

# Resource Adequacy Framework

By: Central Electricity Authority

# Policy Framework

- ✓ MoP has notified Electricity (Amendment) Rules, 2022 on 29.12.2022

## ***Rule 16:***

- ***Resource Adequacy Guidelines*** for assessment of resource adequacy during the generation planning stage (one year or beyond) as well as during the operational planning stage (up to one year) shall be issued by the Central Government in consultation with the Authority, within six months from the date of commencement of these rules. - **Final Guidelines issued on 28<sup>th</sup> June 2023.**
- State Commission shall ***frame regulations*** on resource adequacy, in accordance with the ***guidelines*** issued by the Central Government, the ***distribution licensees*** shall formulate the ***resource adequacy plan*** in accordance with these Regulations and ***seek approval of the Commission***
- The ***National Load Dispatch Centre and the Regional Load Dispatch Centers*** shall carry out assessments of resource adequacy, for ***operational planning, at the national and regional levels***, respectively, on an annual basis

# Policy Framework

- *The **State Commission** may determine **non-compliance charges** for failure to comply with the resource adequacy target approved by the Commission.*
- *The **State Load Dispatch Centre** shall carry out assessments of resource adequacy, for **operational planning, at the state level**, in consultation with all the concerned stakeholders on an annual basis ,in accordance with the guidelines issued by the Central Government and the directions of the State Commission.*
- *The State Load Dispatch Centre **shall review** the **operational resource adequacy** on a daily, monthly and quarterly basis*

# Role of CEA

- Publish Long Term National Resource Adequacy Plan (LT-NRAP) for 10 years containing the following:
  - National Level PRM and reliability indices
  - Share of State in National Peak Demand
  - Capacity credit of all generation technologies
  - Optimal Generation Mix at national level
- LT-NRAP shall be revised annually
- Vetting of state specific LT-DRAP for all states

# Role of NLDC

- To Publish **Short Term** National Resource Adequacy Plan (ST-NRAP) for one year considering the following :-
  - **Reserves** (Primary, Secondary and Tertiary) in the Grid for grid security
  - **Planned maintenance schedules** of existing stations
  - Station-wise historic **forced outage** rates
  - Resource Availability based on **new projects**
  - Decommissioning plans, if any.

# Role of Distribution Utility

- Long-term Distribution licensee Resource Adequacy Plan (LT-DRAP) (on annual rolling basis) for 10 year for:
  - Meet the *peak demand and energy requirement* of the Discoms along with the RPO Obligations
  - Meeting *contribution towards national peak* with PRM
  - Adhering Reliability norms
- LT-DRAP shall be vetted by CEA and submitted to State Commission for approval
- Demonstrate 100% tie-up for the first year and min 90% tie-up for the second year to meet their contribution towards national peak.
- To submit the details of contracted capacities to the respective STU/SLDC after the approval of State Commission.

# Role of STU/SLDC

- To provide the following inputs for formulation of LT-NRAP:-
  - Hourly demand (15 minute time block wise )
  - Hourly demand forecasts for the next 10 years
  - Availability from the existing/contracted generation resources
  - Any other inputs required for national RA plan
- Aggregate the total contracted capacities at the state level and submit the information to the respective RLDC.
- RLDCs shall aggregate the capacities at Regional Level and submit to NLDC
- SLDC shall carry out assessments of resource adequacy, for operational planning, at the state level
- Review the ST-DRAP on a daily, monthly and quarterly basis based on actual availability of generation resources.

# Role of and SERCs

- SERCs to timely approve the LT-DRAP and contracted capacities of DISCOMs
- Monitoring of RA by SERCs

# Judicious mix of Long, Medium and Short-Term Contracts

Type of Contract	Meeting Distribution Licensee Contribution in national Peak	Distribution licensee own peak and electricity requirement
Long-Term	75-80%	>75%
Medium-Term	10-20%	10-20%
Short-Term	0-15*%	0-15%

\* Power procurement through the power exchanges, such as the Day-Ahead Market segment, shall not be considered

# Timely Procurement of Resources

- The distribution licensee must ensure that procurement process for the projected demand is undertaken and completed sufficiently in advance to ensure its availability for meeting the demand.

