A Probabilistic Approach to Resource Adequacy Assessment

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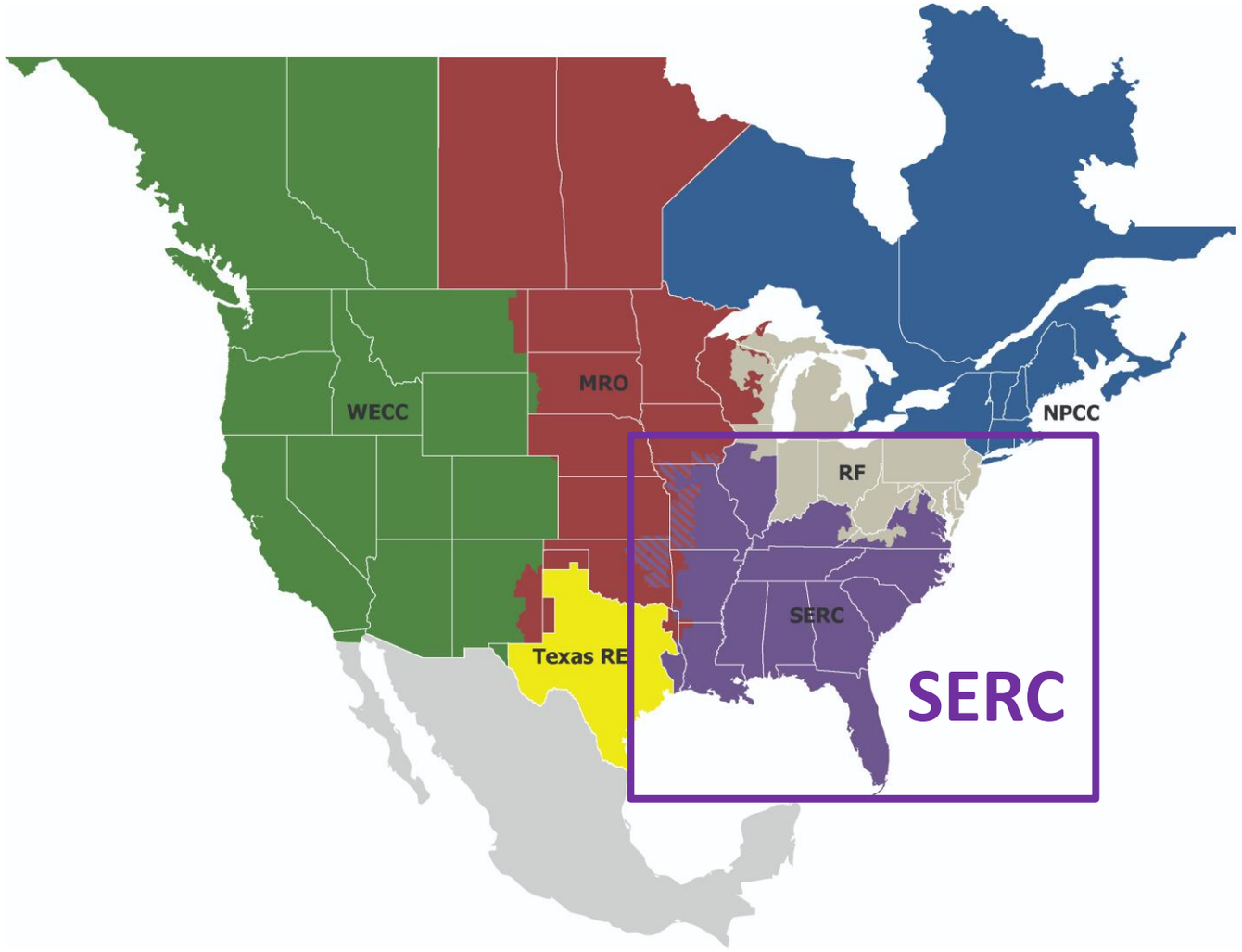
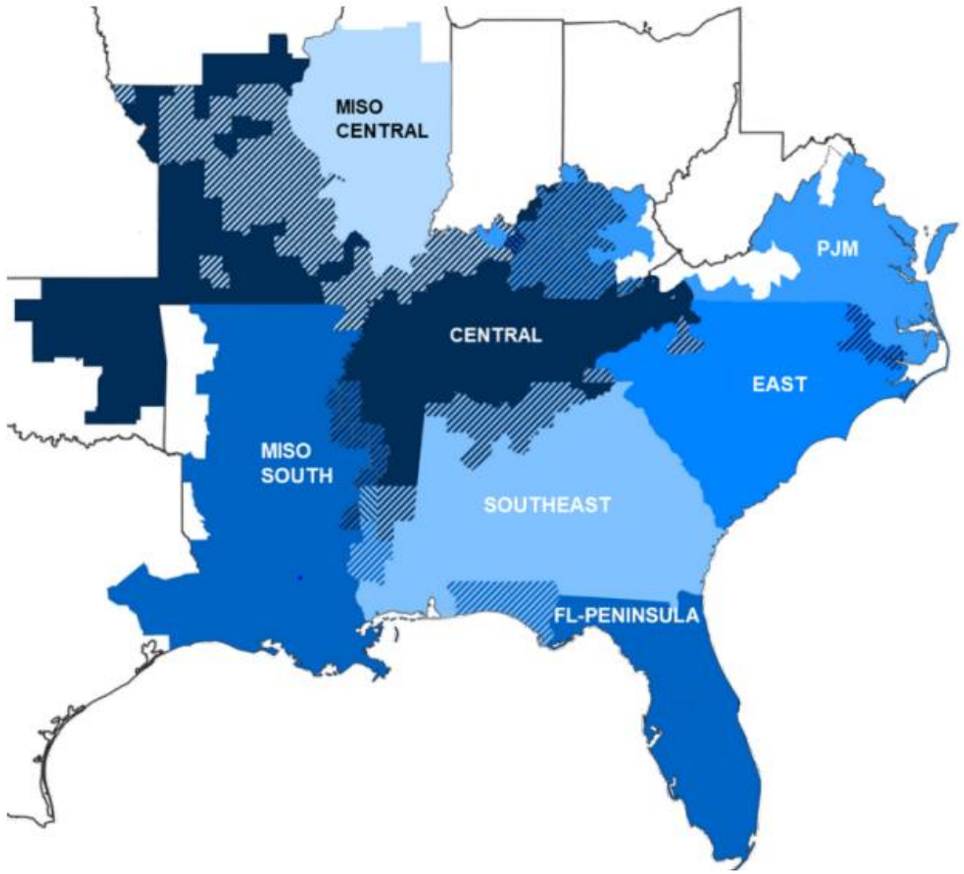
Topic Overview



