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RENEWABLE ENERGY

For more than a century, burning fossil fuels like coal, oil and gas has satisfied most of our energy needs. Even today, about 80% of our energy needs are met by fossil fuels. They are very cheap and their usage is very economical on a large scale. But today we are reaching a tipping point due to their prolonged usage. Using fossil fuels for energy has exacted an enormous toll on humanity and the environment—from air and water pollution to global warming. The IPCC report states that it is very important for global economies to come together and act unified on climate change to prevent the global temperatures from rising to 1.5^0 C above preindustrial levels to ward off and prevent major catastrophes all around the world. This is the right time to move toward a clean energy future.

Renewable energy, often referred to as clean energy, comes from natural sources or processes that are constantly replenished. For example, sunlight or wind keep shining and blowing, even if their availability depends on time and weather. Due to years of research and innovation in cleaner sources of energy, today they have become less expensive and are competing head to head with fossil fuels. The major types of Renewable Energy sources available today are:

1) Solar

2) Wind

3) Geothermal

4) Hydropower

5) Biomass

6) Nuclear

7) Hydrogen & Fuel Cells

Solar Energy

The sun has produced energy for billions of years and is the ultimate source for all of the energy sources and fuels that we use today. People have used the sun's rays (solar radiation) for thousands of years for warmth and to dry meat, fruit, and grains. Over time, people developed technologies to collect solar energy for heat and to convert it into electricity. Solar technologies convert sunlight into electrical energy either through photovoltaic (PV) panels or through mirrors that concentrate solar radiation. This energy can be used to generate electricity or be stored in batteries or thermal storage. In PV technology, when the sun shines onto a solar panel, energy from the sunlight is absorbed by the PV cells in the panel. This energy creates electrical charges that move in response to an internal electrical field in the cell, causing electricity to flow. Whereas in concentrating solar-thermal power (CSP) systems, mirrors are used to reflect and concentrate sunlight onto receivers that collect solar energy and convert it to heat, which can then be used to produce electricity or stored for later use. It is used primarily in very large power plants. Solar energy can help to reduce the cost of electricity, contribute to a resilient electrical grid, create jobs and spur economic growth, generate back-up power for night time and outages when paired with storage, and operate at similar efficiency on both small and large scales. Solar energy has two main benefits:

- Solar energy systems do not produce air pollutants or carbon dioxide.
- Solar energy systems on buildings have minimal effects on the environment.

Wind Energy

Wind is caused by uneven heating of the earth's surface by the sun. Because the earth's surface is made up of different types of land and water, it absorbs the sun's heat at different rates. One example of this uneven heating is the daily wind cycle. Energy present in wind is converted into electricity through the use of Wind Turbines. Wind energy turns a turbine’s blades, which feeds an electric generator and produces electricity. There are two basic types of wind turbines: those with a horizontal axis, and those with a vertical axis.

The majority of wind turbines have a horizontal axis: a propeller-style design with blades that rotate around a horizontal axis. Wind, which accounts for a little more than 6 percent of U.S. generation, has become the cheapest energy source in many parts of the country. Top wind power states include California, Texas, Oklahoma, Kansas, and Iowa, though turbines can be placed anywhere with high wind speeds—such as hilltops and open plains—or even offshore in open water.

Geothermal Energy

Geothermal energy is heat within the earth. It is a renewable energy source because heat is continuously produced inside the earth. The slow decay of radioactive particles in the earth's core, a process that happens in all rocks, produces geothermal energy. People use geothermal heat for bathing, to heat buildings, and to generate electricity. Drilling deep wells brings very hot underground water to the surface as a hydrothermal resource, which is then pumped through a turbine to create electricity. Geothermal plants typically have low emissions if they pump the steam and water they use back into the reservoir.

Hydropower

Hydropower relies on water—typically fast-moving water in a large river or rapidly descending water from a high point—and converts the force of that water into electricity by spinning a generator’s turbine blades. Water constantly moves through a vast global cycle, evaporating from lakes and oceans, forming clouds, precipitating as rain or snow, then flowing back down to the ocean. The energy of this water cycle, which is driven by the sun, can be tapped to produce electricity.

Conventional hydroelectric facilities include

- Run-of-the-river systems, where the force of the river's current applies pressure on a turbine. The facilities may have a weir in the water course to divert water flow to hydro turbines.
- Storage systems, where water accumulates in reservoirs created by dams on streams and rivers and is released through hydro turbines as needed to generate electricity. Most U.S. hydropower facilities have dams and storage reservoirs.

Biomass

Biomass is organic material that comes from plants and animals, and includes crops, waste wood, and trees. When biomass is burned, the chemical energy is released as heat and can generate electricity with a steam turbine. Biomass can also be turned into Biofuels such as ethanol and bio-diesel which are generally used for transportation. Ethanol and biodiesel are also cleaner-burning fuels than pure gasoline and diesel fuel.

Ethanol is an alcohol fuel made from the sugars found in grains such as corn, sorghum, and barley. Most of the fuel ethanol used in the United States is distilled from corn. Biomass-based diesel fuels include biodiesel and renewable diesel. They are both called biomass-based diesel fuels because they are mostly produced for use in diesel engines, but they can also be used as heating fuels. Both fuels are made from biomass or materials derived from biomass, but they differ in how they are produced and in their physical properties. Biomass-based diesel fuels can be used in diesel engines without modifying the engines.

Nuclear Energy

Nuclear power uses sustained nuclear fission to generate heat and electricity, and contributes nearly 20 percent of the electricity generated in America. Nuclear energy is produced when the bonds that hold the nucleus together in an atom are broken through nuclear fission. All nuclear power plants use nuclear fission, and most nuclear power plants use uranium atoms. During nuclear fission, a neutron collides with a uranium atom and splits it, releasing a large amount of energy in the form of heat and radiation. More neutrons are also released when a uranium atom splits. These neutrons continue to collide with other uranium atoms, and the process repeats itself over and over again. This process is called a nuclear chain reaction. This reaction is controlled in nuclear power plant reactors to produce a desired amount of heat. Nuclear energy can also be released in nuclear fusion, where atoms are combined or fused together to form a larger atom. Fusion is the source of energy in the sun and stars.

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Hydrogen and Fuel Cells

Hydrogen is the simplest element on earth—it consists of only one proton and one electron—and it is an energy carrier, not an energy source. Hydrogen can store and deliver usable energy, but it doesn't typically exist by itself in nature and must be produced from compounds that contain it. Hydrogen can be used in fuel cells to generate power using a chemical reaction rather than combustion, producing only water and heat as byproducts. It can be used in cars, in houses, for portable power, and in many more applications. Hydrogen can be produced using diverse, domestic resources—including fossil fuels, such as natural gas and coal (with carbon sequestration); nuclear energy; and other renewable energy sources, such as biomass, wind, solar, geothermal, and hydro-electric power—using a wide range of processes.

Fuel cells work like batteries, but they do not run down or need recharging. They produce electricity and heat as long as fuel is supplied. In a hydrogen fuel cell, a catalyst at the anode separates hydrogen molecules into protons and electrons, which take different paths to the cathode. The electrons go through an external circuit, creating a flow of electricity. The protons migrate through the electrolyte to the cathode, where they unite with oxygen and the electrons to produce water and heat.

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The above information is quoted from the following sources:

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