5. Renewable Revolution - Environment

India's renewable energy sector is moving from rapid expansion to building a strong, stable, and resilient system to support its 500 GW non-fossil capacity target by 2030

Overview of India's Renewable Energy Growth

Installed Capacity Growth - In the past decade, India's installed renewable capacity (excluding large hydro) increased from ~35 GW in 2014 to over ~197 GW today. The country continues to add 15–25 GW of new renewable capacity annually, maintaining one of the fastest renewable capacity addition rates globally.

Shift in Focus - Current policy emphasis is on "capacity absorption" rather than merely capacity addition. Capacity absorption involves integrating renewable energy smoothly into the grid, market mechanisms, and system operations, ensuring reliability and efficiency.

Concept of Capacity Building in Renewable Energy

Definition - Capacity building refers to developing the skills, knowledge, infrastructure, institutions, and systems necessary to plan, deploy, operate, and maintain renewable energy technologies effectively. It ensures that human resources, technical capabilities, and institutional frameworks are equipped to support the rapid energy transition to clean sources.

Core Objectives -

1. Strengthening grid management and operational expertise.
2. Upskilling manpower for advanced renewable technologies.
3. Enhancing institutional, policy, and regulatory frameworks.
4. Supporting local manufacturing and domestic production to reduce import dependence.
5. Engaging communities and workforce in renewable deployment and energy transition.

Need for Capacity Building

Grid Integration - As the share of solar and wind rises, grid operators must manage variability and intermittency. Ensures stability, reliability, and quality of power supply.

Technical Expertise - Skilled manpower is essential for -

1. Design, installation, and maintenance of solar PV, wind, hybrid, and storage projects.
2. Operation of emerging technologies such as offshore wind, battery storage, and green hydrogen projects.

Institutional Strengthening - State and central agencies need capacity to plan, regulate, implement, and monitor large-scale renewable and transmission projects efficiently.

Local Manufacturing Ecosystem - Capacity building supports domestic production of solar panels, inverters, wind turbines, and storage systems, reducing dependence on imports.

Policy and Regulatory Capacity - Continuous training helps policymakers and regulators adapt to evolving energy markets, new technologies, and international commitments.

Community and Workforce Engagement - Local capacity building ensures job creation, social acceptance, and effective participation in the energy transition, especially in rural and semi-urban areas.

Challenges in Capacity Building

Skill Gaps - Shortage of trained engineers, technicians, and project managers for advanced renewable technologies.

Limited Training Infrastructure - Few institutions provide specialized courses. Existing technical institutes often lack up-to-date labs, equipment, and faculty expertise.

Rapid Technological Change - Fast-evolving areas like battery storage, hybrid projects, smart grids, and green hydrogen require continuous upskilling.

Coordination Across Agencies - Aligning central ministries, state agencies, private sector, and academia remains fragmented and challenging.

Financial Constraints - Funding for training, research, and skill development is limited, especially for

smaller states and institutions.

Retention of Skilled Workforce - Trained personnel often migrate to other sectors or abroad, reducing the impact of capacity-building efforts.

Government Initiatives for Capacity Building

Grid Integration Plan - India's ₹2.4 lakh crore Transmission Plan for 500 GW aims to link renewable-rich states with demand centers. Green Energy Corridors and high-capacity transmission lines from Rajasthan, Gujarat, and Ladakh will unlock over 200 GW of new renewable capacity.

Vision Till 2032 - Build High-Voltage Direct Current (HVDC) corridors. Boost inter-regional transmission capacity from 120 GW today to 143 GW by 2027 and 168 GW by 2032.

Incentives for Domestic Manufacturing - Production-Linked Incentive (PLI) schemes, Domestic Content Requirements, and duties/duty exemptions for capital equipment reduce import dependency.

Capacity Building Institutions

National Institute of Solar Energy (NISE) - Offers training, workshops, and research support for solar PV, solar thermal, and hybrid technologies.

State Nodal Agencies (SNAs) - Receive training and technical support for project implementation, monitoring, and policy enforcement.

Research & Innovation Support - Funding R&D in battery storage, hybrid projects, offshore wind, and green hydrogen.

International Cooperation - Partnerships with IRENA, GIZ, and other global agencies facilitate knowledge exchange and best practices.

Way Ahead

Large Hybrid and RTC Projects - Execution underway in Rajasthan, Gujarat, and Karnataka.

Offshore Wind and Pumped Hydro Storage - Gaining momentum to support grid stability and round-the-clock power supply.

Distributed Solar & Agrovoltaics - Initiatives like PM Suryaghar and PM KUSUM increase rural participation and income generation.

National Green Hydrogen Mission - Links renewable energy with industrial decarbonization, promoting green hydrogen production.

Green Energy Corridor Phase III - Focus on renewable energy integration and optimized transmission utilization.

Conclusion

Policy focus has shifted from pure capacity addition to system design and capacity absorption. Emphasis on transmission optimization, workforce training, and technology integration addresses core implementation challenges in the renewable sector. These reforms aim to -

1. Maximize grid stability.
2. Accelerate stranded renewable projects.
3. Build a resilient and sustainable renewable energy ecosystem in India.

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