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Building a Sustainable Future Through Renewable Energy Exploration

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Abstract

Climate change is one of the most pressing current challenges in terms of ecosystem stability, individual and global health and economy. The emissions of greenhouse gases due to the activities of anthropogenic origin on the combustion of fossil fuels, deforestation and other industrial processes. A renewable energy system converts the energy found in sunlight, wind, falling water, sea waves, geothermal heat or biomass, such 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 renewable. Renewable energy that includes technologies, like solar, wind, hydro and biomass, has really received lots of attention and is identified as an effective strategy to cut back on greenhouse gas emissions and makeshift to a sustainable energy. Renewable energy sources are one of the greatest challenges of the 21st century. Traditional energy sources are depleting due to the growing population of the world and unlimited demands. Renewable energy sources supplies depend on technological innovation and instrument policy. Renewable energy sources based on coal, fuel, wood and fossil fuel are extensively used for the manufacturing industries like generation of electricity. Growing population increased demand of non-renewable energy resources are depleting and recognition of scientific reasons for the climate change in the global community. There is the need of alternative energy resources to transition from fossil fuels. The exhaustion of these resources, together with the environmental deterioration resulting from their extraction and use, highlights the need for a major transformation in energy production and consumption methods. The non-renewable energy sources are depleting due to the growing population of the world and unlimited demands. Renewable energy sources supplies depend on factors, technological innovation and instrument policy. In this paper we explore how renewable energy could have a positive effect on greenhouse gases and sustainable development by combating the current environmental issues.

Keywords: Climate change, renewable energy, greenhouse gas emissions, sustainable development, fossil fuel transition

INTRODUCTION

The term “sustainable development” becomes more popular due to the serious problems faced by humankind, such as the risk of depletion of sources [1–9]. and increasing human impact on the environment. The United Nations defines sustainable development as “The development that meets the needs of the present without compromising the ability of future generations to meet their own needs”. Therefore, human activities which have negative effects on the world’s delicate balance can be determined as unsustainable activities. Increasing public awareness towards sustainability issues [10–12]. especially environmentally problems as well as the pressure from stakeholders and society to go green triggered. Reducing the impacts related to energy

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consumption is one of the most effective efforts to achieve sustainability targets. This can be achieved either by using energy saving measures or using the power generated from renewable energy technologies. Since energy plays the major role in terms of sustainability. Today we primarily use fossil fuels to heat and power our homes and fuel our cars. It is convenient to use coal, oil, and natural gas for meeting our energy needs, but we have a limited supply of these fuels on the Earth. We are using them much more rapidly than they are being created. Eventually, they will run out. Renewable energy (Figure 1) is plentiful, and the technologies are improving all the time. There are many ways to use renewable energy [13–16]. Most of us already use renewable energy in our daily lives. We often call renewable energy technologies "clean" or "green" because they produce few if any pollutants. Burning fossil fuels, however, send greenhouse gases into the atmosphere, trapping the sun's heat and contributing to global warming. Climate scientists generally agree that the Earth's average temperature has risen in the past century. If this trend continues, sea levels will rise, and scientists predict that floods, heat waves, droughts, and other extreme weather conditions could occur more often. Green energy is a current concern of many nations throughout the world as a means of addressing the challenge of depleting non-renewable resources and the effects this has on the environment and human resources. Coal, petroleum, oil, kerosene, and other non-renewable resources are examples. Natural renewable resources, like the sun, wind, water, etc., are used to generate green energy which helps to reduce problems like pollution, climate change, and carbon footprint.

Figure 1. Renewable energy.

IMPACTS OF CLIMATE CHANGE DUE TO GLOBAL WARMING

Climate change is one of the main environmental challenges facing the world today. Climate change occurs because of an imbalance between incoming and outgoing radiation in the atmosphere. Climate change is mainly caused by human activities, especially through increased greenhouse gas emissions. Climate change **(**Figure 2) is associated with various adverse impacts on agriculture, water resources, forest and biodiversity, health and increase in temperature. Decline in agricultural productivity is the main impact of climate change. Most of the population depends on agriculture directly or indirectly due to rapid industrialization, urbanization and economic development. Climate change is already affecting the global environment in a variety of ways. Glaciers are melting, enhanced sea level rise, plant and animal ranges have shifted, and trees are flowering sooner. During the 20th century, the Earth's average temperature rose one degree Fahrenheit to its highest level in the past four centuries. Scientists project that if emissions of heat-trapping carbon emissions are not reduced, average surface temperatures could increase by 3 to 5 degrees Fahrenheit by the end of this century.

