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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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The domestic production of crude oil which stood at 36.95 million tonnes in 2015-16 decreased by 1.36% when compared to the output in the corresponding period of last year. Whereas, the net production of natural gas decreased to 32,249 million cu meters in 2015-16 which is about 4.18% less as against the production in 2014-15. India has emerged as a refinery hub and is the second largest refiner in Asia after China and fourth largest in the world. After the commissioning of 15 MMTPA refinery at Paradip in February 2016, the country's refining capacity has touched 230.066 MMTPA as on 01.04.2016. With this jump, India's share in total refinery capacity in the world increased to 4.75 percent.

Energy is a key driver of economic growth. Efficient, reliable and affordable energy is essential for the sustainable development and inclusive growth of the overall economy of India. India is at present the fastest growing economy of the world with 7.9% growth in GDP at constant (2011-12) prices during 2015-16 (1st Revised Estimate).

Due to rapid economic expansion, India has become world's fastest growing energy market. India surpassed Russia to become the 3rd largest energy (primary) consumer in the world after China and USA during 2015. Oil & gas accounted for around 35% share in India's energy consumption.

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 India's growing energy demands, reliance on imports and limited domestic fossil fuel resources, the country has ambitious plans to increase domestic oil & gas production and exploit all possible forms of the energy to the fullest. Government has taken several initiatives for increasing exploration and production of all domestic hydrocarbons viz. petroleum, natural gas, coal bed methane and shale gas/oil as well as distribution, marketing and pricing of petroleum products.

Government has taken several policy initiatives and reforms in the hydrocarbon sector which include, inter alia, new Hydrocarbon Exploration and Licensing Policy (HELP), Discovered Small Field Policy, marketing and pricing freedom for new gas production from Deepwater, Ultra Deepwater and High Pressure-High Temperature areas, extension of Production Sharing Contracts for small and medium size fields, linking the transparent new gas pricing formula to the global market, early monetization of hydrocarbon discoveries, policy on testing requirements for discoveries in New Exploration Licensing Policy (NELP) block, reassessing the hydrocarbon potential in India's sedimentary basin and setting up of National Data repository.

RESOURCES

As on 1.4.2016, the total balance recoverable reserves of crude oil were estimated at 621.11 million tonnes, out of which 337.59 million tonnes (54%) are in onshore and 283.53 million tonnes (46%) in offshore areas (Table-1). ONGC (nomination) has the largest share of 72% in reserves of crude oil with OIL (nomination) and PSC regime contributing 13% and 15%, respectively.

The balance recoverable reserves of natural gas as on 01.04.2016 were placed at 1,227.20 billion cu m, out of which 481.79 billion cu m (39%) are in onshore and 745.41 billion cu m (61%) in offshore areas (Table - 1). PSC regime has the largest share of 48% in natural gas reserves with ONGC (nomination) and OIL (nomination) at 42% and 10%, respectively.

EXPLORATION & DEVELOPMENT

The Oil and 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 in the country.

As on 31.3.2016, there were in all 427 oil/gas fields under these companies in the country including offshore areas.

Table – 1 : Proved and Indicated Balance Recoverable Reserves of Crude Oil and Natural Gas in India as on 1.4.2016

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

Area	Crude oil	Natural gas
India	**621.11**	**1227.20**
Onshore	**337.59**	**481.79**
Andhra Pradesh	10.90	42.03
Arunachal Pradesh	1.57	0.76
Assam	160.79	153.76
Gujarat	121.16	63.06
Jharkhand*	-	28.13
Madhya Pradesh*	-	32.12
Nagaland	2.38	0.09
Rajasthan	31.72	35.66
Tamil Nadu	8.99	31.68
Tripura	0.07	28.28
West Bengal*	-	66.24
Offshore	**283.53**	**745.41**
Western offshore@	247.13	293.96
Eastern offshore	36.39	451.46

Source: *Indian Petroleum and Natural Gas Statistics, 2015-16, Ministry of Petroleum and Natural Gas, Govt. of India.*

@: Includes Gujarat offshore.

**: Relates to Coal Bed Methane (CBM).*

Note*: As per the the Table I.8 of Indian Petroleum and Natural Gas Statistics, 2015-16, the balance recoverable reserves of crude oil and Natural Gas were 754.34 MMT and 1497.21 BCM, respectively.*

In Public Sector, ONGC's jurisdiction extended to 348 fields – Cambay basin (Gujarat) – 84 oil/gas fields; Upper Assam – 36 fields and Assam & Assam Arakan – 7 fields; Jodhpur (Rajasthan) – 8 fields; Krishna-Godavari basin (Andhra Pradesh) – 64 fields; Cauvery basin (Tamil Nadu) – 29 fields; Assam & Assam Arakan in Tripura - 10 fields and Assam & Assam Arakan in Nagaland –2 fields; besides, 80 offshore fields in the Mumbai offshore; 4 in Kachchh and 2 in Cambay basin in West Coast and 22 offshore fields in Cauvery and Krishna-Godavari basins (shallow and deep) in East Coast. OIL, a Public Sector Company was engaged in 19 fields – Upper Assam basin in Assam (14 fields) and Arunachal Pradesh (1 field); Jaisalmer basin (3 fields) and Bikaner-Nagaur basin (1 field) in Rajasthan. Private/Joint venture companies were engaged in 60 oil/gas fields - Cambay basin (Gujarat) at 34 fields; Kharsang basin (Arunachal Pradesh) at 1 field; Amguri basin (Assam) at 1 field; Jharia & Bokaro (Jharkhand) at 1 field (CBM) each; Sohagpur (Madhya Pradesh) at 2 fields (CBM); Rajasthan at 7 fields and Raniganj East basin (West Bengal) at 2 fields (CBM) in onshore areas. In offshore areas, these companies covered 2 fields in Cauvery basin and 4 fields in Krishna-Godavari basin on the East Coast and 3 fields in Mumbai basin and 2 fields in Cambay basin on the West Coast.

During 2015-16, a total of 7816.12 GLKM of 2D seismic data was acquired, mostly of which is in offshore region by Private/JVs. A total of 6236.12 SQM of 3D seismic data was acquired, majority of which was carried out by ONGC in its offshore nomination areas. A total of 138 exploratory wells and 363 developments wells were drilled in 2015-16. Majority of the development wells were drilled by ONGC in its onland nomination areas. The exploratory and development efforts under nomination and PSC regime during 2015-16 are furnished in Table - 2.

During 2015-16, ONGC carried out seismic surveys and acquired 256.8 GLKM of 2D & 1309.12 SKM of 3D seismic data in the onland area and 4134.71 SKM of 3D seismic data in the offshore area under nomination regime. A total of 72 exploratory wells with a meterage of 2,01,989 and 252 development wells with a meterage of 4,88,637 has been drilled under nomination regime. A total of 168.82 of 2D seismic data was acquired by ONGC under PSC regime in 21 exploratory wells.

Exploratory efforts of ONGC during 2015-16 resulted in 17 oil and gas discoveries (07 inland and 10 offshore areas) in domestic acreage (operated by ONGC). Out of these, 08 discoveries were made in the new prospects, whereas 09 were new pool discoveries. A total of seven discoveries was made in New Exploration Licencing Policy blocks and ten in the nomination blocks. Out of seven inland discoveries, three discoveries during the year i.e. North Kovilkappal-6 (NKKAC), Rokhia-62 (ROBD) and Kesanpalli West-47 (RWDN) have already started production and efforts are being continued to bring other discoveries also on production in the near future.

The ultimate reserve (2P) accretion of oil and oil equivalent gas (O+OEG) in 2015-16 in domestic assets of ONGC was 65.58 million tonnes.

