

GREEN FINANCE FOR RENEWABLE ENERGY IN INDIA: ASSESSING THE ROLE OF IREDA IN SOLAR CAPACITY EXPANSION

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Abstract

Meeting India's climate commitments and securing long-term resilience towards a low-carbon economy demand a decisive transition to renewable energy. The country's thrust towards renewable energy is spearheaded by institutional machineries such as the Indian Renewable Energy Development Agency Limited (IREDA), policy frameworks like the National Solar Mission and initiatives such as the PM-KUSUM Scheme and several significant state level programs. This study investigates the contribution of IREDA through mobilization of green capital towards the development of renewable energy capacity, with particular emphasis on the solar energy sector. The study adopts a quantitative research approach that integrates descriptive and inferential methods, drawing on secondary data, to explore the relationship between solar financing initiatives of IREDA and the development of installed solar energy capacity of the country over the past decade. The analysis is structured in the context of India's global commitments on environmental sustainability, while also assessing whether the growth of the solar sector has significantly influenced the nation's overall renewable energy capacity. The findings underscore the pivotal role of IREDA in driving renewable energy development through green financing, highlighting its consistent prioritization of solar energy within its sectoral loan portfolio, thereby reflecting its strategic importance in India's clean energy transition.

Keywords: Renewable Energy, Green Finance, IREDA, Solar Energy, India

JEL Classification: Q42, G21, G28, O13, Q48

Introduction

Green finance is a strategy to incorporate financial activities and investments that supports sustainable development by promoting various environment friendly projects for a smooth transition to a low carbon economy (Fu et al., 2023). For the adaptation of climate change, green finance is a core part of low carbon green growth and it comprises of investment in renewable energy resources, pollution control mechanisms, green infrastructure, promote biodiversity etc.

Several international agreements and initiatives like, The United Nations Framework Convention on Climate Change (UNFCCC, 1992), The Kyoto Protocol (1997), The Paris Agreement (2015), The UN 2030 Agenda for Sustainable Development Goals (SDGs) (2015), Addis Ababa Action Agenda (2015), G20 Green Finance Study Group (2016), EU Sustainable Finance Action Plan (2018), Glasgow Financial Alliance for Net Zero (GFANZ) (2021) etc. are collectively promoting green finance for sustainable development. These agreements provide frameworks, rules, guidelines and commitments for all the countries and financial institutions to mobilize resources for climate action, biodiversity conservation and low – carbon growth. The global energy transition is increasingly dependent on emerging economies, with India at the forefront. Despite remarkable progress, fossil fuels still dominate India's primary energy consumption (Denya, 2025). This paradox underscores the critical need for scalable green

financing mechanisms to align with India's *Panchamrit*¹ climate targets, including 500 GW of non-fossil energy capacity by 2030 (Perwez et al., 2024).

In India, various government institutions and agencies like, Reserve Bank of India (RBI), Securities Exchange Board of India (SEBI), Indian Renewable Energy Development Agency Limited (IREDA), Small Industries Development Bank of India (SIDBI), Rural Electrification Corporation Limited, Power Finance Corporation Limited (PFC), National Bank for Agriculture and Rural Development (NABARD), Multilateral & Development banks, Private ESG funds coupled with a host of government policies such as FAME, PM-E-drive, National Solar Mission, PM-KUSUM, Sovereign Green Bonds and green deposits frameworks for banks and financial institutions, sustainability reporting guidelines and frameworks to name a few are all working synchronously towards sustainable environment goals. The Indian Renewable Energy Development Agency Limited (IREDA) is a Public Sector Financial Institution under the Ministry of New and Renewable Energy (MNRE), Government of India, which is playing a crucial role in promoting sustainable development through green finance. The *Navaratna* company is playing a vital role in promotion, development and commercialization of new and renewable resources of energy and it provides financial assistance, risk-mitigation and other services to energy efficiency and conservation projects with the motto "Energy for Ever" (Indian Renewable Energy Development Agency Limited, 2025). Since its inception, IREDA has made a major contribution in financing various projects with a record Rs. 1.63 Lakh Crore loan disbursements towards various clean energy sectors such as solar, wind, hydro, biomass, e-mobility and green hydrogen (ETEnergy World, 2024). With its robust loan book, a 27 per cent compound annual growth rate over the last five years and a proactive leadership duly acknowledged during the MNRE Secretary's performance review, IREDA is playing a pivotal role in propelling India towards achieving its ambitious environmental targets (Shetty, 2025). In line with the Paris Agreement commitments towards achieving a Net Zero carbon emissions target by 2070, India has amplified its installed Renewable Energy (RE) capacity by over 500 per cent from about 36 thousand MW to 1.87 lakh MW over the past decade with solar energy accounting for over 63 per cent of its total RE capacity as on July, 2025 (Ministry of New and Renewable Energy, 2025). In light of the above, this study aims to carry out an in-depth analysis of the contribution of IREDA in powering India's solar revolution- advancing the nation closer to its aspiration of becoming a global leader in clean energy.

