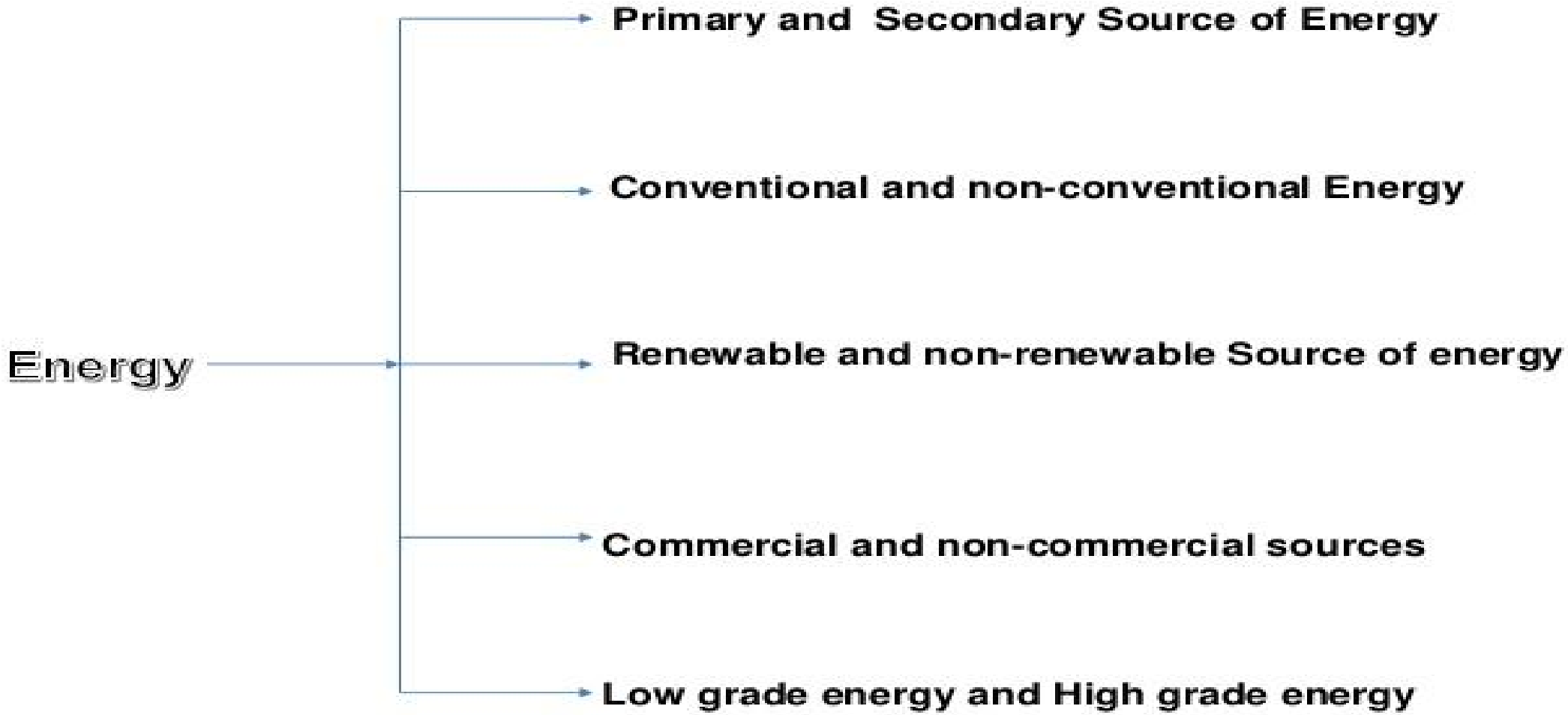
Indian Energy Scenario

INTRODUCTION TO ENERGY

- Energy is commonly defined as the ability or capacity to do any work.
- According to thermal aspect energy means the ability of generating the heat ,like burning a fuel.
- Earlier muscular power was considered as source of internal energy.
- And the solar energy and energy stored in flowing water was considered as source of external energy

Classification Of Energy



Primary or Secondary Source of Energy

PRIMARY SOURCE OF ENERGY

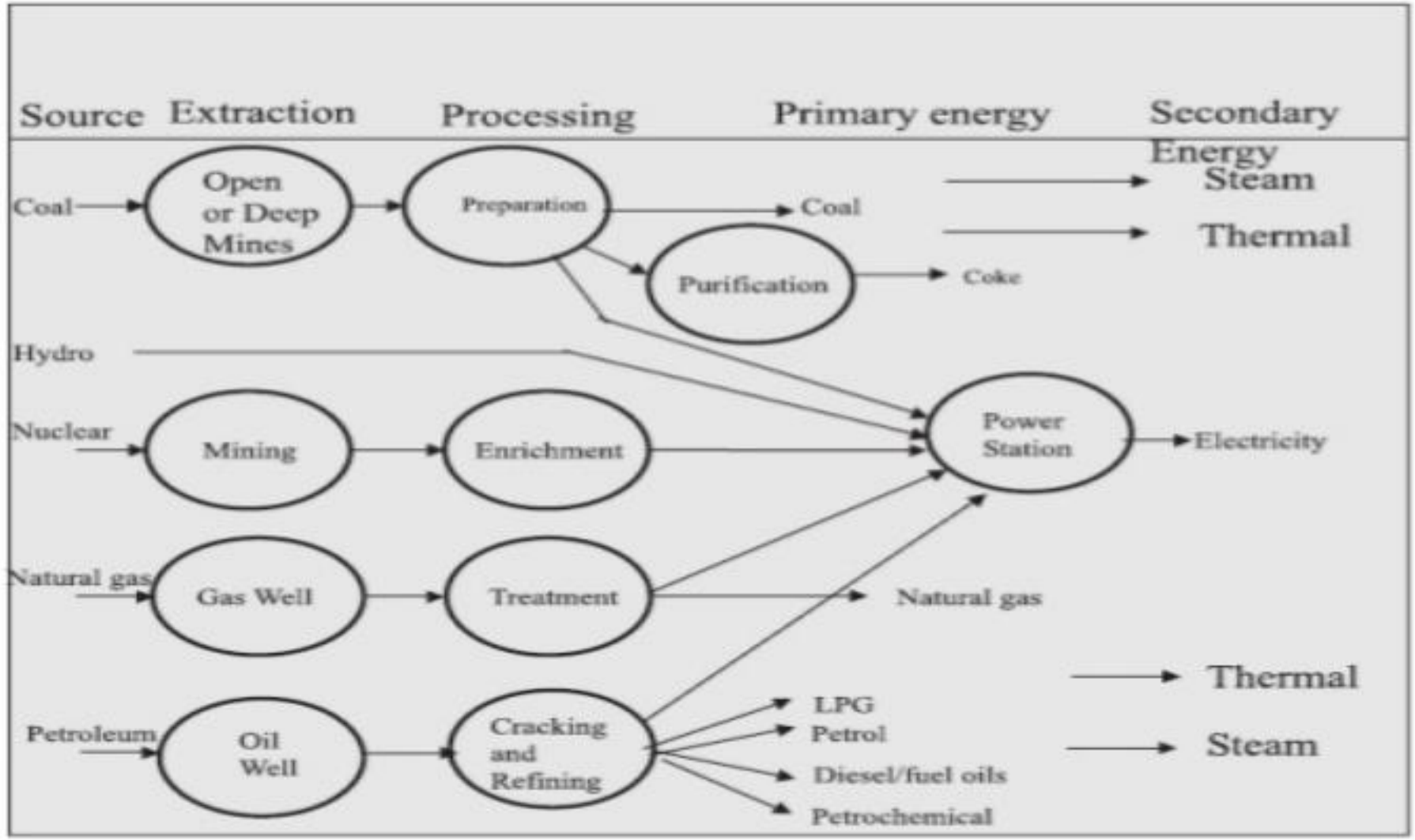
- Primary sources can be used directly, as they appear in the natural environment.Such kind of sources has not undergone any transformation or conversion other than **separating and cleaning**
- E.g. Coal, oil, natural gas and wood, nuclear fuels (uranium), the sun, the wind, tides, mountain lakes and the Earth heat that supplies geothermal energy.
- Thus the primary energy sources are those that are either found or stored in nature.
- Primary energy sources are mostly converted in industrial utilities into secondary energy sources
- For ex. Coal,oil or gas converted into steam and electricity
- But primary energy sources can also be used directly e.g coal used for cooking

