Delivery personnel	2,50,830	30,100 - 50,000	37,625 - 62,708
LPG Mechanic	50,166	6,000 - 10,000	7,525 - 12,542
LPG Dealership staff - Handling and storekeeping	75,249	9,000 - 15,000	11,287 - 18,812

Summary - manpower demand analysis for LPG dealership

1,875 new dealerships are estimated to come up by 2030

¹⁰² Replacement manpower for retirement and attrition. Replacement rate - 3% to 5%

¹⁰³ Replacement manpower for retirement and attrition. Replacement rate - 3% to 5%

Demand for manpower for new dealerships: ~30,000	
Incremental demand till 2030 across existing dealerships - ~1,00,000 - ~1,80,000	
States in focus	Bihar, Gujarat, Madhya Pradesh, Odisha Jharkhand, Chhattisgarh

5.7 Sales and distribution - ATF fueling and refueling

Aviation fuelling centres or Aviation Turbine Fuel station

Airliners use kerosene-based fuel in jet engines commonly known as Jet Fuel. At every airport, jet fuel is stored in a dedicated facility called a fuel farm.

- ▶ Jet fuel from oil refinery is delivered to fuel farm from time to time (based on fuel demand forecast for the respective airport). An airport fuel farm mainly consists of large storage tanks with allied systems for maintaining and controlling jet fuel quality.
- ▶ From the fuel farms it is supplied to airlines for aircraft refuelling either through a refuel trucking system or fuel hydrant system.
 - ▶ A refuelling truck is simply a fuel tanker that carries several thousand litres of fuel in its tank and is fitted with necessary pumping systems to be hooked to an aircraft and top up its fuel. A fleet of refuelling trucks is maintained at airports where this system is used, and this fleet

remains in action throughout the day refuelling airplanes and replenishing themselves from the airport fuel farm once their tank is depleted.

- ▶ In the fuel hydrant system, the airport is fitted with an underground network of fuel supply lines that reach from the airport fuel farm to aircraft stands/parking bays on airside. A fuel hydrant dispenser is a specialized machine/vehicle that connects itself with the underground supply line on one end and the airplane on the other.

OMCs also operate aviation fuelling centres across the airports. Currently there are more 250 fuelling station across the country. Number of manpower at each of these fuelling stations is determined the size and airline volume handled by the airport. New manpower demand is further only created due to development of a new airport or expansion of existing ones.

Job Roles at ATF stations at airports
ATF station manager
AFT tank farm/fuel farm manager
AFT tank farm supervisor
ATF control room supervisor
ATF control room operator
Fuelling coordinator/Dispatch
Blue collared operators (Fuel Farm)- Storage tank operations, stock management, product assessment, valve change, maintenance, pump house operations, receiving and dispatch coordination with tank lorry
Refuelling Supervisor
ATF Refuelling operators
ATF Hydrant refuelling operators
Driver - Fuel hydrant Dispenser
Driver - Bulk tanker truck

5.8 Sales and distribution -direct to home sales/fuel delivery

Door to door delivery of High-Speed Diesel

There is a considerable demand of HSD for stationary equipment like generator sets, earth moving equipment, heavy machineries used in construction sites, mobile towers, etc. and these may not have facility / resource to store HSD. There is a demand from such customers for delivering HSD at their doorstep.

In a collaborative effort of Ministry of Petroleum and Natural Gas and Ministry of Commerce and

Industry, DDD services have been actualized by engagement of start-ups that are registered as s “DDD Resellers” of Oil Marketing Companies (OMC) and have signed a legal agreement with the concerned OMC.

In this retail model, the start-ups need mobile dispensers/fuel tanks to transport and deliver the fuel to the customer. The manpower start-ups are termed as *fuelEnt*, i.e., fuel entrepreneurs.

Table 34: Doorstep delivery/mobile dispensers for doorstep delivery

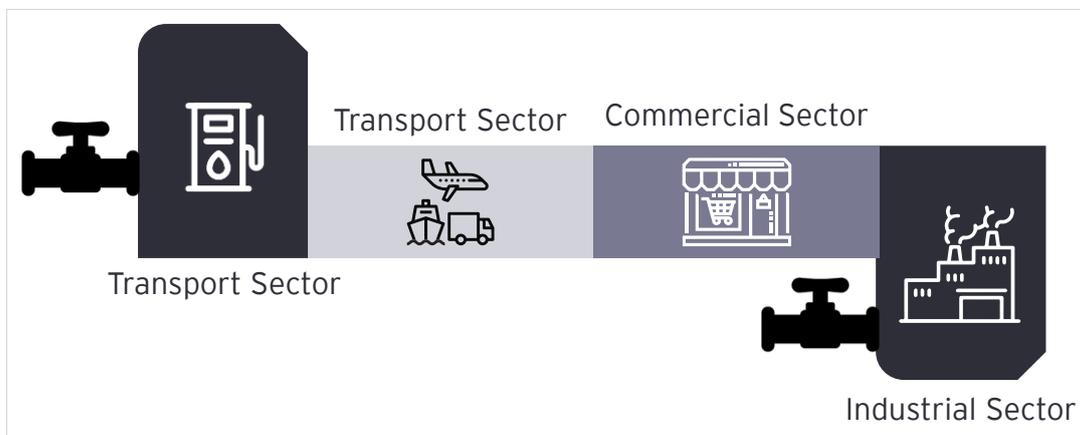
Job roles for Door to Delivery of High-Speed Diesel
Driver - Bulk tanker truck
Operator/Dispenser DDD

5.9 City Gas Distribution

A city gas distribution network is an interconnected network of pipelines and associated infrastructure to ensure supply of environment friendly cooking fuel at the doorstep of the consumers as well as

clean fuel to the transport sector. *Domestic, Commercial and Industrial Sectors use Piped Natural Gas (PNG) whereas the Transport Sector uses Compressed Natural Gas (CNG).*

Figure 42: The four major sectors identified for the city gas distribution in India



The growth of city gas distribution in India in the last 5 years accounts for more 70% of the growth since 2008

Ministry of Petroleum and Natural Gas (MoPNG) established the Petroleum and Natural Gas Regulatory Board (PNGRB) in 2007, under the PNGRB Act 2006, which is responsible for phasing out the country wide implementation of CGD network through bidding rounds. Bidding rounds in CGD refers to the process of the allocating certain authorisation areas to Oil and Gas companies,

called the operators with minimum work targets. Authorized area means the specified geographical area for a city or local natural gas distribution

network identified for laying, building operating or expanding the CGD network¹⁰⁴

11 bidding rounds have been conducted across the country since 2008, reaching over 28 states and UTs and benefiting over 70% of India's population

The following provides an overview of the coverage and reach of the CGD network¹⁰⁵.

Figure 43: Snapshot of City Gas Distribution Authorizations in India

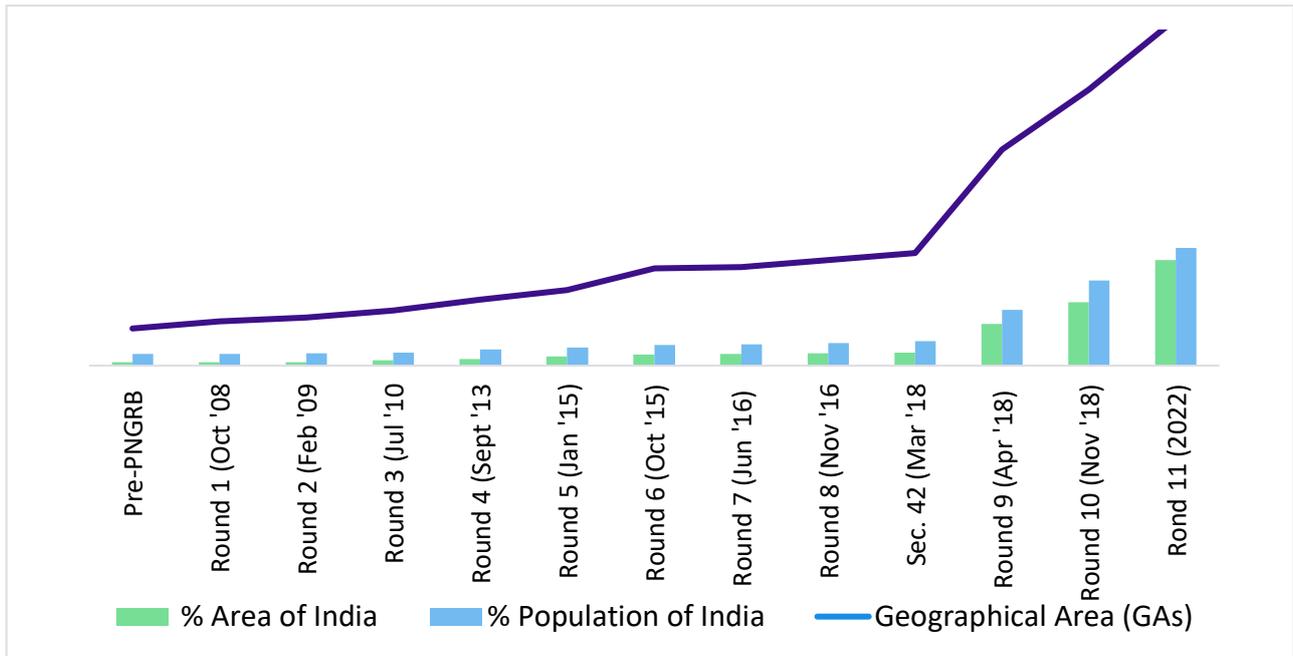


Figure 44 CGD Coverage in India

11 Biddings rounds	289 Geographical areas	402 Districts	28 States and UTs
~96 - 98% Population		88% Geographical area	

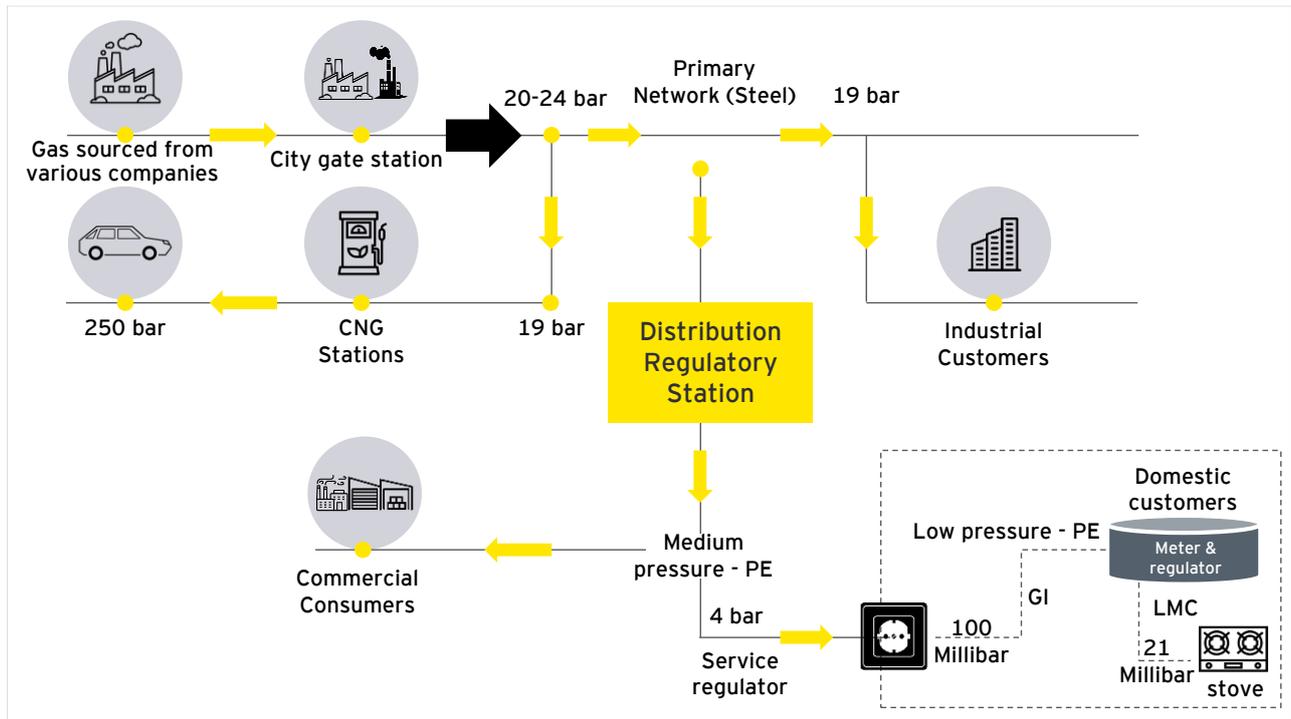
Figure 45 Achievements under CGD in India

94,12,909 Domestic PNG Connections	35,031 Commercial PNG Connections	13,320 Industrial PNG Connections
4,462 CNG stations		
Some key CGD entities in India		
<i>and others</i>		

104 The Petroleum and Natural Gas Regulatory Board (Authorizing Entities to Lay, Build, Operate or Expand City or Local Natural Gas Distribution Networks) Regulations, 2008

105 PNGRB Press Release, 2019. Accessed from <https://www.pngrb.gov.in/pdf/cgd/bid10/PressRelease26022019.pdf>

Figure 46 City gas distribution value chain - Infrastructure and process flow



CGD value chain primarily involves the end-to-end process, from production of natural gas to taking it to the end user for consumption.

