De-Carbonization / DER Report for NYSRC Executive Committee Meeting 7/8/2022

Contact: Matt Koenig (koenigm@coned.com)

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

- NERC June Newsletter: Mark Lauby on 3-D Grid Transformation
  New Guides About Inverter-Based and Distributed Energy Resource Activities
- New York Times Article: Can Dual-Use Solar Panels Provide Power and Share Space with Crops?
- ESIG: Multi-Value Transmission Planning for a Clean Energy Future
- EPRI: Analyzing the Impact of Aggregated DER Behavior on Bulk Power System Performance
- EPRI: Physical Climate Risk Assessment & Mitigation: Future Resilience and Adaptation Planning
- NYISO Blog: Podcast Episode 20: The ROI of Energy Security Investment with Karen Wayland
  Press Release: Power Trends 2022 -The Path to a Reliable, Greener Grid for New York
- Snapshot of the NYISO Interconnection Queue: Storage / Solar / Wind / Co-located Storage

Highlights from the June NERC Monthly Newsletter (Link) include:

ERO Executive Spotlight: Mark Lauby on 3-D Grid Transformation

As the electricity industry transitions toward a net-zero carbon future and the economy becomes more electrified, we are witnessing a sustained shift toward what is known as, "Three-Dimension (3-D) Grid Transformation." That is:

- Decarbonized – the interconnection of variable energy generation
- Distributed – energy resources, such as rooftop solar, connected to the distribution system
- Digitized – in load management and also in grid operations

While collectively the 3-Ds will deliver a grid with a lower carbon footprint, more localized control over resources, and better operational data for efficiency and optimization with variable generation like wind and solar, there is increased risk associated with fuel availability. In addition, distributed resources (including Behind-the-Meter) mask true loads and operator visibility to them, and every digital device added to the grid increases the attack surface for cybercrime.

NERC's Reliability Issues Steering Committee (RISC) has highlighted four significant evolving risks in their 2021 ERO Reliability Risk Priorities Report:

- Grid Transformation: The generation resource mix continues to shift from conventional synchronous central-station generators toward a new mix of resources that includes natural gas-fired generation; unprecedented levels of non-synchronous resources, such as renewables and battery storage; demand response; smart- and micro-grids; and other emerging technologies.
- Security: The transforming grid continues to become more dependent on digitized communications and advanced controls, consequently increasing the attack surface for bad actors — be they nation-states or organized cyber criminals.
- Extreme Events: The new resource mix is more susceptible to long-term, widespread weather systems and more weather dependent. Increasingly extreme temperatures have resulted in unprecedented loads, which are further exacerbated by wider geographic footprints. As neighboring systems are experiencing the same conditions, their ability to transfer power between affected systems is reduced. In addition, the increasing duration of weather events places strain on inventoried fuels and reduces the efficacy of demand response.
- Critical Infrastructure Interdependencies: As the grid decarbonizes, the role of balancing resources — such as natural gas — becomes more vital. The irony is that the gas industry depends on electricity to support its ability to operate. This intersection was brought into sharp focus during Winter Storm Uri in 2021 when extraordinary failures in coordination between the Texas natural gas industry and the power sector led to operator-initiated rotating electricity outages and the failure of multiple water systems.

NERC Announcement: New Guides About Inverter-Based and Distributed Energy Resource Activities

The Announcement from NERC describes the North American grid as undergoing a rapid transformation to its resource mix, adding increasing amounts of renewable generation — wind, solar, battery storage and hybrid plants. While these inverter-based resources present new opportunities in terms of grid control, they also introduce instability and potential risks to the system, as documented by NERC in multiple disturbance reports since 2016.

Over the past seven years, the ERO Enterprise has taken action to support the reliable integration of inverter-based resources to the grid, addressing emerging reliability risks related to inverter-based resources and focusing on the impacts of distributed energy resources from a transmission planning and system analysis perspective. NERC's Inverter-Based Resource Performance Task Force (IRPTF) and System Planning Impacts of Distributed Energy Resources Working Group (SPIDERWG) have conducted workshops and other activities and produced a vast array of resources — including disturbance reports and reliability guidelines — to provide industry and stakeholders with information they need to reliably integrate these new technologies.

To better highlight the work being done surrounding these technological advancements and provide an easier way for industry to access the information, NERC has added two new resources to the Initiatives tab on NERC.com, shown as Distributed Energy Resource Activities and Inverter-Based Resource Activities, each with subsets of related material:

The Inverter-Based Resource Activities Quick Reference Guide is subdivided into the following sections.

- Disturbance Reports
- Alerts
- Reliability Guidelines
- White Papers
- Technical Reports
- Standards Authorization Request (SAR) Activities
- Other Activities

This document acts as a quick reference guide for the work that the ERO Enterprise has done regarding inverter-based resource activities over the past seven years to ensure the continued reliability of the North American power grid.