Resource	Long Term	Medium Term
Coal/Lignite Based Capacity	7	2
Hydro	9	2
Solar	2	1
Wind	3	1
PSP	5	3
Other Storage	2	1
Nuclear	9	3

# Key Design Parameters

## ➤ Reliability Indices

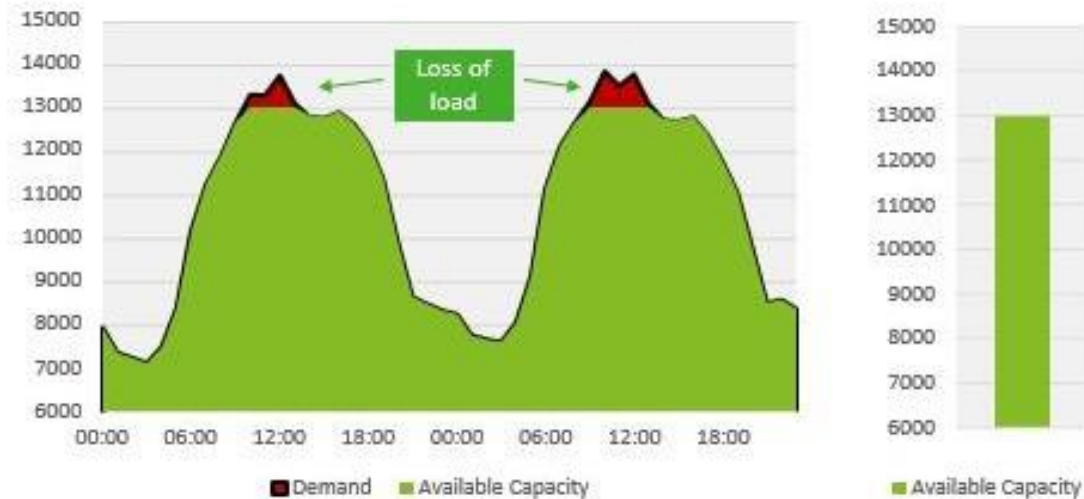
- Loss of Load Probability (LOLP)
- Expected Energy Not Served (EENS) and Normalised ENS (NENS)

## ➤ Planning Reserve Margin- Sufficient Reserve margins are required for adequately addressing the demand and supply variations to meet reliability criteria.

- PRM is expressed as a certain % of peak load of the system.

# Loss of Load Probability

- Measure of the probability that a system's load may exceed the available generation to meet the load in a year.



- The LOLP value adopted by CEA for the purposes of the National Electricity Plan (NEP) is 0.2%

