

Power sector

State of the industry - 2023

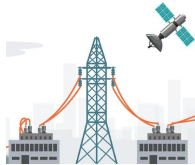
REConnect Energy - Key Business Activities

Climate Tech and Engineering



Renewables

- RE Aggregation through Forecasting & Scheduling
- RE Aggregation and DSM Underwriting



Utilities - Transmission, Distribution, System/Grid Operations

- Predictive Analytics and Grid Automation
- IoT led Distribution Network Automation

Environmental Markets



Environmental Markets

- Domestic - RECs, ESCERTs
- International - iRECs, TIGR, Carbon (under evaluation)

Partnerships - Investors, Clients, Strategic Alliances

Venture Capital



Utility Scale Projects



Renewable Energy Developers



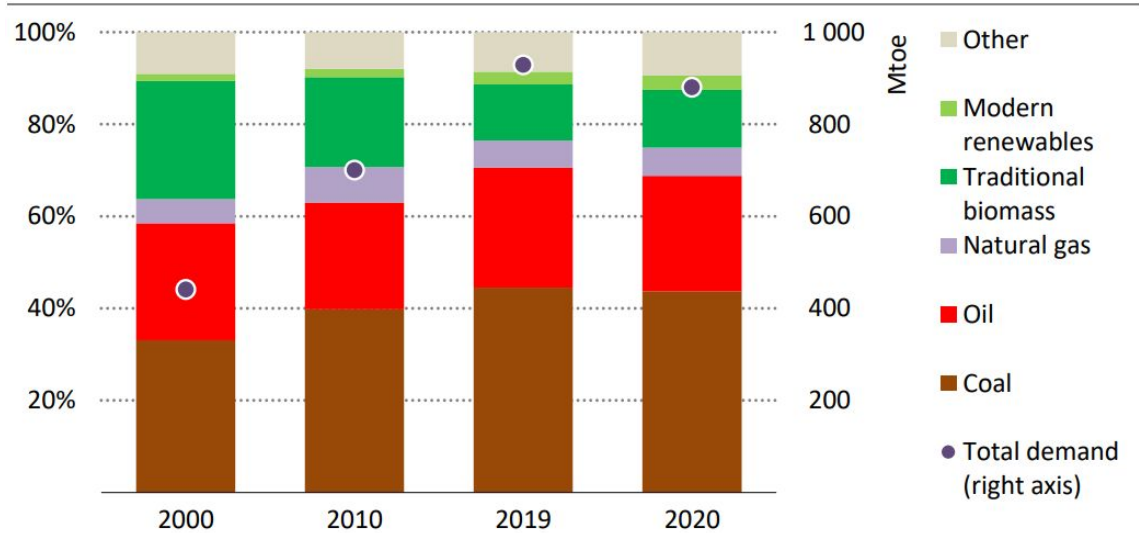
Key issues to ponder on

- Electricity - Its role in powering us
- State of the Indian Power sector
 - Generation
 - Transmission
 - Distribution
 - Power Markets
- Emerging technologies and trends to look out for
- Analysis of some of the large companies in each area
- Q&A

Electricity - Its role in powering us

Electricity, Oil, Biomass, Gas remain the fundamental energy sources in India

Near-universal household access to electricity was achieved in 2019, meaning that over 900 million citizens have gained an electrical connection in less than two decades.



Source IEA 2021 India outlook report

Electricity to be the single important source of secondary energy followed by coal in the coming decade

Key sectoral issues

- **Energy transition – *RE addition and decarbonisation***
- **Development of Energy Storage Systems: PSP / BESS /alternate chemistry**
- **Fuel availability concerns – *Coal shortages, Non-availability of Gas***
- **Low PLF of Coal / Lignite based Power Plants**
- **Stressed assets in generation**
- **Right of Way and Forest Clearance – *Takes long time to resolve***
- **Financial Health of State Discoms - Huge outstanding debts.**
- **Development of domestic capacities in design/ manufacturing of solar, wind, storage and other emergent technologies based electrical systems in the country.**
- **Gaining prominence in the trans-national/ regional energy markets.**