1. About SERC
2. Benefits of probabilistic tools
3. Communicating results
4. Data requirements
5. SERC's extreme winter modeling

SERC Mission: Assure effective and efficient reduction of risks to the reliability and security of the BPS



- Non-profit, one of only six Regional Entities across North America
- Area: ~ 630,000 square miles, all or portions of 16 states in the Southeast of US
- Volunteer based participation of members through technical committee structure

Capacity resources	310 GW
Total internal demand	258 GW
Transmission miles, ≥100kV	122,000

DUKE ENERGY® MISO TVA TENNESSEE VALLEY AUTHORITY

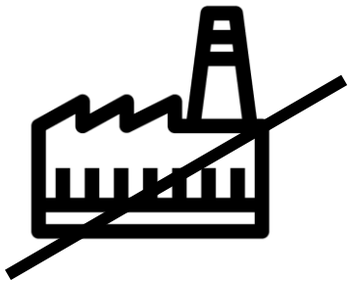
FRCC Florida Reliability Coordinating Council, Inc. Southern Company

..and others

Probabilistic tools allow factoring multiple variables

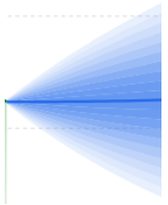
8760 Hours assessment

Historical weather-based load and resource

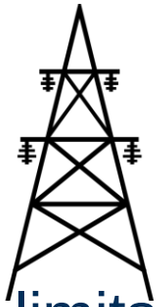


Generator forced outages

Maintenance outage schedule



Load forecast error (LFE)



Power flow limits

Example simulation case count

40 weather years

X

5 points LFE

X

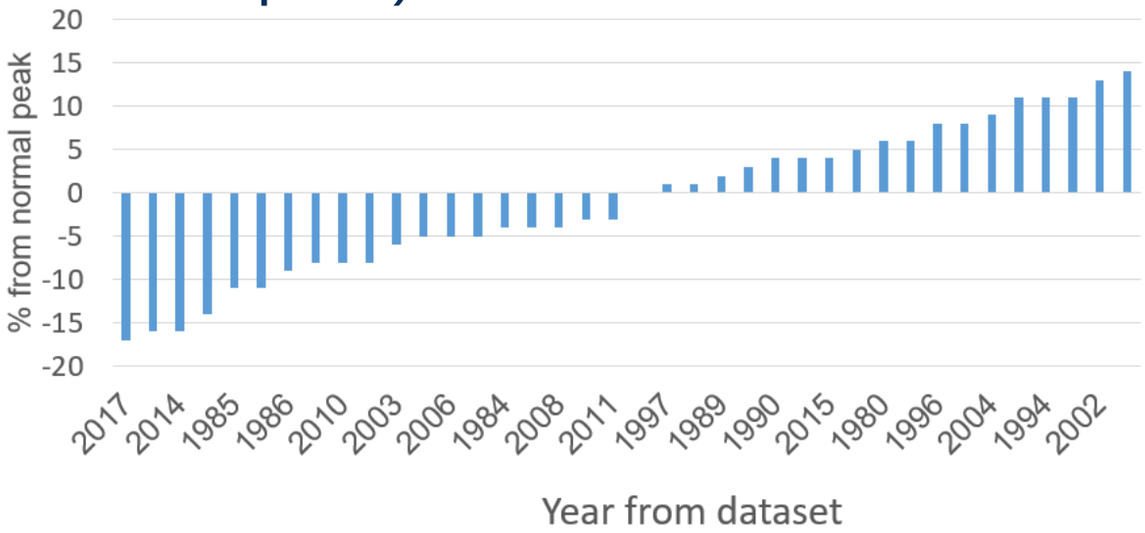
25 outage draws

= **5, 000** Simulations for each hour of a study year

Data Requirements

Data (SERC example)	Source
Load, capacity forecast	SERC registered entities
Solar Nameplate data	SERC + EIA 860
Forced outages	NERC GADS fuel type averages
Transfer limits	SERC calculated
Weather year data	Vendor
Solar, wind profiles	Vendor/ NREL etc
Load Forecast Error, economic dispatch	Modeling assumption
Planned generator outages	Software

Example variability of load (% from normal peak)