Review of Literature

Berensmann et al. (2017) suggested that to adopt climate change and foster sustainable global growth, the G20 need to implement a sustainability agenda both at the national and international level. The author confronted that G20 countries facing a worldwide investment shortfall of US\$ 80-90 trillion over 15 years across sectors such as energy, water, transport, telecommunications, cannot depend solely on public funds for transforming into green finance. To bridge this gap, they must coordinate with banking, capital markets and insurance sectors with sustainability goals to have the benefit of large-scale private capital.

According to International Renewable Energy Agency (IRENA, 2023), IREDA has facilitated approximately 20 GW of renewable capacity via its financing especially in solar sector. The author also suggested promote funding in emerging technologies like battery storage, green hydrogen, e-mobility, waste-to-energy by deploying novel financing tools. The study featured

¹ The term 'Panchamrit' refers to the significant climate commitments made by India at the United Nations Climate Change Conference (COP26) in Glasgow in November 2021.

IREDA's substantial contribution as a long standing and consistent financier in India's clean energy sector.

Ravichandran and Roy (2022) in their study provide a comprehensive overview of the growing need of climate finance and its vital role in sustainable economic development. This study emphasized how considerably green funding will help in reduction in greenhouse gas emissions. The study stated that India has a huge potential to build a green infrastructure if given more importance in removing obstacles and raising corporate citizen's knowledge relating to the need of sustainable growth.

Sahoo and Nayak (2007) in their study highlighted that green finance has become a vital enabler for India's energy transition specially in wind and solar sector. The paper highlighted the crucial role of IREDA in supporting green finance initiatives in India. The authors recommend the need for policy coherence, credit enhancements and standardized green taxonomies to boost investor confidence and reduce capital costs. The analysis of the paper also provides a framework for strengthening India's green finance architecture, positioning institutions like IREDA as key players in the transition.

Sunmista and Sathana (2014) in a study found that commercial banks are taking new initiatives and promoting different types of green banking products and adopting different types of environment friendly policies. The authors stressed that bank employees should consider green finance as a necessity rather than desirability, they should change their routine operation by adopting paperless banking, mobile banking, online banking etc.

In course of review of existing literature, several reports and publications have been found to have acknowledged the significant contribution of IREDA in promoting clean energy in the country. However, few studies have been found to have adopted an empirical approach to establish the significance of IREDA financing towards the country's functional renewable energy capacity expansion. The present study adds to the existing stock of knowledge in this regard.

Research Problem

The clean energy transition targets of India critically depend on consistent financing and goal-oriented uniform government policy. IREDA has been serving as the principal arm under MNRE to channelize funds for a wide variety of RE projects; across multiple sectors. While the solar sector constitutes the largest share of IREDA's cumulative loan portfolio, limited empirical evidence exists on how IREDA's financing has augmented the country's overall RE capacity, in general, and solar energy capacity, in particular. This study addresses this gap through an empirical approach towards explaining the relationship between the IREDA's solar finance and the RE growth of the country over the past decade.

Objectives of the study

The objectives of the study are:

1. To outline IREDA's financing contribution across different renewable energy (RE) sectors;
2. To analyze the association between IREDA's solar loans and growth of installed solar energy capacity in India; and
3. To assess the impact of IREDA's solar financing on the proliferation of India's total RE capacity.

