De-Carbonization / DER Report for NYSRC Executive Committee Meeting 3/8/2024

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The March 2024 edition of the De-Carbonization / Distributed Energy Resources (DER) Report includes the following items:

- NERC White Paper: Potential Bulk Power System Impact of Electric Vehicle Chargers
- NERC Launches IBR Registration Initiative Resources to Highlight Progress & Keep Stakeholders Informed
- EPRI Collaborative Group: Verifying Performance of BPS-Connected Wind, Solar, and Storage Plants
- Advanced Energy United Publishes Generation Interconnection Scorecard
- NY Times Guest Essay: China's Electric Vehicles are Going to Hit Detroit Like a Wrecking Ball
- Snapshot of the NYISO Interconnection Queue: Storage / Solar / Wind / Co-located

NERC White Paper: Potential Bulk Power System Impact of Electric Vehicle Chargers

On February 8th, NERC announced the publication of their White Paper entitled Potential Bulk Power System Impact of Electric Vehicle Chargers to help inform electric vehicle (EV) stakeholders and policymakers about the need for greater cross-sector collaboration regarding the potential effects of the rapid growth of EV charging on BPS reliability.

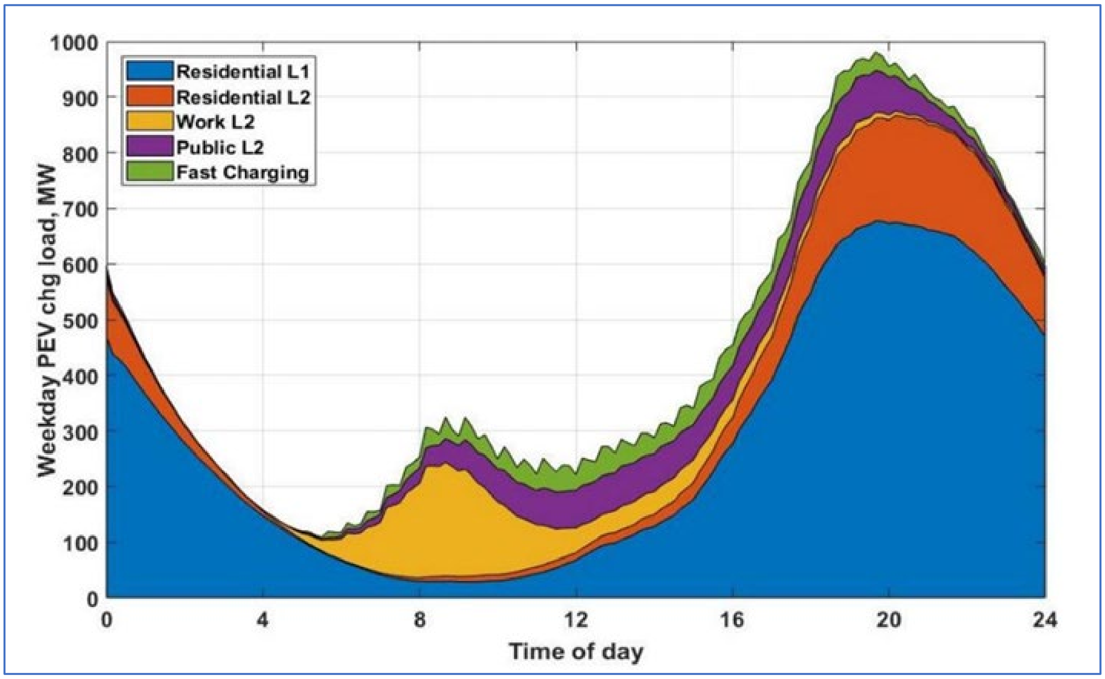
The following deficiencies are the most prevalent in modeling, standardization, and studies:

- Modeling: As it currently stands, there is only a single, generic electrical model to represent EV charging. More work is needed to ensure that the electric system planners and operators have the quality of models needed.
- Standardization: Currently, EVs and their charging systems do not follow consistent control philosophies or performance. Simply put, two different EVs that use Level 2 chargers do not necessarily interact with the grid in the same way. This lack of standardization makes grid planning difficult. Efforts are under way within the electric industry to address this issue.
- Studies: EVs and the effect of their charging systems on the grid have not been sufficiently studied.

