

Original Article

Need for Clean and Green Energy in India

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Abstract

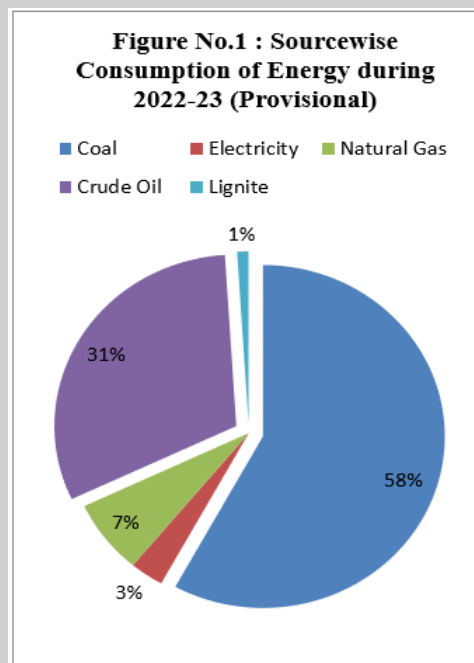
India's transition to clean and green energy is crucial for addressing environmental concerns, ensuring energy security, and promoting sustainable development. The current energy landscape of India is highlighting the country's heavy reliance on fossil fuels and its associated challenges, including high carbon emissions, air pollution, and energy import dependence. The paper explores the potential of renewable energy sources in India, discussing their environmental, health, economic, and social benefits. It outlines key government initiatives and policies promoting clean energy adoption, such as the National Solar Mission and the National Green Hydrogen Mission. Despite significant progress, with non-fossil fuel sources accounting for 46.3% of total installed capacity as of October 2024, India faces challenges in its clean energy transition, including financial constraints, technological barriers, and infrastructure bottlenecks. The paper presents opportunities for accelerating clean energy adoption through public-private partnerships, international collaboration and innovation in energy storage. Case studies from Gujarat, Tamil Nadu, and Maharashtra demonstrate a successful implementation of renewable energy projects. The conclusion emphasizes the need for enhanced policy implementation, strategic investments, and community participation to achieve India's target of 500 GW of non-fossil fuel energy capacity by 2030.

Keywords: Clean and green energy, India energy policy, sustainable development, climate change, energy transition.

Introduction

India's rapid industrialization, economic growth and urbanization have significantly increased energy consumption. However, this growth has come at a cost with fossil fuels accounting for the majority of energy production, leading to severe environmental and health impacts. The shift toward clean and green energy is no longer a choice but a necessity for ensuring energy security, reducing greenhouse gas (GHG) emissions, and achieving sustainable development.

The Energy Landscape in India



Source: Energy Statics India 2024 (page. -51)

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India's energy mix is predominantly reliant on coal, natural gas and oil, which collectively account for over 80% of total energy consumption. The dependence of traditional source of energy has lead to:

High carbon emissions: India is the third-largest emitter of GHGs globally¹.

Air pollution: India has been linked as the world's third most polluted country, as per the World Air Quality Report 2023 by Swiss organization IQAir.² Major cities of India consistently report air quality index levels in the hazardous range.

Energy imports: A significant portion of oil and gas is imported, straining the economy. Over the past decade, the net import of coal has steadily risen from 143.34 MT in 2012-13 to 216.54 MT in 2014-15. This was followed by a marginal decline in the succeeding 2 years but again has started increasing and reached to 247.51 MTs in 2019-20. During FY: 2021-22, the net-import of Coal came out to be 236.51 MTs as compared to 207.31 MTs during FY: 2021-22. However, during FY: 2022-23

the fuel import has again experienced a growth of 2.33% over previous year and reached at 232.73 MTs. India is an exporter of Petroleum Products. However, the same stood at 26.30 BCM for the year 2022-23 as compared to 31.03 BCM in the 2021-22 recording a decline of (-)15.22%.³

India's energy demand is projected to grow rapidly, driven by population growth and increased industrial activity. Meeting this demand sustainably necessitates a transition to cleaner and renewable energy sources.

