International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 05 | May - 2024 SJIF Rating: 8.448 ISSN: 2582-3930

Current scenario of Renewable Energy in achieving net Zero energy in India

Vanshika Bhardwaj[1], Parampreet Kaur[2], Mayuri Rathi[3]

[1] *Amity University Chhattisgarh*
[2] *Amity University Chhattisgarh*
[3] *Amity University Chhattisgarh*

Abstract - The shift to net zero energy buildings (NZEBs) that are powered by renewable energy sources is critical for India's sustainable development goals as well as the global climate change imperative. The importance of adopting net zero strategies in India's built environment is highlighted by this study, which also emphasizes the critical role that renewable energy plays in realizing this radical objective. The paper emphasizes the pressing need to shift towards sustainable building practices by scrutinizing the present state of renewable energy adoption and policies in India, along with the emerging trends in NZEB development. Moreover, it emphasizes the necessity of cooperation among policymakers, industry participants, and the broader community to surmount obstacles and expedite the uptake of NZEBs supplied by renewable energy. In the end, adopting net zero strategies offers a revolutionary chance to develop healthier, more resilient, and energy-efficient built environments for both the current and future generations, in addition to being in line with India's commitments to environmental sustainability.

***Key Words*:** Net zero energy, Renewable energy, carbon emissions reduction, Incentives, Solar Power.

1.INTRODUCTION

The global conversation about climate change mitigation and sustainability has become more intense in recent years, which has forced countries all over the world to reconsider their energy policies and shift to cleaner, renewable energy sources. It is especially important to find sustainable energy solutions in the context of India, a nation that is rapidly becoming more urbanized and experiencing economic growth. The notion of net zero energy buildings (NZEBs) has surfaced as a viable approach to attaining energy efficiency and carbon neutrality in the built environment, as India endeavors to fulfill its expanding energy requirements while concurrently tackling environmental issues.

In order to achieve a net zero energy balance over a predetermined period of time, NZEBs represent a paradigm shift in building design and operation. Their goal is to balance energy consumption with on-site renewable energy generation. Renewable energy systems, the foundation of sustainable energy infrastructure, are at the center of this revolutionary vision. These systems include solar photovoltaic (PV) panels, wind turbines, biomass, and geothermal technologies.

Considering this, the goal of this study is to thoroughly investigate the role that renewable energy plays in helping India achieve net zero energy buildings. The research aims to clarify the critical role that renewable energy technologies play in the development and operation of NZEBs through a thorough analysis of current trends and opportunities.

2. Commitments and Achievements of Renewable Energy in India

India has committed to obtaining roughly half of its installed capacity for electric power from non-fossil fuel sources by 2030, as per the most recent version of the Nationally Determined Contributions (NDC). The nation has already installed 167.75 GW of renewable energy capacity as of December 31, 2022. Furthermore, 78.75 GW of projects are presently in varying phases of implementation, and 32.60 GW of projects are in varying phases of the bidding process. According to the REN21 Renewables 2022 Global Status Report, India occupies the fourth position in the world with regard to installed capacity for renewable energy, wind power, and solar power. From 76.37 GW in March 2014 to 167.75 GW in December 2022, the installed capacity of renewable energy (including large hydro) has more than doubled. In a similar vein, the nation's total solar power capacity increased dramatically over the course of the last 24 years, from 2.63 GW in March 2014 to 63.30 GW in December 2022.

At the first occurrence of an acronym, spell it out followed by the acronym in parentheses, e.g., charge-coupled diode (CCD).

Table -1: Sector-wise Cumulative Achievement (as on 31.12.2022)

Sector	Installed Capacity (GW)	Under Implementation (GW)	Tendered (GW)	Total Installed/Pipeline (GW)
Solar Power	63.30	51.13	20.34	134.77
Wind Power	41.93	12.93	1.20	56.06
Bio Energy	10.73	-	-	10.73
Small Hydro	4.94	0.54	0.00	5.48

Hybrid/Round the Clock (RTC)/Peaking Power/Thermal + RE Bundling	-	-	11.06	11.06
Sub-Total	120.90	64.6	32.6	218.10
Large Hydro	46.85	14.15	-	61.00
Total	167.75	78.75	32.60	279.10

*Source: Ministry of New and Renewable Energy (MNRE)

3. Major Ongoing Renewable Energy Schemes in India

Significant accomplishments made throughout the year under the Ministry of New and Renewable Energy's various ongoing programs are highlighted in this section. The Central Public Sector Undertaking Scheme for Grid-Connected Solar Photovoltaic Power Projects, Solar Rooftop Phase II, and the Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan are just a few of the programs whose progress and results are examined in detail. These programmes have been instrumental in helping various sectors adopt renewable energy and supporting India's sustainable development objectives.