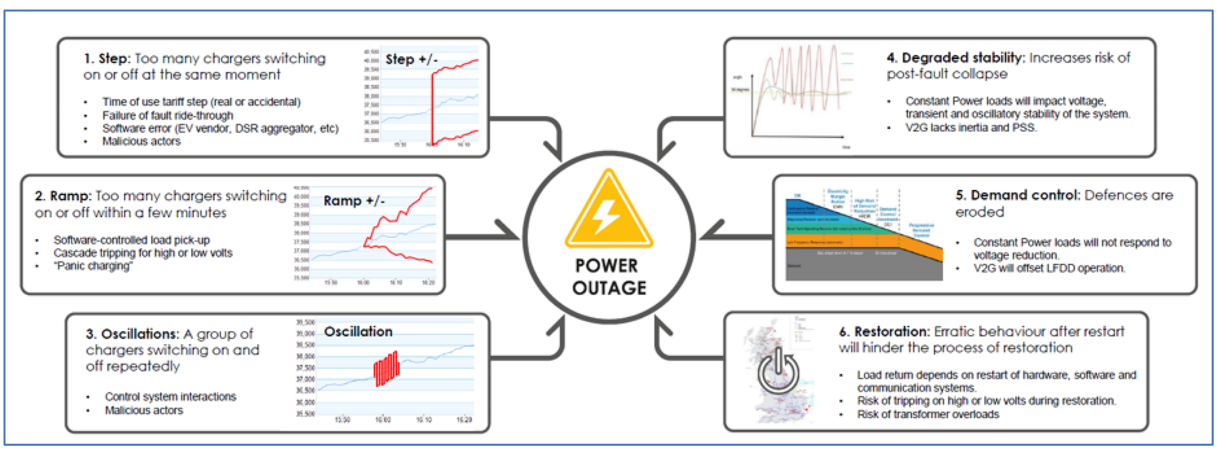
Chargers are categorized into "Levels" of charging capability and the electrical connection required to supply the power to the EV:

- Level 1 Chargers: A range of 2.6 kW for a single-phase ac supply generally using a three-pin socket, which is the slowest of chargers available to end users.
- Level 2 Chargers: A range of 7.4 kW with a single-phase ac supply or 11 kW with a three-phase ac supply (maximum for at home). A dc supply allows for up to 50 kW. These chargers require specialized equipment to be installed regardless of supply.
- Level 3 Chargers: A range of 60–100 kW for "rapid" and up to 350 kW for "ultra-rapid" chargers. These require a strong tie to the distribution substation or a connection for transmission service depending on the facility size and the total chargers in the location. These are generally public charging hubs or parking lots offering charging stations as an amenity for their users.
- Level 4 Chargers: Defined by 1 MW or greater charging capacity. These "megachargers" are in research and development and are planned for the trucking and other heavy equipment industries. Any facility of size (10 or more stalls) would require significant ties to a dedicated distribution substation and will likely need transmission infrastructure updates.

The time of day that EVs charge is a major factor in EV steady-state and stability studies for transmission-level studies. The California Energy Commission has identified a load duration profile to be used to identify which level of EV charger the end-use consumer is using at a given time. As shown in the figure below, there is an anticipated rise in residential Level 1 and Level 2 charging toward the evening hours that will dissipate as vehicles reach full capacity. In the daytime, the EVs are more likely to be plugged into Level 2 chargers at a public parking facility or in a workplace garage with the current rollout of charging locations. Additionally, Level 3 chargers ("Fast Charging") will have inter-hour peaks due to their ability to rapidly charge the EV battery.



The paper makes mention of a two-part study prepared for the National Grid ESO entitled [The Impact of Electric Vehicle Changing on Grid Short-term Frequency and Voltage Stability, and Cascade Fault Prevention and Recovery](). The report seeks to evaluate the transmission grid impacts posed by rapid electrification and summarizes six impacts on the transmission grid as shown in the figure below:



While the report identifies very specific risks to the transmission grid, the risks are largely summarized by the impact of switching the EV chargers on and off, policy-level impacts to their demand control program efficacy, and the uncertain operating characteristics of the devices in specific conditions. The report findings identify that, while the risks may be more granular, the need for well-understood EV charging behavior, clear performance standards with operator training, and regular planning study assessments are needed to achieve a reliable future in the Great Britain's electric system; these findings should be strongly considered for North American grid planning.