Natural gas is produced and processed by the companies or imported through pipelines and regasification infrastructure. Using a gathering network of transmission pipelines¹⁰⁶, the gas component is collected at the city gate station, set up in outskirts of cities, which is the start off point of the main CGD process and infrastructure for both PNG and CNG segment of gas supply.

City Gate Station for the CGD network is the tap off point of the main transmission line, converts the

high-pressure gas from the main trunk line to low/medium pressure for distribution to end user using steel pipelines and pressure regulating stations.¹⁰⁷

- ▶ CNG Segment: In the CNG segment, natural gas from CGS is transferred to a CNG station where it is compressed to 200-250 bar pressure to be supplied to CNG vehicles.
- ▶ PNG Segment: In the PNG segment, gas from the CGS is sent to domestic/commercial and industrial units via pressure regulation at District Regulating Station (DRS) and Service Regulators for domestic and Common Pressure

¹⁰⁶ Transmission pipeline/system : One or more segments of pipeline usually interconnected to form a network that transports gas from a gathering system, the outlet of a gas processing plant or a storage field to a high, medium or low-pressure pipeline system, a large-volume customer or another storage field.

Source - Petroleum and Natural Gas Regulatory Board Notification, 2009

¹⁰⁷ (a) District Regulating Station (DRS): Is located at strategic locations which are sometimes also known as field regulating stations to meet various demand centers for Domestic/ Industrial segment. It too has a pressure reduction system, a filtering unit, Turbine metering system, valves etc.; (b) Industrial Pressure Reduction Station (IPRS): IPRS for the network is located in major Industries. It has a pressure reduction system, a filtering unit, Turbine metering system, valves etc.

Source: Ayush Gupta, Sr. Manager (Training), GAIL (India) Ltd (2009). 4th Pipeline Technology Conference 2009 - Preparedness to handle emergency in city gas distribution networks.

Reduction Skid (CPRS) and Meter Regulating Stations for industrial usage¹⁰⁸

Drivers for growth for CGD sector in India^{109,110}

- ▶ Mega investments in gas infrastructure (pipelines, LNG infrastructure etc) to increase India's natural gas share in energy basket from 6% to 15%
- ▶ Priority allocation of natural to CGD for CNG and PNG segments
- ▶ Industry's shift towards using LPG over other fuels, the Government of India has also banned the use of pet coke and furnace oil in some regions
- ▶ CNG in public transport is being promoted across the country through the introduction of long distance CNG vehicles
- ▶ PNGRB aims to connect 5 crore households with PNG connections (currently at 72.47 lakhs)

As per analysis drawn from industry inputs and PNGRB CGD milestones over 3.42 lakh skilled manpower will be required by the CGD sector to achieve the milestones for 9th, 10th and the 11th CGD rounds.

Ministry of Petroleum and Natural Gas aims to expand the network of CGD to more than 500 cities with a potential investment of Rs. 1.2 trillion by 2030¹¹¹, the significance of providing a skilled and trained manpower to this network and system becomes more critical than before.

Considering the nature of the sector, scale of investment and expansion plans of the Government, the CGD sector requires large number of skilled manpower for efficient operations and management of the sector.

For the purpose of this study, CGD bidding rounds 9, 10 and 11 have been considered for assessing the manpower requirement, since for the prior rounds, work is already underway or accomplished, with required manpower already commissioned/contracted, therefore creating minimum additional manpower requirement. The employment estimates will focus on the blue collared jobs in the sector across various occupational groups.

Under the 9th, 10th and 11th round itself, the CGD network aims to achieve the following milestones across the authorized geographical areas and manpower will be required to actualize these milestones.

Table 35: Key milestones under 9th, 10th and 11th round of CGD authorization

Particulars	9th Round and 10th Round	11 th CGD round
Geographical Areas	136	61
States/UTs	23	19

¹⁰⁸ (a) Service Regulators: Usually located at customer premises for maintaining supply pressure and designed to maintain safe condition even in the event of rupture in the regulator downstream section.

Source: Petroleum and Natural Gas Regulatory Board (Technical Standards and Specifications including Safety Standards for City or Local Natural Gas Distribution Networks), Sept 2008. Accessed from <https://www.pngrb.gov.in/eng-web/regulation-cgd.html>

¹⁰⁹ HD Chambers Hydrocarbon Committee (2020), India IS Set To Emerge As One Of The Primary Drivers Of Growth In Natural

Gas Owing To Consistent Policies By Government. Accessed from India IS Set To Emerge As One Of The Primary Drivers Of Growth In Natural Gas Owing To Consistent Policies By Government - BW Businessworld

¹¹⁰ Press India Bureau (2019), Accessed from <https://pib.gov.in/PressReleasePage.aspx?PRID=1597433>

¹¹¹ Business Standard (2019), Rs 1.2 trillion investment planned for city gas network expansion. Accessed from https://www.business-standard.com/article/pti-stories/pradhan-says-rs-1-2-lakh-cr-investment-planned-for-city-gas-network-expansion-119082600456_1.html

Districts	298 Districts	500+
PNG Connections	423 Lakh	522 lakhs
CNG Stations	8,181	8,331
Steel Pipeline (Inch-KM) in lakhs	1.74	1.17

Source: City Gas Distribution in India, PNGRB. Accessed from [brochure.pdf \(pngrb.gov.in\)](#), and [CGD 11th round authorization letters](#)

To obtain the industry view on manpower demand, discussions and consultations were held with various CGD entities to take their inputs on the manpower entailments for CGD network expansion and operationalization, based on which the following segments provide an estimated skill demand in the CGD sector in India over the next 10 years.

The GA's can vary substantially not only in geographical area but also in terms of their

cumulative population, population density and number of households. The function of these factors plays an important role in deciding the quantum of infrastructure for a GA and provides the variability base for manpower demand to operationalize the CGD network. In order to draw estimates that are in line with the demography of the GAs, the GAs have been categorized as follows and have been considered for subsequent estimations:

Table 36: Geographical areas categorized by population

Category A	GAs with population above 50 Lakh	Category B	GAs with population between 30-50 Lakh	Category C	GAs with population up to 30 Lakh
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Manpower demand estimation for CGD expansion under 9th, 10th and 11th bidding round

CGD players have Minimum Work Programme obligations for each year in terms of the length of pipelines, number of CNG stations and the number of domestic connections to be completed during each of their initial years after receiving exclusive authorization to market gas in each specified area. The typical period for completion of the minimum works targets varies between 5-10 years and further the entities may request for extension period in case of unforeseen events leading to delay.

Commissioning and Pre-Commissioning

The job roles under this group primarily relate to laying of High-Pressure Gas Steel Pipelines and Medium Density Polyethylene (MDPE) Pipelines for CNG and PNC network, construction of CNG Stations including Civil, Mechanical, Electrical and

After detailed discussions with CGD entities across the country, some key job roles significant in operationalization of the CGD milestones for the companies we identified. Skilled manpower will be required to establish, operate and maintain pipelines, to construct and operate CNG retail outlets and to provide PNG connections to the domestic, commercial and industrial customers. The job roles thus identified can be broadly thematised as - Commissioning and Pre-Commission and Operations and Maintenance.

Instrumentation works, connectivity to household, commercial and industrial segments through High Pressure Gas Steel Pipelines, MDPE Pipelines, as per authorization requirements.

Operations and maintenance

Once the network has been set up, there is a need to ensure the continuous availability of gas to consumers and at the same time maintain the condition of the pipeline system and other

infrastructure. Primarily the O&M roles could be spanning across the following activities/functions on part of the CGD entities - survey/patrolling for maintenance and inspection of all



facilities(pipelines, metering/compressor stations, domestic installations), calibration of meters, gauges and other instruments affecting quality and safety of system, functional testing of pressure regulation and control equipment, integrity check for the pipelines (both manual and system managed), fire safety training and operations and operations at retail outlets- dispensing of CNG, maintenance and repair jobs, customer handling, overall supervision etc ¹¹². In addition to the above

the PNG and CNG customers are supported by around the clock complaints and feedback tele calling service to help them address device break down or other emergency situations.

Based on the above functions the city gas distribution network in India till 2030 would entail the following manpower requirement for a 10-year time period for the work that has been commissioned under the three bidding rounds.

Figure 47 Snapshot of manpower requirement in CGD over a 10-year period

Manpower for Commissioning and Pre-Commissioning in CGD	+	Manpower for Operations and maintenance in CGD	+	Manpower for project supervision, customer support and retail in CGD
9th 10th and 11th CGD licencing round		98,472 + 76,229 + 1,67,468 = 342,168		
 Incremental manpower demand for 9 th 10 th and 11 th CGD rounds				

Source: Industry consultations and analysis

- ▶ **The CGD sector will add 3.42 lakh jobs for commissioning and expansion of the CGD network under the 9th,10th and 11th rounds**
- ▶ The demand for skilled manpower in CGD for accomplishing the targets of the 9th,10th and 11th CGD¹¹³ rounds spreads across 25+ states,

however 70% of the demand for skilled manpower for a cumulative 10-year period is concentrated around 9 states Tamil Nadu, Maharashtra, Uttar Pradesh, Madhya Pradesh, Kerala, Chhattisgarh, Karnataka, Rajasthan and Telangana .

Table 37: Distribution of demand for skilled manpower in CGD - 70% of the demand seen across 8 states

State	Incremental manpower	Incremental manpower
	9th 10th and 11th round (0-5 years/by 2025)	9th 10th and 11th round (5-10 years/ by 2030)
Grand total	3,42,168	3,17,078
Tamil Nadu	52,400	50,267
Maharashtra	41,426	38,524
Uttar Pradesh	28,124	23,422
Madhya Pradesh	24,774	22,966
Kerala	23,163	22,315
Chhattisgarh	20,167	19,742
Karnataka	20,130	18,932
Rajasthan	19,953	18,268

¹¹²Petroleum and Natural Gas Regulatory Board (2008). Accessed from [https://www.pngrb.gov.in/OurRegulation/pdf/Reference-Regulation/R-GSR612\(E\)-E.pdf](https://www.pngrb.gov.in/OurRegulation/pdf/Reference-Regulation/R-GSR612(E)-E.pdf)

¹¹³ Since the 11th round of the CGD has just recently been commissioned, some proportion of demand for over 1,67,000 workforce may be realised beyond 2030.