Figure 2. Climate change.

Scientists have predicted that global temperatures will continue to rise for the years to come, largely due to greenhouse gases produced by human activities. According to the Intergovernmental Panel on Climate Change IPCC, the level of climate change effects on different regions will differ over time. High temperatures are to blame for an increase in heat-related deaths and illness, rising seas, increased storm intensity and many other dangerous consequences of climate change. Climate change is a major threat to human existence.

FOUR MAIN FACTORS

1. *Population growth:* In the last century, the world population has tripled. It is expected to rise from the present 7.6 billion to 8.9 billion by 2050. Water use has been growing at more than twice the rate of population increases in the last century.
2. *Increased urbanization:* will focus on the demand for water to more population.
3. *High level of consumption:* As the world becomes more developed, the amount of domestic water used by each person is expected to rise significantly.
4. *The scarcity of fresh water:* will disappear as climate change increases. Scientists point out that higher ocean temperatures as the main culprits since hurricanes and storms get their energy from warm water. Higher temperatures increase the amount of moisture that evaporates from land and water, leading to drought in many areas. As temperatures rise globally, droughts will become more frequent and more severe, with potentially devastating consequences for agriculture, water supply and human health. Climate change and the impacts of climate change affect ecosystems in a variety of ways. For instance, warming could force species to migrate to higher latitudes where temperatures are more conducive to their survival.

HEALTH IMPACTS DUE TO CLIMATE CHANGE

Climate change can affect human health directly (e.g., impacts of thermal stress, death) and indirectly through changes in the ranges of disease vectors (e.g., mosquitoes), water borne pathogens, water quality, air quality and food availability. In India, almost half of the children under age five. There is historical evidence of associations between climatic conditions and vector-borne diseases. Recent analyses have shown that malaria epidemic risk increases around fivefold in the year after an El Nino event. Asthma deaths are expected to increase by almost 20% in the next 10 years if urgent actions to curb climate change. Climate change accelerates the spread of disease primarily because of warmer global temperature. Abrupt change of temperatures leading to heat waves. In addition to changing weather patterns, climatic conditions affect diseases transmitted via vectors, such as mosquitoes.

Sustainable energy is the need of the time, and it is gaining currency due to its low-carbon generation potential, often accompanied by its co-benefits. The transition of fossil fuel based conventional energy to sustainable energy will help in effective management of air pollution, climate change mitigation, and spur sustainable economic growth and improve living standards of people with equality and environmental quality. The IPCC Fifth Assessment Report validates the promising role of bioenergy in encouraging economic development by increasing and diversifying farm incomes and providing rural

employment and in offering cheap alternatives for mitigating climate change. There is a need to adopt and use renewable and sustainable energy technologies for mitigating environmental challenges across all sectors.

Types of few significant types of green energy, such as Solar Energy, Wind energy, Biomass, Hydroelectric Energy, etc.

Wind energy is obtained by harnessing the energy of wind with the help of windmills and wind turbines produce electric power and windmills produce the mechanical power. Wind energy is basically the harnessing of wind power to produce electricity. The kinetic energy of the wind is converted to electrical energy. When solar radiation enters the earth's atmosphere, different regions of the atmosphere are heated to different degrees because of earth curvature. Since air tends to flow from warmer to cooler regions, this causes what we call winds, and it is these airflows that are harnessed in windmills and wind turbines to produce power.

Hydro-Power energy from flowing water into electricity, this turbine is connected into an electromagnetic generator. When the turbine spins produces electricity. Tidal electricity generation involves the construction of a barrage across an estuary to block the incoming and outgoing tide. The head of water is then used to drive turbines to generate electricity from the elevated water in the basin as in hydroelectric dams.

Biomass energy is a renewable energy resource derived from the waste of various human and natural activities. It is derived from numerous sources, including the by-products from the wood industry, agricultural crops, raw material from the forest, household waste, etc. Biomass does not add carbon dioxide to the atmosphere as it absorbs the same amount of carbon in growing as it releases when consumed as fuel. Its advantage is that it can be used to generate electricity with the same equipment that is now being used for burning fossil fuels. Biomass is an important source of energy and the most important fuel worldwide after coal, oil and natural gas. Biomass contains stored energy from the sun. Plants absorb the sun's energy in this process it is called photosynthesis. Biomass is released heat by burning of plants in chemical energy. These resources are found inside the earth they will take years to form. renewable energy sources based on coal, fuel and wood. These are extensively used for the manufacturing industries like the generation of electricity.

