Off Shore Wind Data Review NYSRC Preliminary Findings

1.0 INTRODUCTION

This paper presents preliminary analyses performed by the NYSRC Extreme Weather WG on high resolution data characterizing Off Shore Wind (OSW) performance recently provided by NYISO and its weather service provider DNV. This is of particular importance given rapid transformation of the NY power system to decarbonized intermittent renewable resources including large scale off shore wind resources.

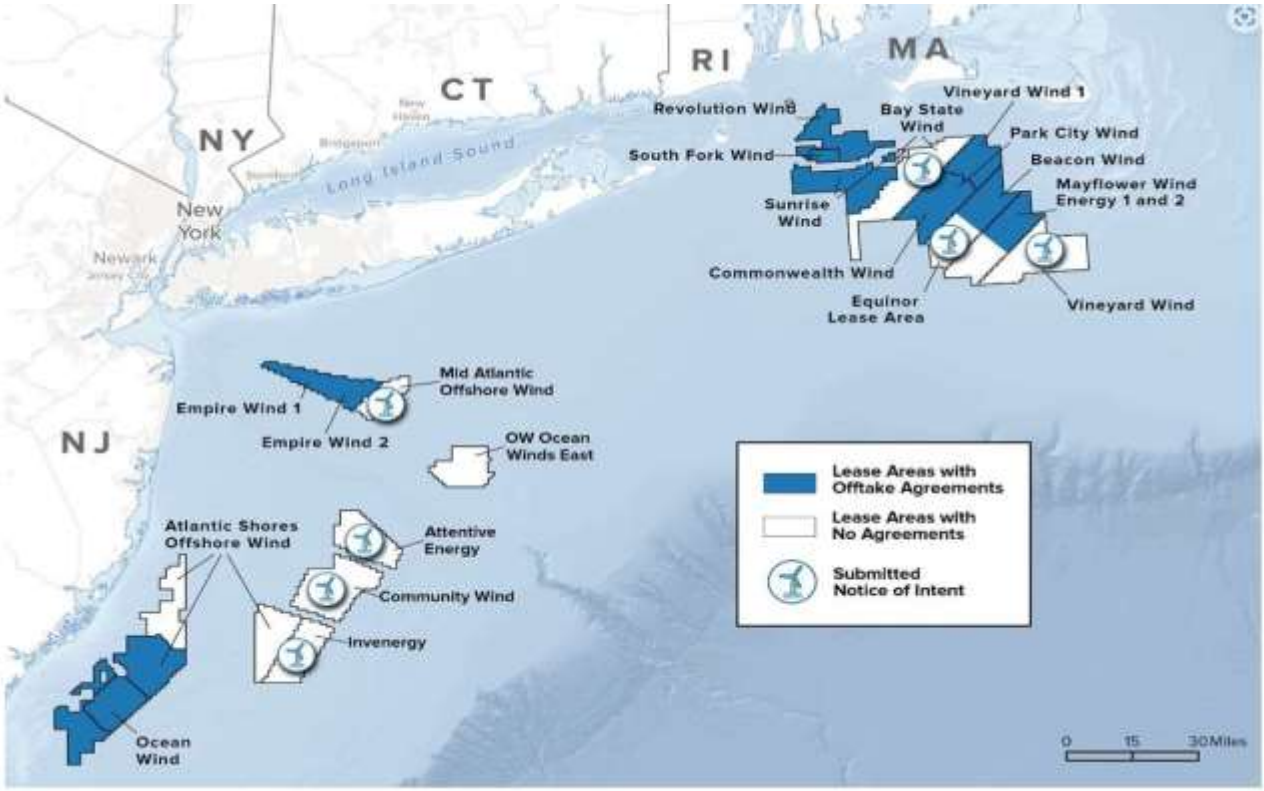
The NY Climate Leadership and Community Partnership Act (CLCPA) calls for the installation of 9,000 MW of OSW by 2035, increasing to 18,000 MW by 2050. NYSERDA and LIPA have already contracted approximately 4,500 MW, which are under development with near term in-service dates[1]. Further NYSERDA expects to award the winner of its July 27, 2022 solicitation for at least an additional 2000 MW of OSW in spring 2023.[2]