During 2015-16, OIL carried out seismic survey

Table - 2: Exploratory & Development Efforts under Nomination & PSC Regime During 2015-16

Sl. No.	Subject	Parameter	ONGC (Nomination)	OIL (Nomination)	Pvt/JVs*	Total
1	2D seismic data acquired	Onland (GLKM)	256.8	175.8	535.96	968.56
		Offshore (GLKM)	-	0	6847.56	6847.56
		Total 2D Seismic	256.8	175.8	7383.52	7816.12
2	3D seismic data acquired	Onland (SKM)	1309.12	1.13	791.16	2101.41
		Offshore (SKM)	4134.71	0	0	4134.71
		Total 3D Seismic	5443.83	1.13	791.16	6236.12
3	Exploratory wells drilled	Onland	52	11	40	103
		Offshore	20	0	15	35
		Total Exploratory Wells	72	11	55	138
4	Exploratory Meterage drilled	Onland (‘000)	152.396	60.211	101.2	313.759
		Offshore (‘000)	49.593	0	40.4	89.9648
		Total Exploratory Meterage	201.989	60.211	141.5238	403.7238
5	Development Wells drilled	Onland	218	33	70	321
		Offshore	34	-	8	42
		Total Development Wells	**252**	**33**	**78**	**363**
6	Development Meterage drilled	Onland (‘000)	403.298	82.55	102.823	588.67
		Offshore (‘000)	85.339	0	21.79	103.022
		Total Development Meterage	488.637	82.55	124.61	695.8

***Source**: India's Hydrocarbon Outlook: 2015-16 - A report on exploration & production activities, Directorate General of Hydrocarbon, Ministry of Petroleum & Natural Gas.*
** Includes 168.82 GLKM of 2D seismic data acquired by ONGC under PSC regime in 2015-16 in 21 exploratory wells.*

in the inland area and acquired 175.8 (GLKM) of 2D & 1.13 (SKM) of 3D seismic data. OIL carried out 60,211 meterage drilling in 11 exploratory wells and 82,550 meterage drilling in 33 development wells in the inland area.

During 2015-16, Oil India Ltd has carried out 2D & 3D Seismic Survey to identify New Prospects in the Petroleum Mining Lease areas of Upper Assam Basin, including spreading exploratory efforts by drilling 5 wells in the NELP Blocks MZ-ONN-2004/1, RJ-ONN-2004/2 & RJ-ONN-2005/2.

Oil India Ltd has made six (6) oil and gas discoveries in the Upper Assam Basin during the year 2015-16. The discovery of oil & gas in a well has opened up new avenue for exploration and exploitation of oil & gas within the respective area of well and the adjoining areas. Details of the discoveries are highlighted below:

i) Samdang-4 (DGP): The well is located in Samdang-I structure under Dumduma PML and has been drilled down to 3,620 m to probe the hydrocarbon prospects within the Barail and Tipam Formations. The well has encountered few prospective sands within Barail and Tipam Formations and produced oil from one of the tested sands within Barail Formation. Presently, the well is kept shut-in.

ii) NHK-625 (Loc. HXY): The well is located in Lohali-Deohal Structure under Hugrijan PML and has been drilled down to 2760 m to probe the hydrocarbon prospects within the Barail Formation. The well has encountered few prospective sands ranges within Barail Formation and produced gas from one sand tested within Barail Formation. Presently, the well is producing @ 35,000 scmpd gas with 8 klpd oil.

iii) South Baghjan-1 (Loc. BGJ): The well is located in the South Baghjan structure under Baghjan PML and has been drilled down to 4154 m to probe the hydrocarbon prospects within Palaeocene-Eocene Formations. The well encountered few prospective sands within Palaeocene-Eocene Formations, and produced oil from two sands tested within Palaeocene-Eocene Formations. Presently, the well is producing @ 92 klpd oil. Further seismic data acquisition and appraisal drilling have been planned to ensure realisation of full potential from this new find.

iv) Sapkaint-2 (Loc. DGK): The well is located in the central part of Sapkaint Structure under Dumduma PML and was drilled and completed

during year 2011. During 2015-16, oil has been discovered in new/unappraised Tipam sand by testing through work-over operations. Presently, the well is producing @ 22 klpd oil.

v) NHK-173 (Loc. NDC): The well is located in the South Chalakataki Structure under Nahorkatiya Extension PML and was drilled and completed during year 1965. During 2015-16, gas has been discovered in new/unappraised Girujan sand by testing through work-over operations. Presently, the well is kept shut-in.

vi) NHK-447 (Loc. NJY): The well is located in the Nahorkatiya Main Structure under Nahorkatiya Extension PML and was drilled and completed during year 1990. During 2015-16, gas has been discovered in new/unappraised Upper Tipam sand by testing through work-over operations. Presently, the well is producing @ 12,500 scmpd gas.

RIL's Performance

KG D6 : As a part of the appraisal programme for the D-55 discovery, continuous evaluation of results of 3 wells were carried out extensively. In addition, enhanced imaging for reservoir characterisation and conceptual engineering/Pre Front-End Engineering Design studies have also been completed. Based on these appraisal efforts, the Commerciality Report has been submitted to Management Committee for its review, leading to a reserves accretion of about 1 TCFe in the current fiscal.

During the year, based on Govt. of India policy on testing requirement, Reliance along with JV partners has performed Drill Stem Test operations in discoveries D29 and D30. In view of smaller and scattered nature of the accumulations, these discoveries are conceptualised to be developed in an integrated manner with the 4 Satellite discoveries. The JV has submitted commerciality report to MC in Q1 FY 2016-17.

D1-D3 field continues to produce from eleven wells. To maximise the life and recovery from the field, two well intervention jobs were successfully completed, i.e. Side-track job A1 ST and Substitute well B7 Sub. In addition, one well B6 was successfully activated. Further measures through field and well management are being undertaken.

In D26 field, given the sand ingress surprise in MA5H Side Track and water ingress in MA2, additional side tracks have been matured and drilling campaign has commenced in Q1 FY 2016-17 to augment production and maximise the recovery from the field.

PANNA-MUKTA: The Panna-Mukta field has entered into the last four years of its contract period. The PSC extension policy announced by the Government will extend the contract period up to the economic life and maximise the recovery from the field. During the year, the following activities were carried out to sustain production from this field:

- Completed work-over of 7 wells.
- 6 wells were drilled and put on production as part of Mukta-B development during the year.
- The MA-MB line was completed in Mukta that helped resuming production from MA platform.
- PE-PF gas lift line was installed in the Panna field leading to revival of 2 sick wells and sustenance of production from flowing wells at PF platform.

TAPTI: The cessation of production occurred in March, 2016. In line with the PSC, an abandonment notice by Reliance Industries was issued to the Government in December 2013. With the signing of Tapti Asset Transfer Agreement, with ONGC, as a Government nominee, Tapti JV has handed over the process facilities and the export pipelines for its Daman development project during Q1 FY 2016-17. As part of the site restoration of Tapti block, Tapti JV will commence necessary decommissioning and abandonment activities (the first of its kind in India's E&P industry) for the balance of the facilities in FY 2016-17.

NEC 25: During the year, based on GoI policy on testing requirement, Reliance along with JV partners has performed DST operations in discovery D32 in the block. The Declaration of Commerciality has been submitted to Management Committee in Q1 FY 2016-17.

CB 10: The block is the only conventional on-land block operated by Reliance. Post completion of phase-I of the exploration period, Reliance made eight oil discoveries out of 18 wells drilled in this

block and the Government has approved Reliance and its partner to enter into exploration phase-II in January, 2015. During the year, the Field Development Plan for seven oil discoveries was submitted and is awaiting approval.

Coal Bed Methane (CBM)

RIL has commenced test production and pre-commissioning and commissioning activities from Sohagpur (West) block. As part of initial development, RIL plans to start test production of CBM with more than 200 wells spread over 450 sq km. It has set-up two gas gathering stations and eight water gathering stations for collection of gas and water, respectively and has laid India's largest HDPE gas gathering network. RIL CBM project is probably the largest surface footprint project in E&P sector in India. The work of laying pipeline for Shahdol-Phulpur Gas Pipeline project was completed and testing and commissioning activities are under progress.

PRODUCTION

Petroleum (Crude)

Production of petroleum (crude) in the country at 36.95 million tonnes in 2015-16 registered a nominal decrease of 1.36% as compared to that in the previous year. Bulk of the total production (69.27%) was shared by the public sector companies. Private sector companies accounted for the remaining 30.73 percent (Table-3).

Offshore areas continued to be the largest producer of petroleum (crude) in 2015-16 with a share of 51.66% in the country's output. Next in order were Rajasthan with a contribution of 23.28%, Gujarat with 12.07 % and Assam with 11.33 percent. The remaining 1.66% of the production was reported by Andhra Pradesh, Tamil Nadu and Arunachal Pradesh.

During 2015-16, the production of petroleum (crude) increased in Andhra Pradesh by 16.14%, Tamil Nadu by 8.30% and offshore areas by 0.87 percent. Whereas, there was a decline in production in Arunachal Pradesh (23.68%), Assam (6.29%), Gujarat (4.11%) and Rajasthan (2.78%) as compared to the previous year.

Natural Gas (Utilised)

The production of natural gas (utilised) at 32,249 m cu m decreased by 4.18% in 2015-16 as compared to that in the previous year. Offshore areas continued to be the largest producer of natural gas (utilised) with a share of 71.36%. Next in the order were Assam with a share of 9.38%, Gujarat 4.62%, Rajasthan 4.15%, Tripura 4.13%, Tamil Nadu 3.13%, Andhra Pradesh 1.92%, West Bengal 1.22% and Arunachal Pradesh accounted for the remaining 0.09% of the total production.

