

MODULE-1

BASIC INTRODUCTION TO ENERGY

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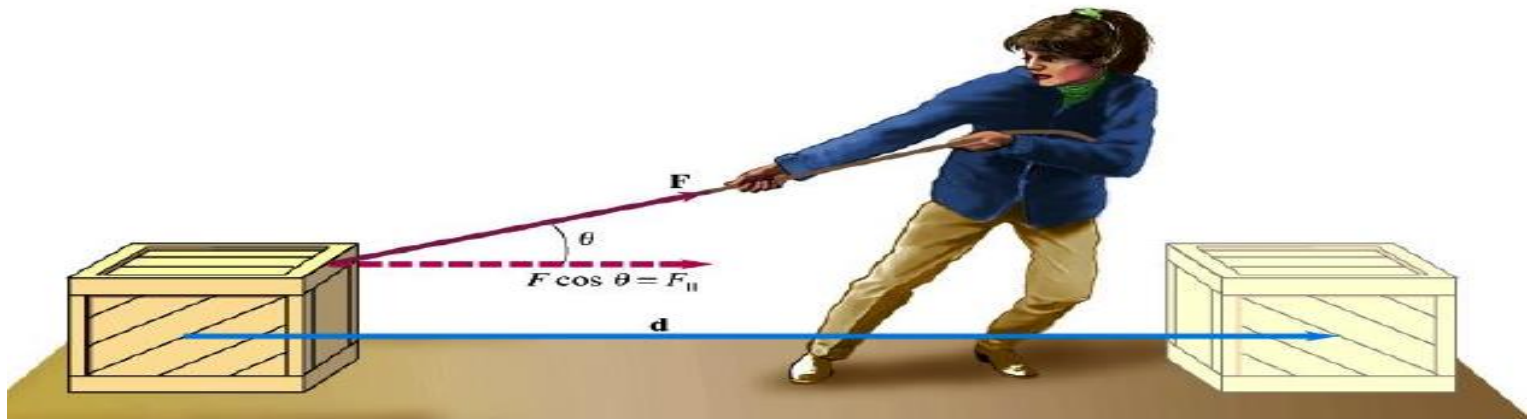
ENERGY:

- Any physical activity in this world, whether carried out by human beings or by nature is caused due to flow of energy in one form or other.
- The word 'energy' itself is derived from the Greek word 'en-ergon' which means 'in-work' or 'work content'. The work output depends on the energy input.
- Energy is the capacity to do work.



Power

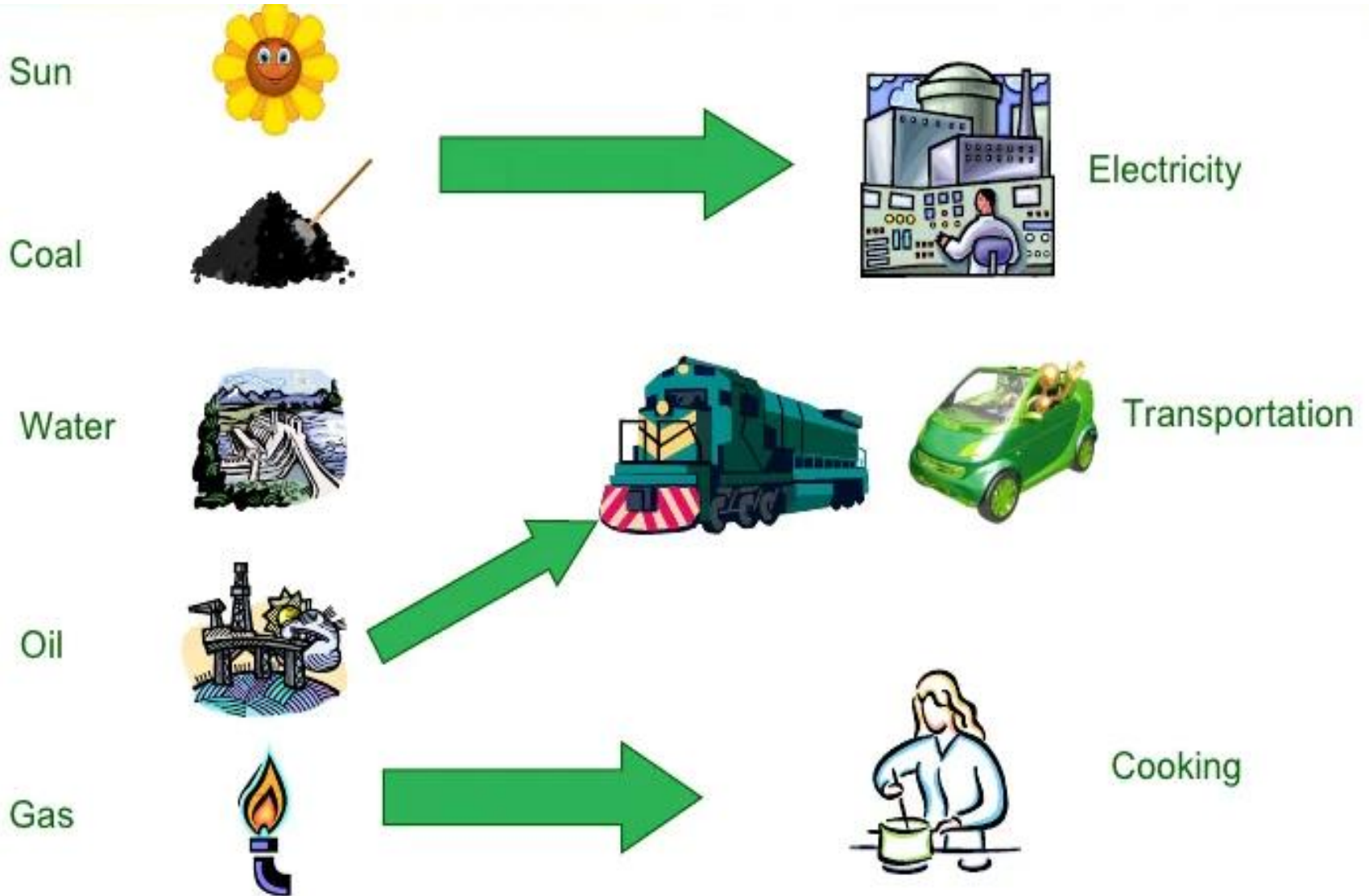
- Energy measures the total quantity of work done; it doesn't say how fast you can get the work done.
- Power is defined as the rate of producing or consuming the energy.



