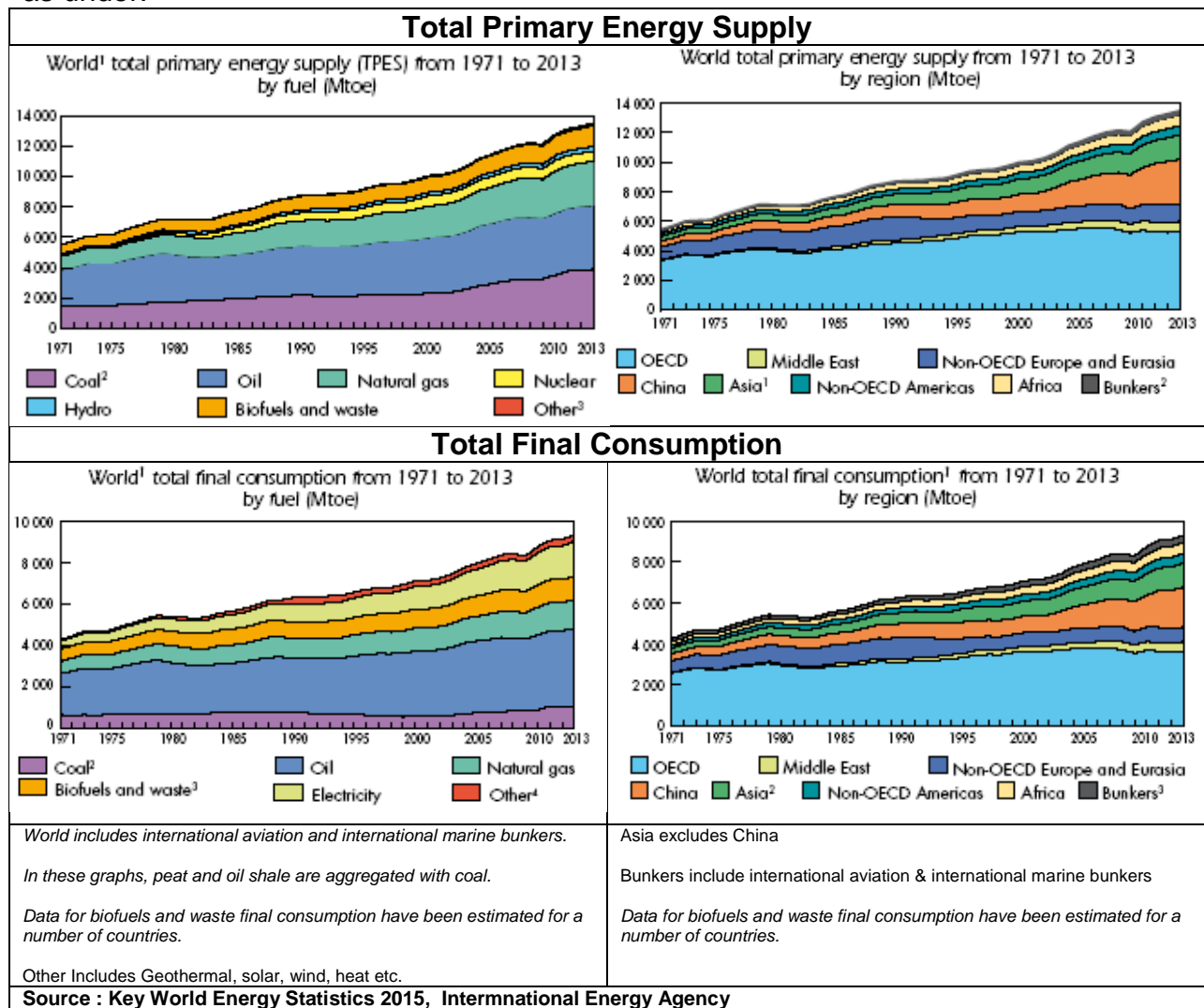


Chapter-16 ENERGY

16.1 Background: Development of economies has seen concomitant increase in energy use across the world, with the pace being faster in the Asian economies like China which joined the wagon later. The demand for energy has also been spurred by burgeoning population in these economies (growth in population in developed economies has slowed down) as not only more people use more energy but also due to increased per capita energy consumption, as individuals aspire for improved standards of living.

16.2 To meet the demand, non conventional sources of energy like nuclear energy and environmental friendly renewable sources of energy have also gained currency. The region wise and fuel wise growth in energy supply and consumption is summarised as under.



Indian Scenario: Issues & Policies

16.3 India is poised to become the 3rd largest energy consumer by 2020 after the USA and China . Surge in energy demand in India due to demographic and economic reasons places enormous pressure on its energy resources. As India walks the path of growth, enormous burden due to subsidies, specially in rural sector, cooking gas , diesel etc, higher T& D losses, power theft etc add to the woes in view of the already existing supply side constraints. In past few years, issues over mining , coal block allocation etc have further aggravated the problem. Consequently the energy situation has worsened in some states like Uttar Pradesh whereas some others like Gujarat have managed a turn around. However more villages have been electrified and electricity is increasingly substituting less cleaner fuels like kerosene, with about 55.3 % rural households having access to electricity as per 2011 Census. Government has also taken steps to rationalize the subsidies, revised gas pricing formula linking price of domestic natural gas to international gas prices . Series of measures have been taken in the recent past regarding pricing of Petrol & other fuels. This includes capping the subsidized LPG cylinders, raising the diesel price one time (by Rs 5 per litre) and permitting the Oil Marketing Companies (OMCs) to raise prices in small measures periodically. Oil companies were already allowed to revise price of petrol in accordance with international prices and exchange rate in June 2010.