Generation -

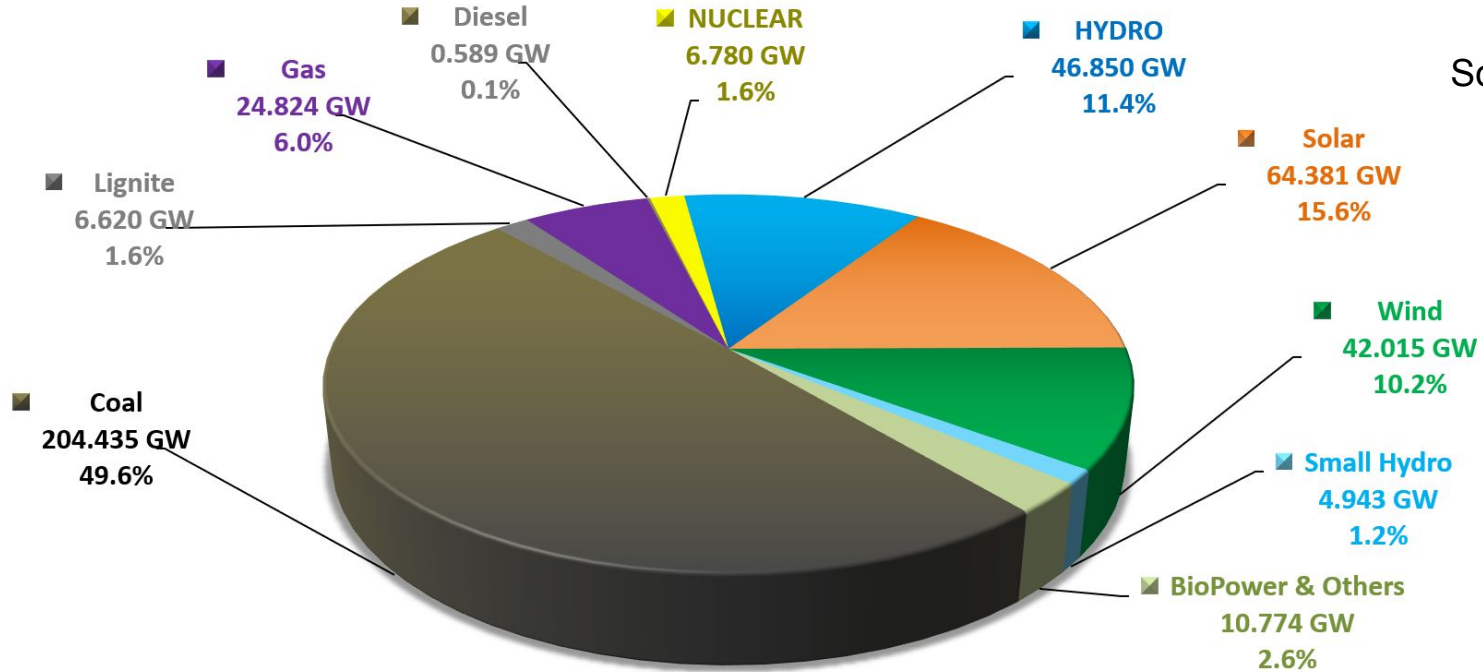
Where is it headed?