Energy v/s Power

	ENERGY	POWER
Definition	Energy is the capacity to do work. Energy is power integrated over time.	Power is the rate at which work is done , or energy is transmitted
Unit	Joule	Watt = Joule /second
Common symbol	J	P

Uses of Energy sources



Forms of Energy

1. primary sources:

It can be used directly , as they appear in the natural environment.

Ex: Coal, Oil, Natural Gas And Wood, Nuclear Fuels (Uranium), The Sun, The Wind, Tides, Mountain Lakes, The Rivers (From Which Hydroelectric Energy Can Be Obtained) And The Earth Heat That Supplies Geothermal Energy.

2 .Secondary Sources:

These are derived from the transformation of primary energy sources.

Ex: petrol, that derives from the treatment of crude oil ,Electric energy, obtained from the conversion of mechanical energy (power plants)

Sources of energy

- Biggest source of energy is our Sun
- Some other sources are

- Coal
- Wood
- Wind
- Water
- Food
- Electricity

Primary Sources of Energy

Secondary Sources of Energy



ENERGY SOURCES

RENEWABLE ENERGY



Wind



Hydropower



Solar



Geothermal



Biomass

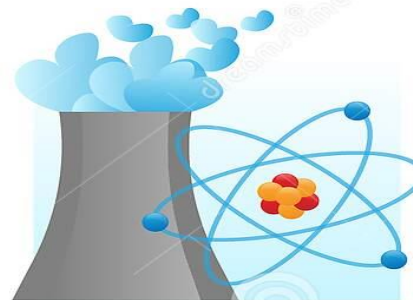
NON-RENEWABLE ENERGY



Oil



Coal

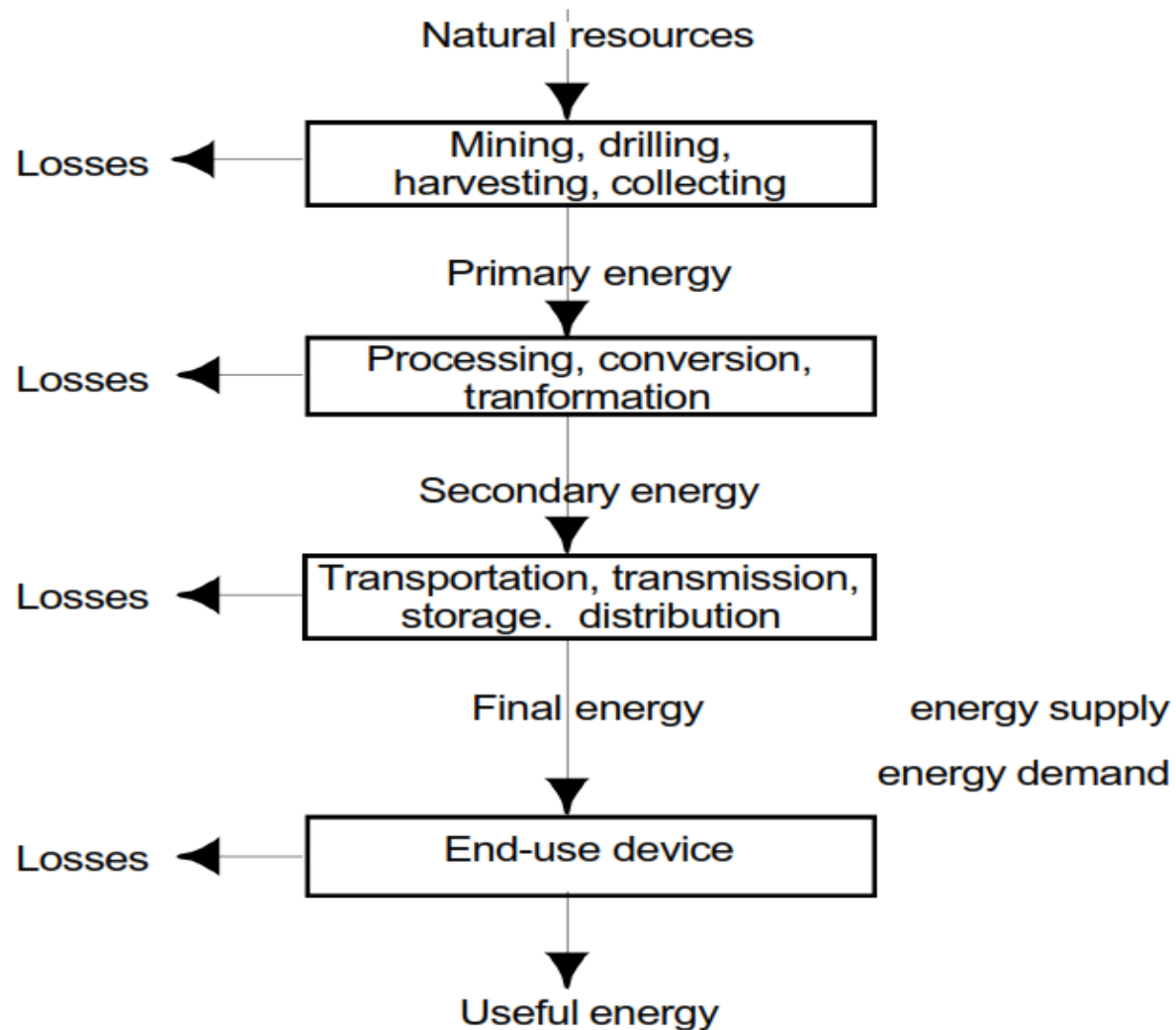


Nuclear

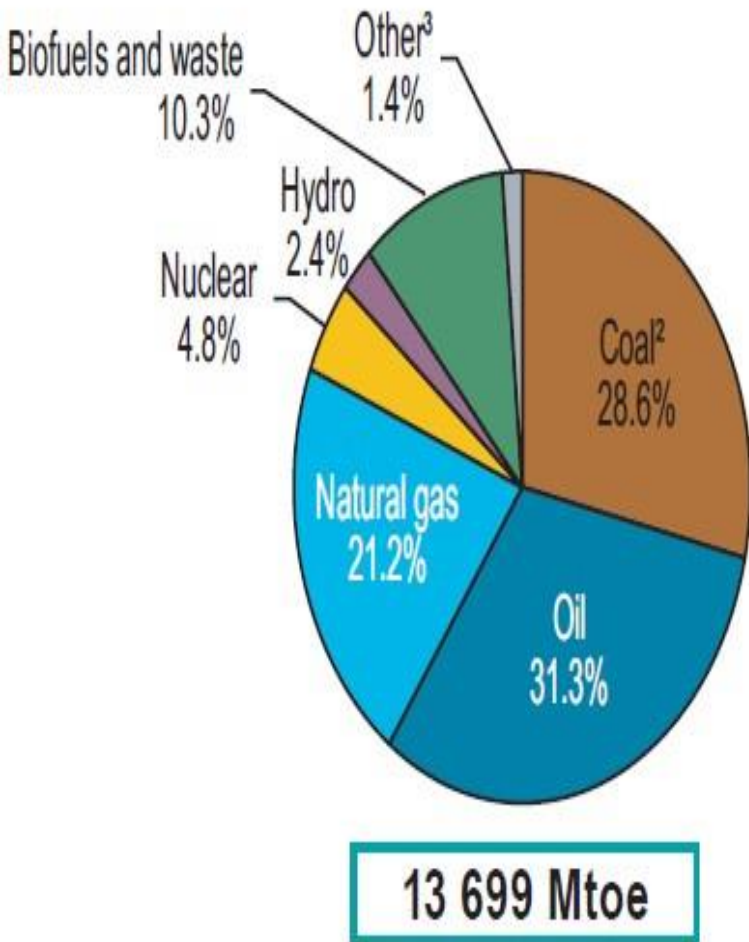


Natural Gas

Energy flow



WORLD ENERGY SCENARIO:

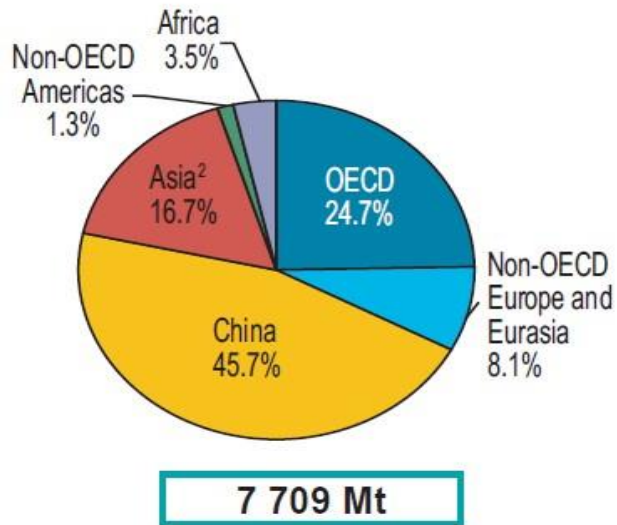


➤ Energy demand in all over the world is increasing day by day. Major growth in energy demand is projected in developing countries.

➤ Coal, Oil & gas are the three major primary sources of energy. World coal reserves are likely to last over 200 years. Both oil & gas reserves likely to last 45-65 years.

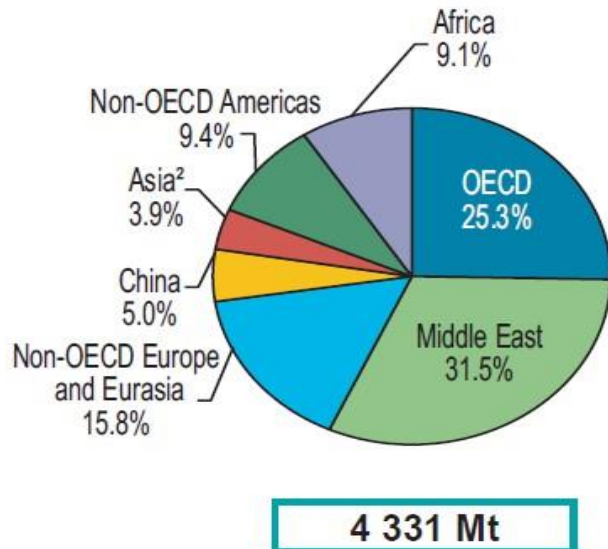
➤ The global energy production at the end of 2014 was equivalent to 14000 Million Tonnes of Oil Equivalent (MToE). Coal Accounted for 29% , Oil 31% , Natural gas for 21% and other at 18% (including nuclear, hydro, biofuels etc)

