INDEPENDENT INTERVENOR EXHIBIT 4

RENEWABLE RESOURCE GAP CHARACTERIZATION

IMPLICATIONS ON RELIABILITY

This exhibit describes the challenges of defining the frequency, duration and intensity of low wind and solar resource availability events. The Public Service Commission presumes that the PSL 66-P Establishment of a Renewable Energy Program can be implemented reliably. However, the fact that there are major uncertainties associated with identifying how many required resources are needed during extended periods of low renewable resource availability means that there are unacknowledged challenges to the presumption that the weather-dependent resources will ensure safe and adequate energy supply.

There are two underlying factors that exacerbate the challenge of this issue. The first factor is that the atmospheric high-pressure conditions that cause temperature extremes are also associated with light winds. The hottest and coldest periods are typically the highest load periods. The second factor is that high-pressure systems can be huge which means that the light wind conditions extend over large areas frequently much greater than the boundaries of New York State.

Observed New York Resource Gaps

As noted in Exhibit 5 "Dispatchable Emissions-Free Resources" the agencies responsible for New York's electricity system and others agree that extended periods of low renewable resource availability must be addressed. The Iowa Climate Science Education[1] explains that the German term for these low resource episodes is Dunkelflaute or "dark doldrums". Typically, they occur when a large high-pressure system stagnates in one location. In New York there was an eight-day dark doldrum event starting on 12 September 2024 hour 0000 and ending on 19 September 2024 hour 2300. During that period[2] the wind capacity of all New York wind energy facilities, including one operational offshore wind farm, was less than 5% of the potential capacity during 96 hours of the eight days (Table 1). That represents 50% of the episode.

[1] https://iowaclimate.org/2024/11/07/the-dunkelflaute-disaster-what-happens-when-wind-power-goes-silent/

[2] https://pragmaticenvironmentalistofnewyork.blog/2024/12/04/september-new-york-dunkelflaute-or-wind-lull/

Table 1: Categorial Hourly Totals for New York State Wind Power from 12 September 2024 hour 0000 to 19 September 2024 hour 2300

Capacity Factor	Capacity	Hours in Category	
(%)	(%)	(n)	(% of period)
5%	<5%	96	50%
10%	<10%	158	82%
15%	<15%	181	94%
20%	<20%	191	99%

Some may argue that because the wind is always blowing someplace that this problem is easily addressed by adding additional transmission to move energy as needed. The dark doldrum last fall affected all the New York wind turbines, so it is not a localized situation. There is a very high correlation of wind resources in New York[3]. For example, using NYISO resources that provide 2021 wind production[4] and 2021 wind curtailment data[5], the hourly total wind production and curtailments for the entire New York Control Area (NYCA) are shown in Table 2. Results from 2024 show similar results (Table 3). All the wind resources in the state must be highly correlated if 25% of the time only between 7% and 10% of the state total wind capacity is available.

[3] https://pragmaticenvironmentalistofnewyork.blog/2024/06/18/personal-comments-submitted-on-the-nys-defr-proceeding/
[4] https://www.nyiso.com/documents/20142/29607069/2021 Hourly Wind Production.xlsx/3aa88145-d5a7-fa2a-cca4-2eac3e8cacef
[5] https://www.nyiso.com/documents/20142/29607069/2021 Hourly Wind Curtailments.xlsx/42239e66-4ab0-cd78-ba5c-df0a80f61711

Table 2: NYISO 2021 Hourly Wind Production at the Aggregated NYCA-Wide Level

Statistic	Production (MW)	Curtailments (MW)	Production % of Total	Curtailment % of Total
Maximum	1,889.9	494.8	86%	25%
99%	1,648.8	198.3	78%	10%
95%	1,329.3	57.5	63%	3%
90%	1,089.4	16.9	52%	1%
85%	930.1	5.9	44%	0%
80%	805.5	1.7	38%	0%
75%	695.6	0.2	33%	0%
70%	601.7	0.0	29%	0%
65%	523.5	0.0	25%	0%
60%	460.0	0.0	22%	0%
55%	401.7	0.0	19%	0%
50%	345.4	0.0	16%	0%
45%	299.3	0.0	14%	0%
40%	257.6	0.0	12%	0%
35%	223.3	0.0	11%	0%
30%	185.7	0.0	9%	0%
25%	151.6	0.0	7%	0%
20%	116.3	0.0	5%	0%
15%	83.6	0.0	4%	0%
10%	51.9	0.0	2%	0%
5%	19.2	0.0	1%	0%
Mean	469.2	9.6	22%	0%