In most cases, inverter-based generating resources refer to Type 3 and Type 4 wind power plants and solar photovoltaic (PV) resources. Battery energy storage is also considered an inverter-based resource. Many transmission-connected reactive devices, such as STATCOMs and SVCs, are also inverter-based. Similarly, HVDC circuits also interface with the ac network though converters. Inverter-based resources are being interconnected at the bulk power system (BPS) level as well as at the distribution level; however, this reference guide focuses specifically on BPS-connected inverter-based resource efforts.

The Distributed Energy Resource Activities Quick Reference Guide is subdivided into the following sections:

- Technical Reference Documents
- White Papers and Reports
- Reliability Guidelines
- Webinars and Workshops
- Key Presentations to NERC SPIDERWG
- Standards-Related Activities
- Other DER Activities

This document acts as a quick reference guide for the work that the ERO Enterprise has done regarding DERs over the past seven years to ensure the continued reliability of the North American power grid.

DER includes both generators and energy storage technologies capable of exporting active power to an electric power system. The NERC System Planning Impacts of DER Working Group (SPDIERWG) uses a this definition of DER: "Any Source of Electric Power located on the Distribution System." The SPIDERWG set of definitions is the preferred set of definitions when discussing reliability-based initiatives. Those resources specifically located on the distribution system are modeled as retail-scale DERs (e.g., rooftop solar photovoltaic (PV)) as well as utility-scale DERs (e.g. - small combined heat and power and small solar PV power plants), abbreviated as R-DERs and U-DERs, respectively.

NY Times: Can Dual-Use Solar Panels Provide Power and Share Space with Crops?

This New York Times article highlights current efforts in the field of Agrivoltaics - a portmanteau of agriculture and voltaic cells, which transform solar power to electrical power. Also called dual-use solar, the technology involves adjusting the height of solar panels to as much as 14 feet, as well as adjusting the spacing between them, to accommodate equipment, workers, crops and grazing animals. The spacing and the angle of the panels allows light to reach the plants below and has the added benefit of shielding those crops from extreme heat.

The photos below show a field of 14-foot-high solar panels on a farm in Grafton, Mass., which have been developed, built and operated by the AES Corporation, an energy company.

Farms in many parts of the country are in peri-urban areas, zones of transition from rural to urban land. Their proximity to high-use metropolitan areas makes open farmland particularly suitable for solar arrays, but in the past, without any coexisting agriculture, that sort of placement can set up a conflict over whether food or energy production should prevail.

In a study by AgriSolar Clearhouse, a new collaboration to connect farmers and other landowners with Agrivoltaic technology, the installations were also shown to foster growth by shielding crops from increasing temperatures and aiding with water conservation. While the technology remains in its infancy in the United States compared with countries in Europe, where the technology has been used for over a decade, federal regulators as well as academics and developers are working to remedy that disparity.

Early results are promising. A project in Arizona has seen a threefold increase in crop yields when they are underneath this kind of system and up to a 50 percent reduction in irrigation requirements because the panels provide shade. Additionally, the plants under the panels release water into the air, which cools the modules.

According to the Fraunhofer Institute for Solar Energy Systems ISE, based in Germany, five megawatts of power were produced through these systems in 2012. By 2021, 14 gigawatts of power were generated in dual-use systems. And the technology is evolving rapidly; in the few years since the installation at The Grafton farm, adjustable panels that can move to maximize the capture of sunlight, have been developed.

Ultimately, though, everything depends on how the crops taste: If flavor or even appearance strays too far from that of traditional produce, the technology will be a hard sell. An early study performed by the Biosphere 2 Agrivoltaics Learning Lab at the University of Arizona found that tasters preferred the potatoes, basil and squash grown with agrivoltaics. Beans, however, may take some time. The small sample of tasters preferred the traditionally grown version.

ESIG Report – Multi-Value Transmission Planning for a Clean Energy Future

The Energy Systems Integration Group (ESIG) is a non-profit educational association that focuses on providing resources and education to the engineers, researchers, technologists and policymakers for the evolving electricity and integrated energy systems, and to support grid transformation and energy systems integration and operation.

ESIG has announced a new report entitled *Multi-Value Transmission Planning for a Clean Energy Future* (Download Page) along with a Fact Sheet and Link to Video Presentation on YouTube), demonstrating a methodology for evaluating a broad range of benefits from large-scale transmission expansion. The premise of the report focuses on today's transmission planning processes that focus primarily on local improvements. While the current planning framework may adequately address average conditions on the grid, it fails to protect consumers from low-probability, high-impact, and costly extreme events.

When a network spans regions with different weather patterns and load profiles, it has increased resilience stemming from neighboring areas experiencing periods of scarcity and abundance at different times. However, in order to evaluate the value of large-scale transmission projects requires going beyond production cost savings and identifying, analyzing, and quantifying a broader range of benefits.

The study modeled three potential transmission lines and quantified six types of benefits in each case: production costs, emissions reductions, generation capital cost savings, risk mitigation, resource adequacy, and resilience benefits.

