

**Climate Investment Funds (CIF)
Renewable Energy Integration (REI)
Program**

India REI Investment Plan

October 2024 V.1



TABLE OF CONTENTS

1	Proposal Summary	7
1.1	Objectives.....	7
1.2	Expected Outcomes.....	7
1.3	Program Criteria, Priorities, and Budgets	8
2	Country Context	10
2.1	Introduction.....	10
2.2	Current State of Energy Generation & Transmission and Distribution Systems	10
2.3	National and International Climate Strategies and Plans	13
2.4	Gap/Barrier Analysis for RE deployment	15
2.5	Social Equity and Inclusion	16
3	Renewable Energy Integration Context	19
3.1	Renewable Energy in the electricity sector	19
3.2	RE integration challenges	22
3.3	States' Low or Zero Carbon Strategies	25
3.4	Institutional Framework & Capacity.....	26
4	Program Description	28
4.1	Power System Strengthening Project.....	31
4.2	Integrated Renewable Energy Solutions Providing Round-the-Clock (RTC) Supply for Commercial and Industrial (C&I) Consumers	34
4.3	Supporting Grid Strengthening in One or More Renewable Energy (RE) Rich States	35
4.4	Offshore Wind Development Programme.....	37
4.5	Stand-alone Battery Energy Storage Systems (BESS).....	38
4.6	Technical Assistance.....	39
5	Financing Plan and Instruments	41
6	Additional development activities	42
7	Implementation Potential with Risk Assessment.....	44
7.1	Country/Regional Risks	44
8	Integrative Approach to Monitoring, Evaluation and Learning	46
8.1	Theory of Change.....	46
8.2	Integrated results framework.....	47
	Appendix A: Investment Concept Briefs	59
	Appendix B: Key Policies and Initiatives by Government of India to Ensure Inclusive Growth.....	62
	Appendix C: Overview of Renewable Energy Technologies in India	64
	Appendix D: Independent Technical Review	69
	Appendix E: Stakeholder Consultations.....	70
	Appendix F: Absorptive Capacity.....	72

List of Figures

Figure 1: India's Electricity Demand Projections (Source: CEA).....	11
Figure 2: Consumption of Electricity by Sectors in India during FY23	11
Figure 3: India's Primary Energy and Power Generation Mix Source: BP Statistical Survey and Central Electricity Authority.....	12
Figure 4: Installed Generation Capacity Projections (Source: NEP 2023, IEA India Energy Outlook).....	12
Figure 5: Share of Electricity Generation from RE sources (Source: CEA).....	19
Figure 6: Share of RE in Overall Electricity Mix in RE Rich States (Source: CEA)	20
Figure 7: India's Electricity Demand Projections (Source: CEA).....	24
Figure 8: Energy Storage Capacity Requirements (GW) (Source: CEA Optimal Energy Mix Report, IEA India Energy Outlook)	30

List of Tables

Table 1: Indicative Financing Plan (\$ million).....	9
Table 2: RE Development in Key States in India	25
Table 3: India's Journey in Sustainable Energy Leadership.....	26
Table 4: Grid Service Applications of Energy Storage Technologies	28
Table 5: Country/Regional Risks.....	44
Table 6: Integrated results framework	49

Table of Abbreviations

ACC	Advanced Chemistry Cell
ACS	Average Cost of Supply
ADB	Asian Development Bank
ARR	Aggregate Revenue Requirement
ASPIRE	Accelerating Smart Power and Renewable Energy
AT&C	Aggregate Technical and Commercial
BEEP	Building Energy Efficiency Project
BESS	Battery-based ESS
BU	Billion Unit
CAGR	Compound annual growth rate
CCEA	Cabinet Committee on Economic Affairs
CCUS	Carbon capture, utilization and storage
CEA	Central Electricity Authority
CECP	Clean Energy and Climate Partnership
CERC	Central Electricity Regulatory Commission
CFA	Central Financial Assistance
CFD	Contract for Differences
CIF	Climate Investment Funds
COP	Conference of the Parties
DDUGJY	Deendayal Upadhyaya Gram Jyoti Yojana
DEA	Department of Economic Affairs
DISCOM	Distribution Company
DMS	Distribution Management Systems
DRE	Distributed Renewable Energy
DSM	Deviation Settlement Mechanism
EA	Electricity Act
ECBC	Energy Conservation Building Code
MoEFCC	Ministry of Environment, Forest and Climate Change
ESCO	Energy Service Companies
ESO	Energy Storage Obligations
ESS	Energy Storage Systems
EU	Europe
EV	Electric Vehicle
FCDO	Foreign, Commonwealth & Development Office
FDI	Foreign Direct Investment
FDRE	Firm and Dispatchable Renewable Energy
FTE	Full-time equivalent
GB	Gender Budgeting
GBA	Global Biofuels Alliance
GDP	Gross domestic product
GEC	Green Energy Corridors
GEM	Green Electric Mobility
GENCO	Generation Company
GGEF	Green Growth Equity Fund
GHG	Greenhouse Gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GSDP	Gross State Domestic Product
GST	Goods and Services Tax
GW	Gigawatt
HPO	Hydro Power Obligation
HVDC	High-voltage direct current
IEA	International Energy Agency
IFC	International Finance Corporation
IGEN	Indo-German Energy Programme