Table 3: NYISO 2024 Hourly Wind Production at the Aggregated NYCA-Wide Level

		Production (MW)	Curtailment (MW)	Production % of Total	Curtailment % of Total
	Total	6,095,928	66,560	24%	
	Average	694	8	24%	0%
	Minimum	0	0	0%	0%
	Maximum	2,309	394	77%	14%
Percentiles	99%	2,058	165	71%	6%
	95%	1,811	57	63%	2%
	90%	1,589	8	55%	0%
	85%	1,403	0	48%	0%
	80%	1,215	0	42%	0%
	75%	1,053	0	36%	0%
	70%	930	0	32%	0%
	65%	803	0	28%	0%
	60%	696	0	24%	0%
	55%	611	0	21%	0%
	50%	530	0	18%	0%
	45%	463	0	16%	0%
	40%	401	0	14%	0%
	35%	340	0	12%	0%
	30%	286	0	10%	0%
	25%	233	0	8%	0%
	20%	186	0	6%	0%
	15%	137	0	5%	0%
	10%	94	0	3%	0%
	5%	47	0	2%	0%
	1%	3	0	0%	0%

Challenges Characterizing the Renewable Energy Resource Gap

Appendix 5 notes that the New York Independent System Operator 2023-2042 System & Resource Outlook[6] includes Appendix E "New York Renewable Profiles and Variability"[7]. The data presented in Appendix E show that there are frequent periods when all the CLCPA Generation Plan projected wind and solar resources are expected to provide much lower output than their rated capacity. The New York Independent System Operator (NYISO) is working with its consultant DNV to develop estimates of New York onshore wind, offshore wind, and solar resource availability[8]. Their analysis uses a 23-year historical meteorological database for the New York State renewable resource areas. Initial results based on evaluation[9] of the 23-year database show that there was a 73-hour period when the average land-based wind, offshore wind, and solar resources was less than 10% of their rated capacity.

[6] https://www.nyiso.com/documents/20142/46037414/2023-2042-System-Resource-Outlook.pdf/8fb9d37a-dfac-a1a8-8b3f-63fbf4ef6167
[7] https://www.nyiso.com/documents/20142/46037616/Appendix-E-Renewable-Profiles-Variability.pdf/76833f16-ca0b-0439-6bae-e45eb75d88fe
[8] https://www.nyiso.com/documents/20142/41314645/06_10430908 DNV LBW and Solar Presentation for NYISO.pdf/9ad3176f-cc96-8f7f-1b32-8fe98e9e095e
[9] https://www.nysrc.org/wp-content/uploads/2024/10/2030_State_Scenario_Longest_Lulls.pdf

The New York State Reliability Council Extreme Weather Working Group[10] (EWWG) analyzed the high-resolution NY offshore wind data[11] provided by NYISO and its consultant DNV for offshore wind resources. The summary of the report stated:

> 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 offshore wind 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 offshore wind volume expected to become operational in the next five to ten years.

The NYISO/DNV analysis used a 23-year database. In a similar type of analysis, for the Independent System Operator of New England (ISO-NE) Operational Impact of Extreme Weather Events[12] report, ERA5 reanalysis data[13] were used to prepare a database covering 1950 to 2021. The reanalysis data

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[10] https://www.nysrc.org/committees/extreme-weather-working-group/
[11] https://www.nysrc.org/wp-content/uploads/2023/07/NYSRC-Wind-Impacts-Final-07_18_2319907.pdf
[12] https://pragmaticenvironmentalistofnewyork.blog/wp-content/uploads/2024/06/iso-ne-operational_impact_of_exteme_weather_events_final_report.pdf
[13] https://rmets.onlinelibrary.wiley.com/doi/10.1002/qj.3803

analysis uses current weather forecast models and historical observations to provide hourly historical meteorological fields. The data can be further refined to finer scales to project the wind and solar resource availability. The analysis evaluated 1, 5, and 21-day extreme cold and hot events.

One of the important results in the ISO-NE analysis was projected system risk for weather events over the 72-year data record (Table 4). In the analysis, system risk was defined as the aggregated unavailable supply plus the exceptional demand during the 21-day event. Note that the analysis considered sliding windows for the 21-day events by shifting the 21-day window every seven days. It shows that the system risk increases as the lookback period increases. If the resource adequacy planning for New England only looked at the last ten years, then the system risk would be 8,714 MW, but over the whole period the worst system risk was 9,160 and that represents a resource increase of 5.1%.

