



2020 Master Plan

Reliability and Markets for the Grid of the Future

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

April 2020

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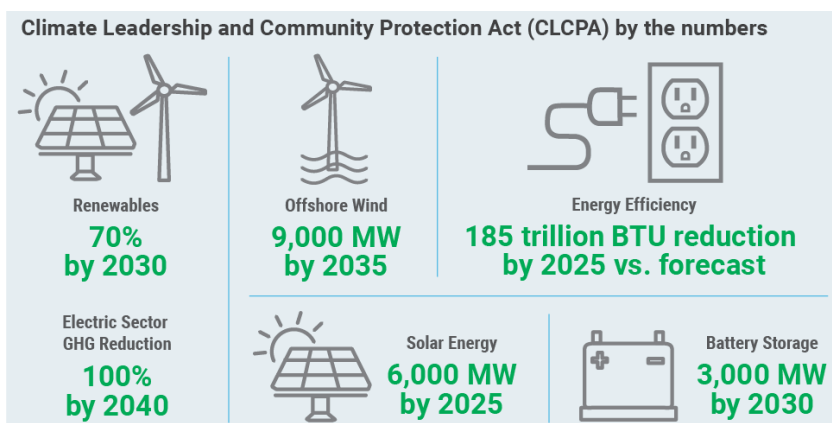
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Introduction

The NYISO serves the public interest and provides benefit to consumers by fulfilling an array of essential responsibilities, which include reliable operation of New York’s bulk power system, fair and open administration of competitive wholesale electricity markets, planning for the future of New York’s power system, and advancing the technological infrastructure of the electric system serving New York.

Wholesale energy markets have successfully facilitated efficiency gains on the grid and cleaner energy production in the state since their inception. Over time, those gains and improvements have worked 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’s Master Plan (Master Plan) for the wholesale markets examines the market structures, rules and processes, and enhancements over the next five years that will help ensure the reliability and economic efficiency of the grid, while supporting the public policy goals of the state of New York as outlined in the Climate Leadership and Community Protection Act (CLCPA). The Master Plan has three concurrent goals: establish a clear framework for achieving the NYISO’s vision of the future wholesale markets; align the objectives for the next five years with the most recent [Strategic Plan](#) (2020-2024); and support annual stakeholder-driven project prioritization efforts. Together, these goals will help to synthesize a clear and direct path forward as we engage in transforming the grid and markets.



2020 Update

In this year's Master Plan, the NYISO describes initiatives that require immediate attention and are recommended for action in the next five years. Many of these options were identified in the *Reliability and Market Considerations for a Grid in Transition* paper and will require continued stakeholder collaboration. As with each Master Plan, projects that the NYISO and its stakeholders believe will bring considerable value to the wholesale markets are planned for continuation into future years (as needed), whereas other efforts may no longer have a high priority due to changes in thinking as more information becomes available.

The Master Plan ties these initiatives into a cohesive five-year plan for our wholesale market platform. With the help and input of our stakeholders, this document discusses the NYISO's recommendations for evolving the wholesale markets and planning processes that the NYISO administers. Projects discussed in this Master Plan include those developed or suggested in one or more of the following publications or projects:

- [Carbon Pricing Proposal](#), (NYISO, December 2018)
- [Distributed Energy Resources Roadmap for New York's Wholesale Electricity Markets](#) (NYISO, December 2017)
- [Power Trends 2019](#) (NYISO, May 2019)
- [State of Storage](#) (NYISO, December 2017)
- [Reliability and Market Considerations for a Grid in Transition](#) (NYISO, December 2019)

The NYISO released the *Reliability and Market Considerations for a Grid in Transition* report (Grid in Transition report) at the end of 2019. The Grid in Transition report includes suggestions for operating and market design changes that will better prepare the NYISO to maintain and enhance grid reliability and resilience while continuing to enable New York State's energy and environmental policies. The Master Plan and the Grid in Transition report are intricately linked in that findings from the Grid in Transition report have informed projects featured in this 2020 Master Plan.

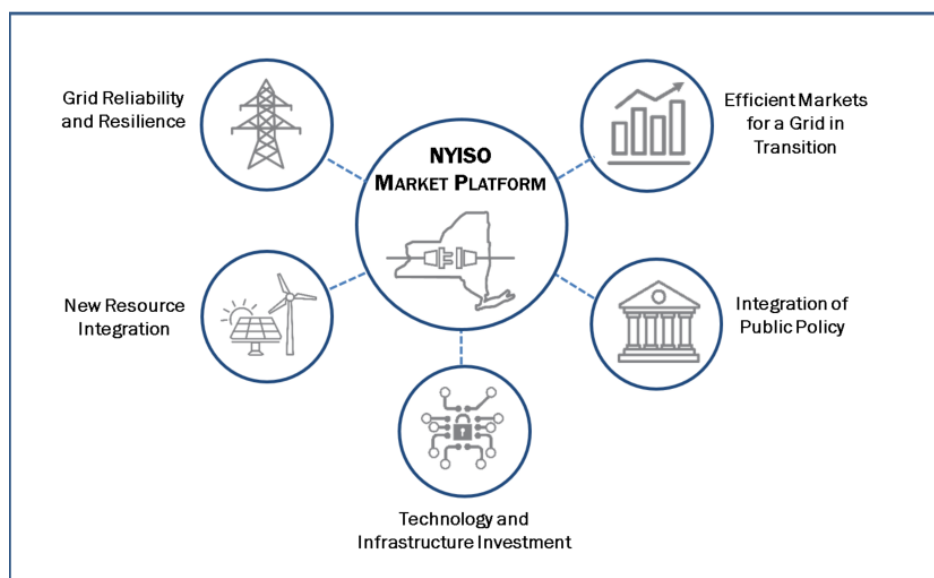
The NYISO is also performing the Reliability Needs Assessment ("RNA") in 2020 to assess the reliability of the New York Bulk Power Transmission Facilities ("BPTF") and will be performing the Comprehensive Reliability Plan ("CRP") in 2021; both of which can help determine whether additional market rule changes are necessary.

The Master Plan establishes a strategic set of market reforms and planning process improvements that place the New York's wholesale electricity markets in the best position to attract and retain the necessary

resources and infrastructure to reliably operate the grid.

Strategic Initiatives and Key Themes

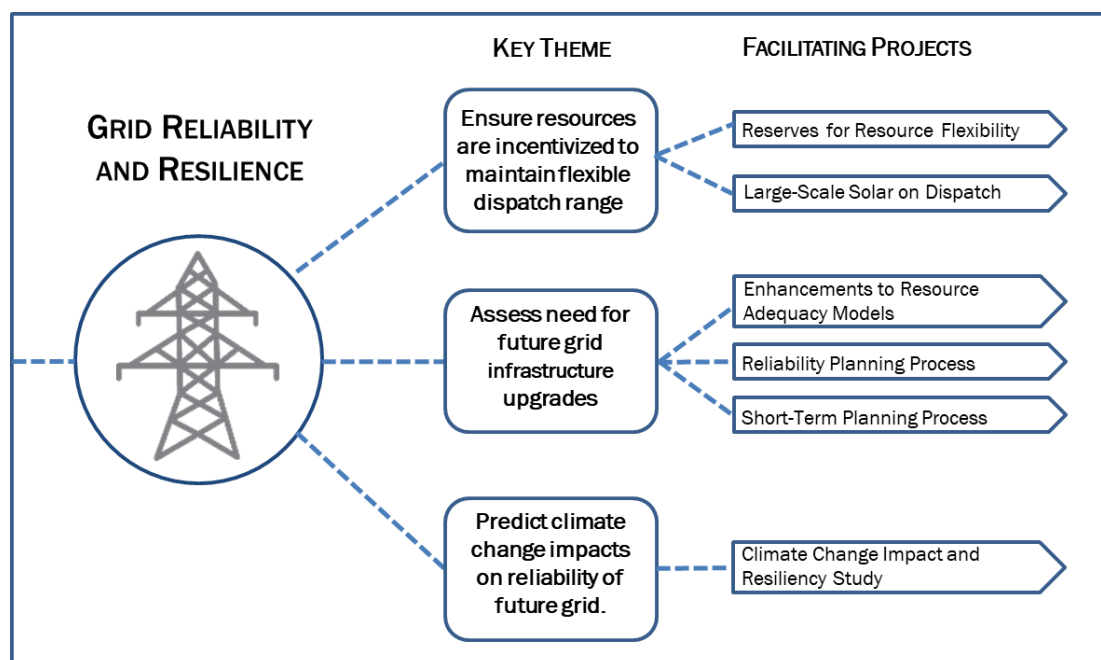
This Master Plan will continue to harmonize the NYISO’s annual Strategic Plan with initiatives that improve New York’s wholesale markets. The Strategic Plan is an important document that guides the NYISO’s overall direction and establishes priorities and initiatives for the next several years; it should be considered in parallel to this document, which dives deeper into market design goals. The projects included within this Master Plan are described in more detail in the project candidate descriptions that are posted as part of the project prioritization process. Each project included in this year’s Master Plan was considered for how it advances one or more of the following initiatives, included in the Strategic Plan as shown in the following graphic.