IMF	International Monetary Fund
INR	Indian rupee
IP	Investment Plan
IPDS	Integrated Power Development Scheme
IPP	Independent Power Producers
IRENA	The International Renewable Energy Agency
IRF	Integrated Results Framework
ISA	International Solar Alliance
ISTS	Inter-State Transmission System
ITEC	Indian Technical and Economic Cooperation
JICA	Japan International Cooperation Agency
KUSUM	Kisan Urja Suraksha evam Utthaan Mahabhiyan
LC	Letter of Credit
LCOE	Levelized Cost of Electricity
LED	Light Emitting Diode
LGBTQ	Lesbian, gay, bisexual, and transgender
LHP	Large Hydro Power
LIS	Liquidity Infusion Scheme
LTLCDs	Long-term Strategy for Low Carbon Development
LTS	Long-term Strategy for Low Carbon Development
MDB	Multilateral Development Bank
MMT	Million Metric Tonnes
MMTPA	Million Metric Tons Per Annum
MNRE	Ministry of New and Renewable Energy
MSME	Micro, Small and Medium Enterprises
MU	Million Unit
MVA	Megavolt-amperes
MW	Megawatt
NCR	National Capital Region
NDC	Nationally Determined Contributions
NEP	National Electricity Plan
NEP	National Education Policy
NIWE	National Institute of Wind Energy
NSGM	National Smart Grid Mission
NSS	National Service Scheme
NTPC	National Thermal Power Corporation
NYP	National Youth Policy
OMS	Outage Management Systems
OSOWOG	One Sun One World One Grid
P2P	Peer-to-Peer
PFC	Power Finance Corporation
PHS	Pumped Hydro Storage
PJ	Petajoule
PLI	Production Linked Incentives
PM	Prime Minister
PMEGP	Prime Minister's Employment Generation Programme
POSOCO	Power System Operation Corporation Limited
PPA	Power Purchase Agreements
PPG	Project Preparation Grant
PSOD	Private Sector Operations Department
PSP	Pump Storage Plants
MoPSW	Ministry of Ports, Shipping, and Waterways
PV	Photovoltaic
RDSS	Revamped Distribution Sector Scheme
RE	Renewable Energy
REC	Renewable Energy Certificate

REI	Renewable Energy Integration
REIA	Renewable Energy Implementation Agencies
REMC	Regional Energy Management Centers
RES	Renewable Energy Sources
RGNIYD	Rajiv Gandhi National Institute of Youth Development
RPO	Renewable Purchase Obligation
RTC	Round The Clock
RYSK	Rashtriya Yuva Sashaktikaran Karyakram
SAGE	South Asia Group for Energy
SAREP	South Asia Regional Energy Partnership
SATAT	Sustainable alternative towards affordable transportation
SC	Scheduled Castes
SCADA	Supervisory control and data acquisition
SDC	Swiss Agency for Development and Cooperation
SDG	Sustainable Development Goal
SECI	(Solar Energy Corporation of India
SERC	State Electricity Regulatory Commissions
SHP	Small Hydro Power
SLDC	State Load Despatch Centers
SOE	State-Owned Enterprise
ST	Scheduled Tribes
STAR-C	Solar Technology Application Resource Centre
STEM	Science, Technology, Engineering, Mathematics
TA	Technical Assistance
TCF	Technical Cooperation Facility
TRANSCO	Transmission Company
UDAY	Ujjwal DISCOM Assurance Yojana
UK	United Kingdom
UMREPP	Ultra Mega Renewable Energy Power Parks
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
USD	United States dollar
VGF	Viability Gap Funding
InVITs	Infrastructure Investment Trusts
VPP	Virtual Power Plant
VRE	Variable Renewable Energy
WB	World Bank
YIAPL	Yamuna International Airport Private Limited

1 Proposal Summary

India's Renewable Energy Integration Investment Plan (REI IP), contained in this document, has been prepared by the Ministry of Finance (MoF), with support from Ministry of New and Renewable Energy. Substantial contributions were also made by the Ministry of Power (MoP), Niti Aayog, Central Electricity Authority (CEA). The Asian Development Bank (ADB), The World Bank and International Finance Corporation (IFC) provided extensive technical support throughout.

Project concepts/interventions are based on broader climate ambitions; list of key policy/schemes/plans etc. These documents contain prioritized lists and detailed descriptions of priority clean energy and climate investments and are the result of extensive analysis and consultation with a wide range of stakeholders.

