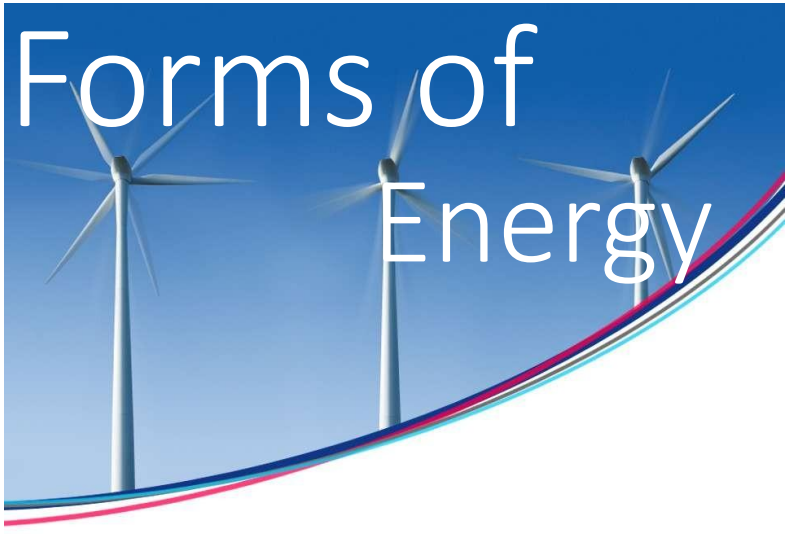
ज्ञानेन प्रकाशते जगत्
INDUS UNIVERSITY
WHERE PRACTICE MEETS THEORY

Subject: Energy Management (OE V)

Subject Code: ME0437

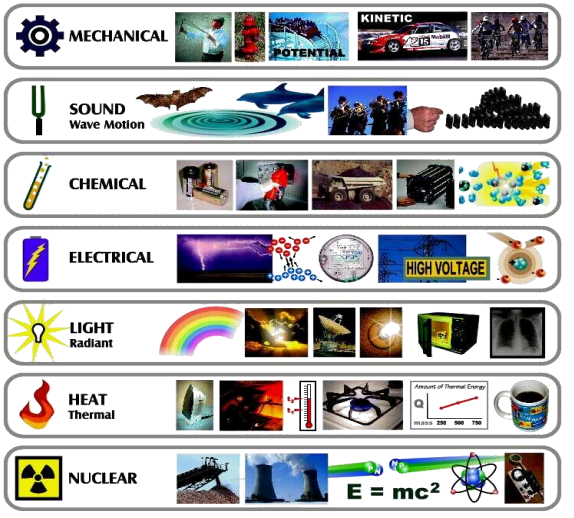
Unit No. 1

Topic : Energy Scenario



DIFFERENT FORMS OF ENERGY

- *Energy cannot be created or destroyed, it can only be changed from one form to another.*
- Energy comes in six forms: **chemical energy**, **electromagnetic energy**, **radiant energy**, **mechanical energy**, **nuclear energy** and **thermal energy**.
- These six forms of energy are all related. Each form can be converted or changed into the other forms. For example, when wood burns, its chemical energy changes into thermal (heat) energy and radiant (light) energy.



FORMS OF ENERGY

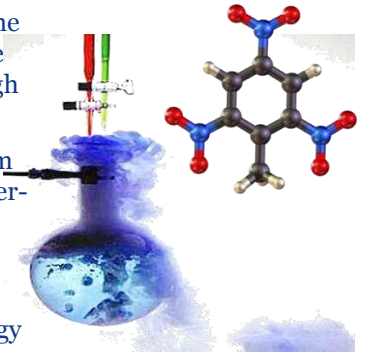
MECHANICAL ENERGY

- Mechanical Energy is the energy a substance or system has because of its motion(K.E.) and position(P.E).
- The Mechanical energy stays alive along with both the kinetic energy and the potential energy which is available in the system.
- Every moving object has mechanical energy, whether it is a hammer driving a nail, a leaf falling from a tree, or a rocket flying in space. Mechanical energy pulls, pushes, twists, turns and throws.
- Our bodies also use mechanical energy to perform motions such as throwing a ball or moving a pencil to write on paper.

MECHANICAL ENERGY

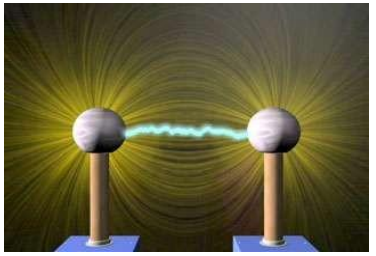
CHEMICAL ENERGY

- The motive force that powers the human body, is provided by the chemical energy derived through the process of respiration.
- Chemical energy is derived from the making and breaking of inter-atomic bonds in molecules.
- Through molecular rearrangements, the biological world derives energy. The energy derived from gasoline is an example of chemical energy utilization.



ELECTROMAGNETIC ENERGY

- Energy from a magnetic field that is produced by the motion of electric charges such as electric current.
- Electromagnetic radiation exists in the form of particles called photons. Each particle or photon is an extremely small grain of energy - an energy packet.
- Electromagnetic energy is said to be the type of energy which comes from electromagnetic waves. These radiation travels with the speed of light and can be composed of radio waves, TV waves, radar waves, heat, light, X-rays, visible waves, etc.
- The Sun, the earth and the ionosphere are main sources of electromagnetic energy in nature.

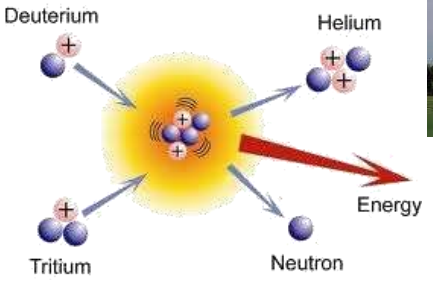


Electromagnetic Energy

NUCLEAR ENERGY

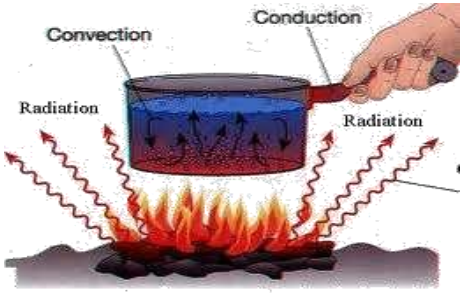
- Nuclear energy originates from the splitting of uranium atoms in a process called fission..
- When the nucleus splits (fission), nuclear energy is released in the form of heat energy and light energy.
- Nuclear energy is also released when nuclei collide at high speeds and join (fuse).
- The sun's energy is produced from a nuclear fusion reaction in which hydrogen nuclei fuse to form helium nuclei.
- Nuclear energy starts with Albert Einstein—his classic formula, $\mathbf{E = mc^2}$ actually describes how much energy is released when an atom splits.

NUCLEAR Energy



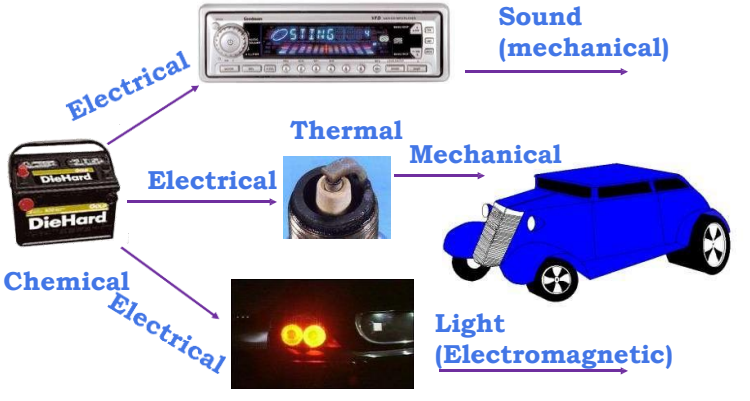
THERMAL ENERGY

- Thermal Energy is a form of internal energy possessed by all material matter due to random motion of atoms and minute particles(kinetic molecular model of matter), and the amount depends on the temperature of the material region.
- Thermal Energy is transferred only when there is a difference in temperature.
- Thermal Energy always flows from a region of higher temperature to a region of lower temperature.



THERMAL ENERGY

ENERGY TRANSFER



ENERGY CONVERSIONS IN MOTORS

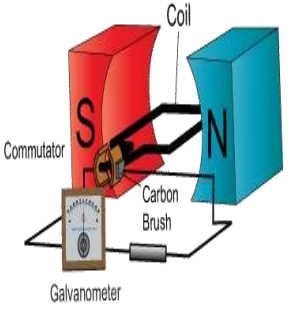
- Electric motors, which convert **electrical energy** to **mechanical energy.**
- Magnetism is the basis for all electric motor operation. It produces the force required to run the motor.
- When current passes through a coil of wire, magnetic field is produced.
- Electric motors operate through the interaction f magnetic field and current - carrying conductors to generate force.

ENERGY CONVERSIONS IN GENERATORS

- **Electric generator** is a device that converts mechanical energy to electrical energy.
- A generator forces electric charge (usually carried by electrons) to flow through an external electrical circuit.

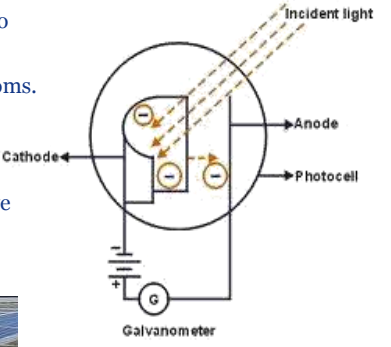
ENERGY CONVERSIONS IN GENERATORS

- The generator is based on the principle of "electromagnetic induction".
- An electric conductor is moved through a magnetic field, electric current will flow in the conductor.
- So the mechanical energy of the moving wire is converted into the electric energy of the current that flows in the wire.
- In a generator The energy conversion occurs when a coil of conducting wire is rotated between two different poles of two permanent magnets.



ENERGY CONVERSIONS IN PHOTOCELLS

- Photocells convert light energy into electrical energy.
- Most photocells contain silicon atoms. As long as a light shines on the photocell, electrons gain enough energy to move between atoms.
- The electrons are then able to move though a wire to provide electrical energy to a device, such as a calculator.



WIND ENERGY

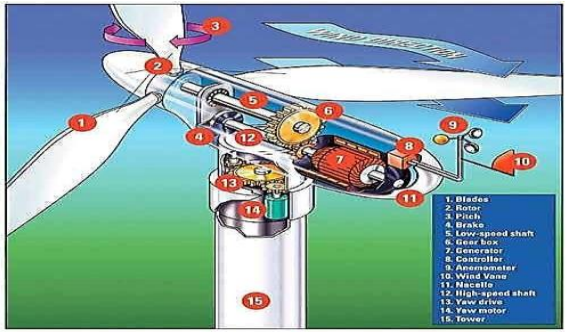
Wind power

- Airflows can be used to run wind turbines. Modern wind turbines range from around 600 kW to 5 MW of rated power, although turbines with rated output of 1.5–3 MW have become the most common for commercial use; the power output of a turbine is a function of the cube of the wind speed, so as wind speed increases, power output increases dramatically.

WIND ENERGY

- Areas where winds are stronger and more constant, such as offshore and high altitude sites, are preferred locations for wind farms. Typical capacity factors are 20-40%, with values at the upper end of the range in particularly favorable sites.

WIND ENERGY



WIND ENERGY

- Globally, the long-term technical potential of wind energy is believed to be five times total current global energy production, or 40 times current electricity demand. This could require wind turbines to be installed over large areas, particularly in areas of higher wind resources. Offshore resources experience mean wind speeds of ~90% greater than that of land, so offshore resources could contribute substantially more energy.

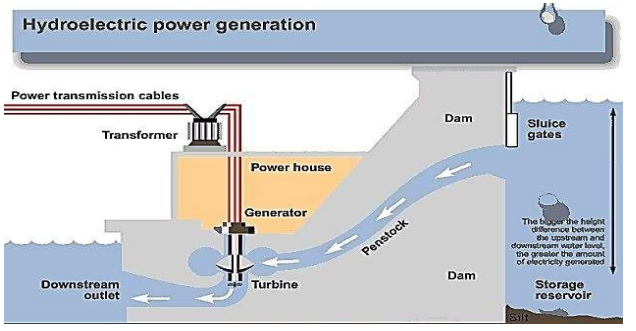
Hydropower

- Energy in water can be harnessed and used. Since water is about 800 times denser than air, even a slow flowing stream of water, or moderate sea swell, can yield considerable amounts of energy.
- There are many forms of water energy:

Micro hydro systems are hydroelectric power installations that typically produce up to 100 kW of power. They are often used in water rich areas as a remote-area power supply (RAPS). There are many of these installations around the world, including several delivering around 50 kW in the Solomon Islands.

Damless hydro systems derive kinetic energy from rivers and oceans without using a dam. Ocean energy describes all the technologies to harness energy from the ocean and the sea. This includes marine current power, ocean thermal energy conversion, and tidal power.

