

Indian Power Sector Landscape: Present and Future

Navigating the NZE Challenge

February 06th, 2024

Flow of the Presentation

Transition to Renewables Power is the Cornerstone of India's Power Policy

01

**Present Power -
Utilities
Landscape**

03

**Transition to Future
keeping NZE
challenges**

05

**SWOT &
Summary**

02

**Present Power - Non
Utilities Landscape**

04

**Funding &
Investment**

Current Power (Utilities) Landscape - Total Installed Capacity 425 GW

Region-wise:

- The Western Region has the highest installed power capacity, followed by the Southern Region and the Northern Region.
- Eastern Region lacks despite being having coal mines due to less development

Mode-wise:

- Thermal power (coal, lignite, gas, and diesel) is the dominant mode of electricity generation in India, accounting for over 56% of the total installed capacity.
- Renewables (hydro and RES) account for about 43% of the total installed capacity. Remaining - Nuclear

Source-wise:

- Coal is the dominant source of power generation in India, accounting for over 48% of the total installed capacity.
- Renewables (hydro, solar, wind, and biomass) account for about 42% of the total installed capacity having Solar 40%, Wind 25%, Hydro 26% and remaining biomass & small Hydro in total RE.
- Gas, diesel, and nuclear power account for the remaining share.

India's current power landscape - region-wise, mode-wise, source-wise and breakup of renewables

Installed Power Regionwise/Source in MW as on Oct 31, 2023

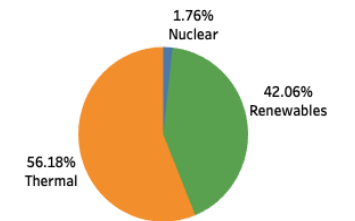
Data Source: Ministry of Power, CEA Graph by MKA

Region	Source							Grand Total
	Coal	RES (W+S)	Hydro	Gas	Nuclear	Lignite	Diesel	
Western Region	74,513	42,755	7,563	10,806	2,540	1,400	0	139,577
Southern Region	47,578	52,326	11,827	6,492	3,320	3,640	434	125,617
Northern Region	55,517	34,540	20,752	5,995	1,620	1,580	0	120,004
Eastern Region	28,448	1,896	4,764	80	0	0	0	35,188
North Eastern ..	770	574	1,944	1,665	0	0	36	4,989
Island	0	40	0	0	0	0	120	159
Grand Total	206,826	132,132	46,850	25,038	7,480	6,620	589	425,536

Installed Power Capacity by mode as on Oct 31, 2023

Data Source : CEA, Ministry of Power, Graph by MKA

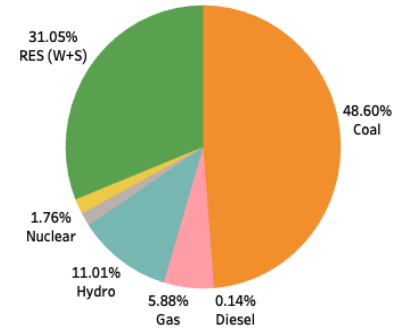
Thermal - Coal, Lignite, Gas & Diesel, Renewables - Renewables - Hydro & RES (Solar, Wind, small Hydro & Bio Mass)



Installed Power Capacity by source as on Oct 31, 2023

Data Source : CEA, Ministry of Power, Graph by MKA

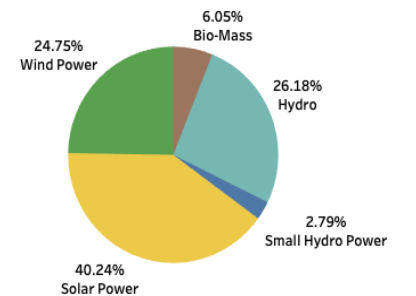
Thermal - Coal, Lignite, Gas & Diesel, Renewables - Hydro & RES (Solar, Wind, small Hydro & Bio Mass)



