




Confederation of Indian Industry



FROM STABILITY TO FLEXIBILITY

The Present & Future of Indian Power
Plants Flexible Operations

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AGENDA

Present
Scenario

Why
Flexibility

Evaluation
Of Flexibility
Metrics

Future
Trends

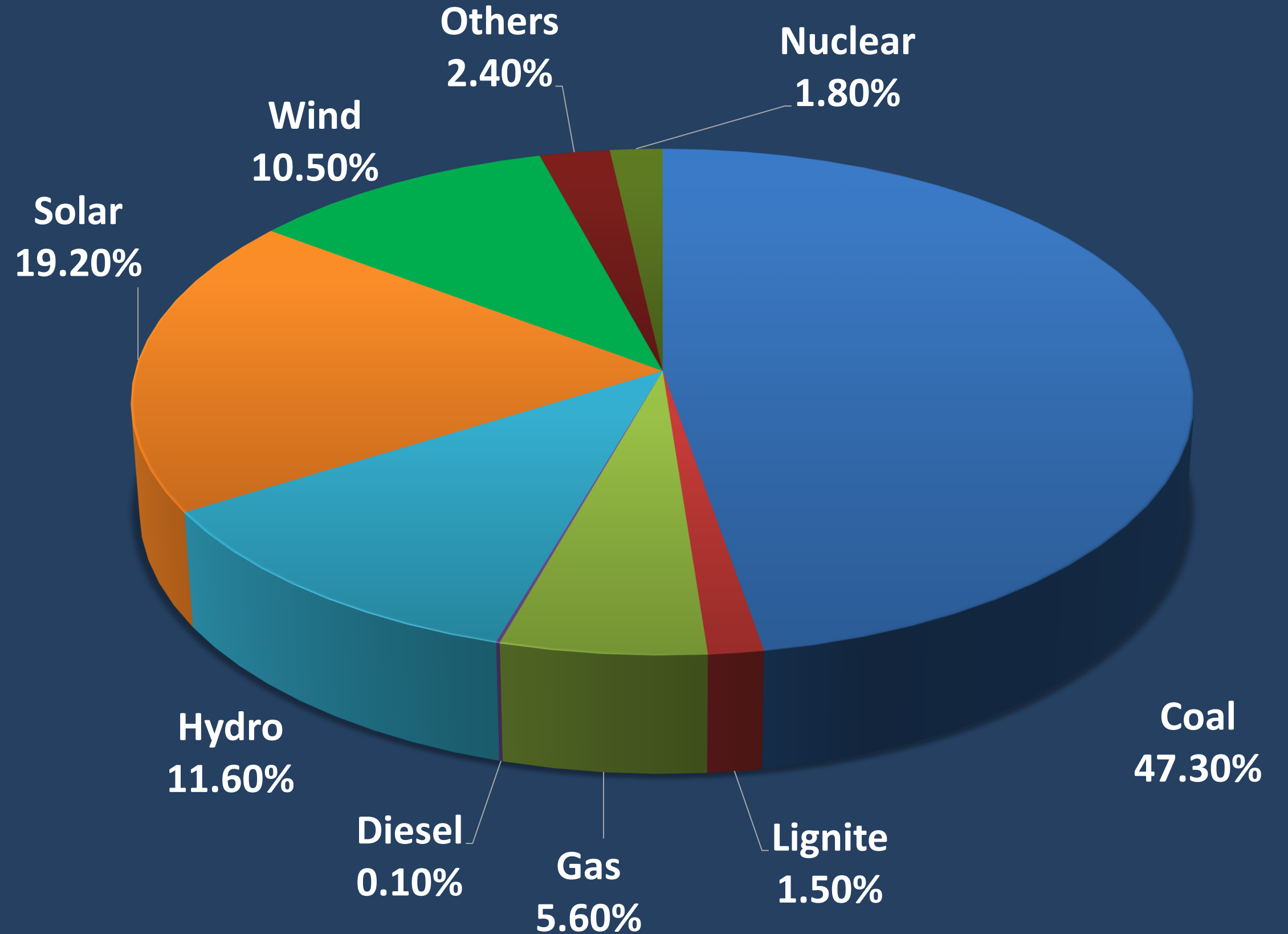
Total Installed Capacity

4,46,190 MW

(As on 30.06.2024)

Fossil Based: 243GW (54.5%)		
Coal	2,10,970 MW	47.3%
Lignite	6,620 MW	1.5%
Gas	24,818 MW	5.6%
Diesel	589 MW	0.1%

Non-Fossil Fuel Based: 203 GW (45.4%)		
Hydro	46,928 MW	10.5%
Wind	46,656 MW	10.5%
Solar	85,474 MW	19.2%
BM Power/Cogen	10,355 MW	2.3%
Waste to Energy	595 MW	0.1%
Small Hydro Power	5005 MW	1.1%