What are the opportunities for investment

Generation - Current status

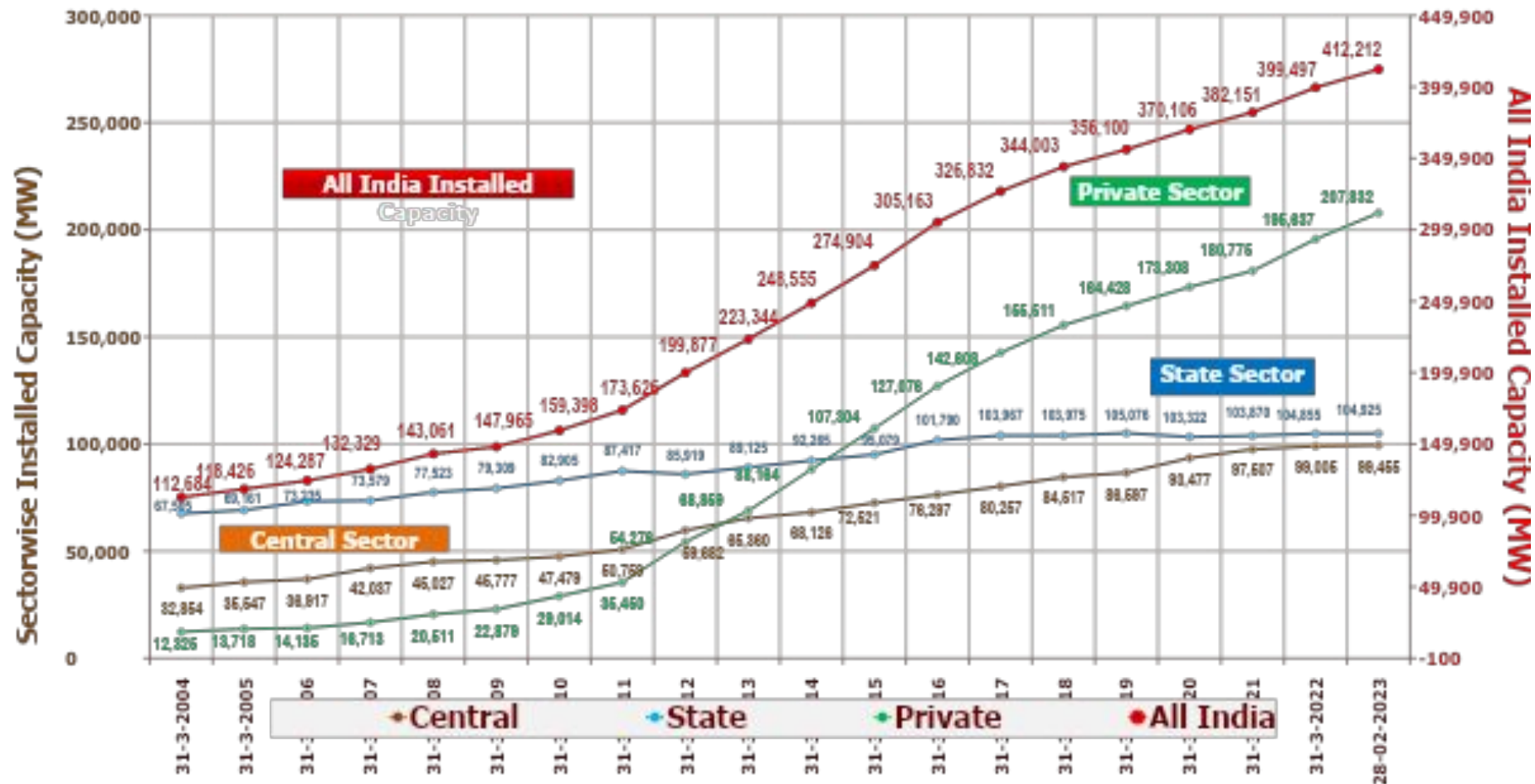
Installed Capacity : (As on 28-February-2023)

Source - CEA



All India Installed Capacity as on 28.02.2023 : 412.212 GW

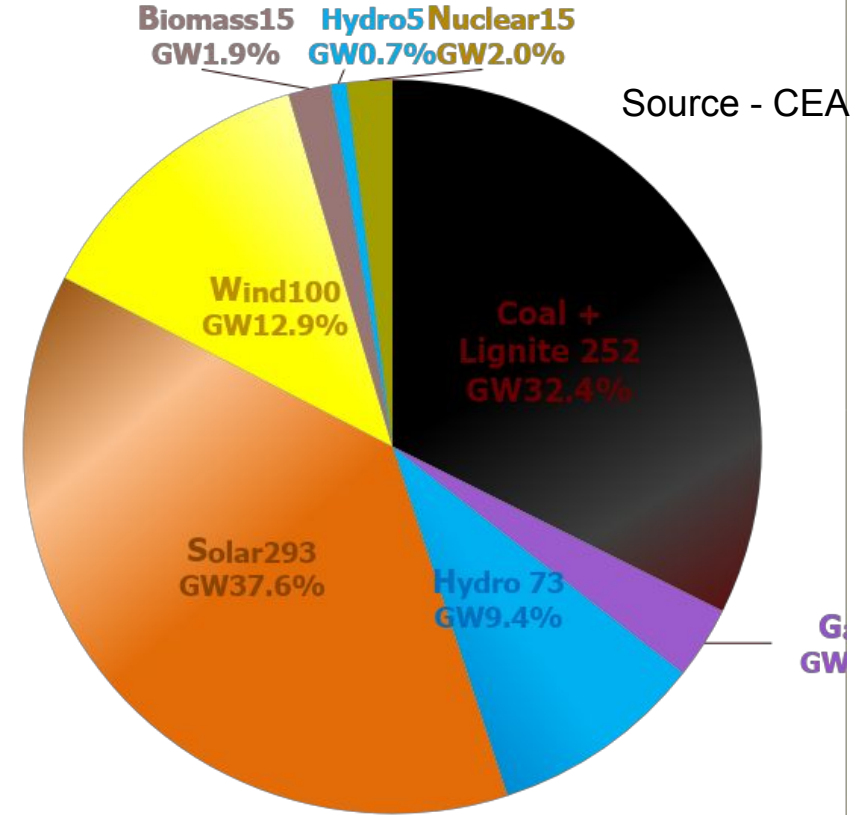
Growth in Installed Capacity (MW) - Sectorwise