Another finding from this report is that regional variation in the rate-of-change-of-frequency (RoCoF) behavior in various areas of the Great Britain system. Further complicating the matter is that dc tie tripping can lead to high RoCoFs when the dc tie is heavily loaded. The report anticipates that the growth of EV charging load can exacerbate RoCoFs and have different magnitudes throughout the system.

The Study Team poses the following recommendations based on EV charger and EV equipment response to bulk grid faults. These recommendations are generalized and should be reviewed by individual TPs and incorporated as appropriate:

- Require EVs to ride through common grid faults via constant power or constant current with a preference to constant current.
- Where necessary to trip, TPs should ensure that the EVs or their charging equipment do not add intentional time delay when voltage returns above the recovery threshold.
- EV recovery should also return to 100% pre-disturbance charging within one second of initiating recovery.
- In areas where Fault-Induced Delayed Voltage Recovery (FIDVR) is a concern, the EV OEMs should coordinate with the TP to determine the required voltage ride-through characteristic and if V2G support can help mitigate FIDVR conditions. In general, if the charger cannot support mitigation of FIDVR conditions, post-disturbance charging should cease to allow for motor load recovery.

Major Findings and Recommendations:

EV charger ride through for grid disturbances is the preferred charging characteristic for the Base Case, and EV charging equipment should default to riding through bulk grid faults if possible. NERC recommends the following actions:

- TPs should identify areas where FIDVR conditions would change recommended EV and charging system ride-through characteristics.
- If EV chargers and their equipment need to cease charging, they should not introduce a time delay when voltage recovers and returns to pre-disturbance charging levels within one second.
- As the EV penetration increases, EVs and charging systems should return to pre-disturbance levels within one second of seeing a recovered voltage if needing to cease consumption.

EV frequency response has an impact on the Interconnection-wide load, and EVs can support system-level frequency depending on droop settings. NERC recommends the following actions:

- EVs and their charging systems should allow and enable a 5% droop characteristic.
- A reasonable deadband should be implemented for this frequency droop behavior, starting at 17 mHz.
- TPs should identify if a different droop parameter is needed for their areas to adjust EV and charging system response for frequency excursions.

Voltage sensing delay does not affect post-disturbance recovery unless it is longer than the recovery time. The following action is recommended: No intentional delay to recovery should be added when sensing a recovered voltage. In line with that recommendation, EVs should not contain a large voltage sensing delay to enable that fast response.

NERC Launches IBR Registration Initiative Resources to Highlight Progress and Keep Stakeholders Informed

As part of its Inverter-Based Resource Strategy, NERC has announced the publication of a Quick Reference Guide for its IBR Registration Initiative. ERO Enterprise assessments has identified a reliability gap associated with the increasing integration of IBRs as part of the grid in which a significant level of bulk power system-connected IBR owners and operators are not yet required to register with NERC or adhere to its Reliability Standards.

In response, FERC issued an Order RD22-4 in 2022 directing NERC to identify and register owners and operators of currently unregistered bulk power system-connected IBRs. Working closely with industry and stakeholders, NERC is executing a FERC-approved work plan to achieve the identification and registration directive by 2026.

In Phase 1 of this project, NERC worked with the Regional Entities to develop potential Rules of Procedure revisions to address registration of owners and operators of unregistered IBRs that have an aggregate, material impact. The proposed revisions, which were approved by NERC's Board of Trustees on February 22 and will be submitted to FERC in early March, would result in materially impactful IBRs becoming subject to NERC's Reliability Standards, commensurate to the amount of BPS-impactful synchronous resources currently subject to these standards. This proposal addresses revisions to NERC registration process rules; however, additional projects will focus on the standards development process as NERC Reliability Standards are updated consistent with FERC directives under Order 901.

NERC is launching several initiatives to ensure industry and stakeholders are kept informed throughout this critical, three-phase project:

- IBR Registration Initiative Quick Reference Guide: This visual dashboard allows stakeholders to easily locate key project updates and resource documents and will be updated regularly. The quick reference guide can be found on the front page of the NERC website under the "Initiatives" tab.
- Quarterly Updates: To further facilitate transparency and alignment, NERC will produce a quarterly progress report that will be posted and shared publicly, and the link added to the IBR Registration Initiative Quick Reference Guide as well as to the Registration web page.