State	Incremental manpower	
	9th 10th and 11th round (0-5 years/by 2025)	9th 10th and 11th round (5-10 years/ by 2030)
Telangana	16,621	15,551
Andhra Pradesh	16,569	15,650
Bihar	14,417	12,931
West Bengal	12,444	10,549
Assam	9,417	8,847
Punjab	8,832	8,034
Haryana	6,335	5,225
Odisha	6,105	5,184
Jharkhand	5,795	5,059
Gujarat	4,224	4,731
Tripura	2,562	2,438
Puducherry	2,459	2,423
Jammu and Kashmir	2,398	2,315
Himachal Pradesh	1,737	1,675
Uttarakhand	1,319	1,270
Himachal Pradesh	762	726
Daman and Diu	36	33

Source - Analysis based on industry inputs.

- ▶ The highest incremental manpower demand is seen for semi-skilled category of job roles followed by unskilled and skilled job roles. In the semi-skilled category, the highest incremental demand over the next 10 years would be for commercial drivers to market and transport the gas products across the GAs. This will be followed by incremental demand for direct marketing agents in the category, who are the backbone for helping register new PNG customers and at the same time attend to the existing network of PNG users.
- ▶ One of the key highlights of CGD network expansion is the setting up of CNG stations across the states, necessitating trained managers and supervisors to monitor the operations at these retail units. The incremental demand for manpower for this role is the highest in the skilled category of manpower requirements for CGD.

Table 38: Distribution of manpower demand across skill category and job roles

Job role	Incremental manpower	
	9th 10th and 11th round (0-5 years/by 2025)	9th 10th and 11th round (5-10 years/ by 2030)
Grand total	3,42,168	3,17,078
Retail outlet Dispenser Operator - CNG	2,31,325	2,31,324
Security Guard	31,130	31,130
Housekeeping Staff	16,523	16,523
Retail Outlet Manager - CNG	16,523	16,523
Plumber Helper	9,434	
Excavation / Civil Labour	7,468	2,326
Driver - HCV/LCV	5,321	
GI Plumber (last mile connect for PNG/CGD)	4,717	
Industrial Technician Electrician (Oil & Gas)	2,934	2,934
Industrial Technician Instrumentation (Oil & Gas)	2,934	2,934
Industrial Technician Mechanical (Oil & Gas)	2,934	2,934
Direct Marketing Agent	2,825	
Customer care Personnel	2,396	2,396
Gas Meter Reader	1,194	1,194
Pipe Fitter-CGD (MDPE Fusion Welder)	806	
Billing Personnel	784	784
Project Supervisor /Inspection	582	
Steel welder Helper	536	
Fire Safety Technician (Oil and Gas)	397	397
Storekeeper- Oil and Gas	328	356
Draftsman/CAD	269	
SS Tubing Technician	269	
Steel welder Helper / Pipeline Helper (Oil and Gas)	268	
Steel-Pipe Fitter	268	

Source -Analysis based on industry analysis.

Considerations for assessment of manpower demand under CGD

- ▶ The estimated manpower is required for the commissioning of the entire physical targets commissioned under the 9th, 10th and 11th round. However, the operators have been awarded work contracts and the work commenced in December 2018. Therefore, the manpower demand thus estimated accounts for all the work commissioned and actual on ground requirement may vary.
- ▶ In addition to CGD 9th, 10th and 11th round targets, works from the previous rounds is also underway, therefore the actual number of manpower currently engaged with CGD is a function of work commissioned and work achieved for each minimum work program contract for all the operators.





6

Supply-Side Manpower

6 Supply-Side Manpower

Against the backdrop of the growing energy demands in the country, the hydrocarbon sector needs to be supported with a pool of trained and skilled manpower to support future expansion projects. The supply side ecosystem of the Oil and Gas sector has limited knowledge about the opportunities of the sector. Further, given the

probabilistic nature of some segments of the sector, it is essential to understand the youth's perspective, current availability of training infrastructure and trained candidates and mapping the same to the industry demand across the country.

6.1 Key inputs from youth aspiration survey at ITIs and SDIs in India

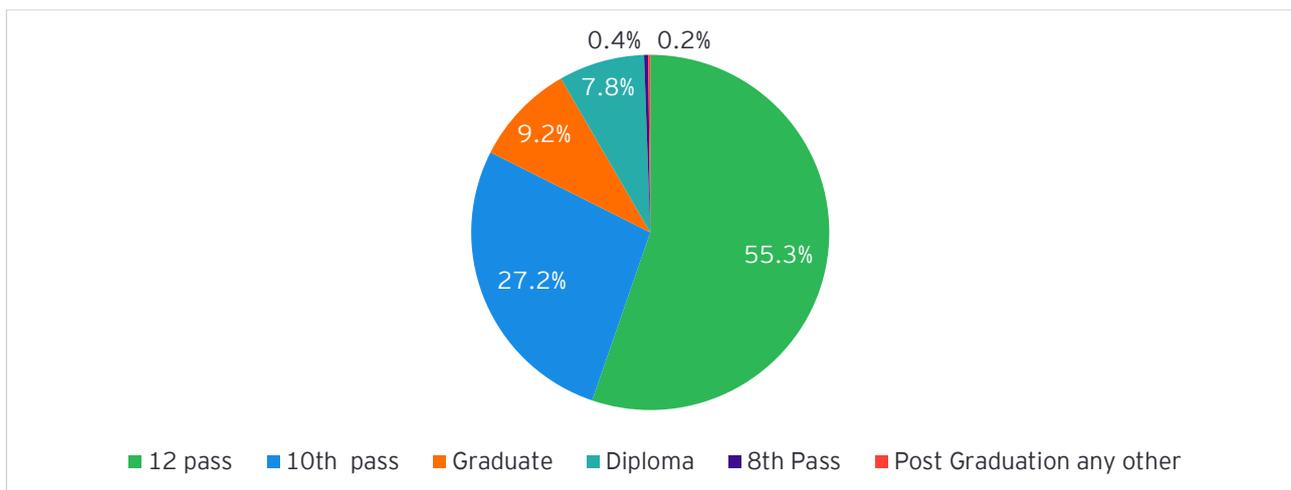
To understand the youth's knowledge about the sector and assess their willingness to join the Oil and Gas sector, an extensive *youth aspiration survey across 500+ trainees* was carried out across the skill development institutes and ITIs in the country. SDIs are national skilling institutes that have been set up by national oil companies

(NOCs) such as IOCL, GAIL, HPCL, ONGC and Oil India in consonance with national priorities of skilling the youth. The SDIs are provided with financial and administrative support by the NOCs to skill the youth in job roles that are most in demand for the Oil and Gas industry.

Profile of the respondents

- ▶ A total of 545 respondents were covered for the youth aspiration survey.
- ▶ 70% of the respondents were enrolled at ITIs and 30% were enrolled at SDIs.
- ▶ 55% of the respondents had completed their education till standard 12th, while 27% of the respondents had completed their education till 10th standard. About 10% of the respondents were pursuing their ITI training after completing graduation.

Figure 48: Highest educational qualification of the respondents



Source: Analysis from youth aspiration survey

- ▶ Key job roles that the respondents were enrolled in:
 - ▶ **ITI trainee respondents were primarily enrolled across COPA, Machinist, Turner and welder.**

- ▶ **While job roles such as pipe fitter, instrumentation technician and process operator roles were popular among the SDI trainees .**

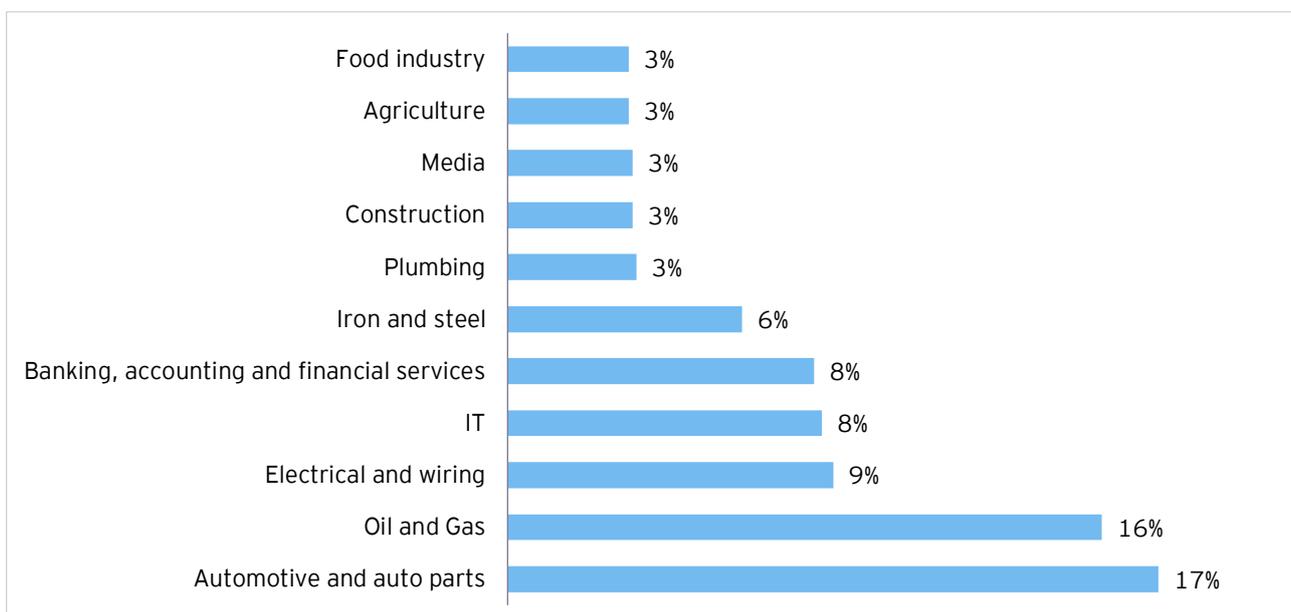
Preferred sector for employment

- ▶ The most preferred sector for employment among the trainees were Automotive and auto parts, Oil and Gas, Electrical, IT, Banking, accounting and financial services, Iron and

steel, Plumbing, Construction, Media and Agriculture.

- ▶ **64% of the trainees that chose oil and gas as their preferred sector were enrolled in SDIs.**

Figure 49: Preferred sector of employment as per the respondents



Source: Youth aspiration survey analysis

- ▶ **About 50% of the respondents that chose Oil and Gas** as their preferred sector for their career were aware about the sector and its

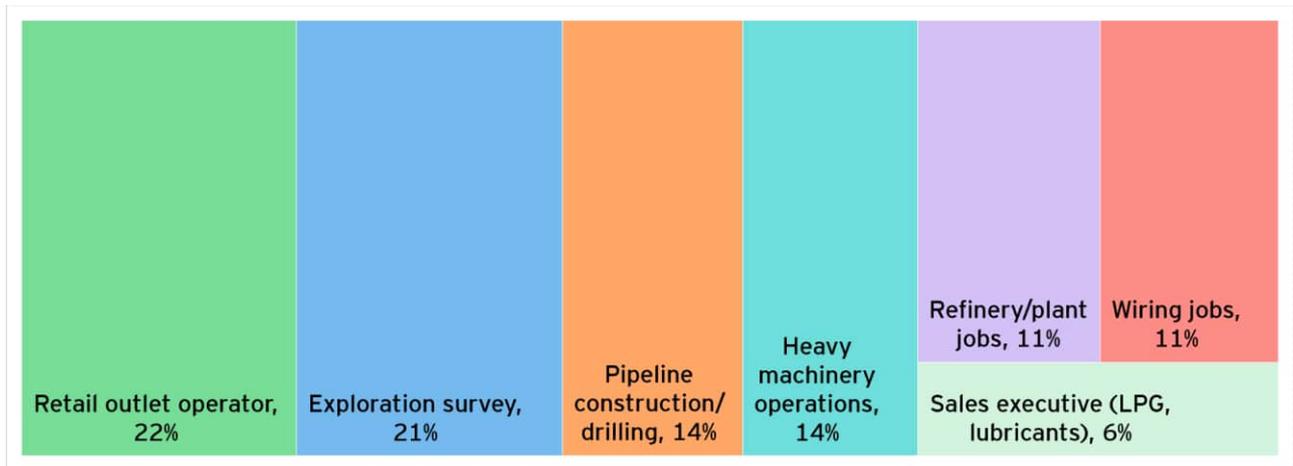
opportunities and more than **90% of them were willing to join the sector for formal employment.**

Perceptions about jobs in the Oil and Gas industry

- ▶ More than **65% of the respondents were willing to be trained in the Oil and Gas sector.**

- ▶ Further, around **67% percent of** the respondents were willing to work in the Oil and Gas sector and provided their preferences for the following roles.

