



Joint Board of Directors & Management Committee Meeting

June 14-15, 2021



Welcome to the 2021 Joint Board of Directors/Management Committee Meeting. For this, our second virtual meeting, we have designed another strong program we fully expect will build upon the tremendous success of last year's event.

Of course, last year's meeting occurred during a time of great uncertainty. Over 2020 and into 2021 we met the challenges of the pandemic and the new concept of working remotely head on. We made swift changes to ensure workforce safety, while maintaining a strong stakeholder process and continuing to deliver on important projects that strengthen the competitive electric markets and support the grid of the future.

At the NYISO we believe in and are committed to our role in forging that Grid of the Future. Historic advances in renewable technology, energy storage, and distributed energy resources are changing how we manage and plan a reliable energy grid. Extreme weather events are occurring more frequently, and supporting aggressive public policies demand bold action.

To fulfill our mission in these modern times, we have improved and expanded our planning processes, achieved market design changes that support more renewable energy, and continue to work to balance public policy goals with reliability of the system. The actions we take and the path we forge from here depends in large part on the work we do together through the strategic planning process, and the Joint Board meeting, in particular.

This Joint Board meeting comes at a critical time. While held virtually, our engagement over the coming days, as always, will help shape the NYISO's path forward.

We remain confident as ever that our shared governance process will produce solutions that will serve the customers, policy goals and the grid itself well into the future. On behalf of all the NYISO, we look forward to working with you.

Sincerely,

Rich Dewey

President & CEO



RICH DEWEY
PRESIDENT & CEO

PURPOSE & FORMAT

The purpose of the meeting is to provide a forum for the New York Independent System Operator’s (NYISO) Board of Directors and Stakeholders to engage in dialogue on emerging topic areas. Strategic feedback received during the meeting is intended to be incorporated in the NYISO’s strategic plan.

The breakout session of the meeting is designed to encourage greater board member and Stakeholder engagement by hosting group discussions, while also incorporating a discussion summary and question and answer period with the greater audience on day two.

Meeting attendees will discuss each identified topic amongst their breakout session for 45-minutes. Upon concluding the topic discussions, NYISO board members and Stakeholders will caucus separately to summarize their observations, to be reported out at the following morning’s session with the larger group.

The topics chosen for this year’s meeting were determined by a consensus of the Committee Chairs and Vice Chairs working in concert with Stakeholders. The NYISO has worked collaboratively with the Committee Chairs to develop briefing materials, provided later in this booklet, to assist in facilitating a robust discussion. The discussion topics for this year’s meeting are:

- **Topic 1: Supporting Resource Adequacy through the Capacity Market**
- **Topic 2: The Role of Emerging Technologies**

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MEETING SCHEDULE

MONDAY, JUNE 14:

SESSION 1 - (8:15 a.m. - 12:00 p.m.)

08:15 a.m. – 08:30 a.m.	Pre Login to the Webex Meeting - General Session (Webex link in calendar invite)
08:30 a.m. – 08:45 a.m.	Commencement of General Session - Opening Comments / Rich Dewey, Dan Hill, Aaron Breidenbaugh and Mark Seibert (Emcee)
08:45 a.m. – 09:00 a.m.	Pre Login to the Webex Meeting - Breakout Session (Webex link in calendar invite)
09:00 a.m. – 10:30 a.m.	Commencement of Breakout Sessions / Topic 1 & 2 (45-min each topic) (Webex link in calendar invite)
10:30 a.m. – 10:45 a.m.	Break
10:45 a.m. – 11:00 a.m.	Pre Login to the Webex Meeting - Caucus Session (Webex link in calendar invite)
11:00 a.m. – 12:00 p.m.	Commencement of Caucus Sessions (NYISO & Stakeholders caucus separately)
12:00 p.m.	End of Session 1

TUESDAY, JUNE 15:

SESSION 2 - (8:45 a.m. - 12:00 p.m.)

08:45 a.m. – 09:00 a.m.	Pre Login to the Webex Meeting - Topic Discussion Summary Q & A (Webex link in calendar invite)
09:00 a.m. – 10:30 a.m.	Commencement of Topic Discussion Summary Q & A
10:30 a.m. – 10:40 a.m.	Closing Comments / Aaron Breidenbaugh, Rich Dewey, Dan Hill
10:40 a.m.	End of Session 2
10:40 a.m. – 11:00 a.m.	Break
11:00 a.m. – 12:00 p.m.	Management Committee Meeting

BEST PRACTICES FOR MEETING PARTICIPATION

The Annual Joint Board of Directors & Management Committee Meeting will be conducted remotely using the Webex conferencing platform, providing the opportunity for participants to collaborate in a virtual setting. Attendees will receive calendar invitations containing an individual Webex link for each meeting segment.

Monday, June 14: Session 1 (Refer to 3 separate calendar invites / Webex links provided)

- 08:15 a.m. – 08:30 a.m. – Pre Login to Webex | General Session (see calendar invite)
- 08:45 a.m. – 09:00 a.m. – Pre Login to Webex | Breakout Session (see calendar invite)
- 10:45 a.m. – 11:00 p.m. – Pre Login to Webex | Caucus Session (see calendar invite)

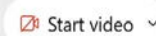
Tuesday, June 15: Session 2 (Refer to 1 calendar invite / Webex link provided)

- 08:45 a.m. – 09:00 a.m. – Pre Login to Webex | Topic Discussion Summary Q & A
(see calendar invite)

Joining the Meeting

- Click on the meeting link in the calendar invite and log in with your full name and email, then click “join” to connect to the meeting.
- By default, your microphone and camera will be muted upon entry.

