



Tapping Renewable Energy Potential in India

Source: LM

For Prelims: [Renewable Energy](#), [Wind Power](#), [500-Gw Non-Fossil](#), [Solar Power](#), [Grid-Connected Rooftop Solar](#), [Small Hydro Power](#), [Biomass Energy](#), [Waste-To-Energy](#), [Fragmented Land Ownership](#), [Grid Infrastructure](#), [Green Hydrogen](#), [Digitized Land Records](#), [Transmission Lines](#)

For Mains: Significance of Boosting Renewable Energy Capacity to achieve Renewable Energy Targets.

Why in News?

Recently, the **Ministry of New and Renewable Energy** has asked states to ease **land availability** for [renewable energy](#) projects with a focus on [wind power](#).

- With a current **wind power** capacity of **47.95 GW**, the government aims to **double it to 100 GW** and enhance land access to reach the [500-GW non-fossil](#) energy target by 2030.

What is Renewable Energy?

- **Renewable Energy:** **Renewable energy** is energy derived from natural, replenishable sources such as [solar](#), [wind](#), [hydropower](#), [biomass](#), [geothermal](#), and [tidal](#).
 - These sources are sustainable and environmentally friendly, reducing dependence on [fossil fuels](#).
- **Types:**
 - **Solar Energy:** Harnessed from the sun's radiation using **solar panels** or **solar thermal systems**.
 - **Wind Energy:** Generated by converting the **kinetic energy of wind** into electricity with **wind turbines**.
 - **Hydropower:** Produced by harnessing the energy of **flowing water** (rivers, dams, waterfalls).
 - **Biomass Energy:** Created from **organic materials** like plant residues and animal waste for heating, electricity, and **biofuels**.
 - **Geothermal Energy:** Derived from **Earth's internal heat** (hot water, steam) for **electricity generation** and direct heating.
 - **Tidal & Wave Energy:** Uses **ocean water movement** (gravitational pull or surface waves) to generate electricity.

What is the Status of Renewable Energy in India?

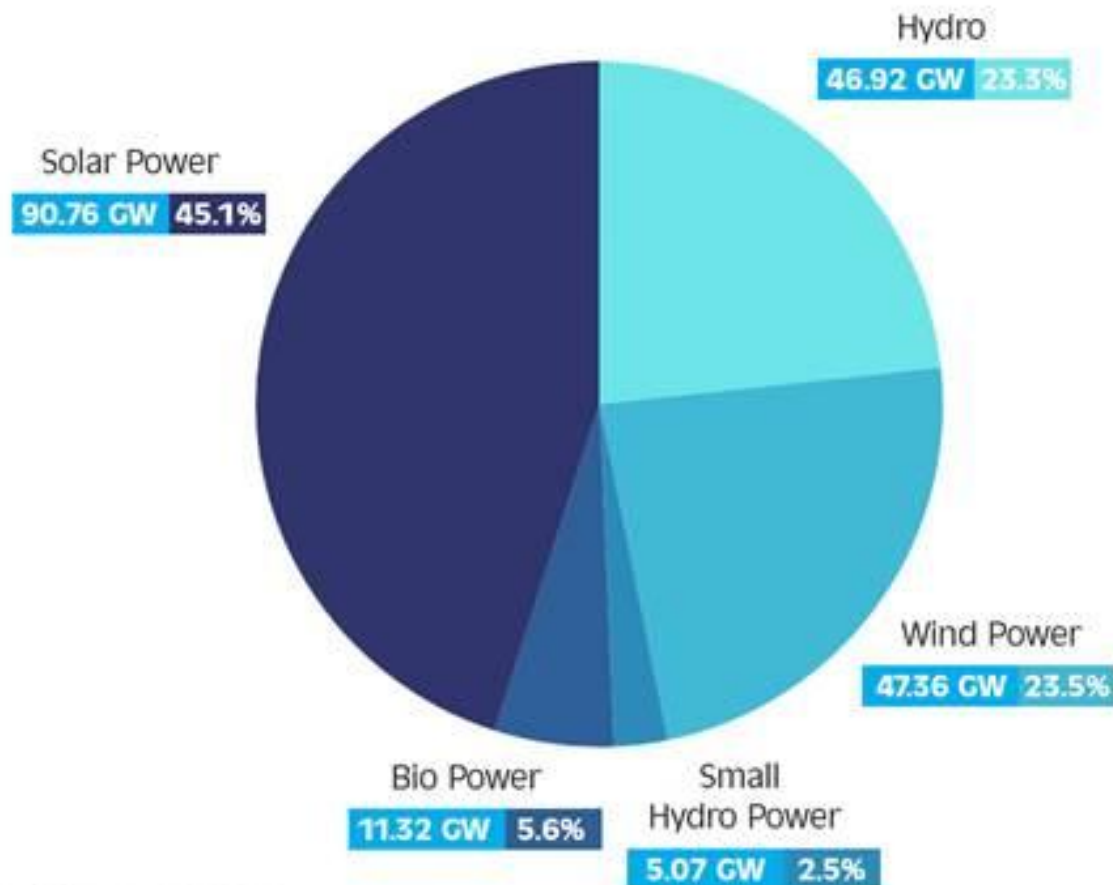
- **Renewable Energy Capacity:** As of November 2024, India's total installed renewable energy

