



ENERGY TRANSITION IN INDIA

India's journey from conventional to renewable sources of electricity generation marks a monumental step towards a sustainable energy future. The Government's unwavering commitment to ambitious renewable energy targets, coupled with innovative policies and incentives, has set the stage for a greener energy landscape.

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India stands at a crossroads of development, grappling with the dual challenge of meeting its soaring energy demands while addressing the pressing concerns of climate change and environmental degradation. With a population of over 1.4 billion and being the fastest-growing major economy, the need for a sustainable and secure energy supply has never been more critical for the country. In recent years, India has embarked on a transformative journey, shifting its focus from conventional fossil fuel-led growth towards sustainable growth through renewable sources of electricity generation. This transition not only promises a cleaner and greener energy landscape but also holds the potential to reshape the country's energy future. This article delves into the motivations behind India's energy transition, explores the progress made so far, highlights the

challenges encountered, and envisions the path forward towards a renewable-powered India.

The Need for Energy Transition

For decades, the energy sector has relied primarily on fossil fuels like coal, oil, and natural gas to generate electricity and fuel its economic growth. However, this reliance has come at a significant cost, both environmentally and socially. The burning of fossil fuels releases greenhouse gases into the atmosphere, contributing to global warming and climate change. Additionally, the air pollution resulting from conventional energy sources has led to severe health implications for the population, affecting not only the quality of life but also the economy.

As a signatory to the Paris Agreement, India has committed to reducing its carbon emissions and playing its part in combating climate change.

India achieves 40% power generation capacity from non-fossil fuel sources

Keeping COP 21 commitments, ahead of time

- Achieved ahead of the 2030 target, committed at COP 21
- Of the total 390.8 GW installed power generation capacity, 156.83 GW are from non-fossil fuel sources
- India to achieve 500 GW installed capacity from non-fossil fuel sources by 2030

Recognising the environmental hazards posed by fossil fuels and the need for energy security, India has embarked on an ambitious journey to transition from conventional energy sources to renewable ones.

The Government of India has displayed a strong commitment to advancing the adoption of renewable energy through comprehensive policies and initiatives. The National Action Plan on Climate Change (NAPCC), introduced in 2008, laid the groundwork for the country's sustainable development goals. Under the NAPCC, several national missions were launched, each focusing on a specific sector that contributes to climate change mitigation and adaptation.

Among these missions, the launch of the National Solar Mission has been a watershed moment in the renewable energy story of the country. Launched in 2010, this mission aimed to promote the deployment of solar energy technologies and reduce the cost of solar power generation. The initial target of 20 GW by the year 2022 was increased fivefold to 100 GW. The total target for renewable energy was also revised to 175 GW. The target has recently been revised to 500 GW of installed electricity generation capacity through non-fossil fuels by the year 2030. This reflects the speed and scale at which the Government intends to move from conventional energy sources to

renewables.

Against the target of 175 GW, a total of 172 GW of renewable capacity has been installed by the end of FY 2023, an increase of 126% from 76 GW in FY 2014. Further, installed solar capacity has increased by approx. 200% with the addition of about 45 GW, and installed wind capacity has increased by 9 GW during the period. The share of renewable energy in the generation mix increased from 17.2% in FY 2014 to 22.5% in FY 2023. During this period, the power sector in India has also attracted USD 78 billion in investment, including over USD 10 billion through FDI. The Government has also provided a budgetary support of over Rs 20,000 crore during the period.

Today, India has the 4th highest installed RE capacity globally. India also ranks 4th in terms of global wind and bioenergy installed capacity, while it ranks 5th in solar installed capacity, closely following Germany. During the last five years (2017-22), a RE capacity of 63 GW has been added, which is the 3rd highest globally during that period.

In the last five years, 70 GW of solar projects and 21 GW of wind projects (including hybrid projects) have been bid out. Standard bidding guidelines for solar and wind energy projects have also been issued to streamline the bidding process. Further, to increase renewable energy consumption, the Renewable Purchase Obligation (RPO) and Energy Storage Obligation (ESO) trajectory till FY 2030 have been issued by the Government. Green Open Access and Green Power Markets have also been introduced to help in the evacuation of power generated through renewable energy sources.