The intent of this paper is to address OSW related aspects of NYSRC goals set forth in the Executive Committee approved Extreme Conditions White Paper dated 7/8/22. That paper discusses a goal to "identify actions to preserve NYCA reliability for extreme weather events and other extreme system conditions" and its corresponding action plan to: "evaluate the potential need for new resource adequacy and transmission planning design rules for planning the system to meet extreme weather and other extreme conditions". Including recommendations which are designed to ensure that the NYS electric system continues to deliver reliable performance in the face of a changing climate the focus of this paper is wind intermittency on availability of OSW resources. It is envisioned additional study phases will be undertaken as further data becomes available.

[1] New York's Offshore Wind Projects - NYSERDA
[2] 2022 Solicitation - NYSERDA

2.0 OFF SHORE WIND DEVELOPMENT

The following figure shows areas of contracted wind resources under active development. OSW under development off the coast of downstate NY is expected to exceed 4,500 MW output by the mid to late-2020s. Further NYSERDA expects to award the winner of its July 27, 2022 solicitation for at least an additional 2000 MW of OSW in spring 2023. Ultimately the NY CLCPA calls for the installation of 9,000 MW of OSW by 2035, increasing to 18,000 MW by 2050. It is noted large-scale OSW development is concentrated in the downstate NY region which has limited transmission flexibility to withstand large output swings associated with intermittency of wind resources. [3] Lastly other regions including PJM and ISONE are also contracting similarly large amounts of OSW off the coast of NJ and Rhode Island, respectively.



[3] Transmission expansion projects proposed for this region are not anticipated to be in-service prior to the 2030's timeframe at the earliest (e.g. PPTN).

2.0 OFF SHORE WIND DATA

At the February 7, 2023 NYISO ICAP WG meeting, NYISO made available 21 years of hourly wind data at seven wind development sites, extending from New Jersey to Rhode Island prepared by its weather service provider DNV. DNV performed analysis of wind data translating meteorological data into detailed power profiles for each site including loss considerations. DNV assumed a generic 15 MW offshore turbine design consisting of 236 m rotor diameter and 150 m hub height with turbine layout of 1 nautical-mile spacing. This is representative of the type of turbines proposed for installation in the next 3 to 5 years. DNV also performed extensive benchmarking and validation of its modeling against other data profiles to verify the veracity of the data set. In total the data provided in this file represented over one million modeled wind power observations which was made available to the NYSRC and other stakeholders in the form of spreadsheet file. [4]

[4] Installed Capacity (ICAP) Working Group - NYISO

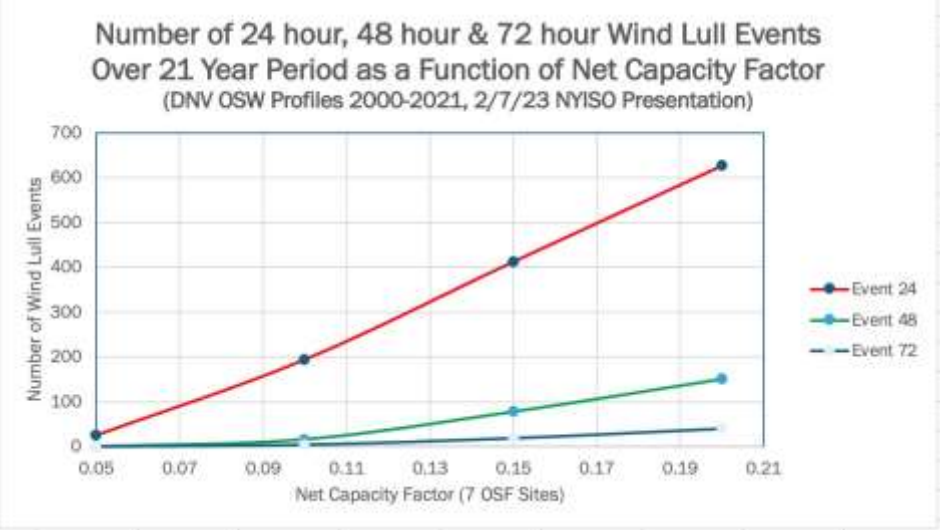
3.0 SUMMARY OF ANALYSIS AND PRELIMINARY FINDINGS

