

## RENEWABLE ENERGY TECHNOLOGIES

### Unit 1: ENERGY SCENARIO

#### Module : 2

Present conventional energy status, Present Renewable energy status, potential of various renewable energy sources.

#### Renewable Energy Status in India

With a population of 1.3 billion, India has a massive demand for energy to fuel its rapidly growing economy. From a power deficit nation at the time of Independence, the efforts to make India energy-independent have continued for over seven decades. Today, we are a power surplus nation with a total installed electricity capacity of over Four lakh MW.

Keeping in mind the sustainable development goals, India's power generation mix is rapidly shifting towards a more significant share of renewable energy. Today, India is the world's third largest producer of renewable energy, with 40% of its installed electricity capacity coming from non-fossil fuel sources.

#### Installed capacity of renewable sources of energy in India

Solar	Wind	Small hydro	Large hydro	Biopower	Nuclear
48.55 GW	40.03 GW	4.83 GW	46.51 GW	10.62 GW	6.78 GW

#### Renewable Energy in India

As a developing nation at the time of Independence, India relied heavily on coal to meet its energy demands. However, India has always been committed to looking for more alternative energy sources for sustainable development. The beginning was made with hydropower, with major hydroelectric power projects appearing on the scene of India's energy arena. Over the years, many policy and regulatory initiatives

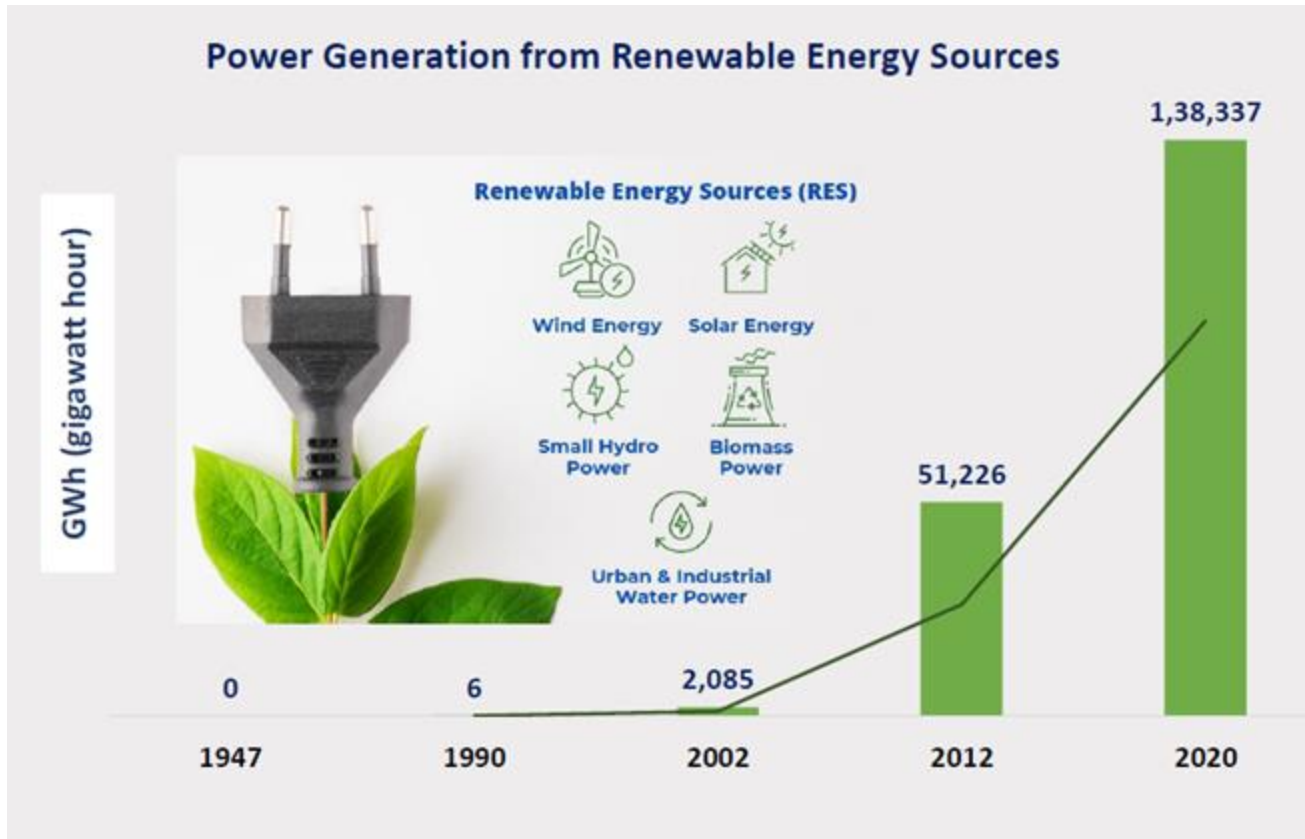
have promoted hydropower development and facilitated investments. Today, we are 5th in the world regarding usable hydropower potential.

