Challenges for Solar Energy Production

Mains: *GS-III- Infrastructure-Energy*

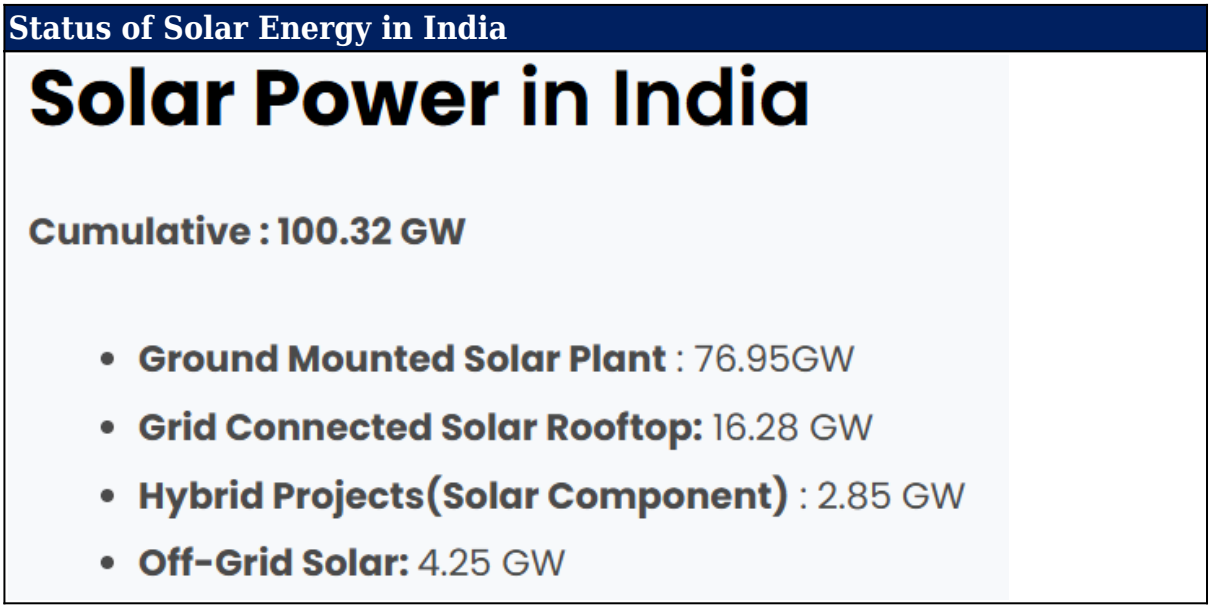
Why in news?

Recently, India made a remarkable progress in its clean energy transition by achieving 50% of its installed electricity capacity from non-fossil fuel sources five years ahead of its 2030 target under the Paris Agreement.

What is solar energy?

- **Definition** – Solar energy is a renewable and sustainable form of power *derived from the radiant energy of the sun.*
- **Technology used** – Photovoltaic cells and solar thermal systems.
- **Photovoltaic (pv) cells** – It convert sunlight directly into electricity by utilizing the photoelectric effect.

Status of Solar Energy in India



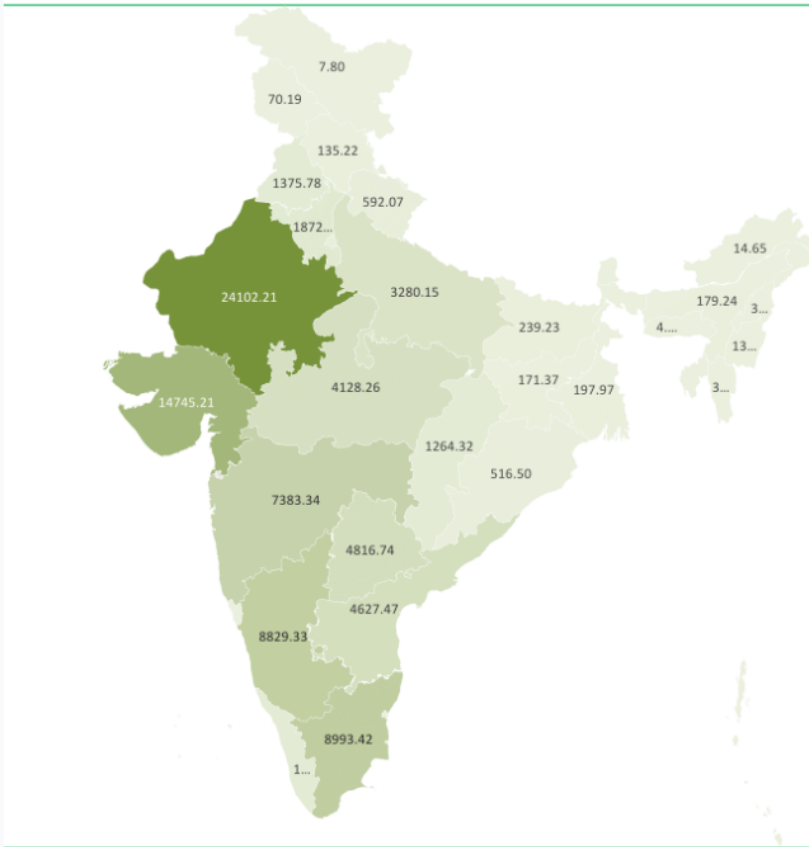
Top states with highest solar power capacity

1	Rajasthan	27,343 MW
2	Gujrat	17,579 MW
3	Tamil Nadu	9,541 MW
4	Maharashtra	9,337 MW
5	Karnataka	9,282 MW

As on Jan 2025.

Western states like Rajasthan, Gujrat and Maharashtra are leading the way in terms of installed solar power capacity.

Map of Indian states with solar capacity.



Source: MINISTRY OF NEW AND RENEWABLE ENERGY

What are the challenges for India?

- **Dependent on imports** – India depends on *imports for nearly 80%* of its solar equipment.
- **China's dominance** – India still relies on China *for over 50% of its solar cells and modules*,
- India also sources from Southeast Asian partners such as Vietnam and Malaysia which also often *rely on Chinese raw materials like polysilicon and wafers.*

- **Lack of capacity** – It lacks manufacturing strength in components like polysilicon and ingots, and efforts to build local capacity.
- **Insufficient policies** – *The Production Linked Incentive (PLI) scheme* still heavily rely on Chinese equipment suppliers.
    - One Indian solar company lists all seventeen of its supply chain partners as Chinese firms.
- **Outdated technology** – Indian manufacturers had the capacity to produce only 3 GW of solar cells and 9-10 GW of solar panels, far below the country's needs.
- **High production cost** – India's *higher energy costs* and *lower labour productivity* makes solar module manufacturing more expensive in the country.
- **Unintentional consequences** – National Solar Mission accidentally *incentivised reliance on cheaper imports* over supporting domestic manufacturing.
- **Lack of global support –** Government support manufacturers through the Domestic Content Requirement and safeguard duties.
- But it has faced challenges including *World Trade Organization disputes* and practical implementation issues, leading to inconsistent support.

How India can diversify its supply chains?

- **Strengthening domestic manufacturing** – India needs to develop an integrated manufacturing supply chain from *silica mining to module assembly* to achieve true self-reliance.
- **Robust policy support & investment** – Government-assisted projects to source India-made modules, is another vital step.
- These efforts require consistent, long-term planning and sufficient funding, especially for *capital-intensive upstream production*.
- **Diversifying international cooperation** – India should actively seek collaborations with a variety of partners, such as the *United States, European Union, and Japan.*
    - **For instance**, the US Development Finance Corporation has already lent nearly $1 billion for solar cell and module production in India but diplomatic tensions delayed it.
- These partnerships can offer concessional financing, advanced technologies and expertise moving beyond simple reliance on a single source.
    - **For example**, green hydrogen, offshore wind technology can be applied from other nations.
- **Research and development** – Investment in domestic R&D is also vital for technological self-reliance and global competitiveness.
- **Strategic balancing** – The non-aligned foreign policy of India can be leveraged to strategically engage with both the US and China.

What lies ahead?

- *Balancing affordability with innovation* could be done to serve national interests without succumbing to external pressures.
- More strategic approach could allow India to capitalise on the competitive aspects of US-China climate policies to negotiate mutually beneficial terms.

Reference

Down to Earth| India's Solar Energy Strategy