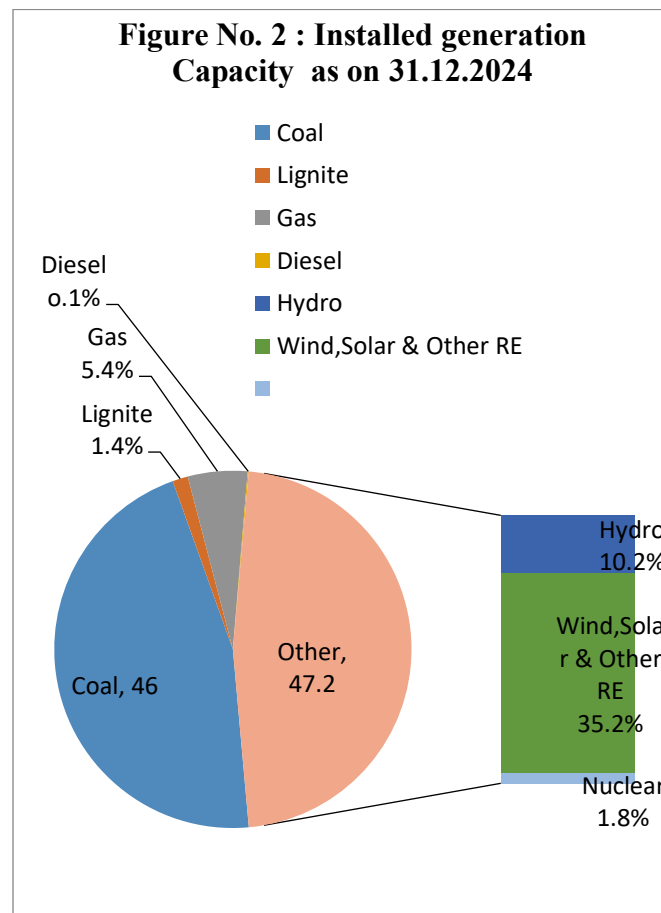
Why Clean and Green Energy?

1. Environmental Sustainability

Reduction in GHG Emissions: Transitioning to renewable energy sources like solar, wind, and hydropower can significantly reduce emissions.

Agreement Climate Change Mitigation: Renewable energy is critical for achieving India's commitment to the Paris.

Preservation of Natural Resources: Clean energy reduces dependence on non-renewable resources, preserving them for future generations.



Source: Central Electricity Authority (CEA)

2. Health Benefits

Reduction in Water Pollution: Renewable energy projects often require less water compared to thermal power plants, minimizing water contamination.

Improved Air Quality: Phasing out coal-based power plants reduces air pollution, decreasing respiratory and cardiovascular diseases.

3. Economic Advantages

Job Creation: In India out of the 1.02 million people employed in renewable energy sector in 2023, Solar Photovoltaic and Hydropower were the largest contributors, employing the most individuals. In addition to that, Solid Biomass handed 58,000 jobs, Liquid Biofuels provided 35,000 jobs and Wind Power generated 52,000 jobs. Biogas created 85,000 jobs while Solar Cooling and Heating sector gave 17,000 jobs, showcasing the diverse employment landscape within the sector⁴.

Cost Efficiency: With technological advancements the cost of renewable energy has dropped significantly and making it more competitive with fossil fuels.

Energy Security: Utilizing domestic renewable resources reduces reliance on imported fuels, enhancing energy independence.