1.1 Objectives

The objective of this Renewable Energy Integration (REI) Investment Plan (IP) for India is to seek both financial support and technical expertise for initiatives aimed at enhancing RE integration. This is to facilitate a seamless integration of a larger proportion of renewable energy sources. The strategy encompasses three primary facets: the deployment of Energy Storage Systems (ESS) to increase grid flexibility, the fortification of infrastructure to boost RE, and technical assistance across RE grid integration value chain. These initiatives are in alignment with India's ambitious goal to establish 500 GW of renewable energy by 2030, reflecting the nation's updated Nationally Determined Contributions (NDCs). These contributions include: (a) a 45 percent reduction in the emissions intensity of its GDP from 2005 levels, an increase from the initial 33-35 percent; (b) achieving over 50 percent of its cumulative electric power capacity from non-fossil fuel sources, up from the previous 40 percent; and (c) expanding carbon sinks by an additional 2.5-3 billion tons of CO₂-equivalent.

The strategies proposed under this REI IP are fully in sync with both India's climate action plans and the Climate Investment Funds (CIF) objectives for financing renewable energy integration efforts. The first intervention focuses on the strategic deployment of Energy Storage and renewable energy-enabling technologies to bolster grid flexibility and ensure a smoother integration of renewable sources. The second intervention involves the enhancement of grid infrastructure to improve both inter and intra-state transmission capabilities, specifically for renewable energy, thus elevating the overall grid reliability and resilience. This aspect could also include upgrading port infrastructure to support offshore wind projects. The third intervention will offer technical assistance to foster innovation in renewable energy technologies and the development of robust power markets, thereby encouraging green electricity adoption and creating an attractive investment climate for firm and dispatchable renewable energy investments. Emphasis will be placed on establishing smart grid infrastructure and improving weather and resource forecasting to optimize grid operations and maximize renewable energy use. The activities proposed will cover all the eligible areas of the REI program, thereby contributing to a comprehensive approach to renewable energy integration in India.

The \$70 million concessional funding from CIF plays a pivotal role in the initial phase of this initiative, representing the first coordinated effort by Multilateral Development Banks (MDBs) to address renewable energy integration (REI) challenges. This immediate intervention will catalyze the deployment of critical ESS infrastructure and grid strengthening projects but acknowledges that more work will need to follow. Given the scale of India's energy transition, the REI IP is only the starting point. Further initiatives beyond the REI IP's timeframe will be essential, necessitating additional concessional funding from CIF or other climate financing mechanisms to support the sustained integration of large-scale renewable energy. This longer-term approach will ensure continued progress toward achieving India's climate goals, enhancing the resilience of its power systems, and unlocking future investments in clean energy technologies.

1.2 Expected Outcomes

The financing and technical assistance interventions foreseen under this REI IP are expected to enhance renewable energy integration, facilitate the uptake of zero carbon electricity in India's electricity mix and attract private sector investment across RE integration value chain. The expected outcomes are:

- Increased renewable energy generation capacity by ~1500 MW, and an additional ~2800 Mus/year of renewable energy.
- Addition of energy storage capacity to the tune of ~1500 MWh catering to various applications supporting generation and distribution segments
- Enhancing distribution and transmission infrastructure by facilitating ~3700 ckm. of 33 kV distribution lines and ~580 ckm. of 400 kV DC transmission infrastructure to enhance RE integration.
- A consequent reduction in the volume of global (CO₂) emissions of ~3.2 MtCO₂/year.
- Improved policies and institutional capabilities, including advanced forecasting tools and successful third-party forecasting models for DISCOMs and REMCs; innovative methods for uptake of RE such as Contracts for Difference (CFD); introduction of new concepts like Virtual Power Plants (VPP), Blockchain-based P2P solar rooftop systems, and RE-based EV charging.
- US\$1100 million leveraged under the financing plan, supporting to the creation of ~13500 FTE green jobs, capacity building and training (upskilling) of women officials.
- Better electricity reliability, resulting from a more diverse portfolio of domestically available renewable fuels and enhanced energy storage and grid management technologies and techniques.
- Better resilience—especially of the transmission and distribution network—to climate-induced disasters and damage to infrastructure.

1.3 Program Criteria, Priorities, and Budgets

As noted above, India's REI IP is based on project concepts developed around three key focus areas- strategic deployment of energy storage systems, grid infrastructure strengthening and technical assistance. The focus areas are finalized after intensive consultations between concerned ministries, development organizations, grid operators, DISCOMs and think-tanks, as well as the CIF implementing MDBs. The proposed focus areas capture the immediate and near future needs of India's power system which is set to be dominated by green energy in near future.