ESIG's Transmission Task Force undertook a case study to demonstrate useful methodologies for employing a multi-value framework to plan transmission effectively. It quantifies two types of transmission upgrades: large-scale transmission upgrades connecting the West Texas renewable energy zones to East Texas and the Houston load center, and a transmission line between the Electric Reliability Council of Texas (ERCOT) and the southeastern United States (Georgia, Mississippi, and Alabama). This case study looked to revitalize multi-value transmission planning, provide a playbook for transmission planners to implement on their own system, and inform comments and proposals to the Federal Energy Regulatory Commission's Notice of Proposed Rulemaking (FERC NOPR)i and ongoing stakeholder efforts at independent system operators and regional transmission organizations on transmission planning reform.

Results showed that a multi-value transmission planning framework yielded significant benefits beyond production cost savings. While production cost savings are enough for some of the evaluated transmission projects to break even, the multi-value framework showed that when a full range of benefits was evaluated, all three of the transmission projects studied had significantly higher benefit-cost ratios. Recognizing these benefits could ultimately change transmission investment decisions

These results also highlight a key finding for transmission planning: different transmission projects can have large differences in the types of value they bring. Transmission that helps to access new, low-cost generating resources, and deliver that energy to load centers, yields large production cost savings and environmental savings, helps meet public policy goals, and brings risk mitigation benefits. Other transmission projects that help a region access more diversified resources are better suited to provide resource adequacy and resilience benefits. The latter have relatively greater generation capital cost benefits and provide an insurance policy against macroeconomic volatility, extreme weather, and other unexpected events.

The multi-value framework also examined the potential avoided cost for ratepayers during extreme events or macroeconomic uncertainty, showing that transmission is a valuable insurance policy for the system that will continue to support the energy transition.

Benefit	Description
Production cost benefits	Quantification of fuel cost savings, reduced curtailment, variable operations and maintenance costs, reduced cycling of thermal power plants.
Emissions reduction benefits	The reduction in emissions of environmental pollutants, including CO_2, NOx, SOx.
Generation capital cost benefits	Reduced capital costs of new generating capacity and lower costs of achieving a renewable energy target from being able to access lower-cost renewable regions that are associated with better resource quality, lower land cost, and easier development.
Risk mitigation benefits	Production cost savings across a range of uncertain future conditions associated with varying gas prices, load growth, renewable build-out and thermal plant retirements.
Resource adequacy benefits	The reduction in loss-of-load expectation attributed to the transmission line, compared to the net cost of a new combustion turbine(s) necessary to achieve the same level of reliability.
Resilience benefits	The reduction in unserved energy attributed to the transmission line during the loss-of-load events remaining after resource adequacy improvements, valued at the ERCOT loss-of-load assumption of $20,000/MWh.

Main challenges remain:

- Transmission planning processes are built around achieving a reliable system at the local level, not necessarily for additional value of economic efficiency or bulk system reliability.
- The interconnection process favors short-term upgrades that are sufficient, but don't consider future expansion
- There is minimal interregional transmission planning between ISO/RTOs and utilities.
- Allocating costs is difficult and controversial.

The planning processes in use today can be improved with the following recommendations:

- Go beyond production costs and implement a multi-value benefit framework. Accurately assessing the wide range of benefits from transmission is important as the system transitions to zero-marginal-cost renewable resources. These benefits should be identified, prioritized, and clearly defined early in the transmission planning process.
- Plan for the long term and start today. Transmission infrastructure can be a 40- to 50-year asset. The planning horizon should reflect that and go out far enough to see the benefits that arise with specific system changes.
- Get comfortable with uncertainty and adopt established methods to deal with it. Move beyond the classic approach to of heuristic-based scenario and parametric analysis. Significant improvements in data science and statistics have been applied in the tech and finance industries and are now migrating to the energy field. Modern power planning tools offer significantly improved capabilities to better quantify risks and benefits.
- Quantify resource adequacy and resilience benefits. Transmission spanning regions that have different weather patterns can mitigate the impacts, both financial and social, of extreme events. This provides an insurance policy for ratepayers. Through transmission expansion, individual regions can achieve reliability with lower capacity investments than if they were unable to share energy with neighbors and had to build a full suite of resources themselves. When extreme weather strikes, the lack of interregional transmission can have devastating consequences for ratepayers.
- Break down silos and plan interregional projects. Interregional coordination is a bedrock of the energy transition. Reliability and resilience benefits accrue most strongly from transmission that connects electrically diverse systems, but market and planning constructs need to account for value from sharing between neighboring systems.