16.4 Petroleum pricing in India has been largely viewed as **black hole of subsidies**. Balancing the social and economic considerations has confronted the governments since independence. From 'import parity' type of pricing, known as the 'Value Stock Pricing' (VSA) after the independence (a cost-plus formula to the import price, which included added elements of all the costs such as shipping charges upto the Indian ports, insurance, transit losses, import duties and other levies and charges) to Administered Price Mechanism (APM) which actually involved artificial price fixing by the government from time to time and hike or reduction in the prices , governments effort to partially insulate the prices of petroleum products in the country from volatile international crude oil prices and to ensure that the prices of certain products like kerosene , used predominantly by poor , remain subsidised have costed a lot in terms of subsidies. However, petrol and diesel have been deregulated (market-linked) with effect from June 2010 and October 2014 respectively. For 2015-16, "the government has approved budgetary support for PDS kerosene under-recovery at a rate of Rs 12 per litre and the remaining under-recovery will be borne by the upstream companies. The government has approved a fixed subsidy of Rs 18 per kg under the Direct Benefit Transfer for domestic LPG.

16.5 India's retail prices for petrol and diesel have traditionally been relatively high, despite subsidies. In fact, the total Government (central and states) taxes and surcharges on petrol products exceeded by far the annual budget subsidies for these products. Development of renewable sources of energy in view of sustainability and cleaner greener environment has become increasingly important. More so to reduce

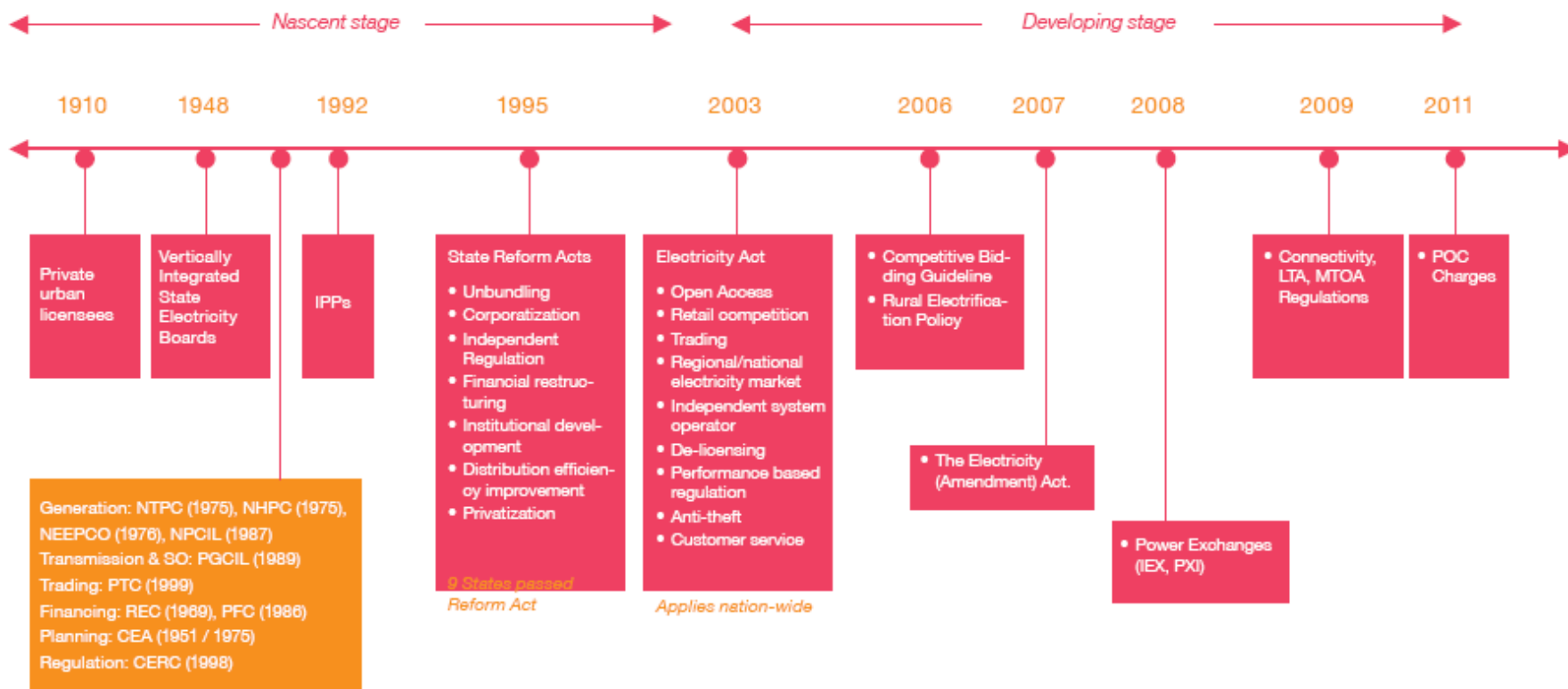
excessive reliance on conventional sources involving significant import costs. The **Jawaharlal Nehru National Solar Mission** envisages establishing India as a global leader in solar energy. An ambitious target of 20,000 MW of solar power by the year 2022 has been set under the Mission. Hydro electricity provides an alternative in hilly states. However several big hydro electric projects like the ones in Uttarakhand face a lot of criticism on the account of displacement of humans and ecological considerations etc . Several initiatives like introduction of Generation Based Incentive Mechanism for grid interactive wind power projects (introduced in December 2009) have been taken by Ministry of New & Renewable Energy.