# Expected Energy Not Served (EENS) and Normalised ENS (NENS)

- Expected amount of total energy (MWh) that may not be served in a year
- Normalized ENS (NENS)- total expected load shed due to supply shortages (MWh) as a percent (%) of the total system energy.
- NENS value adopted by CEA for National Electricity Plan is 0.05%

# Integrated Resource Planning (IRP) for RA

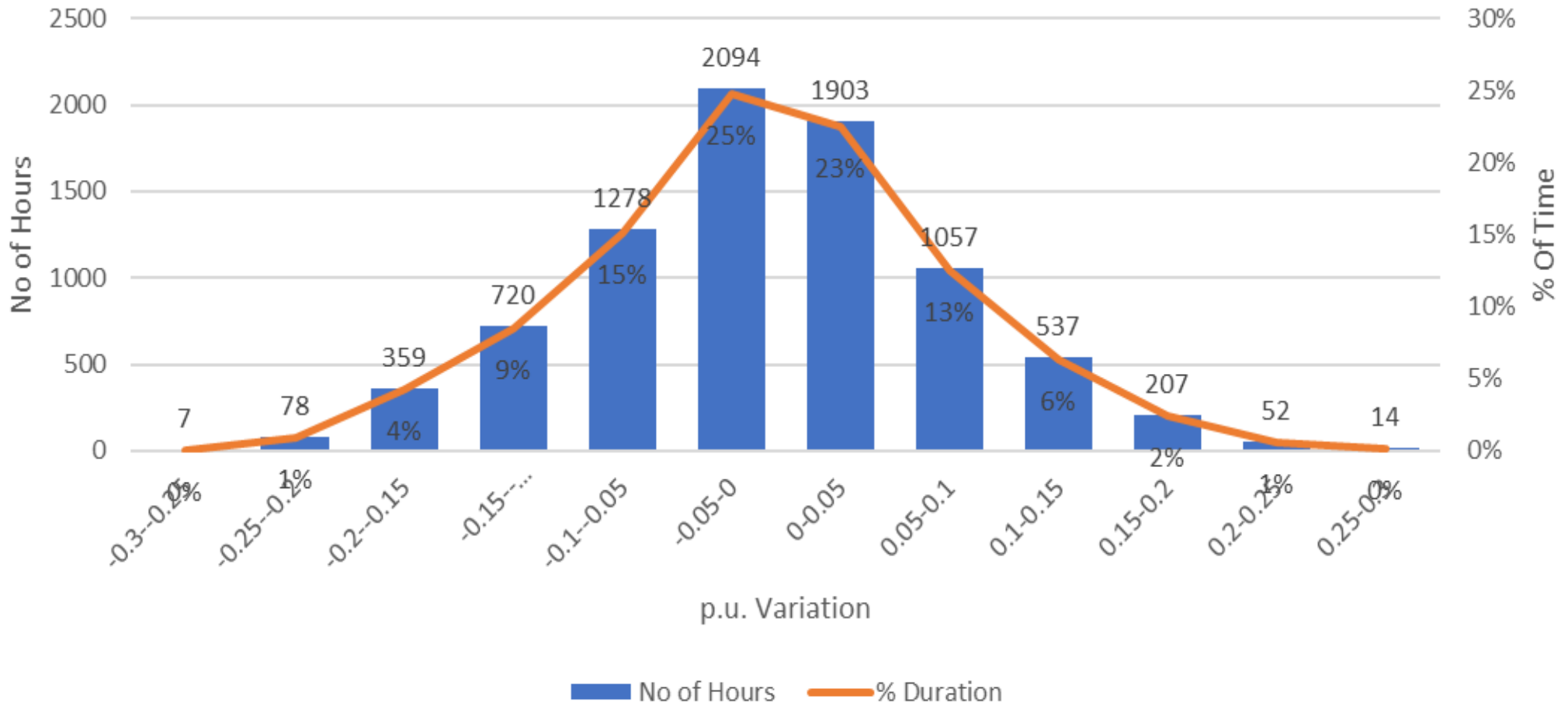
- IRP- To determine the target generation capacities for meeting the forecast peak and energy demand over a specified future period.
- Inputs for IRP-
  - Reliability indices
  - Demand pattern (Hourly/sub-hourly demand pattern)
  - Estimated Load Growth
  - VRE generation profiles
  - Technical & Financial parameters of Existing, Planned and Candidate Generating Plants
  - RPO targets
  - Spinning reserve requirements