Table -2: Major Ongoing Schemes

Scheme	Installed Capacity/Status as of 31.12.2022
Pradhan Mantri Kisan Urja Suraksha Evam Utthaan Mahabhiyan (PM-KUSUM)	Component-A: 88.45 MW solar power plants installed. Component-B: 1.81 lakh stand-alone solar pumps installed. Component-C: 1174 solarised pumps reported.
Roof Top Solar (RTS) Programme Phase-II	Residential sector: Around 1.66 GW capacity installed. Overall grid connected RTS plants: Nearly 7.6 GW capacity installed; Timelines extended to 31.03.2026.
Central Public Sector Undertaking (CPSU) Scheme for Grid-Connected Solar Photovoltaic (PV) Power Projects	Awarded projects: Around 8.2 GW; Commissioned: Around 1.5 GW; Balance under implementation.
Development of Solar Parks and Ultra Mega Solar Power Projects	Approved solar parks: 57 Cumulative capacity: 39.28 GW in 13 states.
PLI Scheme: 'National Programme on High Efficiency Solar PV Modules'	Tranche-I: Around 8.7 GW fully integrated solar PV module manufacturing capacities awarded; Tranche-II bid document issued for Rs 19,500 crore outlay.
Green Energy Corridor	Intra-state transmission lines: 8759 ckm constructed; Intra-state substations: 19868 MVA charged; 2nd phase tendering in 7 states for 20 GW evacuation projects.
Human Resource Development Programme	Trained Suryamitras: 4,363 from April 2021 to December 2022, totaling 51,529; Launched Jal-Urjamitra Skill Development Programme and Vayumitra Skill Development Programme (VSDP) (Phase-1) in 2022.
Renewable Energy Research and Technology Development (RE-RTD) Programme	Continued 17 R&D projects focusing on cost reduction, reliability, and efficiency improvement.
Solar-Wind Hybrid	Amendments in bidding guidelines issued. Commissioning schedule extended to 24 months.
Wind Energy	Concessional custom duty benefit extended till 31.03.2025 for wind turbine components.
Bioenergy	Biomass power and cogeneration: Cumulative installed capacity about 10.2 GW. Waste to energy: 522.42

	MWeq installed capacity.

*Source: Ministry of New and Renewable Energy (MNRE)

3. Recent Policies & Measures on Renewable Energy in India

In order to advance research and studies in the field of renewable energy, the Ministry of New and Renewable Energy (MNRE) of the Government of India has been actively promoting collaborations with national and international institutions or countries. MNRE works to leverage partnerships to advance renewable energy research, innovation, and technology deployment through Memoranda of Understanding (MoUs), Agreements, Joint Development Initiatives (JDIs), and Letters of Intent (LoIs). The goal of this study is to evaluate the influence of the Memoranda and agreements that MNRE has signed during the last three years and this year on research and development related to renewable energy in India.

Table -3: Active collaboration with national and international countries.

S. No.	Country	Brief Objective(s)	Year of Signing / Location of Signing	Date of Expiry / Validity
1	MNRE-IRENA	An agreement for a strategic partnership between the International Renewable Energy Agency (IRENA) and the Ministry of New and Renewable Energy (MNRE), Government of India.	14th Jan. 2022 / New Delhi/Abu Dhabi	Valid until terminated
2	France	To lay the groundwork for collaboration in the field of renewable energy.	28th January 2021 / New Delhi	27th January, 2026
3	Australia	A Letter of Intent (LoI) on New and Renewable Energy Technology was signed by the Australian Department of Climate Change, Energy, the Environment, and Water (DCCEEW) and the Indian Ministry of New and Renewable Energy.	15th February 2022 / New Delhi	-
4	Germany	The Federal Ministry for Economic Cooperation and Development of the Federal Republic of Germany and the Ministry of New and Renewable Energy (MNRE) have signed a Joint Declaration of Intent (JDI) on Indo-German Development Cooperation regarding Renewable Energy Partnership.	02nd May, 2022 / Berlin	01st May, 2024
5	Germany	The Ministry of New and Renewable Energy (MNRE) and the Federal Ministry for Economic Cooperation and Development of the Federal Republic of Germany have signed a Joint Declaration of	02nd May, 2022 / Berlin	-

