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PETROLEUM AND NATURAL GAS

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GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES

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22 Petroleum and Natural Gas

The domestic production of crude oil and Condenstate which stood at 30.49 million tonnes in 2020-21 decreased by 5.2% as compared to that of the output of the corresponding previous year. The production of natural gas (utilised) also decreased to 28,673 million cu. m (MMSCM) in 2020-21 which is about 8.1% less as against the production in 2019-20. Indian Refinery Industry has done well in establishing itself as a major player globally and has emerged as a refinery hub. India is the second largest refiner in Asia after China and is the fourth largest in the world. The country's refining capacity has touched 249.20 MMTPA as on 01.04.2021. With increase in the domestic refining capacity, which has overtaken domestic consumption, country became a net exporter of petroleum products.

Energy is a key driver of economic growth of any country. Efficient, reliable and affordable energy is essential for sustainable development and inclusive growth of the overall economy of India. India is the third largest energy consumer in the world after China and USA.

India's energy requirement is fulfilled primarily by Coal, Crude Oil, Natural Gas and Renewable Energy. Oil & Gas sector within the energy mix play a predominant role as over one-third of the energy required is met by hydrocarbons. Growing economy and population growth are the main drivers for oil & gas demand, increasing every year. Thus, Oil & Gas will continue to remain important elements for India's energy security and its share in global energy demand is set to almost double to 11% by 2040.

India is set to emerge as one of the primary drivers of growth in oil and gas demand in Asia, despite the pressing Covid-19 challenges. Current hydrocarbon demand is much more than the domestic crude oil and natural gas production. The energy needs of the country are increasing continuously, while the indigenously available energy resources are limited and may not be sufficient in the long run. With the growing energy demands, reliance on imports and limited domestic fossil fuel resources, India needs to plan to either limit its consumption or try to augment production. The country has ambitious plans to increase domestic oil & gas production and exploit all possible forms of energy to the fullest.

India's energy security is primarily about ensuring continuous availability of commercial energy at competitive prices to support its economic growth and meet the lifeline energy needs of households with safe, clean and affordable forms of energy. Oil & gas sector is pivotal in meeting the energy needs of the nation. To provide renewed impetus to India's upstream Hydrocarbon Sector and usher in favourable policies aligned with the challenging domestic and global energy landscape, Government of India has introduced systemic reforms in the Hydrocarbon Sector, that have ushered consistency, certainty and transparency in the E&P ecosystem.

In the E&P sector, Government's attention has shifted to production enhancement as compared to revenue maximisation, harnessing technological innovation, fostering collaboration and providing a stable and simplified policy and fiscal regime. The path breaking system in the Indian E&P sector clubbed with single window clearance system, strong institutional frameworks, attractive corporate taxes and revitalised regulatory regimes has generated phenomenal investment opportunities in India across the entire value chain of E&P, right from greenfield to brownfield.

To meet India's energy security and to reduce the rising import dependence, landmark policy reforms were ushered by the Government in the last 5 years that have elicited universal acclaim and fostered a conducive investment ecosystem in the Oil & Gas Sector. Time is now ripe to steadfastly build upon the policy reforms and work in tandem with the Industry needs.

RESERVES/RESOURCE

As on 1.4.2021, balance recoverable reserves of crude oil were estimated at 587.33 MMT (Million Metric Tonnes), out of which 325.73 MMT (55%) are in onshore and 261.61 million tonnes (45%) in offshore areas. ONGC (nomination) has the largest

share of 71% in reserves of crude oil with OIL (nomination) and PSC regime contributing 13% and 16%, respectively.

The balance recoverable reserves of natural gas as on 01.04.2021 were placed at 1,372.64 billion cu. m, out of which 882.72 billion cu. m (64%) are in offshore and 492.91 billion cu m (36%) in onshore areas. PSC regime has the largest share of 50% in natural gas reserves followed by ONGC (nomination) and OIL (nomination) at 40% and 10%, respectively (Table-1).

Table – 1 : Proved and Indicated Balance Recoverable Reserves of Crude Oil and Natural Gas in India as on 1.4.2021(P)

(Crude oil in million tonnes; Natural gas in billion cu. m)

Area	Crude oil	Natural gas
India	**587.33**	**1372.64**
Onshore	**325.73**	**492.91**
Andhra Pradesh	7.33	65.50
Arunachal Pradesh	3.64	3.14
Assam	153.05	166.63
Gujarat	115.41	59.79
Jharkhand	-	8.56*
Madhya Pradesh	-	30.88*
Nagaland	2.38	0.09
Rajasthan	34.77	59.06
Tamil Nadu	9.08	37.89
Tripura	0.07	29.18
West Bengal	-	32.19*
Offshore	**261.61**	**882.72**
Western offshore	219.27	325.65
Eastern offshore	42.34	557.07

Source: *Indian Petroleum and Natural Gas Statistics, 2020-21, Ministry of Petroleum and Natural Gas, Govt. of India.*

Note*: (i)Proved and Indicated Balance Recoverable Reserves ONGCS contingent Resources (2C) Since 2019.*

(ii) Total may not tally due to rounding off.

(iii) Western offshore includes Gujarat offshore.

** Total gas reserves includes CBM reserves CBM Related to Coal bed Methane.*

EXPLORATION & DEVELOPMENT

The Oil & Natural Gas Corporation (ONGC) and Oil India Limited (OIL), the two National Oil Companies (NOC) and a few Private and Joint Venture companies were engaged in exploration and production activities of oil and natural gas, including coal-bed methane, shale gas/oil, etc. in the country. As on 31.3.2021, there were in all 316 oil/gas fields including offshore areas under these companies in the country.

Under nomination regime, ONGC's jurisdiction extended to 189 onshore oil/gas fields and 31 offshore oil/gas fields. Out of the total onshore fields, 77 fields are in Cambay basin (Gujarat); 26 fields in Upper Assam (Assam); 4 fields in Assam & Assam–Arakan (Assam); 4 fields in Jodhpur (Rajasthan); 44 fields in Krishna–Godavari basin (Andhra Pradesh); 25 fields in Cauvery basin (Tamil Nadu); and 9 fields in Assam–Arakan Fold Belt (Tripura). Out of 31 offshore fields, 24 fields in Mumbai, 1 field in Kachchh in the West Coast and 16 offshore fields in Krishna-Godavari (deep) are in East Coast. Besides, OIL was engaged in 19 fields, viz., Upper Assam basin in Assam (14 fields) & Arunachal Pradesh (1 field); Jaisalmer basin (3 fields) & Bikaner–Nagaur basin (1 field) in Rajasthan.

Under PSC and RSC/CBM regime, companies were engaged in 65 onshore oil/gas fields – Cambay basin in Gujarat (38 fields); Assam–Arakan in Arunachal Pradesh (1 field), Assam (2 fields) & Tripura (2 fields); Krishna–Godavari in Andhra Pradesh (1 field); Jharia & Bokaro in Jharkhand (1 field each) (CBM); Sohagpur in Madhya Pradesh (2 fields) (CBM); Rajasthan (14 fields); Cauvery in Tamil Nadu (2 fields), Raniganj in West Bengal (2 fields) and Bengal in West Bengal (1 field) in onshore areas. In offshore areas, the companies covered 2 fields in Cauvery basin and 7 fields in Krishna–Godavari basin on the East Coast and 3 fields in Cambay basin on the West Coast.

During 2020-21, cumulative 17,051.24 LKM 2D and 1,47,107 SKM 3D seismic data was acquired. Out of which approximately 16,806.42 LKM 2D and 7,281.69 SKM 3D data were acquired. This year 55% of 2D seismic and 68% of 3D seismic data acquisition have been carried out in the offshore basins. A total of 115 exploratory wells (including inland and offshore) amounting to a drilling meterage of 3,44,175 m were drilled. Details of exploratory activities in Nomination, PSC regime & RSC regime in the year 2020-21 are furnished in Table-2.

Table – 2 : Exploratory Efforts in Nomination, PSC and RSC Regime during 2020-21

Subject	Parameter	ONGC (Nomination)	OIL (Nomination)	PSC (Pre-NELP & NELP)	RSC (OALP& DSF)	Total
2D Seismic Data acquired	Onland (GLKM)	244.82	-	-	7502.89	7747.71
	Offshore (GLKM)		-	-	9303.53	9303.53
	Total	244.82	-	-	16806.415	17051.24
3D Seismic Data acquired	Onland (SKM)	433.05	124.61	250.05	2321.99	3129.71
	Offshore (SKM)	1,272.26			4959.69	6231.95
	Total	1,705.31	124.61	250.05	7281.69	9361.66
Exploratory well drilled	Onland	61	10	4	1	76
	Offshore	31		8		39
	Total	92	10	12	1	115
Exploratory Meterage drilled	Onland (1000 m)	176.266	42.811	13.25	1.4	233.744
	Offshore (1000 m)	83.177		27.25		110.31
	Total (1000 m)	259.443	42.811	40.5	1.4	344.175

Source: *India's Hydrocarbon Outlook, 2020-21, Directorate General of Hydrocarbons.*

During 2020-21, DGH received a total of 13 discovery notifications of oil and gas from NOC/ PSC/RSC operators, out of these notified discoveries, 3 discoveries were technically accepted. Directorate General of Hydrocarbons (DGH) identified the need of about 48,243 Line kilometer (LKM) 2D seismic data for appraisal for these areas. The project was introduced under broad policy framework of Geo-Scientific Data generation for Hydrocarbons in Indian Sedimentary Basins to appraise the un-appraised onland areas in 26 sedimentary basins and was notified on 20th May 2014. The project is being implemented by National Oil Companies, OIL and ONGC through service providers in North-Eastern states and rest of India respectively. OIL is undertaking seismic data API in Assam shelf & Arakan Basin whereas ONGC carrried out survey work in other basins. As on 31st March 2021, approx. 46,004 LKM of data has been acquired which is about 95% of the total target of 48,243 LKM under NSP campaign.

In-Place hydrocarbon volume of 1,159.33 MM T of Oil and Oil Equivalent Gas (O+OEG) have been established by ONGC, OIL and Pvt/JVs under Nomination, PSC and CBM regime. Ultimate reserves established were 4,374.70 MM T O+OEG and accretion in ultimate resrves in the year 2020-21 was 41.61 MMT O+OEG. Balance recoverable reserves were 1,599.69 MMT O+OEG.

During 2020-21, over 4.91 lakh geological surveys have been conducted in India to explore Oil and gas. About 562 wells (of which 79.2% were development wells and 20.8% exploratory wells) with 12.03 lakh metreage were drilled by Oil and Gas companies during 2020-21.

The details of exploration carried out and discoveries found during the year 2020-21 are covered in General Review on "Exploration & Development".

