Chapter - 17

Energy Resources

Energy is the key to all round development of any nation. Infact, the amount of energy production and consumption is sometimes considered as an index of a country's economic development. It is also equally responsible the for industrial development. As development is now a days synonymous with use of energy. The importance of energy resources is always increasing. Classification of various energy resources is shown in diagram 17.1.

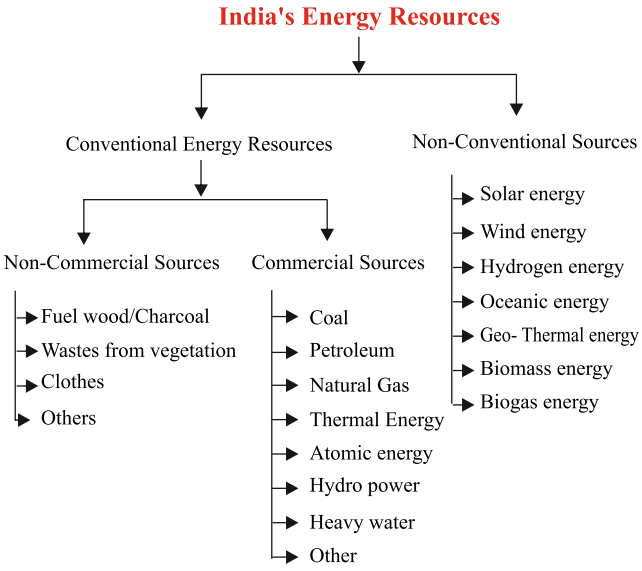


Chart 17.1 : Sources of Energy in India

The condition of energy resources in India is not so satisfactory. The conventional energy sources- are Coal, Petroleum, Natural Gas, Thermal energy, Atomic (Nuclear) energy and Hydel Power.

Electricity is a must for industrial growth and development. Most of the nation's electricity power is generated conventionally. In 2011, the electric power constituted 64.08% of Thermal power (Coal), 32.24% of Hydro-Power and 3.68% of Atomic power. Coal is the prime source of thermal power. In this lesson we will discuss some important energy resources in detail-

Coal

On the basis of industrial revolution in Britain, coal is said to be the mother of industries, Black Gold and Symbol of power. Even today Coal is the most important means of power in the country. Coal is credited for the creation of modern industrialization of the world.

Coal is used in India since ancient times, but development of coal mining begin in 1774 A.D., when Britishers discovered it in Raniganj. India stands third in coal production after China and USA. India produces 4.7% of total coal in the world. In India, about 60% of the energy is obtained from coal.

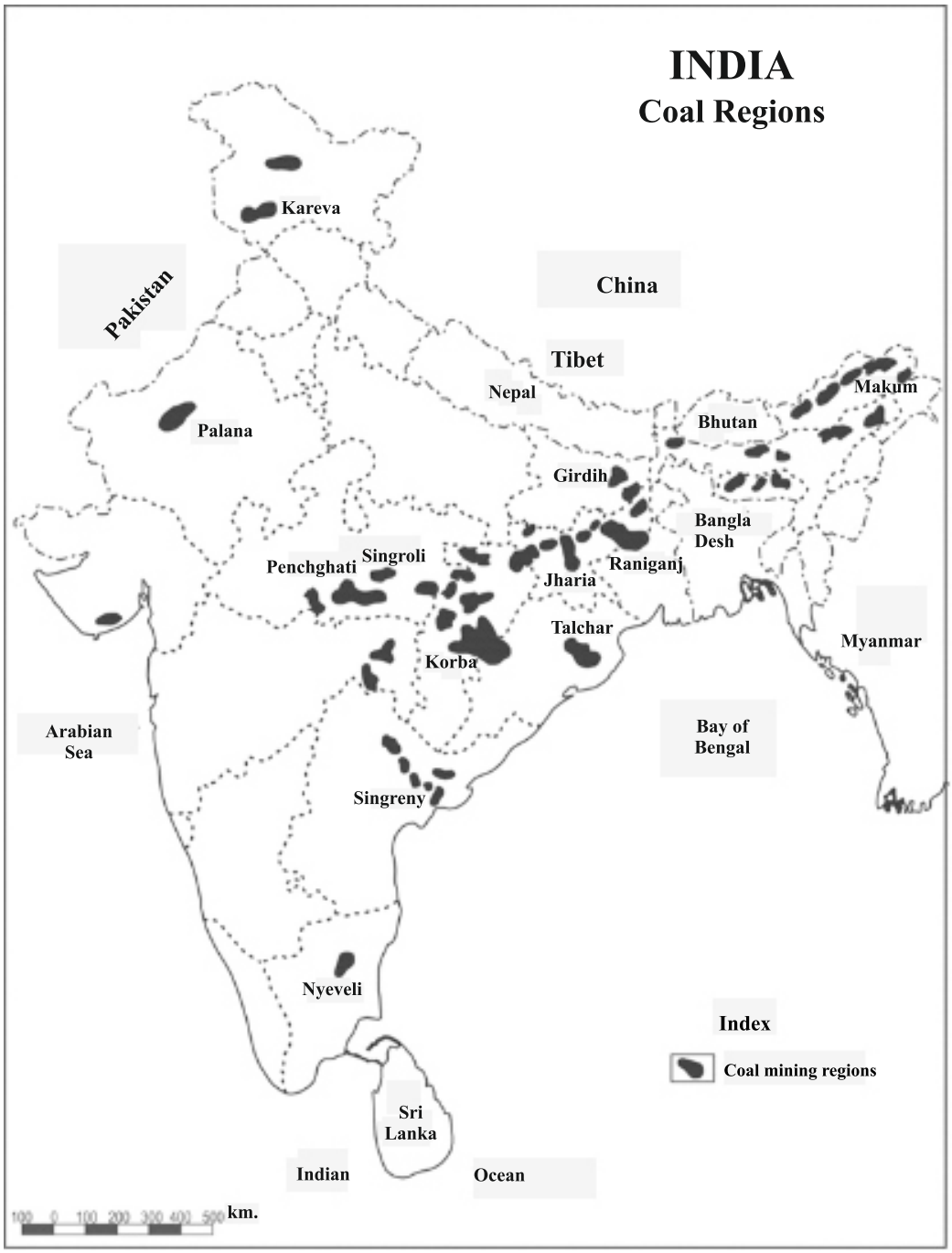
On the basis of the amount of fixed carbon and hydrocarbons forms, the coal is divided into 4 categories-

(1) Anthracite : Carbon is 80 to 90%

(2) Bituminous : Carbon is 75 to 80%

(3) Lignite : Carbon is upto 50%

(4) Peat : Carbon is below 50%



Map 17.1 : Coal regions in India

Coal Production Area

Coal of the two geological periods is available in India :- (A) Gondwana era (B) Tertiary era.

