ENERGY EFFICIENT PRACTICE

18EEO304T

UNIT -1

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Course Learning Outcomes (CLO):

At the end of this unit, learners will be able to:

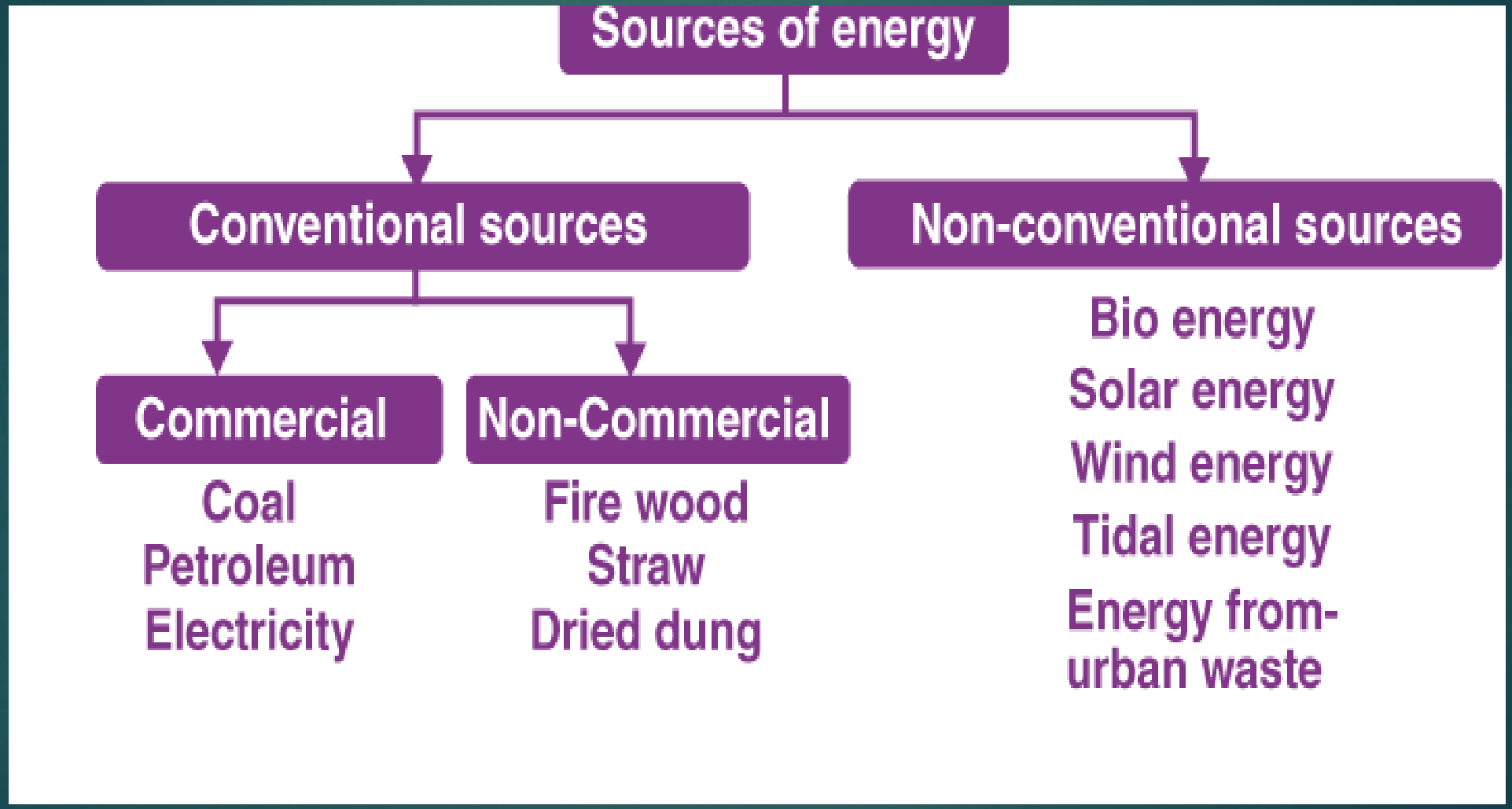
- Apprehend energy scenario and efficiency opportunities

Energy classifications

- Energy is one of the major inputs for the economic development of any country. In the case of the developing countries, the energy sector assumes a critical importance in view of the ever increasing energy needs requiring huge investments to meet them.

- Energy can be classified into several types based on the following criteria

1. Commercial and Non commercial energy
2. Primary and Secondary energy
3. Renewable and Non-Renewable energy


Sources of energy
Conventional sources
Non-conventional sources
Commercial
Non-Commercial
Coal
Petroleum
Electricity
Fire wood
Straw
Dried dung
Bio energy
Solar energy
Wind energy
Tidal energy
Energy from-
urban waste

Conventional Sources of Energy

Conventional Sources of energy are also known as non-renewable sources of energy and are available in limited quantity apart from hydro-electric power.

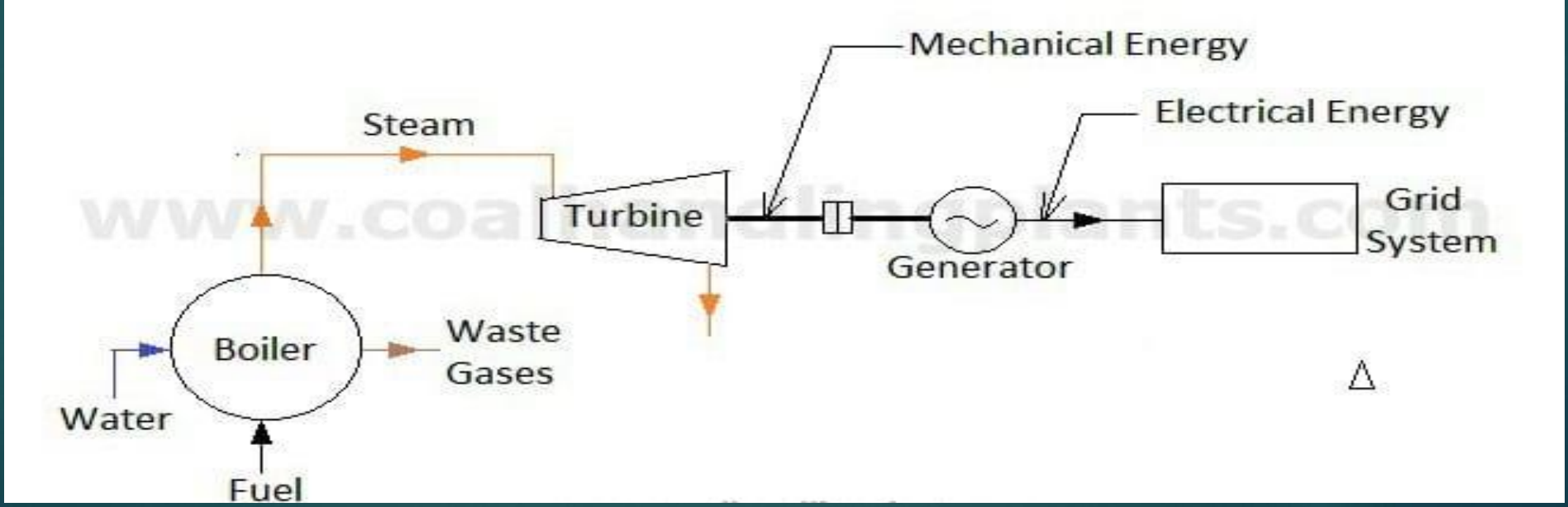
- Commercial energy
- Non-commercial energy

The major sources of power generation are

Nuclear Power
Thermal Power
Hydro-electric power

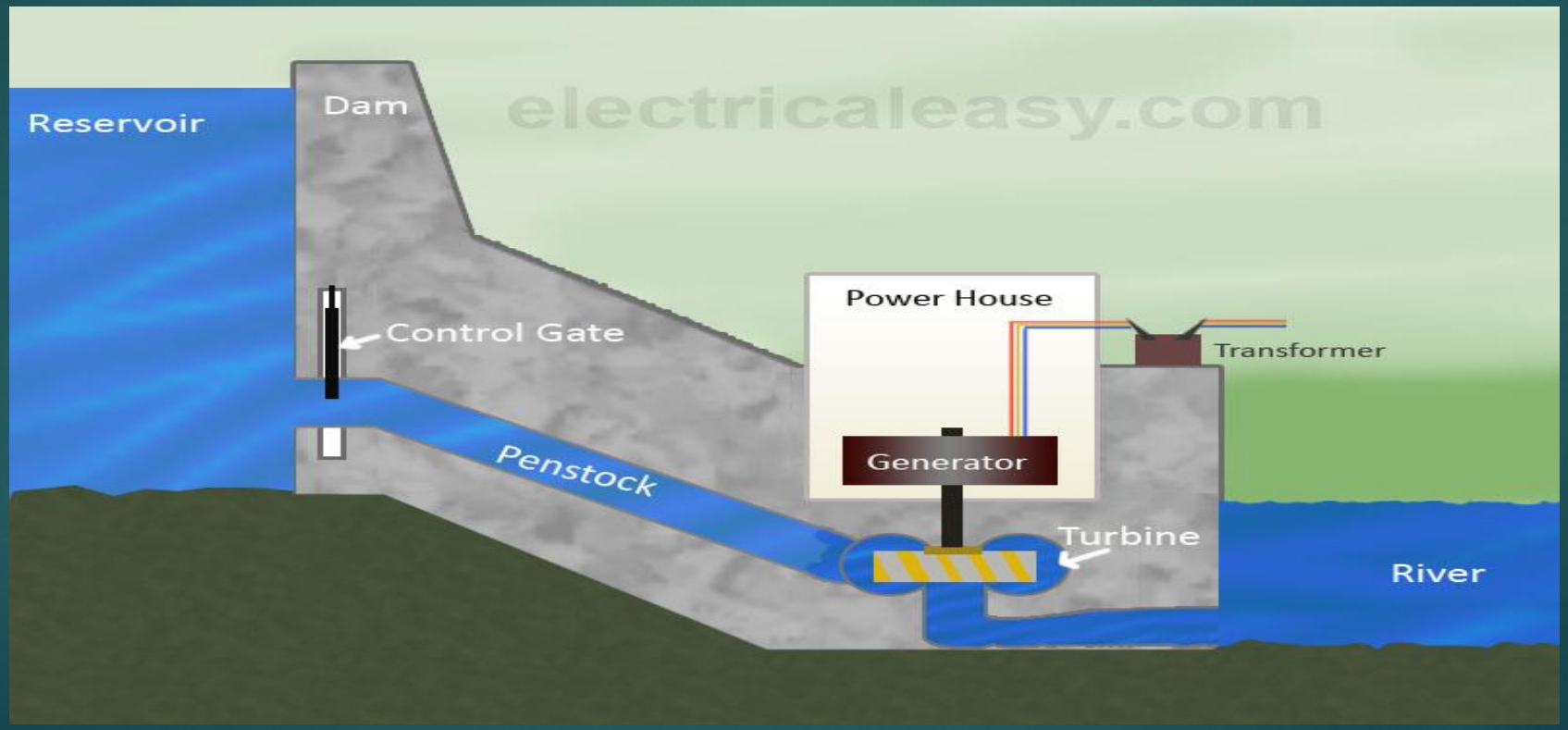
Thermal Power

Thermal power is generated at various power stations utilizing oil and coal. It is a vital source of electric current, and its share in the nation's total capacity in 2024-25 is 75 percent.