16.6 To ensure energy security , besides fixing up the already existing systems viz reduction of transmission & distribution losses of electricity, entering into strategic collaborations, bilateral/multilateral agreements with countries rich in energy reservoirs , harnessing renewable energy, explorations for additional reservoirs of conventional sources of energy etc ,increasing the generation of nuclear energy might prove to be a solution for rapidly developing & urbanizing country like India where population also continues to grow. Nuclear deal with USA was a step in the direction by allowing India to import nuclear power plants and uranium fuel. The US initiative with IAEA support and accepted by the Nuclear Suppliers Group, has the practical effect of making India a sixth nuclear weapons state alongside, if not eventually within, the NPT system. However, setting up of nuclear power plants requires handling resettlement, environmental and other issues even after discounting for adverse international dispositions of some countries in view of India not having signed the Nuclear Non Proliferation Treaty. Though India is self sufficient in reactor design, its uranium resources are limited. So its focussing on developing the Thorium fuel cycle.

16.7 There are plethora of issues concerning Rural electrification, generation, transmission & distribution of electricity, recovery of cost of services & targeted subsidies, technology development and research and development(R&D), competition aimed at consumer benefits, financing power sector programmes including private sector participation, energy conservation, environmental issues, training and human resource development, protection of Consumer interest etc. **National Electricity Policy 2005** aims to address these. However, Some of the objectives including access of Electricity to all, overcoming electricity shortages etc are yet to be realised. The aim of protection of consumers' interest while maintaining commercial viability of electricity sector also continues to be a matter of discord as significant price hikes by private distribution companies creates much furore in the public, often forcing the governments to step in by subsidizing household consumption.

16.8 The Indian Energy Market has matured over the years. Introduction of independent power producers (IPPs) has been a mixed bag with disastrous Dabhol Power Plant Project in Maharashtra to modestly successful GVK project in Andhra Pradesh and Paguthan project in Gujarat and many more IPPS joining the wagon in recent past. Indian Energy Exchange(IEX) operating since June 2008 provides nation wise automated online electricity trading platform.

16.9 Policy measures & maturity of market: The evolution of energy sector through reforms and Institutional set ups is summarized below :



NTPC: National Thermal Power Corporation

NHPC: National Hydro Power Corporation

NPCIL : National Power Corporation of India Ltd

PGCIL: Power Grid Corporation of India Ltd

REC : Rural electrification Corporation Ltd

PFC : Power Finance Corporation Ltd

CEA : Central electricity Authority

CERC : Central electricity Regulatory Commission

IPPs : Independent Power Producers

IEX : Indian Energy Exchange

PXIL : Power Exchange India Ltd.

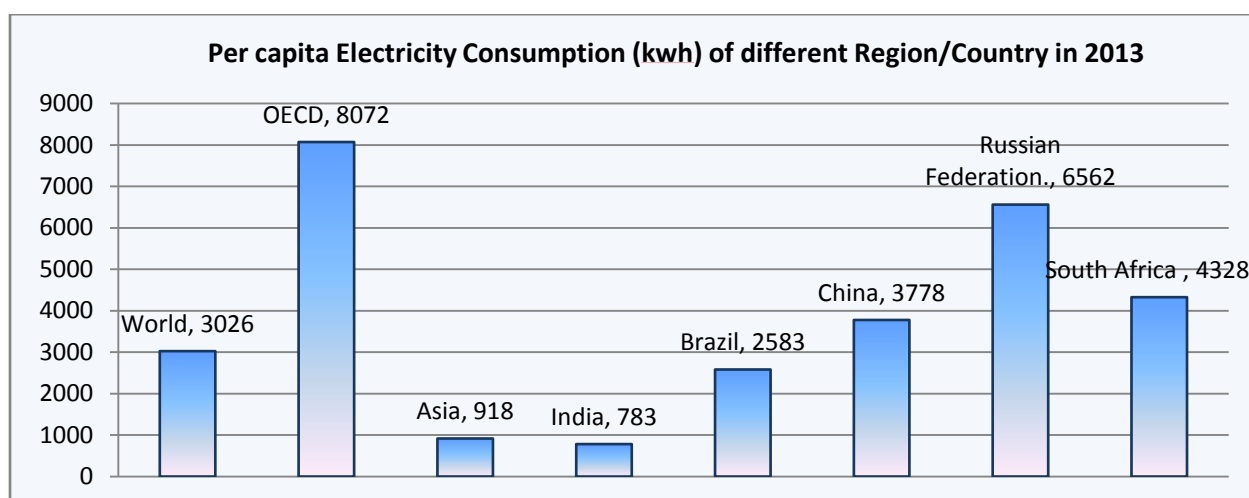
LTA : Long Term Access

MTOA: Medium Term Open Access

POC : Point of Connection

16.10 Recent Trends in Production & Consumption of Energy : During the Eleventh Five year Plan , nearly 55,000 MW of new generation capacity was created ,yet there continued to be an overall energy deficit of 8.7 % and peak shortage of 9 %. A projection in the Twelfth Plan document of the Planning Commission indicates that total domestic energy production of 669.6 million tons of oil equivalent (MTOE) will be reached by 2016-17 and 844 MTOE by 2021-22. This will meet around 71 per cent and 69 per cent of expected energy consumption, with the balance to be met from imports, projected to be about 267.8 MTOE by 2016-17 and 375.6 MTOE by 2021-22.

16.11 Per capita Electricity Consumption (PEC) & Energy Intensity : Despite of rapidly increasing energy demand in India, the present levels of per capita electricity consumption is much less compared to developed countries, world average or even the average per capita consumption in Asia.



Source :Key World Energy Statistics 2015, IEA

16.12 Per-capita Energy Consumption (PEC) increased from 13694.83 Mega Joules in 2005-06 to 19522.15 Mega Joules in 2013-14, a CAGR of 4.53% . The annual decrease in PEC for 2013-14 over 2012-13 is 0.60%.

16.13 The Energy Intensity (amount of energy consumed for generating one unit of Gross Domestic Product) (at 2004-05 prices) decreased from 0.4656 Mega Joules in 2005-06 to 0.4192 Mega Joules in 2013-14.

16.14 In the absence of data on consumption of non-conventional energy from various sources, particularly in rural areas in the developing countries, including India, both per capita energy consumption and energy intensity are generally computed on the basis of consumption of conventional energy. Maximum consumption of energy in Peta joules was in the form of Coal and Lignite which accounted for about 41.29% of the total consumption during 2013-14. Crude Petroleum was second (38.70%), while Electricity (14.47%) was third.

Trends in Per-Capita Energy Consumption (PEC) and Energy intensity in India

Year	Energy Consumption (in Peta Joules)	Population (in Million)	GDP (Rs. Crore) (2004-05 prices)	Per Capita Energy Consumption (in Mega Joules)	Energy Intensity (Mega Joules per rupee)
2005-06	15146	1106	3253073	13694.83	0.4656
2006-07	16421	1122	3564364	14635.85	0.4607
2007-08	17514	1138	3896636	15389.79	0.4495
2008-09	18457	1154	4158676	15994.06	0.4438
2009-10	21233	1170	4516071	18147.99	0.4702
2010-11	21892	1186	4918533	18458.90	0.4451
2011-12	22383	1202	5247530	18621.62	0.4265
2012-13	23903	1217	5482111	19640.72	0.4360
2013-14(p)	24071	1233	5741791	19522.15	0.4192
Growth rate of 2013-14 over 2012-13(%)	0.70	1.31	4.74	-0.60	-3.85
CAGR 2005-06 to 2013-14(%)	5.96	1.37	7.36	4.53	-1.30

Source : Energy Statistics 2015, MOSPI

14.15 Trends in production of energy in India: Coal production in the country during the year 2013-14 was 565.77 million tons (MTs) as compared to 556.40 MTs during 2012-13, registering a growth of 1.68%. The Lignite production during the same period decreased by 4.70%. Considering the trend of production from 2005-06 to 2013-14, it is observed that coal production in India was about 407.04 MTs during 2005-06, which increased to 565.77 MTs during 2013-14 with a CAGR of 3.73%. During the same period the CAGR of Lignite was about 4.33% with production increasing from 30.23 MTs in 2005-06 to 44.27 MTs in 2013-14. Production of crude petroleum increased from 32.19 MTs during 2005-06 to 37.79 MTs during 2013-14, a CAGR of about 1.80%. The CAGRs for natural gas and electricity were 1.06% and 3.99% respectively. Lignite has experienced the highest CAGR i.e. 4.33% among all the conventional sources of energy since 2005.

14.16 The total production of energy from conventional sources decreased from 13409.47 Peta joules during 2012-13 to 13400.15 Peta joules during 2013-14, showing a decrease of 0.07%. The production of energy in Peta joules by primary sources shows that Coal and Lignite were the major sources of energy, accounting for about 73.48% of the total production during 2013-14. Crude Petroleum was second (11.81%), while Natural Gas (10.18%) was third.

Trends in Production of Energy in India by Primary Sources

(in Peta Joules)

Year	Coal & Lignite	Crude Petroleum	Natural Gas	Electricity (Hydro & Nuclear) *	Total
1	2	3	4	5	6= 2 to 5
2005-06	7008.97	1348.00	1240.00	427.74	10024.72
2006-07	7458.57	1423.00	1223.00	476.29	10580.86
2007-08	7925.74	1429.00	1249.00	494.44	11098.18
2008-09	8476.37	1402.90	1265.34	513.27	11657.89
2009-10	9137.06	1410.64	1830.09	451.14	12828.93
2010-11	9206.69	1578.00	2011.00	505.89	13301.58
2011-12	9398.03	1595.00	1832.00	589.67	13414.70
2012-13	9730.08	1585.00	1567.00	527.39	13409.47
2013-14(p)	9846.00	1582.00	1364.00	608.15	13400.15
Growth rate of 2013-14 over 2012-13(%)	1.19	-0.19	-12.95	15.31	-0.07
CAGR 2005-06 to 2013-14(%)	3.85	1.79	1.06	3.99	3.28

* Thermal electricity is not a primary source of energy

Source : Energy Statistics 2015, MOSPI

16.17 The all India gross electricity generation from utilities, excluding that from the captive generating plants, was 6,23,819 Giga Watt-Hours (GWh) during 2005-06 . It rose to 1,022,614 GWh during 2013-14. The production of electricity from utilities has increased from 9,63,811 GWh during 2012-13 to 1,022,614 GWh during 2013-14, registering an annual growth rate of about 6.10%. Total Electricity generation in the country, from utilities and non-utilities taken together during 2013-14 was 11,79,256 GWh. Out of this 8,53,683 GWh was generated from thermal and 1,34,731 GWh was from hydro and 34,200 GWh was generated from nuclear sources. Total output from non-utilities was 1,56,642 GWh.

**Gross Generation of Electricity in Utilities (Thermal, Hydro & Nuclear)
and non Utility in India (GWh)**

Year	Utilities				Non-Utilities	Grand Total
	Thermal *	Hydro	Nuclear	Total		
1	2	3	4	5 = 2 to 4	6	7=5+6
2005-06	505,001	101,494	17,324	623,819	73,640	697,459
2006-07	538,350	113,502	18,802	670,654	81,800	752,454
2007-08	585,282	120,387	16,957	722,626	90,477	813,103
2008-09	617,832	113,081	14,713	745,626	95,905	841,531
2009-10	670,965	106,680	18,636	796,281	109,693	905,974
2010-11	704,323	114,257	26,266	844,846	114,224	959,070
2011-12	708,427	130,511	32,287	922,451	128,172	1,050,623
2012-13	817,225	113,720	32,866	963,811	148,000	1,111,811
2013-14(p)	853,683	134,731	34,200	1,022,614	156,642	1,179,256
Growth rate of 2013-14 over 2012-13(%)	4.46	18.48	4.06	6.10	5.84	6.07
CAGR 2005-06 to 2013-14(%)	6.01	3.20	7.85	5.65	8.75	6.01

* From 1995-96 onwards, Thermal includes Renewable Energy Sources also.

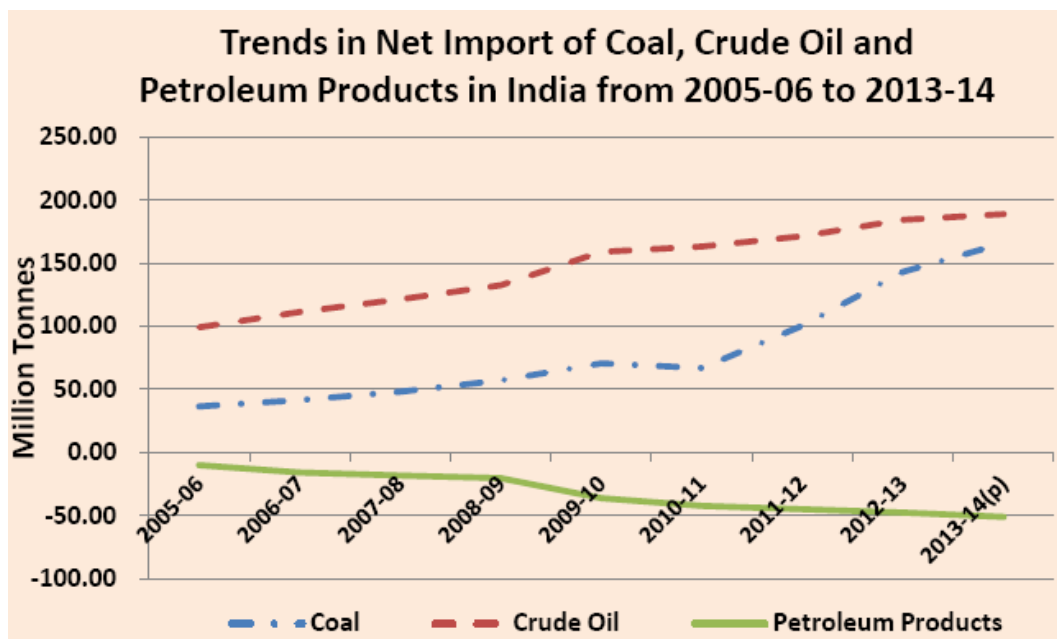
Source : Central Electricity Authority.

16.19 Foreign Trade in Energy Products : The average quality of the Indian coal is not very high and this necessitates the import of high quality coal to meet the requirements of steel plants. There has been an increasing trend in the import of coal. Net Import of coal has steadily increased from 36.60 MTs during 2005-06 to 166.29 MTs during 2013-14. During the said period, the quantum of coal exported increased from 1.99 MTs during 2005-06 to 2.15 MTs during 2013-14. There is growth rate of 15.54% of gross import and 16.01% in net imports of coal in 2013-14 over the previous year. However there was decrease of 11.87% in export of coal during the same period.

16.20 India is highly dependent on import of crude oil. Net imports of crude oil have increased from 99.41MTs during 2005-06 to 189.24 MTs during 2013-14. There has been an increase of 2.41% in the net imports of crude oil during 2013-14 over 2012-13, as the net import increased from 184.80 MTs to 189.24 MTs.

16.21 Although more than 70% of its crude oil requirements and part of the petroleum products is met from imports, India has developed sufficient processing capacity over the years to produce different petroleum products so as to become a net exporter of petroleum products. The export of petroleum product has increased from 23.46 MT during 2005-06 to 67.86 MTs during 2013-14. During 2013-14 exports recorded an

increase of 7.02% from previous year. The import of petroleum products has increased from 13.44 MT in 2005-06 to 16.72 MT during 2013-14, although there are some fluctuations in the trend



16.22 Consumption: The estimated total consumption of raw coal by industry has increased from 407.04 MTs during 2005-06 to 571.89 MTs during 2013-14 with a CAGR of 3.85%. The annual growth rate from 2012-13 to 2013-14 is 0.76%. Electricity generation is the biggest consumer of coal, followed by steel industries. Industry-wise estimates of consumption of coal shows that during 2013-14 electricity generating units consumed 427.23 MTs of coal, followed by steel & washery industries (23.13 MTs), cement industries(11.96 MTs) and paper industries (1.67 MTs).

16.23 Consumption of Lignite increased from 30.23 MTs in 2005-06 to 43.90 MTs in 2013-14 registering a compound growth of 4.23%. Consumption of Lignite is highest in Electricity Generation sector, accounting for about 83.09% of the total lignite consumption.

16.24 The estimated consumption of crude oil has a steady increase, from 130.11 MMTs during 2005-06 to 222.50 MMTs during 2013-14 with CAGR of 6.14%. During the same period consumption of natural gas increased at CAGR of 1.12% from 31.11 billion cubic metres to 34.64 billion cubic metres. The consumption of crude oil and natural gas during 2012-13 was 219.21 MMTs and 39.78 billion cubic metres respectively. The maximum use of Natural Gas is in fertilizers industry (32.56%) followed by power generation (31.02%) and 8.60% natural gas was used for domestic fuel. Industry wise off-take of natural gas shows that natural gas has been used both for Energy (59.42%) and Non-energy (40.58%) purposes.

16.25 High speed diesel oil accounted for 38.83% of total consumption of all types of petroleum products in 2013-14. This was followed by Refinery (10.15%), Petrol (9.73%), LPG (9.28%) and Naphtha (6.50%). Consumption of Light Diesel oil continuously decreased from 2005-06(0.88 MTs) to 2013-14 (0.39 MTs).

16.26 The estimated electricity consumption increased from 4,11,887 GWh during 2005-06 to 882,592 GWh during 2013-14, showing a CAGR of 8.84%. The increase in electricity consumption is 7.07% from 2012-13 (824,301GWh) to 2013-14 .Of the total consumption of electricity in 2013-14, industry sector accounted for the largest share (43.83%), followed by domestic (22.46%), agriculture (18.03%) and commercial sectors (8.72%).

Trends in Consumption of Conventional Sources of Energy in India

Year	Coal #	Lignite	Crude Oil**	Natural Gas ***	Electricity* (GWh)
	(Million Tons)		(MMT)	(Billion Cubic Metres)	
1	2	3	4	5	6
2005-06	407.04	30.23	130.11	31.33	411,887
2006-07	430.83	31.29	146.55	30.79	455,748
2007-08	457.08	33.98	156.10	31.48	510,899
2008-09	492.76	32.42	160.77	31.75	562,888
2009-10	532.04	34.07	192.77	46.52	620,251
2010-11	532.69	37.73	196.99	51.25	684,324
2011-12	535.88	41.88	204.12	46.48	755,847
2012-13	567.60	46.31	219.21	39.78	912,057
2013-14(p)	571.89	43.90	222.50	34.64	967,150
Growth rate of 2013-14 over 2012-13(%)	0.76	-5.22	1.50	-12.93	6.04
CAGR 2005-06 to 2013-14(%)	3.85	4.23	6.14	1.12	9.95

Source : Energy Statistics 2015, MOSPI

*Includes thermal, hydro & nuclear electricity from utilities.

** Crude oil in terms of refinery crude throughput.

Does not include Lignite and imports.

16.27 In India, loss of electricity due to transmission has increased from 17.5 % during 1970-71 to 34% during 2001-02 and decreased on the average (with some fluctuations) thereafter to 30.4 percent in 2005-06, 24.5 % in 2012-13 and 23% in 2013-14(p) . Transmission and distribution losses are much lower in US (6.8%), China (6.5%) etc and even the world average (9.8%) is much lower compared to India as per the available data for 2010.

16.28 Sources of Energy Statistics :

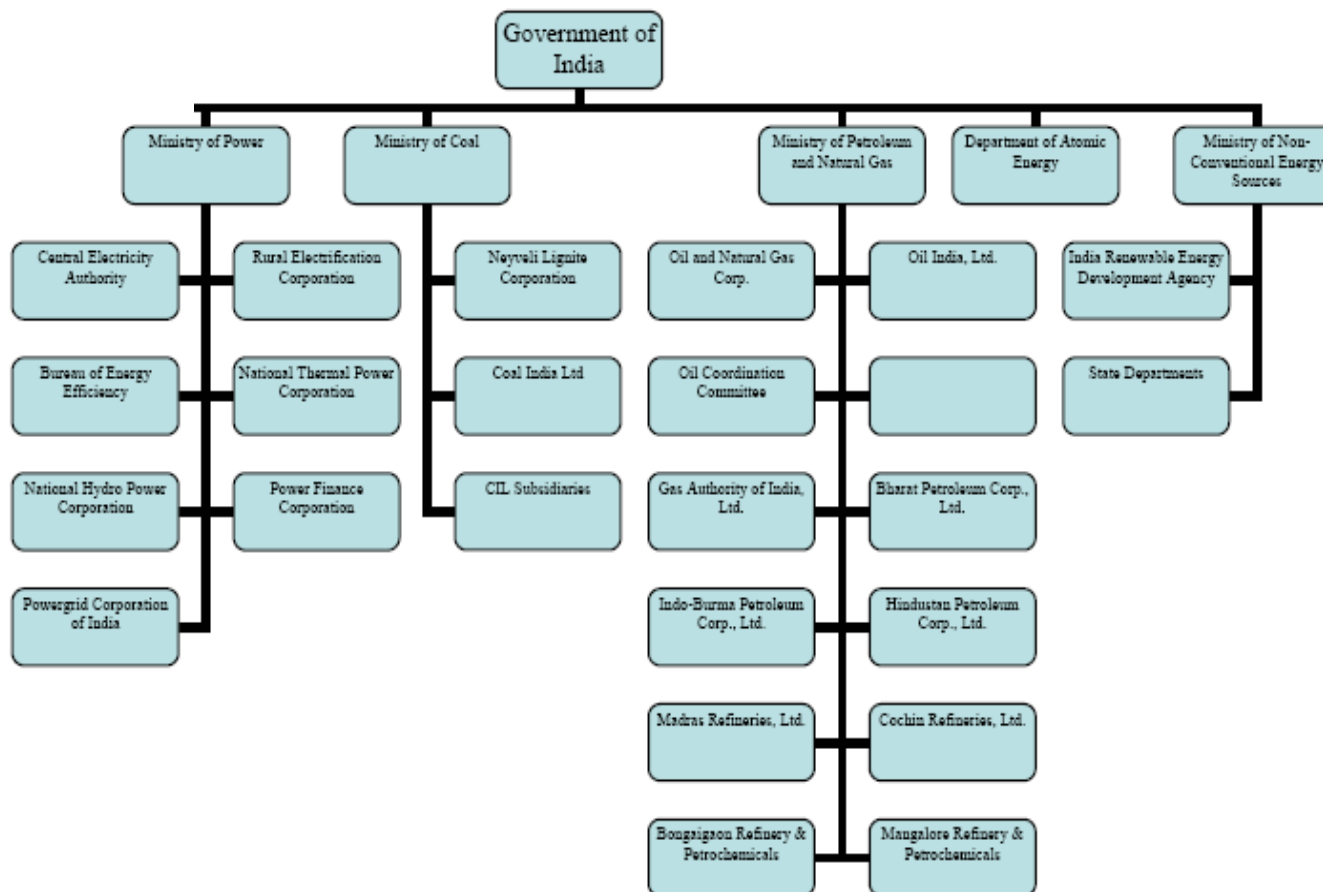
- Depending upon the fuels , the information relating to energy scenario(production, reserve, off take/consumption etc) in India is provided by variety of organizations ranging from **M/o Petroleum & Natural Gas** to **O/o Coal Controller, Ministry of Mines** to **Department of Atomic Energy & Ministry of New & Renewable Energy**.
- Information on Electricity generation, transmission & distribution along with rural electrification is maintained by **Central Electricity Authority, Ministry of Power** .
- **Central Statistics Office, Ministry of Statistics & PI** brings out a publication Energy Statistics **which** draws information from various source agencies and provides a comprehensive report on the subject.
- Various Surveys conducted by **National Sample Survey Office , MOSPI** also provide information on the usage of energy by households for lighting , cooking etc providing an idea about penetration and expenditure besides the coverage / extent of use of different modes by households also being covered by decennial Population Census conducted by **O/o Registrar General, Ministry of Home Affairs**

Terms & Definitions:

16.29 The Definitions of the terms in this chapter are as follows:

- **Hard Coal:** Coal has a high degree of coalification with a gross calorific value over 24 MJ/Kg (5700 Kcal/kg) on an ash-free but moist basis. Included are fines, middling, slurry produced in the installations at pitheads.
- **Lignite :** Brown coal is a coal with low degree of coalification . Its gross calorific value is 5,700 K.cal./kg or less on an ash-free but moist basis.
- **Coke:** The solid product obtained from carbonization of coal or lignite at high temperature.
- **Crude petroleum:** Data for crude petroleum include shale oil and field condensate but exclude natural gas liquids from plants and oils obtained from the distillation of solid fuels.

Structure of Central Energy Sector Institutions



- **Liquefied petroleum gases:** include (i) hydrocarbons extracted by stripping natural gas at crude petroleum and natural gas sources; (ii) hydrocarbons extracted by stripping of imported natural gas in installations of the importing country; and (iii) hydrocarbons produced both in refineries and outside refineries in the course of processing of crude petroleum or its derivatives. Included are mainly propane, butane, isobutene and ethane.
- **Motor gasoline:** comprises of a mixture of relatively volatile hydrocarbons with or without small quantities of additives, which have been blended to form a fuel suitable for use in spark-ignition internal combustion engines. Natural gasoline, aviation gasoline and naphtha's are excluded.
- **Naphtha's:** are refined or partly refined light which are to be further blended or mixed with other materials to make high grade motor gasoline or jet fuel, or to be used as raw materials for town gas or feed stocks to make various kinds of chemical products, or to be used as various solvents, depending on the character of naphtha's derived and the demands of various industries.
- **Kerosene:** It is used as an illuminate and as a fuel in certain types of spark-ignition engines such as those used for agricultural tractors and stationary engines. The data include those products; commonly named as burning oil, vaporizing oil, power kerosene and illuminating oil. Jet fuel, white spirit and naphtha's are excluded.
- **Jet fuels:** comprise of fuel meeting of the required properties for use in jet engines and aircraft-turbine engines, mainly refined from kerosene. Gasoline-type jet fuel (light hydrocarbons, also naphtha's type, intended for use in aviation gas-turbine units as opposed to piston power units) is included.
- **Lubricants:** They are heavy liquid distillates obtained by refining crude petroleum and are used for lubricating purposes. They may be produced either from petroleum distillates or residues at refineries. Solid lubricants (e.g. grease) are excluded.
- **Petroleum coke:** is a solid residue consisting mainly of carbon, obtained by the distillation of heavier petroleum oils; used mainly in metallurgical process (excluding those solid residues obtained from carbonization of coal).
- **Bitumen (Asphalt):** is a brown to black solid or semi-solid material obtained as a residue in the distillation of crude petroleum. It is used mainly in road construction. Natural asphalt is excluded.
- **Natural Gas:** is a mixture of hydrocarbon compounds and small quantities of non hydrocarbons existing in the gaseous phase, or in solution with oil in natural underground reservoirs. It may be sub-classified as associated gas (that originating from fields producing both liquid and gaseous hydrocarbons), dissolved gas, or non- associated gas (that originating from fields producing only hydrocarbons in gaseous form). Included are methane (CH₄) recovered from coal mines, sewage gas and natural gas liquefied for transportation. Excluded, however, are gases used for re- pressuring and reinjection, as well as gas flared, vented or otherwise wasted, and shrinkage accruing to processing for the extraction of natural gas liquids.
- **Coke Oven Gas:** It is a by-product of the carbonization process in the production of coke in coke ovens.

- **Bio Gas:** It is a by-product of the fermentation of biomass, principally animal wastes by bacteria. It consists mainly of methane gas and carbon dioxide.
- **Installed capacity:** The net capacity measured at the terminals of the stations, i.e., after deduction of the power absorbed by the auxiliary installations and the losses in the station transformers.
- **Utilities:** undertakings of which the essential purpose is the production, transmission and distribution of electric energy. These may be private companies, cooperative organisations, local or regional authorities, nationalised undertakings or governmental organisations.
- **Hydro Electricity:** as energy value of electricity is obtained by dividing the electricity generation by the average efficiency of all hydro-power stations.
- **Thermal Electricity:** comprises conventional thermal plants of all types, whether or not equipped for the combined generation of heat and electric energy. Accordingly, they include steam-operated generating plants, with condensation (with or without extraction) or with back-pressure turbines, and plants using internal combustion engines or gas turbines whether or not these are equipped for heat recovery.
- **Nuclear Electricity:** is defined as the heat released by the reactors during the accounting period and is obtained by dividing the generation of nuclear electricity by average efficiency of all nuclear power stations.
- **Production:** comprises gross production, i.e. the amount of electric energy produced, including that consumed by station auxiliaries and any losses in the transformers that are considered integral parts of the station. Included is the total production of electric energy produced by pump storage installations.
- **Imports:** refer to the amounts of electric energy transferred to the countries concerned, which are measured at the metering points on the lines crossing the frontiers. Included are imports of electric energy made by means of high voltage lines crossing frontiers as well as imports of electric energy made by means of low-voltage lines for use in the immediate vicinity of the frontier, if the quantities so transferred are known.
- **Exports:** refer to the amounts of electric energy transferred from the countries concerned, which are measured at the metering points on the lines crossing the frontiers. Included are exports of electric energy made by means of high voltage lines crossing frontiers as well as exports of electric energy made by means of low voltage lines for use in the immediate vicinity of the frontier, if the quantities so transferred are known
- **Per-capita Energy Consumption (PEC):** PEC during a year is computed as the ratio of the
 - estimate of total energy consumption during the year to the estimated mid-year population of that year.
- **Energy Intensity:** It is defined as the amount of energy consumed for generating one unit of Gross Domestic Product (At constant prices).

16.30 In the absence of data on consumption of non-conventional energy from various sources, particularly in rural areas in the developing countries, including India, PEC &

Energy Intensity are generally computed on the basis of consumption of conventional energy.

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