(A) Gondwana era :

On the basis of production and consumption the Gondwana era coal is most important. In India, this type of coal is found in various river basins.

(i) Godavari Valley Region : In Andhra Pradesh the Godavari river valley possesses 75% of coal deposits. Aadilabad, Karimnagar, Khamman, Varangal and Western Godavari districts are major

producers. 250 sq. kms coal area is in between Godawvri and Tandur rivers. Singhreni coal area is the largest producer in the state. The rocks of Barakar series are streched over 54 sq kms. More than 2 metres thick coal layer is spread in this area. Annually 332 lakh tons coal is produced by Andhra Pradesh.

(ii) Mahanadi Valley Region : In Odisha state, about 25% of coal resourcesof India are found, 15.3% of the total production is obtained from here. Talchar coal belt of Dhenkanal district is spread over 548 sq kms. Coal of this belt is used in power generation, fertilizer and gas production. Odisha has 523 lakh tons of coal production annually.

(iii) Damodar Valley Region : This region produces more than 50% of the country's coal. It is the largest coal producing area in India. This area is spread between Jharkhand and West Bengal states. Raniganj (1092 sq.km.) coal belt of Burdhwan, Bakura and Purulia district of West Bengal ,is the biggest and most important coal producing area of India. 29% of the total coal of India is shared by this area. Jharia of Jharkhand is also largest coal producing area spread over 436 sq kms. Best quality of Bituminous coal deposits are found here. Hazaribagh, Bokaro, Girdih, South and North Karanpur, and Ramgarh are the main coal producing regions.

(iv) Western Damodar Valley Region : It is located in Palamau district of Jharkhand. Here Oranga (240 sq kms.), Daltonganj (80 sq kms.) and Hutar are main producing areas of coal, Rajmahal coal area to the west of Rajmahal Hills is spread over 182 sq kms.

(v) Son river Valley Region : This region is spread over Umriya, Sohagpur and Singroli coal fields of Madhya Pradesh. Singroli region of Shahdol and Siddhi districts is spread over 2037 sq km. is the main coal producing region.

(vi) Chhattisgarh Coal Region : This coal region stands third in India. It constitutes 16% of total produced coal. Main coal fields are Ramkola, Tatapani, Korba, Jhilmil, Vishrampur, Lakhanpur, Chirmiri.Ramkola and Tatapani fields are spread on over 250 sq kms. Although the coal quality is inferior here.Vilaspur in Korba region is spread over 515 sq kms, is also having coal deposits. Coal Mines lies in the river basins of Mahanadi and its tributaries are Aehram and Burang rivers.

(vii) Satpura Coal Region : Mohpani coal fields is located to the South of Narmada River Valley on northern slopes of Satpura in Narsinghpur district. Here 4 crore tons of coal reserve deposit is estimated. Near to this, 7 crore tons of coal deposits in Kanha Valley. Most parts of MP and Maharashtra lie in the Satpura coal region. Coal of Patherkheda coal belt in Betul districts is used in thermal power plant is located here.

(viii) Maharashtra : Vardha Valley Region covers the areas of Chandrapur, Vallarpur, Yewatmal, Barora and Nagpur coal belts. 3% of total coal deposits of nation lies in this region. 50 crores tons deposit is estimated here. Quality of coal is low and quantity of Charcoal is also found. This coal is mainly utilised in Thermal power plants.

(ix) West Bengal Region : Vardhman, Bankurda, Purulia, Veerbhumi, Darjleeing and Jalpaigudi possess 11% of total coal deposits of India. It produces 6% of total production of India.

(B) Tertiary Era :

In India, 2% tertiary coal is obtained from mesozoic period of rocks of tertiary era. About 225 crore tons of deposits are estimated in India. Main coalproducing areas are Assam, Meghalaya, Jammu and Kashmir, Tamilnadu, Rajasthan, Arunachal Pradesh and West Bengal.

Pankabadi of West Bengal is the main producing region. Here coal resembles with Gondwana era's coals. Deegrock in Dafala hills of Arunachal Pradesh is the main coal producing region. Others are Lakhimpur and Shivsagar region of Assam spreads over 80 sq kms. Coal is mainly used in gas making. Garo-Khasi-Jayantia Hills of Meghalaya also possess good deposits of tertiary coal.

(i) Lignite Coal : Although the amount of carbon of Lignite coal makes it inferior coal but in thermal energy it is used for producing electricity. Such deposits are found in Neyveli lignite coal deposits of Teruvanallor and Vellor districts of Tamilnadu. Here 330 crore tons of lignite coal deposit is estimated. Neyveli lignite corporation limited, is mining coal since 1956.

Palana of Bikaner district in Rajasthan also have deposits of lignite. Around 3 sq kms of region have deposits of lignite with 50% carbon content. It is mainly used in Railways. Since 2003, deposits of lignite are also found in Bikaner and Barmer districts, which is mainly used in thermal plants.

(ii) Other Regions : Other important regions of coal in India lie in Puducherry, Kutch of Gujarat, Poonch, Riyasi and Udhampur of Jammu Kashmir and Terai region of Uttar Pradesh.