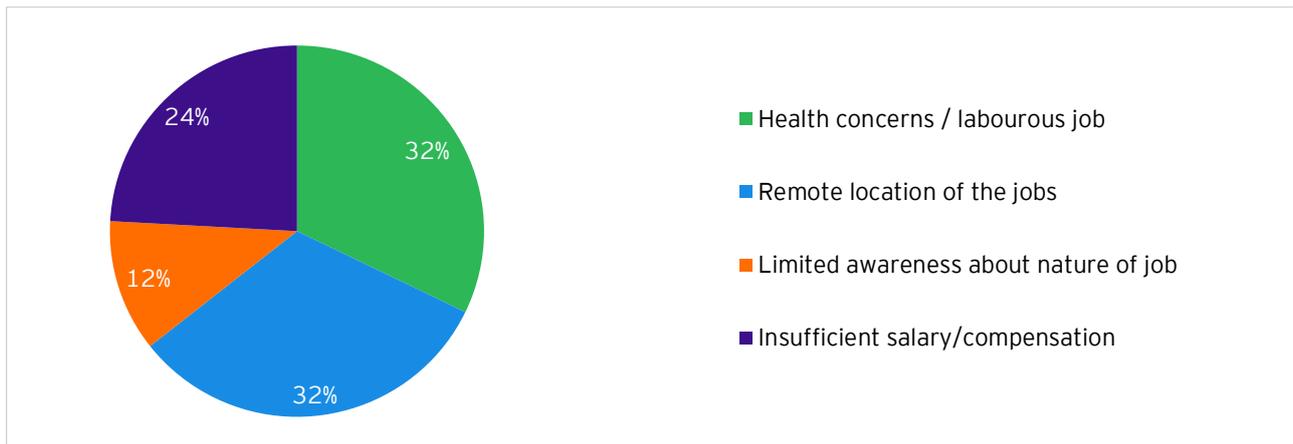
Figure 50: Key Oil and Gas job roles and preferred by trainees at ITIs and SDIs



Source: Youth aspiration survey analysis

- The following were the key reasons cited as challenges for respondents who did not prefer to work in the Oil and Gas sector.

Figure 51: Reasons for not wanting a job in the Oil and Gas sector



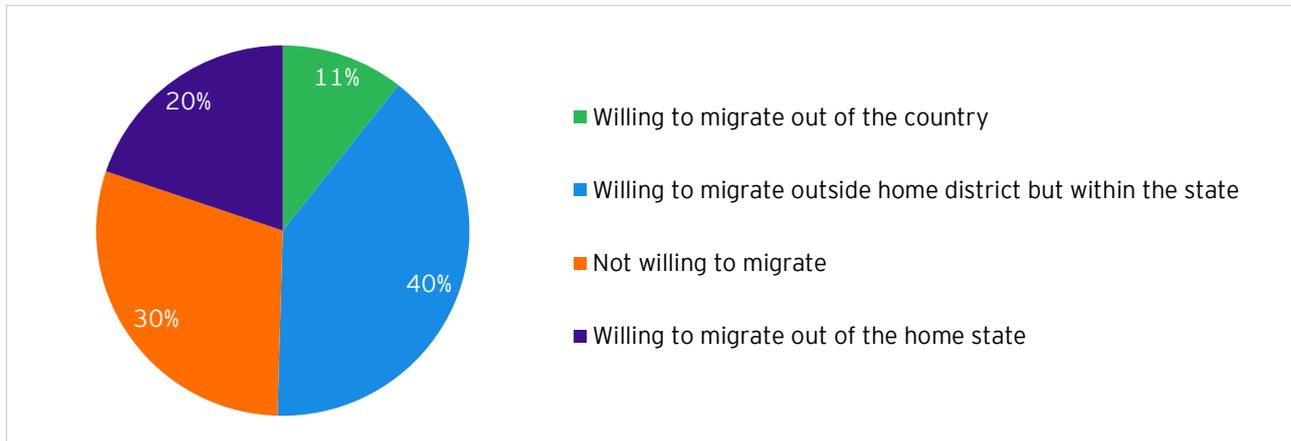
Source: Youth aspiration survey analysis

6.2 Migration pattern analysis

Migration preferences for youth vocationally trained under Oil and Gas courses

- ▶ 70% of the youth covered under the survey was willing to migrate for work, while the distance of the migration varied.

Figure 52: Migration preferences of the youth



Source: Youth aspiration survey analysis

- ▶ The youth responded, “insufficient salary” and “familial responsibilities” as the key challenges for not willing to migrate.
- ▶ Rajasthan, which is one of the states, where short term training for hydrocarbon sector

have commenced, the following trends were observed with the youth through the primary survey: more than 50% of the youth migrated to Uttar Pradesh, while Delhi, Maharashtra, and West Bengal were other key states where the youth migrated to.

Migration preferences for vocationally trained youth

Based on a primary survey with vocationally trained youth, in consonance with industry reports, the following inputs may be of importance. The analysis tries to focus on the top 10 states that account 70% of the manpower demand estimated

in the study. The in and out-migration imperatives of these states, will be basis of identifying the key sources for manpower and will also help to strategize the supply sourcing strategy for the Oil and Gas PSUs.

State	State as 'source"	State as destination
Maharashtra	Key states to which trained youth migrate from Maharashtra <ul style="list-style-type: none"> ▶ Gujarat ▶ Delhi ▶ Telangana ▶ Madhya Pradesh ▶ Uttar Pradesh ▶ Karnataka ▶ Haryana 	Trained youth from the following states migrate to Maharashtra: <ul style="list-style-type: none"> ▶ Uttar Pradesh ▶ Madhya Pradesh ▶ Haryana ▶ West Bengal ▶ Rajasthan ▶ Bihar ▶ Odisha ▶ Delhi ▶ Assam
Tamil Nadu	Key states to which trained youth migrate from Tamil Nadu	Trained youth from the following states migrate to Tamil Nadu

State	State as 'source'	State as destination
	<ul style="list-style-type: none"> ▶ Puducherry ▶ Telangana ▶ Karnataka ▶ Kerala ▶ Maharashtra ▶ West Bengal ▶ Andhra Pradesh 	<ul style="list-style-type: none"> ▶ Andhra Pradesh ▶ West Bengal ▶ Kerala ▶ Puducherry ▶ Odisha ▶ Jharkhand ▶ Meghalaya ▶ Uttar Pradesh ▶ Assam ▶ Tripura ▶ Karnataka
Uttar Pradesh	<p>Key states to which trained youth migrate from Uttar Pradesh</p> <ul style="list-style-type: none"> ▶ Delhi ▶ Haryana ▶ Maharashtra ▶ Uttarakhand ▶ Rajasthan ▶ Gujarat ▶ Punjab ▶ Madhya Pradesh ▶ Karnataka 	<p>Trained youth from the following states migrate to Uttar Pradesh</p> <ul style="list-style-type: none"> ▶ Bihar ▶ Delhi ▶ Madhya Pradesh ▶ Uttarakhand ▶ Rajasthan ▶ Haryana ▶ Punjab
Gujarat	<p>Key states to which trained youth migrate from Gujarat</p> <ul style="list-style-type: none"> ▶ Daman and Diu ▶ Maharashtra ▶ Madhya Pradesh ▶ Uttar Pradesh ▶ Haryana ▶ Delhi 	<p>Trained youth from the following states migrate to Gujarat:</p> <ul style="list-style-type: none"> ▶ Madhya Pradesh ▶ Bihar ▶ Uttar Pradesh ▶ Odisha ▶ Maharashtra ▶ West Bengal ▶ Rajasthan ▶ Delhi ▶ Haryana
Karnataka	<p>Key states to which trained youth migrate from Karnataka:</p> <ul style="list-style-type: none"> ▶ Telangana ▶ Maharashtra ▶ Tamil Nadu ▶ Kerala ▶ Delhi 	<p>Trained youth from the following states migrate to Karnataka:</p> <ul style="list-style-type: none"> ▶ Andhra Pradesh ▶ Odisha ▶ Uttar Pradesh ▶ West Bengal ▶ Bihar ▶ Telangana ▶ Kerala ▶ Jharkhand ▶ Madhya Pradesh ▶ Tamil Nadu ▶ Haryana
Kerala	<p>Key states to which trained youth migrate from Kerala:</p> <ul style="list-style-type: none"> ▶ Tamil Nadu ▶ Karnataka ▶ Telangana ▶ Maharashtra 	<p>Trained youth from the following states migrate to Kerala:</p> <ul style="list-style-type: none"> ▶ Tamil Nadu ▶ Telangana ▶ Karnataka ▶ Puducherry

State	State as 'source"	State as destination
		<ul style="list-style-type: none"> ▶ Andhra Pradesh ▶ Uttar Pradesh ▶ Assam ▶ Madhya Pradesh ▶ West Bengal
Rajasthan	Key states to which trained youth migrate from Rajasthan: <ul style="list-style-type: none"> ▶ Haryana ▶ Uttar Pradesh ▶ Delhi ▶ Maharashtra ▶ Gujarat ▶ Punjab ▶ Madhya Pradesh 	Trained youth from the following states migrate to Rajasthan: <ul style="list-style-type: none"> ▶ Uttar Pradesh ▶ Madhya Pradesh ▶ Haryana ▶ Bihar ▶ Punjab
Andhra Pradesh	Key states to which trained youth migrate from Andhra Pradesh <ul style="list-style-type: none"> ▶ Telangana ▶ Karnataka ▶ Tamil Nadu ▶ Maharashtra ▶ Haryana 	Trained youth from the following states migrate to Andhra Pradesh <ul style="list-style-type: none"> ▶ Telangana ▶ Puducherry ▶ Odisha ▶ West Bengal
Madhya Pradesh	Key states to which trained youth migrate from Madhya Pradesh <ul style="list-style-type: none"> ▶ Gujarat ▶ Uttar Pradesh ▶ Maharashtra ▶ Haryana ▶ Rajasthan ▶ Delhi ▶ Chhattisgarh ▶ Telangana 	Trained youth from the following states migrate to Madhya Pradesh <ul style="list-style-type: none"> ▶ Uttar Pradesh ▶ Assam ▶ Rajasthan ▶ Maharashtra ▶ Bihar
West Bengal	Key states to which trained youth migrate from West Bengal <ul style="list-style-type: none"> ▶ Maharashtra ▶ Gujarat ▶ Tamil Nadu ▶ Karnataka ▶ Delhi ▶ Haryana ▶ Uttar Pradesh ▶ Jharkhand ▶ Telangana 	Trained youth from the following states migrate to West Bengal <ul style="list-style-type: none"> ▶ Bihar ▶ Uttar Pradesh ▶ Jharkhand ▶ Assam ▶ Odisha ▶ Manipur ▶ Madhya Pradesh ▶ Rajasthan ▶ Haryana

Source: Analysis based on industry input, and skilling and migration study reports. The table provides migration dynamics for sector agnostic migration patterns in the key states and not just for oil and gas sector since limited sector specific inputs were available in this regard.