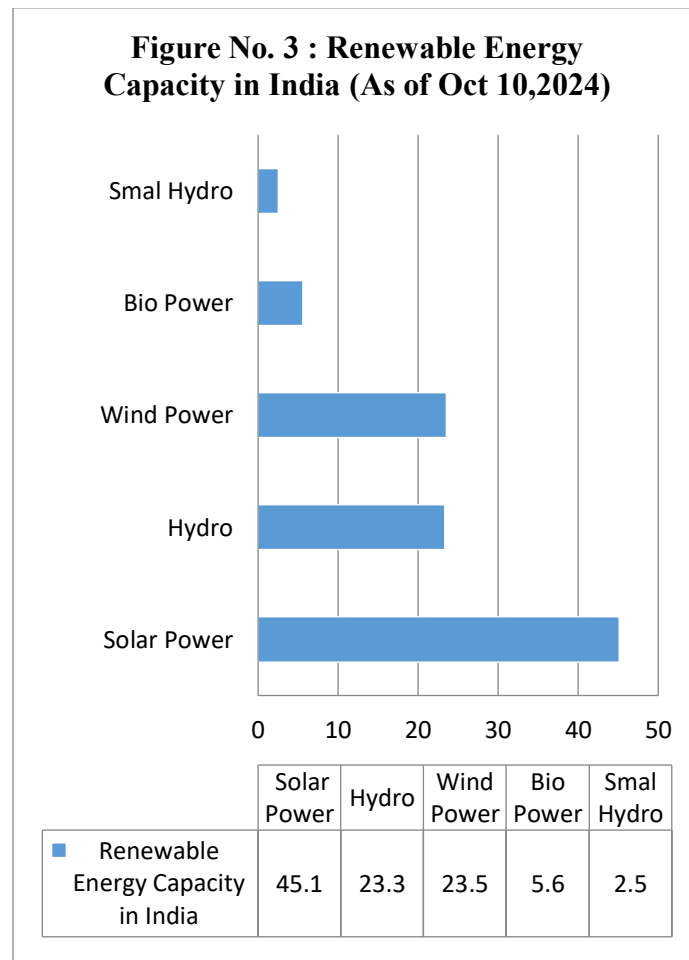
4. Social Equity

Access to Energy: Clean energy solutions like solar mini-grids can electrify remote and rural areas and also bridging the energy access gap.

India's Renewable Energy Potential

By January 20, 2025, India's aggregate capacity for energy derived from non-fossil fuel sources has attained 217.62 GW.⁵

The total electricity generation capacity in India has expanded to 452.69 GW, with a substantial portion coming from renewable sources. As of October 2024, the capacity for electricity generation based on renewable energy has reached 201.45 GW, constituting 46.3 percent of the nation's overall installed capacity. This significant development in India's energy sector demonstrates the country's increasing adoption of cleaner, non-fossil fuel energy alternatives.



Source: <https://npp.gov.in/dashBoard/cp-map-dashboard>

Various renewable energy sources contribute to this remarkable achievement. Solar power takes the lead with 90.76 GW, playing a pivotal role in India's strategy to utilize its plentiful sunlight. Wind power follows with 47.36 GW, leveraging the extensive potential of both coastal and inland wind corridors across the nation. Hydroelectric power also makes a substantial contribution, with large hydro projects generating 46.92 GW and small hydro installations adding 5.07 GW, providing a consistent and eco-friendly energy source from India's waterways.

Biopower encompassing biomass and biogas energy, contributes an additional 11.32 GW to the renewable energy portfolio. These bio-energy initiatives are crucial for converting agricultural waste and other organic materials into power, further diversifying India's clean energy resources. Collectively, these renewable sources are helping the country decrease its reliance on conventional fossil fuels while advancing towards a more sustainable and robust energy future.

These resources position India as a global leader in renewable energy production.

Government Initiatives and Policies

The Indian government has launched various initiatives to promote clean energy⁶:

1. National Solar Mission (NSM)

It launched in January 2010, aims to promote socio-ecological sustainability and address India's energy security. It contributes to global climate change efforts. The government has introduced various schemes to boost solar power generation including Solar Park, VGF, CPSU, and Rooftop schemes. NSM's objectives include establishing India as a global solar leader and achieving Nationally Determined Contributions (NDCs) targets, such as sourcing 50% of power from non-fossil fuels and reducing GDP emissions by 45% by 2030. Additionally, the Off-Grid Solar PV Programme serves areas with unreliable grid power.