Members of the NYSRC Extreme Weather WG performed preliminary analysis of Off Shore Wind (OSW), highlighting various results which could have a significant impact on the design, operation and reliability of the NYS power system. This included frequency analysis, interregional impacts, and cursory analysis of combined wind/solar events. Analysis of this data by NYSRC Extreme Weather Group yielded the following significant findings.

3.1 WIND LULL FREQUENCY ANALYSIS

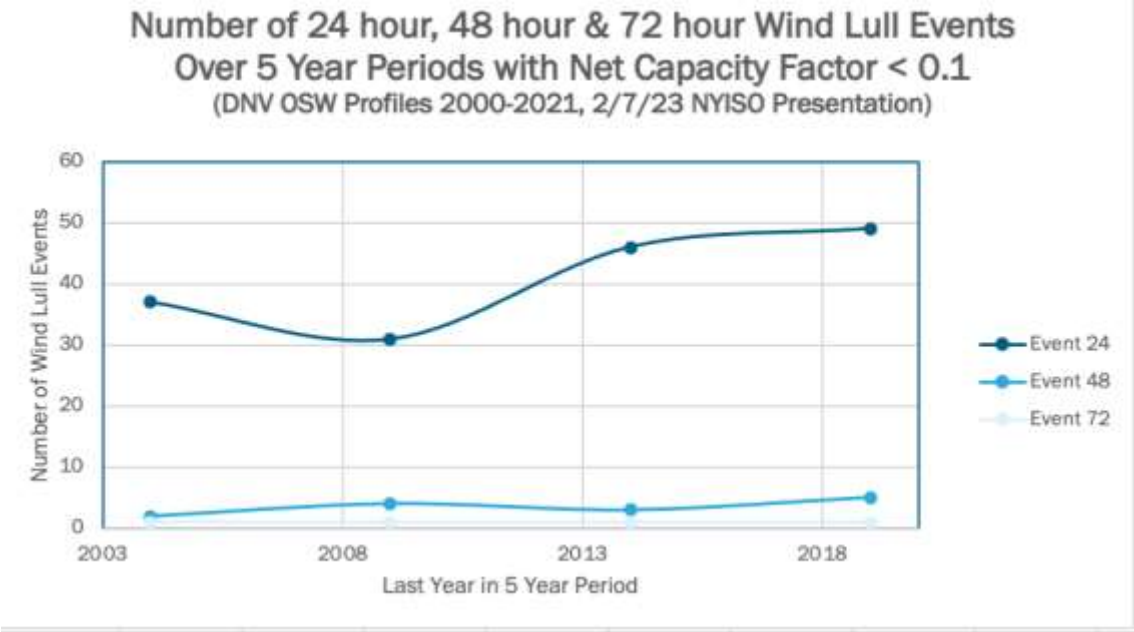
Analysis was performed on OSW data to determine exposure to periods of reduced power output associated with wind intermittency which could impact NYCA operation and design, i.e. "wind lulls". The table below summarize the results of this analysis. As shown Wind lulls, defined for the purposes of this analysis as periods of each hour of wind output less than 20% for extended periods of 24 hours or longer, occur about 30 times per year on average. Wind lulls of 48 hours or longer occur on average about seven times per year, and wind lulls of 72 hours or longer occur on average two times per year.

It is noted events which occur on average 30 times per year represent highly likely occurrences inconsistent with extreme weather characterization and which warrants normal design consideration.