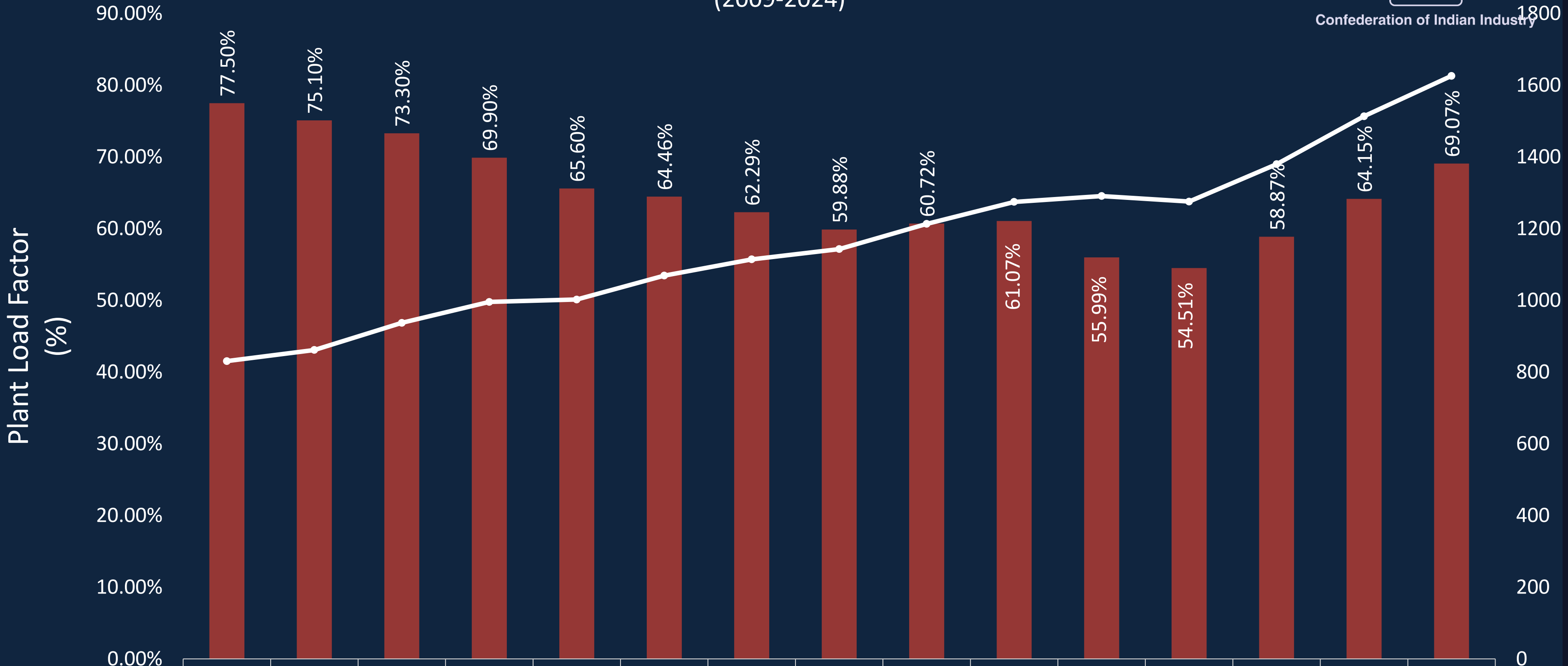


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All India PLF (%) (2009-2024)



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	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24
All India PLF (%)	77.50%	75.10%	73.30%	69.90%	65.60%	64.46%	62.29%	59.88%	60.72%	61.07%	55.99%	54.51%	58.87%	64.15%	69.07%
Demand (BU)	830.594	861.591	937.199	995.557	1002.257	1068.923	1114.408	1142.929	1213.326	1274.595	1291.01	1275.534	1379.812	1513.497	1626.132

