

**International Conference – 2025: Developed India @ 2047****Charting Multidisciplinary and Multi-Institutional Pathways for Inclusive Growth and Global Leadership held on 4th & 5th April, 2025****Organised by: IQAC - Gossner College, Ranchi**

Green Energy for Global Leadership: Positioning Jharkhand as a Renewable Energy Hub by 2047

Pradeep Prasad ¹

Research Scholar, Department of Commerce and Business Management,
Ranchi University, Ranchi.

Email: prasadpradeep44@gmail.com

Dr. F.A Jahangir ²

Assistant Professor, Mandar College, Mandar, Ranchi University, Ranchi.

Abstract

The transition to green energy is a critical component of global leadership in the 21st century. With India's vision of becoming a developed nation by 2047, Jharkhand, a resource-rich state, has the potential to emerge as a significant renewable energy hub. Traditionally known for its coal reserves, Jharkhand is now at the crossroads of an energy transformation that aligns with sustainability, energy security, and economic development. This study explores the state's renewable energy potential, particularly in solar, wind, and bioenergy, and examines strategic interventions necessary for positioning Jharkhand as a leader in the green energy sector. The study highlights key policy frameworks, investment opportunities, and technological advancements that can drive this transition. The role of Jharkhand Renewable Energy Development Agency (JREDA) is critically analyzed to assess the effectiveness of existing initiatives and identify gaps that need to be addressed. Additionally, the study underscores the socio-economic benefits of renewable energy adoption, including job creation, rural electrification, and industrial sustainability. Challenges such as infrastructural limitations, financing constraints, and policy implementation gaps are also discussed, with recommendations for overcoming these barriers. By leveraging its geographical advantages and implementing a multidisciplinary and multi-institutional approach, Jharkhand can contribute to India's global leadership in renewable energy. The study advocates for a roadmap that integrates government policies, private sector participation, and community engagement to accelerate the green energy transition. Positioning Jharkhand as a renewable energy hub by 2047 will not only support India's net-zero targets but also enhance the state's economic resilience and global competitiveness.

Keywords: *Renewable Energy, Jharkhand, Green Energy Transition, Sustainable Development, JREDA, Energy Policy, Economic Growth, Global Leadership, Solar Energy, Wind Energy.*

Introduction

Jharkhand, historically known for its abundant mineral resources, is at a crucial juncture in India's energy transition. As the world shifts towards renewable energy to mitigate climate change and ensure long-term sustainability, Jharkhand has the opportunity to redefine its role from a coal-

**International Conference – 2025: Developed India @ 2047****Charting Multidisciplinary and Multi-Institutional Pathways for Inclusive Growth and Global Leadership held on 4th & 5th April, 2025****Organised by: IQAC - Gossner College, Ranchi**

dependent state to a renewable energy leader. This transformation is essential for meeting India's commitment to achieving net-zero emissions by 2070 and aligning with the broader vision of positioning India as a global leader in clean energy by 2047.

While Jharkhand has traditionally relied on coal mining and thermal power generation, the state possesses significant untapped renewable energy potential. Solar energy, wind energy, and bioenergy resources can play a pivotal role in reshaping the state's energy landscape. This paper explores the feasibility, challenges, and strategic roadmap for establishing Jharkhand as a renewable energy hub, ensuring economic growth, job creation, and environmental sustainability.

Renewable Energy Potential in Jharkhand

1. Solar Energy

Jharkhand's solar energy potential is significant due to the state's favorable climatic conditions and abundant land resources. The region receives an average solar radiation of 4.5 to 5.5 kWh per square meter per day, which is well above the threshold required for efficient solar power generation. This provides a strong foundation for large-scale solar energy projects, especially since solar energy is one of the fastest-growing renewable energy sources globally.

The state boasts vast tracts of barren, non-agricultural, and degraded land, ideal for establishing solar farms. With a substantial amount of unused land, Jharkhand can tap into this resource to meet its energy needs and contribute to national energy goals. Furthermore, the state has a growing number of solar initiatives, with the government already undertaking various solar power projects. However, despite these efforts, the installed capacity of solar energy remains far below the state's potential.

If Jharkhand increases investment in solar power infrastructure, improves grid connectivity, and receives stronger policy support, the state can achieve remarkable growth in solar energy production. This expansion could also generate employment, stimulate local economies, and reduce the state's dependency on fossil fuels, making it a major player in India's push to meet its renewable energy targets.

