Attachment #8.1
Return to Agenda

De-Carbonization / DER Report for NYSRC Executive Committee Meeting 11/10/2021

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The November 2021 edition of the De-Carbonization / Distributed Energy Resources (DER) Report includes two relevant presentations given at the NPCC DER Forum. An article in PES magazine takes a deep dive into the functions and capabilities of Grid-Forming and Grid Following Inverters. A new podcast and videos from the NYISO are now available. The Interconnection Queue has been updated to reflect the End-of-September values for Co-located Storage Resources, energy storage, solar and wind. Topics in this newsletter are covered in the following order:

- NPCC DER Forum (with focus on NYISO and PSEG-NJ presentations)
- IEEE PES Magazine – November / December Edition devoted to renewable energy integration
- NYISO Podcast and Videos
- Snapshot of the NYISO Interconnection Queue: Storage / Solar / Wind / Co-located Storage

The NPCC's quarterly DER Forum was held on October 14th. The following links are available: DER Forum Landing Page, Meeting Agenda, Presentation Material, and a Video Recording of the event. The presenting companies and their topics are listed below:

- NYISO — Planning for a Grid in Transition
- PSEG (NJ) — Offshore Transmission in New Jersey -
- PJM — Offshore Wind and Transmission Planning
- ISO New England — Transmission Planning for the Clean Energy Transition (TPCET)
- IESO — IESO York Region Non-Wires Alternatives Demonstration Project
- PSEG Long Island — Evolving Transmission Grid and Study Considerations

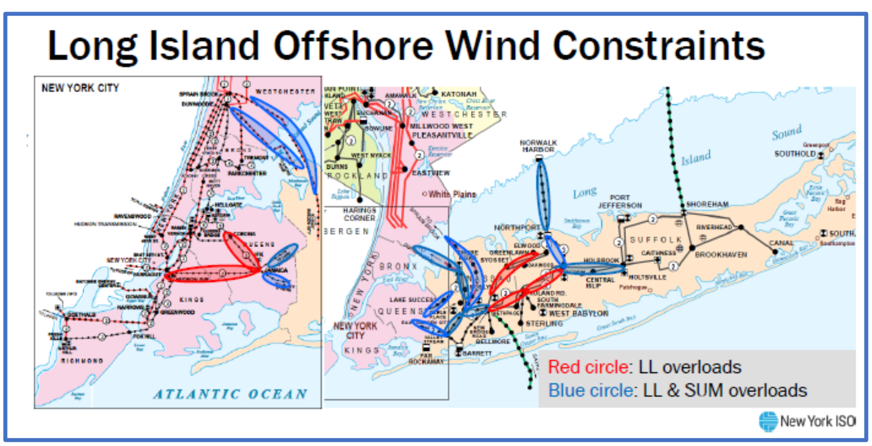
The NYISO presentation, led by Zach Smith, covered some of the themes that have been mentioned in previous monthly summaries, including the Power Trends 2021 publication, Public Policy influence on the resource mix, the "Tale of Two Grids", and the "70 by 30" analysis to identify transmission constraints preventing delivery of renewable energy.

One new item in the presentation focused on the August 12th NYISO solicitation for transmission solutions to address the Public Policy Transmission Need for:

- Adding at least one bulk transmission intertie cable to increase the export capability of the LIPA-Con Edison interface to ensure the full output from at least 3,000 MW of offshore wind is deliverable from Long Island to the rest of the state
- Upgrading associated local transmission facilities to accompany the expansion of the proposed offshore export capability.

Nineteen proposals were received on October 11th, to be evaluated for selection in the Public Policy Transmission Planning Process.

