



Climate Change Driving India's Green Economy

*This editorial is based on “[India's climate challenge and the rise of a new green economy](#)” which was published in *The Livemint* on 24/12/2024. The article brings into picture the critical challenges India faces from climate change, such as rising floods and agricultural instability, while highlighting the opportunities for a green economic transformation through renewable energy, green hydrogen, and sustainable agriculture. Achieving this transition requires innovative financing and a focus on sustainability and urban resilience to set global benchmarks for sustainable development.*

For Prelims: [Climate change](#), [500 GW renewable energy by 2030](#), [2023 Himachal Pradesh floods](#), [Erratic monsoons](#), [Precision Farming](#), [Zero-Budget Natural Farming](#), [Mangrove Initiative for Shoreline Habitats & Tangible Incomes](#), [Perform, Achieve, and Trade \(PAT\) Scheme](#), [National Cooling Action Plan](#), [Atal Bhujal Yojana](#), [Green Energy Corridor](#), [NITI Aayog](#), [Basic Customs Duty](#), [Carbon Border Adjustment Mechanism](#), [National Investment and Infrastructure Fund](#).

For Mains: Climate Change Vulnerability Inducing India's Green Economy Transition, Roadblocks in India's Transition Towards a Green Economy.

India faces critical challenges from [climate change](#), including **rising floods and agricultural instability**, but also has unique opportunities for a green economic transformation. With a goal of [500 GW renewable energy by 2030](#) and advancements in **green hydrogen and sustainable agriculture**, India can become a model for developing nations. However, achieving this demands **innovative financing beyond public funds, given limited global climate finance**. Despite hurdles, India's focus on **renewables, sustainability, and urban resilience** could secure its future and set global benchmarks for a propelling green economy.

What is the Green Economy?

- A Green Economy is an economic system that aims to promote **environmental sustainability, social inclusion, and economic growth simultaneously**.
- It focuses on reducing environmental risks and ecological scarcities by investing in green sectors such as **renewable energy, clean technology, energy efficiency, and sustainable agriculture**.
- The goal is to create **jobs, improve well-being, and promote sustainable development** while minimizing the negative impact on the planet's natural resources.



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How Climate Change Vulnerability is Inducing India's Green Economy Transition?

- **Frequent Disasters Driving Renewable Energy Adoption:** India's increasing exposure to extreme climate events like **floods**, **heatwaves**, and **cyclones** has **disrupted energy supply chains** and underscored the fragility of fossil fuel dependence.
 - For instance, the **2023 Himachal Pradesh floods** caused widespread infrastructure damage, including **energy networks**.
 - India's total renewable energy installed capacity surged by an impressive 13.5% in just one year, reaching **203.18 GW in October 2024**, as part of its target to **reach 500 GW by 2030**.
- **Agricultural Losses Encouraging Sustainable Practices:** **Erratic monsoons** and rising temperatures, linked to climate change, have **heavily impacted crop yields and farmer incomes**.
 - Climate change could reduce wheat yields by **19.3% by 2050** and **40% by 2080**, while kharif maize yields may decline by **18% and 23%** in the same periods, with significant

regional and temporal variations.

- This vulnerability has driven initiatives like [Precision Farming, Zero-Budget Natural Farming](#) in **Andhra Pradesh** and the adoption of [climate-resilient seeds](#), creating a market for sustainable farming practices.
 - In **August 2024**, The Indian Prime Minister **109 climate-resilient and bio-fortified varieties** of crops including 34 field crops and 27 horticultural crops.
- **Rising Sea Levels Promoting Coastal Adaptation Projects:** India's 7,500 km coastline faces threats from sea-level rise, endangering livelihoods and infrastructure in cities like **Mumbai and Chennai**.
 - A recent report estimated that **36 million Indians could be displaced by 2050** due to coastal inundation.
 - To mitigate this, projects like **mangrove afforestation** under the [Mangrove Initiative for Shoreline Habitats & Tangible Incomes \(MISHTI\)](#) have gained momentum, aligning with India's green economy transition through nature-based solutions.
- **Heatwave-Induced Urban Energy Efficiency:** Increasing heat waves, with India recording over **200 heatwave days in 2022**, have escalated cooling demands, straining conventional energy sources.
 - The growing vulnerabilities have prompted urban areas to **adopt green building codes and energy-efficient cooling technologies**.
 - Initiatives like the [National Cooling Action Plan \(NCAP\)](#) aim to reduce cooling energy requirements by 20-25% by 2037-38, integrating sustainability into urban economic growth.
 - The [Perform, Achieve, and Trade \(PAT\) Scheme](#) incentivizes energy efficiency in industries, while **Renewable Energy Export Zones** promote green manufacturing.
- **Water Scarcity Catalyzing Green Innovations:** With India's per capita water availability declining from **5,177 m³ in 1951 to 1,486 m³ in 2022**, **climate-induced water stress** has spurred green economic activities such as wastewater recycling and solar-powered irrigation.
 - For example, the [Atal Bhujal Yojana](#), focused on groundwater management, promotes renewable energy solutions for water extraction.
- **Biodiversity Loss Triggering Ecosystem-Based Solutions:** Deforestation and biodiversity loss due to changing climate patterns have **impacted ecological services vital for livelihoods**.
 - India's commitment to restoring **26 million hectares of degraded land by 2030**, as pledged at [COP15](#), has led to **green economy initiatives like eco-tourism and agroforestry**, creating jobs while addressing climate risks.
 - The **Aravalli Biodiversity Park in Gurgaon, Haryana**, serves as a restored ecological hotspot that combats desertification and supports biodiversity.
- **Financial Risks Propelling Climate Finance Initiatives:** Frequent climate-related disasters have drawn attention to financial vulnerabilities. The cumulative total expenditure for **adapting to climate change in India is estimated to reach ₹85.6 lakh crore (at 2011-12 prices) by 2030**.
 - Green finance mechanisms, such as the [Sovereign Green Bonds](#) issued in 2023 worth ₹16,000 crores, fund renewable energy projects and sustainable infrastructure, making climate resilience a core component of economic policy.
- **Public Health Crises Accelerating Climate Action:** Climate change-induced health crises, such as the **rise in vector-borne diseases** due to warming temperatures, are **increasing healthcare costs**.
 - Studies indicate that around **37.7 million Indians are affected by water borne diseases annually**.
 - It has driven India to adopt green infrastructure solutions, such as the [Atal Mission for Rejuvenation and Urban Transformation \(AMRUT\)](#), which focuses on sustainable urban water supply and sanitation systems.
 - Additionally, initiatives like the **Namami Gange Program** aim to clean and rejuvenate rivers, reducing water contamination and associated health risks

What are the Roadblocks in India's Transition Towards a Green Economy?

- **Insufficient Renewable Energy Infrastructure:** India's ambitious target of achieving 500 GW renewable energy capacity by 2030 faces hurdles due to **inadequate infrastructure and grid integration issues**.

- Currently, India has a percentage of on-grid renewable energy of **just 28.04%**. Furthermore, delays in projects like the [Green Energy Corridor](#), aimed at improving grid connectivity, highlight the gap between policy goals and execution.
- **High Dependence on Fossil Fuels:** Despite progress in renewable energy, **77% of India's electricity generation comes from coal (as of FY23)**, making it challenging to decouple economic growth from fossil fuels.
 - The **Ministry of Coal** has achieved significant growth in overall coal production, reaching **384.08 million tonnes (Provisional) up to August 2024** reflecting its entrenched role in India's energy mix.
 - The lack of a robust strategy for phasing out coal plants undermines efforts to transition toward a green economy.
- **Financial Constraints and Lack of Climate Finance:** The transition requires massive investments, with [NITI Aayog](#) estimating a need for **\$10.1 trillion by 2070 to achieve net-zero targets**.
 - However, green financing remains limited, with India's clean energy investment standing at **\$17 billion in 2022**.
 - The **2023 Sovereign Green Bond issuance worth ₹16,000 crores** is a step forward but insufficient to meet the scale of demand.
- **Policy and Regulatory Uncertainty:** Frequent changes in renewable energy tariffs and unclear regulations deter private investments in green projects.
 - For example, **solar developers faced setbacks due to the imposition of the [Basic Customs Duty \(BCD\)](#) on solar imports**, raising project costs by 20-25%.
 - Such unpredictability undermines investor confidence and delays green initiatives.
- **Challenges in Transitioning the Workforce:** The shift from **carbon-intensive industries to green sectors** threatens millions of jobs, particularly in coal-dependent states like Jharkhand and Chhattisgarh.
 - Accelerated decarbonisation could transform over **30 million jobs by 2050**. The **absence of robust skill development programs hampers the ability of workers** to transition to green jobs.
- **Lack of Public Awareness and Behavior Change:** Sustainable consumption practices remain underdeveloped, with high energy wastage in urban and rural areas.
 - Only a **fourth of the electrified households have heard of Bureau of Energy Efficiency's (BEE) star labels** (launched in May, 2006), with even lower awareness among rural consumers. (**Council on Energy, Environment and Water**)
 - Limited public awareness campaigns and weak enforcement of programs like **Ujala for LED adoption slow the transition**.
- **Technological Gaps and Dependence on Imports:** India's green technology landscape, especially for **battery storage and solar panels**, heavily relies on imports, primarily from China.
 - India's solar sector imports reached **\$7 billion in FY 2024, of which \$3.89 billion came from China alone**, exposing India to geopolitical risks.
 - The absence of domestic manufacturing capacity undercuts the government's **PLI Scheme for Solar Manufacturing**, slowing self-reliance in green technology.
- **Climate Change Impacts on Renewable Projects:** Ironically, climate vulnerabilities, such as **erratic weather and extreme events**, disrupt renewable energy generation.
 - For example, Wind energy generation in Tamil Nadu is projected to decline by **5% in 2024-2025 compared to 2023-24**, due to unpredictable wind patterns.
 - Similarly, **rising temperatures are reducing the efficiency of solar panels**, with studies indicating significant efficiency loss for every degree Celsius rise.
- **Urbanization and Resource Scarcity:** Rapid urbanization, **expected to add 600 million urban residents by 2031**, creates resource pressures that undermine sustainability goals.
 - Poor urban waste management, where only **22-28% of solid waste is processed**, leads to environmental degradation.
 - Projects under the [Smart Cities Mission](#) have seen delays, limiting progress in green urban development.
- **International Trade and Carbon Border Taxes:** Emerging policies like the European Union's [Carbon Border Adjustment Mechanism \(CBAM\)](#) pose challenges for India's exports, particularly for steel and aluminum.
 - CBAM will affect **15-40% of Indian steel exports to Europe**. This creates a competitive

disadvantage for Indian firms struggling to balance economic and environmental priorities.

- **Fragmented Governance and Coordination Gaps:** The lack of inter-departmental coordination between ministries, such as **Environment, Power, and Finance, often results in fragmented policy implementation.**
 - For instance, overlapping jurisdiction between the **Ministry of Renewable Energy and State Electricity Boards** delays renewable energy projects.
- **Limited R&D Investment in Green Technologies:** India's expenditure on R&D for renewable technologies is only **0.7% of GDP**, far below global leaders like Germany and the USA.
 - This lack of funding slows innovation in areas such as **green hydrogen, energy storage, and carbon capture.**
 - For example, **India lags in carbon capture projects**, despite being the third-largest emitter of CO₂ globally.
- **Transportation Challenges in Electrification Goals:** The transport sector, contributing **14% of emissions**, faces significant challenges in transitioning to EVs due to inadequate charging infrastructure and high vehicle costs.
 - As of 2024, India has only 25,000 public charging stations. Moreover, the **discontinuation of subsidies under the FAME-II scheme** has further slowed EV adoption.
- **Social Resistance to Land Acquisition for Renewable Projects:** Land conflicts often delay renewable energy projects, as large-scale solar and wind farms require significant land acquisitions.
 - For example, the **Bhadla Solar Park in Rajasthan**, one of the largest globally, faced protests from local communities due to concerns over displacement.

What Measures India Can Adopt to Accelerate Transitioning Towards a Green Economy?

- **Scaling Up Renewable Energy Infrastructure with Grid Modernization:** India should focus on expanding renewable energy projects while upgrading grid infrastructure to integrate intermittent sources like **solar and wind.**
 - Establishing **regional grid-balancing systems**, as envisioned under the **Green Energy Corridor**, can address underutilization of renewables and ensure stable supply.
 - Enhanced Collaboration with the **One Sun, One World, One Grid (OSOWOG)** initiative can further drive investments and position India as a global renewable energy hub.
- **Enhancing Domestic Manufacturing for Green Technologies:** Promoting **local manufacturing of solar panels, wind turbines, and energy storage systems** through the **Production-Linked Incentive (PLI) Scheme** can reduce dependence on imports.
 - This aligns with India's goal to produce **110 GW of solar module manufacturing capacity by 2025-26**, minimizing reliance on Chinese imports.
 - Coupling this with the **Make in India initiative** can drive job creation and green industrialization.
- **Boosting Green Finance through Innovative Mechanisms:** India should expand access to green financing by launching **more Sovereign Green Bonds.**
 - Establishing a **Green Credit Guarantee Fund for MSMEs** can incentivize sustainable practices and lower borrowing costs.
 - Integration of private investment through platforms like the **National Investment and Infrastructure Fund (NIIF)** can further mobilize resources for large-scale green projects.
- **Developing Integrated Land-Use Policies for Renewable Projects:** To address land acquisition challenges, India needs a **unified policy framework for renewable energy projects** that balances ecological and social concerns.
 - Linking the **National Land Records Modernization Programme (NLRMP)** with renewable development can streamline land allocation.
 - Using degraded or wasteland for solar and wind farms, like **Thar Desert and arid regions of Gujarat**, minimizes displacement and environmental harm.
- **Expanding Electric Vehicle Ecosystem:** Building robust EV infrastructure, including **charging networks and battery recycling units**, can accelerate the transition in the transport sector.
 - India should target **new EV charging stations annually linking them with Dhabas and Petrol Pumps, with significant incentives**, focusing on urban and highway networks.
 - Linking the **FAME scheme with the Battery Waste Management Rules (2022)** can

create a circular EV economy, promoting sustainability and reducing import dependency on lithium-ion cells.

- **Promoting Climate-Resilient Agriculture:** Scaling up sustainable farming practices, such as **organic farming and micro-irrigation**, under the **Paramparagat Krishi Vikas Yojana (PKVY)** can improve resilience and reduce emissions.
 - Linking this with the **National Innovations in Climate Resilient Agriculture (NICRA)** can enable farmers to adopt climate-smart technologies, reducing crop losses.
 - For example, **precision farming using drones**, promoted in the **Drone Didi Scheme**, can optimize resource usage.
- **Establishing a National Carbon Pricing Framework:** Implementing a comprehensive carbon pricing mechanism, including an **Emission Trading Scheme (ETS)**, can incentivize industries to adopt low-carbon technologies.
 - Expanding **pilot ETS programs in Gujarat and Maharashtra** to a nationwide platform could generate a huge sum annually, **funding renewable energy and climate adaptation**. Carbon pricing also aligns India with global trade frameworks like the **EU's CBAM**.
- **Integrating Circular Economy into Industrial Processes:** India must adopt **circular economy practices** across sectors like construction, electronics, and textiles to minimize waste.
 - For instance, mandating the **use of 30% recycled materials in construction projects under the Smart Cities Mission** can promote sustainability.
 - Encouraging **startups in waste management through initiatives like the Startup India Seed Fund Scheme** can boost innovation and job creation.
- **Strengthening Urban Green Infrastructure:** Expanding green urban projects such as **green roofs, solar rooftops, and waste-to-energy plants** under the Smart Cities Mission can make cities sustainable.
 - Integrating the mission with the **National Solar Mission** can incentivize rooftop solar adoption, especially in metro cities.
 - For example, **Surat's integrated waste-to-energy and solar initiatives** have reduced urban emissions.
- **Empowering Communities through Grassroots Green Movements:** Promoting citizen-led initiatives under programs like **Lifestyle for Environment (LiFE)** can **amplify green practices at the grassroots**.
 - This includes awareness campaigns on sustainable consumption and waste segregation.
 - Linking **LiFE with the Swachh Bharat Mission** can **foster behavioral changes**, improving waste management and recycling at the community level.
- **Expanding Mangrove and Wetland Restoration Programs:** India should scale up nature-based solutions by restoring mangroves and wetlands to enhance carbon sequestration and coastal resilience.
 - The **Mangrove Initiative for Shoreline Habitats and Tangible Incomes (MISHTI)** can be integrated with **Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA)** to provide livelihood opportunities. \
- **Investing in Large-Scale Energy Storage Solutions:** Developing advanced battery storage technologies, such as **lithium-ion and sodium-ion**, is essential for renewable energy integration.
 - Establishing **gigafactories under the PLI scheme for energy storage** can meet India's projected demand of 30 GW storage by 2030.
 - Collaborating with global firms like **Tesla and CATL** can **fast-track this initiative**.
- **Developing a Green Skills Workforce:** Launching a **National Green Skill Development Mission** can prepare India's workforce for green economy jobs in renewable energy, EVs, and sustainable manufacturing.
 - Integrating this with existing programs like **Skill India** can upskill workers from traditional industries, **enabling a smooth transition**.
 - For instance, **training coal-sector workers in Jharkhand for solar panel installation** can create inclusive opportunities.

Conclusion:

India's transition to a **green economy is not just an environmental necessity but a pathway to sustainable growth**, directly aligning with the United Nations Sustainable Development Goals (SDGs).

The SDGs, particularly **Goal 7: Affordable and Clean Energy** and **Goal 13: Climate Action** are central to India's green economy aspirations. By advancing renewable energy sources, fostering green hydrogen, and promoting sustainable agriculture, India contributes to SDG 7 while addressing agricultural instability and mitigating climate risks.

Drishti Mains Question:

“India's transition to a green economy is seen as essential for addressing both climate change and sustainable development”. Discuss the challenges and opportunities India faces in achieving this transition.

UPSC Civil Services Examination, Previous Year Question (PYQ)

Prelims

Q. With reference to the Indian Renewable Energy Development Agency Limited (IREDA), which of the following statements is/are correct? (2015)

1. It is a Public Limited Government Company.
2. It is a Non-Banking Financial Company.

Select the correct answer using the code given below:

- (a) 1 only
- (b) 2 only
- (c) Both 1 and 2
- (d) Neither 1 nor 2

Ans: (c)

Mains

Q. “Access to affordable, reliable, sustainable and modern energy is the sine qua non to achieve Sustainable Development Goals (SDGs)”. Comment on the progress made in India in this regard. (2018)