Table 4: ISO-NE Operational Impact of Extreme Weather Events with % Differences Top 10 Unique Events (of 1,470)

Rank	21-Day Event Start Date	Avg. System Risk (MW)	% Difference to Max
1	1961-01-22	9,160	
2	1979-02-02	9,005	1.7%
3	1961-01-15	8,899	2.9%
4	1981-01-01	8,719	5.1%
5	2015-02-14	8,714	5.1%
6	2010-07-05	8,696	5.3%
7	1979-07-13	8,685	5.5%
8	1971-01-15	8,665	5.7%
9	1994-01-11	8,660	5.8%
10	1979-02-09	8,656	5.8%

Source: ISO-NE Operational Impact of Extreme Weather Events[14]

[14] https://pragmaticenvironmentalistofnewyork.blog/wp-content/uploads/2024/06/iso-ne-operational_impact_of_exteme_weather_events_final_report.pdf

Finally, note that there was an EWWG analysis of Historical Weather and Climate Extremes for New York[15] performed by Judith Curry and Roger Caiazza that identified an event in January 1961 as the probable worst-case scenario for New York. There was a 15-day period from January 20 until February 3, 1961, that will likely turn out to be the worst-case cold wave. This was a period when high-pressure systems dominated the weather in the Northeast and those conditions mean light wind speeds.

This comparison of results from different evaluation periods indicates that the longer the evaluations period the more likely that the worst-case event will be discovered. New York has not done an analysis like the NE-ISO study that uses 1950 to present data. Until a detailed analysis is completed that evaluates January 1961 then it is likely that we don't know how much energy will be required during the worst-case New York dark doldrum. The Individual Intervenors believe the goal of an evaluation over the longer period would be to define a probabilistic range of return periods for Dark doldrum events like 100-year floods that could be used for electric system planning. Until that is completed, any assessment of reliability risks of dark doldrum episodes affecting New York is incomplete.

[15] https://www.nysrc.org/wp-content/uploads/2023/06/NY-weather-extremes-rev.pdf

Larger Areas

Some have argued that the wind lull problem can be resolved if sufficient transmission is built to tap into the wind that is always blowing somewhere. To address this presumption, it has been recognized that larger areas need to be assessed wind and solar resource availability using a similar approach. The Electric Power Research Institute has a Low-Carbon Resources Initiative[16] that has been looking at resources across the North American continent. If the Table 2 results that all the New York wind resources generate 7% of the state total wind capacity 25% of the time is observed over larger areas, then the presumption that wind lulls can be addressed by transmission is unlikely to be true.

Using data from the dashboard at the US Energy Information Administration Hourly Electric Grid Monitor[17] it is possible to extend the analysis to the whole country. EIA notes that this is "Hourly total net generation and net generation by energy source for the Lower 48 states." A description of the methodology and

[16] https://lcri-vision.epri.com/
[17] https://www.eia.gov/electricity/gridmonitor/dashboard/electric_overview/US48/US48

limitations is available[18] for the dataset[19] used. The analysis made no attempt to account for the different categories when the data[20] were downloaded.

Ideally the analysis would include the installed capacity for the different energy sources but only EIA values for solar[21] – 107,400 MW, were found. Figure 1 shows the Maximum Hourly Generation (MW) in 2024 for the primary energy source categories that gives an idea how much capacity is installed for each energy source. Note the maximum solar is 75% of the EIA installed capacity. The expected percentage of installed wind relative to the observed maximum hourly MW would be even less.

[18] https://pragmaticenvironmentalistofnewyork.blog/2025/02/11/wind-blowing-somewhere-does-not-solve-the-intermittency-problem/
[19] https://pragmaticenvironmentalistofnewyork.wordpress.com/wp-content/uploads/2025/02/us-eia-electric-energy-source-analysis-2025-02-08.xlsx
[20] https://pragmaticenvironmentalistofnewyork.wordpress.com/wp-content/uploads/2025/02/us-eia-electric-energy-source-analysis-2025-02-08.xlsx
[21] https://www.perplexity.ai/search/using-us-eia-2024-lower-48-sta-nbRUTOzmQNq0r2UCWdEmVQ