The number of Wind Lulls varies significantly over the 21 year data studied. Dividing the DNV data into 5 year tranches results in the number of 24 hour wind lull events with net capacity factor less than 10% varying from a low of 30 to a high of 50 events. Individual annual events indicate even high volatility.[5]

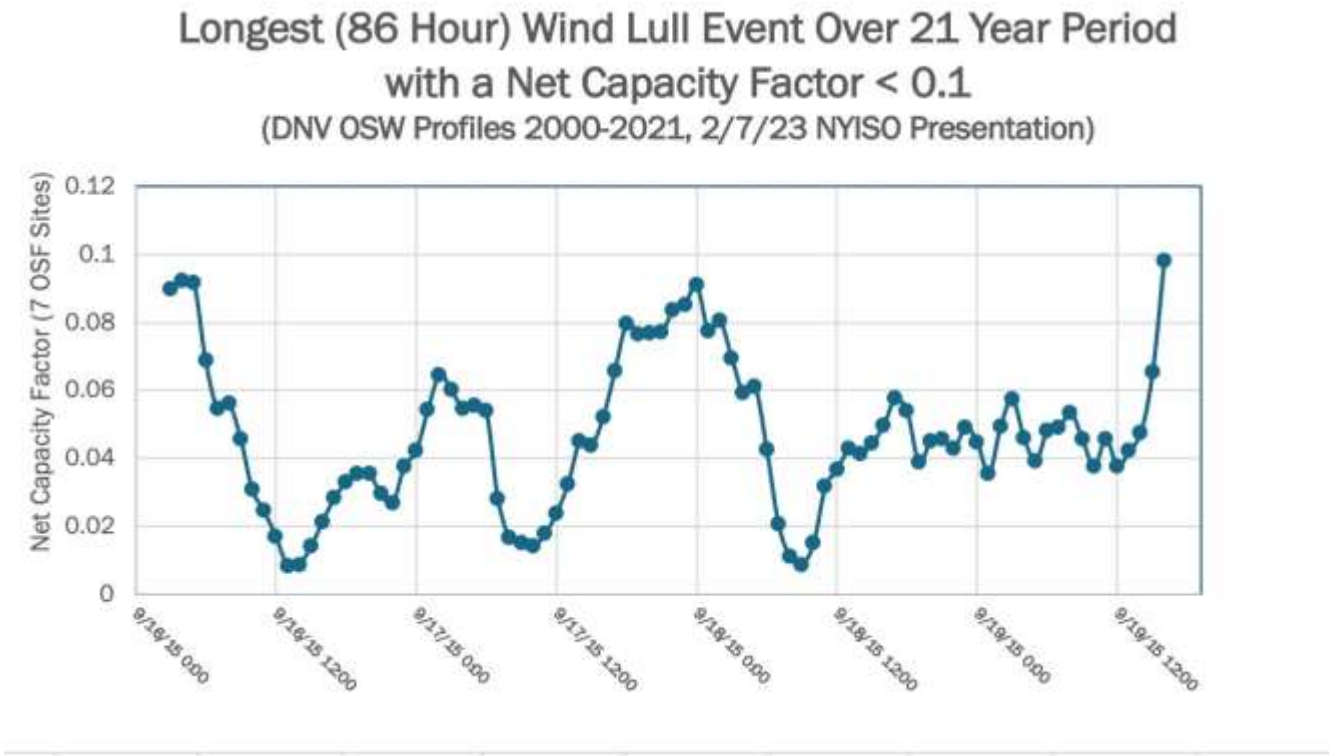
[5] NYSRC Resource Adequacy studies use a 5 year averaging period for a number of models pertinent to LOLE calculations including forced outage rates.



An analysis was also performed to determine coincident of wind lulls with summer peak load periods which are particular impactive to reliability. About 70% of these wind lulls over the 21-year period occurred during the peak four month summer period from June to September.

Row Labels	Continuous Lull Starts
Jan	6
Feb	3
Mar	1
Apr	4
May	5
Jun	9
Jul	36
Aug	51
Sep	35
Oct	22
Nov	14
Dec	8
Grand Total	194

Lastly an analysis was performed to identify the longest wind lull experienced in the 20 year wind data with net capacity factor less than 10% for the entire period across all seven wind sites. Analysis indicates Wind lulls of up to 86 hours with an average energy output of less than 5% rated output occurring across all seven sites were observed in the DNV dataset. While data associated with longer periods were not available it may be appropriate to characterize this as a 1/20 year extreme weather event.[6]



In summary OSW under development off the coast of downstate NY is expected to exceed 4,500 MW output by the mid to late-2020s. The magnitude of wind lulls observed reduces this output by up to 4,500 MW for the duration of the wind lull event. By 2035, NY plans to install 9,000 MW of OSW, which will further increase the impact of wind lulls. It is worth noting the largest contingency currently considered by NYISO for operating reserves/ramping is loss of approximately 1,300 MW.