Source: CEA Reports- June 2024

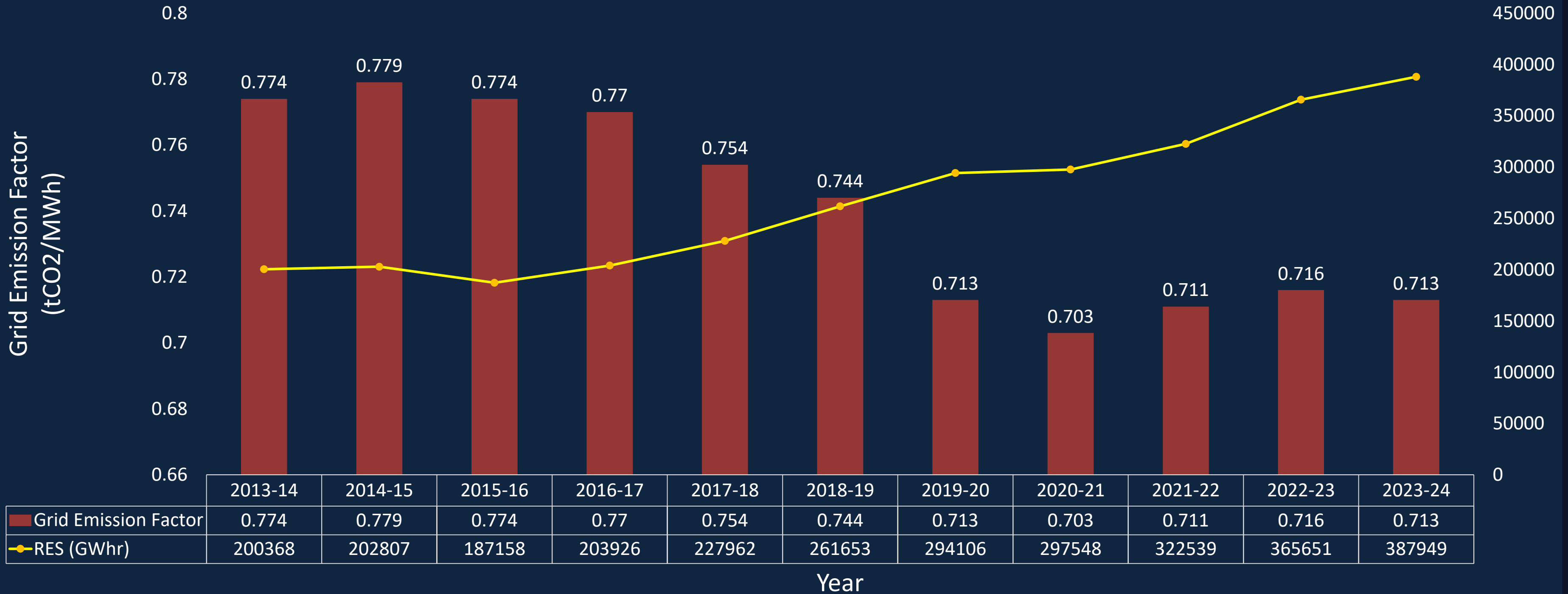
Year

All India PLF (%) Demand (BU)

Grid Emission Factor (2013-2024)



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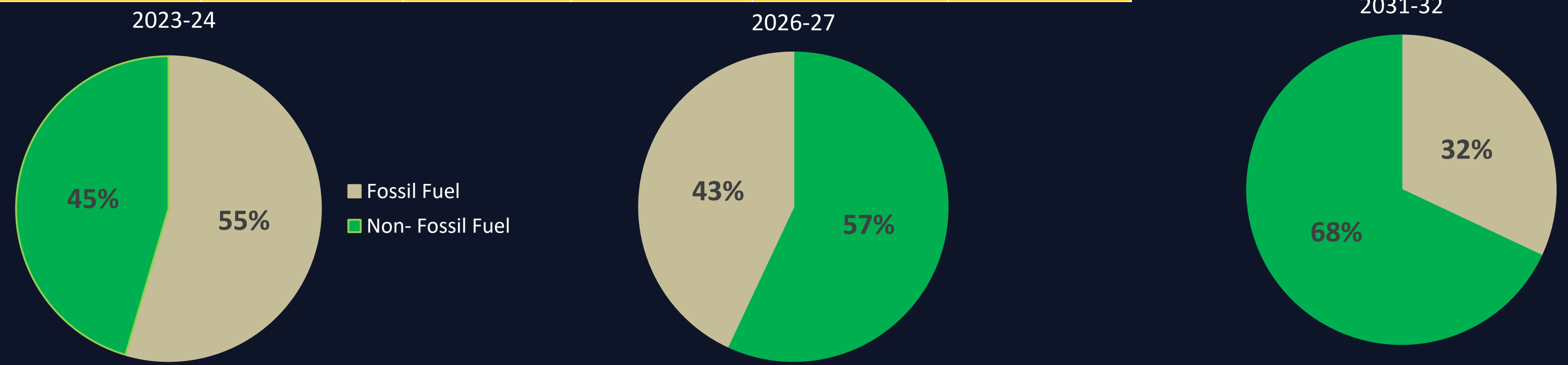
■ Grid Emission Factor ● RES (GWhr)

Due to increasing share of RE in Grid, the Carbon Intensity of grid is reduced by 9% from 2013-14 to 2022-2023.

Source: Ministry of Power

Future Projected Capacity Additions					
	2026-27		2031-32		
	MW	% Share	MW	% Share	% Growth
Large Hydro	52,446	8.60%	62,178	6.90%	18%
PSP	7,446	1.20%	26,686	3.00%	
Small Hydro	5,200	0.90%	5,450	0.60%	4.8%
Solar PV	1,85,566	30.40%	3,64,566	40.50%	96%
Wind	72,896	12.00%	1,21,895	13.50%	67%
Biomass	13,000	2.10%	15,500	1.70%	19.2%
Total RE		55.2%		66.2%	
Nuclear	13,080	2.10%	19,680	2.20%	50%
Coal + Lignite	2,35,133	38.60%	2,59,643	28.80%	10%
Gas	24,824	4.10%	24,824	2.80%	0%
Total	6,09,591		9,00,422		47%

- ❑ The projected growth of Solar PV is 96% while that of Coal based power generation is 10%.
- ❑ The growth in total installation is projected to be 47%.
- ❑ The projected cumulative growth of RE is 77% while for the Fossil Based is 11%.