Salary and compensation

- ▶ Over 32% of the respondents said their minimum salary expectations are between INR 15,000-20,000 per month if they were to be employed in the Oil and Gas sector.
- ▶ However, in case the youth was willing to migrate out of this home district or out of the home state, the minimum salary expectation

International migration for Oil and Gas roles

India forms one of the largest sources of global labour force migration. As per latest ILO estimates, India's international migrant stock stands at 5.6 million (2019).¹¹⁴.

Two distinct types of labour migration have been taking place from India:

- ▶ People with **technical skills and professional expertise** migrate to countries such as the USA, Canada, UK, EU and Australia as permanent migrants. Migrants on the skilled side move to developed countries in search of jobs that suit their qualifications. Skilled workers usually take up healthcare, management, financial services or information technology jobs in countries like USA, UK, Australia and the European Union.
- ▶ **Unskilled and semi-skilled workers** migrate mainly to oil exporting countries of the Middle East on temporary contracts. Migrants at the lower end of the market comprise mostly unskilled casual laborers or those who own or hire small means of livelihood such as carts or rickshaws and are self-employed. Unskilled labor looks to move to the Middle East majorly Saudi Arabia and UAE in search of construction and retail trade jobs as these economies offer more jobs due to the shortage of labour in the region. They are economically sound countries offering a better standard of living and income

was in the range of INR 20,000-30,000 per month, to be able to manage the increased lodging and other expenses.

- ▶ Whereas, in cases where the respondents were willing to migrate to other countries for jobs, the most common response provided minimum salary expectations was INR 50,000.

to unskilled labourers as compared to India. Reports indicate that 90 percent of the Indian migrant workers, most of whom are low- and semi-skilled workers, work in the Gulf region and South-East Asia.¹¹⁵

- ▶ The key states that contribute to outward international migration are, Uttar Pradesh, Bihar, Tamil Nadu, Kerala, Andhra Pradesh, West Bengal, Punjab, and Rajasthan, accounting for 80% of the outmigration.
- ▶ India's diaspora, the largest in the world, is distributed across a number of major countries of destination, with the United Arab Emirates, the United States of America and Saudi Arabia (hosting the largest numbers of migrants from India). Other countries hosting large numbers of migrants from India included Australia, Canada, Kuwait, Oman, Pakistan, Qatar and the United Kingdom of Great Britain and Northern Ireland.¹¹⁶
- ▶ The top oil and gas producing countries in the world offer a large potential to provide jobs for the skilled youth.¹¹⁷
 - ▶ United States of America
 - ▶ Saudi Arabia
 - ▶ Russia
 - ▶ Canada
 - ▶ China
 - ▶ Iraq

¹¹⁴ ILO (2020) - https://migrationdataportal.org/data?i=stock_abs_&t=2019&m49=356

¹¹⁵ India Labour Migration Update 2018. (ILO) - https://www.ilo.org/wcmsp5/groups/public/---asia/---ro-bangkok/---sro-new_delhi/documents/publication/wcms_631532.pdf

¹¹⁶ United Nations Department of Economic and Social Affairs, Population Division (2020). International Migration 2020 Highlights (ST/ESA/SER.A/452). Accessed from : <https://www.un.org/en/file/105459/download?token=TOv3VPkm>

¹¹⁷ <https://worldpopulationreview.com/country-rankings/oil-producing-countries>

- ▶ United Arab Emirates
- ▶ Brazil
- ▶ Iran
- ▶ Kuwait
- ▶ Qatar
- ▶ Egypt
- ▶ Oman

Table 39: Destination countries accounting for more than 90% of India’s immigrant cohort

Destination countries	% of the immigrant cohort from India going to destination country
United Arab Emirates	19%
United States of America	15%
Saudi Arabia	14%
Pakistan	9%
Oman	8%
Kuwait	6%
United Kingdom	5%
Canada	4%
Qatar	4%
Australia	3%
Nepal	2%
Bahrain	2%
Italy	1%
Malaysia	1%
Singapore	1%
New Zealand	1%
Germany	1%

Source : <https://www.un.org/development/desa/pd/content/international-migrant-stock>

- ▶ On conducting a cross-tabulation on both aspects, the following countries are in the focus for demand for blue-collared skilled manpower in the Oil and Gas sector¹¹⁸:
 - ▶ United Arab Emirates
 - ▶ Saudi Arabia
 - ▶ Kuwait
 - ▶ Canada
 - ▶ Qatar
 - ▶ Oman
- ▶ To capitalize on the employment opportunities created in these countries in the Oil and Gas sector, Indian youth will need to get trained in globally high demand job roles. The training framework must be based on:
 - ▶ Developing standard curricula at par with the international standard
 - ▶ Introducing standardized testing of skill levels
 - ▶ Independent third-party certification of skills
- ▶ Few of the job roles that capture the maximum demand for the blue collared workforce globally in the hydrocarbon sector are as follows:
 - ▶ Safety Engineers

¹¹⁸ Factors for identifying the country: Existing destination for blue collared worker migration from India, Countries with pro-

migration policies, countries in which oil and sector is a key sector.

- ▶ QA/QC Engineers/ Technicians
- ▶ Drilling Engineers / Technicians
- ▶ Foreman/Supervisors
- ▶ Operation Technicians
- ▶ Welders (Tig/ Mig/Arc)
- ▶ Pipe Fitters
- ▶ Scaffolders
- ▶ Riggers
- ▶ Tanker truck drivers

6.3 Current training infrastructure for Oil and Gas roles across short term and long-term training programs

In this section, training and skilling options for the Oil and Gas sector will be assessed. The blue collared workforce plays a very critical role for all the segments of the sector, across both construction and operations. The principal source of supply of blue collar is largely catered by ITI,

polytechnics and informal markets. While engineering colleges and other institutes (commerce, arts, etc.) cater to the white collar and middle management roles. A fraction of the demand is met by the private/government skill institutes.

6.3.1 Industrial training institute (ITI)

The programs undertaken at ITIs are essentially categorized as long-term trainings, typically spanning between 6 months to 2 years.

However, there may be some job roles in the worker segment that are sector agnostic and functional in nature and trained youth in these job roles can be leveraged by the sector.

There are no dedicated courses being offered for the Oil and Gas sector within NCVT/ITI ecosystem.

Table 40: ITI Courses from other industries relevant for hydrocarbon sector manpower demand

ITI trades from other sectors	Relevant sub sector in hydrocarbon sector
Maintenance Mechanic (Chemical Plant) (NSQF)	Refinery / Gas processing units / Petrochemical plants
Instrument Mechanic (Chemical Plant) (NSQF)	Refinery / Gas processing units / Petrochemical plants
Technician Power Electronics System (NSQF)	Refinery / Gas processing units / Petrochemical plants
Laboratory Assistant (Chemical Plant) (NSQF)	Refinery / Gas processing units / Petrochemical plants
Pump Operator-Cum-Mechanic (NSQF)	Refinery / Gas processing units / Petrochemical plants / bottling plants
Information Communication Technology System Maintenance (NSQF)	Control rooms and control room management at Refinery / Gas processing units / Petrochemical plants/ ATF stations
Data Base System Assistant (NSQF)	Upstream - for geophysical data management
Geo Informatics Assistant (NSQF)	Upstream - for geophysical data management
Civil Engineer Assistant (NSQF)	Refinery / Gas processing units / Petrochemical plants
Operator Advanced Machine Tools (NSQF)	Refinery / Gas processing units / Petrochemical plants
Attendant Operator (Chemical Plant) (NSQF)	Refinery / Gas processing units / Petrochemical plants
Mechanic Mining Machinery (NSQF)	Upstream - drilling/production processes
Remotely Piloted Aircraft (RPA Drone Pilot) (NSQF)	Operations and maintenance of pipelines- IoT, industry 4.0 roles
ITI trades from other sectors	Relevant sub sector in hydrocarbon sector



Health Safety and Environment (NSQF)	Upstream / midstream / downstream
Firemen (NSQF)	Upstream / midstream / downstream
Fire Technology and Industrial Safety Management (NSQF)	Upstream / midstream / downstream
ITI trades from other sectors	Relevant sub sector in hydrocarbon sector
Mason (Building Constructor) (NSQF)	Construction and commissioning
Draughtsman (Civil) (NSQF)	Construction and commissioning
Draughtsman (Mechanical) (NSQF)	Construction and commissioning
Plumber (NSQF)	Construction and commissioning
Carpenter (NSQF)	Construction and commissioning
Industrial Painter (NSQF)	Construction and commissioning / Refinery/Gas processing units/Petrochemical plants
Electrician (NSQF)	Construction and commissioning / Refinery/Gas processing units/Petrochemical plants
Wireman (NSQF)	Construction and commissioning
Welder (Pipe) (NSQF)	Construction and commissioning
Welder (GMAW & GTAW) (NSQF)	Construction and commissioning
Welder (Fabrication and Fitting) (NSQF)	Construction and commissioning
Welder (Structural) (NSQF)	Construction and commissioning
Welder (NSQF)	Construction and commissioning
Welder (Welding and Inspection) (NSQF)	Construction and commissioning
Fitter (NSQF)	Construction and commissioning
Turner (NSQF)	Construction and commissioning

Source : Analysis on NCVT MIS data accessed from <https://www.ncvtmis.gov.in/Pages/ITI/TradeStats.aspx> on 28 July 2021

6.3.2 Short term training (STT) under skilling programs

Short term training ecosystem in India provides competency-based skilling programs to the youth of the country across sectors with duration that may span between 3-6 months. The short-term trainings owing their briefer gestation period offer a potential to provide quality training to the youth at scale and speed in demand driven roles. Given the growth of the Oil and Gas industry in India, especially the rapid pace at which the downstream retail sector is expanding, and the quantum of manpower needed for construction and services, the STT ecosystem must be capitalized to churn out talent to support the sector.

Hydrocarbon sector is considered as one of the sectors demanding highly technical expertise. Considering the need of varied expertise, existing skill gap, and shortage of desirable skilled workforce Hydrocarbon Sector Skill Council (HSSC)

was conceived in 2013. Oil Industry Development Board (OIDB) and Federation of Indian Petroleum Industry (FIPI) played a crucial role in formation of HSSC.