To achieve the ambitious target of 500 GW of capacity from non-fossil sources, it is also imperative to ensure the evacuation of generation of generated power by building adequate distribution and transmission infrastructure. Under Phase 1 of the Green Energy Corridor (GEC) scheme launched by the Government, 8857 ckm transmission lines and 20868 MVA substations capacity have been completed. Phase 2 of the scheme has been launched for 7 States with a target of 10,750 ckm transmission lines and 27500 MVA substations capacity by 2026. The Government also extended the benefit of Inter State Transmission System (ISTS) charges waiver till June 2025 for all renewable energy projects; for Green Hydrogen Projects

waiver has been extended till December 2030; and for offshore wind projects, it has been extended till December 2032.

A number of important schemes and targets have been announced for the promotion of solar energy: Solar Parks Scheme with a target of 40 GW; Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyaan (PM-KUSUM) Scheme with a target of 30.8 GW; Rooftop Solar (RTS) Phase-2 Scheme with a target of 4 GW; and CPSU Scheme (Ph-1 & 2) with a target of 8.2 GW. The Government has also launched the National Green Hydrogen Mission (NGHM) in January 2023 with a target of 5 MMTPA production capacity by 2030. Till date, 49 green hydrogen production and 19 electrolyser manufacturing projects have been announced so far. It has also announced schemes to incentivise green hydrogen production and electrolyser manufacturing.

Going with the theme of *Atmanirbhar Bharat*, the Government has also focused on the establishment of indigenous manufacturing capacity. Solar PV module manufacturing capacity has increased from 10 GW in 2018 to 25 GW (150%

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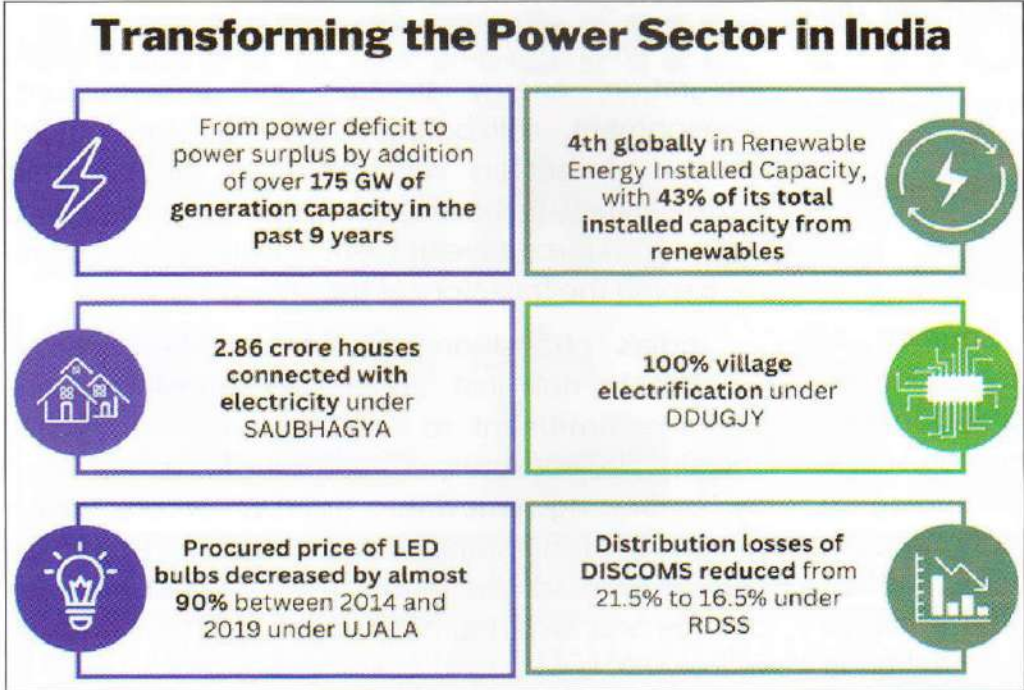
increase) in 2023, and solar PV cell manufacturing capacity has doubled from 3 GW to 6 GW during the same period. To further boost indigenous manufacturing, manufacturing linked tenders (3 GW solar cell & 3 GW solar module) have been issued. One of the major initiatives in renewable energy manufacturing sector is the launch of Production Linked Incentive (PLI) scheme with 8737 MW capacity (fully integrated), awarded under tranche-1 and 39,600 MW capacity (fully/ partially integrated) awarded under tranche-2. Besides these, domestic content linked schemes (CPSU Scheme, PM-KUSUM and RTS

