EFFECT OF GLOBAL INVESTMENTS / MERGING INTO INDIAN PETROLEUM INDUSTRY

BY

MAHESH H. THAKUR

SAP ID : 500066419

GUIDED BY

PANKAJ V. SHET, MANAGER

PETRONET LNG LIMITED

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Signature 

Name of the Student : Mahesh H. Thakur

Residential Address : B-205, New Shree CHS, Sector-8,
Khanda colony, New Panvel (W)-410206

Telephone/Mobile : 8291446143

e-mail: : thakurmahesh05@gmail.com

Date : 28/01/2020

Place : Mumbai

PETRONET LIMITED

Petronet LNG Limited
Survey No. 347, Puthuvypu P.O.
Kochi - 682 508, India.
Tel: +91-484-2502259 Fax: +91-484-2502264
www.petronetlng.com
CIN L74899DL1998PLC093073
PAN: AAACP8148D. GST: 32AAACP8148D1ZP

Date-

Declaration by the Guide

This is to certify that **Mr. Mahesh Thakur**, a student of (**MBA Oil and Gas**), **SAP ID 500066419** of UPES has successfully completed this dissertation report on "**Effect of global investments/merging into Indian Petroleum industry**" under my supervision.

Further, I certify that the work is based on the investigation made, data collected and analysed by him and it has not been submitted in any other university or Institution for award of any degree. In my opinion it is fully adequate, in scope and utility, as a dissertation towards partial fulfilment for the award of Degree of MBA.

Signature

P.V. Shet

Name & Designation- Pankaj Vishnudas Shet (Manager-Operations),

Address- Kochi

Mobile- 8592036888

Email- pankajshet29@yahoo.co.in

Date-

Place - Kochi

Table of Contents

Executive summary/Abstract

Energy is a key driver of economic growth. Efficient, reliable and affordable energy is essential for the sustainable development and inclusive growth of the overall economy of India.

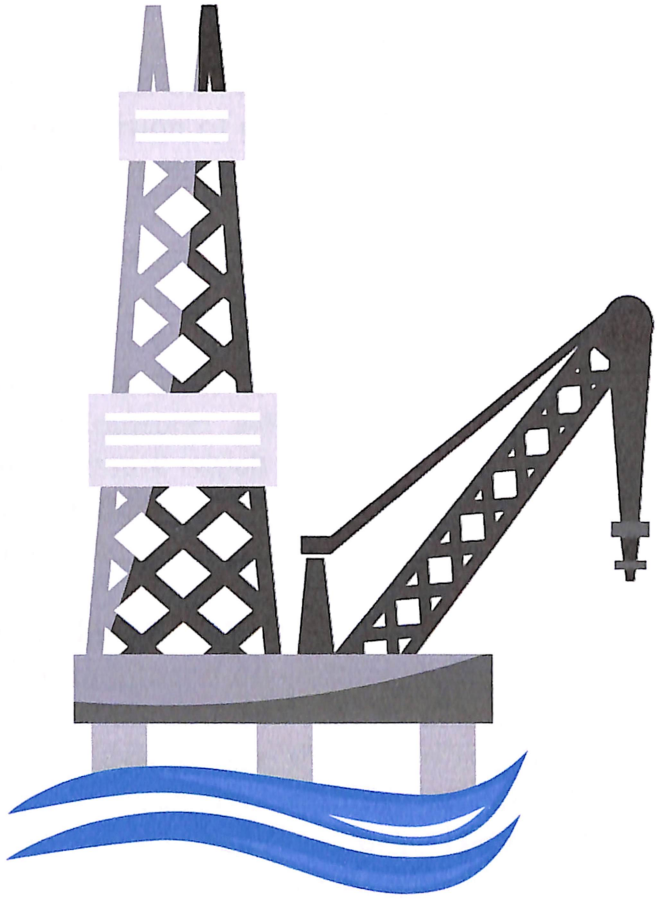
India is at present the fastest growing large economy of the world. The growth in GDP was at 7.6% during 2015-16 and 7.1% and 7.3% in the Q1 and Q2 of 2016-17 respectively. Due to rapid economic expansion, India has become world's fastest growing energy market.

India surpassed Russia to become the 3rd largest energy consumer in the world after China and USA during 2015. Oil & gas accounted for around 35 percent share in India's energy consumption. In fact, India surpassed Japan to become 3rd largest oil consumer in the world after US and China during 2015.

Given India's growing energy demands, reliance on imports and limited domestic fossil fuel resources, the country has ambitious plans to increase domestic oil & gas production and exploit all possible forms of the energy to the fullest.

Hon'ble Prime Minister has urged all stakeholders to increase the domestic production of Oil and Gas to reduce import dependence from 77 % to 67% by the year 2022.

Chapter 1



Effect of Global Investments / Merging into Indian petroleum industry

Introduction

This dissertation is about the Effect of Global Investments/ Merging into Indian Petroleum Industry. But this industry is extremely open; trade flows are large compared to production. And there is considerable overlap between oil production and refining internationally, and to some extent in India. So we begin with a brief discussion of the international petroleum industry and its components – refining being one of them.

Petroleum is extracted from underground reserves; then it is cracked or "refined" into end products for various uses. The petroleum industry thus has two parts: an oil exploration and production industry upstream and a refinery industry downstream. Most oil producers also own refineries. But the reverse is not true; a high proportion of oil is sold to refinery companies that do not produce crude oil. Sedimentary rocks in which hydrocarbons are trapped often hold gas, sometimes in association with crude oil and sometimes alone. It consists mostly of methane, which is lighter than air and toxic. It therefore requires airtight tanks for storage and similarly leak-proof pipes or trucks for transport, which raise its capital costs. Associated gas was flared in early years of the industry; it is still flared at remote or minor wells where the cost of its collection and transport would be high, or often reinjected into the oilfield to maintain pressure which forces oil up to the surface. But where the quantities are large enough, natural gas is mined and traded. It is mainly used as an industrial, domestic and vehicular fuel.

Motor vehicles run almost exclusively on petrol and high-speed diesel oil, both fuels derived from mineral oil – although they can be modified to run on certain biofuels. Vehicles are so widely dispersed that they require an extensive distribution system for these two refinery products. As motor vehicle use has spread across the world, it has brought along with it petrol pumps, logistics, storage and supply of fuels. There is thus a third part of the petroleum industry downstream from refineries which distributes the products. It is owned by refineries in most countries. But this is not inevitable. Some countries have distribution chains that are independent of producers and refiners; and in countries which do not have refineries, distribution is undertaken by either local or foreign oil companies.

Oil has collected in pools and seeps for thousands of years. The Chinese are recorded as having extracted oil from wells 800 feet deep through bamboo pipes in 347; they used it to evaporate brine and make salt. American Indians used to put it to medicinal uses. Persians, Macedonians and Egyptians used tars to waterproof ships. Babylonians used asphalt in the eighth century to construct the city's walls, towers and roads. But the easily available oil was not put to any mass use because the crude itself was not a good fuel; it gave

out much soot and smoke. A distillation process using a retort was invented by Rhazes (Muhammad ibn Zakariya Razi) in Persia in the 9th century; liquid heated in it vaporized, passed through a curved spout and condensed in another container. The process could be used to make kerosene; but it was more often used to make alcohol and essence of flowers for perfume. It was a batch process, its fuel consumption was high, and it was not equally efficient at distilling kerosene from all crudes.

A more efficient and reliable distillation process came out of a series of inventions after 1846. The last invention was the invention of oil fractionation in 1854 by Benjamin Silliman, a professor of science in Yale. It used a vertical column which separated components more efficiently, and which could be used continuously. Oil was first produced in Titusville, Pennsylvania (USA) in 1859 by one Edwin L Drake, who refined it into kerosene, which was then used as an illuminant. Electricity did not emerge as an illuminant till the Edison Electric Light Company was founded in 1878. Well into the 20th century, kerosene, gas and electricity continued to compete as illuminants. Whilst the use of gas as an illuminant has virtually disappeared, a large population, especially in India, continues to use kerosene as illuminant.

The invention of the motor car by Karl Friedrich Benz in 1885 created a market for petrol, a new refined product (petrol is called Benzin in Germany, but is not named after Karl Benz). In 1898, Rudolf Diesel invented an engine in which oil was ignited by compression; the diesel engine he invented came to power larger vehicles, principally trucks and buses. Diesel engines used a different fuel, which was named diesel oil. After this, the production and use of motor vehicles spread rapidly in the United States, especially after 1908 when Henry Ford began mass manufacture of his Model T; and petroleum and diesel oil became the most important refined products, first in the US and progressively across the world.

However, only a certain proportion of crude oil can be converted into motor fuels. The demand for kerosene, the original distillate extracted from crude oil, has gone down with the spread of electricity. So other refined products have been developed, and non-vehicular uses developed for them. Some of the products differ little from motor fuels; for instance, naphtha, extensively used to make nitrogenous fertilizers and chemicals, is little different from petrol; and jet fuel is very similar to kerosene. Thus, refineries find markets for their products in many industries other than motor transport.

Overview

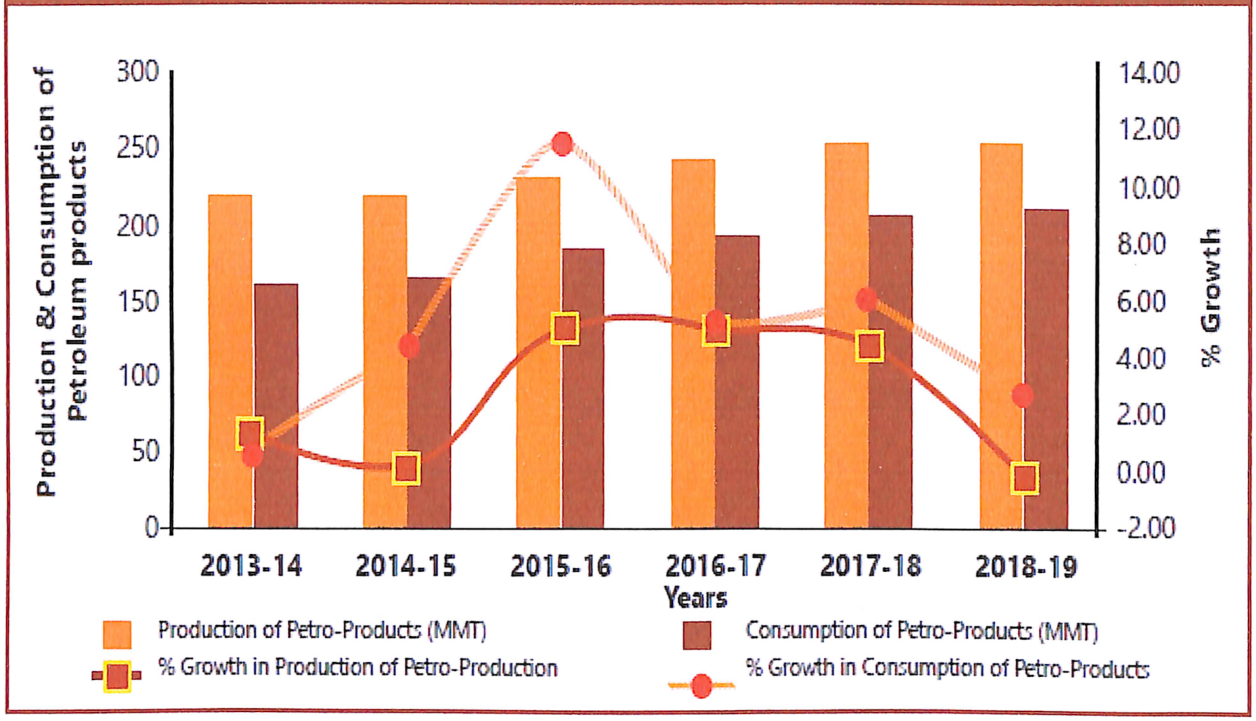
Refinery Technology and Products

This section provides a brief overview of the technology and production process. An understanding of these issues is critical as it helps understand industry structure.

Crude oil is a liquid mixture of hydrocarbons – chemical compounds consisting roughly of six parts of carbon and one of hydrogen, both of which are fuels; it generally also carries small quantities of Sulphur, salts, metals, oxygen and nitrogen. It was formed from organic remains accumulated undersea and eventually trapped in sedimentary rocks; these rocks are where crude oil exploration is concentrated. Generally the oil is compressed, and gushes out if a pipe is pushed into an oil-bearing trap. But as it is extracted, the pressure diminishes, and it is often artificially reinforced by injection of air or water into the reservoir to push up the oil.

Crude oil contains hydrocarbons that vary in their boiling point; refining is a process in which crude oil is heated in a vacuum until it evaporates and then allowed to rise up a column. Different hydrocarbons liquefy at different temperatures and can be collected at various heights in the distillation column. In the basic refinery process, crude is heated to 600°C by injection of superheated steam and pumped in at the bottom of a vertical distillation column. As the vapour rises up the column, it cools. The column has trays at various heights with holes. As the vapour cools, fractions with different boiling points liquefy, collect in the trays and are drained off; products with high boiling points rise to the top, while products with low boiling points collect on lower trays. The principal products, with their approximate boiling points, are petroleum gas (20°C), naphtha (40°C), petrol (70°C), kerosene and jet fuel (120°C), diesel (200°C), lubricant (300°C), and furnace oil (370°C); solid petroleum coke collects at the bottom after the liquid fractions are removed.
The proportions in which these products come out vary to an extent with the crude; crudes are classified as light or heavy according to the proportion of light products. But the balance of demand and supply for the products is such that the prices of furnace oil are much lower than those of light products such as petrol, kerosene and diesel oil. In August 2008, international prices of residual fuel oil ranged from $2.29 to $2.48 a gallon; the corresponding range was $2.68-3.05 for petrol, $3.06-$3.29 for diesel oil, and $3.18-$3.38 for jet fuel. So other technologies are employed to crack, alter or recombine molecules and make lighter hydrocarbons from residual fuel oil.

GRAPH 1.3 : PRODUCTION AND CONSUMPTION (INDIGENOUS SALES) OF PETROLEUM PRODUCTS



The principal products obtained from the primary refining and cracking processes are **(see Appendix - table for product-wise production and consumption)**:

- **Liquefied petroleum gas** (LPG), mostly a combination of butane and propane. It is heavier than air, and liquefies under pressure. It is used as a household cooking fuel, refrigerant, and vehicular fuel; 4 million vehicles are estimated to be powered by LPG in the world.

- **Petrol** is used to fuel internal combustion engines, mainly vehicular. Its early use as a killer of lice and their eggs has completely disappeared.

- **Naphtha** is used to make additives for high-octane petrol, and to make polymeric plastics and urea, a nitrogenous fertilizer.

- **Aviation turbine fuel** (ATF) is the fuel used in propeller planes. It is akin to petrol.

- **Kerosene**, also known as paraffin, is used as an illuminant and cooking fuel in India and other poor countries, and as a space heating fuel in industrial countries.

- **Jet fuel**, used in jet planes, is closely akin to kerosene.

- **High-speed diesel oil** is used in engines running at 750 revolutions per minute (rpm) or more. It is mostly used in diesel-powered vehicles

- **Light diesel oil** is used in diesel engines running at lower speed – mainly irrigation pumps and generation sets.

- **Furnace oil** is made by diluting residual fuel oil from refining with middle distillates such as diesel oil. It is used in boilers, bunkers, heaters, furnaces, or as fertilizer feedstock. Low-Sulphur heavy stock (LSHS) is a variant of furnace oil.

- **Lubricating oil** consists of greases and viscous oils used to lubricate moving parts in industry, automobiles, railway engines and carriages and marine engines.

- **Paraffin wax** is used as an electrical insulator, for heat storage and in thermostats.

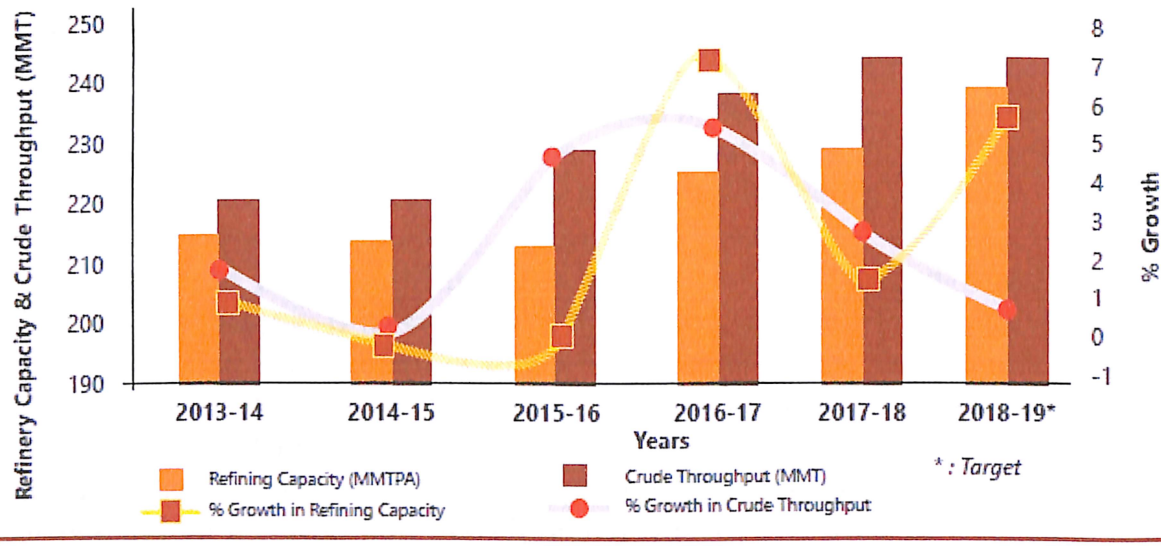
- **Asphalt** is a black thermoplastic product that is used to make roads and sometimes for waterproofing. It is similar to tar, which is made from coal. Asphalt is also found in natural form; it was used to waterproof Egyptian mummies.

- **Petroleum coke** is mostly used as fuel, but is also used to make electrodes and dry cell batteries.

Some petrochemicals are produced in large enough bulk to take a significant

proportion of refinery products: the world consumed 345 million tons of hydrocarbons in 2004 to make 310 million tons of petrochemicals. Most of the hydrocarbons are first turned into one of three intermediates - ethylene, propylene and aromatics – before being converted to other products. Of the latter, plastics accounted for 225 million tons, and fibers for 38 million tons; solvents, detergents and synthetic rubber accounted for most of the rest.

GRAPH 1.2 : REFINERY CAPACITY AND REFINERY CRUDE THROUGHPUT



Background

Global Oil Industry

In the early years of the industry, oil or gas seeped out of the earth in many places; elsewhere it was discovered by accident while drilling for water. But such easy discoveries are long gone. Undiscovered oil is all underground, and oil exploration today uses considerable instrumentation

– gravimeters, magnetometers, seismic reflectors and refractors – and stratigraphy, which is essentially correlation of available geological data. The data obtained are correlated to guess the location of rock formations and identify those that are most likely to contain hydrocarbons. Then rigs are used to drill into those formations. Drilling costs much more than geological tests; so oil companies invest heavily in geological investigation.

Oil production requires drilling a well into land or seabed. Land usually belongs to someone; if it is not privately owned, it belongs to the government. Similarly, maritime countries claim ownership of the continental shelves along their coastlines. If someone wants to explore for oil, he has to get permission to drill. If he finds oil, he will normally want first right of exploitation. So it is normal for explorers to make an agreement with the owner, called a concession, which lays down the rights of the concessionaire and the payments he would make for them. In the early years, when oil developments were small, it was generally enough to get a concession from a private owner or a number of neighbors. In the US, there were large unoccupied areas where companies could drill without anybody's permission.

But as oil is came to be extracted from deeper formations, investment went up, and exploration passed into the hands of companies which could raise capital. Also, a large area of concession became necessary to avoid disputes with neighboring concessionaires. Such large areas required the intervention of governments. In the early concessions, governments played the role of landlords, and generally levied a royalty per barrel of oil extracted. For instance, the Shah of Persia gave a concession in 1901 to William D'Arcy, a rich Englishman, to prospect for oil in most of Iran for 60 years, for which he was promised £20,000 in cash, £20,000 in shares of the oil company and 16 per cent of profits. Standard Oil of California negotiated a concession with the King of Saudi Arabia in 1933.

