Attachment #8.1
Return to Agenda

De-Carbonization / DER Report for NYSRC Executive Committee Meeting 1/14/2022

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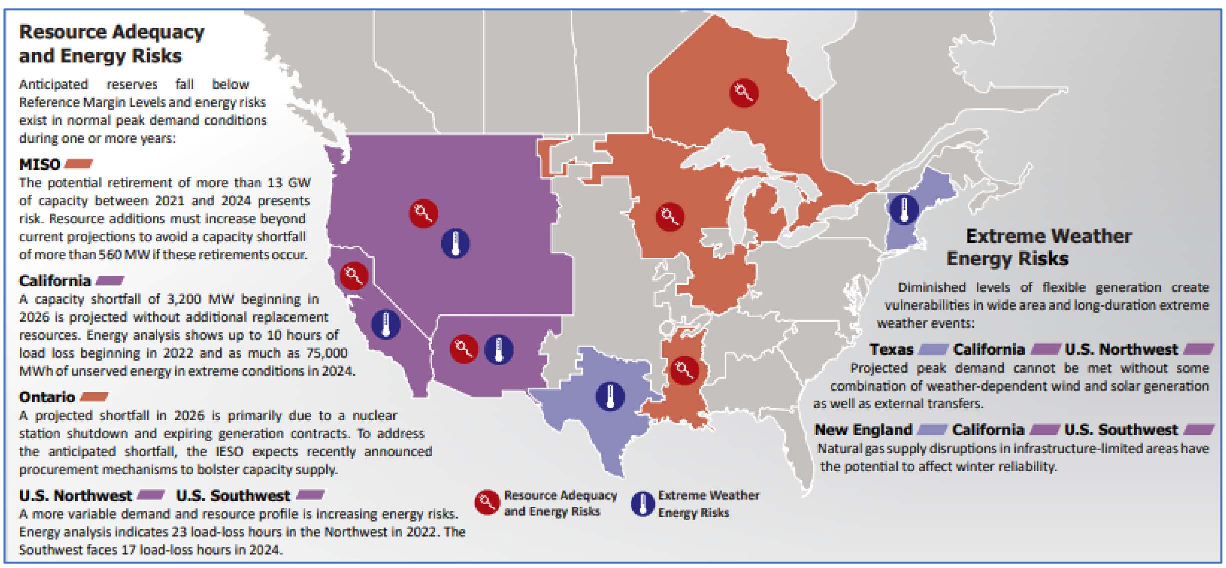
The January 2022 edition of the De-Carbonization / Distributed Energy Resources (DER) Report includes the following:

- NERC December Newsletter
  - Publication of NERC Long Term Reliability Assessment (2021-2031)
  - Posted links from three NERC Monitoring and Situational Awareness Conference Sessions
- NERC IRPWG Meeting – Electranix Presentation on Voltage-Var Control issues
- NPCC DER Guidance Document
- EPRI Presentations at NYS DPS ITWG 12/15 Meeting
- NYISO Blog: Reliability Risks, Largest Transmission Build-out, Wind Energy Production Record
- Snapshot of the NYISO Interconnection Queue: Storage / Solar / Wind / Co-located Storage

The December issue of the NERC Monthly Newsletter can be found here. Highlights include the following:

NERC has published their annual Long Term Reliability Assessment (Announcement / Report / Infographic)
On December 17th, NERC published their 2021 Long-Term Reliability Assessment (LTRA), which concludes that managing the transformation of the grid with associated rapid change to the resource mix will be the greatest challenge to reliability over the next 10 years. The LTRA calls for a collective focus on energy assurance as well as greater coordination between the natural gas and electricity industries as stakeholders and policymakers work together to ensure reliability during this time of grid transition



Infographic – 2021 Long Term Reliability Assessment for the ten-year horizon

The findings indicate there is a high probability of insufficient resources and energy to serve electricity demand, as early as Summer 2022, in many parts of the Western Interconnection. Extreme weather-related events and performance issues associated with some inverter-based resources, such as solar, wind and new battery or hybrid generation, may also have a potential negative impact on reliability. The LTRA identifies a significant projected increase in variable generation and emphasizes the criticality of the role of natural gas as a balancing resource. More transmission is also needed to deliver renewable energy from remote locations to load centers, but the LTRA acknowledges that build-time and siting are additional constraints that need to be considered in planning and policy setting.