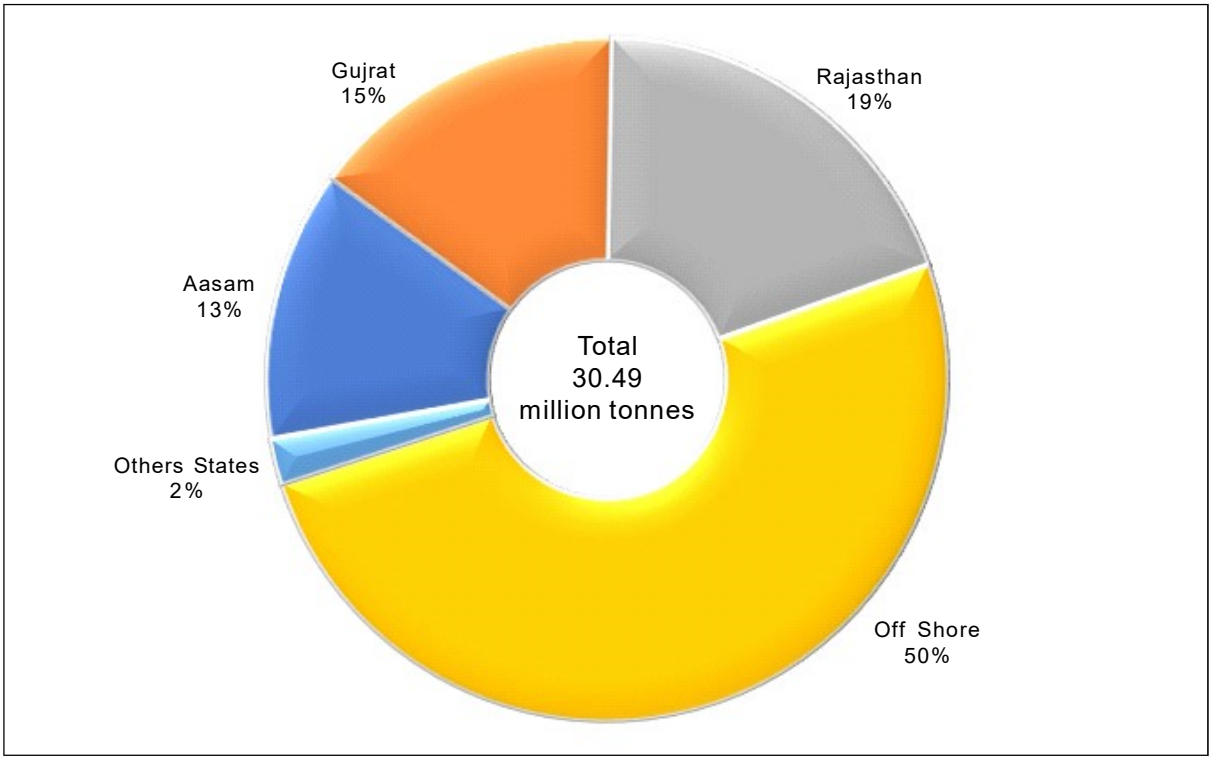
PRODUCTION

Crude Oil and Condensate

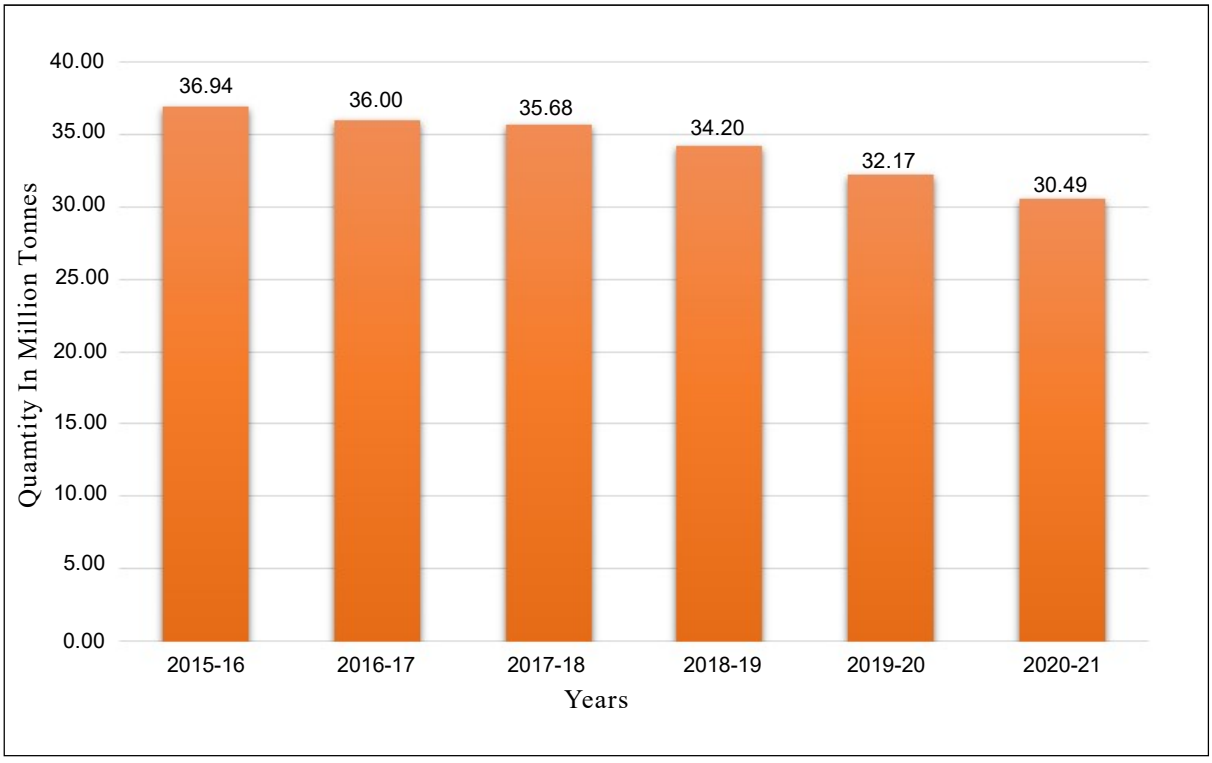
Production of Crude Oil and Condensate in the country was 30.494 million tonnes in 2020-21. It has registered a decrease of 5.20% as compared to that in the previous year. Bulk of the total production, i.e., 76% was shared by the Public Sector companies. Private Sector companies accounted for the remaining 24 per cent (Table-3).

Offshore areas continued to be the largest producer of Crude Oil and Condensate in 2020-21 and had a share of 50.47% in the country's output. Next in order were Rajasthan with a contribution of 19.3%, Gujarat with 15.2% and Assam with 12.7

Production of crude oil & condensate (By States)



Production of crude oil & condensate, 2015-16 to 2020-21



per cent. The remaining 2.33% of the production was reported by Andhra Pradesh, Tamil Nadu and Arunachal Pradesh.

During 2020-21, the production of Crude Oil and Condensate decreased in Arunachal Pradesh by 3.5%, Tamil Nadu by 1.2% and Gujarat by 1.1% as compared to the previous year. Whereas, there was a decline in production in Andhra Pradesh by 20%, Rajasthan by 11% and Assam by 5% & offshore areas by 4%.

Natural Gas (Utilised)

The production of natural gas (utilised) was 28,673 MMSCM. It decreased by 8.00% in 2020-21 as compared to 31,184 MMSCM in the previous year. Offshore areas continued to be the largest producer of natural gas (utilised) with a share of 64%, followed by Assam (10%), Rajasthan (7%), Tripura (6%), Gujarat (4%), Tamil Nadu (3%) and the remaining 5% of the total production was together contributed by Andhra Pradesh, Arunachal

Table – 3 : Production of Crude Oil and Condensate, 2018-19 to 2020-21 (P) (By States)

(Quantity in '000 tonnes)

State	2018-19	2019-20 (R)	2020-21 (P)
India	**34203**	**32170**	**30494**
Public Sector	24335	23734	23120
Private Sector	9868	8436	7374
Andhra Pradesh	296	243	195
Arunachal Pradesh	43	56	54
Assam	4309	4093	3902
Gujarat	4626	4707	4651
Rajasthan	7667	6653	5891
Tamil Nadu	395	415	410
West Bengal	--	--	0
Offshore	16867	16003	15391

Source: *Indian Petroleum and Natural Gas Statistics, 2019-20 & 2020-2021, Ministry of Petroleum and Natural Gas, Govt. of India.*

Table – 4 : Production of Natural Gas (Utilised), 2018-19 to 2020-21 (P) (By States)

(Quantity in MMSCM)

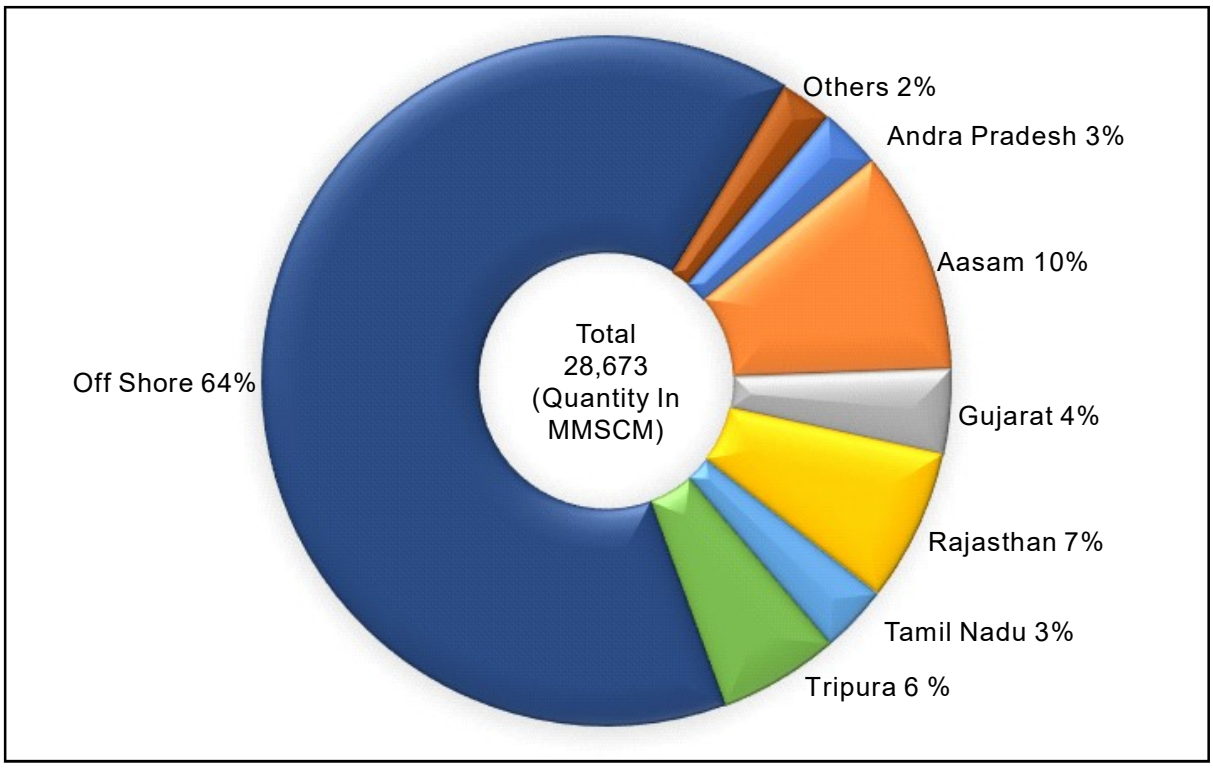
State	2018-19	2019-20	2020-21 (P)
India	**32873**	**31184**	**28673**
Public Sector	27396	26414	24352
Private Sector	5477	4770	4321
Andhra Pradesh	1081	912	827
Arunachal Pradesh	28	45	56
Assam	3289	3141	2995
Gujarat	1402	1342	1138
Jharkhand (CBM)**	4	5	2
Madhya Pradesh (CBM)**	357	345	334
Rajasthan	1483	1883	2040
Tamil Nadu	1208	1097	911
Tripura	1554	1473	1634
West Bengal (CBM)**	350	306	307
Offshore	22117	20635	18429

Source: *Indian Petroleum and Natural Gas Statistics, 2019-20 & 2020-21, Ministry of Petroleum and Natural Gas, Govt. of India.*

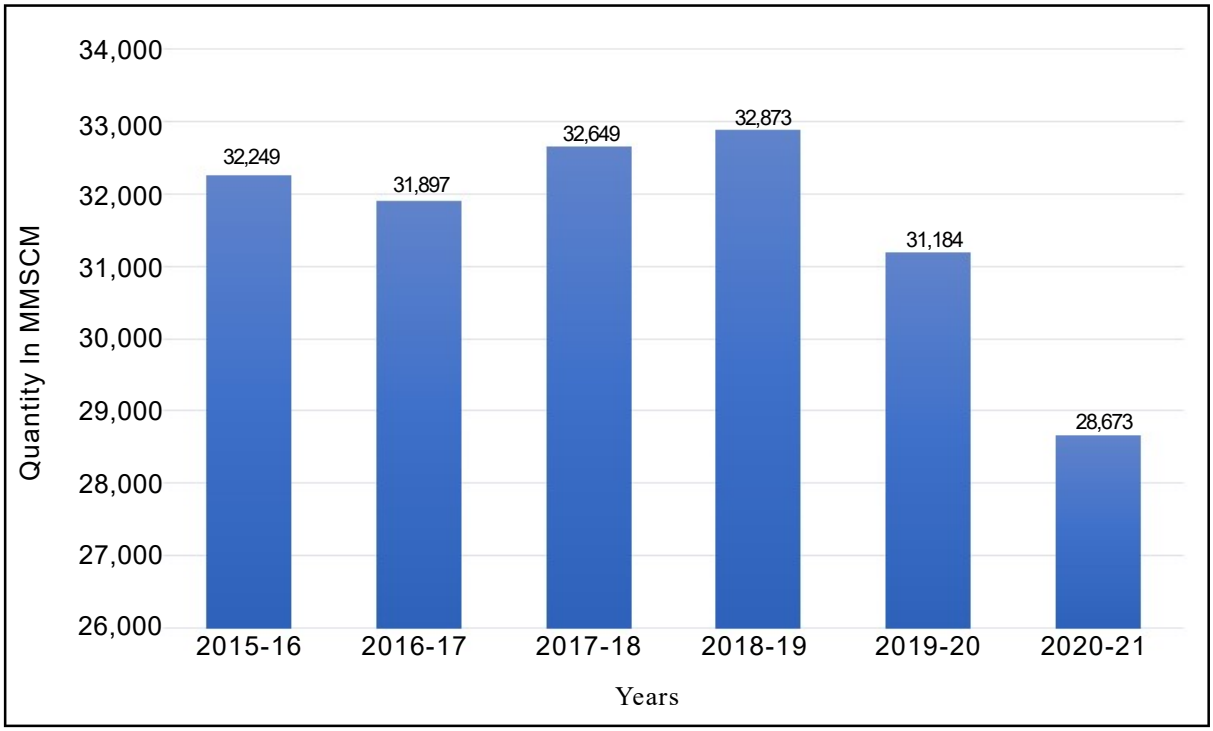
(CBM)**: *Coal-bed Methane production*

Note: *Total may not tally due to rounding off*

Production of Natural Gas (Utilised)



Production of Natural Gas (Utilised), 2015-16 to 2020-21



Pradesh, Jharkhand (CBM), Madhya Pradesh (CBM) and West Bengal (CBM). As much as 85% of the total production came from the Public Sector companies whereas the remaining 15% was that of the Private Sector companies during the year 2020-21 (Table-4).