To enable video, click the start video button (recommended)



To enable (mic) audio, click the red microphone button
(line should remain muted when not speaking)



Have a Question - Use the Webex Chat Feature

■ Attendees will be directed to use the chat feature to ask a question during the General Session on Monday and the Topic Discussion Summary Q & A on Tuesday by typing a “?” in the chat window, select everyone and hit enter. Questions will be placed into a queue and the host will call upon the participant to state their question.



To Leave the Meeting

- Click on the file menu at the bottom of the screen, then select “leave.”



GENERAL MEETING INFORMATION

Technology & Support

- Webex conferencing with camera configuration
- Webex host (NYISO) will manage technology to ensure meeting efficiency
- Support will be provided to answer any technology questions that arise prior to or during the meeting

Session 1: (Monday, June 14 | 8:15 a.m. - 12:00 p.m.)

Pre Login to Meeting - General Session (Monday - 8:15 a.m. - 8:30 a.m.) - Login to Webex link provided

- All participants to login to the General Session
- All participants will receive a Webex link in a calendar invite in advance of the meeting

Commencement of General Session (8:30 a.m. - 8:45 a.m.)

- General session for all participants
- Opening comments from Rich Dewey, Dan Hill, Aaron Breidenbaugh and Mark Seibert (Emcee)
- NYISO Emcee will provide agenda overview, general instructions and answer questions

Pre Login to Meeting - Breakout Sessions (Monday 8:45 a.m. - 9:00 a.m.) - Login to Webex link provided

- All participants will receive a Webex link in a calendar invite in advance of the meeting

Commencement of Breakout Sessions (9:00 a.m. - 10:30 a.m.)

- 9 separate breakout sessions
- Breakout sessions to consist of 1 Board member, at least 1 Vice President/Senior Team member (as a liaison/reference for the Board member) and stakeholders

Discussion

- A stakeholder spokesperson will be identified in advance and will take notes/summarize their respective groups main points to be used by the stakeholders during the Caucus Session (see next page)
- Groups will engage in two 45-minute discussions on each topic. Board members will stay with the same group for both topics
- NYISO Vice Presidents/Senior Team member will take notes and summarize main points from the discussions to be used by the Board members during the caucus session (see next page)

Break (10:30 a.m. - 10:45 a.m.)

- Break for all participants

**Pre Login to Meeting - Caucus Session (Monday 10:45 a.m. - 11:00 a.m.) -
Login to Webex link provided**

- All participants will receive a Webex link in a calendar invite in advance of the meeting

Commencement of Caucus Session (11:00 a.m. - 12:00 p.m.)

- After discussions conclude on the two topics, Board members and Stakeholders will caucus privately in separate meetings via Webex / Camera to share observations and main points
- Main points will be summarized by the NYISO and stakeholders separately, Emilie Nelson will help facilitate the Board/NYISO caucus discussion and Aaron Breidenbaugh, Chris Wentlent and Mark Seibert will facilitate the caucus discussion with the stakeholders

Session 2: (Tuesday, June 15 | 8:45 a.m. - 10: 40 a.m.)

**Pre Login to Meeting - Topic Discussion Summary Q & A (Tuesday - 8:45 a.m. - 9:00 a.m.) -
Login to Webex link provided**

- All participants to login to the Topic Discussion Summary Q&A
- All participants will receive the Webex link in a calendar invite in advance of the meeting

Commencement of Topic Discussion Summary Q & A (9:00 a.m. - 10:30 a.m.)

- Topic Discussion Summary Q & A for all participants
- Summary of stakeholder main points to be presented by Aaron Breidenbaugh (Rodan Energy) and Chris Wentlent (MEUA), Emilie Nelson will present the NYISO key main points followed by open Q & A on the discussion material
- Participants will be able to ask questions within Webex, questions will be placed in a queue format to keep meeting running efficiently
- NYISO hosts will help facilitate Q & A session

Closing Comments (10:30 a.m. - 10:40 a.m.)

- Closing Comments: Aaron Breidenbaugh, Rich Dewey, and Dan Hill

BREAKOUT SESSION ASSIGNMENTS

Breakout Session 1

Topic 1 & 2: Dan Hill, NYISO Board

Sector	B/O Session	First Name	Last Name	Organization
BOARD	1	Dan	Hill	NYISO Board
NYISO	1	Rich	Dewey	NYISO
EU	1	James	Brew	Nucor Steel Auburn, Inc
FERC	1	Clarence	Bell	FERC
GO	1	Brett	Cullen	ENGIE
NV	1	Stu	Caplan	Troutman Pepper
NV	1	Marji	Philips	LS Power
OS	1	Alan	Ackerman	Customized Energy Solutions/Galt Power
OS	1	Aaron	Breidenbaugh	Rodan Energy Solutions (USA), Inc
PPE	1	Andrew	Antinori	NYP&A
PPE	1	Anne	Reynolds	Alliance for Clean Energy NY
TO	1	Patricia	Caletka	NYSEG / RGE
OS	1	John	Reese	Eastern Generation