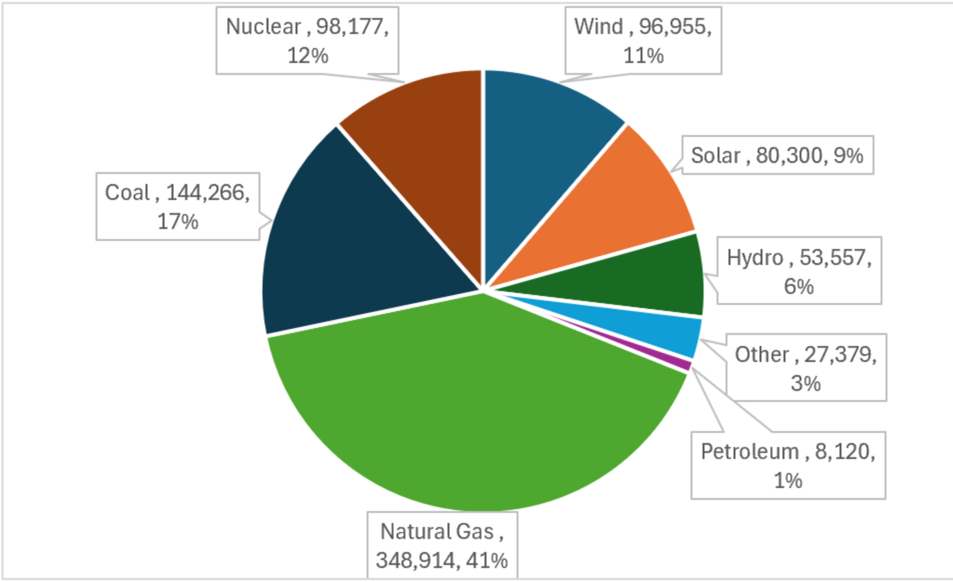

Figure 1: US Energy Information Administration Hourly Electric Grid Monitor 2024 Maximum Hourly Generation (MW)[22]

Figure 2 lists the US Energy Information Administration Hourly Electric Grid Monitor 2024 Total Energy (GWh). It is surprising how much wind energy is generated annually. However, totals and averages are not the primary planning issue – determining how much energy is needed in the worst case is a prerequisite for reliability planning.

[22] https://pragmaticenvironmentalistofnewyork.wordpress.com/wp-content/uploads/2025/02/us-eia-electric-energy-source-analysis-2025-02-08.xlsx

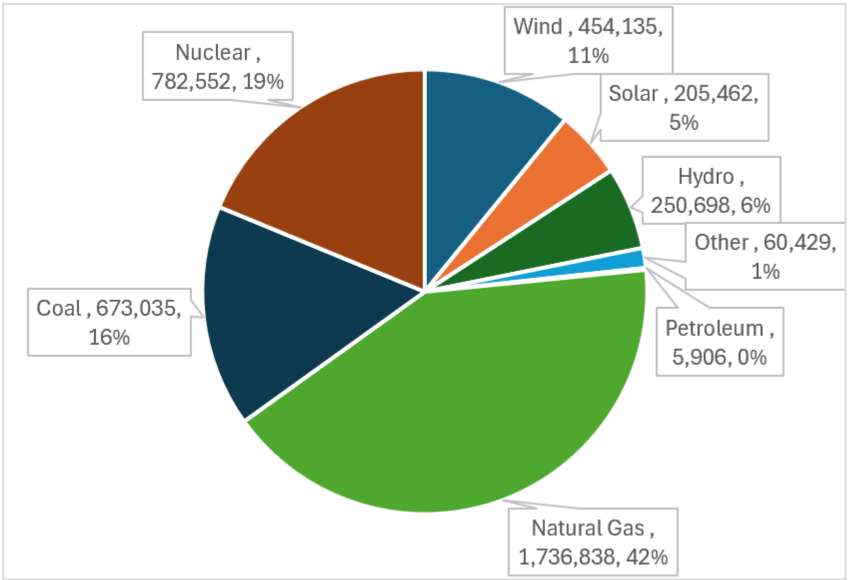

Figure 2: US Energy Information Administration Hourly Electric Grid Monitor 2024 Total Energy (GWh)[23]

Table 5 summarizes nationwide energy source hourly data for 2024. Solar has the most hourly variability because it is unavailable at night. Wind has 95% variability and petroleum that is used for peaking purposes has 99% variability. Only nuclear has less variability than the total energy. Note that even though low wind capacity is reduced over the country compared to NY, the data still show that10% of the time less than 30% of the maximum wind capacity is available. The Individual Intervenors believe that this indicates the maximizing transmission capabilities would not eliminate the need for DEFR.