During 2020-21, Statewise analysis revealed that the production of natural gas (utilised) increased in Arunachal Pradesh (24%), Tripura (11%) and Rajasthan (8%) as compared to the previous year. While decline in production was recorded in Jharkhand (CBM) (60%), Tamil Nadu (17%), Gujarat (15%), offshore area (11%), Assam (5%) and Madhya Pradesh (0.3%) as compared to the previous year.

INDUSTRY

Indian Refinery Industry has done well in establishing itself as a major player globally. India, is the Fourth largest refiner in world and second largest refiner in Asia after China. The operational refining capacity of 23 units in the country which put together touched 249.22 MMTPA in 2020-21. Out of these 23 refineries, 18 are in Public Sector, 3 are in Private Sector and two are Joint Venture. Out of the total refining capacity of 249.22 MMT, 141.92 MMT have been accounted for by the Public Sector, 19.1 MMT by Joint Venture and the balance 88.2 MMT have been reported by the Private Sector. During 2020-21, refinery crude throughput in terms of crude oil processed decreased to 221.77 million tonnes from 254.39 million tonnes in 2019-20 (Table-5). This decrease is attributable to reached demand caused by the pandemic and lockdown that ensved in the country for several months.

As per annual report of MoPNG for 2020-21, the refining capacity augmentation to the tune of 25.75 million tonnes has been planned by 2022-23 at brownfield refineries that are IOCL, Barauni (3 MMTPA); IOCL, Guwahati (0.2 MMTPA); IOCL, Bongaigaon (0.35 MMTPA); IOCL, Mathura (1.2 MMTPA); IOCL, Haldia (0.5 MMTPA); IOCL, Koyali (4.3 MMTPA); HPCL Visakhapatnam (6.7 MMTPA); HPCL, Mumbai (2 MMTPA); and RIL, DTA, Jamanagar (7.5 MMTPA).

Besides, the Greenfield refinery that is coming up in the near future include HPCL Rajasthan Refinery Limited (HRRL), Barmer, Rajasthan (9 MMTPA) and Ratnagiri Refinery & Petrochemicals Ltd, Ratnagiri, Maharashtra (60 MMTPA).

The production of petroleum products during 2020-21 at 233.57 million tonnes decreased by 11.2% from 262.94 million tonnes in the year 2019-20. Production of various petroleum products from refineries and fractionators during 2019-20 to 2020-21 are provided in Table-6.

CONSUMPTION

The total consumption of petroleum products decreased by 9.26% to 194.295 million tonnes in 2020-21 from 214.127 million tonnes in 2019-20. Increase in consumption was reported in the case of LPG (4.6%), LDO (36%), Lubes/Greases (6.8%), and Bitumen (11.96%) during 2020-21 as compared to that of the year 2019-20, whereas, the consumption showed a decline in Fuel Oil (11.36%), Naphtha (1.18%), Furnace Oil (11.9%), ATF (54%), Waxes (20.14%), Petroleum coke (28%), SKO (25%), LSHS (3%) and HSDO (12%) during the same period.

The consumption of various petroleum products from 2018-19 to 2020-21 is furnished in Table-7.

ALTERNATIVE SOURCES

Conventional or fossil fuels, though being limited, non-renewable and polluting, will continue to play a dominant role in the energy scenario in our country in the next few decades. With the ever-increasing dependence on petroleum imports due to stagnant domestic production and spiralling growth in demand, the Government is encouraging the development of alternative sources of hydrocarbons. The Government has vigorously initiated exploration & development for tapping alternate sources, viz. coal-bed methane, gas hydrates, oil shales, underground coal gasification, etc. in the country.

Coal-bed Methane

Coal-bed Methane (CBM), an eco-friendly natural gas stored in coal seams, is generated during the process of coalification and absorbed into solid matrix of the coal. It is classified as unconventional source of natural gas owing to its nature of occurrence. India, having the fifth

Table – 5 : Installed Capacity and Refinery-wise Crude Oil Processed

(In '000 tonnes)

Refinery	Annual installed capacity (as on 1.4.2021)	Refinery Crude throughput		
		2018-19	2019-20	2020-21 (P)
Total	**249200**	**257205**	**254386**	**221773**
Public/Private Sector & Subsidiaries	**141920**	**150976**	**144715**	**127504**
IOCL, Digboi, Assam	650	676	664	605
IOCL, Guwahati, Assam	1000	863	892	849
IOCL, Barauni, Bihar	6000	6661	6516	5469
IOCL, Koyali, Gujarat	13700	13505	13075	11603
IOCL, Haldia, West Bengal	8000	7965	6463	6759
IOCL, Mathura, Uttar Pradesh	8000	9737	8948	8926
IOCL, Bongaigaon, Assam	2350	2513	2045	2450
IOCL, Panipat, Haryana	15000	15281	15038	13181
IOCL, Paradeep, Odisha	15000	14616	15778	12508
BPCL, Mumbai, Maharashtra	12000	14773	15017	12941
BPCL (formerly KRL), Kochi, Kerala	15500	16051	16515	13282
HPCL, Mumbai, Maharashtra	7500	8671	8065	7374
HPCL, Visakhapatnam, Andhra Pradesh	8300	9773	9115	9050
CPCL, Manali, Tamil Nadu	10500	10271	10161	8243
CPCL, Narimanam, Tamil Nadu	1000	423	-	-
Numaligarh Refinery Ltd, Numaligarh, Assam	3000	2900	2383	2707
MRPL, Mangaluru, Karnataka	15000	16231	13953	11475
ONGC, Tatipaka, Andhra Pradesh	70	66	87	81
Joint Venture	**19100**	**18189**	**20155**	**16262**
Bharat Oman Refineries Ltd, Bina[@]	7800	5716	7913	6190
HPCL Mittal energy Ltd (HMEL), Bathinda[#]	11300	12473	12242	10072
Private Sector	**88200**	**88041**	**89515**	**78008**
RIL, Jamnagar, Gujarat	33000	31752	33019	34100
RIL, Jamnagar (SEZ), Gujarat	35200	37393	35876	26841
Nyara Energy Ltd (NEL),Vadinar, Gujarat	20000	18896	20620	17067

Source: *Indian Petroleum and Natural Gas Statistics, 2020-21, Ministry of Petroleum & Natural Gas, Government of India.*

@: Bharat Oman Refineries Ltd (BORL) is a Joint Venture Company promoted by BPCL and Oman Oil Company Ltd (OOCL).

#: HPCL Mittal Energy Ltd is a Joint Venture Company promoted by HPCL and Mittal Energy Investment Pvt. Ltd.

Note: *(i) CPCL and BRPL are subsidiaries of IOCL; NRL of BPCL; and MRPL of ONGC.*

(ii) Crude throughput in terms of crude oil processed.

(iii) Total may not tally due to rounding off.

(iv) CPCL refinery is under shutdown due to limitation in meeting required product specification.

Table – 6: Production of Petroleum Products from Refineries and Fractionators, 2018-19 to 2020-21 (P)

(In '000 tonnes)

Petroleum Product	2018-19	2019-20	2020-21(P)
Total Products	**262361**	**262944**	**233513**
LPG	12786	12823	12072
Motor spirit	38039	38616	35779
Naphtha	19786	20679	19403
ATF	15479	15238	7092
Kerosene	4072	3141	2393
HSD	110535	111198	100441
LDO	702	643	729
Furnace oil	9598	8173	6882
LSHS/HHS/RFO	434	437	360
Lube oils	949	932	1069
Bitumen	5803	5244	5245
Petroleum coke	14676	15528	12655
Paraffin wax	90	96	97
Others	29413	30195	29296

Source: *Indian Petroleum & Natural Gas Statistics, 2020-21, Ministry of Petroleum & Natural Gas, Government of India.*

Note*: (i) Total may not tally due to rounding off.*

(ii) Others include Propylene, Solvents, Reformate, MTO, Black Carbon Feed Stock, Sulphur, etc.

Table – 7 : Consumption of Petroleum Products, 2017-18 to 2019-20 (P)

(In'000 tonnes)

Product	2018-19	2019-20	2020-21 (P)
Total	**213216**	**214127**	**194295**
LPG	24907	26330	27558
Motor Spirit	28284	29975	27969
Naphtha	14131	14268	14100
SKO	3459	2397	1798
ATF	8300	7999	3698
HSDO	83528	82602	72713
LDO	598	628	855
Furnace oil (FO)	6195	5912	5208
LSHS	369	390	378
Fuel Oil (FO+LSHS)	6564	6302	5586
Lubes/Greases	3668	3833	4097
Bitumen	6708	6720	7524
Petroleum coke	21346	21708	15605
Waxes	286	278	222
Others	11437	11087	12569

Source: *Indian Petroleum & Natural Gas Statistics, 2020-21, Ministry of Petroleum & Natural Gas, Government of India.*

Note*: (i) Consumption includes sales by oil companies, own consumption & direct private imports.*

(ii) Total may not tally due to rounding off.

largest proven coal reserve in the world, presents a significant opportunity for considering CBM as an alternative source for augmenting India's energy resource, keeping in line with the vision of reducing hydrocarbon import and making India gas-based economy.

The coal and lignite seam contains varying amounts of methane depending on the rank of the carbonaceous matter, the depth of burial and the geotectonic setting of basins. CBM exploration and exploitation has an important bearing on reducing the greenhouse effect. The extraction of CBM, through degassing of the coal seams prior to mining of coal, is a cost-effective means of boosting coal production and maintaining safe methane level in working mines.

In order to harness CBM potential in the country, the Government of India formulated CBM Policy in 1997, wherein CBM being Natural Gas is explored and exploited under the provisions of Oil Fields (Regulation and Development) Act 1948 (ORD Act 1948) and Petroleum & Natural Gas Rules 1959 (P&NG Rules 1959) administered by Ministry of Petroleum & Natural Gas (MoPNG). Various Policy reforms for CBM are discussed in the Chapter "Policy and Contracts". As per annual report of Ministry of Petroleum & Natural Gas for 2020-21, the estimated resources of CBM are of the order of 2,600 billion cu. m (91.8 trillion cubic feet) spread over in 11 States in the country.

CBM blocks were offered through international competitive bidding for exploration and production of CBM in the country for the first time in May 2001. Subsequently, there were 3 other bidding rounds in the years 2003, 2005 and 2008, respectively. So far, under the CBM policy, the Government has awarded 33 CBM blocks [including 2 CBM blocks on Nomination basis and 1 block through Foreign Investment Promotion Board (FIPB) route] in four rounds of bidding to National, Private & Joint Venture Companies. These CBM blocks are in the States of Andhra Pradesh, Assam, Chhattisgarh, Gujarat, Jharkhand, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu and West Bengal. The total prognosticated CBM resource for the

awarded 33 CBM blocks, is about 62.4 TCF (1,767 BCM), of which, 10.48 TCF (296.9 BCM) has been established as Gas-Inplace (GIP). At present, out of the 33 CBM blocks, 10 are active, 4 of which are in production phase, 4 in development phase and 2 in exploration phase.