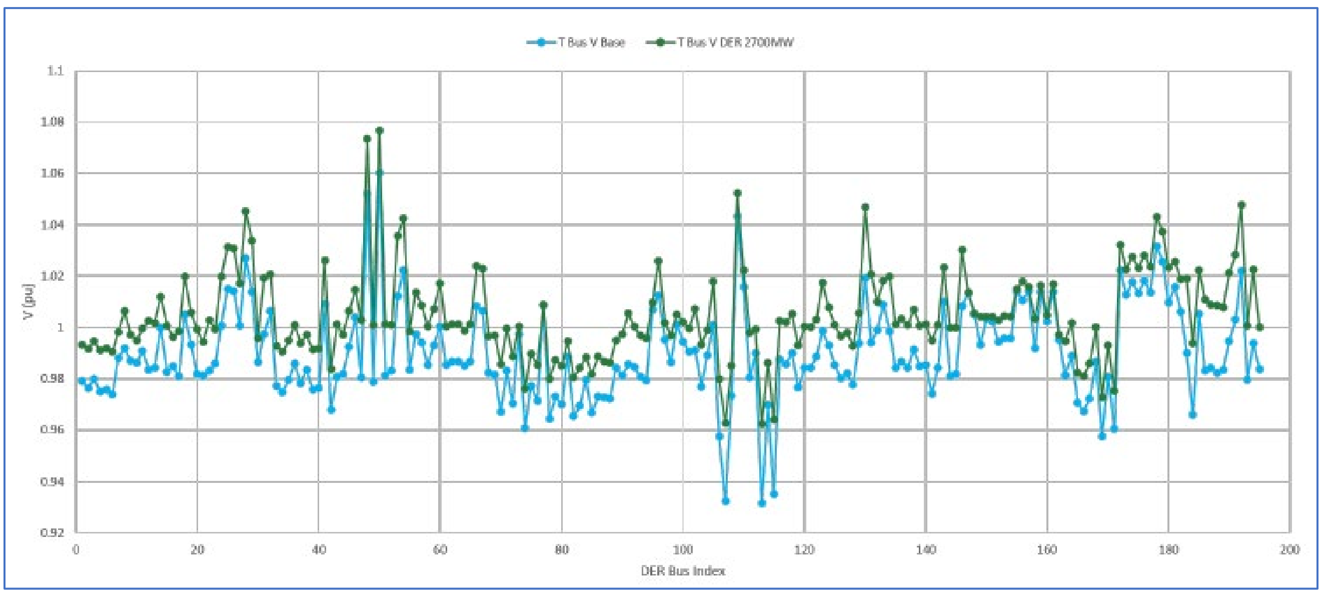
EPRI: Analyzing the Impact of Aggregated DER Behavior on Bulk Power System Performance
This Report from a Case Study (Download Page) performed by EPRI in cooperation with the Southwest Power Pool was developed to investigate the impact of high penetration levels of DER in the Kansas City area of Evergy's system on Bulk Power System (BPS) voltage and frequency performance. Various voltage protection settings and grid support functions defined in IEEE 1547-2018 as well as trip settings based on IEEE 1547-2003 are considered for comparison.

The case study first identified a reasonable penetration level of DER to study. The objective was to include enough aggregate DER such that the influence of their dynamic response can be ascertained. The next step was to develop a power flow case with the appropriate level of modeling detail to capture the impact of the distribution transformer impedance and feeder impedance. Then the dynamic models were parameterized to reflect the configurations of interest. Dynamic simulations were performed for a selected set of contingencies to study the impact of the aggregate DER response on BPS performance.

The remainder of the report is organized as follows:

- Section 2: Transmission hosting capacity analysis results and power flow development.
- Section 3: Dynamics models, DER configurations, and contingencies used in the dynamic analysis.
- Section 4: Results of the dynamic simulations highlighting specific findings.
- Section 5: Summarizes the conclusions of the dynamic analysis.

The figure below compares transmission bus voltage for the base case (light blue) and the high DER case (green).



The report's observations and conclusions are categorized below and on the next page:

In general, increasing the ride-through capability and enabling grid support functions were shown to improve the BPS performance. These results can be used to qualitatively support technical interconnection requirements of future DER installations and identify areas for further comprehensive detailed analysis.

Voltage Trip Settings

The voltage trip setting sensitivities focus on the DER's ability to ride-through voltage dips due to faults on the transmission system.

- Vintage configurations (e.g., IEEE 1547-2003) with voltage trip pickup threshold of 0.88 pu and trip time delay of 160 ms resulted in inferior BPS performance due to DER generation loss as compared to IEEE 1547-2018 voltage trip settings with pickup threshold of 0.5 pu and trip time delay of 160 ms.
- Introducing ride-through capability by lowering the voltage trip threshold from 0.88 pu to 0.5 pu while maintaining the same trip time delay of 160 ms clearly showed improvement in BPS performance due to more DER successfully riding-through the disturbances considered.
- The benefits of IEEE 1547-2018 CAT III ride-through capability and further extended voltage trip clearing times were shown in some delayed cleared fault simulations.
- Based on these results, adopting IEEE 1547-2018 CAT II or CAT III1 ride-through capability and configuration for DER default voltage trip settings provides significant improvement compared to legacy capability and settings from the BPS perspective.

