

Challenges in Ensuring Resource Adequacy in RE-Rich Power Systems

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December 16, 2024

Overview

- MoP Framework and its basis
 - Recognizes some of the challenges, but as RE increases, framework will need some modifications.
- Challenges with RE
- Recommendations for strengthening Resource Adequacy (RA) framework.

MoP Framework for RA

- Uses three reliability metrics: LOLP, PRM, and NENS
- Similar to approach used by many states in the US
 - In the US, rethinking of approach after two recent major reliability failures: (1) 2 days of rolling outages in California in August 2020; and (2) Extreme winter storm in Texas in February 2021.
- MoP's approach recognizes some of the challenges with a RE-rich system
- MoP framework good starting point—Variable RE contribution small ~ 12.6%
- As RE contribution grows rapidly, may have problems
- Some suggestions to strengthen the framework to prepare it for a RE-rich future.

Challenges with RE - 1

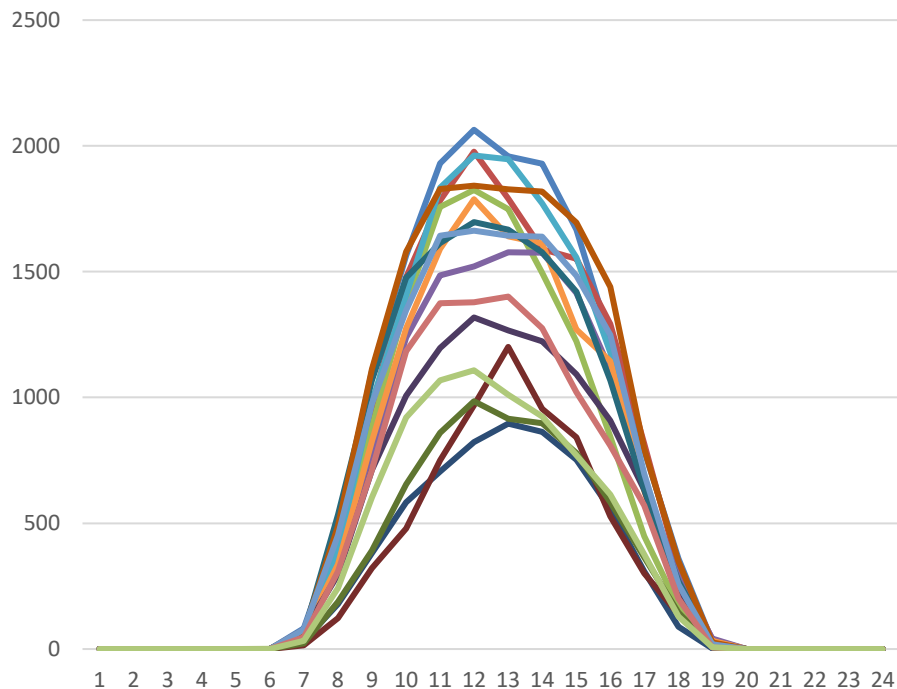
- Maximum vulnerability of the system not necessarily at time of peak load.
 - Having an adequate PRM does not guarantee that system reliable
- Correlated Failures/Outages
 - With fossil fuel driven power plants, outages can be assumed to be independent of each other
 - With RE and extreme weather events, failures can occur over a wide region → much wider and bigger outages
 - For example, in Spain in March 2022, extreme dust storm halved the solar output nationally for two weeks. On worst day, drop was 80% for the country.
 - In India, recurring coal shortages occur Sept-Oct and Mar-April affects all coal plants.

Challenges with RE - 2

- Multiple Stressors Occurring Simultaneously
 - Increased dependence on weather
 - Example: heat wave, dust storm and dry hydro reservoirs coincide.
 - In May 2018, 3 major back-to-back dust storms over large part of North India followed by heavy rainfall. Solar generation would have been severely affected.
 - Impact of correlated outages becomes even greater.
 - Can lead to high impact, low probability events
- RE power plants likely to have fewer but longer outages
- Annual aggregates of loss metrics not enough
 - Individual outages' depth and duration important indicators of consumer distress.
- Cannot rely on historical data alone for estimating demand and RE generation
 - Due to climate change and more frequent extreme weather events, the future will be different from the past
- Variability of RE makes it difficult to rely on averages of generation as a reliable proxy.
 - Use of PRM as a measure of RA relies on capacity credits. This variability indicates that using capacity credits for RE may not be appropriate.

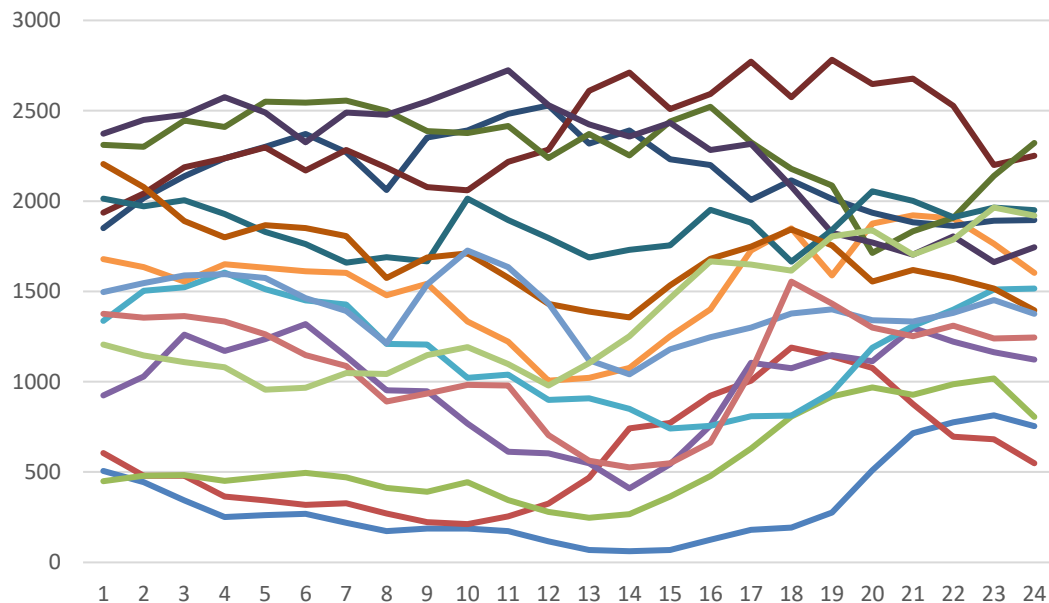
Variability of RE Generation

Solar Generation in Maharashtra for 15 Consecutive Days in Sept 2023 (In Megawatts)



Variability of RE Generation

Wind Generation in Maharashtra for 15 Consecutive Days in Sept 2023 (In Megawatts)



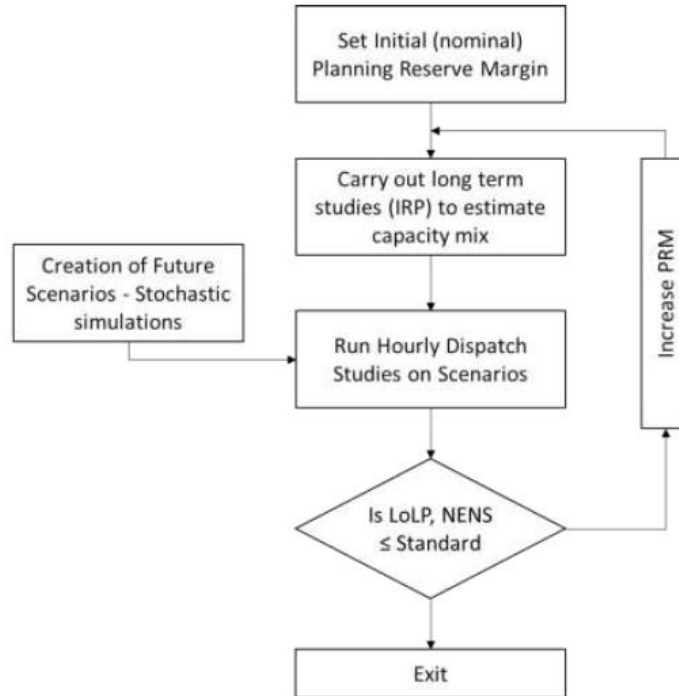
Recommendations for Strengthening Framework - 1

- Use Loss of Load Hours (LOLH) instead of LOLP
 - Hourly metric more intuitive. MoP framework also recommends modelling on an hourly chronological basis.
- Consider using multiple metrics for RA
 - Depth, duration, and frequency of outages and their probability important.
- Stress test for low probability, high impact events

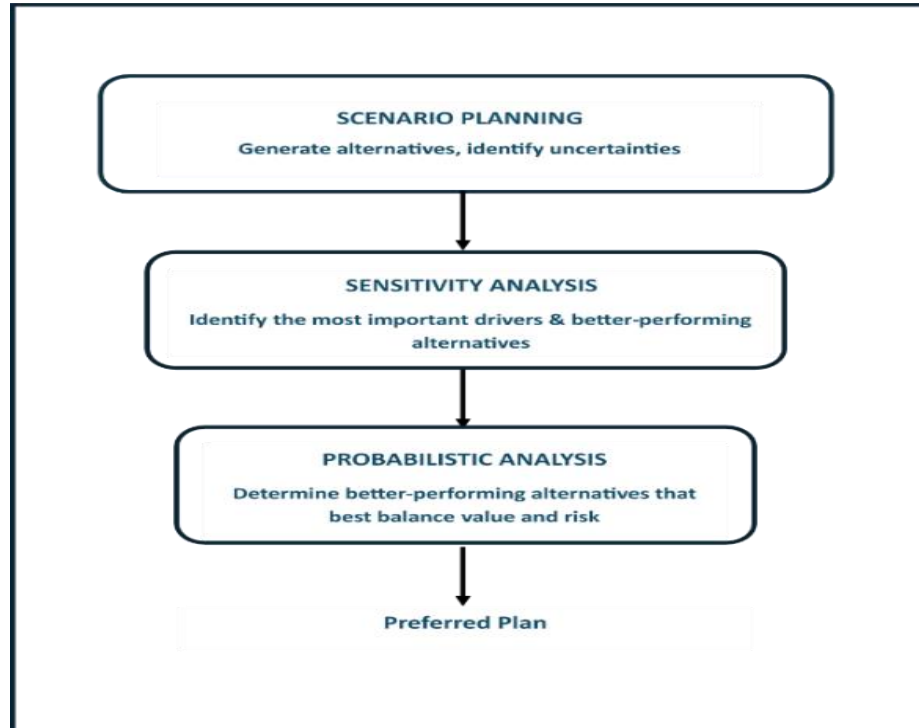
Recommendations for Strengthening Framework - 2

- Collaborate with climatologists for projections of future demand and RE generation.
 - Do not rely on historical data alone.
- Evaluate a few alternate plans to get best balance of value and risk
 - Optimality of a plan should include not only cost under base case conditions but also volatility under uncertainties

Risk Management Approach from Framework



Best Practice for Addressing Uncertainty and Managing Risk



Concluding Remarks

- MoP framework is a good starting point and will work now when the contribution from variable RE is low (~12.6% for FY 2022-23)
- However, as RE contribution grows, ensuring RA will become more challenging.
- Our recommendations may increase complexity of planning.
 - But they are important to avoid decreased reliability and increased costs in the future.
 - Neglecting these recommended changes could lead to the entrenchment of outdated practices, making future framework revisions more difficult.

For More Information

Please refer to our paper, available on the CSEP website:

Singh, D., Chitnis, A. (2024). *Strengthening the Resource Adequacy Framework for an RE-Rich Future* (CSEP Technical Paper 6). New Delhi: Centre for Social and Economic Progress.

Thank you