SECONDARY SOURCE OF ENERGY

- Secondary sources **derive from the transformation** of primary energy sources

- for example petrol, that derives from the treatment of crude oil and electric energy, obtained from the conversion of mechanical energy, chemical plants , or nuclear plants.

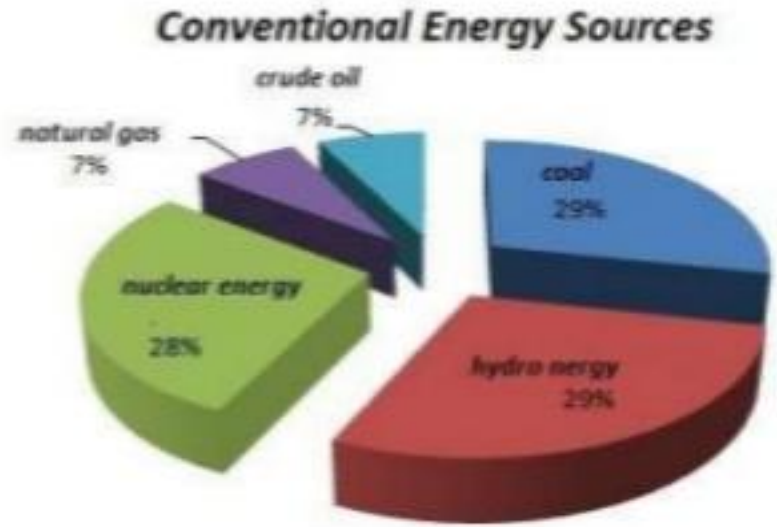
- Electric energy is produced by electric plants, i.e. suitable installations that can transform primary energy (non-transformed) into electric energy


Source
Extraction
Processing
Primary energy
Secondary Energy
Coal
Open or Deep Mines
Preparation
Coal
Purification
Coke
Steam
Thermal
Hydro
Nuclear
Mining
Enrichment
Power Station
Electricity
Natural gas
Gas Well
Treatment
Natural gas
Thermal
Petroleum
Oil Well
Cracking and Refining
LPG
Petrol
Diesel/fuel oils
Petrochemical
Steam

Conventional and non-conventional energy

CONVENTIONAL SOURCE OF ENERGY

- Conventional sources of energy is, "Energy sources which cannot be compensated once they are used".
- Fossil fuels are major sources of conventional energy. They cannot be replenished once they are consumed.
- The coal, petroleum, natural gas and electricity are conventional sources ofenergy.



- Their use leads to increased greenhouse gas emissions and other environmental damage.
- These conventional energy sources are pollutant in nature which leads to many climate problem like Global warming, Acid rain, Climate change etc.

NON-CONVENTIONAL SOURCE OF ENERGY

The energy resources which are inexhaustible are called as non conventional energy source

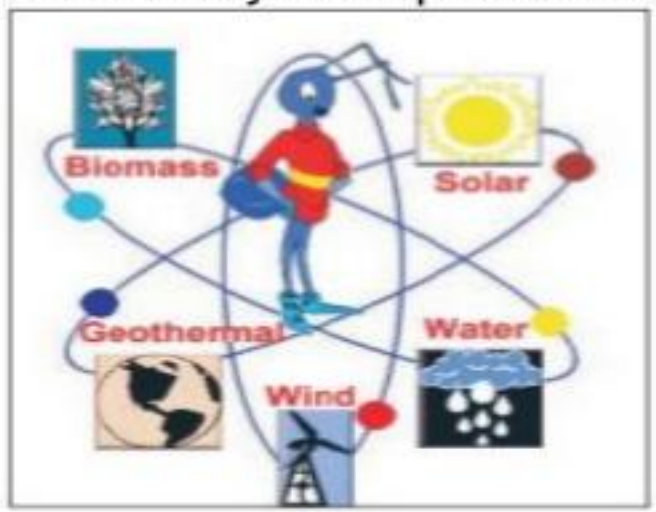
Energy generated by using wind, tides, solar, geothermal heat, and biomass including farm and animal waste is known as **non-conventional energy**.