Estimated Installed Capacity (As on 31-3-2030)

| | Estimated Installed Capacity (GW) (As on 31-3-2030) | % Share in Total Installed Capacity |
|------------------------------------|--|-------------------------------------|
| Coal + Lignite | 251.683 | 32.4% |
| Gas | 24.825 | 3.2% |
| Total Fossil Fuel (Thermal) | 276.508 | 35.6% |
| | | |
| Solar | 292.5664 | 37.6% |
| Wind | 99.8953 | 12.9% |
| Biomass | 14.5 | 1.9% |
| Small Hydro | 5.35 | 0.7% |
| Hydro (Large) | 72.846 | 9.4% |
| Total RE (Incl. Hydro) | 485.158 | 62.4% |
| Nuclear | 15.480 | 2.0% |
| Total Non-Fossil Fuel | 500.638 | 64.4% |
| | | |
| Total | 777.146 | 100.0% |

Estimated Installed Capacity by the end of 2029-30 : 777.146 GW



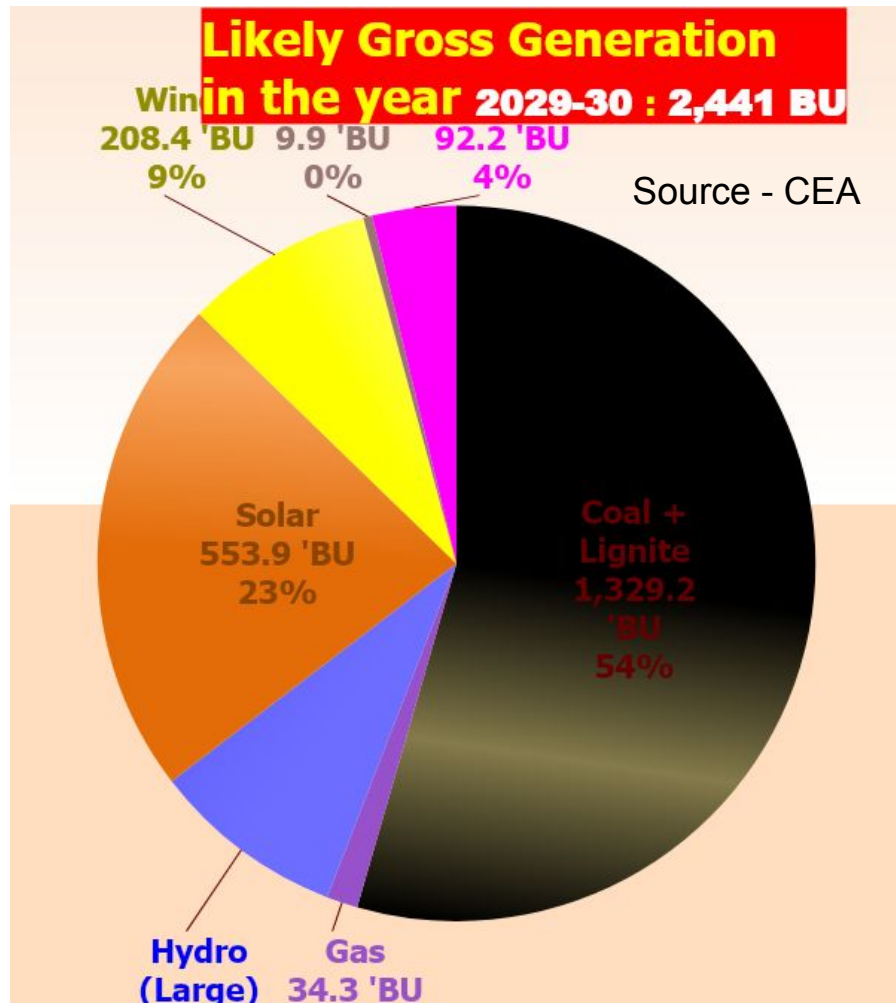
Likely Gross Generation in the year 2029-30