Statewise analysis revealed that West Bengal, Tripura, Andhra Pradesh, Rajasthan, Assam recorded an increase in production whereas, offshore area, Gujarat, Tamil Nadu and Arunachal Pradesh recorded decrease in production of natural gas in 2015-16 as compared to that of previous year.

The production of natural gas increased in West Bengal by 71.93%, Tripura by 16.84%, Andhra Pradesh by 14.42%, Rajasthan by 13.58% and Assam by 2.23% percent. The decline in production was recorded in Tamil Nadu by 15.18%, Arunachal Pradesh by 14.71%, offshore area by 7.42% and Gujarat 2.42%.

As much as 74.46% of the total production came from the public sector companies whereas the remaining 25.54% was the share of the private sector companies during the year 2015-16 (Table-4).

Domestic prices of petroleum (crude) in 2013-14 to 2015-16 are furnished in Table-5.

INDUSTRY

Indian Oil Corporation Ltd (IOCL) has commissioned a new refinery of 15 million tonnes installed capacity at Paradeep, Odisha and commenced production during FY 2016. The total refining capacity of 23 units in operation in the country was about 230.066 million tpy in 2015-16, with a share of about 4.75% in the estimated world refinery capacity of 4841 million tpy during year 2015(P). In 2015-16, refinery crude throughput increased to 232.865 million tonnes from 223.242 million tonnes in 2014-15 (Table-6).

Table – 3 : Production of Petroleum (Crude), 2013-14 to 2015-16 (By States)

(Quantity in '000 tonnes; Value in `'000)

State	2013-14		2014-15		2015-16 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	**37788**	**686826110**	**37461**	**680882633**	**36950**	**671594812**
Public Sector	25711	467317300	25676	466681148	25594	465190734
Private Sector	12077	219508810	11785	214201485	11356	206404078
Andhra Pradesh	297	5398205	254	4616646	295	5361853
Arunachal Pradesh	111	2017511	76	1381359	58	1054195
Assam	4710	85607891	4466	81173002	4185	76065610
Gujarat	5061	91987587	4652	84553696	4461	81082123
Rajasthan	9180	166853596	8848	160819240	8602	156347999
Tamil Nadu	226	4107725	241	4380361	261	4743877
Offshore	18203	330853595	18924	343958329	19088	346939155

Source: *Ministry of Petroleum & Natural Gas*

Table – 4 : Production of Natural Gas (Utilised), 2013-14 to 2015-16 (By States)

(Quantity in million cu meters; Value in `'000)

State	2013-14		2014-15		2015-16 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	**35407**	**292820422**	**33657**	**278347698**	**32249**	**266703358**
Public Sector	25910	214279016	24745	204644317	24015	198607124
Private Sector	9497	78541406	8912	73703381	8234	68096234
Andhra Pradesh	1171	9684320	541	4474139	619	5119209
Arunachal Pradesh	41	339075	34	281184	29	239834
Assam	2868	23718727	2959	24471309	3025	25017137
Gujarat	1657	13703602	1527	12628485	1490	12322491
Rajasthan	982	8121266	1178	9742211	1338	11065431
Tamil Nadu	1304	10784247	1192	9857993	1011	8361099
Tripura	822	6798045	1140	9427946	1332	11015810
West Bengal (CBM)#	165	1364571	228	1885589	392	3241890
Offshore	26397	218306569	24858	205578842	23013	190320456

 # Includes Jharkhand and Madhya Pradesh *CBM: Coal-bed Methane*

Source: *Ministry of Petroleum & Natural Gas*

Table – 5 : Prices of Petroleum (Crude), 2013-14 to 2015-16

(In ` per tonne)

Grade	Market	2013-14	2014-15	2015-16 (P)
Indigenous*	Onshore	45600	37089	22149
Indigenous*	Offshore	49911	40129	24453
Indigenous*	Offshore & Onshore	48504	39215	23799

Source: *Indian Petroleum & Natural Gas Statistics, 2015-16 for indigenous crude prices.*

**Relates to basic prices of petroleum crude which is all inclusive of Gross (pre-discount) price and linked to international crude prices, though ONGC net price realization has been lower due to sharing of under-recoveries of OMCs by extending discount, as per the directives of MoPNG.*

In the coming years, about 92.35 million tonnes of additional refining capacities in both brownfield and greenfield expansion are reportedly planned or expected to come on stream. As per annual report of Ministry of Petroleum & Natural Gas, capacity augmentation to the tune of 17.35 million tonnes is planned/being implemented at brownfield refineries that are IOCL, Haldia (0.5 MMTPA); IOCL, Bonaigaon (0.35 MMTPA); BPCL, Kochi (6.0 MMTPA); HPCL, Mumbai (2.0 MMTPA); HPCL Visakhapatnam (6.7 MMTPA); and BORL, Bina (1.8 MMTPA). Refinery Expansion project at Kochi is under advanced stage of commissioning.

The new refineries that are under implementation and coming up in the near future are Nagarjuna Oil Corporation Ltd, Cuddalore, Tamil Nadu (6.0 million tonnes) and Hindustan Petro Chemical Ltd, Barmer, Rajasthan (9.0 million tonnes). HPCL has signed an agreement with the Rajasthan Government to set-up the joint venture refinery at Pachpadra, Barmer.

Besides, Public Sector Oil Companies, IOCL, BPCL and HPCL are planning to set-up India's Biggest refinery on the West Coast. The proposed refinery would have a capacity of 60 MMTPA which will be built in 2 phases (40 +20 MMTPA). A MoU has been signed by IOCL, BPCL and HPCL for West Coast Mega Refinery at Ratnagiri district in Maharashtra.

Production of various petroleum products from refineries and fractionators during 2013-14 to 2015-16 is provided in Table-7.

CONSUMPTION

Total consumption of petroleum products increased to 184.674 million tonnes in 2015-16 from 165.520 million tonnes in 2014-15, showing an increase of 12%.

Increase in consumption was reported in the case of Petroleum Coke (33%), Naptha (20%), Bitumen (17%), Motor spirit (15%), Furnace oil (16%), LDO (12%), Waxes (11%), ATF & LPG (9% each) and HSDO & Lubes/Greases (8% each) during 2015-16 as compared to that of the year 2014-15, whereas, the consumption showed a decline in LSHS (60%) and SKO (4%) during the same period.

The consumption of various petroleum products from 2013-14 to 2015-16 is furnished in Table-8.

ALTERNATIVE SOURCES

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, as a measure to offer a fillip for tapping alternate sources has vigorously initiated exploration & development for 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 the coalification. The coal and lignite seams contain 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 the 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.

India has the fifth largest proven coal reserves in the world and thus, holds significant prospects for exploration and exploitation of CBM. The prognosticated CBM resources in the country are about 92 TCF (2600 BCM) in 12 states of India. 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 and Petroleum & Natural Gas Rules, 1959. With the announcement of said policy, CBM development gained momentum which laid the foundation of commercial exploitation of CBM in India. The said policy provided level playing platform for exploration and commercial exploitation of CBM by national and international entrepreneurs.

CBM blocks were offered through international competitive bidding for exploration

Table – 6 : Installed Capacity and Crude throughput in Refineries

(In '000 tonnes)

Refinery	Annual installed capacity (as on 1.4.2016)	Refinery Crude throughput		
		2013-14	2014-15	2015-16 (P)
Total	**230066**	**222497**	**223242**	**232865**
Public/Private Sector & Subsidaries	**135066**	**119547**	**121182**	**127087**
IOCL, Guwahati, Assam	1000	1019	1006	904
IOCL, Barauni, Bihar	6000	6478	5944	6545
IOCL, Koyali, Gujarat	13700	12960	13285	13820
IOCL, Haldia, West Bengal	7500	7952	7650	7776
IOCL, Mathura, Uttar Pradesh	8000	6641	8515	8860
IOCL, Bongaigaon, Assam	2350	2328	2403	2442
IOCL, Digboi, Assam	650	651	591	562
IOCL, Panipat, Haryana	15000	15098	14191	15282
IOCL, Paradeep, Odisha	15000	-	-	1817
BPCL, Mumbai, Maharashtra	12000	12684	12821	13371
BPCL (formerly KRL), Kochi, Kerala	9500	10285	10356	10712
HPCL, Mumbai, Maharashtra	6500	7785	7408	8013
HPCL, Visakhapatnam, Andhra Pradesh	8300	7776	8770	9220
CPCL, Manali, Tamil Nadu	10500	10065	10251	9100
CPCL, Narimanam, Tamil Nadu	1000	559	531	544
MRPL, Mangaluru, Karnataka	15000	14589	14632	15532
NRL, Numaligarh, Assam	3000	2613	2777	2520
ONGC, Tatipaka, Andhra Pradesh	66	65	51	67
Joint Venture	**15000**	**14721**	**13526**	**17116**
Bharat Oman Refineries Ltd, Bina[@]	6000	5450	6209	6402
HPCL Mittal Energy Ltd, Bathinda[#]	9000	9271	7318	10713
Private Sector	**80000**	**88229**	**88533**	**88662**
RIL, Jamnagar, Gujarat	33000	30307	30867	32428
RIL, Jamnagar (SEZ), Gujarat	27000	37720	37174	37133
Essar Oil Ltd,Vadinar, Gujarat	20000	20202	20491	19101

Figures rounded off.