Bhabha Atomic Research Centre (BARC) was founded in the 1950s to secure the country's long-term energy independence. Today, we are the only developing nation with indigenously developed, demonstrated and deployed nuclear reactors for electricity generation. This was made possible through several decades of extensive scientific research and technology development.

Work on wind energy started in India during the 1960s when the National Aeronautical Laboratory (NAL) developed windmills, primarily for supplying irrigation water. Today, we have the 4th largest wind power capacity in the world, blessed with a constant movement of wind, especially in the Southern, Western and North Western regions.

Solar energy-based applications have benefited millions of Indians by meeting their cooking, lighting and other energy needs in an environment-friendly manner. Having achieved large-scale success in solar energy solutions, India has spearheaded the International Solar Alliance (ISA) which is an action-oriented, member-driven, collaborative platform for increased deployment of solar energy technologies. The membership of the ISA is open to all member-states of the United Nations, and 107 countries are signatories to the ISA Framework Agreement at present. The Alliance aims to efficiently utilise solar energy to reduce fossil fuel dependence, thereby creating a greener planet.

Biomass has also been an essential source of energy for India. It is renewable, widely available, carbon-neutral and has the potential to provide significant employment in rural areas. Rapidly evolving technology has enabled thermal power plants to have more economical and energy-efficient operations. India has co-fired biomass in thermal plants across the country to reduce its CO<sub>2</sub> footprint in thermal power generation. biomass power/co-generation programme since mid-nineties. Over 800 biomass power and bagasse/non-bagasse cogeneration projects have been installed in the country for feeding power to the grid.



### Promoting Clean Energy and Climate Change

India has progressively decoupled economic growth from greenhouse gas emissions. For example, the Net Zero Emissions target by 2030 by Indian Railways alone will reduce emissions by 60 million tonnes annually. Similarly, India's massive UJALA LED bulb campaign is reducing emissions by 40 million tonnes annually. To further complement these ongoing efforts, India launched the National Hydrogen Mission in 2013 to make India the world's largest hydrogen hub.

Even though it supports the second largest population in the world, India's sustained efforts have ensured that its per capita CO<sub>2</sub> emissions are much lower than the global average. The US emits 14.7 tonnes per capita, China emits 7.6 tonnes per capita, while India's CO<sub>2</sub> emissions amount to 1.8 tonnes per capita.

The global power sector is undergoing an accelerated transformation due to technological innovations and response to climate change protocols. At COP-21 in Paris in 2015, India committed to a 40% share of power generation from non-fossil fuel sources. We have achieved this target a decade ahead of the 2030 timeline.

India has always shown its willingness in leadership to fight climate change. The country's vision is to achieve Net Zero Emissions by 2070, in addition to attaining the short-term targets which include:

Increasing renewables capacity to 500 GW by 2030,

Meeting 50% of energy requirements from renewables,

Reducing cumulative emissions by one billion tonnes by 2030, and

Reducing emissions intensity of India's gross domestic product (GDP) by 45% by 2030.

India's experience will be valuable to other developing nations as they translate their climate pledges into actions and undertake energy transitions towards a more sustainable energy future.

### **Status of Conventional Energy in India**

Energy sources that have been widely used for the bulk of human history are known as conventional. They are non-renewable in nature, which means that once a sample of a traditional energy source has been exhausted, it can no longer be used. Non-renewable materials either require a long time to create or aren't found in nature. Minerals are the most prevalent resource in this group. Non-renewable resources are those whose consumption rate exceeds their replenishment/recovery rate.

### **Fossil Fuels**

- Fossil fuels are combustible geologic deposits of organic matter, such as dead plants and animals, that have been buried beneath thousands of feet of sediment.
- Due to the intense heat and pressure within the earth's crust, these deposits decomposed over time and were changed to natural gas, coal, and petroleum.
- They are also regarded as non-renewable energy sources since they require a long time to refill.

### **Coal**

- In India, coal is the most easily available fossil fuel. It satisfies a large amount of the country's energy needs.