All these **sources** are renewable or inexhaustible and do not cause environmental pollution and are ecofriendly

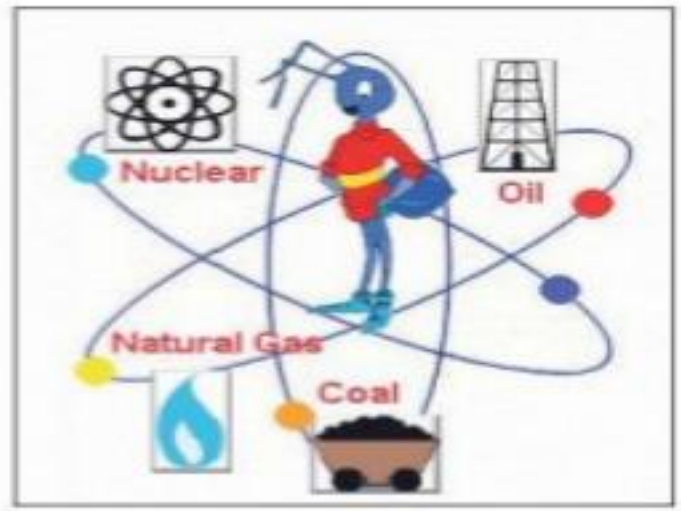
Renewable and non renewable sources of energy

Renewable energy is energy obtained from sources that are essentially inexhaustible. Examples of renewable resources include wind power, solar power, geothermal energy, tidal power and hydroelectric power. The most important feature of renewable energy is that it can be harnessed without the release of harmful pollutants.

Non-renewable energy is the conventional fossil fuels such as coal, oil and gas, which are likely to deplete with time.



Renewable



Non-Renewable

Commercial and non commercial sources

Commercial Energy

- The energy sources that are available in the market for a definite price are known as commercial energy.

- The most important forms of commercial energy are electricity, coal and refined petroleum products

.

- Commercial energy forms the basis of industrial, agricultural, transport and commercial development in the modern world.

- In the industrialized countries, commercialized fuels are predominant source not only for economic production, but also for many household tasks of general population.

Examples: Electricity, lignite, coal, oil, natural gas etc.

Non-Commercial Energy

The energy sources that are not available in the commercial market for a price are classified as non-commercial energy.

Non-commercial energy sources include fuels such as firewood, cattle dung and agricultural wastes, which are traditionally gathered, and not bought at a price used especially in rural households. These are also called traditional fuels.

Example:

- Firewood, agro waste in rural areas;
- solar energy for water heating, electricity generation, for drying grain, fish and fruits;
- animal power for transport, threshing, lifting water for irrigation, crushing sugarcane;
- wind energy for lifting water and electricity generation.

Low grade energy & High grade energy

Low grade energy

- Energy of which only a certain portion can be converted into mechanical work is called low grade energy.
- Thus it is not possible to convert energy source easily and completely into another form of energy.
- For example coal is low grade energy as its only 30% can be converted into electricity with requirement of huge setups.
- It is available at cheaper rate.

Other Examples of Low grade energy are:

- Heat or Thermal Energy
- Heat derived from combustion of fossil fuels
- Heat derived from nuclear fission or fusion.

High grade energy

- Energy that can be completely transformed or converted into work or other forms of energy without any loss i.e. fully utilizable. Are called as high grade energy
- For example. Electrical energy because it is very easy to convert almost all of it into other form by using an electrical heater,mobile battery charging,A.C.,etc
- High grade energy are expensive

Other Examples of high grade energy are:

1. Mechanical work
2. Water Power
3. Wind Power
4. Tidal Power

Global primary energy consumption

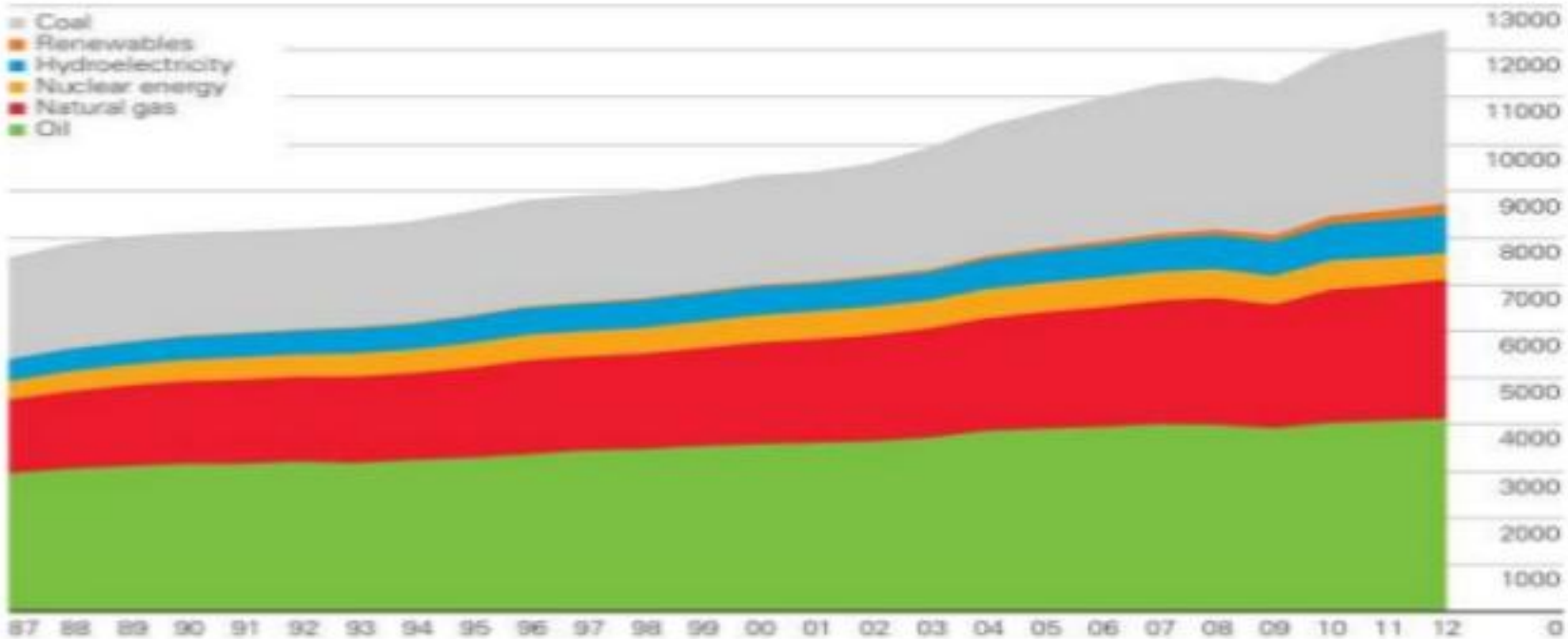
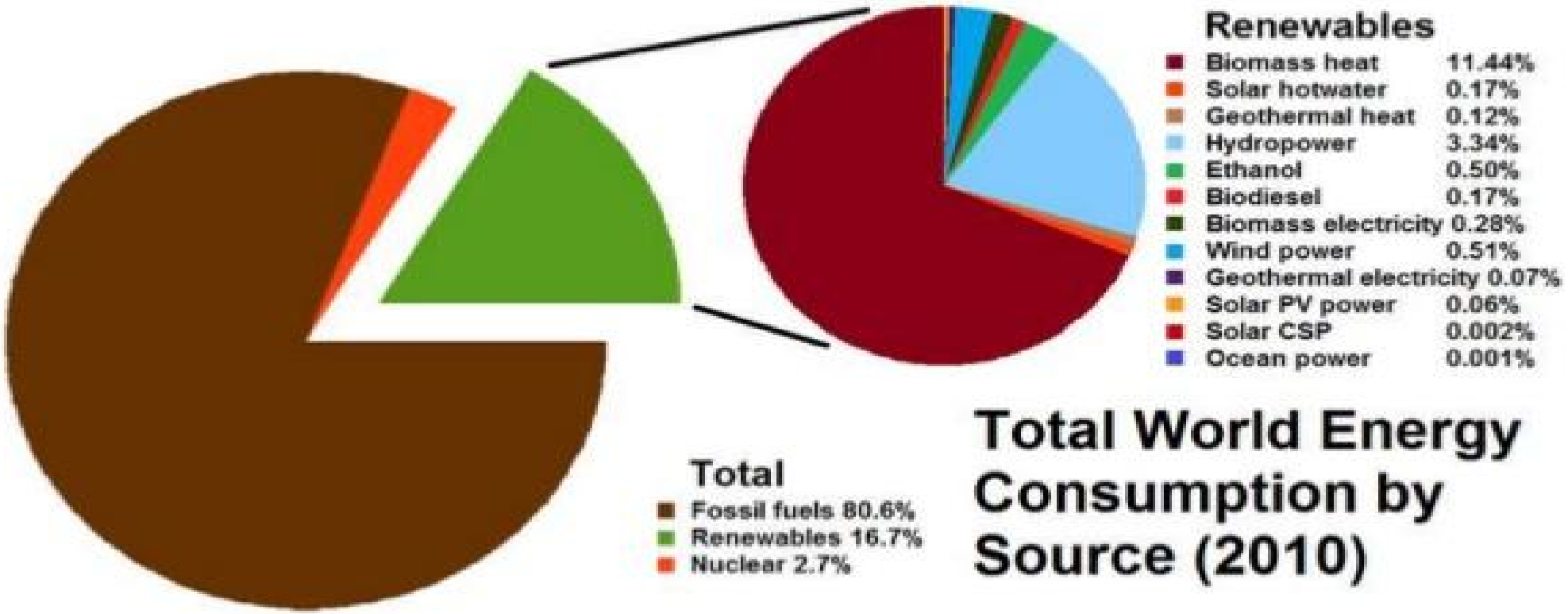


Fig. Primary Energy World Consumption (courtesy BP 2013)(MTOE)

The global energy consumption at the end of 2013 was equivalent to 9741 Million Tones of Oil Equivalent (MTOE) in which oil accounting for 33.1% and coal 30.3% of global energy consumption.

The ***developed countries*** attributable to ***high energy consumption*** as comparing developing countries

Global Primary Energy Consumption



- Fossil fuels constitute most of the energy we use. Only 16.7% of the total energy is renewable energy.

