



2018 Master Plan

Wholesale Markets for the Grid of the Future

**A Report by the
New York Independent System Operator**

June 2018

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Introduction

Wholesale energy markets reflect the confluence of economics, technology, and public policy. Markets have successfully facilitated efficiency gains on the grid and cleaner energy production in the state since their inception. Those gains and improvements have been gradual as price signals have worked over time to influence more efficient (and often cleaner) generation, and investments in the grid that have further enabled energy production from cleaner resources. The NYISO views its markets as an effective platform for reflecting public policy and technological influences in an economically efficient manner to reliably meet consumers' energy needs.

The NYISO continues to lead the industry with efforts to address harmonizing wholesale markets and state policies, and using markets to drive resource performance. The challenge for the NYISO will be to examine its market structures to develop incentives for investment in, and maintenance of, the types of resources needed to sustain reliability.

The NYISO's Master Plan (Master Plan) for the wholesale markets endeavors to tie multiple efforts together into a cohesive market design strategy for the next five years. With the help and input of our market participants, this document discusses the NYISO's recommendations for evolving the wholesale markets that the NYISO administers. Market design concepts discussed include those developed or suggested in one or more of the following publications or projects:

- [Securing 100+ kV Transmission Facilities in the Market Model](#) (NYISO, June 2017)
- [Pricing Carbon into NYISO's Wholesale Energy Market to Support New York's Decarbonization Goals](#), (The Brattle Group, August 2017)
- [Capacity Resource Performance in NYISO Markets](#) (The Analysis Group, November 6, 2017)
- [Distributed Energy Resources Roadmap for New York's Wholesale Electricity Markets](#) (NYISO, December 2017)
- [RTC-RTD Convergence Study](#) (NYISO, December 2017)
- [The State of Storage, Energy Storage Resources in New York's Wholesale Electricity Markets](#) (NYISO, December 2017)
- [Wholesale Market Assessment of the Impact of 50% Renewable Generation](#), (NYISO, December, 2017), "2017 Market Assessment"
- [FERC 206 Order on Fast-Start Pricing](#) (December 21, 2017)
- [FERC Grid Resilience Order](#) (January 8, 2018)

- [Performance Assurance Management Response](#) (NYISO, February 21, 2018)
- [Carbon Pricing Straw Proposal](#), (NYISO, April 2018)

This Master Plan explains how the various market design concepts discussed in these documents can come together strategically to best position the NYISO's markets to remain robust and efficient as the grid evolves.

Resource Flexibility

The addition of renewable resources expected as a result of the Clean Energy Standard will create a more dynamic grid, where supply is heavily influenced by the weather.¹ This necessitates a look at the incentives for flexible resources that will be needed to balance intermittent renewables, as well as alternative market designs that preserve revenue adequacy for generators needed for reliability. Incenting resource flexibility, which includes the ability to respond rapidly to dynamic system conditions, provide controllable ramp with fast response rates, and startup/shutdown quickly and frequently, will be a key element to any market enhancements developed by the NYISO.

Grid Resilience

Maintaining power system reliability is a system operator's primary responsibility, and the role of wholesale markets is critical in carrying out this responsibility. The NYISO administers both Day-Ahead and Real-Time Markets to procure the necessary Energy and Ancillary Services to reliably operate the system and continuously meet the electricity demands of customers, at the lowest overall production cost based on the offers submitted by resources competing to provide service. The NYISO's Day-Ahead and Real-Time Markets each perform a simultaneous co-optimized commitment/dispatch of resources to provide the necessary levels of energy, regulation, and operating reserves to address all system needs and maintain reliability. These market processes also consider system contingencies necessary for maintaining reliability should system conditions change. Catastrophic events like Hurricanes Sandy and Harvey have recently brought the attribute of grid resilience into the spotlight. In its January 8, 2018 Grid Resilience Order, the FERC defined grid resilience as "The ability to withstand and reduce the magnitude and/or duration of disruptive events, which includes the capability to anticipate, absorb, adapt to, and/or rapidly recover from such an event."² In its response to the Grid Resilience Order, the NYISO agreed with this definition, while acknowledging that grid resilience and reliability are "highly intertwined and often indistinguishable."³ The

¹ Order Adopting a Clean Energy Standard, New York State Public Service Commission Order, Case 15-E-0302 (August 1, 2016). available at <http://documents.dps.ny.gov/public/MatterManagement/CaseMaster.aspx?MatterCaseNo=15-e-0302>

² Grid Resilience in Regional Transmission Organizations and Independent System Operators, 162 FERC ¶ 61,012 (2018).

³ See *Grid Resilience in Regional Transmission Organizations and Independent System Operators, Response of the New York Independent System Operator, Inc.*, NYISO, March 8, 2018, p. 5, available at this link:

NYISO also noted that resilience “may also include measures for providing incremental reliability above that required to maintain minimum reliable operation of the system.”⁴

The NYISO intends to evaluate opportunities to leverage competitive wholesale market products and services to bolster the resilience of New York’s bulk power system. The changing portfolio of resources serving the electric needs of New York discussed earlier in Power Trends will require a careful and comprehensive review of the NYISO’s existing market products and operational practices to ensure the continued ability to efficiently and reliably serve New York’s electricity requirements.

Price Formation

The NYISO recognizes the importance that markets and effective market signals play in attracting and retaining resources that are best positioned to maintain grid reliability. The NYISO’s wholesale market design must continue to evolve to reflect the transition that the grid is undergoing.

In order to provide efficient ~~incentives~~operational and investment signals to an increasingly diverse mix of supply resources, ~~it is important for~~ the markets ~~to~~must continue to evolve to maintain and improve alignment between the design of wholesale markets and the reliability needs of the system. The NYISO focuses on improving price formation and ~~transparent~~ market ~~signals, which will lead to transparency,~~ supporting efficient investment ~~in new~~for resources ~~in optimal locations~~to locate in the right places and operate at the right time.

Capacity Markets

The NYISO administers a capacity market that is well suited to keep up with the challenges and opportunities facing the grid. For example, it does not require a long term forward commitment. Therefore, the capacity market design is not in need of a comprehensive redesign at this time. Separately, the NYISO begins the multi-year ICAP Demand Curve reset effort in 2019, which is a resource intensive process for both the NYISO and its stakeholders.

The NYISO evaluated adjustments to both the capacity and energy market rules that might enhance efficient investment signals for managing the grid transition. It determined that focusing efforts on energy market improvements would be more fruitful. The NYISO does recommend improving its capacity supplier performance expectations through enhancements to capacity market participation eligibility and capacity

<https://nyisoviewer.etariff.biz/ViewerDocLibrary//Filing/Filing1356/Attachments/20180309%20NYISO%20Rspns%20Grd%20Rslnc%20AD18-7-000.pdf>

⁴ See Grid Resilience in Regional Transmission Organizations and Independent System Operators, Response of the New York Independent System Operator, Inc., NYISO, March 8, 2018, p. 7, available at this link:

<https://nyisoviewer.etariff.biz/ViewerDocLibrary//Filing/Filing1356/Attachments/20180309%20NYISO%20Rspns%20Grd%20Rslnc%20AD18-7-000.pdf>

supplier obligations. These complimentary capacity market changes support the NYISO's holistic approach to incenting resource flexibility and grid resilience.

Strategic Market Design Concepts and Plans

Proposed Project Timelines

This document suggests timelines for product development and identifies target dates for key milestones. Standard definitions for typical NYISO project milestones are provided below for the reader's convenience.⁵ Some project phases may require more time to complete than others, depending on the complexity of the effort.

Study: Scope of work to be performed has been completed; results and recommendations have been presented to the appropriate Business Owners and stakeholders.

Market Design Concept Proposed: NYISO has initiated, or furthered discussions with stakeholders that explore potential concepts to address opportunities for market efficiency or administration improvements.

Market Design Complete: NYISO has developed with stakeholders, a market design concept such that the proposal can be presented for a vote at the BIC or MC to define further action on the proposal.

Functional Requirements: NYISO has completed documentation of the functional requirements and the Business Owner has approved.

Development Complete: Software development has been completed, packaged and approved by the Supervisor.

Deployment: Required software changes to support commitment have been integrated into the production environment.