Grid Reliability and Resilience

Maintaining power system reliability is the NYISO’s primary responsibility. Wholesale markets play a critical role in meeting New York’s reliability needs. Wholesale energy and capacity market products form price signals that indicate both current and future reliability needs, incentivizing both real-time performance and long-term investment. The changing portfolio of resources serving the electric needs of New York requires an ongoing review of the NYISO’s existing market products and planning processes to ensure the continued ability to efficiently and reliably serve New York’s electricity requirements. Projects categorized

under this initiative serve to maintain reliability and efficient operation of the grid under normal, stressed, and extreme conditions.



Key Theme: Incentives for Flexible Dispatch

Real-Time Market constructs are needed to match the minute-by-minute needs of the grid with the changes in resource output and load consumption. Key to providing for grid reliability and resilience is ensuring that resources and load have an incentive to maintain flexibility to ramp upward and downward as more weather-dependent renewable generation comes online. Upward ramping capability, available for sudden drops in weather-dependent output, is of concern when considering increasing grid flexibility. Additionally, downward ramping capability, procured automatically through resource dispatch economics, is useful in alleviating over-generation cases when the output of renewable resources surpasses the transmission capability in an area.

The *Reserves for Resource Flexibility* project proposes to address the need for upward ramping capability in the Southeastern New York (SENY) reserve region. Procuring additional reserves for operational and net load forecast uncertainty was originally included in this project. However, this scope is now being included within the scope of the *Ancillary Services Shortage Pricing* project, allowing this concept to be fully considered within the context of the operating reserves shortage prices evaluation. Expanding the procurement of operating reserves in the SENY reserve region will help address uncertainties with managing the variability of supply and load on the system. Procuring additional upward ramping capability, beyond minimum applicable reliability requirements, will provide more operating reserves for unforeseen grid conditions,

helping the NYISO integrate large amounts of weather-dependent intermittent resources and continue to meet stringent reliability standards economically.

Weather-dependent generation can similarly provide flexibility to the grid, though only in the downward direction. This flexibility is consistent with the operational incentives of these resources, as resources will be dispatched downward when their bid to produce MW is above the clearing price of electricity. As higher levels of weather-dependent intermittent resources connect to the grid, it will be important to have appropriate market mechanisms to manage the variability with flexible resources that can follow a dispatch signal. Wind resources are on dispatch today in the NYISO markets, meaning that these resources have the ability to be dispatched down if economics or grid security require this action. Similarly, solar resources also have a demonstrated ability to reduce their output in response to a dispatch signal, and the NYISO will seek to implement this capability within its energy markets as part of *Large Scale Solar on Dispatch*. The NYISO has already taken a step in this direction, implementing tariff revisions in 2018 to require solar plants directly supplying the bulk power system to provide meteorological data and pay a forecasting fee to cover the NYISO's costs to procure a unit-specific forecast, similar to current rules for wind generators.¹

The NYISO recommends that wholesale market solar resources be treated similarly to wind resources. 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 retain eligibility for compensation when output exceeds dispatch requests and not be subject to penalties for under-generation.

Key Theme: Future Infrastructure Upgrades

The real-time dispatch requires flexibility to maintain grid reliability and resilience in the future; additionally, incorporating emerging technologies within the NYISO markets will require robust system modeling, as well as adequate transmission capability to move energy to high load areas. The *Enhancements to Resource Adequacy Models* project includes evaluating the robustness of the probabilistic reliability models used to support NYCA reliability and the NYISO markets, and making updates as needed to reflect emerging technologies and changing system dynamics. Appropriately valuing the reliability contribution of these new technologies will be essential to ensuring continued high levels of grid reliability in the future. Appropriately valuing these technologies will be increasingly important as the dependency of the grid on these technologies grows and other sectors begin to decarbonize, placing increased demand on the grid. The modeling of storage

¹ See FERC approval of 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

and other duration-limited resources will have to be included in this evaluation, as well as the modeling of intermittent renewable resources, demand response, and the dynamic and variable behavior of behind-the-meter solar and load modifiers. As these models evolve and adjust for the shifting needs to maintain grid reliability, it will also be important to reassess the reliability value that these resources provide and the associated revenues corresponding to that reliability value.

The *Reliability Planning Process* (“RPP”) is the NYISO’s biennial process to identify reliability needs and, if necessary, select solutions to resolve the needs. The first phase of the RPP is the Reliability Needs Assessment (“RNA”) that assesses future resource adequacy and transmission security needs for the New York State Bulk Power Transmission Facilities (“BPTF”) in accordance with applicable Reliability Criteria. If the BPTF does not meet the applicable Reliability Criteria, then Reliability Needs would be identified. The second phase is the Comprehensive Reliability Plan (“CRP”) where solutions to identified Reliability Needs are proposed and evaluated for their viability and sufficiency. If market-based solutions do not meet the Reliability Needs, the NYISO triggers a regulated solution to maintain reliability. If multiple solutions are available, the NYISO selects the more efficient or cost-effective transmission solution to the identified needs. The draft CRP is also provided to the NYISO’s Market Monitoring Unit for review and consideration of whether market rule changes are necessary to address an identified failure, if any, in one of the ISO’s competitive markets. The RNA will be performed in 2020 and the CRP in 2021.

In the 2020 RNA, the impact of the DEC peaker rule will be modeled in the base case. Additionally, a scenario regarding the State’s 70x30 renewable energy goals will be assessed. Modeling these scenarios will help the NYISO and its stakeholders better assess the potential impacts of current public policy on reliability, as well as anticipate potential future Reliability Needs.

Through the 2019 stakeholder process, a new *Short Term Reliability Process* (“STRP”) was developed and approved. The STRP was approved by the NYISO Board in January 2020 and filed with FERC in February. The STRP builds on the existing Generator Deactivation process by evaluating and addressing Reliability Needs on the BPTF resulting from Generator Deactivations as well as resulting from other changes on the electric grid, such as load and transmission changes. The STRP will address these impacts in a new quarterly Short-Term Assessment of Reliability (“STAR”).

