Perspective: India's Green Energy Strides

For Prelims: Asian Development Bank (ADB), Asia–Pacific Climate Report 2024 Solar Energy, Wind Power, Renewable Energy, COP26, Green Hydrogen, PM-KUSUM (Pradhan Mantri Kisan Urja Suraksha Evam Utthaan Mahabhiyan), National Green Hydrogen Mission, Solar Park Scheme, Land Acquisition, PLI Scheme for High-Efficiency Solar PV Modules, Green Energy Corridor, Viability Gap Funding (VGF), International Solar Alliance (ISA), One Sun, One World, One Grid (OSOWOG), Solar Pv Cell Imports, Solar PV Module , Skill Development, Solar Technology Application Resource Centre (Star-C).

For Mains: Significance of Renewable Energy in Ensuring Energy Security, Sustainable Development and Reducing Environmental Pollution & Degradation.

Why in News?

Recently, the Asian Development Bank (ADB) in its Asia–Pacific Climate Report, 2024 highlighted India's shift from unsustainable fossil fuel subsidies to investing in cleaner, greener energy solutions.

- The report highlighted India's **"remove, target, and shift"** strategy that reduced fossil fuel subsidies by **85%** from 2014 to 2023, freeing up funds for renewable energy investments.

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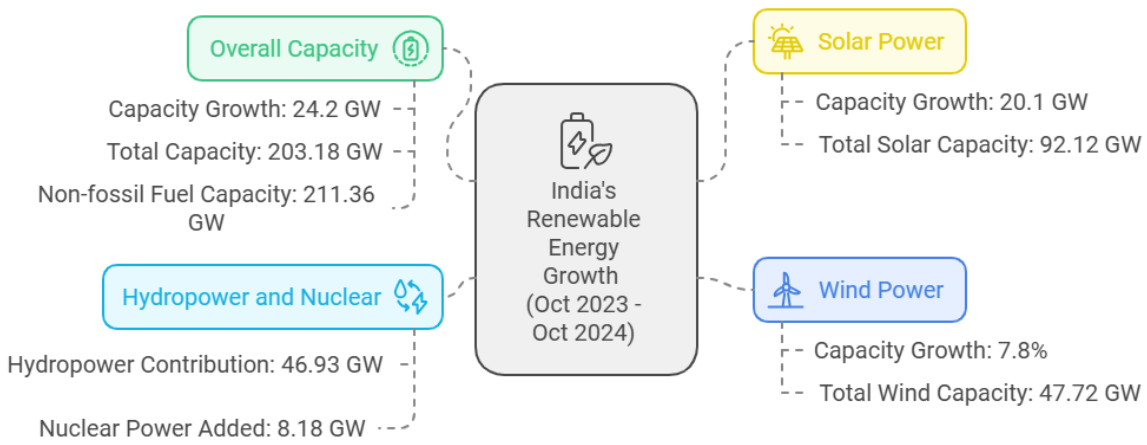
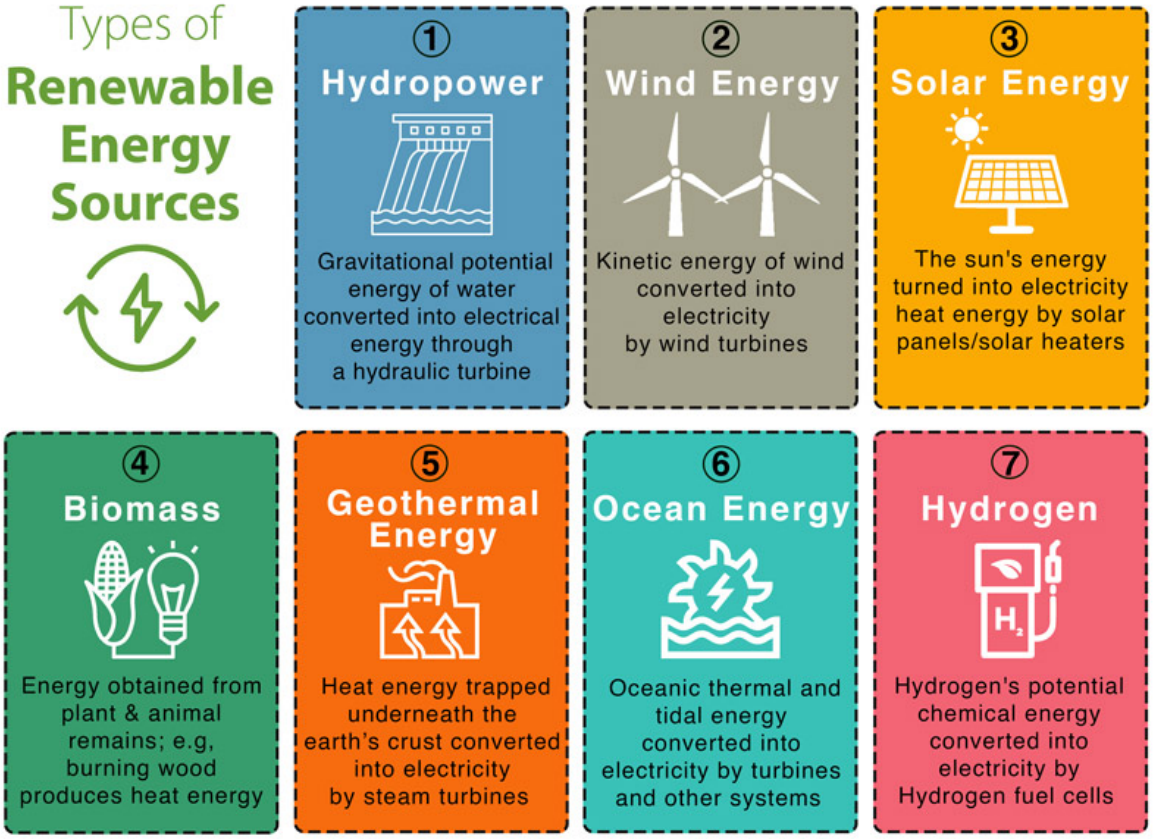