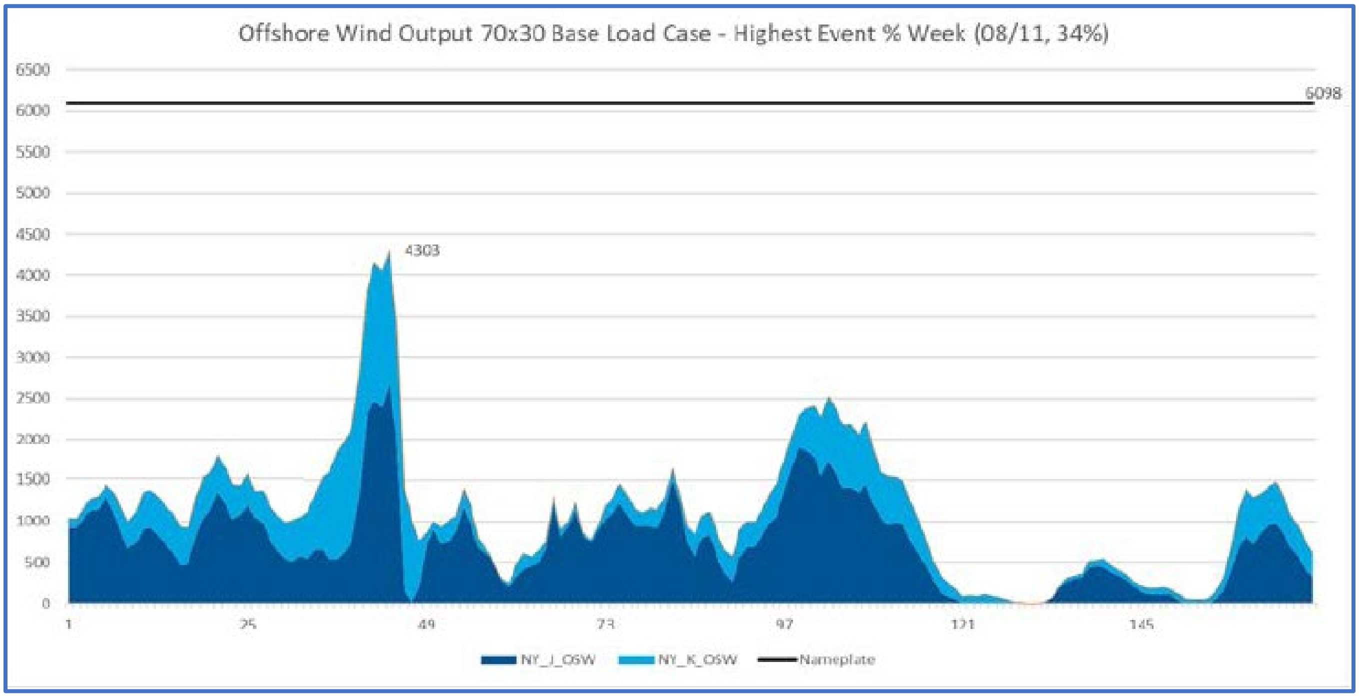
This slide shows where onshore transmission constraints would severely limit the ability to deliver offshore wind through Long Island and into areas north of New York City.



By way of contrast, a separate page in the presentation discussed the Climate Change Impact Study, which created models of various generation scenarios that could meet policy objectives by 2040. The study examined whether the bulk power system would be able to serve load and meet reserve requirements under a variety of conditions. It assessed the resiliency of the grid for climate events such as periods of extreme temperatures, wind lulls, and severe storms.

The graphic below shows a one-week period (168 hours) in which a wind lull could severely limit the output of the anticipated wind farms off the Long Island coast. The Dark blue is Zone J, and light blue is zone K - in contrast to the 6100 MW nameplate capability represented by the horizontal black line. This graphic shows that:

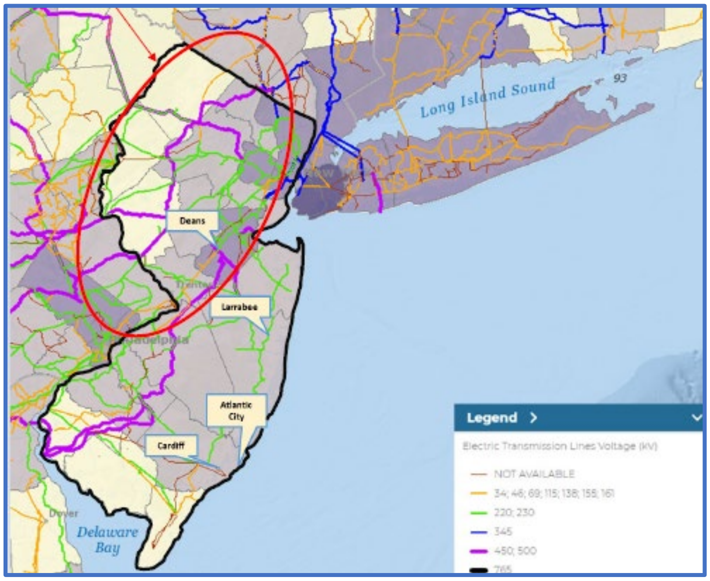
- An Outage of all offshore wind generation has a substantial impact on loss of load events. This is largely due to the co-location of offshore wind, combined with resource deficiencies in New York City and Long Island.
- A one-week outage of 6,100 MW of offshore wind could have roughly the same impact to resource adequacy as the outage of a 1,000 MW conventional generator.

