

## Climate Change and Green Energy

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### Abstract

Climate change is one of the most pressing problems of the 21st century, which endangers the ecosystems, economies, and human communities. The increase in greenhouse gases, which have been majorly caused by carbon dioxide, methane, and nitrous oxide, has added to the greenhouse effect, leading to increased global temperatures, the melting of ice caps, unpredictable precipitation patterns, and increased occurrence of extreme weather events. These impacts have caused an urgent need to alleviate them, making green energy (energy based on renewable and low emission resources) into the limelight of global policy and technological innovation. This paper is an exploration of the interrelationship between climate change and green energy, the present situation of renewable technologies, and how green energy can change energy systems across the world. It also looks at the economic, environmental and policy implications of the shift towards using renewable energy rather than fossil fuels which demonstrate both possibilities and challenges of a sustainable future.

**Keywords:** Climate Change, Green Energy, Renewable Resources, Sustainability, Energy Transition, Carbon Neutrality

### Introduction

The reliance of the modern world on fossil fuels has fueled economic growth in the last century at the expense of environmental degeneration and climate change. Almost three-quarters of the world greenhouse gas (GHG) emissions are due to the combustion of coal, oil, and natural gas which have trapped heat in the atmosphere and disturbed natural climate regimes.

Climate change is not far away anymore; it comes in the form of global rise in temperature, melting glaciers, rising ocean acidity and even changing weather patterns. The Intergovernmental Panel on Climate Change (IPCC) has reported that the global temperature has already risen by about 1.1 C above its pre-industrial temperature level, and without stringent mitigation action, it may hit more than 1.5 C by mid-century.

This crisis necessitates immediate transition of fossil-based energy systems to clean and sustainable energy systems- what is commonly referred to as green energy. Green energy includes the renewable sources like solar, wind, hydroelectric, geothermal, and biomass energy, and also new technologies like hydrogen fuel and energy storage. In addition to decreasing emissions, green energy also provides economic diversification, employment, and increased energy security.

### **Climate Change: Causes and Consequences**

#### **Causes of Climate Change**

Anthropogenic climate change is rooted to the rise in greenhouse gases in the atmosphere by industrial processes, deforestation, agriculture, and wastes. Key contributors include:

- **Carbon Dioxide (CO<sub>2</sub>):** Emitted from burning fossil fuels and deforestation.
- **Methane (CH<sub>4</sub>):** Released from livestock, landfills, and fossil fuel extraction.

- **Nitrous Oxide (N<sub>2</sub>O):** Originating from fertilizer use and industrial processes.

These gases are the cause of the greenhouse effect, which causes heat trapping and changes the radiation balance on Earth. Since the pre-industrial era, human activities have raised CO<sub>2</sub> from 280 parts per million (ppm) in pre-industrial times to over 420 ppm today (NOAA, 2023).

### Consequences of Climate Change

Climate change has far-reaching impacts:

- **Rising Temperatures:** Heatwaves are becoming more frequent and intense.
- **Melting Ice and Rising Seas:** Glacial melt contributes to sea-level rise, threatening coastal populations.
- **Extreme Weather:** Increased frequency of cyclones, floods, droughts, and wildfires.
- **Agricultural Instability:** Altered rainfall patterns affect food production.
- **Biodiversity Loss:** Many species face extinction due to habitat shifts.

These consequences emphasize the urgency of adopting sustainable energy practices to reduce further emissions.

### Green Energy: Concept and Technologies

#### Understanding Green Energy

Green energy means energy that is produced using renewable, naturally replenished resources that create insignificant effects on the environment. In contrast with fossil energy, where the stored carbon is emitted, green energy harnesses ongoing natural processes, which makes it sustainable and compatible with climate.

The primary types of green energy include:

- **Solar Energy:** Converts sunlight into electricity using photovoltaic (PV) cells or concentrates it for thermal use.
- **Wind Energy:** Harnesses kinetic energy from wind through turbines.
- **Hydroelectric Power:** Generates electricity from the flow of water.
- **Geothermal Energy:** Taps heat from within the Earth's crust for power and heating.
- **Biomass Energy:** Converts organic material into biofuels or biogas.

#### Emerging Technologies

Recent advances include hydrogen energy, which can be used as a clean energy in case it is generated through an electrolysis process powered by renewable energy, and energy storage systems like Lithium-ion and flow batteries, which provide stability to grids based on transient renewable sources. The use of carbon capture and utilization (CCU) technologies is also complementary in the sense that it can decrease the emissions produced by the industries that cannot completely switch to renewables.

### The Role of Green Energy in Climate Change Mitigation

#### Reducing Greenhouse Gas Emissions

Substitution of fossil fuels to renewable energy sources will lead to direct reduction of carbon emissions. The International Renewable Energy Agency (IRENA, 2020) estimates that by 2050, renewable sources may provide over 70 percent of global energy production and more than 90 percent energy-related CO<sub>2</sub> reduction.

#### Decentralized and Sustainable Energy Systems

Green energy encourages decentralized production, where communities generate their own electricity through solar rooftops or wind microgrids. This reduces transmission losses, enhances energy security, and promotes equitable access, especially in rural and off-grid areas.

### **Economic and Social Benefits**

Green jobs are an important result of the renewable energy transition. By 2020, the renewable energy industry provided employment to more than 12 million individuals in the world (IRENA, 2020). In addition to this, the production of renewable technologies in local areas and installation of renewable technology improves regional economies and minimizes the reliance on fossil fuels imported.

### **India's Progress in Green Energy**

India, the world's third-largest energy consumer, has made substantial progress in renewable deployment. Key initiatives include:

- **National Solar Mission (2010):** Targeting 280 GW of solar capacity by 2030.
- **National Wind Energy Mission:** Promoting wind energy infrastructure.
- **Ujjwala and LED Programs:** Reducing household pollution and energy waste.
- **Green Hydrogen Mission (2022):** Promoting hydrogen as a future clean fuel.

India's renewable capacity reached over 180 GW in 2023, representing roughly 43% of total installed power — a major step toward its goal of net-zero emissions by 2070.

### **Policy, Research, and the Road Ahead**

#### **Policy Support**

Policies established by governments create the foundation for green energy development. Feed-in tariffs, renewable purchase obligations, carbon taxes, and investment subsidies have driven renewable deployment across many countries.

#### **Role of Research and Innovation**

Continuous research is key to achieving efficiency improvements, lowering costs and evolving new materials for solar cells, wind blades, and storage batteries. Growth in green chemistry and nanotechnology is also helping in the advancement of eco-friendly energy systems.

#### **Public Awareness and Behaviour Change**

Shifting to a low-carbon economy is not just about technology, but also about people. Public engagement, environmental education, and sustainable consumption practices are all essential for meaningful pathways to achieve long-lasting climate objectives.

#### **Conclusion**

The links between climate change and energy are closely linked. The first thing to understand is that the energy sector is both the largest contributor to global emissions and the strongest opportunity for global emissions reductions. The transition of energy to a green energy future is not just a transition to technical aspects of energy, but a societal transition to sustainable and resilient economies.

The challenges to a clean energy future are indeed daunting; whether it is financing and technology development or social and political challenges, the momentum is real. Countries that are transitioning to green energy today are not only reducing climate risks, but they are developing pathways to economic competitiveness, environmental security, and a brighter future for generations.

The action pathway is through multi-national cooperation: integrating renewable technology development, controlling a legislative framework, and innovative transformation. Green energy is not just about climate change; it is about equitable and sustainable world, and a transformational sustainable and prosperous future.

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