Dynamic Voltage Support

The DVS sensitivities focus on the impact of the capability of the DER to provide voltage support during voltage dips due to faults on the transmission system. Dynamic voltage support is an optional function in IEEE 1547-2018 and is not expected to be certified in inverter-based DER until a future revision of IEEE 1547 specifies performance requirements for this function. This function is mandatory for interconnection requirements in Europe and other regions of the world. Many inverter-based DER are able to provide this function, if enabled.

- Enabling DVS with Q-priority resulted in improved voltage response of the BPS.
- Enabling DVS with Q-priority also resulted in faster recovery of active power post disturbance for some simulations due to the higher terminal bus voltage.
- Enabling DVS on the U-DERs resulted in more U-DER successfully riding through the simulated event.
- P-priority was found to limit the DVS effectiveness in some scenarios. In some cases, this resulted in deteriorated active power response of the aggregate of the DER.
- DVS is not a standard and mandatory function per IEEE 1547-2018. Further, how the vendor implements DVS (i.e., the control objective) is not specified in Clause 6.4.2.6 of IEEE 1547-2018. Some DER may have this capability but requiring it could cause UL 1741 certification challenges.

Active Power – Frequency Control

- Frequency droop control is a mandatory function and must always be enabled per IEEE 1547-2018. The default values are 36 mHz for the deadband and 5% for the droop settings; some distribution utility planners may desire to reduce the sensitivity and efficacy of this function by widening the setting for the deadband or by choosing a higher value for the droop setting.
- Frequency droop control from DER resulted in slightly improved system frequency for large generation loss in the interconnection, but are limited to the relative penetration level of DER. For these benefits to be realized, the DER would have to maintain headroom or have storage.

Current Priority

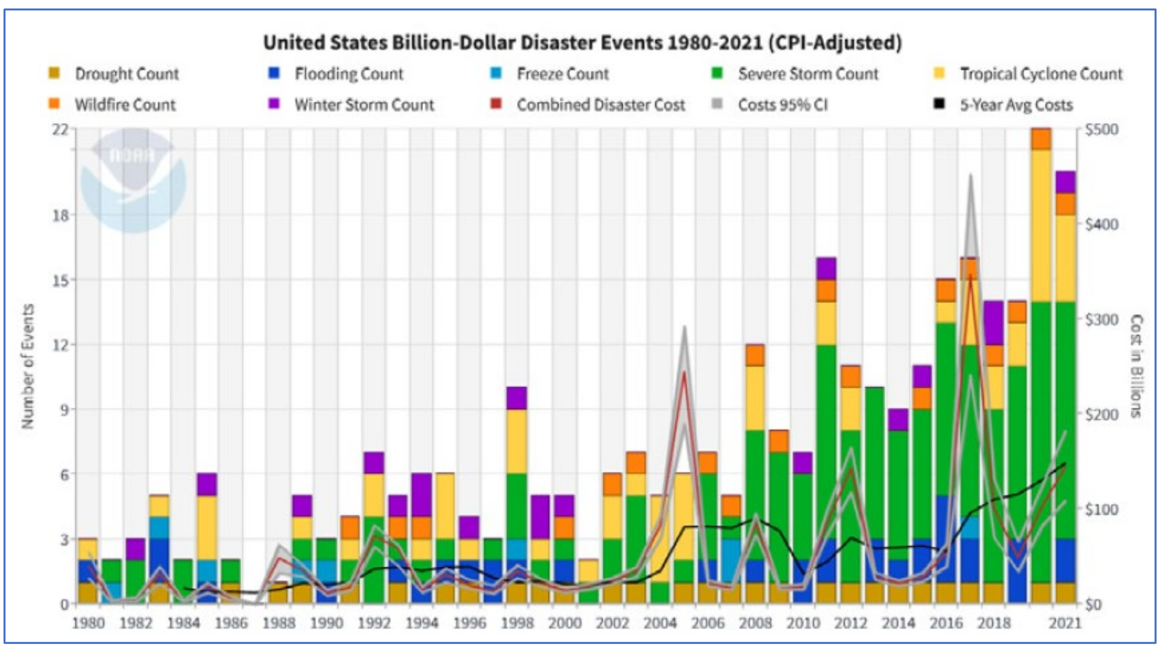
- IEEE 1547-2018 specifies Q priority as default current priority during voltage ride-through.
- Setting the current limit priority of the DER to reactive current (Q priority) provided benefit in terms of BPS voltage. The active power response of the DER was also improved when in Q-priority in some simulations.

EPRI: A Starting Point for Climate Risk Assessment & Mitigation: Future Resilience and Adaptation Planning

This Paper (Download Page) examines the current knowledge base of potential climate-related impacts across the power sector, to serve as a foundation for a standardized and consensus-based framework to inform infrastructure investment and deployment. It also refers to their latest initiative known as Climate READi (REsilience and ADaptation initiative), which EPRI has launched to address the challenges of assessing impacts of physical climate risks on the power system, convening global thought leaders, members of the scientific community, and other stakeholders necessary to build a consistent, industry-accepted framework.