Additional Links:

- NERC Quarterly workplan submitted to FERC on February 12th, 2024
- FAQ: Proposed Revisions to NERC Rules of Procedure to Address Registration of Owners and Operators of Unregistered Inverter-based Resources

EPRI Collaborative Group: Verifying Performance of BPS-Connected Wind, Solar, and Storage Plants

This group was established in 2023 under the EPRI category of Supplemental Projects within Program 173 – Bulk Power Integration of Renewables and Distributed Energy Resources. EPRI coordinates monthly meetings with participating utilities and RTOs with the goal of enhancing overall understanding of the ongoing experiences and issues associated with the implementation of IEEE-2800, with the added focus on the impacts of IBR plants on BPS reliability. Go to this [EPRI website] to download information and learn more about this group.

One example of the material shared at these meetings is shown below, in which various root causes of the problems associated with the Odessa event are mapped to related responses published in subsequent FERC orders, along with subsequent Requirements generated in IEEE 2800-2022, as detailed according to the clause paragraph in which the requirements are located.

IEEE 2800-2022 Mapping to NERC and FERC Recommendations

NERC Odessa 2 Report Table 1.1: Causes of Solar PV Active Power Reductions	FERC Orders	UNIFI Performance Need	IEEE 2800-2022	
			Requirements	Clause
Inverter Instantaneous AC Overcurrent	2023	Y	R	4.3, 4.4, 7.2.2.1, 9.4
Passive Anti-Islanding (Phase Jump)	2023	Y	R	7.3.2.4, 9.5
Inverter Instantaneous AC Overvoltage	2023	Y	R	7.2.3, 9.3
Inverter DC Bus Voltage Unbalance	N	Y	R	(7.2.2)
Feeder Underfrequency	661a, 2023	Y	R	4.3, 4.4, 7.3.2.1, 9.1
Unknown/Misc.	N/A	N/A	N/A	N/A
Incorrect Ride-Through Configuration	N	N	R + P2800.2 design eval.	7.2, 7.3, 12.2.3, 12.2.4, 12.2.5
Plant Controller Interactions	N	TBD	R + P2800.2 design eval.	7.2, 7.3, 12.2.3, 12.2.4, 12.2.5
Momentary Cessation	2023	Y	R	7.2.2, 7.2.2.3.4
Inverter Overfrequency	661a, 2023	Y	R	4.3, 4.4., 7.3.2.1, 9.1
PLL Loss of Synchronism	2023	Y	R	4.3, 7.2, Footnote 91, 7.2.2.3.4, 7.3, 7.3.2.3.5, 11
Feeder AC Overvoltage	661a, 2023	Y	R	4.3, 4.4, 9.3
Inverter Underfrequency	661a, 2023	Y	R	4.3, 4.4, 7.3.2.1, 9.1
Not Analyzed	N/A	N/A	N/A	N/A

Mapping to Causes listed in NERC Odessa 2 Report

Additional IEEE 2800-2022 Requirements

Category	Performance Capability	IEEE 2800-2022	
		Requirements	Clause
General	Range of Available Settings	R	4.10.2, 4.10.3, 5.1, 5.2, 6.2.2, 6.2.3
	Prioritization of Functions	R	4.7
	Ramping for control parameter change	R	4.6.2
Monitoring, Control, and Scheduling	Responding to external control inputs	R	4.6
	Remote Configurability	R	5.2.2, 5.2.3, 5.2.4
Voltage Support	Capability at Zero Active Power	R	5.1
	Constant Reactive Power	R	5.2.4
Dynamic Responses and Reliability Services	Consecutive Voltage Deviation Ride-Through	R	7.2.2.4
	Underfrequency Fast Frequency Response	R	6.2.1
	Overfrequency Fast Frequency Response	R	6.2.1
	Primary Frequency Response	R	

Acknowledgements: Strawman provided by courtesy of MISO (see monthly call on May 17, 2023 [at this link]); reviewed by EPRI staff A. Haddadi, D. Ramasubramanian and J. Boemer.

Causes listed in NERC Odessa 2 report seem to be sufficiently addressed by IEEE 2800-2022 for new IBRs.*

*Disclaimer: This statement does not infer that adoption of IEEE Std 2800-2022 for new installed IBRs will address the potential reliability issues of existing IBRs that may not comply with IEEE Std 2800-2022.

This week, a special meeting was held that included speakers from three OEMs: GE Renewable Energy (Vernova), Vestas Wind Systems, and Tesla, to discuss the impact of IEEE-2800 on their work processes.