[23] https://pragmaticenvironmentalistofnewyork.wordpress.com/wp-content/uploads/2025/02/us-eia-electric-energy-source-analysis-2025-02-08.xlsx

Table 5: US Energy Information Administration Electric Grid Monitor 2024 Hourly Data Distribution[24]

Parameter	Units	Wind	Solar	Hydro	Other	Petroleum	Natural Gas	Coal	Nuclear	Total
Total	(GWh)	454,135	205,462	250,698	60,429	5,906	1,736,838	673,035	782,552	4,169,382
Average	(MW)	51,694	23,388	28,537	6,879	672	197,705	76,612	89,078	474,602
Maximum	(MW)	96,955	80,300	53,557	27,379	8,120	348,914	144,266	98,177	736,962
Minimum	(MW)	4,697	-384	10,358	-1,746	42	104,793	39,765	50,730	327,059
1%	(MW)	14,440	-69	13,469	473	153	126,814	43,811	76,167	358,281
5%	(MW)	22,442	-14	16,385	2,143	209	140,130	48,103	77,743	377,240
10%	(MW)	28,455	67	18,381	3,217	278	149,030	51,358	79,109	392,080
15%	(MW)	32,056	161	19,956	4,039	301	155,908	54,070	79,938	404,054
20%	(MW)	35,709	278	21,392	4,661	310	161,565	56,725	81,639	414,999
25%	(MW)	38,981	372	22,771	5,090	318	166,281	59,165	83,883	423,656
50%	(MW)	51,630	12,132	28,180	6,442	369	188,816	72,663	91,297	458,739
75%	(MW)	64,582	46,244	33,774	8,739	724	221,602	90,391	94,371	509,239
90%	(MW)	75,355	63,574	38,993	11,073	1,433	262,588	109,404	95,656	587,096
95%	(MW)	80,548	68,833	42,440	12,277	2,038	287,646	121,281	96,393	631,880
99%	(MW)	87,634	74,702	47,746	14,341	3,830	321,157	135,993	97,904	681,505
Range	(%)	95%	100%	81%		99%	70%	72%	48%	56%

There was no map of wind energy facilities at the EIA website to show the location of wind facilities. Synapse Energy[25] has developed an interactive map of U.S. power plants, including wind facilities which is shown as Figure 3.

[24] https://pragmaticenvironmentalistofnewyork.wordpress.com/wp-content/uploads/2025/02/us-eia-electric-energy-source-analysis-2025-02-08.xlsx
[25] https://www.synapse-energy.com/tools/interactive-map-us-power-plants