The Master Plan provides project timelines for information, with several important caveats. First, the project milestones in 2019 and beyond are recommendations only. Projects will be selected through the stakeholder prioritization process, which takes place annually in the NYISO's Budget and Priorities Working Group (BPWG). The Master Plan does not supersede the project prioritization process in any way.

Second, as part of market design development, extensive analysis is conducted to determine whether each product is needed and what value it would have for the markets and consumers, so that the NYISO can

⁵ These milestone definitions are consistent with those used by the NYISO's Budget and Priorities Working Group (BPWG).

make an informed recommendation to stakeholders prior to a Business Issues Committee (BIC) vote. As a result of such analysis, the NYISO may recommend that certain designs not move forward to implementation. This document should not be viewed as a commitment to complete any of the projects discussed herein.

The Master Plan attempts to strike a balance between aggressive pursuit of market evolutions desired to meet the needs of the grid of the future, with the time necessary to thoroughly develop and evaluate the market designs. The NYISO understands the stakeholders' expectations to allocate sufficient time to develop a market design and evaluate the effectiveness and cost implications. The staggering of initiatives' schedules will allow all parties involved the opportunity to make the time commitment necessary to effectively consider the market designs. The NYISO's recommendations recognize three staggered collections of project priorities. The first priority reflects those projects with the greatest anticipated value in the near term. The second priority reflects those projects that will require additional time to evaluate and consider. The third priority reflects projects that have a longer time horizon of value contributions, require further consideration to evaluate the market benefits or would benefit from experiences gained in other markets before committing to. This final group is slated for further study and evaluation in the three to five year time horizon to determine the additional set of initiatives to pursue.

Strategic Initiatives and Projects	2018	2019	2020	2021	2022	2023	Resource Flexibility	Grid Resilience	Price Formation
Energy Storage Integration									
Energy Storage Resource Participation Model	MDC	DEP					X	X	
Renewable and Storage Aggregation Model			MDC	FR	DC	DEP	X	X	
DER Integration									
DER Participation Model	MDC	FR	DC	DEP			X	X	
NYISO Pilot Framework	S	S					X		
Carbon Pricing	CP	MDC	FR	DC	DEP				X
Evolution of Ancillary Services									
Reserve Procurement for Resilience	CP	MDC	DC	DEP				X	X
More Granular Operating Reserves (SOM)	CP	MDC	FR	DC	DEP			X	X
Ancillary Services Shortage Pricing	CP		MDC	FR	DC	DEP	X	X	X
Flexible Ramping Product	CP			MDC	FR	DC	X	X	X
Dynamic Reserve Requirements (SOM)			CP	MDC	FR	DC		X	X
Pricing Reserves for Congestion Management (SOM)						S	X		X
Review Regulation Capacity Requirements				S			X	X	
Separate Regulation Up and Regulation Down				S			X	X	
Review Regulation Movement Pricing					S		X		X
Performance Assurance									
Tailored Availability Metric		CP	FR	DC	DEP			X	
External Capacity Performance & Obligations	CP	MDC	DC	DEP				X	
More Frequent Interchange Scheduling									
5-minute Transaction Scheduling with HQ		CP	MDC	FR	DC	DEP	X		
More Frequent Interchange Scheduling with IESO					S		X		
5-minute Interchange Scheduling with ISO-NE			S				X		
5-minute Interchange Scheduling with PJM				S			X		
Large Scale Solar Integration									
Solar Forecast Data Requirements	DEP							X	
Solar On Dispatch	CP		MDC	DC	DEP		X	X	
Model 100+ kV Transmission Constraints									
Secure Facilities Without Mitigation Concerns	DEP							X	X
Develop & Implement Mitigation Rules	MDC	FR	DC	DEP				X	X
Additional Projects									
Constraint Specific Transmission Shortage Pricing	CP	FR		DC	DEP				X
Enhanced Fast Start Pricing	CP	FR	DEP						X
RTC-RTD Convergence Improvements	CP		MDC	FR	DC	DEP			X
Real-Time Performance Incentives	CP	MDC	DC	DEP			X		

Market Strategy - 2018 Master Plan	2018	2019	2020	2021	2022	2023	Resource Flexibility	Grid Resilience	Price Formation
Energy Storage Integration									
Energy Storage Resource Participation Model (SOM)	MDC	DEP					X	X	
Renewable and Storage Aggregation Model			MDC	FR	DC	DEP	X	X	
DER Integration									
DER Participation Model	MDC	FR	DC	DEP			X	X	
NYISO Pilot Framework	S	S					X		
Carbon Pricing	CP	MDC	DC	DEP					X
Evolution of Ancillary Services									
Reserve Procurement for Resilience	CP	MDC	FR	DC	DEP			X	X
More Granular Operating Reserves (SOM)	CP	MDC	FR	DC	DEP			X	X
Ancillary Services Shortage Pricing (SOM)	CP		MDC	FR	DC	DEP	X	X	X
Flexible Ramping Product	CP			MDC	FR	DC	X	X	X
Dynamic Reserve Requirements (SOM)			CP	MDC	FR	DC		X	X
Pricing Reserves for Congestion Management (SOM)						S	X		X
Review Regulation Capacity Requirements				S			X	X	
Separate Regulation Up and Regulation Down				S			X	X	
Review Regulation Movement Pricing					S		X		X
Performance Assurance									
Tailored Availability Metric		CP	FR	DC	DEP			X	
External Capacity Performance & Obligations	CP	MDC	DC	DEP				X	
Enhancing Fuel and Energy Security		S	MDC	DEP				X	
Large Scale Solar Integration									
Solar Forecast Data Requirements	DEP							X	
Solar On Dispatch	CP		MDC	DC	DEP		X	X	
Additional Projects									
Model 100+kV Transmission Constraints (SOM)	DEP							X	X
Constraint Specific Transmission Shortage Pricing (SOM)	CP	FR			DC	DEP			X
Enhanced Fast Start Pricing	CP	FR	DEP						X
Real-Time Performance Incentives	CP	MDC	DC	DEP			X		

KEY

S

Study

CP

Market Design Concept Proposed

MDC

Market Design Complete

FR

Functional Requirements

DC

Development Complete

DEP

Deployment



Energy Storage Resource (ESR) Integration

ESR Participation Model (SOM)⁶

2018	2019	2020	2021	2022	2023	Resource Flexibility	Grid Resilience	Price Formation
Market Design Complete	Deployment					X	X	

The NYISO is pursuing the expansion of wholesale market participation for ESRs in recognition that their “ability to shift load as a consumer when load is low and as a supplier when load is peaking, can help grid operators handle peak demand, manage the variability of intermittent resources, and potentially defer transmission upgrades in some instances.”⁷ Their unique ability to withdraw from and inject energy into the grid is expected to significantly increase both resource flexibility and grid resilience.

The NYISO’s market design efforts are timely given the State of New York’s goal to install 1,500 MW of storage capacity by 2025,⁸ and FERC Order No. 841 concerning the participation of Energy Storage in the nation’s wholesale markets.⁹ In compliance with FERC Order No. 841, the NYISO will establish an energy, capacity, and ancillary services participation model that recognizes the unique characteristics of storage assets by December of 2019.¹⁰ The NYISO’s ESR participation model will allow storage resources to set price and enable suppliers to offer as little as 100 kW of energy, capacity, and ancillary services.