Table 17.1 : India - Coal Reserves and Production 2012-13

S. No.	States	Estimated Deposits (%)	Total Deposits (%)	Production (%)	Main Regions
1	Madhya Pradesh	6.35	7.77	13.80	Shahdol, Chhindwada, Sidhi, Narsinghpura, Betul
2	Chhattisgarh	11.48	16.31	17.03	Sarguja, Bilaspur, Ramgarh, Korba, Vishrampur, Bastar
3	Jharkhand	36.85	28.08	22.03	Jharia, North & South Karanpur, West & East Bokaro, Rajmahal, Ramgarh, Devgarh, Hutar, Ornga, Daltengunj
4	Andhra Pradesh -Telangana	8.74	6.75	9.37	Khanan, Adilabad, Varangal, Tandoor, Singreni, Kalapalli, Sarsi
5	Maharashtra	4.84	3.57	9.11	Chandrapur (Verdha Valley), Kanvati (Nagpur), Yavatmal (Ballakhur)
6	West Bengal	11.84	10.94	6.00	Raniganj, Vardhman, Bakunda, Purulia, Veerbhumi, Darjeeling, Newjalpaigudi
7	Odisha	17.59	24.39	16.63	Thekanal, Sambalpur, Talchar, Sundergarh, Eb River Valley, Brahmani River Valley
8	Uttar Pradesh	0.80	0.42	0.15	Sonbhadra
9	Eastern States	0.15	0.23	0.10	Meghalaya, Arunachal Pradesh, Nagaland
10	Other States	1.36	1.54	5.78	
	Gondwana Coal	99.73	99.68	93.56	States all above
	Tertiary Coal	0.27	0.34	6.87	Asom (Nakum, Nazira), Palana (Rajasthan), Neyveli (T.N.)

Source : Statistical Abstract India, 2014

Trade

After meeting domestic demands, India exports coal to its neighbouring countries- Bangladesh, Nepal, Bhutan, Myanmar and Srilanka. In 2010, India exported coal worth 521 crore rupees. High quality cooking coal is imported from Australia, Canada and other European Nations. In 2012-13, India imported coal of Rs. 83,998.35 crore.

Petroleum

It is the derived from the words petra = rock and oleum = oil obtained from rocks. Deposits of

petroleum are found in about 30 lakhs years old sedimentary rocks. About 0.5% of mineral oil deposits are found in India out of the total world reserves.

History

Crude petroleum in India is found in anticlines and faults of rocks of tertiary era. Petroleum was searched accidently when Assam railways company making tracks in Margrita area in 1860. Technically, oil well was dug out in Makum (Assam) in 1866, where petrol was found at 36 meters of depth. Another oil well at Digboi with 202 meters depeth was dug in 1890. Afterwards in 1899- Assam oil company was established. In 1915, Burma oil company started exploration Near Silchar in Surma Valley for oil. In 1938, Petrol was discovered at Naharkatiya and in 1956 at Shivsagar district. Indian Government established a joint venture with Burma oil as Indian Oil Limited in 1959.

Oil and Natural Gas Cooperation (ONGC)

Since 1953, the Geological survey of India started exploration of natural oil in different parts of the country. Oil and Natural Gas commission was formed in 1956. This commission works for exploration of mineral oil on land and in oceanic parts of India.

Bharat Petroleum Cooperation

In January 1976, Government of India took over, Burma Shell Refinery and Burma Shell Company to establish Bharat Petroleum cooperation.

Oil India Limited

It works on discovery, excavation and production of mineral oil and natural gas in India. It also supplies crude oil to refineries and then ensures it's availability to consumers.

Production and Trade

Requirements of mineral oil is continuously increasing day by day. To meet out the needs, it is being imported from foreign countries. India's mineral oil production and import is mentioned in the table below.

Table 17.2 : India Production of Mineral Oil from 1950 to 2013

S. No.	Year	Production (in lac ton)	Consumption (in lac ton)	Import (in crore Rs.)
1	1951	2.69	33.0	58.00
2	1961	5.13	77.0	69.00
3	1971	71.85	179.0	136.00
4	1981	149.25	309.0	5,284.00
5	1991	330.21	550.0	10,316.00
6	2001	324.00	1107.6	71,604.00
7	2011	35,039	138,275	614,387.12
8	2012	38,086	134,305	743,074.38
9	2013	41.235	137,378	920,455.65

Source : Statistical Abstract India, 2014

Producing Areas/Regions

Presently mineral oil is being mined in the following regions of the country-

(1) Assam : Assam state possesses huge reserves deposits at Digboi, Surma Valley & new areas of Assam. Mineral oil is digged at regions around Assam. Mineral oil is digged at around the depth of 2000 meters in Digboi, Badhapung and Hansapung in Lakhimpur district. Refinery was established at Digboi which has a capacity to refine annually about 4.0 metric ton mineral oil. Badarpur, Machinepur and Patharia of Surma Valley of Assam is mining oil since 1971 and has almost reached the bottom of its deposits.

Naharkatiya, Hugrijan and Moran of Brahmaputra Valley began production of mineral oil in 1953. They are producing 25 lakh metric ton mineral oil annually. Important places are Rudaurasagar, Lakva, Goleki & Amgari. Oil of these places is refined at Noonmati and Barauni refineries.

(2) Gujarat : Gujarat state has deposits of mineral oil of about 15500 sq. km at Gulf of Kutch, Surat, Baroda, Bharuch, Mehsana and Kheda districts. Oil is digged out at Ankleshwar region just at a depth of 1200 meters. It annually produces 30

lakh tons of oil, which is refined at Trombay and Koyli refineries. Gulf of Khambhat is producing 15 lakhs tons of oil and 5 lakh cubic meter of gas annually. To the West of Ahmedabad, Nayagoan near Kalol, Mehsana, Sanand, Kothana are new emerging hopes of mineral oil in Gujarat.

(3) Northern Region : Ludhiana, Hoshiarpur and Dasuza of Punjab, Jawalamukhi, Dharamshala and Nurpur of Himachal Pradesh and Moosalgarh of J&K have possibilities of deposits of mineral oil in India. Presently they are producing Natural Gas.

