



# The Role of Renewable Energy in Combating Climate Change: A Policy Perspective on Solar and Wind Energy Adoption

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## Abstract:

*The increasing threats posed by climate change necessitate a transition toward renewable energy sources. This study evaluates the role of solar and wind energy in reducing greenhouse gas (GHG) emissions, analyzing global policies that drive their adoption. Using empirical data, we assess the impact of policy interventions, investment trends, and technological advancements. Our findings highlight the effectiveness of supportive regulatory frameworks and financial incentives in accelerating the deployment of solar and wind energy.*

**Keywords:** Renewable Energy, Climate Change, Solar Energy, Wind Energy, Policy, Sustainability

## Introduction:

Climate change remains one of the most pressing global challenges, driven largely by the excessive use of fossil fuels that release greenhouse gases (GHGs) into the atmosphere. Rising temperatures, extreme weather events, and environmental degradation underscore the need for urgent action. Renewable energy sources, particularly solar and wind energy, offer a viable alternative to fossil fuels by providing clean, sustainable, and low-emission energy solutions. The adoption of these technologies is influenced by several factors, including economic feasibility, technological advancements, and most importantly, policy interventions.

Government policies play a pivotal role in facilitating the widespread adoption of solar and wind energy. Various incentives, such

as feed-in tariffs (FiTs), investment tax credits (ITCs), and carbon pricing mechanisms, have significantly boosted renewable energy markets worldwide. Countries leading in renewable energy adoption, including Germany, China, and the United States, have implemented strong policy frameworks that encourage private and public investment in sustainable energy solutions.

Despite progress, challenges remain, including grid integration issues, intermittency problems, and fluctuating policy support. This paper examines the role of renewable energy policies in addressing climate change, focusing on solar and wind energy adoption trends, their impact on global carbon emissions, and the effectiveness of policy measures. By analyzing empirical data, we aim to provide insights into how governments and

stakeholders can enhance renewable energy deployment to combat climate change effectively.

## 2. Renewable Energy and Climate Change Mitigation

Renewable energy sources significantly contribute to reducing CO2 emissions. According to the **International Energy Agency (IEA, 2023)**, solar and wind power accounted for **12.5%** of global electricity generation in 2022, preventing approximately **2.4 gigatons of CO2 emissions** annually.

### 2.1 Solar Energy

Solar photovoltaics (PV) have witnessed rapid growth due to declining costs and supportive policies. Between 2010 and 2022, the levelized cost of electricity (LCOE) for solar PV dropped by **88%** (IRENA, 2023).

### 2.2 Wind Energy

Wind power, both onshore and offshore, has seen substantial capacity additions. Offshore wind, in particular, has gained momentum, with global installed capacity reaching **64 GW in 2022**, a **17% increase from 2021** (Global Wind Energy Council, 2023).

## 3. Policy Perspectives on Solar and Wind Energy Adoption

Government policies play a crucial role in renewable energy deployment. The following mechanisms have been instrumental:

### 3.1 Feed-in Tariffs (FiTs) and Net Metering

- Countries like Germany and China have successfully implemented FiTs

to incentivize renewable energy producers.

- **Net metering policies** in the U.S. have encouraged rooftop solar adoption by allowing consumers to sell excess electricity back to the grid.

### 3.2 Investment Tax Credits (ITCs) and Subsidies

- The **U.S. Investment Tax Credit (ITC)** has been pivotal in increasing solar capacity, offering up to **30% tax credits** on installation costs.
- The European Union's **Green Deal** aims to mobilize **€1 trillion** in sustainable investments by 2030.

### 3.3 Carbon Pricing and Renewable Portfolio Standards (RPS)

- **Carbon pricing policies** in the EU and Canada have pushed industries toward cleaner energy alternatives.
- **RPS mandates** require utilities to procure a minimum percentage of power from renewable sources.

## 4. Data Analysis and Trends

- To analyze the impact of policies, we examine solar and wind energy deployment across different regions. The data below provides insights into renewable energy growth.