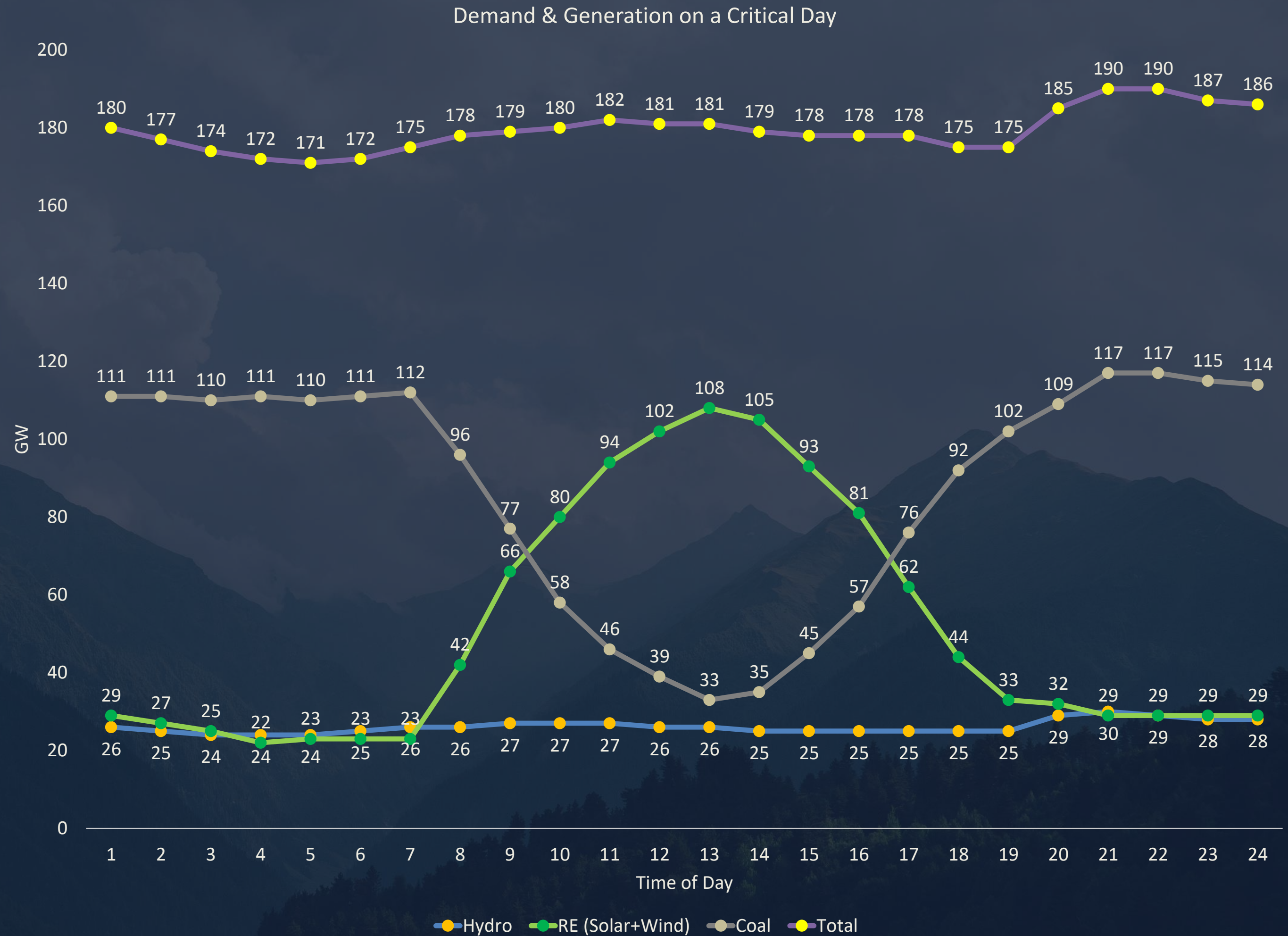
Why Flexibility

Limitations of RE:

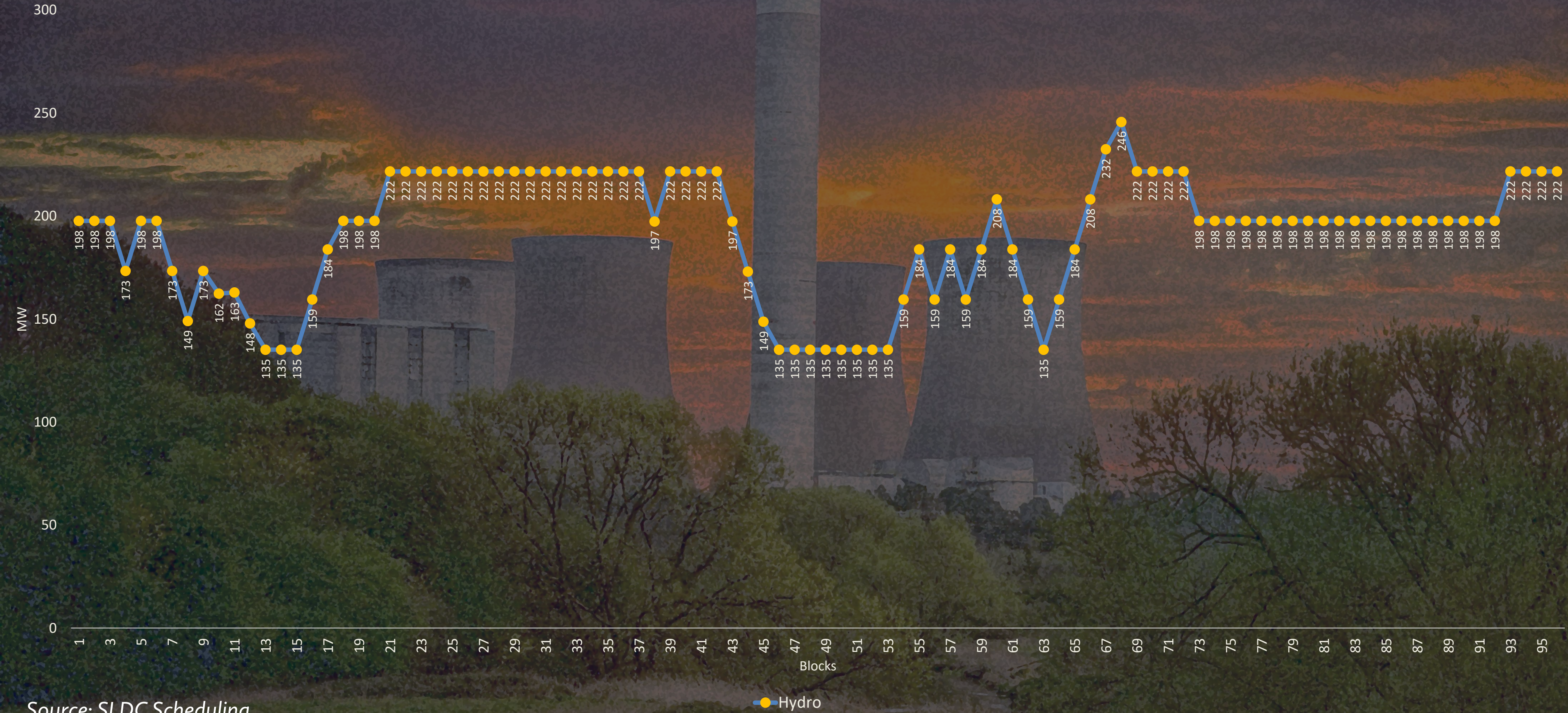
Variability

Uncertainty

Concentration



Scheduled Generation of a Power Plant



Source: SLDC Scheduling

Hydro



Evaluation Of Flexibility Metrics

Based on Flexible Operation Data Collected from Plants.



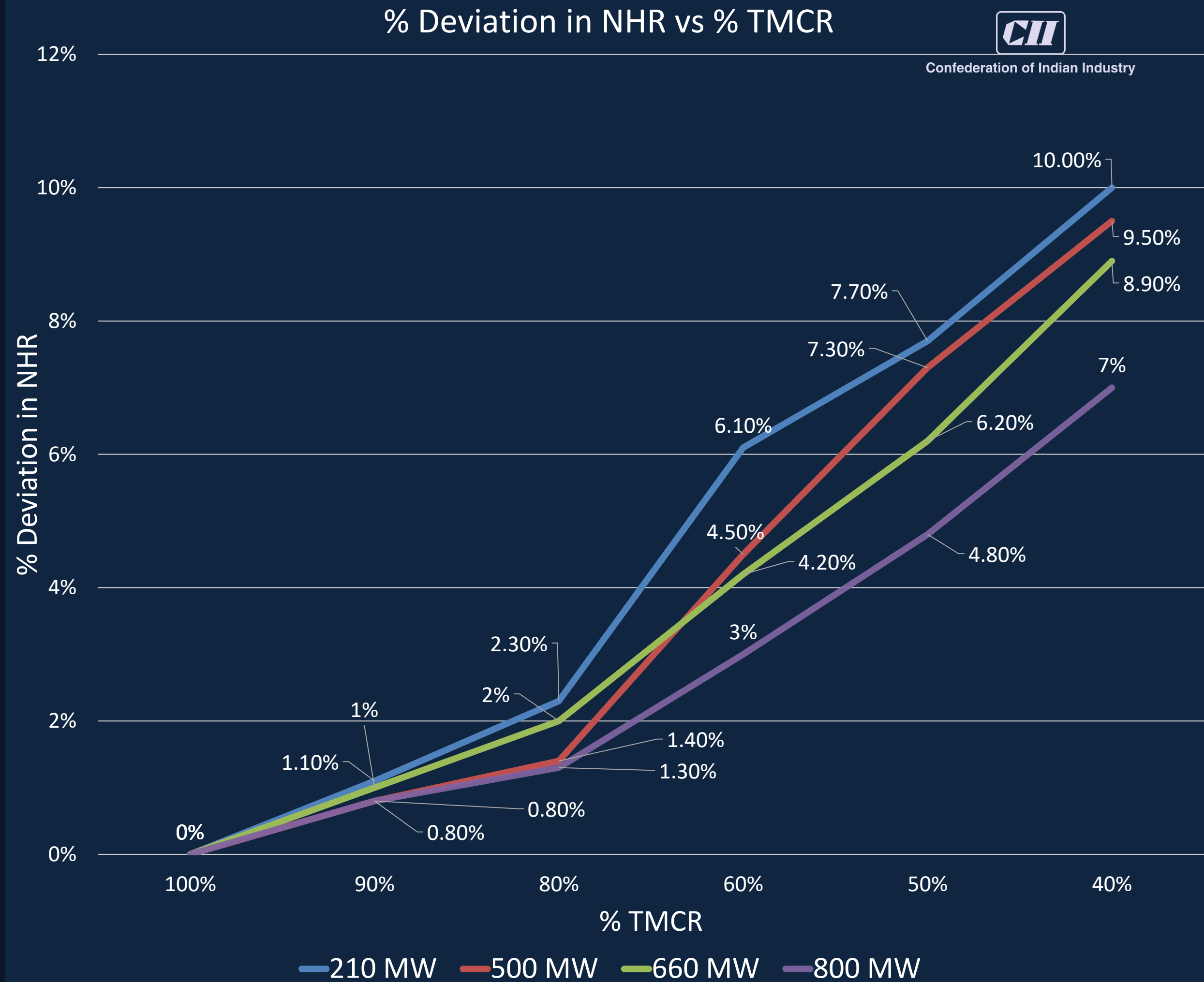
Evaluation Of Flexibility Metrics

For 100% TMCR to 50% TMCR Reduction

- **APC (increase):**
 - Average: 1.7%
 - Supercritical Units: 1%
 - Subcritical Unit (>150 MW): 1.5-1.9%
 - Subcritical Unit (<150 MW): 2.0-2.3%
- **Boiler Efficiency (decrease):**
 - Average: 1.5%
 - Supercritical Units: 1%
 - Subcritical Unit (>150 MW): 1.5%
 - Subcritical Unit (<150 MW): 2.5%

Effect of Load Reduction on NHR:

- The deviation in NHR for 210 MW is 10% while for ultra supercritical plant is 7%.
- The deviation becomes steep below 80% TMCR for all capacity plants.