(4) Offshore Areas : The marine area of India is spread over 385000 sq kms. ONGC has surveyed Gulf of Kutch and Khambhat in Arabian sea. Coromandel Coast, Deltas of Krishna and Godavari and Sunderban are hope for future. After surveys and exploration the commercial production has started in some areas. Out of these :-

(i) Deposits of oil at Aliabet Island in Arabian sea, which is 45 kms away from Bhavnagar of Saurashtra. Oil exploration was started with the help of Russia.

(ii) Mumbai High is 176 kms away from coast in NW of Mumbai in Arabian sea produces oil and natural gas with the platforms of Sagar Samrat ship. The commercial production started in 1976 at 1416 meters of depth in sea. Maximum portion of total oil production in India is contributed by Bombay-High.

(iii) To the South of Mumbai High, Vasai also has good deposits of oil at 1900 meter depth, which possesses better oil deposits than Mumbai High.

(iv) In 1980's decade, the ONGC of India surveyed and explored new oil deposits in India, which are located in the basin of Cauvery, Krishna and Godavari and also in offshore regions from 1981, Rainum coastal oil wells produces 1500 barrel oil daily, from 1988 at Madnum coast 4300 barrel per day from 1986-Nagpattinum 200 barrel per day and Kovilkalpal 206 barrel per day production is done.

(v) Some oil wells around 49 are also explored in Krishna and Godavari Basins of Andhra Pradesh, although they produces low oil.

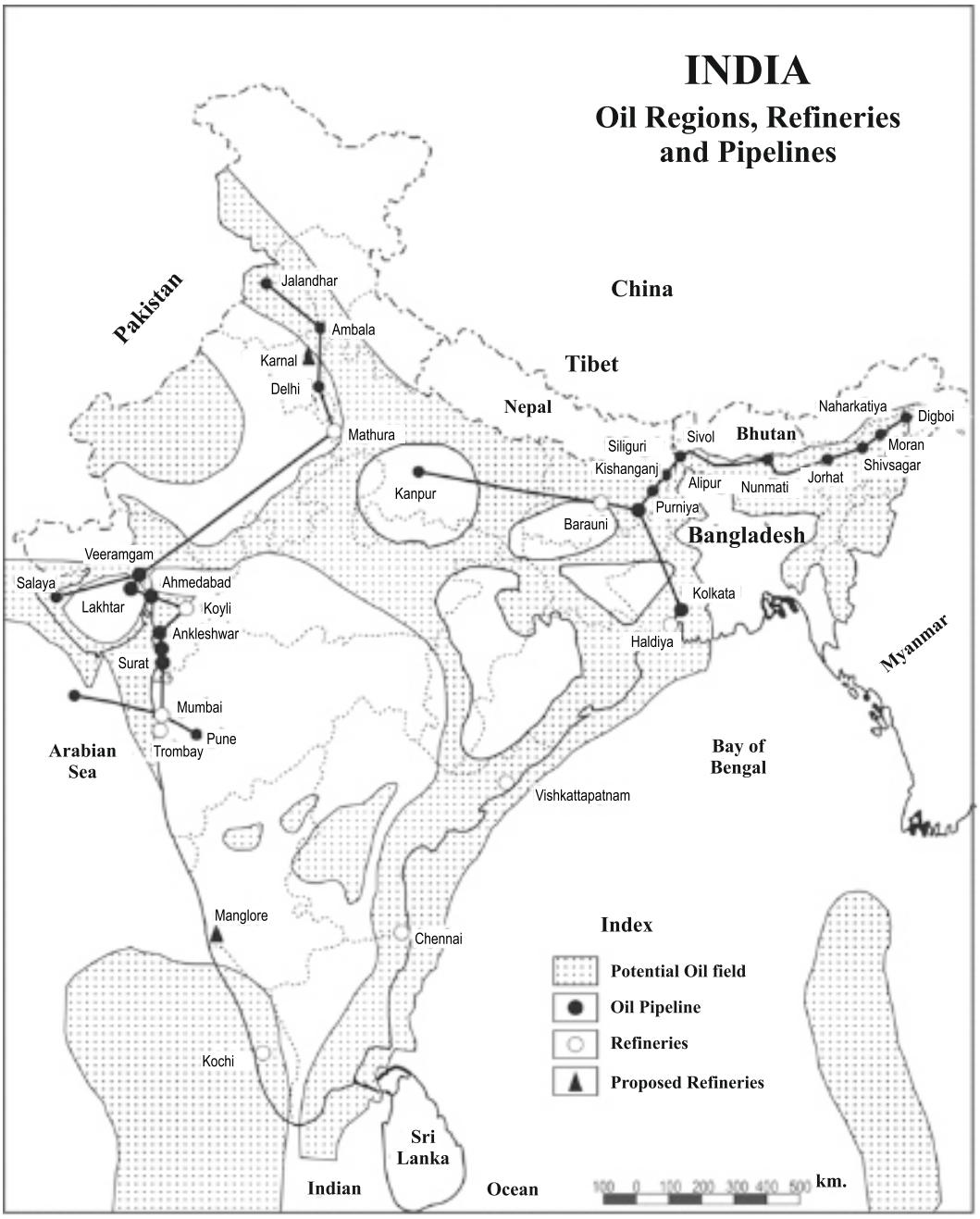
(vi) Cairns energy limited is mining petroleum in Barmer district of Rajasthan.