Region wise consumption

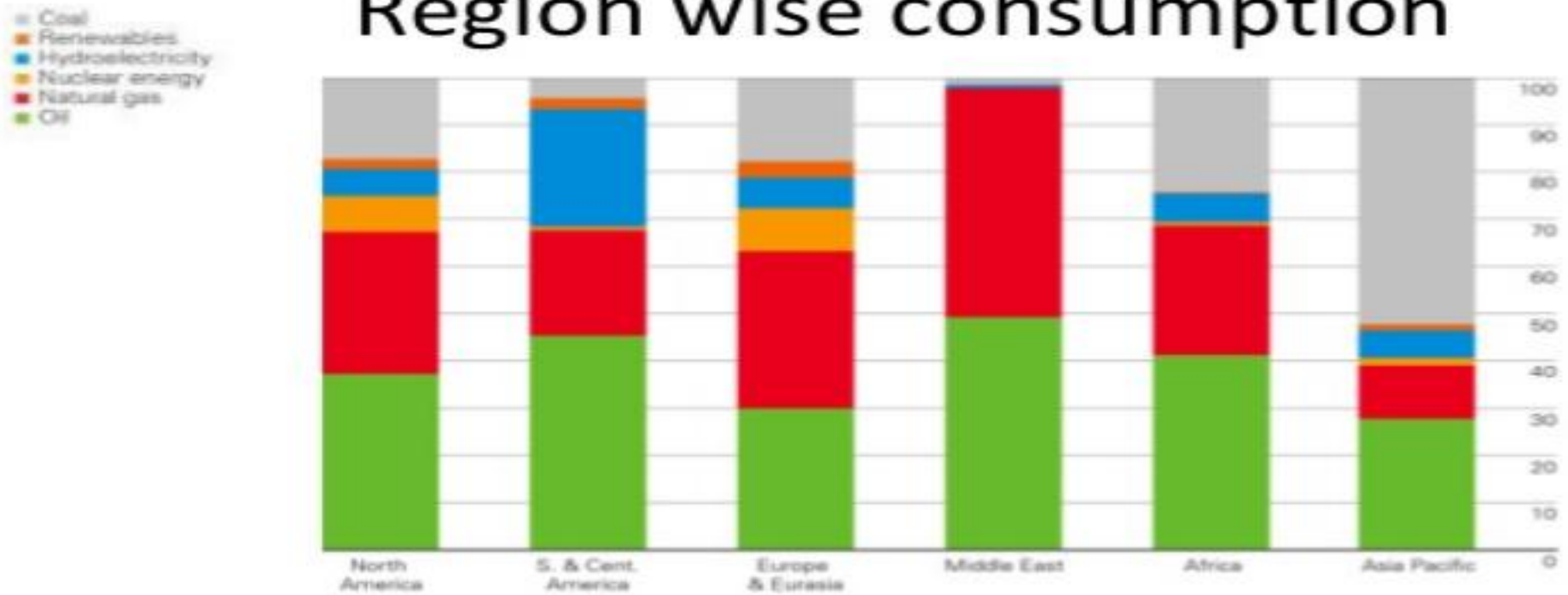


Fig. Primary energy regional consumption pattern 2012 (courtesy BP 2013) (Percentage)

From graph we can conclude that Asia Pacific region is the world's largest energy consumer,accounting 39.1% of global energy consumption and 68.6% of global coal consumption

Commercial energy production

- The modal mix of power generation in future and requirement of primary energy for same will depend on the level of development of the modes in the coming years,the increase in efficiency of power generation,transmission and distribution and end use.

- The production of various forms of energy particulary coal and electricity is assumed on basis of growth achieved in respective sectors during the period. The assumptions for primary commercial energy production in india is given below in table

Assumptions for Primary Commercial Energy Production in India				
Energy Forms	**1994-95**	**2001-02**	**2006-07**	**2011-12**
Hydro Capacity (MW)	20837	31456	34918	38380
Nuclear Capacity (MW)	2225	3105	4105	5105
Wind Generation (GWH)	182	1150	1900	2700
Solar Generation (GWH)	-	30	60	120
Crude Oil (MMT)	32.2	37	40	45
Natural Gas (MCM)*	17339	29165	33915	38665
Coal (MMT)	253.7	370.6	498.9	67108
Lignite (MMT)	19.1	46.1	61	75

FINAL ENERGY CONSUMPTION

- Final energy consumption is the actual energy demand at the userend.
- This is the difference between primary energy consumption and the losses that takes place in transport ,transmission and distribution and refinement.
- The actual final energy consumption is given table.

Projected Demand for Final Consumption of Commercial Energy in India

Energy Forms	1994-95	2001-02	2006-07	2011-12
Electricity (Bkwh)	289.4	496.1	756.2	1150.2
Petroleum Pdt. (MMT)	63.8	104.9	153	226.3
Coal (MMT)*	79.6	114	140	179.5
Natural Gas (MCM)*	12110	15730	18291	20853
Lignite (MMT)	4.85	11.69	16.02	19.70

INDIAN ENERGY SCENARIO

- India's energy scenario is constrained by country's energy resources and import possibilities. unfortunately, India is not well endowed with natural energy resources.
- Reserves of oil gas and uranium are meager through India has large reserves of thorium.

1. COAL:-

- It is the most important and abundant fossil fuel in India. It accounts for 55% of the country's energy need.

- Commercial primary energy consumption in india has grown by about 700% in the last decades.

- Indian coal offers a unique eco-friendly fuel source for the domestic energy market for the next country and beyond.

- Hard coal deposits, spread over 27 major coalfields, are mainly confined to eastern and south central parts of Indian.

- Lignite reserves stand at around 36 billion tones, of which 90% occur in the southern state of Tamil nadu.

- Coal powered thermal power plant accounted for 92418MW as of february,2011 indicating that most of India's electricity needs are dependent on coal.

2.PETROLIUM OIL:-

- India has total reserves of 1201 million metric tons of crude oil. crude oil production during 2009-10 at 33.69 million metric tons was 0.55% higher than the 33.51 million metric tons produced during 2008-09.

- The consumption of petroleum product during 2009-10 was 138.196 million metric tons which is 3.60% higher than the sales of 133.400 million metric tons during 2008-09.

- Due to rapid growth of automobile sector the demand for petrolium products will witness a growth in demand and it is expected to rise to more than 240 million metric tons by 2021-22 which will further increase to around 465 million metric tons by 2031-32 considering a high output growth.

3.NATURAL GAS:-

- India has total reserves of 437 billion cubic meters of natural gas as of 1st april 2010.

- gross production of natural gas in the country at 47.51 billion cubic meters during 2009-10 was 44.635 higher than the production of 32.85 billion cubic meter during 2008-09.

- The total installed capacity of gas fired plants as of February 2011 stood at 17706MW.

- Natural gas can replace existing fuels in various sectors both for feedstock as well as for energy purposes.

4.NUCLEAR ENERGY:-

- Nuclear power is the fourth-largest source of electricity in india after thermal, hydroelectric and renewable sources of electricity.

- As of 2010, India has 20 nuclear reactors in operation in six nuclear power plants, generating 4780MW while 5 other plants are under construction and are expected to generate an 2720MW.

- India's nuclear power industry is undergoing rapid expansion with plans to increase nuclear power output to 64,000MW by 2032.

5.HYDRO POWER:-

- The estimated potential for power generation in India from hydro plants is about 15000MW from 5718 identified sites.

- In order to accelerate the pace of hydro development, both public and private sector participation for commercial projects and decentralized micro hydro for remote village electrification are being encouraged.

- Attention is being focused on states with maximum hydro potential and improving environment policies to attract private sector investments.

6.SOLAR POWER:-

- Among the various renewable energy resources, india possesses a very large solar energy potential; most parts of the country are blessed with good amounts of sunshine.

- There are about 300 clear sunny days in a year in most parts of country.
- the average solar radiation incident over the Indian land area is estimated to be about 5000 trillion kwh/year.
-
- The Jawaharlal Nehru national solar mission was launched by the prime minister of India in January 2010,with a target of 20,000MW grid solar powers.