Solar Energy is the energy extracted from the sun, the greatest source of renewable energy, at the least cost. The most abundant and least expensive kind of renewable energy is solar energy, which is one of the few important sources of green energy. Nuclear fusion is the process by which lighter, heavier atoms are created by the fusing of smaller, lighter atoms under heat and pressure. The solar radiation is then used to create electricity from this energy. Solar energy is mostly obtained from photovoltaic cells found in sun panels that collect solar radiation. Solar electricity or photovoltaic technology converts sunlight directly into electricity. Solar electricity has been a prime source of power for space vehicles since the inception of the space program. It has also been used to power small electronics and rural and agricultural applications. Solar Photovoltaic (PV): Photovoltaic is the technical term for solar electric. Photo means "light" and voltaic means "electric". PV cells are usually made of silicon, an element that naturally releases electrons when exposed to light. Number of electrons released from silicon cells depend upon intensity of light incident on it.

Merits of Green Energy

The following factors make green energy, which is essentially energy derived from renewable sources, more beneficial:

- *Reduced Greenhouse Gas Emissions:* Renewable energy has decreased our reliance on fossil fuels, resulting in a significant reduction in greenhouse gas emissions and helping to combat climate change.

- *Improved Air Quality:* The shift to renewable energy has led to cleaner air, reducing air pollution-related illnesses and deaths.
- *Energy Independence:* Renewable energy has increased energy self-sufficiency, reducing dependence on imported fuels and enhancing energy security.
- *Economic Benefits:* The renewable energy industry has created millions of jobs, stimulated local economies, and attracted investments.
- *Water Conservation:* Most renewable energy sources require very little water to operate, conserving this precious resource for future generations.
- *Enhanced Energy Access:* Renewable energy has expanded energy access to remote and underserved communities, promoting energy equity and social justice.
- *Technological Innovation:* The renewable energy sector has driven innovation, leading to improved efficiencies, reduced costs, and new technologies.
- *Climate Change Mitigation:* Renewable energy has played a crucial role in reducing global carbon emissions, helping to mitigate the worst impacts of climate change.

Solar Energy

There are two techniques of using solar energy: thermal and photovoltaic way. The thermal route employs the heat from solar energy for cooking, water heating and purification, drying, etc. The solar photovoltaic method transforms the light in solar energy into electricity via the use of solar cell installed in a solar panel, which can then be used for lighting, pumping and communication.

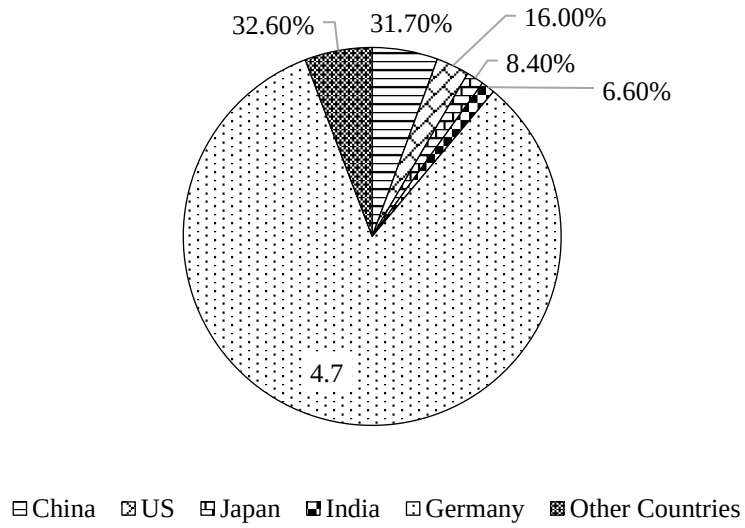

Figure 3. Globally solar energy generation from (2016–2021).