- **Energy Storage Systems deployment:** The projects are aligned with one of the qualifying themes of CIF REI Programme- viz. Scaling up renewable energy enabling technologies. The following projects will provide flexibility to the grid by focusing on the strategic deployment of energy storage systems to support grid integration of variable RE: Enabling Round the Clock (RTC) Supply through Advanced Grid Management and Energy Storage at the State Level
- **Infrastructure Strengthening:** The following projects will strengthen infrastructure to provide greater grid reliability and resilience and are aligned with the 'Enhancing infrastructure to be renewable energy ready' qualifying theme of the CIF REI Programme and will support GoI initiatives such as Green Energy Corridor. Supporting grid strengthening in one or more RE rich states and Infrastructure (including port infrastructure) to support Offshore Wind Development Programme
- **Technical assistance** across RE grid integration value chain: These interventions is as a pivotal element of the CIF Renewable Energy Integration (REI) program, addressing a spectrum of regulatory, technical and capacity needs critical for enhancing the uptake of renewable energy (RE) across various stakeholder domains. This intervention is designed to navigate the complexities of integrating a substantial amount of RE capacity and is aligned with both selected themes of the CIF REI Programme, namely "Supporting renewable energy innovation" and "Enhancing system and market design and operation." The proposed intervention will focus on Advanced Forecasting Tools and Innovative Methods for Uptake of RE, each of which are key gaps in the current RE market and integration context.

India is requesting \$70 million in financing from CIF of which only \$5 million would be requested as technical assistance including project preparation grants and capacity building. The proposed projects expected to mobilize nearly \$ USD 1100 million will be funded by the ADB, World Bank and the IFC, including funding mobilized through development partners and the private sector. The following table shows the amounts estimated for each of the interventions described above.

Table 1: Indicative Financing Plan (\$ million)

Financing Source	CIF				Others				Total
Program	CIF Financing	CIF Guarantee	Project Preparation (Grant)/ TA	Total CIF	ADB	World Bank	IFC	Private Sector	
(US\$ Million)									
Power System Strengthening Project	23	0	2 ¹	25	200			200	425
Integrated RE Solutions Providing RTC Supply for C&I Consumers	10	0	0	10	100*			100	210
Supporting Grid Strengthening in One or More RE Rich States	23	0	2	25		200		200	425
Offshore Wind Development Program									
IFC (sand-alone BESS)	9	0	1	10			45	20	210
Total	65	0	5	70	300	200	45	520	1135

¹ for capacity building, project management, and regulatory support

2 Country Context

2.1 Introduction

India's journey over the past two decades has been marked by significant strides towards economic stability, poverty reduction, and an increasing focus on sustainable development. The nation has successfully halved the rate of extreme poverty from 22.5% in 2011 to 12.7% in 2019², a testament to its concerted efforts in enhancing the well-being of its population. Despite the setback caused by the pandemic in 2020, which saw a rise in extreme poverty by two percentage points, India's swift action through broad vaccine distribution and government mitigation strategies enabled a notable recovery, bringing the extreme poverty rate down to an estimated 11.9% in FY 2021/22². This resilience in the face of adversity is further highlighted by the significant reduction in multidimensional poverty, from 27.7% in 2015/16 to 16.4% in 2019/21³, alongside stable consumption inequality with a Gini index of around 35³. These achievements, coupled with improvements in child malnutrition and employment indicators, underline India's commitment to fostering inclusive growth and setting a foundation for sustainable energy initiatives as part of its broader economic reforms.

India's economic landscape, characterized by a robust ~7% GDP growth rate in 2022-23⁴, showcases the pivotal role of the service, industrial, and agricultural sectors in driving its economic engine. The service sector, making up nearly half of the GDP, alongside significant contributions from the industrial and agricultural sectors, underscores the diverse nature of India's economy. With the industrial sector accounting for 41% of electricity consumption and agriculture consuming 18%⁵, the critical importance of the energy sector in supporting sustainable economic growth is evident. In response, India has embarked on a series of ambitious economic reforms aimed at improving competitiveness, attracting foreign investment, and enhancing the ease of doing business. These reforms, which include raising the limit for FDI across various sectors and focusing on infrastructure development, are intricately linked to India's energy security and attracting investments in renewable energy sector, aligning economic growth with environmental sustainability.

Looking ahead, India is poised to remain the fastest-growing large economy, with forecasts predicting a GDP growth rate between 6.3-7.3% in FY23/24⁴. This growth is supported by a strong investment push expected to crowd in private investment, buoyed by healthy corporate profits, easing inflation, and strong macroeconomic fundamentals. The government's commitment to narrowing the fiscal deficit to 8.7% in FY23/24⁶ and stabilizing the debt-to-GDP ratio underscores the strategic management of public finances, further contributing to a favorable external position marked by growing services exports and substantial foreign exchange reserves exceeding USD 600 billion⁴. These macroeconomic indicators, coupled with India's demographic advantage and strategic reforms, present a compelling case for enhancing renewable energy into its development paradigm. The emphasis on renewable energy not only addresses the critical need for energy security but also aligns with India's goals for sustainable growth, environmental conservation, and enhanced global competitiveness, positioning India as a leader in the transition towards a more sustainable and resilient future.

2.2 Current State of Energy Generation & Transmission and Distribution Systems

India, with its burgeoning economy and vast population, stands at a critical juncture in its holistic energy transition journey. As the nation is preparing to meet its pressing need to cater to its growing energy demands, the structure and composition of its energy mix are poised to change with an increasing share of RE. With a reliance on fossil fuels, the current state of India's energy generation, transmission, and distribution systems presents both challenges and opportunities for integrating renewable energy at a scale necessary to meet future demands sustainably.

India's total energy consumption was 35,159 Petajoule (PJ) in 2022-23⁸. Coal accounts for 54.2 percent of India's primary energy mix, along with oil 28.2 percent, gas 6.7 percent, nuclear 1.3 percent, hydro 4.5 percent, and renewable

² World Bank. Macro Poverty Outlook (MPO). October 2023

³ World Bank. Poverty and Equity Brief. Fall 2023 Edition

⁴ Reserve Bank of India

⁵ Energy Statistics India 2024

⁶ India: 2022 Article IV Consultation-Press Release; Staff Report; and Statement by the Executive Director for India

energy only 4.5 percent⁷. India imported substantial 42% of its total primary energy requirement in 2020-21⁸. It is noteworthy that in the same year, India's electricity import was a negligible 0.6%⁸, indicating a potential area for growth in domestic electricity generation to enhance energy security and reduce reliance on imports.

India's per capita power consumption at 1,255 kWh is well-below the global average and demand for electricity is expected to grow by ~55% in the coming decade⁹. The industrial sector, being the largest consumer of electricity, underscores the critical need for robust and efficient transmission and distribution systems. However, the current electricity infrastructure will face constraints, especially in light of the increasing shares of renewable energy into the grid. Enhancing the grid's capacity to integrate renewable energy sources effectively is paramount to addressing these challenges along with the escalating demand.

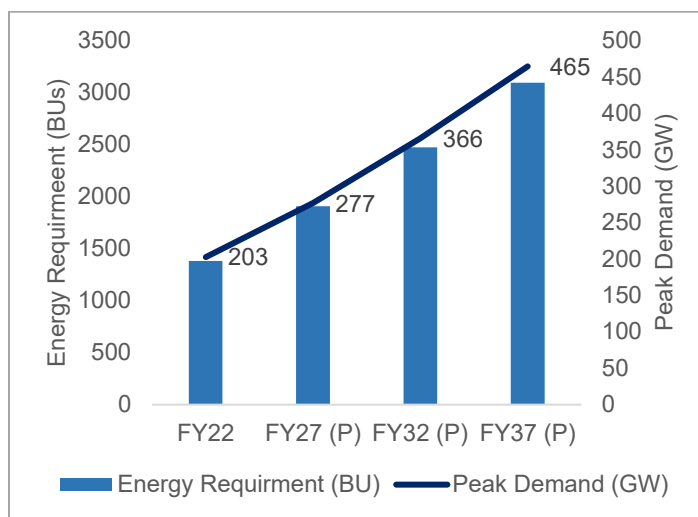


Figure 1: India's Electricity Demand Projections (Source: CEA)

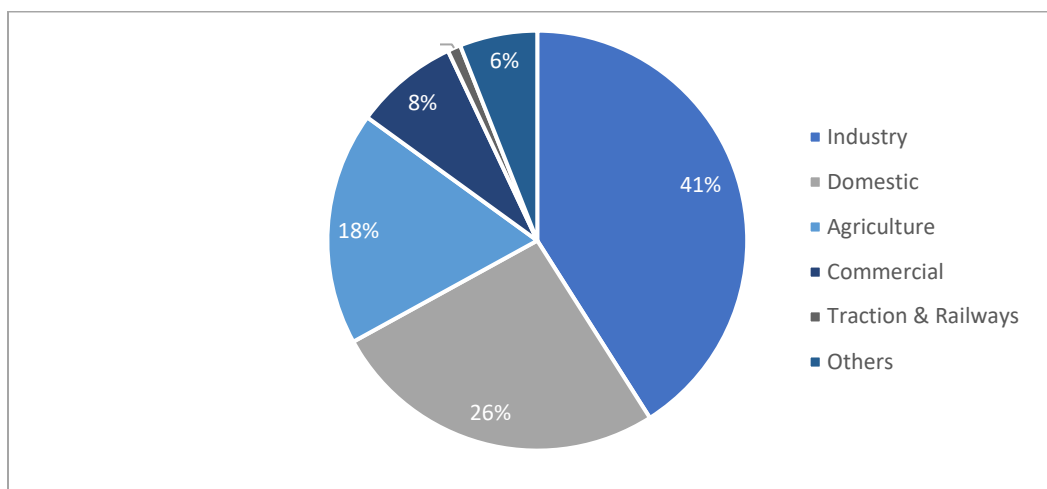


Figure 2: Consumption of Electricity by Sectors in India during FY23

The **generation segment** of the Indian power sector has shown significant diversification with a blend of conventional (thermal, hydro, and nuclear) and non-conventional (renewable energy sources) means. Over the years, there has been a notable shift towards renewable energy sources, increasing their share of installed generation capacity from 8.9% in

⁷ BP statistical survey

⁸ [Energy Statistics India 2023](#)

⁹ Report on twentieth electric power survey of India, CEA

2008-09 to ~40% in 2022-23. This shift has contributed to the Compound Annual Growth Rate (CAGR) of total installed electricity generation capacity at about 7.7%, with renewable energy sources (RES) growing at a remarkable rate of 17.4%. The liberalization of the generation process by the Electricity Act of 2003 encouraged more private participation, significantly enhancing the sector's competitiveness and efficiency.

As on September 2024, India had an overall installed power generating capacity of 417 GW, comprising 52.3 percent coal, 6.2 percent natural gas, ~40 percent renewables and 1.7 percent nuclear.¹⁰ The RE installed capacity in the country was 178.98 GW (including 46.85 GW large hydro).¹¹ As per the CEA estimates, the installed power generation capacity is poised to reach 899 GW and 1466 GW by the end of FY32 and FY40 respectively.

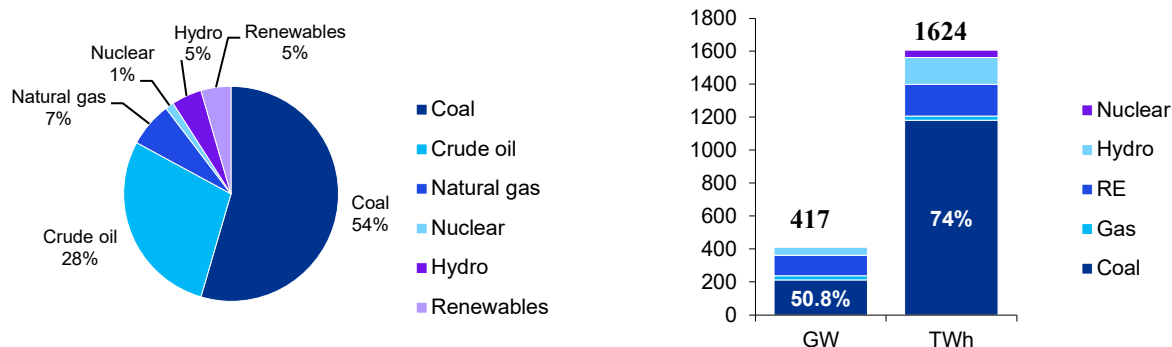


Figure 3: India's Primary Energy and Power Generation Mix Source: BP Statistical Survey and Central Electricity Authority

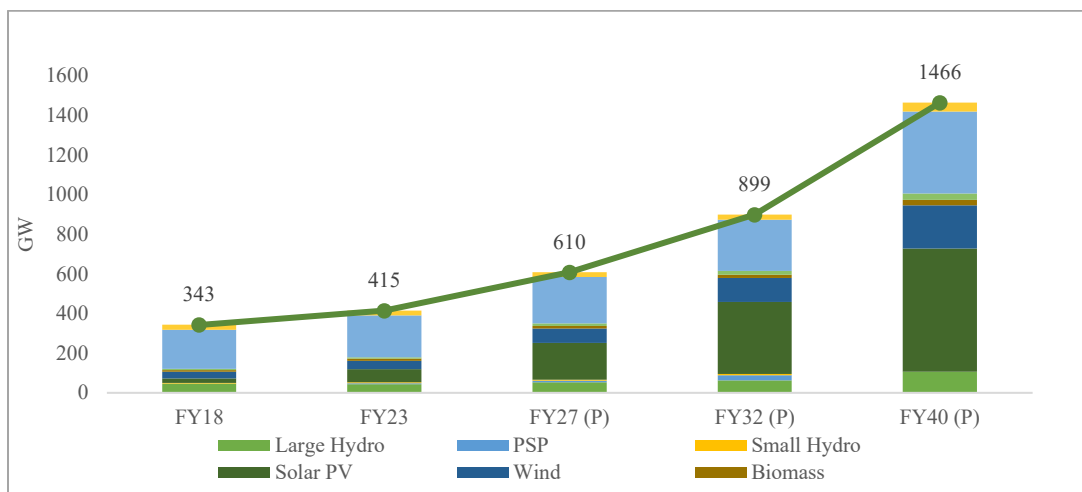


Figure 4: Installed Generation Capacity Projections (Source: NEP 2023, IEA India Energy Outlook)

The expansion of the transmission sector plays a crucial role in supporting India's growing electricity demand and the integration of renewable energy sources. From 2008-09 to 2022-23, the transmission line network experienced a comprehensive extension from 2.21 lakh circuit kilometers (ckm) to 4.71 lakh ckm, and the transformation capacity of substations escalated from 2.89 lakh MVA to 11.80 lakh MVA.¹² This growth facilitated an enhanced CAGR of

¹⁰ <https://powermin.gov.in/en/content/power-sector-glance-all-india>

¹¹ https://cea.nic.in/wp-content/uploads/psp_a_i/2024/01/Draft_NEP_Vol_II.pdf, Chapter 10

¹² One lakh is equivalent to 100,000.

5.6% in transmission lines and an impressive 10.6% in substation capacity, ensuring the robustness and reliability of India's power transmission network. Moreover, the introduction of Open Access has democratized the transmission sector, allowing a multitude of players, including generators and large consumers, to access the transmission network on a non-discriminatory basis, thus fostering competition and efficiency within the sector. This strategic expansion and regulatory foresight have been instrumental in meeting the burgeoning electricity demand while accommodating the surge in renewable energy generation.

The **distribution sector**, the final leg of the electricity supply chain, has seen a focused intervention to address its operational and financial challenges. Recognizing the critical role of distribution in ensuring universal access to reliable electricity, the government has launched several initiatives aimed at revitalizing this segment. Among these, the UDAY scheme sought to improve the operational efficiencies and financial health of DISCOMs, resulting in a decrease in AT&C losses and narrowing the ACS-ARR gap. Despite these efforts, the sector continues to face challenges, highlighted by the all-India average AT&C losses standing at approximately 16.42% in 2021-22.¹³ To further address these issues, the Revamped Distribution Sector Scheme (RDSS) was introduced, targeting a reduction in AT&C losses to 12-15% by 2024-25 and aiming for zero ACS-ARR gap, marking a significant push towards enhancing the quality, reliability, and affordability of power supply to consumers. These concerted efforts signify a strategic overhaul of the distribution sector, emphasizing efficiency, financial sustainability, and improved consumer experience.

The Electricity Act of 2003 is the key governing act of Indian power sector. The Act, which came into force on 15 June 2003, has the objective to introduce competition, protect consumer's interests and provide power for all. The Act provides for National Electricity Policy, Rural Electrification, Open access in transmission, phased open access in distribution, mandatory State Electricity Regulatory Commissions (SERCs), license free generation and distribution, power trading, mandatory metering and stringent penalties for theft of electricity. The National Electricity Policy aims at laying guidelines for accelerated development of the power sector, providing supply of electricity to all areas and protecting interests of consumers and other stakeholders keeping in view the availability of energy resources, the technology available to exploit these resources, the economics of generation using different resources, as well as overall energy security issues. Right from unbundling and privatization(s) of generation, transmission, and distribution segments to Revamped Distribution Sector Scheme, India's power sector is shaped by multiple waves successive reforms. Renewable Purchase Obligation (RPO), Net Metering Policy, Green Tariff Policy, Green Hydrogen Mission are some of the key policies in RE sector of India.

2.3 National and International Climate Strategies and Plans

India is among the countries most vulnerable to climate change, facing some of the highest disaster risk levels in the world, ranked 29 out of 191 countries by the 2024 Inform Risk Index.¹⁴ More than 80 percent of India's population lives in districts highly vulnerable to extreme hydro-met (floods, droughts, cyclones) disasters.¹⁵ Climate induced disasters combined with resource stress will impact India's goals of providing reliable electricity and transport to its citizens. More than 60 per cent of the country's agriculture is rainfed, leaving its poorest people, especially women, vulnerable to food insecurity and malnutrition. India is not only vulnerable to extreme heatwaves like the recent one experienced in 2022, but to a range of other climate impacts on "agriculture, water resources, Himalayan region, coastal regions, health and disaster management".¹⁶ This extreme climate vulnerability, along with the public's concerns about air pollution, has prompted the country to respond holistically to the challenge of climate change by demonstrating leadership both internationally and domestically by promoting low-carbon growth and reducing its overall emissions intensity, as well as adopting adaptation measures to enhance India's climate resilience.