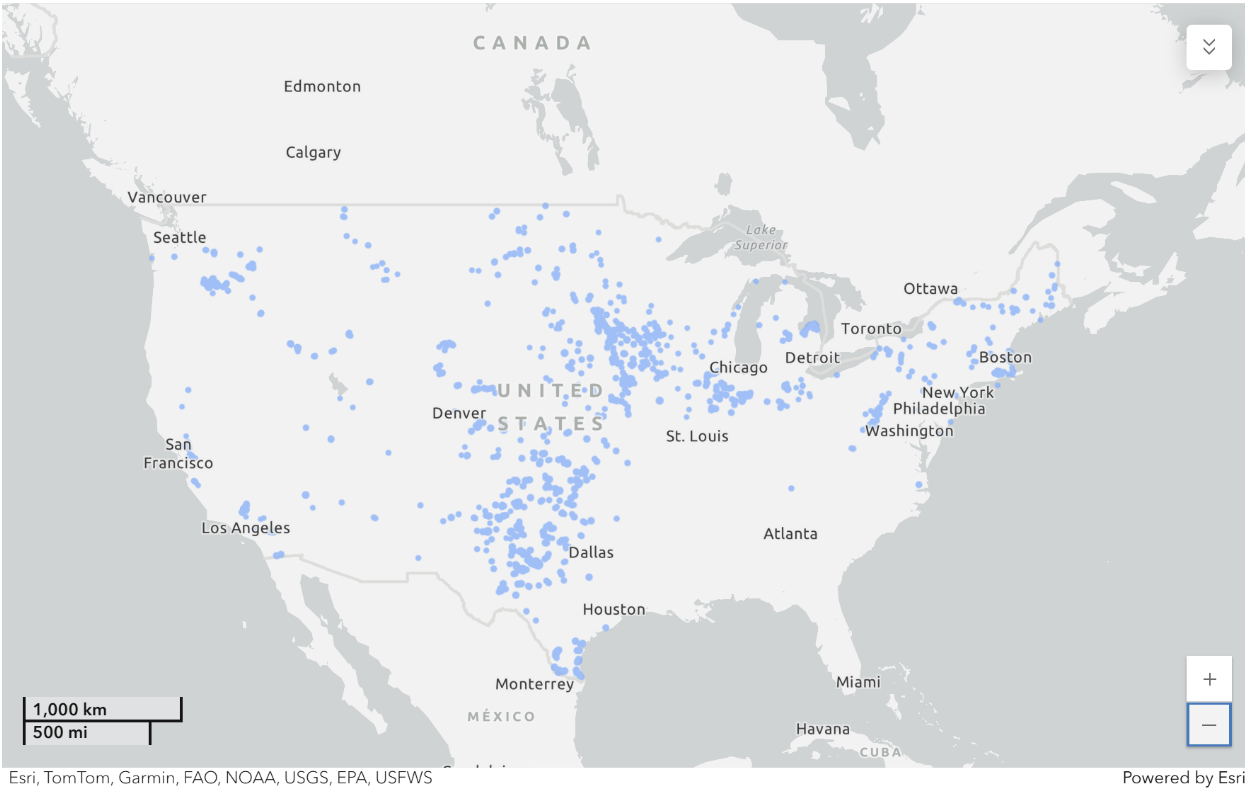

Figure 3: Synapse Energy Map of U.S. Wind Power Plants[26]

Assuming that the EIA wind energy facilities are similar to those used by Synapse Energy, there is a wide spatial distribution across the Lower 48. Consider that if a wind lull in New York City was caused by a high-pressure system that covers everything east of the Mississippi that transmission committed to dedicated wind turbines 1,000 miles away would be required to ensure that New York State wind energy could be supplied by wind elsewhere. Obviously, that is not feasible.

Table 6 provides an estimate of wind lulls at different thresholds for the Lower 48 United States. The hourly data evaluated to determine the total available

[26] https://synapse.maps.arcgis.com/apps/dashboards/201fc98c0d74482d8b3acb0c4cc47f16

wind energy (GWh) available when the total available wind capacity was less than six percentile thresholds. At the first percentile only 14,440 MW or less was generated. This level is 15% of the maximum observed hourly wind capacity. There were 14 episodes that met this threshold and total energy generated during those periods was 988 GWh.

From a planning standpoint the maximum duration is important. There was a 14-hour period when all the Lower 48 wind facilities produced less than 15% of the maximum observed capacity and the total energy generated was only 29 GWh which is only 2% of the capability over that period. At the 25th percentile, all the wind facilities produced just 40% of the maximum observed capacity. There were 180 episodes that met this threshold and total energy generated during those periods was 63,430 GWh. For the maximum duration there was a 115-hour period when all the Lower 48 wind facilities produced less than 40% of the maximum observed capacity and the total energy generated was 2,319 GWh which is 21% of the capability over that period.

Table 6: US EIA Electric Grid Monitor 2024 Hourly Wind Lulls

		Total		Maximum	
	Capacity (MW)	Energy (GWh)	Episodes (N)	Energy (GWh)	Length (N)
Maximum	96,955				
1%	14,440	988	14	29	14
5%	22,442	7,515	52	1,045	67
10%	28,455	18,749	85	1,553	88
15%	32,056	32,085	125	2,039	112
20%	35,709	46,970	145	2,243	113
25%	38,981	63,430	180	2,319	115

This analysis shows that it is necessary to extend the area covered to determine the amount of New York DEFR capacity and energy needed when the North American grid is all "zero emissions" electricity relying on wind and solar generation. Failure to do so is an added uncertainty that increases the risk that the CLCPA Generation Plan approach incorporated in the JP is not feasible.

Climate Variability

As noted, New York has not evaluated dark doldrum events over the 75-year period 1950 to the present when adequate meteorological data are available to estimate wind and solar resource availability. This is necessary to estimate how much energy would be needed for the DEFR technologies to replace. However, an analysis over that time frame only addresses weather variability and cannot address climate variability over periods greater than 75 years or the effects of climate change.

Roger Pielke, Jr. described the underappreciated importance[27] of climate variability in a recent post. One of the frustrating characteristics of climate advocates is the constant attribution of any unusual weather to climate change.[28] Roger Pielke, Jr. provides nuance and detail to the question[29] "what is climate change."