| Fuel Type | Likely Gross Generation in 2029-30 (BU) | Percentage Mix (%) |
|-----------|---|--------------------|
|-----------|---|--------------------|

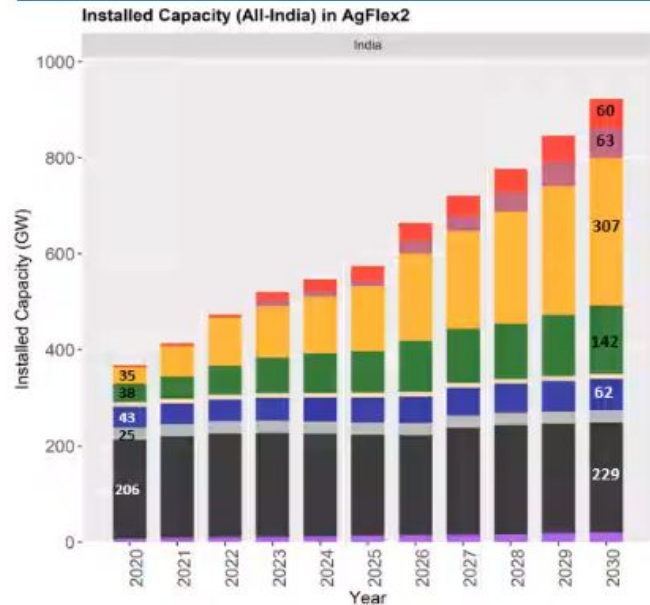
| | | | |
|--------------|----------------------------|----------------|--------------|
| Fossil Fuel: | Coal + Lignite | 1,329.2 | 54.5% |
| | Gas | 34.3 | 1.4% |
| | Total Fossil Fuel : | 1,363.5 | 55.9% |

| | | | |
|--------------------------------|--------------------------|--------------|--------------|
| Non-Fossil Fuel: | RES (Incl. Hydro) | 984.9 | 40.4% |
| | Hydro * | 212.7 | 8.7% |
| | Solar, Wind & Other RE | 772.2 | 31.6% |
| | Solar | 553.9 | 22.7% |
| | Wind | 208.4 | 8.5% |
| | Biomass & Other RE | 9.9 | 0.4% |
| | Nuclear | 92.2 | 3.8% |
| Total Non-Fossil Fuel : | 1,077.1 | 44.1% | |

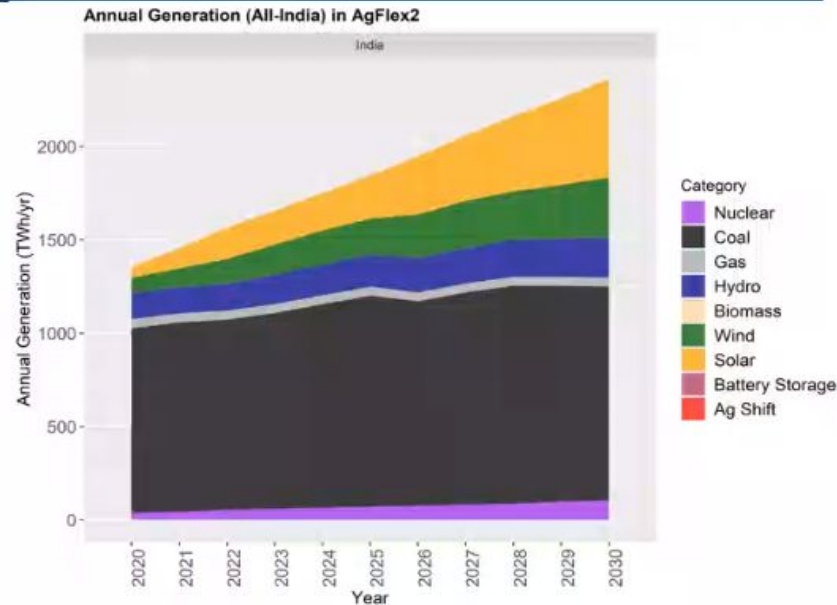
| | | |
|---|--------------|---------------|
| Likely Generation in 2029-30 (Fossil & Non-Fossil) | 2,441 | 100.0% |
|---|--------------|---------------|