1. Coal



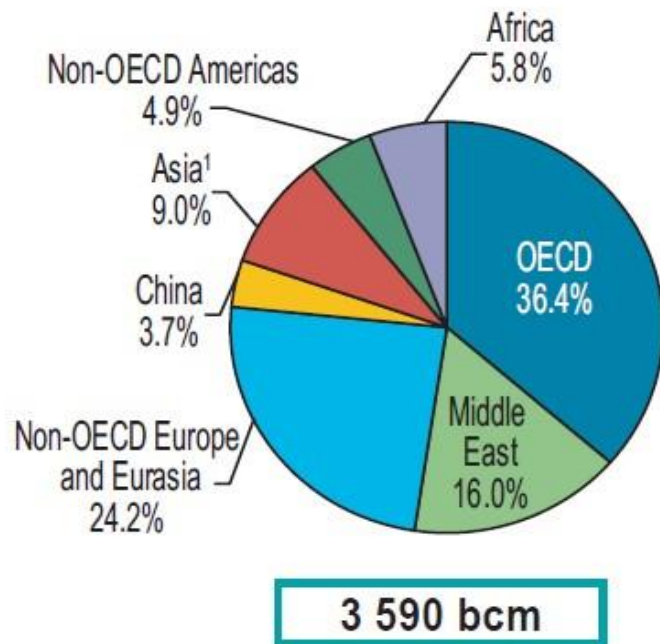
➤ Global coal production stood at 7700 MToE as on 2015. Global coal production fell by 4% when compared to historical data. China accounted for a larger share with about 46%, other Asian countries about 17%, OECD (Organization for Economic Co-operation and Development) countries about 25%.

2. Oil



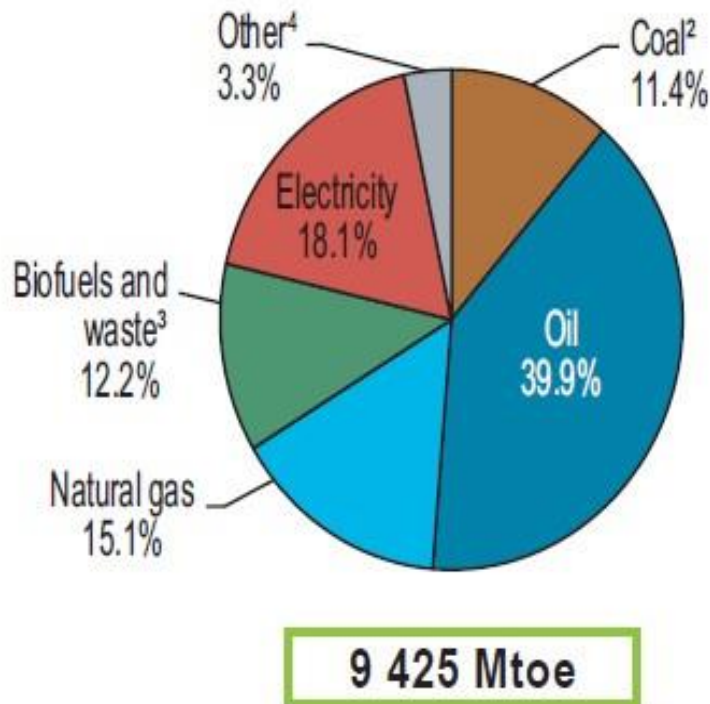
➤ Global oil production stood at 4300 MToE as on 2015. Global oil production increased rapidly (3.2%). Middle east accounted for about 32%, Europe and Asia about 16%, America about 9% compared to historical data.

3. Natural Gas:



➤ Global natural gas production stood at 4000 billion cubic meter (bcm) as on 2015. Global production grew by 2.2% compared to historical data. OECD countries accounted for 37 % share while Europe and Eurasia 24 %, Asia about 9%.

Consumption



Global energy consumption was 9425 MToE as on 2014.

- Oil accounted for 40%,
- Electricity about 18%,
- natural gas about 15%,
- Coal about 11%.

- **Coal:** Global coal consumption fell by 1.8% compared historically. This was accounted by US by a decline of 12.7%, China of 1.5%. India recorded an increase in coal dependence by about 5%.
- **Oil:** Global Oil consumption grew by 1.9 million barrels/day (nearly 1.9%) as compared to historical data. US accounted for increase in 1.6%, China about 6.5%, India about 8.1% with an exception of Japan which recorded a decline of about 4%.
- **Natural Gas:** Global natural gas consumption grew by nearly 1.7%. Iran accounted for 6.2%, China about 4.7%, US about 3%. Meanwhile, few countries recorded largest volumetric decline including Russia (5%) and Ukraine (21%).