2. CCDC Wind Initiative

Centralized Data Collection and Coordination (CCDC) Wind Initiative launched in June 2020, aims to enhance India's wind energy sector by improving wind resource assessment. It supports site identification, investment, and large-scale project implementation. The government, through NIWE, has installed 800 monitoring stations, contributing to a 48.16 GW capacity by 2024.

3. Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME I & II)

The scheme was launched by Government of India (GOI) to promote electric mobility through demand incentives for electric vehicles (EVs). FAME-II, launched in 2019 with Rs. 11,500 crore, supports electric vehicles and charging stations. By October

2024, Rs. 8,844 crore was spent, incentivizing 16.15 lakh EVs and 10,985 charging stations.

4. National Green Hydrogen Mission

It was launched in January 2023, aims to transition India to a hydrogen-based economy. It focuses on developing indigenous technology, infrastructure, and promoting green hydrogen as a clean energy source. With over Rs. 8 lakh crores in investments, the mission targets 5 million metric tons of capacity by 2030, creating 6 lakh jobs. Key achievements include ₹19,744 crore allocated for infrastructure, three production hubs, and financial incentives for electrolyser manufacturing. India also hosted key international events to foster collaboration on green hydrogen technology and innovation.

5. Energy Efficiency Programs

Initiatives like UJALA (Unnat Jyoti by Affordable LEDs for All) and PAT (Perform, Achieve, Trade) have been launched to improve energy efficiency in industries and households.

Challenges in the Transition to Clean Energy

Despite the potential, India faces several challenges⁷:

1. Financial Constraints

- High initial investment costs for renewable energy projects.
- Limited access to affordable financing for small-scale projects.

2. Technological Barriers

- Dependence on imported technology for solar panels and wind turbines.
- Lack of adequate research and development in clean energy technologies.

3. Infrastructure Bottlenecks

- Insufficient grid infrastructure to integrate renewable energy.
- Challenges in energy storage and transmission.

4. Policy and Regulatory Issues

- Delayed implementation of policies and inconsistent state-level regulations.

5. Land Acquisition

- Difficulty in acquiring land for large-scale renewable projects, especially in densely populated areas.

Opportunities for Accelerating Clean Energy Adoption⁸

1. Public-Private Partnerships (PPPs)

Encouraging collaboration between the government and private sector to share risks and pool resources.

2. International Collaboration

Engaging with global organizations and countries for technology transfer, investments and knowledge sharing.

3. Innovation in Energy Storage

Investing in battery storage and other energy storage solutions to address intermittency issues of renewable.

4. Decentralized Energy Systems

Promoting rooftop solar, micro-grids, and community-based energy systems to enhance access in remote areas.

5. Awareness and Education

Educating the public about the benefits of clean energy and encouraging behavioral changes for energy conservation.

Case Studies of Success

1. Gujarat's Solar Parks⁹

The Charanaka Solar Park is a significant initiative established under the 'Gujarat Solar Power Policy 2009, a state-level policy aimed at positioning Gujarat as a leader in solar power generation. The policy facilitates the development of both small and medium-sized private solar projects, as well as large-scale solar parks through public-private partnerships. Under this framework, the state acquires and allocates land for the parks, while expediting planning processes to enable private developers to establish projects within designated plots.

2. Wind Energy in Tamil Nadu

In 2006, Tamil Nadu (Odanthurai) became a pioneer in renewable energy by setting up a windmill to generate revenue for the village panchayat. While it inspired others, the project faced challenges due to low economic viability. Despite investing Rs. 20 million, revenue of Rs. 2 million fell short of offsetting electricity expenses.¹⁰

3. Biogas in Rural Maharashtra

The Kakadpana test project in Nasik, Maharashtra, initiated on April 13, 2011, installed a 10 kW biomass gasifier to provide electricity to 85 households. Managed by GOMUKH and MEDA, the project transformed village life, enabling evening work, study, and entertainment. Plans include a bore well, community hall, and biogas plants, further improving village development.¹¹

The Road Ahead

India's journey toward clean and green energy is critical for its socio-economic growth and environmental well-being. Achieving the target of 500 GW of non-fossil fuel energy capacity by 2030 will require¹²:

- Enhanced policy implementation.
- Strategic investments in infrastructure and technology.
- Community participation and capacity building.