Oil Refineries

Of the total 22 refineries 17 are in public sector, 2 are in joint sector and 3 are in private sector. A brief description of oil refineries in India is given below :

Table 17.3 : Oil Refineries

S. No.	Refinery Plants	Refinery Station	Current Capacity
I	**Government Sectors**		
1	Indian Oil Corp. Ltd.	Gauhati	1.00
2	Indian Oil Corp. Ltd.	Baruani	6.00
3	Indian Oil Corp. Ltd.	Koyli	13.70
4	Indian Oil Corp. Ltd.	Haldia	7.50
5	Indian Oil Corp. Ltd.	Mathura	8.00
6	Indian Oil Corp. Ltd.	Digboi	0.65
7	Indian Oil Corp. Ltd.	Panipat	15.00
8	Indian Oil Corp. Ltd.	Bongoi	2.35
9	Hindustan Petro. Corp. Ltd.	Mumbai	6.50
10	Hindustan Petro. Corp. Ltd.	Vishakapattanam	8.30
11	Bharat Petrolium Corp. Ltd.	Mumbai	12.00
12	Bharat Petrolium Corp. Ltd.	Cochhi	9.50
13	Chennai Petro. Corp. Ltd.	Manali	10.50
14	Chennai Petro. Corp. Ltd.	Nagpattinam	1.00
15	Nusaligarh Refinery Ltd.	Numaligarh	3.00
16	Manglore Ref. & Petro. Chemicals Ltd.	Manglore	15.00
17	Oil & Natural Gas Corp.	Tatipaka	0.66
	Total (I)		120.66
II	**Joint Venture Sectors**		
18	Bharat-Oman Ref. Ltd.	Beena	6.00
19	HPCL	Bhatinda	9.00
	Total (II)		15.00
III	**Private Sectors**		
20	Reliance Ind. Ltd.	Moti Khawdi Jamnagar	33.00
21	Reliance Petro. Ltd.	SEZ, Jamnagar	27.00
22	Essar Oil Ltd.	Vadinar	18.00
	Total (III)		78.00
	Grand Total (I + II + III)		213.66



Map 17.2 : Oil Regions, Refineries & Pipelines

Pipe Lines

For refining crude oil, the production areas have to transport oil to refineries. There is a total of 13000 kms of pipelines in India out of it 7700 kilometers pipelines is for petroleum products. Here are details of such pipelines

(1) Nation's first pipelines was established between Naharkatiya to Noonmati to Barauni (Bihar),which is 1152 kms long. It's annual capacity is 40 lakh tons. It crosses 78 big and small rivers through its way and having 9 pumping stations in all. It is also connected to Rudrasagar and Lachaya oil producing areas. Its main sub pipelines are Noonmati to Silligudi, Barauni to Kanpur, Barauni to Haldia & Morigram, Noonmati to Bongaigaon.

Fig. 17.1 : Petroleum Pipe Lines

Fig. 17.2 : Refinery Industry

(2) Second most important pipeline is from Bombay-High and Gujarat oil producing areas to Koyli Refinery. There are two main pipelines of 210 kms from Bombay-High to Mumbai's coast, one for oil and other for gas.

(3) Other important pipeline is from Gulf of Kutch's coast (Salaya) to Mathura around 1075 kms long. It is also connected to Koyli. This pipeline transport crude oil from Bombay-High to Mathura refinery.

(4) Refined Petrol is transported from Mathura via Delhi-Ambala to Jhalandar.

(5) Another pipelines have been set up from Mumbai to Pune for transportation of petroleum products in Karnataka and Andhra Pradesh.

(6) Vishakapattam Vijaywada Sikandrabad pipeline is 572 kms long.

(7) Hazira (Gujarat) Bijaypur Jagdishpur (HBJ) pipeline is 1750 kms long.

(8) Kandla (Gujarat) Bhatinda (Punjab) pipeline is 931 kms long.

(9) Chennai- Trichi Madurai pipeline is 683 kms long is in the process of construction by IOC

Hydro-Electricity

Hydro-Electricity is the most comprehensive and long lasting in all forms of energy. It's demand in industry, transportation, agriculture and in domestic fields is rapidly increasing because of its various characteristics.

Development

In India, Hydro electricity energy developed with electricity supply in Darjeeling in 1897. Afterward Shiv Samudram-Hydro-Electric power plant was established in Karnataka. Upto 1947 nation's Hydel Electric power was not so developed but during Five year plans, it was developed rapidly. Huge capital was invested in these Hydel Electricity power projects in different parts of India.

In 2010, total Electricity production was 163.6 thousand MW. Central Electricity Authority has been set up for the development of electricity. National Hydro-electricity power corporation was established in 1975 for the development of hydro-power. Currently 18 states have established State Electricity Boards.

About 15000 MW is estimated capacity of small Hydroelectric projects. Upto 31st December 2007, 611 Hydel Electricity projects were completed and 225 projects are under construction. Following are the Hydro-electric projects in the various states of India.

Andhra Pradesh : Nagarjun sagar, Sieleru, SriShelam, Machkund, Tungbhadra and Nizam Sagar.

Fig. 17.3 : Hydro Electricity power production at Karnatka

Fig. 17.4 : Under construction Hydro Electricity power centre at Himachal Pradesh

Himachal Pradesh : Bairasiul, Naptha-Jhakari, Rampur, Luhari, Khad, Chamera, Paravati, Chirchind-Chamba.

Punjab : Dehar (Beas), Bhakra, Pong, Gangwan, Kotla, Senam, Bhoruka.

Uttrakhand : Khatima, Tehri, Devsari, Vishnugad, Pipalkoti,

Jharkhand : Subarnarekha, Maithon.