Purpose of the Study

Crude oil prices played a critical role in substantially reducing economic growth in any economy whether it is developed or developing economy. Worldwide demand for crude oil arises from demand for the refined products that are made from crude; and changes in crude oil prices are passed on to consumers in the prices of the final petroleum products. When the prices of petroleum products increase, consumers use more of their income to pay for oil-derived products, and their spending on other goods and services declines. The extra amount spent on those products is basically go to foreign oil producers as India is net importer of oil. Higher oil prices cause, to varying degrees, increases in other energy prices.

Depending on the ability to substitute other energy sources for crude the price increases can be large and can cause macroeconomic effects similar to the effects of oil price increases. Thus, though energy is the prime mover in an economy, the demand and supply gap of crude oil must be bridged through import to meet the country's requirement, hence, crude oil price is an important parameter in determining reserve position and trade balance and finally balance of payment. Inflation is also an important area arising with the increase of crude oil prices, with the increase of inflation, capacity to purchase is reduced and expenditure increases, saving decreases, ultimately slows down the business and economic activities thus slows down GDP growth.

An examination of the price determination and factors contributing towards shaping crude oil prices revealed a significant correlation among the variables. In case of developed and developing countries crude oil compliment gold prices, Index, silver prices, GDP, imports, exports, equity stocks of oil producing companies and their futures. It is also observed that, crude oil has indirect correlation with inflation, CPI and interest rate. It was also observed that, the crude oil prices are negatively affecting equity shares and futures of non-oil producing companies. The studies also revealed that, economic growth in case of developing countries affected crude oil prices. This may be due to the fact that, during the developmental phases the consumption of crude oil increases, which further result in increase in crude oil prices. Using Johansen model by various researchers it was noteworthy that, there existed a long term relationship between crude oil, exchange rate, gold and capital market determinants. The studies (Kilian, 2009) unearthed the fact that oil

extracting countries has a less impact on price changes on the basis of macroeconomic variables than oil importing countries. The studies also provided a linkage of crude oil with money market instruments like T- Bills and Euro rate and it was seen that, there was a long term impact and relationship among these variables (Basher, etal, 2010). Few researches focused on the contribution of crude oil prices affecting stock prices future cash flows of the listed companies and concluded that, there were instances that, these changes affect the investment pattern of investors at large. This provokes banks to raise interest rates and further financial innovations were carried to cater to these revisions and there was push strategy in capital market. Finally, it was observed that crude oil prices increases cost of production, reduces profits of companies and their stock and futures prices which leads a positive shocks and spillover in almost all the studied macroeconomic variables.

The government also wanted a number of things.

1. It wanted Standard Vacuum to set up a local subsidiary to build and run the refiner. Standard Vacuum was against it for three reasons: (1) The subsidiary would be subject to income tax; (2) it would have to pay sales tax on whatever refined products it sold to the distribution company; and (3) if the government placed controls on dividend payments, the subsidiary would be subjected to them. But eventually it did agree to set up a subsidiary. The government wanted the local subsidiary to issue shares to local shareholders; it issued a quarter of its capital of $6 million to them in preference shares. The other two companies issued non-voting shares to local shareholders.

2. Should India discover oil, the government wanted the Company to promise to use it in preference to imports. The company agreed; price was unspecified.

3. The government reserved the right to impose and vary excise duties, but promised to maintain the existing differentials between excise and import duties. In other words, if it imposed or increased an excise duty, it would increase import duty by at least that much.

4. The government wanted the company to train and employ Indians.

5. The government had agreed at independence to continue pooling dollars with the Commonwealth; at the same time, the British government owed it a large debt, termed sterling reserves, for supplies during the War. So it wanted Standard Vacuum to buy crude and other importable from the Sterling Area as far as possible. The company agreed, since AIOC, the company that produced oil in Iran and Kuwait, was British and would accept Pounds.

6. In the event of the government acquiring tankers, it wanted the company to use them in preference to other tankers. The company agreed, subject to the use of its own tankers and prior contractual commitments.

7. The government wanted the company to give priority to local purchases over imports; the company agreed. The negotiations continued for three years, but no agreement emerged. The oil companies prevaricated. The government suspected that the oil companies were happy with the import of refined products from Abadan refinery, which they sold in India at certain and high profits. But after Iran nationalized the Abadan refinery in May 1951, India looked a safer country to operate.

In November, Standard Vacuum signed an agreement with the government to set up a refinery. Burmah Shell and Caltex followed in the next two years. Esso's 25,000 bpd refinery was inaugurated in Bombay in 1954, Burmah Oil Company's 30,000 bpd refinery went on-stream in Bombay in 1955, and Caltex's 10,000 bpd refinery went up in Vizagapatam in 1957.

The government was frustrated with the experience of negotiations with the three oil companies. In the 1950s, the government took a number of steps to reduce dependence on foreign oil companies. In 1956, it set up Oil and Natural Gas Commission to explore for oil, and brought in Soviet and Rumanian rigs and crews to prospect for oil. The two areas chosen were the Cambay area in Gujarat and the Jawalapuri-Janaur area in what is now Himachal Pradesh. The Soviet crew considered Gujarat more promising, and

drilled there first. The first well was spudded on 25 July 1958; on 24 September it struck oil under 150 atm pressure at 7000 feet. Further exploratory drilling led to the discovery of Ankleshwar and Kalol oilfields in 1960, and suggested that the oil- bearing strata extended offshore to what came to be known as Bombay High. Oil from this area was the foundation of ONGC's emergence as an oil producer. Gas too was found in and off Gujarat, both associated and non-associated.

In 1984, the government separated ONGC's gas business and gave it to a separate subsidiary, Gas Authority of India Limited (GAIL). GAIL built a pipeline from Hazira on the Gujarat coast to Delhi, and supplied gas to government-owned power stations and fertilizer plants on the way. It also set up joint ventures with government oil companies and state governments to supply gas to Bombay and Delhi for transport and domestic fuel, and to Andhra Pradesh for transport. In 1987 it set up Petronet, a joint venture with three other government oil companies, to import LNG from Qatar. Pricing and distribution of public sector gas are entirely decided by the government; there is no element of market in this area.

The Soviet surveys had shown the oil-bearing structures of Gujarat extending into the sea in 1964-67, but the Soviets did not have the technology for offshore exploration or production. In 1974, a Japanese survey ship leased by ONGC discovered the prolific Bombay High offshore field. It has been the mainstay of ONGC's business since then.

Once oil was discovered in Gujarat, the government had to think about how to exploit it. In 1958, it set up Indian Refineries to set up refineries. In 1959, it set up Indian Oil Company to undertake distribution. The two were later merged into Indian Oil Corporation. IOC was given a monopoly of imports of refinery products; with that, it soon overtook the three foreign companies in distribution. Thus the foundations of the government-owned oil industry were in place by 1961.

A 2mtpa refinery to process Gujarat crude was built with Soviet help in Koyali, Gujarat in 1966. But Gujarat crude could not meet the growing national demand. So in the 1960s, the government took to building coastal refineries in joint ventures with foreign companies. The 2.5 mtpa Cochin refinery came up in 1966 with investment from Phillips Petroleum, the 2.5 mtpa Madras refinery went on-stream in 1969 with participation from

AMOCO and National Iranian Oil Company, and the lubricants plant of Lubrizol India came up in Bombay in 1969 with participation of Esso.

In 1960, US President Dwight Eisenhower introduced oil import quotas favouring Mexico and Canada and discriminating against Middle Eastern producers and Venezuela. This upset the latter. In September 1960, Iraq, Iran, Saudi Arabia, Kuwait and Venezuela got together to "coordinate" policies and formed the Organization of Petroleum Exporting Countries. The organization was just a talking club for ten years. But in 1970, OPEC resolved to raise its members' share of oil revenue to 55 per cent, and began negotiations with oil companies to effect the increase. There followed a spate of measures by which Middle Eastern oil producing countries nationalized or imposed revenue shares on oil producing companies, or cancelled concessions. Oil concessions were nationalized by Algeria in 1971, Iraq in 1972 and Kuwait in 1976-77. Libya nationalized a number of oilfields held by foreign companies between 1971 and 1976, and took an 85 per cent share onshore and an 81 per cent share in the oilfields of others.

(Iran had nationalized the British-owned Anglo-Iranian Oil Company in March 1951.) The Saudi King threatened Arabian American Oil Company (Aramco) with nationalization with 1950 and got a half-share in profits. He acquired a 25 per cent share in Aramco in 1973, increased it to 60 per cent in 1974, and took full ownership of the company in 1980. Kuwait nationalized its oil industry in 1975, Bahrain took a majority share in its concessionaire oil company in 1980.
After the 1967 war between Israel and Palestine, Arab members of OPEC formed Organization of Arab Petroleum Exporting Countries. Israel defeated Egypt and Syria in the Yom Kippur war in 1973. Enraged, OPEC raised the price of its crude from $3 to $12 a barrel, and made it effective by cutting supply. After this, oil producing countries realized that they could raise their revenue by raising the price of their crude. So they started increasing prices without coordination.

While the nationalizations of the 1970s did not immediately disrupt the relationships between oil producing countries and their licensee foreign companies, they introduced extreme uncertainty in the companies' business environment. Their attempts to cope with this uncertainty changed the world oil industry in three major ways.

1. The companies began to explore for oil in more difficult environments

such as the North Sea, Gulf of Mexico, and the Caspian Sea. Exploration in these fields was more expensive. So smaller companies failed or were bought up; the industry got more concentrated.

2. The governments of the US and Britain did not control oil produced in their jurisdictions in the way the Middle Eastern oil producers did. So oil produced in Texas, Gulf of Mexico and the North Sea began to be traded on commodity markets. For the first time, an open market in crude emerged. Quotations for crude such as Brent

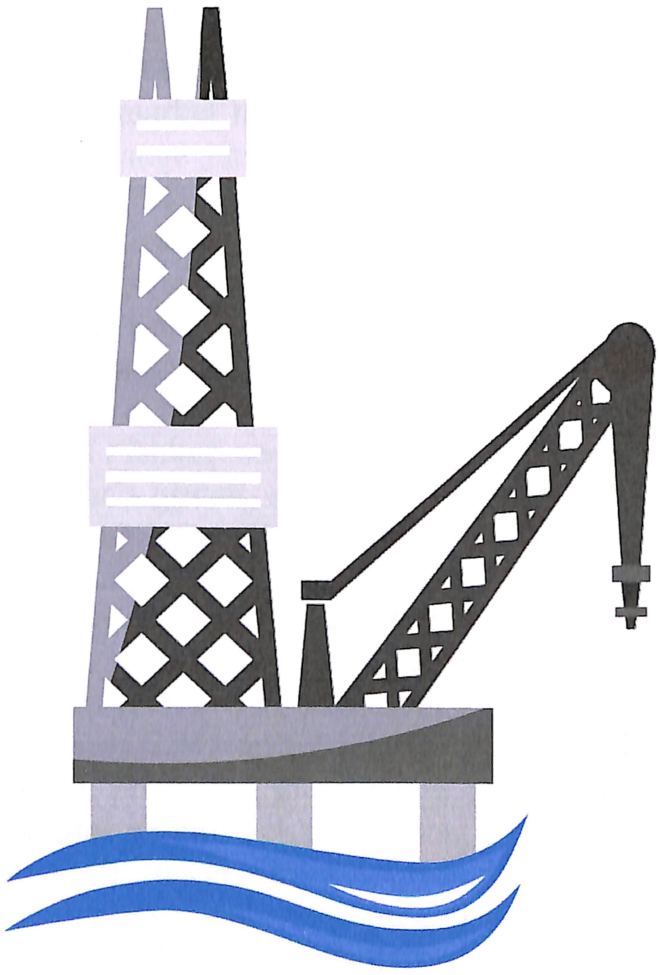
3. Till the 1970s, refineries were tailored to a single crude source, and generally produced a limited set of products. The uncertainty of crude supply led refiners to design or modify refineries to take a broader variety of crudes and make a greater range of products. Not all refineries did; refineries are quite durable, and many refineries remained unchanged. Many closed down. But catalytic cracking technology developed to make refining more flexible.

As oil producing countries increased their share of profits and oil at the expense of foreign oil companies, the oil supplies they controlled went up and those of oil companies went down. In the circumstances, the main reason for having foreign oil companies operate refineries in India – namely, their access to crude – disappeared. In 1976, India nationalized the three refineries owned by Shell, Caltex and Esso. In 1981, the government bought out Burmah Oil's 50 per cent stake in Assam Oil Company. With the nationalizations, the entire Indian oil industry passed into government hands, and came to be run as a part of the government.

In 1977, the government introduced an Administered Price Mechanism, to be operated by an Oil Coordinating Committee. The ministry of petroleum fixed so-called retention prices designed to give oil producers 15 per cent and refiners 12 per cent on their net worth. And it set administered prices at which products were sold to consumers. The difference between the revenue and dues of an oil company went its account with OCC. So overall, the price level was cost-plus; but the government could cross-subsidize individual products at will.

It was the oil companies' practice to construct their own petrol pumps and give them to dealers to run. Under the private companies, dealerships were given to trusted associates, and they became a part of the companies. After nationalization, the government decided to set up a fairer system. In 1983 it set up four Oil Selection Boards; each board had a retired judge and one other member. Oil pumps made good profits with little investment on the part of the dealer and at low risk. So many more people wanted pumps than could get them, and recommendations and corruption were rampant in their allocation. In January 1996, a PIL led to a court enquiry, which revealed that the personal assistant of Satish Sharma, the petroleum minister, got oil companies to give pumps to relatives and friends of politicians, and charged others money. The same scandal continued under the ensuing BJP government, and blew up in 2002; Prime Minister Vajpayee cancelled all the 3850 allotments made in the previous two years. There has been no public scandal since then, but that does not necessarily mean that the system works any better now.

Chapter 2



Review of literature

Literature Review

Snapshot of Indian Economy:

With a GDP growth rate of 6.8% in FY'19, as per the Central Statistics Office (CSO), India remained the fastest growing major economy, on an annualised basis, ahead of China. However, GDP growth rate recorded in FY'19 is the lowest in the last 5 years (since FY'15), and Q4FY'19 growth at 5.8% paints an outlook for the economy that is more sobering than bullish. Despite a slowdown, most estimates still project a return to stronger growth in FY'20 as the domestic market has recalibrated to the new normal in a post-GST and currency-exchange environment. However, the numbers clearly outline the need to consistently stay on the path of economic reforms and measures that are geared to kick start private investment and industrial activity. An industry analysis showed all sectors except manufacturing, construction, and financial, real estate and professional services to experience slowdown during the fiscal. The growth in the 'Manufacturing' sector is estimated at 6.9% as against previous year's growth rate of 5.9%. On the other hand, the 'Agriculture, Forestry and Fishing' sector has shown a growth rate of 2.9 percent as against previous year's growth rate of 5.0 per cent. Exports recorded an unexpected spurt in late FY'19, pulling up overall growth for FY'19 to 8.6%, which was close to the import growth of 9%. There was good news on the inflation front as well – Consumer Price Index (CPI) inflation was 3.4%, down from 3.6% in fiscal 2018, making it the second consecutive year when inflation has remained within the RBI's medium term target of 4.0%. The IMF projects a growth rate of 7.3% and 7.5% in FY'20 and FY'21 respectively while the World Bank projects a growth rate of 7.5% during both the years. Growth largely comes on the back of upswing in consumption and investment growth. Further, GST harmonization, recapitalization of banks, an aggressive sovereign policy focus on stressed assets and an effective and prompt bankruptcy resolution mechanism are also expected to a lend a positive dimension to the economy's overall growth outlook while providing a robust underpinning to its structural framework.

Policymakers must still keep a keen watch on the issue of currency volatility, crude price swings and the proportion of non-performing assets on the books of major banks as any negative development on any of these counts could adversely affect the country's growth narrative. Among these, high crude prices have historically been a source of risk for the sovereign exchequer

because of our strong dependence on oil imports. The domestic crude basket averaged USD69.67/bbl. in FY'19, compared to USD56.53/bbl. during FY'18. Forex outgo on account of oil imports for FY'19 stood at USD112 bn, the highest in the last 4 years.

Global Energy Snapshot

Global Energy Basket

As per BP Statistical Review of World Energy 2019, Energy demand grew by an impressive 2.9% in 2017, the fastest since 2010 even as calls for limiting carbon emissions and accelerating energy conservation efforts strengthened globally. This growth was driven by the biggest consumers on the planet: China and the US and together they accounted for two-thirds of this demand increase. While China and India, as big populous countries and industrializing economies, have been driving consumption for quite some time now, it is the demand growth in US that is quite remarkable. US energy consumption grew by a robust 3.5% in 2018, bucking a trend of decline of the past 10 years.

Within the energy basket, demand for gas grew by 5.3%, easily its strongest growth in close to 30 years. Renewables remained the fastest growing energy source at over 14%, but growth rates did edge lower relative to past few years. Oil consumption growth averaged 1.5% (or 1.4 million bpd), above its 10-year average of 1.2%. However, the demand growth story on the oil side was easily upstaged by the solid supply growth of 2.2 million bpd, more than double its historical average. A vast majority of this growth was driven by the 2.2 million bpd increase in US production. Interestingly, coal also registered increase in both consumption (1.4%) and production (4.3%) with most of the gains concentrated in Asia.

Oil and Gas Demand-Supply:

Bulk of the oil demand growth of 1.4 million bpd in 2018 was driven by China (0.7 million bpd), US (0.5 million bpd) and India (0.3 million bpd). The uncharacteristic rise in US consumption was driven by gasoline and then diesel, buoyed by lower prices and economic recovery respectively. Further, increased demand for ethane also supported growth in the latter half of the year. The growing importance of petrochemicals came to the fore in 2018 as products most closely related to petrochemicals (ethane, LPG and naphtha)

accounted for around half of the overall growth. On the supply side, US registered the largest-ever annual increase in output by any country. In fact, since 2011 and the onset of the tight oil revolution, US production has increased by over 7 Mb/d – broadly equivalent to Saudi Arabia's crude oil exports. There was also growth in some other non OPEC countries, led by Canada (0.4 million bpd) and Russia (0.2 million bpd). On the other hand, OPEC production fell by 0.3 million bpd in 2018, with a marked increase in Saudi Arabian production (+0.4 million bpd) offset by falls in Venezuela (-0.6 million bpd) and Iran (-0.3 million bpd). But cumulative OPEC production is a net-result of multiple factors - the impact of Vienna group's (the group of OPEC and select non-OPEC countries, most notably Russia) decision to manage the markets through production adjustments; situation arising out US sanctions in Iran; uncertainty around Libyan production and the steep fall in Venezuelan supplies.

Building on the impressive growth in 2017, Natural gas recorded another solid year in 2018, expanding in terms of both production as well as consumption by over 5%. Like in oil, US played a significant role in boosting supplies as well as contributing to demand growth. As per BP Statistical Review, US gas production increased by 86 bcm, an increase of almost 12%, driven by shale gas plays in Marcellus, Haynesville and Permian. The gains in global gas production were supported by Russia (34 bcm), Iran (19 bcm) and Australia (17 bcm). On the demand side, gas consumption in US increased by 78 bcm as weather-related events created greater heating-cooling requirements and demand in the power sector picked up. Beyond the US, growth was principally driven by China (43 bcm), Russia (23 bcm) and Iran (16 bcm). Gas consumption in China grew remarkably at 18% as the country reaffirmed its commitment to cleaner air quality by encouraging coal-to-gas switching in industries and buildings.

Global Crude Prices:

2017 was a rare year of steady recovery for crude oil prices – a welcome respite from the lows of 2016. However, come 2018, crude oil prices entered another characteristic period of volatility, particularly towards the latter half as a host of factors combined to swing prices in both directions. Prices did not skyrocket beyond rational bounds nor did they plunge below a certain comfort level but the sudden spikes and dips further reinforced the critical role that capital discipline is likely to play, at least in the near to medium term, in the investment strategies of major upstream, operators.