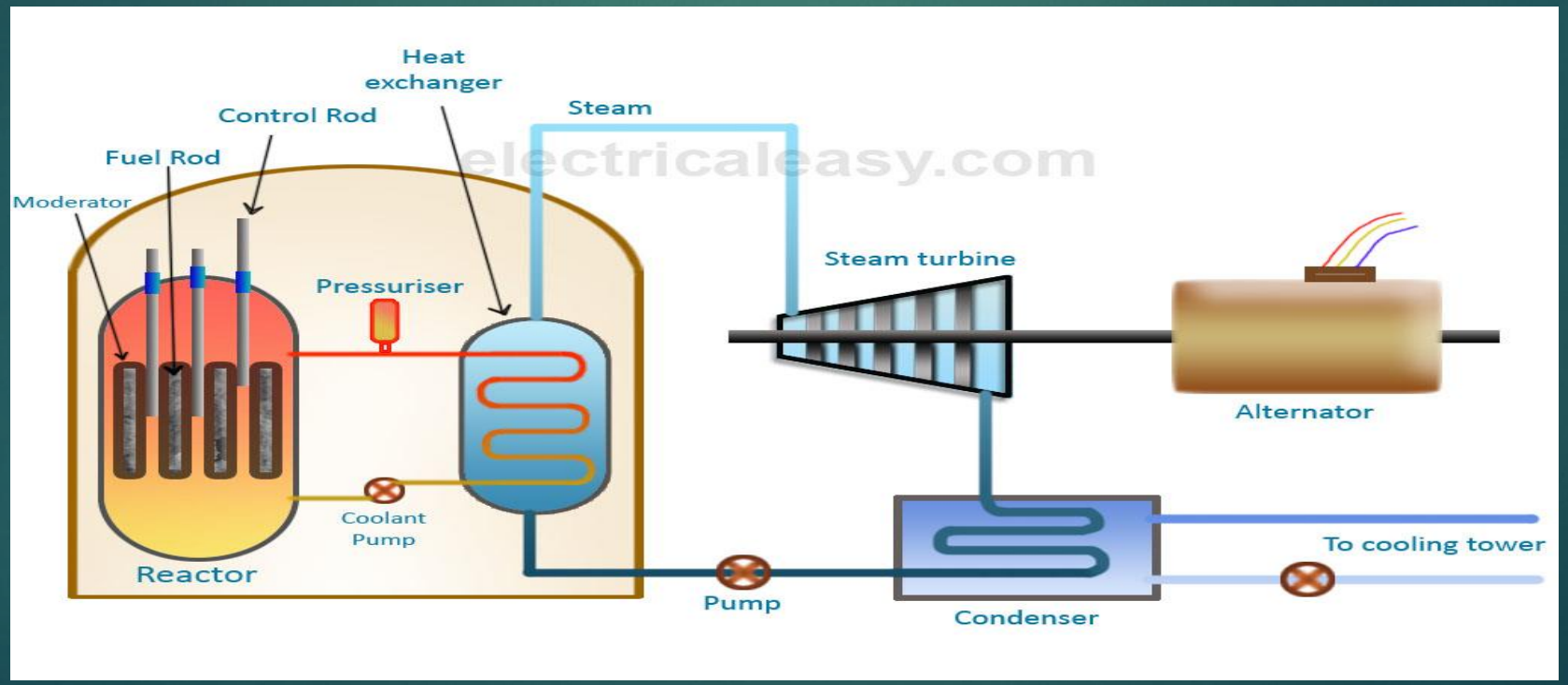
Hydroelectric Power

Hydroelectric power is produced by constructing dams above flowing rivers like Damodar Valley Project and Bhakra Nangal Project. The installed capacity of hydroelectric power was 587.4 mW in 1950-51 and went up to 19600 mW in 2004-05.



Nuclear Power

The fuel used in nuclear power plants is Uranium, which costs less than coal. Nuclear power plants can be found in Kaiga (Karnataka), Kota (Rajasthan), Naroura (UP) and Kalapakam(Chennai).



Commercial Energy

Definition: Commercial energy is energy that is bought and sold in the market. It is typically produced, stored, and distributed by energy companies and is available for consumer use.

Examples:

Electricity: Generated from power plants using fossil fuels, nuclear energy, hydroelectricity, etc.

Coal: Used for industrial processes and electricity generation.

Oil and Gas: Used in transportation, heating, and power generation.

Non-Commercial Energy

Definition: Non-commercial energy refers to energy that is not bought and sold but is gathered directly by consumers, often from natural resources. It is typically used in rural or underdeveloped areas.

Examples:

Firewood: Collected from forests for cooking and heating.

Animal Waste: Used as fuel in rural areas.

Crop Residue: Agricultural waste used for energy purposes.

Commercial Energy

- **Source:** Power plants, oil fields, refineries.
- **Process:** Production -> Distribution -> Consumption.
- **Market:** Bought and sold in markets, regulated by companies and governments.

Non-Commercial Energy

- **Source:** Natural resources (forests, farms, etc.).
- **Process:** Direct collection and use.
- **Market:** Not bought or sold, typically free for direct collection.

Non-Conventional Sources of Energy

Non-conventional sources are also known as renewable sources of energy. Examples of non-conventional sources of energy include

- Solar energy,
- Bio energy
- Tidal energy
- Wind energy.

Difference Between Conventional and Non-conventional Sources of Energy

Conventional Sources of Energy	Non-conventional sources of energy
These sources of energy are also known as a non-renewable source of energy	These sources of energy are also known as a renewable source of energy
They find both commercial and industrial purposes	They are mainly used for household and Commercial purposes
These can be considered to be one of the reasons for the cause of pollution	These are not responsible for the cause of pollution
Coal, fossil fuels are two examples	Wind, solar energy and Biomass two examples

Energy classifications:

- Primary and Secondary Energy
- Primary energy sources are those that are either found or stored in nature. Common primary energy sources are coal, oil, natural gas, and biomass (such as wood).
- Other primary energy sources available include nuclear energy from radioactive substances, thermal energy stored in earth's interior, and potential energy due to earth's gravity.

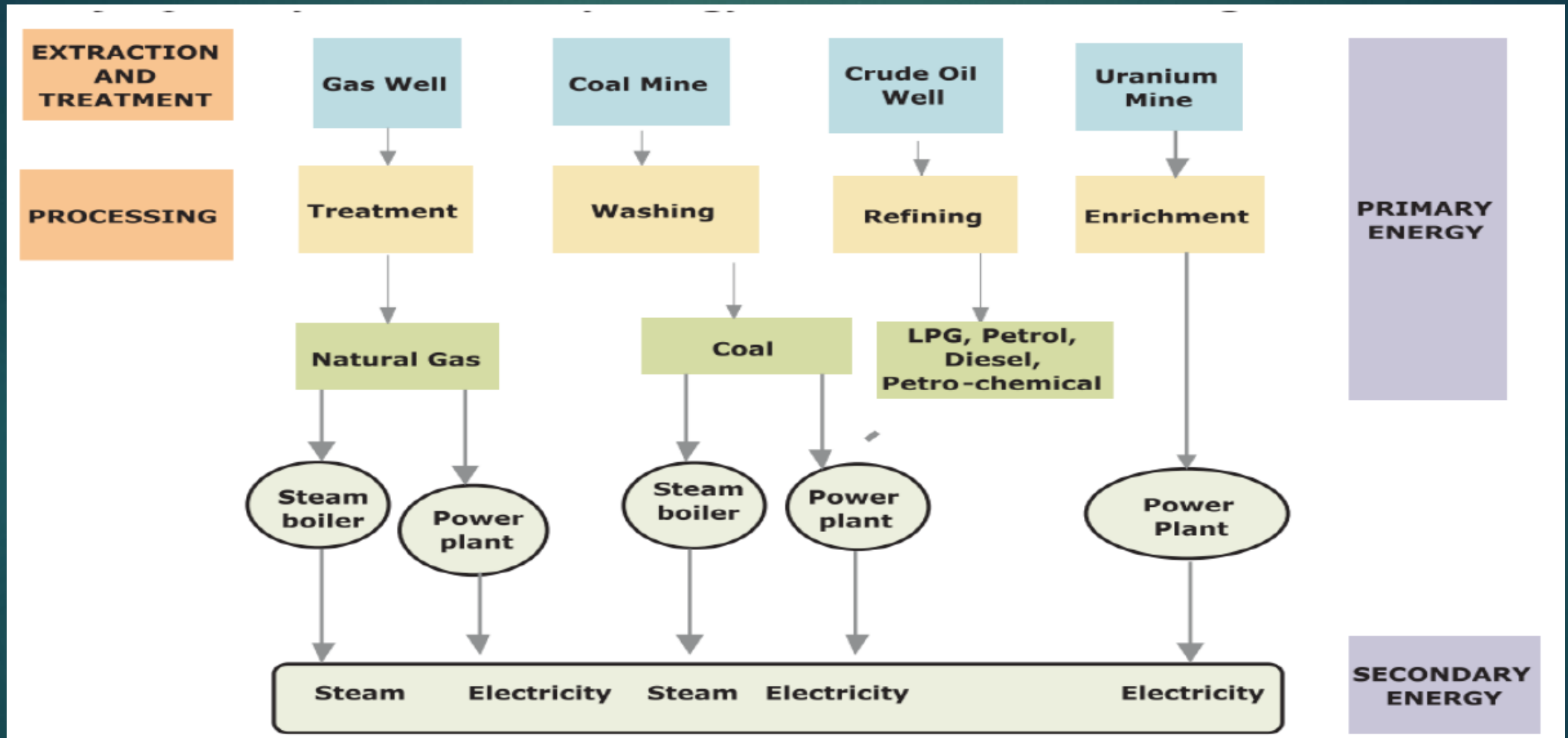


Figure 1.1 Major Primary and Secondary Energy Sources

Primary Energy

Primary energy refers to the energy found in natural resources before undergoing any conversion or transformation. It is the energy contained in raw fuels and other forms of energy received as input to a system. These include

Fossil Fuels: Coal, natural gas, and crude oil.

Renewable Resources: Solar radiation, wind, biomass, geothermal, and hydropower.

Nuclear Energy: Energy from nuclear reactions, typically in the form of uranium or thorium.

Other Natural Sources: Energy from ocean tides and waves.

Characteristics of Primary Energy

Raw Form: It is directly extracted from nature.

Varied Sources: Includes both renewable and non-renewable sources.

Conversion Required: Usually needs to be converted into secondary energy for practical use.

Secondary Energy

Secondary energy refers to the energy that results from the transformation of primary energy. It is more refined and convenient for use in various applications. Examples include

Electricity: Generated from primary sources like coal, natural gas, nuclear, wind, or solar.

Refined Fuels: Gasoline, diesel, and other petroleum products derived from crude oil.

Characteristics of Secondary Energy

Processed Form: Converted from primary energy.

Usability: Easier to transport, store, and use in day-to-day life.

Specific Applications: Tailored for particular uses like powering vehicles, heating homes, and running appliances.