capacity stands at **158.55 GW**, showcasing significant strides in transitioning to cleaner energy sources.

- **Wind Power:** **Wind Power** accounts for **47.96 GW**, with **2.07 GW** added during FY 2024-25.
- **Solar power:** **Solar power** in India leads with an installed capacity of **94.17 GW**, including **15.16 GW** from **grid-connected rooftop solar** and **4.10 GW** from **off-grid solar solutions**.
- **Hydro Power:** **Small Hydro Power** has an installed capacity of **5.08 GW**, focusing on utilizing river streams for clean energy.
- **Biomass Energy:** **Biomass Energy** contributes a combined total of **10.72 GW**, with **9.80 GW** from bagasse-based cogeneration and **0.92 GW** from non-bagasse-based cogeneration.
- **Waste-to-Energy:** **Waste-to-Energy** projects, including off-grid systems, contribute **0.61 GW**, emphasizing efforts to utilize waste for sustainable energy generation.



Renewable Energy Capacity in India



As of October 10, 2024

What is India's Potential in Renewable Energy ?

- **Solar Energy:** With over **300 sunny days** annually, the **National Institute of Solar Energy (NISE)** estimates its potential at **748 GW**, assuming **3% of wasteland** is covered by **Solar PV modules**.

- States like Rajasthan, Gujarat, and Tamil Nadu lead in solar energy development, with massive solar parks contributing to the national grid.
- **Wind Energy:** India's wind energy potential exceeds **300 GW**, primarily concentrated in **Tamil Nadu, Gujarat, Maharashtra, Andhra Pradesh, and Karnataka**.
 - Emerging offshore wind projects in coastal areas, such as Gujarat and Tamil Nadu, could significantly boost capacity.
- **Hydro Energy:** India has an estimated more than **148 GW** of hydroelectric potential, of which **46 GW** remains untapped.
 - Small hydropower plants (<25 MW) offer **20 GW** of potential, particularly in the Himalayan and northeastern regions.
- **Geothermal Energy:** India has significant geothermal potential, with notable sites in **Ladakh, Himachal Pradesh, and Jharkhand**, capable of generating **10 GW**.
 - Projects in [Puga Valley \(Ladakh\)](#) highlight the untapped potential of geothermal energy.
- **Ocean Energy:** Seawater stores **tidal, wave and Ocean thermal energy**. Among them, the harnessing of **40GW wave energy** is possible in India.
 - Coastal areas such as the [Gulf of Kutch](#) and the **Sundarbans** offer tidal energy potential.