Note that Con Edison is a participant in these meetings. At this particular meeting, concern had been voiced that each of the RTO's is in the process of incorporating their IBR-based interconnection requirements to various but not necessarily equivalent degrees in conformity with IEEE-2800. I advised the team that New York was a prime example, in that the NYSRC's PRR-151 had been recently adopted to establish the minimum interconnection standards for large IBR facilities, based on IEEE 2800 – 2022. The following links from the NYSRC's publicly sited Rule Postings webpage were also provided to the participants on the group chat:

- RR #151 2-12-2024.pdf.org(nysrc.org)
- RR #151 Procedure Document 2-11-2024
- RR #151 Memorandum 2-12-2024.pdf(nysrc.org)

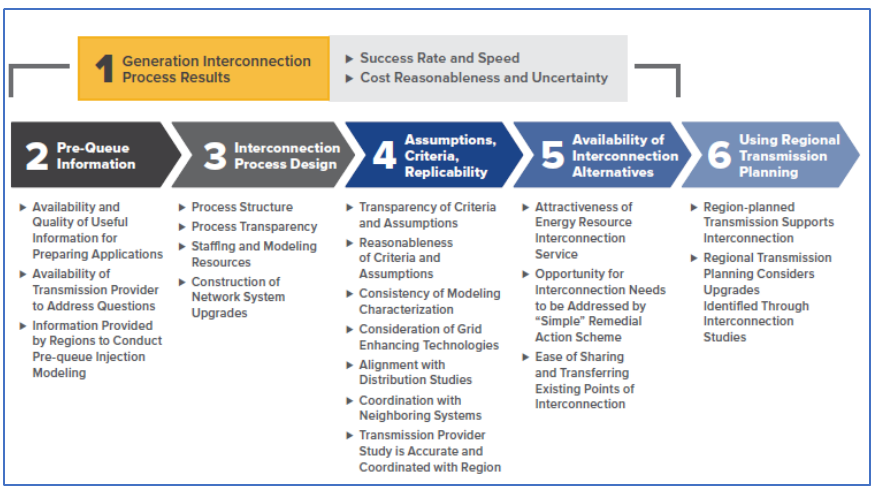
Advanced Energy United Publishes Generation Interconnection Scorecard

This 72-page 2024 Generator Interconnection Scorecard was produced for [Advanced Energy United](#) by Grid Strategies and the Brattle Group, and is based on public data and interviews with twelve generation developers and engineering firms, along with data furnished by Lawrence Berkeley National Labs (LBNL). It evaluates the outcomes and processes of the generator interconnection process across the seven U.S. regional grid operators (the RTOs/ISOs), finding some bright spots and room for significant improvement. The report can be downloaded by completing a short form located on this [Reports Link](#).

The report measured each Region's interconnection process on six dimensions as shown below:

	CAISO	ERCOT	ISO-NE	MISO	NYISO	PJM	SPP
Interconnection Process Results	B -	A	C	C	D	D	C -
Pre-queue Information	C +	C	D	C+	C	C	C -
Interconnection Study Process Design	B	A -	C -	D+	B -	F	D
Study Assumptions, Criteria, Replicability	A	A +	C +	D	C +	F	C
Usefulness of Interconnection Alternatives	B +	B	D	B-	D	D	B
Using Regional Transmission Planning	A -	D	D	B	C +	D +	C+
Final overall grade	**B**	**B**	**D +**	**C -**	**C -**	**D -**	**C -**

Components included within each category are shown below:



No region scored an "A" but two regions stand out as doing a better job than the rest: both the California Independent System Operator (CAISO) and the Electric Reliability Council of Texas (ERCOT) received a "B" score. CAISO is seen as having a good process that has failed to keep up with the recent increased volume of interconnection requests, while ERCOT has an efficient interconnection process, but projects face a high risk of curtailment once connected.

Key drivers of Scorecard overall grades are shown below:

CAISO B: gets strong marks for its high rates of studying resources, proactive upgrades to its transmission system, transparency, and cost sharing approach. CAISO's use of mitigation strategies to bring projects into operation until upgrades are constructed is also appreciated by interconnection customers. However, recent delays in interconnection study results have made it more difficult to complete CAISO's queue.