Conclusion

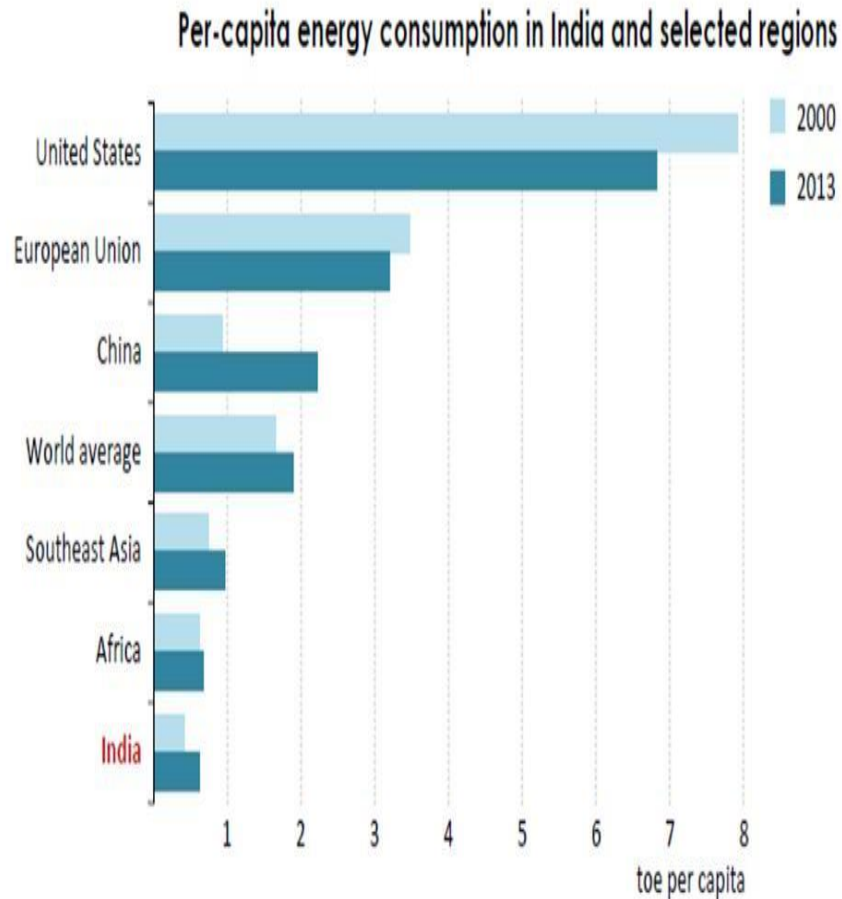
- Developed countries are consuming more energy with energy demand continues to grow strongly.
- sources will dominate and energy system complexity will increase by 2050
- we need to develop our renewable energy resources more and more if we want to enjoy peaceful and satisfactory life in today's energy hungry world...

KEY ENERGY TRENDS IN INDIA:

The various key energy trends in India include

- Demand
- Electricity
- Access to Modern Energy
- Energy Production and Trade

Demand

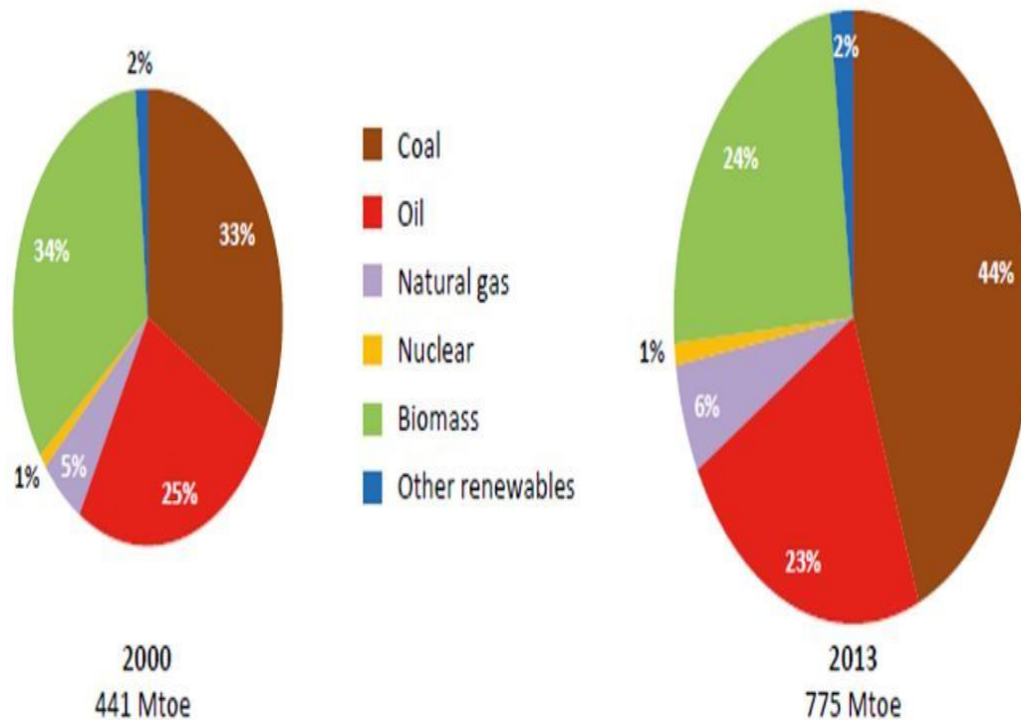


Note: toe = tonnes of oil equivalent.

➤ India has been responsible for almost 10% of the increase in global energy demand since 2000.