Rationale of the study

India has set several ambitious environmental targets which can be broadly summarized into achieving the Net Zero Carbon Emissions Target by 2070- the long-term goal- preceded by specific medium-term essential prerequisites, such as, achieving 500-GW of non-fossil fuel energy by 2030. In meeting these targets, along with strong policy initiatives, robust financial mechanisms to ensure sustainability of the clean energy projects, are a critical requirement. In this regard, IREDA under MNRE, Govt. of India plays a pivotal role as the financial backbone of the country's RE projects. While IREDA's contributions are frequently acknowledged in related policy reports and research papers including presentation of facts and data, there remains a lack of empirical research that carves out its role in augmenting RE growth. This study attempts to address this void through providing insights into the impact of IREDA's financial interventions- backed by evidence and highlighting IREDA's solar financing as a key determinant of the nation's overall RE capacity expansion. The study is expected to offer significant inputs for policy-makers, financial institutions, investors and other stakeholders in developing sustainable strategies for clean energy; as well as, strengthening the academic discourse on the finance- energy nexus.

Methodology of the study

Research Design:

The study adopts a quantitative research approach combining descriptive and inferential methods to assess the role of the IREDA in solar capacity expansion in India. The design accommodates an empirical analysis of IREDA's loan portfolio, sectoral emphasis, and establishing the significance of their impact on RE growth.

Data Sources:

The study is based on secondary data obtained from authentic and reliable sources such Annual Reports of IREDA, reports and statistics published by the MNRE, facts and findings of reputed publications of individual authors and organizations and other reputed and reliable internet sources.

The data period covers the decade from 2015-present in line with the accelerated RE expansion in India owing to the increased recognition and expression of the national environmental targets at various global stages during the period.

Data Analysis:

The study resorts to both descriptive tools - for mapping IREDA's financing contributions across different RE sectors, as well as, inferential tools- correlation analysis and regression analysis to assess the impact of IREDA finance on the growth of the country's solar as well as overall RE capacities. Pearson's correlation co-efficient has been used to assess the strength of the association between IREDA loan disbursement to solar power sector and total installed solar capacity of the country over the past decade. Further, in order to study the role of IREDA loans towards India's RE capacity growth the following multiple linear regression model has been employed:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \varepsilon$$

where, the dependent variable Y denotes the Total installed RE Capacity of India, while the independent variables X_1 and X_2 represent IREDA loans disbursed to Solar Energy Sector and Wind Energy Sector respectively. The marginal effect of the IREDA loans to the respective RE sectors on total installed RE capacity are estimated by the coefficients β_1 and β_2 respectively.

The random error term capturing unobserved influences is denoted by ε . The model parameters have been estimated using the Ordinary Least Squares (OLS) method based on secondary data obtained from IREDA Annual Reports and data sources of Ministry of New and Renewable Energy (MNRE), Government of India.

Scope and Limitations of the study

While other factors such as government policy, private investments, international collaborations and global economic events also influence the India's green energy transition, the thrust of this study is on analyzing exclusively the role of IREDA financing on India's RE growth in order to highlight its strategic importance. The study is based on secondary data and hence the findings are limited by the availability and accuracy of published reports and sources referred.

Analysis and Discussion

Profile of the Indian Renewable Energy (RE) Sector:

As of July, 2025, India has achieved the 50 per cent milestone of its RE target of 500 GW by 2030 (Ministry of New and Renewable Energy, 2025). The rapid growth of the RE capacity of the country is marked by a 500 per cent increase in the cumulative RE capacity between 2014 and 2025 (Ministry of New and Renewable Energy, 2025). Table 1 below shows the rapid growth in cumulative of RE capacity across different RE Sectors in India.