Breakout Session 2

Topic 1 & 2: Ave Bie, NYISO Board

Sector	B/O Session	First Name	Last Name	Organization
BOARD	2	Ave	Bie	NYISO Board
NYISO	2	Emilie	Nelson	NYISO
NYISO	2	Gary	Davidson	NYISO
EU	2	Seth	Berkman	City of NY
EU	2	Erin	Hogan	NYS UIU
FERC	2	Gary	Will	FERC
GO	2	Kaley	Bangston	Invenergy
GO	2	Doreen	Saia	Entergy
NV	2	Peter	Dotson-Westphalen	C&P Energy Management
OS	2	Rich	Mancini	Customized Energy Solutions
OS	2	Matthieu	Plante	HQUS
PPE	2	Christopher	Casey	NRDC
TO	2	John	Borchert	Central Hudson
TO	2	Chris	Hargett	Con Edison

Breakout Session 3

Topic 1 & 2: David Hill, NYISO Board

Sector	B/O Session	First Name	Last Name	Organization
BOARD	3	David	Hill	NYISO Board
NYISO	3	Rob	Fernandez	NYISO
NYISO	3	Ray	Stalter	NYISO
EU	3	Kevin	Lang	Couch White, LLP
FERC	3	Leanne	Khammal	FERC
FERC	3	Kurt	Longo	FERC
FERC	3	Natalie	Propst	FERC
NV	3	Adam	Evans	NYS DPS
OS	3	David	Applebaum	NextEra Energy Resources, LLC
OS	3	Scott	Leuthauser	HQUS
PPE	3	Dave	Clarke	LIPA
TO	3	Paul	Didsayabuttra	Avangrid
TO	3	Ryan	Hawthorne	Central Hudson Gas & Electric
GO	3	John	Brodbeck	EDP Renewables

Breakout Session 4

Topic 1 & 2: Gizman Abbas, NYISO Board

Sector	B/O Session	First Name	Last Name	Organization
BOARD	4	Gizman	Abbas	NYISO Board
NYISO	4	Mike	DeSocio	NYISO
NYISO	4	Karen	Gach	NYISO
NYISO	4	Kevin	Jones	NYISO
NYISO	4	Wes	Yeomans	NYISO
EU	4	Michael	Mager	Couch White, LLP
FERC	4	Scotia	Bennett	FERC
GO	4	Liz	Delaney	Borrego Solar Systems, Inc.
GO	4	Matthew	Schwall	Eastern Generation
NV	4	Michael	Kramek	Boston Energy Trading and Marketing
TOS	4	Michael	Macre	Enel North America
OS	4	Matthew	Picardi	Shell Energy North America
PPE	4	Glenn	Haake	NYP&A
TO	4	Dana	Lazarus	Con Edison

Breakout Session 5

Topic 1 & 2: Mark Lynch, NYISO Board

Sector	B/O Session	First Name	Last Name	Organization
BOARD	5	Mark	Lynch	NYISO Board
NYISO	5	Rick	Gonzales	NYISO
NYISO	5	Cheryl	Hussey	NYISO
EU	5	Marc	Montalvo	NY UIU
FERC	5	John	Miller	FERC
GO	5	Cheryl	Dietrich	NextEra Energy Resources
NV	5	Sarah	Ladin	Institute for Policy Integrity
NV	5	Denise	Sheehan	NY-BEST
OS	5	Liam	Baker	Eastern Generation
OS	5	Neal	Fitch	NRG
PPE	5	Alan	Michaels	NYP&A
TO	5	Jane	Quin	Con Edison
GO	5	Ellen	Allman	Bayonne Energy Center, LLC

Breakout Session 6

Topic 1 & 2: Teresa Marrinan, NYISO Board

Sector	B/O Session	First Name	Last Name	Organization
BOARD	6	Teresa	Marrinan	NYISO Board
NYISO	6	Zach	Smith	NYISO
NYISO	6	Shaun	Johnson	NYISO
EU	6	Amanda	Trinsey	Couch White, LLP
FERC	6	Emma	Nicolson	FERC
NV	6	Pallas	LeeVanSchiack	Potomac Economics
NV	6	Polly	Shaw	Plus Power
OS	6	Matt	Cinadr	Energy Spectrum
OS	6	Steve	Kirk	Exelon
OS	6	Chris	LaRoe	Brookfield Renewable
OS	6	Jake	Rabinowitz	COI Energy Services, Inc
PPE	6	Andrew	Neuman	NYPA
TO	6	Christopher	Raup	Con Edison