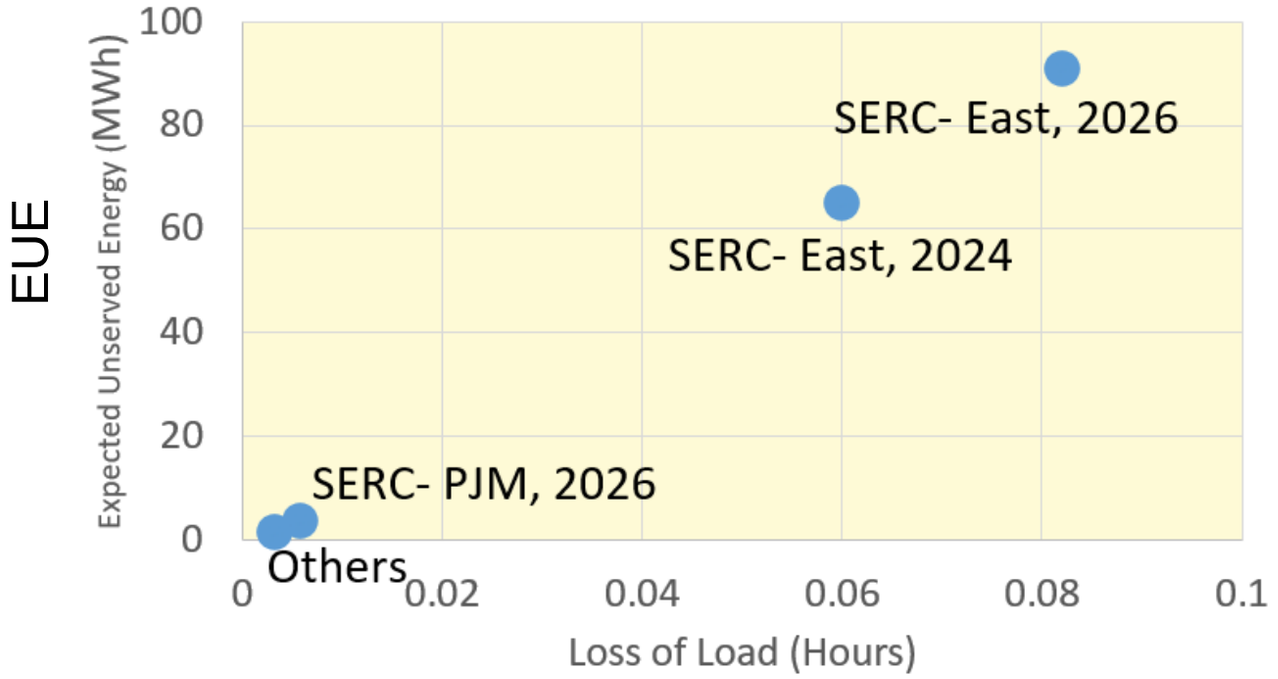


Load scaling varies by subregion with the projected study year as median value

Communicating Probabilistic Results

1. Modeling assumptions vary widely, impact metrics need to be communicated.
2. Not all events are the same risk. Use multiple metrics to tell a story.
3. Assess metrics with context to system size. Ex: 90 MWh of EUE might seem like a lot but for 237619 GWh of annual net energy for load, it is only 0.39 parts per million.

Example composite metric view: Magnitude, duration, and frequency of loss of load event



Communicating Probabilistic Results-cont.