- Primary Energy Sources
  - Fossil Fuels (Coal, Natural Gas, Oil)
    - Conversion (Power Plants, Refineries)
      - Electricity (Secondary)
      - Refined Fuels (Gasoline, Diesel - Secondary)
  - Renewable Energy (Solar, Wind, Hydro)
    - Conversion (Solar Panels, Wind Turbines)
      - Electricity (Secondary)
  - Nuclear Energy (Uranium, Thorium)
    - Conversion (Nuclear Reactors)
      - Electricity (Secondary)

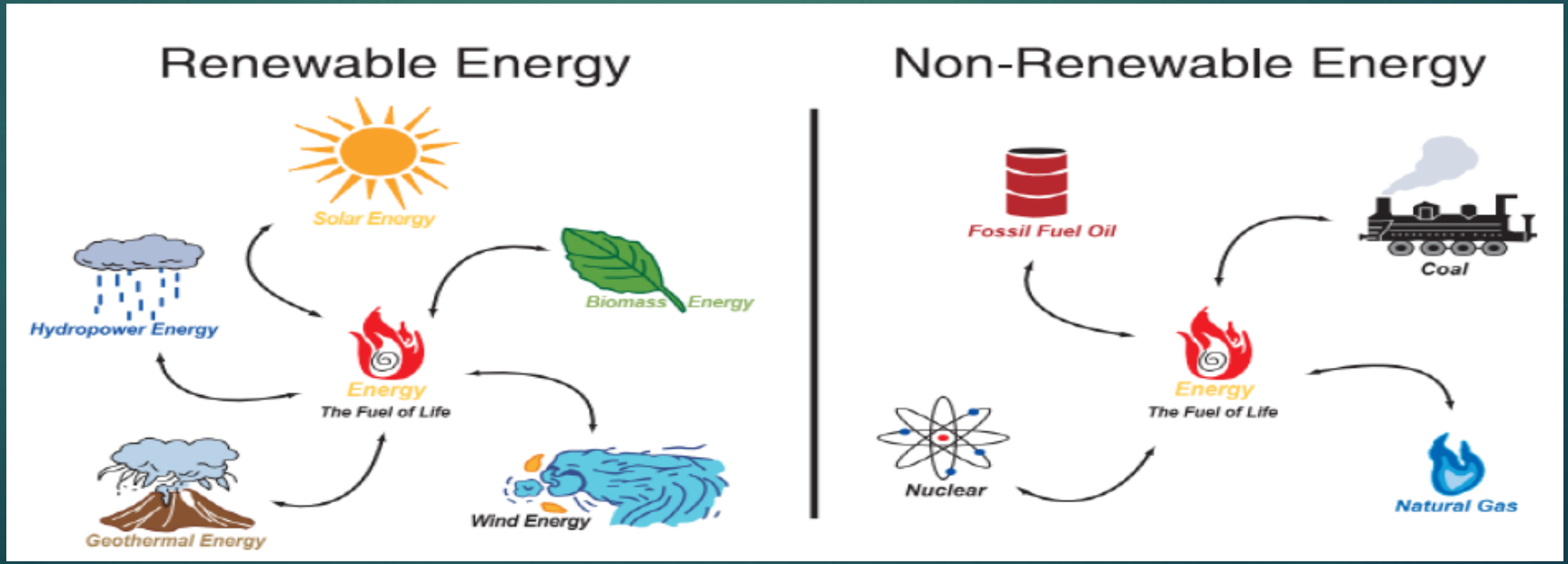
Detailed Conversion Processes

Electricity Generation: Primary sources like coal or natural gas are burned in power plants, or renewable sources like wind or solar are harnessed to generate electricity.

Refining Petroleum: Crude oil is refined into usable products like gasoline or diesel.

Renewable and Non-Renewable 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.



Energy Needs of Growing Economy

•India's energy demand will increase more than that of any other country over the next two decades, the International Energy Agency (IEA) said on India overtaking the European Union as the world's second-largest energy consumer by 2030.

•India at present is the Third-largest global energy consumer behind China, the United States and the European Union. By 2023, India's power system is bigger than that of the European Union, and is the world's third-largest in terms of electricity generation; it also has 30 per cent more installed renewables capacity than the United States

Mapping India's energy system

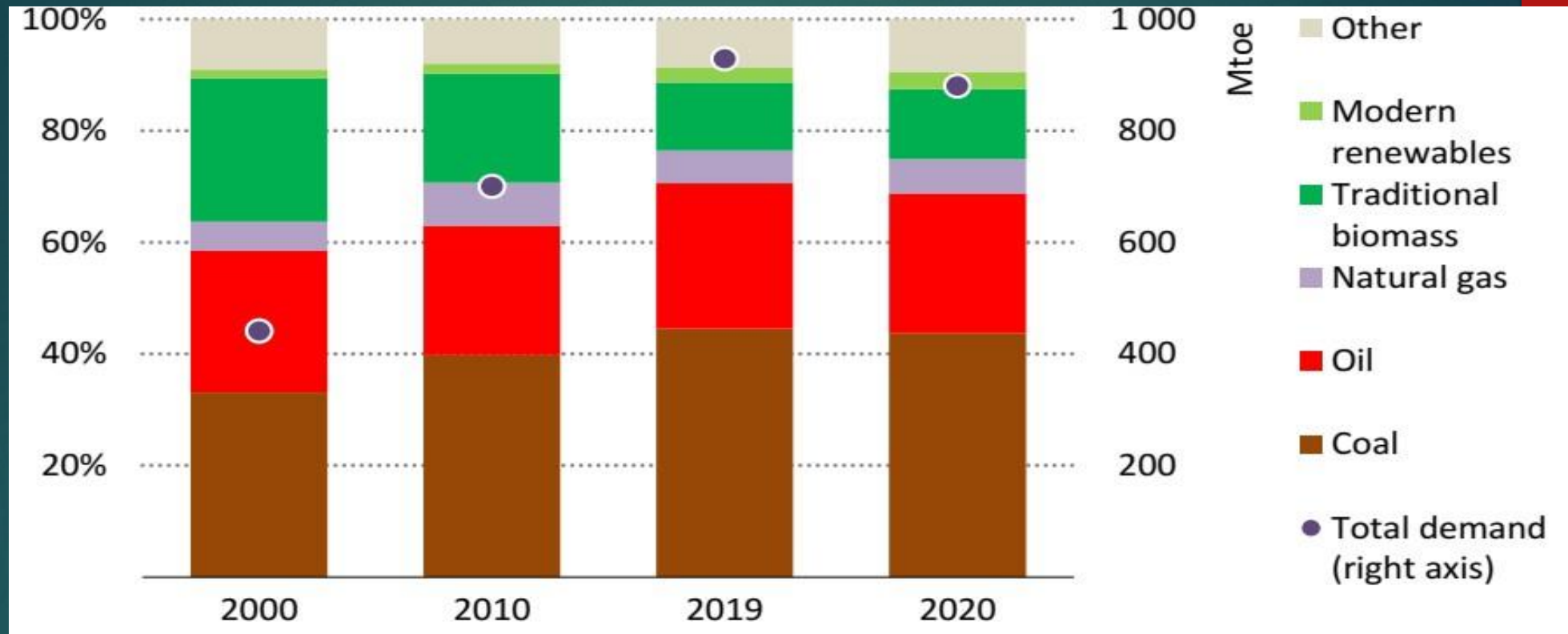
•India's energy needs are largely met by **three fuels – coal, oil and biomass**

•Oil demand has more than doubled since 2000 as a result of growing vehicle ownership and road transport use.

•Transport energy demand grew 3.5 times, since 2000.

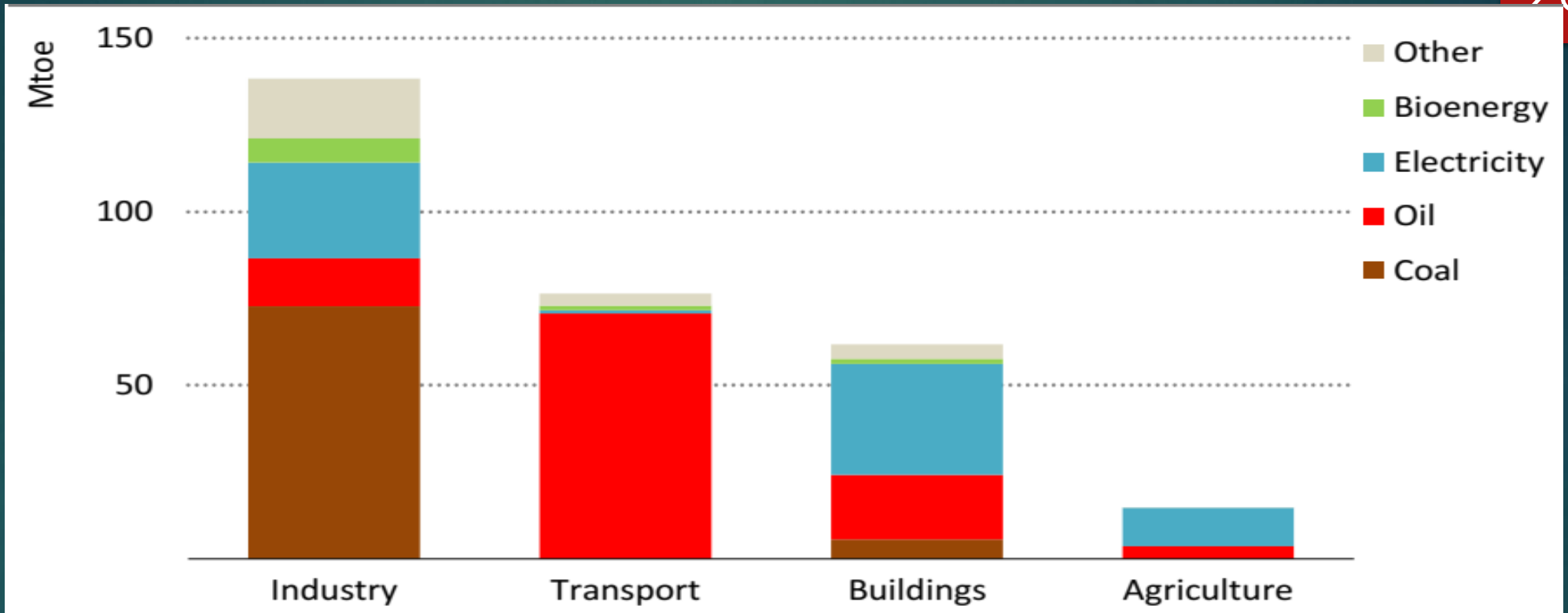
•Electricity consumption has nearly tripled over the past two decades
– growing faster than total energy demand.

•Solar PV and wind accounted for 18% of the capacity mix in 2019, but their combined share of generation was less than 10%.



India's energy demand has tripled over the last three decades: the share of traditional biomass has fallen, leaving coal and oil dominant.

Note: Mtoe = million tonnes of oil equivalent.



Among end-use sectors, the growth in energy demand has been larger in industries than in transport and buildings, and this growth has largely been fuelled by coal.

Figure 1.6 ▷ Final energy consumption per capita by state, 2018

Energy needs of growing economy, energy intensity:

- Economic growth is desirable for developing countries, and energy is essential for economic growth. However, the relationship between economic growth and increased energy demand is not always a straightforward linear one.

- For example, under present conditions, 6% increase in India's Gross Domestic Product (GDP) would impose an increased demand of 9 % on its energy sector.

- Energy intensity is energy consumption per unit of GDP. Energy intensity indicates the development stage of the country. India's energy intensity is 3.7 times of Japan, 1.55 times of USA, 1.47 times of Asia and 1.5 times of World average.

$$EI = \frac{FC}{GDP}$$

Where:

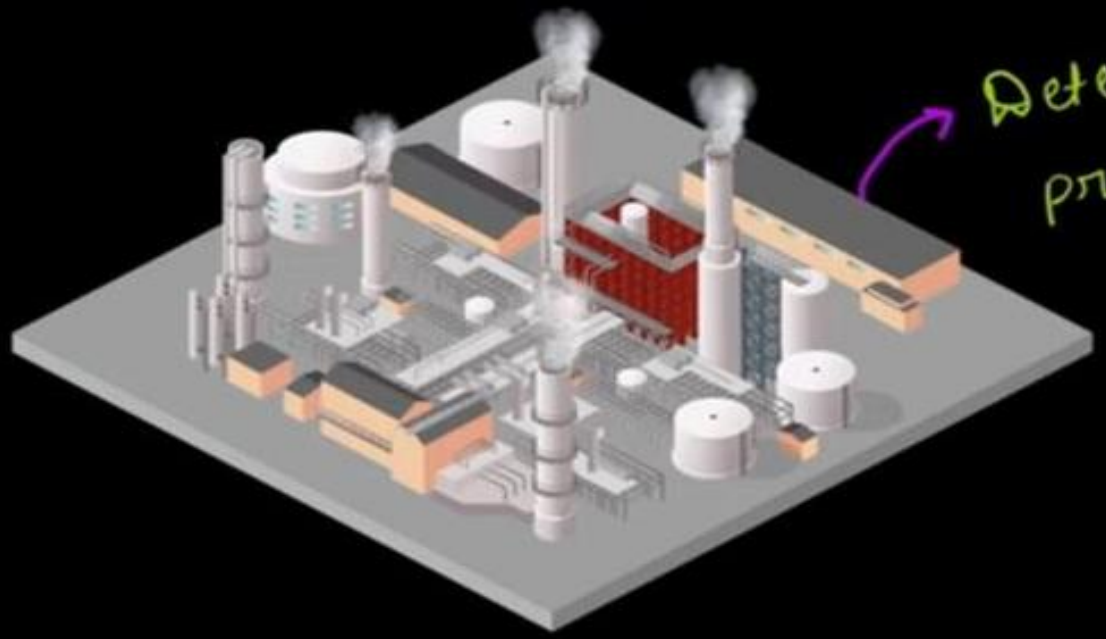
EI = Energy intensity, national level, toe per million US $

FC = Total final consumption, national level, toe

GDP= Gross domestic product, million US $

Energy Pricing

"The cost of determining the per unit (1kWh) cost of production of electrical energy is known as Economics of power generation"



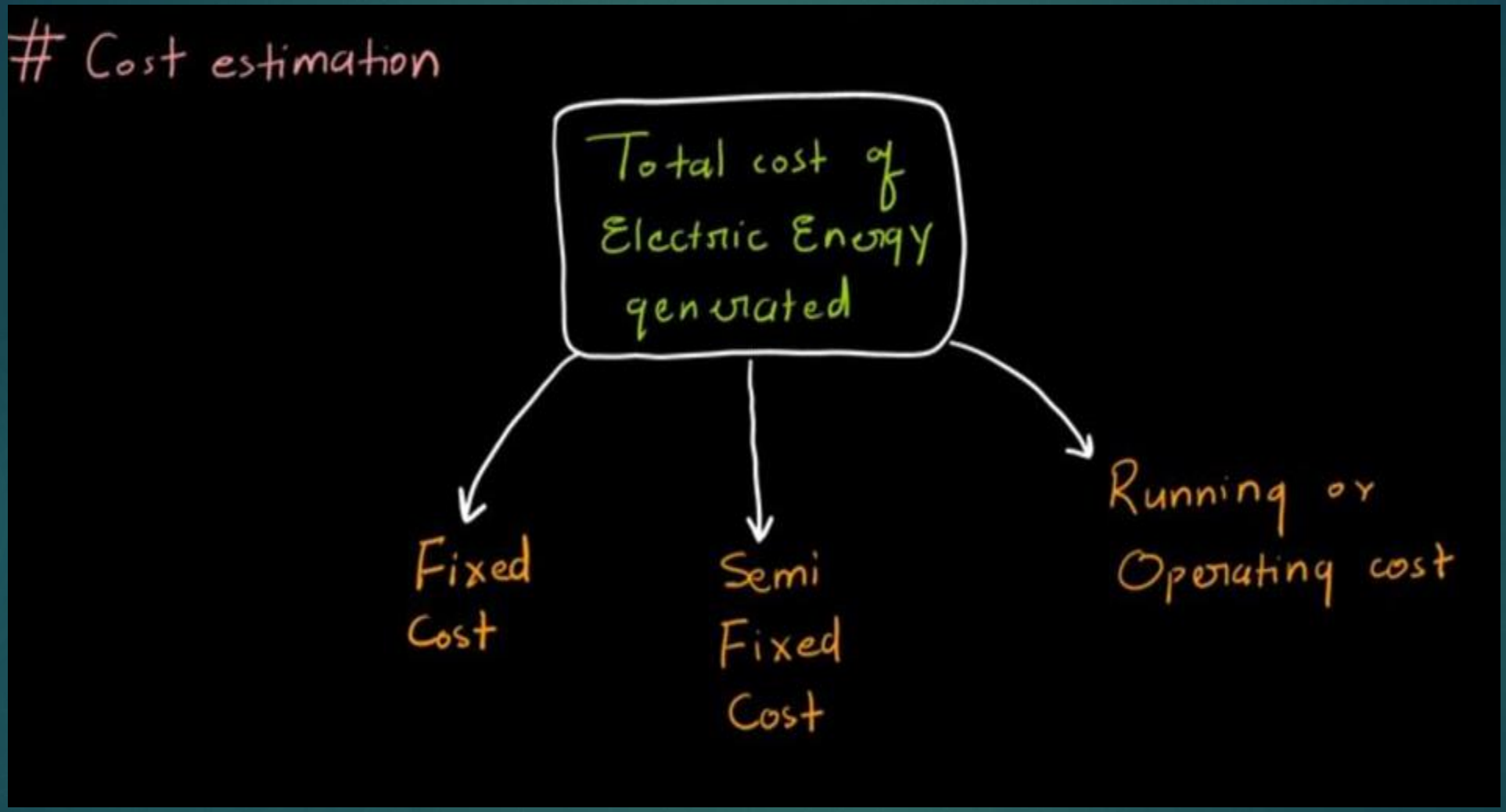
Determining the production cost is very complex

Cost of Land

Depreciation cost

Staff Salary

Interest on Capital


Cost estimation
Total cost of Electric Energy generated
Fixed Cost
Semi Fixed Cost
Running or Operating cost

1. Fixed Cost

"Cost which is independent of maxm demand and Units generated"

Fixed Cost

Annual cost of organization

High rank official Salaries

Capital cost of Land

* Fixed Cost = a → Constant

2. Semi - Fixed Cost

depends on max^m demand

independent of units generated

Variable

* Semi fixed Cost ∝ Max^m demand on Power station

= b. kW

Interest on Capital

Depreciation Cost

Management & Clerical staff

* Higher the maxm demand ⟶ Higher the semi-fixed cost

Max demand on Power Station ↑

⟶ Staff ↑ ⟶ 

↑

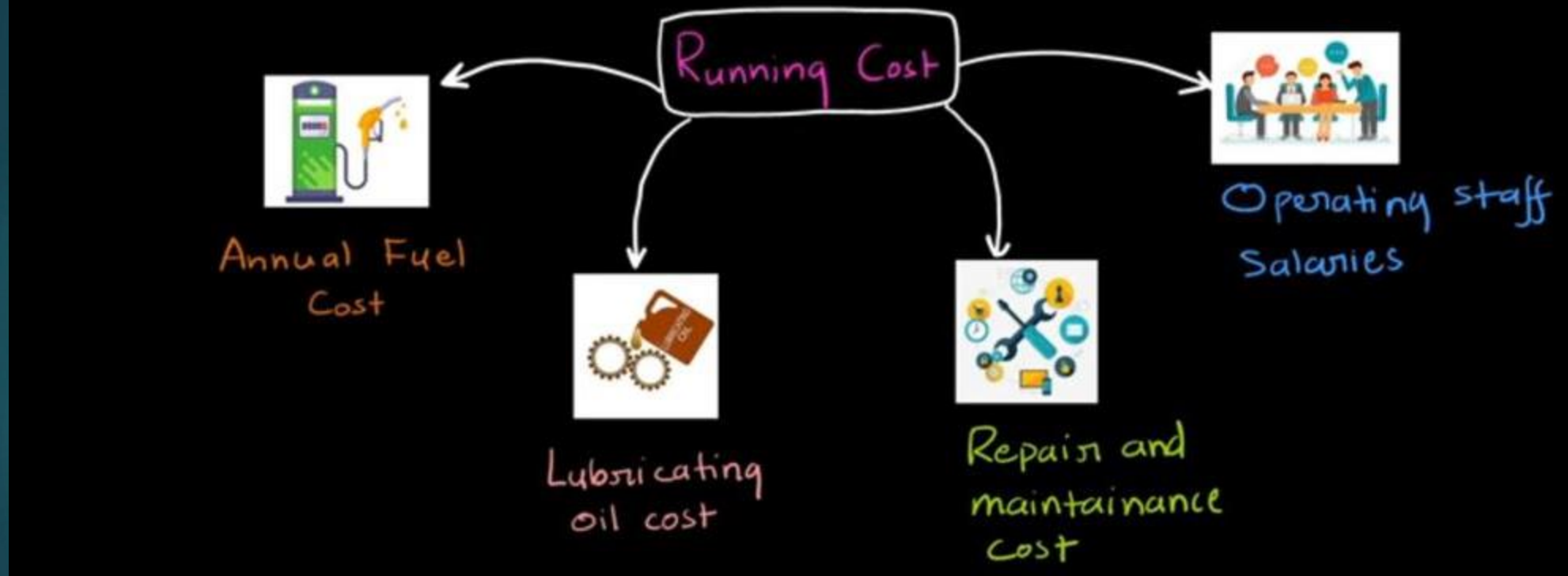
⟶ Equipment ↑

⟶  Depreciation Cost ↑

⟶  Interest on Capital ↑

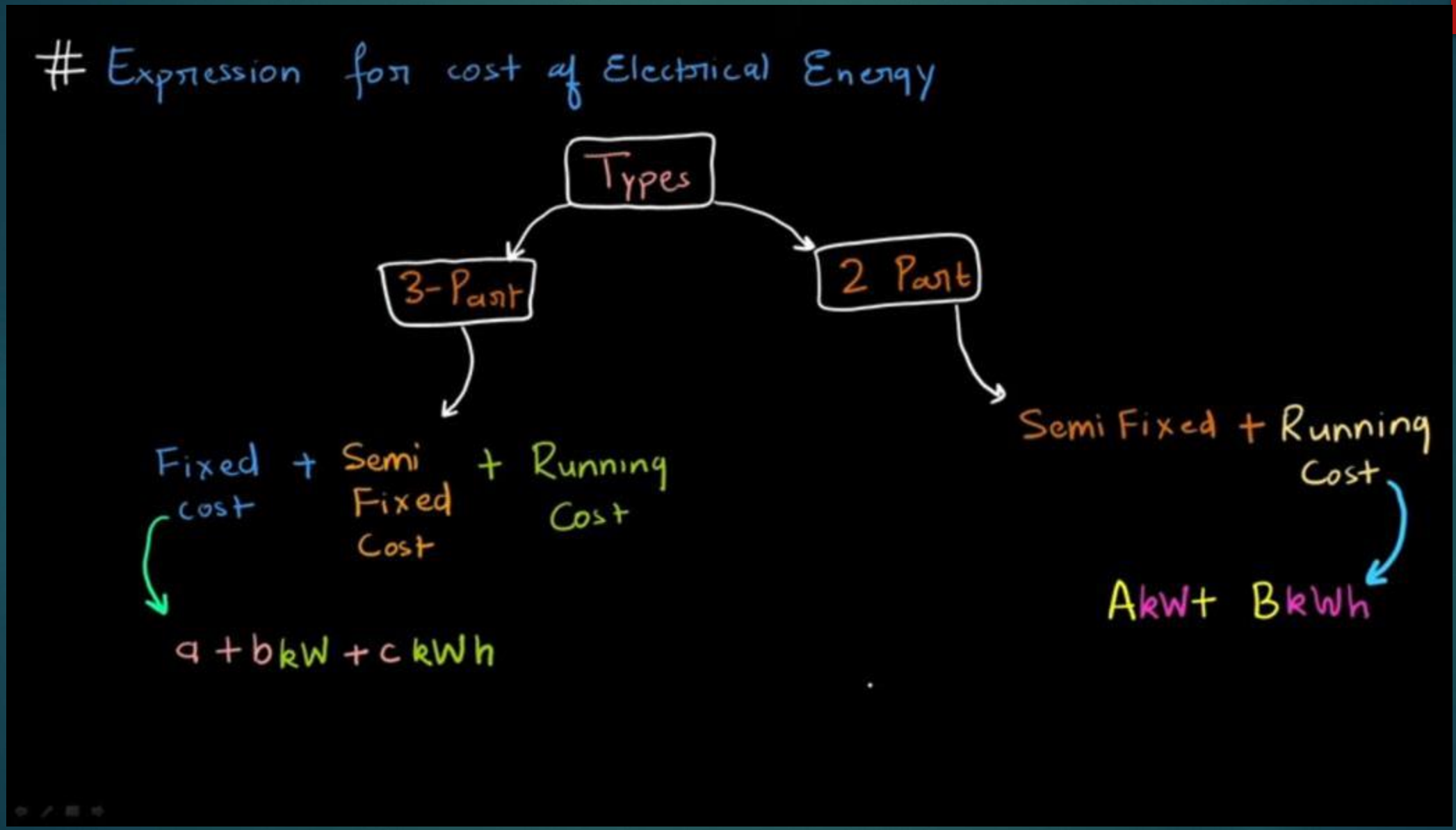
3. Running Cost

"Depends on number of units generated"



* Running Cost = C. kWh

Expression for cost of Electrical Energy



Energy Pricing in India

•Price of energy does not reflect true cost to society. The basic assumption underlying efficiency of market place does not hold in our economy, since energy prices are undervalued and energy wastages are not taken seriously. Pricing practices in India like many other developing countries are influenced by political, social and economic compulsions at the state and central level.

•More often than not, this has been the foundation for energy sector policies in India. The Indian energy sector offers many examples of cross subsidies e.g., diesel, LPG and kerosene being subsidized by petrol, petroleum products for industrial usage and industrial, and commercial consumers of electricity subsidizing the agricultural and domestic consumers.

Energy Pricing in India

•Electricity tariffs in India are structured in a relatively simple manner. While high tension consumers are charged based on both demand (kVA) and energy (kWh), the low-tension (LT) consumer pays only for the energy consumed (kWh) as per tariff system in most of the electricity boards.

•The price per kWh varies significantly across States as well as customer segments within a State. Tariffs in India have been modified to consider the time of usage and voltage level of supply.

•In addition to the base tariffs, some State Electricity Boards have additional recovery from customers in form of fuel surcharges, electricity duties and taxes

Long term energy scenario, energy pricing:

Coal :

- Coal is the predominant energy source for power production in India, generating approximately 70% of total domestic electricity. Energy demand in India is expected to increase over the next 10-15 years; although new oil and gas plants are planned, coal is expected to remain the dominant fuel for power generation.

Oil:

- India's demand for petroleum products is likely to rise from 97.7 million tonnes in 2001-02 to around 139.95 million tonnes in 2006-07, according to projections of the Tenth Five-Year Plan. The plan document puts compound annual growth rate (CAGR) at 3.6 % during the plan period.
- India's self sufficiency in oil has consistently declined from 60% in the 50s to 30% currently

Long term energy scenario, energy pricing

Natural Gas:

- India's natural gas production is likely to rise from 86.56 million cmpd in 2002-03 to 103.08 million cmpd in 2006-07. It is mainly based on the strength of a more than doubling of production by private operators to 38.25 mm cmpd.
- Electricity India currently has a peak demand shortage of around 14% and an energy deficit of 8.4%. Keeping this in view and to maintain a GDP (gross domestic product) growth of 8% to 10%, the Government of India has very prudently set a target of 20,000 MW by 2020.

Energy pricing:

- The Indian energy sector offers many examples of cross subsidies e.g., diesel, LPG and kerosene being subsidized by petrol, petroleum products for industrial usage and industrial, and commercial consumers of electricity subsidizing the agricultural and domestic consumers.
- All the resources (Coal, Oil, Natural Gas, Electricity) having different pricing.

Energy and Environment

The usage of energy resources in industry leads to environmental damages by polluting the atmosphere. Few of examples of air pollution are sulphur dioxide (SO_2), nitrous oxide (NO_X) and carbon monoxide (CO) emissions from boilers and furnaces, chloro-fluro carbons (CFC) emissions from refrigerants use, etc. In chemical and fertilizers industries, toxic gases are released. Cement plants and power plants spew out particulate matter. Typical inputs, outputs, and emissions for a typical industrial process are shown in Figure 1.10.

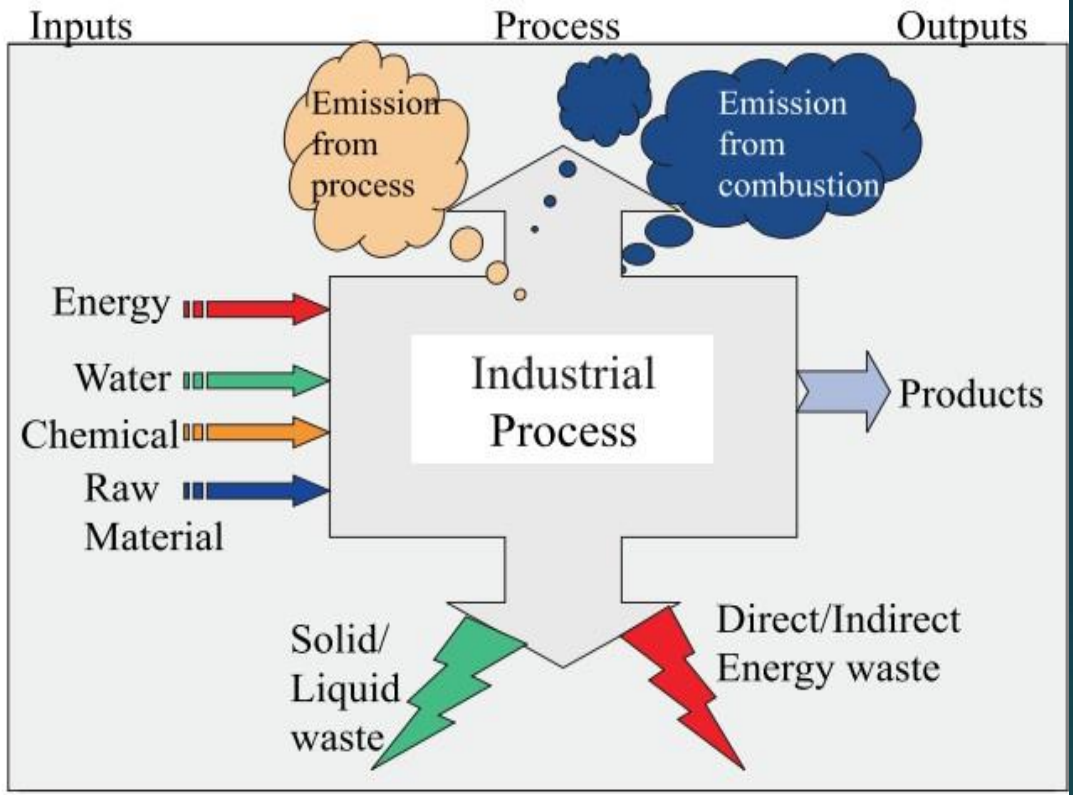


Figure 1.10 Inputs & Outputs of Process

Principle Pollutants

The principle pollutants produced by industrial, domestic and traffic sources are

- Sulphur dioxide
- Nitrogen oxides
- Acidification from SO2 and NO
- Carbon monoxide (CO)
- Ground-level ozone (O3)
- Hydrocarbons
- TOMPs (Toxic Organic Micro pollutants)
- Heavy Metals and Lead

3.1 Definition & Objectives of Energy Management

The fundamental goal of energy management is to produce goods and provide services with the least cost and least environmental effect.

The term energy management means many things to many people. One definition of energy management is:

> *"The judicious and effective use of energy to maximize profits (minimize costs) and enhance competitive positions"*
>
> (Cape Hart, Turner and Kennedy, Guide to Energy Management Fairmont press inc. 1997)

Another comprehensive definition is

> "The strategy of adjusting and optimizing energy, using systems and procedures so as to reduce energy requirements per unit of output while holding constant or reducing total costs of producing the output from these systems"

The objective of Energy Management is to achieve and maintain optimum energy procurement and utilisation, throughout the organization and:

- To minimise energy costs / waste without affecting production & quality
- To minimise environmental effects.

Energy Security

- The basic aim of energy security for a nation is to reduce its dependency on the imported energy sources for its economic growth.
- India will continue to experience an energy supply shortfall throughout the forecast period.
- This gap has widened since 1985, when the country became a net importer of coal.
- India has been unable to raise its oil production substantially in the 1990s. Rising oil demand of close to 10 percent per year has led to sizable oil import bills.

Energy Security

- Some of the strategies that can be used to meet future challenges to their energy security are
- Building stockpiles
- Diversification of energy supply sources
- Increased capacity of fuel switching
- Demand restraint
- Development of renewable energy sources
- Energy efficiency
- Sustainable development.

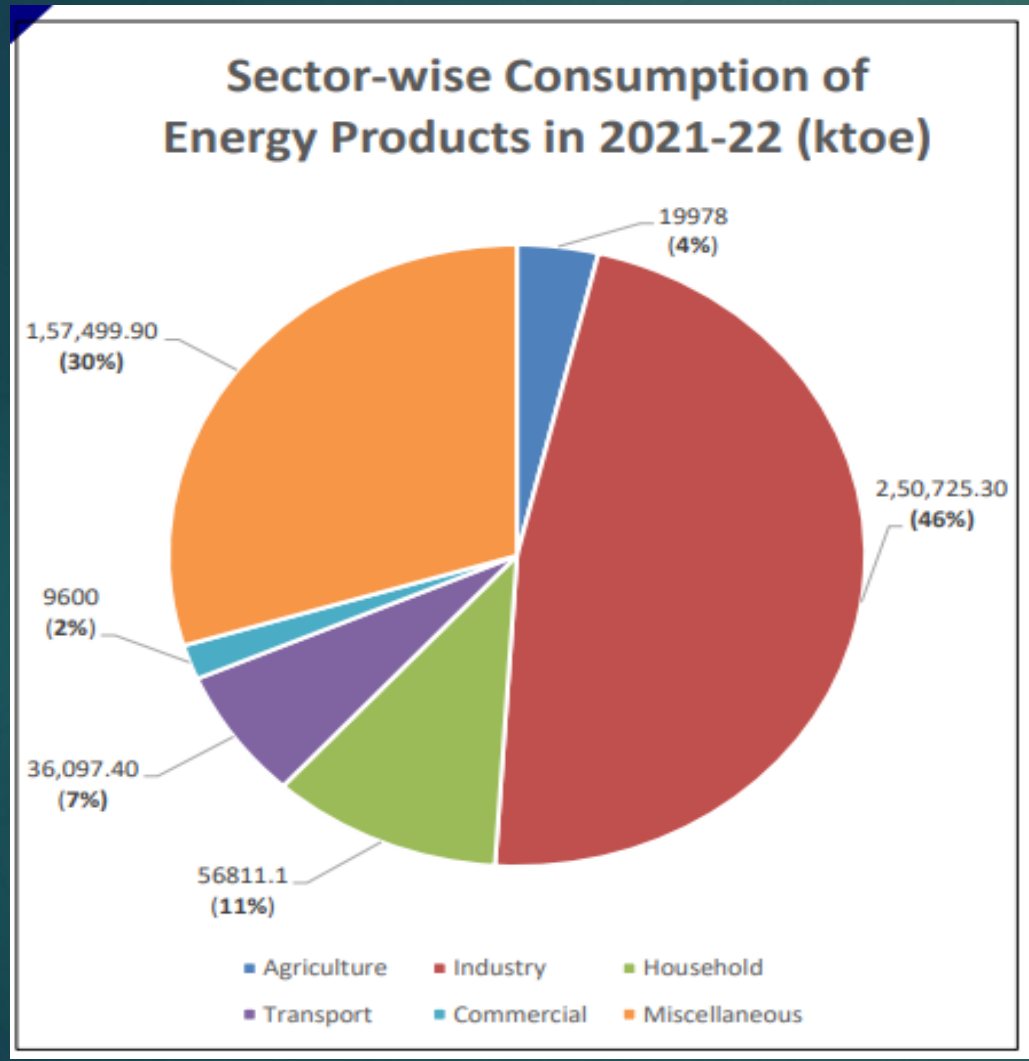
Energy Conservation and its Importance:

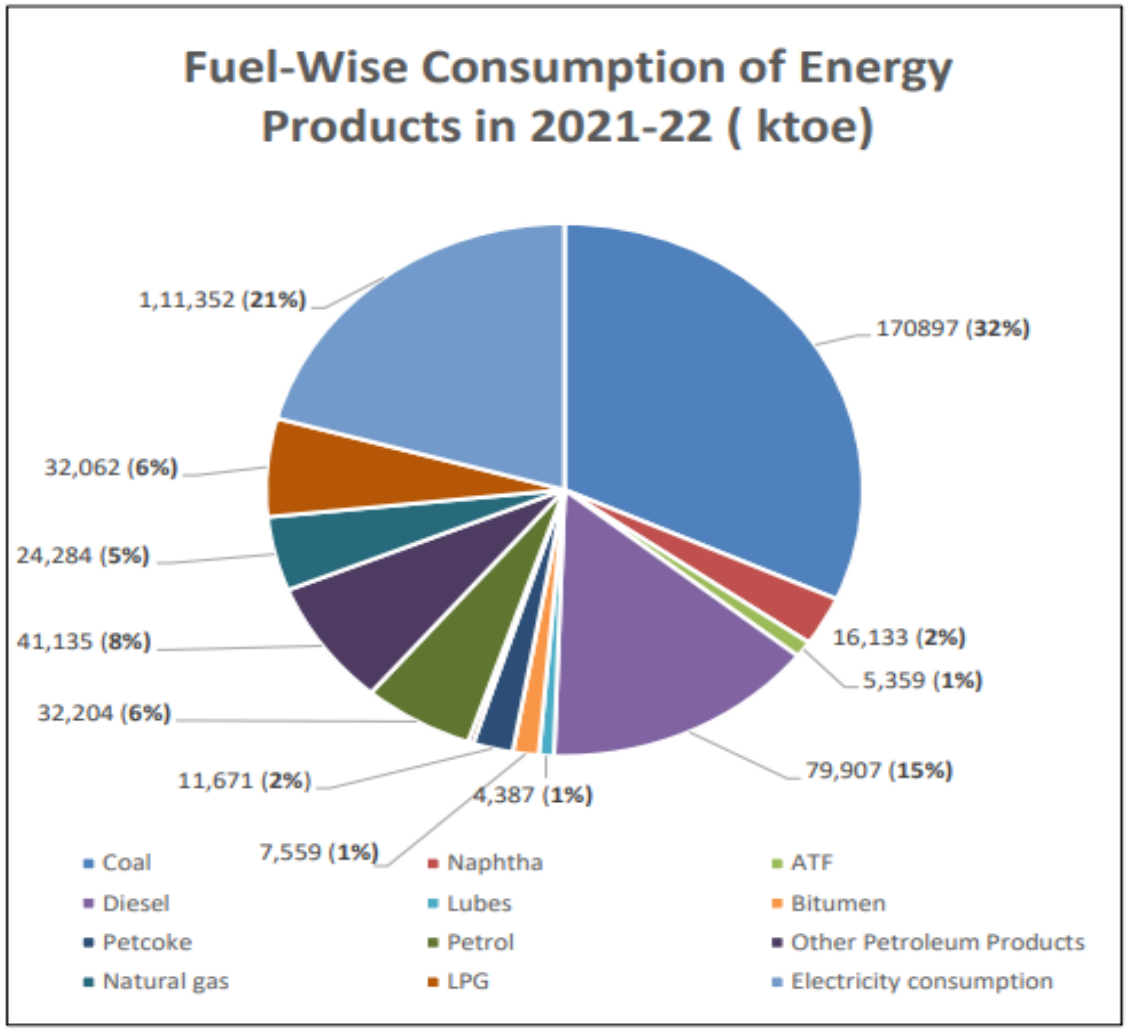
- Energy Conservation and Energy Efficiency are separate, but related concepts.
- Energy conservation is achieved when growth of energy consumption is reduced, measured in physical terms. Energy Conservation can, therefore, be the result of several processes or developments, such as productivity increase or technological progress.
- Coal and other fossil fuels, which have taken three million years to form, are likely to deplete soon.

Contd…

- In the last two hundred years, we have consumed 60% of all resources. For sustainable development, we need to adopt energy efficiency measures.
- Today, 85% of primary energy comes from nonrenewable, and fossil sources (coal, oil, etc.).
- These reserves are continually diminishing with increasing consumption and will not exist for future generations

National Energy consumption Data:





Environmental aspects associated with energy utilization:

- The usage of energy resources in industry leads to environmental damages by polluting the atmosphere.
- Few of examples of air pollution are sulphur dioxide (SO2), nitrous oxide (NOX) and carbon monoxide (CO) emissions from boilers and furnaces, chloro-fluro carbons (CFC) emissions from refrigerants use, etc.
- In chemical and fertilizers industries, toxic gases are released.
- Cement plants and power plants spew out particulate matter.

The Major issues with environment are:

1. Air Pollution
2. Climate Change
3. Greenhouse Effect and Carbon Cycle

The effects of increase in the earth's temperature are as follows:

- Severe Storms and Flooding
- Food Shortages
- Reduced Freshwater supply
- Loss of Biodiversity
- Increased Diseases etc…

Energy Conservation Act, 2001

The **Energy Conservation Act, 2001** is a key legislation in India aimed at promoting energy efficiency and conservation. Here are the main highlights of the Act:

Objectives:

Efficient use of energy: To promote the efficient use of energy and its conservation across various sectors.

Energy standards: To establish energy consumption standards and enforce compliance.

Energy Conservation Act 2001

- With high energy saving potential and its benefits, bridging the gap between demand and supply, reducing environmental emissions through energy saving, and to effectively overcome the barrier, the **Government of India has enacted the Energy Conservation Act - 2001.**
- The Act provides the much-needed legal framework and institutional arrangement for starting an energy efficiency drive.
- Under the provisions of the Act, Bureau of Energy Efficiency would be responsible for implementation of policy programs and coordination of implementation of energy conservation activities.

Features of energy conservation Act,2001

- The Act empowers the Central Government and, in some instances, State Governments to:
- specify energy consumption standards for notified equipment and appliances;
- direct mandatory display of label on notified equipment and appliances;
- prohibit manufacture, sale, purchase and import of notified equipment and appliances not conforming to energy consumption standards;
- notify energy intensive industries, other establishments, and commercial buildings as designated consumers;
- establish and prescribe energy consumption norms and standards for designated consumers;
- prescribe energy conservation building codes for efficient use of energy and its conservation in new commercial buildings having a connected load of 500 kW or a contract demand of 600 kVA and above;

Proposed Amendments

- The amendment has defined the minimum share of renewable energy to be consumed by industrial units or any establishment.
- There is incentivising of efforts to use clean energy by issuing carbon saving certificates.
- It also talks about the strengthening of institutions set up originally under the Act, such as the BEE.

Proposed Amendments

- It will facilitate the promotion of Green Hydrogen as an alternative to the fossil fuels used by industries.

- It includes larger residential buildings under energy conservation standards to promote sustainable habitats.

  - Currently, only large industries and their buildings come under the ambit of the Act.

Carbon Market

- The creation of a domestic carbon market is one of the most significant provisions of the proposed amendment Bill.
- Carbon markets allow the trade of carbon credits with the overall objective of bringing down emissions.
- The provisions relating to setting up a new carbon market are described in Article 6 of the Paris Agreement.

Energy Auditing: Needs, Types:

- As per the Energy Conservation Act, 2001, Energy Audit is defined as…
- “The verification, monitoring and analysis of use of energy including submission of technical report containing recommendations for improving energy efficiency with cost benefit analysis and an action plan to reduce energy consumption".
- The objective of Energy Management is to achieve and maintain optimum energy procurement and utilization, throughout the organization and: To minimize energy costs / waste without affecting production & quality to minimize environmental effects.

Energy Audit Types:

The type of Energy Audit to be performed depends on:

1. Function and type of industry
2. Depth to which final audit is needed
3. Potential and magnitude of cost reduction desired

- Thus Energy Audit can be classified into the following two types.

i) Preliminary Audit

ii) Detailed Audit

Methodology and Barriers:

1. Preliminary Energy Audit Methodology

Preliminary energy audit is a relatively quick exercise to:

- Establish energy consumption in the organization
- Estimate the scope for saving
- Identify the most likely (and the easiest areas for attention
- Identify immediate (especially no-/low-cost) improvements/ savings
- Set a 'reference point'
- Identify areas for more detailed study/measurement
- Preliminary energy audit uses existing, or easily obtained data

2. Detailed Energy Audit Methodology

- Detailed energy auditing is carried out in three phases:

Phase I, II and III.

- Phase I - Pre Audit Phase
- Phase II - Audit Phase
- Phase III - Post Audit Phase

Role and Need of Energy Managers:

"The tasks of energy manger are setting goals, tracking progress, and promoting the energy management program. An Energy Manager helps an organization achieve its goals by establishing energy performance as a core value."

- The Energy Manager is not always an expert in energy and technical systems.
- Successful Energy Manager understands how energy management helps the organization achieve its financial and environmental goals and objectives.
- Depending on the size of the organization, the Energy Manager role can be a full-time position or an addition to other responsibilities.

Contd…

"Energy Manager: Responsibilities and Duties to be Assigned Under The Energy Conservation Act, 2001".

Responsibilities

- Prepare an annual activity plan and present to management concerning financially attractive investments to reduce energy costs.
- Establish an energy conservation cell within the firm with management's consent about the mandate and task of the cell.
- Initiate activities to improve monitoring and process control to reduce energy costs.

Contd....

- Analyze equipment performance with respect to energy efficiency
- Ensure proper functioning and calibration of instrumentation required to assess level of energy consumption directly or indirectly.
- Prepare information material and conduct internal workshops about the topic for other staff.
- Improve disaggregating of energy consumption data down to shop level or profit center of a firm.
- Establish a methodology how to accurately calculate the specific energy consumption of various products/services or activity of the firm.

Instruments for energy auditing:

Energy Audit Instruments

Electrical Measuring Instruments:

These are instruments for measuring major electrical parameters such as kVA, kW, PF, Hertz, kVAr, Amps and Volts. In addition some of these instruments also measure harmonics.

These instruments are applied on-line i.e on running motors without any need to stop the motor. Instant measurements can be taken with hand-held meters, while more advanced ones facilitates cumulativereadings with print outs at specified intervals.

Combustion analyzer:

This instrument has in-built chemical cells which measure various gases such as O2, CO, NOX and SOX.

Fuel Efficiency Monitor:

This measures oxygen and temperature of the flue gas. Calorific values of common fuels are fed into the microprocessor which calcu- lates the combustion efficiency.

Fyrite:

A hand bellow pump draws the flue gas sample into the solution inside the fyrite. A chemical reaction changes the liquid volume revealing the amount of gas. A separate fyrite can be used for O2 and CO2 measurement.

Contact thermometer:

These are thermocouples which measures for example flue gas, hot air, hot water tempera- tures by insertion of probe into the stream.

For surface temperature, a leaf type probe is used with the same instrument.

Infrared Thermometer:

This is a non-contact type measurement which when directed at a heat source directly gives the temperature read out. This instru- ment is useful for measuring hot spots in furnaces, surface temperatures etc.

Power, Past & Present scenario of World:

Coal :

Coal is the most abundant fossil fuel in the world. Coal reserves are available in almost every country in the world.

- The largest coal reserves are available in the USA followed by Russia, China, Australia and India.
- The global coal reserve was estimated to be 891.531 billion tones by the end of 2013. But by the end of 2003, it was estimated to be 984.453 billion tones.

Crude Oil:

- The global proven crude oil reserve was estimated to be 1687 billion barrels by the end of 2013. But by the end of 2003, it was estimated to be 1147 billion barrels.
- Almost 48% of proven oil reserves are in the Middle East countries. Saudi Arabia has the largest share of the reserve with 15.8% followed by Russia and USA.