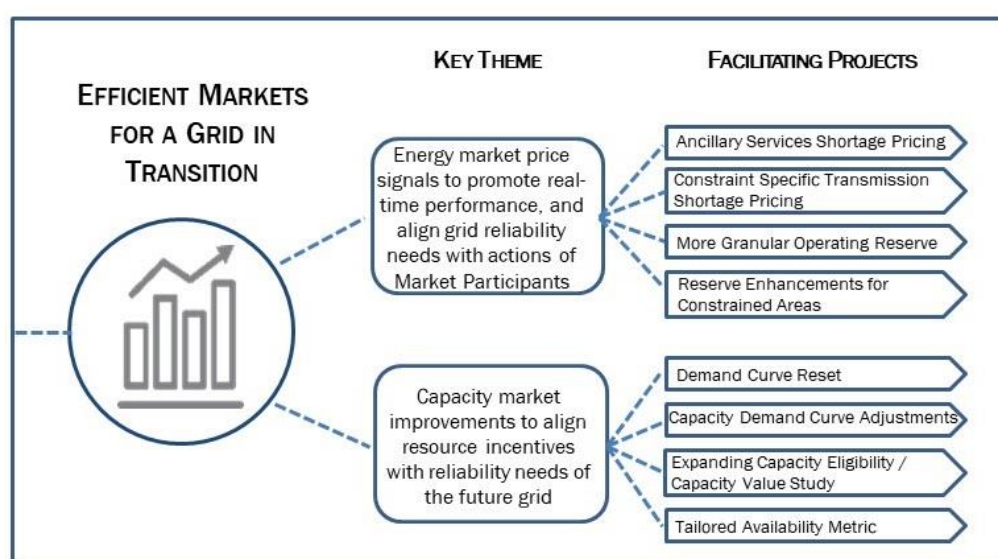
Key Theme: Climate Change Impacts

In addition to robust State emission reduction policies, the NYISO is contemplating the impacts of climate change itself on the reliability of the future grid. The *Climate Change Impact and Resilience Study* will help to inform the NYISO’s Planning, Forecasting, and Operations departments, as well as aid in the development of wholesale market designs to enhance grid resilience. Using load forecasts developed as part of Phase I of the

study in 2019, the Phase II portion of the study is taking place in 2020 and is expected to identify and examine impacts to the bulk power system under the conditions identified in Phase I as well as impacts to generation and transmission that could potentially impact system reliability. The focus of the study will be 2040 when, under the CLCPA, 100% of electricity is to be supplied by zero-emissions resources.

Efficient Markets for a Grid in Transition

The addition of weather-dependent intermittent resources, ESRs, and DERs expected as a result of the CLCPA and other policy initiatives will create a more dynamic grid. Certain projects will provide an expected improvement in market efficiency as we move towards this new, more dynamic paradigm.



Key Theme: Performance and Alignment

An efficient market for the grid in transition will require accurate, location-based, real-time price signals. Weather-dependent generation with zero to near-zero variable costs has the potential to significantly lower energy prices throughout the year. In a future where energy prices may often be low or negative, ancillary services price signals will be especially important to promote real-time performance and to align the reliability needs of the grid with the actions of Market Participants. The *Ancillary Services Shortage Pricing* project will consider whether current shortage pricing levels are adequate to promote real-time responsiveness and incent investment in and/or retention of needed performance capabilities. The purpose of this project is to evaluate the NYISO's Ancillary Services shortage pricing values, considering the operator actions taken to maintain operating reserve requirements, market incentives necessary to maintain flexibility, and payment incentives in neighboring markets, especially pay-for-performance capacity market

designs. Aligning the value of operator actions taken to maintain operating reserves with operating reserve demand curve prices will more appropriately compensate resource performance during critical operating periods.

Because the NYISO's market software makes tradeoffs between Energy and Ancillary Services products and transmission limitations based on pricing levels and other constraints, the relative value of Ancillary Service shortage prices from one product to another and from those products to transmission should be reassessed by the NYISO as the grid transitions toward more weather-dependent intermittent resources. *Constraint Specific Transmission Shortage Pricing* seeks to improve resource scheduling efficiency and investment signals by enhancing the way that constraints on the transmission system are priced in the NYISO's energy markets. As part of this effort, the NYISO will seek revised transmission shortage pricing values that adapt to the operating reserve demand curve values established as part of the *Ancillary Services Shortage Pricing* project.

Transmission facility and line ratings limit the amount of energy that can flow from one location to another on the bulk electric system. As transmission constraints arise, the NYISO's energy market software prices the quantity of energy that would be necessary to alleviate them. The existing transmission shortage pricing logic excludes certain conditions, and may over or under-value constraints in other instances, which has the potential to cause market inefficiencies and adversely impacts long-term investment signals.

The transmission shortage pricing logic enables the NYISO's market software to efficiently re-dispatch to alleviate constraints, and incentivizes long-term investment in locations where resources could provide the greatest benefits. The NYISO proposes to utilize more refined demand curves that better account for the various non-zero Constraint Reliability Margin ("CRM") values assigned to facilities, as well as eliminate most occurrences of constraint relaxation, by instead seeking to utilize a demand curve mechanism to value all shortages for internal facilities. Appropriately pricing transmission violations should lead to more efficient resource scheduling in the short term, and more informed investment and retirement decisions in the long term.

Ancillary Services Shortage Pricing and *Constraint Specific Transmission Shortage Pricing* will work together to produce appropriate price signals; however, the NYISO has made progress on a few projects that seek an even more granular price signal for Ancillary Services. The NYC load zone (Zone J) was modeled as an independent reserve region in the NYISO's market software starting in 2019, reflecting in the market software New York State Reliability Council (NYSRC) reliability rules that require certain quantities of

reserves be held within New York City.² The locational reserve region for Zone J, together with the associated 10-minute and 30-minute reserve requirements, incentivize resource flexibility, support grid reliability, and provide location-specific market signals. As part of the *More Granular Operating Reserves* project, following the implementation of the Zone J reserve region, the NYISO has explored with stakeholders a proposal for implementing more granular reserve requirements within certain New York City load pockets that would better represent the value of short-notice responsive resources in desirable locations. As part of *More Granular Operating Reserves*, the NYISO and its stakeholders also reviewed existing practices and resource performance with respect to operating reserves. The most efficient implementation of load pocket reserve requirements may be via a dynamic reserve procurement methodology that does not exist today.

Reserve Enhancements for Constrained Areas seeks to dynamically procure operating reserves based on system needs and transmission capabilities, which will enable operating reserves to be scheduled more efficiently in constrained areas. Today, the NYISO procures fixed quantities of operating reserves in specified regions across the state. Under this structure, the static modeling of reserve regions and their associated requirements does not reflect the flexibility of the grid to respond to system needs by utilizing the transmission system to import capacity into generation-constrained regions. As reserve regions become smaller, this static modeling can lead to market inefficiencies and unnecessary price volatility.

This project would be responsive to a recommendation from the Market Monitoring Unit (MMU) to “[d]ynamically adjust operating reserve requirements to account for factors that increase or decrease the amount of reserves that must be held on internal resources [Recommendation 2015-16].” This project would also consider two separate recommendations made by the Market Monitoring Unit in past State of the Market Reports. In 2016, the MMU recommended that the NYISO “[c]onsider rules for efficient pricing and settlement when operating reserve providers provide congestion relief [Recommendation 2016-1].” Finally, in 2017, the MMU recommended that the NYISO “[m]odel local reserve requirements in New York City load pockets [Recommendation 2017-1].”

Key Theme: Capacity Markets and Alignment

Improving market signals in real-time as outlined above is an important step for the NYISO to take to prepare for the grid of the future. Additionally, there are several capacity market improvements that will align resource incentives with the reliability needs of the grid as we look toward the future. The NYISO envisions that these improvements to the capacity market will take place before the next *Demand Curve Reset* (“DCR”) for the Summer 2025 Capability Period. Every four years, the NYISO, along with its stakeholder

² 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>

community, conducts this comprehensive review to determine the parameters used in establishing the Installed Capacity (ICAP) Demand Curves. As required by the tariff, the study includes an examination of potential peaking unit technologies and the financial parameters assumed in the construction and operation of that unit, along with an estimate of the projected profit earned in the Energy and Ancillary Service markets, to determine the unit type with the “lowest fixed costs and highest variable costs among all other units’ technology that are economically viable” that serves in establishing values for each of the ICAP Demand Curves. The NYISO anticipates that, in the future, new technologies, such as storage, may be competitive with the gas turbine technologies that have traditionally defined the net Cost of New Entry (“CONE”) unit. If necessary, such a shift may require tariff revisions.