Following its COP-26 announcement of Net Zero emissions by 2070, the GoI released both an updated NDC as well as shared its Long-term Strategy for Low Carbon Development (LTLCDS or LTS) with the UNFCCC. India's climate change-related goals over both the long-term (2070) and the short-term (2030) are intended to be in line with its overall commitments to economic development, equity, and welfare. The updated NDC by 2030 includes:

¹³ <https://www.pib.gov.in/Pressreleaseshare.aspx?PRID=1985549>

¹⁴ <https://reliefweb.int/sites/reliefweb.int/files/resources/Inform%202019%20WEB%20spreads.pdf>

¹⁵ <https://www.ceew.in/publications/mapping-climate-change-vulnerability-index-of-india-a-district-level-assessment>

¹⁶ [%20First%20Nationally%20Determined%20Contrib.pdf](#)

(a) reducing emissions intensity of its GDP by 45 percent from 2005 levels (up from 33-35 per cent in the initial NDC); (b) achieving 50 percent cumulative electric power installed capacity from non-fossil fuel-based energy resources (up from the previous 40 per cent); and (c) enhancing carbon sinks by an additional 2.5-3 billion tons of CO₂-equivalent. India's short-term NDC milestones are intended to provide a clear signal of the country's future climate mitigation objectives related to catalyzing a clean energy transition and ushering in low emission growth pathways with sufficient lead-time for the relevant sectors and the capital markets to respond by shifting investments toward the lower emitting and innovative technologies required to achieve India's long-term Net Zero ambition.

The LTS shared that India's achievement of its long-term objectives rested on "seven key transitions to low-carbon pathways" that "were comprehensive and covered the entire economy."¹⁷ Anchored on eradicating India's development deficits and maintaining energy security, the LTS identified the electricity sector as the first of these seven transitions because of its importance for "enabling industrial expansion, enhanced employment and incomes, and achievement of Aatmanirbhar Bharat where low carbon options were to be "assessed in the context of inclusive growth and expansion needed in the sector". The LTS recognizes that India's long-term transition would be "evolutionary and flexible, accommodating new developments in technology, the global economy and international cooperation". It notes that it is "based upon an economy-wide multiple objectives approach, including integrating dimensions of gender equity and inclusion of marginalised and vulnerable groups, that consciously seeks to move to a low-carbon path of development."¹⁸

The Government has launched a series of actions and initiatives, including several national "missions" to help achieve its NDC climate change objectives. India is implementing an extensive range of domestic climate mitigation actions, including putting into place the *National Solar Mission*, along with other national missions such as the National Green Hydrogen Mission, and other relevant national missions on Energy Efficiency and on *Battery Storage & Transformative E-mobility and*, among others. In addition, India has also demonstrated its global climate leadership in several ways, including by launching the *International Solar Alliance* (ISA) initiative and through its active involvement and commitment to the multilateral climate change process. In October 2022, India's Prime Minister along with United Nations Secretary General Antonio Guterres launched "Mission Life", a flagship initiative to motivate every individual to adopt a more sustainable lifestyle.

India has made noteworthy progress on implementing its climate agenda, including through increasing the share of energy production from renewables and by improving energy efficiency. India has been rapidly scaling up renewable energy to meet the expected growth in electricity demand over the coming years, with some projections that electricity demand growth is not likely to peak until around 2030-2035.¹⁹ From a low base, modern renewables are the fastest growing source of domestic primary energy production driven, in part, by state renewable purchase obligations which mandate minimum purchase levels of wind power, large hydro power, and energy storage. The structural orientation of India's economy towards the services sector has also long been an important driver of economic growth and improvement in energy efficiency, resulting in a steady decline in the carbon intensity of India's electricity grid to 710 g CO₂/kWh, with future declines expected.²⁰

Accelerating this transformation to more affordable, efficient, and sustainable energy generation will help stimulate overall economic growth and competitiveness, including providing a boost to India's emerging green economy and exports. The National Solar Mission includes production-linked-incentive (PLI) schemes for domestic production of batteries and solar panels which aims to bring down the cost of solar energy. India is targeting improved energy efficiency through the sale of LEDs, compulsory audits for energy intensive firms, and improved consumer information about appliance energy efficiency. Households are gradually replacing traditional cooking biofuels with clean fuels.. Incentives for the development of local green manufacturing and service industries create green jobs and help maintain national resilience and safeguard supply chains, including those for critical minerals that are important for RE and battery storage. Initiatives such as "Make in India" to make the country a global hub for design and manufacturing will, in turn, benefit from cleaner, more efficient, and affordable energy. Fiscal incentives have been used in the transport sector to encourage the production and sale of electric vehicles (EVs). India's National Green

¹⁷ https://unfccc.int/sites/default/files/resource/India_LTLEDS.pdf

¹⁸ <https://moef.gov.in/wp-content/uploads/2022/11/Indias-LT-LEDS-2.pdf> (pp. 20)

¹⁹ <https://pib.gov.in/Pressreleaseshare.aspx?PRID=1885381>

²⁰ [Approved_report_emission_2021_22.pdf](https://ceacnic.in/Approved_report_emission_2021_22.pdf) (ceacnic.in)