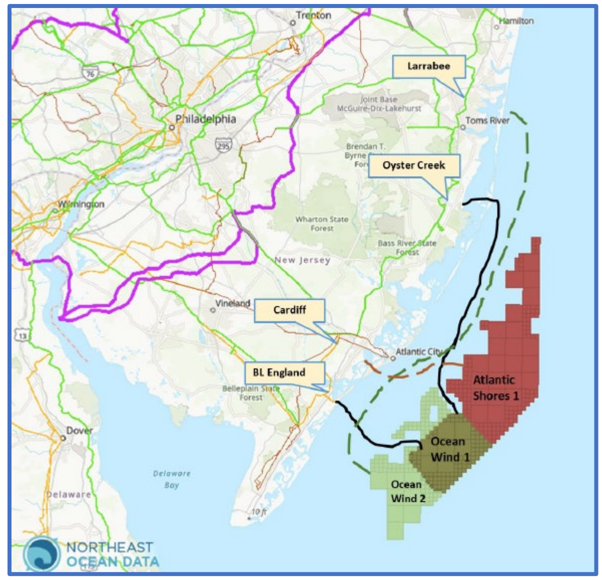


The presentation concludes with these points:

- Transmission investment, at both bulk and local levels, will be necessary to efficiently deliver renewable power to New York consumers.
- The variability of meteorological conditions that govern the output from wind and solar resources presents a fundamental challenge to relying on those resources to meet electricity demand
- Battery storage resources help to fill in voids created by reduced output from renewable resources, but periods of reduced renewable generation rapidly deplete battery storage resource capabilities
- The current system is heavily dependent on existing fossil-fueled resources to maintain reliability. Eliminating these resources will require investment in new and replacement infrastructure, and/or the emergence of a zero-carbon fuel source for thermal generating resources.
- The dispatchable and emissions-free resources needed to balance the system must be significant in capacity, able to ramp quickly, and be flexible enough to meet rapid, steep ramping needs.

The PSEG (New Jersey) Presentation illustrates challenges for offshore wind interconnections similar to those for New York State. Transmission lines are tied to the more highly populated areas in the state, with insufficient capacity for the stations closer to the ocean which are anticipated to become the interconnection sites.





Onshore transmission infrastructure mirrors the load: The 500kV and 345kV backbone is primarily inland, and is not optimally located to support offshore wind:

- Closer to shore, a less robust and lower voltage network predominates
- Often developers must run export cables several miles before reaching substations capable of handling the power they need to inject
- With addition of large quantities of OSW, NJ generation moving from "rivers to ocean" to "ocean to rivers" topology

The projects are making the best use of existing infrastructure, but options are limited:

- Ocean Wind 1 – interconnecting at two retired generating stations, one to the north and one to the south
- Ocean Wind 2 – Southernmost project connecting furthest north
- Atlantic Shores – Northern most project connecting generally south
- Large upgrade costs currently forecast for interconnections at Larabee and Cardiff