Source: *Indian Petroleum and Natural Gas Statistics, 2015-16, 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: *1. CPCL and BRPL are subsidiaries of IOCL; NRL of BPCL and MRPL of ONGC.*

2. IOCL refinery at Paradip in Odisha was commissioned in FY2016.

3. Excludes other inputs from refineries crude throughput during 2013-14, 2014-15 & 2015-16.

Table – 7: Production of Petroleum Products from Refineries and Fractionators, 2013-14 to 2015-16

(In '000 tonnes)

Product	Production		
	2013-14	2014-15	2015-16 (P)
Total : Petroleum Products	**220756**	**221136**	**231924**
From Refineries	**216456**	**217141**	**227908**
From Fractionators	**4300**	**3994**	**4016**
LPG	10030	9840	10568
Motor Spirit	30275	32325	35321
Naphtha	18505	17391	17861
Kerosene	7418	7559	7504
ATF	11220	11103	11789
HSD	93759	94428	98588
LDO	423	358	429
Furnace oil	12920	11248	9468
LSHS/HHS/RFO	485	671	259
Lube oils	941	946	1037
Bitumen	4785	4632	5157
Petroleum coke	12068	12448	13322
Paraffin Wax	55	51	65
Others	17871	18137	20557

Source: *Indian Petroleum & Natural Gas Statistics, 2015-16, Ministry of Petroleum & Natural Gas, Government of India.*

Table – 8 : Consumption of Petroleum Products 2013-14 to 2015-16

(In'000 tonnes)

Product	2013-14	2014-15 (R)	2015-16 (P)
1. Light distillates	**47578**	**50944**	**57743**
(a) LPG	16294	18000	19623
(b) Motor Spirit	17128	19075	21847
(c) Naphtha	11305	11082	13271
(d) Others	2851	2787	3002
2. Middle distillates	**81830**	**82933**	**88517**
(a) SKO	7165	7087	6826
(b) ATF	5505	5723	6262
(c) HSDO	68364	69416	74647
(d) LDO	386	365	407
(e) Others	411	342	375
3. Heavy ends	**28999**	**31643**	**38414**
(a) Furnace oil (FO)	5787	5584	6482
(b) LSHS	449	377	150
(c) Lubes/Greases	3305	3310	3571
(d) Bitumen	5007	5073	5938
(e) Petroleum coke	11756	14557	19297
(f) Waxes	177	156	173
(g) Others	2519	2586	2802
Total (1+2+3)	**158407**	**165520**	**184674**

Source: *Indian Petroleum & Natural Gas Statistics, 2015-16, Ministry of Petroleum & Natural Gas, Government of India.*

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

and production of CBM in the country for the first time in May 2001. So far, under the CBM policy, the Government has awarded 33 CBM blocks [including 2 blocks on Nomination and 1 block through Foreign Investment Promotion Board (FIPB) route] in four rounds of bidding to National, Private & Joint Venture Companies. These 33 blocks cover 16,613 sq km out of the total available coal bearing areas for CBM exploration of 26,000 sq km. These CBM blocks are in the states of Andhra Pradesh, Assam, Chhattisgarh, Jharkhand, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Telangana and West Bengal.

In India, most CBM exploration and production activities are pursued by domestic Indian companies. Total prognosticated CBM resource for awarded 33 CBM blocks, is about 62.4 TCF (1767 BCM), of which, so far, 9.9 TCF (280.34 BCM) has been established as Gas in Place (GIP).

The vast majority of the best prospective areas for CBM development is in Eastern India, situated in Damodar Koel valley and Son valley. CBM projects exist in Raniganj South, Raniganj East and Raniganj North areas in the Raniganj coalfield, the Parbatpur block in Jharia coalfield and the East and West Bokaro coalfields. Son valley includes the Sonhat North and Sohagpur East and West blocks.

Within the next few years, CBM is expected to emerge as a new source of natural gas production in the country. India has emerged as the fourth country in the world capable of producing CBM on commercial scale. Currently, commercial production has commenced from Raniganj South CBM block operated by M/s. GEECL since July 2007. As on March 2016, CBM production is around 1.168 MMSCMD from 4 CBM blocks which includes test gas production from 3 CBM blocks and commercial production from one CBM block. Eight more CBM blocks are expected to start commercial production in near future. The total CBM production is expected to be around 5.7 MMSCMD by 2018.

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 future energy source world over. World over production of gas from gas hydrate is in research & development stage. USA, Japan, Russia, China, Germany and Korea are deeply involved in developing a technology to exploit these proved Gas hydrates reserves.

In India, Gas hydrate research and exploratory activities are being steered by the Ministry of Petroleum & Natural Gas under National Gas Hydrate Programme (NGHP). The presence of gas hydrate is established in Krishna-Godavari, Mahanadi, Gulf of Mannar and Andaman Basin.

Under National Gas Hydrate Programme (NGHP), technically coordinated by Directorate General of Hydrocarbons (DGH), various R&D studies are in progress to develop vast resources of gas hydrates in western and eastern offshore and Andaman offshore areas. It is a consortium of National E & P Companies, namely, ONGC, GAIL, OIL and national research institutions NIO, NIOT and NGRI. There are numerous potential offshore areas of gas hydrates in KG, Mahanadi and Andaman deepwaters which are under different stages of development.

NGHP-Expedition-01 exploration programme was carried out in 2006 for mapping gas hydrates zones in Krishna-Godavari, Kerala Konkan, Mahanadi and Andaman offshore. Total 39 holes at 21 sites were drilled and established the physical presence of gas hydrate in Krishna-Godavari, Mahanadi and Andaman Basin in clay dominated complex geological settings.

NGHP-02 was commenced on 3rd March 2015 and has been completed on 28th July 2015. Total 42 wells were drilled at 25 sites in Krishna-Godavari and Mahanadi area in sand reservoirs for gas hydrates. LWD was completed in 25 wells in 4 areas A, B C & E. Coring and wire line logging was carried out in 17 wells in areas ‘B’ ‘C’ & ‘E’. NGHP-02 has discovered significant gas-hydrate-bearing sand reservoir system in the Krishna-Godavari B, C and E areas. Area A which is in the Mahanadi deep water basin, has several sand

zones devoid of gas hydrates. Identified two distinct gas hydrate accumulations in Krishna-Godavari Basin, one is approximately 20 to 100 m thick, layer-type, depths 400 m and other accumulation is a fracture-type unit of variable thickness at shallow levels.

NGHP Expedition-02 results are encouraging and further extensive studies to be carried out to assess the gas hydrate resource potential, reservoir characterization, reservoir delineation and geo-mechanical modelling for seafloor and wellbore stability and identification of sites for pilot production for testing. KG deep offshore Area 'B' & 'C' contains gas hydrate accumulations which can be suitable sites for future gas hydrate production testing under NGHP Exp-03. NGHP-3 aims at carrying out pilot production testing of at least one site in Indian deep water environment.

Two NGHP R&D projects under direct funding by OIDB were approved in 15th steering committee. The first NGHP R&D project of KDMIPE, ONGC with IIT-Kanpur entitled "Modelling and Simulation of Methane Extraction from Gas Hydrates via Simultaneous Depressurisation and CO_2 Injection" was taken up with an aim to design a simulator with all dynamic variables and estimate methane release per unit time. The second project of NGRI entitled, "Carbon Dioxide & Methane Hydrate Phase Stability in Sandy and Clay Environment: Laboratory Studies" approved under NGHP funding was formulated to carry out the CO_2 phase stability experiments using synthetic sand & clay particles and to find out the rate of methane yield due to depressurisation.

The challenges faced for commercial exploitation of gas from gas hydrates are more or less similar all over the world. 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 under way 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.