Stakeholders have expressed interest in the development of rules to govern storage aggregations and

⁶ Throughout this report, a (SOM) designation indicates that the project or initiative is related to a recommendation from 2016 *State of the Market Report for the New York ISO Markets*, Potomac Economics (May 2017), available at this link: http://www.nyiso.com/public/webdocs/markets_operations/documents/Studies_and_Reports/Reports/Market_Monitoring_Unit_Reports/2016/NYISO_2016_SOM_Report_5-10-2017.pdf or 2017 *State of the Market Report for the New York ISO Markets*, Potomac Economics (May 2018), available at this link: http://www.nyiso.com/public/webdocs/markets_operations/documents/Studies_and_Reports/Reports/Market_Monitoring_Unit_Reports/2017/NYISO-2017-SOM-Report-5-07-2018_final.pdf

⁷ *The State of Storage, Energy Storage Resources in New York’s Wholesale Electricity Markets*, NYISO, December 2017, p. 7, available at this link: https://home.nyiso.com/wp-content/uploads/2017/12/State_of_Storage_Report_Final_1Dec2017.pdf

⁸ Governor Cuomo’s 2018 State of the State Clean Energy and Jobs Agenda press release: <https://www.nyserda.ny.gov/About/Newsroom/2018-Announcements/2018-01-02-Governor-Cuomo-Unveils-20th-Proposal-of-2018-State-of-the-State>

⁹ FERC Docket Nos. RM16-23-000; AD16-20-000; Order No. 841 <https://www.ferc.gov/whats-new/comm-meet/2018/021518/E-1.pdf>

¹⁰ Please see the NYISO’s Key Topics section on ESR’s for recent presentations about the ESR participation model design: [www.nyiso.com/public/markets_operations/key_topics/topic/index.jsp?meta=Energy Storage Int and Opt](http://www.nyiso.com/public/markets_operations/key_topics/topic/index.jsp?meta=Energy%20Storage%20Int%20and%20Opt)

opportunities for simultaneous participation in both retail programs and wholesale markets, both of which lie outside of the directives in FERC Order No. 841. Because these topics are not included in FERC’s directives, new market rules governing them cannot be included in the NYISO’s Order No. 841 compliance filing in late 2018. The NYISO recognizes that such enhancements may further contribute to resource flexibility and grid resilience, and they are being actively developed as part of the DER Participation market rules. These rules will be technology neutral and therefore available to ESRs that meet the proposed eligibility criteria.

The initial implementation of the NYISO’s ESR participation model will provide storage resources with the option to either self-manage their energy levels through their economic offers or to utilize the NYISO’s energy level monitoring capabilities. NYISO energy level monitoring will prevent storage resources from receiving physically infeasible schedules throughout the dispatch day. The ability to specify an ending energy level would enable ESRs to better manage their energy levels throughout the dispatch day.

The addition of an ending energy level parameter would address the State of the Market recommendation to consider allowing generators to submit offers that reflect certain energy storage and fuel supply constraints in the day-ahead market, which “would facilitate more efficient scheduling and pricing when they are subject to fuel or other production limitations.”¹¹ The NYISO will consider whether to add this feature to the ESR participation model. The NYISO expects its ESR participation model to evolve as it gains operational experience.

Renewable and Storage Aggregation

2018	2019	2020	2021	2022	2023	Resource Flexibility	Grid Resilience	Price Formation
		Market Design Complete	Functional Requirements	Development Complete	Deployment	X	X	

State and Federal initiatives such as REC procurements provide incentives for developers to couple storage and intermittent renewable assets. Such programs are aimed at reducing the volatility and improving the availability of intermittent resources. The NYISO’s market rules do not permit co-located large scale ~~(21 MW or greater)~~ renewables and energy storage resources to participate in the wholesale markets in aggregate today. Instead, where two or more resource types are collocated, each resource type must be

¹¹ See Recommendation 2013-11 in 2016 *State of the Market Report for the New York ISO Markets*, Potomac Economics (May 2017), p. 100, which states that “Currently, generators with such limitations would likely respond by raising their offer prices, which is imprecise and can lead to uneconomic outcomes for the supplier and the market overall. Hence, allowing generators to submit offers that reflect quantity limitations over the day would facilitate more efficient scheduling and pricing when they are subject to fuel or other production limitations.” The report is available at this link: http://www.nyiso.com/public/webdocs/markets_operations/documents/Studies_and_Reports/Reports/Market_Monitoring_Unit_Reports/2016/NYISO_2016_SOM_Report_5-10-2017.pdf

separately metered and have its own point identifier (PTID). This phase of the Energy Storage Resource Integration initiative will develop market rules that better integrate large-scale weather dependent and energy storage resources that are co-located behind a single interconnection point, while the Distributed Energy Resource (DER) Integration initiative will develop aggregation rules for -smaller resources that are generally distributed behind multiple interconnection points.

Distributed Energy Resource (DER) Integration

DER Participation Model

2018	2019	2020	2021	2022	2023	Resource Flexibility	Grid Resilience	Price Formation
Market Design Concept Proposed	Functional Requirements	Development Complete	Deployment			X	X	

DER are poised to transform New York's wholesale electric system. DER can help system operators by improving grid resilience, energy security, and fuel diversity. DER can lower consumer prices, improve market efficiency, and allow consumers to take greater control of their electricity use and costs through a variety of new technologies. DER will also improve our environment through the development of new renewable generation and energy storage technologies, helping the State of New York achieve its goals under the Reforming the Energy Vision (REV) initiative¹² and Clean Energy Standard.¹³

The NYISO is in the midst of a multi-year effort that, at its completion, will open New York's wholesale Energy, Ancillary Service, and Capacity Markets to DER. In December 2017, the NYISO released its DER Market Design Concept Proposal (MDCP)¹⁴ which is the second step in the market design process, and builds on the ideas outlined in NYISO's February 2017 DER Roadmap¹⁵ and subsequent stakeholder discussions. Currently, the NYISO is developing an appropriate set of rules for DER integration and implementation in 2021.

¹² Reforming the Energy Vision, New York State Department of Public Service Staff Report and Proposal, Case 14-M-0101 (April 24, 2014), available at this link: [http://www3.dps.ny.gov/W/PSWeb.nsf/96f0fec0b45a3c6485257688006a701a/26be8a93967e604785257cc40066b91a/%24FILE/ATTKOJ3L.pdf?Reforming%20The%20Energy%20Vision%20\(REV\)%20REPORT%204.25.%2014.pdf](http://www3.dps.ny.gov/W/PSWeb.nsf/96f0fec0b45a3c6485257688006a701a/26be8a93967e604785257cc40066b91a/%24FILE/ATTKOJ3L.pdf?Reforming%20The%20Energy%20Vision%20(REV)%20REPORT%204.25.%2014.pdf)

¹³ Order Adopting a Clean Energy Standard, New York State Public Service Commission Order, Case 15-E-0302 (August 1, 2016), available at this link: <http://documents.dps.ny.gov/public/MatterManagement/CaseMaster.aspx?MatterCaseNo=15-e-0302>

¹⁴ ~~New York Indep. Sys. Operator, Inc., See Distributed Energy Resources Market Design Concept Proposal, NYISO~~ (Dec. 2017), available at this link: http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_miwg/meeting_materials/2017-12-19/Distributed%20Energy%20Resources%202017%20Market%20Design%20Concept%20Proposal.pdf

¹⁵ ~~See New York Indep. Sys. Operator, Inc., See Distributed Energy Resources Roadmap for New York's Wholesale Electricity Markets, NYISO~~ (Feb. 2017), available at this link: <https://home.nyiso.com/wp-content/uploads/2017/10/Distributed-Energy-Resources-Roadmap-DER.pdf>.

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NYISO Pilot Framework

2018	2019	2020	2021	2022	2023	Resource Flexibility	Grid Resilience	Price Formation
Study	Study					X		

The NYISO has initiated a Pilot Project Program to test innovative technology and assist with the development of the DER participation model.¹⁶ The newly created Pilot Framework that will allow developers and the NYISO to gain knowledge about the technology's capabilities and uses as well as supporting REV demonstration efforts. This will ultimately inform the NYISO's continued development of market rules to appropriately incorporate new technology capabilities and meet grid needs. The Pilot Framework will provide the opportunity to test the new capabilities and paradigms that Distributed Energy Resources present.

The NYISO will select applicant projects subject to a value screening and resource availability that offer the greatest capacity to test and demonstrate the coordination, aggregation, and communication concepts that are currently being proposed and discussed in working groups at the NYISO and in the greater DER community. The NYISO will share the lessons learned and knowledge gained from the program with its stakeholders throughout the lifecycle of Pilot Program until its culmination in mid-2020.