While the LTRA finds that all interconnections will face increasing reliability issues over the next 10 years, California, parts of the northwestern and southwestern United States and the Midcontinent Independent System Operator (MISO) areas are projecting capacity shortfalls and periods of insufficient energy due to declining reserve margins and generator retirements. Texas, California and the Northwest United States project that peak demand cannot be met without some combination of variable generation and imports. In addition, natural gas infrastructure that supports electricity generation in New England, California, and the southwestern United States is susceptible to disruptions that can affect winter reliability. Regional coordination and resource adequacy planning among entities in these at-risk regions is strongly encouraged.

NERC 2021 Monitoring and Situational Awareness Technical Conference

Links to all three conference sessions follow:

Presentation1	Streaming Webinar1
Presentation2	Streaming Webinar2
Presentation3	Streaming Webinar3

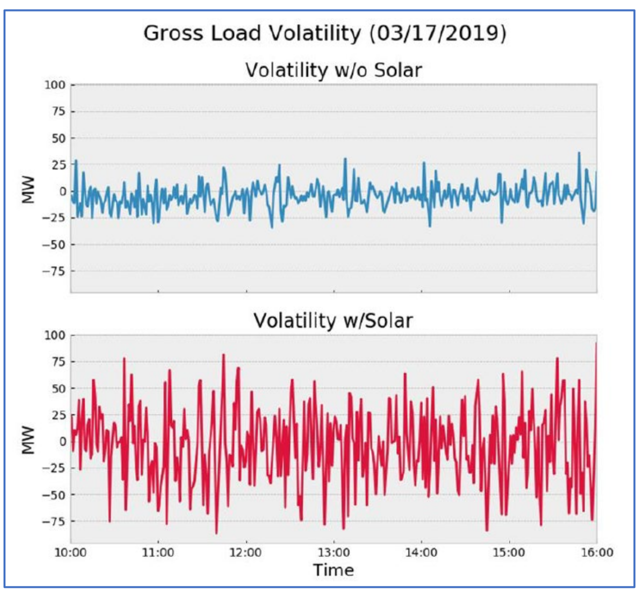
Presentations from Session 2 included the following:

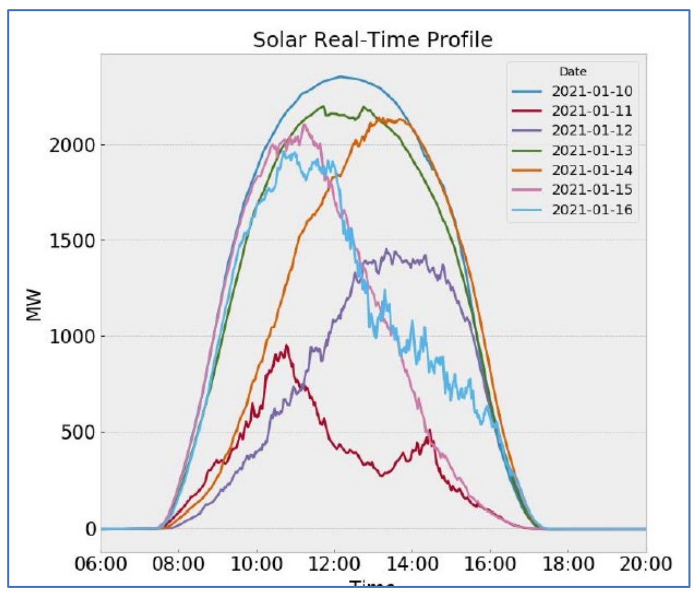
- Inverter Based Resource Integration at Duke Energy
- Distributed Energy Resources (PJM)
- DER Order 2222 (MISO)
- Modeling Distributed Energy Resources in CAISO systems

