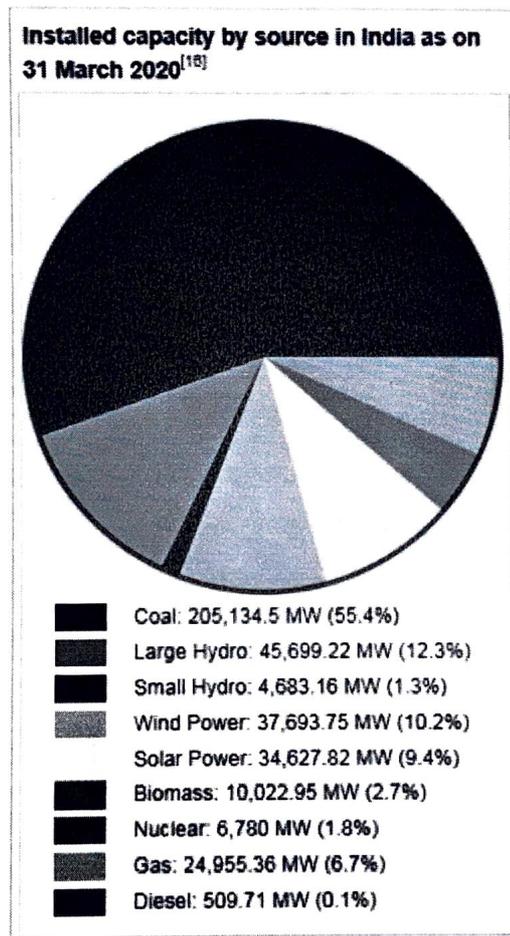


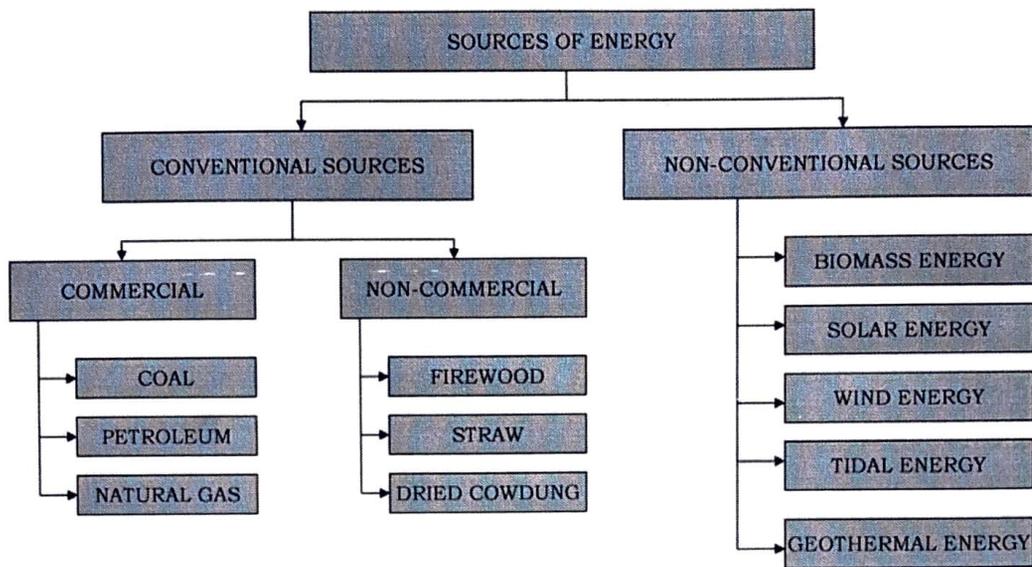
## ENERGY RESOURCES

Energy is the prime factor for economic growth, social and industrial development of a country. It is estimated that, by the next two decades the world energy consumption will be 2/3<sup>rd</sup> more than today. India, being one of the fastest developing and populous country of the world, have experienced high economic boom in past 30 years on one hand and on the other, is suffering from huge energy shortage.



The known energy sources at present can be broadly categorized as:

1. Non – conventional sources
2. Conventional sources



FLOWCHART SHOWING CATEGORIZATION OF DIFFERENT SOURCES OF ENERGY

### 1. Non – conventional energy sources:

The non – conventional energy sources also called as renewable energy, are the sources that are continuously replenished by natural processes. These are the new sources of energy which are still not in common / regular use. Their contribution to India’s power generation is nominal. The solar energy, wind energy, bio fuel, hydropower etc. are some of the examples of non – conventional and renewable energy sources.

A renewable energy system converts the energy found in sunlight, wind, falling water, sea waves, geothermal heat or biomass into a form, which can be used as heat or electricity. Most of the renewable energy comes either directly or indirectly from sun and wind and can never be exhausted and therefore they are called as renewable.

However, at present most of the world’s energy sources are derived from conventional sources like fossil fuel (such as, coal, petroleum oil, natural gases) and nuclear energy. These fuels are often termed as non – renewable energy sources. Although the available quantities of these fuels are extremely large, they are nevertheless finite and so will exhaust at sometime in the future.