Within the next few years, CBM is expected to emerge as a new source of natural gas production in the country. The first commercial production from the CBM blocks commenced in the year 2007 from Raniganj (South) block operated by M/s Great Eastern Energy Corp. Ltd (GEECL). Raniganj (East) Block operated by M/s Essar Oil & Gas Exploration & Production Ltd (EOGEPL) started its commercial production from July 2016. Similarily, Sohagpur (West) operated by M/s Reliance Industries Ltd (RIL) started producing from March 2017 and Bokaro operated by M/s Oil and Natural Gas Ltd (ONGC) from August 2019. In addition to this incidental CBM gas is being produced during testing of CBM wells in Jharia block operated by ONGC and Sohagpur (East), operated by RIL. The cumulative CBM production from these blocks as of FY 2019-20 is 3.7 BCM. The average gas production rate during FY 2019-20 was 1.79 MMSCMD. To date, most of the CBM exploration and production activities in India are pursued by domestic Indian companies.

Gas Hydrates

Gas hydrates are formed when gas and water mixtures are subjected to high pressure and low temperature conditions in the sea, usually in water depths of more than 800 m, within sediments just below the sea bottom. They are also formed in some permafrost region of the world. The gas hydrates also act as a cap under which natural gas can get accumulated. Gas hydrates can be an unconventional energy source of the future.

In India, research and exploratory activities for Gas Hydrate are being steered under National Gas Hydrate Programme (NGHP), technically coordinated by Directorate General of Hydrocarbons (DGH). Under NGHP, various R&D studies are in progress to develop vast resources of gas hydrates in western and eastern offshore and Andaman offshore areas. Two expeditions 01 & 02 have been completed under NGHP.

NGHP Expedition-01 exploration programme was carried out in 2006 for mapping gas hydrate zones in Krishna–Godavari, Kerala, Konkan, Mahanadi and Andaman offshore areas. A total of 39 holes drilled at 21 sites and the physical presence of gas hydrate was established predominantly in Krishna–Godavari, Mahanadi and Andaman Basin, but, were non-exploitable with available technologies.

NGHP-02 was conducted successfully in Eastern offshore from 09.03.2015 to 31.07.2015. A total of 42 wells were drilled at 25 sites in Krishna–Godavari and Mahanadi areas in sand reservoirs for Gas Hydrates. NGHP-02 discovered two distinct Gas hydrate-bearing sand reservoir areas B & C in KG basin, while Area A sand-rich reservoir systems was observed to have limited formation of concentrated gas hydrate accumulations whereas in Area-E, the drilled wells indicated the presence of gas hydrate with a combination of fracture/displacement and pore-filling type gas hydrate. The results of this expedition were found to be encouraging and further extensive studies are being carried out to assess the gas hydrate resource potential, reservoir characterisation, reservoir delineation & geomechanical modelling for seafloor and wellbore stability & identification of sites for pilot production for testing. KG deep offshore Area B & C were observed to contain gas hydrate accumulations and may be suitable for gas hydrate production. Testing under NGHP Expedition-03 have to be designated.

The challenges faced for commercial exploitation or production of gas from Gas Hydrates are more or less similar all over the world. The planning and execution of NGHP Expedition-03 were to test the technology and assess the commerciality of Gas Hydrates exploitation in Indian offshore. At present, collation and interpretation of all data is being done to identify sites for pilot production testing. The objective of NGHP Expedition-03 was to carry out pilot production testing at a suitable site identified during the NGHP Expedition-02.

Extracting methane from gas hydrate in marine environments is relatively a new path. Japan has taken a lead in this direction. From the progress

being made by the Indian NGHP, steps are underway to mitigate anticipated challenges in the Indian context. The NGHP expeditions are an appropriate line of research investigation which could help the country move forward by harnessing this yet elusive resource.

Shale Oil/Shale Gas

Oil Shales are usually fine-grained sedimentary rocks containing relatively large amounts of organic matter from which significant quantities of shale oil and combustible gas can be extracted by destructive distillation. An oil shale, which has a very high proportion of organic matter in relation to mineral matter, is categorised as coal. Oil shales occur in many parts of the world ranging from small occurrences of little or no economic value to those of enormous size that occupy thousands of square miles and contain many billion barrels of potentially extractable shale oil. Shale Gas/Oil is a form of Natural Gas/Oil that remain unexpelled, unmigrated and entrapped within the pore space and fractures of a source rock (commonly, shale). They are categorised as unconventional resource due to their nature of occurrence and method of extraction. In general, shales have insufficient permeability for fluid flow to a well bore. The shale gas/oil is produced commercially when sufficient fracture conductivity is induced by hydraulic fracturing.

With the continuing decline of petroleum supplies accompanied by increasing costs of petroleum, oil shale presents opportunities for supplying some of the fossil energy needs of the world in the years ahead. Thus, Shale gas can emerge as an important new source of energy in the country. India has several Shale Formations which seem to hold shale gas. The Shale Gas Formations are spread over several sedimentary basins, such as, Gangetic plain, Gujarat, Rajasthan, Andhra Pradesh and other coastal areas in the country including hydrocarbon-bearing ones - Cambay, Assam–Arkan & Damodar Basins which have large shale gas deposits.

In India, a preliminary resource assessment of Shale Gas/Oil was carried out by three different organisations.

(i) ONGC in August, 2013 has estimated Shale Gas resources of 187.5 TCF from 5 sedimentary basins, namely, Cambay, Krishna–Godavari, Cauvery, Ganga and Assam.

(ii) Central Mine Planning and Design Institute (CMPDI) in July, 2013 has estimated Shale Gas resources of 45.8 TCF in Gondwana basin.

(iii) United States Geological Survey (USGS) in January, 2011 estimated Technical Recoverable Shale Gas of 6.1 TCF in three basins, namely, Cambay, Krishna–Godavari (KG) and Cauvery. Again in 2014, it estimated a technical recoverable volume of 62 million barrels of shale oil in Cambay Basin alone.

In order to understand the prospectivity and untap the Shale Gas and Oil resource potential in India, GoI announced a Shale Gas and Oil Exploration Policy on 14th October, 2013 for the National Oil Companies (NOCs), ONGC and OIL. The companies were required to carry out exploration in their PML and ML areas in three phases.

Under the Shale Gas Policy - 2013, 50 blocks in 4 basins (Assam, Krishna Godavari, Cauvery & Cambay) were identified by ONGC and 6 blocks in 2 basins (Jaisalmer and Assam) were identified by OIL in the Phase-I of exploration which ended in April-2017. Till 2019-20, ONGC had drilled a total of 29 wells in 4 basins and OIL has drilled 4 shale wells in 2 basins.

During 2019-20, ONGC drilled two exclusive shale wells (NJSGA in Cambay Basin and MDSGA in KG Basin) and one dual objective well PGAE . At present, a dual objective well, LKEAA in KG Basin is under drilling. Out of the 29 wells completed so far, across four basins viz. Cambay, KG, Cauvery and A&AA Basins, 10 are exclusive wells and 19 are dual objective wells. Indications of presence of shale oil have been recorded in some wells, namely, JMSGA, NSGB and NJSGA in Cambay Basin and WGSGA in KG Basin during activation after hydro-fracturing. In the shale well, NGSGA (Cambay Basin), a zone encountered within the Nawagam Middle Pay (Tight Reservoir) was hydro-fractured and on activation, produced oil. The shale well WGSGA in KG Basin requires further activation whereas another well GNSGC in Cambay Basin is awaiting hydro-fracturing.

During 2019-20, OIL has completed conventional core analysis of 5 wells, namely, Dandewala-26, Sologuri-2, Matimekhena-5 and South Tinali-5. Final evaluation reports of Jaisalmer PML in Rajasthan and Dibrugarh Extn. PML, Chabua PML, Dumduma PML in Assam incorporating the above conventional core results have been submitted to DGH. Around 17 m of conventional core from well Balimara-6 of Dumduma PML was acquired for prospectivity evaluation of Barail shales. Detail laboratory analysis is currently in progress at M/s Weatherford Laboratories. Two locations have been identified in Jairampur Extn. PEL and Deomali PEL for acquiring conventional core against the target shale of Upper Tikak Parbat and Disang shales for evaluation. Environmental Clearance (EC) is awaited.

Underground Coal Gasification

Underground Coal Gasification (UCG) is a method of converting unworked coal, still in the ground, into a combustible gas which can be used for industrial heating, power generation or the manufacture of hydrogen, synthetic natural gas or diesel fuel. UCG is a new well-proven technology of coal extraction that is being investigated and implemented around the world and that avoids most of the challenges of coal mining. With a vast proven reserve of coal, India has the potential to use UCG technology to effectively utilise coal. Development of UCG is envisaged to provide for energy security.

The Government has approved a policy framework on 16.12.2015 for development of Underground Coal Gasification in coal/lignite-bearing areas in the country. A policy, broadly similar to the existing policy for Coal-bed Methane (CBM) development on revenue sharing basis, will be adopted for offering the blocks through competitive bidding. An Inter-Ministerial Committee (IMC) under the Ministry of Coal with members from concerned Ministries will be responsible for identification of the areas, deciding about blocks to be put to bidding or awarding them to PSUs on nomination basis.

ONGC has taken up Vastan Mine block site belonging to Gujarat Industries Power Company Limited (GIPCL) in Naninaroli, Surat district, Gujarat as an R&D Pilot Project to establish UCG technology in collaboration with M/s National Mining Research Center–Skochinsky Institute of Mining (NMRC–SIM), Russia. The Agreement of Collaboration (AoC) between ONGC and National Mining Research Center–Skochinsky Institute of Mining (NMRC–SIM), Russia, to co-operate in the Services, Operations, Development and Research related to UCG in India has been renewed up to March 4, 2020. Mining lease with respect to the Vastan Pilot Project has already been awarded to GIPCL.

Moreover, a number of sites have been jointly identified by ONGC and Neyveli Lignite Corporation Limited (NLC) for studying their suitability to UCG. These are Tadkeshwar in Gujarat and Hodu-Sindhari & East Kurla in Rajasthan. One more site was jointly identified by ONGC & GMDC viz. Surkha in Bhavnagar district, Gujarat. The data of all the sites have already been analysed and have been found suitable for UCG exploration.

Once the technology is established in India, UCG will emerge as a major clean coal utilisation technology capable of providing significant impact in our country in the near future.

Biofuels

Biofuels seek to provide a higher degree of national energy security in an environment-friendly and sustainable manner by supplementing conventional energy resources, reducing dependence on imported fossil fuels and meeting the energy needs of India's vast population by use of even non-food feedstocks. The Government has been promoting and encouraging production and use of ethanol derived from molasses and other non-food feedstock for blending with petrol and biodiesel derived from inedible oils, tree borne oil seeds and oil waste for blending with diesel. The Government has notified National Policy on Biofuels 2018 on 8th June, 2018 which is expected to give boost to the biofuel programme of the country. The major features of the Policy are as below:

(i) Categorisation of biofuels as "Basic Biofuels" viz. First Generation (1G) bioethanol & biodiesel and "Advanced Biofuels" — Second Generation (2G) ethanol, bio-CNG etc.

(ii) Expanding the scope of raw material 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) The Policy indicates a viability gap funding scheme for 2G ethanol Biorefineries.

Ethanol Blended Petrol (EBP) Programme

Ethanol Blended Petrol (EBP) Programme is aimed at achieving multiple outcomes, such as, addressing environmental concerns, reducing import dependency and providing boost to Agriculture Sector. The Government, through Oil Marketing Companies (OMCs), is implementing this programme under which, OMCs sell ethanol blended petrol. The Government, with effect from 01.01.2003, resolved to supply ethanol-blended petrol in nine States and four Union Territories for sale of 5% Ethanol-blended Petrol. This was later increased to 10% w.e.f. 01.10.2008 and extended to 24 States and 5 Union Territories w. e. f. 01.04.2019.

In order to augment the supply of ethanol, the Government on 10th December, 2014, decided to procure ethanol produced from other non-food feed stocks besides molasses, like cellulosic and lignocellulosic materials including petrochemical route. It was also decided to administer the price of ethanol under EBP Programme. Different prices of ethanol have been fixed depending upon the raw material used. The Ethanol Supply Year (ESY) is taken as 1st December to 30th November of the following year so as to align it with the sugarcane crushing season.

From ESY 2018-19, additional sources like B heavy molasses, sugarcane juice, damaged food grains like wheat and rice unfit for human consumption, surplus food grains and fruit and vegetable wastes have been permitted. During ESY 2018-19, a total of 188.57 crore litres of ethanol were blended in petrol which is the highest quantity in the history of the EBP programme till date, an increase of around 25% over previous year. For ESY 2019-20, the Government has fixed an enhanced remunerative price for ethanol procurement based on raw material utilised. From ESY 2019-20, for the first time sugar and sugar syrup has been allowed for ethanol production to support the industry in liquidating their excess stocks.