The Duke Energy presentation on Inverter-based resource integration had these observations:

- Solar generation is incredibly intermittent
- Has doubled the regulation requirement from regulating resources
- Becomes more problematic during Lighter loads and with higher solar penetrations

The graphics below show the impact of DER's on load volatility in the North Carolina service area:



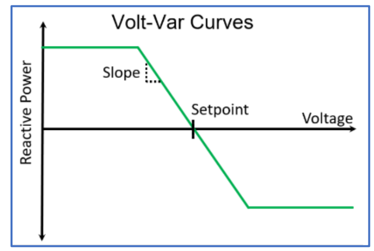


NERC IRPWG December Meeting
The NERC Inverter-Based Resource Performance Task Force (IRPWG) meets monthly to cover both technical and regulatory topics related to the modeling, deployment and usage of inverter-based resources. Here are the links for the IRPWG Landing Page, as well as the December meeting Agenda, Minutes and Presentation Materials

The slide deck contains a presentation by Electranix entitled *V/Q Proportional Voltage Control Issues*, which covers the concepts associated with Volt-Var control, in which the inverter's reactive power output is proportional to the voltage "error" or offset from desired value.

The report notes the following behavioral concerns:

- Inverters can get "stuck", especially at the limits of operational range
- Output can oscillate or chatter on recovery from a significant change
- Linear response characteristic can lead to insufficient support for overvoltage / undervoltage conditions



Potential mitigating strategies include:

- Add integral path for inverter level response
- Utilize faster PPC's
- Add hysteresis or smoothing on transition
- Coordinate dead-bands and slopes (good practice)

NPCC DER Guidance Document
NPCC has published an updated version of the document entitled *Distributed Energy Resources (DER) Considerations to Optimize and Enhance System Resilience and Reliability*. Changes to the document include: the addition of new sections on DER characteristics and capabilities, resource planning impacts, DER aggregation (FERC Order 2222), interconnection standards (IEEE 1547), and a new appendix summarizing transmission connected inverter-based resources. The review period extends through January 27th, 2022.

Recommendations for planning based on the changing resource mix include:

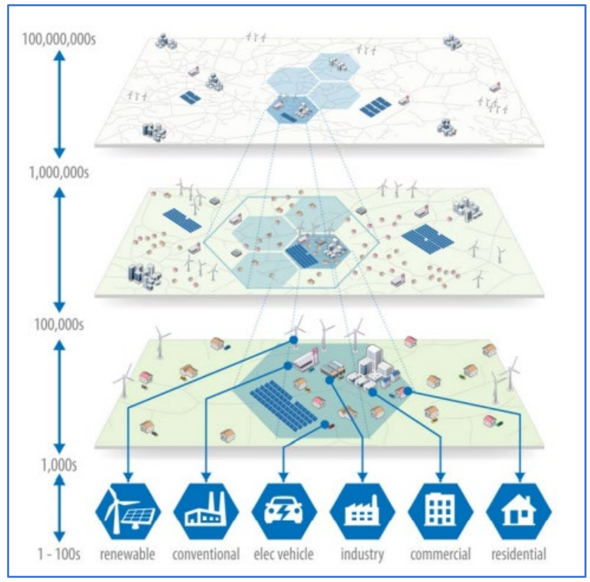
- Identify and consider new methods to obtain and facilitate collection of DER modeling and performance data to enable Long-Term Resource, Long-Term Transmission and Operational Planning of the BPS 28
- Clearly identify DER in the NPCC Region's Area interconnection queues or forecasts where DER is being proposed for installation, including the magnitude and location relative to the existing resource base and load projections.
- Address masking of load by DER at the distribution level to ascertain its impact on the behavior of load, as well as the assumptions that underpin UFLS programs.
- Determine the appropriate entities responsible for providing DER data to the Planning Coordinator for the purposes of model building and maintenance and ensure that this data is provided.
-

Recommendations in the areas of analytics and simulation include:

- Support interconnection wide inertia loss study efforts, to determine potential reliability impacts, as DER replaces conventional synchronous generation resources.
- Obtain DER modelling data to be able to model, predict and examine system behavior and assess the interactions between the new resources and the existing reliability preserving systems and programs. Examples include:
  - Dynamic behavior of the transmission system
  - Sudden loss of large amounts of DER due to transmission system events

- Under Frequency Load Shedding,
  - Under Voltage Load Shedding,
  - Frequency response sharing mechanisms (BAL standards).
  - Analysis of system protection systems (both T and D) so that the parameters for protection settings and other control systems are used to obtain for the most reliability benefits from these resources
- Determine the T&D benefits and challenges of DER fault-related dynamic voltage support.
- Determine the value to T&D systems of the different DER steady state voltage/reactive power control

Appendix H in the document contains an article from The National Renewable Energy Laboratory (NREL) regarding their efforts in "Autonomous Energy Grids (AEGs)", which are multi-layer, or hierarchical, cellular-structured power grid and control systems. Supported by a scalable, reconfigurable, and self-organizing information and control infrastructure, AEGs rely on cellular building blocks that can self-optimize when isolated from a larger grid and participate in optimal operation when interconnected to a larger grid.



The figure at right shows how a scalable approach to control can be built from the lowest level of individual controllable technologies (renewable energy, conventional generation, electric vehicles, storage, and loads) and used to control hundreds of millions of devices by implementing hierarchical cells.

Control algorithms for AEGs will need to be developed and implemented with the following characteristics:

- Operate in Real Time – Control algorithms must operate fast enough to ensure real-time operations in power grids that balance load and generation every second.
- Handle Asynchronous Data and Control Actions – Data needs to be used from a variety of asynchronous measurements and sources, whereas distributed decision-making leads to asynchronous control actions.
- Robustness – This covers both reliability (fault tolerance) and resilience (return from a failed state). These control systems must also be robust to communications failures, prolonged communications outages, and large-scale disturbances.
- Scalable– Control algorithms must operate in a scalable fashion to ensure control of hundreds of millions of devices.

Links for further information on NREL's AEG:

Autonomous Energy Grids	Link
From the Bottom Up: Designing a Decentralized power system	Link
Small Colorado Utility Sets National Renewable Electricity Example Using NREL Algorithms	Link

EPRI Presentations from the New York State DPS ITWG Meeting on December 15th

Two EPRI presentations were given at the DPS Interconnection Technical Working Group (ITWG) meeting held on December 15th. Links for the meeting are available for the Agenda and Meeting materials. The EPRI presentations are summarized below:

Smart Inverter Settings Guidance for High Performing Smart Grid Applications (NYSERDA PON 3770)

NYSERDA had issued PON (Program Opportunity Notice) 3770 back in 2018, providing up to $15 million in funds for proposed work under the general category of advanced methods in grid monitoring, materials, modeling, and planning. Relevant categories included DER integration and smart inverters. Project highlights from EPRI's efforts in this area included the following:

Top Ten List of observations regarding DER regulation:

1. Defining an overall objective(s) for using advanced functions and settings is important. Objective(s) may conflict with one another.
2. Universal settings can be selected, but location-specific the settings provide greater benefits.
3. Voltage regulation strategies have a significant impact on the feeder voltage profile and are a critical consideration when choosing DER functions and settings.
4. Volt-var control stability is a function of open loop response time, system strength in relation to DER, and slope. Default 1547 parameters work for all but the weakest systems.
5. DER location on the feeder and RPA are very important to selection of function and setting pairs.
6. If voltage range at DER locations is not well understood, then voltage independent function (fixed PF or watt-var) selection may be more appropriate.
7. Fixed power factor is effective at "self-mitigation" of DER impacts
8. Voltage-dependent functions can mitigate issues not caused by the DER itself.
9. When voltage regulating equipment is on a feeder, the voltage behavior is non-linear and not easily predicted through simplified approaches.
10. Default settings may work for low DER penetration levels but as voltage regulating headroom diminishes over time and DER needs to actively participate in regulating voltage, site-specific functions and settings may be required.