Renewables distribution by source as on Oct 31, 2023

Data Source - CEA, Ministry of Power, Graph by MKA

RES (W+S) - Small Hydro (<25MW), Solar, Wind & Bio Mass



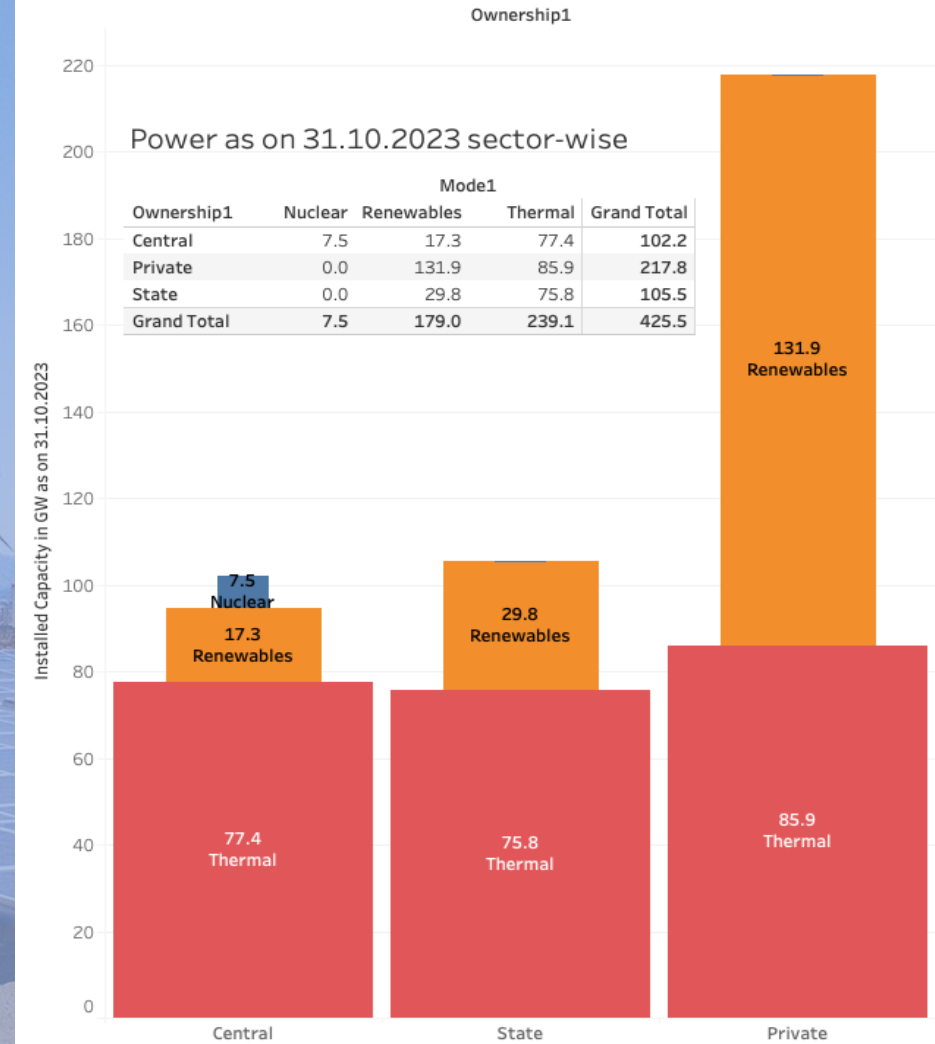
Current Power (Utilities) Landscape - Total Installed Capacity 425 GW

Ownership wise:

- Private sector has the largest share with 218 GW having 132 GW of Renewables and 86 GW of thermal
- State govt. has the share of 105 GW having 30 GW of Renewables and 76 GW of thermal
- Central govt. has the share of 102 GW having 17 GW of Renewables and 77 GW of thermal
- Nuclear is developed by the central govt only with 7.5 GW capacity

Installed Power as on 31.10.2023 in GW, ownership wise

Data Source : Ministry of Power, CEA; Graph by MKA



Current Power (Utilities) Landscape - Total Installed Capacity 425 GW

Power Generation:

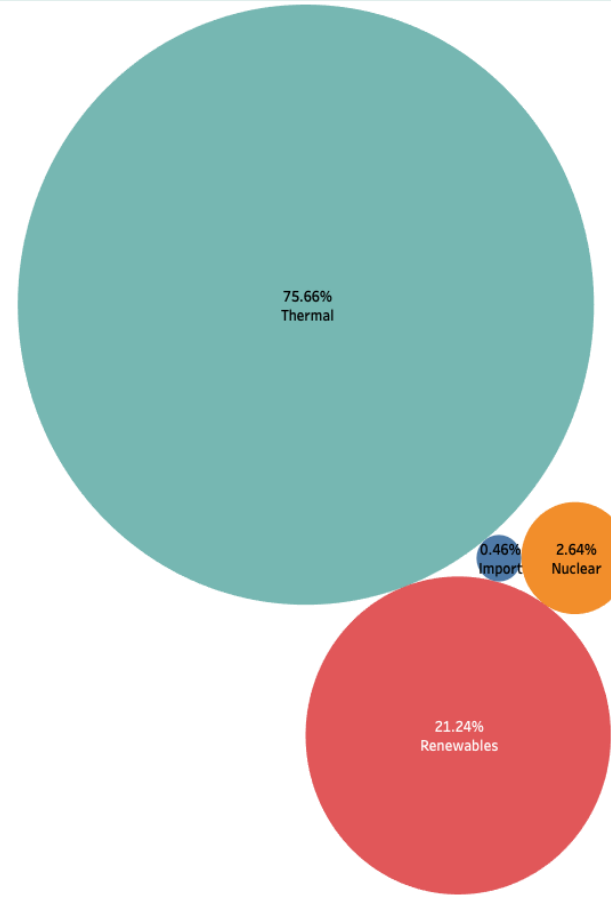
- Power Generation in the current financial year ie 2024 is expected to be 1750 BU (TWh) with thermal power share at 76% is far higher than the Renewable power of 21% and Nuclear at 3%.
- It includes a small power import of 8 BU (TWh) from Bhutan

Power Companies Eco-system:

- 187 companies steering the power generation with 113 companies in private sector, 66 in govt sector and 8 in mix holdings
- Transmission is with 27 Govt companies
- Distribution is by govt & private both with 57 and 27 companies respectively
- Total Transmission lines are over 6 million Ckt Kms.