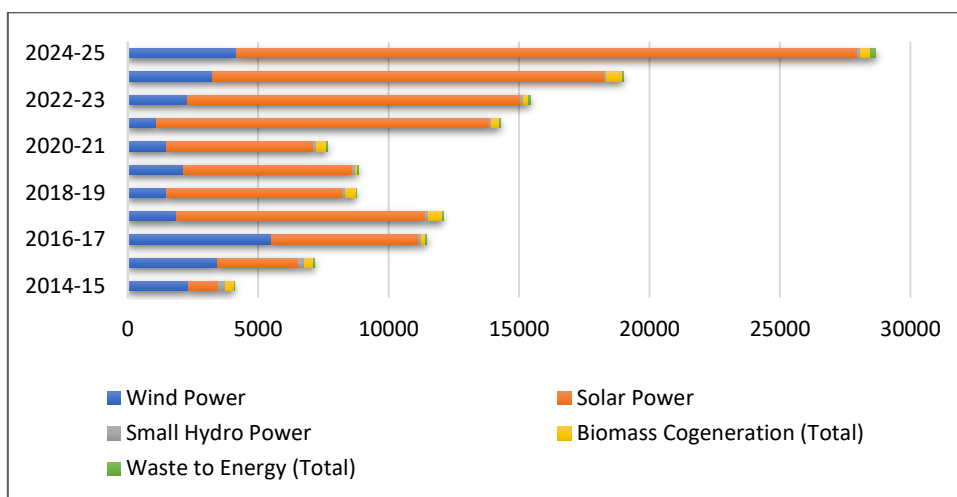
Table 1: Sector wise Installed Renewable Energy (RE) Capacity (in MWs)

Sector	Cumulative Achievements (till-31.03.14)	Cumulative Achievements (till-31.07.25)
Wind Power	21042.58	52140.10
Solar Power	2821.91	119016.54
Small Hydro Power	3803.68	5108.71
Biomass (Bagasse) Cogeneration	7419.23	9821.32
Biomass (Non-bagasse) Cogeneration	531.82	921.79
Waste to Energy	90.58	309.34
Waste to Energy (Off-grid)	139.79	545.11
Total	35849.59	187862.91

Source: Ministry of New and Renewable Energy, Govt. of India (2025)

The analysis of the sectoral contribution to RE Capacity reveals that more than 63 per cent of the Cumulative RE capacity as on July, 2025 comes from Solar Power, making it the largest contributor to the overall RE Capacity of the country. Table 1 above also reveals that the solar capacity has grown most rapidly and there is a shift in the sectoral contribution to overall RE capacity from Wind Energy to Solar Power over the last decade; which is further described by Figure 1 below:

Figure 1: Sectoral Contribution to RE Capacity (in MWs)



Source: Compiled from Year-wise Achievements published in the Official Website of Ministry of New and Renewable Energy, Govt. of India (2025)

In the context of power generation, RE contributed to 124.9 BUs (billion units) accounting for 24.4 per cent of total power generation with solar power leading at 33.2 Bus, followed by wind power at 23.2 Bus and biomass at 11.2 BUs (Anand, 2025).

Several national and international agencies such as credit rating institutions and independent think tanks project a prolific growth of the Indian RE Sector. The projections of different entities uniformly agree on a robust acceleration in India’s RE Capacity by 2030, particularly solar. However, no projection has predicted the attainment of *Panchamrit* goal of 500 GW by 2030; which certainly highlights the vital role of consistent policy support, financing and infrastructure investments mobilized through generators like IREDA. The growth projections made by different agencies and institutions have been summarized in Table 2 below:

Table 2: Summary of Indian RE Capacity Projections

Forecasting Agency	Target Year	Projected RE Capacity (GW)	Key Highlights
Institute for Energy Economics and Financial Analysis (IEEFA)	FY 2029–30	~405 GW	35–40 GW annual additions anticipated
CRISIL Limited	FY 2030	360–370 GW (excluding large hydro)	175–180 GW solar additions expected
S&P Global Ratings	2025–2030	Needs ~50 GW/year additions	214 GW as of Mar 2025; acceleration essential
ICRA Limited	Mar-26	~250 GW	Driven by strong project pipeline and tenders

Source: Compiled from ETEnergyworld.com (From the Economic Times)