# Reliability Analysis

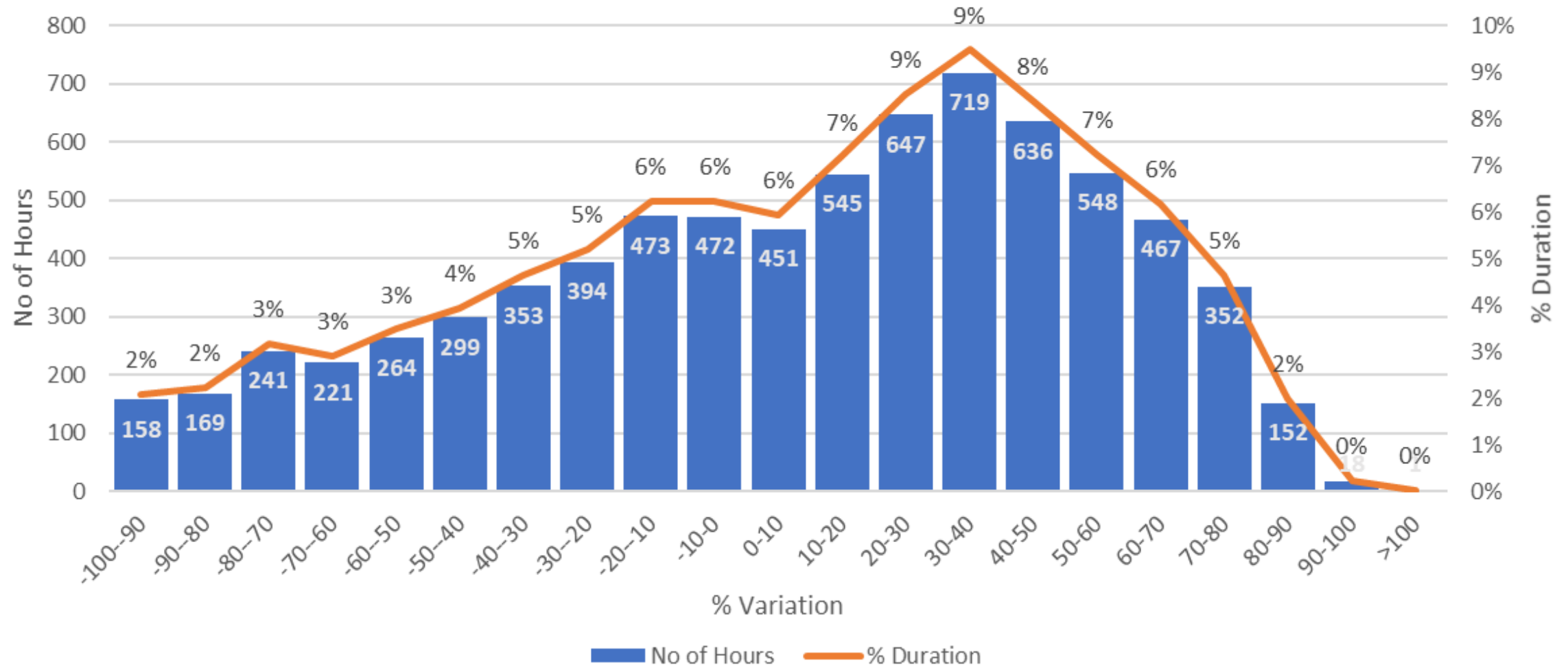
Monte Carlo /Stochastic simulation - To factor-in the uncertainty associated with various generation resources and demand