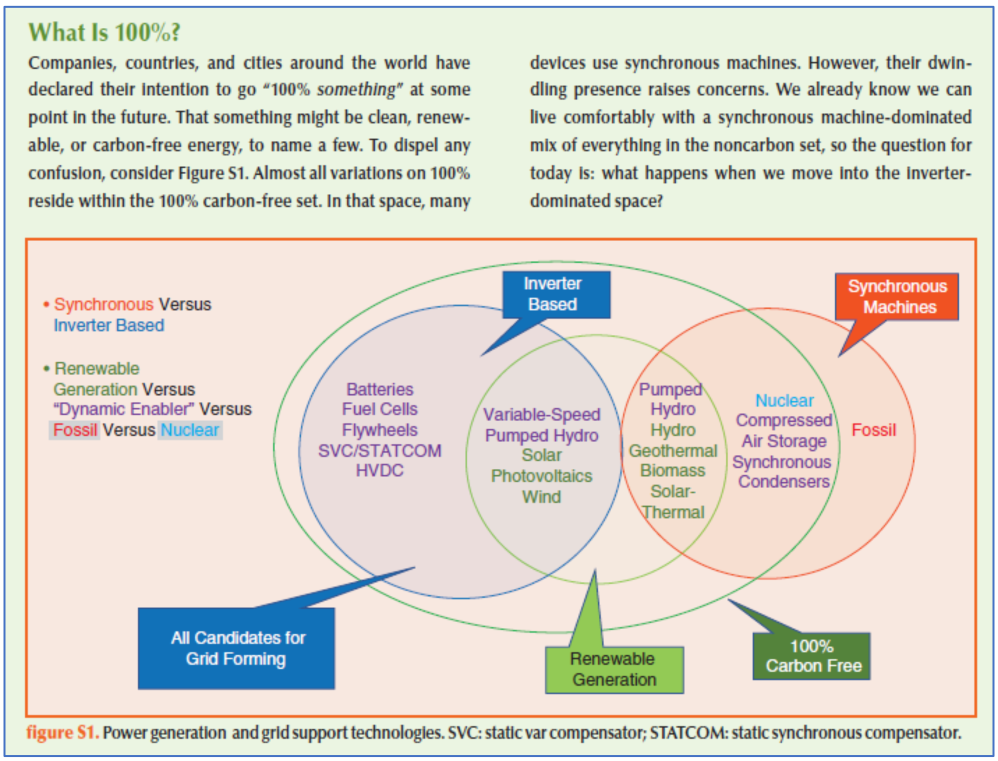
Recent experiences with subsea and underground cables around Long Island have not been reassuring:

- Long Island relies on cable connections to Westchester, CT, and NJ for approximately 45% of its peak load (~2,200 MW import capability, ~5,000 MW peak load)
- Due to a variety of cable system failures and derates over this past year, import capacity has generally been limited to approximately 20% (~900 MW)
- Missing imports had to be made up by older steam and peaking units during peak summer conditions

<u>The November / December Edition of the IEEE Power and Energy Magazine</u> (IEEE PES Membership required)
The latest issue of PES Magazine focuses on the twin forces of extensive renewable system integration and increasing demands of electrification. This edition of the magazine can be found from the main page of the [IEEE PES Website](). Articles in the edition cover:

- A Future with Inverter-Based Resources
- Quantifying Risks in an Uncertain Future
- Hybrid Resources
- Carbon Free Energy
- Enabling Power System Transformation Globally
- Transmission Planning for 100% Clean Electricity
- Forecasting and Market Design Advances
- Variable Renewable Energy integration

The article entitled "A Future with Inverter-Based Resources" included some highly informative graphics, such as the Venn Diagram below highlighting key properties of energy sources in terms of commonality and exclusivity. It is important to note that the boundaries of synchronous vs. inverter don't match perfectly with renewables vs. Fossil. Note the new category of "Dynamic Enabler" given to various types of energy storage functions.



What Is 100%?

Companies, countries, and cities around the world have declared their intention to go "100% *something*" at some point in the future. That something might be clean, renewable, or carbon-free energy, to name a few. To dispel any confusion, consider Figure S1. Almost all variations on 100% reside within the 100% carbon-free set. In that space, many devices use synchronous machines. However, their dwindling presence raises concerns. We already know we can live comfortably with a synchronous machine-dominated mix of everything in the noncarbon set, so the question for today is: what happens when we move into the inverter-dominated space?

figure S1. Power generation and grid support technologies. SVC: static var compensator; STATCOM: static synchronous compensator.