Since, 2016, HSSC has been functional with multiple initiatives under its implementation process with a focus on expanding the training infrastructure capacity of the sector. Some of the key job roles developed for the sector and wherein training has been commenced are (primarily in the retail sector):

- ▶ LPG Delivery Personnel
- ▶ LPG Mechanic
- ▶ Retail Outlet Attendant (Oil and Gas)

While the short-term training ecosystem under HSSC is being developed to train youth directly under the Oil and Gas job roles, there are some job

roles from other sector and the youth trained under these roles can form as supply sources for the hydrocarbon sector manpower demand. While new training infrastructure is a time intensive process, the following methods of capacity identification and creation can be deployed:

- ▶ Leveraging industry infrastructure to create short term training infrastructure
- ▶ Capitalizing the resources and infrastructure of the educational institutes
- ▶ Advocacy and outreach with Oil and Gas companies for their participation as training providers

Job roles for Oil and Gas sector - Refinery / Gas processing units / Petrochemical plants/Pipelines O&M	
Electrical Technician	Electronics Sector
Mechanic (Electrical/ Electronics/Instrumentation)	Infrastructure/Equipment Sector
Job roles for Oil and Gas sector - Upstream (exploration, field development and production)	
Forklift Operator (Driver)	Automotive Sector
Safety Operator	Mining Sector
Rigger - Rigging of Heavy Material	Construction/ Iron and steel sector
Rig Mounted Drill Operator	Mining sector
Excavator Operator	Mining sector
Hydra Crane Operator	Mining sector
Job roles for construction and services	
Welding and Quality Technician	Doors and Windows Fixer
Welding Assistant Level 2/3/4	Fabricator
Draughtsman Mechanical	Foreman - Roads and Runways
Fitter - Electrical and Electronic Assembly	Foreman Fabrication
Fitter Fabrication	Helper - Construction Laboratory and Field Technician
Fitter Mechanical Assembly	Junior Storekeeper -Construction
Assistant Bar Bender and Steel Fixer	Mason Concrete
Assistant Construction Painter and Decorator	Mason General
Assistant Electrician	Mason Tiling
Assistant Façade Installer	Multi Skill Technician - Fabrication
Assistant False Ceiling and Drywall Installer	Rigger - Piling
Assistant Mason	Rigger - Precast Erection
Assistant Pavement Layer	Rigger - Structural Erection
Assistant Scaffolder System	Rural Mason
Assistant Shuttering Carpenter	Scaffolder System
Assistant Technician - Prestress	Shuttering Carpenter - System
Bar Bender and Steel Fixer	Store Assistant -Construction
Chargehand - Shuttering Carpenter- Conventional	Supervisor Electrical Works
Chargehand - Shuttering Carpenter -System	Surveyor
Construction Electrician - LV	Tack Welder
Construction Fitter	Technician - Prestress
Construction Laboratory and Field Technician	Pipe Fitter City Gas Distribution
Construction Painter and Decorator	Mazdoor / Helper



6.3.3 Skill Development Institutes

Skill Development Institutes are skill academies set up under the aegis of Ministry of Petroleum and Natural and Gas and financed and administered by national oil companies like IOCL, ONGC, GAIL, HPCL, BPCL, OIL, EIL amongst the key ones. The

SDIs are state-of-the-art Institutes, imparting skill training of Hydrocarbons sector, sub-sector to cater the sectoral need in different part of the country with a training capacity of over 3,000 students.

Skill Development Institute/Location	Focus Area	Promoted by	Courses offered
Skill Development Institute, Bhubaneswar	Downstream Sector	Indian Oil as main promotor and other PSUs	<ul style="list-style-type: none"> ▶ Fitter Fabrication ▶ Industrial Welding ▶ Industrial Electrician ▶ Pipe Fitter ▶ Technician Instrumentation ▶ Building Automation Specialist ▶ Industrial Automation Specialist ▶ Designer- Mechanical ▶ CNC Programmer ▶ Advanced Welding Technology
Skill Development Institute, Ahmedabad	Upstream Sector	ONGC as main promotor and other PSUs	<ul style="list-style-type: none"> ▶ Industrial Welder ▶ Assistant Technician - Drilling ▶ Assistant Technician - Production ▶ Pipe Fitter - City Gas Distribution ▶ Retail Outlet Attendant
Skill Development Institute, Kochi	Overseas placement	Multiple stakeholders (PSU's, MoPNG, MSDE etc)	<ul style="list-style-type: none"> ▶ Fitter Fabrication ▶ Process ▶ Instrumentation ▶ Industrial Welder (Oil and Gas) ▶ Industrial Electrician (Oil and Gas)
Skill Development Institute, Guwahati	Northeastern Region	OIL and other PSUs	<ul style="list-style-type: none"> ▶ Industrial Welding ▶ Industrial Electrician
Skill Development Institute, Vizag	Downstream Sector	HPCL as main promotor and other PSUs	<ul style="list-style-type: none"> ▶ Retail Outlet Attendant ▶ Retail Outlet Supervisor ▶ LPG Delivery Personnel ▶ LPG Mechanic ▶ LPG Supervisor ▶ Industrial Electrician ▶ Industrial Welder ▶ Pipe Fitter ▶ Draughtsman - Mechanical ▶ Technician Instrumentation ▶ Assembly Operator - PLC ▶ HVAC Maintenance Supervisor/In-charge ▶ Warehouse Packer
Skill Development Institute, Rae Bareli	Midstream and Gas	GAIL as a main promotor and other Oil & Gas PSUs	<ul style="list-style-type: none"> ▶ Pipe fitter (City Gas Distribution) / Pipe fitter (oil and gas) ▶ Industrial welder ▶ Process Instrumentation Operator ▶ Industrial electrician ▶ Data entry operator

6.3.4 Training programs conducted by academic Institutes

While HSSC is working to expand the training infrastructure to conduct training at scale and speed for developing a pool of skilled youth for the hydrocarbon industry, there are a few academic institutes, whose infrastructure, faculty and other educational ecosystem components maybe leveraged for:

- ▶ Support in development of curriculum and training content
- ▶ Training of trainers
- ▶ Develop pool of master training
- ▶ Industry knowledge dissemination through guest lectures
- ▶ Infrastructure support

Some of these institutes are:

- ▶ **University of Petroleum and Energy Studies** - Was established in the year 2003 through UPES Act, 2003 of the State Legislature of Uttarakhand. It offers over 50 industry aligned courses in sectors such as: Oil and Gas, Power, Information Technology, Electronics, Infrastructure (Ports, Highways, Airports), Automobiles, Aviation, Logistics and Supply Chain.
- ▶ **Institute of Drilling Technology by ONGC** provides an opportunity to learn various state-of-the-art well control techniques through scrupulously designed Oil and Gas training courses. IDT has a wide range of courses to offer like rig courses, well courses, well control courses, rig crew courses, oil rig courses and many more which are instrumental in equipping the students with appropriate skills required for various phases of extraction and feasibility studies.
- ▶ **Indian Institute of Petroleum:** Training Programs conducted by Indian Institute of Petroleum: The institute provides a complete array of technical support and training services to the petroleum refining industry on a worldwide basis. Since inception IIP has trained more than 7000 personnel from India and abroad. These courses are customized in terms of technical contents and duration as per the need of client. The client's portfolio includes refining sector, power sector, automotive companies, Government departments, EPC companies etc.
- ▶ **Rajiv Gandhi Institute of Petroleum Technology:** The Government of India set up Rajiv Gandhi Institute of Petroleum Technology (RGIPT) under the governance of the Ministry of Petroleum and Natural Gas (MoPNG) and has been accorded the eminence of being an institute of national importance along the lines

of IITs. RGIPT is co-promoted as an energy domain specific institute by six leading Oil PSUs namely ONGC, IOCL, OIL, GAIL, BPCL and HPCL in association with the Oil Industry Development Board (OIDB). The institute is associated with leading international universities/ institutions specializing in the domain of energy management. The prime objective of the institute is to provide world-class education, training, and research to roll out efficient human resources to meet the growing requirements of the Petroleum and Energy sector.

- ▶ **Pandit Deendayal Petroleum University:** PDPU's School of Petroleum Technology offers B.Tech., M.Tech. and Ph.D. programs in Petroleum Engineering. It is academically engaged in creating a high-quality talent pool for the hydrocarbon sector across the entire value chain.
- ▶ **Petroserv Institute of Technology:** Institute with its focus on imparting training and education in the Oil and Gas sector in areas Oil and Gas production technology, Oil and Gas drilling technology and other training segments for oil rigging related jobs.
- ▶ **Rig Tech Oilfield Training Centre Pvt. Ltd.:** Rig Tech HSE and Oil field training center, Kochi was started with the intention to impart training to economically disadvantaged youth in HSE and Natural Oil and Gas sector. It offers short duration and certification courses in trades for exploration and production, drilling operations, roustabout, floorman operations, well testing jobs, heavy machine operations.
- ▶ **GAIL Institute of Skills (Guna and Nagaram) :** The training facilities set up by GAIL provide training across employment linked certificate courses such as AutoCAD, industrial electrician, pipe welding, instrumentation

technician to the employed youth for gainful placements in the oil and gas sector. To add to the aspirational value to learning, the Nagaram campus recently added new building housing state of the art training facilities.

- ▶ **Other colleges offering courses relevant to the sector are** - Indian School of Mines, Dhanbad, IIT Roorkee, IIT BHU, Andhra University, IIT Mumbai, IIT Kharagpur, Cochin University, Kurukshetra University, MIT Pune, Jadavpur University, Kolkata University

6.3.5 Leveraging industry's resources, technology and expertise for training of youth for oil and gas roles

Training for even entry level roles in the oil and gas sector would entail know how about complex processes, machinery and equipment and requires handling of flammable products and working in flammable environment. This necessitates that training provisions are made available at scale, speed and quality and an effective way to supplement training capacity creation is through leveraging the existing infrastructural facilities with the oil and gas companies.

- ▶ The premises of the oil and gas entities can be leveraged for training, industry exposure, on the job training etc. especially so for the niche job roles that need high capital investment for setting up the training infrastructure. This also provides a shorter gestation period to initiate the training, since the infrastructure set up time is curtailed substantially

- ▶ Training at industry premise also gives the trainees an opportunity to interact with the industry members, learn about latest industry practices, gain exposure to latest technology and enrich the learning process.
- ▶ Roles across the exploration and production, pipeline maintenance and refineries maybe taken up in blended training model, combining classroom led theoretical learning with direct industry led learning and training for practical learning.
- ▶ Industry onboarding adds value to the skilling process even at an overall level and some indicative avenues of leveraging the industry offering maybe: industry inputs to design training curriculum, enable hands on training (apprenticeships, teaching factory), expert interactions/guest lectures , training of trainers/instructor refresher modules etc.





7

Recommendations for Skill Development Initiatives in the Oil and Gas Sector

7 Recommendations for Skill Development Initiatives in the Oil and Gas Sector

7.1 Leveraging the existing long term and short-term training ecosystem for training youth for the Oil and Gas industry

Manpower demand for Oil and Gas sector is created across two categories:

- ▶ Skilling for manpower demand due to **construction works** in greenfield and brownfield projects
- ▶ Skilling for manpower demand due to **core operations and maintenance jobs** across upstream, midstream and downstream

For core Oil and Gas roles, mode of skilling will be impacted by the scale of manpower required for the activity

- ▶ Skilling for activities with low to medium/niche manpower demand
- ▶ Skilling for activities with large-scale manpower demand

Skilling strategy for large scale construction projects in the Oil and Gas sector

In the hydrocarbon sector, construction services are required for commissioning of refineries, petrochemical, pipeline commissioning projects gas gathering stations, crude oil and gas terminals and production structures, equipment, heavy lift, electrical and instrumentation works.

In the preceding sections, various greenfield and brownfield projects have been discussed with significant construction works involved for **midstream natural gas pipelines, key refinery projects, CGD network expansion, road transport, retail network expansion, large scale installations for exploration and production etc.**

Suggested skilling model

- ▶ Construction roles though do not form a part of the core oil and gas roles, accounts for over

80% of the manpower demand that a project entails.

- ▶ Given the scale of manpower required for a construction project, short term skilling courses under public funded schemes are well suited to leverage their capacity for training the manpower for upcoming projects.
- ▶ Also given the extensive network of short-term training centres and the coverage across the country, local youth can be trained at the centres close to oil and gas construction projects and subsequently absorbed into those projects.
- ▶ In addition, these centres and training courses require low capital investment that adds to the strength of this training ecosystem.