The table below shows advantages and disadvantages for various methods of DER reactive power regulation. Note that the Fixed Power Factor appears to be most suitable with respect to the key criteria is the list:

Key Criteria	Fixed Power Factor	Watt-Var	Volt-Var	Reference Tracking Volt-Var
Advantages				
Effective in reducing over-voltage	Yes	Yes	Yes	Sometimes
Reduced Voltage Fluctuations	Yes	Sometimes	Sometimes	Yes
Coordinates with Feeder voltage	No	No	Sometimes	Yes
Settings may be determined with limited information modeling	Yes	Yes	Sometimes	Sometimes
Brings local secondary voltages closer to nominal	Sometimes	Sometimes	Yes	Yes
Mitigates voltage issues unrelated to DER	No	No	Yes	Yes
Only absorbs / injects VARs when producing active power	Yes	Yes	No	No
Disadvantages / Challenges				
Absorbs VARs when not needed	Yes	Sometimes	Sometimes	No
Only provides VAR control when producing active power	Yes	Yes	No	No
Can potentially cause unacceptable low voltage	No	Sometimes	Sometimes	Unlikely
Can potentially interact with other feeder controls (default settings)	No	No	Sometimes	Sometimes
Can potentially increase system losses and compensation requirements	Yes	Sometimes	Yes	Yes
Can potentially decrease system load capacity	No	Yes	Yes	Yes

Additional information can be found in the following links:

Glossary of terms Current Status Integration Considerations Commonly Asked Questions

EPRI Presentations from the New York State DPS ITWG Meeting on December 15th Continued)

Second Presentation - Increasing DER Value and Utilization for NYS through Learning Smart Inverters

This study evaluated the utilization of Self-Learning Smart Inverters to optimize output according to the Volt-Var relationship. The DER models used system data (X, R, X/R) and historic data (Day-Before conditions) to establish settings for DER's at every system node, spanning one year of simulated conditions. During the study period, up to 125 setpoint and slope simulations were evaluated on a daily basis.

Key Findings showed that:

- Smart inverter functions are not needed every day
- There is a significant value in optimizing volt-var settings
- Optimizing setpoint is more effective than optimizing the slope
    - Lower setpoints on high voltage days, higher setpoints on low voltage days
    - High slopes have diminishing returns
- Scheduling volt-var curves is more effective than year-round optimum
- Smart inverters could self-select functions and outperform default curves
    - Forecasting is difficult, overfitting is easy
    - Default settings are likely good enough for residential
- Smart inverters will not solve every problem

NYISO: Announcements on the Blog Page of the NYISO Website:

Features from the Blog Page of the NYISO Website include a video presentation with Yachi Lin on upcoming Transmission concerns, a press release highlighting increasing land-based wind support in the state, and an audio podcast with Zach Smith covering key concepts associated with the Comprehensive Reliability Plan.

Video: New York's Largest Transmission Buildout in Over 30 Years

Yachi Lin, the NYISO's Senior Manager for Transmission Planning, talks about how her team prepares New York State's transmission system to meet the energy needs of today and tomorrow. The team must make fact-based assessments of today's energy needs, and work with energy planners to forecast up to 20 years in the future. Factors include the aging transmission infrastructure, new areas of congestion as well as generator retirements and new generation expected to come online that will dramatically change how the grid operates. Yachi talks about the Tale of 2 Grids, in which the balance of resources vs. load varies across the state, which is driving the need for sufficient transmission to get the power across the state, along with the impact from new transmission and offshore wind resources.

Press Release: New Wind Energy Record Production in New York State

The first new record output of 1,803 MW was set during the 10:00 p.m. hour on Thursday, December 2. That total was later surpassed by an 1,808 MW output during the 10:00 p.m. hour on Monday, December 6. Prior to this month, the previous record of 1,748 MW was set during the 9:00 a.m. hour on January 11, 2020.

The new records were aided by the addition of two new utility-scale wind projects that recently connected to the bulk electric system: Cassadaga Wind, a 126.5 MW facility in Chautauqua County, and Roaring Brook, a 79.7 MW facility in Lewis County.