ERCOT B: gets high marks for processing a high volume of resources on a reasonable timeline and at reasonable costs. However, the lack of proactive regional transmission planning to address system constraints and resulting high levels of generator curtailment is a major impediment to development and deployment of new generation resources.

ISO-NE D+: has a relatively low interconnection volume. Portions of its system are highly constrained (Maine and southeast Massachusetts), making it likely that projects will trigger significant system upgrade costs. Those upgrades, as well as planned transmission expansions, are difficult to build, making it difficult to bring projects online. Another criticism is the unique requirement for a high-cost model with the initial application.

MISO C-: strongest point is its recent commitment to transmission expansion both within its system and in coordination with SPP along the seams of the two systems. However, its gap in planning studies has recently left the system with limited available capacity. Another positive is the availability of interconnection alternatives permitted outside of queue order. MISO's interconnection process is considered unreliable and slow with unpredictable cost outcomes. An additional concern includes recent changes to MISO's interconnection business practices to raise impact criteria for new projects.

NYISO C-:gets its highest recognition for design of its interconnection process, with mostly reasonable study assumptions and criteria. However, the process has not produced compelling results, with long timelines and unpredictable costs that come late in the process. NYISO's use of regional transmission planning to expand opportunities for new generation resources has some promise but is not yet delivering substantial benefits. The availability of interconnection alternatives in NYISO is more limited than in other Regions.

PJM D-: There are few bright spots for generator interconnection in PJM. Overall, it appears that PJM stuck with a sub-par serial process too long and its transition to a cluster process has frozen opportunities for new projects. In addition, PJM has not planned its system to create headroom for new resources, other than its recent process concerning NJ offshore wind. PJM receives a better score than other Regions on its responsiveness to questions.

SPP C-: scores well for its coordination with MISO, but its current transmission planning process lacks a focus on creating opportunities for new generators. Its process operates closer to official timelines than some other Regions, but the resulting studies are often compromised by frequent restudy and errors that make results undependable. While it is difficult to get interconnection alternatives considered in most Regions, SPP has 11 GW of operational ERIS resources (with another 26 GW in its queue), yet interconnection customers indicated that scale of ERIS is creating challenges for recent interconnection applications.

Additional information can be found at these links:
Utility Dive Brief: ERCOT, CAISO offer best grid interconnection processes; PJM, ISO-NE the worst, report finds
Renewable Energy World: Interconnection 'report card' shows an ongoing struggle to connect new generation

NY Times Guest Essay: China's Electric Vehicles Are Going to Hit Detroit Like a Wrecking Ball

This [Guest Essay] warns that the biggest threat to the Big Three comes from a new crop of Chinese automakers, especially BYD, which specialize in producing plug-in hybrid and fully electric vehicles. BYD's growth is astounding: It sold three million electrified vehicles last year, more than any other company, and it now has enough production capacity in China to manufacture four million cars a year. But that isn't enough: It's building new factories in Brazil, Thailand, Hungary, and Uzbekistan, which will produce even more cars, and it may soon add Indonesia and Mexico to that list. A deluge of electric vehicles is coming.

BYD's cars deliver great value at prices that beat anything coming out of the West. Earlier this month, BYD unveiled a plug-in hybrid that gets decent all-electric range and will retail for just over $11,000 equivalent in the Chinese market. BYD benefits from its home country's lower labor costs, but this explains only some of its success. The fact is that BYD, and Chinese automakers like Geely, which owns Volvo Cars and Polestar, are very good at making cars. They have leveraged China's dominance of the battery industry and automated product ion lines to create a juggernaut.

Ford and GM plotted an ambitious E.V. transition three years ago. But it didn't take long for them to stumble. Last year, Ford lost more than $64,000 on every E.V. that it sold. Since October, it has delayed the opening of one of its new E.V. battery plants, and GM has fumbled the start of its new Ultium battery platform, which is meant to be the foundation for all of its future electric vehicles. Ford and GM have notched some wins here (the Mustang Mach-E and Chevrolet Bolt are modest hits), but they aren't competing at the level of Tesla and Hyundai - companies that operate factories in less union-friendly states in the Sun Belt.

The good news is that Congress has already done some of the work for him. You may have heard about the Inflation Reduction Act's generous subsidies for domestic electric car production. Can it help here? It can, and it will, but the act alone is not nearly big enough to insulate these companies from the threat posed by Chinese E.V.s. The Chinese automaker Geely is preparing to sell the small, all-electric Volvo EX30 S.U.V. in the United States for $35,000. That price rivals what American automakers are capable of doing today, even with the Inflation Reduction Act's subsidies.