Rajashtan : Ranapratap Sagar, Jawahar Sagar, Mahi-Bajaj Sagar

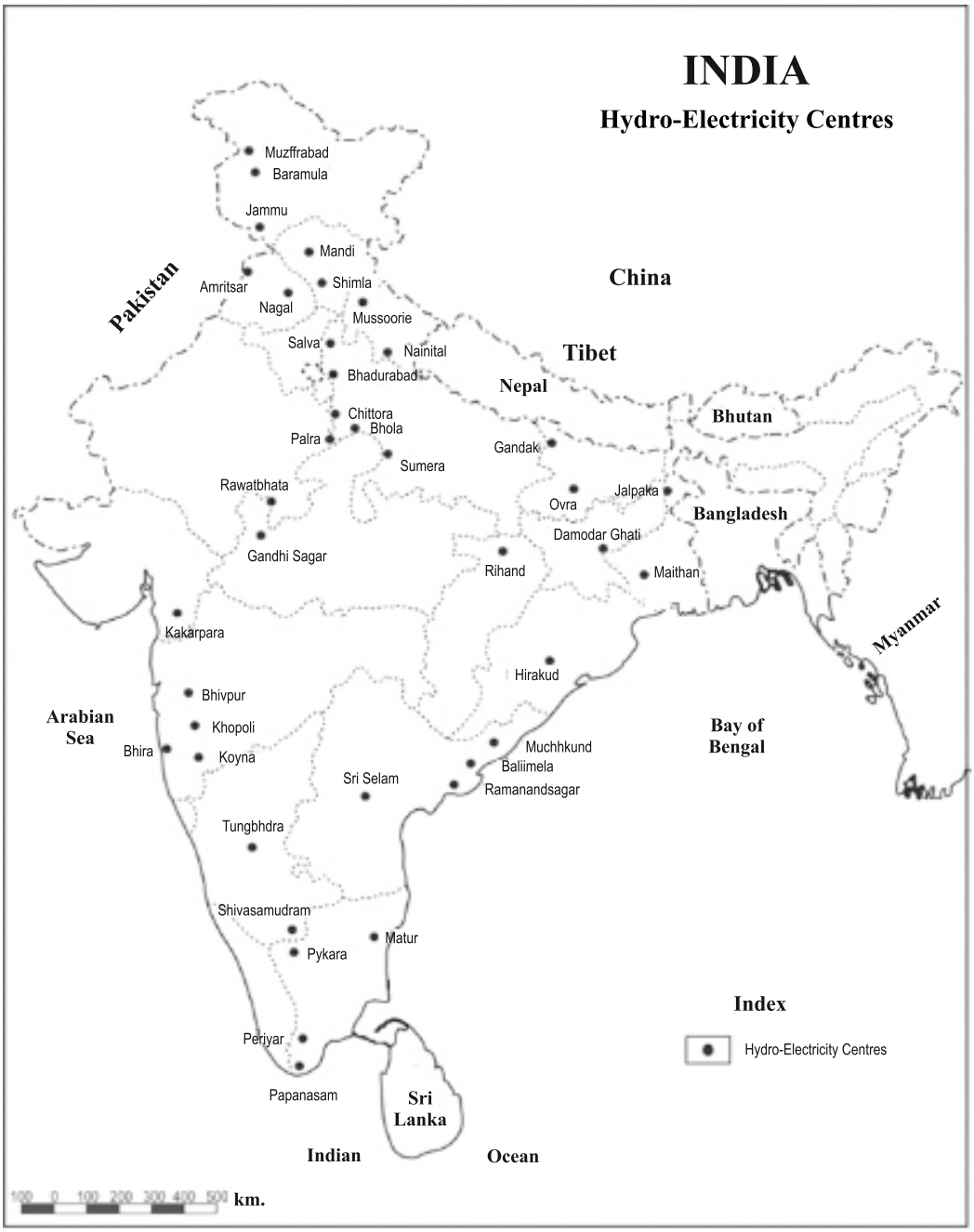
Odisha : Hirakund, Balimela

Maharashtra : It's the leading state in India in Hydro-electricity production.Here suitable & favourable geographical conditions are found for development of elecritcity.Tata Hydel Power (Three Power Houses) , Bhivpuri, Khopoli, Bheera, Koyna,

Table 17.4 : Hydro Electricity Producing Region 2013-14

S. No.	States	Electricity Capacity (%)	Production Percentage	Major Hydro-electricity projects
1	Andhra Pradesh-Telangana	12.15	11.18	Nagarjun, Sieleru, SriShelam, Machkund, Tungbhadra and Nizam Sagar
2	Karnataka	10.08	11.08	Sharatavi, Kali River, Jog, Lingen, Makki, Shivasamundra, Bhadra, Munirabad, Shimmapura
3	Maharashtra	9.78	10.16	Koyna, Tata, Vaiterni
4	Punjab	8.14	8.19	Dehar, Bhakada, Pong, Mangwal, Kotala, Sanam
5	Tamilnadu	6.78	6.59	Papanasham, Sarkarpathi, Suruliyar, Moyar, Aliyar, Paikara, Sholiyar, Kodiyar, Periyar, Maitur Kunda
6	Odisha	6.36	6.31	Heerakund, Balimela
7	Kerala	6.13	6.04	Eduki, Sabrigiri, Kutiyadi, Shailavar, Segulam, Nariya, manglam, Palli Vasal, Paniyar, Pervinkulan
8	Madhya Pradesh	6.04	5.96	Gandhi Sagar, Narmada Sagar, Hansdev Bango, Van Sagar
9	Himachal Pradesh	5.86	5.14	Bera Siual, Giriwara, Rampur, Luhari, Khab, Bassi, Chamera, Devar
10	Eastern States	9.12	10.14	Umiyaj (Assam), Kardankulai (Meghalaya), Nichla Lagyap (Sikkim), Loktal (Manipur), Doiyang (Nagaland), Ranganadi (Arunachal Pradesh)
11	Other States	19.62	19.23	Rajasthan, Bihar, Jharkhand, Jammu Kashmir, U.P.

Source : Statistical Abstract India, 2014



Map 17.3 : India Hydro-Electricity Centres

Purna, Vaiterna, Bhatnagar Beed are major Hydro-Electric centres.

Karnataka : Electricity power production was firstly started in Karnataka, Shiv Samudram on Cauvery, Shimla, Jog, Tungbhadra, Bhadra, Sharavati etc. on cauveri are major Hydro-Electricity power projects.

Tamilnadu : Mettur, Pykara on Cauveri, Papanasam on Tambrepani, Modar, Kunda, Periyar, Parimbikulam, Aliayar are major projects.

Kerala : Perennial and speedy rivers have favourable conditions for Hydro-Electricity generation in Kerala. Pallivasar, Sangutam, Shillyar, PoringathKutthu, Nariyamangar, Ponriar

Sabrigiri, Ittukki, Kadiyadi etc. are main projects.