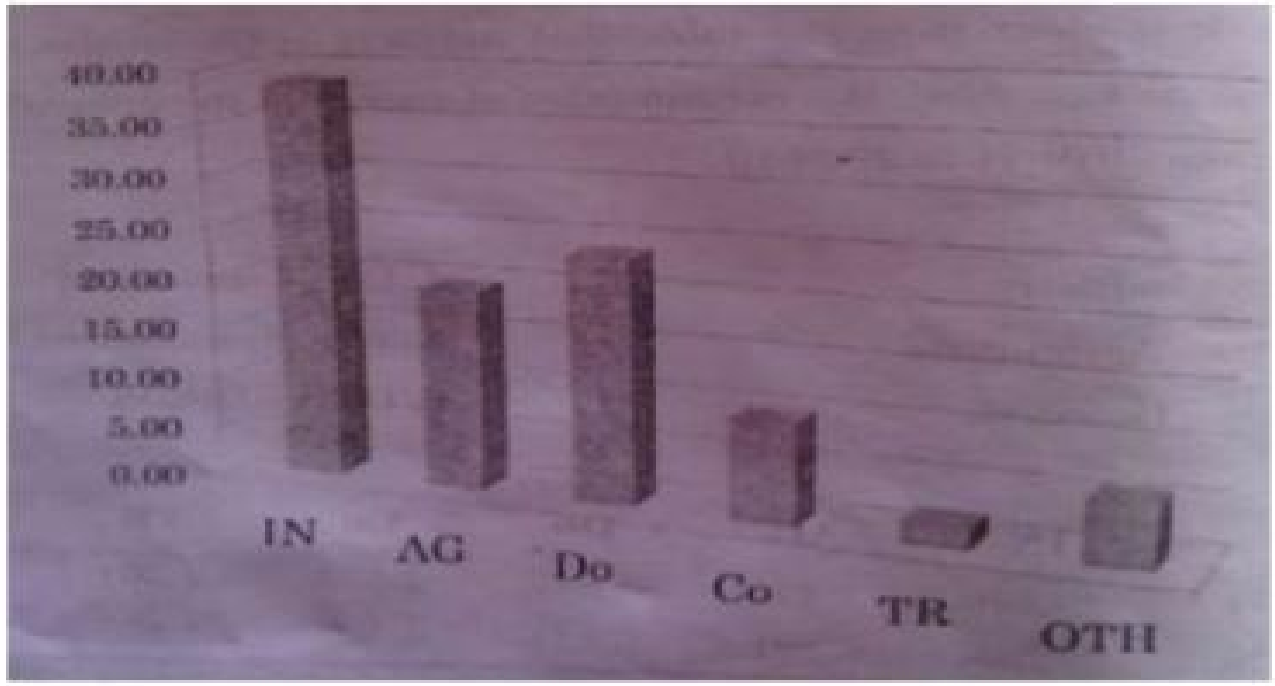
SECTORIAL ENERGY CONSUMPTION

- The major commercial energy consuming sectors in the country is given in the table. it is clear from table that industry is the biggest consumer of commercial energy.

1. IN Industry
2. AG Agriculture
3. Do Domestic
4. Co Commercial
5. TR Traction and Railways
6. OTH Others

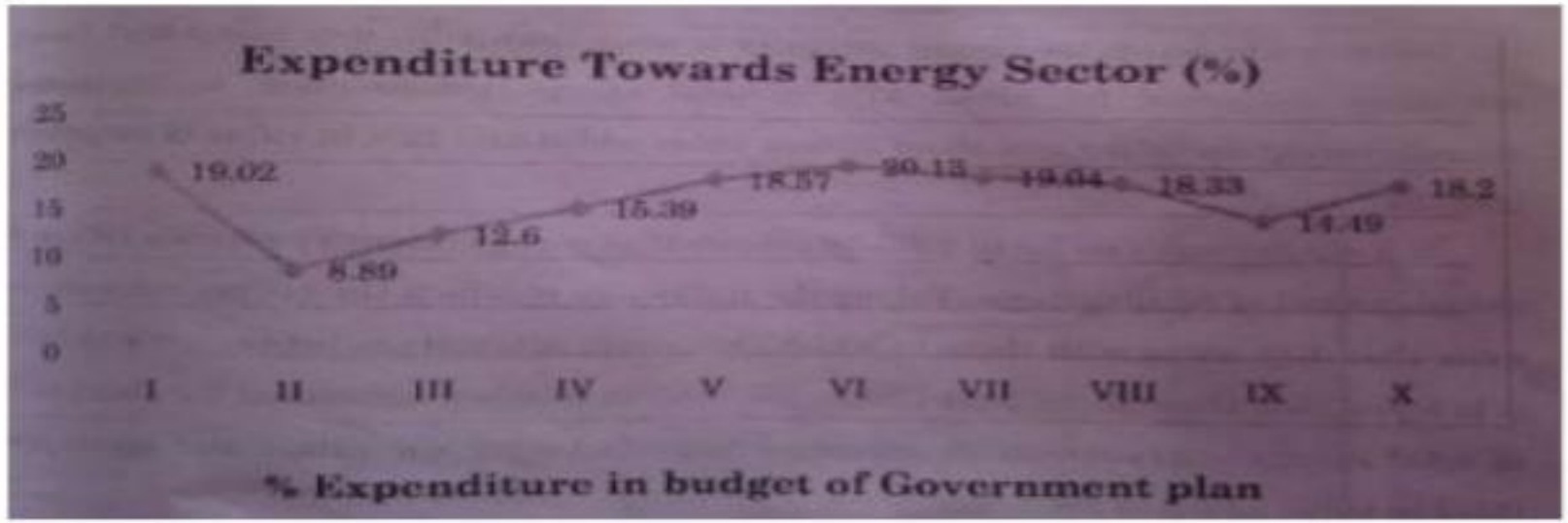
	IN	AG	Do	Co	TR	OTH	Total
1970-71	28,579	1,170	3,810	2,573	1,994	1,899	39,725
1975-76	37,548	3,723	5,821	3,072	1,855	2,774	60,246
1980-81	48,069	11,189	9,245	4,682	2,266	3,615	82,967
1985-86	66,980	21,422	17,258	7,280	3,182	4,967	123,089
1990-91	84,209	50,321	31,982	11,181	4,112	8,552	190,357
1995-96	104,683	85,733	51,733	16,696	6,223	11,652	277,029
2000-01	107,622	84,729	75,629	22,545	8,213	17,862	316,600
2005-06	151,557	90,292	100,090	35,965	9,944	24,039	411,887
2006-07	171,293	98,923	111,002	40,220	10,800	23,411	455,749
2007-08	189,424	104,182	120,918	46,685	11,108	29,660	501,977
2008-09	209,474	109,610	131,720	54,189	11,425	37,577	553,985
2009-10*	236,752	120,209	146,090	60,600	12,408	36,585	612,644
Growth rate%	13.02	9.67	10.90	11.83	8.60	-2.61	10.59

- The following chart shows the% age of each sector in year 2009-10.here major consumption is in the industrial sector, while domestic sector holds the second position.