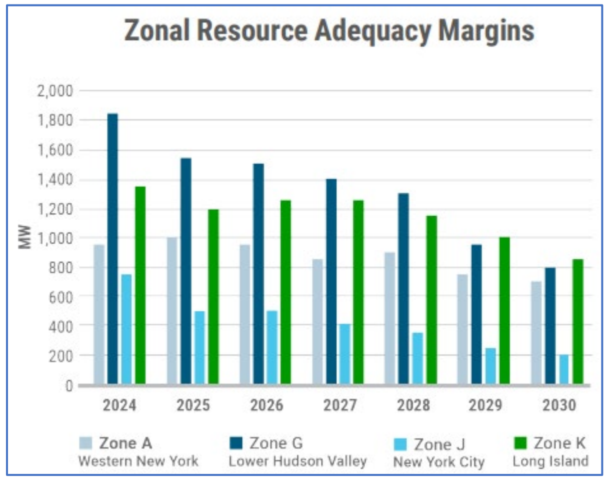
When overall wind production peaked at 1,808 MW on Monday night, it provided 11% of all energy being consumed in New York. The record output represents 82.5% of the 2,191 MW of installed wind capacity in New York State.

NYISO: Announcements on the Blog Page of the NYISO Website (Continued):

Podcast: Reliability Risks from Extreme Weather, Transmission Constraints, and Electricity Economics
Zach Smith, the NYISO's VP of System & Resource Planning, highlights key activities, trends, and observations that have been factored into the NYISO's Comprehensive Reliability Plan 2021-2030. An abbreviated Datasheet highlights the most significant risks anticipated to impact the State's transmission grid over the next 10 years.

The discussion included takeaways from the report such as:

- Reliability margins will shrink in upcoming years due primarily to the planned unavailability of simple cycle combustion turbines that are impacted by the DEC's Peaker Rule.
- The figure at right shows the tightening of zonal resource adequacy margins for western New York (Zone A), lower Hudson Valley (Zone G), New York City (Zone J), and Long Island (Zone K). New York may experience even smaller resource adequacy margins if additional power plants become unavailable or if demand is greater than forecasted.



The CRP has identified these additional ongoing risks to reliability and resilience:

- While transmission security within New York City is maintained through the ten-year period in accordance with current design criteria, the margin would be very tight starting in 2025 and would be deficient beginning in 2028 if forced outages are experienced at the historical rate.
- The reliability plan is heavily reliant on the timely completion of planned transmission projects. If the planned projects were delayed for any reason, the grid's ability to reliably serve customer demand would be jeopardized.
- Extreme events such as heatwaves or storms could result in deficiencies to serve demand statewide, especially in New York City considering the plans included in the CRP. This outlook could improve as more resources and transmission are added to New York City.

Additional discussion focused on key takeaways associated with the Road to 2040 Strategies:

- Transmission expansion is necessary throughout the State, to maximize access to renewable resources.
- Climate change will impact meteorological conditions and events that introduce additional reliability risks.
- Variable output from renewables is a fundamental challenge to reliably meeting electricity demand.
- Battery storage is vulnerable to extended periods that deplete capabilities, resulting in the need for longer running dispatchable emission-free resources.
- Significant amounts of dispatchable, emission-free resources are needed to balance renewable intermittency on the system. Resources with this combination of attributes are not commercially available at this time but will be critical to future grid reliability. By 2040, the amount of necessary dispatchable emission-free resources could be over 32,000 MW, approximately 6,000 MW more than the total fossil-fueled power plants on the New York grid in 2021.