SI No.	System Parameter
1.	Forced outage of conventional generators
2.	Solar Generation
3.	Wind generation
4	Hydro generation
5.	Demand

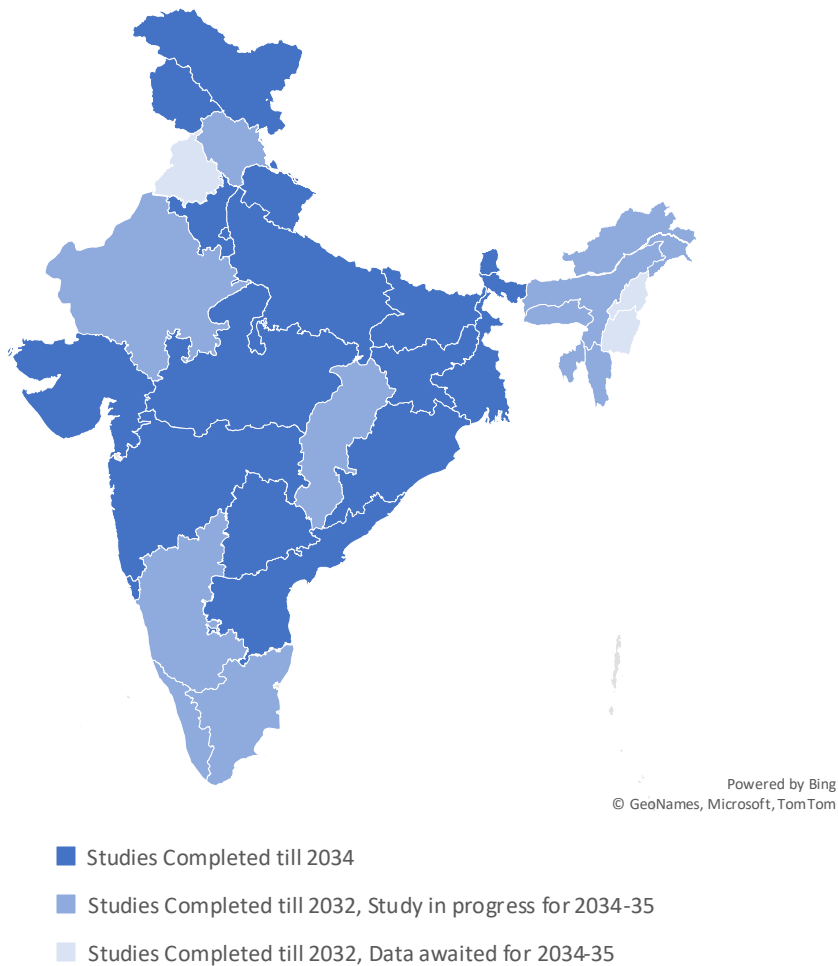
# Demand variation 2021-22 vs 2022-23



## Wind generation Variation in 2022-23 Vs 2021-22

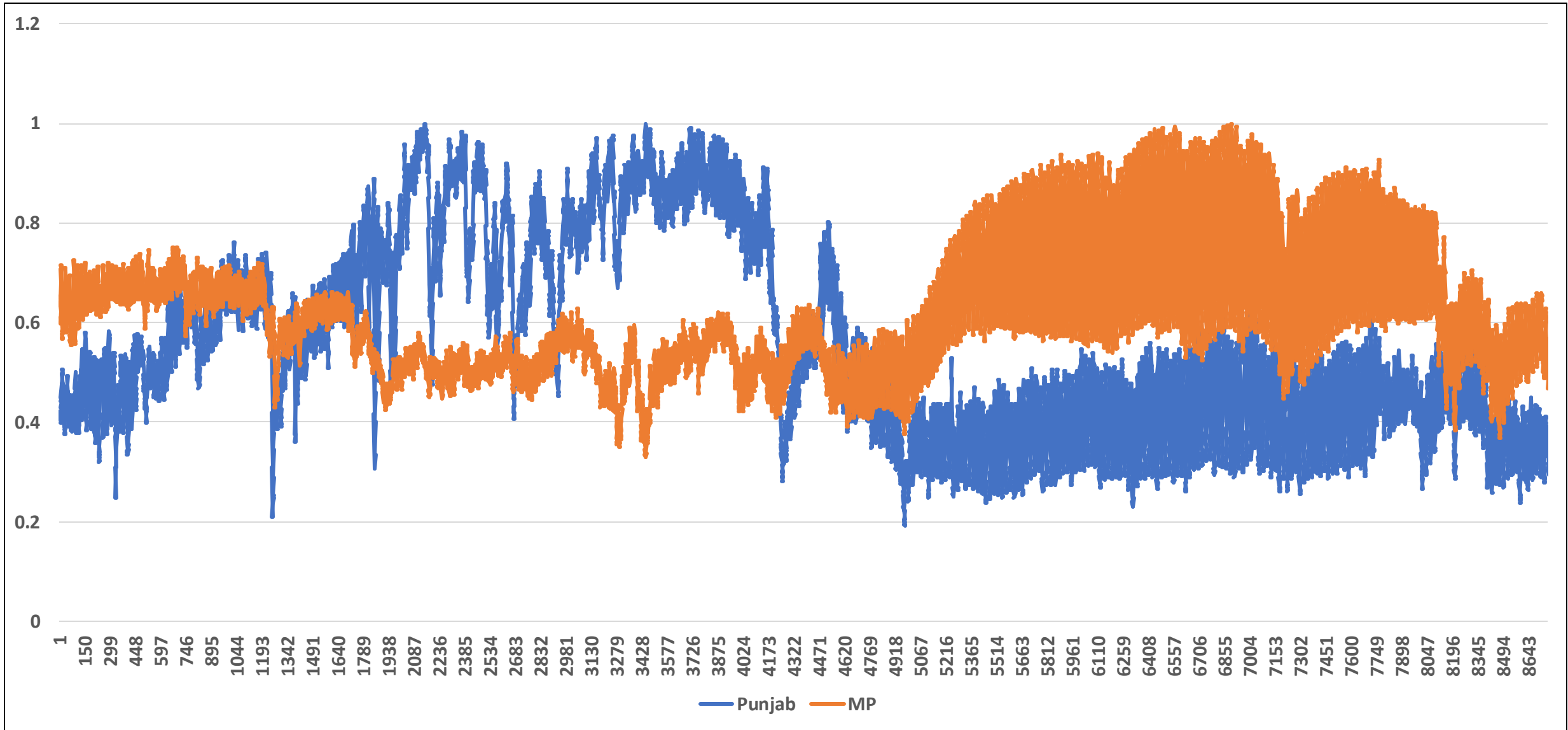


# Long Term Resource Adequacy Studies of CEA

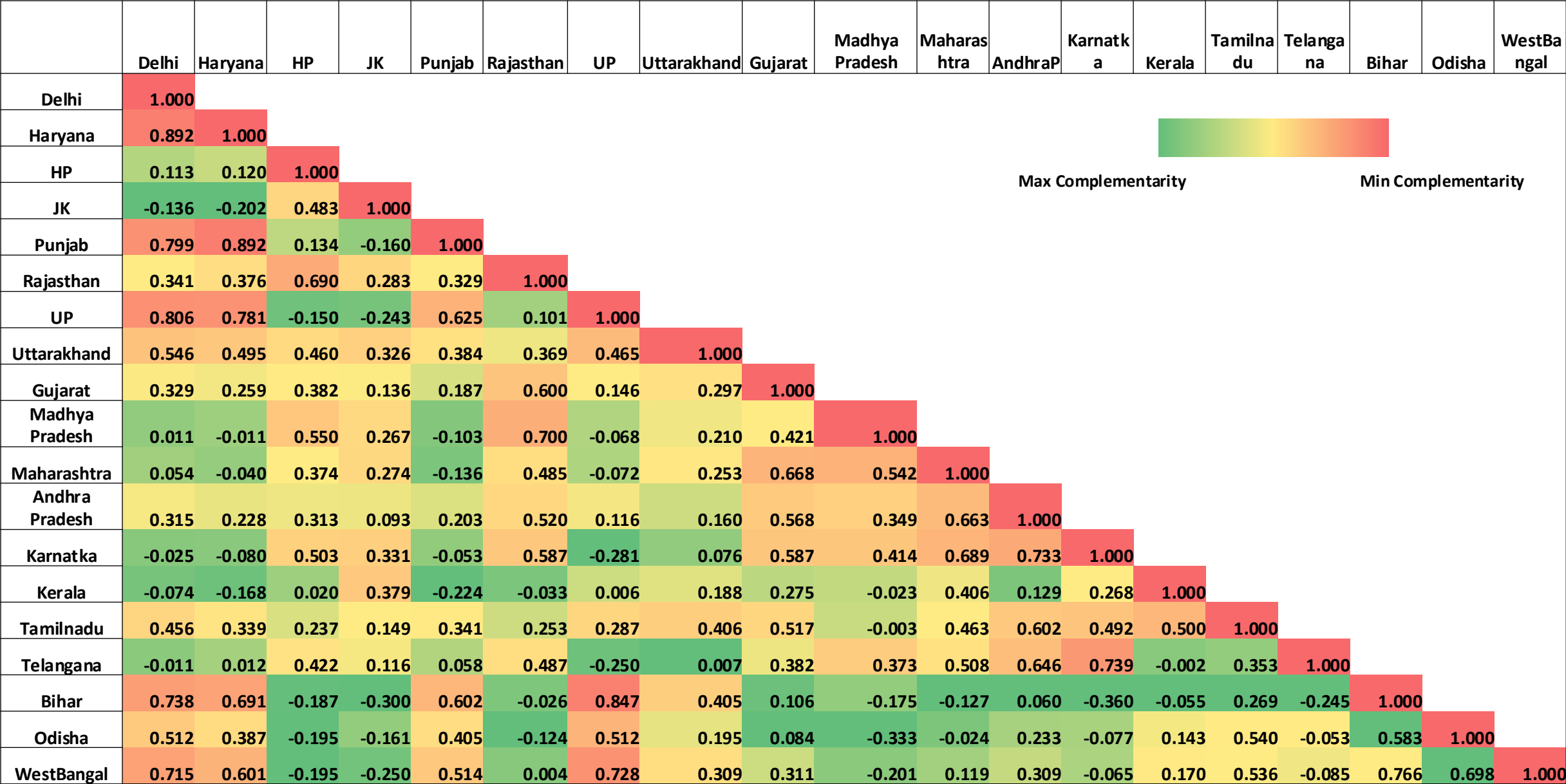


Status of RA studies	States
<b>Studies Completed till 2034</b>	Haryana, Jammu & Kashmir, Uttarakhand, Uttar Pradesh, Delhi, Chandigarh  Maharashtra, Goa, Gujarat, Madhya Pradesh  Andhra Pradesh, Telangana  Bihar, Jharkhand, West Bengal, Odisha, Sikkim, DVC
<b>Studies Completed till 2032, Study in progress for 2034-35.</b>	Himachal Pradesh, Rajasthan  Chhattisgarh  Tamil Nadu, Kerala, Karnataka  Assam, Tripura, Arunachal Pradesh, Meghalaya, Mizoram
<b>Studies Completed till 2032, Data awaited for 2034-35.</b>	Manipur, Nagaland Punjab