[6] Metrological experts on the Extreme Weather group have suggested a 70 year analysis should be performed to get a more fuller understanding of range and return period of events.

3.2 INTERREGIONAL IMPACTS

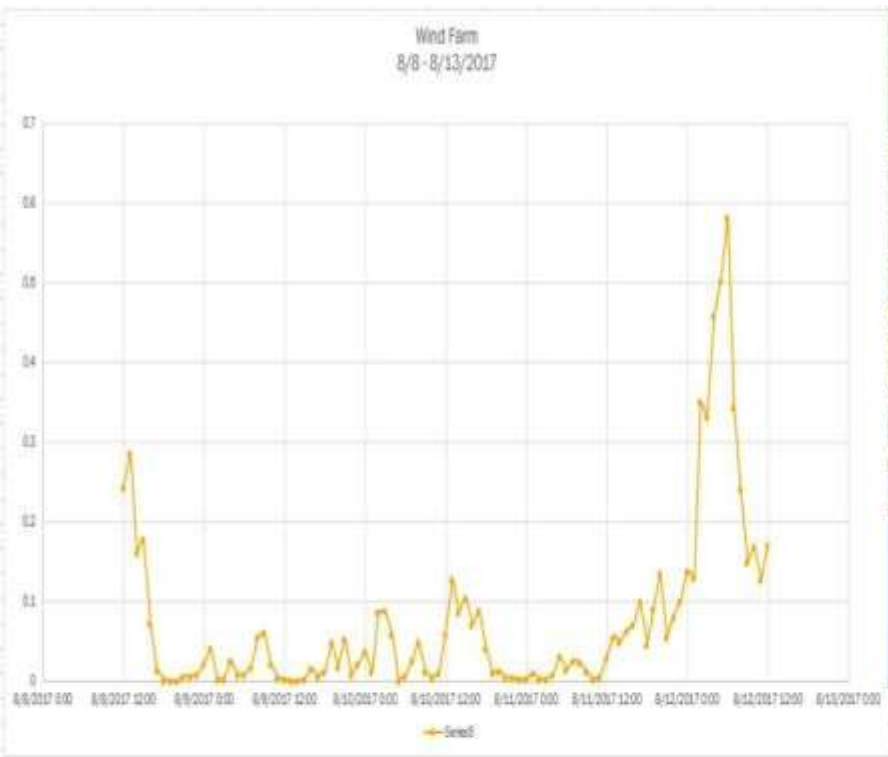
NY relies on emergency assistance from neighboring regions to achieve reliable system design, thus continued availability of surplus power from these areas is an important consideration. [7] Similar to NY, policy makers from PJM and New England are also moving forward with policies to install large scale wind power to address decarburization and planned shutdown of thermal units, with proposals in each region also totaling tens of thousands of MW, in addition to NY CLCPA plans for 9,000-18,000 MW between 2035-2050.