Breakout Session 7

Topic 1 & 2: Roger Kelley, NYISO Board

Sector	B/O Session	First Name	Last Name	Organization
BOARD	7	Roger	Kelley	NYISO Board
NYISO	7	Rana	Mukerji	NYISO
NYISO	7	Tariq	Niazi	NYISO
EU	7	Susanne	DesRoches	City of NY
FERC	7	Jason	Rhee	FERC
GO	7	Howard	Fromer	Bayonne Energy Center
NV	7	Lawrence	Willick	LS Power
OS	7	Rich	Barlette	Exelon
OS	7	Sarah	Bresolin Silver	ENGIE
OS	7	Ruben	Brown	E-Cubed Company
PPE	7	Mark	Reeder	Alliance for Clean Energy NY
TO	7	Pat	Fox	NYSEG
TO	7	Bahaa	Seireg	Con Edison
OS	7	John	Casellini	ENGIE (Guest)

Breakout Session 8

Topic 1 & 2: Mike Bemis, NYISO Board

Sector	B/O Session	First Name	Last Name	Organization
BOARD	8	Mike	Bemis	NYISO Board
NYISO	8	Robb	Pike	NYISO
EU	8	Anthony	Fiore	City of NY
FERC	8	David	Rosner	FERC
GO	8	Mark	Younger	Hudson Energy Economics, LLC
GO	8	Philip	Denara	Key Capture Energy
NV	8	Tim	Lundin	LS Power
OS	8	David	Ahrens	Energy Spectrum Inc
OS	8	Bruce	Bleiweis	DC Energy
PPE	8	Chris	Wentlent	MEUA
TO	8	Margaret	Janzen	National Grid
TO	8	David	Kimiecik	NYSEG
TO	8	Dmitriy	Kiselev	Con Edison

Breakout Session 9

Topic 1 & 2: Joseph Oates, NYISO Board

Sector	B/O Session	First Name	Last Name	Organization
BOARD	9	Joseph	Oates	NYISO Board
NYISO	9	Doug	Chapman	NYISO
NYISO	9	Kevin	Lanahan	NYISO
FERC	9	Frank	Swigonski	FERC
GO	9	Gavin	Donohue	IPPNY
GO	9	Rachel	Goldwasser	Key Capture Energy
NV	9	Rich	Felak	Consultant
NV	9	James	Okenfuss	Savion, LLC
OS	9	Norman	Mah	Con Edison
OS	9	Cristina	Villegas	Energy Spectrum Inc
PPE	9	Tom	Rudebusch	Duncan, Weinberg
TO	9	Mayer	Sasson	Con Edison

DISCUSSION TOPICS

The topics chosen for this year's Joint Board/Management Committee meeting were determined by a consensus of the Committee Chairs and Vice Chairs.

- **Topic 1:** Supporting Resource Adequacy through the Capacity Market
- **Topic 2:** The Role of Emerging Technologies

Management Committee

- **Aaron Breidenbaugh**, Rodan Energy, Chair
- **Chris Wentlent**, MEUA, Vice Chair

Business Issue Committee

- **Matt Schwall**, IPPNY, Chair (term – Dec 20' – May 21')
- **John Marczewski**, East Coast Power, Vice Chair (term Dec 20' – May 21'); Current Chair (May 21')

Operating Committee

- **Liam Baker**, Eastern Generation, Chair
- **Matt Antonio**, National Grid, Vice Chair

TOPIC BRIEFING MATERIAL

Background for Sessions

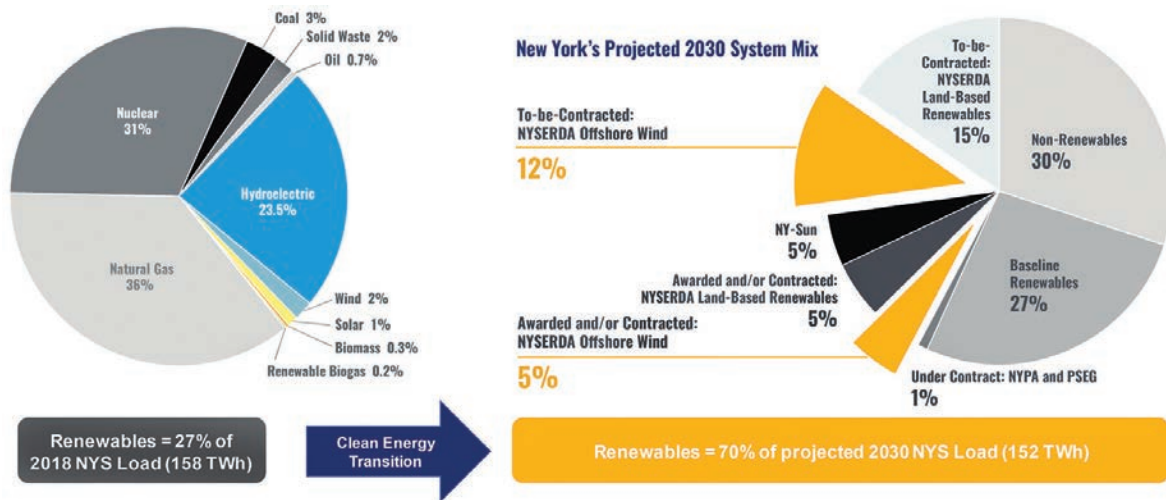
Dramatically expanded adoption of renewable energy sources is a key strategy to mitigate climate change, improve local air quality, increase energy security, and provide other benefits. Most recently, the new federal administration has prioritized reducing carbon dioxide emissions from fossil fuels as a core part of its \$2.2 trillion infrastructure plan and called for putting the U.S. on a path to eliminate net greenhouse gas pollution altogether by mid-century. Beyond rejoining the Paris Climate Accord, President Biden plans to speed the United States' transition away from fossil fuel electric generation, to accelerate growth of solar and wind energy, and to foster technological breakthroughs in clean power. In addition to recently indicating an openness to supporting tax credits for aging nuclear power plants to help reach net-zero emissions goals, the President's plan includes a range of steps:

- National clean electric standard of 100 percent carbon-free electricity by 2035
- \$174 billion to boost EV market share
- \$10 billion for Civilian Climate Corps
- \$35 billion for breakthrough technology
- \$15 billion for climate-related demo projects
- \$8 billion to modernize electric grid
- Creation of a Grid Deployment Authority at DOE
- Tax credits for large-scale inter-regional transmission highways

With new leadership at the Federal Energy Regulatory Commission (FERC), a new emphasis is being placed on climate change and social justice. Some of the new priorities include reforming energy market policies that restrict state-supported clean energy resources, expanding transmission capacity and unblocking new grid interconnections, looking to boost interregional transmission buildout, incorporating climate change impacts into the agency's decision-making process, considering market rules for incorporating state-determined carbon pricing, adding senior level position on environmental justice, and establishing an Office of Public Participation.

In New York State, which has one of the most aggressive clean energy and climate agendas in the country, a rapid transition is already underway from a power grid where energy is largely produced by central-station fossil fuel generation towards a grid with greatly increased renewable resources and distributed generation. The pace of this transition is driven primarily by state policy, notably New York's Climate Leadership and Community Protection Act (CLCPA), which requires that 70% of load will be served by energy generated from renewables by 2030 and 100% of the energy serving load be zero emission by 2040. The CLCPA requires the deployment of 9,000 MW of offshore wind, 6,000 MW of distributed solar, and 3,000 MW of energy storage. Figure 1 below shows the impact the CLCPA will have on New York's resource mix from current (2018) levels to 2030.

FIGURE 1: NEW YORK SYSTEM MIX, 2018 - 2030



Source: Power Generation Advisory Panel Evening Public Input Session, February 3, 2021.

To help achieve the targets of the CLCPA, the 22-member Climate Action Council (CAC) was formed and is responsible for preparing a Scoping Plan to achieve the emissions reductions called for by the CLCPA. The CAC established and oversees sector-specific advisory panels and working groups, and works in consultation with the state’s Climate Justice Working Group and the Environmental Justice Advisory Group. The NYISO is participating on the Power Generation Advisory Panel and has contributed to the recommendations under consideration for the draft Scoping Plan that will be finalized by the end of 2021 and issued for public comment before being delivered to the Governor and the Legislature. The Power Generation Advisory Panel has recommended the state pursue the following strategies to achieve CLCPA goals:

- Growth of Large-Scale Renewable Energy Generation
- Clean Energy Siting & Community Acceptance
- Distributed Generation / Distributed Energy Resources
- Existing Storage Technology
- Demand Side
- Reliability of the Future Grid
- Access and Affordability for All
- Workforce Development
- Market Solutions
- Technology Solutions
- Long-Duration Storage Technology
- Energy Delivery & Hosting Capacity
- Gas Infrastructure, Transmission & Methane Leakage
- Retirement of Fossil Fuel-Fired Facilities

When the Scoping Plan is finalized and adopted, the NYISO will collaborate to achieve the objectives of the CLCPA in a manner that maintains reliability, minimizes costs to consumers, and benefits our environment. As technologies change and the resource mix supplying the grid transforms, the NYISO will

continue to evolve its approach by leveraging wholesale electricity markets, which minimize costs and investment risks to consumers while promoting innovation, and is a powerful means to drive needed energy infrastructure investment to achieve the CLCPA.

Maintaining reliability is the NYISO's most critical role; a role it supports primarily through three complementary markets for energy, ancillary services and capacity. Each addresses specific reliability necessities and each provides competitive market pricing designed to meet reliability needs at an overall least-cost to consumers. A major difference between the NYISO's markets and the markets in other states, such as California and Texas, is that the NYISO administers a centralized, transparent market to buy and sell capacity.

The NYISO's capacity market serves as a platform to procure the least-cost supply mix required to maintain system resilience and reliability. Consumers of New York State's electricity benefit from competitive capacity auctions that minimize costs while rewarding resources that perform when needed. The capacity market includes specific rules to incentivize performance and availability of resources when system needs are greatest, while including penalties for non-performance. Investors in new technologies benefit from transparent market prices that align market signals with system needs.

Existing suppliers benefit from market signals that reward resources that operate efficiently by maintaining or upgrading their performance capabilities. Determining the level of capacity needed requires an extensive planning process derived from strict reliability rules, engagement with stakeholders, and oversight from state and federal regulators. The process is conducted annually, involving the expertise of NYISO operations and planning, which evaluates changes in forecasted demand, supply performance capabilities, and transmission system constraints. This analysis supports the efforts of the New York State Reliability Council (NYSRC) to develop the installed capacity reserve margin (IRM). The NYSRC determines the appropriate IRM and submits necessary revisions of such values to both the New York State Public Service Commission and FERC for acceptance.