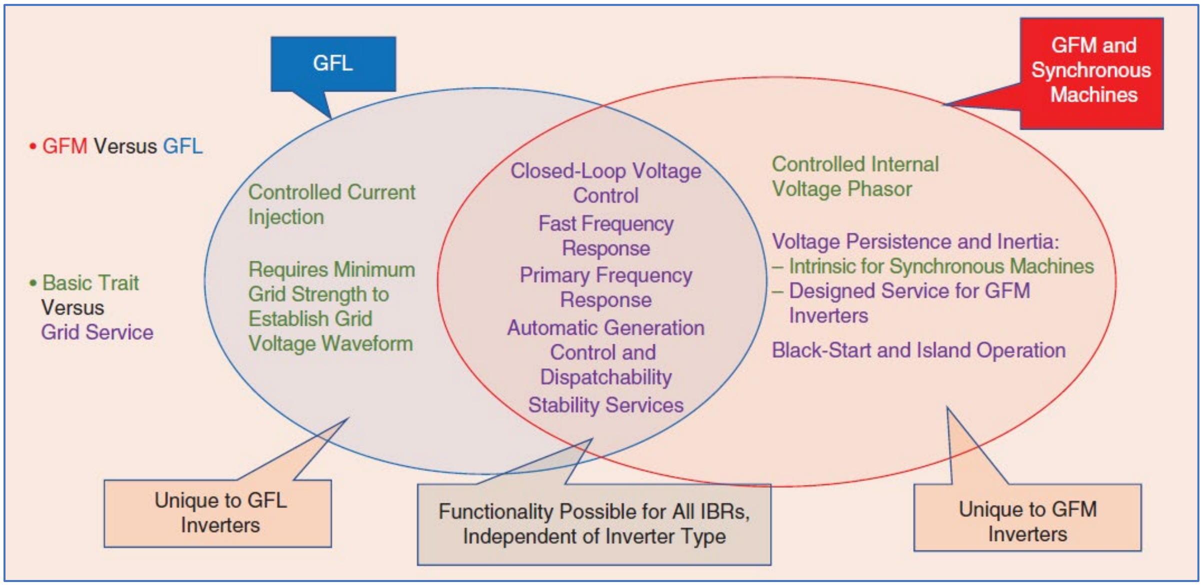
The article goes on to clarify the functional differences between Grid Following Versus Grid Forming Inverters:

<u>Grid Following:</u> *They rely on fast synchronization with the external grid to tightly control their active and reactive current outputs. If these inverters cannot remain synchronized during grid events and challenging network conditions, they are unable to maintain controlled, stable outputs.*

<u>Grid Forming:</u> *The primary objective of GFM control for IBRs is to maintain an internal voltage phasor. This enables IBRs to immediately respond to changes in the external system and maintain stability and control during challenging network conditions.*

There are many variations of GFM and GFL controls. Both are subject to physical equipment constraints, including voltage, current, and energy limits; mechanical equipment constraints (in wind turbines); and external power system limits.

The Venn Diagram below clarifies the functionalities of Grid Following (GFL) vs. Grid Forming (GFM) inverters:



The article continues with an in-depth evaluation on the impact of IBR's on Power System Stability. It concludes with the following notes of both warning and hope:

> *As the generation mix evolves, system services that were inherently provided by synchronous generators are becoming scarce. The reduction of these intrinsic services tends to weaken the grid, making it less able to tolerate the disturbances that accompany the operation of any power system. IBR penetration levels and system characteristics are defining dominant stability concerns. Frequency, voltage, and control instability manifest themselves in new ways, and the system may fail faster and without warning as IBR penetration grows.*
>
> *GFM technology is a necessary enabler of the high penetration of IBRs but not sufficient to resolve all issues. Developers should examine current and future benefits when choosing between GFM and GFL technology for newly planned batteries. Moreover, inverter-based network assets, such as static synchronous compensators and HVDC links, may need to be equipped with GFM capabilities combined with a sufficient energy buffer to mitigate stability challenges. Thus, IBRs themselves can become a "new-found strength in traditional weakness."*

NYISO: Podcast Interview and new Videos have been published on the Blog Page **of the** NYISO Website.

The latest postings include an Interview with Wes Yeomans, VP of NYISO Operations, entitled Summer Reliability Retrospective & Modeling for Climate Change. In this podcast, he reviews the NYISO performance in managing the electric grid last summer, preparations for the winter ahead, and plans for a zero-emissions grid of the future. He also discusses the rise in electric vehicles, and trends to move away from oil and natural gas to electric heat in buildings, especially downstate.