Capacity Demand Curve Adjustments is one concept that should be explored prior to the DCR for the Summer 2025 Capability Period. This effort includes exploring alternative slopes and shapes of the ICAP Demand Curves that may help stabilize capacity market pricing outcomes and improve the predictability of future market revenues as large quantities of new resources are deployed across New York State in the coming years. The NYISO is aware of potential price volatility that may occur in part due to the current slope and shape of its ICAP Demand Curves. The current structure of the ICAP Demand Curves is a fixed linear slope from the Zero Crossing Point (ZCP), through the Reference Point up to the established price cap. With this project, the NYISO intends to evaluate whether the current structure is still effective in producing efficient price outcomes as new resource types enter the market at a fast rate in the upcoming years. The NYISO will hire a consultant for the *Capacity Demand Curve Adjustments* project to conduct a study in 2021 to assess the impacts on capacity prices of various slopes and shapes of demand curves.

The NYISO has been engaged in a multi-year effort to allow shorter duration resources to be eligible to participate in the NYISO markets. FERC accepted the NYISO Services Tariff revisions to support the market design for the DER project, including a requirement to periodically review the Capacity Values. As the NYISO anticipated that shorter duration resources will increasingly enter the markets in the upcoming years, the NYISO conducted a review of the Capacity Values and subsequently proposed rules to allow shorter duration resources to participate in the markets and to value these resources based on the reliability benefit that the resources provide to the system. Every four years, the NYISO will select a consultant to reassess the reliability benefit of short duration resources in the NYISO markets and provide the right investment signals to developers.

The goal of the *Expanding Capacity Eligibility/ Capacity Value Study* is to assess the changes to the reliability benefit of resources through time to continue to support reliable grid operations. The NYISO will re-evaluate the Capacity Values every four years to accurately reflect the reliability benefit of short duration

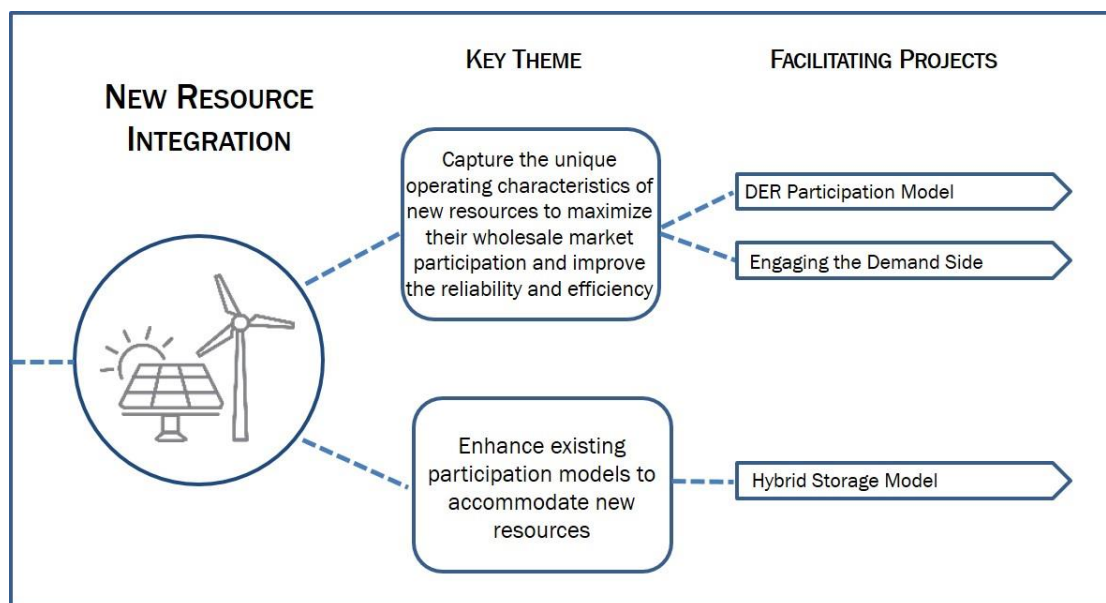
resources in the As-Found System and send appropriate investment signals to developers. The most recent evaluation took place in 2019. The implementation of the capacity values requires software changes to the NYISO systems to allow shorter duration resources into the markets.

Resource incentives in the NYISO markets typically originate from energy market payments dependent upon real-time performance, or capacity market payments dependent upon resource qualification. The *Tailored Availability Metric* project ties these two concepts together by incenting resource performance and availability during peak load periods through capacity payments. This project will help the NYISO to maintain the availability and incentivize performance of capacity suppliers during peak operating conditions. The *Tailored Availability Metric* project addresses this by incentivizing resources to be available and perform during these critical operating periods. The objective for this project is to implement a market design that assigns higher value to resources that are available and can perform during peak operating periods.

For the current derating factors, all periods of operation are weighted equally, following the belief that outages occur randomly. A tailored metric could weight critical operating periods higher than others, under the assumption that these stressed conditions occur during peak periods. Weighting these peak periods reflects the concept that availability and performance during these times has higher significance to the reliability of the system. Through reevaluating the current structure of how availability and performance of capacity suppliers is measured, tailored metrics will better indicate how much capacity these resources will be allowed to sell in the market to more accurately reflect the reliability contribution of these resources.

New Resource Integration

Technological advancements and public policies, particularly Reforming the Energy Vision (REV), Climate Leadership and Community Protection Act (“CLCPA”), and the State’s storage and offshore wind initiatives, are encouraging greater adoption of DER, energy storage resources (ESRs), flexible load and other new resource types to meet consumer energy needs. DER, ESRs, and hybrid storage resources (generation co-located with energy storage resources behind a single point of interconnect) offer the potential to make load and supply resources more adaptable and responsive to wholesale market price signals and system needs, potentially improving overall system efficiencies. Developing participation models that capture the unique operating characteristics of these new resources will allow them to maximize wholesale market participation and improve the reliability and efficiency of New York’s electric grid.



Key Theme: Wholesale Market Participation

Throughout 2018 & 2019, the NYISO developed concepts, proposals and Tariff edits for the DER Market Design Concept Proposal to enhance its market rules for DER to participate in NYISO's Energy, Ancillary Services, and Installed Capacity markets. The NYISO also modified its existing Demand Response programs to align with this effort. This work helps to position the NYISO for future electric grid advancements that will affect wholesale electricity markets. Technological advancements and public policy support are encouraging greater adoption of DER to meet consumer energy needs as well as system needs. DER offer the potential to make load more dynamic and responsive to wholesale market price signals, potentially improving overall system efficiencies.

The *DER Participation Model* has many facets that harmonize New York's REV goals and compliance with FERC Order Nos. 719, 745 and 841, while simplifying the operational matrix of rule sets for product offerings of both demand response and distributed resources, for all stakeholders involved. These changes more closely align the bidding and performance measurements for those resources mentioned with the rule sets for generators. By doing this, the NYISO has created a rule set that is more universally applicable to all resources.

The *DER Participation Model* provides a means by which DER resources, through the use of aggregations, may participate in the NYISO markets. As a next step, the NYISO will develop market concepts to encourage the participation of flexible load. Further *Engaging the Demand Side* through load participation (inclusive of DER) will become increasingly important as deployments of intermittent wind and solar resources rise to support New York's decarbonization goals. Today, supply resources are dispatched by NYISO to meet load

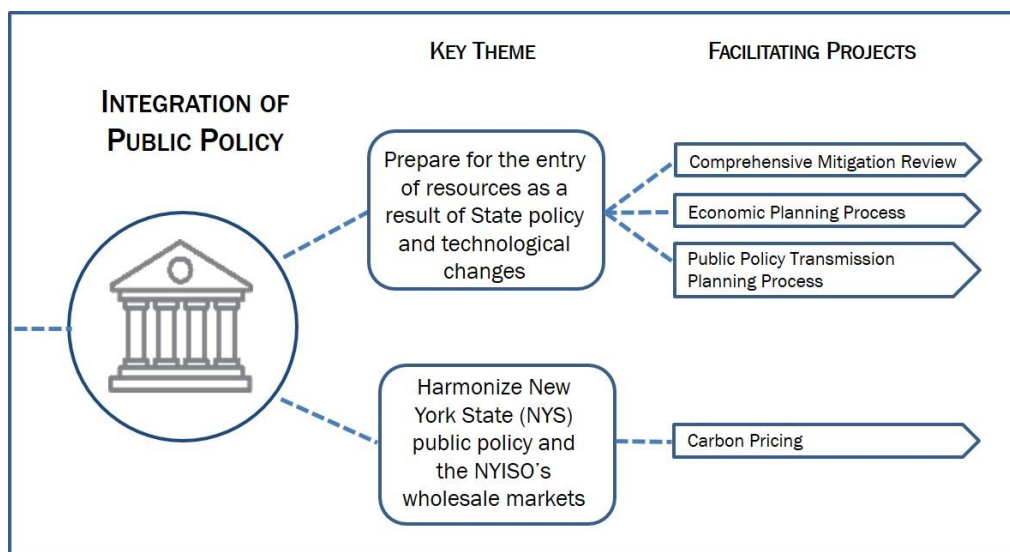
that has limited flexibility. From an operations perspective load is seen as “uncontrollable” whereas generation resources are considered controllable. Controllable and flexible load can help to balance inflexible/intermittent supply and provide ancillary services.