Prices held steady around the USD65/bbl mark for the early part of the year. But speculation was rife of prices heading north in the latter half as the market prepared for the impending reintroduction of US sanctions on Iranian oil. On top of this, depleting Venezuelan production and the Vienna Group's (OPEC-select non OPEC group) production cutback arrangement further supported a tighter market outlook for the rest of the year. Prices peaked in the early part of October as Brent breached USD85, despite OPEC having announced that it would go easy on the Vienna Group's aggressive compliance of 1.8 million bpd cutback deal and bring on more barrels to the market in a bid to offset losses in Venezuela and Libya as well as in anticipation of blocked Iranian barrels. Some analysts and investment bank even predicted oil sailing past the 'symbolic' USD100 mark as the US assumed a more hardline stance on Iran than expected and the market's spare capacity was deemed insufficient to meet growing demand under circumstances of constrained supplies.

But as the year neared its end, far from the USD100 mark, Crude settled in the low USD50s a barrel, dropping by almost a third from its peak in October. A few factors that possibly explains this change in direction – US allowing waivers to a few select countries (which included India) for their compliance to Iran sanctions; solid growth is US crude oil production (almost 2 million bpd for 2018); OPEC's decision to increase supplies and dampening effect of global trade tensions on energy demand.

For the whole of 2018, Brent averaged USD71.5/bbl and WTI averaged USD64.9/bbl (source: Global Data). Prices are on the upswing again in 2019 on the back of the US administration's refusal to extend sanction waivers to key importers of Iranian oil beyond the original 180-day period (that expired on May 2) and the continued production cut arrangement by the Vienna group (announced in Dec'18). A higher than expected growth from the US and a global slowdown in oil demand on account of weak economy are among the major factors that present a downside risk to high oil prices.

Exploration

The price crash of 2014 while it spelt immediate gloom for the business of exploration within the upstream oil and gas industry, evidenced by significant cutbacks on outlays for exploration within company budgets, however, contributed to bringing value-creation and efficiency right into the Centre of

exploration puzzle. The risk still remains, but E&P operators globally are hedging that risk through drilling less number of wells and improved prospect high-grading. As per initial estimates of Wood Mackenzie, conventional discoveries for 2018 stood at 10.5 billion boe with a success rate of 35% which makes it comparable to 2017 numbers. Gas accounted for 60% of discovered volumes, upstaging oil which in 2017 had accounted for a larger share (56%) of the discovered volumes. These volumes are currently the lowest for a decade but they are expected to be boosted further upon additional disclosures and reappraisals. 2017 numbers were revised upwards by 50%. The average new field discovery size in 2018 is 58 mmboe, same as Woodmac's equivalent initial estimate for 2017.Discovery costs of USD1.44/boe in 2018 were slightly better than 2017 (USD1.74/ boe) and comfortably improved over the 10 year average of USD2.27/boe. While small and mid-sized companies may have significantly cut down on their exploration spends, the risky enterprise remains critical as ever to the growth plans of large E&P companies, these includes the majors and National Oil Companies (NOCs). This probably explains, as per Woodmac, why exploration success is concentrated in the hands of relatively few companies. The top 15 explorers captured 74% of all industry volumes in 2017, rising to a 77% share in 2018.

A leaner exploration segments translates to a more resilient overall E&P ecosystem. Across project categories, breakeven prices globally have been driven 30% lower compared to before the downturn. Explorers can create double-digit full-cycle returns at USD50 per barrel or even lower.

Upstream Investments and Project FIDs

Brent averaged almost 30% higher in 2018 than in 2017. Higher crude prices contributed to making 2018 a solid year for E&P project Final Investment Decisions (FIDs). As per Wood Mackenzie, a total of 49 projects with estimated cumulative capex of USD184.8 bn were sanctioned for development in 2018 compared to a total of 35 projects in 2017 with a total outlay of USD92.6 bn. Sanctioned reserves for the 49 projects totaled 33.5 billion, compared to 12.9 billion boe the year earlier. Moreover, average capex allocations and reserve size for projects were also on the higher side. NPV break-evens for projects saw a big drop from USD52/boe in 2017 to USD41/boe in 2018. It may also be noted that Middle-eastern projects and big brownfield expansions played a major role in the overall composition of the project slate for 2018 which explains the healthy reductions in breakeven or capex/boe.

The trend is unlikely to continue in 2019 as most energy consultants predict capital-intensive deep water and LNG projects as major themes for FIDs during 2019 as well as 2020. As much as 100 MMTPA of new LNG capacity is expected to be sanctioned during 2019-20 while over 18bboe of deep-water reserves are in play in 2019. Still, break evens are expected to remain below USD50/boe, as per Wood Mackenzie.

A Global Data analysis notes that a majority of the projects lines up for approval in 2019 are likely to be gas-based (almost 70%) –a consequence of uncertainty around oil prices as well as future oil demand. Gas-based developments also fit the longer term focus and priority for energy sector investments as countries plan to transition to a lower carbon energy mix. The firm expects a total new-build capex of USD846 billion to be spent globally on planned and announced upstream projects during 2019–2025 period. In terms of overall spends, as per Wood Mackenzie, Upstream E&D capex for the industry stood at USD279 bn in 2018, against USD249 bn in 2017, a growth of over 12% y-o-y. Investments are likely to rise modestly in 2019 as well, indicating a healthy outlook for project approvals, production growth and, most importantly, stable prices. Of course, the lower price structure that came into effect as a response to low energy prices has also significantly reduced project break-evens since 2014.

Global Gas and LNG

The global market for gas has grown considerably over the last decade and there are legitimate and strong prospects that the momentum will sustain, at least in the medium term. Gas has grown in an environment where there is a growing demand of cleaner energy systems across the map, primarily driven by a global consensus on the need to curb carbon-related emissions. As per the BP Energy Outlook 2019, the share of gas grows across all its outlook scenarios, from a 20% share in 2017 to not less than 25% in 2040. Gas-based discoveries are also on the rise – the resource accounted for 56% of total discovered conventional hydrocarbon volumes in 2018. 2018's largest discovery – NOVATEK's North Obski-1 well in shallow waters of the mature South Kara Sea basin (Russia) – was a gas find. Preliminary estimates peg its resources at over 11 tcf. More importantly, the market is growing on either side – producers as well as consumers. The supply side dynamics is dominated by the US, which has been a recent and significant entrant to global gas trade because of abundance of cheap gas, and Russia, a traditional

piped gas powerhouse which also is now making big-time plans for its LNG business. The entry of US, more than anything, has completely redefined the global gas landscape with ramifications across piped gas and LNG, forcing traditional players like Qatar (LNG) and Russia (piped gas) to reassess their market strategy. Today, North American natural gas resource stands at over 1300 tcf at a Henry Hub delivered price of below $4/MMBtu as per IHS-Mar kit, enough to supply anticipated growth in domestic and export demand for decades with only slow increases in gas prices. It amply supports the emergence of US, along with Canada, as strong LNG suppliers in international markets. Coming to Russia, its exports to Europe alone breached 200 BCM in 2018, an all-time high. The country also has plans to develop as much as 100 MMTPA of LNG by 2030 and aims to be at par with Qatar, Australia or US. As of 2018, Qatar (with 78.7 MMT) and Australia (with 68.6 MMT) remain the top two LNG exporters in the globe, as per the International Gas Union's World LNG Report.

Asia remains the hub for global gas demand and the epicenter of demand growth, as both traditional consumers Japan (biggest LNG importer) and South Korea and emerging consumers, China and India, are in this region. China is the world's third largest gas market and the fastest-growing major gas market thanks to Beijing's efforts to replace coal-burning boilers with gas-fired ones. South Korean LNG imports are also expected to support demand as the Government has prioritised gas over coal and nuclear in its energy transition plan. Here, in India, the outlook for gas is positive on the back of clear Government mandate to more than double the fuel's share in the energy mix in the next 5 years as well as the aggressive expansion of downstream gas network and infrastructure. While gas plays a prominent role in European energy markets, its role, in the longer term, is likely to come under pressure as governments of the region have ambitious climate-targets and dis-incentivize unabated gas consumption growth.

Global LNG trade continued its growth for the fifth consecutive year. Trade volume reached 316.5 MMT, marking an increase of 28.2 MMT from 2017, or 9.8% year-on year growth, as per IGU's Global LNG Report. Australia led all exporters in incremental growth (+12.2 MT), supported by the new Wheatstone LNG and Ichthys LNG projects. Bulk of the demand was driven by Asian consumers with China accounting for over 40% of the incremental volumes. Asian imports totaled over 70% of the 2017 trade volume. Asia remained the driver of international LNG demand - China added an

astounding 16 MMT of LNG imports, representing 57% of the global incremental demand in 2018.

LNG project FIDs made some headway in 2018 after an unflattering two year period of 2016-17 when just 3 projects were sanctioned. 4 projects, totaling liquefaction capacity of 21.5 MMTPA, achieved FID in 2018. Most LNG-related prices around the world followed an upward trend in 2018, influenced by rising oil prices and strong LNG demand in Asia. Northeast Asian spot price averaged $9.78/MMBtu in 2018. But there is a downside risk to the prices from oversupply, milder winter weather and slowing Chinese growth. Since reaching a peak in September at just under $12/ MMBtu, the Asian spot price has fallen to below $8/MMBtu.

Renewables

Renewables recorded a growth of close to 8% during 2018, as per International Renewable Energy Agency. This translated to 171 GW new installed renewable capacity, taking total capacity to 2,351 GW. Solar saw the largest growth in 2018, with a capacity increase of 94 GW. The majority of these were installed in Asia, which accounted for 64 GW of new capacity. Wind capacity increased by 49 GW in 2018. Expansions in China formed over 40% of new wind capacity with 20 GW, followed by the US with 7 GW. Despite being accounting for the largest share of renewable energy, hydropower installations have slowed in recent years, with just 21 GW installed in 2018.Asia was the largest installer of renewable energy, adding 105 GW or 61% of total capacity additions and a growth of 11.4%.

Concurrent with the growth in installed capacity, investments in clean energy, bulk of which comprises commitments in renewables, also continued to grow. As per Bloomberg New Energy Finance analysis, global clean energy investment totalled $332.1 billion in 2018, marking the fifth in a row in which investment exceeded the $300 bn. Total investment in solar dropped 24% to $130.8 bn due to declining capital costs as well as a sharp change in policy in China in mid-year. Offshore wind projects featured strongly, attracting USD25.7 billion, up 14% from 2017.

However, the growth in renewables must be seen in the context of growing global energy demand to gauge how effective the newer forms of energy have been in catering to the overarching objective of curtailing global carbon

emissions. As per IEA's Global Energy and CO2 Status Report, global energy consumption in 2018 increased at nearly twice the average rate of growth since 2010, resulting in Energy-related CO2 emissions to rise 1.7% to a historic high of 33.1 Gt CO2 . While demand for renewable energy grew by 4%, it was still upstaged by gas consumption of which grew by 4.6%. This is where the opportunity opens up in areas such as Energy storage systems, Electric Vehicles (EVs), Carbon Capture and Storage (CCS) and Hydrogen.

The potential for renewable energy sources are significant in our country. India is ranked fourth in EY Renewable Energy Country Attractive Index 2018. As per the Ministry of New and Renewable Energy, India has a wind potential of more than 300 GW at a hub height of 100 meter, solar potential of ~750 GW assuming 3% wasteland is made available and small hydro potential of~20 GW. As of February 2019, total renewable power generation (including large hydro) installed capacity in the country stood at 120 GW, which is 34.3 per cent of the total installed capacity of 350 GW. As part of the country's COP 21 commitments, the Government has formulated an action plan to achieve a total capacity of 60 GW from hydro power and 175 GW from other RES (excluding large hydro projects) by March, 2022, which includes 100 GW of Solar power, 60 GW from wind power, 10 GW from biomass power and 5 GW from small hydro power.

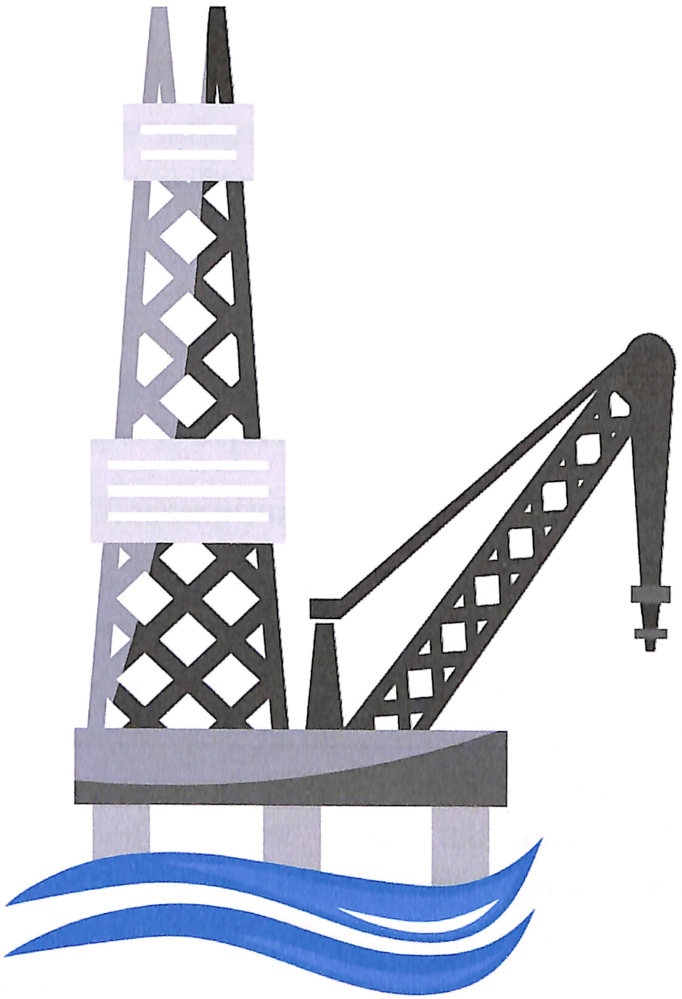
Factors critical to success of the study

Oil price is a critical leading indicator of the economic health and prosperity of any nation and results in drastic economic changes. Crude oil price determination mechanism is still not left open fully to the market forces as it is a developing country. Therefore, any upward and downward movements in prices are closely tracked in the domestic market place which is influenced by international factors. Oil price fluctuations tremendously affect any economy both directly and indirectly. The purpose of this research is to explore the variables having impact on crude oil pricing and the spill over in the prices of crude oil affecting macroeconomic variables. The reviews of literature unearth the factor that, contributed the price formation of crude oil across the globe.

Crude oil price is an important parameter for refining industries, which has a bearing on economy, because it is vital input for productivity. There is a vast gap in demand and production of crude oil in India. National oil companies are able to produce 23-24% of India's total requirements of crude oil. The production of crude oil from public sector enterprises in India has been decreasing due to old and the maturity of the fields. India is not self-reliance on crude oil production; therefore, it is necessary and inevitable to import the crude oil to bridge the gap between demand and supply.

The increase in international crude oil prices will make import costly and raise the Indian crude basket price. Therefore, both international crude oil price rise and import dependency on crude oil are the problematic area that may damage the Indian economy. It is estimated that the import dependence of India associated with crude oil is expected to 94% by the end of 2030. Therefore, the trouble water in Indian crude oil demand and supply management is the rise in international crude oil prices followed with the extent of the increase in crude oil requirement with respect to feasible higher GDP growth 8% to 9%. The import dependence of India associated with crude oil is from 76% in 2011-12 to 80% by the end of twelfth plan (2012-17). As crude oil prices are rising globally and imports will be expensive, it is necessary to understand the consequences of crude oil price rise on the economy. Therefore, there is a need to look at crude oil prices have an implication on consumer price Index(CPI) and GDP.

Chapter 3



Research Design Methodology and Plan

Sources of Data

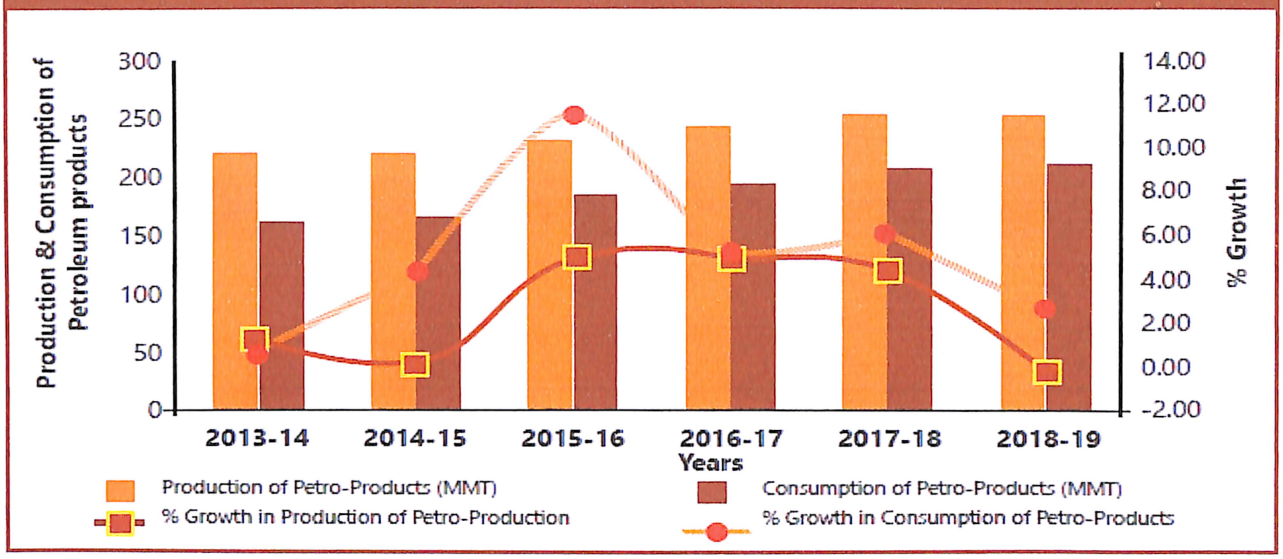
Refining Capacity & Refinery Crude Throughput

India has emerged as a refinery hub. India is second largest refiner in Asia after China. Refining capacity exceeds the demand. The country's refinery capacity has increased to 247.57 MMTPA at present. Capacity of BPCL-Kochi increased from 9.5 MMTPA to 15.5 MMTPA. Further, there was an addition of 2.3 MMTPA and 8.2 MMTPA capacities in HMEL-Bhatinda. and RIL (SEZ) Jamnagar refineries respectively during the year. Refinery Crude Throughput (Crude Oil Processed) for the FY 2017-18 is 251.93 MMT as against 245.36 MMT in FY 2016-17, showing an increase of about 2.68%. Refinery capacity utilisation is 107.68 for the FY 2017-18. Crude throughput during April-December. 2018 was at 192.68 MMT. higher by 2.51% against 187.96 MMT during April-December. 2017. The trend in Refining Capacity and Crude throughput is depicted below (details in Appendix IV & V):

Production and Consumption of Petroleum Products

The production of petroleum products recorded at 254.40 MMT in FY 2017-18 as against 243.55 MMT achieved in FY 2016-17, showing an increase of about 4.46%. The production of petroleum products is targeted at 254.40 MMT in FY 2018-19. During April-December, 2018, production of petroleum products was at 196.69 MMT i.e. an increase of 4.10% over 188.94 MMT of production achieved during the corresponding period last year. During the FY 2017-18, the consumption of petroleum products in India was 206.17 MMT with a growth of 5.95% as compared to consumption of 194.60 MMT during FY 2016-17. The consumption of petroleum products during April December, 2018 was at 157.40 MMT i.e. an increase of 2.52% over 153.53 MMT in April-December, 2017. Year-wise production and consumption of petroleum products are depicted below (details in Appendix VI & VII).