The renewable / non-conventional sources energy includes:

- (i) Solar energy

- (ii) Wind energy
- (iii) Hydro energy
- (iv) Bio energy
- (v) Geothermal energy
- (vi) Wave and tidal energy

As of 31 March 2018, India's grid-connected electricity generation capacity is about 69.02 GW from non-conventional renewable technologies and 45.29 GW from conventional renewable power or major hydroelectric power plants.

Installed capacity of non-conventional renewable power

Type	Capacity (in MW)
Wind	34,046.00
Solar	21,651.48
Small Hydro Power Projects	4,485.81
Biomass Power & Gasification and Bagasse Cogeneration	8,700.80
Waste to Power	138.30
<b>Total non-conventional renewable Power - Grid Connected 69,022.39</b>	

**(i) SOLAR ENERGY:**

Solar power is energy from the sun that is converted into thermal or electrical energy. Solar energy is the cleanest and most abundant renewable energy source available. Solar energy can be utilized through two different routes:

- (a) solar thermal route, and
- (b) solar electric (solar photovoltaic) route.

**(a) Solar thermal route:**

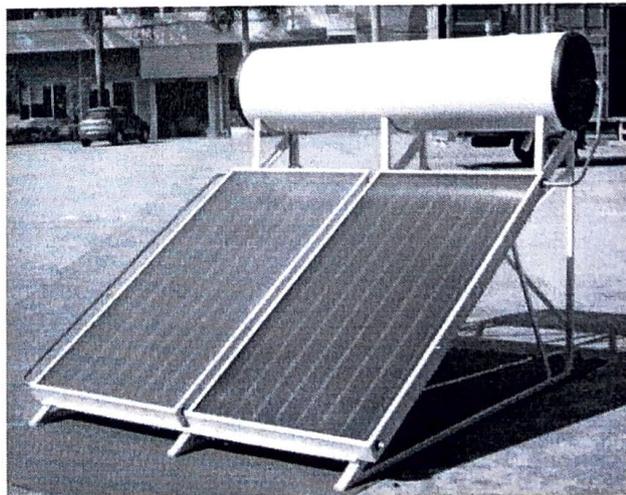
In solar thermal route, solar energy can be converted into thermal energy with the help of solar collectors and receivers known as solar thermal devices. Solar thermal devices are used in solar water heaters, air-heaters, solar cookers and solar dryers for domestic and industrial applications.

***Solar water heaters***

Most solar water heating systems have two main parts: a solar collector and a storage tank. The most common collector is called a *flat-plate collector*. It consists of a thin, flat,

rectangular box with a transparent cover that faces the sun, mounted on the roof of building or home. Small tubes run through the box and carry the fluid, either water or other antifreeze fluid to be heated. The tubes are attached to an absorber plate, which is painted with special coatings to absorb the heat. The heat builds up in the collector, which is passed to the fluid passing through the tubes. An insulated storage tank holds the hot water. It is similar to water heater, but larger in size. In case of systems that use fluids, heat is passed from hot fluid to the water stored in the tank through a coil of tubes. Solar water heating systems can be either active or passive systems. The active system, which are most common, rely on pumps to move the liquid between the collector and the storage tank. The passive systems rely on gravity and the tendency for water to naturally circulate as it is heated. A few industrial applications of solar water heaters are listed below:

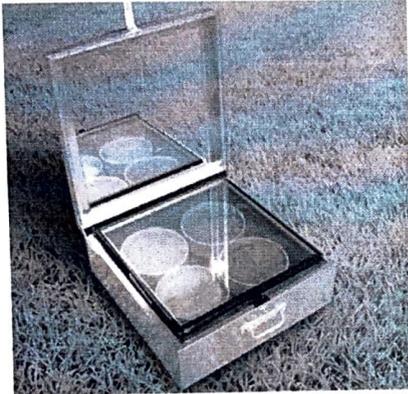
- ❑ *Hotels*: Bathing, kitchen, washing, laundry applications
- ❑ *Dairies*: Ghee (clarified butter) production, cleaning and sterilizing, pasteurization
- ❑ *Textiles*: Bleaching, boiling, printing, dyeing, curing, ageing and finishing
- ❑ *Breweries & Distilleries*: Bottle washing, wort preparation, boiler feed heating
- ❑ *Chemical /Bulk drugs units*: Fermentation of mixes, boiler feed applications
- ❑ *Electroplating/galvanizing units*: Heating of plating baths, cleaning, degreasing applications
- ❑ *Pulp and paper industries*: Boiler feed applications, soaking of pulp.