Uttar Pradesh : Ganga Electric Grid on upper Ganga canal is important one. It includes Padhri, Muhhamadpur, Nirgajani, Chittora, Salava, Bhola, Paleda, Sumera etc. Where artificial dam were developed to produce Hydro-electricity. Rihand, Matateela, Yamuna Hydril, Ramganga are prominent hydro power projects.

Jammu & Kashmir : Indus, Jhelum, Salal, Chenani etc are major Hydro-electricity projects.

Atomic Energy

Due to rising demand of energy and limited resources in the country, atomic power was developed as an alternative. This energy is obtained from the disintegration of radioactive atoms. This disintegration process is costly and highly technical in nature, but the electricity it generates is cheaper. It is because 20 to 25 lakhs kilogram coal is required for producing electricity equivalent to 1 kg uranium.

Map 17.5 : Atomic power plants

India is far back among developed countries in producing atomic energy, as only 3% of total energy is contributed by atomic energy. Atomic Energy department was established in 1954.

Sources of Atomic Energy

For Atomic energy minerals with special radioactive elements needed such as- Uranium, Thoriunm, Beryllium, Ilmenite, Zircon, Graphite and Antimony are used. Such type of mineral's availability in India is as follows.

Table 17.5 : Atomic Power Plants

S. No.	Thermal Plant	Year of begning	Capacity (MW)
1	Tarapur (Maharashtra)	1969, 1970	160×2
2	Kota (Rajasthan)	1973, 1981	200×2
3	Kalppakam (T.N.)	1984, 1986	235×2
4	Narora (U.P.)	1991, 1992	235×2
5	Kakrapar (Gujarat)	1993, 1995	235×2
6	Kaiga (Karnataka)	2000, 2000	235×2
7	Rawatbhata (Rajasthan)	2000, 2000	235×2
8	Tarapur (Maharashtra)	2006, 2006	500×2
9	Kaiga (Karnataka)	2007	235×4
10	Rawatbhata (Rajasthan)	2008	500×4
11	Kudankulam (T.N.)	2007, 2008	1000×2
12	Kalppakam (T.N.)	2010	500

(1) Uranium : Uranium is found in rocks of Dharwar and Archean rocks of Singhbhumi of Bihar and Rajasthan, Northern Bihar, Nellore of Andhra Pradesh, Pagmetite rocks of Mica regions of Rajasthan, in monozite deposits of coastal parts of Kerala and among the rocks of Kulu, Chamoli of Himachal Pradesh.

(2) Thorium : Monozite minerals and found in the coastal sand of Kerala in 8 to10% and 10% in sands in Bihar. Thorium is obtained from Monozite.

(3) Ilmenite : It is found in the sand of Western coast of India, Cape Comorin, Estuary of Narmada and Mahanadi rivers. Ilmenite reserves are found highest 93% in sand of Kerala.

(4) Beryllium : In the Mica mining areas of Rajasthan, Bihar, Andhra Pradesh, Tamilnadu Beryllium is found.

(5) Zircon : Is found in the sand of Kerala.

(6) Graphite : Graphite is found in Kalahandi, Ganjam, Koraput districts of Odisha, Warangal,Vishakhapattanam, West Godavari of Andhra Pradesh, Thirunveli of Tamilnadu, Mysore of Karnataka, Jaipur, Ajmer of Rajasthan, Betul of M.P., Bhagalpur of Bihar, Suchtang distict of Sikkim. 50% of total production of graphite comes from Odisha, 20% from Bihar and 18% from Andhra Pradesh.

Atomic Energy Development

Dr. Homi Jahangir Bhabha was the founder of atomic programme in India. Atomic energy commission was established in 1948. And in 1954 Atomic Energy institute was established at Trombay, which was renamed as Bhabha Atomic Research centre in 1967. In 1987 Nuclear Power Corporation of India was established which had ten atomic power stations. Producing 2770 MW electricity. Currently 17 Nuclear reactors are working to produce 4800 MW of electricity.

Non-Conventional Energy Resources

After discussing conventional energy resources of India in detail in this chapter, a brief description of non-conventional resources is given. All sources of conventional energy are limited and will exhaust shortly. From environment point of view, they are polluting too. That's why the use of non-conventional energy resources is being emphasized in India and in the whole world. In 1982- Non-conventional Energy department was established under energy ministry. With the help of world Bank-IRDA-Indian Renewable Development Authority was established in 1987. This institute deals in use and development of Solar, Wind, Biotic, Oceanic and Hydrogen energy.

(1) Wind Energy

Vast country like India has good capacity of total 45000 MW of wind energy. 150 MW capacity electricity generation project was established at Muppdal in TN which is largest in Asia. Tamilnadu stands first in wind energy production. The producing states and production details are mentioned in table 17.6.

Fig. 17.6 : Wind energy production in Tamil Nadu

Table 17.6 : Wind Energy Leading States in Production

S.No.	States	Production (MW)
1	Tamilnadu	6007
2	Maharashtra	2310
3	Gujarat	2884
4	Karnataka	1730
5	Rajasthan	1524.

(2) Solar Energy :

India is a tropical country. It has enormous possibilities for solar energy production. Most parts of the country have 300 or more clear days, which receive good amount of sunlight. Here, annually 5000 Trillion KW/per hour solar radiation is received. With the help of Solar energy, works like heating water, cooking food and running electric pumps etc. and in industrial and domestic fields power generation is done. Solar thermal energy programs and solar photo voltaic programs are being run by the Ministry of energy at national level. Triupati Balaji temple of Andhra Pradesh had India's biggest solar energy setup which is used for preparing food for 15000 peoples since 2002. Similar biggest solar water heater is used at Birla

Fig. 17.7 : Use of Solar Energy in Agriculture

Fig. 17.8 : Domestic use of Solar Energy

Institute of Technology and Science Pilani-Rajasthan, its capacity is 55000 litres of water.