GRAPH 1.3 : PRODUCTION AND CONSUMPTION (INDIGENOUS SALES) OF PETROLEUM PRODUCTS

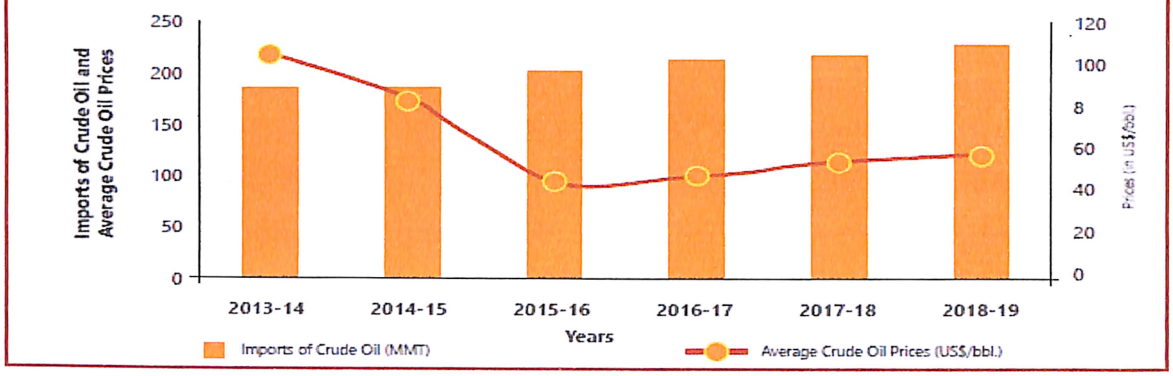


Import of Crude Oil

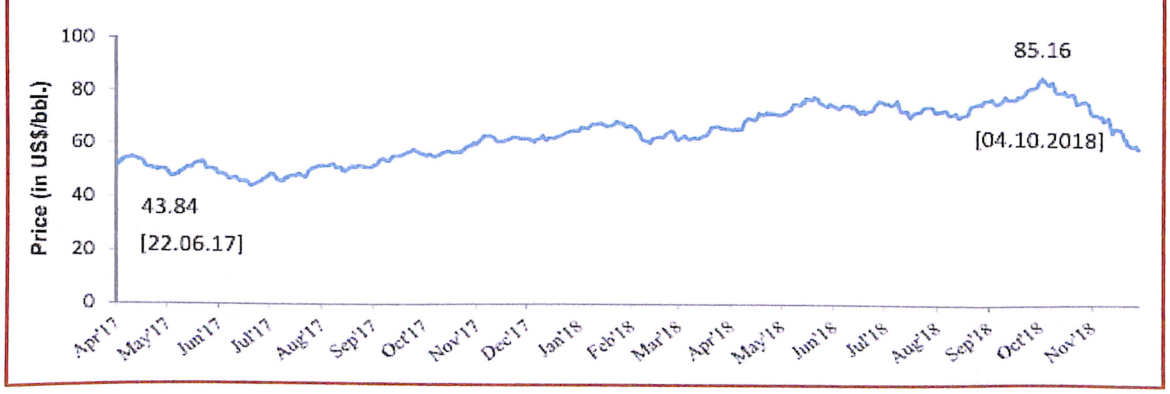
Import of crude oil during FY 2017-18 was 220.43 MMT valued at ` 566450 crore as against import of 213.93 MMT valued at ` 470159 crore in FY 2016-17 which marked an increase of 3.04% in quantity terms and 20.48% in value terms as compared to the import of crude oil during FY 2016-17. Import of Crude Oil during April November, 2018 was 150.98 MMT valued at `548021 crore which marked an increase of 4.13% in quantity terms and 59.62% in value terms as against the imports of 144.99 MMT valued at `343321 crore for the same period of last year. The prices of crude oil and petroleum products have shown a declining trend after July, 2014. As a result, the average price of Indian crude oil basket during FY 2015-16, FY 2016-17 and FY 2017-18 was recorded at $46.17/bbl, $47.56/bbl and $56.43/bbl respectively. The price has increased to $72.16/ bbl during the current FY 2018-19 (up to 27th December, 2018). Since the price of crude oil and petroleum products in the international markets are quoted in US Dollars, the Indian `–US$ exchange rate plays a vital role in the Indian context. The rupee dollar exchange rate was moving in a narrow band till FY 2011-12, but subsequently there was a depreciation of the Indian rupee thus making the prices of crude oil and petroleum products expensive in domestic currency.

The trend in growth of crude oil imports and crude oil international (Indian Basket) prices is shown in Table-1.4 & Graph- 1.4A. The trend in prices of Indian basket crude oil during April, 2017 to December, 2018.

GRAPH 1.4A : QUANTITY OF CRUDE OIL IMPORTS AND AVERAGE INTERNATIONAL CRUDE OIL PRICES (INDIAN BASKET)



GRAPH 1.4B : DAILY PRICE OF INDIAN BASKET CRUDE OIL SINCE APRIL, 2017



Imports & Exports of Petroleum Products

During April to November, 2018, imports of petroleum products were 21.25 MMT valued at Rs 75160 crore, which shows a decrease of 11.24% in quantity terms but increase of 37.33% in value terms, against the imports of 23.94 MMT valued at Rs 54731 crore for the corresponding period of previous year. The quantity of petroleum products imported during FY 2017-18 was 35.46 MMT valued at Rs 88374 crore. During April-November, 2018, exports of petroleum products were 41.69 MMT valued at Rs 192154 crore, which shows decline of 6.04% in quantity terms and increase of 36.39% in value terms, as against the exports of 44.37 MMT valued at Rs 140882 crore for the same period of last year. During FY 2017-18, 66.83 MMT of petroleum products, valued at Rs 225388 crore were exported. November, 2018 (provisional) During April-November, 2018, import of LNG was 14.03 MMT valued at Rs 46565 crore which marked an increase of 8.1% in quantity terms and 57.37% in value terms, against imports of 12.98 MMT valued at Rs 25590 crore for the same period of previous year. During FY 2017-18, 19.87 MMT of LNG, valued at Rs 49941 crore was imported.

Equity Oil and Gas from Abroad

Government is committed to ensure energy security of the country and is focusing on acquiring quality overseas oil and gas assets and importing oil & gas from diverse sources at competitive prices through oil diplomacy and enhanced coordination between various Ministries and Departments of the Government and Indian Missions abroad. Oil & Gas PSUs are also being encouraged to diversify crude oil & LNG import sources. Presently, PSU companies have 59 overseas assets in total 28 countries. These assets range from exploratory blocks to producing assets and pipeline projects. The producing assets yield approximately 22 MMTOE of oil and gas annually. The focus of PSU oil and gas companies has shifted from acquiring exploratory blocks to acquiring stake in producing blocks. The latest acquisitions being: (i) Indian Consortium of IOCL, OIL, OVL and BPRL acquired 10% stake in Lower Zakhum offshore field in UAE and (ii) IOCL acquired 17% participating interest in Mukhaizna oilfield in Oman. Indian PSU companies have diversified their oil and gas import sources. Russia was added as a new source for our long term LNG imports. India has also added USA and Australia as its LNG import source apart from earlier and largest source Qatar.

Foreign Direct Investment Inflows

The Government is encouraging Foreign Direct Investment (FDI) in order to supplement domestic investment and technological capabilities in the petroleum sector. The present FDI policy for petroleum & natural gas sector allows 100% FDI through automatic route for exploration and production, refining by the private companies (for public sector companies 49% on automatic route without any divestment or dilution of domestic equity in the existing PSUs), marketing of petroleum products, pipelines, storage and LNG regasification infrastructure and all related services, subject to the existing sectoral policy and regulatory framework in the oil and gas sector. During April- June FY 2018-19, FDI inflow received was Rs 825 crore contributing 0.97% of total FDI inflow (`85180 crore) in the economy.

Outlay for Ministry of Petroleum & Natural Gas

The actual expenditure of Internal & Extra Budgetary Resources (IEBR) of Oil and Gas CPSEs in FY 2017-18 was Rs 132002.98 crore against Budget Estimate (BE) of Rs 86027.28 crore. Budget Estimates (BE) of IEBR of Oil and Gas CPSEs under Ministry of Petroleum & Natural Gas in FY 2018-19 is Rs 89335.09 crore. Detailed Budget Estimates of the Ministry of Petroleum & Natural Gas are given in Appendix IXA & IXB.

Strategic Crude Oil Storage

The Indian Strategic Petroleum Reserves Ltd (ISPRL) signed an MoU with ADNOC of UAE to explore the possibility of storing ADNOC crude oil at ISPRL's Strategic Petroleum Reserve (SPR) facility at Padur in Karnataka. ADNOC has already stored, at its own cost, crude oil at one of the two caverns at Mangaluru SPR facility under an Amended and Restated Agreement on Oil Storage and Management. ISPRL has been authorized by Government to explore filling crude oil in Padur SPR facility based on the key principles of the 'ADNOC Model' as used for filling Cavern-A at Mangaluru SPR facility by overseas National Oil Companies (NOCs).

In order to further augment India's preparedness during emergency oil shortage situation, Government has given 'in principle' approval for establishment of two additional SPR facilities at (i) Chandikhol in Odisha and

(ii) Padur in Karnataka with a total capacity of 6.5 MMT. The Ministry is closely working with the two State Governments to take the project forward. The pipelines will put in place a mechanism for assured, long-term, uninterrupted and eco-friendly supply of petroleum products to Bangladesh and Nepal. India is also working with Sri Lanka and Japan to set up an LNG Terminal near Colombo. Taking advantage of proximity, Indian PSU refineries i.e. IOCL and Numaligrah Refineries Ltd. are also working with Myanmar companies to supply petroleum products to the country.

The Ministry also worked with various Ministries and Departments of the Government and engaged with interlocutors from the USA to obtain waiver from US sanctions for continued import of Iranian crude oil for Indian refineries. This is important achievement from the perspective of India's energy security as ensures continues import of required crude oil for our refineries. Ministry also worked with stakeholder Ministries and Departments of the Government and engaged with interlocutors from Iran for 100% rupee mechanism settlement of bilateral trade payments.

Exploration & Production

In the upstream sector, the two Upstream National Oil Companies (NOCs) viz., Oil and Natural Gas Corporation Limited (ONGC) and Oil India Limited (OIL) play a dominant role with a total share of about 71.5% in oil and 81% in gas production in the country in the year 2017-18. ONGC produces nearly 61% of indigenous crude oil and 71.5% of country's gas production, while OIL's share is 10% of indigenous crude oil and 9% of gas production. The share of Private/JV companies in oil and gas production is 29% and 19.5% respectively.

The Directorate General of Hydrocarbons (DGH) was established under the administrative control of Ministry of Petroleum and Natural Gas by Government of India Resolution in 1993. The objective of setting up of DGH was to promote sound management of the Indian oil and natural gas resources having a balanced regard for environment, safety, technological and economic aspects of petroleum activity. In addition, DGH has been strengthened with certain responsibilities concerning the Production Sharing Contracts for Discovered fields/Exploration blocks, promotion of investment through

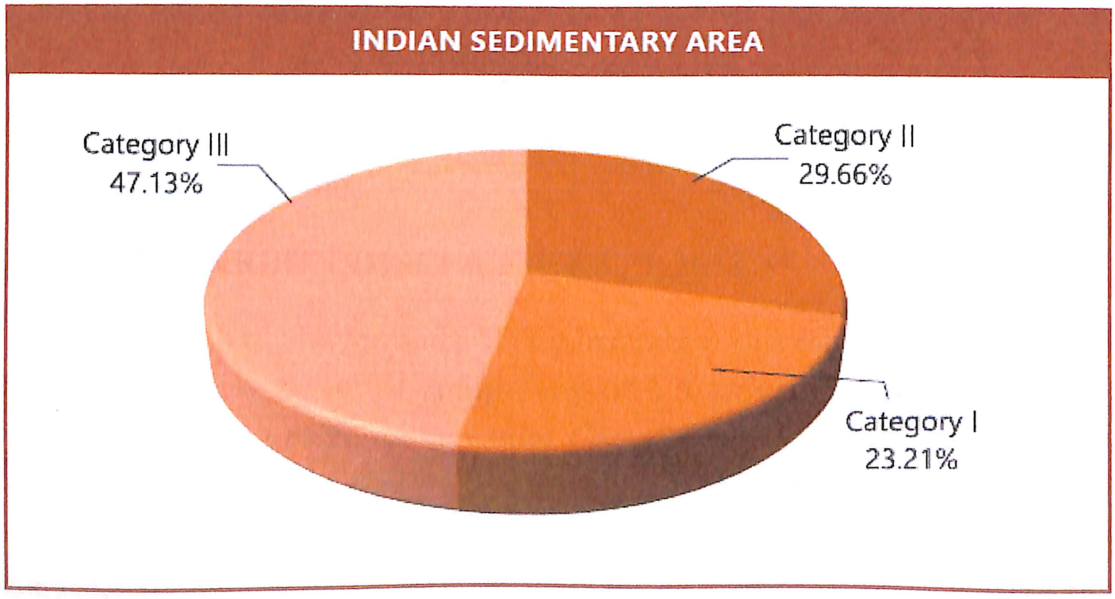
implementation of policies including Discovered Small Field Policy, Hydrocarbon Exploration & Production Policy (HELP) and monitoring of E&P activities.

SEDIMENTARY BASINS IN INDIA

India has 26 sedimentary basins covering an area of 3.36 million square kilometers. The sedimentary basins of India, on land and offshore up to the 400m isobaths, have an aerial extent of about 2.04 million sq. km. In the deep-water beyond the 400m isobath, the sedimentary area has been estimated to be about 1.32 million square kilometers.

The Indian sedimentary basins have been broadly divided into three categories based on their degree of prospectively as presently known.

Crude oil and natural gas production in the country is from 7 sedimentary basins, under Category I, there are 5 basins in Category II that have established petroleum resources but are yet to produce commercially. The distribution of total Indian sedimentary area of 3.36 million square kilometer under different categories.



ESTIMATED RESOURCES OF CRUDE OIL & NATURAL GAS CONVENTIONAL HYDROCARBON RESOURCES

The prognosticated conventional hydrocarbon resources in 26 sedimentary basins of the country are of the order of 41.87 billion tonnes (oil and oil equivalent of gas), which is about 49% increase as compared to earlier estimates of 28.08 billion tonnes.

As on 1st April, 2018 in-place hydrocarbon volume of 10680 million tonnes of oil and oil equivalent gas has been established through exploration by ONGC, OIL and Private/JV companies. About 74% of resources are under "yet to discover' category. Out of 10,680 MMT of oil and oil equivalent gas of in-place volumes, the ultimate reserves which can be produced are about 4,095 MMT of oil and oil equivalent gas. The balance recoverable reserves are of the order of 1,812 MMT of oil and oil equivalent gas. The break-up of hydrocarbon reserves explored by ONGC, OIL and private/JV companies in the country as on 1st April, 2018.

PETROLEUM EXPLORATION LICENCE (PEL) AND PETROLEUM MINING LEASE (PML)

Under Nomination regime, ONGC is operating 9 PEL and 334 PML blocks covering an area of about 94,358 sq. Km. In addition, OIL is operating 3 PEL and 22 PML under nomination regime covering an area of 5,158 square Kilometers. The basin-wise details of PEL/PML operated by ONGC and OIL.

Private/JV companies are operating 64 PEL and 62 PML blocks covering an area of 62,251 Sq. Km. The basin-wise details of PEL/PML operated by private/JV companies.

HYDROCARBON DISCOVERIES IN 2018-19

ONGC and OIL have made 12 hydrocarbon discoveries. ONGC has made 9 hydrocarbon discoveries comprising of 6 discoveries in onshore acreages and 3 discoveries in offshore acreages. Out of these, four on land discoveries have been monetized by ONGC. OIL has made 3 hydrocarbon discoveries in the State of Assam. The details of hydrocarbon discoveries made in 2018-19 up to December, 2018.

NATIONAL DATA REPOSITORY (NDR)

The Government of India notified the Open Acreage Licensing Policy (OALP) as a part of the Hydrocarbon Exploration and Licensing Policy (HELP) on 30th June, 2017. National Data Repository (NDR) is a pre-requisite and key component for making OALP operational to view the surface and sub-surface geological, geophysical and other technical data by the investors. NDR was launched on 28th June, 2017.

NDR is managed by DGH. Entire country's E&P data is uploaded in NDR so that any interested party from around the globe can have access to these data and show interest to invest in India. As on 30th November, 2018, 19.92 Lakh Line Kilometer(LKM) of 2D Seismic data, 7.03 Lakh Sq. KM of 3D Seismic data and 15,712 well log data have been uploaded in NDR system.

SHALE GAS EXPLORATION

In order to promote Shale Gas and Oil exploration in India, the Government of India on 14th December, 2013 notified the policy guidelines for exploration and exploitation of Shale gas and oil by National Oil Companies (NOCs) in their on land Petroleum Exploration Lease (PEL) / Petroleum Mining Lease (PML) blocks awarded under the nomination regimes.

As per policy guidelines, ONGC Ltd. and Oil India Ltd have to carry out Shale Gas and Oil exploration in 50 and 5 blocks respectively for assessment under Phase-I. ONGC is carrying out Shale Gas and Oil exploration activities in Cambay, Cauvery, Krishna Godavari and Assam and Arakan Basins. Oil India Ltd is carrying out Shale Gas and Oil exploration activities in Assam and Rajasthan basins. In phase II and III ONGC is to carry out exploration in 75 and 50 blocks respectively. Oil India is to carry out exploration in 5 blocks each in Phase II and III. So far ONGC has drilled 23 wells in 19 blocks. Presently, shale exploration activities are in progress in Cambay and KG Basins where two wells [exclusive shale assessment well NDSGA(NADA#37) in Cambay Basin and dual objective well NGSAA (Nandigam South#1) in KG Basin] are under drilling.

GAS HYDRATE

National Gas Hydrate Project-2 (NGHP-2) was conducted successfully in Eastern offshore from 9th March, 2015 to 31st July, 2015. NGHP-Expedition-02 carried out in 2015 drilled 42 wells at 25 sites in Krishna Godavari and Mahanadi area in sand reservoirs for gas hydrates. Based on the results of NGHP-02, two world class gas hydrate reservoirs have been discovered (Block KG-DWN- 98/5 and Block KGDWN-98/3). Based on the post-expedition studies and review by international experts, the site located in KG-DWN-98/5 has been found suitable for pilot production test during NGHP-03 expedition for which various studies like sand control measures, well design, reservoir and production simulation modelling as prerequisite for the pilot production have been completed.

POLICY INITIATIVES TAKEN BY THE GOVERNMENT FOR ENHANCING CRUDE OIL AND GAS PRODUCTION

Government has formulated path breaking policies to revolutionize the E&P sector. The Policy-wise details have been enumerated as under: In a major policy drive to give a boost to upstream hydrocarbon sector, the Government has unveiled a series of policy reforms in last one year. Some of the notable Policy reforms are listed as under:

Hydrocarbon Exploration and Licensing Policy/ Open Acreage Licensing Policy

» Government notified Hydrocarbon Exploration and Licensing Policy (HELP) on 30th March, 2016 and formally put in operation w.e.f. 1st July, 2017 with notification of Open Acreage Licensing Policy (OALP) and operationalisation of National Data Repository (NDR). HELP is a paradigm shift from Production Sharing Contract (PSC) regime to Revenue Sharing Contract (RSC) regime which completely overhauls the regulatory regime for the future Exploration and Production (E&P) activities by reducing the regulatory burden based on the principle of 'Ease of doing business'. It provides for single License for exploration and production of conventional as well as nonconventional Hydrocarbon resources, pricing and marketing freedom, reduced rate of royalty for offshore blocks etc. Open Acreage Licensing Policy (OALP)means potential investors/ companies can carve out

exploration acreages of their choice and submit Expressions of Interest round the year. Bidding is carried out every 6 months.