Skilling strategy for Oil and Gas roles with low to medium manpower demand / niche skills/technical knowledge

- ▶ In some segments of the Oil and Gas value chain, operations and maintenance of the Oil and Gas projects require a limited number of trained and skilled manpower with technical and safety knowledge about sector. For example, the technicians, operators, quality technicians, maintenance personnel etc need specific sectoral knowledge along with technical knowledge. For these roles, training at ITIs and SDIs are a suitable source of a talent pool.
- ▶ For instance, large scale refinery and pipelines projects can leverage the trainees from the ITIs. ITI trained graduates can be hired at the construction stage, trained and skilled on the job and then absorbed for operations.
- ▶ Industry and academia collaborations design effective hiring strategy leveraging ITI ecosystem and also provide an avenue of regional employment to the local youth.
- ▶ Some of the job roles are given below that maybe explored for training in the ITI and SDI

ecosystem to align with the demand for the industry.

- ▶ Some of the jobs roles below may entail niche training areas that warrant high end infrastructure. However, the volume of skilling

for these roles may not make the same commercially viable, hence machine learning tools such as AR/VR technology should be leveraged to make the learning experiential .

- ▶ The courses may range from short term courses to long term courses.

▶ GI Plumber (PNG/CGD)	▶ DGR guards	▶ Chemist/analyst
▶ Industrial Technician Electrician (Oil and Gas)	▶ Engineering assistant P &U electrical maintenance	▶ Operator - Hydrocarbon Pipeline
▶ Industrial Technician Mechanical (Oil and Gas)	▶ Engineering assistant Mechanical Maintenance	▶ P & U Operations Engineers
▶ Industrial Technician Instrumentation (Oil and Gas)	▶ Draftsman/CAD	▶ Operator - Hydrocarbon Pipeline
▶ Technician Chemical - Refinery	▶ SS Tubing Technician	▶ Technician- Mechanical
▶ Engineering Assistant Production	▶ Engineering assistant P&U Operations (BOE)	▶ SS Tubing Technician
▶ Feedstock Manager	▶ Mechanical Maintenance Engineer	▶ Draftsman - Civil
▶ Pipe Fitter-CGD (MDPE Fusion Welder)	▶ Engineering assistant Maintenance (Instrumentation)	▶ Draftsman - Electrical/Instrumentation
▶ Fire Safety Technician (Oil and Gas)	▶ Maintenance (Instrumentation) Engineer	▶ Draftsman - Mechanical
▶ Steel welder Helper	▶ P&U electrical maintenance Engineer	▶ Chemist/analyst

Key job roles across upstream segment can also be selected for training of youth in the ITI and SDI ecosystem to address the manpower requirement when a new production project/exploration yields to be commercially viable. Since demand for manpower in

upstream is subject to various preconditions pertaining to viability and commercial suitability analysis, it is recommended that periodic industry consultations are held to record the demand for such job roles.

Some high demand blue collared job roles from upstream are:

▶ Derrickman	▶ Pumpman	▶ Technician - Geophysicist
▶ Lead roughneck	▶ Junior pumpman	▶ Technician - Geologist
▶ Roughneck	▶ Heavy equipment mechanic	▶ Technician - Petrophysicist
▶ Platform roustabout	▶ Drilling technician	▶ Junior well completion technician
▶ Toolpusher	▶ Junior drilling technician	▶ Junior well testing technician
▶ Rig mechanic	▶ Driller	▶ Telecom/SCADA technician
▶ Scaffolder	▶ Assistant Driller	
▶ PSV mechanic	▶ Draftsman	



Skilling strategy for Oil and Gas roles with high manpower demand

- ▶ Certain job roles, specifically in the downstream segment for retail and marketing require large scale workforce such as marketing agents, store operations, RO dispensing agents etc.
- ▶ For these role short term training courses run under public schemes are suggested to train at scale and speed.

▶ Retail outlet Dispenser Operator -CNG	▶ Godown keeper
▶ Retail outlet Dispenser Operator - Petrol/diesel	▶ Driver - HCV/LCV
▶ Security Guard	▶ Driver - Bulk tanker truck
▶ LPG Delivery personnel	▶ Driver - Packed LPG
▶ Gas Attendant (Air Boys)	▶ Direct Marketing Agent
▶ Pollution Check Attendant	▶ Customer care Personnel
▶ Storekeeper- Oil and Gas	▶ Gas Meter Reader
▶ LPG Mechanic	
▶ Housekeeping Staff	

7.2 Recommendations - for skilling, reskilling and new training imperatives

Industry 4.0 in Oil and Gas sector

In a global survey across Oil and Gas companies, it was observed that companies realise the merits of the technology enabled transformation and are embracing decisions to encourage data integration and digital investments.¹¹⁹ Survey found 80% are investing at least a moderate amount in digital technology today, relative to their budget and are currently using and actively developing new use cases or improvements across a breadth of digital technologies.

Technical advancements using digital transformation: remote monitoring, AI, ML, augmented reality, 3D printing, digital twins are all part of the digital transformation bouquet in the Oil and Gas sector, with application across operations such as spill monitoring/flare monitoring of offshore/subsea/ assets, surveillance, inspections, predictive maintenance etc across pipelines, storage terminals, fleets, and other remote infrastructure. Other digital interventions: Mobile platforms/apps, Cloud computing, Robotic process

automation (RPA), Internet of Things (IoT), Chatbots, Edge computing, Next-gen enterprise resource planning (ERP), blockchain, autonomous transport etc.

The value framework of a digitally transformed Oil and Gas enterprise can encompass the following.

- ▶ Active use of big data analytics to assess data from oil fields to increase operational efficiency, boosting decision making with agility and accuracy.
- ▶ Use of mobile devices: Oil and Gas companies have invested heavily in fully integrating mobile devices into everyday operations.
 - ▶ The major benefits of this integration include workflow improvements from better group communication, increased worker productivity and better recording of field data. Mobile technology also allows for real-time data monitoring via specialized software on smartphones.

¹¹⁹ Ernst and Young (2020), Oil and Gas Digital Transformation and the Workforce Survey 2020.

- ▶ Deploying mobile applications in combination with radio-frequency identification tags is making assets smart and their movements visible.
- ▶ Capitalizing the benefits of industrial internet of things to optimize analysis of diverse sets of operational data across:
 - ▶ Drilling production and recovery: Identify suitable drilling parameters, capitalize cross-disciplinary data for building geological models during the exploration phase to enhance results and outcomes. Oil fields are dispersed, remote and unmanned, however a strong data driven foundation will enable to establish digital assets and provide for adequate safeguard measures.
 - ▶ Pipelines and terminals: enhance surveillance of transport and pipeline network by deploying data-enabled infrastructure, terminal automation, fleet tracking, leak detection system, corrosion management, intelligent pipelines.
- ▶ Refineries: OMCs benefit from digital initiatives such as Integrated Manufacturing Operations Management, Blend Performance Analytics, Energy Management Analytics, Remote Operation Centre, Yield/Quality Optimization etc.
- ▶ Retail and marketing: digital solutions for salesforce automation, cloud-based head office and back-office operations management, B2C/B2B pricing analytic, Digital Unified CRM (Retail) etc. increase the profitably and process integration across operations.

Skills for process automations and improved manufacturing processes in Oil and Gas sector

- ▶ Modern technologies, combined with digitization, can bring new skill sets and cost efficiencies to the Oil and Gas sector. For instance, modern technology has benefitted the refinery value chain in optimising refinery margin and efficiency, automated data collection systems for simulations, modelling and scheduling to reduce manual interventions.
- ▶ Technological advancements in retail, distribution and marketing segment have streamlined the distribution, transfer, or sale of petroleum and petroleum products from wholesale to retail to last mile delivery.

Relevant skills and job roles to support digital transformation and automation in the Oil and Gas sector

- ▶ Key job roles:
 - ▶ Remote visual inspection (Drone Operators/ Specialists)
 - ▶ Digital Solutions Specialist
 - ▶ Machine learning (ML)/ Deep learning (DL) engineer
 - ▶ Artificial Intelligence /ML/DL developer
 - ▶ Robotic process automation (RPA) solution developer
 - ▶ Data Steward
 - ▶ Computer Vision (AI) Solution Design Specialist
 - ▶ Automation Technicians
 - ▶ IT Administrators
- ▶ IT support roles to support and maintain automated equipment
- ▶ Instrumentation technologists to be able to carry out and maintenance of sensor enabled instruments
- ▶ In addition, as the industry increasingly integrates digital technologies across the value chain, the workforce will need to be skilled and upskilled across the following functional skills:
 - ▶ Wireless Communication
 - ▶ Technological literacy skills for field workers in a digital environment.
 - ▶ Digital engineering
 - ▶ Geospatial analytics
 - ▶ Robotic process automation (RPA)
 - ▶ Physical robotics



Skills to support OMC's focus areas pertaining to alternate energy/green economy, diversification and gas-based economy imperative

Renewable Energy

With the focus on renewable energy, OMCs are making efforts to diversify their operations into generating renewable or gas-based energy fuels.

- ▶ Job roles for renewable sector development across current Oil and Gas companies
 - ▶ Energy (specialist)
 - ▶ Energy auditor
 - ▶ Renewable energy: Electrical Engineer
 - ▶ Renewable energy: Electrical Technician
 - ▶ Renewable energy: Mechanical Engineer
 - ▶ Renewable energy: Mechanical Technician
- ▶ Further to pursuing clean energy objectives, oil PSUs are increasing their ethanol blending capacities by establishing bio refineries across

the country, with focus on locations such as Bathinda (Punjab), Panipat (Haryana), Bargarh (Odisha) and Numaligarh (Assam). While the major refinery job roles maybe common to conventional refineries, the skilling efforts need to be dynamic through constant engagement with the PSUs to ensure that any new job roles are identified as the companies diversify their refining business.

- ▶ This also holds true for the increased focus on blending of biodiesel and oil PSUs' efforts to increase their capacity to achieve so thereof.
- ▶ To this effect, some cross-cutting or hybrid green sector job roles will become increasingly more relevant for conventional hydrocarbon sector companies.

Electric vehicles and allied refuelling support at retail outlets

The Indian electric vehicle market is growing at a rapid pace. The Indian government's vision is electrification of all public transport and new cars by 2030. To realize this, the government will need to create new business models for electric vehicles to enable, battery swapping, charging infrastructure management and fleet management models.

In this regard, the existing retail outlets or standalone EV charging or battery swapping

facilities have to be provided with manpower to handle the EV related services. Key job roles in this regard would be **Charging attendant**.

The processes at the EV charging stations are largely expected to be autonomous or can be easily handled by the users, thus indicated lesser need for manpower at the retail outlets with EV charging facility or standalone EV charging infrastructure.

Liquified Natural Gas

Oil and Gas companies have laid the foundation stone to set up LNG fuelling stations along the country's highways, which is a first step towards eventually setting up 1,000 such outlets across the country over the next few years. It is expected that LNG supplies will provide fuel supplies to ten lakh vehicles by 2035. Regasified LNG is cheaper and cleaner than diesel as motor fuel.