Power, Past & Present scenario of World:

Natural Gas:

- Natural gas is a gaseous fossil fuel consisting primarily of methane but also includes small quantities of ethane, propane, butane and pentane.
- Natural gas resources are large but they are highly concentrated in few countries. Iran has largest share (18.2%) followed by Russia (16.8%) and Qatar (13.3%). India has only about 0.7% of global natural reserves.
- The global proven natural gas reserve was estimated to be 176 trillion cubic meters by the end of 2003.
- But by the end of 2013, it was estimated to be 186 trillion cubic meters

Sectorial energy consumption:

Domestic, industrial and other sectors:

(In Petajoules)

Year	Coal	Lignite	Crude Oil *	Natural Gas	Electricity #	Total
1	2	3	4	5	6	7
2011-12	9664	476	8547	2483	2827	23996
2012-13	10794	527	9178	2210	2967	25676
2013-14	11186	499	9316	2017	3147	26166
2014-15	12439	534	9347	1976	3415	27711
2015-16	12660	480	9750	2023	3604	28517
2016-17	12667	491	10273	2145	3820	29397
2017-18	13594	527	10549	2279	4044	30993
2018-19	14651	521	10769	2342	4356	32639
2019-20	14463	481	10651	2471	4493	32559
2020-21 (P)	13709	423	9286	2336	4417	30171
% Share in total consumption for 2020-21 (P)	**45.4**	**1.4**	**30.8**	**7.7**	**14.6**	**100.0**
CAGR 2011-12 to 2020-21 (%)	**3.96**	**-1.30**	**0.93**	**-0.67**	**5.09**	**2.58**

*: Crude oil in terms of refinery crude processed. (P): Provisional.

#: Include Hydro, Nuclear and other renewable sources electricity from utilities

Note: Here the value of energy in peta joules relates to the production value from Hydro and Nuclear only. Due to non availability of the data the consumption value is taken equivalent to production value

Sources:

1. *Office of Coal Controller, Ministry of Coal*
2. *Ministry of Petroleum & Natural Gas.*
3. *Central Electricity Authority.*

Sectorial energy consumption:

Domestic, industrial and other sectors:

	Coal	Lignite	Crude	Petroleum Products	Natural Gas	Primary Hydro	Primary Nuclear	Primary Renewables	Electricity	Total
Domestic Production	292.9	12.0	34.2	0.0	23.4	11.6	3.3	11.2	0.0	388.7
Imports	120.1	0.0	226.5	33.3	25.6	0.0	0.0	0.0	0.4	406.0
Exports	0.0	0.0	0.0	61.1	0.0	0.0	0.0	0.0	0.0	61.1
Primary Energy Supply	413.1	12.0	260.7	-27.7	49.0	11.6	3.3	11.2	0.4	733.6
Non-Energy Use	0.0	0.0	0.0	-21.6	-18.3	0.0	0.0	0.0	0.0	-39.9
Statistical Differences	27.9	-0.4	0.0	-1.7	11.9	0.0	0.0	0.0	1.2	38.8
Electricity Plants	-292.8	-10.3	0.0	-0.9	-10.8	-11.6	-3.3	-11.2	141.4	-199.4
Refineries	0.0	0.0	-239.2	239.2	0.0	0.0	0.0	0.0	0.0	0.0
Transformation Losses	0.0	0.0	-21.5	0.0	0.0	0.0	0.0	0.0	-7.4	-28.9
Transport Losses	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-24.3	-24.3
Final Energy Consumption	92.4	2.2	0.0	190.7	16.0	0.0	0.0	0.0	108.9	410.3
Agriculture	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	19.2	20.0
Commercial	0.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0	8.8	11.3
Industry	92.4	2.2	0.0	27.3	4.2	0.0	0.0	0.0	46.7	172.9
Other	0.0	0.0	0.0	91.9	8.2	0.0	0.0	0.0	6.5	106.6
Residential	0.0	0.0	0.0	25.0	0.0	0.0	0.0	0.0	25.9	50.9
Transport	0.0	0.0	0.0	43.4	3.6	0.0	0.0	0.0	1.7	48.7

Bureau of Energy Efficiency

•The **Bureau of Energy Efficiency** is an agency of the Government of India, under the Ministry of Power, created in March 2002 under the provisions of the nation's 2001 Energy Conservation Act.

•The agency's function is to encourage the efficient use of energy in India by developing programs to support it. For example, the government proposed to make it mandatory for certain appliances in India to have ratings by the BEE from January 2010 onwards.

•The mission of the Bureau of Energy Efficiency is to institutionalise energy efficiency services, enable delivery mechanisms in the country and provide leadership to energy efficiency in all sectors of the country. Its primary objective is to reduce energy intensity in the economy.

The primary objective of BEE is to reduce energy intensity in the Indian economy.
In order to translate the objectives into result-oriented action, the broad strategies of BEE include:
To develop policies and programmes on efficient use of energy and its conservation with the involvement of stakeholders.

Bureau of Energy Efficiency (BEE):
BEE was established on 1st March 2002, under the provisions of the **Energy Conservation Act, 2001**, under the **Ministry of Power.**
The mission of BEE is to assist in **developing policies** and strategies for energy efficiency with the primary objective of reducing the **energy intensity** of the Indian economy.

Functions: It is responsible for **regulatory and promotional functions** outlined in the Energy Conservation Act, 2001.

BEE has helped India reduce its energy consumption by around 3.5%.

Bureau of Energy Efficiency

Energy Conservation (EC) Act 2001

- Norms for Energy Intensive Industries
- **Standard & Labeling**
- Energy Conservation Building Code
- Demand Side Management
- Certification of Energy Professionals

BEE Established on 1st March 2002 under EC Act

- Implement regulatory and promotional functions of EC Act.
- Reduce Energy Intensity of our country
- Has State Designated Agencies in each state for enforcement and awareness

Functions of Bureau

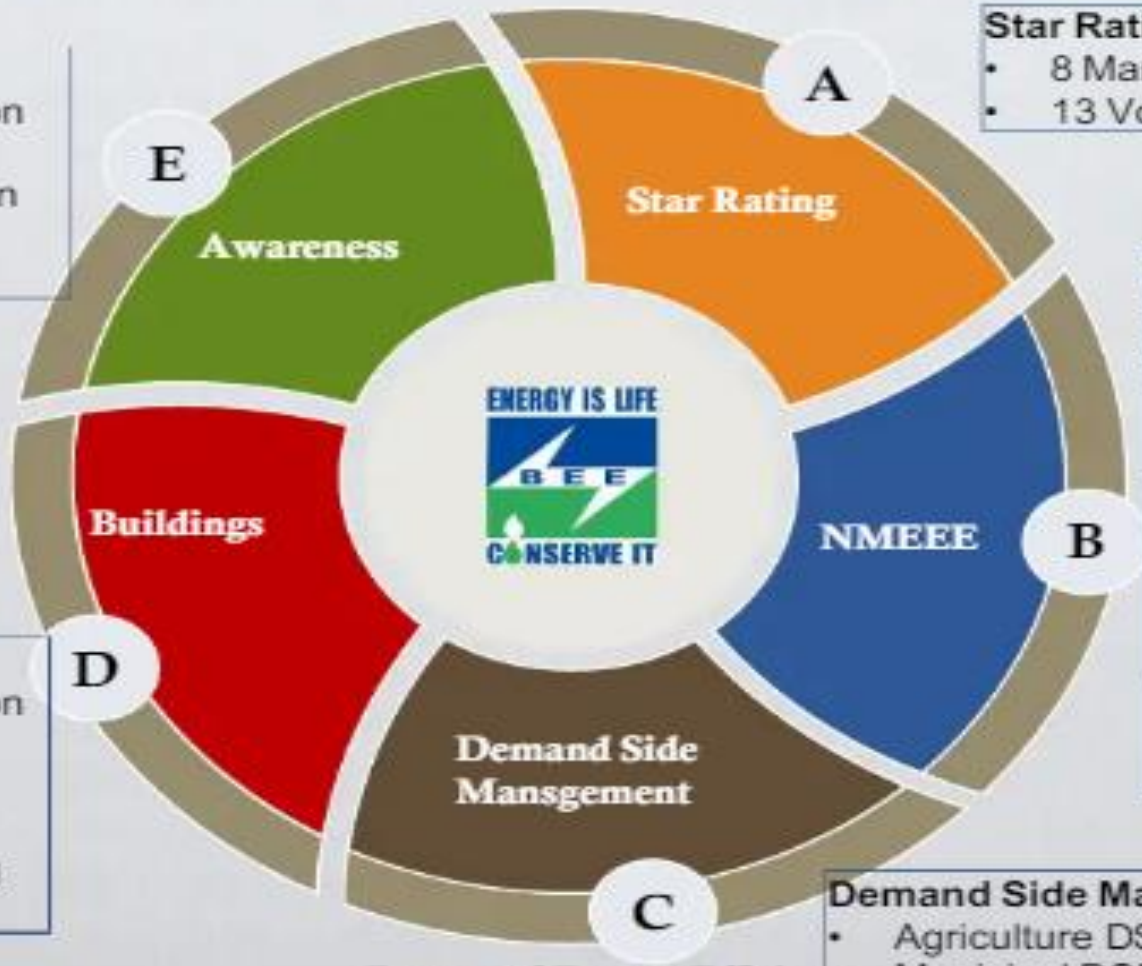
Functions of the Bureau are as follows:

- The process and energy consumption standards required to be notified;
- The labeling of certain equipment requiring some input of energy, along with the prescription about the display of standards upon such labels;
- To notify users or class of users as 'designated consumers' under this law.

In addition to these, the Bureau according to its functions under the law has to take suitable steps to:

- create awareness and disseminate information for efficient use of energy and conservation
- training of personnel;
- strengthen consultancy services;
- promote research and development in the field of energy efficiency
- the develop good testing and certification procedure;
- promote use of energy efficient process, equipment, devices and systems;
- promote innovative financing of energy efficiency projects; etc.

BEE Portfolio



Awareness
- Energy Conservation Awards
- Painting Competition
- State Designated Agencies

Star Rating of Appliances
- 8 Mandatory Labelled Appliances
- 13 Voluntary Labelled Appliances

National Mission for Enhanced Energy Efficiency
- Perform, Achieve & Trade (PAT)
- Market Transformation for Energy Efficiency (MTEE)
- Framework for Energy Efficient Economic Development (FEEED)
- Energy Efficiency Financing Platform (EEFP)

Buildings
- Energy Conservation Building Codes
- Retrofit in old buildings
- Residential Building Guidelines

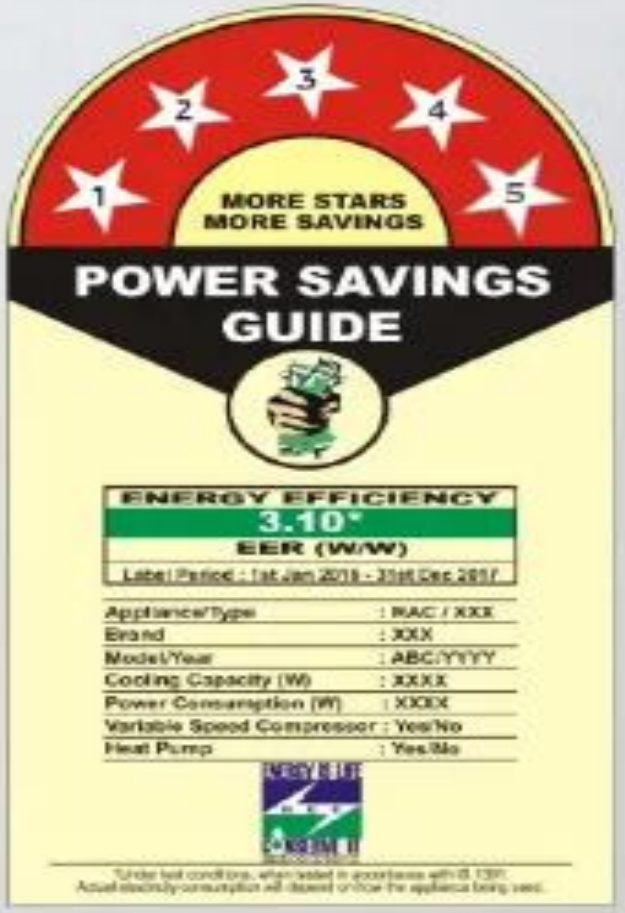
Demand Side Management
- Agriculture DSM
- Municipal DSM
- Energy Efficiency in SMEs

Why Star Labeling?