The Government in recent years has taken a series of steps to boost the indigenous production of ethanol. These include re-introduction of administered price mechanism, permitting additional feedstock sources for ethanol production, amending Industries (Development & Regulation) Act, 1951 for bringing exclusive control of the Central Government over denatured ethanol, reduction in Goods & Service Tax (GST) rates from 18% to 5% on ethanol utilised under EBP Programme, notifying National Policy on Biofuels-2018 with a target of 20% ethanol blending by 2030 and an Interest Subvention Scheme for augmentation of ethanol production capacity.

Ethanol meant for EBP Programme is compulsorily denatured in the distillery itself and rendered unfit for human consumption, prior to its dispatch from the distillery. As per Notification of amendment to the Industries (Development and Regulation) Act, 1951 in 2016, the denatured ethanol, which is not meant for human consumption, will be controlled only by the Central Government. Presently, 13 States have already implemented the IDR Act amendment.

Further, MoP&NG has also issued a 'Long Term Ethanol Procurement Policy' under EBP Programme on 11.10.2019 so that the industry can plan towards long-term investments in this Sector. The salient features of this policy are as under:

(i) The ethanol procurement quantity shall be estimated by the OMCs for a period of 5 years and will form part of the procurement tender.

(ii) The annual ex-mill price from sugarcane-based raw materials shall be declared by Government.

(iii) A mechanism will be made by OMCs for change in transportation rates with the change in fuel prices over this long-term contract period.

(iv) Flexibility to introduce any new category of raw material for ethanol procurement.

(v) Mechanism to be available for induction of a new distillery/sugar mill or additional quantity offers by an existing ethanol supplier as well as a

provision for exit by an existing/participating distillery/sugar mill as per ESY in the tender.

A scheme for extending financial assistance to sugar mills through interest subvention for enhancement and augmentation of Ethanol Production capacity has been notified by Department of Food and Public Distribution. Under this Scheme, 328 proposals worth ₹ 16,481.67 crore have been accorded in-principle approval which are estimated to add 533 crore litres per annum of ethanol distillation capacity.

With an aim to provide more choices of alternative automotive fuels to consumers, the following approvals have been given by the Government:

(i) Retailing of 100% Ethanol (E-100) as a transportation fuel on a pilot basis by OMCs at a few retail outlets in areas where ethanol is sufficiently available. After assessment of the economic, operational and developmental aspects of usage of E100 as automotive fuel, the same may be expanded to other outlets.

(ii) Retailing of petrol blended with methanol (M15) as an automotive fuel by Indian Oil Corporation Ltd, at a few outlets in Assam and NE States on a pilot basis. Based on the outcome of this pilot and availability of methanol for blending, the same may be subsequently expanded to other retail outlets.

Second Generation Ethanol

The National Policy on Biofuel announced in 2018 is aimed at accelerated promotion of Biofuels with indicative targets of achieving 20% blending of ethanol in petrol. Therefore, to maximise the production of ethanol in the country for the purpose of blending with petrol, other options/ routes for enhancing ethanol production need to be explored.The Government has already allowed procurement of ethanol produced from other non-food feedstock like cellulosic and lignocellulosic materials, including petrochemical route (known as 2nd generation ethanol). Lignocellulosic biomass is being considered as a prospective source of Second Generation (2G) ethanol for supplementing the rising demand of ethanol for EBP Programme.

Subsequent to opening up of alternate route, i.e., Second Generation (2G) route for ethanol production, Public Sector Oil Marketing Companies are in the process of setting up 12 2G biorefineries and these are at various stages of development. In order to improve the financial viability of the 2G ethanol projects, Government has launched "Pradhan Mantri JI-VAN (Jaiv lndhan-Vatavaran Anukool fasal awashesh Nivaran) Yojana" for providing viability gap funding to provide initial thrust to create 2G Ethanol capacity in the country and attract investments in this sector. In this scheme, financial support to twelve Integrated Bioethanol Projects using lignocellulosic biomass & other renewable feedstock with total financial outlay of ₹ 1,969.50 crore for the period 2018-19 to 2023 -24 will be provided along with support to ten demo projects for 2G technology.

The foundation stone of Numaligarh Refinery Limited Bio-Refinery Project, a Joint Venture named Assam Bio-refinery Private Limited, was laid on 09.02.2019. Further, the foundation stone of IOCL's Biofuel complex for production of second generation biofuels was also laid at Gorakhpur on 18.09.2019.

Biodiesel Blending Programme

Biodiesel is a mixture of fatty acid easters having properties similar to diesel. It is derived from transesterification process which involves reaction of vegetable/animal fats and oils with alcohol preferably methanol. The properties of biodiesel are such that it can be mixed with any diesel fuel. Experiments for extraction work of biofuel from various plant seeds have been carried out in the country. Of these, *Jatropha curcas* has been found most suitable for the purpose. The R&D studies indicated that it enhances the life of the engine and results in less pollution.

To encourage production of biodiesel in the country, the Government announced the "Biodiesel Purchase Policy" in 2005, w.e.f. 01.01.2006. However, no biodiesel could be procured till 2014. The Government on 16.01.2015 allowed direct sale of biodiesel by manufacturers/ suppliers of biodiesel/their authorised dealers and Joint Ventures (JVs) of OMCs as authorised by

MoP&NG to all consumers. On 10.08.2015, the Government allowed sale of biodiesel (B100) by private manufacturers to bulk consumers. Also, retailing of biodiesel blended diesel by Public Sector OMCs was started on the same day. The Government, vide Notification dated 29th June, 2017, has allowed direct sale of Biodiesel (B-100) for blending with High Speed Diesel to all consumers, in accordance with the specified blending limits and the standards specified by the Bureau of Indian Standards.

Ministry of Petroleum & Natural Gas has issued Gazette Notification dated 30.04.2019 regarding 'Guidelines for sale of Biodiesel for blending with High Speed Diesel for transportation purposes-2019'. Marketing Division of this Ministry has also issued "The Motor Spirit and High Speed Diesel (Regulation of Supply, Distribution and Prevention of Malpractices) Amendment Order, 2019 dated 30.05.2019 vide Gazette Notification on 31.05.2019" to incorporate the above guidelines.

During the period April, 2019 to Feb., 2020, 10.13 crore litres of biodiesel has been procured by OMCs for biodiesel blending.

Presently, Biodiesel is mainly being made through imported palm seatrain oil. In order to encourage production of biodiesel from Used Cooking Oil (UCO), OMCs have floated Expression of lnterest on 10.08.2019, for supply of biodiesel produced from UCO at 100 locations across the country and it was further extended to 200 locations on 10.10.2019. The ex-factory UCO based biodiesel price has been fixed for three years. The price for the first year has been fixed at ₹ 51/litre, for the second year at ₹ 52.7/litre and for the third year at ₹ 54.5/litre. GST and Transportation shall be payable in addition to this price.

POLICIES AND CONTRACTS

One of the landmark outcomes of the Liberalisation Policy vis-a-vis Petroleum Sector is the impetus for participation of foreign and other Indian Companies in exploration and development activities. The Government further sent signals of encouragement to the National Oil Companies to aggresively pursue oil and gas opportunities overseas.

The New Exploration Licencing Policy (NELP) and the Coal-bed Methane (CBM) Policy were formulated by the Government of India, with Directorate General of Hydrocarbons (DGH) as the nodal agency, during 1997-98 to provide a level playing field to both the Public and Private Sector Companies in exploration and production of hydrocarbons. NELP has steered steadily towards a healthy spirit of competition between National Oil Companies and private companies. The Government had initiated bids under the NELP in February 1999 to accelerate and expand exploration of oil and gas in the country. Under NELP, acreages are offered to the participating companies through the process of open international competitive bidding. The first round of offer of blocks was launched in 1999 and most of the ninth round awards were concluded in 2012. The Government had also formulated a CBM Policy in 1997 and implemented the same in 2000 providing attractive fiscal and contractual framework for exploration and production of CBM.

In order to bridge the gap between energy supply and demand, GoI has adopted multi-pronged strategy for giving momentum to exploration and production (E&P) activities for hydrocarbons in the country. The major steps taken in this regard include offering of exploration blocks in Indian sedimentary basins through NELP; development of alternate sources of hydrocarbon, such as, CBM and Shale Gas; Research & Development for new sources, such as, Gas Hydrate; and carrying out E&P operations in safe and environment-friendly manner.

The Government has issued "Policy Guidelines for Exploration and Exploitation of Shale Gas and Oil on 14th October, 2013. Under this Policy, the right to exploration and exploitation of Shale Gas & Oil will lie with the National Oil Companies (NOCs) holding Petroleum Exploration Licence (PEL)/Petroleum Mining Lease (PML) granted under the nomination regime.

During Pre-NELP era, 28 exploration blocks and 28 small/medium-sized discovered fields were awarded to private companies where ONGC and OIL have the rights for participation after hydrocarbon discoveries. Under NELP regime, nine rounds of bids have so far been concluded

during 1999-2012, in which production sharing contracts for 254 exploration blocks have been awarded and signed. Two DSF bidding rounds have been carried out till date and 53 contract areas have been awarded. Under HELP, four bidding round has been implemented through OALP and received an overwhelming response with 94 blocks getting awarded. As on 01.04.2020, a total of 224 blocks (77 under PSCs and 147 under RSCs) are active comprising 11 Pre-NELP, 21 Small & Medium Size Field PSCs, 45 NELP, 53 Discovered Small field and 94 OALP (under HELP Policy) Blocks. The details of the blocks awarded under various policy/regime are highlighted in Table-8.

The Government's prime objective is to enhance domestic oil & gas production, reduce import dependency and achieve energy security. Therefore, the oil & gas regulatory ecosystem has been overhauled to achieve conducive business environment and to foster investments in the E&P sector. Major policy drives and initiatives have been ushered in by the Government in upstream hydrocarbon segments in India in the last couple of years to provide impetus to the investment climate and to scale up domestic production. The Government has formulated path-breaking policies to revolutionise the E&P sector. Through the various initiatives, the Government envisages to accelerate E&P activities that would provide impetus to expeditious production of oil & gas. Some of the notable policy reforms of recent years have been enumerated below —

Table - 8: Status of Exploration Block Awarded

Round	No. of blocks awarded	No. of blocks relinquished	No. of blocks active	Present Area sq.km
NELP-I	24	21	3	231527
NELP-II	23	22	1	267883
NELP-III	23	19	4	204596
NELP-IV	20	17	3	192810
NELP-V	20	16	4	115180
NELP-VI	52	44	8	306426
NELP-VII	41	33	8	112950
NELP-VIII	32	29	3	52573
NELP-IX	19	10	9	26431
Total NELP	**254**	**211**	**43**	**1510376**
DSF Round-I	30	11	19	777
DSF Round-II	24	5	19	3000
Total DSF	**54**	**16**	**58**	**3777**
OALP-I	55	-	55	59283
OALP-II	14	-	14	29233
OALP-III	18	-	18	29765
OALP-IV	07	-	07	18510
OALP-V	11	-	11	19789
Total	**105**	**-**	**94**	**156580**
G. Total	**413**	**227**	**186**	**1670733**

***Source**: Indian Statistics 2020-21, Ministry of Petroleum and Natural Gas. Outlook, 2020-21,*

1. Categorises onshore and offshore oil & gas exploration activities as Category B2 for green clearance: The Ministry of Environment, Forest and Climate Change (MoEF&CC) vide Notification dated 16th January 2020 categorises onshore and offshore oil & gas exploration activities as B2 category for seeking prior Environmental Clearance (EC). As exploration activities in Hydrocarbon sector have been moved from Category A to Category B2, such activities will now require environmental clearance only from the States concerned and will not require preparation of an EIA report or conduct of Public Hearing. However, Development or Production, both on offshore/onshore fields as hydrocarbon blocks, will continue to merit assessment as "Category A".

2. Self-certification of processes under Production Sharing Contracts (PSC): Vide Notification dated 28.02.2020, a review of the processes for various approvals and submission of documents for the same under Production Sharing Contracts (PSC) under NELP/Pre-NELP has been undertaken. The documents shall be submitted to DGH and/or MoPNG. The Government has reviewed the processes and segregated 37 processes into three categories, viz. (i) 22 Processes where documents shall be accepted on self-Certification basis and no approval is required; (ii) 3 Processes where approval will be deemed on expiry of 30 days of submission of self-certification of documents and (iii) 12 Processes where approvals shall be required under the Act/Rules or Contracts.