Key Theme: Participation Model Enhancement

Through the *DER Participation Model* and *Engaging the Demand Side* the NYISO seeks to add new means by which resources can participate in the NYISO markets, as well as enhance existing participation models. Along a similar theme, the *Hybrid Storage Model* project seeks to develop market participation rules for front-of-the-meter generators co-located with ESRs. The NYISO’s market rules do not offer a participation model for co-located generation resources and ESRs today; instead, where two or more resource types are co-located behind the same point of interconnection, each resource type must be separately metered and have its own point identifier (PTID). This project will build on work completed as part of the Energy Storage Resource and Distributed Energy Resource Integration initiatives to develop market rules that offer alternate accommodations for resources and ESRs that share a common interconnection point and/or meter. Developing a method for hybrid resource participation in the wholesale markets will support policy efforts to integrate more clean energy into the grid.

Integration of Public Policy

The Climate Leadership and Community Protection Act (“CLCPA”) sets the stage for aggressive state action to reduce greenhouse gas emissions and promote expansion of renewable, distributed energy, and storage resources. It is imperative the NYISO accelerates development of steps to harmonize wholesale electric power market design with state public policy goals. A number of projects that support Grid Reliability and Resilience as well as Efficient Markets for a Grid in Transition outlined above will also support the Integration of Public Policy in the NYISO markets. For example, *Reserves for Resource Flexibility*, *Large-Scale Solar on Dispatch*, *Ancillary Services Shortage Pricing*, *Constraint Specific Transmission Shortage Pricing*, *Reserve Enhancements for Constrained Areas*, and others are all projects that will help the grid to prepare for an increase in weather-dependent resources by enhancing the NYISO’s ability to achieve reliability through markets.



Key Theme: New Resource Entry

A *Comprehensive Mitigation Review* will allow the NYISO to further prepare for the entry of resources as a result of State policy and technological changes. As part of this project, the NYISO will conduct an evaluation to consider whether the current framework of Buyer-side Market Power Mitigation (“BSM”) rules will be adequate in a future with significant penetration of weather-dependent intermittent, energy storage, and distributed energy resources that are expected to result from policy objectives such as those found in the CLCPA and CES mandates. Evaluating the mitigation framework is an essential part to maintaining efficient resource entry and exit as the generation mix rapidly changes in the coming years.

The installed capacity market has undergone significant changes in both design and resource mix since the BSM measures were first implemented in May 2008. The BSM rules were originally developed to evaluate traditional generators, but new resource types, such as battery storage, weather-dependent intermittent resources and DER, are fundamentally different in design and operation. Additionally, these resources are more likely than traditional generator technologies to be partially funded by governmental entities to meet policy goals or promote environmental attributes. New rule sets and tests may provide a better evaluation of these resources for instances of buyer-side market power and thus result in more accurate BSM determinations.

Part of preparing for new resource entry is adding to the NYISO’s existing procedures and processes, as discussed for the 70 x 30 scenario studied as part of the Planning Department’s RNA, as described above. The NYISO also develops the Congestion Assessment and Resource Integration Studies (CARIS) during the course of its standard *Economic Planning Process*. The purpose of the CARIS studies is to identify whether transmission build-out or the introduction of other resources is economic based on forecasted congestion

costs within the NYISO market. Similar to the RNA, CARIS will include consideration of a 70 x 30 scenario to provide stakeholders with additional information regarding the possible effects of integrating additional weather-dependent generation into the grid. Considering transmission specifically, the NYISO's *Public Policy Transmission Planning Process* is the means by which the NYISO addresses transmission needs that are driven by Public Policy Requirements. Recently, this process has evaluated and selected transmission upgrades in Western NY, as well as transmission upgrades to alleviate Central East and UPNY-SENY congestion. New transmission built out is important, as it better enables the participation of new resources within the NYISO markets.

Key Theme: Public Policy and Market Harmonization

The NYISO continues to believe that its *Carbon Pricing* proposal, or another economy-wide carbon pricing mechanism, has the potential to provide significant value as a means to integrate public policy into the NYISO markets. The NYISO's *Carbon Pricing* proposal seeks to harmonize New York State (NYS) public policy and the NYISO's wholesale markets by incorporating the social cost of carbon dioxide ("carbon") emissions when scheduling resources through the energy markets. NYS public policy promotes carbon-free resources through the CLCPA³ and CES.⁴ However, the wholesale electricity markets operated by the NYISO do not fully align with these policy objectives. As a result, the wholesale markets are restricted in their ability to signal cost-effective carbon abatement options and send effective price signals to retain needed units to sustain the reliable operation of the grid.

Carbon pricing will charge generators for their carbon emissions, while allowing these generators to include the carbon charge within their offers. Under the proposal, the NYISO would continue to commit and dispatch resources to meet load; however, the resulting dispatch would incorporate the price of carbon emissions and allow units to compete on both fuel and emissions costs. Imports would be charged the carbon impact to the LBMP, while exports would be credited the carbon impact to the LBMP; this rule is intended to allow transactions compete with internal resources on a status quo basis. The carbon charge collected from generators would be returned to Load Serving Entities (LSEs).

Currently, the social cost of carbon is not reflected within the NYISO markets, thus resources compete mainly on fuel costs. Implementation of the NYISO's carbon pricing proposal will allow resources to compete on emissions costs, in addition to fuel costs. The NYISO will look to move forward with a stakeholder vote on

³ New York State Senate Bill S. 6599 and Assembly Bill A. 8429, 2019–20 Session.

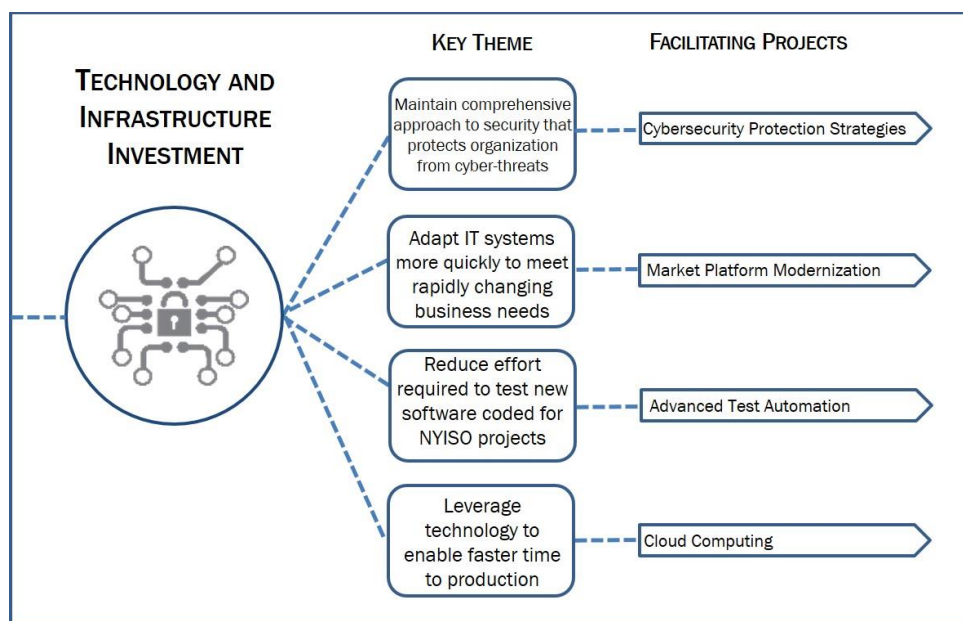
⁴ New York Public Service Commission, *Order Adopting a Clean Energy Standard*, Issued and Effective August 1, 2016. Available at <http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7B44C5D5B8-14C3-4F32-8399-F5487D6D8FE8%7D> .