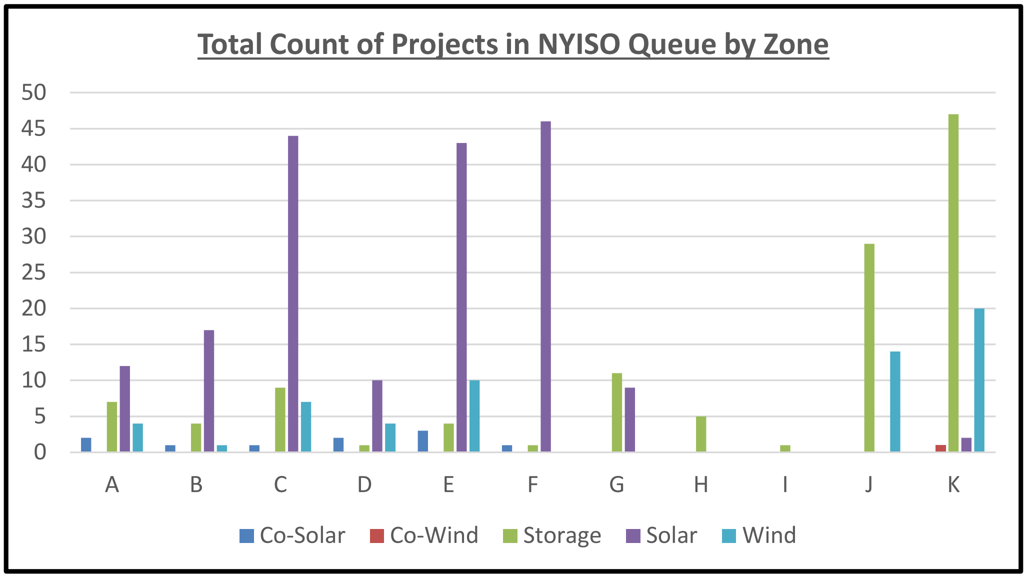
Interconnection Queue: Monthly Snapshot – Storage / Solar / Wind / CSRs (Co-located Storage)

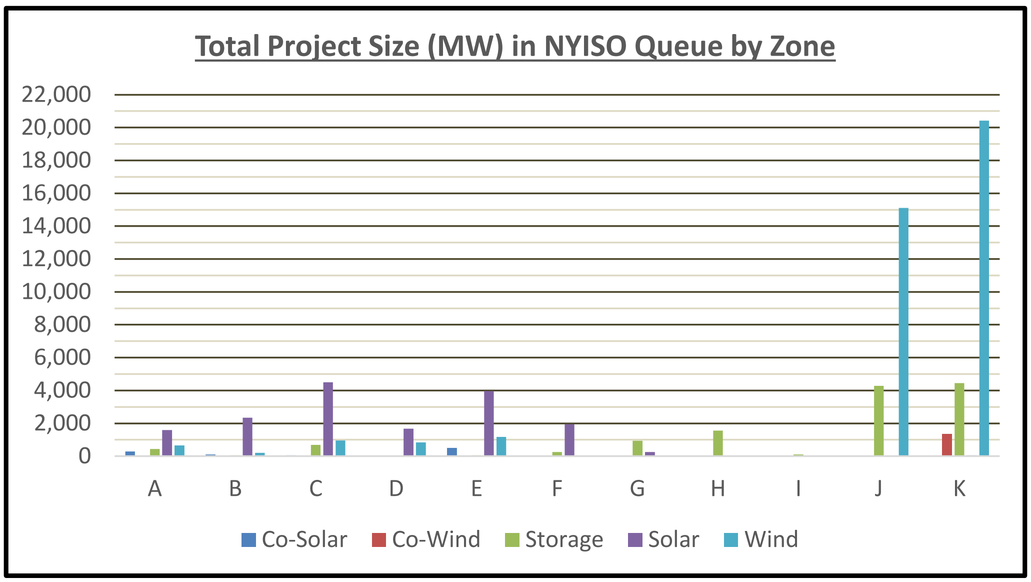
The intent is to track the growth of Energy Storage, Wind, Solar and Co-Located Storage (Solar and Wind now in separate categories) projects in the NYISO Interconnection Queue, looking to identify trends and patterns by zone and in total for the state. The information was obtained from the NYISO Interconnection Website, based on information published on December 21st, and representing the Queue as of November 30th. Note that 8 projects were added, and 15 were withdrawn during the month of November. Results are tabulated below and shown graphically on the next page.