Conclusion

India's transition to clean and green energy is crucial for addressing sustainable development, ensuring energy security and promoting environmental concerns. The country has made significant strides in expanding its renewable energy capacity, with non-fossil fuel sources accounting for 46.3% of the total installed capacity as of October 2024. This progress is supported by various government initiatives and policies aimed at promoting solar, wind, hydroelectric, and other renewable energy sources. However, the path to a clean energy future is not without challenges. Financial constraints, technological barriers, infrastructure bottlenecks, policy issues and land acquisition difficulties continue to impede rapid adoption. Overcoming these obstacles requires a multi-faceted approach involving public-private partnerships, international collaboration, innovation in energy storage, promotion of decentralized energy systems and increased public awareness. Successful case studies from states like Gujarat and Tamil Nadu demonstrate the potential for large-scale renewable energy projects. However, these examples also highlight the need for careful planning and economic viability assessments to ensure long-term sustainability. As India moves forward, it must balance its growing energy demands with environmental sustainability. The continued focus on clean and green energy will not only help India meet its climate commitments but also create new economic opportunities, improve public health and enhance energy access for all citizens. The country's success in this transition will have significant implications for global efforts to combat climate change and achieve sustainable development goals.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper

References

1. Greenhouse Gas Emissions from Energy, accessed January 12, 2025
<https://www.iea.org/countries/india/emissions>
2. World Air Quality Report 2023 by Swiss organization IQAir, accessed February 7, 2025
<https://www.iqair.com/in-en/world-air-quality-report>
3. Energy Statistics India – 2024, page no.-38
https://www.mospi.gov.in/sites/default/files/publication_reports/EnergyStatistics_India_publication_2024N.pdf
4. IRENA's Renewable Energy and Jobs Annual Review 2024
https://www.irena.org//media/Files/IRENA/Agency/Publication/2024/Oct/IRENA_Renewable_energy_and_jobs_2024.pdf
5. Press Information Bureau. (2025, January 22). India's Renewable Energy Revolution 2024 Achievement & 2025 Roadmap.
<https://pib.gov.in/PressReleasePage.aspx?PRID=2094992#:~:text=As%20on%20the%20Jan,wind%20installations%20compared%20to%202023.>
6. Press Information Bureau. (2025, February 1). Energy security in India
<https://pib.gov.in/PressReleasePage.aspx?PRID=2098441#:~:text=The%20National%20Solar%20Mission%20has,adoption%20among%20farmers%20and%20household>
7. NITI Aayog. Report of the inter-ministerial committee on just transition from coal.
https://www.niti.gov.in/sites/default/files/2022-11/Report_Just-Transition-Committee_compressed.pdf
8. Saleh, H. M. and Hassan, A.I. (2024). The challenges of sustainable energy transition: A focus on renewable energy. Applied Chemical Engineering. Volume 7, issue 2
9. Yenneti, Komali and Day, Rosie. (2015). Procedural (in) justice in the implementation of solar energy: The case of Charanaka solar park, Gujarat, India. Science Direct: Elsevier. Volume 86, pages 664-673
10. Subramaniam, Gowthami. 2023. Odanthurai's windmill experiment, a pioneering move that

had its wind knocked out. Mongabay
<https://india.mongabay.com/2023/08/odanthura-is-experiment-with-wind-energy-confronts-economic-complexities/>

11. Case Study of Kakadpana Test Project in Nasik District of Maharashtra
http://mnre.gov.in/mnre-2010/file-manager/UserFiles/case_study
12. Ministry of Power (Government of India)
<https://powermin.gov.in/en/content/500gw-nonfossil-fuel-target>