Carbon Pricing

2018	2019	2020	2021	2022	2023	Resource Flexibility	Grid Resilience	Price Formation
Market Design Concept Proposed	Market Design Complete	Development Complete	Deployment					X

A proposal to price carbon into NYISO-administered wholesale markets is being developed for the Integrating Public Policy Task Force.¹⁷ Carbon pricing would contribute to price formation by realizing the social cost of high carbon-emitting resources and incentivizing the development of lower-emitting resources. It may enable the State's public policy goals to be achieved more quickly and at a lower cost to consumers

¹⁶ See *NYISO Pilot Guide*, NYISO (Oct. 2017) available at: http://www.nyiso.com/public/webdocs/markets_operations/market_data/demand_response/DER_Roadmap/Pilot_Program/NYISO-Pilot-Program-Guide-Final.pdf

¹⁷ See *Carbon Pricing Straw Proposal*, NYISO (April 2018) available at this link: http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_miwg_ipptf/meeting_materials/2018-04-23/Carbon%20Pricing%20Straw%20Proposal%2020180430.pdf

than the status quo. Additional benefits could include transparency for consumers, market and regulatory stability.

Efforts to determine whether a carbon price would achieve the expected benefits will continue through the end of 2018. The NYISO proposes to finalize the carbon pricing market design in 2019 and recommends that this project be prioritized for the development of a completed market design in 2019.

Evolution of Ancillary Services

The 2017 Market Assessment demonstrated that characteristics such as the ability to ramp up or down, respond rapidly to dispatch, or start up quickly will be critical to ensure the continued resilience of the bulk power system as the participation of intermittent renewables increases. In the future, energy revenues alone may not adequately compensate suppliers for the value that their ancillary services provide.

Enhancing the wholesale market's ancillary service offerings as well as reforming the ancillary service shortage pricing will help bolster the revenue adequacy of flexible resources and support improving the operational flexibility of the grid. A number of new ancillary services products and market rule enhancements that could improve price formation, enhance grid resilience, and incent increased resource flexibility have been discussed in 2018 as a result of both the Performance Assurance Management Response and 2017 Market Assessment. These projects and the NYISO's recommendations for their prioritization are discussed in this section.

Reserve Procurement for Resilience

2018	2019	2020	2021	2022	2023	Resource Flexibility	Grid Resilience	Price Formation
Market Design Concept Proposed	Market Design Complete	Functional Requirements	Development Complete	Deployment			X	X

The Performance Assurance Management Response proposed that procuring operating reserves in addition to the amount required to maintain grid reliability could promote grid resilience.¹⁸ Low-priced demand curves could be used to schedule resources to supply operating reserve as a cost-effective “insurance policy” against unforeseen disruptions on the grid. These reserve schedules would recognize the value of resource availability that can be responsive to unanticipated real-time operating needs. The

¹⁸ See *Management Response to the Analysis Group's Report Capacity Resource Performance in NYISO Markets: An Assessment of Wholesale Market Options*, NYISO (February 2018) p. 2, available at this link:

http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_miwg/meeting_materials/2018-02-21/Performance%20Assurance%20Management%20Response%20Feb%2021%20MIWG%20FINAL.PDF

additional financial incentives would encourage procurement of the necessary fuel and incent improved resource performance. The NYISO plans to present a market design concept for this product to stakeholders in 2018, and recommends that it be prioritized for the development of a completed market design with additional analysis in 2019.

More Granular Operating Reserves (SOM)

2018	2019	2020	2021	2022	2023	Resource Flexibility	Grid Resilience	Price Formation
Market Design Concept Proposed	Market Design Complete	Functional Requirements	Development Complete	Deployment			X	X

New York State Reliability Council (NYSRC) reliability rules require that “[s]ufficient ten (10) minute operating reserves shall be maintained in the NYC zone”.¹⁹ The Performance Assurance Management Response ~~indicated~~ and the 2017 State of the Market report recommend that the NYISO ~~should~~ consider establishing and securing a separate 10-minute reserve requirement for New York City.^{20, 21} Doing so would provide location-specific market signals consistent with the reliability need. In addition, exploring load pocket reserves would further enhance the location-specific value of maintaining short notice responsive resources in desirable locations. This effort is being proposed as an additional project for 2019 prioritization.²²

As part of the More Granular Operating Reserve project, the NYISO plans to address stakeholder concerns about reserve performance by reviewing scheduling practices to ensure deliverability. The NYISO believes that doing so will also help address Potomac Economics’s 2016 State of the Market recommendation that the NYISO “consider means to allow reserve market compensation to reflect actual and/or expected

¹⁹ See New York State Reliability Council, Reliability Rules and Compliance Manual, September 8, 2017, version 41, rules G.1 B.R.3, available at the following link: <http://www.nysrc.org/pdf/Reliability%20Rules%20Manuals/RRC%20Manual%20V41.pdf>

²⁰ See Management Response to the Analysis Group’s Report Capacity Resource Performance in NYISO Markets: An Assessment of Wholesale Market Options, NYISO (February 2018) p. 2, available at this link: http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_miwg/meeting_materials/2018-02-21/Performance%20Assurance%20Management%20Response%20Feb%2021%20MIWG%20FINAL.PDF

²¹ See Management Response to Recommendation 2017-1 in 2017 State of the Analysis Group’s Market Report Capacity Resource Performance in NYISO for the New York ISO Markets: An Assessment of Wholesale Market Options, NYISO (February, Potomac Economics (May 2018) p. 297, available at this link: http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_miwg/meeting_materials/2018-02-21/Performance%20Assurance%20Management%20Response%20Feb%2021%20MIWG%20FINAL.PDF
http://www.nyiso.com/public/webdocs/markets_operations/documents/Studies_and_Reports/Reports/Market_Monitoring_Unit_R_eports/2017/NYISO-2017-SOM-Report-5-07-2018_final.pdf

²² See Shortage Pricing for Ancillary Services, NYISO (MIWG, April 10th, 2018) available at this link: http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_miwg/meeting_materials/2018-04-10/Re%20Evaluate%20Shortage%20Pricing%20for%20Ancillary%20Services%20April%2010%20MIWG.pdf

performance.”²³

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²³ See Recommendation 2016-2 in *2016 State of the Market Report for the New York ISO Markets*, Potomac Economics (May 2017) p. 96, available at this link:
http://www.nyiso.com/public/webdocs/markets_operations/documents/Studies_and_Reports/Reports/Market_Monitoring_Unit_Reports/2016/NYISO_2016_SOM_Report_5-10-2017.pdf

Ancillary Services Shortage Pricing (SOM)

Ancillary Services Shortage Pricing

2018	2019	2020	2021	2022	2023	Resource Flexibility	Grid Resilience	Price Formation
Market Design Concept Proposed		Market Design Complete	Functional Requirements	Development Complete	Deployment	X	X	X

The NYISO's ancillary services demand curves reward suppliers for providing regulation and operating reserves when they are most needed. Because ancillary services are simultaneously co-optimized with energy in the NYISO's Day-Ahead and Real-Time Markets, shortage pricing contributes to effective price formation and promotes resource flexibility and grid resilience.

The NYISO recommends and its MMU recommend that current ancillary services shortage pricing levels be carefully evaluated in relation to external shortage pricing incentives, transmission constraint shortage pricing, and the value of lost load in the New York Control Area (NYCA).^{24,25} Shortage events were observed in the 2017 Market Assessment, suggesting that regulation and operating reserves may become more valuable as more intermittent renewables come online. Additionally, the Independent System Operator of New England (ISO-NE) and the PJM Interconnection, LLC (PJM) have recently introduced capacity market payments to incent suppliers to deliver energy during critical operating periods. Although neighboring "pay for performance" incentives are not guaranteed and do not impact LMP's, they could exceed the NYISO's Energy market payments; encouraging suppliers to respond more readily to external price signals than to NYCA needs during shortage events.

While this will be an important strategic initiative, the NYISO recommends that the completion of a detailed design proposal be delayed until 2020, after the designs for More Granular Operating Reserves, Reserve Procurement for Resilience, and Constraint Specific Transmission ~~Constraint~~ Shortage Pricing have been developed. This will also enable the NYISO to observe the effect that ISO-NE and PJM "pay-for-performance" incentives have on supplier behavior before making any significant changes to NYISO shortage

²⁴ See *Market Design Concepts to Prepare for Significant Renewable Generation, Ancillary Services Shortage Pricing*, NYISO (MIWG, May 9th, 2018) available at this link: http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_icapwg/meeting_materials/2018-05-09/Ancillary%20Services%20Shortage%20Pricing%20May%209%20MIWG%20FINAL.pdf

²⁵ See *Recommendation 2017-2 in 2017 State of the Market Report for the New York ISO Markets*, Potomac Economics (May 2018) p. 98, available at this link: http://www.nyiso.com/public/webdocs/markets_operations/documents/Studies_and_Reports/Reports/Market_Monitoring_Unit_Reports/2017/NYISO-2017-SOM-Report-5-07-2018_final.pdf

pricing.