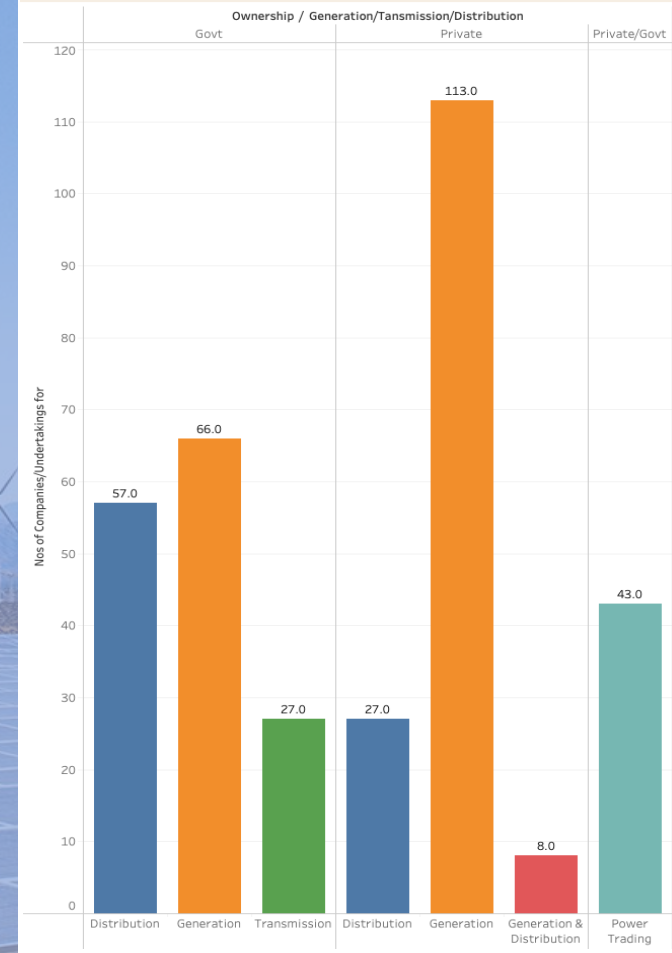
Electricity Generation in 2024- Total 1750 BU distribution by thermal, Renewables & Nuclear in %

Data Source : CEA, Ministry of Power Reports, Graph by MKA



Companies engaged in the sector for Gen/Trans/Distribution

Data Source : CEA, MoP, Graph by MKA



Current Power (Non Utilities) Landscape - Total Installed Capacity 77 GW

Captive Power:

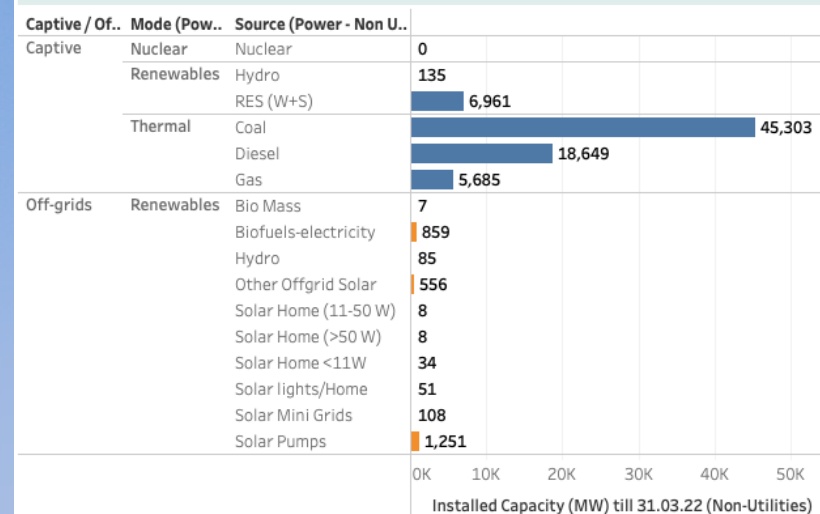
- As of 2023, India's captive power capacity at 76.7 GW and constitutes by thermal power 90% and remaining with Renewable power
- Captive power generation presently is 209 BU and this is also planned to reach to 369 BU (TWh) in 2026-27 and whopping 601 BU by 2031-32.

Off-grid Power:

- As per IRENA, off-grid installed capacity in India is ~30GW the break-up as per the relevant slide.
- Captive power generation presently is 209 BU (TWh) and this is also planned to reach to 369 BU (TWh) in 2026-27 and whopping 601 BU (TWh) by 2031-32.

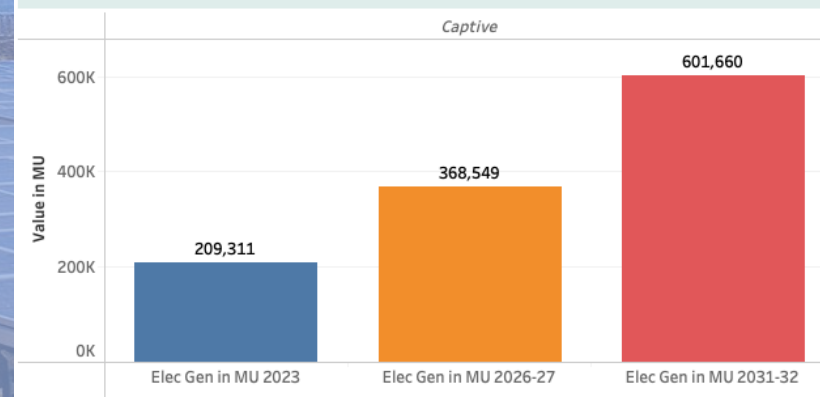
Non-Utilities (Captive) & Off-grid Power in MW 2023

Data Source : Ministry of Power, IRENA; Graph by MKA



Captive Power forecast till 2031-32 in MU

Data Source : CEA, Ministry of Power; Graph by MKA



Transition to the Future - Installed Cap 900 GW by 2031-32

NZE Challenges:

- By 2070, Net Zero Emissions
- BY 2030, GHG emissions are limited to 4.6 GtCO₂e from present 2.8 GtCO₂e
- Reduction of its GDP intensity of its GDP by 35% by 2030 from 2005 level
- 40% power from non-fossil fuels by 2030
- India would require 30-50 GW of annual Renewables to achieve the target
- Govt of India providing incentives through Production linked scheme, coal gasification, Green Hydrogen & battery manufacturing to promote Renewables and less CO₂ emissions

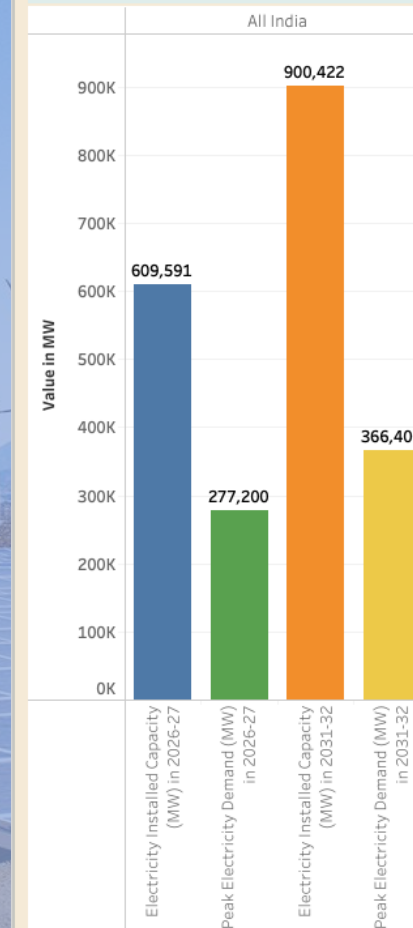
Installed Power Landscape:

- By 2026-27, total installed capacity will be increased to 609 GW from present 425 GW and then to 900 GW in 2031-32.
- Total Power generation will be increased from present level to 1907 BU (TWh) by 2026-27 and by 2500 BU (TWh) by 2031-32.
- Expansion to Renewable will be the cornerstone of Indian Power plans to meet the above NZE targets

Forecasted Power Installed and Generation Capacity

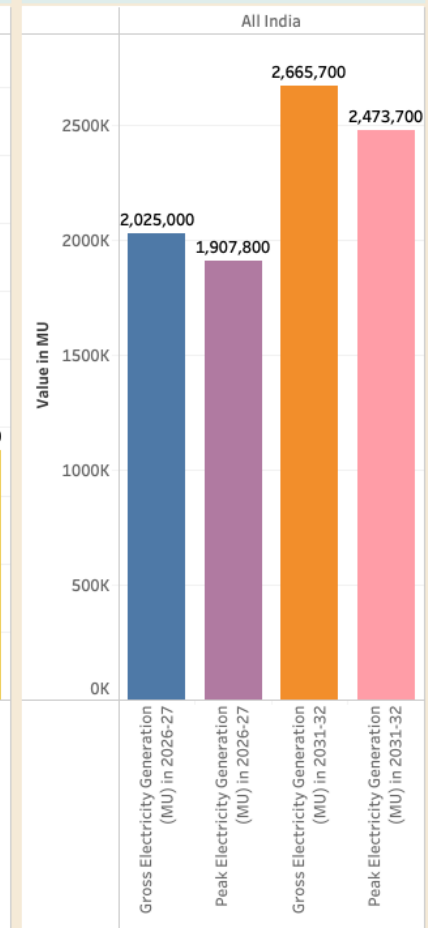
Planned Gross/Peak Installed Capacity in MW

Data Source: NEP, CEA, Ministry of Power, Graph by MKA



Planned Gross/Peak Power Generation Capacity in MU

Data Source: NEP, CEA, Ministry of Power, Graph by MKA



Transition to the Future - Installed Cap 900 GW by 2031-32

NZE Challenges:

- By 2070, Net Zero Emissions
- BY 2030, GHG emissions are limited to 4.6 GtCO₂e from present 2.8 GtCO₂e
- Reduction of its GDP intensity of its GDP by 35% by 2030 from 2005 level
- 40% power from non-fossil fuels by 2030
- India would require 30-50 GW of annual Renewables to achieve the target
- Govt of India providing incentives through Production linked scheme, coal gasification, Green Hydrogen & battery manufacturing to promote Renewables and less CO₂ emissions

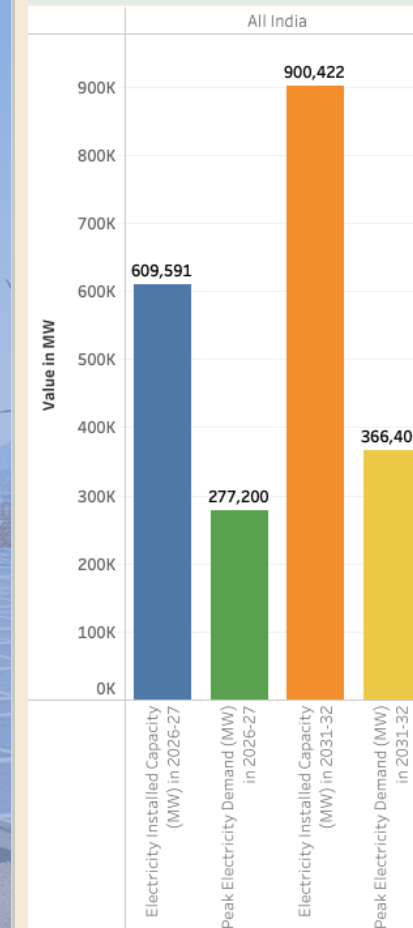
Installed Power Landscape:

- By 2026-27, total installed capacity will be increased to 609 GW from present 425 GW and then to 900 GW in 2031-32.
- Total Power generation will be increased from present level to 1907 BU (TWh) by 2026-27 and by 2500 BU (TWh) by 2031-32.
- Expansion to Renewable will be the cornerstone of Indian Power plans to meet the above NZE targets

Forecasted Power Installed and Generation Capacity

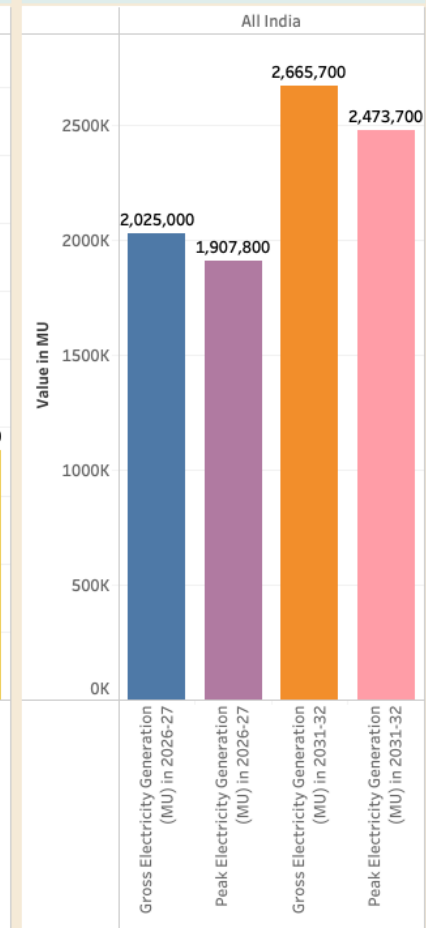
Planned Gross/Peak Installed Capacity in MW

Data Source: NEP, CEA, Ministry of Power, Graph by MKA



Planned Gross/Peak Power Generation Capacity in MU

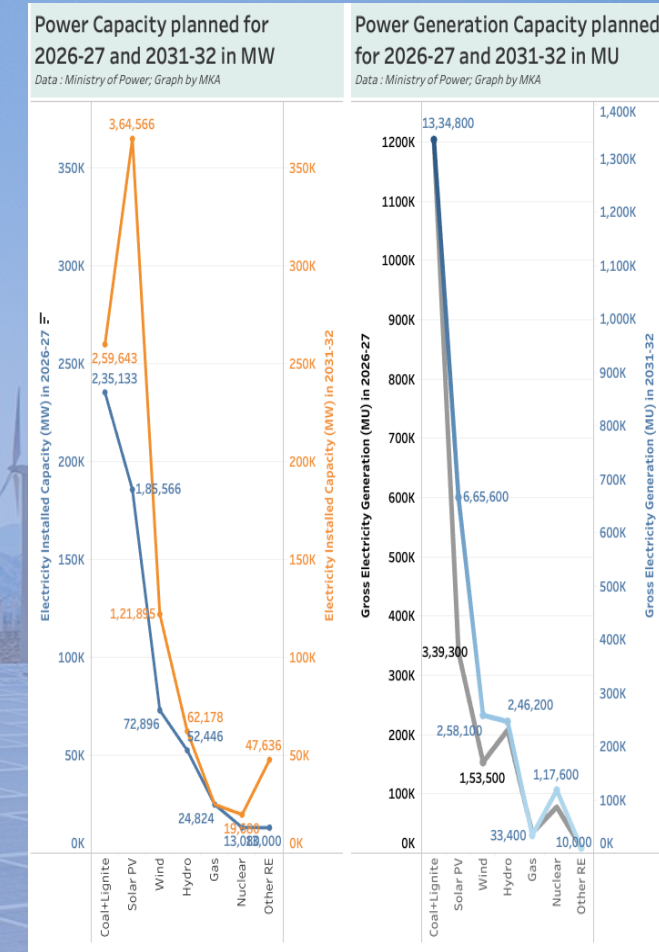
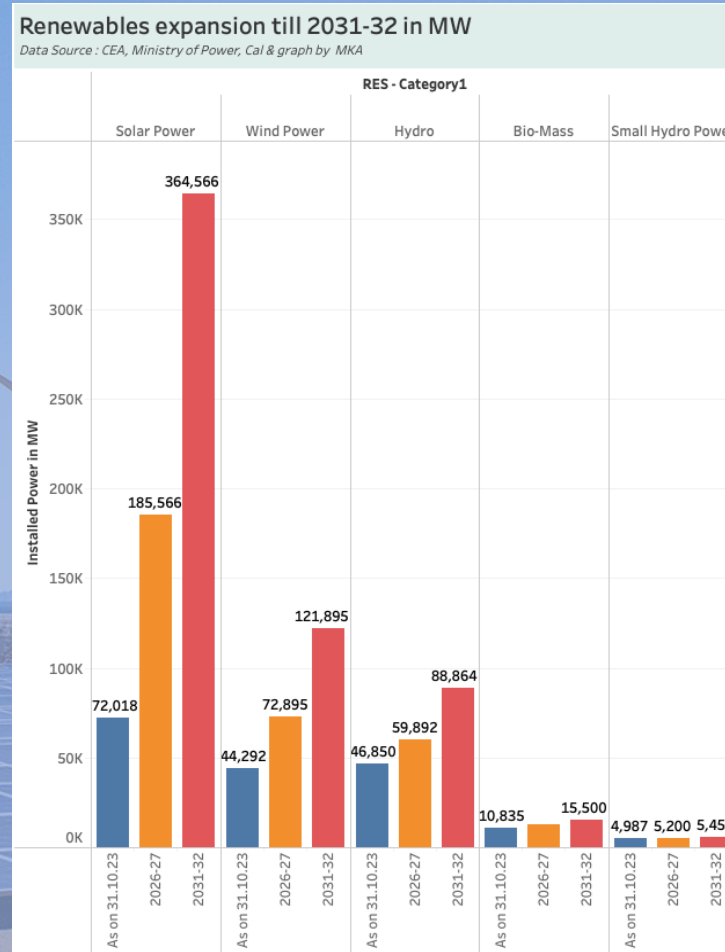
Data Source: NEP, CEA, Ministry of Power, Graph by MKA



Transition to the Future - Installed Cap 900 GW by 2031-32

- Transition to Renewables

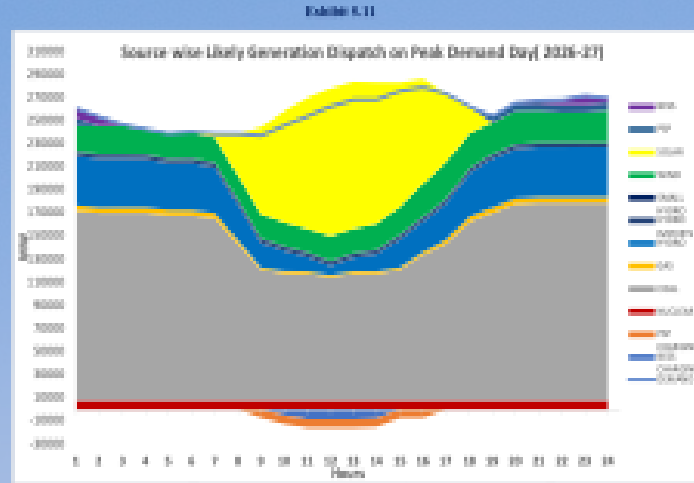
- Renewable Power (ie Solar, Wind, Hydro, Small Hydro and Bio-Mass) will be increased from present level of 178 GW to 336 GW by 2026-27 and 596 GW by 2031-32.
- Solar Power share in the renewable power shall be 185 GW by 2026-27 and 365 GW by 2031-32 from the present level of 72 GW.
- Wind power will be 73 GW by 2026-27 and 122 GW by 2031-32 from the present level of 44 GW.
- Hydro will be increased to 60 GW by 2026-27 and 89 GW by 2031-32 from the present level of 46 GW. In support to achieve NZE targets, Coal & lignite based power plant will have a marginal increase from 235 GW in 2026-27 to 259 GW in 2031-32.
- The gross power generation pie chat will still be dominated by Thermal 61% (59% coal + 2% Gas) in 2026-27 and decreasing to 51% (50% coal + 1% Gas) in 2031-32
- Renewable power share will reach
- Renewable Power Gen - from present 21% to 35% in 2026-27 and 44% in 2031-32.. In the Renewable Power, share of Solar will be 17% in 2026-27 and 25% in 2031-32 and Wind aiming to be 8% in 2026-27 and 10% in 2031-32.
- Coal based Power decommissions post 2035..



Transition to the Future - Renewables Maximization Limit and coal Power reduction

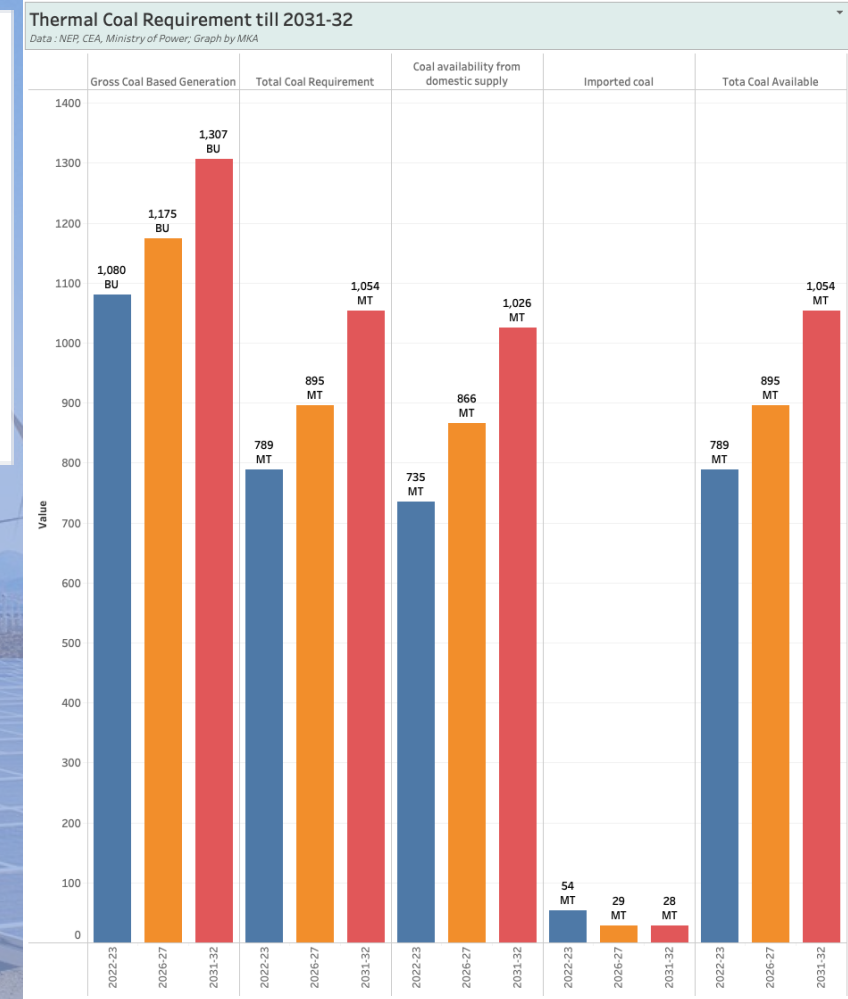
Maximum RE Generation

- As per CEA, about 1% of RE based generation may not be absorbed during the year 2026-27 while around 3.3 % of the RE based generation may not be absorbed during 2031-32
- Considering 40% minimum technical load the RE based generation not absorbed will decrease to 0.09% and 1.29% in FY 2026-27 and 2031-32 respectively.



Thermal (Coal) Power Reduction

- The domestic coal requirement has been estimated to be 866.4 Million Tonnes for the year 2026-27 and 1025.8 Million Tonnes for the year 2031-32 and estimated requirement of 28.9 MT of coal imports for the plants' designed to run on imported coal.
- The average PLF of the total installed coal capacity of 235 GW was found to be about 58.4% with ~1200 BU (TWh) in 2026-27 and install cap of 259 GW, PLF of about 58.7% with 1334 BU (TWh) in 2031-32.
- The average emission factor is expected to reduce to 0.548 kg CO₂/kWh in 2026-27 and to 0.43 kg CO₂/kWh by the end of 2031-32.



Transition to the Future - Funding & Investments

Investments

- Indian Power sector has planned the total investment in debt : equity ratio of 3:1 or 25% equity with 75% debt level. India Power sector needs the total investment of US\$ 175 Billion till year 2026-27 and additional US\$ 230 Billion to meet the target of year 2031-32.
- Solar has the largest investment ie US\$ 82 Billion by 2026-27 & then additional of US\$ 96 Billion to meet 2031-32 targets
- Wind will follow Solar with US\$ 28 Billion in 2026-27 and another US\$ 40 Billion by 2031-32
- Thermal Power will be on decline trajectory from US\$ 26 Billion to US\$ 22 Billion with the phasing out mode from 2035 onwards
- One Notable investment will be in the Battery storage with US\$ 35 Billion as it is expected that the battery storage cost by then will come down
- Nuclear is expected to be on a declining trajectory which arguably should be on incline
- Pump Storage Hydro (PSP) will see investment going forward to US\$ 9 Billion by 2031-32
- Off-shore wind will also see investments in year 2031-32 for US\$ 3 billion

Funds Requirements till 2031-32

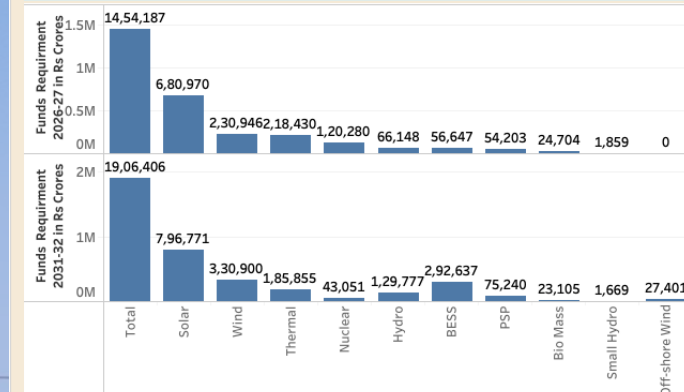
Data: NEP, CEA; MoP; Graph by MKA

Source (Fund Requirments)	2026-27 in Rs Crores	2026-27 in USD Million	2031-32 in Rs Crores	2031-32 in USD Million
BESS	56,647	6,816	292,637	35,211
Bio Mass	24,704	2,972	23,105	2,780
Hydro	66,148	7,959	129,777	15,615
Nuclear	120,280	14,472	43,051	5,180
Off-shore Wind	0	0	27,401	3,297
PSP	54,203	6,522	75,240	9,053
Small Hydro	1,859	224	1,669	201
Solar	680,970	81,936	796,771	95,869
Thermal	218,430	26,282	185,855	22,363
Wind	230,946	27,788	330,900	39,815
Grand Total	1,454,187	174,971	1,906,406	229,383

Investment Required to meet the forecasted Power Demand

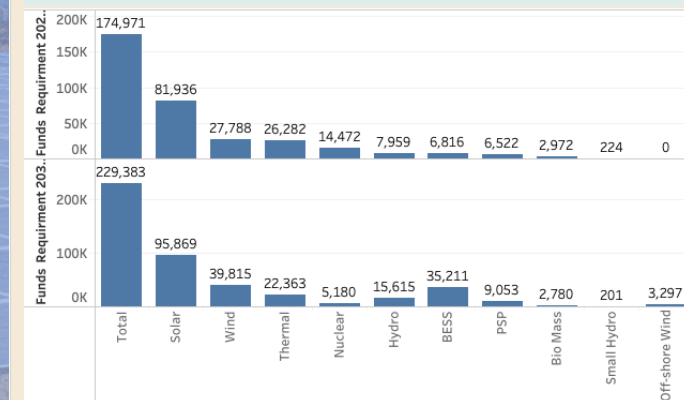
Investment Required to Meet the Power Expansion in Rs Crores