Subsidies likely won't be enough; Mr. Biden will need to impose new trade restrictions. But here's where it gets messy. The case for protecting the American auto market from Chinese E.V.s is obvious and politically essential but also highly troublesome. In the short term, American automakers, even the homegrown electric-only carmakers like Tesla and Rivian, must be shielded from a wave of cheap cars. But in the long term, the American car market should not be cordoned off from the rest of the world, turning the United States into an automotive backwater of bloated, expensive, gas-guzzling vehicles. The Chinese carmakers are the first real competition that the global car industry has faced in decades, and American companies must be exposed to some of that threat, for their own good. That means they must feel the chill of death on their necks and be forced to rise and face this challenge.

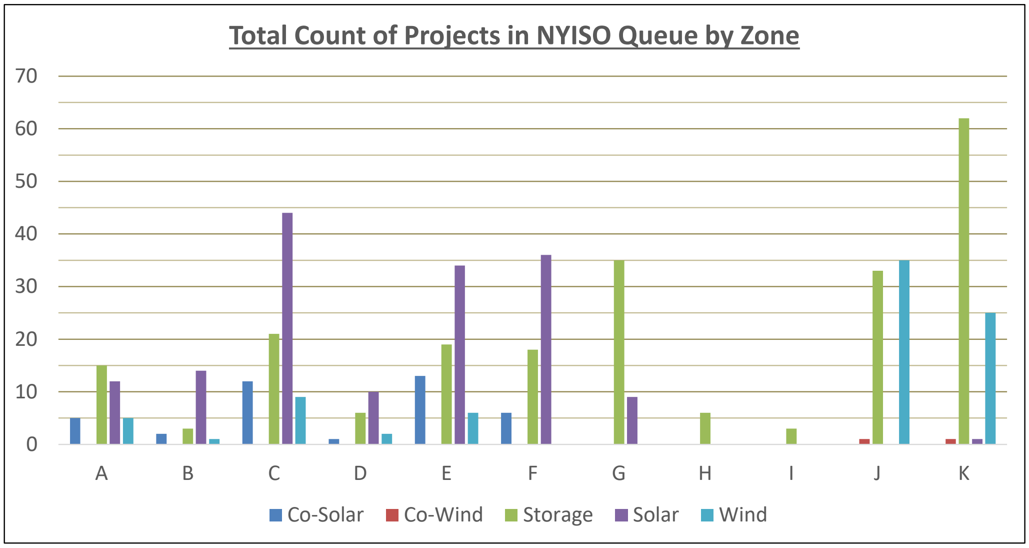
Interconnection Queue: Monthly Snapshot – Storage / Solar / Wind / CSRs (Co-located Storage)

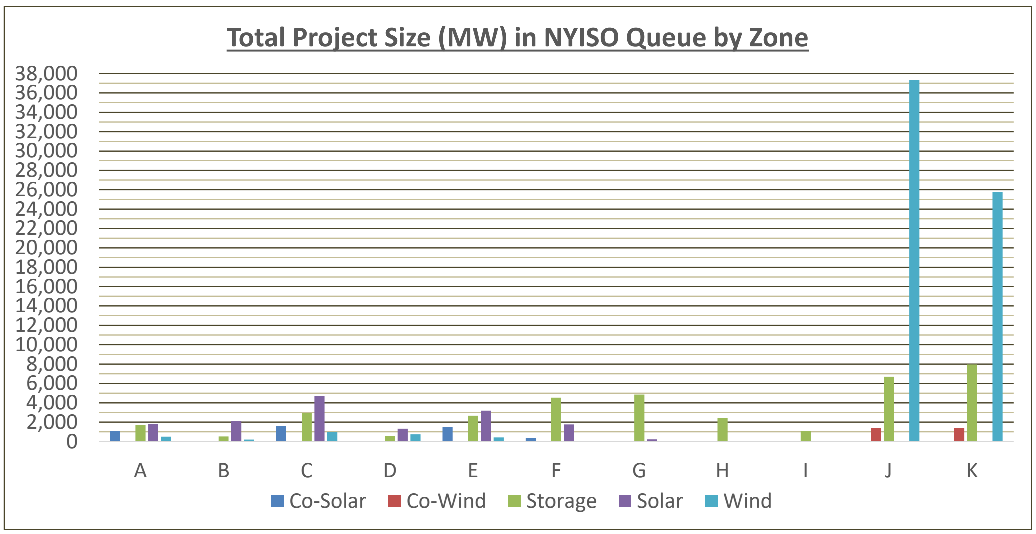
The intent is to track the growth of Energy Storage, Wind, Solar and Co-Located Storage (Solar and Wind) projects in the NYISO Interconnection Queue, looking to identify trends and patterns by zone and in total for the state. The information was obtained from the NYISO Interconnection Website, based on information published on February 20th, and representing the Interconnection Queue as of January 31st. Note that 9 projects were added, and 7 were withdrawn during the month of January.