> One of the most pervasive misunderstandings of climate — even among some who publish on climate — is the belief that any long-term trend in a measured climate variable indicates a change in climate, as defined by the Intergovernmental Panel on Climate Change (IPCC}. In practice, "long-term" is often defined to be only a few decades worth of observations. Some trends in observational data are not an indication of a change in climate, and others are — telling the difference is not easy when it comes to extreme weather events.

Pielke explains why this should be considered when estimating climate change effects:

[27] https://open.substack.com/pub/rogerpielkejr/p/the-underappreciated-importance-of?r=hpo52&utm_campaign=post&utm_medium=email
[28] https://pragmaticenvironmentalistofnewyork.blog/climate-leadership-and-community-protection-act/climate-leadership-and-community-protection-act-weather-vs-climate-page/
[29] https://open.substack.com/pub/rogerpielkejr/p/the-underappreciated-importance-of?r=hpo52&utm_campaign=post&utm_medium=email

> The IPCC AR6 explains[30] that the detection of a change in climate requires some certainty that the trend is not simply due to climate variability: “An identified change is detected in observations if its likelihood of occurrence by chance due to internal variability alone is determined to be small, for example, <10%.”
>
> Quantifying internal variability with respect to any climate metric is challenging, typically with multiple valid interpretations possible. Superimposed upon the challenge is the fact that internal variability itself has been influenced by human factors, notably the emission of greenhouse gases.

Pielke’s post goes on to address the question “How near or far into the past does one need to go to adequately characterize a ‘current climate’?” to use as the baseline for a climate change comparison. He uses flood data for various periods to show how easy it is to find a “convincing” trend showing larger floods over time since 1897 consistent with the hypothesis that increased greenhouse gases are causing the increase based on the data used. However, when data prior to 1897 Hirsch (2011)[31] explain that:

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[30] https://apps.ipcc.ch/glossary/

[31] https://doi.org/10.1111/j.1752-1688.2011.00539.x

> . . . we get a very different and more complex picture. . . Now we would say that although there has been some increase in flood magnitudes over time, the pattern is no longer very consistent with a hypothesis that this is driven by greenhouse gas increases in the atmosphere. The high values in the 19th Century are inconsistent with this hypothesis. In fact, one could put forward the argument that there are two populations of annual floods at this location. One is the population that spanned the years of about 1900 to 1941, and the other population existed before 1900 and after 1942. Without the benefit of the longer record, we could easily conclude that the data were highly supportive of a greenhouse-gas driven trend in flood magnitudes, but with it we find ourselves having to entertain other highly plausible hypotheses about an abruptly shifting population, with shifts that take place at time scales of many decades. The data do not negate the possibility that greenhouse forcing is a significant factor here, but they make it much more difficult to argue that these data provide a clear demonstration of the effect of enhanced greenhouse gas forcing on flood magnitudes.

Pielke goes on to describe how this issue affects the US government's approach to flood policy. He notes that a common application of flood risk fails to account for this problem. This challenge has been long recognized by flood experts. Leslie Bond[32] described this 20 years ago:

> In the statistical estimation of a flood peak of a specific recurrence interval requires that all of the recorded peak flows be accurate and that the record be stable over the period of the record and the period for which the estimate is to be applied. That is, if there is a 50-year record of stream flow from 1931 through 1980, and you want a current estimate of the 1% flood to be valid for 30 years, the hydrology, the meteorology and the hydraulics must be stable from 1930 through 2034. In fact, we do not have sufficient historic rainfall data to be sure that the meteorology is stable, and few watersheds in the world are not changing as a result of urbanization, deforestation, agriculture, grazing or other causes.

The issues described by Pielke related to long-term weather observations are relevant to wind and solar resource availability for specifying DEFR capacity. It is obvious that we need to know the worst-case scenario for low wind and solar resource availability to determine how much long-term storage and/or some magical dispatchable emissions-free resource is needed to provide sufficient energy during resource droughts. His references to floods are apropos. We need

[32] http://chrome-extension/efaidnbmnnnibpcajpcglclefindmkaj/https:/biotech.law.lsu.edu/blog/nrcs143_009401.pdf

to develop a probabilistic renewable resource drought parameter equivalent to the 100-year flood.

Pielke's analysis shows that using as long a period of data as possible to determine a probabilistic assessment is necessary but not sufficient to remove uncertainty. These results complicate wind and solar-depending electrical system planning because it means even using the longest period of data may cause an unacceptable reliability risk. Also note that we apparently must worry about not just storage but also whatever weather conditions that cause extreme inertial frequency fluctuations that can lead to blackouts like in Spain earlier this year.