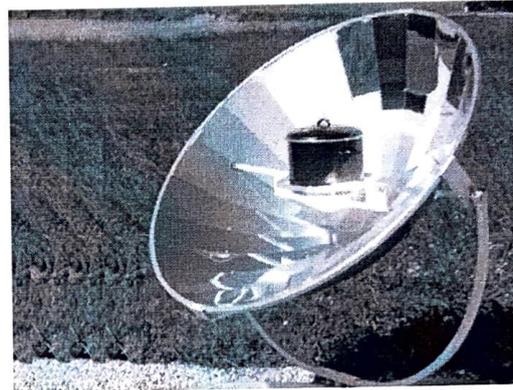
Flat plate collector water heater

## ***Solar Cooker***

Solar cooker is a device, which uses solar energy for cooking, and thus saving fossil fuels, fuel wood and electrical energy to a large extent. However, it can only supplement the cooking fuel, and not replace it totally. It is a simple cooking unit, ideal for domestic cooking during most of the year except during the monsoon season, cloudy days and winter months.



Box type solar cookers



Parabolic concentrating solar cooker

### ***Box type solar cookers:***

The box type solar cookers with a single reflecting mirror are the most popular in India. These cookers have proved immensely popular in rural areas where women spend considerable time for collecting firewood. A family size solar cooker is sufficient for 4 to 5 members and saves about 3 to 4 cylinders of LPG every year. The life of this cooker is upto 15 years. This cooker costs around Rs.1000 after allowing for subsidy. Solar cookers are widely available in the market.

### ***Parabolic concentrating solar cooker:***

A parabolic solar concentrator comprises of sturdy Fibre Reinforced Plastic (FRP) shell lined with Stainless Steel (SS) reflector foil or aluminised polyester film. It can accommodate a cooking vessel at its focal point. This cooker is designed to direct the solar heat to a secondary reflector inside the kitchen, which focuses the heat to the bottom of a cooking pot. It is also possible to actually fry, bake and roast food. This system generates 500 kg of steam, which is enough to cook two meals for 500 people. This cooker costs upward of Rs.50,000.

**(b) Solar electric (Solar photovoltaic) route:**

Solar photovoltaic (photo means 'light' and voltaic means 'electric') route uses Sun's heat to produce electricity for lighting homes and buildings, solar lanterns, running motors, pumps, electric appliances etc. Solar PV cells are usually made of silicon, an element that naturally releases electron when exposed to light. The silicon cells are covered with grids of metal that direct the electron to flow in a path to create electric current. This current is guided into a wire which is connected to the battery or DC appliances.

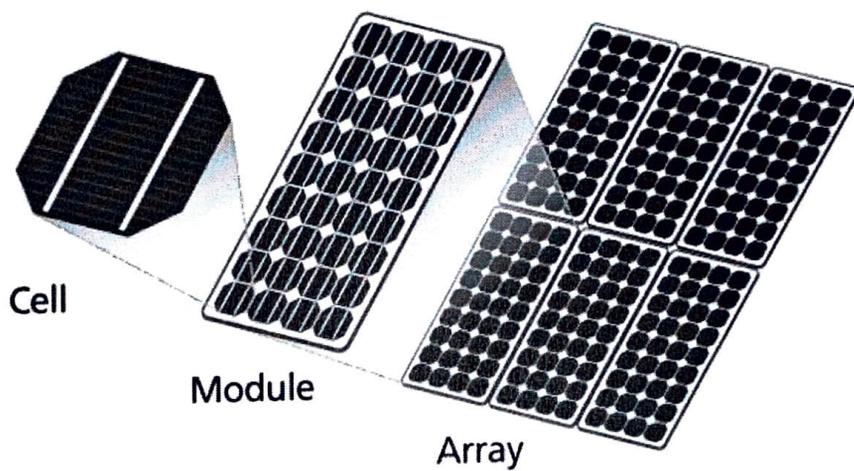


Figure: Solar photovoltaic array

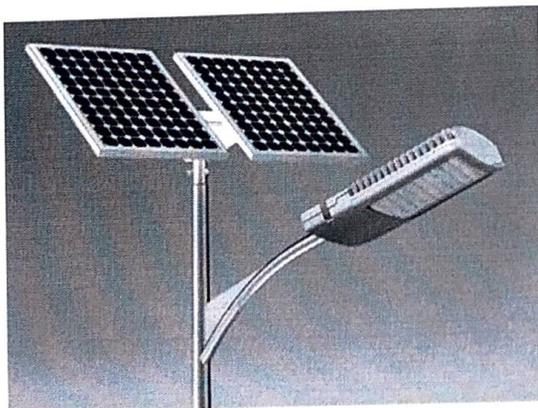


Figure: Solar lights



Figure: Solar lantern

The largest solar energy producers of world are Germany, China, Japan, Italy and USA. Although, India is far behind in utilizing solar energy for power generation, the total solar installed capacity has now reached 31.696 GW as of October 31, 2019. The biggest solar park in India, having 590 MW capacity is located at village Charanka, Dist. Patan in Gujarat. Another installation is at village Chandrasan, Dist. Mehsana in Gujarat, the solar panels are installed over 750 m length of irrigation canal. The advantage of this project is that no land is required.

The development of affordable, inexhaustible, and clean solar energy technologies will have huge longer-term benefits. It will increase countries' energy security through reliance on an indigenous, inexhaustible, and mostly import-independent resource, enhance sustainability, reduce pollution, lower the costs of mitigating climate change, and keep fossil fuel prices lower than otherwise.

To be continued.....