		Intent (JDI) on Indo-German Development Cooperation regarding the Renewable Energy Partnership.		
6	UAE	To encourage discussion and cooperation among the Parties regarding Possible Areas of Collaboration in the Range of Green Hydrogen Development and Investments in India and the United Arab Emirates	13th January 2023 / Abu Dhabi, UAE	Valid for three years & automatically renewed for successive periods
7	Saudi Arabia	To establish a framework for the two parties' cooperation in the renewable energy sector.	10th September 2023 / New Delhi	Valid till five years & shall be automatically renewed for similar period

*Source: Ministry of New and Renewable Energy (MNRE)

The nationwide promotion of Renewable Energy (RE) has been spearheaded by the Ministry of New and Renewable Energy through several initiatives. These policies cover a broad spectrum of tactics meant to promote the development and application of renewable energy sources.

Table -4: Various initiatives by MNRE for the promotion of Renewable Energy

Initiative	**Description**
National Green Hydrogen Mission	Commenced to make India a major global hub for the production, use, and export of green hydrogen and its byproducts.
Production Linked Incentive Scheme for High Efficiency Solar PV Modules	An incentive programme aimed at encouraging India to produce solar photovoltaic modules with high efficiency.
Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan (PM-KUSUM)	Initiative to encourage farmers to install solar panels on their land in order to generate solar power.
Solar Rooftop Phase II	The goal of the Solar Rooftop Scheme's second phase was to increase the number of rooftop solar installations on residential, business, and industrial properties.
12000 MW CPSU Scheme Phase II	Scheme to support Central Public Sector Undertakings (CPSUs) in India install solar power projects.
Ultra Mega Renewable Energy Parks	Establishment of wide-ranging renewable energy parks to supply renewable energy projects with land and transmission infrastructure.
Green Energy Corridor Scheme	Initiative to expand sub-station capacity and install new transmission lines in order to improve the transmission infrastructure for the evacuation of renewable energy.
Waiver of Inter State Transmission System (ISTS) charges for solar and wind power	ISTS fees will be waived for interstate sales of wind and solar power projects that are put into service by June 30, 2025.
Prescribed trajectory for RE power bids	Renewable Energy Implementation Agencies will notify bidders of the renewable energy power trajectory starting in FY 2023–2024 and ending in FY 2027–2028.
Standard Bidding Guidelines for Grid Connected Solar PV and Wind Projects	Guidelines for conducting competitive tariff-based bidding for the procurement of power from grid-connected wind and solar PV projects.
Notification of standards for solar photovoltaic system/devices	Standards for the installation of solar photovoltaic systems and equipment are announced in order to guarantee their effectiveness and quality.

Power dispatch against Letter of Credit (LC) or advance payment to ensure timely payment to RE generators	To guarantee prompt payment to renewable energy generators, government orders for power dispatch against Letters of Credit (LC) or advance payment are required.
Promoting Renewable Energy through Green Energy Open Access Rules 2022	Notification of regulations aimed at encouraging open access in the electricity market to support renewable energy.
The Electricity (Late Payment Surcharge and related matters) Rules (LPS rules)	Notification of regulations pertaining to the late payment surcharge and renewable energy issues.
Foreign Direct Investment (FDI) up to 100 percent under the automatic route	Permission to invest up to 100% of Foreign Direct Investment (FDI) in the renewable energy sector through the automatic route.
Green Term Ahead Market (GTAM)	The creation of the GTAM to enable the exchange-based sale of power generated by renewable sources.
Minimum share of consumption of non-fossil resources by designated consumers up to 2029-30	The minimum percentage of non-fossil resource consumption that designated consumers must meet until 2029–2030.

*Source: Ministry of New and Renewable Energy (MNRE)

4. Measures taken by Government of India to increase the production of Solar Energy, Wind Energy and Green Hydrogen

The implementation of crucial policies to support the production of renewable energy and improve hydropower generation in India represents a major advancement in the direction of sustainable energy development. Proactive steps to diversify the energy mix include the declaration of large hydro power projects as renewable energy sources and the waiver of interstate transmission charges for wind and solar projects. The introduction of expansive programs such as the Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan Yojana and the National Green Hydrogen Mission highlights India's dedication to promoting innovation and infrastructure development in the renewable energy industry.