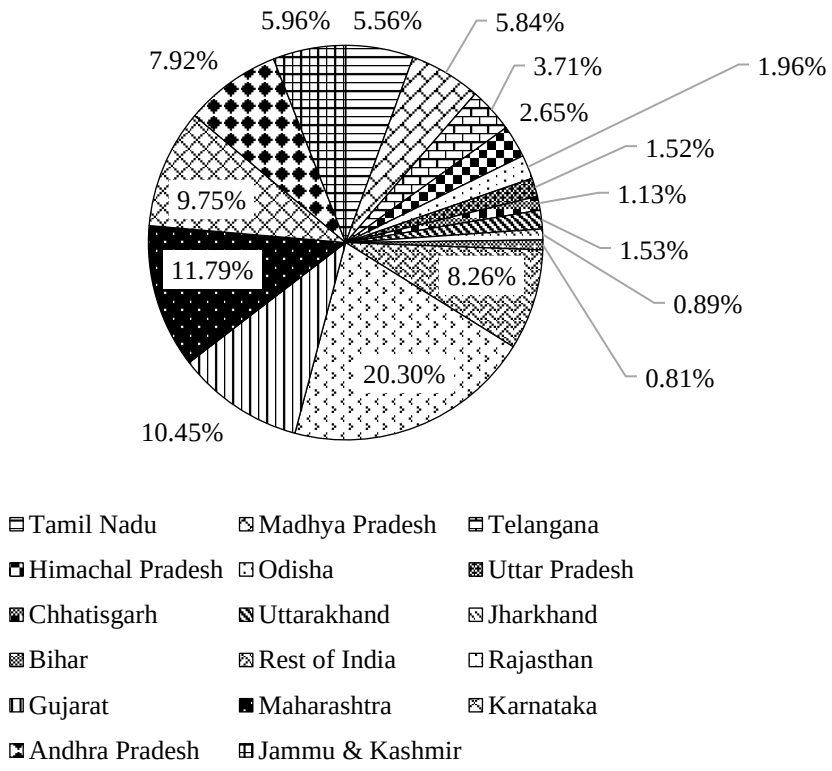

Figure 4. State-wise installed capacity of solar power in India.

Being a tropical country, India is bestowed with abundant number of clear sunny days, obtaining 4–7 kilowatt-hour per square meter per day radiation on an average and as a result, shows good potential for development of solar power. The desert state of Rajasthan receives the highest annual solar radiation in India. The below data reveals the installed capacity of solar energy generation in significant states of India over the years. It depicts that there has been a significant improvement in solar energy generation from 2016–2021, the march of the nation towards renewable energy sources, increasing the green corridor of the nation (Figure 3). Here is also a display of the world's improvement in solar energy generation (Figure 4).

Together, we can create a sustainable, equitable, and climate-resilient future powered by renewable energy (Figure 5).

Figure 5. Sustainable and climate-resilient future powered by renewable energy.

CONCLUSIONS

By taking a close look at reveals environment friendly renewable energy technologies on the planet stand out as critical solution to climate change and resulting environmental destruction. Therefore, this mind-opening knowledge shows how urgent it is to pass on to the world the era of clean energy consumption to keep natural balance within the Earth and create a suitable environment for the generations to come. To combat the crisis of unfavorable climate change and other geopolitical events, various countries, especially developing economies, have recently given the importance of renewable energy transition. Our Prime Minister Narendra Modi's initiative to achieve net zero emissions in India by 2050 requires focus on solar energy. Almost all the countries are now on the primary mission in achieving Net Zero, lowering Carbon emissions, adopting cleaner energy techniques. Using renewable sources for producing energy plays an important role in achieving sustainable development. Major global issues, like depletion of sources and environmental concerns, trigger the rapid development of these clean energy production systems. As we celebrate Earth Day on 22nd April 2025, we recognize the profound impact of renewable energy on our planet. The transition to renewable energy sources has transformed the way we generate, consume, and interact with energy. Renewable energy sources and technologies have the potential to provide solutions to the long-standing energy problems being faced by the developing countries. The renewable energy sources, like wind energy, solar energy, geothermal energy, ocean energy, biomass energy and fuel cell technology, can be used to overcome energy shortage in India. To meet the energy requirement for such a fast-growing economy, India will require an assured supply of 5 times more energy than the total energy consumed today. Renewable energy is one of the options to meet this requirement. Today, renewable account for about 38% of India's energy consumptions. India is increasingly adopting responsible renewable energy techniques and taking positive steps towards carbon emissions, cleaning the air and ensuring a more sustainable future.

As we Look to the Future, We Must Continue to

- Invest in Renewable Energy Technologies with advance research and development to improve efficiency, affordability and scalability.
- Promote Energy storage solutions. Develop and deploy cost-effective energy storage technologies to ensure a stable and reliable energy supply.
- Foster Global Cooperation: Collaborate internationally to share knowledge, best practices, and technologies, accelerating the global transition to renewable energy.
- Support Climate-Resilient Infrastructure. Develop and implement climate-resilient infrastructure to protect communities from the impacts of climate change.
- Empower Communities. Educate, engage, and empower local communities to take ownership of their renewable energy future.

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