Hydropower



Hydropower

Solar energy

- Solar energy is the energy derived from the sun through the form of solar radiation. Solar powered electrical

• generation relies on photovoltaic and heat engines. A partial list of other solar applications includes space heating and cooling through solar architecture, day lighting, solar hot water, solar cooking, and high temperature process heat for industrial purposes.

Solar energy

- Solar technologies are broadly characterized as either passive solar or active solar depending on the way they capture, convert and distribute solar energy. Active solar techniques include the use of photovoltaic panels and solar thermal collectors to harness the energy. Passive solar techniques include orienting a building to the Sun, selecting materials with favorable thermal mass or light dispersing properties, and designing spaces that naturally circulate air.

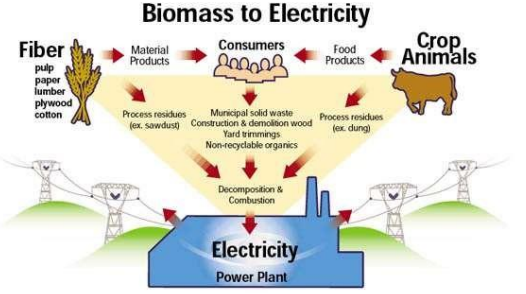
Biomass

Biomass (plant material) is a renewable energy source because the energy it contains comes from the sun. Through the process of photosynthesis, plants capture the sun's energy. When the plants are burned, they release the sun's energy they contain. In this way, biomass functions as a sort of natural battery for storing solar energy. As long as biomass is produced sustainably, with only as much used as is grown, the battery will last indefinitely.

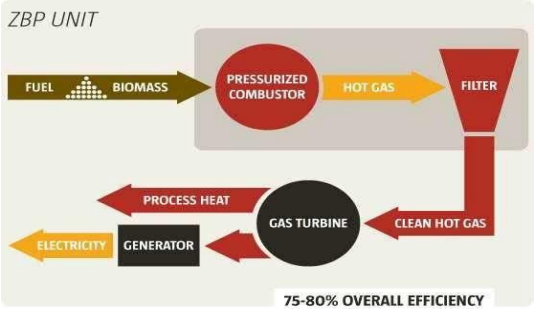
In general there are two main approaches to using plants for energy production: growing plants specifically for energy use, and using the residues from plants that are used for other things. The best approaches vary from region to region according to climate, soils and geography.


Sewage
Municipal Solid Waste
Agricultural Crops & Residues
Biomass Sources
Animal Residues
Forestry Crops & Residues
Industrial Residues
Biomass Innovation Centre

Biomass

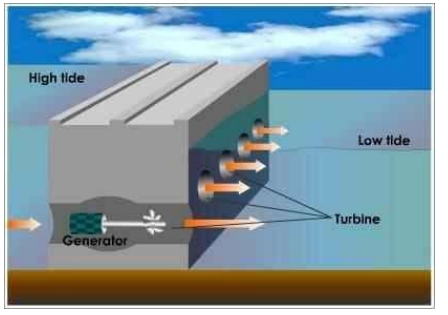

Biomass to Electricity
Fiber
pulp
paper
lumber
plywood
cotton
Material Products
Consumers
Food Products
Crop Animals
Process residues (ex. sawdust)
Municipal solid waste
Construction & demolition wood
Yard trimmings
Non-recyclable organics
Process residues (ex. dung)
Decomposition & Combustion
Electricity
Power Plant

Biomass

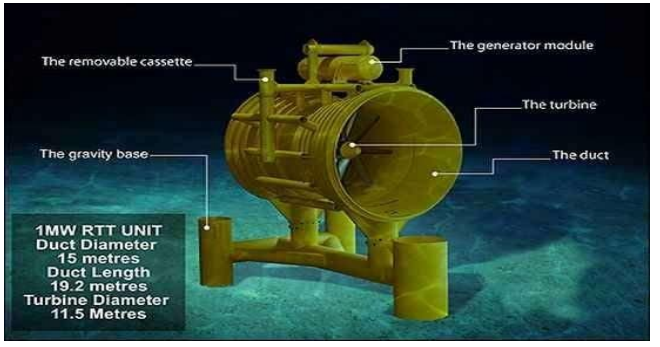


Tidal Energy

- This is another unlimited and inexhaustible source of energy. The Gulfs of Kutch is preferably suited to build up electricity from the energy produced by high and lofty tides entering into slender creeks.



Tidal Energy

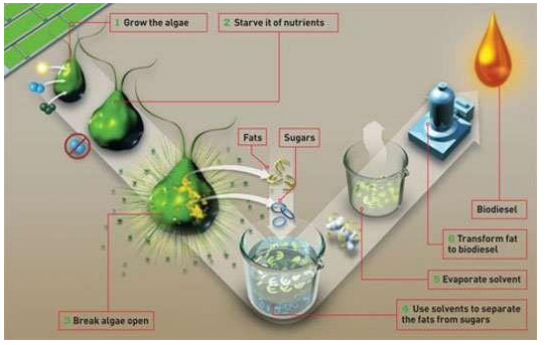


Tidal Energy

Biofuel

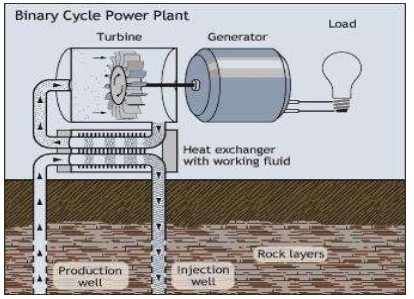
- Liquid biofuel is usually either bio alcohol such as bioethanol or an oil such as biodiesel. Bioethanol is an alcohol made by fermenting the sugar components of plant materials and it is made mostly from sugar and starch crops. With advanced technology being developed, cellulosic biomass, such as trees and grasses, are also used as feedstock for ethanol production. Ethanol can be used as a fuel for vehicles in its pure form, but it is usually used as a gasoline additive to increase octane and improve vehicle emissions.
- Biodiesel is made from vegetable oils, animal fats or recycled greases. Biodiesel can be used as a fuel for vehicles in its pure form, but it is usually used as a diesel additive to reduce levels of particulates, carbon monoxide, and hydrocarbons from diesel-powered vehicles. Biodiesel is produced from oils or fats using trans esterification.

Biofuel



Geothermal energy

- Geothermal energy is energy obtained by tapping the heat of the earth itself, both from kilometers deep into the Earth's crust in volcanically active locations of the globe or from shallow depths, as in geothermal heat pumps in most locations of the planet. It is expensive to build a power station but operating costs are low resulting in low energy costs for suitable sites. Ultimately, this energy derives from heat in the Earth's core.



Geothermal energy

- Three types of power plants are used to generate power from geothermal energy: dry steam, flash, and binary.
- Dry steam plants take steam out of fractures in the ground and use it to directly drive a turbine that spins a generator.
- Flash plants take hot water, usually at temperatures over 200 °C, out of the ground, and allows it to boil as it rises to the surface then separates the steam phase in steam/water separators and then runs the steam through a turbine.
- In binary plants, the hot water flows through heat exchangers, boiling an organic fluid that spins the turbine. The condensed steam and remaining geothermal fluid from all three types of plants are injected back into the hot rock to pick up more heat.
- The geothermal energy from the core of the Earth is closer to the surface in some areas than in others. Where hot underground steam or water can be tapped and brought to the surface it may be used to generate electricity.

Advantages of renewable energy sources

- Renewable energy sources consist of solar, hydro, wind, geothermal, ocean and biomass. The most common advantage of each is that they are renewable and cannot be depleted.
- They are clean energy, as they don't pollute the air, and they don't contribute to global warming or greenhouse effects.
- Since their sources are natural the cost of operations is reduced and they also require less maintenance on their plants.

Disadvantages of Renewable energy sources

A common disadvantage to all is that it is difficult to produce the large quantities of electricity their counterpart the fossil fuels are able to. Since they are also new technologies, the cost of initiating them is high.

- wind : turbines are expensive. Wind doesn't blow all the time, so they have to be part of a larger plan.
- Solar :panels are expensive. Governments are not all willing to buy home generated electricity. Not all climates are suitable for solar panels.
- waves : different technologies are being tried around the world. Scientists are still waiting for the killer product.
- tides : barrages (dams) across river mouths are expensive to build and disrupt shipping. Smaller turbines are cheaper and easier to install.

Disadvantages of Renewable energy sources

- Rivers : Dams are expensive to build and disrupt the environment. They have also caused earthquakes.
- Geothermal : Difficult to drill two or three kilometers down into the earth.
- Biofuel : Often uses crop lands and crops (like corn) to produce the bio-alcohol. This means that more land has to be cleared to grow crops, or there is not enough food, or that food becomes more expensive.

CLASSIFICATION OF NATURAL RESOURCES

What are resources?

Any material which is part of earth and **satisfy human need** and add value is called as resource.

Materials occurring in the environment thus are nothing more than 'neutral matter' until people recognize their presence, attach great importance to them, and develop means to capitalize on them. Then the natural materials **fulfill a function**

Example: rocks, minerals, soil, rivers, plants & animal.

Human is a resource because developing his skill, he can develop other resource by adding value to the physical material .

- Resources are commonly classified with respect to their exhaustibility.
- The differentiation between exhaustible and inexhaustible resources only focuses on their quantitative availability and not on their potential for natural growth and recycling.
- **Renewable** and **non-renewable** resources. This differentiation is by no means identical to the exhaustibility classes.
- Renewable resources (animals, tree species) **are exhaustible**
- **Non-renewable** resources (stones, different metals) **are**, economically speaking, **inexhaustible**.

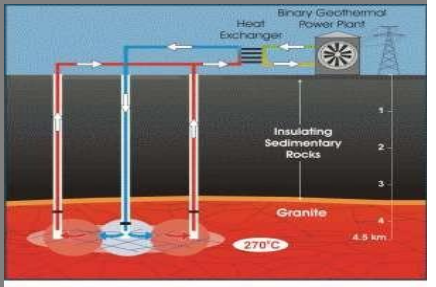
Inexhaustible Resources

Inexhaustible resources are resources that will never run out.

Non-renewable resources (stones, different metals) are, economically speaking, inexhaustible.

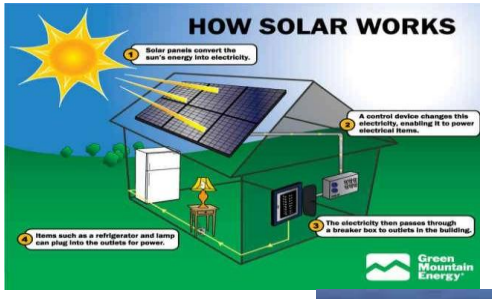
Examples:

geothermal sources



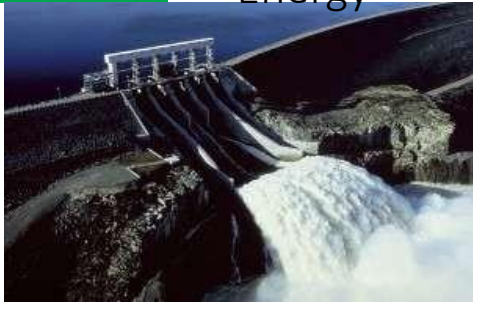
Tidal energy

Wind



Solar Energy

Running Water



Types Of Resources

Natural Resources

Human Resources

Man-made Resources

Natural Resources

All of Earth's organisms, air, water and soil as well as oil, gas and ores that are removed from the ground

List of Natural Resources

Forest resources (pertaining to plant and tree life)

Aquatic / Marine resources

Hydro geological resources (water bodies of all kinds)

Animal resources (domesticated animals, or those that can be easily approached by humans)

Microbial resources (organisms that aren't visible to the naked eye)

Human resources (the population at large)

Atmospheric resources (anything that humans cannot control - rainfall, sunlight, temperature, and the like)

Crop resources (agricultural growth)

Geological resources (naturally occurring formations - rocks, valleys, minerals, precious metals, and the like)

Edaphic resources (anything related to the soil and its properties)

Wildlife resources

Category Of Natural Resource

Renewable

non-Renewable

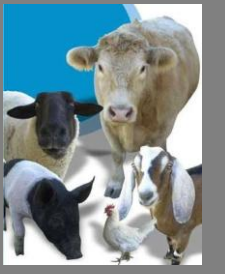
Renewable Resource

- are resources that have a continuing process of renewal and supply in nature
- commonly named "flow resources", as it is possible to maintain use indefinitely, provided the production (the flow) continues.
- Example: solar energy crops (food and fiber)

water soil
air wind
biomass organic matter
wood geothermal energy

Food and Fiber

- **Crops grown for human and livestock consumption**
- **Wild and planted forest crops**
- **Wild and domesticated animals**



Have to be careful not to use these faster than we can replenish them

Soil

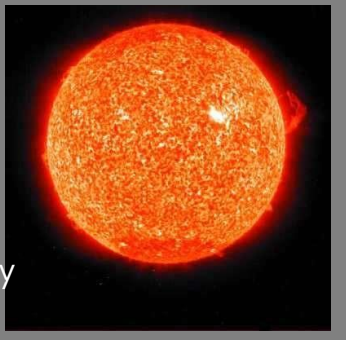
Mixture of living and nonliving things (tiny rocks, minerals, organic matter, water and air) that provides habitat for plants and organisms.