What are the Key Achievements of India's Renewable Energy Sector?

- **India's Fossil Fuel Subsidy Reforms**: India began reducing petrol and diesel subsidies gradually from 2010 to 2014, followed by incremental tax hikes up to 2017.
  - As per **Asia-Pacific Climate Report 2024**, by 2023, **fossil fuel subsidies** were reduced by **85%**(from USD 25 billion in 2013 to USD 3.5 billion by 2023), demonstrating India's commitment to clean energy.
  - **Reduced subsidies** enabled investments in **alternative energy sources,** such as LPG

for rural areas, balancing environmental and social goals.
    - The **additional revenues** were redirected to fund clean energy projects such as solar parks, electric vehicles, and grid infrastructure.
- **Role of Taxation**: From 2010 to 2017, India imposed a **cess on coal production** and imports, which funded **clean energy initiatives.**
    - Around **30% of cess collections** were allocated to the National Clean Energy and Environment Fund (NCEEF), supporting **clean energy projects** and **research.**
    - The cess significantly bolstered the **Ministry of New and Renewable Energy's** budget, financing key programs like the Green Energy Corridor and National Solar Mission, reducing **solar energy costs** and supporting **off-grid solutions.**
- **Installed Capacity and Growth**: Renewable energy capacity grew by 24.2 GW (13.5%), reaching **203.18 GW** in October 2024 (up from 178.98 GW in October 2023).
    - **Non-fossil fuel capacity** (including nuclear) rose to **211.36 GW** in 2024, from 186.46 GW in 2023.
    - **Solar power** capacity increased by 20.1 GW (27.9%), reaching **92.12 GW** in October 2024 (up from 72.02 GW in 2023).
        - The country's potential for solar energy is estimated at **748 GW** by the **National Institute of Solar Energy (NISE).**
    - **Wind energy** capacity grew by 7.8%, from 44.29 GW in October 2023 to 47.72 GW in 2024.
    - **Large hydro projects** contributed 46.93 GW to the renewable portfolio and **Nuclear power** added 8.18 GW to the total capacity.
    - India ranks **4th globally in total renewable power capacity, 4th in** wind power **capacity**, and **5th in** solar power **capacity**, solidifying its position as a global leader in the renewable energy transition.
- **Renewable Energy Targets**: India has set a bold target to achieve **500 GW of renewable energy** capacity by 2030, a major part of its commitment under the Panchamrit framework outlined at COP26.
    - The goal is to ensure **50% of the country's total energy mix** comes from renewable sources by 2030.
    - These efforts align with India's broader climate goals of reducing carbon intensity by **45%** by the end of the decade and achieving net-zero emissions **by 2070.**
- **Green Hydrogen Commitment:** A key component of India's renewable energy strategy is the development of green hydrogen.
    - The government aims to produce **5 million tonnes (MT) of green hydrogen** annually by 2030, supported by a dedicated **125 GW of renewable energy** capacity for hydrogen production.
    - This initiative is expected to position India as a global leader in clean hydrogen production, which is crucial for decarbonizing hard-to-abate sectors like industry, transport, and heavy-duty power generation.



What are Key Schemes & Initiatives to Boost India's Renewable Energy Sector?

- **Union Budget 2024:** The Union Budget 2024-25 allocates Rs 10,000 crore to the **Centrally Sponsored Scheme for Solar Power (Grid),** marking a significant **110% increase** from the Rs 4,757 crore allocated in the previous budget.
  - Additionally, the PM-Surya Ghar Muft Bijli Yojana, launched in February 2024 with an overall outlay of **Rs 75,000 crore,** has received **Rs 6,250 crore** for implementation. It aims to promote the adoption of solar rooftop systems.
  - The budget also announces the **exemption of Basic Customs Duty (BCD)** on imports of 25 critical minerals, essential for the growth of the renewable energy sector.
- **PM-KUSUM Scheme:** The PM-KUSUM (Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan) scheme plays a crucial role in promoting solar energy in agriculture.
  - It aims to install **solar pumps and solarized agricultural feeders,** reducing farmers' reliance on grid power and diesel.
  - With a target to install **34.8 GW** of solar capacity through decentralized solar projects, this initiative supports sustainable farming practices and enhances rural energy access.
- **National Green Hydrogen Mission:** India's National Green Hydrogen Mission, with a budget of **Rs 19,744 Cr,** aims to develop a competitive and self-reliant green hydrogen industry.
  - The mission focuses on producing green hydrogen at scale and promoting its use in sectors like **industrial decarbonization, heavy transport, and energy storage**, helping India meet its climate goals while creating jobs and boosting economic growth.
- **Solar Park Scheme:** India has approved **55 solar parks** with a combined capacity of **40 GW** under the **Solar Park Scheme.**
  - This initiative simplifies land acquisition, provides infrastructure, and attracts private investments by offering pre-developed sites for solar projects.
  - It plays a pivotal role in achieving the country's solar energy expansion goals.
- **PLI Scheme for High-Efficiency Solar PV Modules:** To reduce dependency on imported solar components, India has launched the PLI Scheme for High-Efficiency Solar PV Modules, which incentivizes domestic manufacturing.
  - The scheme has a target to build **65 GW** of annual manufacturing capacity by 2026, with a focus on enhancing the efficiency and competitiveness of **India's solar manufacturing sector.**

- **Green Energy Corridor:** The Green Energy Corridor aims to strengthen transmission infrastructure to efficiently transfer renewable power from energy-rich regions to demand centers.
    - The first phase, covering **eight renewable energy-rich states,** is already underway, with phase II planned to expand transmission networks to other parts of the country, further integrating renewable energy into the grid.
- **Viability Gap Funding (VGF) for Offshore Wind**: The Viability Gap Funding (VGF) scheme supports the development of offshore wind projects along India's coastlines.
    - With a target of **30 GW** of offshore wind by 2030, this initiative focuses on **Gujarat** and **Tamil Nadu** as primary sites for offshore wind farm development, aiming to create a new source of renewable energy generation.
- **International Leadership in Renewable Energy**: India has demonstrated its global leadership in renewable energy through initiatives such as the International Solar Alliance (ISA), which it co-founded with France.
    - The ISA aims to mobilize **USD 1 trillion** in solar investments and facilitate the deployment of **1,000 GW** of solar power by 2030.
    - The idea of One Sun, One World, One Grid (OSOWOG) proposed for the first time, in 2018, at the first assembly of the **International Solar Alliance (ISA)** aims to create a global interconnected renewable energy grid.
        - It involves **three phases:** connecting India to neighboring regions, expanding to Africa, and achieving global interconnection by 2050.

What are Challenges in the Renewable Energy Sector in India?

- **Land Acquisition:** One of the major challenges in the **renewable energy sector** is acquiring sufficient land for large solar and wind projects.
    - Many suitable land areas are either **densely populated** or used for **agriculture,** creating delays in project implementation and escalating costs.
- **Taxation in Clean Energy**: From 2010 to 2017, India levied a cess on coal production to fund clean energy projects.
    - However, the introduction of GST in 2017 subsumed the coal cess into the GST compensation cess, altering fund distribution to offset states' revenue losses.
    - This shift in taxation illustrates the challenges and ongoing adjustments needed to support **clean energy** financing within India's fiscal landscape.
- **Availability and High Cost of Technology:** The renewable energy sector faces significant challenges due to the **high cost** and **limited availability** of critical technologies.
    - **China's reluctance** to provide access to **solar manufacturing technologies** is compounded by the fact that **98% of solar module equipment** is produced in China.
    - India relies heavily on imports for critical components such as solar panels, wind turbine parts, and electrolyzers for green hydrogen.
    - In FY23, **China** made up a staggering **94%** of India's total solar PV cell imports and **93%** of its solar PV module shipments.
    - This dependency exposes the sector to risks related to **global supply chain disruptions and price fluctuations**, hindering the sustainability of India's renewable energy growth.
- **Grid Infrastructure and Stability**: India's existing grid infrastructure requires substantial upgrades to integrate large volumes of intermittent renewable energy like **solar and wind.**
    - The lack of adequate storage solutions and flexible grid systems can lead to instability, affecting the seamless supply of **renewable energy.**
- **Financing and Investment**: Despite India's renewable energy growth, **attracting long-term capital** remains a challenge due to **high upfront costs,** constant upgradation of technologies, and concerns over return on investment.
    - The sector's **capital-intensive** nature requires **consistent investment**, but uncertainties regarding policy changes and global economic conditions pose risks to potential investors.
- **Regulatory and Policy Hurdles**: Inconsistent regulatory frameworks and delays in project approvals across states create barriers to the timely development of renewable energy projects.
    - **Streamlining regulations** and improving coordination between the central and state governments are crucial to ensuring faster implementation and fostering investor confidence.
- **Skilled Workforce Shortage:** As the renewable energy sector expands, there is a significant need for a skilled workforce, particularly in areas like **green hydrogen** production, **energy**

storage technologies, and **advanced solar and wind technologies.**
    - Building a robust workforce through training and skill development programs is essential for sustaining growth in the sector.

Way Forward

- **Land Acquisition:** To address **land acquisition challenges,** India must explore **innovative solutions** such as utilizing **non-agricultural** or **degraded land** for solar and wind farms.
- Promoting **rooftop solar** and integrating renewable energy in **urban infrastructure** can reduce dependency on large tracts of land.
    - Collaborative **land pooling models** and **policy incentives** for landowners can also expedite the process.
- **Taxation in Clean Energy:** The government should revisit the **taxation framework** to ensure that **clean energy projects** receive consistent and sustainable **funding.** Clarifying the allocation of **cess revenues** and enhancing **tax incentives** for renewable energy investments will encourage **long-term financing.**
    - Strengthening the connection between **GST collections** and clean energy subsidies can help stabilize funding streams.
- **Availability and High Cost of Technology:** India should focus on strengthening **domestic manufacturing** capabilities for critical components like **solar panels, wind turbines,** and **electrolyzers.** This can be achieved through incentivizing **innovation** and production under schemes such as the **PLI Scheme.**
    - Additionally, fostering public-private partnerships (PPP) to reduce dependency on foreign suppliers and mitigate **supply chain risks** is essential.
    - Negotiating **technology-sharing agreements** with countries that have advanced manufacturing capacities could also alleviate the technology gap.
- **Grid Infrastructure and Stability: Upgrading grid infrastructure** to accommodate renewable energy is crucial.
    - The government should invest in **modernizing the transmission network**, focusing on smart grid technology, and incorporating **energy storage solutions** such as **batteries** to handle intermittency.
    - Strengthening **cross-border grid interconnections** can help balance supply and demand across regions, enhancing **grid stability.**
- **Financing and Investment:** To attract more **investment,** India should introduce attractive **financial models,** such as **green bonds** and **renewable energy investment funds,** while ensuring **policy stability.**
    - Clear long-term **incentives,** a reduction in **bureaucratic hurdles,** and **risk mitigation strategies** like power purchase agreements (PPAs) will foster investor confidence.
    - Furthermore, creating a **dedicated green energy fund** can ease the flow of capital into clean energy projects.
- **Regulatory and Policy Hurdles: Streamlining regulatory processes** and creating **uniform policies** across states will expedite **project approvals** and reduce delays.
    - Centralized platforms for **project monitoring** and **approval** can also improve coordination between the **central** and **state governments,** ensuring faster implementation of renewable energy projects.
- **Skill Development Programs:** Expanding training programs for skilled workers in renewable energy technologies will address the sector's labor shortage.
    - Initiatives like Solar Technology Application Resource Centre (Star-C) and vocational training for emerging sectors like hydrogen production and energy storage will build a capable workforce to support the country's **renewable energy transition.**

UPSC Civil Services Examination, Previous Year Question (PYQ)

Prelims:

Q. 'Net metering' is sometimes seen in the news in the context of promoting the (2016)

(a) Production and use of solar energy by the households/consumers

(b) Uuse of piped natural gas in the kitchens of households

(c) Installation of CNG kits in motor cars

(d) Installation of water meters in urban households

Ans: (a)

Mains:

Q.India has immense potential of solar energy though there are regional variations in its developments. Elaborate. **(2020)**