EPRI cites the following drivers for addressing the impacts of climate change on the power grid in a more holistic manner:

- Climate change may expose the electric power system to changes in chronic climate conditions and extreme weather events, both of which can threaten the safe, reliable, and affordable delivery of electricity.
- Changes in extreme weather events potentially pose more significant operational and planning-related threats to the electric power system than changes in mean climate conditions.
- Extreme weather and climate-related events can impact the full extent of the power system, including thermal generation, renewable generation, transmission and distribution assets, distributed energy resources, and customer equipment and consumption patterns.
- Changes in climate may intersect with other drivers of change in the electric power sector–such as electrification, decarbonization, technological innovation, customer preferences and socioeconomic trends, and new policy or regulatory environments–in both amplifying and offsetting ways.
- Addressing physical climate risk requires collaboration between traditionally separate utility business units.
- A comprehensive evaluation of how generation, transmission, and distribution (GT&D) as well as end-use assets and consumption may be impacted by future changes in local climate and extreme weather will help inform resilient strategies and investments.



The graph on the previous page shows the history of billion-dollar disasters in the United States each year from 1980 to 2021, showing event type (colors), frequency (left vertical axis) and cost (right vertical axis). The number and cost of weather and climate disasters is rising due to a combination of population growth and development (greater exposure of people and assets to risk) along with the influence of human-caused climate change on some types of extreme events.

Key terms are defined as follows:

- Reliability: The ability to meet the electricity needs of customers with grid services even when unexpected equipment failures or other factors reduce the amount of available electricity.
- Resilience: The ability to anticipate, prepare for, respond to, and recover from significant high-impact, low-frequency (HILF) threats with minimum damage.

The report continues by focusing on the impact of climate change in each of the following areas:

- Thermal Generation (Coal and Natural Gas)
- Nuclear Generation
- Renewables
- Power Delivery
    - Transmission Line Capacity
    - Transmission Planning and Operations
    - Substations
    - Transformers
    - Overhead Distribution
    - Underground Distribution
- Utilization and Energy Demand
- Infrastructure and Adjacent Systems

With these potential impacts to the power system better understood, it becomes clear the need for an industry-accepted approach to physical climate risk assessment - Climate READi (REsilience and ADaptation initiative) is an effort to develop a Common Framework that will facilitate analysis and application of appropriate climate data among all stakeholders to enhance the planning, design, and operation of a resilient power system.

Workstream 1	Workstream 2	Workstream 3
PHYSICAL CLIMATE DATA & GUIDANCE	ENERGY SYSTEM & ASSET VULNERABILITY ASSESSMENT	RESILIENCE/ADAPTATION PLANNING & PRIORITIZATION
• Identify climate hazards and data required for different applications • Evaluate data availability, suitability, and methods for downscaling & localizing climate information	• Evaluate vulnerability at the component, system, and market levels from planning to operations • Identify mitigation options from system to customer level • Enhance criteria for planning and operations to account for event probability	• Assess power system and societal impacts: resilience metrics and value measures • Create guidance for optimal investment priorities • Develop cost benefit analysis, risk mitigation, and adaptation

NYISO: Announcements on the Blog and Press Release Pages of the NYISO Website:

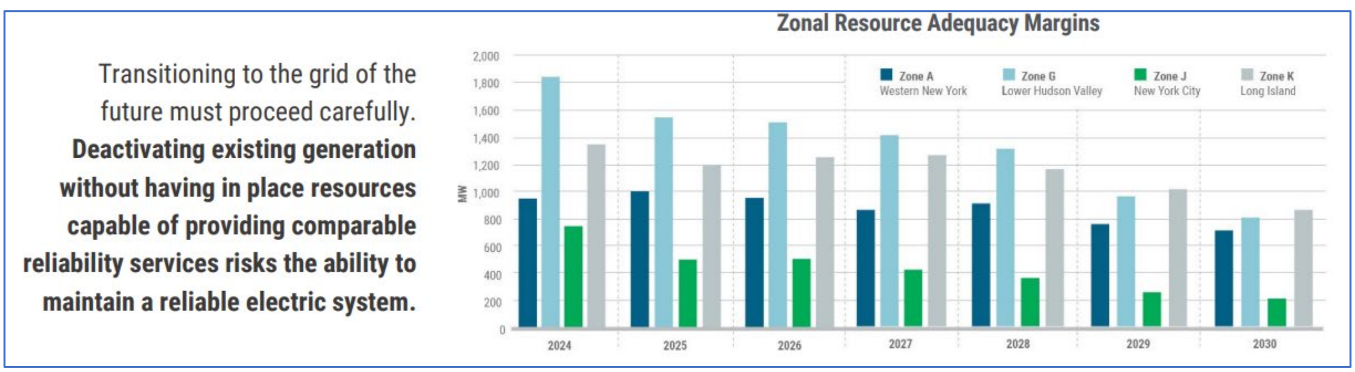
Features from the Blog Page and Press Release Page of the NYISO Website are as follows:

Podcast Episode 20: The ROI of Energy Security Investment with Karen Wayland
Dr. Karen Wayland is CEO of GridWise Alliance, an organization made up of energy utilities and technology leaders. She is a noted policy expert who focuses on the path to grid modernization and infrastructure improvements aimed at a cleaner, more efficient, and more secure grid. Wayland sees "autonomous healing" grid technology as a way to address outages caused by extreme weather. In the future she sees tools on the electric system that can automatically reroute power when a line is down to reduce the impact away from concentrated populations.