Takes thousands of years to form

- Hot, humid climates form larger amounts more quickly
- Dry climates form small amount over longer periods

Soil only "renewable" as long as living organic matter stays fertile.

Sun



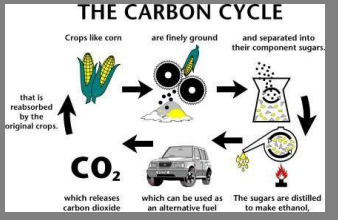
- **Solar energy**
  - **Provides heat and light**
- Provides energy needed by autotrophs (producers) to produce their own food
- **Essentially inexhaustible; estimated that it can continue to provide energy for 5 billion years**

Water

- Amount of water on Earth today is same as when Earth was formed
- Constantly cycles and changes form
- Only 3 percent is fresh water for use
- In many parts of world, clean, unpolluted water becoming scarce

- **Water used to generate energy**

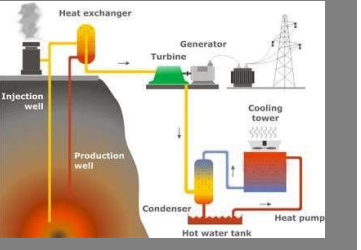
Biomass Fuels



- **Organic matter that contain stored solar energy**
  - **Mostly plant parts; wood, dried vegetation, crop residues and aquatic plants**
  - **Some derived from animal wastes**
- **Become one of the most commonly used and renewable energy sources**

Geothermal Energy

- Heat generated deep within the Earth
- Fueled by the decay of radioactive elements
- Heat is transferred by water that absorbs heat from center of Earth
- Used to drive electric generators and heat buildings
- Inexhaustible energy source



Non-Renewable

- types of resources whose physical quantity does not increase significantly with time
- the rate of renewal is so slow as to be negligible
- The non-renewable resources are often defined as "stock resources". The total supply of the resource is limited in quantity, and each rate of use diminishes some future rate of use.
- Most developed nations are dependent on *non-renewable* energy sources such as fossil fuels (coal and oil) and nuclear power.
- Industrialized societies depend on non-renewable energy sources.

Example Of Non-Renewable Resource

COAL

OIL

NATURAL GAS

OIL SHALE ANDTAR SANDS

NUCLEAR POWER

Ores

Rocks

Petroleum and Natural Gas

Ores

•Mineral deposits from which valuable metals and nonmetals can be recovered at a profit

•Metallic Ores:
iron, aluminum, copper, zinc, lead, silver, gold, manganese and others

•Non metallic Ores:
fluorite, salt, clay, sand, gravel, quartz, diamonds, gypsum, sulfur, talc and others

Rocks

•Mixtures of one or more minerals

•Marble, sandstone, granite, limestone shale and slate

•Mostly used as ornamental stones in buildings and the grounds around them

Fossil Fuels

- **Fossil fuels do NOT come from dinosaurs! They come from decayed plant and animal remains from the ocean. From the TIME of the dinosaurs!**

Coal

- Fossil fuel that forms when wetland plants die, become buried, and undergo physical and chemical changes over millions of years
- Starts out as peat~50% carbon
- Over time peat becomes lignite ~ 70 % carbon
- Lignite becomes bituminous coal (soft coal) ~ 85 % carbon
- Bituminous coal becomes anthracite (hard coal) > 90% carbon… burns very cleanly

Petroleum and Natural Gas

- Fossil fuels that are the remains of plants, bacteria, algae, and other microscopic marine organisms
- Oil well drilled in Titusville PA in 1859 marked the beginning of the oil boom in US
- Source rocks: rocks in which oil and gas form
- Reservoir rocks: rocks that collect flowing oil and gas

OIL

Crude oil or liquid petroleum, is a fossil fuel that is refined into many different energy products

e.g., gasoline, diesel fuel, jet fuel, heating oil

NATURAL GAS

Natural gas is a mixture of gases *methane ethane propane butane*.

It is cleanest burning fossil fuel

propane and butane are removed from the natural gas and made into *liquefied petroleum gas* (*LPG*)

Natural gas is highly flammable and is odorless

natural gas is used primarily for heating, cooking, and powering vehicles

methane

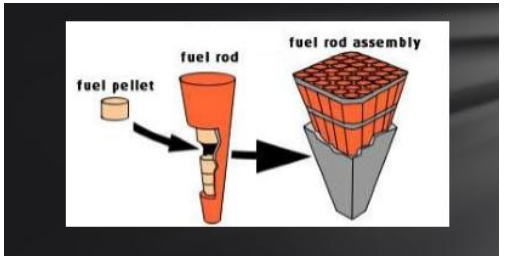
OIL SHALE ANDTAR SANDS

Oil shale and tar sands are the least utilized fossil fuel sources. *Oil shale* is sedimentary rock with very fine pores that contain *kerogen*, a carbon-based, waxy substance.

If shale is heated to 490° C, the kerogen vaporizes and can then be condensed as shale oil, a thick viscous liquid

Tar sand is a type of sedimentary rock that is impregnated with a very thick crude oil

NUCLEAR POWER



Citation

http://inexhaustibleresources.org/

http://www.geo.fu-berlin.de/fb/e-learning/geolearning/en/glossary/natural_resources/index.html

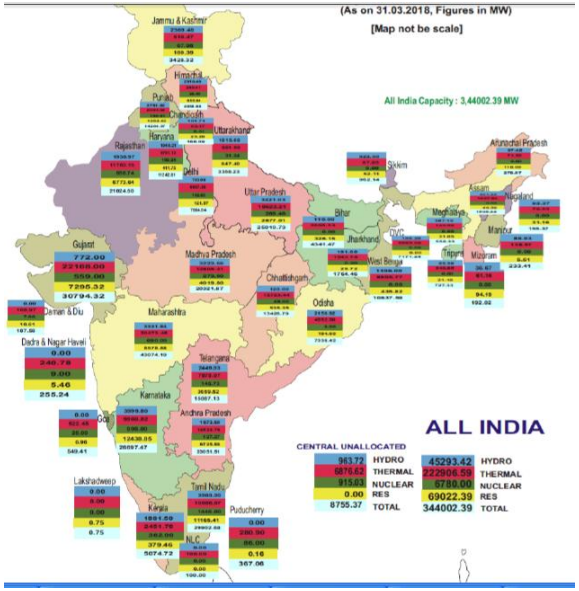
http://www.buzzle.com/articles/different-types-of-natural-resources.html

http://en.wikipedia.org/wiki/Non-renewable_resource

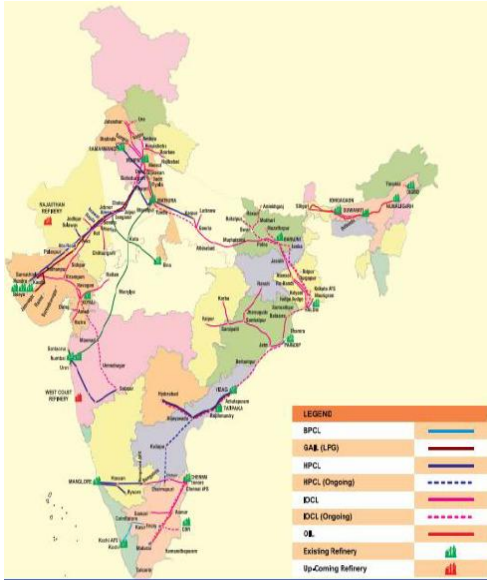
http://en.wikipedia.org/wiki/Renewable_resource

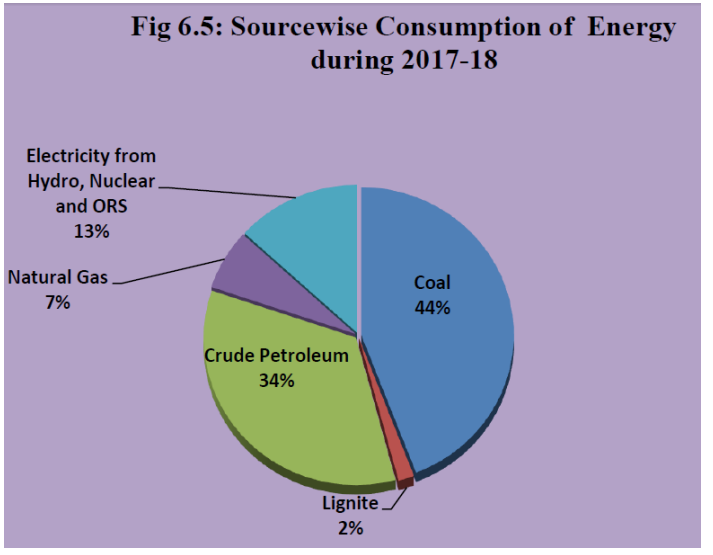
Energy Scenario & Sectorial energy Consumption

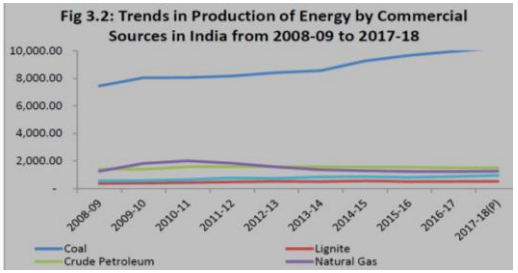
Energy Scenario

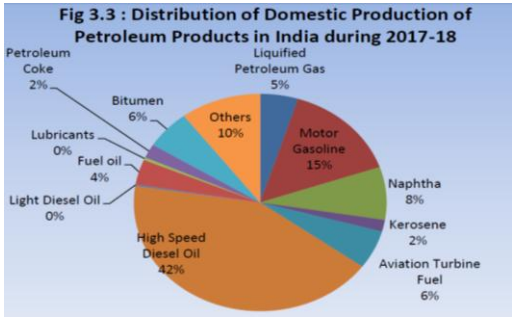


Refineries and Petroleum Product Pipelines









Production and Consumption.

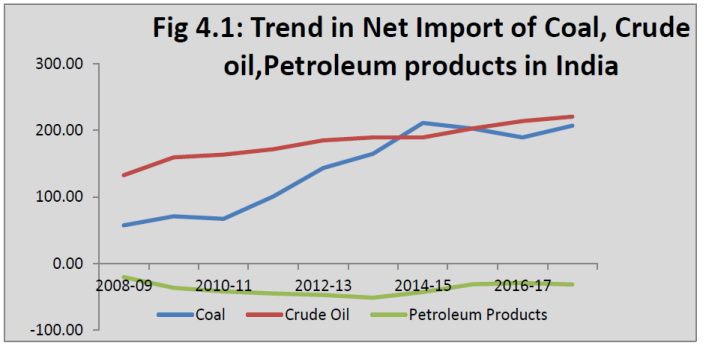
- Compound Annual Growth Rate (CAGR) of Production of Coal & Lignitein 2017-18 over 2008-09 are 3.20% & 3.62% respectively whereas theirconsumption grew at 5.01% and 3.70% respectively during the same period.
- In case of Crude Oil and Natural Gas, during the period 2008-09 to 2017-18 the Production increased by 0.63% and (-) 0.06% whereas Consumptionincreased by 4.59% & 4.82%.
- During the aforesaid period, Generation of Electricity increased by 5.71 %and Consumption of electricity increased by 7.39%.

Imports and Exports.

- Imports of the Coal during 2008-09 to 2017-18 increased at a CAGR of13.44% whereas the Exports during the corresponding period decreased at(-) 0.96%.
- During the period 2008-09 to 2017-18, the imports of Natural Gas and CrudeOil increased at CAGR of 9.44% and 5.20% respectively.
- The imports of petroleum products, during the period 2008-09 to 2017-18increased at CAGR of 6.67%, whereas during the same reference period the exports registered an increase of 5.55%.
- For electricity, the net imports witnessed significant change in last two years i.e. 2016-17 and 2017-18. The exports have robust increase at CAGR of61.83% during 2008-09 to 2017-18 whereas the imports registered a decline with CAGR of (-) 0.50%.

(Compound annual growth rate (CAGR) is the rate of return that would be required for an investment to grow from its beginning balance to its ending balance)

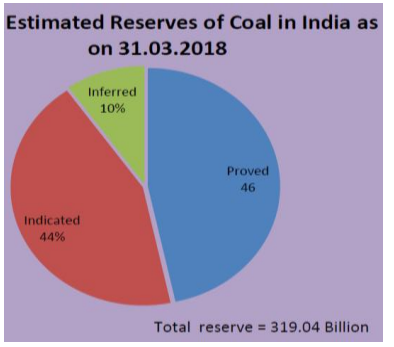
❖ India is highly dependent on import of crude oil. Net imports of crude oil have increased from 132.78 MTs during 2008-09 to 220.43 MTs during 2017-18.