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Flexible Ramping Product

2018	2019	2020	2021	2022	2023	Resource Flexibility	Grid Resilience	Price Formation
Market Design Concept Proposed			Market Design Complete	Functional Requirements	Development Complete	X	X	X

Volatility in load ramp net of renewable generation was observed in the 2017 Market Assessment. Additionally, uncertainty in the NYISO's load forecast may become more significant as more intermittent renewable generation comes online. A ramping product would enable the NYISO to procure additional ramp-up and/or ramp-down capability to prepare for load forecast uncertainty and load variability by holding a portion of wholesale generating capability to a high or low level of output.²⁶ This could be similar to the NYISO's current 10 and 30-minute reserve procurement in that such a product would be co-optimized with energy and other applicable ancillary services products. Also similar to reserves, online units bidding self-committed flex and ISO-committed flex would be eligible to provide the ramping product. A ramp-down product could provide flexibility that is not incented by the procurement of operating reserves or regulation today.

The NYISO recommends that the detailed design of a flexible ramping product be prioritized after enhancements to existing reserve products have been contemplated within the More Granular Operating Reserves, Reserve Procurement for Resilience, and Ancillary Services Shortage Pricing projects. Further industry experience with flexible ramping product implementations will better inform the design of a similar product for the NYISO markets. For example, the California Independent System Operator (CAISO) has implemented a flexible ramping product that is co-optimized with other ancillary services, and this implementation may be similar to a design that the NYISO could ultimately develop; however, CAISO is "...currently in the process of identifying and evaluating modifications to the calculation of the flex ramp requirement."²⁷ CAISO's market monitoring department also recently published a report detailing certain flexible ramp implementation issues.²⁸ It would be prudent to wait for additional market outcomes to develop with CAISO's flexible ramping product implementation before proceeding with a NYISO flexible

²⁶ For more information, please see *Flexible Ramping Product*, NYISO (MIWG, April 20th 2018) available at this link: http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_miwg/meeting_materials/2018-04-26/Flexible%20Ramping%20Product%20April%2026%20MIWG%20FINAL.pdf

²⁷ From CAISO's presentation on their Flexible Ramping Product (February 22nd, 2018) available at this link: www.caiso.com/Documents/Presentation-FlexibleRampingProductPerformanceDiscussionFeb222018.pdf

²⁸ For more information, see *CAISO Flexible Ramping Product Uncertainty Calculation and Implementation Issues*, CAISO Market Monitor (April 18th, 2018) available at this link: <http://www.caiso.com/Documents/FlexibleRampingProductUncertaintyCalculationImplementationIssues.pdf>

ramping product design.

Prioritizing the development of a flexible ramping product farther in the future will not impact reliability or efficiency in the near term. The NYISO's multi-interval look-ahead software currently considers net load variability when dispatching resources, and this has not yet been significantly impacted by intermittent renewables. Additionally, output from wind generators can be dispatched down for economic and reliability reasons within the NYCA. The NYISO also sees adequate ramp-up capability from 10-minute locational spinning reserves. Reconsidering the flexible ramping product market design may prove promising in the future as more intermittent renewable resources enter the market.

Dynamic Reserve Requirements (SOM)

2018	2019	2020	2021	2022	2023	Resource Flexibility	Grid Resilience	Price Formation
		Market Design Concept Proposed	Market Design Complete	Functional Requirements	Development Complete		X	X

The NYISO procures fixed quantities of operating reserve across 4 areas in the NYCA.²⁹ In the future, operating reserve could be procured dynamically based on real-time changes in available transmission capability. This would allow reserves to be shifted to resources in lower cost regions as transmission capacity is made available or shifted to resources that are not export constrained due to insufficient transmission capacity. The NYISO's market software would respond to system constraints dynamically by scheduling reserves where they are most needed, which would help to ensure grid resilience in the event of an unforeseen disruptive event.³⁰ Price signals would be better aligned with the precise locations where operating reserves would provide the most value, reducing costs to load.

Because this product will require significant software modifications, the NYISO recommends it for medium-term prioritization, with market design beginning in 2020 and continuing through implementation in 2024. Beginning work on this product after the design concepts for More Granular Operating Reserves, Reserve Procurement for Resilience, Ancillary Services Shortage Pricing, and the Flexible Ramping Product are well defined will help launch a more successful design.

²⁹ NYISO Locational Reserve Requirements are available at this link:
http://www.nyiso.com/public/webdocs/markets_operations/market_data/reports_info/nyiso_locational_reserve_reqmts.pdf

³⁰ See Recommendation 2015-16 in 2016 State of the Market Report for the New York ISO Markets, Potomac Economics (May 2017) p. 97, available at this link:

http://www.nyiso.com/public/webdocs/markets_operations/documents/Studies_and_Reports/Reports/Market_Monitoring_Unit_Report_s/2016/NYISO_2016_SOM_Report_5-10-2017.pdf

Pricing Reserves for Congestion Management (SOM)

2018	2019	2020	2021	2022	2023	Resource Flexibility	Grid Resilience	Price Formation
					Study	X		X

In its 2016 State of the Market Report, Potomac Economics recommended that “the NYISO evaluate ways to compensate operating reserves that help manage congestion efficiently.”³¹ Based on New York State Reliability Council (NYSRC) rules, the NYISO is required to ensure that transmission facilities are not loaded above their Long-Term Emergency (“LTE”) rating post-contingency. In some cases, exceptions to the NYSRC rules exist, to ~~allow permit use of~~ operating reserve capacity ~~may be used~~ to satisfy this requirement, which allows the NYISO to reduce production costs by increasing the utilization of the transmission system in load centers. Today, operating reserve providers are not compensated for helping manage congestion in this way, therefore the market may not provide efficient signals for investment in new and existing resources with flexible characteristics. Due to the uncertainty surrounding how this product would be scheduled and priced within the markets, the NYISO recommends that ways of improving market signals for resources that are providing congestion relief but are offline be studied beginning in 2023.

Regulation Service Improvements

Regulation is procured by the NYISO to help maintain system reliability, consistent with criteria established by the North American Electric Reliability Council (NERC).³² It is comprised of two components, Regulation Movement and Regulation Capacity, and is adjusted every six seconds by the NYISO’s Automatic Generation Control (AGC) program. High regulation prices were observed in the 2017 Market Assessment, which suggests that the NYISO’s ability to support the Eastern Interconnection frequency as required by the NERC standards could be compromised if additional grid flexibility is not incented before a large number of intermittent renewables come online. There is no immediate need to revise the NYISO’s regulation procurement processes because the NYISO regularly reviews regulation requirements to ensure that they still meet reliability needs.³³ For this reason, the NYISO recommends that the following market design initiatives be re-evaluated in three to five years.

³¹ See Recommendation 2016-1 in *2016 State of the Market Report for the New York ISO Markets*, Potomac Economics (May 2017) p. 96, available at this link:
http://www.nyiso.com/public/webdocs/markets_operations/documents/Studies_and_Reports/Reports/Market_Monitoring_Unit_Reports/2016/NYISO_2016_SOM_Report_5-10-2017.pdf

³² NYISO regulation procurement requirements are posted on the NYISO website at this link:
http://www.nyiso.com/public/webdocs/market_data/reports_info/nyiso_regulation_req_sum04.pdf.

³³ See *Manual 2, Ancillary Services Manual*, NYISO (April 2018) p. 19, available at this link:
http://www.nyiso.com/public/webdocs/markets_operations/documents/Manuals_and_Guides/Manuals/Operations/ancserv.pdf

Review Regulation Capacity requirements

2018	2019	2020	2021	2022	2023	Resource Flexibility	Grid Resilience	Price Formation
			Study			X	X	

The NYISO recommends that Regulation Capacity requirements be studied in 2021 to determine whether changes would incent additional grid flexibility and minimize shortages as intermittent renewable penetration increases.