Evaluation Of Flexibility Metrics

During Load Reduction to Technical Minimum:

- **Coal Mills:** All plants, except those <150 MW, considers stopping coal mills.
- **Boiler Passes:** All plants are operating both passes.
- **BFP:** Except some supercritical plants, all other plants runs both BFPs.
- Average time required from 100% TMCR to technical minimum load is as low as **45 mins**.



Evaluation Of Flexibility Metrics

During Load Reduction to Technical Minimum:

- **Soot Blowers:** No plant has reported operating Wall Blowers & LRSBs except APH soot blowers.
- **CMC/CCS:** All has declared successful tuning of CMC/CCS for load reduction/increment.
- Almost all plants has adopted **Boiler Metal Temperature excursion monitoring.**
- All plants (except <150 MW) has reported successful trial of load reduction up to **40% TMCR.**
- **ESP Fields:** No plants has reported discharging of ESP fields during low load operations even if the emissions are within limits.



Evaluation Of Flexibility Metrics

Unit Startup Time Optimization:

Up to **45 mins** of cold startup time reduction by adopting various techniques

- **Deaerator Initial Heating & Pegging:** Filling boiler with hot water from Deaerator. Initial heating & Pegging lines are charged using PRDS steam from adjacent operating unit.
- **HFO to LDO** conversion.
- **charging HPH-6:** To increase FW temp by charging HPH-6 after establishing steam flow through HPBP & LPBP system.
- Using **SCAPH** to rapidly increase furnace temperatures along with avoiding cold end corrossions.