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. North-East India is endowed with rich deposits of coal, found in the Barail Formation of Tertiary Age. Carbonaceous shale occurs interbedded with the coal. Studies have indicated that these coals and carbonaceous shale constitute the principal source rocks that have generated the hydrocarbons produced from the region.

DGH had entered into an MoU with IOCL, R&D Centre, Faridabad on 3rd January 2013 for tenure of 3 years with an aim to develop Oil Shale as alternate source of energy. During 2015-16, a team comprising of representatives from DGH along with a geologist and a scientist from IOCL's R&D Centre, Faridabad visited Tikaka colliery, Margherita coalfield, Assam collected Oil Shale samples to study the hydrocarbon potential of these samples at IOCL, R&D centre, Faridabad. In view of the positive outcome of the ongoing studies carried out by IOCL, R&D centre, it was strongly felt that this MoU should be extended for another three years on same terms and conditions with an aim to (a) finish the extensive studies on the samples in hand which may shed light on the potential of shale available in the Assam colliery and (b) study the Oil Shale samples available in other parts of the country.

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 hydrocarbons bearing ones - Cambay, Assam-Arkan & Damodar Basins have large shale deposits. Various developmental activities are going on in Gandhar area of Cambay Basin, KG Basin,Cauvery Basin and Assam & Assam Arakan Basin.

The Government of India on 14.10.2013 has notified the policy guidelines for exploration and exploitation of shale gas and oil by National Oil Companies (NOCs) in their onland Petroleum Exploration Lease /Petroleum Mining Lease blocks awarded under the nomination regimes. As per policy guidelines, ONGC and OIL are required to carry out exploration in 50 and 6 blocks, respectively for assessment under phase-I.

Oil India Ltd is presently carrying out shale gas and oil exploration in two onland basins namely Assam & Arakan and Jaisalmer basin. It has identified six Blocks, viz. Dibrugarh PML, Chabua PML, Dumduma PML, Jaisalmer PML, Jairampur PEL & Deomali PEL and started G&G evaluation. It has completed G&G evaluation of four Blocks i.e, Dibrugarh, Chabua, Dumduma and Jaisalmer and submitted the report to management for peer review before finalisation. Jairampur Extension PEL and Deomali PEL are situated in thrust best area of Upper Assam basin which have paucity of G&G data. In this regard, OIL has planned to drill three core holes up to a maximum depth of 2000 m in these two areas to acquire additional G&G information.

ONGC is presently carrying out shale gas and oil exploration in four onland basins namely, Cambay, KG, Cauvery, Assam and Assam-Arakan. A total of twelve exploratory locations for shale gas and oil are available for drilling in 2016-17 and subsequent year. In addition, coring and other data collection are planned in suitable exploratory wells in identified blocks. ONGC has drilled 18 wells so far and one well is under drilling. So far 69 cores have been collected in 17 wells. During the current year 2015-16, ONGC has completed coring and other data collection programme in six wells (four in Cambay and one each in KG and Cauvery basins) in different blocks. These data will help in assessment of the shale gas and oil potential of respective blocks. Three of these wells were drilled in Cambay basin exclusively for shale gas and oil. Besides, the drilling of above mentioned shale gas and oil wells, ONGC has also carried out hydro-fracturing in one well JMSGA which was drilled in 2013-14.

In order to accelerate shale gas and oil development in the country, a two-day "International Shale Gas and Oil Workshop" was organised by DGH on 28th and 29th January 2016 in New Delhi. The broad objectives of the workshop were two-fold: (a) devise policy framework for facilitating and regulating shale development in India and (b) establish favourable regulatory and fiscal environment for stakeholders to promote investment and infrastructure development.

Underground Coal Gasification

Underground Coal Gasification (UCG) is a method of converting unworked coal (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. With a vast proven reserve of coal, India has the potential to use UCG technology to effectively utilise coal. 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. Development of UCG is envisaged to provide for energy security.

Government has approved a policy framework on 16.12.2015 for development of UCG in coal and lignite bearing areas in the country. A policy, broadly similar to the existing policy for Coal Bed Methane (CBM) development 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. In the perspective of next two years some explored blocks will be identified for offer. Subsequently, additional blocks will be identified for offer in the long term.

ONGC has taken up Vastan Mine block site belonging to GIPCL in Naninaroli, Surat district, Gujarat as an R&D Pilot Project to establish UCG technology in collaboration with M/s Skochinsky Institute of Mining (SIM), Russia. The Agreement of Collaboration (AoC) between ONGC and M/s 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. All the ground work and inputs for construction and implementation of UCG Pilot Project at Vastan, has been completed since 2009. Further, development and project execution will be carried out by a joint venture between GIPCL & ONGC for Underground Coal Gasification purposes. Besides, two number of sites, viz. Tadkeshwar in Gujarat and Hodu-Sindhari & East Kurla in Rajasthan identified jointly by ONGC & Neyveli Lignite Corporation Limited and One site viz. Surkha in Bhavnagar district, Gujarat identified jointly by ONGC & GMDC have been found suitable for UCG exploration. Once the technology is established in India, UCG will emerge as a major clean coal utilization technology capable of providing significant impact in our country in near future.

Biofuels

Biofuels seek to provide a higher degree of national energy security in an environmental 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. Government has been promoting and encouraging production and use of (a) ethanol derived from sugar molasses and/or second generation biofuels (biomass, agricultural waste, etc.) for blending with petrol and (b) biodiesel derived from inedible oils, tree borne oil seeds and oil waste for blending with diesel.

Ethanol Blended Petrol (EBP) Programme

Government of India launched EBP Programme in January, 2003 for sale of 5% ethanol blended Petrol. In order to support the domestic industry, Government decided during 2013 to source ethanol from domestic sources only. Currently EBP programme is being carried out in 21 States and 4 UTs under which oil marketing companies (OMCs) are mandated to sell EBP with up to 10% Ethanol. Mechanism for procurement of ethanol by OMCs to carry out EBP programme was approved on December 10, 2014. In order to give a stimulus to this programme, the ethanol procurement price was enhanced and delinked from the crude price being offered in the past. The Government has also opened alternate route like cellulosic and lingo cellulosic materials, including Petrochemical route. On 10.12.2014, the Government , inter alia, decided to fix the delivered price of ethanol in the range of ` 48.50 per litre to ` 49.50 per litre, depending upon the distance of distillery from the depot/installation of the OMCs. Further, OMCs have been directed to sign MoU with the state governments for a comprehensive system for uninterupted inter-depot transfer of Ethanol within and outside the State.

OMCs also eased the procurement process for the benefit of suppliers including floating monthly EOIs. A Steering Committee and Working Group on Biofuels was set-up.

All these steps helped in supply of 111 crore liters of ethanol during the ethanol supply year 2015-16 (till 30.11.2016). Blending to the tune of 10% was carried out in six States during major part of 2015-16 based on ethanol availability.

Further, Oil Public Sector Undertakings are establishing 12 nos. of Second Generation (2G) Ethanol plants across 11 states with an objective to enhance ethanol production in the country to meet the enhanced blending target. The first Biofuel refinery is planned to be set up by Hindustan Petroleum Corporation Limited in Bathinda, Punjab.

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 announced the "Biodiesel Purchase Policy" in 2005, which became effective from 1st January 2006. However, no biodiesel could be procured till 2014. With renewed focus on Biofuels, the Government on 16.01.2015 allowed direct sale of biodiesel by manufacturers/suppliers of biodiesel/their authorized dealers and Joint Ventures (JVs) of OMCs as authorised by MoP&NG to all consumers. On 10th August, 2015, the Government has allowed sale of biodiesel (B100) by private manufacturers to bulk consumers. Also, retailing of biodiesel blended diesel by Public Sector OMCs has started on the same day. Currently, biodiesel is being sold by OMCs in more than 750 retail outlets.

POLICIES AND CONTRACTS

One of the landmark outcome 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 Licensing 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.

In order to explore and produce new sources of natural gas from coal-bearing areas, the Government had formulated a CBM Policy in 1997 and implemented the same in 2000 providing attractive fiscal and contractual framewotk for exploration and production of CBM which is an environment friendly clean gas fuel similar to conventional natural gas.

In order to bridge the gap between energy supply and demand, GOI has adopted multi-pronged strategy for giving momentum to exploration and production 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 vests with the National Oil Companies (NOCs) holding Petroleum Exploration Licence (PEL)/Petroleum Mining Lease (PML) granted under the nomination regime.

Considering the constraints experienced in the different contractual regime, it was proposed that the award of acreages for hydrocarbon exploration & production in future will be under a uniform licencing policy covering all types of hydrocarbons, with new fiscal terms ensuring ease of operation for E&P companies.