3. Delegating powers to award contract areas to Minister of Petroleum & Natural Gas and Minister of Finance on the recommendations of Empowered Committee of Secretaries (ECS) (Date

of Notification: 29-06-2018): In line with the Government initiative of ease of doing business, the Government has approved delegating of powers to Minister of Petroleum and Natural Gas and Finance Minister to award the Blocks/ Contract Areas to successful bidders under Hydrocarbon Exploration and Licencing Policy (HELP) after International Competitive Bidding (ICB) based on the recommendations of ECS. Under HELP the competitive bidding will be continuous and blocks will be awarded thrice a year.

4. Exploration and Exploitation of Coal-bed Methane (CBM) from areas under Coal Mining Lease allotted to Coal India Limited (CIL) and its subsidiaries: The decision is in line with the Government's initiatives of Ease of Doing Business & reducing the hydrocarbon import. The amendment will expedite the exploration and exploitation of CBM, enhance the availability of natural gas and reduce the gap in demand and supply of natural gas. Production of CBM from existing coalfields will further ensure safe mining practices. The increased development activities for exploration and exploitation of CBM gas reserves in-and-around the block will generate economic activities which in turn has potential to create employment opportunities in CBM operations and in the industries.

The Cabinet Committee on Economic Affairs chaired by the Prime Minister has accorded approval for issuing a notification amending Clause 3(xiii) of the Notification dated 03.11.2015 issued by the Ministry of Petroleum & Natural Gas under Section 12 of the Oil Fields (Regulation and Development) Act, 1948 (ORD Act, 1948). Due to this amendment, relaxation is granted under the Petroleum & Natural Gas Rules 1959 (PNG Rules, 1959) to Coal India Limited (CIL) and its subsidiaries for not applying for grant of licence/ lease under the PNG Rules, 1959 for extraction of Coal-bed Methane (CBM) under their Coal-bearing Areas. On 8th May 2018, Ministry of Petroleum & Natural Gas has approved the consolidated terms and conditions for grant of exploration and exploitation rights to Coal India Limited (CIL) and its subsidiaries for CBM.

CIL has come out with a tender for carrying out CBM operations in their Jharia and Raniganj Coal Fields.

5. Policy Framework for Streamlining working of Production Sharing Contracts in respect of Pre-NELP and NELP Blocks: The policy framework has been notified on 14.08.2018 and includes:

i) Special dispensation for E&P activities in North Eastern Region (NER) — The Government has extended timelines for exploration and appraisal period in operational blocks of North Eastern region of India considering geographical, environmental and logistical challenges. The exploration period has been increased by two years and appraisal period by one year. Further, to stimulate natural gas production in NER, Government has also allowed marketing including pricing freedom for natural gas to be produced from discoveries which are yet to commence production as on 1st July, 2018.

ii) Sharing of Royalty and Cess in Pre-NELP Exploration Blocks — The Government has created an enabling framework for sharing of statutory levies including royalty & cess in proportion to the participating interest of the Contractor in Pre-NELP Exploration Blocks and the same has been made cost recoverable with prospective effect.

iii) Extending tax benefits under Section 42 of Income Tax, 1961 prospectively to operational blocks under Pre-NELP discovered fields for the extended period of contract under PSC extension policy dated 28th March 2016. Section 42 of Income Tax allows the companies to claim 100% of expenditure incurred under a PSC as tax deductible for computing taxable income in the same year.

iv) Relaxing the timeline from 7 days to 15 days for giving written notice to notify the occurrence of a Force Majeure event in the PSCs.

6. Policy Framework for Exploration and Exploitation of Unconventional Hydrocarbons under Existing Production Sharing Contracts (PSCs) Coal-bed Methane (CBM) Contracts and Nomination Fields: This policy was notified on 20.08.2018 and will enable the realisation of prospective hydrocarbon reserves in the existing Contract Areas which otherwise would remain unexplored and unexploited. With this policy dispensation, new investment in Exploration and

Production (E&P) activities and chances of finding new hydrocarbon discoveries and resultant increased domestic production thereof is expected. This will lead to induction of new, innovative and cutting-edge technology and forging new technological collaboration to exploit unconventional hydrocarbons. As on 31.03.2020, NOC's are carrying out shale Oil/Gas Exploration work in their PEL/PML areas. Operators of blocks Raniganj (South) and RG (East)-CBM-2001/1 have evinced their interest to carry out shale operations in their blocks.

7. Policy framework to promote and incentivise enhanced recovery methods for Oil and Gas: The Government notified the Policy on 10th October 2018 with objective to encourage and incentivise additional investments towards adoption of enhanced recovery techniques through fiscal waivers to increase domestic hydrocarbon production. The policy aims at building a supportive ecosystem through academic and research institutes, industry-academia collaboration and to support and encourage Exploration and Production (E&P) Contractors to deploy ER/IR/UHC Methods/ techniques. Salient Features of the policy are as follows:

(i) This ER Policy framework is to promote and incentivise Enhanced Recovery (ER)/ Improved Recovery (IR)/ Unconventional Hydrocarbon (UHC) production Methods/techniques to improve recovery factor of existing hydrocarbons reserves for augmenting domestic production of oil and gas.

(ii) The ER includes Enhanced Oil Recovery (EOR) and Enhanced Gas Recovery (EGR), Unconventional Hydrocarbon (UHC) production methods which include shale oil and gas production, tight oil and gas production, production from oil shale, gas hydrates and heavy oil.

(iii) The policy will be applicable to all contractual regimes and Nomination fields.

(iv) The Policy, having a sunset clause, will be effective for 10 years from the date of its notification. However, the fiscal incentives will be available for a period of 120 months from the date of commencement of production in ER/UHC projects.

(v) In case of IR Projects, the incentives will be available from the date of achievement of the prescribed benchmark.

(vi) The fiscal incentives are extended in form of partial waiver of applicable Cess/Royalty on incremental production resulting from the adoption of ER methods on designated wells.

(vii) An Enhanced Recovery (ER) Committee comprising of representatives of MoPNG, DGH, experts from upstream sector, and academia would monitor and implement the Policy.

(viii) The Policy envisages 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 to make the investment financially viable.

(ix) Mandatory Screening of fields through designated institutions, to be notified by Government, and conducting Pilot-scale studies before actual implementation of ER Project on commercial level.

The implementation of the policy broadly involves 3 major stages – screening studies, pilot phase and commercial implementation. The first stage is the screening of ER methods compatible with the field/reservoir under consideration and selection of the most appropriate ER method accordingly. The second stage is the pilot phase of an ER project which commences after the approval of ER proposals/screening report by DGH. The third stage is the commercial implementation of the ER method by the Operator post a successful pilot phase. Based on this plan for commercial ER implementation, the ER Committee decides upon the quantum of fiscal incentive to be made available to the Operator for the project under the ER Policy.

As on 31.03.2020, a total of 215 commercial fields were screened under the policy. After the first stage screening, the ER screening reports were clubbed field-wise and a total of 72 fields have been deemed to be suitable ER candidate fields. After comprehensive screening studies, a total number of 17 ER proposals have been received in 2019-20 (as on 31st March 2020). Of the 17 ER proposals submitted, 6 proposals have been approved by DGH for next stage.

8. Reforms in Hydrocarbon Exploration and Licencing Policy for enhancing domestic exploration and production of oil and gas: The Government notified 'Reforms in Exploration and Licencing Policy' on 28th February 2019, with the objective to intensify exploration activities, attract foreign and domestic investment and enhance domestic production. E&P companies under the Reformed Policy will get following exclusive benefits during contract period:

i) No Revenue Sharing with Government in Category–II & III sedimentary basins except in case of "Windfall Gain";

ii) Royalty concessions for early monetisation and commercial production;

iii) In Category-I, sedimentary basin Revenue share at HRP is capped at 50%;

iv) Simplified contractual terms with emphasis on cutting down approvals of Government/DGH/ Management Committee and expeditious grant of approvals;

v) Empowered Coordination Committee (ECC) under the chairmanship of Cabinet Secretary for expediting process of approvals;

vi) New Dispute Resolution Mechanism for amicable and speedy redressal of contractual dispute.

vii) Electronic Single Window mechanism based on IT workflow and processes for processing of approvals.

The benefits are applicable to OALP Bid Round IV onwards. As on 31.03.2020, 7 Blocks spread over an area of 18,510 sq. km was successfully awarded under OALP Bid Round IV, to ONGC. ONGC has committed 1,400 LKM of 2D, 2,450 SKM of 3D and 61 exploratory wells for an investment amount of USD 340.70 million. OALP Bid Round V with 11 Blocks (8 Onland, 1 Ultra-Deep-Water and 2 Shallow Water blocks) on offer spread over an area of 19,800 sq. km is under progress.

9. Marketing including pricing freedom for gas to be produced from Discoveries in Deepwater (DW), Ultra Deepwater (UDW) and High Pressure-High Temperature areas (HP-HT): On 10th March 2016, the Government approved marketing and pricing freedom for Gas discoveries in HP-HT, DW and UDW Reservoirs and details were notified on 21.03.2016. This shall incentivise exploration and production in DW/UDW/HPHT areas and will unlock huge Hydrocarbon potential. The ceiling gas price is determined (based on alternative fuels) by the Government. Up to 31.03.2020, ONGC has started producing gas from Discoveries in Deepwater Ultra Deepwater and High Pressure-High Temperature areas eligible under Notification dated 21.03.2016 from S1-VA field at East Coast from Aug'16. ONGC has also invited tenders for upcoming gas from KG-DWN-98/2. RIL has also invited tenders for upcoming gas from KG-DWN-98/3.

10. Policy for the Grant of Extension to the Production Sharing Contracts signed by Government awarding small, medium-sized and discovered fields to private Joint Ventures (Date of Notification: 28.03.2016): On 10th March 2016, the Government approved for grant of extension to the Production Sharing Contracts for 28 small, medium-sized and discovered fields signed by Government of India and Private JVs. The Policy allows extension for a period of 10 years for both Oil and Gas fields. The Government approved the policy to grant extension for 10 years or economic life of the field, whichever is earlier, to small and medium-sized discovered fields in March, 2016. The Government share of profit Petroleum during the extended period of contract would be 10% higher for these fields. As on 31.03.2020, under this policy, 11 PSCs of Pre-Nelp Discovered Fields have been extended by 10 years and 1 PSC of Pre-Nelp Discovered Field (Hazira) has been extended by 5 years.

11. New Hydrocarbon Exploration Licencing Policy (HELP) along with Open Acreage Licencing Programme (OALP): Hydrocarbon Exploration and Licencing Policy (HELP) was launched (Notified on 30.03.2016) with the clear objective of boosting the production of oil & gas in the Indian sedimentary basin. The policy formally put in operation w.e.f. 1st July, 2017 with notification of Open Acreage Licencing Policy (OALP). This policy is based on the new model of Revenue Sharing Contract (RSC) which has replaced the earlier model of Production Sharing Contract (PSC). This policy is a paradigm shift 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'. Under HELP, Open Acreage Licencing Policy allows the investors to carve out blocks of their choice by assessing E&P data available at NDR & by submitting an Expression of Interest (EoI) throughout the year without waiting for a formal bid round from the Government. These blocks would be subsequently offered through bi-annual formal bidding process. OALP would be manifested through National Data Repository which will provide rapid jump start to E&P activities by providing seamless access to the country's entire G&G data for interpretation and analysis. The Salient Features of HELP are as below —

i) Unified licence for all types of hydrocarbon viz. conventional oil and gas, coal-bed methane, shale oil, gas hydrates, etc.

ii) Revenue Sharing Model: Simple, easy to monitor; only two monitoring parameters for the Government revenue & production of the contractor, no cost recovery; no micro-management by the Government; operational freedom to the operator.

iii) Freedom to carve out blocks under OALP

iv) Reduced and graded royalty rates. Further, to encourage exploration in deep water and ultra-deep water areas, the royalty was exempted for first seven years (and subsequently royalty of 5% and 2% will be made applicable in deep water and ultra-deep water areas, respectively).

v) Other fiscal incentives viz. exemption of cess on crude oil and custom duty applicable on equipment/services for exploration and production activities, reduced rate of GST on specified goods being purchased for petroleum operations.

vi) Full marketing and pricing freedom of gas produced on arm's length basis.

vii) Extended period for exploration and production, i.e., 8 years for onland/ shallow water and 10 years for deep water/ frontier areas.

viii) Pre-determined Liquidated Damages (LDs) for any shortfall in committed work program.