» Under OALP, 55 Blocks having an acreage area of 59,282 Sq. Km. have been awarded in Bid Round-I in October, 2018. Under OALP Bid Round-II, bid for 14 blocks having an acreage area of 29,233 Sq. Km. is launched on 7th January, 2019. Under OALP Bid Round-III, 23 Blocks having an acreage area of 31,722 Sq. Km. are proposed for bidding through International Competitive Bidding (ICB) process.

» Under National Data Repository (NDR), launched by Government in June, 2017 to assimilate, preserve and upkeep the vast data, till November, 2018 19,92,776 Line Kilo Meters (LKM) of 2D seismic processed data, 7,03,733 sq.km of 3D seismic processed data, 15,712 numbers of Well data log, 32,142 numbers of Well reports etc. have been uploaded on NDR. The data in NDR is used by Exploration and Production (E&P) Companies for bidding in OALP.

Discovered Small Field Policy (DSF) Policy

» For early monetization of un-monetized discoveries of National Oil Companies (NoCs), Government in September, 2015 approved 69 marginal fields for offer under Discovered Small Fields Policy. The Policy envisages awarding of Contract Areas under the new regime of Revenue Sharing Model with an objective to provide faster development of fields and facilitate early production of oil and gas.

» First bidding round under the Discovered Small Field Policy was launched on 25th May 2016, offering 67 discovered small fields/discoveries clubbed into 46 Contract Area for international bidding. Total 30 contracts for 43 discovered small fields/discoveries were signed in March, 2017. It is expected that in-place locked hydrocarbons reserves of 44.7 Million Metric Tonnes (MMT) of oil and oil equivalent gas (O+OEG) will be monetised over a period of 15 years.

» On 7th February, 2018, Government approved the Discovered Small Field (DSF) Policy Bid Round II, an extension of the Discovered Small Field Policy notified on 14.10.2015. Under DSF Bidding Round-II, 59 discovered

small fields/unmonetized discoveries estimated to have 189.61 Million Metric Tonnes (MMT) Oil and Oil equivalent gas in-place are offered for bidding. Bidding under DSF Bidding Round –II was launched on 9th August, 2018 and bid closing date is 18th January, 2019.

Policy Framework to Promote and Incentivize Enhanced Recovery Methods for Oil and Gas (October, 2018)

» The Government approved the Policy framework to promote and incentivize Enhanced Recovery (ER)/Improved Recovery (IR)/Unconventional Hydrocarbon (UHC) production methods/ techniques through fiscal incentives in the form of partial waiver of royalty and cess and an enabling ecosystem to improve productivity of existing fields and enhance overall production of domestic hydrocarbons. The Policy provides for systemic assessment of every field for its ER potential, appraisal of appropriate ER techniques and fiscal incentives to de-risk the cost involved in ER Projects and to make it economically viable.

National Seismic Programmme (NSP)

» Government formulated National Seismic Programmme (NSP) in October, 2016 to appraise the unapprised areas in all sedimentary basins of India where no/scanty data was available. Under the programme, Government approved the proposal for conducting 2D seismic survey for data Acquisition, Processing and Interpretation (API) of 48,243 Line Kilo Meters (LKM). The estimated cost of the project is RS 2,932.99 crore and expected to be completed by 2019-20.

» As on 30th December, 2018, out of 48,243 LKM, surface coverage of 31,323 LKM has been achieved under NSP.

Policy Framework for streamlining the working of the Production Sharing Contracts (August, 2018)

Government notified the policy for expeditious development of hydrocarbon resources by streamlining the working of PSCs in August, 2018. Policy includes extending exploration period by 2 years and appraisal period by 1 year for operational blocks in North Eastern Region (NER) besides allowing marketing including pricing freedom for natural gas to be produced in future in NER; sharing of the statutory levies including royalty & cess in Pre NELP

Exploration Blocks and to be cost recoverable with prospective effect; extending tax benefits under Section 42 of Income Tax, 1961 to operational blocks under Pre-NELP discovered fields with prospective effect for the extended period of Contract.

Re-assessment of Hydrocarbon Resources

A Multi Organisation Team comprising of representatives of National Oil Companies (ONGC and OIL) and DGH has carried out estimation of hydrocarbon resource potential in the country. The prognosticated conventional hydrocarbon resources in 26 sedimentary basins of the country are reassessed to the order of 41.87 billion tonnes of oil and oil equivalent of gas (O+OEG), which is about 49% increase as compared to earlier estimates of 28.08 billion tonnes.

Policy Framework for Exploration & Exploitation of Unconventional Hydrocarbons under Existing Production Sharing Contracts, Coal Bed Methane Contracts and Nomination Fields (August 2018)

Government approved the policy to encourage the existing Contractors to unlock the potential of unconventional hydrocarbons including shale oil and gas and CBM in the existing acreages under PSCs and CBM contracts subject to conditions stipulated in policy document. An area of 72,027 sq. km. held under PSCs and 5,269 sq. km. area under CBM contracts has been opened up for simultaneous exploration and exploitation of conventional or unconventional hydrocarbons.

Pipelines & Natural Gas

India is not only the 3rd largest energy consumer in the world after China and USA but also one of the fastest growing energy consumers. In the year 2017, the primary energy consumption in the country was about 754 Million Tonnes of Oil Equivalent (MTOE) and Natural Gas has a share of 6.2 % of the country's primary energy mix. It has been envisaged to increase the share of Natural Gas in primary energy mix of the country from current level to 15% in coming years. In order to move forward, thrust has been put to enhance domestic gas production, encourage the import of Liquefied Natural Gas (LNG) and augment LNG import capacity, completion of national gas grid

and speedier roll out of City Gas Distribution (CGD) network across the country.

GAS GRID

At present, about 16,800 km long gas pipeline network is under operation in the country and around 14,200 km pipeline is approved/under construction. In order to develop the national gas grid, the Government has taken a decision to provide a capital grant of ` 5,176 crore (i.e. 40% of the estimated capital cost of ` 12,940 crore) to GAIL for development of a 2,655 km long Jagdishpur-Haldia/Bokaro-Dhamra Gas Pipeline (JHBDPL) project, popularly known as the "Pradhan Mantri Urja Ganga' of Eastern India. It will pass through 50 districts in the State of Uttar Pradesh, Bihar, Jharkhand, Odisha & West Bengal. The construction work on the pipeline is under progress and it is scheduled to be completed by 2020. GAIL has also been entrusted to develop Barauni (Bihar)- Guwahati (Assam) pipeline as an integral part of JHBDPL project which will connect North East region with the National Gas Grid.

To further extend the gas grid to North-Eastern Region. five CPSEs viz. ONGC, OIL, GAIL, IOCL and NRL signed a MoU on 3rd February, 2018 for formation of a Joint Venture Company to develop Gas pipeline connectivity to all North-Eastern States viz. Assam, Sikkim, Mizoram, Manipur, Arunachal Pradesh, Tripura, Nagaland and Meghalaya. These promoters have formed a Joint Venture (JV) company, named as Indradhanush Gas Grid Ltd, on 10.08.2018. The JVC has also been authorized to develop NER Gas Grid of about 1656 Km long in a phased manner at the total cost of about ` 9265 Crore. On completion, NER grid will ensure uninterrupted availability of natural gas across the region and boost industrial growth in the region. The construction work to develop Kochi-Kottanad Managlore-Bangalore Pipeline (KKBMPL) and EnnoreThiruvallur-Bengaluru-Puducherry-NagapatinamMadurai-Tuticorin (ETBPNMT) in the southern part of the country is in progress. Efforts are underway for time bound development of this pipeline project and provide accessibility of natural gas sources (domestic and imported both) to southern cities by connecting KKMBPL and ETBPNMT projects with the existing gas grid. Construction work is also going on in Mallavaram - Bhopal - Bhilwara via Vijaipur pipeline to connect Ramagundum Fertiliser plant.

PERFORMANCE OF PETROLEUM & NATURAL GAS SECTOR-SOME KEY MACRO-ECONOMIC TRENDS

According to CSO's advanced estimates dated 7th January, 2019, Indian economy is estimated to grow 7.2% in FY 2018-19 as compared to 6.7% in FY 2017-18. The growth in the economy has triggered energy demand. On domestic front this strong growth is due to robust private consumption, expectation of greater stability in GST and public investment as well as ongoing structural reforms. It may also be mentioned here that global tension on trade front and volatile global oil market has hardened the crude oil prices. Oil and Gas being the important import for our economy, many initiatives have been taken by the Ministry for increasing production and exploitation of all domestic petroleum resources to address the priorities like Energy Access, Energy Efficiency, Energy Sustainability and Energy Security.

Refineries and Auto Fuel Vision and Policy

India's total refining capacity increased from 233.97 Million Metric Tonnes (MMTPA) (as on 1.4.2017) to 247.57 MMTPA at present with the capacity additions in BPCL Kochi, HMEL Bhatinda & RIL (SEZ) Jamnagar refineries. Taking advantage of investor friendly policies, Saudi Aramco (Saudi Arabia) and Abu Dhabi National Oil Company (ADNOC) of UAE signed an MoU in June 2018, with Indian promoters, IOCL, BPCL and HPCL, to jointly develop and built an integrated refinery and petrochemicals complex, i.e. Ratnagiri Refinery & Petrochemicals Ltd (RRPCL) in Maharashtra.

National Policy on Biofuels 2018

The Government has notified National Policy on Biofuels 2018 on 8th June, 2018 which envisages a target of 20% blending of ethanol in petrol by 2030. The policy has widened the scope of raw material for ethanol procurement and thereby is expected to give boost to the Biofuel programme of the country. The major features of the Policy are as below:

i) Categorization of biofuels as "Basic Biofuels' viz. First Generation (1G) bio ethanol & biodiesel and "Advanced Biofuels' – Second Generation (2G) ethanol, bio-CNG etc. to enable extension of appropriate financial and fiscal incentives under each category.

ii) Expanding the scope of raw material for ethanol production by allowing use of sugarcane Juice, sugar containing materials like sugar beet, sweet sorghum, starch containing materials like corn, cassava, damaged food grains like wheat, broken rice, rotten potatoes, unfit for human consumption for ethanol production.

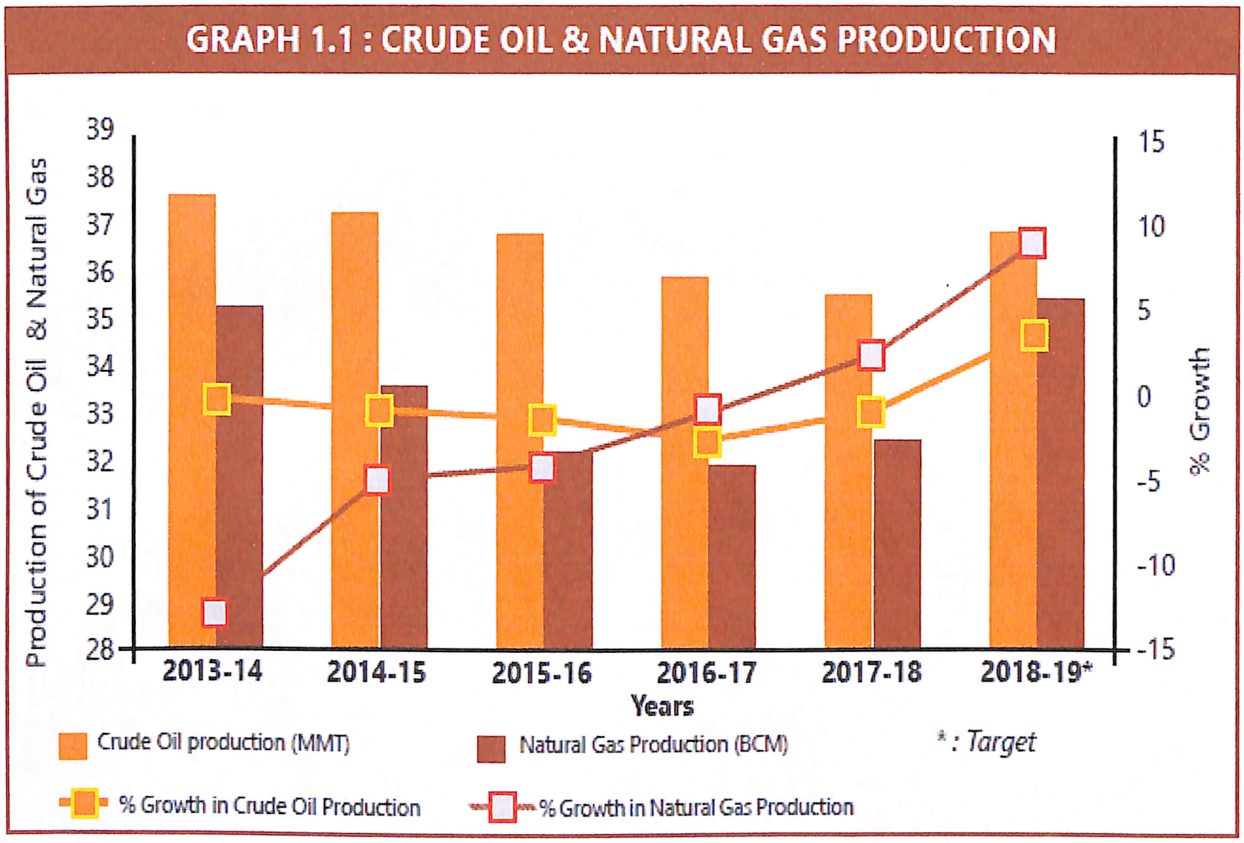
iii) The Policy allows use of surplus food grains for production of ethanol for blending with petrol with the approval of National Biofuel Coordination Committee.

iv) With a thrust on Advanced Biofuels, the Policy indicates a viability gap funding scheme for 2G ethanol Bio refineries of `5000/- crore in 6 years in addition to additional tax incentives, higher purchase price as compared to 1G biofuels. The World Biofuel Day 2018 was organised by Ministry of Petroleum and Natural Gas on 10th August, 2018 with Prime Minister addressing diverse gathering of participation including farmers, students, scientists, technology providers, etc.

Crude Oil and Natural Gas Production

The crude oil production during FY 2017-18 is at 35.68 MMT as against production of 36.01 MMT in FY 2016-17, showing a decline of 0.9%. 71.8% of crude oil production is by ONGC and OIL from nomination regime and remaining 28.2% of crude production is by Private/JVs companies from PSC regime. The projected crude oil production in FY 2018-19 is 37.01 MMT. Crude oil production during April-December, 2018 was at 25.94 MMT which was lower by 3.70% against 26.94 MMT during April-December, 2017. Shortfall in production by ONGC during FY 2017-18 was mainly due to delay in deployment of MOPUSagar Samrat, non-realisation of production from Integrated Development of B 127 Cluster due to delay in implementation, ESP related issues in NBP field of western offshore and increase in water cut in wells of Heera, Neelam & B-173 fields. Production by OIL is mainly from matured fields where decline rate encountered more than expected, less than planned contribution from work-over wells due to bandhs, blockades, miscreant activities which contributed to direct loss of production. Shortfall in production under PSC Regime was mainly due to shutdown at RJON-90/1 to 85 oil wells are closed due to high water cut, require WOJ etc., poor reservoir performance of Bhagyam field and wells of Panna-Mukta closed for riser line pigging & closure of certain wells owing to well integrity issues. Natural Gas production during the FY 2017-18 is at 32.65 Billion Cubic Meters (BCM) which is 2.36% higher than production of 31.90 BCM in FY 2016-17. 80.59% of natural gas production is by ONGC and OIL from nomination regime and remaining 19.41% of natural gas production is by Private/JVs companies from PSC regime. The projected natural gas production in FY 2018-19 is 35.60 BCM. The actual production of natural gas during April-December, 2018 was at 24.65 BCM which was lower by 0.15% against 24.69 BCM during April December, 2017. Shortfall in production by OIL was mainly attributed to less than planned production due to decline in associated gas production in Makum, Hapjan and Barekuri area and non-associated gas in few wells in Naharkatiya and Kusijan area. Gas production was also affected due to number of unscheduled shutdowns of plants of major gas customers like BCPL, BVFCL, NTPF & LTPS and various intermittent problems like bandhs, blockades in operational areas in Assam. Shortfall in production under PSC Regime was mainly due to underperformance of KG-DWN-98/3 due to closure of wells, lower reservoir pressure and no offtake by

major customers. The trend in the production of crude oil and natural gas is depicted below



Data analysis for Research

Financial Assistance : R&D and other Grants

Section 6 of Oil Industry (Development) Act, 1974, inter-alia, provides that the Board may render assistance for scientific & technological research useful to oil industry. Hydrocarbon Vision 2025 also envisages that sufficient resources may be made available for appraising the unexplored/ partly explored acreages through Oil Industry Development Board cess and other innovative resource mobilization approaches.

UPSTREAM SECTOR

In respect of OIDB grant in aid related to Upstream Sector, the OID Board in its 76th meeting held on 27.03.2014 decided that a Committee headed by DG, DGH with other members to be nominated by Chairman, OIDB may be constituted to identify and examine the R&D project(s) related to Energy Security for providing financial grant for their execution. Accordingly, a Committee for Utilisation of OIDB grants with Director General, DGH as Chairman and Secretary, OIDB, Director (Exploration), ONGC, Director-IIP, Dehradun, Director (R&D)-IOCL, Director (Tech)-EIL and Director General-Petro fed as Members.

The Committee examines the proposals in the first instance and gives its recommendations. The recommendations of the Committee are submitted to OID Board for taking a decision. The projects that are approved by OID Board with an outlay of more than Rs.25 lakh are sent to Central Government for conveying its approval before release of grant in terms of Rule 24(1)(ii) of Oil Industry (Development) Rules, 1975. Since inception, the OID Board/Central Government has approved more than 120 projects. Most of these projects have been completed and yielded considerable benefit to oil industry in terms of oil production, upgradation of technology and identifying the new areas for exploration.

Review of the Projects

A Sub-Committee headed by DG, DGH, comprising Secretary-OIDB, Director(E)-ONGC, Director-IIP Dehradun, Director (R&D)-IOCL, Director(Tech)-EIL and Director General- Petro fed or his nominee constituted by OID Board reviews the progress of the OIDB funded projects in the upstream sector from time to time. The recommendations of the Sub-Committee are presented before OID Board for consideration and appropriate directions for implementation of the projects in a more efficient manner wherever necessary.

R&D Projects under Upstream Sector : National Gas Hydrate Programme

Steered by the Ministry of Petroleum & Natural Gas and technically coordinated by Directorate General of Hydrocarbons (DGH), National Gas Hydrate Programme (NGHP) is a Consortium of E&P companies, namely ONGC, GAIL India Ltd & Oil India Ltd and national research Institutions namely National Institute of Oceanography (NIO), National Geophysical Research Institute (NGRI) and National Institute of Ocean Technology(NIOT).

The success of the National Gas Hydrate Programme Expedition-01 has established presence of gas hydrates in Krishna Godavari, Mahanadi and Andaman Basins. This has brought the Indian gas Hydrate Programme on the global map. The discoveries have stimulated widespread and intensive research in gas hydrates in the country as well as abroad. The consequent studies have also brought out a large number of publications and scientific data. As gas hydrates are still at the global research level and no commercial production from marine gas hydrates have been proven, these data and publications are of vital importance for further research in the field of gas hydrates.

The envisaged Scientific Research Volume project intends to capture all researches and scientific investigations in one single module enabling researchers to have a complete understanding of the progress of scientific studies carried out in the field of gas hydrates in the country. The Scientific Research Volume intends to stimulate further research and studies to the future scientists. The large volume of data generated during the NGHP Expedition-01 through national and international agencies will also provide the necessary insight for the future programs of the NGHP.

R&D Projects of Downstream Sector

The projects related to downstream sector are considered and recommended by Scientific Advisory Committee (SAC) on Hydrocarbons setup by the Ministry. These projects are primarily funded through CHT. The members representing SAC are eminent persons in various fields of Oil Industry. The tenure of this Committee is two years after which Ministry of Petroleum & Natural Gas reconstitutes it. Scientific Advisory Committee (SAC) on Hydrocarbons also reviews progress of R&D projects in the downstream sector in its meetings.