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. Nine rounds of bids have so far been concluded under NELP, spanning 1999-2012, in which production sharing contracts for 254 exploration blocks have been signed. As on 01.04.2016, a total of 122 blocks are active comprising 12 Pre-NELP, 84 NELP & 26 Small & Medium Size Field PSCs. The details of the blocks awarded are highlighted in Table -9.

Major policy drives and initiatives have been ushered by the Government in upstream hydrocarbon segment in India in the last couple of years to give a boost to the investment climate and domestic production and many others are

Table - 9: Details of Exploration Block Awarded

Round	No. of blocks awarded	No. of blocks relinquished	No. of blocks operational	Currently Active Area
Pre NELP	28	16	12	9539.64
Pre NELP (small & medium discovered field)	28	02	26	3713.86
NELP-I	24	20	4	18369.12
NELP-II	23	19	4	5130.96
NELP-III	23	18	5	7210.85
NELP-IV	20	16	4	1438.29
NELP-V	20	14	6	15973.24
NELP-VI	52	40	12	22412
NELP-VII	41	27	14	21830
NELP-VIII	32	14	18	13477
NELP-IX	19	2	17	18053.36
Total	**310**	**188**	**122**	**137148.32**

***Source**:India's Hydrocarbon Outlook, 2015-16, Directorate General of Hydrocarbons, Ministry of Petroleum & Natural Gas.*

under consideration. All such policies/guidelines being considered or implemented by the Government are listed below:

1. Discovered Small Field (Marginal) Policy: It was observed that many discoveries made in Nomination blocks have not been monetized and are categorized as Marginal fields. Government of India in October 2015 announced Marginal Field Policy which was later rechristened to Discovered Small Field Policy. It will boost production and provide increased revenue to both government and contractor. Highlights of this policy are as follows:

- **Revenue Sharing contract:** A simple and easy to administer contractual model requiring minimum regulatory burden for field monetization
- **Single license for Conventional & Non-conventional hydrocarbon:** Single license to explore and extract all hydrocarbon resources, including CBM, Shale gas/oil, tight gas, gas hydrates and other resources to be identified in future.
- **No restriction on exploration activity during contract period**
- **Eligibility for Bidding:** Up to 100% participation by foreign companies, Joint Ventures will be allowed.
- **Crude Oil & Gas Pricing and Sale:** Contractor will be free to sell the Crude Oil and Natural Gas exclusively in domestic market through a transparent bidding process at arm's length.
- **Oil Cess & Royalty:** No Oil Cess will be applicable on Crude Oil production however, Royalty rates will be as under NELP regime.
- **Customs Duty:** Customs duty exemptions for specified goods and services will be available for contract areas .

2. Marketing and Pricing Freedom for New Gas Production from Deepwater, Ultra Deepwater and High Pressure- High Temperature Areas: Much of unexploited oil and gas resources are in the Deepwater, Ultra Deepwater and High Pressure-High Temperature Areas and recognising the need for incentivizing gas production from such difficult areas, Government of India on 21.03.2016 notified marketing including pricing freedom for gas produced from all discoveries which are yet to produce commercial production as on 01.01.2016 and to all future discoveries in Deepwater, Ultra Deep water and High Pressure-High Temperature areas. Continuing the further reforms in pricing on 21.03.2016, Government approved marketing and pricing freedom for Gas discoveries in Deepwater and Ultra Deepwater areas which are yet to commence commerical production as on 01.01.2016 and all such future discoveries. Further, the policy aims to improve the economic viability of discoveries already made in such difficult areas and would lead to early monetization of future discoveries as well.

3. New Domestic Natural Gas Pricing Guidelines: In order to strengthen the developing Gas market in the country, Government of India started pricing reforms for the natural gas sector by approving new gas pricing scheme in October 2014. This policy is based on the prevailing hub prices of United States, Mexico, Canada, European Union and Russia. The price has revision cycle of six months and will be applicable to all sectors uniformly. With a view to protects the interests of the consuming sector as well as paying heed to the requests from producing sector, a ceiling based on the landed cost of the alternate fuel has been imposed. The ceiling price in US $ per MMBTU

(GCV) shall be calculated as lowest of the (i) landed price of imported fuel oil (ii) weighted average import landed price of substitute fuels and (iii) landed price of imported LNG. The landed price-based ceiling will be calculated once in six months and applied prospectively for the next six months.

4. Hydrocarbon Exploration and Licensing Policy (HELP): On 10 March 2016, Government approved Hydrocarbon Exploration and Licensing Policy (HELP) which is based on new contractual model i.e. Revenue Sharing. As the model is centered around a matrix of biddable revenue share vis-a-vis level of production by the Contractor itself, it is expected to eliminate the areas of disputes related to cost recovery, Investment multiple calculation, cost of unfinished work programme, rigidities of timelines, delays in implementation of FDP, etc. The implementation of Revenue Sharing Contract (RSC) model is envisaged to minimize regulatory burden for the sake of ease of doing business and increase the ease of business in India for both National and International contractors. Major highlights of HELP are as follows:

- **Open Acreage Policy** – option to select the exploration blocks without waiting for formal bid round.
- **Revenue Sharing Model** – simple, easy to administer- no cost recovery - no micro-management by the Government - operational freedom to the operator.
- **Pricing and Marketing Freedom** – Major incentive for investment.
- **Single License for Exploration and Production of Conventional as well as Non-conventional Hydrocarbon Resources.**
- **Exploration Allowed throughout the Contract Period.**
- **Increase in Exploration Phase** – Exploration Phase for onshore areas have been increased from 7 years to 8 years and for offshore increased from 8 years to 10 years.
- **Reduced Royalty Rates for Offshore Blocks.**

5. Policy for Extension of Production Sharing Contracts (PSCs): To enable optimal recovery of oil and gas reserves from fields after expiry of PSC, Government of India on 10 March 2016 has approved a policy for the grant of extension to the Production Sharing Contracts for 28 Pre-NELP discovered (small and medium size) fields. The policy aims at bringing out clear terms of extension so that the resources can be expeditiously exploited in the interest of energy security of the country and improving the investment climate.

This policy provides for a uniform, non-discretionary framework for extension of contract for a period of 10 years both for Oil and Gas. During the extension period, it is proposed to increase the Government take by way of charging normal royalty and cess in place of concessional royalty and cess charged during the original contract period. The profit petroleum during extension period will also be 10 percent higher than the normal percentage.

6. Policy for Testing Requirement: Government has approved a policy on testing requirements for discoveries made under New Exploration and Licensing Policy (NELP) Blocks on 29.04.2016 in order to resolve the disputes related to testing requirements and to monetize the stuck up discoveries. This decision was implemented on 13.05.2015. The contractors are now allowed to carry out the pending drill stem test on the discoveries and submit the results in a specified time line. Testing is being carried out on all concerning/applicable discoveries which were stuck up earlier.

7. Policy Framework for Relaxations, Extensions and Clarifications at the Development and Production stage under PSC Regime for Early Monetization of Hydrocarbon Discoveries: To address various issues and concerns regarding PSCs, the policy framework was notified in November 2014. As a result of implementation of these guidelines, more than 40 long pending PSC related issues have been resolved.

8. Exploration in Mining Lease Areas: Government of India has formulated a policy to allow exploration in Mining Lease Areas with cost recovery subject to establishment of commerciality. Till 31.03.2016, 15 hydrocarbon discoveries (14 Oil & 1 Gas) have been notified in the Mining Lease (ML) areas after announcement of above policy. Document of Commerciality

(DoC) for one discovery D-55, from the Block KG-DWN-98/3 is submitted.

9. Policy Guidelines of Exploration and Exploitation of Shale Gas and Oil: Shale Gas and Oil Policy was announced on 14 October 2013 and under this Policy the right to exploration and exploitation of Shale Gas & Oil has been vested with the National Oil Companies (NOCs) holding Petroleum Exploration License (PEL)/Petroleum Mining Lease (PML) granted under the nomination regime. NOCs have identified 55 blocks for Assessment Studies during the Phase-I of three years. Further, NOCs will identify 80 blocks under Phase-II of three years and 55 blocks in Phase-III.

10. Policy Framework for Development of Underground Coal Gasification in Coal and Lignite bearing Areas in India: The Union Cabinet in December 2015 has approved a policy framework for development of Underground Coal Gasification (UCG) in coal and energy from coal/lignite resources which are otherwise regarded as uneconomical to work through conventional mining methods. A policy on lines 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.

OTHER INITIATIVES

Site Restoration Guidelines for Petroleum Operations: Government of India has constituted a committee for formulation of Site Restoration guidelines for petroleum operations. Recommendation of committee members has been finalised, adopted and submitted to Ministry.