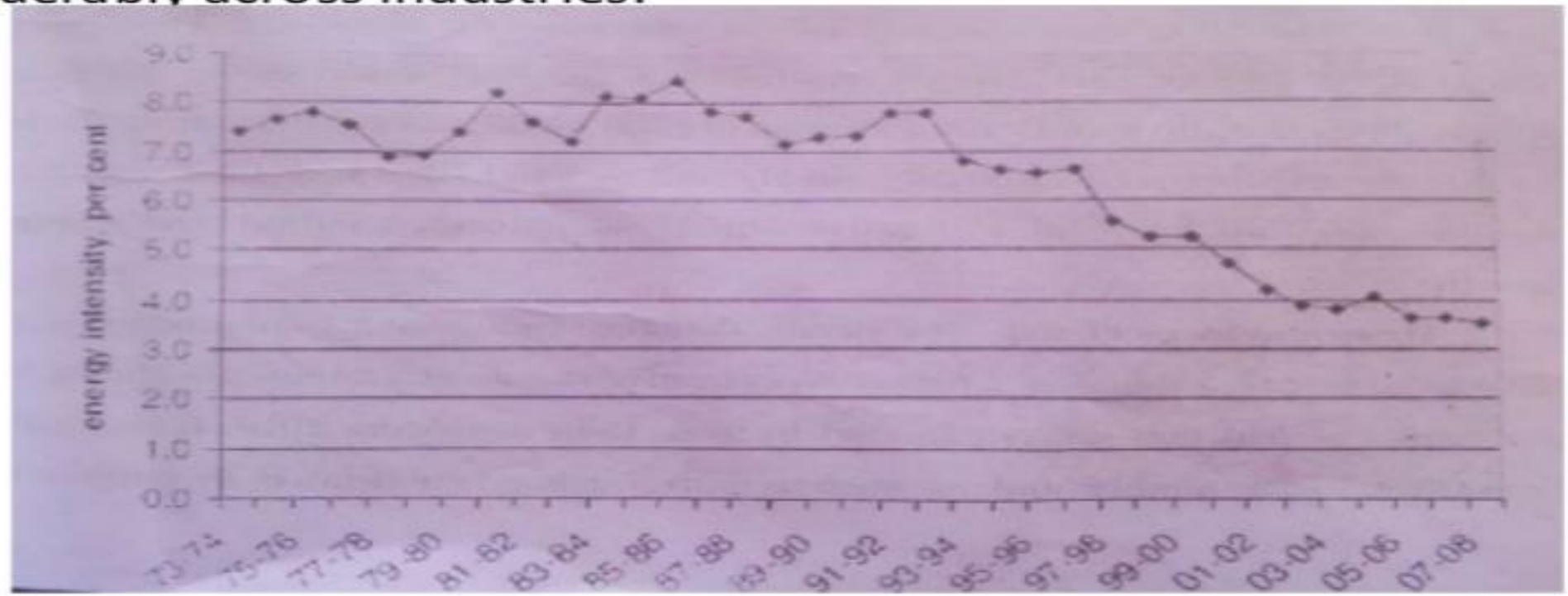
ENERGY NEEDS OF GROWING ECONOMY

- For growing economy, the need of electricity is very crucial.electricity plays very important role in growth of country.
- Although the overall growth of the country and need of electricity does not have any linear relationship, electricity is working as driving force.



ENERGY INTENSITY

- Energy intensity indicates the development stage of country. energy intensity is defined as the ratio of energy cost to the value of output.
- it is also defined as energy consumption per unit of GDP.it varies considerably across industries.



Bureau of Energy Efficiency (BEE)

- BEE was set up in March 2002 under the provisions of Energy Conservation Act of 2001 to provide a legal framework for the government's energy efficiency initiatives in the country.
- The Bureau's mission is to develop policies and strategies with a thrust on self regulation and market principles with the primary objective of reducing energy intensity of the Indian economy.
- The above objective can be achieved only with the active participation of all stakeholder.

Bureau of Energy Efficiency (BEE)
Primary Objectives

- To provide policy framework and direction to national energy efficiency and conservation efforts and programs.
- To establish system and procedure to measure, monitor and verify energy efficient results in individual sectors as well as at national level.
- To take private sector support in implementation of energy conservation act.
- To plan, manage and implement energy conservation programs as expected in energy conservation act.

Bureau of Energy Efficiency (BEE)
Functions

- Arrange and Organize training of personnel and specialist to learn techniques for efficient use of energy and conservation.
- Develop testing and certification procedure and promote testing facilities and strengthen consultancy services.
- Create awareness and spread information.
- Formulate and facilitate implementaion of pilot(small) project and demonstration project.
- Promote innovative financing of energy efficient projects.
- Promote use of energy efficient process, equipment ,device and system.
- Implement international co-operation programs relating to efficient use of energy

Penalties

- Penalty for each offence under the act would be in monetary terms i.e. Rs.10,000 for each offence and Rs.1000 for each day for continued non compliance (failure to act in accordance to a command).
- The initial phase of 5 year is promotional and creating infrastructure for implementation of act. No penalties would be effective during this phase.
- The power to adjudicate(examine) has been vested(given)with state electricity regulatory commission which shall appoint any one of its member to adjudicate the penalty imposed.

Duties of Energy Manager

- He can directly force any consumer to appoint energy manager for efficient use of energy
- May ask to submit the report in the manner and form as prescribed at the end of every financial year to the designated agency.
- He has duties and responsibilities with regard to implementaion of energy cost reduction measures of the company.
- He is in charge of implementation of energy conservation act at the state level.
- He is also responsible for asking an energy audit firm to conduct an energy audit and prepare recommendation on how to reduce energy costs.