Press Release: The New York Independent System Operator (NYISO) released Power Trends 2022: The Path to a Reliable, Greener Grid for New York. The NYISO's annual publication provides critical information and analysis on how dynamic factors such as technology, economic forces, and public policies are shaping New York's complex electric system. In addition to the report, there is a 30 minute Media Briefing with Rich Dewey, and a Summary Datasheet that can be found on the NYISO's Power Trends webpage.

Key messages:

- The NYISO has established new market rules that advance the state's clean energy policies. Wholesale electricity markets are open to significant investment in wind, solar and battery storage.
- The transition to a cleaner grid in New York is leading to an electric system that is increasingly dynamic, decentralized, and reliant on weather-dependent renewable generation.
- Reliability margins are shrinking. Generators needed for reliability are planning to retire.
- Delays in the construction of new supply and transmission, higher than expected demand, and extreme weather could threaten reliability and resilience in the future.
- A successful transition of the electric system requires replacing the reliability attributes of existing fossil fueled generation with clean resources with similar capabilities. These attributes are critical to a dynamic and reliable future grid.
- New transmission is being built but more investment is necessary to support the delivery of offshore wind energy and to connect new resources upstate to downstate load centers where demand is greatest. Planning for additional new transmission to support offshore wind is underway.



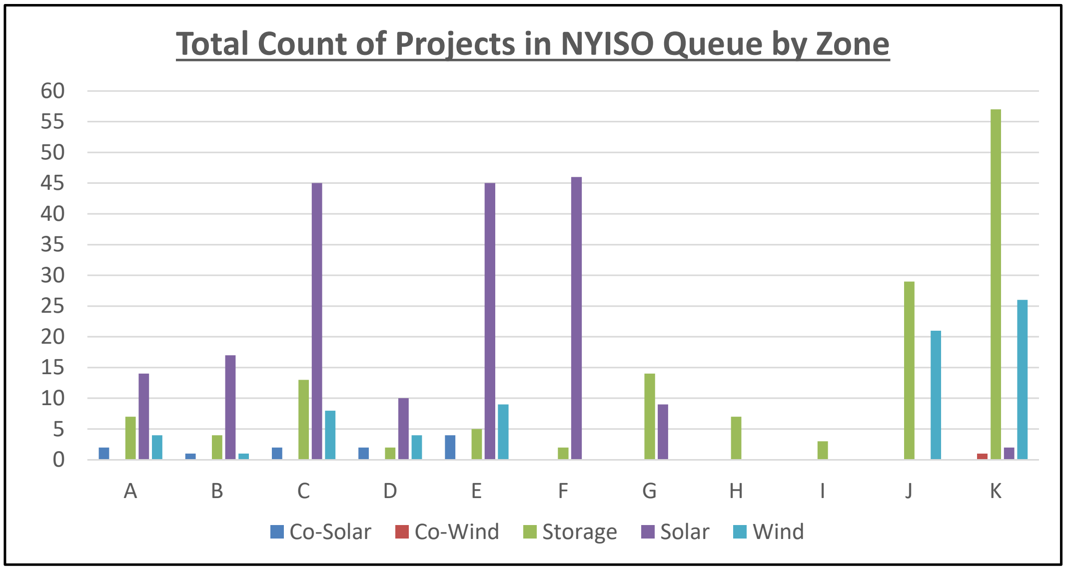
Interconnection Queue: Monthly Snapshot – Storage / Solar / Wind / CSRs (Co-located Storage)