Carbon Pricing only with agreement on the proposal from New York State.

Technology and Infrastructure Investment

The NYISO's Information Technology ("IT") strategy is focused on providing the company the flexibility and agility to comprehensively respond to emerging industry trends like the integration of renewable and distributed resources, and at the same time, continue to maintain reliable operation of grid and market systems while being responsive to increased security risks.

The initiatives included under the umbrella of Technology and Infrastructure Investment are at a higher level than the other process improvements and projects described in this Master Plan. These IT initiatives are not individual projects; instead, each of these initiatives, *Market Platform Modernization*, *Advanced Test Automation*, and *Cloud Computing*, provide an over-arching direction that will guide IT in support of future projects.



Key Theme: Cybersecurity Protection Strategies

The NYISO views cyber and physical security as a crucial component of its strategic plan, and invests significant time and resources to maintain a comprehensive approach to security that protects the organization and allows it to fulfill its mission to reliably operate the electric grid and wholesale electricity markets in New York State. A key element of the NYISO's *Cybersecurity Protection Strategies* is a high degree of situational awareness that reduces the time between when a potential threat is introduced, and when that threat is identified and effectively mitigated. The NYISO operates a state-of-the-art Cyber Security Operations Center (CSOC) around-the-clock to monitor the organization's cyber posture, and

provide the capability to continuously evaluate and respond to rapidly evolving cyber risks. To ensure the CSOC continues to have access to actionable, real-time information, an area of focus for the NYISO Security program will be to continue building advanced technologies that collect and orchestrate threat & vulnerability indicators, security events, and alerts from government and commercial sources around the world. This data will feed systems that leverage automation to aggregate events and orchestrate a response through integration of threat indicator information, evidence collection, and application of decision logic to drive analyst effectiveness. In addition to situational awareness enhancements, the cyber security plan will ensure security architecture and capabilities continue to evolve as next-generation cyber security advancements take shape.

Key Theme: Market Platform Modernization

Recent projects such as the *DER Participation Model* and Energy Storage Resources (“ESR”) Participation Model highlight the increasing demands to adapt IT systems more quickly to meet rapidly changing business needs. These types of projects often bring in new modeling approaches for the market software, as well as additional data processing requirements. IT’s *Market Platform Modernization* initiative focuses on utilizing modern software delivery approaches and systems architecture that significantly improve IT’s responsiveness to emerging business needs with the high-quality that the business demands. The goal is to optimize the market platform to be adapted quickly and safely to enable the NYISO to be responsive to the emerging business needs of a grid in transition. The measures of success are increased agility coupled with improved quality, security, and efficiency.

Key Theme: Advanced Test Automation

The intent of the Advanced Test Automation initiative is to reduce the time and effort required to validate software changes. This initiative seeks to leverage automation to reduce manually intensive data setup and test execution tasks. Benefits include faster feedback loops, shorter test cycles, increased test coverage, and more efficient use of staff time. This initiative enables greater agility and efficiency while reinforcing high quality standards.

Key Theme: Cloud Computing

NYISO IT’s *Cloud Computing* strategy focuses on building capabilities that will allow the NYISO to effectively manage the cost, risk, and efficiency of cloud based services. The IT Cloud strategy positions NYISO to selectively gain access to platforms that enable faster time to production to better support market demands and enhance ability to react to scalability needs without having to manage and forecast capacity. *Cloud Computing* has the potential to enable greater market participation model efficiency and agility.

Proposed Project Timelines

This document also serves to support the annual stakeholder-driven project prioritization effort. The project prioritization process engages stakeholders to collaboratively determine which projects the NYISO will devote its resources to in the next year. This document aims to develop a larger, multi-year plan by providing a snapshot of what the NYISO sees as the most important projects over the next several years. The Master Plan does not replace, circumvent, or reduce the project prioritization pursued annually in the NYISO's Budget and Priorities Working Group (BPWG), but supplements it by providing a multi-year vision of initiatives based on the most recent strategic plan, stakeholder feedback from the most recent sector meetings, industry trends, and public policies .

This document suggests timelines for product development and identifies target dates for key milestones. These standard definitions for typical NYISO project milestones directly correspond to those used in the project prioritization process, and are provided in Appendix I.⁵ This document should not be viewed as a commitment to complete any of the projects discussed herein. This is due to the extensive analysis that is conducted as part of each initiative to determine whether the effort would provide value to the grid, the markets, and consumers. As a result of such analysis, the NYISO may recommend that certain proposed designs not move forward to implementation.

The Master Plan attempts to strike a balance between aggressive pursuit of market evolutions to meet the future needs of the grid, and 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, evaluate its effectiveness, and analyze any other implications. After careful examination of each project's intended benefits and potential impact to the market, some projects that were included previously are excluded from this year's plan as a result of shifting priorities.

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

Overall Project Timeline by Strategic Initiative

The overall view of the timeline for the projects, organized by strategic initiative is shown below:

Milestone Key:

ON	Additional Work Anticipated, Not Yet Defined
ID	Issue Discovery
SD	Study Defined
SC	Study Complete
CP	Market Design Concept Proposed
MDC	Market Design Complete
FR	Functional Requirements
SD	Software Design
DC	Development Complete
DEP	Deployment

	2020 Master Plan							
Grid Reliability and Resilience			2020	2021	2022	2023	2024	2025
	Incentives for Flexible Dispatch							
1	Reserves for Resource Flexibility		MDC	DC	DEP			
2	Large-Scale Solar On Dispatch			DEP				
	Future Infrastructure Upgrades							
3	Enhancements to Resource Adequacy Models			Ongoing				
4	Reliability Planning Process		Ongoing					
5	Short-Term Planning Process		DEP	Ongoing				
	Climate Change Impacts							
6	Climate Change Impact and Resiliency Study		SC	CP				
Efficient Markets for a Grid in Transition			2020	2021	2022	2023	2024	2025
	Performance and Alignment							
7	Ancillary Services Shortage Pricing		MDC	DC	DEP			
8	Constraint Specific Transmission Shortage Pricing		MDC	DC	DEP			
9	More Granular Operating Reserve		MDC	DEP				
10	Reserve Enhancements for Constrained Areas			SC	FR	DC	DEP	
	Capacity Markets and Alignment							
11	Demand Curve Reset		SC	DEP		SD	SC	DEP
12	Capacity Demand Curve Adjustments			SC	MDC	DC		
13	Expanding Capacity Eligibility/Capacity Value Study		DC	DEP	SD	SC		DEP
14	Tailored Availability Metric		MDC	DEP	SD	SC		DEP
New Resource Integration			2020	2021	2022	2023	2024	2025
	Wholesale Market Participation							
15	DER Participation Model		SD	DEP				
16	Engaging the Demand-Side			ID	SD	SC	CP	CP
	Participation Model Enhancement							
17	Hybrid Storage Model		MDC	DC	DEP			
Integration of Public Policy			2020	2021	2022	2023	2024	2025
	New Resource Entry							
18	Comprehensive Mitigation Review		MDC/DEP	MDC/DEP				
19	Economic Planning Process		Ongoing					
20	Public Policy Transmission Planning Process		Ongoing					
	Public Policy and Market Harmonization							
21	Carbon Pricing		FR					
Technology and Infrastructure Investment			2020	2021	2022	2023	2024	2025
22	Cybersecurity Protection Strategies		Ongoing					
23	Market Platform Modernization		Ongoing					
24	Advanced Test Modernization		Ongoing					
25	Cloud Computing		Ongoing					

Potential Grid Benefits, NYISO Effort, and Project Dependencies

The NYISO and its stakeholders work collaboratively during the project prioritization process to identify where the NYISO should focus its efforts in the coming year. The sections that follow outline the NYISO's view on the potential benefits that each project can provide to the grid, as well as a discussion of the level of effort that each project could potentially require. Dependencies between projects are also highlighted in this section. Some items discussed above are not projects for prioritization. The Reliability Planning Process, Economic Planning Process,, and Public Policy Transmission Planning Process(for example) are existing Planning processes, not a project for prioritization, and are thus not included in this section. Also, the Short Term Planning Process improvements described above are targeted for 2020 completion, and are not included in the discussion below. Additionally, efforts discussed above under the umbrella of Technology & Infrastructure Investment include IT strategic initiatives that do not include individual projects for prioritization, and so no projects under this umbrella are included below.