Additional material includes:

- Video with Dave Edelson : How "Dispatchable" Solar Power Can Help Maintain Reliability on the Grid
- Video with Diana Hernandez: With Clean Energy Growing in NY, We Streamlined the Review Process
- Informational Video: Reliably Greening New York's Power Grid and the Role of Markets

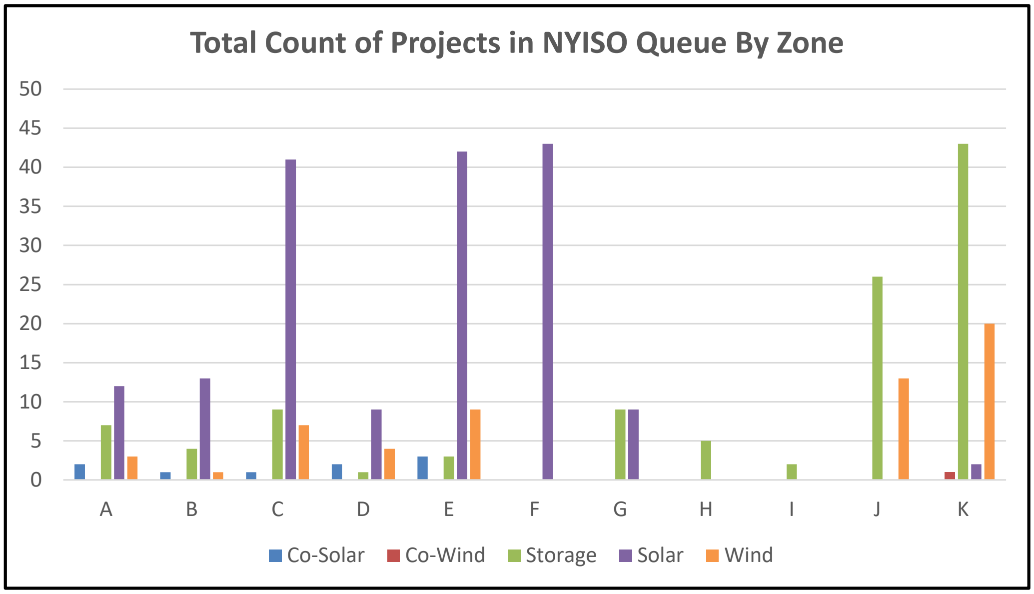
Interconnection Queue: Monthly Snapshot – Storage / Solar / Wind / CSRs (Co-located Storage)

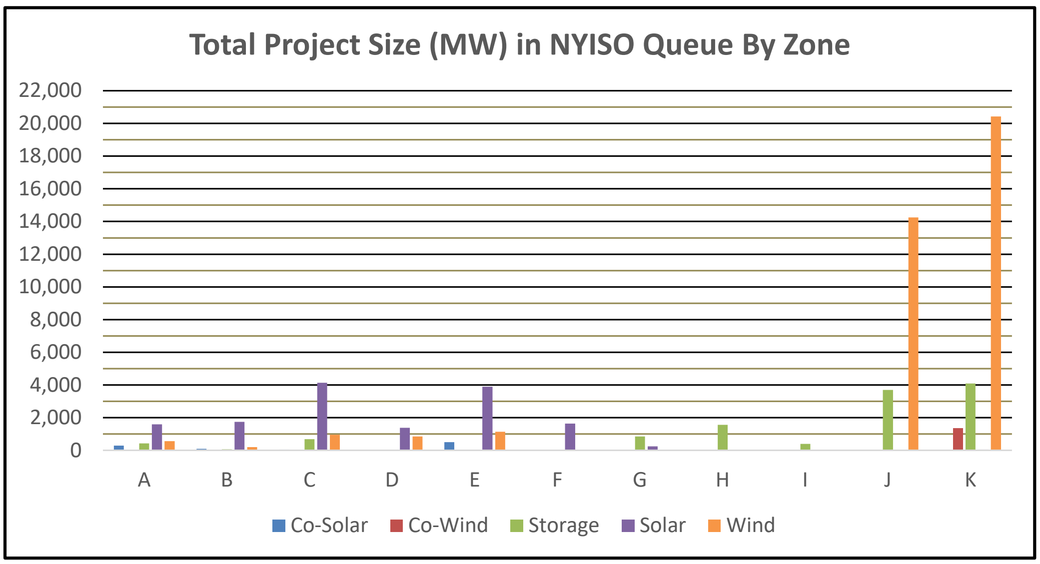
The intent is to track the growth of Energy Storage, Wind, Solar and Co-Located Storage (Solar and Wind now in separate categories) projects in the NYISO Interconnection Queue, looking to identify trends and patterns by zone and in total for the state. The information was obtained from the NYISO Interconnection Website, based on information published on October 16th, and representing the Queue as of September 30th. Note that 32 projects were added and 4 were withdrawn during the month of September. Results are tabulated below and shown graphically on the next page.