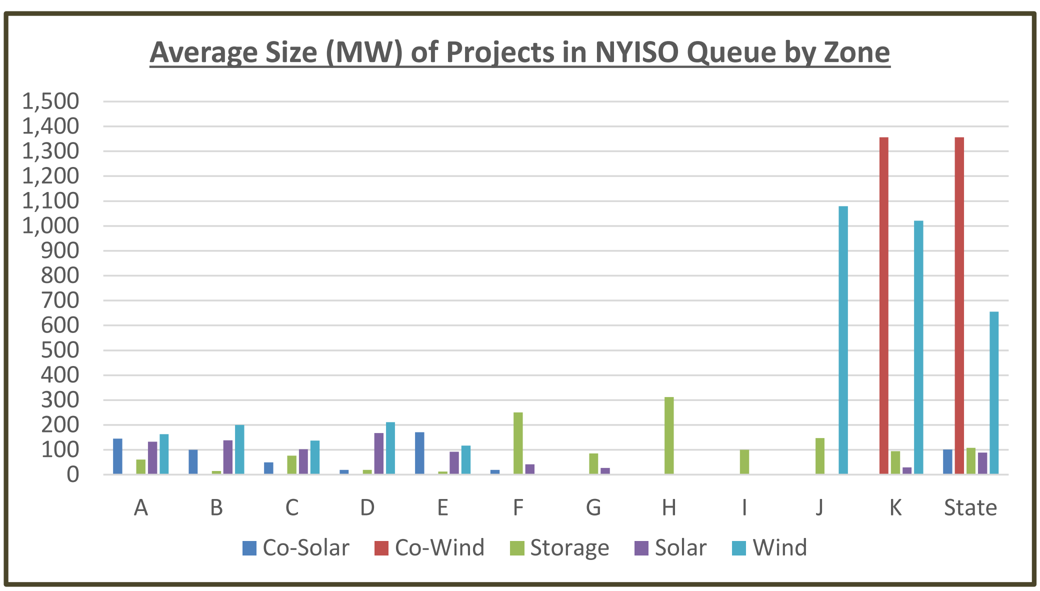
Total count of Projects in NYISO Queue by Zone					
Zone	Co-Solar	Co-Wind	Storage	Solar	Wind
A	2		7	12	4
B	1		4	17	1
C	1		9	44	7
D	2		1	10	4
E	3		4	43	10
F	1		1	46	
G			11	9	
H			5		
I			1		
J			29		14
K		1	47	2	20
State	10	1	119	183	60

Total Project Size (MW) in NYISO Queue by Zone					
Zone	Co-Solar	Co-Wind	Storage	Solar	Wind
A	290		430	1,590	652
B	100		61	2,345	200
C	50		689	4,495	960
D	40		20	1,674	847
E	513		50	3,969	1,165
F	20		250	1,937	
G			947	250	
H			1,560		
I			100		
J			4,280		15,112
K		1,356	4,446	59	20,418
State	1,013	1,356	12,833	16,318	39,355

Average Size (MW) of Projects in NYISO Queue by Zone					
Zone	Co-Solar	Co-Wind	Storage	Solar	Wind
A	145		61	132	163
B	100		15	138	200
C	50		77	102	137
D	20		20	167	212
E	171		13	92	117
F	20		250	42	
G			86	28	
H			312		
I			100		
J			148		1,079
K		1,356	95	29	1,021
State	101	1,356	108	89	656


Total Count of Projects in NYISO Queue by Zone
50
45
40
35
30
25
20
15
10
5
0
A
B
C
D
E
F
G
H
I
J
K
Co-Solar
Co-Wind
Storage
Solar
Wind


Total Project Size (MW) in NYISO Queue by Zone
22,000
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
A
B
C
D
E
F
G
H
I
J
K
Co-Solar
Co-Wind
Storage
Solar
Wind


Average Size (MW) of Projects in NYISO Queue by Zone
1,500
1,400
1,300
1,200
1,100
1,000
900
800
700
600
500
400
300
200
100
0
A
B
C
D
E
F
G
H
I
J
K
State
Co-Solar
Co-Wind
Storage
Solar
Wind