The NYISO and its stakeholders annually review locational capacity requirement levels for regions within New York where transmission constraints limit the delivery of needed capacity. This review establishes requirements to procure capacity within specific areas to safeguard resource adequacy in those regions. These requirements are reflected in the NYISO's capacity market, through which competitive auctions facilitate efficient procurement of the needed resources. This process is another important tool in supporting reliability and resiliency for all areas of New York. This process of establishing capacity requirements and obligations works to reliably meet demand, even as the supply mix changes in response to clean energy policies. The NYISO has prioritized a comprehensive review of capacity market rules which will focus on reforms that improve alignment of markets and clean energy policies while continuing to reliably meet demand as the grid changes. Improving the robustness of capacity requirements to support reliability, evolving the methods for measuring reliability, and enhancing capacity accreditation measures are critical to the future success of the installed capacity market as the grid's resource mix transitions.

Wholesale energy and ancillary services markets provide the least-cost mix of resources to maintain daily and intra-daily operational reliability, dispatching every six seconds and re-running the markets across New York every five minutes. Capacity markets work in tandem with these markets to preserve the availability of these services through competitive monthly and seasonal auctions. Together, the energy,

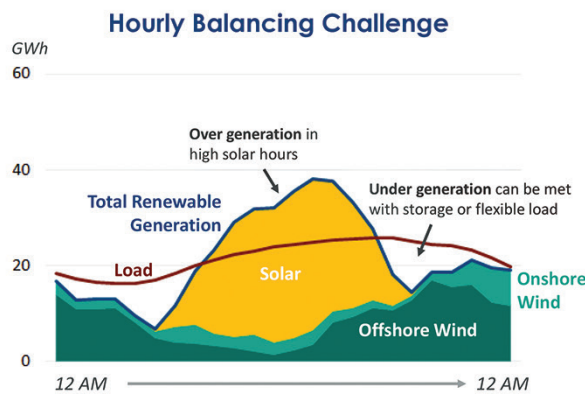
ancillary services, and capacity markets support reliability through competitive markets that reward performance, even in the most challenging conditions, while minimizing overall consumer costs.

The NYISO’s market-based approach together with expected capacity additions using existing technologies – onshore wind, offshore wind, battery storage and solar – the NYISO’s modeling indicates that the 70% renewable target by 2030 can be achieved. However, considering what is required by the CLCPA in 2040 – without an alternative to conventional fossil generation – it is increasingly clear that the performance of existing assets and the storage capabilities of existing battery technologies will be inadequate to achieve zero emissions by 2040.

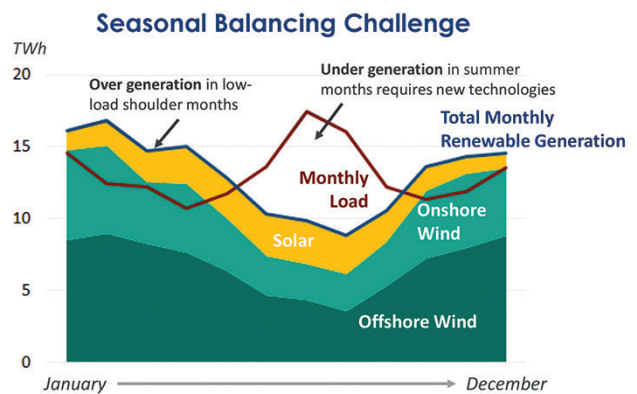
Furthermore, as the portion of electricity coming from renewable sources grows, grid balancing will become increasingly more difficult to maintain. Periods of over-generation will increase renewable curtailment, while periods of low renewable generation will require large amounts of flexible, dispatchable generation (today this is provided mainly by fossil fuel power plants which run at low capacity factors but provide system balancing services) together with an increasing component of energy storage devices.

The intermittent nature of wind and solar generation creates more risk when balancing supply and load on the system. Today, fossil fuel plants provide this balancing (where the flexibility of the unit to start up quickly and ramp up or down rapidly to follow the demand is procured through the NYISO’s energy, reserve and regulation products). However, as the policy objectives of the CLCPA are to transition completely away from fossil fuels by 2040, the role of storage technologies will likely become more important.

FIGURE 2: THE BALANCING CHALLENGE ACROSS MULTIPLE TIMESCALES



Batteries and load flexibility can provide short-term balancing.



Seasonal balancing is the more difficult challenge, requiring new technologies such as seasonal storage or zero-emission dispatchable generation.