The Independent Intervenors worry that electrical planners currently base their reliability projections based on decades of experience with power plant outages that are uncorrelated. Planners have a good handle on the failure probabilities and how much installed reserve capacity is needed as backup. In the future the reliability requirements for wind and solar resource availability will be driven by weather that is fickler than plant shutdown variability. In addition, this variability correlates over large areas so many of the wind and solar resources will behave the same.

The Independent Intervenors believe that the likelihood of exceeding the planning parameters is much greater for the weather dependent CLCPA Generation Plan than today's grid. When the CLCPA Electrification Mandate is in place and everybody and everything possible is electrified, and the resource drought planning criteria are exceeded, the results will be catastrophic.

NYISO Challenge Defining the Amount of DEFR Required

The New York Independent System Operator 2023-2042 System & Resource Outlook[33] also includes Appendix E "New York Renewable Profiles and Variability"[34]. The data presented in Appendix E show that there are frequent periods when all the wind and solar resources are expected to provide much lower output than their rated capacity. Initial results show that there was a 36-hour period when land-based wind, offshore wind, and solar resources were each less than 10% of their rated capacity. At the September 27, 2024 New York State Reliability Council (NYSRC) Extreme Weather Working Group (EWWG) meeting[35], Thomas Primrose from PSEG Long Island presented a refined analysis of these data. Among other things, his evaluation[36] found that when New York solar, onshore wind, and offshore wind capacity were averaged the hours meeting the less than 10% criterion doubled to a 73-hour period.

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[33] https://www.nyiso.com/documents/20142/46037414/2023-2042-System-Resource-Outlook.pdf/8fb9d37a-dfac-a1a8-8b3f-63fbf4ef6167

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

[35] https://www.nysrc.org/committees/extreme-weather-working-group/extreme-weather-working-group-schedule-and-meeting-page/

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

For context consider that Exhibit 4 shows that if the renewable resources projected in the Integration Analysis, without any fossil-fired resources, were operating over those 73 hours that there would have been a cumulative generation deficit of up to 103,465 MWh within the lull. Note that the lull deficiency projection length is dependent upon the location of the solar and wind facilities, so this is an approximation. Nonetheless, it suggests that specifying the amount of DEFR needed is challenging.

Summary

The Public Service Commission believes that PSL 66-P Establishment of a Renewable Energy Program can be implemented reliably. This exhibit shows that there are major uncertainties associated with the current assessment of necessary DEFR resource requirements. New York has not projected the potential need for DEFR using the longest period of data available. It is also necessary to expand the area covered in such an analysis so that the potential for imports from outside New York can be determined. Even if an analysis were completed for the longest meteorological data set over the North American continent, it is not possible to address natural climate variability. This Proceeding should establish an acceptable reliability metric for weather variability.

Recently, Russ Schussler (a retired electric planning engineer) argued[37] that the intermittency issue addressed here might be solvable: "The long-term problems associated with wind and solar due to their intermittency could and may likely be made manageable with improved technology and decreasing costs." The Independent Intervenors note that may not be practical. It would be necessary to upgrade the electric transmission system, deploy short-term storage, and develop and deploy a dispatchable emissions-free resource all to address short and infrequent periods and to somehow finance those resources with those constraints.

Importantly, even if intermittency can be addressed Schussler argues[38] that there is a fatal flaw:

> Overcoming intermittency though complex and expensive resource additions at best gets us around a molehill which will leave a huge mountain ahead. Where will grid support come from? Wind, solar and batteries provide energy through an electronic inverter. In practice, they lean on and are supported by conventional rotating machines. Essential Reliability Services include the ability to ramp up and down, frequency support, inertia and voltage support. For more details on the real problem see this posting. "Wind and Solar Can't Support the Grid"[39] that describes the

[37] https://wattsupwiththat.com/2025/02/01/how-the-green-energy-narrative-confuses-things/
[38] Ibid
[39] https://judithcurry.com/2024/12/05/wind-and-solar-cant-support-the-grid/

situation and contains links to other past postings provide greater detail on the problems.

It is incumbent upon the PSC to prove that these issues can be addressed such that safe, affordable, and affordable electricity is feasible in the PSL 66-P Establishment of a Renewable Energy Program. This evaluation should be a component of the safety valve reliability assessment.