RESERVES AND POTENTIAL

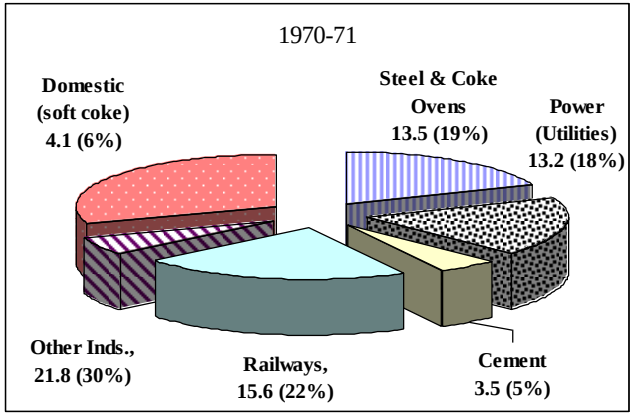
Coal

- Telangana and Maharashtra account for 98.26% of the total coal reserves in thec ountry. The State of Jharkhand had the maximum share (26.06%) in the overall reserves of coal in the country as on 31st March 2018 followed by the State of Odisha (24.86%)
- As on 31.03.18, the estimated reserves of coal were 319.04 billion tonnes, an addition of 3.88 billion tones over the last year in corresponding period.
- increase of 1.23% in the estimated coal reserves during the year2017-18 with Odisha accounting for the maximum increase of 2.6%.

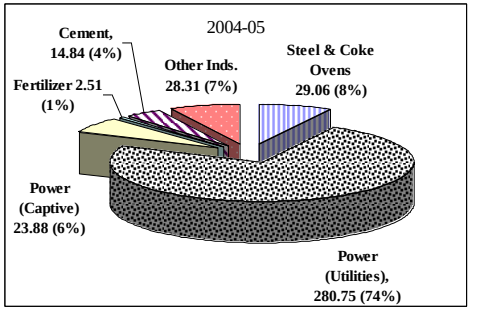


- The estimated total reserves of lignite as on 31.03.18 was 45.66 billion tonnes against 44.70 billion tonnes on 31.03.17

Sector Wise Coal Consumption (1970-71) (million tonnes)

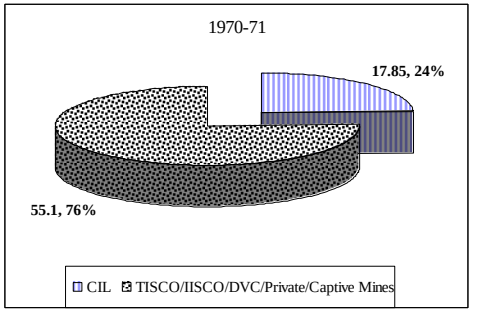


Sector Wise Coal Consumption (2004-05) (million tonnes)

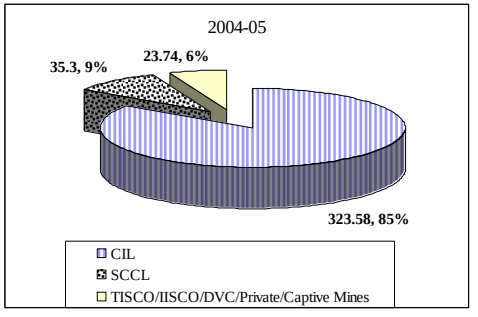


Significantly high share by Power Sector.

Ownership Wise Coal Production (1970-71) (Total = 72.95 million tonnes)



Ownership Wise Coal Production (2004-05) (Total = 382.62 million tonnes)



Significantly high share of Govt. Sector.

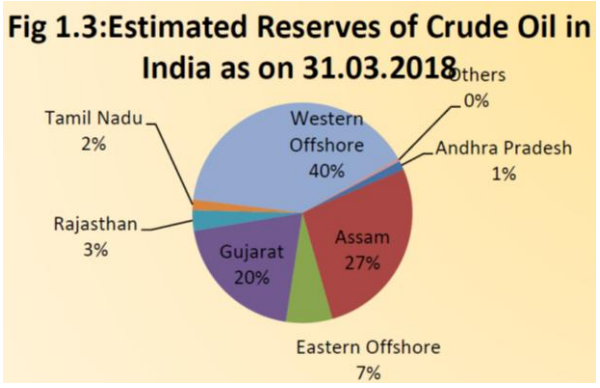
Table 1.1: Statewise Estimated Reserves of Coal in India as on 31.03.2017 and 31.03.2018

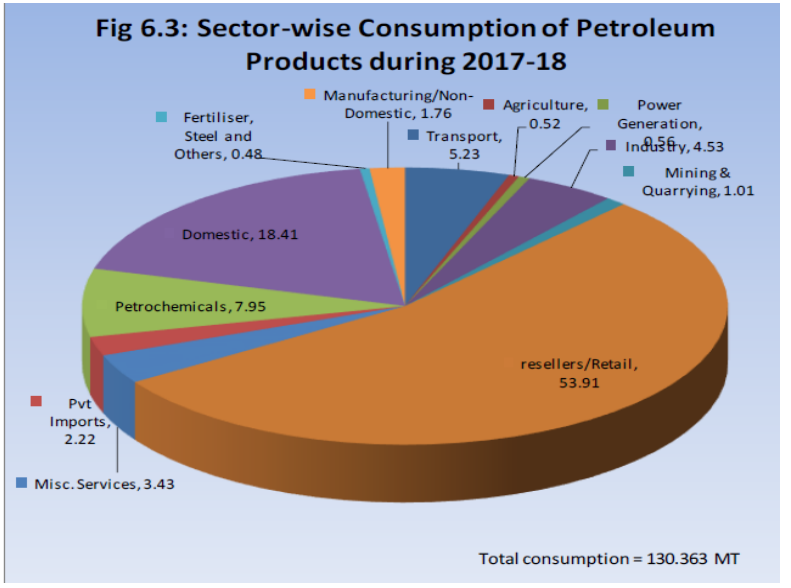
(in Billion Tonne)

States/ UTs	Proved		Indicated		Inferred		Total		Distribution (%)	
	31.03.2017	31.03.2018	31.03.2017	31.03.2018	31.03.2017	31.03.2018	31.03.2017	31.03.2018	31.03.2017	31.03.2018
Andhra Pradesh	0	0	1.15	1.15	0.43	0.43	1.58	1.58	0.50	0.50
Arunachal Pradesh	0.03	0.03	0.04	0.04	0.02	0.02	0.09	0.09	0.03	0.03
Assam	0.47	0.47	0.06	0.06	0.00	0.00	0.53	0.53	0.16	0.16
Bihar	0.00	0.16	0.00	0.81	1.35	0.39	1.35	1.37	0.43	0.43
Chhattisgarh	20.00	20.43	34.46	34.58	2.20	2.20	56.66	57.21	17.98	17.97
Jharkhand	44.34	45.56	31.88	31.44	6.22	6.15	82.44	83.15	26.16	26.06
Madhya Pradesh	11.27	11.96	12.76	12.15	3.65	3.88	27.67	27.99	8.78	8.77
Maharashtra	7.04	7.18	3.16	3.07	2.06	2.05	12.26	12.30	3.89	3.88
Meghalaya	0.09	0.09	0.02	0.02	0.47	0.47	0.58	0.58	0.18	0.18
Nagaland	0.01	0.01	0.00	0.00	0.40	0.40	0.41	0.41	0.13	0.13
Odisha	34.81	37.39	34.06	34.17	8.42	7.74	77.29	79.30	24.52	24.86
Sikkim	0.00	0.00	0.06	0.06	0.04	0.04	0.10	0.10	0.03	0.03
Uttar Pradesh	0.88	0.88	0.18	0.18	0.00	0.00	1.06	1.06	0.34	0.33
West Bengal	13.72	14.16	12.95	12.87	4.99	4.64	31.67	31.67	10.05	9.92
Telangana	10.40	10.47	8.54	8.58	2.52	2.65	21.46	21.70	6.81	6.80
All India Total	**143.06**	**148.79**	**139.31**	**139.18**	**32.78**	**31.06**	**315.16**	**319.04**	**100.00**	**100.00**
Distribution (%)	**45.39**	**46.64**	**44.20**	**43.62**	**10.40**	**9.74**	**100.00**	**100.00**		

Source: Office of Coal Controller, Ministry of Coal

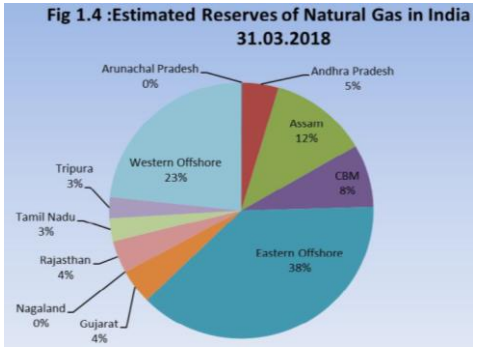
- **Petroleum**
- The estimated reserves of crude oil in India as on 31.03.2018 stood at 594.49million tonnes (MT) against 604.10 million tonnes on 31.03.2017.
- Western Offshore (40%) followed by Assam (27%), whereas the maximum reserves of Natural Gas are in the Eastern Offshore (38.13%) followed by Western offshore (23.33%).

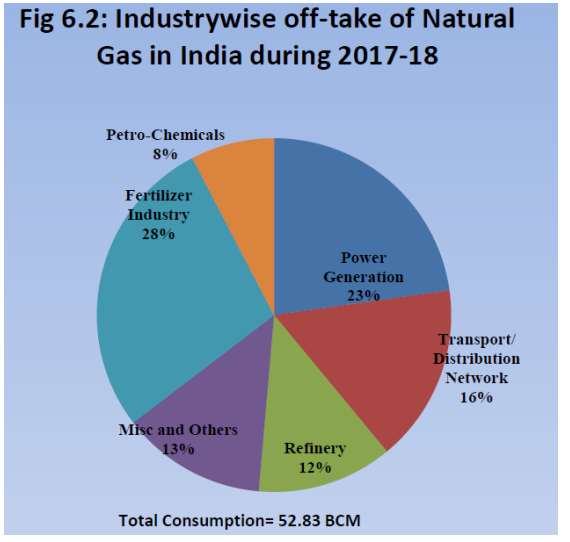




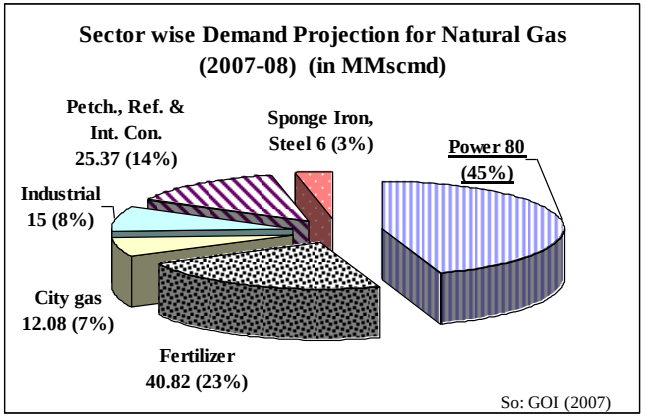
Natural Gas

- The estimated reserves of Natural Gas in India as on 31.03.2018 stood at 1339.57Billion Cubic Meters (BCM) as against 1289.70 BCM as on 31.03.2017.
- The estimated reserves of Natural Gas increased by 3.87% over the last year. The maximum contribution to this increase has been from Arunachal Pradesh, and Rajasthan followed by Andhra Pradesh and Tamil Nadu.