2. Wind Energy

While Jharkhand is not traditionally viewed as a high-wind energy state, certain regions, particularly in the hilly and elevated terrains of Netarhat, Ranchi, and other nearby areas, hold substantial potential for wind power generation. These regions experience higher wind speeds, which, combined with advancements in wind turbine technology, could significantly improve the feasibility of wind energy production.

As turbine technology continues to evolve and become more efficient, areas once considered unsuitable for wind farms may become viable candidates for wind energy projects. For instance, smaller-scale and more efficient wind turbines can operate in areas with lower wind speeds, which

**International Conference – 2025: Developed India @ 2047****Charting Multidisciplinary and Multi-Institutional Pathways for Inclusive Growth and Global Leadership held on 4th & 5th April, 2025****Organised by: IQAC - Gossner College, Ranchi**

could make wind power more accessible in Jharkhand. By incorporating wind energy into its renewable portfolio, the state can enhance its energy security, diversify its renewable energy sources, and potentially create new jobs in the renewable energy sector.

The development of wind energy could also align with India's broader strategy to achieve 50% renewable energy capacity by 2030. Jharkhand could emerge as an important contributor to wind energy if the government supports technological advancements, offers incentives for investments, and creates a conducive policy framework.

3. Bioenergy and Waste-to-Energy

One of the most promising renewable energy resources in Jharkhand lies in its substantial agricultural, forestry, and urban waste sectors. The state's abundant biomass, including agricultural residues, forest waste, and urban refuse, offers a significant opportunity for bioenergy generation. The agricultural industry produces a vast amount of crop residues such as straw, husks, and stubble, which can be converted into biogas or biofuels.

In rural areas, bioenergy solutions can be pivotal for electrification, especially in remote villages where access to the grid is limited or unreliable. Utilizing agricultural waste, such as rice husks, wheat straw, and sugarcane bagasse, for electricity generation could help power rural communities and industries. Additionally, the energy derived from waste products can contribute to reducing the state's dependence on fossil fuels while mitigating the adverse environmental impact of burning agricultural residues.

Moreover, Jharkhand's urban centers, such as Ranchi, Jamshedpur, and Dhanbad, face significant waste management challenges. Converting urban waste into energy through waste-to-energy (WTE) technologies can solve two problems at once—helping to reduce landfill waste while simultaneously generating electricity. The implementation of WTE plants could also contribute to the state's sustainable development goals, providing a green solution to both energy generation and waste management.

As the demand for cleaner and more sustainable energy solutions rises, bioenergy could emerge as a key component of Jharkhand's energy mix. The development of bioenergy projects would require investment in technology and infrastructure, but the potential benefits for the environment, economy, and society are immense.

4. Hydropower Potential

In addition to solar, wind, and bioenergy, Jharkhand also has moderate hydropower potential, with several rivers and water bodies that could be harnessed for energy generation. The state is home to the Subarnarekha, Damodar, and Koel rivers, all of which have hydropower potential that remains largely untapped.

**International Conference – 2025: Developed India @ 2047****Charting Multidisciplinary and Multi-Institutional Pathways for Inclusive Growth and Global Leadership held on 4th & 5th April, 2025****Organised by: IQAC - Gossner College, Ranchi**

Small and micro-hydropower projects could be developed in these areas, especially in regions with steep terrain and flowing rivers. These projects would provide decentralized, renewable energy to rural communities and could complement the state's larger renewable energy goals. Hydropower is also a relatively stable and reliable source of energy compared to solar and wind, which can be intermittent.

The development of hydropower resources in Jharkhand would require a detailed environmental impact assessment, given the importance of preserving water ecosystems. However, with the right planning, these hydropower resources could contribute significantly to the state's energy mix.

Policy Framework and Institutional Support for Renewable Energy in Jharkhand**1. Role of Jharkhand Renewable Energy Development Agency (JREDA)**

The Jharkhand Renewable Energy Development Agency (JREDA) is at the forefront of the state's clean energy transition. The agency's primary responsibility is to spearhead the promotion and implementation of renewable energy initiatives across Jharkhand. JREDA has already launched several significant programs aimed at encouraging the use of renewable resources such as solar, wind, and biomass energy. These programs include initiatives for solar rooftop installations, decentralized energy solutions, and rural electrification, which aim to provide clean energy access to remote and underserved communities.

To accelerate the state's renewable energy adoption, it is essential to strengthen JREDA's mandate by increasing its financial and technical support. A more robust agency will be better equipped to manage large-scale projects, handle complex implementation processes, and coordinate various renewable energy activities. Additionally, increased collaboration with private sector players is critical to fast-track the deployment of renewable energy systems and technologies. By partnering with experienced renewable energy companies and leveraging their expertise, JREDA can streamline project execution, reduce costs, and scale up the use of renewable energy.