Data: CEA, Graph by MKA



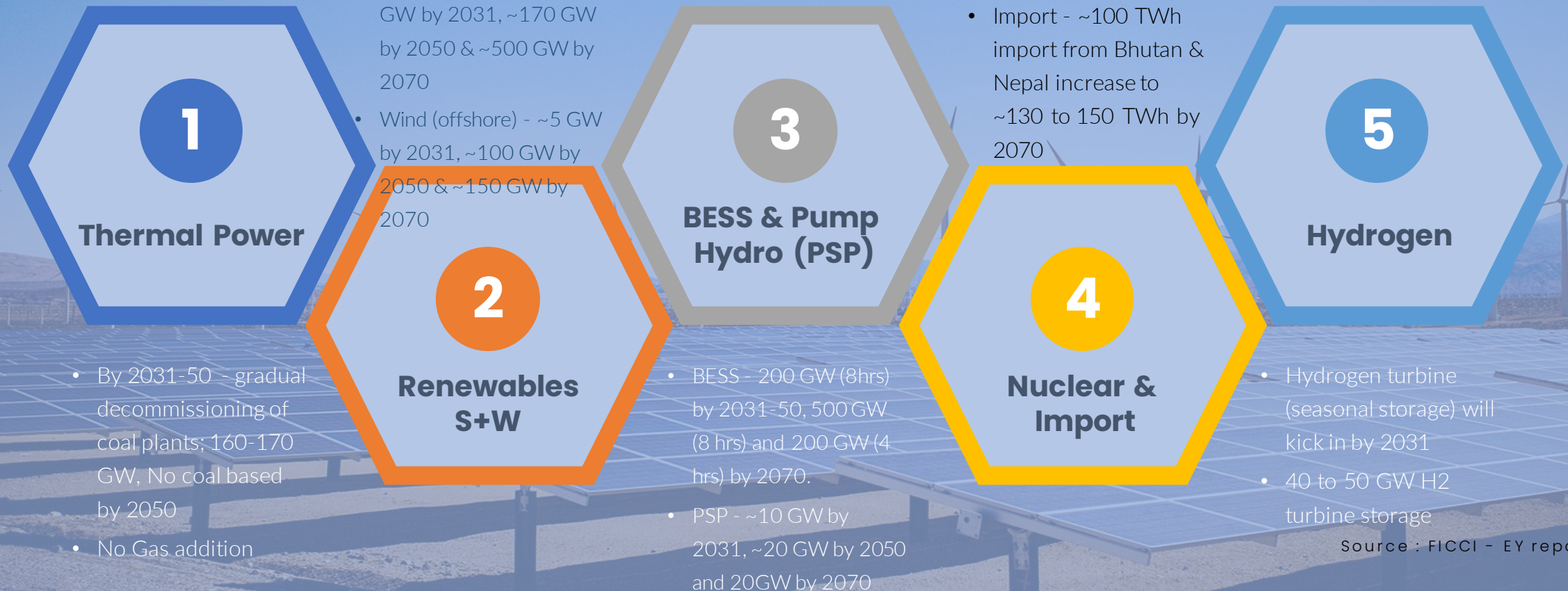
Investment Required to Meet the Power Expansion in USD Million

Data: CEA, Graph by MKA



Pathways for Grid Decarbonization

A Summary Plan till 2070



Source : FICCI – EY report 2023

Making it to happen - Govt support

Incentives - financial assistance to promote Clean Technologies

Coal Mine Auctions

Coal mines are auctioned by Govt on Revenue sharing basis. Developer committing to Coal gasification - 50% reduction in Revenue share

Coal Gasification Plants

Over \$1 billion financial assistance from govt for govt & private companies, including pilot projects

Green Hydrogen

Over \$ 2 billion financial assistance for the developers and manufacturers of equipment for GH2. 1st lot of 0.45 Mt has been allotted under the scheme very recently

Production Linked Schemes (PLI) - Renewables

- PLI scheme for 14 key sectors with an outlay of US\$ 26 billion
- Manufacturing of high efficiency solar PV module US\$ 2.5 billion
- Advanced Chemistry Cells Battery - US\$ 2.5 billion

SWOT Analysis

Challenges are stepping stones to opportunities

S

Strengths

- Abundant renewable energy potential >1000 GW
- Growing Installed Cap - 425GW to 609 GW to 900 GW by 2031-32
- Skilled workforce
- Policy support & incentives for RE
- Technology advancement & promotion with PLIs

W

Weakness

- Heavy Reliance on Fossil fuels due to low cost from domestic coal
- Transmission & Distribution Losses - presently being ~17%, aiming to be <10%
- Financial health of DISCOMS
- Skill gap in specific areas like smart grid, AI, Green Hydrogen and energy Storage

O

Opportunity

- Decarbonization efforts - NZE by 2070
- Modernization of Grids with smart technologies
- Energy efficiency program
- Private sector participation and investments
- Technology advancement

T

Threats

- Global energy market volatilities
- Climate change impact -droughts & floods
- Cyber security vulnerabilities
- Policy inconsistencies
- Availability of critical materials for solar & wind
- Funding & financing

Summary

The Road Ahead is Paved with Both:

Despite the ambitious plans meeting both growth with NZE challenges mitigation and supporting policies, hurdles remain. Land acquisition for renewable energy projects, high upfront costs of storage solutions, financing the mammoth expansion and the need for a skilled workforce in new technologies are some of the significant challenges that need to be addressed.

Conversely, the transition presents immense opportunities for job creation in green industries, attracting foreign investments, and fostering technological innovation.