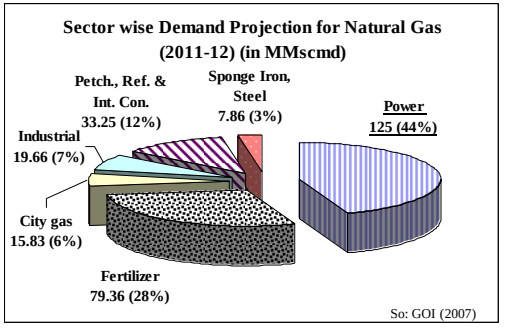




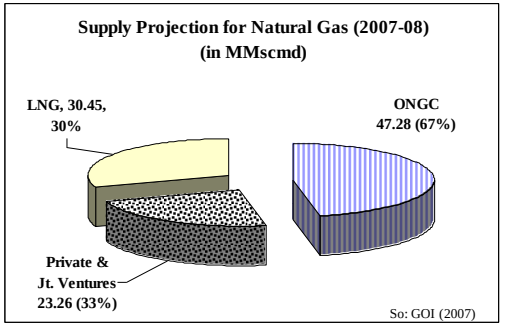
Sector Wise Demand Projection for Natural Gas (2007-08)



Sector Wise Demand Projection for Natural Gas (2011-12)



Supply Projection for Natural Gas (2007-08)



Supply Projection for Natural Gas (2011-12)

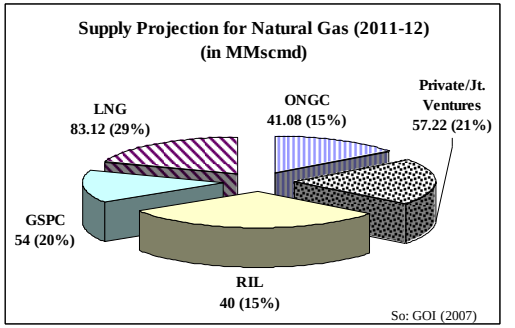


Table 1.2 :Statewise Estimated Reserves of Crude Oil and Natural Gas in India as on 31.03.2017 and 31.03.2018

States/ UTs/ Region	Crude Petroleum (million tonnes)				Natural Gas (billion cubic metres)			
	31.03.2017		31.03.2018		31.03.2017		31.03.2018	
	Estimated Reserves	Distribution (%)	Estimated Reserves	Distribution (%)	Estimated Reserves	Distribution (%)	Estimated Reserves	Distribution (%)
Arunachal Pradesh	1.52	0.25	1.74	0.29	0.72	0.06	1.26	0.09
Andhra Pradesh	8.15	1.35	7.94	1.34	48.31	3.75	59.89	4.47
Assam	159.95	26.48	160.34	26.97	158.57	12.30	161.65	12.07
Cold Bed Methane (CBM)	0.00	0.00	0.00	0.00	106.67	8.27	105.94	7.91
Eastern Offshore[1]	40.67	6.73	40.42	6.80	507.76	39.37	510.83	38.13
Gujarat	118.61	19.63	118.20	19.88	62.28	4.83	58.23	4.35
Nagaland	2.38	0.39	2.38	0.40	0.09	0.01	0.09	0.01
Rajasthan	24.55	4.06	17.99	3.03	34.86	2.70	54.85	4.09
Tamil Nadu	9.00	1.49	9.16	1.54	31.98	2.48	39.11	2.92
Tripura	0.07	0.01	0.07	0.01	36.10	2.80	35.20	2.63
Western Offshore[2]	239.20	39.60	236.25	39.74	302.35	23.44	312.52	23.33
Total	604.10	100.00	594.49	100.00	1289.70	100.00	1339.57	100.00

* CBM : Cold Bed Methane (Jharkhand, West Bengal and M.P.)

Notes:

1. Proved and indicated Balance Recoverable Reserves as on 1st April.
2. Western offshore includes Gujarat offshore
3. Total may not tally due to rounding off

Source: M/o Petroleum & Natural Gas

Renewable energy sources

- The total potential for renewable power generation in the country as on 31.03.18 is estimated at 1096081MW (Table 1.3). This includes solar power potential of748990 MW (68.33%), wind power potential of 302251 MW (27.58%) at 100mhub height, SHP (small-hydro power) potential of 19749 MW (1.80%), Biomass power of 17,536 MW (1.60%), 5000 MW (0.46%) from bagasse-based cogeneration in sugar mills and 2554 MW (0.23%) from waste to energy.
- The geographic distribution of the estimated potential of renewable power as on31.03.2018 reveals that Rajasthan has the highest share of about 15% (162238MW), followed by Gujarat with 11% share 122086 MW) and Maharashtra with10% share (113933MW), mainly on account of solar power potential.

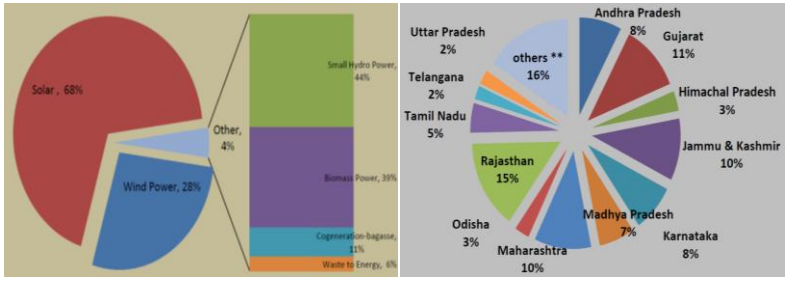


Table 1.3 :Sourcewise and Statewise Estimated Potential of Renewable Power in India as on 31.03.2018

(in MW)

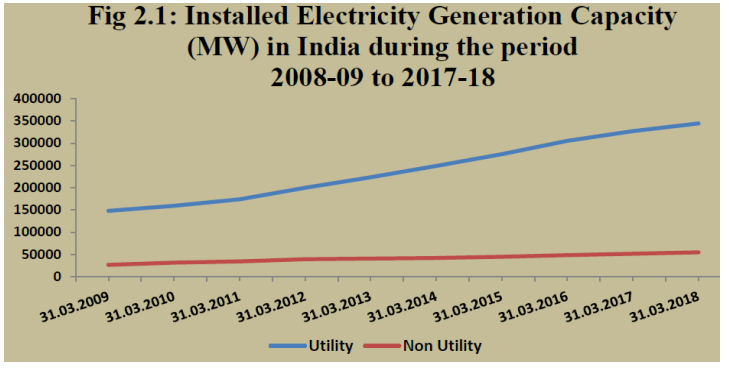
Sl. No.	States/ UTs	Wind Power @ 100m	Small Hydro Power	Biomass Power	Cogeneration-bagasse	Waste to Energy	Solar Energy	Total Estimated Reserves	Distribution (%)
1	Andhra Pradesh	44229	978	578	300	123	38440	84648	7.72
2	Arunachal Pradesh		1341	8			8650	10000	0.91
3	Assam		239	212		8	13760	14218	1.30
4	Bihar		223	619	300	73	11200	12415	1.13
5	Chhattisgarh	77	1107	236		24	18270	19714	1.80
6	Goa	1	7	26			880	913	0.08
7	Gujarat	84431	202	1221	350	112	35770	122086	11.14
8	Haryana		110	1333	350	24	4560	6377	0.58
9	Himachal Pradesh		2398	142		2	33840	36382	3.32
10	Jammu & Kashmir		1431	43			111050	112523	10.27
11	Jharkhand		209	90		10	18180	18489	1.69
12	Karnataka	55857	4141	1131	450		24700	86279	7.87
13	Kerala	1700	704	1044		36	6110	9595	0.88
14	Madhya Pradesh	10484	820	1364		78	61660	74406	6.79
15	Maharashtra	45394	794	1887	1250	287	64320	113933	10.39
16	Manipur		109	13		2	10630	10755	0.98
17	Meghalaya		230	11		2	5860	6103	0.56
18	Mizoram		169	1		2	9090	9261	0.84
19	Nagaland		197	10			7290	7497	0.68
20	Odisha	3093	295	246		22	25780	29437	2.69
21	Punjab		441	3172	300	45	2810	6768	0.62
22	Rajasthan	18770	57	1039		62	142310	162238	14.80
23	Sikkim		267	2			4940	5209	0.48
24	Tamil Nadu	33800	660	1070	450	151	17670	53800	4.91
25	Telangana	4244					20410	24654	2.25
26	Tripura		47	3		2	2080	2131	0.19
27	Uttar Pradesh		461	1617	1250	176	22830	26333	2.40
28	Uttarakhand		1708	24		5	16800	18537	1.69
29	West Bengal	2	396	396		148	6260	7202	0.66
30	Andaman & Nicobar	8	8				0	16	0.00
31	Chandigarh					6	0	6	0.00
32	Dadar & Nagar Haveli						0	0	0.00
33	Daman & Diu						0	0	0.00
34	Delhi					131	2050	2181	0.20
35	Lakshadweep	8					0	8	0.00
36	Puducherry	153				3	0	156	0.01
37	Others*					1022	790	1812	0.17
	All India Total	**302251**	**19749**	**17536**	**5000**	**2554**	**748990**	**1096081**	**100.00**
	Distribution (%)	**27.58**	**1.80**	**1.60**	**0.46**	**0.23**	**68.33**	**100.00**	

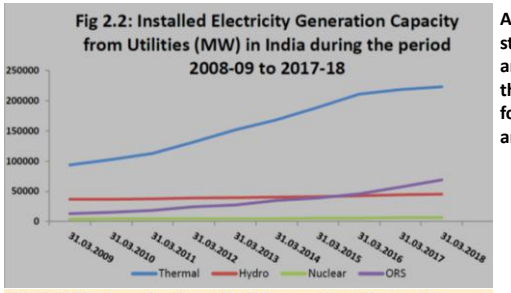
* Industrial waste

Source: Ministry of New and Renewable Energy

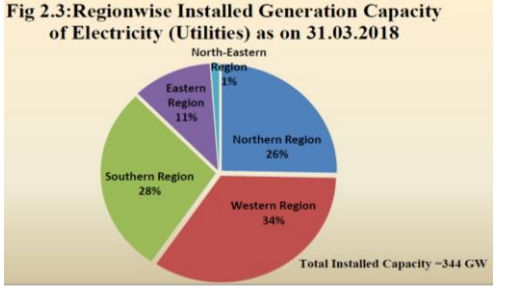
Electricity

- Total installed capacity for electricity generation in the country has increased from 1,74,639 MW as on 31.03.2009 to 3,99,000 MW as on 31.03.2018, registering a compound annual growth rate (CAGR) of 8.61%
- Non-utilities accounted for 13.78% (54997MW) of the total installed electricitygeneration capacity.





Among all the states Bihar registered highest annual growth (106.31%)in the installed capacity followed by Sikkim (33.60%) and Telangana (28.40%).



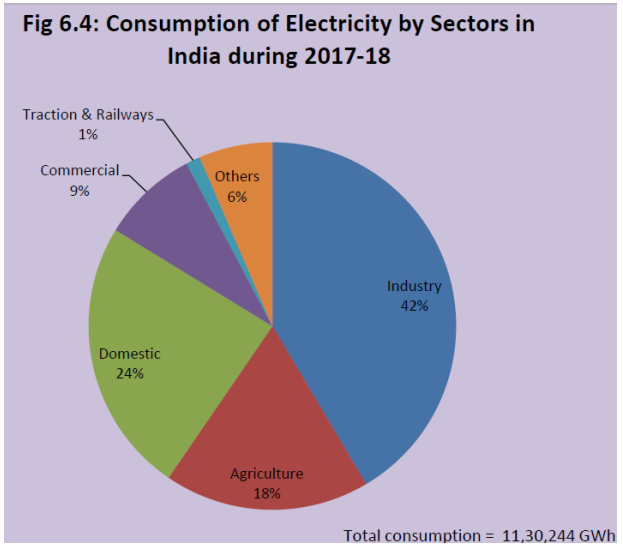


Fig 6.4: Consumption of Electricity by Sectors in India during 2017-18
Traction & Railways 1%
Commercial 9%
Others 6%
Industry 42%
Domestic 24%
Agriculture 18%
Total consumption = 11,30,244 GWh

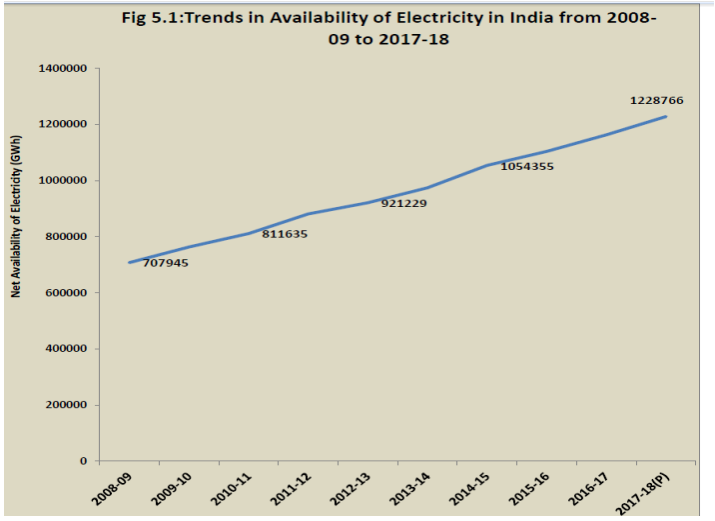


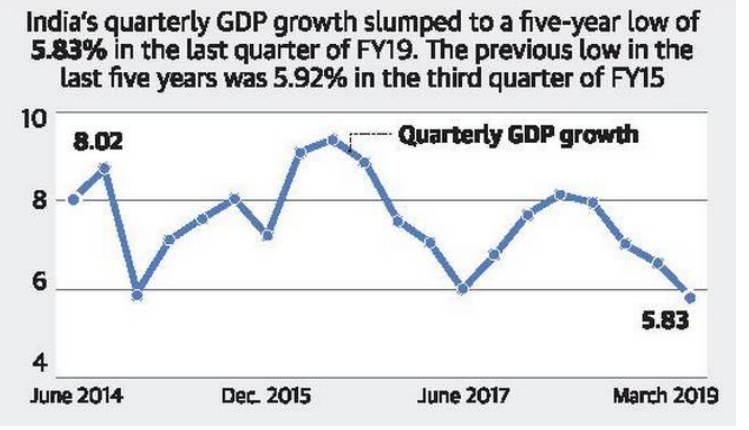
Fig 5.1:Trends in Availability of Electricity in India from 2008-09 to 2017-18
Net Availability of Electricity (GWh)
1400000
1200000
1000000
800000
600000
400000
200000
0
707945
811635
921229
1054355
1228766
2008-09
2009-10
2010-11
2011-12
2012-13
2013-14
2014-15
2015-16
2016-17
2017-18(P)