The Primary Least Cost Pathway



- **Least cost capacity mix for 2030:**
- RE = 465GW (non fossil = 545 GW)
- Net coal capacity addition = 23 GW
- Energy storage = 63 GW/252 GWh



- Between 2020 and 2030, as the load nearly doubles, coal generation increases only by ~10%.
- Non-fossil sources provide ~50% of energy generation by 2030
- Emissions intensity of electricity generation reduces by 43%

Is the grid dependable ? (e.g. Primary Least Cost Pathway)

National Dispatch During Peak Net Load Week (FY 2030)

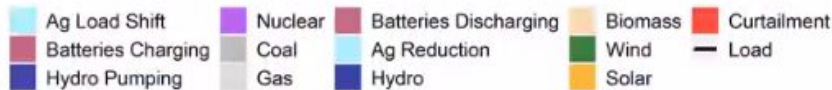
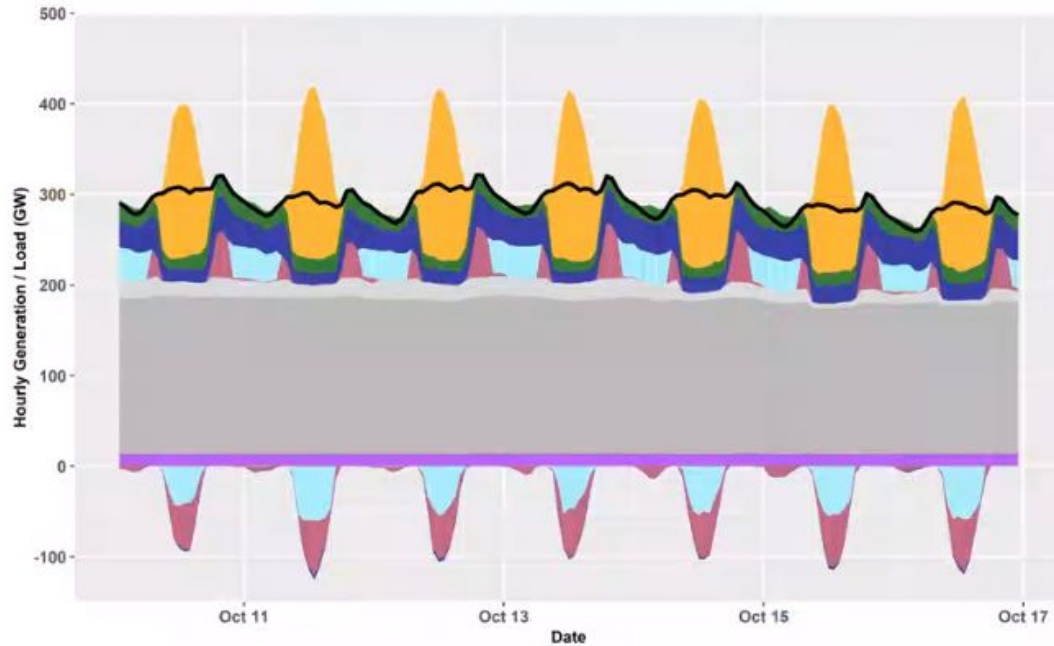


Chart shows results from simulating the hourly power plant level dispatch (8760 hours x ~2,500 generation units x 75 interstate transmission corridors) during the **highest net load week in FY 2030**.