As on 31.03.2020, since the inception of HELP, four bid rounds have been concluded so far and Fifth Bid Round is ongoing. Under four Bid Rounds, 99 blocks were on offer and 94 exploration blocks covering an area of 1,36,790 sq. km were awarded. Five un-awarded blocks were part of OALP Round-III and in all of them CBM was the focus.

12. Early Monetization of CBM: The policy was notified on 11.04.2017 and it was expected to boost CBM production and generate new avenues of employment and increased investment in CBM blocks. It was also envisaged that 14 CBM blocks which are under relinquishment will be provided an easy exit option under the policy. As on 31.03.2020, after implementation of policy one GSA (Gas Sales Agreement) was signed in Raniganj East CBM Block and exit from 6 CBM Blocks was approved. CBM production during 2019-20 was ~1.80 MMSCMD in the country.

13. Policy for the Grant of Extension to the Production Sharing Contracts signed by GoI awarding Pre-NELP Exploration Blocks (Date of Notification: 22.03.2017): This policy enables the contractors to extract not only the remaining reserves but also plan to extract additional reserves by implementing new technologies. The policy will enable to acceleration and supplementation of indigenous production of hydrocarbon from existing blocks and will act as a progressive step towards achieving the target of 10% reduction in import of energy by 2021-22. In certain fields, additional recovery of hydrocarbons can be obtained and as such the production would extend beyond the current duration of PSC. The Government share of Profit Petroleum during the extended period of contract would be 10% higher for these fields, thus bringing additional revenues to the Government. In addition, the policy brings out detailed guidelines regarding grant of extension, criterion for evaluation of request, time frame for consideration of request, duration of extension etc. The extension of these contracts is expected to bring extra investments in the fields and would generate both direct and indirect employment. The policy aims at bringing out clear terms of extension in fair and transparent manner so that the resources can be expeditiously exploited in the interest of energy security of the country besides improving the investment climate. As on 31.03.2020, out of 10 blocks applicable under the policy, extension of 10 years has been granted to Pre-Nelp Exploration block RJ-ON-90/1, and 6 blocks have more than 2 years for expiry of PSC.

One block has been terminated and remaining 2 blocks are under exploration in PSC.

14. Survey of Un-Appraised Areas of Sedimentary Basins of India (Date of Notification:12.09.2017): The project was sanctioned to acquire 48,243 Line Kilometer (LKM) 2D seismic data for appraisal of Indian sedimentary basins where limited data is available. The project will be implemented by NOCs, i.e., OIL and ONGC. OIL will conduct survey in North Eastern States while remaining area will be covered by ONGC. Survey work will be carried out in 24 States over a period of 5 years. The timeline to complete the project was June 2020. DGH reviewed the progress of work and construed that reasons for shortfall in completing the project target are inevitable. Due to the Covid-19 restrictions and lockdown, MoP&NG has been requested to extend the timeline till June 2021. As on 31.03.2020, cumulative data acquisition by ONGC and OIL was 40,137.40 LKM (98.29%) and 4,637.28 LKM (76.10%) respectively. Processing of 35,431.50 LKM data and interpretation of 22,003.97 LKM data by ONGC have been completed whereas, 3,559.68 LKM data were processed in the case of OIL.

15. New Domestic Natural Gas Pricing Guidelines, 2014: In supersession of MoPNG's Gazette Notification no. 22011/3/2012ONG.D.V dated 10.01.2014, the Government of India notified the New Domestic Natural Gas Pricing Guidelines, 2014 on 25.10.2014, effective from 01.11.14. Domestic Natural Gas prices are being determined in accordance with the pricing formula dated 25.10.2014 and notified by MoPNG on half- yearly basis. In terms of these guidelines, domestic gas price is determined based on weighted average formula considering (a) annual average prices prevailing at Henry Hub, Alberta Hub, National Balancing Point & Russia and (b) annual volume of natural gas consumed in USA & Mexico, Canada, European Union & Former Soviet Union countries excluding Russia.

16. Policy framework for relaxations, extension and clarifications at the development and production stage for early monetisation of Hydrocarbon discoveries under PSC regime: The policy was notified on 10.11.2014 and the salient features of the policy initiative are as under:

i) Extension of Appraisal period for submission of Declaration of Commerciality (DoC) in respect of Hydrocarbon discovery.

ii) Extension of time period for submission of Field Development Plan (FDP) after review of DoC by the Management Committee.

iii) Reduction in Minimum Work Programme (MWP) in case a block or its part is not available for exploration activities consequent to denial of permission by Government Agencies.

iv) Swapping of 2D and 3D Seismic Minimum Work Programme, on the request of the operator.

v) In cases where the committed Minimum Work Programme of any exploration phase is not completed, entry into subsequent exploration phases, would be permitted after paying cost of unfinished MWP of previous phases.

vi) Condoning delays in submission of notice for entering next phase.

vii) Condoning delays in submission of Annual Work Programme and Budget and the Appraisal work programme.

viii) Permission for drilling of Appraisal Wells after Submission of DoC.

ix) Probing additional reservoirs during appraisal programme.

x) Acceptance of discoveries for which notification to the Government has not been made and also notification for testing has not been provided as prescribed.

As on 31.03.2020, over 40 cases have been resolved under this policy. Extension of time period for submission of DoC and FDP were granted in 8 Blocks and 4 Blocks, respectively. Operator allowed to Exit in 14 Blocks whereas in 3 Blocks Minimum Work Programme (MWP) Reduction was granted and 2 applications are under consideration. Swapping of 2D and 3D seismic MWP were granted in 7 Blocks. Entry into subsequent exploration phase, after paying cost of unfinished MWP of previous phases was granted in 1 Block. One application was received for Condoning delays in submission of notice for entering next phase. Drilling of Appraisal Wells after submission DoC was granted in 1 Block. Probing of additional reservoirs during appraisal programme was approved in 3 Blocks.

17. Policy on Testing Requirements for discoveries in NELP Blocks: The Government of India approved (notified on 13.05.2015) a clear policy on testing requirements for discoveries made under NELP Blocks. The policy settled the long pending issue of about 13 discoveries in five blocks pertaining to ONGC (Seven discoveries) and Reliance Industries (six discoveries). The reform allows the contractors to choose one of the following three options for discoveries which are stuck on account of testing requirement:

(i) Relinquish the blocks

(ii) Develop the discoveries after conducting Drill Stem Test (DST) with 50 per cent cost of DST being disallowed as penalty for not conducting the test on time. The cost recovery for carrying out DST would be capped at US $ 15 million.

(iii) Develop the discoveries without conducting DST in a ring-fenced manner.

As on 31.03.2020, after availing this policy in block KG-DWN-98/3, the Contractor has submitted DOC and FDP for D-29 and D-30 discoveries which got reviewed/approved by MC and currently it is under development. Also under this policy, Contractor has relinquished D-31 and D-42 discoveries of block KG-DWN-98/3.

18. Discovered Small Field Policy (Earlier called as Marginal Field Policy) (Date of Notification: 14.10.2015): To reduce the import dependency of hydrocarbons, to effectively exploit the untapped established reserves and increase indigenous production, the Government approved the Marginal Field Policy (MFP). The Government has attempted to include certain reforms in the hydrocarbon exploration and production management through this policy with sole intention to increase the production at the earliest. The policy was later rectified as Discovered Small Field Policy. The objective of the Discovered Small Field Policy is to bring discovered small fields to production at the earliest to augment the domestic production of oil and gas. For early monetisation of these fields, in September 2015, the Cabinet approved 69 marginal fields for offer under DSF Policy. These contract areas have been awarded under the new regime of Revenue Sharing Model. Award of contract is expected to provide faster development of fields and facilitate production of oil and gas thereby increasing energy security of the country.

Under Discovered Small Field Bid Round-I & Round-II, a total of 53 contract areas comprising 100 fields were awarded. Of which, 37 Contract Areas awarded were on-land and 16 remaining Contract Areas were offshore. As on 31.03.2020, Bid Work for 111 wells and anticipated investment under FDPs to the tune of 1,600 million USD are under progress. PML has been granted for 42 contract areas (27 Onland and 15 Shallow water), while for 08 contract areas (Andhra Pradesh-05, Tamil Nadu-02, Arunachal Pradesh-01), it is pending . A total of 23 FDPs have been approved with total Inplace of 154.5 MMtoe and cumulative production of 41.9 MMtoe contribution during field life.

STRATEGIC CRUDE OIL STORAGE

Keeping in view India's high import dependence for oil & gas and country's energy security, MoPNG took up construction of crude oil reserve facilities as a buffer to deal with any situation of supply chain disruption due to external reasons. A Special Purpose Vehicle (SPV) named Indian Strategic Petroleum Reserve Limited (ISPRL), a subsidiary Company of Oil Industry Development Board (OIDB), was created on 16th June, 2004. Under Phase I, three underground rock caverns for Strategic Petroleum Reserve (SPR) with total crude oil storage capacity of 5.33 million tonnes located at Visakhapatnam (1.33 million tonnes), Mangaluru (1.5 million tonnes) and Padur (2.5 million tonnes) have beeen constructed and were dedicated to the nation on 10th February 2019. The National Oil Company of Abu Dhabi (ADNOC), UAE, has already stored crude oil at its own cost at one of the two cavern of Mangaluru SPRs as per restated agreement signed with ADNOC on 10th February 2018. The Indian Strategic Petroleum Reserves Ltd (ISPRL) signed an MoU with Saudi Armaco to explore possibility of filling one cavern at Padur on the sidelines of the PM's visit to Saudi Arabia in October 2019. The total reserve of Phase-I of SPRs is currently estimated to supply approximately 10 days of India's crude requirement.

In order to further augment India's preparedness during emergency oil shortage situation, the Government under Phase-II gave 'In Principle' approval for establishing additional 6.5

MMT Strategic Petroleum Reserves at locations Chandikhol (4 MMT) in Odisha and Padur (2.5 MMT) in Karnataka. The 'In Principal' approval is to take up the project under PPP model to reduce budgetary support of Government of India. On completion of 6.5 MMT storage envisaged in Phase II, there will be an additional storage capacity created to cover another 12 days of crude oil requirement. Thus, the total cover would be approximately 22 days.

WORLD REVIEW

The world proved reserves of crude oil and natural gas at the end of 2020 were estimated at 244.4 billion tonnes and 188.1 trillion cu. m, respectively (Tables - 9 & 10). The largest share of reserves of world crude oil is available in Middle East (48.3%) followed by South & Central America (18.7%), North America (14%), CIS (8.4%), Africa (7.2%), Asia Pacific (2.6%) and Europe (0.8%).

Of the total world reserves of natural gas, the largest share is from Middle East (40.3%), CIS (30.1%), Asia Pacific (8.8%), North America (8.1%), Africa (6.9%), South & Central America (4.2%) and Europe (1.7%).

The world production of crude petroleum in 2020 decreased by 7% to 4,126 million tonnes from 4,441 million tonnes in 2019. USA with share of 18% followed by Saudi Arabia (13%), Russia (12%), Iraq, China & Canada (5% each), Brazil & UAE (4% each) and Kuwait & Iran (3% each) were

Table – 9 : World Proved Reserves of Crude Oil* (By Principal Countries)

(In billion tonnes)

Country	Reserves
World: Total	**244.4**
Algeria	1.5
Angola	1.1
Azerbaijan	1.0
Brazil	1.7
China	3.5
Canada	27.1
Iran	21.7
Iraq	19.6
Kazakhstan	3.9
Kuwait	14.0
Libya	6.3
Nigeria	5.0
Norway	1.0
Qatar	2.6
Russian Federation	14.8
Saudi Arabia	40.9
UAE	13.0
USA	8.2
Venezuela	48.0
Other countries	9.5

Source: *BP Statistical Review of World Energy, 2021.*
** At 2020 end.*

Table– 10 : World Proved Reserves of Natural Gas* (By Principal Countries)

(In trillion cu. m)

Country	Reserves
World : Total	**188.1**
Algeria	2.3
Australia	2.4
Azerbaijan	2.5
Canada	2.4
China	8.4
Egypt	2.1
India	1.3
Indonesia	1.3
Iran	32.1
Iraq	3.5
Kazakhstan	2.3
Kuwait	1.7
Libya	1.4
Malaysia	0.9
Nigeria	5.5
Norway	1.4
Qatar	24.7
Russian Federation	37.4
Saudi Arabia	6.0
Turkmenistan	13.6
UAE	5.9
Ukraine	1.1
USA	12.6
Venezuela	6.3
Other countries	9.0

Source: *BP Statistical Review of World Energy, 2021.*
** At 2020 end.*

the principal producers of crude petroleum in 2020.