Table -5: Measures to Increase RE Production & to Expand Hydro Power Generation

Measures to Increase Renewable Energy Production	**Measures to Expand Hydro Power Generation**
- Exemption from ISTS fees for the interstate sale of solar and wind energy projects that are scheduled for commissioning by June 30, 2025, with subsequent grading of ISTS charges.	- Declaring Large Hydro Power (LHPs) (> 25 MW projects) as Renewable Energy source.
- A trajectory declaration for the Renewable Purchase Obligation (RPO) through 2030.	- Hydro Purchase Obligation (HPO)
- Launch of new initiatives and programs, such as the National Bioenergy Program, the Renewable Energy Research and Technology Development (RE-RTD) Program, the Development of Solar Parks and Ultra Mega Solar Power Projects Scheme, the Grid Connected Solar Rooftop Programme, the Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan Yojana (PM-KUSUM), the Production Linked Incentive Scheme under the National Programme on High Efficiency Solar PV Modules, the National Bioenergy Program, and the National Green Hydrogen Mission's schemes for electrolyser manufacturing and green hydrogen production.	- Tariff rationalization measures for bringing down hydro power tariff.
- Ultra Mega Renewable Energy Parks are being established to give land and transmission to renewable energy developers on a plug-and-play basis.	- Budgetary Support for Flood Moderation/Storage Hydro Electric Projects (HEPs).
- The construction of new substation capacity and transmission line layout to	- Budgetary Support to Cost of Enabling Infrastructure, i.e. roads/bridges.

facilitate the evacuation of renewable energy.	
- Setting up of Project Development Cell for attracting and facilitating investments.	- Up to June 30, 2025, the ISTS fees waiver is extended to Pumped Storage Projects for which construction work is awarded.
- Guidelines for Standard Bidding for Tariff-Based Competitive Bidding Processes for Grid-Connected Solar PV and Wind Power Purchases.	- Guidelines have been released by the Ministry of Power to encourage the growth of pumped storage projects across the nation.
- In order to guarantee that distribution license holders pay RE generators on time, the government has issued directives stating that power will be distributed against LC or advance payment.	- The Central Electricity Authority has released updated Guidelines for DPR of PSP Formulation and Concurrence.
- Notification of the Green Energy Open Access Rules 2022's Promotion of Renewable Energy.	
- Notification of Late Payment Surcharge and related matters Rules 2022.	
- Notification of Electricity Amendment Rules 2022 with provision of Uniform Renewable Energy Tariff for Central Pool.	
- Launch of the National Green Hydrogen Mission with the objective to make India a hub for Green Hydrogen production and exports.	

*Source: Ministry of New and Renewable Energy (MNRE)

5. CONCLUSION

India's dedication to renewable energy is a big step in the right direction toward combating climate change and attaining sustainability. In its Nationally Determined Contributions (NDC), India has set ambitious goals to achieve by 2030, including the use of non-fossil fuels for half of its installed electric power capacity. The country has made significant strides in this direction; as of December 2022, the nation had installed 167.75 GW of renewable energy capacity, making it the fourth-largest installed capacity of wind, solar, and renewable energy in the world.

India has advanced the adoption of renewable energy across sectors significantly through a number of ongoing programs and initiatives run by the Ministry of New and Renewable Energy (MNRE). Solar energy has been deployed more frequently, especially in rural areas and on rooftops, thanks to initiatives like the Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan (PM-KUSUM) and the Solar Rooftop Phase II. Furthermore, partnerships with IRENA and agreements with nations like France and Germany serve as examples of collaborations with international organizations and nations that show India's commitment to utilizing global expertise and resources to advance renewable energy research and technology.

In addition, new initiatives like the Production Linked Incentive Scheme for High Efficiency Solar PV Modules and the National Green Hydrogen Mission highlight India's proactive approach to supporting innovation and infrastructure development in the renewable energy sector.

To sum up, India is making a deliberate effort to promote sustainable energy development as evidenced by its efforts to enhance the production of solar, wind, and green hydrogen. In addition to supporting international efforts to lessen climate change, India is laying the groundwork for a cleaner, more resilient energy future by utilizing the potential of renewable resources and putting supportive laws and practices into place.

REFERENCES

1. The Ministry of New and Renewable Energy (MNRE) (mnre.gov.in)
2. Department of New Energy Sources (DNES)
3. Various state govt. portals (cgstate.gov.in)
4. nzeb.in
5. Energy efficient buildings in India by Mili Majumdar
6. Asam Ahmed, Tianshu Ge, Jinqing Peng, Wei-Cheng Yan, Boon Tuan Tee, Siming You (2022). Assessment of the renewable energy generation towards net-zero energy buildings: A review