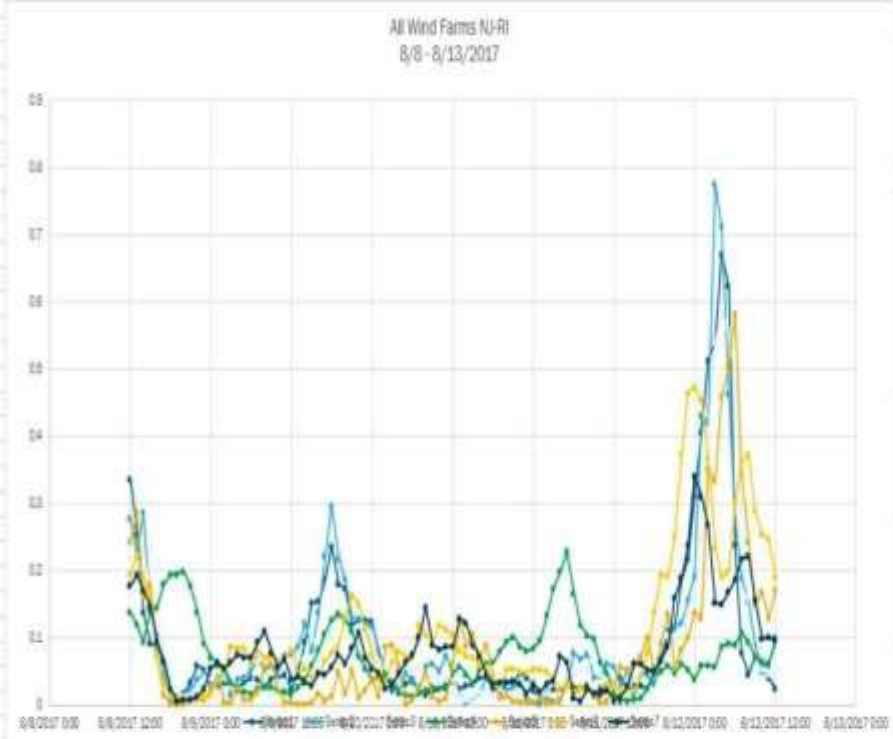
The analysis below finds Wind Lull events to be highly correlated interregional events extending from NJ to Rhode Island. As shown the impact of wind lulls does not respect control area boundaries and extends to OSW located in PJM and NE.

It is noted reliability of the traditional interconnected power system design relies on diversity of forced outage rates and independence of outage events. Correlation of interregional wind lulls eliminates diversity of loss of power output events associated with OSW and alters this aspect of system design.

Interregional wind lulls impacting thousands of MWs of interregional OSW located in PJM, NY and NE could simultaneously reduce reserve sharing and emergency assistance available for support from neighboring control areas impacting operational reliability and resource adequacy.

[7] IRM sensitivity studies show impact of isolated NYCA. Typically this adds about 8% increase in additional margin requirements.





Wind Plant Nar	Capacity (M	Turbine Cou	Sub Area
Wind Farm 1	2,100	140	New York Harbor
Wind Farm 2	390	26	Long Island Shore
Wind Farm 3	1,530	102	Long Island Shore
Wind Farm 4	16,095	1,073	Long Island East End
Wind Farm 5	1,260	84	Long Island Shore
Wind Farm 6	6,075	405	New York Harbor
Wind Farm 7	6,615	441	New York Harbor
	34,065		

3.3 COMBINED WIND/SOLAR CORRELATED EVENTS

A concern of the Extreme Weather WG is coincident of wind lulls with other coincident extreme weather phenomena. Very Preliminary findings have also identified periods of correlated OSW wind lulls coincident with simultaneous solar lulls in downstate region.

