Resource Adequacy Plan Perspective of MSEDCL

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Maharashtra State Electricity Distribution Co. Ltd.

Importance of RA in MSEDCL's Operations

Resource Adequacy is the backbone of a reliable electricity system. Ensures the power system has sufficient resources to reliably meet electricity demand under various conditions, accounting for peak loads, unexpected outages, and renewable variability.

Resource adequacy plays an important role in:

- **Reliability of Supply:** Ensuring a consistent and uninterrupted power supply to Maharashtra's diverse consumer base.
- **Economic Efficiency:** Strategically procuring a balanced energy mix to minimize costs and maintain competitive electricity tariffs for consumers.
- **Compliance with Regulatory Standards:** Ensuring that MSEDCL meets all regulatory requirements while ensuring a robust and compliant electricity supply.
- **Grid Stability and Addressing Peak Demand :** Preparing for uncertainties like peak demand, fuel shortages, and potential grid disturbances to avoid disruptions in power delivery.
- **Support for Industrial Growth:** Providing a reliable power supply to Maharashtra's industrial sector, essential for the state's economic growth and productivity.
- **Sustainable Energy Integration:** Incorporating renewable energy sources like solar, wind, and hydro into the grid, ensuring that the state meets its environmental targets while maintaining reliability.
- **Flexibility in Power Procurement:** Utilizing a diverse set of generation sources, including thermal, renewable, and emerging technologies, to handle fluctuations in demand and supply.

Challenges towards Resource Adequacy Planning

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Ensuring resource adequacy is essential for MSEDCL to deliver reliable power supply amidst growing demand, renewable integration, and evolving grid complexities; however, this comes with challenges that must be effectively addressed.

Challenges

- **Demand Variability**
- **Accuracy of Forecast**
- **Integration of Renewables**
- **Transmission Constraints**
- **Integration of New Technologies** (Roof-top, Solar-pump, Green OA etc.)
- **Capacity Credit methodology**
- **Resource Tie-up for Peak Demand**

Challenges towards Resource Adequacy Planning

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1. **Demand Variability**

Dynamic Consumption Patterns:

- Maharashtra's power demand fluctuates significantly due to its diverse consumer base: agricultural irrigation, high industrial activity, and rapid urbanization. This results in variations in customer demand.
- Sharp seasonal and daily peaks create operational challenges for balancing supply and demand.
- 30% Agri demand hampers power procurement planning as it depends on the rainfall which unpredictable on longer horizon.

2. Accuracy of Forecast

- Despite using advanced models and scientific methods, there is inherent uncertainty in demand predictions
- Deviations between forecasted and actual demand can result in:
  - *Stranded Capacity: Overestimation may lead to underutilized assets.*
  - *Insufficient Capacity: Underestimation risks unmet power demand during peak periods.*

3. Integration of Renewables

Ambitious Targets:

Maharashtra's push for renewable energy, particularly solar and wind, aligns with national goals.

Intermittency Challenges:

- Integrating Renewable Energy (RE) into capacity planning is challenging due to its intermittent and variable nature which makes the availability unpredictable.
- Balancing the grid amidst renewable energy fluctuations requires robust storage solutions and operational flexibility.

Challenges towards Resource Adequacy Planning

4. Transmission Constraints

Bottlenecks in Power Delivery:

- Transmission infrastructure expansion should be in line with the generation capacity addition plan otherwise it affects the power evacuation and cause financial implications to the Discom.

Impact on Grid Operations:

- Transmission constraints can lead to stranded generation capacity even when demand exists elsewhere.
- Regions with insufficient transmission capacity may face unmet demand or voltage issues.

5. Integration of New Technologies

Emerging Trends:

- Growth in Electric Vehicles (EVs), Rooftop Solar installations, and energy storage systems is transforming the power landscape.
- The estimated impact of solar roof-top, solar pump and EV demand may vary which will impact on adequacy planning may results in standard capacity or shortfall in capacity.

Grid Impacts:

- Decentralized energy generation and EV charging infrastructure add complexity to grid management.

Challenges towards Resource Adequacy Planning

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6. Resource Tie-up for Peak Demand

Peak Hour Challenges:

Resource adequacy studies recommend contracting sufficient capacity to meet peak demand and national co-incident peak demand. Ensuring the capacity planning is compliant with both the requirements may lead to surplus and economic losses.

- **Surplus Power During Off-Peak Hours**: Non-peak hours might see significant power surplus, which tend to increase the management complexities.
- **Technical minimum of thermal power plants:** During the surplus hours (Solar hours) all the thermal generators might run at technical minimum and despite this there may be surplus power available which may be difficult to manage.
- **Economic Implications**: Maintaining surplus capacity raises costs, potentially straining budgets and increasing tariffs.

***7.* Capacity Credit methodology**

- As per the MERC regulation, the five-year average CC factors has to be used for the study.
- The top load hours have been different for MSEDCL historically and all the RE resources were not present historically, hence capacity credit estimation would then not be justified if the historical load pattern is different.
- Thus, calculating CC factors considering top 250 hrs, which might not capture the actual contribution of the resources and will result in lower values.
- Lower capacity credit requires higher capacity additions to ensure that firm capacity requirements are met. However, this excess capacity may prove unnecessary, leading to surplus generation and increased financial costs
- Thus, using top 10% of load hours gives more accurate results as most of the generation is captured in top 10% hours

Challenges towards Resource Adequacy Planning

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8. Generation uncertainty

- Generation of old thermal power plants particularly of state Genco is not consistent and by using its contribution to meet demand based on historical data may affect the resource adequacy planning.
- In Resource adequacy capacity should be added in such that the power purchase cost should be optimize and for this resources like solar, wind capacity requires to be added in portfolio.
- Wind generation is maximum generally in rainy season and adding wind capacity in portfolio will result excess capacity during lean demand period.

***9.* Monitoring of real time Demand and Generation**

- In Maharashtra real time demand visibility is still not available, which hampers real time demand management.
- In Maharashtra most of the distributed solar generation will be added in next two-three years, hence proper visibility of the distributed generation is needed as it hampers demand management at state level.

MSEDCL's Approach to Resource Adequacy

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To address these challenges, MSEDCL has developed a robust framework for Resource Adequacy Planning, focusing on the following pillars:

- **Comprehensive Demand Forecasting :**
  - MSEDCL utilised advanced analytics and AI-driven model to assess and forecast demand (MW) and energy (MWh) including open access and other emerging impacts
- **Diversified Resource Portfolio**
  - **Flexible and Innovative Solutions:** With the increasing share of intermittent renewable energy sources (RE). A diversified mix of resources helps in maintaining a balance between generation and demand, even during periods of low renewable energy output.
  - **Energy Storage:** ESS increases the flexibility and reliability of renewable energy resources, allowing them to act as firm capacity during periods of high demand or low renewable output.
- **Grid Modernization**
  - Upgrading infrastructure with smart grid technology to improve real-time monitoring and management of demand and supply.
  - Implementing advanced metering infrastructure (AMI)
- **Strengthening Transmission and Distribution Networks**

  Collaborating with MSETCL to alleviate transmission constraints.

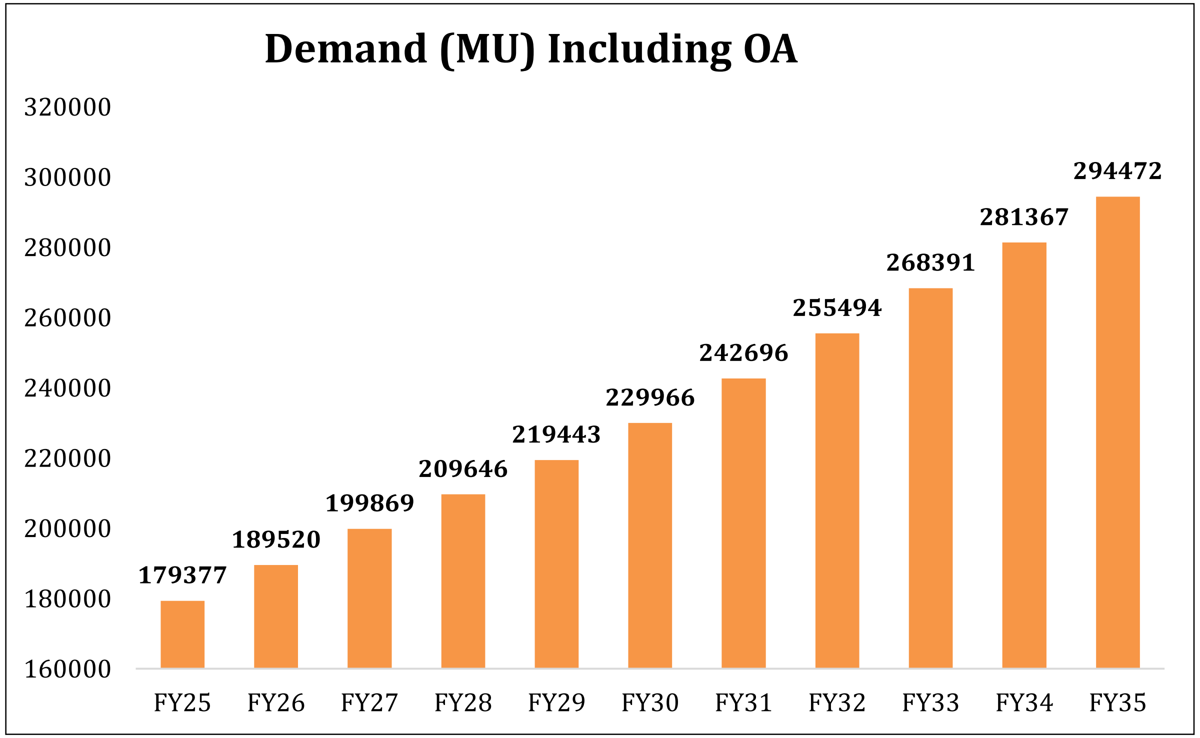
  Expanding and upgrading distribution networks to accommodate increased load and renewable integration.

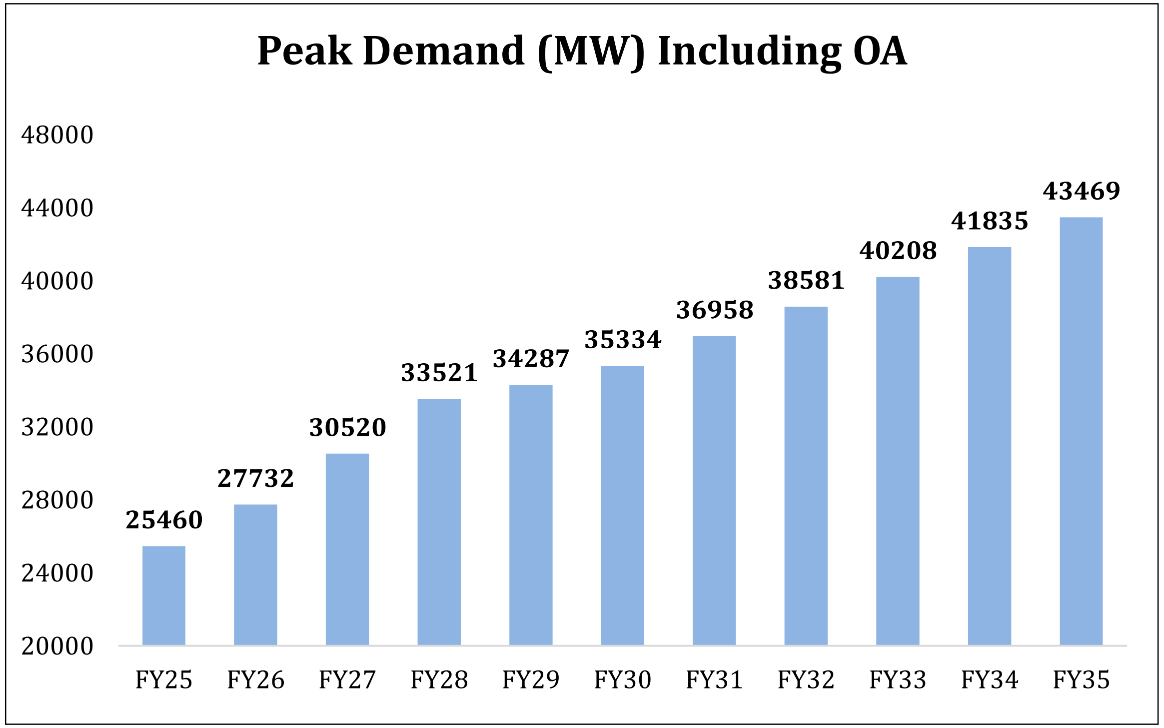
Comprehensive Demand Forecasting

- MSEDCL's business interests serve the major consumer categories; Domestic, Commercial, LT Industries, HT Industries, Public Water Works (PWW), Streetlight , and Agriculture. To forecast the overall demand of MSEDCL, a hybrid model approach is employed, combining both time series (SARIMA) and econometric models.

- MSEDCL has additionally considered impact of policy interventions including:
  (i) promotion of Electric Vehicles, (ii) Roof Top Solar (RTS), (iii) Solar pumps, (iv) shifting of agricultural load and (v) open access.

- MSEDCL is projected to have **a peak of 35 GW in FY2030 and 43 GW in FY2035**, with the demand increasing at a CAGR of 5.1%.





Resource Adequacy Planning - Result

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- As per the LT-DRAP study, the target value of 0.2% LoLP and 0.05% EENS have been observed **at 7% PRM above the peak**.
- The capacities are planned considering a PRM of 7% above the peak.
- The below table shows the year-on-year cumulative contracted capacities at 7% PRM above peak demand

Cumulative capacity addition (in MW)

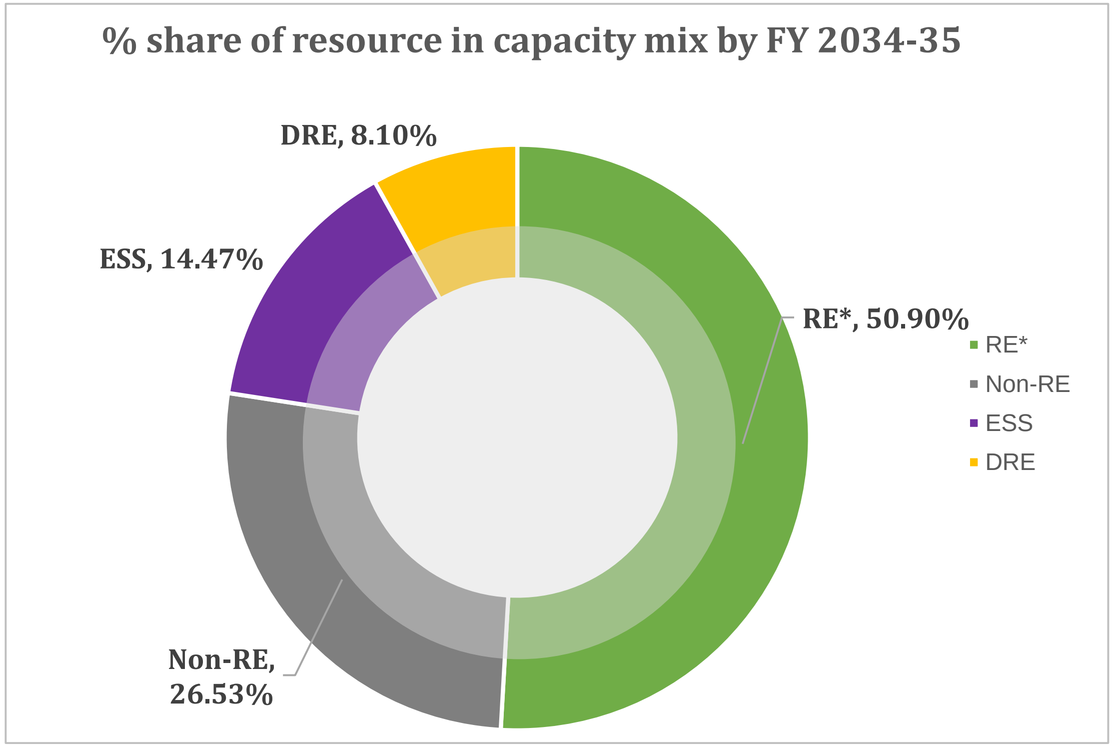
Year	Thermal	Solar	Wind	Hydro	SHP	Hybrid	FDRE	Biomass	Nuclear	BESS-2hr	Bess-4hr	PSP	RTS (DRE)	TOTAL
2026	22551	16031	2823	2825	317	300	-	2911	1191	-	-	250	2675	**51874**
2027	22551	20506	2823	2934	317	2880	1468	3256	1191	-	-	250	3234	**61410**
2028	22551	20506	2823	3247	317	2880	1468	3601	1191	-	-	250	4016	**62850**
2029	22551	24506	4823	3351	317	2880	1929	3601	1191	-	-	1183	5111	**71444**
2030	23379	28506	4823	3351	317	2880	2000	3601	1191	-	-	4601	6644	**81293**
2031	24834	29506	4823	3351	317	2880	2000	3601	1191	-	-	5806	6909	**85218**
2032	24834	30506	4823	3639	317	2880	2000	3601	1191	-	-	8177	7189	**89157**
2033	24834	31506	4823	3962	317	2880	2000	3601	1191	622	1238	8574	7485	**93034**
2034	24834	32506	4823	3962	317	2880	2000	3601	1191	1414	2812	8574	7798	**96712**
2035	25434	33506	4823	3962	317	2880	2000	3601	1191	1989	3957	8574	8129	**100364**

Resource Adequacy Planning - Result

Year-on-year Capacity Addition as per MSEDCL current plan (in MW)

Year	Thermal	Solar Intra	Solar Import	Wind Intra	Wind Import	FDRE	BESS-2	BESS-4	PSP	DRE*
2026	-	-	-	-	-	-	-	-	-	399
2027	-	-	-	-	-	-	-	-	-	559
2028	-	-	-	-	-	-	-	-	-	782
2029	-	-	4000	1000	1000	461	-	-	933	1095
2030	600	-	4000	-	-	71	-	-	3093	1533
2031	600	-	1000	-	-	-	-	-	1205	265
2032	-	-	1000	-	-	-	-	-	2371	280
2033	-	1000	-	-	-	-	622	1238	397	296
2034	-	1000	-	-	-	-	791	1574	-	313
2035	600	1000	-	-	-	-	575	1145	-	331
Total	**1800**	**3000**	**10000**	**1000**	**1000**	**532**	**1989**	**3957**	**8000**	**5853**

- The proportion of **RE based capacity*** in the total contracted capacity is projected to increase to **51%** by 2034-35, excluding storage and Distributed Renewable Energy (DRE).
- This increase aligns with the Renewable Purchase Obligation (RPO) trajectory, reflecting a greater reliance on RE based generation.



*inclusive of hydro

Collaborative Stakeholder Engagement and Looking Ahead.

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- MSEDCL recognizes that Resource Adequacy is not a solitary endeavor. It requires collective effort:
  - **With Generators:** Ensuring timely capacity addition through coordinated planning with generation companies.
  - **With Consumers:** Educating consumers on energy conservation and the role of demand-side management in maintaining grid stability.
  - **With Policymakers:** Advocating for policies that support investment in renewable energy and grid infrastructure.

- **Looking Ahead: A Resilient and Sustainable Future**
  - As MSEDCL moves forward, our Resource Adequacy Plan will evolve to address emerging trends such as:
  - Increased penetration of **distributed energy resources (DERs)**.
  - A sharper focus on **climate resilience**, ensuring that our systems can withstand extreme weather events and other disruptions

Thank you

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