Net Zero Emission and Nuclear Energy

In the last few decades, humans have made significant improvements in technology, resulting in an improved standard of living, quality of living, and overall lifespan. We are constantly working on methods to make our life easier and better. Machines have played an important role in doing so, whether it is a simple loom or an advanced 3D printer, they have reduced the effort and cost required to carry out a task. Machines are efficient and help us reduce our workload, but they also come with some disadvantages. The first machines to be made were simple and do not cause any harm to the environment but as our need increased, we started building more complex and advanced machines like cars, laptops, electric generators, etc., these daily-use machines require some kind of fuel to power and they release heat, carbon, and other harmful pollutants in large quantity as the product of reaction occurring them. The end products of the reaction that undergo in modern machines, Heat, and Carbon cause great harm to the environment. Carbon and its compounds like Methane (CH_4) and Carbon Dioxide are called greenhouse gases which play a major role in increasing Earth's temperature. Carbon is also released when coal, a form of carbon is used for domestic or commercial uses. Coal is also a source of generating electricity through thermal power plants around the globe. According to the Ministry of Coal, coal is used to generate 75% of India's total electricity. Gadgets also release Carbon Dioxide in large amounts. Research shows that a single smartphone releases 70kg of Carbon annually. The Carbon that is generated by our actions is called Carbon Footprint. The average carbon footprint of an Indian is 1.9 tons per year which are way less than that of a person in the US, which is 16 tons per year. The average carbon footprint has seen a constant rise since the Industrial Revolution in the 18^{th} century. Carbon Dioxide with other greenhouse gases is responsible for climate change which results in hotter temperatures around the globe, a rise in sea level, unpredictable weather, severe drought, etc. The recent 2022 Pakistan floods were because by Climate Change which resulted in the loss of over 1000 lives and $14.9 billion of damage. The hurricanes in the US, the forest fire in Australia, the drought in Africa, and the severe cold all across Europe are because of climate change.

The impact of climate change has waked up the countries to take necessary action to reduce their carbon footprint. One such initiative by the countries is the 'Net Zero Emission' which was first discussed by the Parris Agreement in 2015 at the United Nation Climate Change Conference, COP21 to limit the emission of greenhouse gases. As the name suggests, Net Zero Emission means reducing carbon emissions to as close to zero as possible and maintaining a balance between the amount of greenhouse gas produced and the number of greenhouse gases removed from the Earth's atmosphere. The countries aim to reduce global greenhouse emissions by 45% by 2030 and reach net zero by 2050. The world's three largest greenhouse gas emitters are China, the United States, and India. China plans to reach net zero by 2060, the US plans to reach it by 2050 while India has the target to reach net zero by 2070. Only seven countries that are China, the United States of America, India, the European Union, Indonesia, the Russian Federation, and Brazil account for half the greenhouse gases emission in 2020. Countries have introduced policies that deal with the emission of greenhouse gases by industries, giving incentives to companies that focus on creating green energy. The government also imposes a 'carbon tax' on the factories that need to pay for each ton of carbon emitted by them. There are several ways to reduce carbon emissions like switching off lights, fans, etc., when not in use and avoiding overcharging smartphones and laptops, new gadgets

automatically turn off chagrining when they are fully charged to reduce electricity consumption and the carbon released because of the chemical reaction inside their cell.

Countries are exploring newer ways to generate electricity and power automobiles that are cost-efficient and produce very little to no carbon like SNG (Synthetic Natural Gas) and green methanol. Such types of fuels are called green fuels. The Government of India has introduced CNG (Compressed Natural Gas) powered automobiles that do not release carbon while burning. Tata, Tesla, and Hyundai are the companies that are producing automobile which runs on lithium-ion batteries. The idea of electric vehicles is revolutionary and it is getting popular. There is another type of fuel that can power the automobile industry and it is made with the first element of the periodic table, Hydrogen. Hydrogen fuel is a clean fuel that when used as a fuel produces only hydrogen and water. The research on creating hydrogen fuel is still in progress and the only advantage of it is that the amount of hydrogen that we produce is insufficient to power such a large number of automobiles. The Government also practices ethanol-blending to reduce the number of hydrocarbons when fuel is burnt. Ethanol blending is the process in which ethanol is a mix which with petrol to reduce cost and cause less pollution. In India, we blend petrol with 10% ethanol.

India is 5th largest economy in the world and it requires a huge amount of electricity to carry out its daily functions. Most of the energy in India is produced by thermal power plants and solar plants. India ranks 4th in the deployment of most solar panels and producing solar energy. Solar Energy is used to generate 7% of the total electricity of India. The reason we do not shift to solar energy is that solar panels are costly, they need the bright sun's light to produce electricity and due to weather conditions, they cannot be the primary source of electricity.

There is one more source of producing electricity, and that is nuclear power plants which run on nuclear energy. Nuclear Energy is the form of energy that is released when two or more atoms join or break apart. This energy can be used to produce clean and safe electricity as well as deadly nuclear weapons. When an atom is split into several parts through Nuclear Fission it produces a large amount of heat and radiation as the product of the chain reaction. The fuel for powering this nuclear plant is Uranium-235 and Plutonium-239. In a nuclear reaction, a Uranium-235 atom is made to hit by a neutron which splits the atom into two atoms of smaller nuclei, these nuclei then collide with another Uranium-235 atom thus creating a chain reaction till the atoms can no longer divide or the nucleus of the atom contains no more energy. The heat released as the end product of the chain reaction is used to convert water into steam which when passed under high pressure turns the turbine which drives an electrical generator to create electricity. The Sun also uses Nuclear Energy to power itself but instead of splitting atoms, it joins two or more atoms to release energy. This reaction occurs at the core of the Sun and is called Nuclear Fusion. In the core of the Sun, two hydrogen atoms join together to form a helium atom which releases an immense amount of energy as heat, light, and radiation.

Nuclear Fusion is currently impossible to perform on Earth due to various factors but researchers are working to find a way to make electricity with nuclear fusion. On Earth, we make electricity by nuclear fission which generates a lot of radioactive waste which needs to be safely stored. Nuclear

Fission comparatively releases less energy and produces more radioactive waste than Nuclear Fusion. Only a few countries have been able to harness the power of nuclear energy and only a handful of them can use this power to create a weapon of mass destruction. When working with nuclear energy, it is necessary to take safety measures and handle radioactive materials carefully. The International Atomic Energy Agency (IAEA) is an inter-governmental agency that lays down the precaution to be taken while handling nuclear weapons, monitors the use and transport of radioactive material, and promotes its peaceful use. Any minor mistake would result in a disaster as happened at Chornobyl Nuclear Plant on 26th April 1986, in USSR, which resulted in the death of 31 people and affected a thousand others.

- Mayank Vikash