- It is used to both generate and deliver power to businesses and residences.
- India's commercial energy demands are mainly reliant on coal.
- Coal is formed by the compression of plant material over millions of years.
- As a result, depending on the degree of compression, as well as the depth and duration of burial, coal can be found in a variety of forms.
- In wetlands, decomposing plants generate peat.
- It has a low carbon and moisture content, as well as a restricted heat capacity.
- Lignite is a mushy, low-grade brown coal with a high moisture content. The main lignite deposits are in Neyveli, Tamil Nadu, and they are used to generate electricity.
- Coal that has been excavated deep and subjected to high temperatures is known as bituminous coal. It is the most widely used coal in industry.
- Metallurgical coal is high-grade bituminous coal with a specific use in blast furnaces for smelting iron. The best quality hard coal is anthracite.
- Coke is a dark, rough, porous material. It's carbon that's practically completely free of impurities. Coke is utilised in the production of steel as well as the extraction of a variety of metals.
- Coal gas is created when coal is processed to make coke. It is utilised as a fuel in a number of businesses located near coal-fired power stations.
- As of 2016, India ranked fifth in the world with 107,727 million tonnes of proven coal reserves, accounting for nearly 9% of the world's total coal reserves of 1,139,471 million tonnes.

## **Petroleum**

- The majority of petroleum occurrences in India are connected with anticlines and fault traps in tertiary rock strata.
- It occurs in regions of folding, anticlines, or domes where oil is trapped in the crest of the upfold.
- The oil-bearing layer is a porous limestone or sandstone that allows oil to flow through it. Intervening non-porous layers keep the oil from rising or sinking.
- Petroleum can also be discovered in fault traps formed by porous and non-porous rocks.
- Due to the gas being lighter than oil, it frequently appears above it.

- In India, important petroleum-producing locations are Mumbai High, Gujarat, and Assam.
- The primary source of motive power is petroleum and petroleum products. It's a little, lightweight liquid fuel that's changed the way people travel on land, in the air, and on the sea.
- Tankers can transfer it readily from the producing areas to the consuming areas, but pipelines are more convenient, efficient, and cost-effective.
- It produces extremely little smoke and no ash (as is the case with coal) and may be utilised until the very last drop.
- It is a major raw ingredient for different petrochemical products and supplies the most essential lubricating agents.
- India is the world's third-largest oil consumer, consuming around 4.6 percent of the world's total of 97,103,871 barrels per day.

## **Natural Gas**

- Natural gas is considered an environmentally beneficial fuel due to its minimal carbon dioxide emissions and is hence the fuel of the twenty-first century.
- Natural gas deposits of significant size have been identified in the Krishna-Godavari basin.
- The reserves of the Mumbai High and related fields are enhanced along the west coast by discoveries in the Gulf of Cambay.
- Andaman and Nicobar Islands are also major places with significant natural gas deposits.
- Natural gas is created over millions of years when layers of decaying plant and animal waste are exposed to tremendous heat and pressure under the Earth's surface.
- The energy that the plants get from the sun is stored in the gas in the form of chemical bonds.
- Currently, the manufacturing of fertilisers consumes the majority of natural gas, accounting for around 40% of total consumption.
- About 30% is utilised in electricity generation, while 10% is used in the production of LPG.

- Natural gas production and all of these industries have seen complementary expansion.
- The non-energy use of natural gas, which accounted for 35 percent of overall consumption, included the fertiliser sector, petrochemicals, sponge iron, and LPG shrinkage.

## **Electricity**

- Electricity is produced primarily in two ways: by flowing water, which drives hydro turbines to produce hydroelectricity, and by burning other fuels such as coal, petroleum, and natural gas, which drives turbines to provide thermal power.
- Fast flowing water, a renewable resource, is used to create hydroelectricity.
- Hydroelectric power is produced by a variety of multi-purpose projects in India, including the Bhakra Nangal, Damodar Valley Corporation, and the Kopili Hydel Project.
- Coal, petroleum, and natural gas are used to create thermal electricity.
- Thermal power plants generate energy using nonrenewable fossil sources.
- The gross electricity generated by utilities in India in fiscal year (FY) 2019-20 was 1,383.5 TWh, while total power generation (utilities and non-utilities) was 1,598 TWh.

## **Conventional Energy - Advantages**

- Conventional Energy has a high energy content. Compared to renewable energy sources such as solar or wind, fossil fuels such as coal and oil tend to give us more energy.
- Coal extraction, oil sales, and natural gas pipeline development may all create substantial profits.
- These resources are simple to utilise in the home or elsewhere.
- Non-renewable resources are available at a low cost to consumers.
- New technologies and other energy sources are unable to replace conventional minerals such as coal and oil for certain individuals. As a result, it is sometimes referred to as traditional energy.