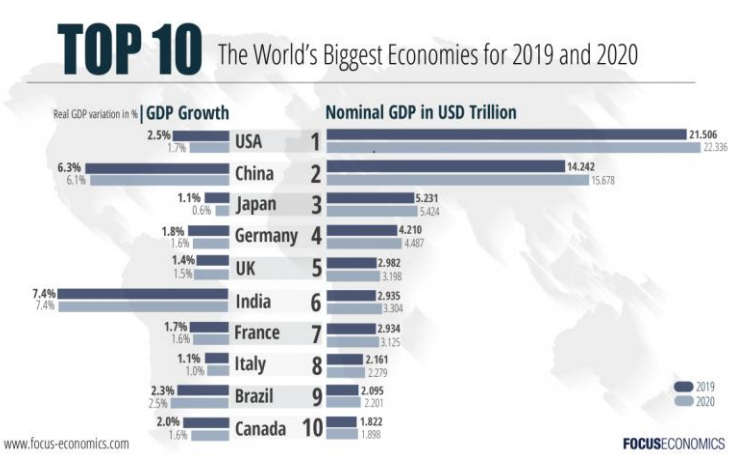
Energy Economy, energy Intensity & energy Security

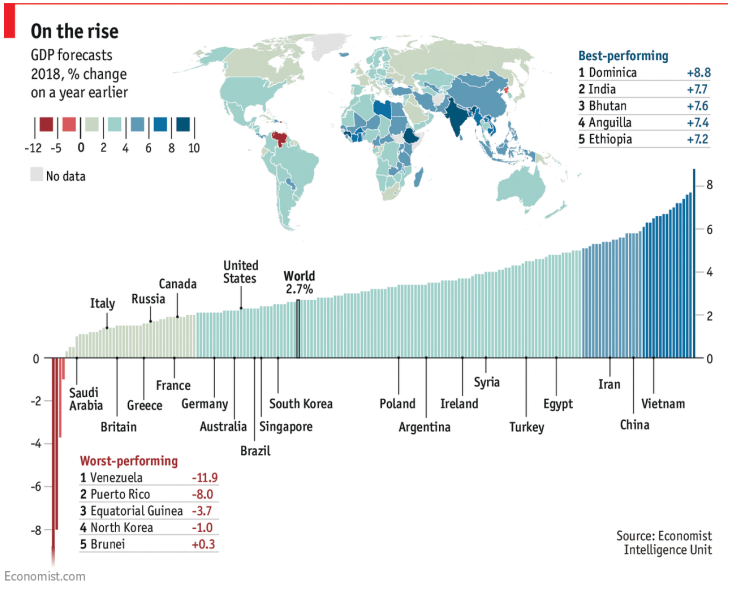
Energy Economy

- **Gross domestic product** (**GDP**) is a monetary measure of the market value of all the final goods and services produced in a specific time period, often annually.
- GDP (nominal) per capita does not, however, reflect differences in the cost of living and the inflation rates of the countries; therefore using a basis of GDP per capita at purchasing power parity (PPP) is arguably more useful when comparing differences in living standards between nations.
- an aggregate measure of production equal to the sum of the gross values added of all resident and institutional units engaged in production (plus any taxes, and minus any subsidies, on products not included in the value of their outputs)

GDP	▲ $2.972 trillion (nominal; 2019 est.)[3] ▲ $11.468 trillion (PPP; 2019 est.)[3]
GDP rank	7th (nominal; 2018) 3rd (PPP; 2018)
GDP growth	▼ 6.8% (FY 2019)[4] 8.2% (16/17) 7.2% (17/18) 7.2% (18/19e) 7.5% (19/20f)[5]
GDP per capita	▲ $2,199 (nominal; 2019 est.)[3] ▲ $8,484 (PPP; 2019 est.)[3]
GDP per capita rank	142nd (nominal; 2018) 119th (PPP; 2018)
GDP by sector	Agriculture: 15.87% Industry: 29.73% Services: 54.40%

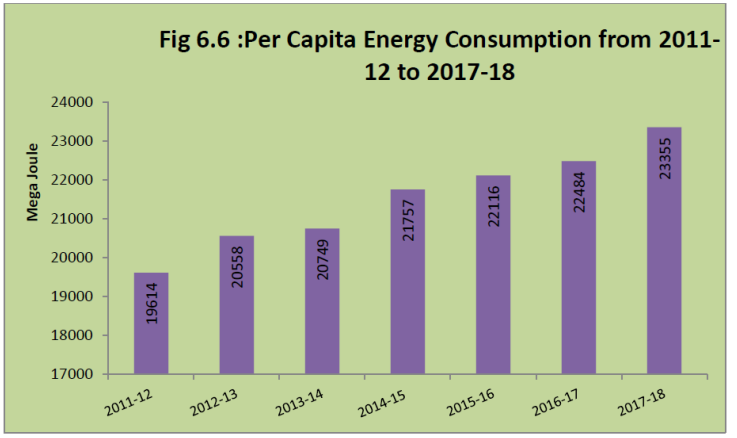



TOP 10
The World's Biggest Economies for 2019 and 2020
Real GDP variation in %
GDP Growth
Nominal GDP in USD Trillion
2.5% 1.7% USA 1 21.506 22.336
6.3% 6.1% China 2 14.242 15.678
1.1% 0.6% Japan 3 5.231 5.424
1.8% 1.6% Germany 4 4.210 4.487
1.4% 1.5% UK 5 2.982 3.198
7.4% 7.4% India 6 2.935 3.304
1.7% 1.6% France 7 2.934 3.125
1.1% 1.0% Italy 8 2.161 2.279
2.3% 2.5% Brazil 9 2.095 2.201
2.0% 1.6% Canada 10 1.822 1.898
2019
2020
www.focus-economics.com
FOCUSECONOMICS


On the rise
GDP forecasts 2018, % change on a year earlier
-12 -5 0 2 4 6 8 10
No data
Best-performing
1 Dominica +8.8
2 India +7.7
3 Bhutan +7.6
4 Anguilla +7.4
5 Ethiopia +7.2
Italy
Canada
Russia
United States
World 2.7%
Saudi Arabia
Britain
Greece
France
Germany
Australia
Brazil
Singapore
South Korea
Poland
Argentina
Ireland
Syria
Turkey
Egypt
Iran
China
Vietnam
Worst-performing
1 Venezuela -11.9
2 Puerto Rico -8.0
3 Equatorial Guinea -3.7
4 North Korea -1.0
5 Brunei +0.3
Source: Economist Intelligence Unit
Economist.com

Per Capita energy Consumption

- The Total energy consumption divided by total population at the same time.
- 606 Kwh per year at the end of 2004-05
- Very low compare to developed countries like USA, UK. Just 4% of USA and 20% of the world average.
- Per-capita Energy Consumption (PEC) increased from 19,599 Megajoules in 2011-12 to 23,355 Megajoules in 2017-18, The annual increase in PEC for 2017-18 over 2016-17 was 3.87%



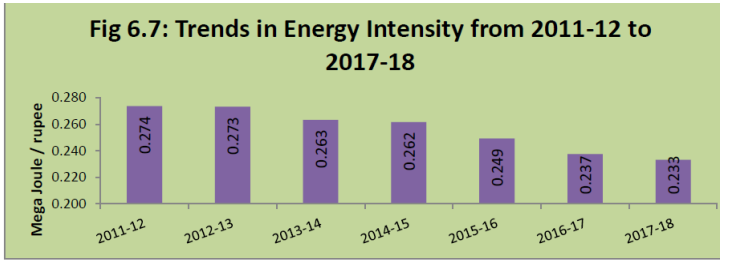
❖ Energy Intensity is defined as the amount of energy consumed for generating one unit of Gross Domestic Product (at constant prices).

Energy intensity

- Energy Intensity is defined as the amount of energy consumed for generating one unit of Gross Domestic Product (at constant prices).

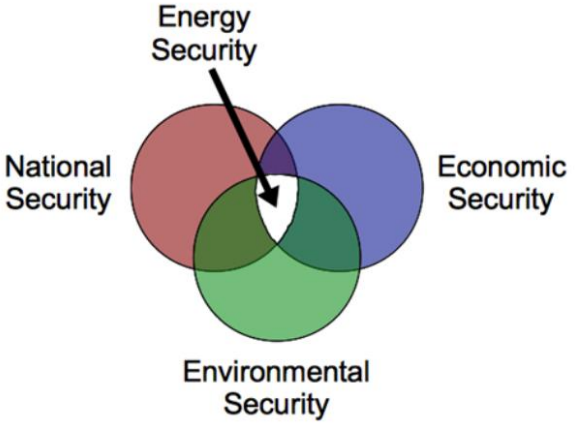
OR

- Energy Consumption per unit GDP.
- Indicates net energy consumption to produce the product
- If Figure is higher, higher energy consumed behind production, steps for reduce the energy intensity.
- 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.



- The Energy Intensity (at 2011-12 prices) decreased from 0.274 Megajoules per rupee in 2011-12 to 0.233 Mega Joules in 2017-18 (Table 6.3).
- Energy intensity has decreased over the last decade. This decline may be attributed to faster growth of GDP than energy demand, the services sector having a growing share of the economy, use of energy efficiency programmes, etc.

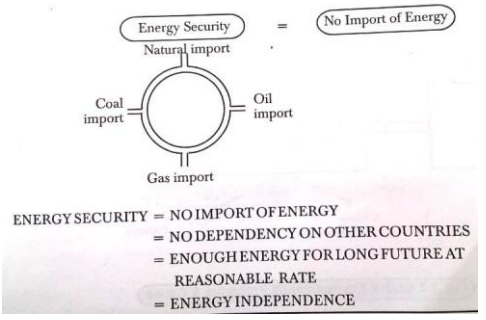
Energy Security



- Energy should secured for long time a nation.
- Huge energy resources will progress and develop rapidly.
- Energy security: Availability of all forms of energy at al times in necessary quantity and best quality at a affordable prices.
- Ensuring and guarantying energy supply to energy demand all times at a optimum charge.
- ES makes Energy Independence or reducing dependency of imported energy sources from other nation.

Energy Sources	$>$	Energy demand	$\Rightarrow$	Energy Security or Energy Independency
Energy Sources	$<$	Energy demand	$\Rightarrow$	Unsecured Energy or Energy dependant
Energy Sources	$=$	Energy demand	$\Rightarrow$	Unpredictable because may be future demand of energy increases.

Energy Demand & Production in India (2008)		
Energy	Production	Demand
Coal	290 Million tonnes/yr	510 Million tonnes/yr
Oil	34 Million Tonnes/yr	140 Million Tonnes/yr
Gas	67 Mcmd	96 Mcmd



• Options to achieve energy Security:

1. Appropriate EC measures and implementations
2. Expand the use of renewable energy
3. Implement a roadmap for a hydrogen economy
4. Expand the capacity of nuclear power generation
5. Remove the hurdles in the growth of hydro power potentials
6. Use substantially biomass, biogas and biofuels
7. Reduce demand by EC measures and aware strongly about energy management
8. Adoption advanced efficient technologies in industries, residential, Transportation
9. Augmenting the energy resources and supply.

ENERGY SECURITY CONCERNS

New cold war in Europe as Russia turns off gas supplies

By Daniel McLaughlin in Budapest and Vanessa Mock in Brussels

Wednesday, 7 January 2009

Fears of a deep chill spread across Europe yesterday after a row between Russia and Ukraine over gas prices cut supplies to the rest of the continent on a day of plummeting temperatures and heavy snowfalls.

The European Union said the situation was "completely unacceptable" as thousands of businesses were urged to switch fuels, and households struggled to keep warm in sub-zero temperatures. But there was no sign of an end to the standoff between Russia's energy monopoly Gazprom and Ukraine, locked in battle since New Year's Day.

Gazprom stopped pumping gas to Ukraine for domestic consumption on 1 January after the

Europe starved of gas

INDEPENDENT GRAPHICS

China blocked exports of rare earth metals to Japan, traders claim

China blocked exports of rare earth metals to Japan days before Tokyo's decision on Friday to free a Chinese boat captain whose detention sparked the worst diplomatic row between the sides in years, traders said.

Adani buys Australian coal port for $1.98bn

By Peter Smith in Sydney and James Fontanella-Khan in Mumbai
Published: May 3 2011 12:30 | Last updated: May 3 2011 12:30

India has underlined its desire to play a bigger role in the development of Australia's coal sector after Adani Enterprises, the country's largest coal importer, agreed to buy Queensland's Abbot Point Coal Terminal for A$1.83bn ($1.98bn).

It is the latest in a spate of deals by Indian groups in Australia and elsewhere as the country secures more energy resources to meet rising demand for power to complete vital infrastructure projects.

Source : Telegraph, FT

28 March 2020

THE ENERGY CONSERVATION ACT, 2001

INTRODUCTION

- Energy conservation refers to efforts made to reduce energy consumption. Energy conservation can be achieved through increased efficient energy use, in conjunction with decreased energy consumption and/o reduced consumption from conventional energy sources.
- Individuals and organizations that are direct consumers of energy choose to conserve energy to reduce energy costs and promote economic security.
- Industrial and commercial users can increase energy use efficiency to maximize profit.