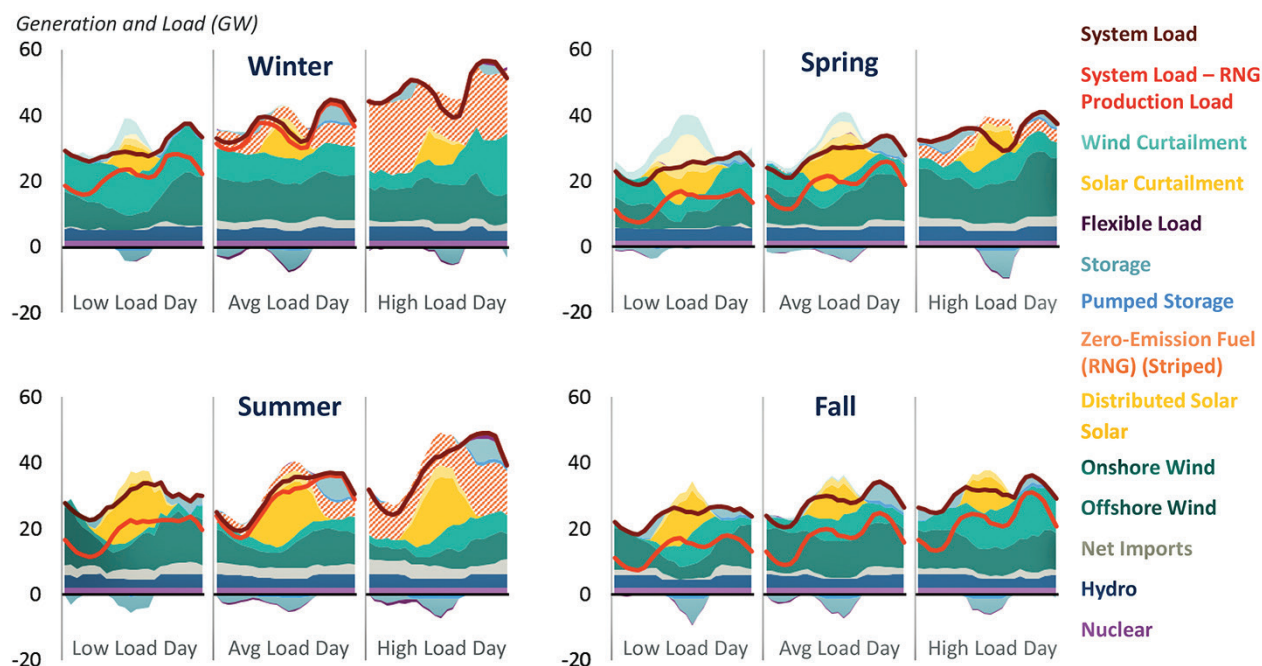
Source: The Brattle Group, New York’s Evolution to a Zero Emission Power System, prepared for NYISO, June 22, 2020.

The NYISO-led Grid in Transition study identified the need for two specific types of storage. One is short-duration storage, which may be met by technologies such as lithium ion batteries, and will help the system balance load with generation over a 24-hour daily cycle. The 24-hour storage cycle illustrated in

Figure 2 shows typical load profiles with typical generation profiles for wind and solar resources. In this example, load exceeds generation in the morning and evening hours when the sun is not shining, while there is an excess of solar production in the afternoon hours. So while there is enough energy overall to meet demand, there is the need to shift the generation from the afternoon peak to the morning and evening hours. This daily shifting of energy can be achieved by short-duration storage technologies such as lithium ion, sodium ion and advanced lead acid batteries, as well as pumped storage and certain other technologies such as compressed air storage.

The second need is for much longer duration storage, which may be required for several days (up to a week or more) to balance extended periods of load generation mismatch. For example, the seasonal storage cycle in Figures 2 and 3 show the mismatch between generation and load over the summer months when the demand is the highest but wind production generally dips or during winter extended cold spells from polar vortex-type phenomenon. This calls for shifting large quantities of energy from the spring and winter months into the summer months. This can only be achieved through long-duration storage such as pumped storage or other long duration storage technologies.

FIGURE 3: LONG-TERM (2040): HOURLY OPERATIONS BY SEASON



Source: The Brattle Group, New York's Evolution to a Zero Emission Power System, prepared for NYISO, June 22, 2020.

A number of long-duration storage technologies are in development including flow batteries, sodium sulfur batteries, zinc batteries, geomechanical pumped storage, stacked blocks, molten salts, superconducting magnetic energy storage, liquid metal batteries, thermal steel, liquid air and compressed air.

Hydrogen storage is increasingly seen as a highly promising means to smooth the variability of wind and solar generation by using their excess electricity to generate hydrogen rather than curtailing it. Grid-connected hydrogen production could support the deployment of variable renewables, by providing demand flexibility to the system. Electrolyzers used for hydrogen production have the ability to flex up and down to help match the variable and intermittent supply profile of wind or solar energy. This peak shaving improves the case for renewables, as it partially offsets the intermittency problems on the supply side. Where required, stored hydrogen can also be converted back into power via fuel cells or using hydrogen-ready gas turbines (at a new or retrofitted power stations). In this way, hydrogen can provide a long-term, high-capacity electricity storage mechanism. Underground storage of hydrogen-based fuels, especially in salt caverns, are envisaged and could be one of the most space-efficient long-term storage options.

In addition to storage solutions, nuclear proponents are also suggesting that next-generation designs, like small, modular versions of conventional light-water reactors (SMRs), micro reactors or advanced reactors could play a role in the future grid. Nuclear power plants have historically operated as baseload units as a result of their low fuel costs, however future nuclear systems are being designed to be more flexible and could potentially support renewable generation by quickly ramping their power output up or down to match grid demand.