Financing contributions of IREDA

As highlighted in the previous sections of the paper, IREDA serves as the primary instrument for government policy intervention spearheading India's transition towards a clean and green energy ecosystem. It serves as a financing engine for India's renewable energy push with a focused approach towards the following:

i. *Strategic Funding for RE Projects:*

With over INR 1.63 lakh crore loans disbursed the agency has contributed up to 15 per cent of the country's total renewable energy debt making it the principal financier in the sector (ETEnergy World, 2024). To meet the varied needs of the RE developers and suppliers IREDA offers a wide range of tailored financing schemes spanning long term and short-term loans, bridge financing, subsidy-linked financing, bond guarantee schemes, securitized loans, factoring of receivables and more (Indian Renewable Energy Development Agency Limited, 2025).

ii. *Mobilizing investments targeting the national vision:*

With India reaching the 50 per cent milestone of total renewable energy target of 500 GW by 2030, the CMD of IREDA Mr. Pradip Kr. Das estimates that the annual installed RE capacity must be ramped up to 50-60 GW from 20-30 GW at present for which the sector requires an investment of around INR 30 Lakh Crore (Indian Mastermind, 2025).

iii. *Driving emerging technologies:*

Emerging clean technologies like ethanol, electric vehicle (EV) fleets, pumped storage hydropower, green ammonia, battery storage systems, and green hydrogen electrolyzers are promoted by IREDA through tailored funding instruments directed towards reducing the cost of capital and fostering an innovative clean energy ecosystem (International Renewable Energy Agency, 2023).

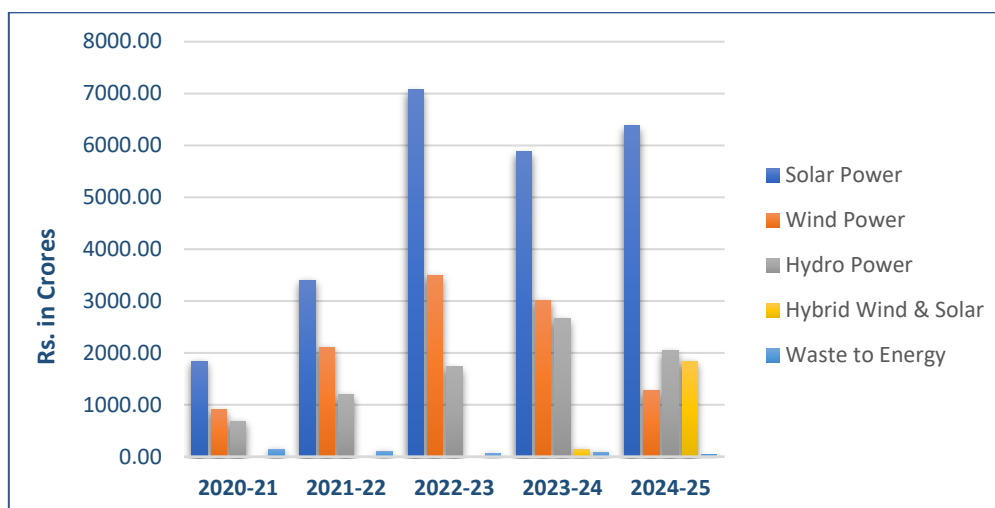
iv. *Providing reliance to stakeholders through institutional strength and structure:*

With a "Navaratna" status operating under the Ministry of New and Renewable Energy of the government, IREDA delivers paperless, streamlined and borrower centric services, securing stakeholder confidence and trust with regard to new and high-value projects (ETGovernment Online Bureau, 2024).

Assessment of data disseminated through Annual Reports of IREDA spanning over the past decade reveals that the finance to different RE sectors constitute a major share of the total loan disbursement portfolio on a year-to-year basis. Among the different RE sectors, solar energy has been the prime focus of IREDA financing with an average of 24 per cent² of total loan disbursements during the last five-year period. Figure 2 below portrays the loan disbursements to different RE sectors over the last five-year period:

² Compiled from loan disbursement data from IREDA Annual Reports for the period 2020-21 to 2024-25.