Scheme) and Basic Custom Duty (BCD) on solar modules & cells have been introduced to give the needed fillip to local manufacturing. A total of 75 GW of solar module manufacturing capacity and 55 GW of solar cell manufacturing capacity annually is likely to be achieved by the year 2026. Wind turbine manufacturing capacity of more than 15 GW per annum with 70-80% indigenisation level has been developed in the country.

To improve skilling in the sector, over 32,000 persons have been trained under *Suryamitra* programme. *Vayumitra* for wind power projects and *Jal-Urjamitra* for small hydro plants have also been launched and training programmes are underway.

Challenges and the Path Ahead

While India's energy transition has been remarkable, it is not without challenges. One of the primary concerns is the intermittent nature of renewable energy sources like solar and wind. Balancing electricity supply and demand becomes complex due to fluctuations in generation. The adoption of advanced energy storage technologies, such



as batteries and pumped hydro storage, is essential to store excess energy during peak generation periods and release it during low-generation times.

Moreover, the integration of renewable energy into the existing grid infrastructure requires significant investments and upgrades. The development of a robust transmission network capable of handling intermittent and decentralised energy sources is crucial to maintaining grid stability and reliability.

Following challenges have been witnessed in the implementation of RE schemes and programmes:

- i. **Land:** The availability of land for RE projects has been one of the major challenges. The preparation of State Renewable Energy Plans, considering the land available, can address this issue.
- ii. **Regulatory Issues:** To achieve the RE installation targets, earnest action is needed from the State Governments on the following aspects:
 - Compliance of Renewable Purchase Obligation (RPO)
 - Timely adoption of tariff by State Electricity Regulatory Commissions (SERCs)
 - Avoiding levy of additional charges by the States
- iii. **Transmission infrastructure:** Realistic transmission and RE project planning coupled with regular monitoring and remedial actions are needed to achieve the targets.

Economic and Environmental Implications

The transition to renewable sources of electricity generation carries numerous economic and environmental implications. On the economic front, the growth of the renewable energy sector would stimulate job creation, spur technological innovation, and attract foreign investment, as also described in the previous sections. Further, a decrease in fossil fuel imports would enhance energy security and reduce the vulnerability of

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the economy to global energy market fluctuations.

Environmentally, the shift away from fossil fuels significantly reduces carbon emissions, mitigates air pollution, and safeguards public health. During COP26 in Glasgow, the Prime Minister of India, announced five nectar elements, the *Panchamrit*, to deal with this challenge of climate change. These elements of *Panchamrit* will help the

country to make its contribution in dealing with the climate change emergency. The above discussions reflect that India's commitment to renewable energy aligns with its international climate pledges and also enhances its reputation as a global leader in this aspect.

Conclusion

India's journey from conventional to renewable sources of electricity generation marks a monumental step towards a sustainable energy future. The Government's unwavering commitment to ambitious renewable energy targets, coupled with innovative policies and incentives, has set the stage for a greener energy landscape. The surging popularity of solar energy, the consistent growth of wind power, and the exploration of other renewable sources signify India's determination to strike a balance between economic advancement and ecological well-being.

As India navigates the complexities of grid integration, energy storage, and infrastructure development, collaboration between the public and private sectors will be crucial. International partnerships, technological advancements, and skilled workforce development will play pivotal roles in shaping the trajectory of the energy transition.

India's transition to renewable energy sources is not just an energy transformation but a commitment to securing a cleaner, more sustainable, and prosperous future for its citizens. By embracing renewable sources of electricity generation, India stands poised to lead by example, contributing to the global fight against climate change and inspiring nations around the world to follow suit. □