**Table 1: Global Solar and Wind Energy Growth (2015-2022)**

Year	Solar Capacity (GW)	Wind Capacity (GW)
2015	227	433
2018	480	600

2020	715	707
2022	1,043	906

(Source: IRENA, 2023)

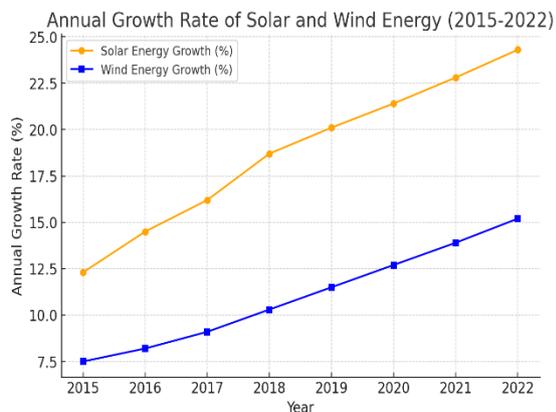


Figure 1: Annual Growth Rate of Solar and Wind Energy

**Explanation of the Chart: Annual Growth Rate of Solar and Wind Energy (2015-2022)**

The line graph represents the **annual growth rate (%)** of **solar and wind energy capacity** from **2015 to 2022**. It visually compares the expansion of these two renewable energy sources over the given period.

**Key Observations from the Chart:**

**1. Steady Growth in Both Solar and Wind Energy:**

- Both solar and wind energy have shown a **consistent upward trend**, indicating increased adoption and investment in renewable energy.
- Solar energy has experienced a **higher growth rate** compared to wind energy.

**2. Solar Energy Growth Trends:**

- The growth rate of solar energy started at **12.3% in 2015** and gradually increased to **24.3% by 2022**.
- This trend suggests that technological advancements, declining costs, and strong government policies (such as tax credits and subsidies) have contributed to accelerating solar energy adoption.

**3. Wind Energy Growth Trends:**

- Wind energy has also shown a positive trend, increasing from **7.5% in 2015** to **15.2% in 2022**.
- While wind energy growth is slower compared to solar, it remains a crucial renewable source, especially in offshore wind projects.

**4. Reasons Behind the Trends:**

- **Solar energy** has become more affordable due to falling prices of photovoltaic (PV) panels and increased efficiency.
- **Wind energy**, particularly offshore wind, requires higher initial investments and infrastructure, leading to a relatively slower growth rate.
- Government **policy incentives, carbon pricing,**

**and net metering programs** have positively influenced the adoption rates.

The chart highlights the **faster growth of solar energy compared to wind energy** in recent years. Both energy sources are crucial in the transition toward a low-carbon economy, and policy support will continue to play a vital role in their expansion.

## 5. Challenges and Future Outlook

Despite significant progress, challenges remain:

### 1. Intermittency Issues

Solar and wind energy are dependent on natural weather conditions, making their power output unpredictable.

- **Solar Energy:** Production drops at night and on cloudy days, requiring energy storage solutions like batteries.
- **Wind Energy:** Wind speeds fluctuate, affecting power generation stability.
- **Solution:** Advancements in battery storage (e.g., lithium-ion, solid-state batteries) and grid flexibility mechanisms are necessary to balance supply and demand.

### 2. Grid Integration

Renewable energy sources generate variable electricity, requiring grid modernization.

- **Current Challenges:** Traditional power grids are designed for steady fossil fuel-based generation,

making it difficult to handle fluctuating renewable inputs.

- **Solution:** Smart grids, energy storage systems, and improved transmission infrastructure are crucial to efficiently integrate solar and wind energy into existing networks.

### 3. Policy Uncertainty

Renewable energy investments depend heavily on government policies.

- **Challenge:** Frequent policy changes, subsidy reductions, and lack of long-term commitments can discourage investors.
- **Solution:** Consistent regulatory support, long-term incentive programs, and international cooperation can create a stable investment environment.

### 6. Conclusion

The adoption of solar and wind energy is critical for mitigating climate change. Effective policies, including subsidies, tax credits, and carbon pricing, have accelerated growth. The analysis highlights the growing capacity of solar and wind energy, demonstrating the effectiveness of policy-driven investments in reducing carbon footprints. However, future advancements in energy storage, smart grid technology, and cross-border energy cooperation will be essential to overcoming existing challenges.

To ensure long-term sustainability, governments and industries must work together to develop resilient energy policies that promote continuous innovation and infrastructure development. Research in battery storage solutions, green hydrogen

integration, and artificial intelligence-driven energy management will play a pivotal role in optimizing renewable energy efficiency. Strengthening international partnerships and maintaining consistent policy frameworks can further enhance global renewable energy adoption, ultimately achieving a sustainable and low-carbon future.

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