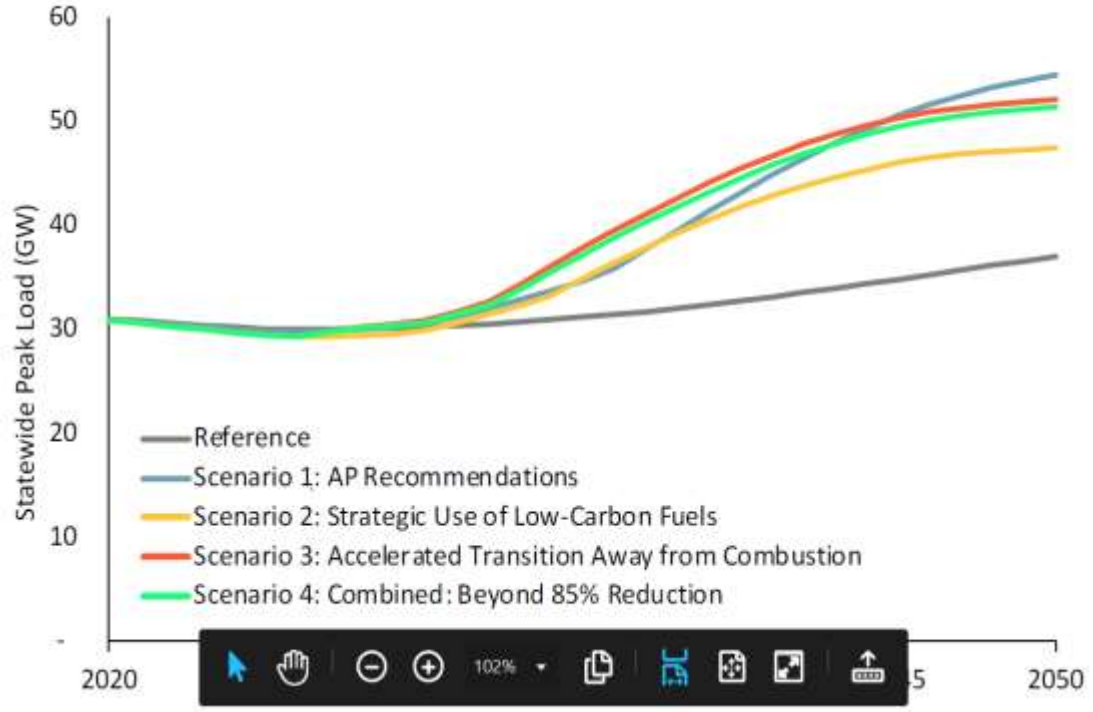
While only cursory analysis was performed into this consideration due to limited data availability the analysis below highlights one illustrative event that occurred 12/19/14 – 12/22/14. The point of this analysis is to demonstrates the possibility of combined wind and solar lull events and highlight this as an area requiring future exploration.

It is noted the CLCPA calls for the installation of 10,000 MW of solar by 2030.

3.4 OTHER CONSIDERATIONS - ELECTRIFICATION

Decarbonization aspects of CLCPA reduces diversification of alternate energy sources presently in the electric sector including natural gas and petroleum and will reduce energy diversification available to society as a whole as more end uses rely upon electricity. Electrification of the NY economy is also projected to significantly increase electric load. Under CLCPA, electric load is projected to nearly double in the next 20 years, which will substantially increase societal reliance on electricity as a reliable energy source while alternate sources of energy are reduced or eliminated.[8] Mandatory time of use rates shifting load have been enacted by some utilities, notably LIPA, starting in 2024, with the intent of altering daily load cycle shapes to extend usage to hours traditionally non-peak hours which may reduce the impacts of electrification[9].

Figure 17. Statewide Peak Load Growth[12]



[8] Draft Scoping Plan - New York's Climate Leadership & Community Protection Act (ny.gov)
[9] Time of Use Rate Plans (TOU) - PSEG Long Island (psegliny.com)

4.0 NEXT STEPS

The results of this analysis suggest it is important to continue to conduct additional studies to identify correlations among decarbonized sources such as OSW, terrestrial wind, solar, and electric demand. This is important to ensure sufficient backup to address wind lulls and other correlated loss of supply events as the renewable energy rapidly increases as a portion of the overall energy mix. More detailed analysis is required to understand what other features of a renewable-dominated electrical grid will need to be present to guarantee sufficiency to meet expected demand at all times.

At the April 28, 2023 Extreme Weather meeting the NYISO indicated it is working with its weather service provider DNV to provide data sets describing hourly input terrestrial wind, solar, and electric demand to perform additional analysis. This data is projected to become available during the summer 2023 period.

5.0 SUMMARY

The magnitude, duration, and widespread geographic impacts identified by this preliminary analysis are quite significant and will be compounded by load growth from electrification. This highlights the importance of reliability considerations associated with OSW and wind lulls be accounted for in upcoming reliability assessments, retirement studies, and system adequacy reviews to ensure sufficiency of system design to handle the large OSW volume expected to become operational in the next 5-10 years.

The NYSRC will support NYISO and NYS in conducting these near-term investigations and in taking associated actions to ensure the reliability of the NY power system.