Standing Committee on Petroleum Industry Practices: Government of India has constituted Standing Committee to identify the areas requiring codification of "Good International Petroleum Industry Practices (GIPIP)" and to prepare national codes for petroleum operations. Subsequent to several deliberations with stakeholders, the Standing Committee has approved, adopted the report and submitted to Ministry.

Encouraging E&P Activities in North-East India: To encourage hydrocarbon exploration and production activities in the North-East (NE) Region of India, Government of India carried out special study with consultant for framing Hydrocarbon Vision Document 2030 for NE India. The vision document was released on 09.02.2016. This vision document aims to prepare a roadmap for the next 15 years to increase the production of oil and gas in north-east India and outline the necessary investment in the hydrocarbon sector to increase exploration activities, expand the Piped Natural Gas (PNG) network and ensure availability of petroleum products, including LPG, in the remotest corners of the region. For implementation of the action plans emerged from this vision documents, an Executive Council is formed consisting of government officials and industry stakeholders.

Multi-client Geo-scientific Surveys: Seven proposals have been received for generation of approx 107,386 LKM 2D Seismic data, under the policy for Geo-scientific data generation for hydrocarbons in Indian sedimentary basins, through Non-exclusive Multi-client Geo-scientific surveys/ activities. All the seven proposals have received clearances from Ministry of Defence (MoD) and Ministry of Home Affairs (MoHA). M/s Electromagnetic Geoservices ASA, Norway, started data acquisition in West Coast of India.

Re-assessment of Prognosticated Hydrocarbon Resources of India: A Multi-Organisation Team (MOT) has been constituted to carry out re-assessment of hydrocarbon resources of India in all its 26 sedimentary basins. The project is to be carried out by ONGC in association with OIL and DGH. Work has been initiated at seven work centres of ONGC for eight priority basins. Entire work for all 26 sedimentary basins is expected to be completed by November, 2017.

Appraisal of Unappraised Sedimentary Areas: Out of total sedimentary area of 3.142 million sq. km, an area of 1.502 million sq. km is yet to be appraised. To appraise unappraised areas, MoP&NG has formulated a plan to conduct 2D seismic surveys in all sedimentary basins of India where no/scanty data is available. ONGC and OIL have been entrusted with the task of surveying these areas. OIL has been assigned to carry out 2D seismic API of 7408 LKM falling in North

Eastern part of India and ONGC has been assigned to carry out 2D seismic API of approx. 40835 LKM seismic data in inland part of 22 sedimentary basins of India.

National Data Repository (NDR): To consolidate and store all the Geo-scientific data available in the country and to create a base for Open Acreage Licensing Policy, GoI has taken initiative to build National Data Repository (NDR) for Oil and Gas Industry in India. Initial population of data is in progress and the priority data pertaining to reassessment of 26 sedimentary basins is being loaded. As on 31.03.2016, total 169144.77 LKM 2D Seismic data, 15716.28 SKM 3D Seismic data, 237 wells and logs data and 618 wells report are loaded in NDR.

Strategic Crude Oil Storage

Taking into account the oil security concerns of India, the Government has also decided to build a Strategic Crude Oil Reserve of 5.33 million tonnes at three locations in the country viz. Visakhapatnam, Andhra Pradesh (1.33 million tonnes), Mangaluru, Karnataka (1.5 million tonnes) and Padur, Karnataka (2.5 million tonnes) through a Special Purpose Vehicle (SPV) named Indian Strategic Petroleum Reserves Ltd (ISPRL), a subsidiary Company of OIDB. The storage facility at Visakhapatnam has already been filled up and one half of Mangalore storage facility has also been filled. The storage facility at Padur has also been completed. ISPRL signed a Definitive Agreement with Abu Dhabi National Oil Company (ADNOC) of UAE for Oil Storage and Management for the second half of Mangalore storage facility.

The Strategic Petroleum Reserve of Phase-I is estimated to supply approximately 10.5 days of India's crude requirement according to the consumption during 2015-16. Thus, the need for additional crude oil storage is being felt in the light of increasing requirement of crude oil and subsequently, construction of storage facilities at Chandikhol in Odisha and at Bikaner in Rajasthan, under Phase II of Strategic Petroleum Reserve Programme have also been proposed.

WORLD REVIEW

The world proved reserves of crude oil and natural gas at the end of 2016 were estimated at

Table – 10 : World Proved Reserves of Crude Oil* (By Principal Countries)

(In billion tonnes)

Country	Reserves
World: Total	**240.7**
Algeria	1.5
Angola	1.6
Brazil	1.8
China	3.5
Canada	27.6
Iran	21.8
Iraq	20.6
Kazakhstan	3.9
Kuwait	14.0
Libya	6.3
Nigeria	5.0
Qatar	2.6
Russian Federation	15.0
Saudi Arabia	36.6
UAE	13.0
USA	5.8
Venezuela	47.0
Other countries	13.1

Source: *BP Statistical Review of World Energy, June 2017.*
** At 2016 end.*

Table – 11 : World Proved Reserves of Natural Gas* (By Principal Countries)

(In trillion cu m)

Country	Reserves
World : Total	**186.6**
Algeria	4.5
Australia	3.5
Azerbaijan	1.1
Canada	2.2
China	5.4
Egypt	1.8
India	1.2
Indonesia	2.9
Iran	33.5
Iraq	3.7
Kazakhstan	1.0
Kuwait	1.8
Libya	1.5
Malaysia	1.2
Myanmar	1.2
Netherlands	0.7
Nigeria	5.3
Norway	1.8
Qatar	24.3
Russian Federation	32.3
Saudi Arabia	8.4
Turkmenistan	17.5
UAE	6.1
USA	8.7
Uzbekistan	1.1
Venezuela	5.7
Other countries	8.2

Source: *BP Statistical Review of World Energy, June 2017.*
** At 2016 end.*

240.7 billion tonnes and 186.6 trillion cu m, respectively (Tables - 10 & 11). The largest share of reserves of world crude oil is available in Middle East (45.74%) followed by South & Central America (21.11%), North America (14.33%), Europe & Eurasia (9.06%), Africa (7.02%) and Asia Pacific (2.66%).

Of the total world reserves of natural gas, Middle East possesses the largest share (42.55%) followed by Europe & Eurasia (30.39%), Asia Pacific (9.38%), Africa (7.66%), North America (5.95%) and South & Central America (4.07%).

The world crude petroleum production in 2015 increased to 4,225 million tonnes from 4,127 million tonnes in 2014. OPEC countries, namely, Algeria, Angola, Ecuador, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, UAE and Venezuela had a share of about 40.69% (not included Equatorial Guinea and Gabbon) in the world crude oil production in 2015. Saudi Arabia, Russia & USA (13% each), Canada, China, Iran & Iraq (5% each), Kuwait & UAE (4% each) and Brazil, Mexico & Venezuela (3% each) were the principal producers of crude petroleum in 2015.

The world production of natural gas also marginally increased to 3.61 trillion cu m in 2015 from 3.59 trillion cu m in 2014. OPEC countries had a share of 18.54% (include Algeria, Iran, Nigeria, Qatar, Saudi Arabia and UAE only) in the world natural gas production in 2014. USA (21%),

Table – 12 : World Production of Crude Petroleum (By Principal Countries)

(In million tonnes)

Country	2013	2014	2015
World : Total	**4135**	**4127**	**4225**
Algeria	69	69	69
Angola	87	83	89
Argentina	29	28	28
Azerbaijan	43	39	39
Brazil	109	121	131
Canada	173	186	191
China[#]	210	211	215
Colombia	50	49	53
Ecuador	27	28	29
Egypt	34	35	36
India*	38	37	37
Indonesia	41	39	39
Iran	180	186	195
Iraq	153	160	197
Kazakhstan	82	81	79
Kuwait[@]	151	151	149
Libya	49	24	21[e]
Malaysia	28	29	31
Mexico	149	144	134
Nigeria	111	11	11
Norway	90	93	96
Oman	47	47	49
Qatar	84	84	79
Russia	523	525	533
Saudi Arabia[@]	542	543	569
UAE	166	167	176
UK	41	40	45
USA	462	545	548
Venezuela	138	138	135
Other countries	229	230	221

Source: *World Mineral Production, 2011-2015.*
@ Including shares of production from the Neutral Zone.
 # Including oil from shale and coal.
** Year ended 31st March following that stated.*

Table – 13 : World Production of Natural Gas (By Principal Countries)

(In billion cu m)

Country	2013	2014	2015
World: Total	**3538**	**3592**	**3609**
Algeria	82	83	83
Argentina	42	41	43
Australia	61	65	73
Canada	145	152	154
China	121	130	127
Egypt	56	49	46
India*	35	34	31
Indonesia	77	76	76
Iran	167	182	193
Kazakhstan	42	43	45
Malaysia	65	65	63
Mexico	58	57	53
Netherlands	81	69	51
Nigeria	36	45	50
Norway	109	109	95
Oman	32	30	31
Pakistan**	43	42	42
Qatar	177	177	181
Russia	668	639	633
Saudi Arabia***	100	102	106
Thailand	42	42	40
Trinidad & Tobago	43	42	40
Turkmenistan	62	69	72
UAE	56	58	56
UK	38	39	41
USA[#]	689	733	766
Uzbekistan	57	57	58
Other countries	354	361	359

Source: *World Mineral Production, 2011-2015.*
** Year ended 31st March following that stated.*
*** Year ended 30th June of that stated.*
**** Including one half of the output of the natural Zone.*
 # Dry gas.