Solar energy is also being used commercially in various sectors. Until 2010, about 15 lakh sq km area was setup as energy collector in India. More than 10,38,000 photovoltaic systems of 66.5MW capacity have been developed. In India about 6 lakh domestic light equipments, 8 lakh solar lanterns, 90,000 Solar power street lights and 141 solar power packs have been installed.

Currently 60 cities in the country are planned to be developed in the form of solar power cities. Under this scheme, towns having population of 50,000 to 5 lakh have been included Jawahar lal Nehru Solar Mission which was started on January 11,2010 for the development of Solar energy in the country. Under 13th five year plan 20,000 MW solar energy production target is set for 2022, country's solar energy production is shown in the table 17.7

Table 17.7 : Major Solar energy producing states

S. No.	States	Production (MW)	Percentage
1	Tamilnadu	15.0	1.5
2	Maharashtra	20.0	2.0
3	Gujarat	654.8	66.9
4	Andhra Pradesh	21.9	2.2
5	Rajasthan	197.5	20.2

(3) Biomass energy :

Biomass is a renewable energy source. It is a biological material derived from living, or recently living organisms, such as wood, waste and alcohol fuels. Biomass is commonly plant matter grown to generate electricity or produce heat.

A national program is being run for the development of biomass energy, which aims to utilize various materials of biomass. It includes the wastage of forests and agriculture to produce energy. Government of India has targeted planting 16.5 million hectare of Jatropha crop till 2015. By which the ambitious projects to make biodiesel could run. Under the 11th Five year plan, the target of developing 620 MW biomass power has to be achieved, until October 2013, 1248 MW electricity was produced.

Biogas has been developed in the rural areas through dung rubbish and human faces, which aims to provide cheap and alternative energy sources in the rural areas. In Urban areas the energy is produced from industries and garbage wastes to meet the demands. Along with protecting the environment, alternative sources of energy are being developed by operating this programme in metros. Such plants have been established at Tanuku (Andhra Pradesh), Faizabad (U.P.), Ankleshwar (Gujarat), Muktsar (Punjab) and Belgaum (Karnataka). 20 projects have been started for the purpose of generating biogas power from garbage whose total installed capacity is 25.27 MW.

In order to get energy from solid waste through municipal corporations, three projects of 17.6 MW capacity were established at Hyderabad, Vijaywada and Lucknow. Project based on animal waste in Ludhiana, power generation from biogas in cleaning plant of waste water in Surat and 150 KW energy project from vegetable markets wastes in Vijaywada had been established. Similarly a project of 250 KW capacity is being established at Chennai.It will use vegetable market waste to produce electricity.

IMPORTANT POINTS

1. For industrial development of any country power resources are essential elements.
2. All the sources of energy are classified into conventional and non-conventional resources.
3. Depending on the amount of carbon, coal is divided into- Anthracite, Bituminous, Lignite and Peat coal.
4. Two periods of coal in India are found in Gondwana and Tertiary periods.
5. Gondwana period's coal are found in the valleys of rivers like Damodar. Mahanadi, Son and Godavari.
6. India has a total of 0.5% of the world's petroleum reserves.
7. ONGC was established in 1956 for exploration of natural oil in India.
8. Total 22 refineries are working in India.
9. 1152 kms long first pipeline in the country was laid from Naharkatiya(Assam) to Barauni.
10. Hydro power was started in 1897 at Darjeeling in India.
11. The main minerals of Atomic energy are Uranium, Thorium, Zirkon, Graphite and Ilmenite.
12. Total 17 nuclear reactors are operated in India, with production capacity of 4800 MW.
13. Non-Conventional sources of energy include- solar, wind, geothermal, tidal and biomass energy.
14. In 13th five year, the aim is to produce 20,000 MW energy by 2022.

EXERCISE

Multiple Choices Type Questions

1. Ankleshwar oil field is located in -
   (a) Assam (b) Maharashtra
   (c) Andhra Pradesh (d) Gujarat
2. Maximum Thorium is extracted from -
   (a) Tamilnadu (b) Kerala
   (c) Karnataka (d) Maharashtra
3. Bombay-High is famous for -
   (a) Submarine construction
   (b) Nuclear Reactor
   (c) Petroleum reserves
   (d) Fishing
4. India's Nunmati oil refinery is located in -
   (a) Bihar (b) Maharashtra
   (c) Kerala (d) Assam
5. Suitable conditions for production of solar energy are found in -
   (a) Tamilnadu (b) Rajasthan
   (c) Uttaranchal (d) Madhya Pradesh
6. India's maxium petroleum reserves are found in-
   (a) Mumbai-High
   (b) Godavari-Basin
   (c) Coastal areas of Gujarat
   (d) Brahamputra Valley
7. Leading state in coal reserves is-
   (a) Madhya Pradesh (b) Chhattisgarh
   (c) Jharkhand (d) Odisha

8. Longest Petroleum pipeline of India is -

(a) Nunmati-Barauni

(b) Mathura-Jhalandhar

(c) Salaya-Mathura

(d) Mumbai-Jhalandhar

9. Most important among non-conventional sources of energy is -

(a) Solar energy (b) Wind energy

(c) Tidal energy

(d) Energy form Garbage/Waste

10. Which of the following river basins does not have deposits of coal ?

(a) Brahamputra (b) Godavari

(c) Damodar (d) Ganga

Very Short Answer Type Questions

11. Write the names of conventional energy resources found in India.

12. Write the names of non-conventional energy resources found in India.

13. Where is the coal of Tertiary period found in India?

14. Write five major coal producer states of India.

15. Name of major mineral oil reserves of India.

16. Write the names and capacities of India's five major oil refineries.

17. Name the five major projects of hydro-power in India.

18. Write the names of the major minerals of atomic energy.

19. Write the names of five solar power producing states of India.

20. Write the uses of Solar energy.

Short Answer Type Questions

21. Write about the status of energy resource in India.

22. Describe the production, distribution, and possibilities of Hydro-Electricity in India.

23. Write a description of solar and wind energy in India.

Essay Type Questions

24. Write an essay on coal-resources of India.

25. Write an article on non-conventional energy sources of India.