Net Load Peak (National)
= 307 GW on Oct 13 at 7:00 PM

Coal and Nuclear generate at near full load:
Coal = 175 GW
Nuclear = 13 GW

Supply side FRs play a crucial role in meeting the net load peak

Storage = 60 GW (diurnal balancing)
Gas = 22 GW (seasonal balancing)
Hydro = 40 GW (incl small hydro)

Source : IDAM infra and Lawrence Berkley National Lab study 2023

Role of Battery Energy Storage - Crucial

1. Energy Storage for VRE Integration on MV/LV Grid
2. Energy Storage for EHV Grid
3. Energy Storage for e-Mobility
4. Energy Storage for Telecom Towers
5. Energy Storage for Data Centres, UPS and Inverters
6. Energy Storage for DG Replacement
7. Energy Storage for other > 1 MW Applications

Source - NITI Ayog - [ISGF-Report-on-Energy-Storage-System-\(ESS\)-Roadmap-for-India-2019-2032](#)

Key opportunities in generation

- Massive shift to renewables
- Private sector to play a major role in generation. Government moving out slowly
- Large generation companies to form Green companies. For example NTPC Green, Also Tata Power, Adani Green will see massive uptake
- Massive opportunities for indigenization in Solar and Wind manufacturing technologies. Look out for spinoffs from players like Tata , Reliance for PV manufacturing
- Distributed Energy Resources - Solar Roof top, Battery charging stations to witness major rise
- Massive opportunities for Battery storage
- Coal continues to be mainstay till mid 2030s
- Rise of Green Hydrogen as a secondary source of energy

Transmission -

Where is it headed?

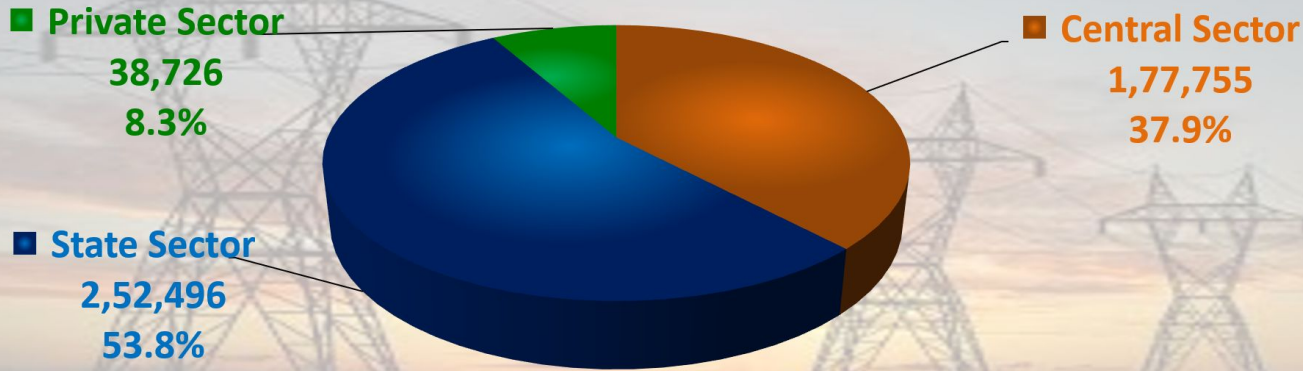
What are the opportunities for investment

Status of the Transmission sector

Transmission Lines (cKm)

As on February 28, 2023

(220 KV & above)



Key players

- PGCIL
- Sterlite Power
- Adani
- Essel Infra
- L&T Power



Transmission Lines : 4,68,977 cKm
(As on February 28, 2023)

Some emerging opportunities in transmission

- **4 new corridors planned**
 - ± 800 kV Bhadla-III - Fatehpur HVDC line
 - ± 350 kV Pang - Kaithal HVDC line
 - ± 800 kV Barmer-II - Jabalpur HVDC line
 - ± 800 kV Khavda - Aurangabad HVDC line
- **Dedicated corridors and transmission lines for Green hydrogen**
- **Dedicated lines for Data centers**
- **Extra capacity for Battery storage**

Key opportunities in Transmission

- **PGCIL**
 - Largest player in the transmission sector 17400 C Kms
 - Listed business
 - Remains a monopoly business
- **Adani transmission largest in private sector with around 18000 CKms of transmission capability**
 - Green industrial cluster in Mundra
 - Increasing participation in renewable grid (eg: HVDC Mumbai, Khavda) Transmission development in green corridor
 - Listed business, badly hit by Hindenburg issue
- **Tata power in transmission**
 - Powerlinks Transmission Limited (PTL) is a joint venture between The TATA Power Company Limited (51%) and Power Grid Corporation of India Limited (49%).operates 1200 ckm line
 - Tata power largely into distribution sector. Transmission sector operates only about 3600 CKm of line
- **Sterlite transmission**
 - Operates about 9500 cKm of transmission network
 - Operates in Brazil as well
 - May come up with IPO in 2023

Distribution -

Where is it headed?