To further support these initiatives, JREDA could also focus on increasing awareness and training programs to educate local communities about the benefits of renewable energy and how they can participate in energy-generation programs, either as consumers or producers of renewable energy.

2. State and National Policy Alignment

For Jharkhand to achieve its renewable energy goals, it must ensure that its state-level policies align closely with national programs and objectives. The central government of India has rolled out several key initiatives to promote renewable energy, and Jharkhand can benefit greatly by aligning its policies with these programs:

National Solar Mission: This flagship program aims to boost India's solar energy capacity. Jharkhand should focus on increasing its solar energy installations, aligning with this mission to contribute to the national target of achieving 500 GW of non-fossil fuel capacity by 2030.



International Conference – 2025: Developed India @ 2047

Charting Multidisciplinary and Multi-Institutional Pathways for Inclusive Growth and Global Leadership held on 4th & 5th April, 2025

Organised by: IQAC - Gossner College, Ranchi

Faster Adoption and Manufacturing of Electric Vehicles (FAME): FAME is designed to promote the adoption of electric vehicles (EVs) and the necessary infrastructure. Jharkhand can align with this program by promoting EVs in urban areas like Ranchi, Jamshedpur, and Dhanbad, as well as building the necessary charging infrastructure and offering incentives to both manufacturers and consumers.

Renewable Energy Investment Promotion: As part of the national renewable energy agenda, Jharkhand can also leverage central government schemes like the Viability Gap Funding (VGF) and Green Energy Corridor projects. These schemes provide funding support for renewable energy infrastructure, including grid connectivity and the transmission of renewable energy, which will be critical as Jharkhand scales up its renewable energy generation.

By aligning state-level policies with these national programs, Jharkhand can tap into central government incentives, subsidies, and financing options, which can significantly reduce the financial burden of renewable energy projects. It can also ensure a more coordinated approach to energy development, helping to avoid regulatory bottlenecks and expedite project implementation.

3. Public-Private Partnerships (PPP) and Investment Opportunities

Encouraging private investment in renewable energy projects is crucial for Jharkhand to meet its renewable energy goals. The state can attract investment from both domestic and international players by offering favorable policies, subsidies, and tax incentives that reduce the financial risks associated with renewable energy projects.

One of the most effective ways to foster this investment is through Public-Private Partnerships (PPP). In a PPP model, the state and private companies can collaborate to develop and manage renewable energy projects. This model allows for sharing of risks and responsibilities, with the private sector providing expertise and capital, while the government provides policy support, incentives, and land for renewable energy projects. Key areas where PPPs could be effective include:

Solar Power Projects: Large-scale solar power plants can be developed on Jharkhand's vast barren and non-agricultural lands. Private players can bring in the capital and technical expertise, while the government can provide incentives and subsidies.

Wind Energy: As Jharkhand explores its potential for wind energy, PPPs could help set up wind farms in suitable regions, such as Netarhat and Ranchi, where wind speeds are favorable.

Bioenergy: With abundant agricultural waste, forest residues, and urban waste, PPPs could be instrumental in setting up biomass and waste-to-energy plants. These collaborations could help meet the energy needs of rural communities while addressing waste management challenges.

Additionally, establishing renewable energy parks and industrial zones powered entirely by green energy would create a concentrated ecosystem for renewable energy businesses. These industrial zones would not only attract companies in the renewable energy sector but also help boost local economies by creating jobs in the manufacturing, installation, and maintenance of renewable energy systems.

**International Conference – 2025: Developed India @ 2047****Charting Multidisciplinary and Multi-Institutional Pathways for Inclusive Growth and Global Leadership held on 4th & 5th April, 2025****Organised by: IQAC - Gossner College, Ranchi**

4. Key Investment Opportunities

Several specific investment opportunities in renewable energy could provide substantial returns while contributing to the state's energy security. These include:

Solar Parks: Establishing large-scale solar parks in areas with high solar radiation can attract national and international companies to invest in the development and operation of solar power plants. Such projects could be developed in collaboration with JREDA, benefiting from the state's vast tracts of barren land.

Wind Power: Wind farms in regions such as Ranchi and Netarhat, supported by advances in wind turbine technology, present viable investment opportunities for both private investors and developers.

Electric Mobility Infrastructure: As the state works to promote electric vehicles (EVs), there is significant potential for investment in the EV charging infrastructure. Private sector participation can help build charging stations across major cities and highways, offering convenience for consumers and contributing to the adoption of EVs.