# Complimentary Load Profile of MP and Punjab



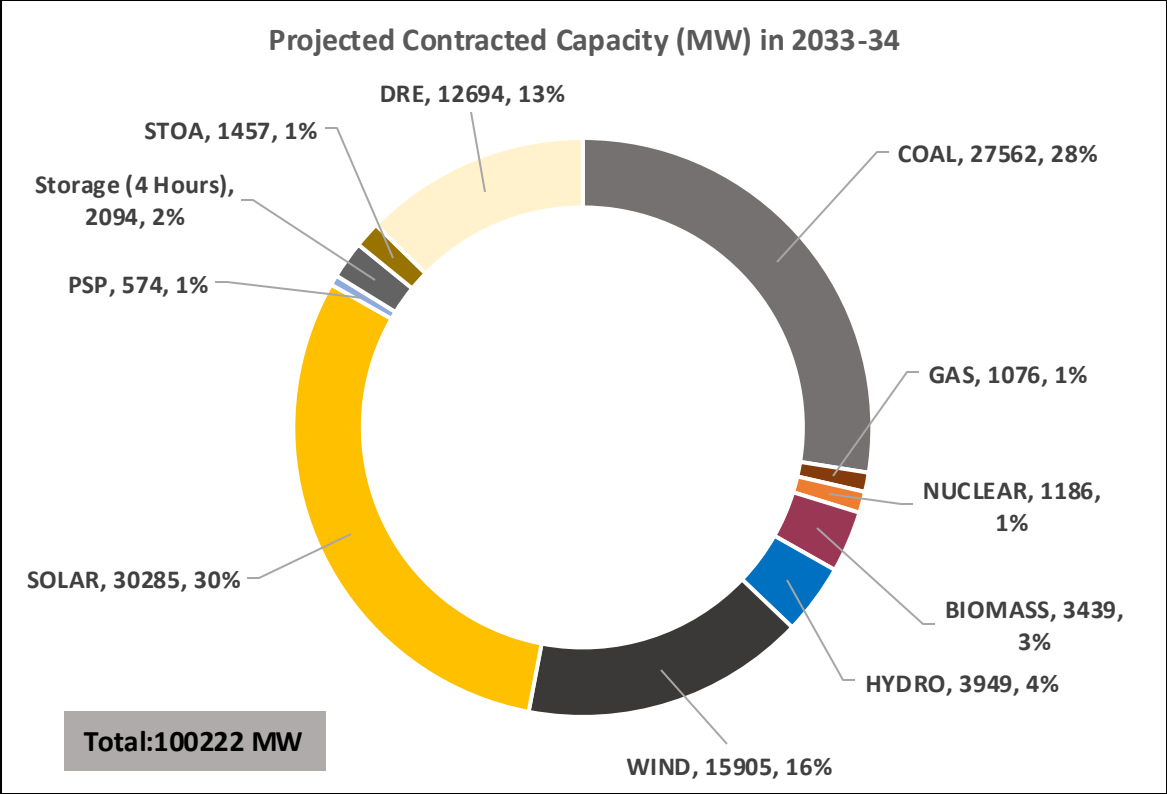
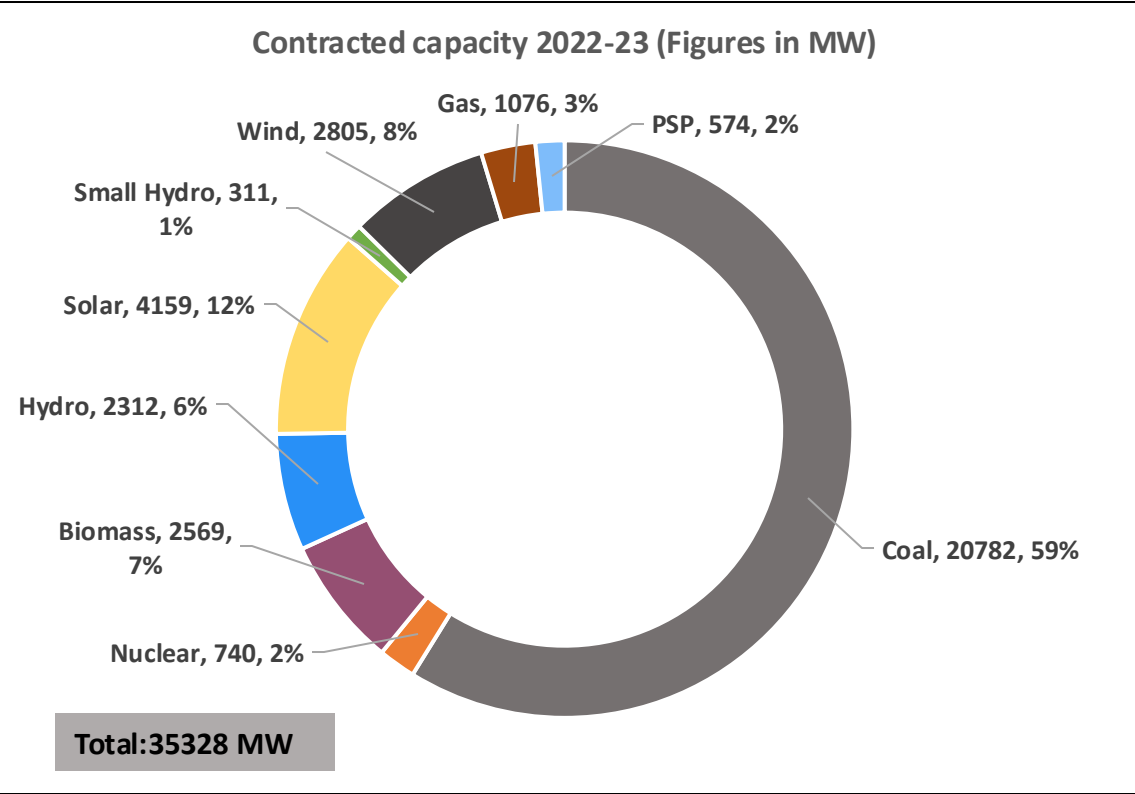
# Complimentary analysis of States