➤ energy demand in India has grown by a more modest 46% since 2000 and remains only around one-third of the world average

Primary energy demand in India by fuel

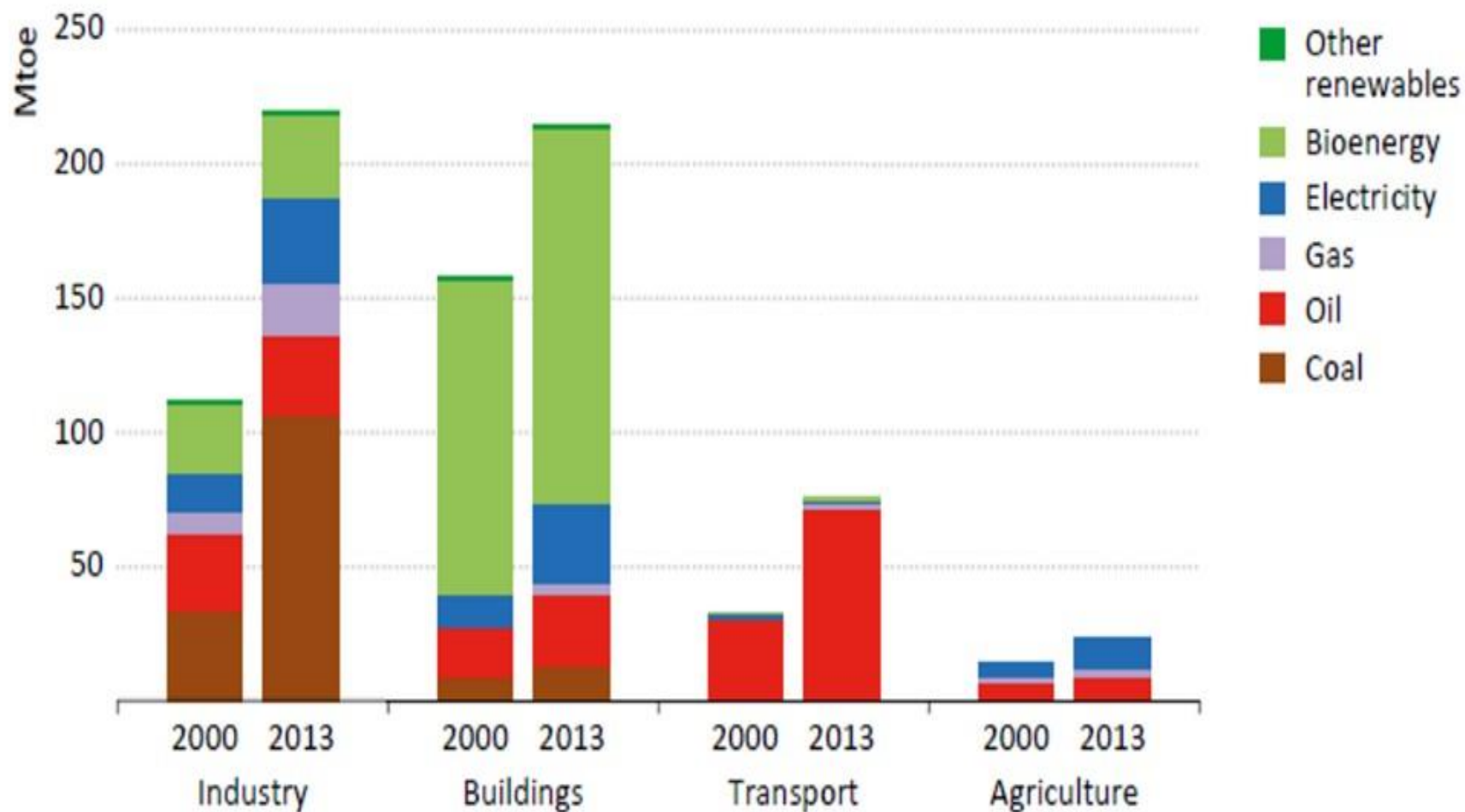


➤ Almost three-quarters of Indian energy demand is met by fossil fuels, a share that has increased since 2000 because of a rapid rise in coal consumption.

➤ Oil consumption in 2014 stood at 3.8 million barrels per day (mb/d), 40% of which is used in the transportation sector.

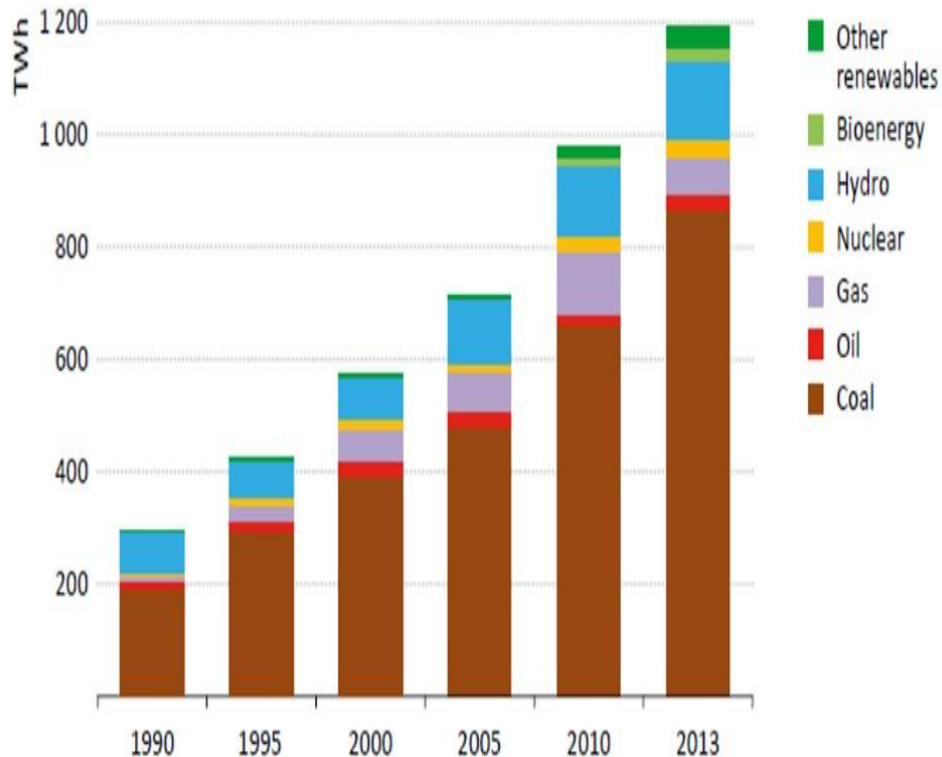
➤ Natural gas makes up a relatively small share of the energy mix (6% in 2013 compared with 21% globally).