Bioenergy Projects: By setting up biogas plants or biomass-to-energy conversion facilities, investors can tap into the local waste-to-energy potential. With state and central government support, these projects could be scaled up in rural areas, benefiting from access to raw materials like agricultural waste and forest residues.

Energy Storage Solutions: As renewable energy sources like solar and wind are intermittent, energy storage solutions will be key to balancing supply and demand. Investment in large-scale battery storage or other energy storage technologies would ensure reliable energy supply, especially during peak demand or cloudy/windless days.

Socio-Economic Impact of Renewable Energy Transition

Job Creation and Skill Development

The shift towards renewable energy can generate thousands of jobs in manufacturing, installation, operation, and maintenance of solar and wind energy projects. Training programs in collaboration with technical institutes and universities can equip the local workforce with the necessary skills for the green economy.

Rural Electrification and Energy Security

Decentralized renewable energy solutions, such as solar microgrids and biogas plants, can enhance energy access in remote and tribal areas of Jharkhand. This will improve education, healthcare, and overall quality of life while reducing dependence on expensive and polluting diesel generators.

**International Conference – 2025: Developed India @ 2047****Charting Multidisciplinary and Multi-Institutional Pathways for Inclusive Growth and Global Leadership held on 4th & 5th April, 2025****Organised by: IQAC - Gossner College, Ranchi****Industrial Sustainability and Economic Diversification**

Transitioning industries to renewable energy sources can enhance Jharkhand's industrial competitiveness. Green energy adoption in steel, mining, and manufacturing sectors can attract eco-conscious investors and boost exports.

Challenges and Solutions**Infrastructure and Grid Integration**

Jharkhand's renewable energy expansion requires upgraded transmission and distribution infrastructure to handle variable energy sources. Smart grids and energy storage solutions can improve grid stability and efficiency.

Financial Constraints and Investment Risks

High initial capital costs and financial risks often deter investors from renewable energy projects. The government must implement risk mitigation measures such as low-interest loans, credit guarantees, and renewable energy purchase obligations to encourage investment.

Policy Implementation and Bureaucratic Hurdles

Inconsistent policies and bureaucratic delays can slow down renewable energy adoption. Streamlining regulatory approvals and ensuring transparency in project allocation can enhance investor confidence and project execution.

Roadmap to 2047: Strategies for Positioning Jharkhand as a Renewable Energy Hub

1. Expansion of Solar and Wind Infrastructure – Targeting 10 GW of Solar and Wind Capacity by 2047

- **Identification of Suitable Land:** Mapping high solar irradiation zones and wind potential sites in Jharkhand.
- **Large-Scale Solar Parks:** Development of ultra-mega solar parks through public-private partnerships (PPP).
- **Wind Energy Deployment:** Conducting feasibility studies to assess offshore and onshore wind energy potential.
- **Hybrid Energy Systems:** Encouraging hybrid solar-wind farms to optimize energy generation.
- **Grid Infrastructure Modernization:** Expanding transmission networks to integrate large-scale renewable energy projects into the grid.



International Conference – 2025: Developed India @ 2047

Charting Multidisciplinary and Multi-Institutional Pathways for Inclusive Growth and Global Leadership held on 4th & 5th April, 2025

Organised by: IQAC - Gossner College, Ranchi

2. Strengthening JREDA and Policy Reforms – Enhancing Institutional Capabilities for Effective Policy Execution

- **Capacity Building within JREDA:** Increasing funding, staff training, and technical expertise.
- **Renewable Energy Policy Updates:** Strengthening Jharkhand's Renewable Energy Policy with clear incentives for investors.
- **Simplified Regulatory Framework:** Streamlining approvals for renewable projects and ensuring single-window clearance.
- **Mandating Renewable Purchase Obligations (RPOs):** Ensuring industries and DISCOMs procure a minimum share of power from renewables.

3. Investment Promotion and PPP Models – Attracting Domestic and International Investors

- **Incentive Schemes:** Offering tax benefits, subsidies, and low-interest financing to renewable energy developers.
- **Foreign Direct Investment (FDI) Promotion:** Conducting investor summits to attract global clean energy players.
- **Public-Private Partnerships (PPPs):** Collaborating with private firms for financing, technology transfer, and infrastructure development.
- **Green Bonds and Climate Finance:** Raising funds through green bonds and tapping into climate finance initiatives.