Grid Reliability & Resilience

Reserves for Resource Flexibility

Grid Benefits & NYISO Effort

This project is expected to provide a significant benefit to the grid, because additional upward ramping capability in Southeastern New York ("SENY") will enhance the NYISO's ability to more effectively manage the transmission system and real-time uncertainty. Procuring additional reserves in SENY will allow the NYISO to return the transmission system to normal transfer criteria after a contingency occurs, potentially avoiding out of market actions that may otherwise be needed.

The software changes anticipated are relatively small for this project; however, the level of effort required may change based on the market design ultimately approved by stakeholders.

Dependencies

NYISO staff recommends that this initiative be developed and deployed before or in parallel with the *Ancillary Services Shortage Pricing* effort because of the potential for both projects to alter the NYISO's Operating Reserve Demand Curves.

Large-Scale Solar on Dispatch

Grid Benefits & NYISO Effort

This project is expected to offer high benefits because placing bulk system solar resources on dispatch would positively influence price formation, grid reliability, and resource flexibility. The ability to dispatch solar resources would reduce less efficient out of market actions by (1) enabling solar plants to indicate their economic willingness to generate, (2) identifying the most efficient resources to reduce output that aggravates system constraints, (3) minimizing the duration of necessary energy curtailments, and (4) incorporating NYISO dispatch instructions into market clearing prices. The ability to send an economic market basepoint to a solar resource to reduce its output in response to system needs would also increase reliability, decrease total production cost, and increase system ramp capability by enabling solar suppliers to provide down ramp.

Because this project would require limited software changes, its completion is expected to require low effort. At such time that this project is prioritized, it could be implemented in about one year.

Dependencies

This project does not share any dependencies with other projects. The NYISO recommends that the market rule changes needed to place solar on dispatch be implemented in a few years, subject to the necessary stakeholder, NYISO Board, and regulatory approvals. 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.

Enhancements to Resource Adequacy Models

Grid Benefits & NYISO Effort

The NYISO's resource adequacy models are used to set the Installed Reserve Margin and Locational Capacity Requirements. Improvements to these models could better align compensation with performance to better reflect the emerging technologies and adapt to changing system dynamics. Modeling enhancements include storage and other duration-limited resources, intermittent renewable resources, and demand response. Through reevaluating the accuracy of the current models, reliability metrics and probabilistic tools, the NYISO expects enhancements to reflect high benefits to grid reliability. This is projected to be a medium effort project.

Dependencies

The NYISO expects this work will be an ongoing effort as changes to the installed capacity market design are continuously made.

Climate Change Impact and Resilience Study

Grid Benefits & NYISO Effort

This study will focus on 2040 under the CLCPA, where electricity is to be zero emission. The project will provide a longer range benefit, providing a look into grid conditions in the future. This study will inform the NYISO's Planning, Forecasting, and Operations departments, as well as aid in the development of wholesale market designs to enhance grid resilience. This project will require a medium level of NYISO effort.

Dependencies

This project is dependent on the initial phases of this effort.

Efficient Markets for a Grid in Transition

Ancillary Services Shortage Pricing

Grid Benefits & NYISO Effort

This project will help prepare for a future where a significant number of generation assets are weather-dependent intermittent resources. Appropriate Ancillary Services shortage pricing values can help incentivize resource flexibility, support grid reliability during critical operating periods and appropriately reflect the incremental value of Ancillary Services. This project would also consider procuring additional reserves for grid uncertainty. Procuring additional reserves as part of this project would allow the NYISO to signal an approaching shortage of Operating Reserves procured as the system becomes more constrained.

Well designed shortage pricing supports reliable grid operations through strong price formation. Overall, this effort provides high benefits by adding price transparency to emerging grid conditions while improving hedging opportunities for market participants, including load, which is not possible when costs for maintaining reliability are borne through uplift payments. The Market Monitoring Unit has identified appropriate Ancillary Services shortage pricing values as beneficial to efficient market outcomes.

This project requires relatively low implementation effort. This topic requires substantial stakeholder discussion during the market design phases. Once the market design is complete, the NYISO anticipates that software changes and deployment could be completed within two years.

Dependencies

As part of this project, the NYISO will consider the interaction of Operating Reserve, Regulation Service and Transmission Shortage Cost pricing levels, to appropriately reflect tradeoffs between market products under various grid conditions.

NYISO staff also recommends that this initiative be developed and deployed after or in parallel with the *Reserves for Resource Flexibility* effort because of the potential for both projects to alter the NYISO's Operating Reserve Demand Curves.

Constraint Specific Transmission Shortage Pricing

Grid Benefits & NYISO Effort

The project is expected to provide medium to high benefits to the grid, because it will promote incremental improvements in price formation and investment signals compared to the current transmission constraint pricing logic. Using more refined demand curves to establish pricing levels will enable the NYISO's market software to reflect the severity of transmission constraints with better precision. This project is expected to require medium effort to implement, due to its impact on several NYISO systems and processes, including the NYISO's market software and price validation procedures.

Dependencies

The NYISO's energy market software uses factors such as resource costs and facility ratings to evaluate tradeoffs between transmission constraints and procurement of other required products and services, such as reserves. If transmission constraint prices intersect with reserve prices incorrectly, they might drive non-intuitive or inefficient market outcomes. Because operating reserve prices must be considered in parallel with transmission constraint prices, this project is dependent on the completion of *Ancillary Services Shortage Pricing*, *More Granular Operating Reserves* and *Reserve for Resource Flexibility*, which are all expected to impact reserve pricing.

More Granular Operating Reserve

Grid Benefits & NYISO Effort

This project will establish effective price signals for more granular reserve procurements in NYC (including load pockets within NYC). It is a high benefit project because it will improve the location-specific price signals for maintaining short-notice responsive resources in constrained regions.

It is expected that the project deliverables will require medium effort over the course of the next several years to complete due to their impacts on several different NYISO software applications.

Dependencies

The market design for the load pocket reserve requirements component of this project will likely result in changes to reserve pricing, and therefore may benefit from being developed in parallel with *Ancillary Services Shortage Pricing* and *Reserves for Resource Flexibility*, which are also expected to change reserve

pricing. Further, it may not be possible to implement load pocket reserve requirements without the development of a dynamic reserve procurement methodology, which will be explored as part of the *Reserve Enhancements for Constrained Areas* project.

Reserve Enhancements for Constrained Areas

Grid Benefits & NYISO Effort

A dynamic reserve procurement methodology could improve market efficiency by scheduling reserves in a less expensive region using available transmission capability to import power into a more constrained region post-contingency, rather than hold reserves in the more expensive reserve area. By scheduling reserves dynamically, reserves could be shifted to resources in lower cost regions as transmission capacity is made available or shifted to resources that are not export constrained. Dynamic reserves present opportunities to enhance grid resilience, incentivize resource flexibility, lower total production costs, and increase efficiency in meeting applicable reserve requirements.

Because this project would provide a cost-effective approach to securing reserves across the NYCA, it is considered a high benefit project. In the absence of such a market mechanism, economic incentives for investment in resources capable of providing the required services within load pockets may be understated. As the grid evolves, this could eventually lead to insufficient availability of reserve capability in highly constrained areas of New York City.

Due to the expected complexity of this project and the potential impacts to several different NYISO software applications, including the market optimization, it will require high effort to complete. Study and market design are anticipated to take approximately one year, with implementation requiring approximately two to three years of development and testing before deployment.