Figure 2: IREDA Loan Disbursements to RE Sectors



Source: Compiled from IREDA Annual Reports (2020-21 to 2024-25)

IREDA finance and Solar Capacity expansion

The data presented in Figure 2 above clearly show that the solar power sector has received a significantly larger share of the total loan basket of IREDA relative to the other RE sectors, towards augmenting the RE capacity of the country. The impact of the thrust towards the solar sector is explained by Table 3 below which presents a correlation analysis (Pearson's correlation coefficient) between IREDA loan disbursement to solar sector and solar capacity development. The results indicate a very high positive correlation between the IREDA loans disbursed to solar sector and solar capacity growth of the country over the period from 2015-16 to 2024-25.

Table 3: Correlation Matrix of IREDA Solar Finance³ and Installed Solar Energy Capacity⁴

	Loans Disbursed to Solar Power Sector (₹ in Crores)	Installed Solar Energy Capacity (MW)
Loans Disbursed to Solar Power Sector (₹ in Crores)	1	
Installed Solar Energy Capacity (MW)	0.812859721	1

Source: Authors' Self-construct

Impact of IREDA Solar finance on India's 2030 RE Targets:

As of July, 2025, India has reached the 50 per cent landmark of its targeted non-fossil fuel energy capacity of 500 GW by 2030. Data presented in Table 1 above indicates that among the different RE sectors, the solar energy and wind energy sectors combined contribute more than 91 per cent towards the cumulative total installed RE capacity as on 31st July, 2025⁵, augmenting the total installed renewable energy capacity of the country by more than 500 per

³ Data compiled from IREDA Annual Reports.

⁴ Data obtained from Official Website of MNRE, Govt. of India

⁵ Compiled from data on Installed RE Capacity published in the Official Website of MNRE, Govt. of India.

cent over the past decade. Constituting 15 per cent of the country’s total renewable energy sector debt, IREDA is a vital source of fueling the remarkable clean energy achievements of the country. In order to explain the statistical significance of IREDA loans towards the country’s RE capacity growth the multiple linear regression model elaborated in the methodology of the study above has been used. The model has been estimated using ten years of data (2015-16 to 2024-25) on IREDA’s sector-specific loan disbursements alongside the corresponding figures for total installed RE capacity. The results are summarized in Table 4 below:

Table 4: Impact of IREDA’s Sectoral RE finance on Installed RE Capacity

	Coefficients	Standard Error	t Stat	P-value
Intercept	5519.971464	3820.087189	1.444985727	0.191695
Solar Power (X₁)	2.643160936	0.876143356	3.016813307	0.019474
Wind Power (X₂)	-1.028066653	1.877206036	-0.547657867	0.600945

Source: Authors’ Self-construct

With a *p-value* of less than 0.05, IREDA loans towards the Solar Power Sector show a statistically significant impact on the development of overall RE capacity of the country. The sectoral loan disbursal towards Wind Power, however, fails to display a substantial impact.

Conclusion

The study highlights the critical role of IREDA in propelling renewable energy development through its green financing initiatives, in alignment with India’s environmental commitments outlined by ambitious declarations made through global platforms such as Paris Agreement in 2015 and *Panchamrit* Action Plan in Conference of the Parties (COP 26) to the UNFCCC⁶ held in Glasgow in 2021. Over the last decade, IREDA has consistently directed a significant share of its sectoral loan portfolio towards solar energy, reflecting its strategic importance in India’s clean energy transition. The analysis demonstrates that IREDA’s financing has been instrumental in driving the impressive growth of installed solar capacity, which now constitutes a significant portion of the country’s renewable energy mix. Correlation analysis confirms a very high positive relationship between IREDA’s solar loan disbursements and solar capacity growth, while the regression results further validate the significant contribution of solar finance to the growth of overall renewable energy capacity. These findings highlight that IREDA’s financial interventions have not only supported India’s achievements in clean energy but have also laid a foundation towards fulfilling the prerequisites for meeting the vision of Net Zero carbon emissions by 2070. Nonetheless, the way forward remains challenging, requiring rigorous policy initiatives, substantial additional investments and innovative financing models as India’s environmental commitments demand sustained financial flows and strengthened institutional support for a consistent renewable energy growth.

⁶ United Nations Framework Convention on Climate Change.

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