Russia (18%), Iran & Qatar (5% each), Canada & China (4% each) and Norway & Saudi Arabia (3% each) were the major producers of natural gas in 2015 (Tables - 12 & 13).

The world consumption of oil in 2016 was estimated as 4,418.2 million tonnes, while that of natural gas was 3,212.9 million tonnes oil equivalent. Consumption of oil and natural gas in India in the same period was 212.7 million tonnes (with 4.81% share) and 24.9 million tonnes oil equivalent (with 0.78% share), respectively.

FOREIGN TRADE

Exports

Exports of natural gas decreased in 2015-16 to 1,26,951 tonnes against 1,38,168 tonnes in 2014-15. Exports of natural gas were mainly to Singapore (91%) and Nepal (9%) (Table -14).

Exports of petroleum products were 60.54 million tonnes during 2015-16 which shows a decrease of 5.31% against the exports of 63.93 million tonnes during 2014-15.

Imports

Imports of crude petroleum increased considerably to 202.31 million tonnes in 2015-16 as compared to 187.91 million tonnes in 2014-15. Imports were mainly from Saudi Arabia (20%), Iraq (18%), Nigeria & Venezuela (11% each), UAE & Iran (7% each), Kuwait (6%) and Angola (4%). Imports of natural gas increased significantly to 14.38 million tonnes in 2015-16 from 13.29 million tonnes in 2014-15. Main suppliers were Qatar (66%), Nigeria (11%), Australia (5%) and Oman & South Africa (3% each) (Tables - 15 & 16).

Imports of petroleum products were at 28.30 million tonnes during 2015-16 which shows an increase of 32.87% against 21.30 million tonnes during 2014-15.

Besides, 16.58 million tonnes of Liquefied Natural Gas (LNG) was imported in 2015-16 which registered an increase of 17.67% against imports of 14.09 million tonnes of LNG during 2014-15.

Table – 14 : Export of Natural Gas (By Countries)

Country	2014-15		2015-16 (P)	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**138168**	**4901801**	**126951**	**3798602**
Singapore	64000	1413078	115006	3327033
Nepal	8961	528223	11827	459058
Bhutan	179	10614	105	7868
UAE	15	3333	8	2951
Indonesia	-	-	3	1295
Bangladesh	-	-	2	234
Iran	-	-	++	158
Germany	++	7	++	5
Korea, Rep. of	65000	2945008	-	-
Saudi Arabia	13	1392	-	-
Other countries	++	146	-	-

Table – 15 : Import of Petroleum (Crude)
(By Countries)

Country	2014-15		2015-16 (P)	
	Qty ('000 t)	Value (`'000)	Qty ('000 t)	Value (`'000)
All Countries	**187913**	**7093793565**	**202314**	**4293999334**
Saudi Arabia	34492	1327535834	39592	878771259
Iraq	24017	863280100	35695	700406963
Nigeria	17929	788791574	22971	588802998
Venezuela	22752	707902967	22721	369980764
UAE	16262	673889089	14806	356408563
Iran	11200	428585363	13616	278154035
Kuwait	18817	699124533	11173	233432772
Angola	6796	269044598	7222	172784989
Qatar	3440	140152407	4435	96960768
Mexico	5126	163798456	5757	90049283
Other countries	27082	1031688644	24326	528246940

Table – 16 : Import of Natural Gas
(By Countries)

Country	2014-15		2015-16 (P)	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**13289155**	**563400559**	**14376924**	**437824475**
Qatar	10896163	467221775	9504899	296343149
Nigeria	886800	36373110	1518750	48770090
Australia	-	-	713026	18971936
Oman	74362	3448601	480207	14358370
South Africa	-	-	413438	12998746
Yemen Republic	-	-	338942	9192022
Indonesia	-	-	258920	7004374
Belgium	-	-	264250	6525655
Trinidad	115216	4115063	218372	5635812
Spain	209485	9821999	127814	3432218
Other countries	1107129	42420011	538306	14592103

FUTURE OUTLOOK

Energy is considered as of the key inputs for economic development of the Country. India is poised to play a significant role in the Global energy space, as it is likely to account for 25% of the rise in global energy demand by 2040. Our Country's energy demand is expected to rise at a Compounded Annual Gowth Rate (CAGR) of 3.5% till 2040 as it advances on the path of development.

As per draft National Energy Policy, 2017, the shares of oil and gas in energy consumption in the country during 2015-16 were 26% and 6.5%, respectively. 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 anticipated that the production of oil and gas has potential (ambitious case) to reach 61 Mtoe and 124 BCM by 2040.

As per annual report of MoPNG for 2016-17, Indian sedimentary basins need intensive exploration efforts for enhancing crude oil & natural gas supply in the country. The Hydrocarbon potential has been witnessed where exploratory inputs have been expended. 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 unappraised. This means, about half of the Indian sedimentary basins has the undiscovered potential of hydrocarbons. Total prognosticated hydrocarbon resources are estimated at about 28,000 million tonnes in the sedimentary basins of the country, out of which 11,241 MMT in-place reserves have been established by ONGC, OIL and Private/JV companies as on 1.4.2016, which means about 60% hydrocarbon reserves are yet to be discovered. Thus, Indian Sedimentary Basins have ample hydrocarbon potential for future exploration and production.

In recent years, the Government has committed to a number of economic and structural reforms that will support the strong projected growth in GDP over the medium to long term. On the other hand, the Government's continued efforts to reduce subsidies on petroleum products are expected to temper demand for liquid fuels. In the IEO2016 Reference case, consumption of petroleum and other liquid fuels in India more than doubles, from 3.6 million b/d in 2012 to 8.3 million b/d in 2040, as its GDP more than quadruples over the period.

Natural gas production in India grows by an average of 1.3%/year in the IEO2016 Reference case, from 1.4 TCF in 2012 to 2.1 TCF in 2040. India faces several production challenges. For example, a large portion of its current production comes from ageing western offshore fields and production volume from the Krishna Godavari Basin - located off India's eastern coast - has failed to meet earlier expectations. India has several basins that are prospective for shale gas. India's oil ministry has announced that the Government will unveil a shale gas and oil policy in the near future and begin selling shale gas development blocks, although no awards have been made to date. In the later years of the IEO2016 Reference case, shale resources provide nearly one-quarter of India's total natural gas production.

Presently, domestic refining capacity is higher than the country's demand for petroleum products. This surplus capacity may be a source for high foreign exchange earning and assures us energy security. The surplus refining capacity in North India and North East holds the potential for supplying neighbouring countries. India may become a net importer of refined products in the near future.

As per Hydrocarbon Vision 2030 for North East, the Vision 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 till 2030 in North East India.

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. Petrochemical sector is closely linked to availability of feedstock from refineries. 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 storage of crude and petroleum products, to assure supplies at times of supply disruption, are available only for 5.33 MT which need to be augmented on considering the 90-day consumption requirement of strategic and commercial storages.

Apart from above as Oil India Ltd, has significant presence in the North East part of India and presently operating in the Upper Assam basin which happens to be one of the most prolific basins in India, it will concentrate efforts in the North East to achieve continued reserve accretion.

To enhance recovery, water injection and other EOR/IOR technologies will be adopted which has the ability to liberate additional production capacity of around 0.32 to 0.35 MMTPA of crude over the next 12 to 15 year period.

It will continue to pursue acquisition of prospective overseas E&P opportunities. In addition to acquisition of conventional assets, it would also look towards acquisition of non-conventional assets, such as oil sands, shale gas, shale oil, gas hydrate, etc.

Selective diversification into midstream, downstream and renewable energy segments, such as, pipelines, wind/solar energy, CGD, LNG, refineries, etc. would also be planned to balance the existing portfolios.