CHT coordinates the activities of SAC in identifying and funding of research projects for hydrocarbon sector. The 73rd Meeting of Scientific Advisory Committee (SAC) on hydrocarbons of Mop & NG was held on 7th October 2013 at Hyderabad. The following R&D projects proposals, post revision, were reviewed and approved for funding by CHT/OIDB:

Assistance to Technical Institutes/CSIR Laboratories

OIDB also provides assistance to educational institutes as well, for creating infrastructure for training and research. These institutions includes Indian Institute of Technology (IIT), Mumbai, Rajiv Gandhi Institute of Petroleum Technology etc. for carrying out various R&D activities for the development of oil industry.

The OIDB incurred the following expenditure on grants/schemes sponsored by Government of India/OIDB during the year 2016-17:

Rs. in crore

1	National Gas Hydrate Programmes -2	321.02
2	IOCL (R&D) INDAdeptG	35.88

National Gas Hydrate Programmes (NGHP)

During the year 2016-17, Oil Industry Development Board has provided grant of Rs.321.02 crore for National Gas Hydrate Programme – Expedition 2 Project. This project is steered by the Ministry of Petroleum & Natural Gas and technically coordinated by Directorate of Hydrocarbons (DGH).

NGHP is a consortium of National E&P companies, namely ONGC, GAIL, OIL, IOC and national research institutions like NIO, NIOT and NGRI. ONGC had studied the data of Krishna Godavari Basin (offshore), Cauvery Basin (offshore), Gulf of Mannar and Western offshore for assessing Gas Hydrate prospectively during the period 1998 to 2003. These studies provided technical support in formulating NGHP Expedition-01 programme, wherein 21 sites were drilled/cored in Indian offshore in 2006 using the ship Joides Resolution. Gas hydrates has been stimulating considerable interest globally as a future energy resource. Countries like US, Japan, Korea, China are making considerable advances. India has also embarked on this journey in 1997 with the formation of the National Gas Hydrate Programme (NGHP). India had completed the NGHP Expedition- 01 in 2006 and established the presence of gas hydrate on the east coast of India in the KG, Mahanadi and Andaman Basins.

The Steering Committee of NGHP approved the execution of NGHP Expedition-02 in the 15th meeting held on the 7th October, 2013. NGHP Expedition-02 is presently under execution and consists of LWD/MWD (Logging while drilling/Measurement while drilling), Conventional coring/ pressure coring, wireline logging, Vertical Seismic Profiling (VSP) and Modular Dynamic Testing (MDT) operations in KG and Mahanadi deep offshore areas with the aim of identifying sand dominated depositional systems within the Gas Hydrate stability zone. The cost of NGHP Expedition-02 shall be shared by OIDB (50%), ONGC (20%), OIL (10%), GAIL (10%) and IOCL (10%). The integration of the field and laboratory studies & pilot production testing will be carried out during NGHP Expedition-03.

Member organizations of the NGHP proposed a total of about 87 + locations in the Krishna Godavari Basin & Mahanadi Basin. These were reviewed by a team of national and international experts. Based on the review about 34 Primary and Alternate targets were identified. These targets fall in four geographical areas named 'A' in Mahanadi Basin, 'B', 'C' & 'E' in the Krishna- Godavari basin, from north to south along the east coast.

Two NGHP R & D projects under direct funding by OIDB have been approved and formalities for the release of funds to the execution organizations are at an advanced stage.

RESEARCH PROJECTS UNDER NGHP:

An R&D project on firming up of theoretical background on heat transfer was undertaken by ONGC & IIT Kharagpur. The results of the project were significant as it revealed that the heat transfer rates were very slow and hence the ultimate production rate by thermal stimulation will also be very slow. The results are of significant importance as it highlights the importance of other techniques like depressurizing & sequestration.

NGRI, in a research project under NGHP, has demonstrated core competency development by successfully carrying out experimental studies on synthesizing gas hydrates in the laboratory and studying basic properties using Raman Microphone.

Indian Oil Corporation Ltd. (R&D)

Indian Oil Corporation (Indian Oil) is India's largest commercial enterprise with a 33,000 strong work force currently has been meeting India's energy demands for over half a century. With a corporate vision to be 'The Energy of India' and to become 'A globally admired company. Indian Oil's business interests straddle the entire hydrocarbon value chain from refining pipeline transportation and marketing of petroleum products to exploration & production of crude oil & gas, marketing of natural gas and petrochemicals, besides forays into alternative energy and globalization of downstream operations.

Indian Oil accounts for nearly half of India's petroleum products market share 35% national refining capacity (together with its subsidiary Chennai Petroleum Corporation Ltd.) and 71% downstream sector pipelines through capacity. The Indian Oil Group owns and operates 11 of India's 23 refineries with a combined refining capacity of 80.7 MMTPA. The Corporation's cross country pipelines network, for transportation of crude oil to refineries and finished products to high demand centers, spans about 11,750 km. With a throughput capacity of 85.5 MMTPA for crude oil and petroleum products and 9.5 MMSCMD for gas, this network meets the vital energy needs of the consumers in an efficient, economical and environment friendly manner.

The corporation has a portfolio of leading energy brands that includes Indane LPG cooking gas, SERVO lubricants, XTRAPREMIUM petrol, XTRAMILE diesel, PROPEL petrochemicals, etc. Besides Indian Oil both SERVO and Indane have earned the coveted super brand status. Indian Oil (R&D) has developed a basket of technologies with unique identifying prefix "Ind".

The flagship technology INDMAX, developed by Indian Oil R&D has been successfully implemented at Paradip Refinery in December 2015 with an installed capacity of 4.17 MMTPA.

Indian Oil R&D has developed INDAdeptG process and proprietary adsorbent with the objective of reducing sulfur from cracked gasoline feed stocks for meeting BS-IV Sulphur specifications. The technology comprises two numbers of fixed bed reactors operated in swing mode of adsorption and regeneration, whose ultimate aim is to undergo deep desulfurization of gasoline under optimized operating conditions.

In this process, Sulphur in gasoline is being removed by Reactive Adsorption mechanism and after reaching the S-Breakthrough point; the adsorbent is regenerated under controlled conditions with lean air (1% O2 in N2) by oxidation of adsorbed sulfur and coke followed by activation with nitrogen-hydrogen mixture.

INDAdeptG technology is the result of extensive research work conducted by IOCL R&D Centre for about last 10 years. IOCL is now jointly licensing the technology along with Engineers India Limited. Two patents have been granted in United States & India on process and adsorbent composition.

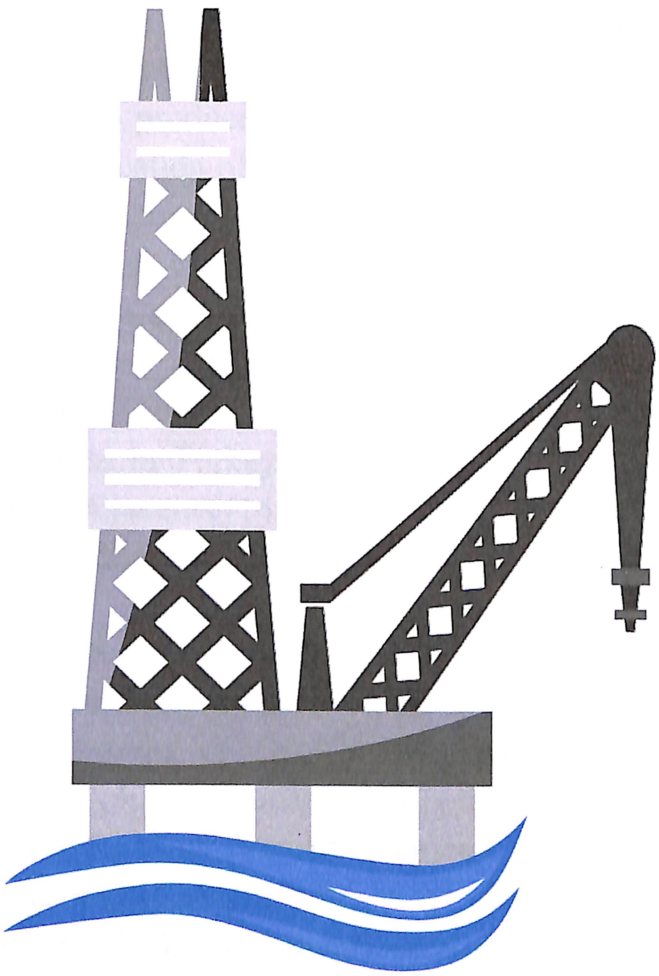
A demonstration unit of 35000 Metric Tons Per Annum capacity was successfully commissioned in January 2017 at Guwahati Refinery with total project cost of Rs.126.6 crore in which Rs.88.5 crore is being funded by Oil Industry Development Board as grant and remaining funding is by IOCL. The unit is currently upgrading heavy gasoline with product Sulphur of less than 50 ppm for production of BS-IV gasoline.

Rajiv Gandhi Institute of Petroleum Technology (RGIPT)

The Rajiv Gandhi Institute of Petroleum Technology (RGIPT) has been set up under an Act of Parliament (54 of 2007). The Institute is under the administrative control of Ministry of Petroleum & Natural Gas. The funding for construction of the institute's campus is being supported by Government of India through budgetary provision and grant from the Oil Industry Development Board. The recurring expenditure of the institute is met from the interest income from its endowment fund which is created for the contributions from the major Oil Companies (ONGC, IOCL, OIL, GAIL, BPCL and HPCL), besides collected from students.

RGIPT's objective is to create an educational and training Centre of excellence for catering to the technical and managerial talent requirement of the Petroleum sector. The academic activities of the Institute have commenced in the year 2008, from temporary campus at Rae Bareli and Noida. Currently, the following programs are conducted by RGIPT:

Chapter 4



Finding and Analysis

Sampling of Data

R & D and New Technology

Oil Companies have undertaken number of R&D Projects which have resulted in improved technology in upstream and downstream sector.

R&D BY INDIAN OIL CORPORATION LIMITED (IOCL)

The year was marked by deployment of major technologies developed by R&D Centre at Indian Oil refineries. An Octamax unit was commissioned at Mathura Refinery to produce high-octane fuel for BS-VI gasoline pool. The unit is a true amplification of the 'Make in India' drive as the technology was conceptualised, engineered and executed by R&D team and Mathura Refinery. The DHDT Unit at Gujarat Refinery based on indDiesel technology developed by R&D Centre was implemented during the year 2017-18. The unit produces Diesel meeting BS-VI norms for Sulphur. The flagship innovation of R&D Centre, INDMAX was adjudged winner in 22nd World Petroleum Congress in Turkey. Indian Oil R&D Centre filed for 82 patents and was granted 54 patents (14 Indian and 40 overseas) during the year 2017-18. Indian Oil now has 611 active patents in its kitty.

R&D BY OIL & NATURAL GAS CORPORATION LIMITED (ONGC)

ONGC has established separate R&D institutions to undertake specific activities in key areas of Exploration, Drilling, Reservoir Management Production Technology, Ocean Engineering and Health, Safety and Environment (HSE) Management. Regional laboratories have also been established at various Assets and Basins of ONGC to support these institutes. ONGC through its R&D Institutes is pursuing adaptation/customization and applied research. ONGC has also established Gas Hydrate Research & Technology Centre (GHRTC) at ONGC, Panvel and is functional since 14th September, 2016 and studies pertaining to fundamentals of gas hydrates, research for exploration and potential exploitation of gas hydrates, techno-economics and commercialization of gas hydrates in a safe and environment friendly manner are being carried out. In the year 2018-19, ONGC carried out R&D work for conventional and Nonconventional Hydrocarbons includes studies undertaken at different Institutes of ONGC. As per DPE guidelines,

one project on "Production enhancement through innovative stimulation in low pressure wells' has been selected and included in the MOU with MOP & NG for 2018-19 which is likely to be completed by 31st March, 2019.

Industry-Academia Participation:

To create a strong Industry-academia interface, ONGC has initiated the "PAN IIT Collaborative Research Program" with seven IITs viz. IIT Kharagpur, Delhi, Kanpur, Mumbai, Madras, Roorkee and Guwahati. ONGC's R&D Institutes and the IITs shall jointly undertake advanced research and development projects for the E&P sector of the country.

R&D Initiatives by ONGC in the field of IOR/EOR activities: ONGC puts efforts on continuous basis for performance analysis of fields and suitable corrective measures are taken for improvement in the field performance and recovery. The salient measures including the use of the state of art technology to enhance global recovery factor are as under:

a) Simulation studies for development of Basal Clastics of Mumbai High.
b) Integrated GCM for Cluster-7 and WO-24 area of Mumbai High including recent discoveries.
c) Low Salinity water flood (LSWF) as EOR pilot for L-III reservoir of Mumbai High South.
d) Feasibility studies for CO2 EOR.
e) Borholla Gas Injection Scheme & immiscible gas injection in Lakwa field of Assam.
f) Studies for Northern part of Balol and Southern part of Lanwa of Mehasana.

R&D BY GAIL (INDIA) LIMITED

Natural Gas business has undergone a number of far-reaching developments in the last decade and these changes brought lot of business opportunities. R&D plays a vital role in leveraging these business opportunities for providing a wider, more sustainable mix of energy resources for the country's economic growth. In this direction, GAIL continuously strives to emphasis on R&D for making affordable clean energy available across the length and

breadth of the nation through integrating and mainstreaming emerging technologies. The Major Research themes pursued in this year include works on Bio-based fuels, clean energy development, CO2 utilizations and Pipeline Integrity Management.

R&D BY OIL INDIA LIMITED (OIL)

R&D activities are undertaken primarily with the focus of solving field related problems with regards to increasing oil & gas production. R&D Department carries out applied research to develop in-house remedial solutions in the areas of petroleum geochemical exploration, enhanced oil / improved oil recovery, oil field chemicals, flow assurance, water shut off, well stimulation, petroleum microbiological intervention to mitigate microbial corrosion and for microbial enhanced oil recovery etc. Majority of the projects during the current year are continuation of the earlier projects and studies. The continued ongoing projects and new projects/studies undertaken during the year 2018-19 are as under:

a) Reservoir fluid identification through Geochemical Analysis of Sidewall cores
b) Rock-Eval pyrolysis study of core samples for study of source potential
c) Determination of Source Rock potential and geochemical characterization of the wells from KG Basin Area
d) Characterization of crude oils for understanding the flow and organic deposition behavior in OIL's operational areas of Assam
e) AAQM & Stack Emission Monitoring
f) Geochemical characterization of pipeline deposits in OIL's crude oil transportation pipelines
g) Routine Clay mineralogical study by XRD of Sidewall core, Conventional core and Drill cutting samples from different locations
h) Synthesis and extraction of surfactants from natural resources and their characterization for application in enhanced oil recovery
i) Carbonate water injection (CWI)
j) Laboratory data generation in connection with simulation study for ASP flooding in HJN 2D Block

k) Comparative study of Alkali and polymer flooding with the ASP formulation developed
l) Pilot Polymer flooding project in NHK 11D+18 block
m) Mitigation of corrosion problems
n) Corrosion Monitoring in Crude Oil and Gas Pipelines
o) Optimization of Corrosion Inhibitor Dosage for Acidization jobs
p) Development of new solvent formulation to treat near well bore damage
q) Designing of suitable solvent formulation for removal of excessive wax deposition in Duliajan Digboi branch pipeline
r) Designing of Suitable formulation for Well Stimulation Jobs
s) Development of testing protocol for analysis of pipeline pigging residue
t) Development and Field Trial of Essential Oil as Bactericide
u) Field Trials of In-house Bioremediation technology
v) Bacteriophages as biocontrol agent for Sulphate Reducing Bacteria in Oil and Gas Industry
w) Scale-up of in-house developed MEOR technology for field implementation
x) Periodic monitoring of corrosive bacterial population in Kathaloni OCS and ITF Tengakhat and Evaluation of Bactericide efficacy, generation of dosage plan for their control
y) Development of Low Temperature Demulsifier (LT – OSD)
z) Development of a "Wax Dispersant' additive for Branch line and Main line crude oil

Benefits Achieved for Enhancing Oil & Gas Production through R&D

R&D Department of Oil India Limited at Duliajan, Assam is striving for developing techno-economically feasible solutions to the problems encountered by OIL in its daily operations in the field of exploration, drilling, production, transportation of crude oil, gas, and pollution control and above all to introduce new technologies for improving operational efficiency. All the R&D studies and the projects initiated have been utilized in E&P activities by OIL.

Pricing

The pricing of petroleum products was brought under Administered Price Mechanism (APM) effective July, 1975 when the pricing of petroleum products was shifted from import parity principles to cost plus principles. Under APM (1975 to 2002) various oil pool accounts were maintained with the objective to i) ensure stability in selling price; ii) insulate consumers against international price fluctuations; and iii) subsidization of consumer price of certain products like kerosene for public distribution and domestic LPG by cross subsidization from other products like petrol, Aviation Turbine Fuel (ATF) etc.

Effective 1st April, 2002, the APM was dismantled and the Government decided to provide subsidy on sale of PDS kerosene and domestic LPG at specified flat rates. To administer these budgetary subsidies, the Government formulated a 'PDS Kerosene and Domestic LPG Subsidy Scheme, 2002'. Under this scheme it was decided that these subsidies will be phased out in 3-5 years.

The sharp rise and volatility of prices of oil and petroleum products in the international markets since 2004 became a matter of global concern. The Indian basket of crude oil, which averaged about $23 per barrel (bbl) at the time of dismantling of APM in March, 2002 and $36/bbl in May, 2004 went up to an average of $85.09/bbl during 2010-11. The average price of Indian basket of crude oil further increased to $111.89/bbl. during 2011-12. The prices of crude oil, after continuously being at the level of more than $100/bbl for over three years, started falling sharply during the second half of 2014. As a result, the average price of Indian crude oil basket during 2015- 16, 2016-17 and 2017-18 was recorded at $46.17/ bbl, $47.56/bbl and $56.43/bbl respectively whereas the same is at $71.28/bbl during the current financial year 2018-19 (up to 15th January, 2019). The trend of Indian basket of crude oil during 2002-03 to 2018-19.

Even though APM was dismantled effective 1st April, 2002, since 2004, the consumers of sensitive petroleum products viz. petrol (decontrolled w.e.f. 26th June,2010), diesel (decontrolled w.e.f. 19th October, 2014), PDS Kerosene and Domestic LPG are being insulated from the impact of high international oil prices by the Government / Oil Companies. The retail selling

price of the sensitive petroleum products are kept lower than what is warranted by the international oil prices. This results in under recoveries of Oil Marketing Companies (OMCs) with corresponding subsidization of prices for the consumers. The trend of under recovery in the two sensitive petroleum products i.e. PDS Kerosene and subsidized Domestic LPG.

PETROL AND DIESEL

The Government has made the prices of petrol and diesel market determined effective 26th June, 2010 and 19th October, 2014 respectively. Since then, the OMCs take decision on prices of petrol and diesel in line with changes in international market and domestic conditions. The OMCs have not only increased but also decreased the prices of petrol and diesel in line with changes in international prices and rupee dollar exchange rate. Effective 16th June, 2017, daily pricing of petrol and diesel has been implemented in the entire country resulting in closer alignment with the international prices.

DOMESTIC LPG (SUBSIDISED)

In order to insulate the common man from the impact of rise in international oil prices, the Government continues to modulate the effective price to consumer of Domestic LPG (up to cap of 12 cylinders per annum to each household). The prices of non-subsidized Domestic LPG are however determined by the OMCs in line with changes in the international markets.
Effective 1st January, 2015, the 'PAHAL (DBTL) Scheme 2014' has been implemented in the entire country wherein the subsidy on Domestic LPG is being transferred to the eligible consumers directly to their bank accounts.
Based on the refinery gate price as on 1st January, 2019, the consumers are getting a total DBTL subsidy of `194.01/Cylinder (including cash compensation towards uncompensated costs charged in the RSP) under the DBTL scheme at Delhi. Details of cash compensation from January 2018-19.