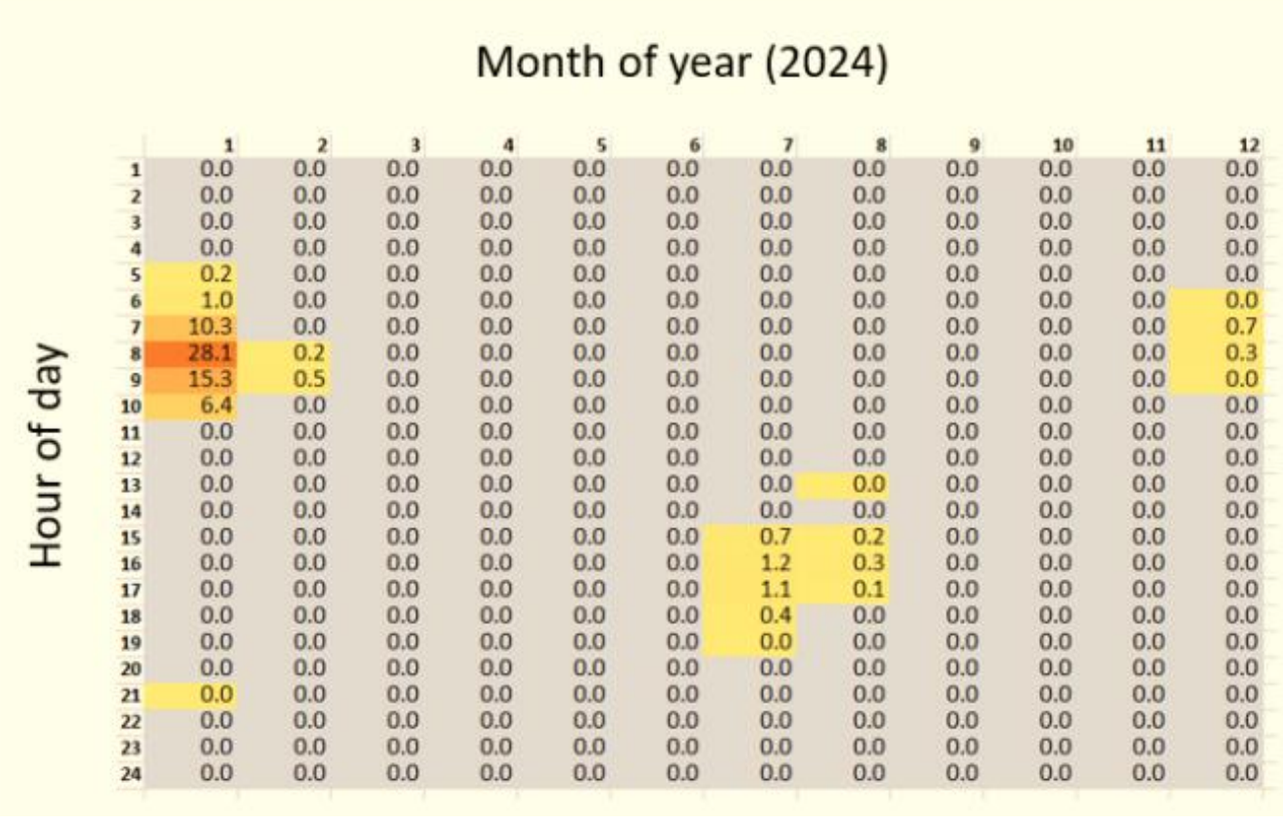
5. Statistical results could be non-intuitive to audience. Example, coin toss experiment: win $10 for heads and lose $ 5 for tails.

“Expected” earning = 0.5*$10 -0.5*$5
= $2.5

Focus on narrative and patterns for practical takeaways.

6. Visuals that communicate high-level risks are an effective starting point which can then be supplemented with details.

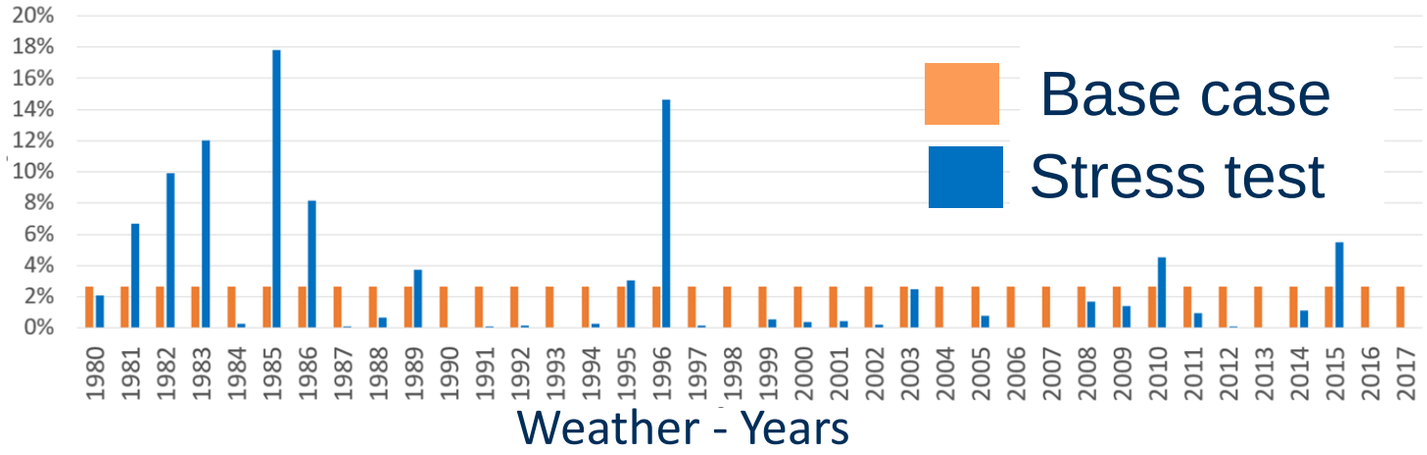
Example EUE (MWh) heat map



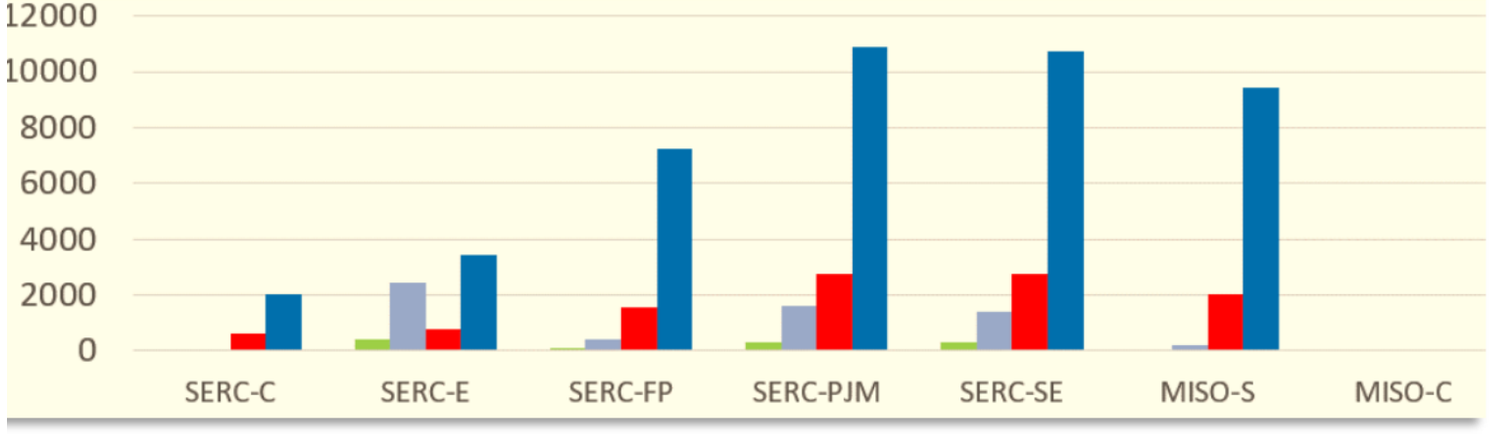
Hour of day	1	2	3	4	5	6	7	8	9	10	11	12
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	10.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7
8	28.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
9	15.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	6.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.2	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.3	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.1	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Modeling extreme winter scenario for wide area (stress test)

Example: Probability weighting of weather-years



Expected Unserved Energy (MWh)



1. Avoided arbitrary model of future
2. Increased probability of extremer winter years by subregion
3. Each subregion was at its 90/10 load with assumed correlated generator outages

Base case

Weather reweighted

2x outages

Combined weather + 2x outages

Key Takeaways

1. Sharing SERC's experience so that others may benefit.
2. Probabilistic tools can handle multiple variables and system constraints. Use simple, practical assumptions where needed.
3. Historical weather-year data sets can be used by increasing frequency and or intensity of events on a subregional basis.
4. Focus on trends and narrative instead of just the numbers for practical takeaways. Normalized metrics can be insightful.
5. Region wide modeling captures risks such as reliance on power transfers that may not be captured in smaller area assessments.

Additional References

Publicly available at Serc1.org

Available on the NERC Probabilistic Assessment Working Group website

Questions

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