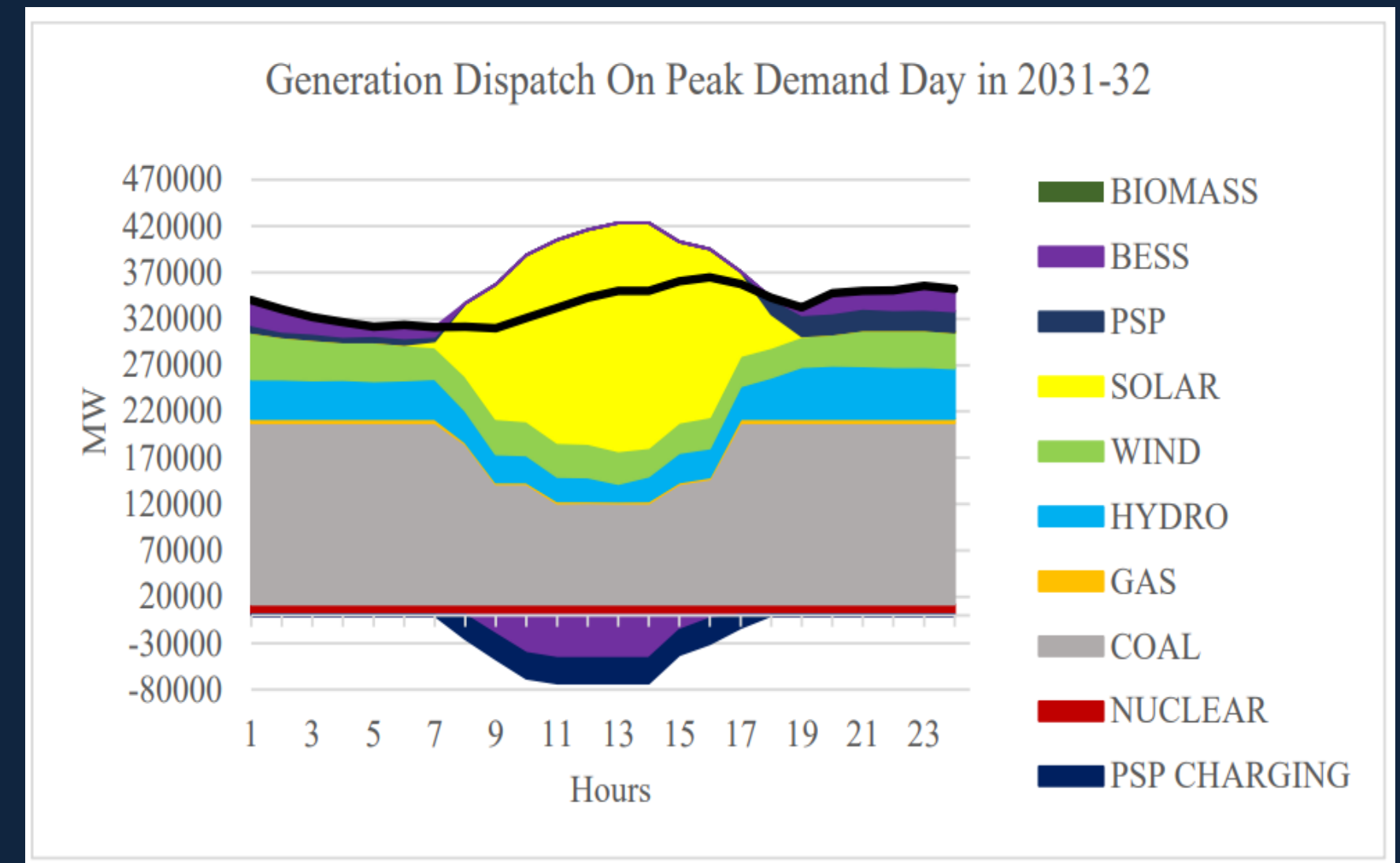
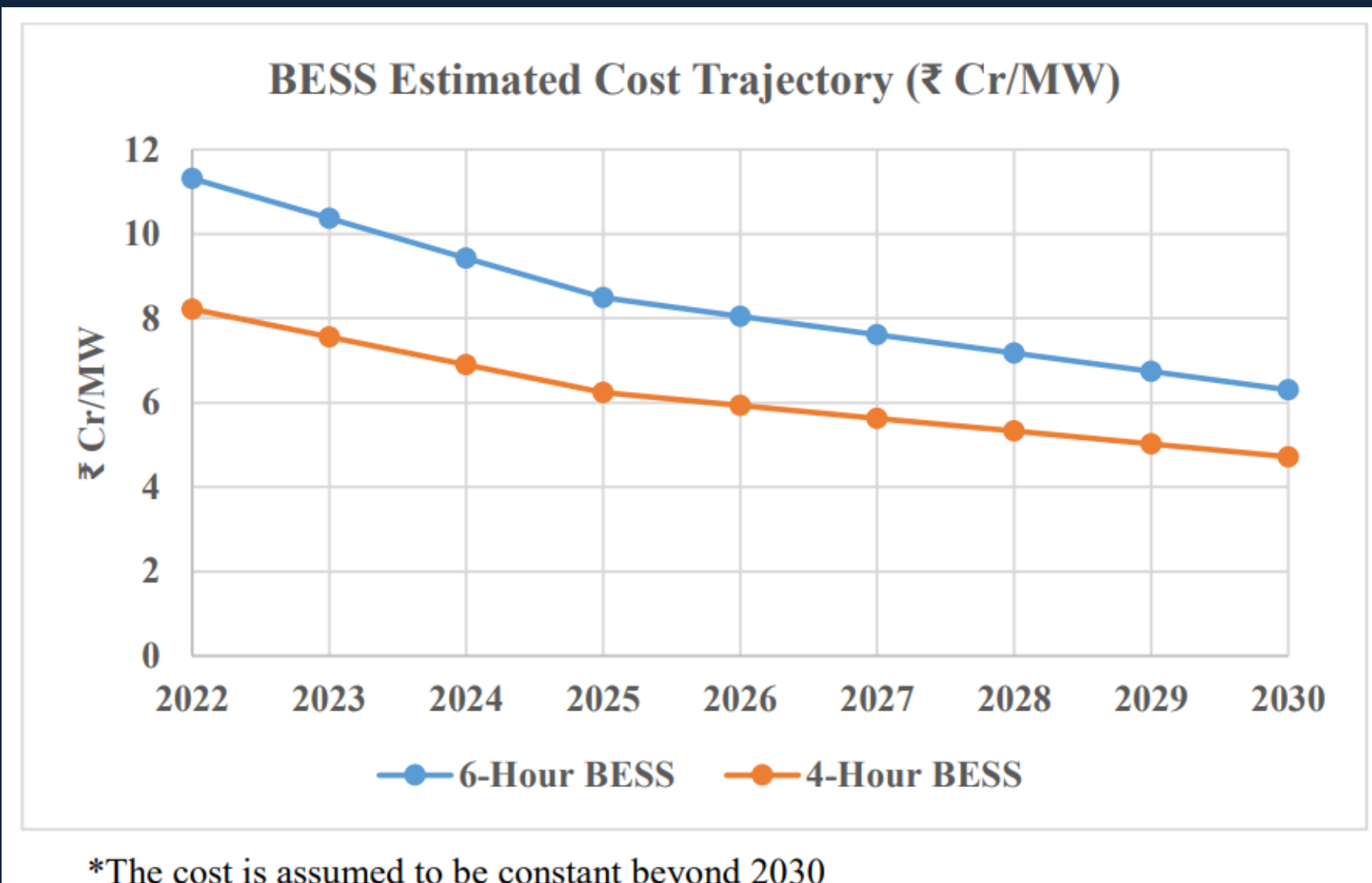
FUTURE OF FLEXIBLE OPERATIONS IN INDIAN POWER PLANT



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Battery Energy Storage System (BESS)

- ❑ BESS is seen as one of the solution to ensure grid stability, efficient utilization of storage with minimum curtailment of RE sources.
- ❑ The projected reduction in cost is estimated to be close to **50% from 2022 to 2030** making it an attractive option for Electricity Storage.