Energy demand by fuel in selected end-use sectors in India



Electricity

Total electricity generation in India by fuel



Note: Other renewables includes solar PV and wind.

➤ The country's electricity demand in 2013 was 897 terawatt-hours (TWh), up from 376 TWh in 2000, having risen over this period at an average annual rate of 6.9%.

➤ Electricity now constitutes some 15% of final energy consumption since 2000. The situation varies from state to state, but higher tariffs paid by commercial and industrial consumers.

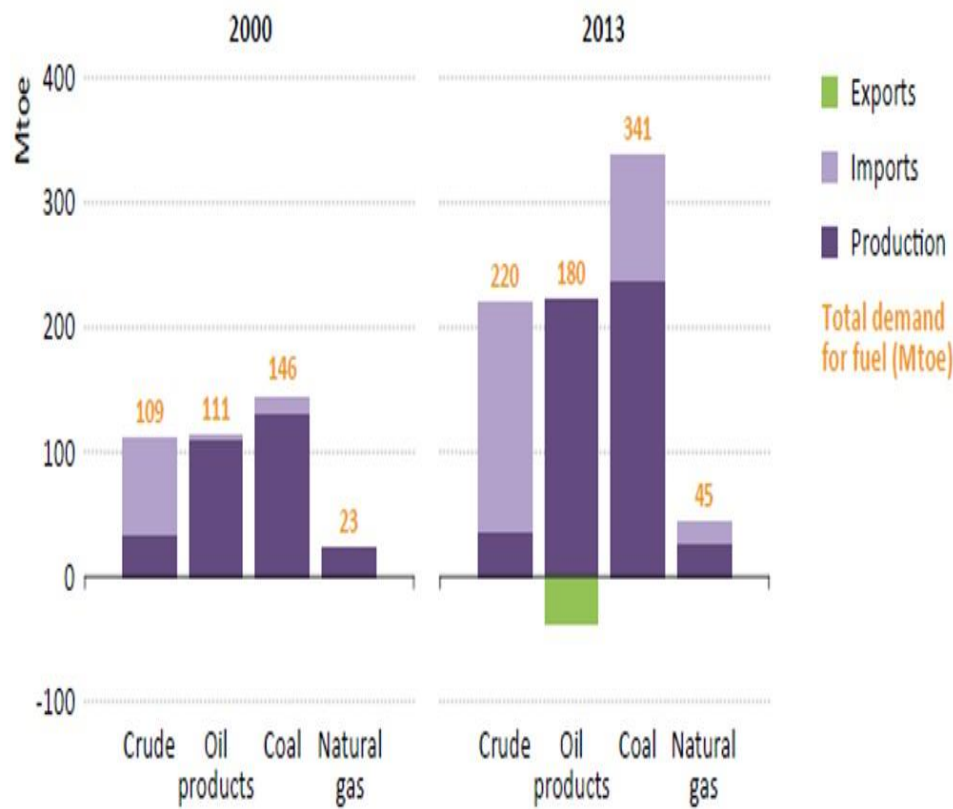
➤ India has some 290 gigawatt (GW) of power generation capacity, of which coal (60%) makes up by far the largest share, followed by hydropower (15%) and natural gas (8%).

Access to Modern Energy

- India's rural electrification programme, **the Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY)**, was launched in 2005 and aimed to **provide electricity to villages of 100 inhabitants or more and free electricity to people below the poverty line**. The effective implementation of RGGVY has faced several challenges and there are strong variations in outcomes between states.
- In July 2015, RGGVY was subsumed within a new scheme, **the Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY)**. **The main components of this scheme are the separation of distribution networks between agricultural and non-agricultural consumers to reduce load shedding, strengthening local transmission and distribution infrastructure, and metering.**
- Using LPG as alternative cooking fuel

Energy Production and Trade

Fossil-fuel balance in India



Note: Demand for crude oil shows refinery intake.

1. Coal

➤ In 2013, India produced almost 340 million tonnes of coal equivalent (Mtce), but it also imported some 140 Mtce.

➤ Around 7% of national production comes from captive mining, i.e. large coal-consuming companies that mine for their own use. At present, more than 90% of coal in India is produced by open cast mining.

2. Oil and Oil Products

- India has relatively modest oil resources and **most of the proven reserves (around 5.7 billion barrels) are located** in the western part of the country, notably in **Rajasthan and in offshore areas near Gujarat and Maharashtra,**
- India has almost doubled its refining capacity in the last ten years and has added more than 2 mb/d of new capacity since 2005,