Dependencies

Due to the expected complexity of this effort, the NYISO currently envisions deployment of Reserve Enhancements for Constrained areas at a future date, after the study, market design, and software development are completed. Implementation would occur after large projects such as the *DER Participation Model* and the *Energy Storage Resource Participation Model* have been completed.

Demand Curve Reset

Grid Benefits & NYISO Effort

The DCR is a complex, resource intensive process for both the NYISO and stakeholders and is considered a high effort project. Several potential peaking units are separately analyzed for each Locality along with a multitude of operational and financial considerations that must be evaluated and discussed with stakeholders.

This project has a significant impact on the ICAP market as a whole by establishing the parameters for how the market will clear over the next several years. As a result, this project will provide high benefit to the grid.

Dependencies

The current DCR is underway with no dependencies. The next DCR, scheduled to begin in 2023 may have other project dependencies, such as *Improving Capacity Price Formation*, which may result in recommendations that can impact that schedule.

Capacity Demand Curve Adjustments

Grid Benefits & NYISO Effort

The ICAP Demand Curves are used in each month's spot auction to determine the amount of capacity that is purchased and the clearing price for that capacity. Incremental adjustments to the slope and/or shape of the ICAP Demand Curves may be needed to maintain resource adequacy as system conditions evolve, which the NYISO expects will produce medium benefits to grid reliability. Although the NYISO's DCR process considers the shape and slope of the ICAP Demand Curves, the NYISO recommends a targeted effort to review the efficacy of the ICAP Demand Curves to better evaluate whether alternative slopes and/or shapes would improve resource adequacy and grid reliability.

The NYISO anticipates that this is a medium to large effort project. While this project is a targeted effort that is focused solely on whether different slopes and/or shapes for the ICAP Demand Curves can produce benefits to grid reliability and resource adequacy, there are significant downstream impacts to other NYISO processes that must be considered, such as to Buyer-side Mitigation Exemption Tests and determinations.

Dependencies

This project should be completed prior to beginning the next DCR, and should be considered in parallel with other capacity projects such as the Comprehensive Mitigation Review and Capacity Zone Evaluation project.

Expanding Capacity Eligibility/ Capacity Value Study

Grid Benefits & NYISO Effort

This project is a recurring evaluation performed once every 4 years, with the most recent evaluation performed in 2019. This project has high benefits as the NYISO is expecting a large number of short duration resources to enter the market in coming years. This project seeks to improve the efficient operation of the grid with respect to these new resources as well as to align the value of these resources with the reliability benefit that they provide to the system.

The NYISO anticipates that the periodic review process will take one to two years from hiring the consultant to completing the stakeholder review process. The results associated with the current market changes will be implemented in the 2021-2022 Capability Year, and the results of future periodic reviews will be implemented three Capability Years after the review process begins. Implementing this software change, along with revisiting capacity values on a recurring basis, represents a high effort.

Dependencies

The implementation of the DER Participation Model is dependent on this project. Subsequent capacity value reviews can be performed with no dependencies and the dates are defined by the tariff.

Tailored Availability Metric

Grid Benefits & NYISO Effort

The NYISO expects a tailored availability metric to provide benefits to the reliability and efficiency of the grid that will increase over time. The project is currently underway, with the anticipated Market Design Complete in 2020 and the implementation in 2021. From the Market Design Concept Proposed to implementation, this project is expected to be a medium effort with normal resourcing considerations.

Dependencies

There are no dependencies for this project.

New Resource Integration

DER Participation Model

Grid Benefits & NYISO Effort

DER Participation will have a significant impact on the market, diversifying resources and encouraging a more resilient grid that is more efficient than the conventional structure. As a result, this project is expected to have high benefits, allowing the NYISO to cultivate a market that is accessible and competitive for DER, in line with state policy goals.

The NYISO expects the above deliverables and overall initiative to require ongoing high effort, given the extent of software development and market design necessary for effective and timely implementation. The next milestone, Development Complete, is underway, with Deployment targeted for 2021.

Dependencies

The *DER Participation Model* is dependent on the following initiatives:

- *ESR Participation Model*
- *Expanding Capacity Eligibility*

Engaging the Demand Side

Grid Benefits & NYISO Effort

This project will provide a medium to high level of benefits to the grid, as controllable and flexible load can help to balance inflexible/intermittent supply and provide ancillary services. There will be a high level of NYISO effort required to develop market rules and discuss this project with stakeholders.

Dependencies

This project should be completed only after the DER Participation Model is implemented.

Hybrid Storage Model

Grid Benefits & NYISO Effort

Hybrid storage facilities may offer increased flexibility and have the potential to enhance grid reliability. Because there are not a large number of hybrid storage projects currently in the NYISO's interconnection queue, implementation is currently estimated to be of medium benefit.

NYISO staff anticipate that this project will require medium-high effort to complete. The developing market design for this project is anticipated to affect multiple NYISO systems and processes. The market

design phase will build upon work that has been completed for dependent projects. While it will require dedicated resources, market design is not expected to be a multi-year effort.

Dependencies

It is expected that the extensive design work that has already been completed for both the ESR and DER initiatives will provide a foundation for the development of this participation model. This project is distinct from the DER integration initiative, which has developed aggregation rules for smaller resources that are generally distributed behind multiple interconnection points.

Integration of Public Policy

Comprehensive Mitigation Review

Grid Benefits & NYISO Effort

The goal of BSM is to maintain competitive behavior within mitigated capacity zones, which would remain unchanged if a different or new Mitigation Exemption Test methodology is implemented. Additionally, only a small set of projects in a limited portion of the NYCA are subject to BSM rules. As this project is a multiyear effort that may or may not result in a material redesign of the BSM rules and exemption framework, it is premature to characterize the benefits of the project but it will require high effort and possibly a hired consultant. It is not anticipated that this project will require significant software development.

Dependencies

There are no dependencies for this project.

Carbon Pricing

Grid Benefits & NYISO Effort

Carbon Pricing is expected provide a way to advance New York State public policy goals at lower cost. This project is therefore expected to yield high benefits.

Though the proposed pricing methodology is expected to work well within the NYISO's existing market structure, significant upgrades to software and the ISO procedures will be necessary to implement *Carbon Pricing*. Based on the market design discussed at the June 20, 2019 Business Issues Committee, the NYISO anticipates approximately 18 months to develop, test, and deploy once the design is approved. It is therefore expected that the *Carbon Pricing* initiative will require high effort to complete.

Dependencies

The NYISO will continue to work with New York State and NYISO stakeholders on the merits of the proposal to garner support. After the *Carbon Pricing* proposal is approved by stakeholders, the NYISO expects to complete the software implementation in 18 months.

Conclusion

Many of the initiatives discussed in this document are already underway while nearly half are ongoing efforts in response to a grid that is transitioning to incorporate new resource technologies. While all of the initiatives described herein may offer value to the wholesale markets, the NYISO does not have the resources to address all of them simultaneously. Unanticipated initiatives may also result from future FERC orders, stakeholder input, and/or evolving public policies, causing the proposed timelines to require revision. In light of these and other unknowns, this document lays out what the NYISO believes to be an efficient path toward effective wholesale market reform.

Appendix I – Project Milestone Definitions

Ongoing:

- Unique to the Master Plan, this milestone acknowledges that additional development of potential projects is required before laying out a detailed project plan.

Issue Discovery:

- NYISO has facilitated education sessions for stakeholder knowledge development of problem/issue, conducted stakeholder solicitation of potential solutions to address problem/issue, and summarized findings at a working group meeting for potential ranking and future project identification.

Study Defined:

- The scope of work for the study has been presented to stakeholders, including a discussion on the necessary input(s), assumption(s) and objective(s) of the study.

Study Complete:

- 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 Business Issues Committee (BIC) and/or Management Committee (MC) to define further action on the proposal.

Functional Requirements:

- NYISO has completed documentation of the functional requirements (FRS) and the Business Owner has approved.

Software Design:

- The software design document is complete and software development is ready to begin.

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.