भारत का राजपत्र The Gazette of India

4

THE GAZETTE OF INDIA : EXTRAORDINARY

[PART III—SEC.4]

5. **Flexible operation of coal based thermal power generating units.-** (1) The coal based thermal power generating units shall be capable of providing the flexible operation as per these regulations.
(2) The implementation of flexible operation of the coal based thermal power generating units shall be as per the phasing plan specified by the Authority from time to time.
(3) All load despatch centers shall schedule the coal based thermal power generating units, under their jurisdiction, considering the flexible operation capabilities as specified in these regulations.
6. **Minimum power level capabilities of coal based thermal power generating units for flexible operation.-** The coal based thermal power generating units shall have flexible operation capability with minimum power level of forty percent.
Provided that the generating units which are not capable of achieving minimum power level of fifty-five percent, shall achieve the same within one year of the notification of these regulations.
Provided further that the generating units which are not capable of achieving minimum power level of forty percent, shall achieve the same as per phasing plan mentioned in the sub-regulation (2) of regulation 5 of these regulations.
7. **Ramp rates capabilities of coal based thermal power generating units for flexible operation.-** (1) The coal based thermal power generating units shall have ramp rate capability of minimum three percent per minute for their operation between seventy percent to hundred percent of maximum continuous power rating and shall have ramp rate capability of minimum two percent per minute for their operation between fifty-five percent to seventy percent of maximum continuous power rating.
Provided that the generating units which are not capable to comply with this regulation, shall comply with the same within one year of the notification of these regulations.
(2) The coal based thermal power generating units shall achieve ramp rate capability of minimum one percent per minute for their operation between forty percent to fifty-five percent of maximum continuous power rating as per phasing plan mentioned in the sub-regulation (2) of regulation 5 of these regulations.
8. **Relaxation of regulations.** - The Authority may, by an order and for the reasons to be recorded in writing, relax any provision of these regulations in respect of the matter referred to the Authority, on case to case basis.

RAKESH GOYAL, Secy.

[ADVT.-III/4/Exty./588/2022-23]

Key Highlights of the Gazette Notification on Flexible Operation of Coal Based Power Plants:

(Dated: 25 Jan 2023)

Minimum Power Level:

- All generating units to achieve 55% of the power levels within 1 year of the notification.
- Plants to achieve 40% of power level as per the phasing plan.

Ramp Rates:

TMCR	Ramp Rate	660 MW	300 MW
70–100%	3% per min	19.8 MW/m	9 MW/m
55-70%	2% per min	13.2 MW/m	6 MW/m
40-55%	1% per min	6.6 MW/m	3 MW/m

Source: Gazette Notification CEA 25 Jan 2023

Major Concerns During Low Load



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Operations

- Drum level Fluctuations during loads.
- Difficulty in maintaining TDBFPs due to low FW flow.
- Difficulty in maintaining MS & HRH steam temperatures.
- Reduced Flame Stability.
- Lower differential pressure across windbox.
- Any tripping of coal mill may result in MFT due to Loss of Flame.
- Difficulty in keeping the heat transfer surfaces clean due to difficulty in operation of wall blowers and LRSBs.
- Increased Heat Rate & Reduced Boiler Efficiency.
- Increased APC.

Upgrades Required for Low Load Operations

- ❑ Boiler Fatigue Monitoring system (BFMS)
- ❑ Changing BFP recirculation valve to control valve.
- ❑ Automated Milling System – Auto Mill Scheduler
- ❑ Startup / shutdown of ID / FD / PA Fans through auto sequence
- ❑ Single drive operation (Higher Efficiency but Lower Reliability)
- ❑ Condensate throttling for improved ramp rates.
- ❑ Unit Response Optimisation (fine tuning of auto loops)
- ❑ Intelligent Proactive Process control (MS HRH temp, Flue gas temp)



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To Summarize



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- ❑ The coal-fired power units shall remain the main source of flexible power.
- ❑ The average PLF is expected to reduce to 58% by 2031-32.
- ❑ Flexible operations for coal power plants are technically feasible by upgradation, tuning of controls, etc.,
- ❑ The pilot tests conducted at various plants is the proof that Indian plants are capable to flex
- ❑ Lower load operation (40%) shall require measures:
 - automation/optimization of controls,
 - proper flame detection systems,
 - efficient measures to optimize combustion process,
 - stable minimum mill operation,
 - reassessment of O&M practices, etc.

How can CII-GBC support in realizing Net Zero targets?



Corporate Level

- Net Zero Study
- GHG Accounting
- Innovative Technologies
- Green Entrepreneurship
- Training Program – Sustainable Energy Management
- Industrial Benchmarking Study



Plant Level

- GreenCo Rating
- Detailed Energy Audit
- PAT M&V, Facilitation
- Renewable Energy Potential Assessment
- Decarbonization Roadmap
- Green Factory Rating
- Landscape



Buildings & Township

- IGBC Ratings
- Net Zero Building Certification
- Landscape
- Detailed Energy Audit
- Roadmap for 100% RE
- Energy modeling



Supply Chain

- Supplier GHG Emission Evaluation
- Supplier Handholding for Net Zero
- Energy Efficiency Assessment – Supply Chain
- Training Program
- GreenCo for SMEs



Product Related

- GreenPro Rating
- Life Cycle Assessment
- Innovative Products & Services Award
- Rooftop Solar Vendor Rating



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It Always Seems
IMPOSSIBLE
Until it's
DONE

- Nelson Mandela



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Tahoor Khan

Counsellor- Energy Efficiency
CII- Godrej Green Business Centre

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INDIA's 1st Platinum Rated Green Building