# Resource Adequacy Studies of Maharashtra (MSEDCL)

# Maharashtra (MSEDCL) (2024-25 to 2033-34)

	Peak (MW)	Energy (MU)
Actual (2022-23)	23225	155331
Projected (2033-34)	41956	239511



Capacity to be tied up till 2033-34 in addition to contracted capacity as on 2022-23 (Figures in MW)						
Thermal	Nuclear	Hydro	Solar + DRE	Wind	Biomass	Storage (4 Hours)
7781	446	1327	38819	13100	870	2094

# Maharashtra (MSEDCL)-Demand projections

Source: MSEDCL

Energy Requirement (MU) and Peak Demand (MW) Projections										
	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33	2033-34
Energy Projections (MU)	167746	175261	183949	192180	200590	210874	216301	221229	230034	239511
Year on Year Growth (Energy)		4.48%	4.96%	4.47%	4.38%	5.13%	2.57%	2.28%	3.98%	4.12%
Peak Demand Projections (MW)	24963	27621	30892	34298	35596	37163	38726	39000	40414	41956.38
Year on Year Growth(Peak)		10.65%	11.84%	11.02%	3.79%	4.40%	4.20%	0.71%	3.63%	3.82%

# Maharashtra(MSEDCL)-Projected Contracted Capacity (Figures in MW)

Year	COAL	GAS	NUCLEAR	BIOMASS	HYDRO	WIND	SOLAR+DRE	PSP	STOA	Storage (4 Hours)	DRE	Total
<b>2024/25</b>	22442	1076	1186	2749	2812	3405	12710	574	2482	0	2052	<b>49437</b>
<b>2025/26</b>	22442	1076	1186	3439	2812	3905	20069	574	3310	0	3001	<b>58813</b>
<b>2026/27</b>	22442	1076	1186	3439	2921	5405	25618	574	2359	378	4050	<b>65399</b>
<b>2027/28</b>	22442	1076	1186	3439	3234	6905	30239	574	1687	853	5171	<b>71635</b>
<b>2028/29</b>	22670	1076	1186	3439	3338	8405	32664	574	2057	1180	6379	<b>76589</b>
<b>2029/30</b>	25275	1076	1186	3439	3338	9905	34022	574	1117	1180	7737	<b>81113</b>
<b>2030/31</b>	25894	1076	1186	3439	3338	11405	36103	574	1250	1320	8818	<b>85585</b>
<b>2031/32</b>	26018	1076	1186	3439	3626	12905	38207	574	1218	1411	9922	<b>89660</b>
<b>2032/33</b>	26560	1076	1186	3439	3949	14405	40539	574	1487	1755	11254	<b>94970</b>
<b>2033/34</b>	27562	1076	1186	3439	3949	15905	42979	574	1457	2094	12694	<b>100222</b>

# Maharashtra (MSEDCL)-Year-wise Capacity to be Contracted (Figures in MW)

FY	Thermal		Nuclear	Hydro		SOLAR		Wind		Biomass	Storage (4 Hours)	Yearly STOA	DRE	Total	
	Planned	Additional	Planned	Planned	Additional	Planned	Additional	Planned	Additional	Planned	Additional	Additional	Additional	Planned	Additional
2024/25	1660	0	223	183	0	4943	0	500	0	76	0	2482	2052	7585	4534
2025/26	0	0	0	0	0	6410	0	500	0	690	0	3310	949	7600	4259
2026/27	0	0	0	109	0	4000	500	0	1500	0	378	2359	1049	4109	5786
2027/28	0	0	0	313	0	3000	500	0	1500	0	475	1687	1121	3313	5283
2028/29	228	0	0	104	0	717	500	0	1500	0	327	2057	1208	1049	5592
2029/30	3564	42	0	0	0	0	0	0	1500	0	0	1117	1358	3564	4017
2030/31	0	619	0	0	0	0	1000	0	1500	0	140	1250	1081	0	5590
2031/32	0	124	0	288	0	0	1000	0	1500	0	91	1218	1103	288	5036
2032/33	0	542	0	323	0	0	1000	0	1500	0	344	1487	1332	323	6205
2033/34	0	1002	0	0	0	0	1000	0	1500	0	339	1457	1440	0	6738
Total	5452	2329	223	1320	0	19070	5500	1000	12000	766	2094		12693	27831	

Thank You.!!