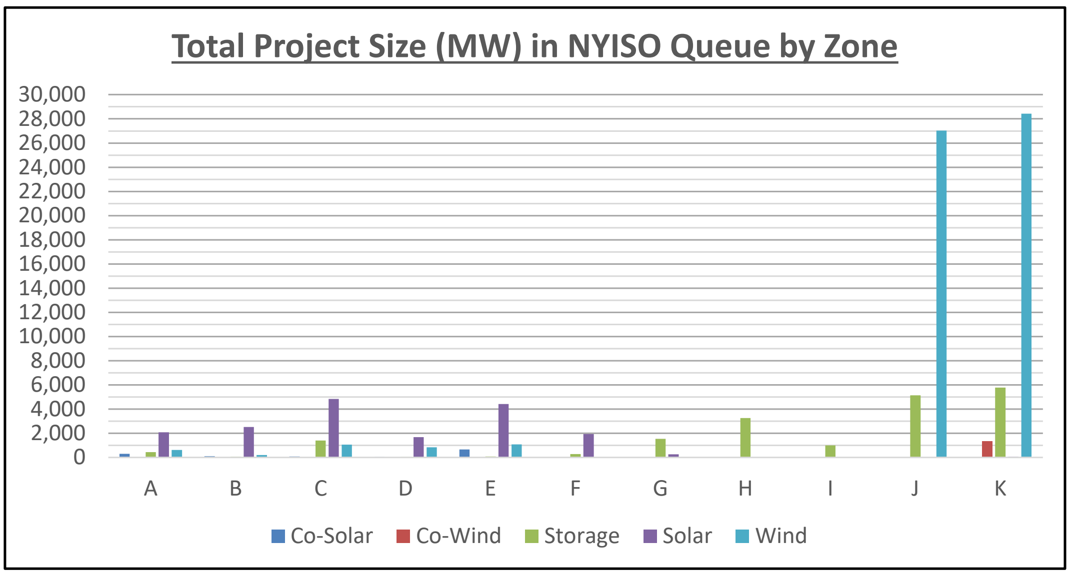
The intent is to track the growth of Energy Storage, Wind, Solar and Co-Located Storage (Solar and Wind now in separate categories) projects in the NYISO Interconnection Queue, looking to identify trends and patterns by zone and in total for the state. The information was obtained from the NYISO Interconnection Website, based on information published on June 20th, and representing the Queue as of May 31st. Note that 3 projects were added, and 1 was withdrawn during the month of May. 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	14	4
B	1		4	17	1
C	2		13	45	8
D	2		2	10	4
E	4		5	45	9
F			2	46	
G			14	9	
H			7		
I			3		
J			29		21
K		1	57	2	26
State	11	1	143	188	73

Total Project Size (MW) in NYISO Queue by Zone					
Zone	**Co-Solar**	**Co-Wind**	**Storage**	**Solar**	**Wind**
A	290		430	2,070	615
B	100		61	2,521	200
C	70		1,395	4,832	1,062
D	40		40	1,674	847
E	654		72	4,407	1,087
F			270	1,937	
G			1,541	250	
H			3,260		
I			1,000		
J			5,141		27,022
K		1,356	5,782	59	28,438
State	1,153	1,356	18,992	17,750	59,271

Average Size (MW) of Projects in NYISO Queue by Zone					
Zone	**Co-Solar**	**Co-Wind**	**Storage**	**Solar**	**Wind**
A	145		61	148	154
B	100		15	148	200
C	35		107	107	133
D	20		20	167	212
E	163		14	98	121
F			135	42	
G			110	28	
H			466		
I			333		
J			177		1,287
K		1,356	101	29	1,094
State	105	1,356	133	94	812


Total Count of Projects in NYISO Queue by Zone
60
55
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
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
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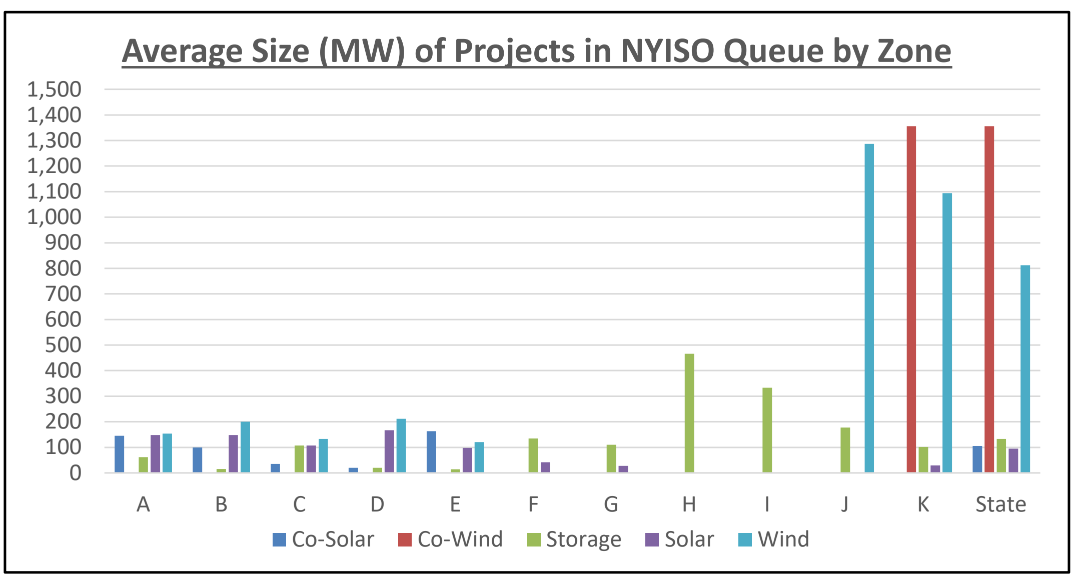
J
K
Co-Solar
Co-Wind
Storage
Solar
Wind


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