WHY TO CONSERVE IT ?

- **We have limited resources available on earth.**
- **Our demands are continuously increasing day by day.**
- **It is possible that someday most of the non-renewable resources will be exhausted and we will have to switch over to alternate energy**

We save our money when we save energy.

We reduce pollution when we save energy.

We save our energy when we save energy.

What we can do ?

¬The need for efficient use of resources, energy conservation assume significance and must be an integral part of the policy tools

¬**RECYCLE** waste materials into new products to prevent waste of potentially useful materials.

¬**REPLACE** old light bulbs with energy saving fluorescent bulbs. They may cost more, but will save you much more in the long run.

RECYCLING IS AN EXCELLENT WAY OF SAVING ENERGY AND CONSERVING THE ENVIRONMENT.

Do you know that:

- 1 recycled tin would save enough energy to power a television for 3 hours.
- 1 recycled glass bottle would save enough energy to power a computer for 25 minutes.
- 1 recycled plastic bottle would save enough energy to power a 60-watt light bulb for 3 hours.
- 70% less energy is required to recycle paper compared with making it from raw materials.

THREE R's

¬ The slogan *reduce, reuse, recycle* is widely used to raise awareness against the use of non-renewable source of energy.

- Reduce consumption
- Reuse manufactured products
- Recycle raw materials

- India needs to sustain a GDP growth rate per annum over the next two to three decades in order to eliminate poverty
- Energy consumption will need to grow at a commensurate pace for such a GDP growth
- The present installed capacity is 1,38000 MW
- The estimated potential for energy saving during peak hours is 9240 MW

ENERGY CONSERVATION ACT 2001

- An Act to provide for efficient use of energy and its conservation and for matters connected therewith or incidental thereto
- It extends to the whole of India except the state of Jammu and Kashmir
- It was enacted by Parliament in the Fifty-second Year of the Republic of India on October 2001
- The Bureau of Energy Efficiency (BEE) came into force from March 2002 onwards

POWERS OF CENTRAL GOVT.

- Specify the norms for processes and energy consumption standards for any equipment, appliances which consumes, generates, transmits or supplies energy
- Specify equipment or appliance or class of equipments or appliances, as the case may be, for the purposes of the proposed legislation
- Prohibit manufacture or sale or purchase or import of equipment or appliances unless such equipment or appliances conforms to energy consumption standards
- Direct display of such particulars on label on equipment or on appliance

.....Powers Of Central Govt.

- Specify, having regard to the intensity or quantity of energy consumed by any user or class of users of energy as designated consumer for the purposes of the legislation
- Direct any designated consumer to get energy audit conducted by an accredited energy auditor
- Direct designated consumer to appoint energy manager in charge of activities for conservation of energy
- Prescribe minimum qualifications for appointment of energy managers

…….Powers Of Central Govt.

- Direct any designated consumer to furnish information with regard to energy consumed and action taken on the recommendation of the accredited energy auditor
- Direct any designated consumer to prepare a scheme for efficient use of energy and its conservation and implement such schemes as may be prescribed
- Prescribe energy conservation building codes for efficient use of energy and its conservation in the building or building complex

HOW WILL IT HELP ?

- **Let's Take an simple example :**
- **let us assume electricity is available for Rs.4.00 per unit , a 100 watt bulb is used for 8 hrs a day then:**
- **If we replace a 100 watt bulb with 22 watt CFL ,**
- **The annual saving would be…**
- **Power saved : 100W– W = 78W**

ENERGY CONSERVATION IN INDIA

- About 70% of India's energy generation capacity is from fossil fuels, with coal accounting for 40% of India's total energy consumption followed by crude oil and natural gas at 24% and 6% respectively. India is largely dependent on fossil fuel imports to meet its energy demands.
- By 2030, India's dependence on energy imports is expected to exceed 53% of the country's total energy consumption. In 2009-10, the country imported 159.26 million tonnes of crude oil which amount to 80% of its domestic crude oil consumption and 31% of the country's total imports are oil imports. The growth of electricity generation in India has been hindered by domestic coal shortages[and as a consequence, India's coal imports for electricity generation increased by 18% in 2010

Conservation Of Energy At Various Levels:-

- **Energy conservation at household level**
- **Energy conservation at community level**
- **Energy conservation in industry and other places**
- **Energy conservation in transportation sector**

Energy Conservation At Household Levels:-

- **Energy conservation in major appliances for domestic use:-**

*Energy Conservation in Refrigerator

*Energy Conservation in Oven/Microwave Oven

*Energy Conservation in Ironing

*Energy Conservation in Cooking

*Energy Conservation in Washing machine

- **Energy Conservation During Lighting**
- **Energy Conservation During Cooling**

At Home

- We should not keep lights unnecessarily switched on.
- Reduce the energy your appliances consume by analyzing star ratings.
- Improve your water heating efficiency to reduce energy costs.

At Public Places

- Switch of the fans and lights in the places like bus terminal and railway stations when not necessary.
- Switch off the street lights.
- Big Hoardings, lightened up for the whole evening and nights are other wastage of power which can be and should be avoided

Energy Conservation At Community Level:-

- All unnecessary lights should be turned off especially when conference rooms etc. are not in use.
- Computers, monitors, photocopiers and other business equipments should be set to their energy saving mode.
- Skylights should be used for warehouses.
- We Should ensure that offices having air conditions have proper windows and all doors are closed when the air conditioner is in use.

Energy Conservation At Community Level:-

- **Use Of Renewable Energy Resources:-**
- Alternative resources i.e. renewable energy sources should be used in place of nonrenewable energy sources e.g. solar energy, biogas, wind energy etc.
- solar energy for cooking and heating should promoted.
- Projects involving wind-generated energy for community and municipal needs should be demonstrated to the whole community.
- Demonstration of biogas programmes is also required to tell people for the efficient used of it.

Energy Conservation At Community Level:-

- Energy Conservation At Community Level For Housing Complexes:-
- Installation of photoelectric controls or timers should be used
- Water pumps should be switched off during non-peak utility hours
- Only single Elevator/Lift should be operated during "non-peak" hours
- Training programme about energy efficient repairs should be organized
- Locally manufactured, improved cook stoves should be introduced to reduce charcoal/fuel consumption

Energy conservation in industry and other places:-

- **Auditing**
- **Process modification**
- **Improved measuring instruments**
- **Energy loss reduction**
- **Light load reduction**

Energy conservation in transportation sector:-

- **Reduction of fuel consumption:-**
- Car speed should be maintained as far as possible 50 to 60 km/hr.
- We should avoid free frequent starts and stops to reduce fuel consumption.
- We should apply brakes gradually as far as possible
- **Fuel economy- maximizing behaviour:-**
- Moderate driving
- Driving at lower speeds
- Turning off a vehicles engine at stops rather than idling & using cruise control

Energy Efficient Devices:-

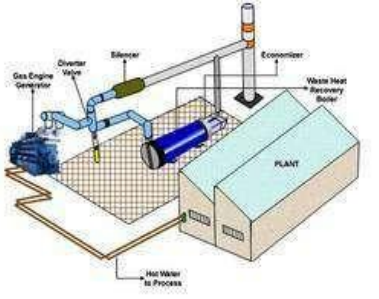
- CFL
- Pressurized steam cooker & Solar cooker
- Natural water cooler is a safe drinking water device which works on the principle of "cooling by evaporation". No external source of energy such as electricity or ice is required.

CONCEPT OF ENERGY AUDITING:-

- Energy auditing is a systematic approach to monitor industrial energy consumption and to find out the sources of energy wastage.
- The first and most important role of energy auditing is to identify the areas of energy consumption and to find the overuse for accessing the opportunity of saving energy.
- Analysis of energy use is done for identifying the areas of energy consumption.

Development & Design of Power plants:-

- Development, design and engineering of co-generation & captive power plants. Our engineering consultation services encompass Design and Engineering of Co-generation & Captive Power Plants. These services are executed with in the shortest frame of time and meet the consultation requirements for:
- Co-generation power plants for sugar mills, rice mills, maize processing plants, industrial sector, etc.
- Waste heat recovery from hot gases and liquids for generation of steam for process use and power generation.



ENERGY CONSERVATION IN ELECTRICAL MOTORS

- Motor Efficiency =O/P Power/Input PowerX100

Watt Losses-
Stator & rotor losses
Iron Losses
Friction & Windage losses Stray Load losses

- Energy Waste- Causes

@Use of less efficient motors
@Improper supply voltage
@Voltage fluctuations
@Poor power factor
@Less efficient driven equipment
@Idle running

- By supplying proper voltage and running the motor on proper load the efficiency of the motor can be increased.

Total saving in mcl from 95-96 till 2000-2001:-

Sl. No.	Area of Saving	Saving in Crore Rupees
1	Power factor improvement in Talcher Coalfields	26.04
2	Power factor improvement in Ib-Valley Coalfields	0.66
3	Power factor penalty during 1998 – 1999 to 2000 – 2001.	(-) 0.22
4	Over drawal penalty during 1998 – 1999 to 2000 – 2001.	(-) 0.95
5	Saving due to higher Load factor	3.46
6	Prompt payment rebate	0.84
7	10% rebate for domestic consumption	10.29
8	5 paise/KWH, Electricity Duty from May 2000 to October 2000.	0.37
9	Supply of power for 7 consumer points from Jorabaga Sub-station	0.64
10	Transmission loss in Daulbera feeder	0.60
	Grand saving	41.73
	Refund expected from GRIDCO / CESCO / WESCO / HIW	8.27
	Total saving	50.00

Energy Policy of India – Short term

- Maximize returns from the existing assets
- Reduce losses in transportation and in end use
- Initiate action to reduce energy intensity of different consuming sectors and promote conservation through organizational and fiscal measures
- Initiate steps to meet the basic energy need of rural and urban households so as to reduce the existing inequities.
- Maximize satisfaction of demand for energy from indigenous resources

Energy Policy of India – Medium term

- Progressive steps to substitute petroleum products by coal, natural gas and electricity
- Action for accelerated development of all renewable energy resources especially hydro potential
- Promote programmes to achieve self-reliance in energy sector
- Create appropriate organizational changes in consistent with the over all energy strategy

Energy Policy of India – Long term

- Promote an energy supply system, largely based on renewable sources of energy
- Promote technologies of production, transportation and use of energy that are environmentally benign and cost effective

POWERS OF STATE GOVT.

- Amend the energy conservation building codes to suit the regional and local climatic conditions
- Direct every owner or occupier of a building or building complex being a designated consumer to comply with the provisions of the energy conservation building codes
- Direct if considered necessary for efficient use of energy and its conservation, any designated consumer to get energy audit conducted by an accredited energy auditor in such manner and at such intervals of time as may be specified by regulations

.....Powers Of State Govt.

- Designate any agency as designated agency to coordinate, regulate and enforce provisions of EC Act 2001 within the State
- Take all measures necessary to create awareness and disseminate information for efficient use of energy and its conservation

PENALTIES & APPELLATE TRIBUNAL

- If any person fails to comply, he shall be liable to a penalty not exceeding ten thousand rupees
- An additional penalty of one thousand rupees for every day during which such failures continues
- Member of State Commission shall be appointed as an adjudicating officer for holding an inquiry
- No civil court shall have jurisdiction to entertain any matter related to the inquiry
- To hear appeals against the orders of the adjudicating officer, the Central Govt. shall establish an ATEC

Advantages:-

- Energy conservation can result in increased financial capital, environmental quality, national security, personal security, and human comfort.
- Energy efficiency saves money.
- It is environmental friendly.
- It improves indoor air quality.
- Longer life span to appliances.