What are Challenges in Expanding Renewable Energy Including Wind Energy in India?

- **Land Scarcity and Use Conflicts:** The renewable energy sector, especially wind sector faces challenges in accessing land and ideal wind sites, especially in densely populated or ecologically sensitive areas.
 - **Farmers and local communities** are resistant to reallocating land for wind energy projects.
 - Consolidating suitable parcels of land is particularly challenging in states such as **Gujarat, Maharashtra, and Tamil Nadu**, where land is often divided among multiple owners.
- **Financing and Investment Issues:** Wind energy projects have substantial upfront capital requirements. Uncertainty in returns and long payback periods deter private investors.
- **Grid Integration and Curtailments:** Wind power's intermittent nature and **seasonal wind patterns** cause supply instability, with grid curtailments during peak seasons reducing profitability.
- **Exhaustion of High-Quality Sites:** Many prime locations with optimal wind speeds are already occupied, forcing new projects into less viable areas.
- **Approval Delays and Policy Gaps:** Wind projects face prolonged delays in obtaining environmental, [wildlife and forest clearances](#).
 - The lack of **consistent financial incentives** or long-term policies reduces investor confidence.
- **Offshore Wind Challenges:** **Offshore wind** potential remains untapped due to high installation costs, advanced technology needs, and limited government support.

What is India's Initiative to Boost Renewable Energy?

- [Pradhan Mantri Kisan Urja Suraksha Evam Utthaan Mahabhiyan \(PM-KUSUM\)](#)
- [PLI Scheme for Solar PV Modules](#)
- [Pradhan Mantri Suryodaya Yojana](#)
- [Solar Parks and Ultra Mega Solar Power](#)
- [Green Energy Corridor Scheme](#)
- [National Green Hydrogen Mission](#)
- [National Bioenergy Programme](#)
- [FDI in Renewable Energy](#)

Way Forward

- **Improving Land Access:** Establish transparent policies for acquiring **unused government land** and streamline processes through [digitized land records](#) and designated renewable zones.
 - Promote **dual-use projects** where solar farms coexist with agriculture or grazing to optimize land use.
- **Strengthening Transmission Infrastructure:** Speed up development of **green energy corridors** to link renewable projects with demand centers.
 - Accelerate the setup of [transmission lines](#) and invest in hybrid systems (solar + wind + storage) to **stabilize power output** and reduce variability.
- **Harmonizing Policies:** Formulate a unified national renewable energy policy to address state-level inconsistencies.
 - Provide long-term incentives such as **tax breaks**, [interest subsidies](#), and performance-based rewards to attract investments.
 - Encourage local production of solar panels and wind turbines under "[Make in India](#)" by offering subsidies and reducing dependence on imports.
- **Focusing on Offshore Wind:** Pilot offshore wind projects and offer financial incentives while reducing import duties on specialized equipment to promote development.
- **Financing and R&D:** Set up green banks to provide affordable financing and invest in research for advanced technologies to improve efficiency and lower costs.
- **Environmental Sustainability and Skill Development:** Ensure rigorous environmental assessments, promote recycling of energy components, and conduct community engagement programs.

Drishti Mains Question

What are the key challenges in expanding renewable energy capacity in India, and how can they be addressed to meet the 500 GW non-fossil fuel target by 2030?

UPSC Civil Services Examination, Previous Year Questions (PYQs)

Prelims:

Q. Which one of the following is a purpose of 'UDAY', a scheme of the Government? (2016)

- (a)** Providing technical and financial assistance to start-up entrepreneurs in the field of renewable sources of energy
- (b)** Providing electricity to every household in the country by 2018
- (c)** Replacing the coal-based power plants with natural gas, nuclear, solar, wind and tidal power plants over a period of time
- (d)** Providing for financial turnaround and revival of power distribution companies

Ans: (d)

Mains:

Q. Write a note on India's green energy corridor to alleviate the problem of conventional energy.(2013)