PDS KEROSENE

In order to insulate the common man from the impact of rise in international oil prices, the Government continues to modulate the retail selling prices of PDS Kerosene. The consumers continue to get the product at subsidized rates and the OMCs are incurring under recovery on its sale. Effective 1st October, 2016 Direct Benefit Transfer in PDS Kerosene Scheme 2016 (DBTK) was implemented in 4 districts in Jharkhand State. This scheme was extended to another 6 districts effective 1st April, 2017 and the entire state of Jharkhand was covered under DBTK effective 1st July, 2017.

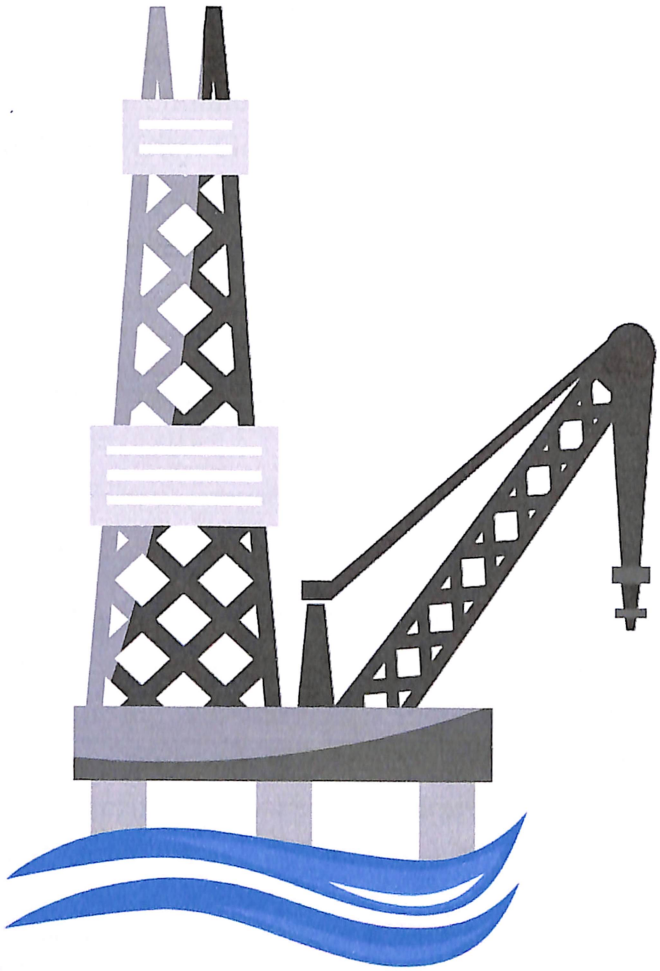
In the year 2016-17 there was an overall reduction of 20% in the PDS Kerosene allocation given to the States in comparison to the allocation of 2015-16. In the year 2017-18 there was an overall reduction of 28% in the PDS Kerosene allocation given to the States in comparison to the allocation of 2016-17. The allocation for the year 2018-19 has been further reduced by 12% in comparison to the allocation of 2017-18. Over and above the above reduction in the PDS Kerosene allocations, till date, 12 State Governments/UTs (Karnataka, Haryana, Telangana, Nagaland, Chandigarh, Gujarat, Andhra Pradesh, Bihar, Goa, Puducherry, Rajasthan and Maharashtra) have voluntarily surrendered their PDS kerosene allocations under DBTK Scheme. As on date, 8 State Governments/UTs have already cut down their PDS Kerosene allocation to nil. Based on the refinery gate price effective 1st January, 2019, the OMCs are currently (as on 16th January, 2019) incurring under-recovery of `7.78 per Litre on PDS Kerosene at Mumbai.

PRICING OF CRUDE

OIL Indian basket of crude oil represents the average of crude oil processed by Indian refineries in the ratio of actual processing of sweet crude and sour crude in the immediate preceding year. For sweet crude oil price, the daily Platts assessments for benchmark crude oil "Brent' is considered. For sour crude oil, the average of Platts assessment for benchmark crude oil "Dubai' and "Oman' is considered. During 2017- 18, Indian refineries processed 74.77% sour crude and 25.23% sweet crude. Therefore, for 2018-19, Indian basket of

crude oil represented the daily price assessment by Platts for benchmark under average of "Dubai' and "Oman' (sour crude) and "Brent' (sweet crude) in the ratio of 74.77:25.23. Domestic crude oil producing companies are also offered international crude oil prices benchmarked to international crude that corresponds to their crude assay. Import of crude oil takes place at international prices.

Chapter 5



Interpretation of Results

Interpretation of Results

Creation of competitive Gas market in the country

Natural Gas is recognized as a cleaner and environment friendly energy source. Government is focused to promote the usage of natural gas as a fuel/feedstock across the country to move towards a gas based economy in the long run. Government is taking necessary policy and regulatory steps to attract investment in enhancing domestic gas production, gas infrastructure including pipelines, City Gas Distribution (CGD) networks and Liquefied Natural Gas (LNG) import terminals. The Government is exploring means for establishing a gas market where natural gas can be traded freely and supplied. It is expected that free gas market will attract new investment in Exploration & Production (E&P) activities so as to increase gas availability and accessibility to all at market price.

Refining

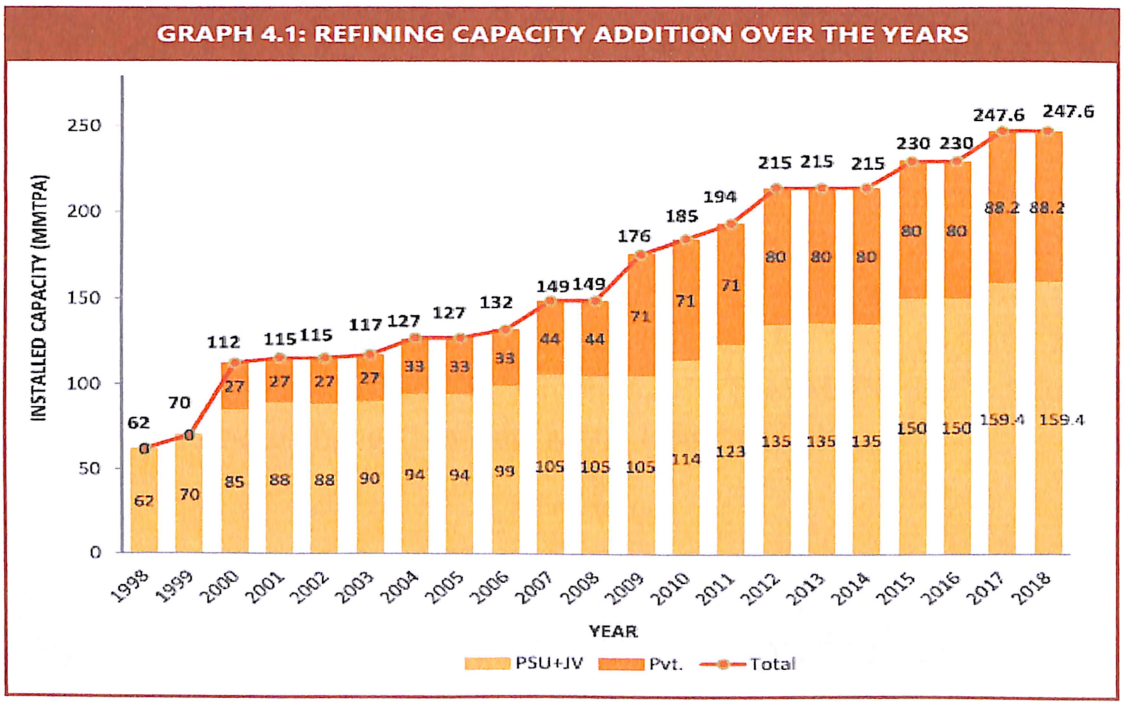
Refining Capacity

The Indian refining industry has established itself as a major player globally. India is emerging as a refinery hub and refining capacity exceeds the demand. The country's refining capacity has increased from a modest 62 Million Metric Tonnes Per Annum (MMTPA) in 1998 to 247.566 MMTPA at present, comprising of 23 refineries – 18 under Public Sector, 3 under private sector and 2 in Joint Venture (JV).

The refining capacity is not only sufficient for domestic consumption but leaving a substantial surplus also for export of petroleum products. Since FY 2001-02, India is a net exporter of petroleum products. During FY 2018-19 (From April, 2018 to November, 2018), the country has exported 41.7 Million Metric Tonnes (MMT) of Petroleum products worth US Dollars 27.5 Billion (provisional). India is the largest exporter of petroleum products in Asia since August 2009.

Refining Capacity Addition over the Years

The graphical representation of the refining capacity addition over the years shown in Graph



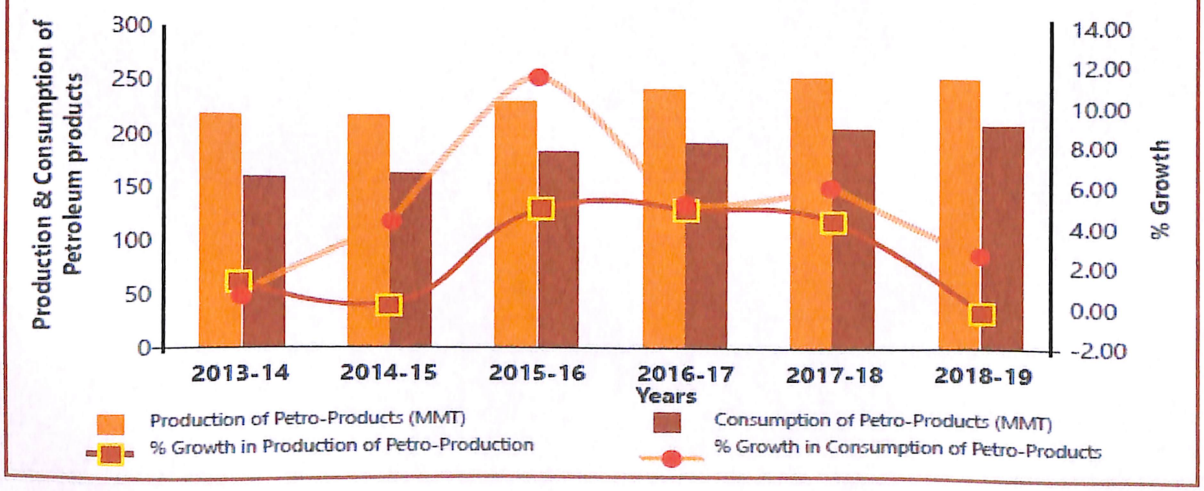
Expansion of Existing Refineries

The Capacity expansion planned by 2022 is as under:-

Refinery Performance Improvement

Indian public sector refineries are equipped with modern technologies and have continuously upgraded the technologies in line with the International trend and as per the requirement. Indian refineries have accorded top priority to reduce the energy consumption through various energy conservation measures. The Centre for High technology (CHT) carried out a Performance Benchmarking Study of public sector Refineries through M/s Solomon Associates for consecutive cycles 2010, 2012, 2014, 2016 and the study for 2018 has been initiated. Adoption of modern technologies by Indian refineries and energy conservation measures has helped in increasing the distillate yield, quality upgradation of petrol/diesel and reduction in Specific energy consumption (MBTU/bbl/NRGF-MBN). The PSU refineries' average distillate yield (wt% on crude) has improved from 73.3% in FY 2005-06 to 79.7% in FY 2017-18 as depicted in Graph 4.2A. Similarly, the industry average MBN has come down from 76.4 (Old) in FY 2005-06 to 63.3 (New) in FY 2017-18 as depicted in Graph 4.2B. The MBN methodology and reporting has been changed to New MBN from 2015- 16.

GRAPH 1.3 : PRODUCTION AND CONSUMPTION (INDIGENOUS SALES) OF PETROLEUM PRODUCTS



International Cooperation & Engagement

In pursuit of new avenues and to fortify existing bilateral cooperation in the hydrocarbon sector, India witnessed heightened level of engagements with the neighboring countries under the umbrella of 'Neighborhood First' and our policy shift from 'Look East' to 'Act East'. There has been a conscious effort to take the neighboring countries along and share our developmental experiences, particularly in the field of energy. It has become a significant vehicle to promote cooperation in our neighborhood, one that aims at strengthening regional self-reliance. Ensuring greater energy security has been another objective that has been made possible by forging bonds of friendship in our extended neighborhood and beyond.

The Neighborhood First Policy of the Government is designed to underline the greater importance attached to relationships in South Asia. South Asia struggled with development of connectivity and shared developmental endeavors for decades. That has started to change and the more positive sentiment is being harnessed to accelerate greater economic cooperation. Addressing growing energy demands is of great significance as it directly impacts both growth prospects and quality of life. India can make the difference for the entire region not just due to its geographical centrality but also as it can bring to bear scale and capacities in a manner that would benefit its neighbors.

KEY HIGHLIGHTS OF ACTIVITIES PURSUED to strengthen INTERNATIONAL COOPERATION DURING FY 2018-19

Engagement with Nepal

a. India has been supplying all of Nepal's petroleum product requirements since 1970s. The contract between Indian Oil and Nepal Oil Corporation was renewed for another five years in March, 2017.
b. To make the supplies more weather-proof, efficient and cost effective, Prime Ministers of India and Nepal witnessed the groundbreaking of a 69 km petroleum product pipeline from Motihari in India to Amlekhgunj in Nepal in April this year. Since then over 70% of the pipeline work has already been completed.

c. Indian companies are in the process of setting up a petroleum skill development Centre in Nepal.
d. A delegation led by Minister of Petroleum & Natural Gas, Shri Dharmendra Pradhan, visited Nepal from 28th to 29th September, 2018 to discuss issues related to Oil and Gas.

Engagement with Bangladesh

a. The ground breaking of Indo-Bangla Friendship Pipeline (IBFPL) was witnessed by Prime Minister Narendra Modi and Prime Minister Sheikh Hasina in September, 2018. India is constructing a 130 km long pipeline from Siliguri in India to Parbatipur in Bangladesh which will supply 1 Million Metric Tonne (MMT) of diesel to Bangladesh Petroleum Corporation for 20 years.
b. Till the pipeline becomes operational, Numaligarh Refinery is supplying diesel by rail rakes through the Radhikapur-Birol Rail route.
c. Indian companies are also working on building a land based Liquefied Natural Gas (LNG) Terminal to augment supply of natural gas to Bangladesh as well as a pipeline to the Jessore-Khulna power plant across the Panitar - Satkhira border points on the Indian and Bangladeshi side respectively. The pipeline will supply R-LNG from upcoming Dhamra LNG terminal in Odisha.
d. As a goodwill gesture, India supplied 20,000 cooking stoves and kerosene oil to displaced persons in the Cox bazaar area.
e. India is trying to work out modalities with Bangladesh for supplying LPG from its storage facilities in Chittagong to demand centers in Tripura.

Engagement with Myanmar

a. The 1st India-Myanmar JWG on oil and gas sector was held in Nay Pyi Taw, Myanmar during 7th to 8th March, 2018.
b. Minister of Petroleum & Natural Gas, Shri Dharmendra Pradhan held a meeting on 4th October, 2018 with H. E. U. Win Khaing, the Union Minister for Construction, Electricity and Energy of Myanmar. The Myanmar Minister was on an official visit to India to attend the first

General Assembly of International Solar Alliance (ISA). Both Ministers expressed their keenness to work towards strengthening the bilateral engagements in the hydrocarbon sector and make it one of the important areas of bilateral cooperation between both the countries.

c. Numaligarh Refinery is working with interested parties in Myanmar for supplying diesel to Myanmar by land route across the Moreh-Tamu border to reduce logistical costs in ferrying petroleum products from Yangon to the North Eastern parts of Myanmar. d. IOCL is working on possibilities of implementing petroleum sector infrastructure projects

d. IOCL is working on possibilities of implementing petroleum sector infrastructure projects

Engagement with Sri Lanka

a. IOCL Lanka, which is a subsidiary of IOCL, has 43.5% of the total market share and is, therefore, a major stakeholder in the oil industry of Sri Lanka.
b. India is creating an LNG Terminal in partnership with a Japanese Company in Sri Lanka. There is also a proposal to develop City Gas Distribution (CGD) and Compressed Natural Gas (CNG) market & infrastructure in Sri Lanka.

Engagement with Bhutan

a. India continues to strengthen the engagements with Bhutan and supplies full requirement of petroleum products of Bhutan.
b. The Government of Bhutan is planning to extend 100% LPG coverage by end 2018 from its current penetration of nearly 38%. This additional product demand is envisaged to be supplied from the refineries in Assam.
c. India is also working with Government of Bhutan to share the experience of successfully implemented Pradhan Mantri Ujjwala Yojna (PMUY) for implementation in Bhutan.

Engagement with Mauritius

a. India continues to be a reliable supplier of 100% of petroleum product requirements of Mauritius through Mangalore Refinery and Petrochemical Ltd (MRPL) since 2006.
b. IOCL has been present in the energy sector of Mauritius since 2004 covering retail, bunkering, lubricants and consumer sales. It is the leading supplier of Jet Fuel in Mauritius.
c. In order to harness the strategic locations of Mauritius as a base for bunkering the exports to countries of East and South East Africa, IOCL and EIL along with STC of Mauritius are in are in the process of setting up petroleum storage and bunkering facilities in Albion.

Keeping pace with the expanding comprehensive strategic partnership with countries of India's extended neighborhood such as Saudi Arabia, UAE and Iran some major landmarks have been achieved in the oil and gas sector.

Engagement with Saudi Arabia

a. Saudi Arabia is an important country for India. It is today the second largest exporter of crude oil to India. India buys nearly 18 % of annual requirement of crude oil from Saudi.
b. Minister of Petroleum & Natural Gas, Shri Dharmendra Pradhan held a bilateral meeting with Saudi Oil Minister, Khalid Al Falih during February, 2018. During the meeting, Shri Pradhan discussed details of various investment opportunities in India in downstream and upstream sectors. b. Engaged with Saudi Aramco for setting up world's largest single location refinery. Saudi Aramco, along with ADNOC of UAE, have signed an MoU with the Indian promoters of Ratnagiri Refinery and Petrochemical plant. The estimated investment for this 60 MMTPA plant is around US $ 44 billion.
c. The Government of India has been strongly taking up the issue of high crude oil price and the issues of Asian Premium and balanced price, bilaterally with crude oil producing countries such as Saudi Arabia and with OPEC.

d. Prime Minister, on 30th November, 2018, during his meeting with Prince Mohammed Bin Salman (MBS) of Saudi Arabia in Buenos Aires, Argentina had strongly taken up the issue of high crude oil prices and also the issue of Asian Premium. Prince of Saudi Arabia assured PM that Saudi Arabia will seriously consider India's consider and work with India in this regard.
e. Following Prime Minister's meeting with Prince of Saudi Arabia, there has been a reduction in the premium charged to Asian market on grades of crude oil sold by Saudi Arabia. On comparison with the current months the premium has been reduced by approximately US$ 1 to 1.5 per barrel for different crude varieties.
f. Approximate saving for January, 2019 was US $ 72 million and presuming that Asian Premium remains at January, 2019 level – savings for First Quarter of 2019 will be US$ 218 million which would be a saving of `1544 crore and this saving is passed on to the consumers with reduction in prices of products.
g. During a recent OPEC meeting, Mr. Khalid Al Falih, the Saudi Energy Minister, stressed that the organization will "seriously consider' Indian Prime Minister's views on oil pricing before a decision is taken on production cuts during the meeting.