Separate Regulation Up and Regulation Down

2018	2019	2020	2021	2022	2023	Resource Flexibility	Grid Resilience	Price Formation
			Study			X	X	

Separating Regulation Service into two products: regulation-up and regulation-down, would liberate some of the operating capacity of regulating resources by enabling them to provide either one product or the other. For example, a combined-cycle plant sitting at its minimum generation point could provide regulation-up, and a wind turbine producing energy at its maximum output could provide regulation-down. Today, neither would be able to provide regulation at those operating points, due to the symmetrical Regulation Capacity requirement. Whether this enhancement would promote grid resilience and resource flexibility should be studied in parallel with the recommended study of Regulation Capacity requirements in 2021.

Review Regulation Movement Pricing

2018	2019	2020	2021	2022	2023	Resource Flexibility	Grid Resilience	Price Formation
				Study		X		X

Although the Regulation Capacity price includes the impacts of shortage pricing when the Regulation Capacity requirement is not met, the same is not true for Regulation Movement. The bid of the last dispatched resource is used to set the Regulation Movement price. To incent an appropriate amount of movement in a future with significantly more renewable resources, it may be necessary to rethink the optimization of Regulation Movement and to set the Regulation Movement price by a demand curve during times of shortage.

The NYISO recommends that this possibility be studied in 2022, after Regulation Capacity has been studied.

Performance Assurance

The NYISO compensates resources for maintaining capacity availability so that they can be called upon when needed. While many of the NYISO's active and proposed market design projects have performance implications for market participants, the following projects will focus exclusively on improving capacity market expectations to incent resource availability in the NYISO's Energy markets.

In 2017, the NYISO contracted with Analysis Group to develop a report reviewing the NYISO's markets and other ISO/RTO markets to identify any issues with generation resource performance and what solutions exist to incent better performance. More information on the performance assurance project can be found in the presentation and report produced by the Analysis Group.^{34, 35} In its report, Analysis Group provided a number of recommendations. NYISO management carefully considered the recommendations and feedback from stakeholders and identified three key areas as offering the most promise for improvements in the near term. These include reviewing the performance and eligibility of external resources and providing a tailored availability mechanism for resources. The third key area, enhancements to the operating reserve market, are covered in prior sections.

Tailored Availability Metric

2018	2019	2020	2021	2022	2023	Resource Flexibility	Grid Resilience	Price Formation
	Market Design Concept Proposed	Functional Requirements	Development Complete	Deployment			X	

One of those recommendations was for NYISO to review how performance of resources is used in establishing the capacity value of resources, and if adjusting the calculation of capacity value of resources to put additional emphasis on critical operating periods is warranted. The NYISO has a number of different methods for arriving at the Unforced Capacity value of a particular resource. For most resources, the NYISO uses an Equivalent Forced Outage Rate on Demand (EFORD), derived from Generator Availability Data System (GADS) information provided by resources. This calculation treats all time frames as equivalent.

³⁴ See *AG Performance Assurance Study, Study Report*, The Analysis Group, Inc. (ICAPWG, November 6th, 2017) available at this link: [http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_icapwg/meeting_materials/2017-11-06/Analysis%20Group%20ICAPWG%20Presentation%2011-6-2017%20\(rev\).pdf](http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_icapwg/meeting_materials/2017-11-06/Analysis%20Group%20ICAPWG%20Presentation%2011-6-2017%20(rev).pdf)

³⁵ See *Capacity Resource Performance in NYISO Markets An Assessment of Wholesale Market Options*, The Analysis Group, Inc. (October 2017), available at this link: http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_icapwg/meeting_materials/2017-11-06/Analysis%20Group%20Draft%20Capacity%20Resource%20Performance%2010-31-17%20rev.pdf

However, in reality, the NYISO's needs for capacity are heightened during peak operating windows in the summer and winter. This current method may not accurately represent a unit's preparedness during critical operating periods and may not set an appropriate level of accountability for performance. Enhancing these measurements has the potential to help NYISO markets accommodate the entrance of significant renewable generation, as well as create a more efficient cost structure for consumers. Additionally, other methods currently being used to calculate the Unforced Capacity value of resources may need to be evaluated as well to align the market incentives of those resources with units using EFORD.

External Capacity Performance & Obligations

2018	2019	2020	2021	2022	2023	Resource Flexibility	Grid Resilience	Price Formation
Market Design Concept Proposed	Market Design Complete	Development Complete	Deployment				X	

An additional recommendation made in the Performance Assurance report was for NYISO to review the rules by which external resources participate in the NYISO capacity market, including eligibility requirements and offer obligations and terms.^{36,37} The NYISO allows resources both inside the New York Control Area and outside the New York Control Area in neighboring Control Areas to register as capacity suppliers and participate in the New York Capacity Market. While the rules for participation of external capacity suppliers are similar to those of internal capacity suppliers, there are a number of additional requirements that external capacity suppliers are subject to.

In 2018, the NYISO worked with stakeholders on the "Deliverability Requirements for Capacity Imports" effort. This effort has enhanced the notice regarding the minimum requirements for external capacity from PJM into the NYISO capacity market to demonstrate deliverability. Additionally, the NYISO is currently reviewing the Supplemental Resource Evaluation (SRE) process and how external capacity suppliers are treated, and as well as the penalties associated with external capacity suppliers failing to deliver energy when called upon. The 2019 effort would continue to evaluate what, if any, additional performance requirements and obligations are needed, including an evaluation of requirements to demonstrate deliverability to the NYCA border at other interfaces. This project will work to enhance requirements for external capacity

³⁶ See AG Performance Assurance Study, Study Report, The Analysis Group, Inc. (ICAPWG, November 6th, 2017) available at this link: [http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_icapwg/meeting_materials/2017-11-06/Analysis%20Group%20ICAPWG%20Presentation%2011-6-2017%20\(rev\).pdf](http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_icapwg/meeting_materials/2017-11-06/Analysis%20Group%20ICAPWG%20Presentation%2011-6-2017%20(rev).pdf)

³⁷ See Capacity Resource Performance in NYISO Markets An Assessment of Wholesale Market Options, The Analysis Group, Inc. (October 2017), available at this link: http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_icapwg/meeting_materials/2017-11-06/Analysis%20Group%20Draft%20Capacity%20Resource%20Performance%2010-31-17%20rev.pdf

resources to ensure these resources are providing value to grid operations that is comparable to internal resources.

More Frequent Interchange Scheduling

Increasing the frequency of transaction scheduling at external interfaces could help the NYISO address net load fluctuations by providing access to an expanded set of resources that could balance the bulk power system more efficiently.³⁸ It could also improve price convergence between the Real-Time Commitment (RTC) and Real-Time Dispatch (RTD) programs by providing RTD with additional scheduling flexibility.³⁹

The implementation of more frequent interchange scheduling depends on the ability and willingness of neighboring control areas to coordinate with the NYISO to plan and effectuate the necessary changes. The proposed project timelines in this section reflect the NYISO's best understanding of how and when such efforts could begin, based on recent conversations with neighboring control areas.⁴⁰ The NYISO expects to continue to engage with the Independent Electricity System Operator of Ontario (IESO), ISO-NE and PJM to monitor their interest and ability to support developing more frequent interchange scheduling provision and to provide recommendations for pursuit of those efforts at the appropriate time.

5-Minute Transaction Scheduling with HQ

In the near term, only the development of five-minute scheduling between the NYISO and Hydro-Quebec (HQ) control areas has the requisite mutual support from both parties to proceed. HQ has expressed a strong interest in coordinating with the NYISO on an effort to allow external transaction bids to be evaluated on a five-minute basis. Likewise, the NYISO recognizes that dispatchable hydroelectric resources in HQ are well positioned to help balance fluctuations of supply and demand in the NYCA. Because this effort will require extensive collaboration with HQ and will likely to result in significant software modifications, a phased implementation may need to be pursued. Over the coming years, the NYISO will continue discussions with neighboring control areas regarding the mutual benefits that more frequent interchange scheduling could provide and each control area's readiness to pursue them.