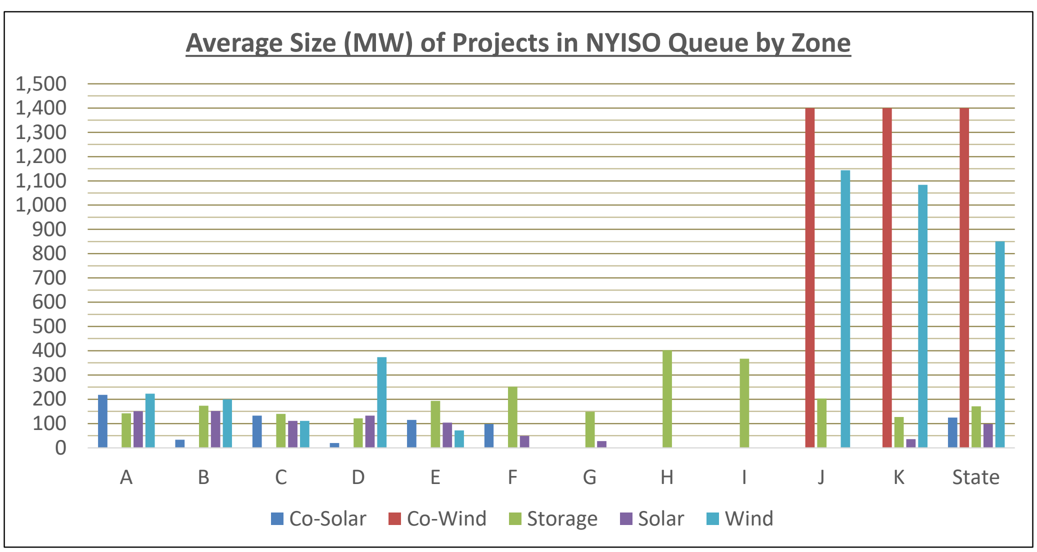
Total Count of Projects in NYISO Queue by Zone					
Zone	**Co-Solar**	**Co-Wind**	**Storage**	**Solar**	**Wind**
A	5		15	12	5
B	2		3	14	1
C	12		21	44	9
D	1		6	10	2
E	13		19	34	6
F	6		18	36	
G			35	9	
H			6		
I			3		
J		1	33		35
K		1	62	1	25
State	39	2	221	160	83

Total Project Size (MW) in NYISO Queue by Zone					
Zone	**Co-Solar**	**Co-Wind**	**Storage**	**Solar**	**Wind**
A	1,092		2,136	1,813	1,114
B	67		520	2,125	200
C	1,591		2,936	4,872	1,001
D	20		730	1,322	747
E	1,492		3,669	3,536	430
F	587		4,532	1,761	
G			5,208	250	
H			2,416		
I			1,100		
J		1,400	6,705		40,026
K		1,400	7,865	36	27,096
State	4,848	2,800	37,816	15,715	70,612

Average Size (MW) of Projects in NYISO Queue by Zone					
Zone	**Co-Solar**	**Co-Wind**	**Storage**	**Solar**	**Wind**
A	218		142	151	223
B	34		173	152	200
C	133		140	111	111
D	20		122	132	374
E	115		193	104	72
F	98		252	49	
G			149	28	
H			403		
I			367		
J		1,400	203		1,144
K		1,400	127	36	1,084
State	124	1,400	171	98	851


Total Count of Projects in NYISO Queue by Zone
70
60
50
40
30
20
10
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
38,000
36,000
34,000
32,000
30,000
28,000
26,000
24,000
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