The world production of natural gas decreased to 4047 billion cu. m in 2020 from 4191 billion cu. m in 2019. USA with share of 23% followed by Russia (17%), Iran (6%), Qatar, China, Canada & Australia (4% each) and Norway & Saudi Arabia (3% each) were the major producers of natural gas in 2020 (Tables-11 & 12).

Table – 11 : World Production of Crude Petroleum (By Principal Countries)

(In million tonnes)

Country	2018	2019	2020
World : Total	**4477**	**4441**	**4126**
Algeria	65	64	58
Angola	74	69	65
Argentina	26	26	26
Azerbaijan	39	38	35
Brazil	139	150	158
Canada	228	233	223
China[(a)]	189	191	190
Colombia	46	47	41
Ecuador	28	29	26
Egypt	33	32	30
India[(c)]	34	32[e]	30
Indonesia	39	37	36
Iran	219	158	143
Iraq	227	234	202
Kazakhstan	90	91	86
Kuwait[(d)]	147	143	130
Mexico	107	99[e]	99
Nigeria	96	101	87
Norway	91	85	99
Oman	49	48	47
Qatar	80	79	76
Russia	556	561	512
Saudi Arabia[(d)]	578	557	520
UAE	177	180	166
UK	51	52	49
USA	701	781	747
Venezuela	76	47	27
Other countries	293	278	222

Source: *World Mineral Production, 2016-2020.*
Note: *The figures shown in this table include natural gas liquids.*
(a): Including oil from shale and coal.
(c): Years ended 31 March following that stated.
(d):Including shares of production from the Neutral Zone.

Table – 12 : World Production of Natural Gas (By Principal Countries)

(In billion cu. m)

Country	2018	2019	2020
World: Total	**4039**	**4191**	**4047**
Algeria	94	86	82
Argentina	40	46	42
Australia	131	154	154
Azerbaijan	19	25	26
Bahrain	22	25	25
Bangladesh	27	27	25
Brazil	27	27	25
Canada	157	161	158
China	160	176	176
Egypt	59	65	59
India[(d)]	32	30	29
Indonesia	73	67	59
Iran	232	241	251
Kazakhstan	55	57	55
Malaysia	66	69	63
Mexico	46	39*	39*
Nigeria	48	46	49
Norway	122	115	112
Oman	35	36	35
Pakistan[(c)]	41	41	40
Qatar	169	172	171
Russia	726	738	694
Saudi Arabia[(e)]	112	111	112
Tanzania	59	60	60*
Thailand	37	38	33
Trinidad & Tobago	37	37	31
Turkmenistan	62	63	59
UAE	58	58	55
UK	41	39	39
USA[(a)]	871	961	948
Uzbekistan	57	57	47
Other countries	324	318	292

Source: *World Mineral Production, 2016-2020.*
Note*: So far as possible the figures in this table exclude flared or reinjected gas.*
(a):Dry gas.
(c): Years ended 30 June of that stated.
(d): Years ended 31 March following that stated.
(e): Including one-half of the output of the Neutral Zone.
**: estimated*

The world consumption of oil (which includes biogasoline, biodiesel and derivatives of coal & natural gas) in 2020 was estimated as 91,297 thousand of barrel per day, while that of natural gas (excludes natural gas converted to liquid fuels but includes derivatives of coal as well as natural gas consumed in gas-to-liquids transformation) was 3,822.8 billion cu. m. The share of India in the world consumption of oil and natural gas was 5.26% (4,669 thousand of barrels per day) and 1.56% (59.6 billion cu. m), respectively, during 2020 .

FOREIGN TRADE

Exports

Exports of natural gas decreased significantly by 66% to 17,992 tonnes in 2020-21 from 52,408 tonnes in 2019-20. Exports of natural gas were mainly to Nepal (99.9%) (Table -13).

Imports

Imports of crude petroleum decreased by 15% to 188.182 million tonnes in 2020-21 as compared to 220.870 million tonnes in 2019-20. Imports were mainly from Iraq (26%), Saudi Arabia (18%), UAE

Table – 13 : Export of Natural Gas (By Countries)

Country	2020-21(R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**17992**	**658242**	**3**	**883**
Bhutan	2	299	3	484
U Arab Emts	++	100	++	399
Nepal	17988	65779	--	--
Nigeria	2	46	--	--

Figures rounded off

Table – 14 : Import of Petroleum (Crude) (By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty ('000 t)	Value (₹'000)	Qty ('000 t)	Value (₹'000)
All Countries	**188182**	**4396561618**	**220034**	**9139168005**
Iraq	43028	951898108	56467	2265536210
Saudi Arabia	34201	795811634	38878	1707845805
UAE	21883	543546952	21664	918227357
USA	15030	396119190	19976	845421712
Nigeria	14220	361689340	14994	641122361
Kuwait	9590	230800971	14228	592834902
Mexico	7343	146424544	7252	254741881
Russia	2760	70008285	4317	184101269
Oman	3267	85023664	6276	269194922
Brazil	3027	68733737	4158	165830985
Other Countries	33833	746505193	31824	1294310601

Figures rounded off

Table – 15: Import of Natural Gas (By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**25054872**	**583289424**	**23417029**	**1005206968**
Qatar	9928514	232229782	10100902	441047128
USA	2903231	82166511	3652704	141562657
UAE	3222307	61110991	3212749	124276361
Nigeria	2153556	47593774	1793215	106236403
Angola	1927953	40107265	996410	45916693
Oman	1502556	34754703	931216	50252252
Cameroon	203350	2797193	337501	9716406
France	475546	13764633	308815	10783085
Egypt	455788	13321517	733197	22514425
Belgium	287728	7266895	210528	9618472
Other Countries	1994343	48176160	1139792	43283086

Figures rounded off

and USA (9% each), Nigeria (7%), Kuwait (6%), Mexico (3%) and Oman, Russia & Brazil (2% each). Imports of natural gas Increased marginally by 3% to 25 million tonnes in 2020-21 from 24.41 million tonnes in 2019-20. Main suppliers were Qatar (43%), USA (16%), UAE (14%), Nigeria (7%) , Angola and Oman (4% each), Egypt (3%),(Tables - 14 & 15).

FUTURE OUTLOOK

Energy is considered as one of the key inputs for economic development of any country. India is expected to be one of the fastest growing economies of the world in the near future. With the population anticipated to grow in the future and improvements in socio-economic developments, energy demand is expected to rise consequently. Thus, India will be the biggest contributor to energy growth demand globally in the years to come and hydrocarbons is an important component of India's energy basket in future.

As India moves towards a 5 trillion dollar economy with commensurate energy needs, the criticality of hydrocarbons in meeting this growing energy requirement hardly needs emphasis. Thus, India is set to emerge as one of the primary drivers of growth in oil & gas demand in Asia, despite the pressing Covid-19 challenges. Oil & Gas will continue to remain important elements for India's energy security and its share in global energy demand is set to almost double to 11% by 2040. Further, Government has taken an ambitious target to increase the share of natural gas from the existing 6% to 15% by 2030 to transform India into a gas-based economy.

As per the BP World Energy Outlook 2019, India's primary energy consumption is set to rise from around 754 MMtoe in 2017 to 1,928 MMtoe in 2040 (4.2% CAGR). As per the BP World Energy Outlook 2020, the growth of industrial energy demand would be concentrated in the emerging world (outside of China) – especially, India, rest of Asia and Africa.

In recent years, the Government has committed itself to a number of economic and structural reforms that are aimed at achieving strong growth in GDP over the medium to long term range. The role of renewables in India's energy basket is likely to see a quantum leap in the longer term driven primarily by increasing penetration of renewable energy. Despite the healthy outlook for renewables, the energy mix is still massively dependent on fossil fuels. Within fossil fuels, while the country benefits from abundance of cheap coal, reliance on imports for securing oil & gas requirements is not likely to

change anytime soon. The country is deficient in oil resources and most of the domestic requirements are met through imports and this trend is likely to continue in the near future as well.

As per the draft National Energy Policy, 2017 put out by NITI Aayog, it is expected that in the medium term while the share of oil may not come down, share of gas would rise. Based on the present extent of knowledge of the hydrocarbons potential, the said policy anticipates that the production of oil and gas has potentials (ambitious case) to reach 61 Mtoe and 124 BCM by 2040.

As per Annual Report of MoPNG 2019-20, 100% Indian sedimentary area is to be appraised and as of now, only 48% of the basinal areas have been appraised. About 4% sedimentary basinal area has been declared as "NO GO area" by Ministry of Defence/ Ministry of Environment & Forest which remains unapprised. This means, about half of the Indian sedimentary basins have the undiscovered potential of hydrocarbons. Besides, the prognosticated conventional hydrocarbon resources in 26 sedimentary basins of the country have been reassessed or estimated at about 41.87 billion tonnes of oil and oil equivalent of gas (O+OEG), which reflected 49% increase as compared to the earlier estimates of 28.08 billion tonnes. Further, about 74% of resources, as on 1st April, 2019, are under "yet to discover" category. Out of 10,950 MMT of oil and oil equivalent gas of in-place volumes, the ultimate reserves which can be produced are about 4,259.5 MMT of oil and oil equivalent gas. The balance recoverable reserves are of the order of 1,909 MMT of oil and oil equivalent gas. Thus, Indian sedimentary basins have ample hydrocarbon potential for future exploration and production.

The Hydrocarbon Vision 2030 for Northeast aims at doubling Oil & Gas production by 2030, making clean fuels accessible, fast tracking projects, generating employment opportunities and promoting cooperation with neighbouring countries and targets an investment of ₹1.30 lakh crore by 2030.

To exploit the logistical advantage of imported crude supplies, there are potential for capacity expansion and setting up of Greenfield refineries, preferably at coastal locations.

Strategic Petroleum Reserve is estimated to supply approximately 10 days of India's crude requirement. In order to further augment India's preparedness during emergency oil shortage situation, the Government under Phase-II gave 'In Principle' approval for establishing additional 6.5 MMT Strategic Petroleum Reserves under PPP model. On completion, the total storage capacity would be sufficient to cover approximately 22 days of crude oil requirement. Further, the SPR capacity needs to be augmented on considering the 90-day consumption requirement of strategic and commercial storages.

Apart from the above, Oil India Ltd will concentrate efforts to maintain its position as the leading operator in the Northeast by consolidating acreage position through OLAP and intensifying exploration activities both in Mining Leases and Exploration Licences areas. To enhance recovery from the mature fields of Upper Assam, water injection and other IOR/EOR technologies would have to be adopted which has the ability to liberate additional production capacity. With the success of Cyclic Steam Stimulation technology in Baghewala Heavy Oil field in Rajasthan, development plans would be implemented to enhance production in an efficient manner. Apart from Northeast and Rajasthan, the Company plans to carry out detailed exploration in Mahanadi Onland, Andaman Offshore and Kerala–Kokan Offshore in quest of establishing hydrocarbon reserves.

Oil India Ltd will continue to pursue acquisition of prospective overseas E&P opportunities to ensure energy security for the country, to grow by enhancing own E&P portfolio and decrease risks in existing E&P portfolio. In addition to acquisition of conventional assets, OIL would also look towards acquisition of non-conventional assets.

Recently, ONGC reframed Perspective Plan 2030 and approved an Energy Strategy 2040 in April 2019 that outlines strategic growth initiatives across the energy value-chain. The expectation and the strategy for ONGC is to act as the fulcrum around which an ecosystem for thriving Oil & Gas Industry in the country can be created consistent with expectations to reduce import dependence. ONGC has continuously been reviewing its

engagements to move up higher in value chain to concentrate on areas where the expected risk-reward payoff offers better business opportunities for growth. ONGC, in its efforts to augment production of oil and gas, is endeavouring to engage all interested players so that the concept of 'Atmanirbhar Bharat' remains central to the domestic project execution agenda ONGC has rolled out its separate Gas vertical, which will increase its activities in Gas Sector leveraging on its strong domestic and international presence. It is also taking steps to augment its renewables portfolio. ONGC is also looking into strategic relationships and close alliances with key international players through ONGC Videsh. Intention is to invite foreign participations to explore Category-II and Category-III basins which match size and scale of expectations and portfolio of these large players. ONGC has been aggressively pursuing its deepwater projects in East Coast and couple of shallow water projects in West Coast. ONGC also has plans of acquiring much larger acreage through OALP.