- Conventional energy may be found just about anywhere. This means they can be easily transported throughout the world.
- Non-renewable energy can also be used by those who live in difficult-to-access places.
- Non-renewable resources, above all, are employment creators. The parts of non-renewable sources that create employment include extraction, transportation, and refining.
- The majority of non-renewable resources are also quite simple to store.

### **Conventional Energy - Disadvantages**

- Conventional Energy has a number of drawbacks, one of which is its time-consuming nature.
- Coal mining, oil exploration, oil drilling, oil rig construction, and natural gas extraction and transportation are all time-consuming activities. It also necessitates a significant amount of work.
- Non-renewable energy takes billions of years to create, therefore it is slowly but steadily disappearing from the planet.
- It may be selfish to use nonrenewable resources indiscriminately without considering future generations.
- Due to fossil fuels releasing chemicals like carbon monoxide, nonrenewable energy can be harmful and cause respiratory difficulties in humans.
- Workers in coal mines and oil rigs are more vulnerable to a variety of health hazards. As a result, a great number of infections, injuries, and even fatalities have occurred.
- When coal, oil, and natural gas are burned, a huge amount of carbon dioxide is released. The ozone layer is quickly depleting as a result of these substances.
- Sulphur oxide and other oxides generated by the combustion of fossil fuels turn rain into acidic rain, which is damaging to both wildlife and humans.
- Smog is produced by a variety of non-renewable sources, which envelops the structures.

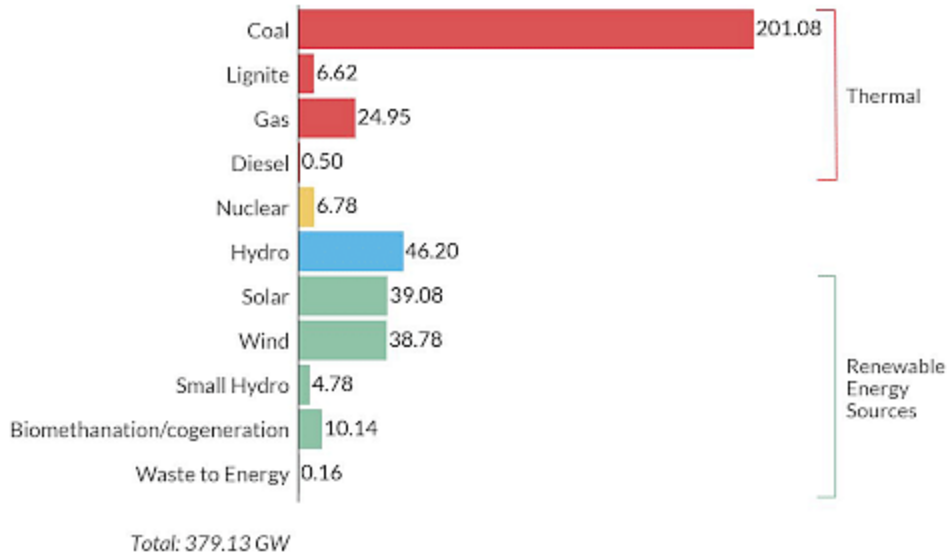


- People in modern cities, for the most part, complain about the same thing. Black smog may darken and pollute your building and other property over time.
- Transporting non-renewable resources can be hazardous at times, when large cargo ships and oil tankers collide and dump their contents in the sea or elsewhere.
- It is potentially fatal to sea creatures and humans that come into touch with it.
- We need to have a large amount of fuel in reserve at all times to keep the power station running. This may be costly and take up a lot of room.

### **Conventional Energy - Current Usage**

- **India Energy Outlook 2021** examines the potential and problems that the country has as it strives to provide a rising population with dependable, cheap, and sustainable energy.
- Due to the growing wages and **expanding living standards**, India is the world's third-largest energy consumer.
- Since 2000, energy consumption has increased, **with coal, oil, and solid biomass still meeting 80%** of demand.
- Based on today's policy settings and constraints, and the assumption that the spread of **Covid-19** is largely brought under control by 2021, the **Stated Policies Scenario (STEPS)** provides a balanced assessment of the direction in which India's energy system is heading.
- India's electricity demand is set to increase much more rapidly than its overall energy demand.
- **Natural gas** is a fast-growing market in India, however, its function varies by industry, circumstance, and period.
- **Natural gas** accounts for only 6% of India's current energy mix, which is among the lowest in the world.
- The grip of **coal** over India's power sector is eroding, with industry accounting for the majority of the growth in coal consumption in the **STEPS** to 2040.

All India installed power capacity in gigawatts (As on Feb 28, 2021)



Installed power capacity in Gigawatts 2021