What are the opportunities for investment

Discom

Discom still remains regulated

Discom still remains stressed

Reforms needed

Schemes attempted but no major results

Power Markets -

Where is it headed?

What are the opportunities for investment

Volume of Transactions thru Power Exchanges (IEX+PXIL+HPX) on all Platforms (DAM, TAM, RTM, G-TAM & G-DAM)

- Over the years

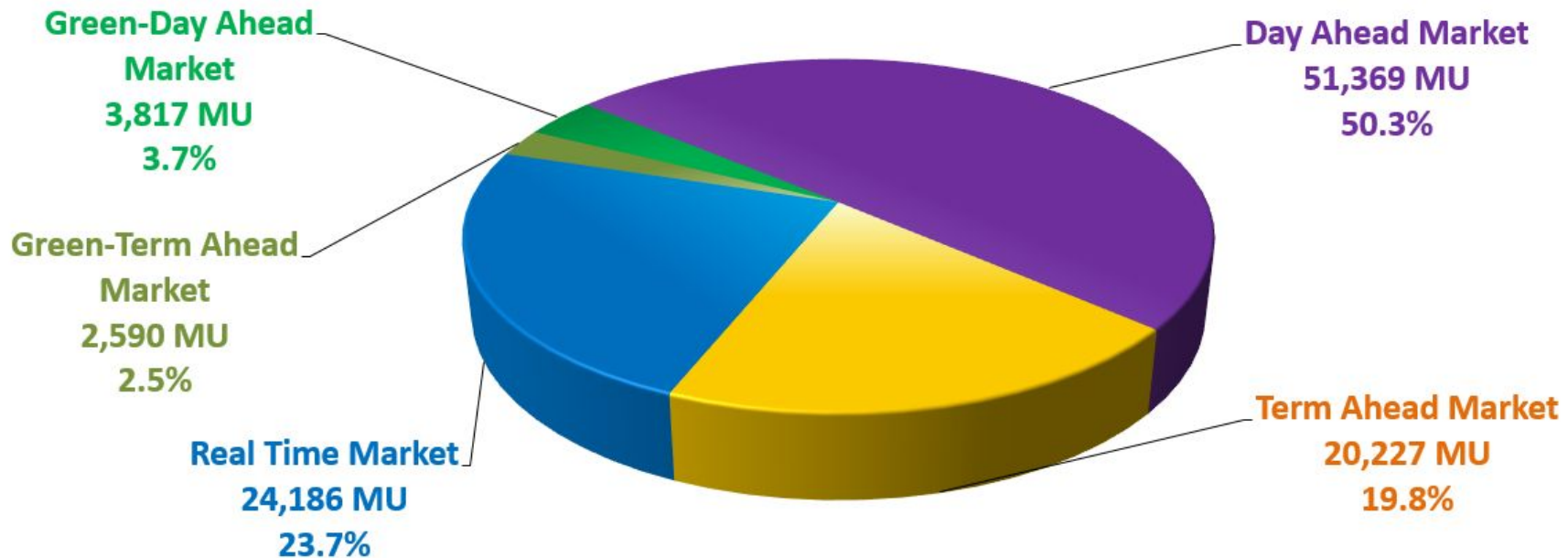
Figures in Billion Units (BU)

Transactions thru Power Exchanges (In BU)



**Share of each trading platform (DAM, TAM, RTM, G-TAM & G-DAM)
of Power Exchanges (Inclusive of IEX, PXIL & HPX)
in Total Volume Transacted at Power Exchanges**

Year : 2022-23



Total Volume Transacted in Power Exchanges (Inclusive of IEX, PXIL & HPX) during 2022-23 :

1,02,190 MU