INITIATIVES OF BUREAU OF ENERGY EFFICIENCY

POWERS OF BEE

- Recommend to the Central Government the norms for processes and energy consumption standards for equipment and appliances
- Recommend to the Central Government for notifying any user or class of users of energy as a designated consumer having regard to intensity or quantity of energy used by it
- Recommend to the Central Government the particulars required to be displayed on label of equipments or on appliances and manner of their display
- Take suitable steps to prescribe guidelines for energy conservation building codes

.....Powers Of BEE

- Develop testing and certification procedure and promote testing facilities for certification and testing for energy consumption of equipment and appliances
- Promote use of energy efficient processes, equipment, devices and systems
- Specify qualifications for the accredited energy auditors, the manners and interval of time in which the energy audit shall be conducted by such auditors
- Specify certification procedures for energy managers to be appointed by designated consumers

.....Powers Of BEE

- Prepare educational curriculum on efficient use of energy and its conservation for educational institutions, boards, universities or autonomous bodies and coordinate with them for inclusion of such curriculum in their syllabus

STATE DESIGNATED AGENCIES

- The Govt. during the XI Five Year Plan has initiated a scheme to strengthen institutions at national level as well as the State Designated Agencies (SDA's) at the state level
- SDA's are statutory bodies set up by states to implement energy conservation measures at state level and are expected to play the roles of a developmental agency, a facilitator and a regulator / enforcing body

STATE DESIGNATED AGENCIES

- The scheme seeks to develop and implement Energy Conservation Action Plan (ECAP) based on a uniform template evolved for taking measures necessary to build institutional and human capacity
- As a part of the scheme, an amount to the tune of Rs. 34.30 lakhs has already been disbursed to Department of Renewable Energy, Haryana as 1st installment for the financial year 2007-08

BACHAT LAMP YOJANA

- To promote energy efficient and high quality CFLs as replacement for incandescent bulbs in households
- The scheme seeks to leverage CDM revenues as a result of energy consumption reduction to reduce the price of the CFLs
- BEE will monitor the scheme under an approved methodology of CDM Executive Board of UNFCCC
- Target replacement of 400 million incandescent bulbs with CFLs could save an estimated 4000 MW demand during the XI plan

STANDARDS & LABELLING SCHEME

- It targets high-energy end use equipments and appliances to lay down minimum energy performance standards
- The scheme is being implemented on voluntary basis for Room Air conditioners, Refrigerator (No-Frost), Direct Cool and Tubular Fluorescent Lamps
- The wider proliferation of energy efficient equipments is expected to save 18 billion units per annum by 2011 which translates into annual saving of electricity worth Rs 5,500 crores and an avoided capacity addition of over 3000 MW during XI plan

ENERGY CONSERVATION BUILDING CODE

- Setting up of minimum energy efficiency standards for design and construction, while enhancing occupant comfort
- Building means any structure or erection or part of a structure or erection which is having a connected load of 500 kW & intended for commercial purpose only
- State Govt. can amend the code to suit local and regional climatic conditions
- The code deals with Building Envelope, HVAC, Lighting, Service Hot Water & Pumping and Electrical Power

AGRICULTURAL DSM

- It promises immense opportunity in reducing the overall power consumption
- Improving efficiencies of ground water extraction and reducing the subsidy burden of the states without sacrificing the service obligation of this sector
- An estimated capacity addition of 1000 MW can be avoided during the XI plan

MUNICIPAL DSM

- The energy costs constitute up to 60-70 percent of an Indian municipality's total cost of pumping water to its residents
- This financial constraint can be overcome through efficient water delivery systems
- This can translate into measurable energy savings due to reduced pumping requirements and improved performance
- An estimated capacity addition of 1000 MW can be avoided during the XI plan

SMALL & MEDIUM ENTERPRISES

- To promote energy efficiency in SMEs during the XI plan
- Many energy-intensive SMEs clusters located in various states of the country have large potential for energy savings
- Initially 25 clusters in the country have been identified which have immense savings potential
- An estimated capacity addition of 500 MW can be avoided during the XI plan
- Many energy-intensive SMEs clusters located in various states of the country have large potential for energy savings. Initially 25 clusters in the country have been identified which have immense potential savings.

EXPECTED OUTCOMES

- Barriers for EE & DSM to be removed.
- The State Regulatory Commissions and Utilities to be encouraged to implement the Conservation initiatives
- Engagement of Stakeholders

Industrial and Commercial users

- Time of use tariff for industrial and commercial users.
- Incentives to industry to adopt conservation/ efficiency measures

.....Expected Outcomes

States

- Encourage implementation of DSM programmes in Agriculture/ Municipalities

Domestic consumers

- Ensuring availability at low cost and promoting use of low cost CFLs.
- Awareness

• Energy Strategy for future

1. Appropriate EC measures and implementations
2. Expand the use of renewable energy
3. Implement a roadmap for a hydrogen economy
4. Expand the capacity of nuclear power generation
5. Remove the hurdles in the growth of hydro power potentials
6. Use substantially biomass, biogas and biofuels
7. Reduce demand by EC measures and aware strongly about energy management
8. Adoption advanced efficient technologies in industries, residential, Transportation
9. Augmenting the energy resources and supply.

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Energy Conservation &
Bureau of Energy Efficiency

Energy Efficiency

- Energy efficiency is “Using less *energy to provide the same service/output".*
- • Improving energy efficiency can make a real difference. It saves money, reduces carbon emissions and
- decreases your country's dependence on foreign energy supplies... all at the same time!

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

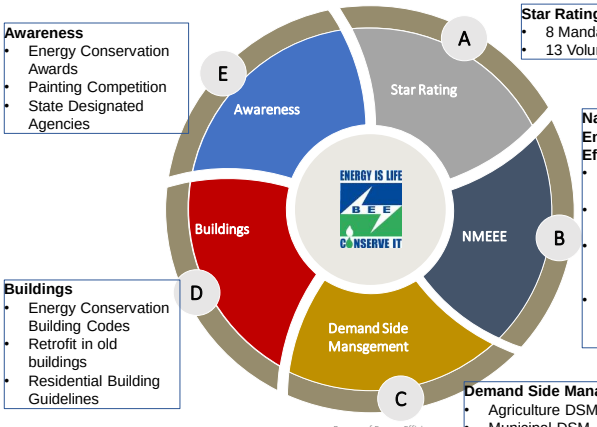
Functions of the Bureau are as follows:

- 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

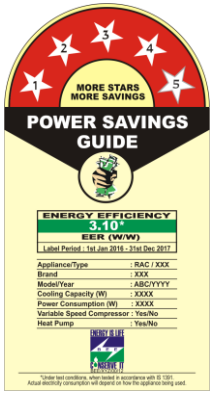
Demand Side Management
- Agriculture DSM
- Municipal DSM
- Energy Efficiency in SMEs

Why Star Labeling?

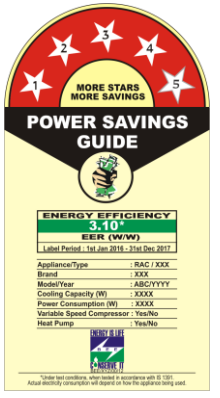
- Wide variation in energy consumption by products of manufacturers is observed.
- Information on energy consumption is often not easily available, sufficient or easy to understand from the nameplate.
- Lead to continued manufacture and purchase of inefficient equipment and appliances.

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.)

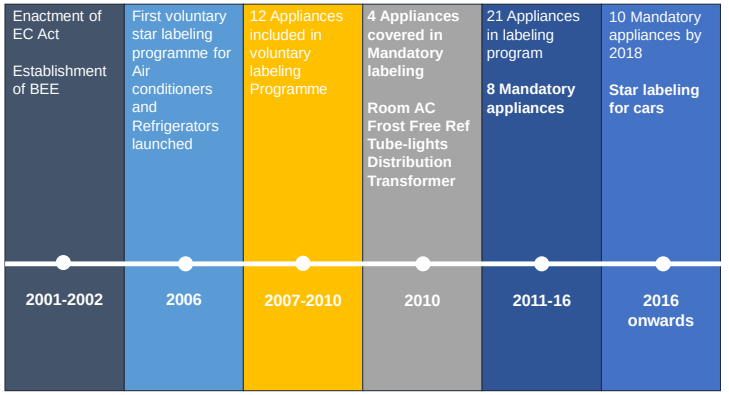


Brand – Star Label



- 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

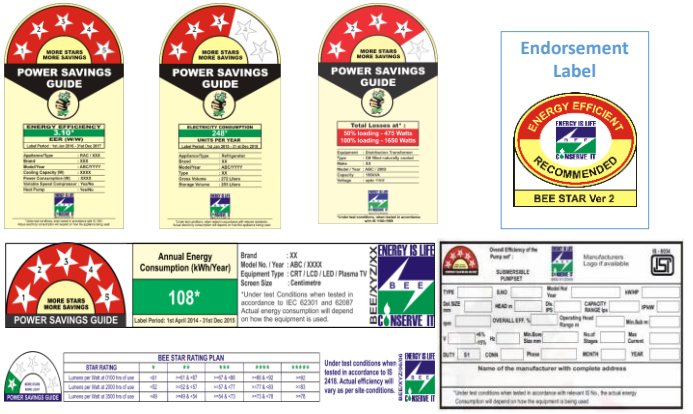
What is Label?

- 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:

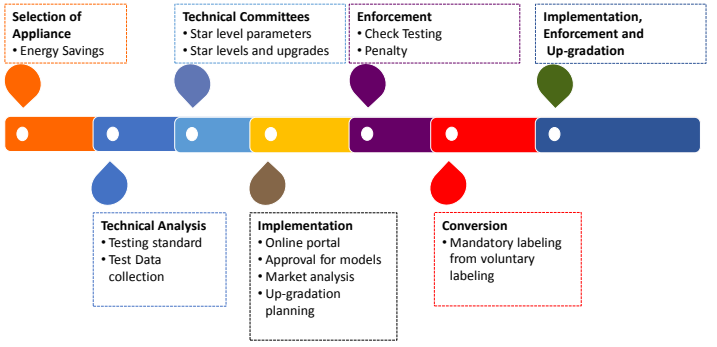
Comparative Label	Endorsement Label
Allow consumers to compare the energy consumption of similar products, and factor lifetime running cost into their purchasing decision	Provide a 'certification' to inform prospective purchasers that the product is highly energy efficient for its category.

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

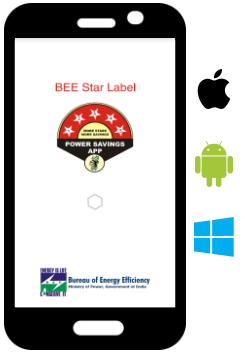
- Room Air Conditioners
- Frost Free Refrigerator
- Tubular Florescent Lamp
- Distribution Transformer
- Room Air Conditioner (Cassette, Floor Standing)
- Direct Cool Refrigerator
- Color TV
- Electric Geysers

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

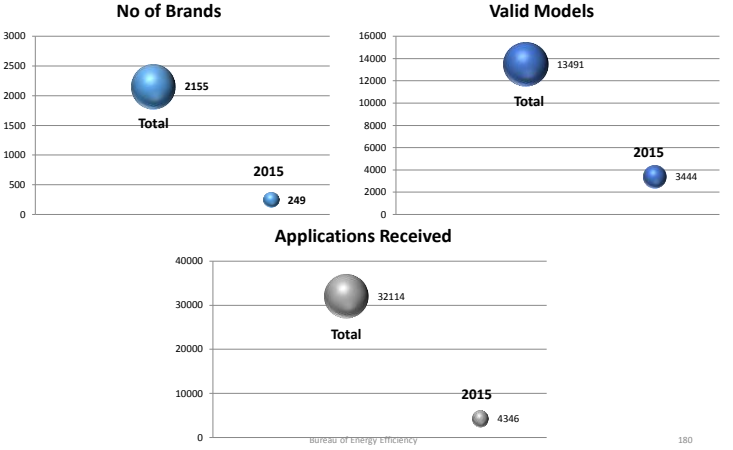
Where info is available?

www.beestarlabel.com

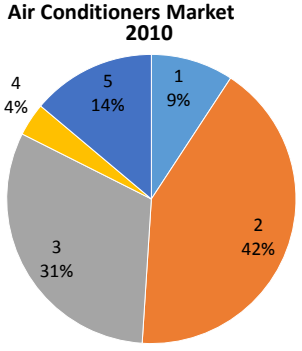


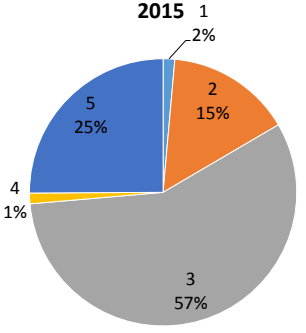
Search "bee star label"

Star Labeling Impact

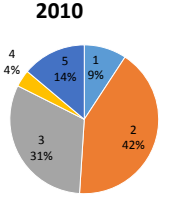


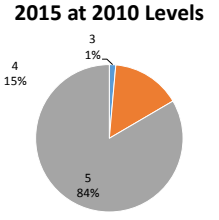
Star Labeling Impact

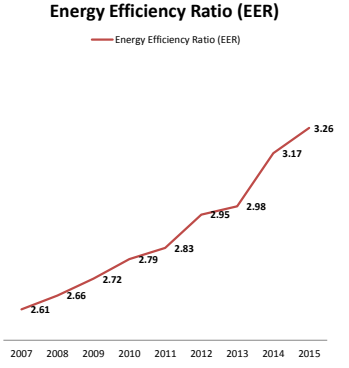




Market Transformation







Question Bank

1. Explain different form of Energy.
2. Enlist different sources of energy and explain each one in brief.
3. What are the major sources of the India? Explain utilization of Energy sources in India.
4. Which are major places of the India for coal, Petroleum and natural gases?
5. Explain about GDP and role of Energy in National GDP.
6. Explain following terms in detail
    1. Per capita energy consumption
    2. Energy Intensity
    3. Energy Security
7. What is meaning by energy conservation. How it can be done at household level?
8. Explain possibility of energy conservation at community, industry and transportation level.
9. Explain Energy policy about energy conservation for India.
10. Which are the State designated agencies for energy conservation?
11. Explain in detail about Bureau of energy efficiency (BEE).
12. What is star labeling? Write advantages of star labeling.
13. Explain type and list of appliances for star labeling.
14. Explain in detail salient feature of Electricity act 2003.
15. Journal Paper Topics: Role of Energy in National GDP, Energy Security, Energy conservation, Scope of Energy conservation in various industries, Energy efficiency, Star labeling on appliances, Electricity acts.