- ▶ The job roles that will be relevant to support the upcoming LNG projects in this regard:
 - ▶ LNG dispenser operators for the Ros
 - ▶ Cryogenics Calibration Senior technician
 - ▶ Cryogenics Calibration technician
 - ▶ Cryogenic tanker truck operator

Compressed biogas

- ▶ Sustainable Alternative Towards Affordable Transportation (SATAT) was launched on 1st October 2018 aiming to establish an ecosystem for production of CBG and Bio manure from various waste/ biomass sources in the country.
 - ▶ SATAT has envisaged developing 5,000 CBG plants with total CBG production capacity of 15 million Metric Tonne Per Annum (MMTPA).
 - ▶ Compressed Bio-Gas plants are proposed to be set up mainly through independent entrepreneurs. CBG produced at these plants will be transported through cylinders to the fuel station networks of OMCs for marketing as a green transport fuel alternative.
 - ▶ The SATAT aims to set up 5,000 Compressed Bio-Gas plants across India in a phased manner, with 250 plants by the year 2020, 1,000 plants by 2022 and 5,000 plants by 2025, which will require a pool of manpower to support the operations.
- ▶ This is a labour-intensive segment that includes both skilled and unskilled roles for tasks involved in the collection of biomass, installation, operation, and maintenance of the biogas plants, production and procurement of biogas, conversion of biogas, and other operations¹²⁰.
 - ▶ CBG Plant designers/CBG plant site supervisor
 - ▶ CBG plant operations supervisor
 - ▶ CBG Plan procurement and value chain supervisor
 - ▶ CBG Plant operator (administration and operations)
 - ▶ Unskilled labour
 - ▶ Industry assessment reports suggest that over 2,00,000 skilled and unskilled manpower has the potential of being employed across these plant.

Ethanol production and blending

The government of India has rolled out the Ethanol Blended Petrol (EBP) Programme and aims to achieve a 20% ethanol blended petrol benchmark by 2025-26. To give shape to these efforts, the Government has launched the Roadmap for Ethanol Blending in India 2020-25, to provide the much-needed policy imperative to supply and procurement of ethanol to enable blending of the petrol for commercial uses.

Oil marketing companies, the PSUs especially, are making notable investments to enhance the blending infrastructure in India at their terminals and depots to meet the blending targets. The OMCs have also proposed to set up large scale commercial blending plants and units to augment the production of ethanol.

Key job roles that can be in focus for ethanol production and blending plants are:

- ▶ Microbiologists
- ▶ Industrial engineers
- ▶ Chemical & mechanical engineers
- ▶ Feedstock procurement manager
- ▶ Shift supervisor
- ▶ Ethanol plant operator / Distiller operator
- ▶ Clean room technicians
- ▶ Boiler attendant
- ▶ Operators/Fitters
- ▶ Pumpman
- ▶ Helpers

¹²⁰ Indian Biogas Association (2022). Accessed from <https://biogas-india.com/rural-employment-generation-through-biogas-production-in-villages-of-india/>

Recognition of prior learning: RPL¹²¹ efforts to certify the existing workforce

While large scale skilling manpower demand in the sector would need fresh skilling and scale and speed, certifying and validating the existing workforce is equally important.

Oil and Gas companies can undertake RPL programs for its existing employees and some of the job roles suitable for this are:

Job role	Estimated number of existing manpower that can be trained and certified under RPL
Retail outlet Dispenser Operator -CNG	~3,000 - 5,000 personnel working across 3000 CNG stations
Retail outlet Dispenser Operator - Petrol/diesel	More than 3,00,000 across the existing network of ~80,000 retail outlets
LPG Delivery Personnel	~2,00,000 across the existing network of LPG dealerships
Tank Lorry Driver	~20,000
HSSC can facilitate RPL certification for the construction manpower that is engaged through contractors for greenfield and brown field projects	
Gas Cutter, Assembly Operator, Structural Welder, Machinist, Electrician, Pipe welder, Fire Stewart, Driller, Rigger, Grinder, Blaster, Painter, Pipe Fitter, Wireman, Concrete and Excavation Worker, Roof Setter	

Reskilling, upskilling of the existing workforce

A survey across Oil and Gas companies revealed that 60 % of the workers needed to be reskilled/upskilled to maintain competitive advantage¹²².

- ▶ Oil and Gas companies are currently using and actively developing new use cases or improvements across a breadth of digital technologies. Such changes are going to be actively realised in the upstream segment with the use of industry 4.0 tools and methods.
- ▶ Reskilling of workers across job roles that may see an imminent phase out - The focus of upskilling and reskilling programs should aim at those occupations that run the threat of declining due to disruptive technology and economy transitions. The competency building efforts should either help them to grow in the

sector or empower them to access employment in other sectors. A few such jobs are given below.

- ▶ Testers, sorters, samplers and weighers
- ▶ Drilling and Boring Machine Tool Setters, Operators
- ▶ Electrical and Electronic Equipment Assemblers
- ▶ Data Entry Operator
- ▶ Cashiers/billing persons
- ▶ Industry-wide training and capacity building needs to be undertaken to foster technology-based competencies, creative problem-solving, and the ability to manage change to analyze data in real-time in the field, conduct course corrections and innovate.

¹²¹ Recognition of Prior Learning (RPL) largely refers to an assessment process used to evaluate a person's existing skill sets, knowledge and experience gained either by formal, non-formal or informal learning.

¹²² The 2020 EY Oil and Gas Digital Transformation and the Workforce survey (2021). Accessed from https://assets.ey.com/content/dam/ey-sites/ey-com/en_gl/topics/oil-and-gas/ey-oil-and-gas-digital-transformation-and-the-workforce-survey-2020.pdf

Apprenticeship model for training delivery in oil and gas sector

To promote apprenticeship/on the job training in India, Government of India, on 19th August 2016, launched the National Apprenticeship Promotion Scheme (NAPS). Under the current operational framework of NAPS, Ministry of Skill Development and Entrepreneurship anchors the program in the country. Under NAPS the OJT is carried out under two categories- Designation and Optional Trades ¹²³

The Directorate General of Training is nodal agency responsible for apprenticeship training in designated trades, while the National Skill Development Corporation along with the SSCs is responsible for apprenticeship training in Optional Trades

The optional trades are selected and recommended by the industry for inclusion in the apprenticeship program. The training curriculum under for the optional trades is designed prepared in consultation with the industry and

ensures that workplace level competencies and related training are adequately imparted to make the youth job ready.

The ITI trades under DGT have already been extensively introduced into the apprenticeship ecosystem through the National Apprenticeship Program Scheme (NAPS) under the designated trades. However, the optional trades should also be promoted for more active inclusion in NAPS given their alignment with the industry standards.

Given the technical nature of the skills and the aspects of health and safety that the jobs in the oil and gas entail, apprenticeship must be promoted to provide a dynamic learning environment to the youth. Optional trades for the oil and gas sector will be very critical as they supplement the technical know-how of the trainings with skills and competency for a real life working environment from a sector perspective.

¹²³ As per NAPS Operational Framework, designated and optional trades are defined as follows:

Designated Trade: means any trade or occupation or any subject field in engineering or non-engineering] or technology or any vocational course which the Central Government, after consultation with the Central Apprenticeship Council, may, by notification in the Official Gazette, specify as a Designated Trade

Optional Trade: means any trade or occupation not included in notified list of or any subject field in engineering or non-engineering or technology or any vocational course as may be determined by the employer lead to a competency work force (i.e. any trade or occupation not included in notified list of Designated Trades, in the field of manufacturing, services or trade, chosen by the employer under the apprenticeship programme to develop a set of workplace competencies in the Apprentice)



8 Abbreviations used

2D	Two Dimensional
AG&P	Atlantic, Gulf & Pacific Company of Manila, Inc.
ATF	Aviation Turbine Fuel
B2B	Business-To-Business
B2C	Business-To-Customer
BCM	Billion Cubic Metres
BOE	Boiler Operation Engineer
BORL	Bharat Oman Refinery Ltd
BPCL	Bharat Petroleum Corporation Ltd
CAD	Computer-Aided Design
CAGR	Compound Annual Growth Rate
CBG	Compressed Biogas
CGD	City Gas Distribution
CGDN	City Gas Distribution Network
CMB	Coalbed Methane
CNG	Compressed Natural Gas
COPA	Computer Operator and Programming Assistant
COVID	Corona Virus Disease
CPCL	Chennai Petroleum Corporation Ltd
Cr.	Crore
DBTL	Direct Benefit Transfer In LPG
DDD	Door To Door Delivery
DGH	Directorate General Of Hydrocarbons
DL	Deep Learning
DSF	Discovered Small Field Policy
E&P	Exploration And Production
EBP	Ethanol Blended Petrol
EOR/IOR	Enhanced Oil Recovery/Improved Oil Recovery
ER	Enhanced Recovery
EV	Electric Vehicle
FDI	Foreign Direct Investment
FIPI	Federation of Indian Petroleum Industry
FPSO	Floating Production Storage and Offloading
FSRU	Floating Regasification Storage Units
GAIL	Gas Authority of India Ltd.
GAIL(KLPL)	Gail (Konkan LNG Private Limited)
GIS-CAD	Geographical Information System - Computer-Aided Drafting
GMAW & GTAW	Gas Metal Arc Welding Gas Tungsten Arc Welding
GOI	Government Of India
GW	Gigawatt

HCV	Heavy Commercial Vehicles
HELP	Hydrocarbon Exploration Licensing Policy
HMEL	HPCL Mittal Energy Ltd
HPCL	Hindustan Petroleum Corporation Ltd
HS&E	Health Safety & Environment
HSD	High Speed Diesel
HSEPL	HPCL Shapoorji Energy Private Limited (
HUC	Hook-Up And Commissioning
IC	Internal Combustion
IDT	Institute Of Drilling Technology (ONGC)
IIoT	Industrial Internet of Things
IIP	Indian Institute of Petroleum
IIT	Indian Institute of Technology
IIT BHU	Indian Institute of Technology Banaras Hindu University
IIT Kharagpur	Indian Institute of Technology Kharagpur
IIT Mumbai	Indian Institute of Technology Mumbai
IIT Roorkee	Indian Institute of Technology Roorkee
ITI	Industrial Training Institute
KB/d	Thousand Barrels Per Day
kg	Kilogram
Kwh	Kilowatt-Hour
LCV	Light Commercial Vehicle
LDO	Light Diesel Oil
LKM	Lakh Kilometre
LNG	Liquefied Natural Gas
LNG	Liquefied Natureal Gas
LPG	Liquefied Petroleum Gas
MDPE	Medium Density Polyethylene
ML	Machine Learning
MMSCM	Million Metric Standard Cubic Meters.
MMT	Million Metric Ton
MMTPA	Million Metric Tonne Per Annum
MoPNG	Ministry Of Petroleum and Natural Gas
MRPL	Mangalore Refinery and Petrochemicals Ltd
NCVT	National Council for Vocational Training
NDR	National Data Repository
NEL	Nayara Energy Limited
NOC	National Oil Companies
NRL	Numaligarh Refinery Ltd
NSQF	National Skills Qualification Framework
O&M	Operations And Maintenance

O+OEG	Oil And Oil Equivalent of Gas
OALP	Open Acreage License Policy
OFSE	Emergence Of Oil Field Services and Equipment
OIDB	Oil Industry Development Board
OIL	Oil India Ltd
OIM	Offshore Installations Manager
OMC	Oil Marketing Companies
ONGC	Oil And Natural Gas Corporation
OPEC	Organization of the Petroleum Exporting Countries
P&U	Power & Utilities
PDPUI	Pandit Deendayal Petroleum University
PIB	Press Information Bureau
PNG	Petroleum Natural Gas
PNGRB	Petroleum And Natural Gas Regulatory Board.
PPAC	Petroleum Planning & Analysis Cell
PSU	Public Sector Undertakings
PSV	Public Service Vehicle
QA/QC	Quality Assurance/ Quality Check
RGIPT	Rajiv Gandhi Institute of Petroleum Technology
RIL	Reliance India Limited
RO	Retail Outlets
RPA	Remotely Piloted Aircraft
RPL	Recognition Of Prior Learning
SATAT	Sustainable Alternative Towards Affordable Transportation
SCADA	Supervisory Control and Data Acquisition
SDI	Skill Development Institute
SKO	Superior Kerosene Oil
SME	Subject Matter Expert
STT	Short Term Training
TFS	Total Final Consumption Energy Supply
TMT	Thousand Metric Tonnes
toe	Ton Of Oil Equivalent
TPES	Total Primary Energy Supply



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