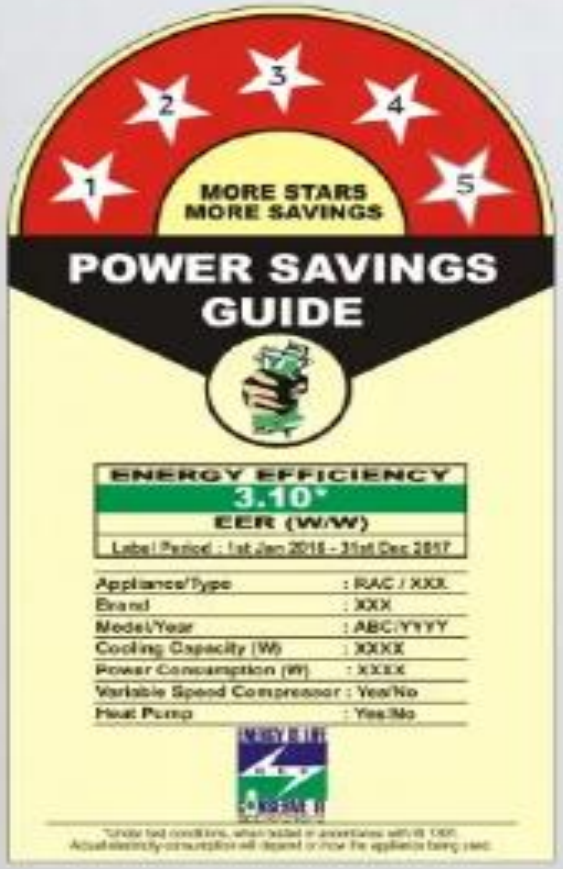
- Wide variation in energy consumption by products of manufacturers is observed.
- Information on energy consumption is often not easily available, sufficient or easy to understand from the nameplate.
- Lead to continued manufacture and purchase of inefficient equipment and appliances.

History and Success

- Started in Poland way back in 1962
- Worldwide 65 countries implemented including California USA in 1976
- Australia, Canada, China, Brazil, Thailand, Japan, and the United Kingdom (U.K.)

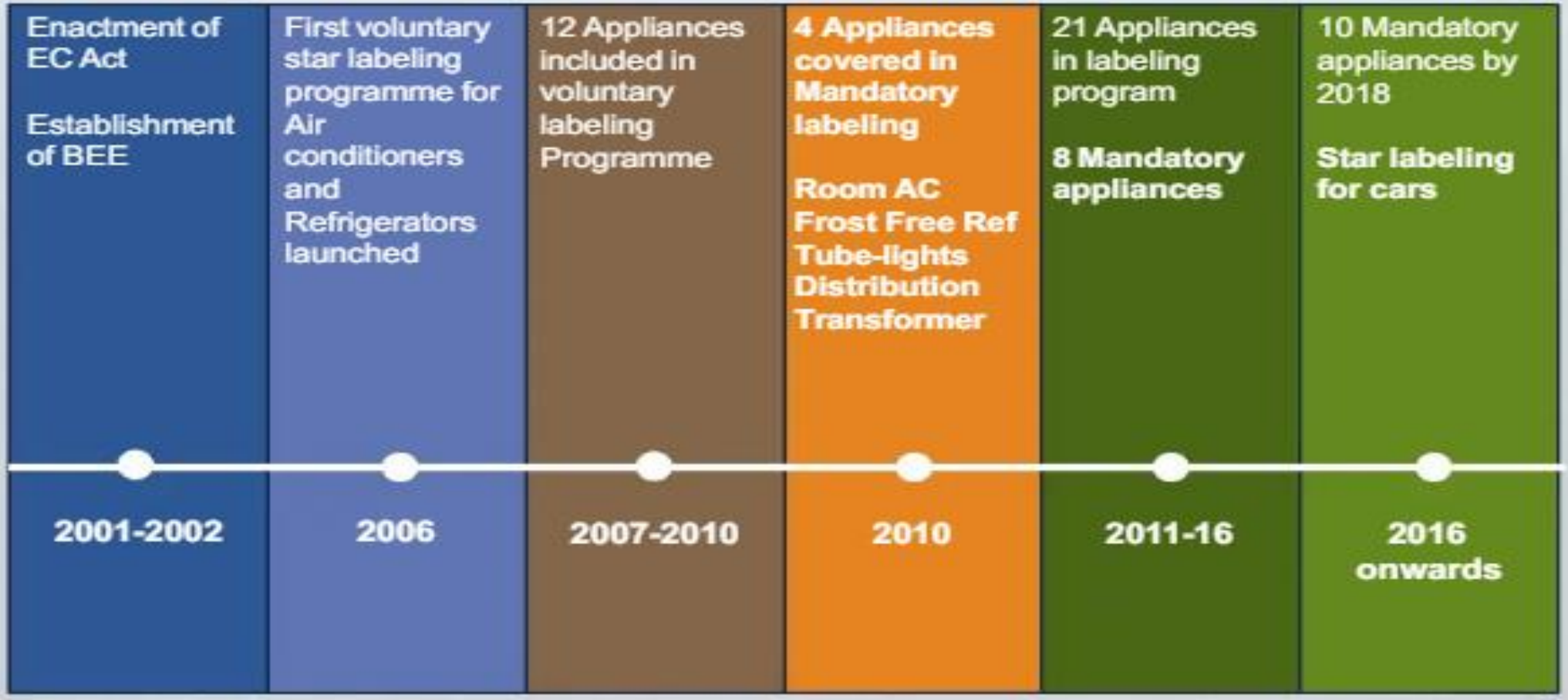


Brand – Star Label



- Voluntary labels for refrigerators and air conditioners introduced in December 2006
- Aggressive advertising and outreach promoted labels as a brand of superior products – manufacturers piggybacked on label advertising
- Labeled products bought for check testing
- Labeling seldom works if payback period is more than 4-5 years; maximum sales is of products with 2-3 years payback

Journey so far.



What is standard or label?

What is Standards?

- Prescribe limits on the energy consumption (or minimum levels of the energy efficiency) of manufactured products.
- "Standards" commonly encompasses two possible meanings:
  - well-defined test protocols to obtain a sufficiently accurate estimate
  - target limits on energy performance

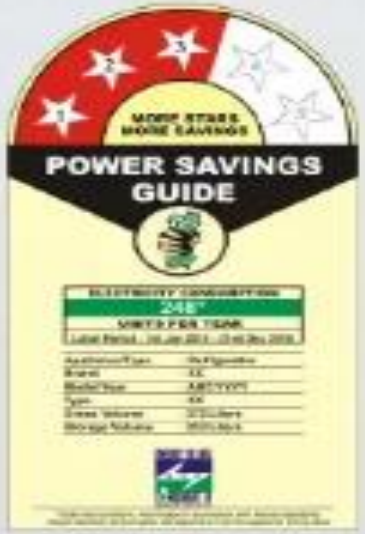
What is Label?

- Describes energy performance (in the form of energy use, efficiency or energy cost)
- "Labels" mainly give consumers the necessary information to make informed purchase. There are two types of labels:

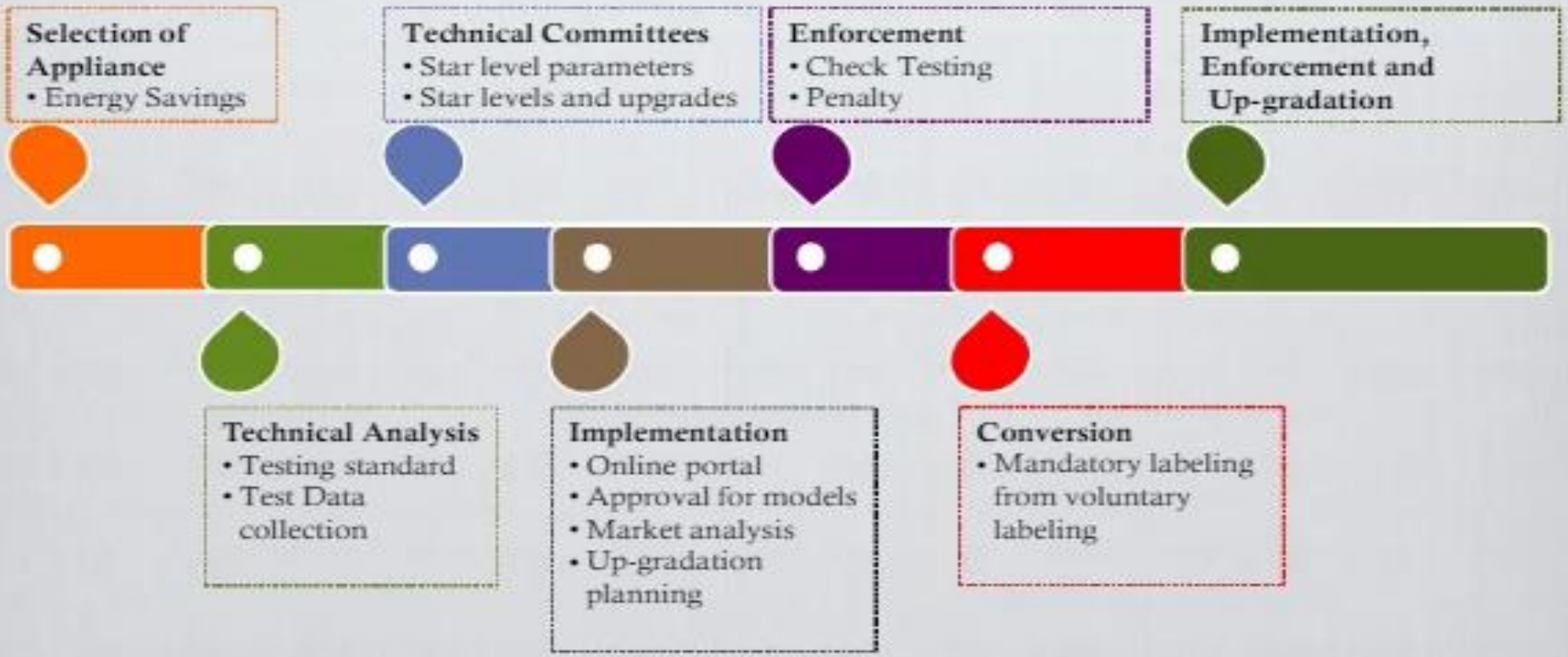
Comparative Label	Endorsement Label
Allow consumers to compare the energy consumption of similar products, and factor lifetime running cost into their purchasing decision	Provide a 'certification' to inform prospective purchasers that the product is highly energy efficient for its category.

Type of Labels

Comparative Labels



Typical Cycle for Each Appliance



Voluntary to Mandatory Labeling

Voluntary Phase	Transition Phase	Mandatory Phase
After 2-3 years of the launch of the voluntary scheme, **Bureau** conduct market assessment to evaluate the market transformation; **Study** for enhancement in technology and related institutional requirements for transition from voluntary to Mandatory Phase	**For transition**: **BEE sends** draft proposal to Ministry of Power. **Once approved by MoP**, proposal is forwarded to Ministry of Law for legal vetting. **Draft approved** by MoL sent back to MoP. ***Draft regulations*** *published in official gazette for seeking public comments* ***Draft regulations***, *modified if required and again sent to MoP and MoL.* ***Once approved***, *regulation is notified in official gazette*	After regulation is notified in the official gazette, it becomes mandatory to display the star rating label on the appliance from the date of commencement of the regulation in the public domain.

List of Appliances

Mandatory

- Room Air Conditioners
- Frost Free Refrigerator
- Tubular Florescent Lamp
- Distribution Transformer
- Room Air Conditioner (Cassette, Floor Standing)
- Direct Cool Refrigerator
- Color TV
- Electric Geysers

Voluntary

- Induction Motors
- Pump Sets
- Ceiling Fans
- LPG-Stoves
- Washing Machine
- Computer (Notebook/Laptops)
- Ballast (Electronic/Magnetic)
- Office Equipment's (Printer, Copier, Scanner, MFD's)
- Diesel Engine Driven Mono-set Pumps
- Solid State Inverter
- DG Sets
- Variable Capacity Inverter Air Conditioners
- LED Lamps