Designated Consumer

- Designated Consumer means any consumer notified by the Central government under clause (e) of section14 of the Energy Conservation Act, 2001and for which a target is notified under the Statutory Orders issued by the Government of India from time to time.
- Section 14 clause(e) specify, any user or class of users of energy in the energy intensive industries and other establishments are specified in the Schedule as a designated consumer
- (f) the list of Energy Intensive Industries specified in the Schedule.
- The central government has notified the mandatory energy audit for the designated consumer to help in identifying various energy saving opportunities in energy intensive industries and other establishments.

DesignatedConsumer

As per provision of clause (e) and (f) section 14 of energy conservation act 2001,15 energy intensive sectors are notified as designated consumer as follows:

- Aluminium
- Cement
- Chemical
- Alkali
- Fertilizer
- Iron and steel
- Commercial buildings and establishment
- Petrochemicals, Gas-crackers, Naptha cracker and Petroleum refineries
- Paper and pulp
- Port Trust
- Railways
- Sugar
- Textiles
- Transportation sector
- Thermal power station, Hydel power station, Electricity transmission and distribution companies

Electricity Act 2003

- In August 2001, an electricity bill was introduced by central government
- The bill was debated in the budget session of parliament in 2003 and passed by both the houses
- Afterwards, it was enacted as electricity Act 2003 on June 10,2003
- This act increased competition in the different sector by facilitating open access in transmission and distribution, power trading and allowing setup of captive power plants.
- Open Access is a permission to use the power Lines without any restrictions.
- Electricity Act 2003 is a 134 odd page document with 185 section covering 18 parts.

Previous Electricity Act

- Earlier, the electricity supply industry was governed by three acts namely, the Indian Electricity act 1910, the Electricity (supply) Act 1948 and the Electricity Regulatory commission Act 1998.
- The 1910 E-Act gave the basic framework for the industry and encouraged growth through private license to supply electricity to a specified area.
- The 1948 Act mandated the creation of state electricity boards for managing the supply of electricity in state.
- The 1998 Act created central regulatory commission and gave the legal framework for creating state regulatory commissions.
- Afterwards E-Act 2003 came and replaced all the above law.

Electricity Act 2003 Features

- Thermal generation does not need clearance from CEA except large or inter-state Hydel project
- Setting up captive power generation does not need permission
- Private companies can build transmission lines for captive use or common use.
- Any generating system can get access to a transmission system at a fee.
- Generation companies are free to get distribution license.
- Panchayat can carry out distribution in rural areas.

Electricity Act 2003 Features

- Power trading can be done by authorization of RCs.
- After open access, consumer came in direct relationship with generating company and hence lower costs per unit.
- Strict provision to deal with the power theft.
- An Apellate tribunal was created for disposal of appeals against the decision of CERC and SERCs.

INTEGRATED ENERGY POLICY

- India faces for midable challenges in meeting its energy needs and providing adequate energy of desired quality in various forms to users in a sustainable manner and at reasonable costs.
- India needs to sustain a 8% to 10% economic growth to eradicate poverty and meet its economic & human development goals.
- To deliver a sustained growth of 8% through 2031, India would, in the very least, need to

We briefly look at issues that call for an integrated policy and describe some of the attributes of such a policy.

(a) Relative Prices:-

- Different fuels have different calorific values. Their efficiency in use and convenience also differ. Moreover, they generate different kinds and amounts of pollution. And yet often they are substitutes in specific uses. Their relative prices have to be set in a way that the resulting inter-fuel choices are socially desirable. For this, their marginal use values per rupee of fuel need to be equivalent. Thus e set independently of each other.) prices of different fuels should not be set independently of each other.

(b) Consistent Tax Structure:-

- Relative prices can be affected by taxes and subsidies. Excise and import duties have to be consistent across different fuels. It also requires that taxes on capital goods that use different fuels to produce the same output should be consistent if we desire optimal allocation of resources.

(c) Level Playing Field:-

- All players and energy projects, public or private, large or small, mega projects or micro projects, domestic or foreign should be treated equally if the sector is to be efficient.

(d) Public Infrastructure:-

- Many elements of the energy system constitute public infrastructure with many positive externalities and economies of scale. Some of them are natural monopolies. Ports, roads, rail roads, urban mass transport, etc., play an important role in the energy system. Their development needs to be coordinated and functioning regulated.

(e) Energy for the Poor :-

- Some amount of clean cooking fuels (LPG and Kerosene) and electricity are merit goods justifying subsidies to the poor. These subsidies have to be consistent, progressive and implementable. Also if they could be self-targeting and self-limiting they would be preferable. They relieve, especially for women, drudgery, reduce health impact, increase productivity and enhance livelihood options.

ECBC Code For Building Construction

- The Energy Conservation Building Code was launched by ministry of power, Government of india in may 2007, as a first step towards promoting energy efficiency in the building sector.
- The ECBC was developed by as expert committee, set up by india's bureau of energy efficiency.
- BEE with the support of USAID ECO- III Project is promoting ECBC awareness and voluntary adoption through training and capacity building programs.

The ECBC provides design norms for:-

- Building envelope including thermal performance requirements for walls, roofs and windows;
- Lighting system , including daylighiting,and lamps
- Electrical system and
- Water heating and pumping systems,including requirements for olr hot water systems.

National Action Plan On Climate Change

- India is faced with the challenge of sustaining its economic growth while dealing with the global threat of climate change caused due to greenhouse gas emissions in the atmosphere.
- India needs a national strategy to firstly adapt to climate change and secondly to further enhance the ecological sustainability of indias development path
- To achieve sustainable development path that simultaneously advances economic and environmental objectives .

- National action plan for climate change will be guided by following principles:

1. Protecting the poor and vulnerable sections of society through an inclusive and sustainable development strategy , sensitive to climate change
2. Development appropriate technologies for both adaption and mitigation of greenhouse gases emissions
3. Welcoming international cooperation for research,development sharing and transfer of technologies that facilitates technology

Following are the 8 missions for NAPCCC:

- National Solar Mission
- National Mission for Enhanced Energy Efficiency
- National Mission On Sustainable Habitat
- National Water Mission
- National Mission For Sustaining The Himalayan Ecosystem
- National Mission For a "Green India"
- National Mission For Sustainable Agriculture
- National Mission On Strategic Knowledge For Climate Change

For successfully accomplishment of these missions, development of public awareness is very tidal

Thank You