3. Natural Gas

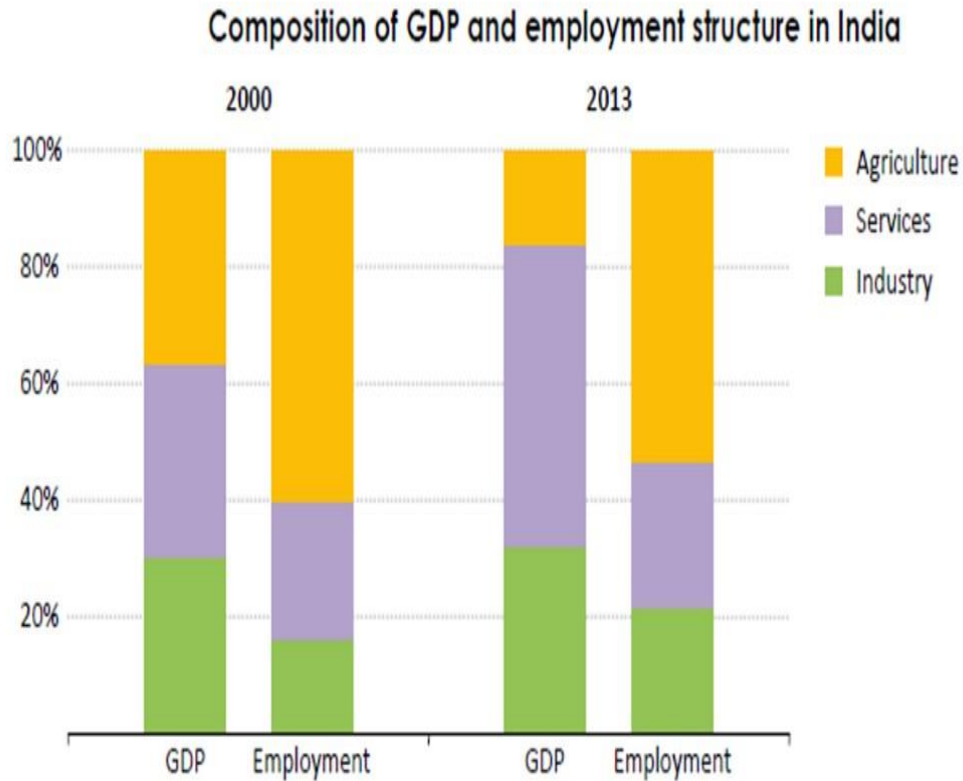
- **Natural gas has a relatively small share (6%) of the domestic energy mix.** Production of conventional gas reached 34 bcm in 2013

FACTORS AFFECTING INDIA'S ENERGY DEVELOPMENT

The various factors that affect our country's energy development are:

- Energy and Demographics**
- Policy and Institutional Framework**
- Energy Process and affordability**
- Social and environmental aspects**
- Investment**

a) Energy and Demographics



➤ India's economy has grown at an average rate of 6.5% a year, second only to China among the large emerging economies, and two-and-a-half-times the global average.

➤ India alone has accounted for over 9% of the increase in global economic output since 1990.

➤ Services sector has been the major driver of growth in India's economy, accounting for around 60% of the increase in GDP between 1990 and 2013.

The government has expressed its intention to re-balance the economy and announced the “Make in India” initiative, with an intention of increasing the share of manufacturing in GDP to 25% by 2022 and creating 100 million jobs in the process.

b) Policy and Institutional Framework

- The direction that national and state policies take, and the rigour and effectiveness with which they are implemented, will naturally play a critical role in India's energy outlook.
- few policies listed such as **Integrated Energy Policy 2008, National Action Plan on Climate Change**, Planning, Commission (now the National Institution for Transforming India, [**NITI Aayog**])

Some key aspects of the emerging energy vision are

- A commitment to the efficient use of all types of energy in order to meet rapidly growing demand
- **Increase the target for renewables to 175 GW by 2022**
- A sharpened focus on achieving universal access to modern energy, including the objective of supplying round-the-clock electricity to all of India's population
- Reorientation of energy subsidy programmes

- A drive for market-oriented solutions and **increased private investment (including foreign investment) in energy**, both through some energy-specific reforms
- Drive to simplify and deregulate the business environment.
- A pledge to pursue a more climate-friendly and cleaner path than the one followed thus far by others at corresponding levels of economic development.
- Twin energy-related commitments **to increase the share of non-fossil fuel power generation capacity to 40% by 2030 and to reduce the emissions intensity of the economy by 33-35% by the same date, measured against a baseline of 2005.**

c) Energy Prices and Affordability

- The relationship between income levels, energy prices and energy expenditure is fundamental to the evolution of India's energy system.
- Energy consumption increases with income. Level of consumption and the fuel choice are also affected by location.
- Household expenditure on energy is, on average, almost **two-and-a-half-times higher in urban centres than in rural areas**. India has made significant moves towards market-based pricing for energy in recent years. Gasoline (in 2010) and diesel (2014) prices have both been deregulated
- Ex: LPG, the government is committed to make them more efficient through the use of "AADHAAR"

d) Social and environmental aspects

Pollution:-

- India is burning more fossil fuels, and biomass than it has at any other time in the past, releasing more pollutants, including fine particulate matter and sulphur and nitrogen oxides, into the air.
- Deteriorating air quality in growing urban centres is becoming an alarming issue for India. Estimated that life **expectancy, as a result, is reduced by 3.2 years** for each person living in these areas

Land

- Welfare of India's rural population is closely linked to the amount of land they have available for productive use.
- Land acquisition for public or private enterprises wishing to build infrastructure, from roads and railways to power plants and steel mills, is therefore an issue Legislative changes introduced in 2013 introduced stringent procedural requirements for land acquisition.

Water:-

- High rates of population and economic growth, along with highly inefficient patterns of water use in the agricultural sector, are putting severe strain on India's water resources.
- **Around 90% of India's water withdrawal is for use in agriculture and livestock**, often extracted by tube wells powered from the grid and drawing from groundwater reserves.
- Subsidised electricity tariffs for agricultural users and a lack of metering have led to hugely inefficient consumption of both electricity and water

e) Investment:

- Since 2000, investment in energy supply in India has increased substantially, reaching **almost \$77 billion on average since 2010** with power sector absorbing the largest share.
- India's government aims to **increase investment in infrastructure to 8.2% of GDP from roughly 7.2% in 2007-2011**. 2014 saw a significant **increase in FDI inflows**, which rose by **22% compared to the previous year**.