38 See *Integrating Public Policy: A Wholesale Market Assessment of the Impact of 50% Renewable Generation*, NYISO, December 2017, available at this link: http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_miwg/meeting_materials/2017-12-20/2017%20Market%20Assessment%20with%2050%20percent%20Renewables,%20Report.pdf.

39 See *RTC-RTD Convergence Study*, NYISO, (December 2017) p. 46, available at this link: http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_miwg/meeting_materials/2017-12-05/RTC-RTD%20Convergence%20Study.pdf.

40 For a recent summary of the willingness of other neighboring control areas to work with the NYISO to improve interchange scheduling, see *Market Design Concepts to Prepare for Significant Renewable Generation, More Frequent Transaction Scheduling*, NYISO (MIWG, May 9th, 2018), available at this link: www.nyiso.com/public/webdocs/markets_operations/committees/bic_icapwg/meeting_materials/2018-05-09/More%20Frequent%20Transaction%20Scheduling_MIWG_5-9-2018_Final.pdf

Enhancing Fuel and Energy Security

2018	2019	2020	2021	2022	2023	Resource Flexibility	Grid Resilience	Price Formation
-	Study	Market Design Complete	Deployment	-	-	-	X	-

From a statewide perspective, New York has a relatively diverse mix of generation resources today. However, New York's grid is characterized by stark regional differences, whereby the downstate supply mix is less diverse than the upstate supply mix. Factors such as transmission constraints and reliability standards have resulted in the power demands of New York City and Long Island being served with local generation that is primarily fueled by natural gas.

The NYISO expects evolving environmental regulations and renewable energy goals to accelerate the transition from higher-emitting generation to lower-emitting resources. This will drive a shift in supply resources on the grid, placing the downstate region at increased risk of fuel and energy supply disruption. This shift will require greater operational flexibility to more quickly adapt to real-time changes in how energy is produced and delivered; and adept system planning to identify system needs as the grid undergoes a transition toward cleaner energy technologies.

The NYISO also appreciates stakeholder concerns related to a wide range of grid resilience risks, including extreme weather scenarios and climate change impacts. The NYISO believes that one of the important elements to address grid resilience concerns is fuel and energy security and proposes the performance of a study to examine fuel and energy security for the New York State grid looking over a ten-year horizon. The NYISO is concerned that future changes to New York's fuel supply mix as well as the expected increased demands for natural gas may challenge the ability to meet electric system demands under certain stressed system conditions, such as a prolonged cold weather event and/or natural gas transportation disruptions. The study would also report on similar fuel and energy security studies and initiatives underway by other ISO/RTOs. Depending on the results of the study, the NYISO would facilitate the subsequent development of recommendations for potential operational and/or capacity and energy market mechanisms necessary to achieve desired improvements in grid resilience as related to fuel and energy security.

Large-Scale Solar Participation Model

Solar Forecast Data Requirements

2018	2019	2020	2021	2022	2023	Resource Flexibility	Grid Resilience	Price Formation
Deployment							X	

Front-of-the-meter solar installations are relative newcomers to the NYCA.⁴¹ Their participation in the NYISO's wholesale markets is expected to grow significantly in the coming years; there are currently more than 50 large solar projects in the NYISO's interconnection queue, totaling more than 1,800 MW.⁴² In preparation for this shift in the resource mix, NYISO has recently filed tariff revisions to better accommodate front-of-the-meter solar generators.^{43,44} If these revisions are approved, large-scale solar plants will soon be required to provide meteorological data and pay a forecasting fee to cover the NYISO's costs to procure a unit-specific forecast. Similar requirements exist for wind generators today.

Solar on Dispatch

2018	2019	2020	2021	2022	2023	Resource Flexibility	Grid Resilience	Price Formation
Market Design Concept Proposed		Market Design Complete	Development Complete	Deployment		X	X	

The NYISO recommends that front-of-the-meter solar resources be treated on an equivalent basis to wind resources in NYISO-administered markets. This would require solar plants to submit flexible offers that indicate their willingness to generate at various price levels, and to receive and respond to economic dispatch instructions to curtail output. Like wind plants, the NYISO proposes that solar plants meeting these requirements retain eligibility for Compensable Overgeneration payments and be exempt from Persistent Undergeneration charges. Some of the expected benefits of placing solar on dispatch include minimizing less efficient out of market actions, enabling solar plants to indicate their economic willingness to generate, better identifying the most efficient resources to limit during overgeneration events, minimizing the duration of

41 For more information, see *Power Trends, New York's Dynamic Power Grid*, NYISO (April 2018), available at this link: www.nyiso.com/public/webdocs/media_room/publications_presentations/Power_Trends/Power_Trends/2018-Power-Trends.pdf

42 *Large Scale Solar Integration*, NYISO (MIWG, September 2017), slide 6
http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_miwg/meeting_materials/2017-09-25/Large%20Scale%20Solar%20Integration%209_25_2017_FINAL.pdf

43 See *Solar Integration*, NYISO (BIC, January 17th, 2018)
http://www.nyiso.com/public/webdocs/markets_operations/committees/bic/meeting_materials/2018-01-17/Solar%20Integration%20BIC_01_17_2018_vFINAL.pdf

44 NYISO filing of Services Tariff revisions addressing forecasting data requirements and service costs for solar resources in the New York Control Area, FERC Docket No. ER18-1408-000, (April 20, 2018)

necessary energy limitations, and incorporating NYISO dispatch instructions into market clearing prices. This project is expected to positively influence both price formation and resource flexibility.

The NYISO recommends that the market rule changes needed to place solar on dispatch be implemented in 2022. The necessary tariff and software changes can be prioritized beyond the immediate short term because the impact of large-scale solar installations will be minimal for the next several years as proposed projects begin construction.

Model 100+ kV Transmission Constraints (SOM)

2018	2019	2020	2021	2022	2023	Resource Flexibility	Grid Resilience	Price Formation
Deployment							X	X

	2018	2019	2020	2021	2022	2023	Resource Flexibility	Grid Resilience	Price Formation
Secure Facilities Without Mitigation Concerns	Deployment							X	X
Develop & Implement Mitigation Rules	Market Design Complete	Functional Requirements	Development Complete	Deployment				X	X

The NYISO is engaged in a multi-year effort to secure lower kV facilities in the market model. Since most 115kV constraints are not reflected in the market scheduling process today, Real-Time Dispatch and Day-Ahead commitment decisions are sometimes inefficient. Lower kV facility constraints are currently managed through out of market actions such as transaction curtailments, PAR adjustments, and Out of Merit (OOM) designations.

Securing 100+ kV transmission constraints in the market model should improve price formation, in part because it will become increasingly important to incorporate the impacts and value of maintaining transmission system reliability into market prices as Distributed Energy Resources (DERs) begin to locate at the 100+kV level. Facilities that are secured in the market model impact price signals that inform decisions to build transmission, as well as invest in new and existing generation resources.⁴⁵ Additionally, securing 100+ kV facilities in the market model will contribute to grid resilience because it will provide the NYISO with additional tools and visibility to better manage disruptions in the NYCA.

Lower kV facilities for which the NYISO does not have market power concerns will be added to the

⁴⁵ See *Securing 100+ kV Transmission Facilities in the Market Model*, NYISO (MIWG, July 31st, 2017), p. 30, available at this link: https://www.nyiso.com/public/webdocs/markets_operations/committees/bic_miwg/meeting_materials/2017-07-31/Securing%20100+kV%20Transmission%20Facilities%20in%20the%20Market%20Model.pdf.

market model as soon as they can be accurately represented. Mitigation provisions and related tariff changes to accommodate facilities that may have the ability to exert market power will be completed in 2018. ~~The NYISO recommends that functional requirements development be prioritized as a 2019 project effort, so that new mitigation measures can be built into the market software and implemented by 2021.~~

Constraint Specific Transmission Shortage Pricing (SOM)

2018	2019	2020	2021	2022	2023	Resource Flexibility	Grid Resilience	Price Formation
Market Design Concept Proposed	Functional Requirements			Development Complete	Deployment			X

When transmission shortages occur today, the NYISO uses a graduated ~~transmission demand curve pricing mechanism (i.e., the graduated Transmission Shortage Cost mechanism)~~ to set price in many instances. Shortage pricing is set according to a shortage quantity in MWs, which may not provide the optimal solution in all instances because it fails to account for additional factors such as the location or duration of transmission constraints. Appropriately pricing transmission violations through the use of constraint-specific ~~demand curves pricing mechanisms~~ should lead to more efficient resource scheduling in the short term, and more rational investment and retirement decisions in the long term. Additionally, constraint-specific ~~demand curves pricing mechanisms~~ could reduce the occurrence of constraint relaxation, in which transmission constraints are not reflected in market prices.