In order to accommodate a high penetration of variable renewable energy, the future grid will require a great deal of flexibility on both the electricity supply and demand sides. There are many ways to increase grid flexibility and improve the integration of renewable resources including energy storage, added transmission capacity, combining different emissions resources, demand-side management, and generator compensation for quick ramping capability. Renewables are paving the way for a low carbon future, but the impacts of their intermittency on managing grid reliability must also be addressed. It will take advances in technology, careful planning, and increased flexibility to ensure a smooth transition to a renewables-dominated electrical grid. All options must continue to be explored and not prematurely dismissed. Those options can be informed by the expertise of the NYISO and its stakeholders which will help accelerate New York's path to a clean and reliable electric grid.

Topic 1: Supporting Resource Adequacy through the Capacity Market

During this session, stakeholders would engage in discussions about the evolution they envision for the capacity market in order to continue to meet the next ten years of resource adequacy needs as the resource mix begins to shift to include more renewable and storage resources.

Table Discussion: Seed Questions

1. What role does the capacity market need to play over the next ten years?
2. During the transition envisioned over the next ten years, how does the NYISO's existing capacity market structure support what is needed on the grid and where does it fall short?
3. Valuing resources' contribution to resource adequacy accurately is important for an efficient capacity market.
 - a. Is it appropriate for the capacity accreditation of unique resource types, such as renewable, storage and thermal resources, be valued differently?
 - b. Considering the changes envisioned to the grid over the next ten years, how frequently should these values be updated?
 - c. As the NYISO considers revisions to the capacity accreditation process, what type of process would need to be considered that would allow the NYISO to transparently and accurately update the capacity accreditation values?
4. Thinking beyond resource adequacy, what other improvement to the capacity, energy, and/or ancillary services markets are necessary in the short run to continue to maintain grid reliability?
 - a. Are there reliability services, such as Voltage Support as an example that may grow in value as the resource mix evolves? What should the NYISO be considering to address those growing concerns?
 - b. Should the capacity market be expanded to include other reliability or policy attributes?

Topic 2: The Role of Emerging Technologies

During this session, stakeholders would discuss the technology gap for clean, long-duration, dispatchable resource technologies envisioned beyond 2030 and how the NYISO could better inform stakeholders on the role of emerging technologies.

Table Discussion: Seed Questions

1. What more can the NYISO do to educate stakeholders on the technology gaps that have been highlighted in the Grid in Transition and Climate Change studies?
2. Is there additional information that the NYISO can provide to inform developers & decision makers of the attributes that emerging technologies should have in order to close the technology gap?
3. Is there additional analysis or research that the NYISO could perform for stakeholders that would help to support development of emerging technologies?
4. Thinking about the electrification of other sectors of the economy and how that impacts changes to demand profiles, such as a shift from summer peaking to winter peaking, what does the NYISO need to do to better inform stakeholders on the types of emerging technology or transmission infrastructure investments that will be necessary to prepare the electric system to meet those future demand needs?

A SPECIAL THANKS TO THE 2021 NYISO COMMITTEE CHAIRS

The NYISO would like to give a special thanks to the committee and working group chairs for their outstanding leadership and dedication throughout the year. All governance members are welcome and encouraged to chair a future committee or working group.

Those interested in chairing a committee in 2022, please reach out to the Member Relations team.

MANAGEMENT COMMITTEE/WORKING GROUPS

- **Management Committee:** Chairs: Aaron Breidenbaugh/Rodan Energy; Vice Chair: Chris Wentlent/MEUA
- **Budget & Priorities WG:** Alan Ackerman/Customized Energy Solutions
- **By-Laws Subcommittee:** Alan Ackerman/Customized Energy Solutions
- **Market Participant Audit Advisory Subcommittee:** Rich DeJong/NYSEG/RG&E

BUSINESS ISSUES COMMITTEE/WORKING GROUPS

- **Business Issues Committee:** Matt Schwall, IPPNY, Chair (term – Dec 20' – May 21'); John Marczewski, East Coast Power, Vice Chair (term Dec 20' – May 21'); Current Chair (May 21')
- **Billing & Accounting & Credit WG:** Norman Mah/Con Edison
- **Electric System Planning WG:** Co-Chairs: Dana Lazarus/Con Edison & James Kane/NYPA
- **Installed Capacity WG:** Julia Popova/NRG
- **Load Forecasting TF:** Bryan Irrgang/Long Island Power Authority
- **Market Issues WG:** Matt Schwall/Independent Power Producers of New York
- **Price Responsive Load WG:** Peter Dotson-Westphalen/CPower

OPERATING COMMITTEE

- **Operating Committee:** Chair: Liam Baker/Eastern Generation; Vice Chair: Matt Antonio/National Grid
- **Communication Data Advisory Subcommittee:** Alex Mostoslavsky/Con Ed
- **Electric Gas Coordination WG:** Liam Baker/Eastern Generation
- **Electric System Planning WG:** Dan Mahoney/New York Power Authority
- **Restoration Working Group:** Edwin Thompson/Con Edison
- **System Operations Advisory Subcommittee:** Steve Senus/NYPA
- **System Protection Advisory Subcommittee:** Leland Krumenacher/Central Hudson
- **Transmission Planning Advisory Subcommittee:** Scott Leuthauser/HQUS



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