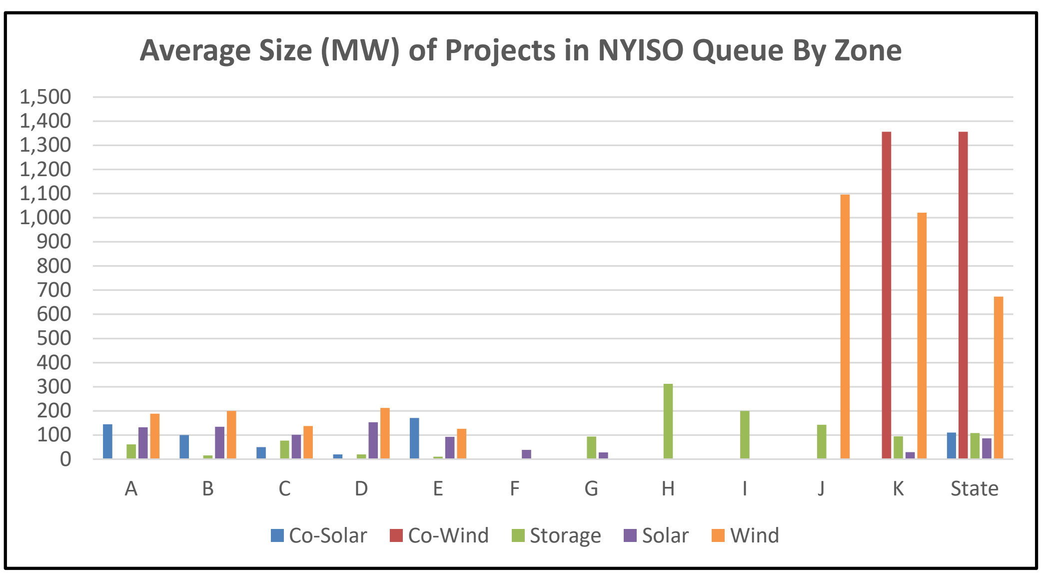
Total Count of Projects in NYISO Queue By Zone					
Zone	Co-Solar	Co-Wind	Storage	Solar	Wind
A	2		7	12	3
B	1		4	13	1
C	1		9	41	7
D	2		1	9	4
E	3		3	42	9
F				43	
G			9	9	
H			5		
I			2		
J			26		13
K		1	43	2	20
State	9	1	109	171	57

Total Project Size (MW) in NYISO Queue By Zone					
Zone	Co-Solar	Co-Wind	Storage	Solar	Wind
A	290		430	1,590	566
B	100		61	1,745	200
C	50		689	4,142	960
D	40		20	1,377	847
E	513		30	3,895	1,135
F				1,645	
G			847	250	
H			1,560		
I			400		
J			3,704		14,248
K		1,356	4,086	59	20,418
State	993	1,356	11,827	14,702	38,374

Average Size (MW) of Projects in NYISO Queue By Zone					
Zone	Co-Solar	Co-Wind	Storage	Solar	Wind
A	145		61	132	189
B	100		15	134	200
C	50		77	101	137
D	20		20	153	212
E	171		10	93	126
F				38	
G			94	28	
H			312		
I			200		
J			142		1,096
K		1,356	95	29	1,021
State	110	1,356	109	86	673


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