The NYISO is currently exploring opportunities to improve its transmission shortage pricing, with the goal of a completed study by Q3 of 2018. The energy market design team's extended goal is to propose a market design concept in 2018. The NYISO recommends that this project be prioritized for continuation with a goal of implementation in ~~2022~~2023.^{46, 47} Although the development of Constraint Specific Transmission Shortage Pricing was initially thought to be critical to ensure the successful implementation of 100+ kV facilities in the market model, the NYISO no longer believes the two projects to be directly coupled. Findings from the ongoing Constraint Specific Transmission Shortage Pricing study are expected to support this recommendation.

46 See *Securing 100+ kV Transmission Facilities in the Market Model*, NYISO (MIWG, July 31st, 2017), p. 30, available at this link: https://www.nyiso.com/public/webdocs/markets_operations/committees/bic_miwg/meeting_materials/2017-07-31/Securing%20100+kV%20Transmission%20Facilities%20in%20the%20Market%20Model.pdf

47 See *Constraint Specific Transmission Shortage Pricing*, NYISO (MIWG, April 10th, 2018), available at this link: http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_miwg/meeting_materials/2018-04-10/Constraint%20Specific%20Transmission%20Shortage%20Pricing_MIWG_4-10-2018_Final_Approved.pdf

Enhanced Fast Start Pricing ~~(SOM)~~

2018	2019	2020	2021	2022	2023	Resource Flexibility	Grid Resilience	Price Formation
Market Design Concept Proposed	Functional Requirements	Deployment						X

On December 21, 2017, the FERC issued an order to the NYISO related to fast-start pricing in the NYISO-administered markets.^{48,49} Consistent with the Commission’s instructions, the NYISO filed an Initial Brief on February 12, 2018 outlining the NYISO’s proposed approach to amend its tariffs and revise its market software to:

- (1) “Modify pricing logic to allow fast-start resources’ commitment costs (i.e., start-up costs and minimum generation (no-load) costs) to be reflected in prices; and
- (2) Allow the relaxation of all dispatchable fast-start resources’ economic minimum operating limits by up to 100 percent for the purpose of setting prices.”⁵⁰

The NYISO’s MMU has previously recommended that the startup costs of gas turbines be included in LBMPs to ensure that the NYISO’s real-time energy prices “reflect the full costs of the resources needed to satisfy the system’s demands.”⁵¹ The NYISO expects to complete the fast-start pricing market design in 2019, with implementation to follow in 2020.

As a result of the modified approach, pricing logic that is applied today only to block loaded GT’s will initially be extended to a limited pool of existing internal resources. As an increasing number of units meeting the fast-start definition enter the NYISO-administered markets, the inclusion of start-up costs in market prices will become more impactful. For example, many ESRs and DERs may have the ability to start in 30 minutes or less. The proposed pricing logic will influence price formation in the NYISO-administered DA and RT markets, and should be considered in conjunction with other projects such as RTC-RTD convergence

48 See FERC Docket No. EL18-33-000, available at this link: <https://www.ferc.gov/whats-new/comm-meet/2017/122117/E-3.pdf>

49 The Order does not propose to change NYISO’s start-up time requirement or other price setting eligibility criteria for fast-start resources. The NYISO expects that it will continue to require fast-start resources to be able to start, synchronize to the grid and inject Energy in 30 minutes or less. The NYISO will also continue to require fast-start resources to have a minimum run time of one hour or less and to submit economic energy offers (i.e., not self-schedule offers) into the market for evaluation. NYISO intends to exclude Generator offers to self-schedule Energy from the resource offers used to establish prices. In New York, all resources must submit flexible, economic energy offers to have their offers considered during price setting in the NYISO-administered markets.

50 See NYISO Initial Brief, FERC Docket No. EL18-33-000, NYISO (February 12, 2018), available at this link: https://nyisoviewer.etariff.biz/ViewerDocLibrary//Filing/Filing1351/Attachments/20180212_NYISOInitialBrief_FastStart206.pdf

51 See Recommendation 2014-10 in 2016 *State of the Market Report for the New York ISO Markets*, Potomac Economics (May 2017), p 96, available at this link: http://www.nyiso.com/public/webdocs/markets_operations/documents/Studies_and_Reports/Reports/Market_Monitoring_Unit_Reports/2016/NYISO_2016_SOM_Report_5-10-2017.pdf

improvements and the development of ESR and DER participation models.

RTC-RTD Convergence Improvements (SOM)

—The NYISO conducted a study in 2017 to identify the primary drivers of divergence between RTC and RTD, which generated a number of concepts for market design changes that could improve convergence.⁵² Study findings, further analysis, stakeholder input and MMU recommendations are now being used to determine which of the proposed market design concepts should move forward. Better aligning RTC and RTD would create more efficient transaction scheduling with PJM and ISO-NE, decrease unnecessary real-time price volatility, and result in more transparent price signals. Changes to ramping assumptions made in the ideal and physical passes of RTC and RTD could also help to improve price formation in tandem with new fast-start pricing logic.

The market design improvements under consideration would not resolve the inherent timing latency between RTC and RTD that causes prices and schedules to diverge when unforeseen conditions arise in real time. Rather, the proposed concepts would effectuate incremental improvements in convergence between the two programs. Because this project will result in a lower impact outcome for NYISO-administered markets than other active projects, the NYISO recommends that its prioritization for market design completion be delayed until 2020.

Real-Time Performance Incentives

2018	2019	2020	2021	2022	2023	Resource Flexibility	Grid Resilience	Price Formation
Market Design Concept Proposed	Market Design Complete	Development Complete	Deployment			X		

It will be critical for energy suppliers to continue to follow NYISO dispatch instructions under future scenarios in which LBMPs may be negative or closer to zero more frequently as a result of increased market participation from subsidized intermittent renewables. The 2017 Market Assessment recommended that incentives for suppliers to follow dispatch be explored as a means to encourage resource flexibility. As part of this effort, the NYISO is reviewing existing cost-recovery payments, including balancing market supplier

⁵² See *RTC-RTD Convergence Study*, NYISO (MIWG, December 5th, 2017), at this link: http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_miwg/meeting_materials/2017-12-05/RTC-RTD%20Convergence%20Study.pdf

settlements, Bid-Production Cost Guarantee (BPCG) payments to generators within the NYCA, Day-Ahead Margin Assurance Payments (DAMAP), and over and under-generation penalties.⁵³ If existing mechanisms are ineffective under persistently low LBMP scenarios, the NYISO will propose appropriate adjustments to those payments. In addition, the NYISO will explore whether enhancements to existing payments or new incentive payments may incent additional resource flexibility.

The NYISO recommends that this project be prioritized for the development of a completed market design in 2019, with implementation to follow in 2021.

Conclusion

Many of the projects discussed in this document are under active development by NYISO staff, and nearly half are in the conceptual design phase. While all of the initiatives described herein may offer value to the wholesale markets, the NYISO does not have the resources to complete the detailed design and implementation of all of them simultaneously. Unplanned work may also result from future FERC orders and stakeholder input, causing the proposed timelines in the Master Plan to require revision. In light of these and other unknowns, this document lays out what the NYISO believes to be an efficient path toward market reform, in preparation for anticipated changes to the bulk power system as a result of state policies, FERC compliance directives, and evolving technology.

⁵³ See *Real Time Performance Incentives*, NYISO, (MIWG, April 10, 2018), available at this link: http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_miwg/meeting_materials/2018-04-10/RT%20Performance%20Incentives%20MIWG%204_10_SD.pdf