Engagement with UAE

The year 2018 was a landmark year for India and UAE which has transformed the energy relationship from buyer-seller to the level of strategic partners in the energy sector. 3 concrete milestones have been achieved in the year which include:

a. A Restated Agreement on Oil Storage and Management was signed between ISPRL and ADNOC in February, 2018 for storing crude oil by ADNOC in Cavern A of Mangluru SPR. The agreement was implemented with ADNOC storing 5.86 Million Barrels of crude oil. The first consignment was received in May, 2018, second consignment received in October, 2018 and the final consignment received in November 2018. Thus, ADNOC has completed filling of crude oil in

Mangaluru SPR facility thereby successfully implementing the first PPP model in the SPR programme.

b. On 8th November, 2018, Cabinet approved filling of crude oil in Padur SPR facility by overseas National Oil Companies (NOCs) on the key principles of the 'ADNOC Model' as used for filling Cavern-A at Mangaluru SPR facility. Subsequently, ISPRL signed MoU in Abu Dhabi with ADNOC on 12th November, 2018, to explore possibility of storing crude oil at Padur SPR facility.
c. Acquisition of 10% PI in Lower Zakhum offshore field by Indian Consortium comprising of ONGC Videsh Ltd., Indian Oil Corporation Ltd. and Bharat Petro Resources Ltd. in February, 2018. The average share for India will be 1.75 MMTPA for next 40 years. Total cumulative share will be 70 MMT.
d. Partnering of ADNOC in the Ratnagiri Refineries and Petrochemical project (RRPCL) along with Saudi Aramco. The MoU between ADNOC and Saudi Aramco was signed during June, 2018.
e. A delegation led by Shri Dharmendra Pradhan, Minister for Petroleum and Natural Gas and Skill Development & Entrepreneurship, visited UAE from 11th to 12th November, 2018 to Attend Abu Dhabi International Exhibition and Conference (ADIPEC).

Engagement with Iran

a. Iran is an important neighbor in the region and has been an important source of crude oil for India. It is the 3rd largest exporter of crude oil to India.
b. Most of Indian refineries are reliant for technical and commercial reasons on the Iranian crude oil.
c. The USA, on 8th May, 2018, unilaterally announced that it was walking out of the JCPOA and imposing sanctions on Iran from 5th November, 2018, on countries engaging in trade with Iran, including in the energy sector.
d. The Government is strongly committed to provide affordable energy to our citizens and therefore, India had strongly taken up with USA for continued sourcing of Iranian crude oil.

e. After several rounds of negotiations, on 5th November, 2018, USA announced exemption from sanction to eight countries, including India, for sourcing of crude oil from Iran.
f. India has also worked out a mechanism of 100% Rupee payment for trade with Iran, including for import of crude oil from Iran. Government's approach towards energy diplomacy has been simple - diversify sourcing; bargain for better terms; find new markets; collaborate with countries that are similarly placed; and seek investments. Government to-Government dialogues have been stepped up and with the synergy of external affairs ministry and Indian missions, there have been unprecedented milestones which have been achieved towards ensuring energy security.

Engagement with USA

a. In an effort to reduce over reliance on few geographies for crude supplies, India has further diversified crude sourcing by importing crude from non-traditional sources such as the USA since October, 2017.
b. More than 30 million barrels of US crude have been imported by Indian public sector refiners till January, 2019 which is equivalent to a trade value of approximately $ 2 billion.
c. Import of crude from the US is likely to go up much further in 2019 once port and pipeline infrastructure in the US gets completed.
d. India also has investments in the oil and gas sector in the USA to the tune of over US$ 4 billion, in the conventional and unconventional hydrocarbons.
e. GAIL has a long-term contract for LNG import from US which is equal to US $ 2 billion per year.
f. In order to further strengthen the energy relations, India launched Strategic Energy Partnership with USA in April, 2018. 1st Meeting of the India-US Strategic Energy Partnership was held on 17th April, 2018 in New Delhi. Indian delegation was led by Shri Dharmendra Pradhan, Minister (PNG) and US delegation was led by Mr. Rick Perry, Secretary Energy.
g. It has opened a new chapter in our bilateral energy engagements. This was a follow up of the bilateral meeting between Prime Minister Narendra

Modi and President Donald Trump in July, 2017 in which both discussed trade in the energy sector.

Engagement with Russia

a. Russia has been India's time tested partner in the oil and gas sector. Our historic hydrocarbon relationship with Russia goes back to 1970s when a team of Soviet oil and gas experts helped ONGC to explore and strike oil in Indian waters and the joint efforts led to the discovery of Bombay High, which even today remains India's biggest oil and gas field.
b. We have strengthened our hydrocarbon engagement and there is an 'Energy Bridge' between our two countries.
c. Russia is our largest oil and gas investment destination with over US $ 15 billion investments so far.
d. In 2016 our PSU companies invested over US $ 5.4 billion in acquiring quality producing oil and gas assets in Russia.
e. Rosneft's investment of nearly US $ 13 billion in Vadinar refinery is the largest FDI investment in India in the Indian oil and gas sector.
f. GAIL has contracted 2.5 MMTPA of LNG from Gazprom on a long term basis which works out to be nearly US $ 2 billion per annum. The first cargo of Russian LNG was received on 4th June, 2018 at Dahej.

Engagements with International Organizations

The last few years have also witnessed increasing engagement of India with International oil and gas organizations.

a) **Engagement with IEF India chaired the International Energy Forum (IEF)** over 2016-18 which comprises countries contributing 90% to global energy consumption and production. The leadership of this organization culminated in India's hosting the 16th edition of the International Energy Forum Ministerial meetings in New Delhi. Prime Minister Shri Narendra Modi inaugurated the event on 11th April, 2018 which saw participation of about 40 Ministers, 10 Heads of International organizations about 30 CEOs. External Affairs Minister, Smt. Sushma Swaraj delivered the

valedictory remarks on 12th April, 2018. The theme of IEF 16 was "The Future of Global Energy Security: Transition, Technology Trade and Investment' focused on how global shifts, transition policies and new technologies influence market stability and future investment in the energy sector.

b) Engagement with IEA

i) India also became an association country in Paris based International Energy Agency in March, 2017.

ii) The hotline was re-established and the First test conversation on hotline took place on 22nd June, 2017 Dr. Fatih Birol, Executive Director, IEA made a call to JS(IC) to reactivate hotline. The hotline will be used in case of any supply side disruption or threats of any such disruption. The hotline will also be used to convey urgent messages from time to time.

iii) IEA organized meetings of Standing Group on Emergency Question and Standing Group on the Oil Market and special Workshop on the Oil Stockholding Workshop for India during 20th – 22nd March, 2018 in Paris.

iv) India became member of the Advanced Motor Fuels Programme on 9th May, 2018.

v) India-IEA Joint Workshop on Oil Stockholding Strategy for India was conducted on 29th August, 2018 at Delhi. The workshop focused on the Importance of Oil Stocks in Energy Security and IEA's role and coordination.

vi) Executive Director of IEA, Dr. Fatih Birol, made positive references to Indian oil and gas sector in IHS CERA Week in Houston in March, 2017 and highlighted India's role in the increasing global gas demand and trends towards a transparent, flexible and competitive gas market

in the LNG Producer – Consumer dialogue in Tokyo during October, 2017.

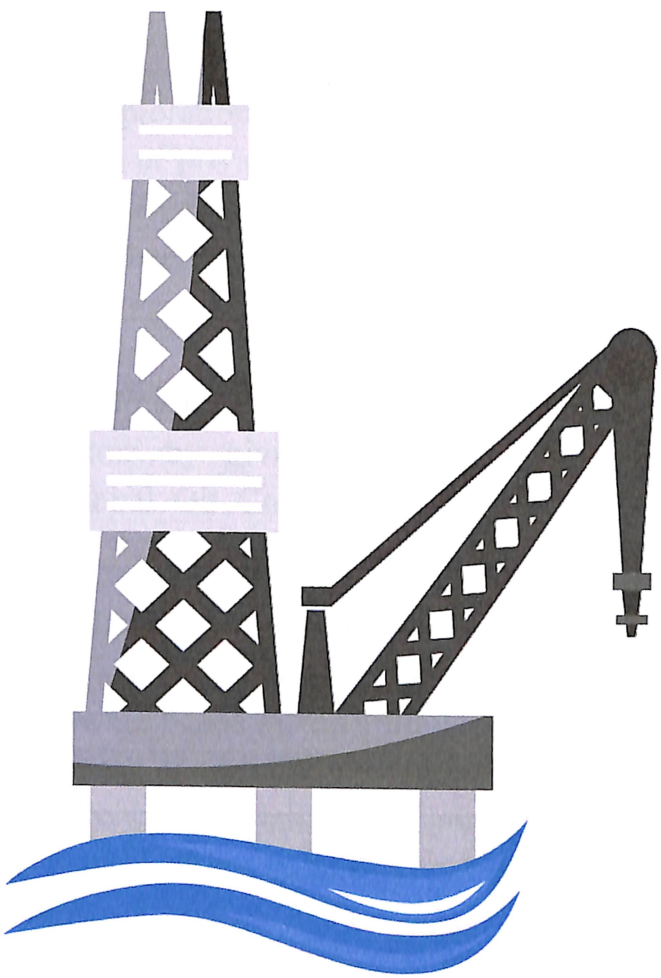
c) **Engagement with OPEC**

i) Shri Dharmendra Pradhan, the Minister of Petroleum & Natural Gas and Skill Development & Entrepreneurship on 14th June, 2018 met with the Ambassadors from OPEC countries to India. During the meeting Minister expressed his concern about rising crude oil prices and its negative impact on consumers across the world, particularly in India.

ii) A delegation led by Minister of Petroleum and Natural Gas and Skill Development & Entrepreneurship, Shri Dharmendra Pradhan, visited Vienna, Austria to Attend 7th OPEC International Seminar and Germany to visit German SPR Management entity from 20th – 22nd June, 2018. During the visit in Vienna Shri Pradhan delivered a key note speech on "Sustainable Global Energy Future'.

iii) The 3rd India-OPEC Institutional Dialogue held in New Delhi on 17th October, 2018 to discuss important issues relating to oil and gas sector. The Indian delegation led by Minister PNG and the OPEC delegation led by Secretary General.

Chapter 6



Conclusion and Scope For Future work

Conclusion and scope for Future work

The energy demand will rise with social and economic development in the country. The country is dependent on imports for about 83% of its crude oil requirement and to the extent of about 47% in case of natural gas. In order to bridge the gap between energy supply and demand, it is imperative to accelerate the exploration and production activities in the country.

The reforms in Exploration and Production (E&P) sector were initiated through participation of private and foreign companies in oil and gas sector in 1991 when 28 discovered fields (Pre-NELP Discovered Field) were auctioned during 1991-93. Further, 28 Exploration Blocks were awarded between 1990 -1997 known as Pre-NELP Exploration Blocks. Subsequently, after implementation of New Exploration Licensing Policy (NELP) and Coal Bed Methane (CBM) Policy in 1997- 99, the level playing field was provided to the private investors by giving the same fiscal and contract terms as applicable to National Oil Companies (NOCs) for the offered exploration acreage.

In a major policy drive to give a boost to petroleum and hydrocarbon sector, the Government has unveiled a series of initiatives. The reforms in hydrocarbon sector are based on the guiding principles of enhancing domestic oil and gas production, increasing investment, generating sizable employment, enhancing transparency and reducing administrative discretion. Government has formulated path breaking policies to revolutionize the E&P sector which inter-alia includes –

» Gas Pricing Reforms

» Policy Framework for Early Monetization of CBM

» Discovered Small Field (DSF) Policy

» Reform Initiatives to enhance Domestic Production

» Hydrocarbon Exploration and Licensing Policy (HELP) coupled with operationalization of Open Acreage Licensing Policy (OALP)

» Monetization of the Ratna offshore field

» Permission of Extraction of CBM to Coal India Limited (CIL) & its subsidiaries in Coal Mining area.

» Policy for the Grant of extensions to Pre-NELP Discovered fields and Exploration Blocks

» Hydrocarbon Vision 2030 for North East

» National Seismic Programme of Un-appraised areas

» National Data Repository (NDR)

» Policy framework to permit exploration and exploitation of unconventional hydrocarbons in existing acreage of Production Sharing Contracts (PSCs), CBM contracts and Nomination fields

» Policy framework for streamlining the working of PSCs

» Policy framework to incentivize enhanced recovery methods for oil and gas.

Interests in joint operations

A joint operation is a joint arrangement whereby the parties that have joint control of the arrangement have rights to the assets, and obligations for the liabilities, relating to the arrangement.

The Company has Joint Operations in the nature of Production Sharing Contracts (PSC) and Revenue Sharing Contracts (RSC) with the Government of India and various body corporates for exploration, development and production activities.

The Company's share in the assets and liabilities along with attributable income and expenditure of the Joint Operations is merged on line by line basis with the similar items in the Financial Statements of the Company and adjusted for depreciation, depletion, survey, dry wells, decommissioning provision, impairment and sidetracking in accordance with the accounting policies of the Company.

The hydrocarbon reserves in such areas are taken in proportion to the participating interest of the Company.

Gain or loss on sale of interest in a block, is recognized in the Statement of Profit and Loss, except that no gain is recognized at the time of such sale if substantial uncertainty exists about the recovery of the costs applicable to the retained interest or if the Company has substantial obligation Standalone Financial Statements 193 for future performance. The gain in such situation is treated as recovery of cost related to that block.

Development of North-Eastern Region

The history of oil and gas exploration in India dates back to the 19th century in the state of Assam located in the North-Eastern region of India. The first well that struck oil was in Makum area near Margherita during 1867 drilled by McKillop, Stewart & Co., barely 9 years after Drake's well in 1859 in Titusville, Pennsylvania. Subsequently, a number of wells were drilled in Makum and Namdang areas of Margherita and produced crude oil in minor quantities for more than two decades. The Assam Railway & Trading Co. Ltd, which was involved in the business of timber, coal, tea & construction of railway lines, drilled the first commercial well Digboi-1 (September, 1889 – November, 1890- total depth of 662ft) with an initial production of 200 gallons per day, opened up a new chapter in exploration and production of oil in this part of the world and the oil industry of India was officially born. During the subsequent years before independence of India, Digboi oil field was extensively developed and searched for new oil fields continued.

Other significant milestones in oil and gas exploration in North-East took place mainly during post-independence. These include the discoveries of the Nahorkatiya and Moran fields by Assam Oil Company (AOC) and Rudrasagar oil fields by Oil & Natural Gas Corporation Limited (ONGC) in 1953, 1956 and 1960 respectively. Subsequently, more than 100 oil and gas fields, that include fields such as Jorajan, Kumchai, Hapajan, Shalmari, Dikom, Kathaloni, Tengakhat, Bhogpara, Chabua, Baghjan, Barekuri, Mechaki, Lakwa, Lakhmani, Geleki, Amguri, Kharsang, Charali, Borholla-Champang, Khoraghat, Baramura, Tichna, Gojalia, Rokhia, Khobal, Hortokihave been discovered by Oil India Limited (OIL) and ONGC in the North-Eastern states of Assam, Arunachal Pradesh, Nagaland, Tripura and Mizoram.

Since then, both the national oil companies viz., OIL and ONGC have proven substantial amount of producible hydrocarbons and have technical knowhow of producing and managing complex reservoirs and contributing to about 8.6 Million Metric Tonnes per Annum (MMTPA) of oil plus oil equivalent of gas (O+OEG) from their producing assets in North-East.

The prognosticated hydrocarbon resources of the country has been reassessed based on the newly acquired data. The prognosticated hydrocarbon resources (O+OEG) of Upper Assam Shelf basin has been upgraded to the order of 6001.2 MMT from the level of 3180 MMT and for Assam-Arakan Fold Belt basin, the total prognosticated hydrocarbon resources are of the order of 1633 MMT. Thus, there is about 34% increase in the prognosticated hydrocarbon resources as compared to previous assessment. The North-East region is having around 18% (7634 MMT) of country's total prognosticated hydrocarbon resources. About 2246.6 MMT of in place hydrocarbon reserves have been established so far by E&P companies, which means about 73% of hydrocarbon resources are under "yet to discover' category.

The two national oil companies, namely, Oil and Natural Gas Corporation Limited (ONGC) and Oil India Limited (OIL) have been engaged in the North-East Region for exploration and exploitation of oil and gas for more than 60 years and generated a vast geo-scientific database and geological understanding of the basin.

NORTH-EAST VISION 2030

The North-East Vision Document has been a focused and consultative exercise to develop a common and shared aspiration for benefiting people of the North-Eastern region. With involvement and inputs of various stakeholders, industry players and state governments, the Vision document not only includes the ambition for the region but also an actionable roadmap.

The objectives of the plan are to leverage the region's hydrocarbon potential, enhance access to clean fuels, improve availability of petroleum products, facilitate economic development and to link common people to the economic activities in this sector. The states covered include Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura. The Ministry also undertook series of consultations with the state Governments while drafting the vision document.

The Vision rests on five pillars People, Policy, Partnership, Projects and Production. For People, it foresees clean fuel access to households alongside fostering skill development and involvement of the local community. The Policy focus areas include moderation in light of specific terrain and weather conditions of the region coupled with ensuring fund planning for new projects. As for Partnership, the stress is on greater involvement of state governments in planning and implementation, and on boosting trade with neighboring nations. In Projects, the focus is on pipeline connectivity for carrying liquefied petroleum gas (LPG), natural gas, and petroleum products, oil and lubricants (POL); building refineries and import links; and development of compressed natural gas (CNG) highways and city gas distribution network. The Production side emphases include production enhancement contracts, technology deployment and fast-track clearance, and development of service provider hubs.

Beyond production, the focus areas include exploring hydrocarbon linkages and trade opportunities with Bangladesh, Myanmar, Nepal & Bhutan; implementation of 'Make In India' in the region; development of health & medical facilities; industrial policy & infrastructure related action points; focus on skill development; and employment generation requirement in the region. The vision statement lays out a detailed roadmap for the entire hydrocarbons value chain, covering upstream, midstream and downstream segments. This report includes an action plan – of immediate, medium-term and long-term initiatives – to help achieve the objectives.

The Vision aims at doubling Oil & Gas production by 2030, making clean fuels accessible, fast tracking projects, generating employment opportunities and promoting cooperation with neighboring countries.

To fulfill one of the major goal envisaged under Vision 2030, Government has allowed special dispensation of 2 year extension in exploration period and 1 year in Appraisal period for operational blocks in North–Eastern region. Government has also provided marketing and pricing freedom for natural gas produced in future in North-Eastern region. This is likely to result in increased investment in development of oil & gas resources.

Contribution to Energy Security

To ensure energy security, Government of India had decided to build a strategic crude oil reserve of 5 MMT through a Special Purpose Vehicle (SPV). The SPV named Indian Strategic Petroleum Reserves Limited (ISPRL) was initially a subsidiary of Indian Oil Corporation Limited, which w.e.f. 09.05.2006, became a wholly owned subsidiary of Oil Industry Development Board (OIDB). The caverns are under constructions at three locations namely Visakhapatnam (1.33 MMT), Mangalore (1.5 MMT) and Padur (2.5 MMT). Once completed, these reserves will store crude oil equivalent to India's net import requirement of 13 days.

Capital cost for constructing these strategic storage facilities was originally estimated to be Rs.2397 crore at September, 2005 prices, which had undergone upward revision to Rs.4098.35 crore. The authorized and paid up capital of the company as on 31.03.2017 is Rs.3832.56 crore and Rs.3574.37 crore respectively. OIDB has contributed Rs.3574.37 crore towards its equity participation in ISPRL till 31.03.2017. Shares of value of Rs.3540.01 crore has been allotted by ISPRL to OIDB till 31.03.2017. Status of the projects at the above 3 locations as on 31.03.2017

HYDROCARBON

VISION 2030

FOR NORTHEAST INDIA

Initiatives in the North East

Develop North East Region as a dominant hydrocarbon hub at the forefront of India's energy economy

- **Double the production** of Oil and Natural Gas (O+OEG in MMTOE) by 2030
- **Access to clean fuel for 100% households** at affordable price **in the region (LPG/PNG)**
- Bolster development through creation of **service provider hubs**
- Ensure availability to support growth in per capita **petroleum product consumption**
- Provide pipeline connectivity by **installing new POL and LPG Pipeline**
- Develop **natural gas grid**, CGD networks and CNG Highways
- Generate **employment opportunities** through Industrial and skill development
- Promote **manufacturing industry** related to oil and gas in the region
- Incentivize **production of bio fuel** in the region for providing access to clean fuels and to boost rural economy
- Promote trade between North East Region of India and neighbouring **SAARC countries**

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Thank You !