Renewable Lulls: Issue Discovery Report

A collaborative initiative between the NYSRC EWWG and ICS

1. Background:

The rapid transformation of New York's power system toward a decarbonized grid will increase reliance on intermittent power resources, including offshore wind (OSW), land-based wind (LBW), and solar photovoltaic (PV). As identified in prior analyses, extended periods of low renewable generation, or "renewable lulls", pose a significant challenge to resource adequacy and system reliability.

Recent studies highlight concerns over the frequency, duration, and interregional impacts of wind and solar lulls. Given the state's Climate Leadership and Community Protection Act (CLCPA) targets, which include 9,000MW of OSW by 2035 and 10,000MW of distributed PV by 2030, understanding the potential reliability risks associated with these lulls is critical.

Reliability in the traditional interconnected power system is built on the principle that the forced outages of individual generators occur independently, ensuring that not all capacity is lost at the same time. However, the increasing penetration of OSW, LBW, and PV introduces highly correlated variability, where extended renewable lulls can simultaneously reduce generation across large geographic areas. Unlike thermal outages, which are random and uncorrelated, wind and solar are subject to regional weather patterns that can persist for days at a time, meaning that large portions of the renewable fleet can become unavailable at once. Furthermore, because these lull events extend beyond the NYCA's borders, they reduce the availability of emergency capacity from neighboring ISOs, challenging long standing assumptions about reserve sharing.

This issue discovery report will begin to explore how extended renewable lulls impact the ability of the power system to meet reliability requirements, with a particular focus on:

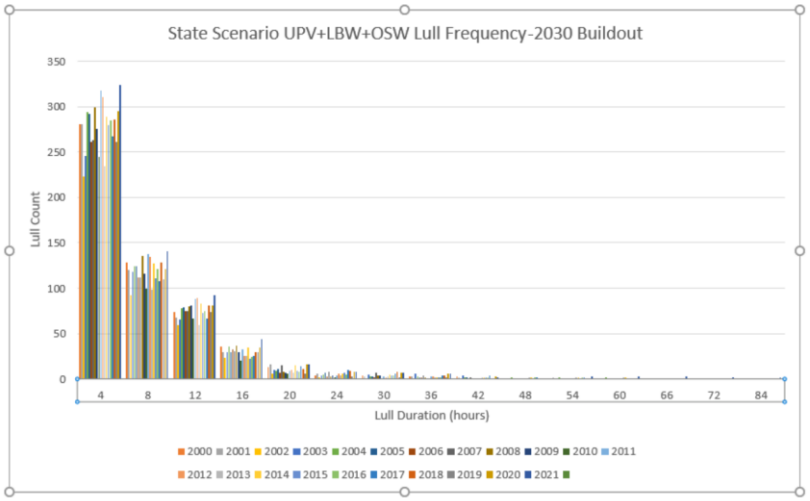
- Historical lull events and their durations.
- Impacts on system planning.
- Interregional wind lull correlation and its effect on emergency assistance from neighboring ISOs.
- Potential mitigation strategies, including enhancements to resource adequacy modeling.

2. Survey of Existing Work:

Existing studies have reinforced the challenges posed by correlated renewable lulls. The NYISO System & Resource Outlook (SRO) Appendix E: Renewable Profiles & Variability[1] highlights the increasing importance of spatiotemporal correlations in renewable generation as wind and solar become dominant sources of supply. Thus study leverages over 20 years of weather data to analyze OSW, LBW, and PV generation patterns, confirming that wind and solar lulls can persist for multiple days and extend across wide geographic areas. This appendix defines lulls as periods where renewable output drops below a critical threshold (10% NCF) for an extended duration. This report identified lulls as long as 83 hours for LBW and as long as 56 hours for OSW.

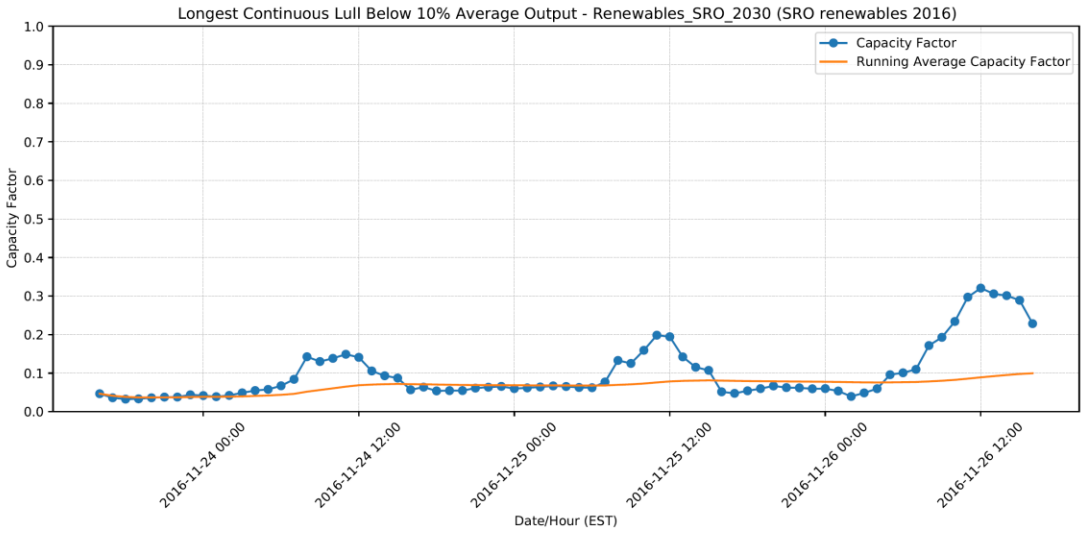
[1] https://www.nyiso.com/documents/20142/46037616/Appendix-E-Renewable-Profiles-Variability.pdf/76833f16-ca0b-0439-6bae-e45eb75d88fe