4. Skill Development and Green Jobs – Training Programs for Employment Generation

- **Renewable Energy Skill Development Centers:** Establishing training institutes focused on solar PV installation, wind turbine maintenance, and battery storage.
- **Partnerships with Educational Institutions:** Collaborating with IITs, NITs, and polytechnic institutes to introduce renewable energy courses.
- **Entrepreneurship Promotion:** Supporting startups and MSMEs in the renewable energy sector.
- **Employment in Green Hydrogen and EV Sector:** Preparing a workforce for emerging areas like green hydrogen production and electric mobility.

5. Decentralized Renewable Energy Projects – Promoting Microgrids in Rural and Tribal Areas

- **Solar Microgrids for Rural Electrification:** Deploying solar-based microgrids in remote areas.
- **Biomass and Waste-to-Energy Solutions:** Encouraging decentralized bioenergy production in tribal regions.
- **Community Ownership Models:** Involving local communities in renewable energy projects to ensure sustainability.

**International Conference – 2025: Developed India @ 2047****Charting Multidisciplinary and Multi-Institutional Pathways for Inclusive Growth and Global Leadership held on 4th & 5th April, 2025****Organised by: IQAC - Gossner College, Ranchi**

- **Mini Hydro Projects:** Developing small-scale hydroelectric projects in hilly and riverine areas.

6. Green Industrial Zones – Encouraging Industries to Adopt Renewable Energy

- **Renewable Energy-Powered Industrial Parks:** Establishing industrial zones with dedicated solar and wind power supply.
- **Mandating Green Energy Usage:** Introducing policies that require industries to use a certain percentage of renewables.
- **Waste Heat Recovery and Energy Efficiency:** Encouraging industries to integrate energy efficiency measures.
- **Carbon Credit Mechanisms:** Enabling industries to trade carbon credits and benefit from sustainability incentives.

7. Technology Adoption and R&D – Investing in Next-Generation Clean Energy Technologies

- **Advanced Solar Technologies:** Promoting bifacial panels, perovskite solar cells, and floating solar farms.
- **Battery Energy Storage Systems (BESS):** Scaling up grid storage solutions to enhance renewable energy reliability.
- **Green Hydrogen Development:** Investing in green hydrogen production and electrolyzer technology.
- **Smart Grid and Digitalization:** Implementing AI and IoT-based solutions for efficient grid management.
- **Collaboration with National Research Institutions:** Partnering with CSIR, IITs, and ISRO for clean energy research.

Conclusion

Jharkhand has the potential to become a leading renewable energy hub in India by 2047. By leveraging its solar, wind, bioenergy and hydropower resources, coupled with strong policy support and private sector investment, the state can drive sustainable economic growth and contribute to India's global green leadership. A structured roadmap with clear targets and multi-stakeholder collaboration will be key to achieving this transformation, ensuring energy security, job creation, and environmental sustainability.

References

1. Ministry of New and Renewable Energy (MNRE). (2023). *Annual Report 2022-23*. Government of India. Retrieved from <https://mnre.gov.in>
2. Jharkhand Renewable Energy Development Agency (JREDA). (2023). *Renewable Energy Initiatives in Jharkhand*. Retrieved from <https://jreda.com>



International Conference – 2025: Developed India @ 2047

Charting Multidisciplinary and Multi-Institutional Pathways for Inclusive Growth and Global Leadership held on 4th & 5th April, 2025

Organised by: IQAC - Gossner College, Ranchi

3. NITI Aayog. (2022). *India's Renewable Energy Roadmap 2030 and Beyond*. Retrieved from <https://www.niti.gov.in>
4. International Renewable Energy Agency (IRENA). (2023). *Renewable Energy Policies for Sustainable Development*. Retrieved from <https://www.irena.org>
5. Central Electricity Authority (CEA). (2023). *Renewable Energy Integration in India's Power Grid: Challenges and Solutions*. Retrieved from <https://cea.nic.in>
6. Press Information Bureau (PIB). (2023). *Government of India's Strategy for Net-Zero Emissions by 2070*. Retrieved from <https://pib.gov.in>
7. Singh, R., & Sharma, P. (2021). *Potential and Challenges of Solar Energy in India: A Case Study of Jharkhand*. *Renewable Energy Journal*, 45(3), 123-137.
8. World Bank. (2022). *Financing Renewable Energy Projects in Developing Economies: The Indian Context*. Retrieved from <https://www.worldbank.org>
9. The Energy and Resources Institute (TERI). (2022). *Pathways to India's Renewable Energy Growth and State-wise Potential Analysis*. Retrieved from <https://www.teriin.org>
10. Jharkhand State Electricity Regulatory Commission (JSERC). (2023). *State Energy Policy and Renewable Energy Tariff Regulations*. Retrieved from <https://jserc.org>