2024 EWWG work expanded on the Appendix E analysis redefining lulls to be periods of average capacity factor below a critical threshold (10% NCF)[2]. Average capacity provides a more reliable metric for assessing the severity of a lull event. This is because average capacity factor better reflects the sustained generation shortfall over the lull period, rather than a single moment of peak generation. This expanded analysis indicates that 24 hour combined renewable lulls (OSW+LBW+UPV) occur multiple times per year with 72 hour lulls occurring multiple times over the 20 year dataset.



Note: The above chart represents lull frequency of the stated buildout type based on which year of NYISO (DNV) renewable data used to develop the overall capacity weighted net capacity factor profile.

Lulls for the purpose of this analysis were defined as periods where **rolling average capacity factor** was below 10%. Rolling mean was implemented using pandas.DataFrame.rolling method.



This analysis also identified that multi day renewable lulls are common across all major renewable resource types. The longest PV lull events exceed 1,200 hours (50+ days), typically occurring in the winter months, when insolation is low and cloud cover is persistent. LBW lull durations vary widely, with

[2] https://www.nysrc.org/wp-content/uploads/2024/10/2030_State_Scenario_Lull_Frequency.pdf
https://www.nysrc.org/wp-content/uploads/2024/10/2030_State_Scenario_Longest_Lulls.pdf

some events lasting up to 575 hours (~24 days) particularly in summer months. OSW lulls show relatively shorter but still significant lull periods, with events frequently exceeding 100 hours (4+ days).

A new addition to the 2025-2026 IRM Study, Table B.3 Results by Weather Year, provides a granular, weather specific assessment by reporting Loss of Load Expectation (LOLE) for each historical weather year in the IRM model[3] [4]. This data point aids in quantifying how different historical weather patterns impact system adequacy, revealing substantial variation in loss of load risks. In future IRM studies, as OSW, LBW, and PV penetrations increase, this variation will likely become more pronounced.

3. Methodology and Data Sources:

This analysis will leverage:

- NYISO historical renewable generation (DNV datasets) covering OSW, LBW and PV performance.[5]
- 2024 EWWG lull analysis documents which detail the longest lull events and lull frequency projections.
- 2023-2042 System and Resource Outlook Appendix E: New York Renewable Profiles and Variability[6]
- ISO New England Variable Energy Resource Data.[7]
- NYISO Resource Adequacy work

4. Key Areas of Investigation:

This issue discovery report will analyze:

- Frequency, duration, and Seasonal Patterns of Renewable Lulls
    - Identify the most severe and longest renewable lull events based on historical and modeled data.
    - Examine seasonal and multi-day lull patterns affecting wind and solar generation.
- Resource Adequacy & Reliability Impacts:
    - Evaluate whether current IRM (Installed Reserve Margin) appropriately accounts for renewable lulls or if improvements can be made.
- Interregional Reliability Implications:

[3] https://www.nysrc.org/wp-content/uploads/2024/11/Final-Draft-IRM-Report-Appendices-Clean-11_21_24-for-ICS-meeting-11_25_24.pdf

[4] NYSRC Resource Adequacy studies uses a 5 years hourly MW data for front of meter wind, solar, run of river hydro, and 5 years data for other models pertinent to LOLE calculations including thermal forced outage rates (10 years for interties).

[5] https://www.nyiso.com/documents/20142/3607 9056/4%20NYISO_OffshoreWind_Hourly_NetCapacityFactor.xlsx/
https://www.nyiso.com/documents/20142/41314645/06_10430908%20DNV%20LBW%20and%20Solar%20Presentation%20for%20NYISO.pdf

[6] https://www.nyiso.com/documents/20142/46037616/Appendix-E-Renewable-Profiles-Variability.pdf/76833f16-ca0b-0439-6bae-e45eb75d88fe

[7] https://www.iso-ne.com/system-planning/planning-models-and-data/variable-energy-resource-data

    - Assess how lulls align with periods of high load in NYCA and neighboring regions.
- Mitigation Strategies
    - Expand the wind and solar dataset beyond the current five-year rolling window to better capture long term variability and retain extreme lull events.

5. Results and Takeaways: