Distributed Energy Resources Roadmap for New York's Wholesale Electricity Markets

A Report by the New York Independent System Operator

January 2017

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I. Introduction

Distributed Energy Resources (DER) are poised to transform New York's wholesale electric system. DER can help grid operators by improving system resiliency, 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) initiative and Clean Energy Standard. The NYISO stands ready to harness these benefits and build the grid of the future.

This DER Roadmap is only the first step in building that grid of the future. We are committed to seamlessly transitioning from a primarily central station-based grid (Figure 1) to a diverse bi-directional grid (Figure 2). The transition will require careful and extensive planning by the NYISO and its stakeholders. NYISO will continue to provide its stakeholders and the public with independent and impartial information it can trust. This transition will fundamentally alter the composition of New York's infrastructure and energy markets and, throughout this transformation, the NYISO will continue to ensure economic electricity that New York's consumers can rely on.

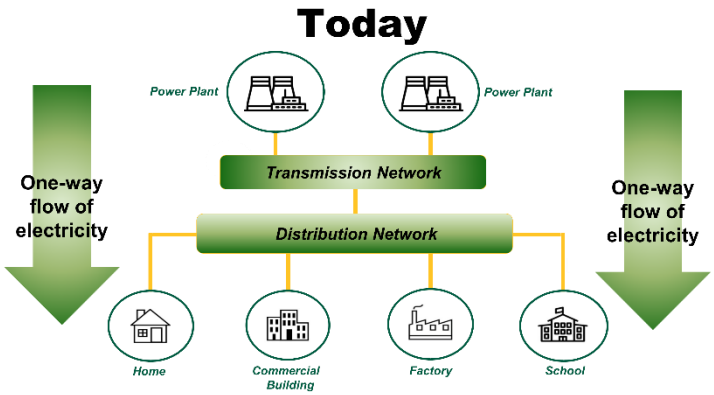

Figure 1 - Today's Electrical Grid

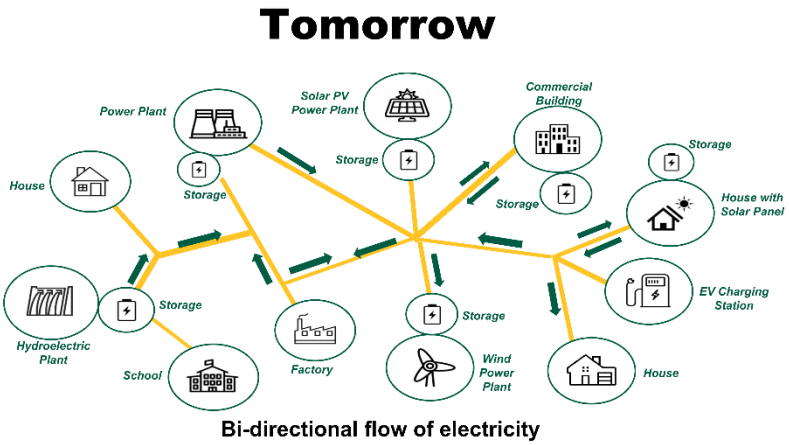

Figure 2 - Tomorrow's Electrical Grid

In the pages that follow we describe how DER is already providing valuable services in New York's Wholesale Markets. We outline the key objectives we intend to achieve in the initial phase of DER integration, and the progress we expect to make in the next three to five years. We also highlight certain technical challenges including measurement and verification of resource performance, and simultaneous participation in wholesale markets and in retail programs. Finally, we explain how the NYISO expects to transition certain existing wholesale market programs (such as demand response) to a fully integrated DER model.

We believe that opening the NYISO's markets to all resource types and configurations will improve the strength and efficiency of the electric grid. The ideas and proposals explained in this Roadmap will transform as we learn more about emerging technologies and receive input from stakeholders. But one thing is certain: in the coming decades we will look back at this evolution of the electric system and know that New York state has been on the leading edge of reforms that have improved reliability, increased resiliency, reduced prices for consumers, and improved our environment.

II. Purpose and Scope of this Roadmap

Technological advancements and public policies, particularly REV, are encouraging greater adoption of DER to meet consumer energy needs as well as electric system needs. DER offer the potential to make load more dynamic and responsive to wholesale market price signals, potentially improving overall system efficiencies.

The NYISO's market enhancements will permit dispatchable DER (*i.e.,* controllable resources) with various capabilities to participate in the wholesale markets. Integrating DER in this manner will require enhancements to wholesale market design, system planning, and grid operations to better align resource investments and performance with system needs and conditions.

The NYISO generally considers DER to be behind-the-meter resources, although small aggregations of Community Distributed Generation (CDG), may also be considered DER. Some DER may be net-generators and others net-loads. The NYISO defines DER as a resource, or a set of resources, typically located on an end-use customer's premises that can provide wholesale market services but are usually operated for the purpose of supplying the customer's electric load. DER can consist of curtailable load (demand response), generation, storage, or various combinations aggregated into a single entity. For resources that are net-generators, the scope of participation in the dispatchable DER program will be limited to resources and aggregations that do not meet the requirements to be Behind-the-Meter Net Generation ("BTM:NG") Resources. [1]

The purpose of this document is to present the NYISO's vision for integrating DER into the NYISO's Energy, Ancillary Services, and Capacity markets. It outlines high-level concepts to facilitate the emergence of dispatchable DER through a series of economic-based products. Doing so will promote greater grid and market efficiencies by coordinating load in conjunction with supply on the basis of price signals. These high level concepts are presented in an order that uses the previous concept's market design to inform the next concept's market design such that each concept builds upon all previous concepts. Existing reliability-based demand response (DR) programs, the Special Case Resource ("SCR") Program and Emergency Demand Response Program ("EDRP"), will continue to be an important tool for system operators to curtail load in response to periods of high demand or emergency system conditions that could threaten reliability in the near term. However, by facilitating the growth of economic-based DER products, the NYISO is looking to more effectively manage demand through automated,

[1] Capitalized terms not otherwise defined in the body of this Report shall have the meaning specified in Section 1 of the NYISO's Open Access Transmission Tariff and Section 2 of the NYISO's Market Administration and Control Area Services Tariff.

market-based economic transactions, that reduce the need for manual operator actions and thereby increase market efficiency.

This document is not intended to be a detailed market design with specific implementation details. Where the NYISO has developed detail on certain concepts, however, it has included that detail in this document as a basis for further discussion with stakeholders.

III. Overview

DER currently have limited opportunities to participate in the NYISO's Energy, Ancillary Services, and Capacity markets. The NYISO's goal in this Roadmap is to develop a series of market enhancements to more fully integrate DER.

Achieving the key objectives of this Roadmap, below, will more fully open New York's wholesale markets to DER, and will support NYISO goals to improve market animation, increase system-wide efficiency, and improve system reliability and resiliency.

Key Objectives

1. Integrate DER into Energy, Ancillary Services, and Capacity markets;
2. Align with the goals of New York State's REV;
3. Enhance measurement and verification methodologies;
4. Align compensation with wholesale service performance; and
5. Focus on wholesale market transactions.

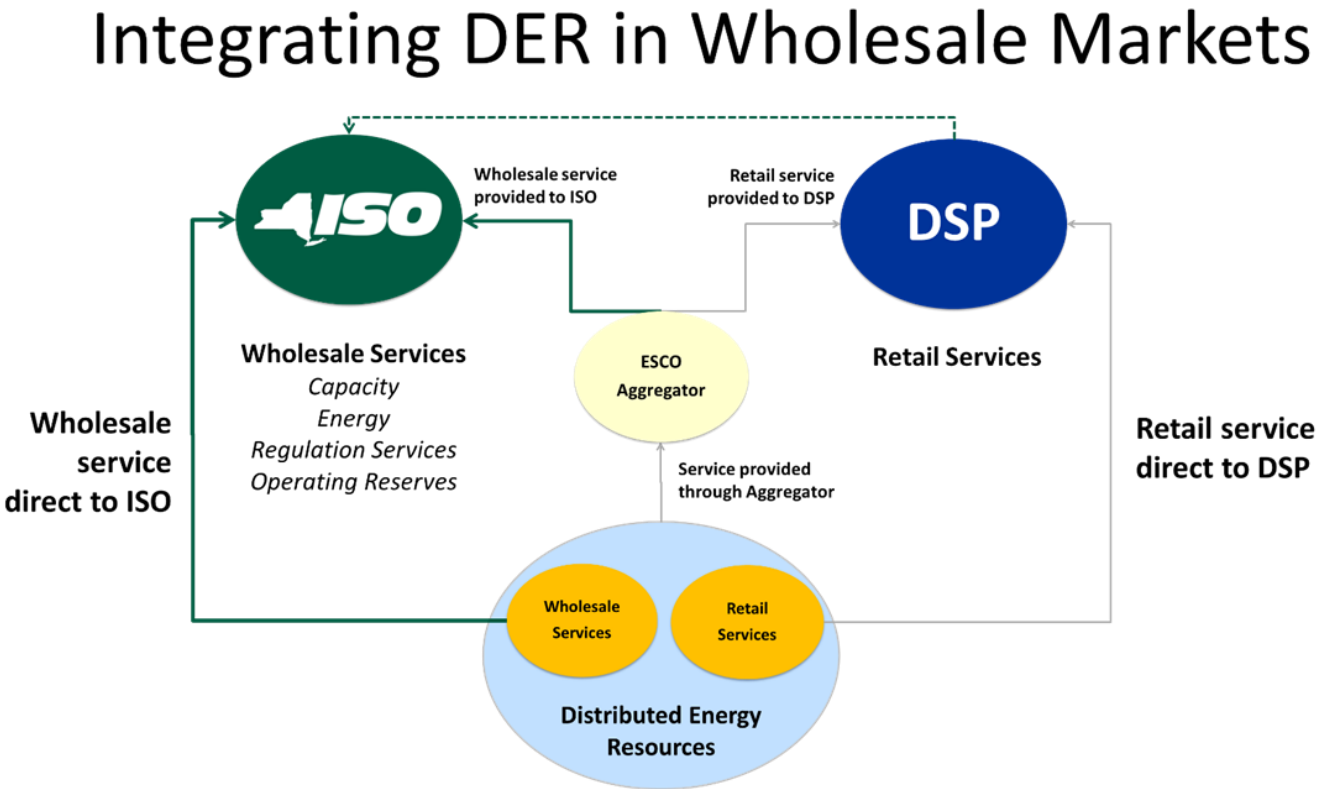

Figure 3 – Integrating DER in Wholesale Markets

Figure 3 depicts how DER may provide services in the wholesale and retail markets in the future, and the dark green lines are intended to show the scope of NYISO's DER Roadmap initiative.

The NYISO's existing Open Access Transmission Tariff (OATT) and Market Administration and Control Area Services Tariff (Services Tariff) do not recognize the full complement of wholesale market services DER are capable of providing. Although DER can currently participate in limited ways, the NYISO recognizes that market enhancements to further integrate DER will benefit the system as a whole. Therefore, the main objective of this Roadmap is to identify the key, high-level concepts we will address in integrating existing and emerging DER technologies. These concepts will be further developed, refined, and implemented through the NYISO's shared governance process.

The objectives described in this Roadmap, though focused on wholesale markets, largely parallel the Public Service Commission's (PSC) REV objectives in order to complement the retail market enhancements undertaken by the PSC and utilities.[2]

The NYISO intends to treat dispatchable DER comparable to traditional generators but recognizes that the capabilities of DER may be different from traditional generators. For example, traditional generators that were awarded capacity in a NYISO ICAP auction, with certain exceptions, currently have a Day-Ahead Market ("DAM") bidding obligation.[3] We anticipate that dispatchable DER participating in the Capacity market will have similar obligations requiring a dispatchable DER to offer into the Energy and Ancillary Services market each day.[4] Commensurate with the operational flexibility provided to DER ICAP Suppliers, the NYISO intends to reflect the operational value of the DER's contribution to the system and prorate Capacity payments based on the service provided.

Unlike traditional generators, DER are likely to participate in the NYISO's wholesale markets on an aggregated basis due to individual resource size and capability. The NYISO's current infrastructure was designed to support central-station supply resources using telemetry for real-time operations and monitoring, and after-the-fact data uploads for financial settlements. This data is collected on a Point Identifier (PTID) basis.[5] We intend to use the existing infrastructure for DER and DER aggregations, however, as described in section VIII below, adjustments to existing metering and telemetry requirements may be appropriate for DER depending on the configuration of a particular resource or aggregation. It is expected, however, that DER will be required, at a minimum, to provide PTID-level real-time supervisory control and data acquisition (SCADA) quality telemetry data and after-the-fact revenue quality meter data from individual resources.[6] The NYISO will explore whether the use of real-time telemetered data from a sample set of resources in a DER aggregation may be appropriate in certain circumstances.

The market enhancements developed over the next three to five years will permit DER participation in the NYISO's Energy, Ancillary Services, and Capacity markets with the option of being either dispatchable for economics or non-dispatchable for economics. The existing Day Ahead Demand Response Program (DADRP) and Demand-Side Ancillary Services Program (DSASP) will be replaced with new initiatives emerging from this Roadmap, while the SCR program, EDRP, and the opportunity for Price-Capped Load Bidding will remain. We also intend to develop rules accounting for wholesale market

[2] Unlike traditional Generators that are connected to the high-voltage transmission grid, many DER will be connected to distribution networks posing operations and planning challenges for the NYISO and New York's utilities.

[3] *See* Services Tariff § 5.12.1.6 and 5.12.7. The NYISO requires ICAP Suppliers, with certain exceptions, to bid, schedule a bilateral transaction, or notify the NYISO of any derates, the full amount of its ICAP obligation on each day.

[4] DER electing not to participate in the NYISO's Capacity market may offer into the Energy and Ancillary Services markets based on their capability.

[5] A Point Identifier is a resource-specific numerical identifier used by the NYISO's software systems to identify Generators and other Suppliers.

[6] Certain metering and telemetry obligations may be performed by an aggregator instead of the individual DER.

load modifiers. Figure 2 depicts the NYISO's vision of future DER participation in the wholesale markets.

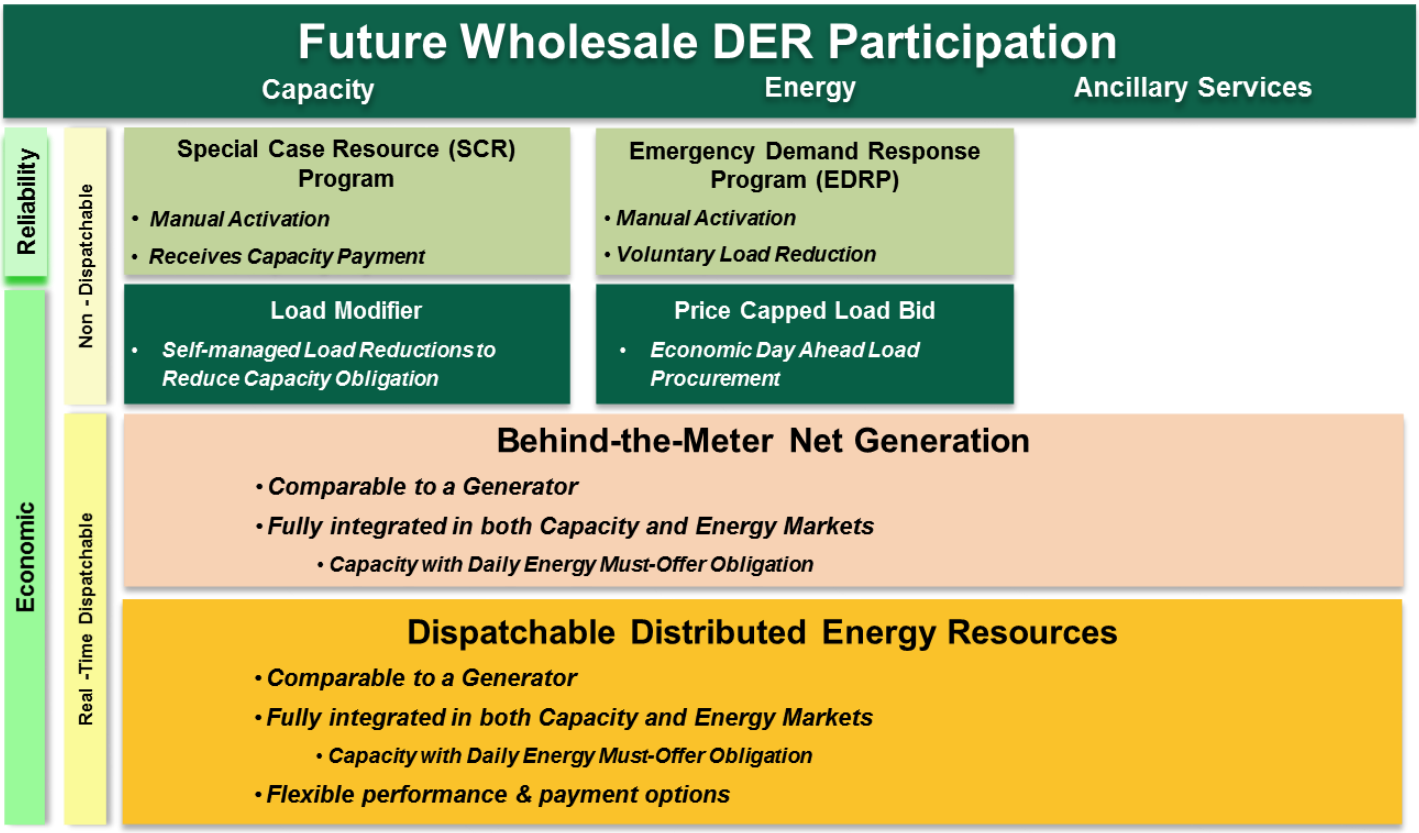

Figure 4 - Future Wholesale DER Participation

Implementing this initiative will entail considerable time, effort, and stakeholder engagement. This Roadmap represents a starting point to initiate discussions that will lead to further refinement on the key market design elements, functional requirements, and tariff language necessary to implement our vision.

Below is a high level timeline depicting the development and implementation of DER Roadmap concepts as well as other supporting initiatives. The implementation schedules noted below are subject to revision based on the specific market designs developed with stakeholders, and upon NYISO's budgeting and project prioritization process.

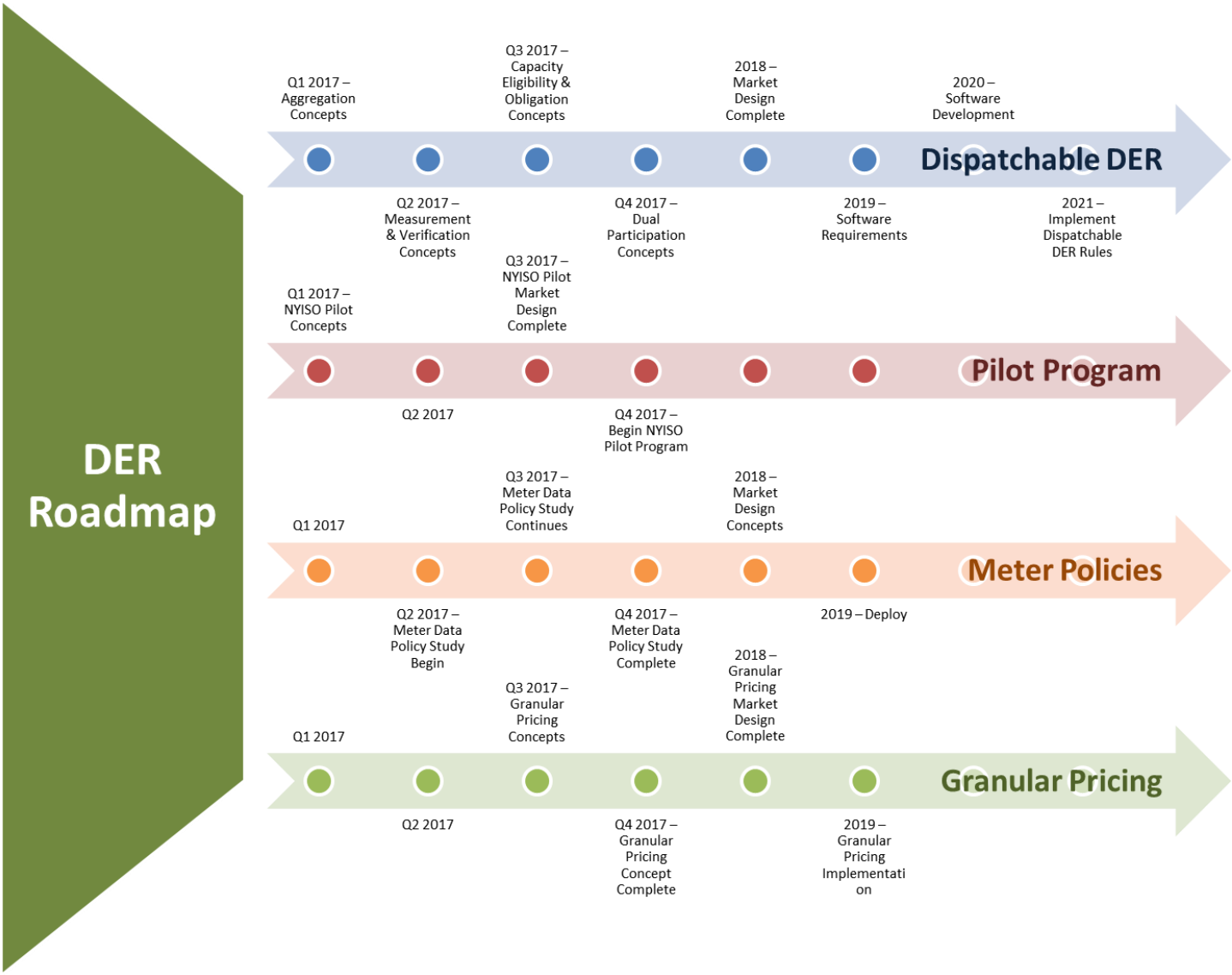

Figure 5 - DER Roadmap Timeline

IV. Current State of DER Integration

The number and type of DER operating in New York has grown over the last decade. Distributed behind-the-meter technologies are changing the way energy is produced, stored, and consumed. DER also address local needs for power quality, energy cost savings, carbon footprint reduction, and resiliency. Energy storage technology in particular has become more efficient and economical over the last decade leading to increased penetration.[7] Combined, these advances will allow consumers to

[7] Ultimately, the NYISO believes that DER applications will be a more effective and complete solution for grid operators and system planners with increased grid-scale storage capability.

change their consumption profiles in an effort to lower costs, access new sources of revenue, and reduce the environmental impacts of their energy use. While the NYISO does not have comprehensive data on the penetration of DER in the state, it commissioned a study in 2014 to (i) review the potential for DER in New York State, and (ii) explore the various DER technologies available to the public. [8]

The 2014 DER Study examined DER investment drivers and the effect of regulatory regimes and other policies in determining the market potential for DER, including a review of how DER is treated in other balancing authorities and by utilities.[9] The study concluded that DER adoption was well underway throughout the United States due to public policies encouraging DER as well as performance improvements and cost reduction of available technology.[10] These findings supported the study's conclusion that there was significant potential for DER expansion in New York.

Despite the 2014 DER Study's conclusion that there is potential for expanded DER use, the precise technological mix and scale of DER penetration is unknown and will be influenced by the economics of the technologies themselves as well as evolving rules and incentives established by public policy and the NYISO's markets. The market enhancements contemplated by the NYISO in this Roadmap are intended to encourage integration of a mix of resources, including aggregations that combine technologies.[11]

While the NYISO's efforts to enhance wholesale market participation of DER are underway, the PSC has been developing concepts for retail DER since 2014 in its Reforming the Energy Vision proceeding. Recognizing the rapid advancements in DER, the PSC initiated the REV proceeding to encourage deeper penetration of retail DER, engage end users, promote system efficiency, and meet the challenges presented by New York's aging infrastructure and severe weather events. The proceeding is designed to examine how regulatory policies, utility business models, and market designs could be enhanced to encourage investment in, and operation of, DER technologies. Through the retail market changes brought by REV, DER will serve local needs through Distribution System Platform (DSP) providers that plan, operate, and administer retail markets for distribution-level services.[12]

The vision articulated by the REV framework is, in many ways, consistent with the manner in which the NYISO administers wholesale markets, plans for bulk power system needs, and operates the grid, and the NYISO shares the goals articulated by the PSC in the REV proceeding. DER has the potential to further enhance the efficiency of wholesale markets with appropriately located injections and demand elasticity. Uncertainty exists, however, regarding the services DER may offer the bulk power system while also serving distribution system or end-user needs, the level of DER investment likely to be realized, and the limited visibility NYISO's market and grid operators will have of DER investments and technologies.

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[8] A Review of Distributed Energy Resources, New York Independent System Operator (Prepared by DNV GL) (Sept. 2014), http://www.nyiso.com/public/webdocs/media_room/publications_presentations/Other_Reports/Other_Reports/A_Review_of_Distributed_Energy_Resources_September_2014.pdf.

[9] The study defined DER as behind-the-meter power generation and storage technologies located on an end user's premises and operated for the purpose of supplying all or a portion of the customer's electric load, but with the potential to inject power into the transmission system, distribution system, and/or a parallel local non-utility grid. The definition used in the 2014 DER Study is more restrictive than that used in this DER Roadmap, and therefore we expect greater benefit than described in the study.

[10] The 2014 DER Study did not specifically examine demand response because the goal was to assess the enabling technologies themselves, and not their impact on the grid.

[11] Although the NYISO has reviewed passive and intermittent technologies that provide energy efficiency, peak shaving, and other services to co-located loads, we do not anticipate that these technologies will directly provide wholesale market services. It is expected that these technologies will instead affect wholesale markets indirectly, in the form of modifications to New York's load profile. Moving forward the NYISO expects to enhance its forecasting tools to assist with more efficient dispatch of supply resources on the bulk power system in a separate forum.

[12] The PSC, NYISO and resource developers are also determining the extent to which retail-level DER can also participate in wholesale markets.

DER provide important but limited support to bulk power system needs under the NYISO's existing market rules. The vast majority of DER are facilities participating in the NYISO's economic and reliability-based demand response programs, and among all demand response programs, the reliability-based programs have more robust participation. Figure 6, below, illustrates the NYISO's current demand response programs. Load modifiers do not actively participate in the NYISO's markets but instead are integrated with the various Load Serving Entities (LSEs) in New York to reduce the Load the LSE must procure from the NYISO.

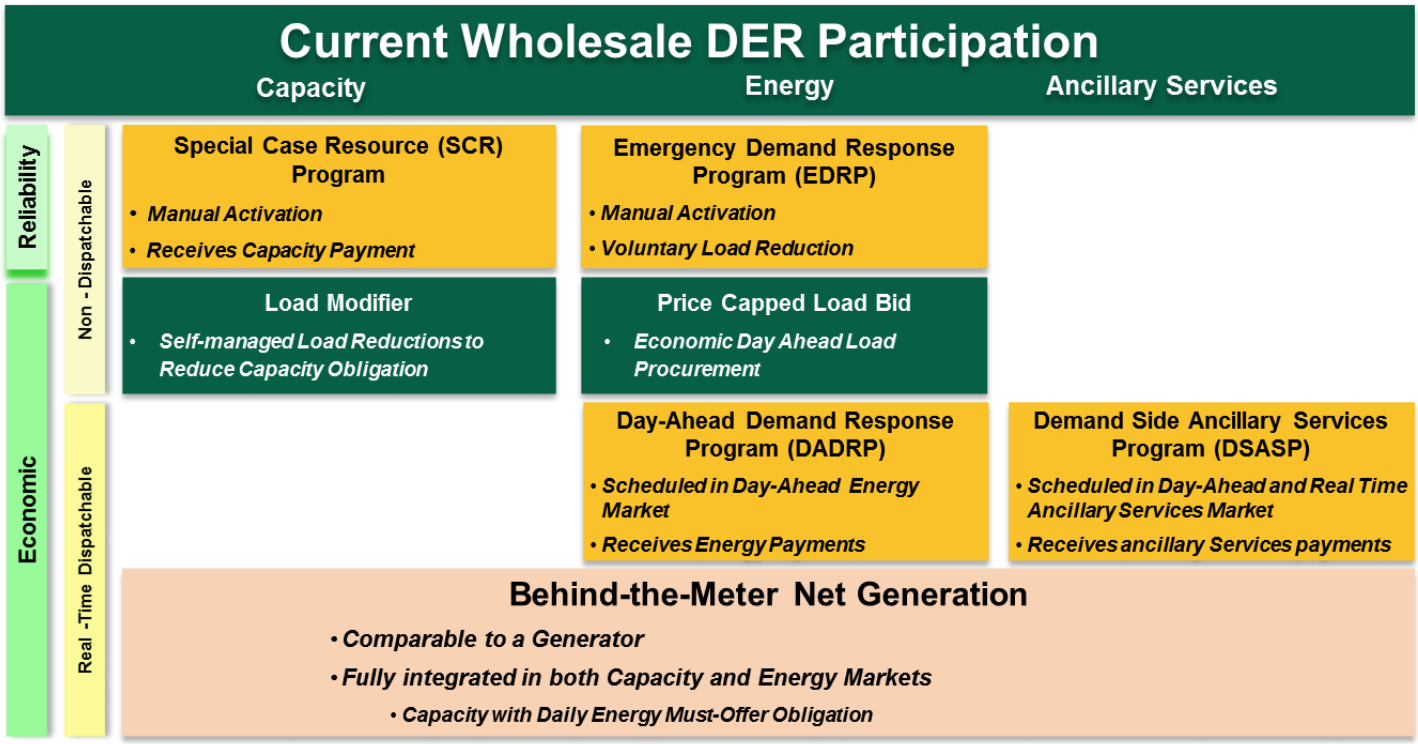


Figure 6 – Current State of DER Integration

A. Economic Programs

1. Economic Demand Response

The DADRP provides eligible resources the opportunity to offer load reduction in response to DAM price signals. DADRP resources offer into the DAM the amount of load reduction they are willing to provide at a particular price (or along a curve). If the bid is accepted, the resource performs by simply reducing consumption or by self-supplying a portion of their load with DER during the intervals in which it is dispatched. DADRP resources receive energy payments for delivering load reduction as if it were generation. We believe that DADRP is an effective tool to elicit demand elasticity, and although there was some historical participation, there is no active participation as of the date of this Roadmap.[13]

Eligible demand response resources may also submit bids for Ancillary Services through the NYISO's DSASP. Demand response resources that are capable of modulating their load in response to basepoint signals from the NYISO are eligible to supply and be paid for Operating Reserves and

[13] The DADRP was initiated in May 2001 and experienced limited participation through December, 2010. There has been no DADRP Resource participation since that time.

Regulation Service. As of July 2016, the DSASP had 106 MW of registered capability providing Ancillary Services. DSASP resources provide approximately 16% of the NYCA's 10-minute spinning reserves.

The NYISO markets also permit LSEs to submit Day-Ahead Price-Capped Load bids. Under existing market rules a LSE may choose to submit price-sensitive Day-Ahead load bids for some, or all, of the load it must procure. That is, a LSE may choose the Day-Ahead Market price at which it will serve its Load. If the Day-Ahead price exceeds the LSE's Price-Capped Load bid, the LSE will then either reduce its Load or procure energy through another source. DER may participate in wholesale markets as a tool LSEs use to modulate load in response to wholesale price signals. LSEs can submit load bid curves to the NYISO reflecting a "willingness to buy" energy by modifying load bids in response to the NYISO's clearing price. In a typical scenario, LSEs would rely more heavily on wholesale energy purchases during periods of low prices while activating DER to displace wholesale energy purchases during periods of high market prices. New York's LSEs submit approximately 3-5% of their day-ahead Load bids as price responsive, some of which is used for other purposes such as price hedging.

2. Behind-the-Meter Net Generation Resources

Another economic-based mechanism for DER that can inject at least 1 MW into the grid is to participate as a Behind-the-Meter Net Generation (BTM:NG) Resource.[14] This initiative is designed for large facilities that have on-site generation capability routinely serving a local, on-site Load (the facility's Host Load), and that have excess generation capability after serving that Host Load. Examples of potential BTM:NG Resources include industrial complexes, large residential facilities, and college campuses. The Resource must have nameplate generation capability with a minimum rating of at least 2 MW, a minimum Load of at least 1 MW, and an interconnection allowing an export of at least 1 MW to the New York State (NYS) Transmission System. Eligible BTM:NG Resources can sell Energy, Ancillary Services, and Capacity to the wholesale markets and participate in a manner similar to traditional Generators.

3. Load Modifiers

Load modifiers are not wholesale market resources, but instead are a tool that LSEs can use to reduce their wholesale market load and capacity obligation.

Load modifiers can consist of many different technologies that LSEs can use to manage its load. Load modifiers are primarily used: (i) to avoid purchasing high-cost power during peak hours, and (ii) to reduce the LSE's seasonal capacity obligations.

Load modifiers are not dispatched by the NYISO and therefore any load reduction is not based on an explicit bulk power system or wholesale market need.

B. Reliability-Based Programs

The NYISO currently has two reliability-based demand response programs: EDRP and the SCR program. The EDRP offers eligible resources the opportunity to voluntarily curtail load in response to NYISO requests for load reduction to address specific system conditions such as forecasted operating reserve shortages.[15] EDRP resources can reduce Load in response to a NYISO activation via curtailment, Local Generator deployment, or both, and receive energy payments for verified load reductions. The EDRP is useful to grid operators because it supports near-term reliability. Because load reductions are voluntary, however, EDRP does not benefit the NYISO's long-term planning and grid management objectives.

[14] The market rules permitting BTM:NG Resource participation in the wholesale energy, ancillary service, and capacity markets became effective on December 13, 2016.
[15] As of July 2016, the EDRP has 75 MW of capability throughout the state.

A more reliable demand response tool for planning and grid management is the SCR program.[16] The SCR program is similar to EDRP in that the NYISO activates SCRs in response to specific reliability-related system conditions, but, in exchange for receiving capacity payments (in addition to energy payments for real-time performance), SCRs are obligated to reduce load when called on by the NYISO.[17] SCRs that fail to respond to appropriate SCR activation notifications can be subject to financial penalties. The SCR program has been activated on numerous occasions to maintain reliable system operation.

The SCR program has proven a valuable tool for grid operators, and planners have relied upon SCR enrollments to determine if the system is capable of handling projected peak loads while maintaining compliance with reserve requirements. Despite its value, the SCR program is an imperfect market product because resources have little ability to predict or control the effect the SCR program participation has on a facility's primary day-to-day operations. From 2014 through 2016 the NYISO had only a single mandatory activation of the SCR program. In 2013, however, the SCR program had mandatory activations five times on five consecutive days in several NYISO load zones.

From the NYISO's perspective, the SCR program is a generally effective way to reduce strain on the bulk power system during periods of high demand. However, the program does have its short-comings. First and foremost, the SCR program must be manually activated: operators must look at load forecasts as well as generator and transmission availability to determine whether SCR resources will be necessary to maintain reliability. Since NYISO Operations must manually activate the SCR program based on the forecasted conditions, these actions are inherently less efficient than automated commitment and dispatch. Further, there is limited ability to target SCR calls in response to local conditions on the transmission grid because SCRs are activated on a zonal basis. Eliminating these inefficiencies will be effective in supporting grid reliability.

V. Key Objectives behind this Effort

While the types, configurations, and capabilities of DER vary depending on the needs of the customer, the following key objectives will guide the effort to integrate DER into the NYISO's wholesale electricity markets:

[16] As of July 2016, 1,192 MW of load reduction capability was enrolled in the SCR program.

[17] Under the existing SCR program rules, the NYISO is required to provide SCRs with a 21-hour advance notification of a potential SCR activation provided that the notification is made by 3 pm. If the notification is provided after 3 pm, the NYISO must provide a 24-hour advanced notification. The NYISO is also required to provide SCRs with a 2-hour intra-day notification of an actual SCR activation. If the NYISO does not meet its notification obligations, resource participation in the SCR activation becomes voluntary.

A. Integrate DER into Energy, Ancillary Services, and Capacity Markets

The NYISO seeks the seamless integration of DER into Energy, Ancillary Services, and Capacity markets. Currently, there are limited options for DER to participate in the NYISO's markets. More fully integrating dispatchable DER will provide a means for DER to take advantage of real-time scheduling. It is important for the NYISO's real-time systems to access and dispatch these resources in response to price signals reflective of grid conditions and needs. From an operational perspective, the intent of this effort is to minimize out-of-market manual activation of these resources by operators. Ultimately, implementation of this roadmap is expected to enhance the NYISO's portfolio of DER products by creating a market environment that facilitates the emergence of DER capable of being economically dispatched within the wholesale markets. At the same time, the NYISO's vision provides end users added flexibility to meet their energy needs more economically by modulating their demand for grid-based electricity in response to price signals.

B. Align with the goals of New York State's REV

The NYISO's goal to provide additional options for DER to participate in the wholesale markets aligns with NYS REV objectives of market animation leveraging customer contributions, increasing system wide efficiency, and improving system reliability and resiliency. The NYISO's approach to DER participation is to focus on system needs and performance requirements of resources and to provide opportunities for facilitating demand-side elasticity.

C. Enhance Measurement and Verification Methodologies

Accurate timely metering and load forecasts are essential to balancing supply and demand in real-time. Enhancing measurement and verification methodologies is critical to ensure that NYISO is able to accommodate various technologies and customer load profiles. The data provided by enhanced measurement and verification will help system planners and grid operators better prepare for system needs and support the continued reliability of the bulk power system while further improving system efficiency. Enhanced measurement is also a critical component to appropriately compensating resources for the services they provide, which also leads to the next key objective.

D. Align Compensation with Wholesale Service Performance

Markets function best when payments are aligned with the value of services provided. In this context, the NYISO intends to align DER incentives and compensation based on the flexibility and measured performance of the DER (or aggregation), and market clearing prices based on the needs of the system. The intent is to treat DER comparably with traditional generators participating in the NYISO's Energy, Ancillary Services, and Capacity markets.

E. Focus on Wholesale Market Transactions

Unlike traditional wholesale generators which are primarily connected to the high-voltage transmission grid, many of the DER will be connected to the distribution networks. To ensure bulk power system reliability, it is important to accurately represent DER impacts at their corresponding interface to the bulk power system, which is typically at the transmission-level substation load bus associated with that distribution network.

Achieving these key objectives will facilitate the integration of dispatchable DER into the NYISO's wholesale markets. The NYISO also hopes to achieve a better understanding of the implications non-dispatchable resources have on wholesale load requirements in a future with demand-side animation. The NYISO envisions that those resources capable of participating in its markets will do so directly or via

third-party aggregation (including potentially via the DSP providers envisioned in the New York State PSC's REV recommendations) such that smaller resources (*e.g.*, those resources less than 100 kW) can be aggregated in a coordinated fashion to respond to price signals in support of bulk system needs. The NYISO also anticipates that the integration of non-dispatchable DER will require new forecasting and planning tools to measure the impact of non-dispatchable activity in order to continue operating the bulk system in an economically efficient manner. Such tools include solar forecasting, enhanced communications and advanced metering to facilitate increased data exchange and collection, and enhanced coordination with utilities to account for DER investments over a long horizon and the impacts on resource adequacy and transmission security.

VI. Integrating Dispatchable DER

Integrating dispatchable DER will expand opportunities for eligible resources by opening wholesale electricity markets to technologies, or combinations thereof, whose participation is limited under the NYISO's existing market rules. Specifically, five types of resources will be enabled to participate in the NYISO's Energy, Capacity, and Ancillary Services markets:

1. Load-only resources – end-users that modulate their energy usage in response to a NYISO dispatch signal strictly through load curtailment measures;
2. Load with generation – end-users capable of dispatching behind-the-meter generation resources, supplemented with load curtailment, to modulate their energy withdrawals and potentially inject energy into the grid in response to a NYISO dispatch signal;
3. Load with storage – end-users capable of dispatching behind-the-meter storage resources, supplemented with load curtailment, to modulate their energy withdrawals and potentially inject energy into the grid in response to a NYISO dispatch signal;
4. Load with generation and storage – end-users with a combination of behind-the-meter generation, storage and/or load curtailment that can modulate the facility's energy withdrawals and potentially inject energy into the grid in response to a NYISO dispatch signal; and
5. Community distributed generation. [18]

The remaining sections of this roadmap further describe concepts that must be enabled in order to achieve the key objectives associated with more fully integrating DER into the NYISO's wholesale markets.

The DER program will treat distributed resources comparably with other wholesale market resources, more fully integrating them with Energy and Ancillary Services markets, while awarding payments reflective of the performance capabilities of the resources. Creating a viable mechanism for DER to participate in markets on an economic basis offers advantages to NYISO markets as well as participants.

Animating these resources will improve economic efficiency by reducing the need to call high-cost peaking generation. At the same time, DER operating in response to economic signals can work to shift grid-based electricity consumption to off-peak hours, creating the potential for greater stability in prices throughout the day by flattening the load. In this sense, the NYISO's vision for dispatchable DER integration aligns well with REV in that it offers the potential to engage or animate certain consumers in ways that support more optimized grid utilization while helping these consumers better manage their own

[18] Use cases for each of these resource types are located in Appendix A.

energy needs and costs. The potential to improve grid utilization of existing infrastructure may help to avoid expensive capital investments that might otherwise be needed to meet peak demands over relatively few hours during the year.

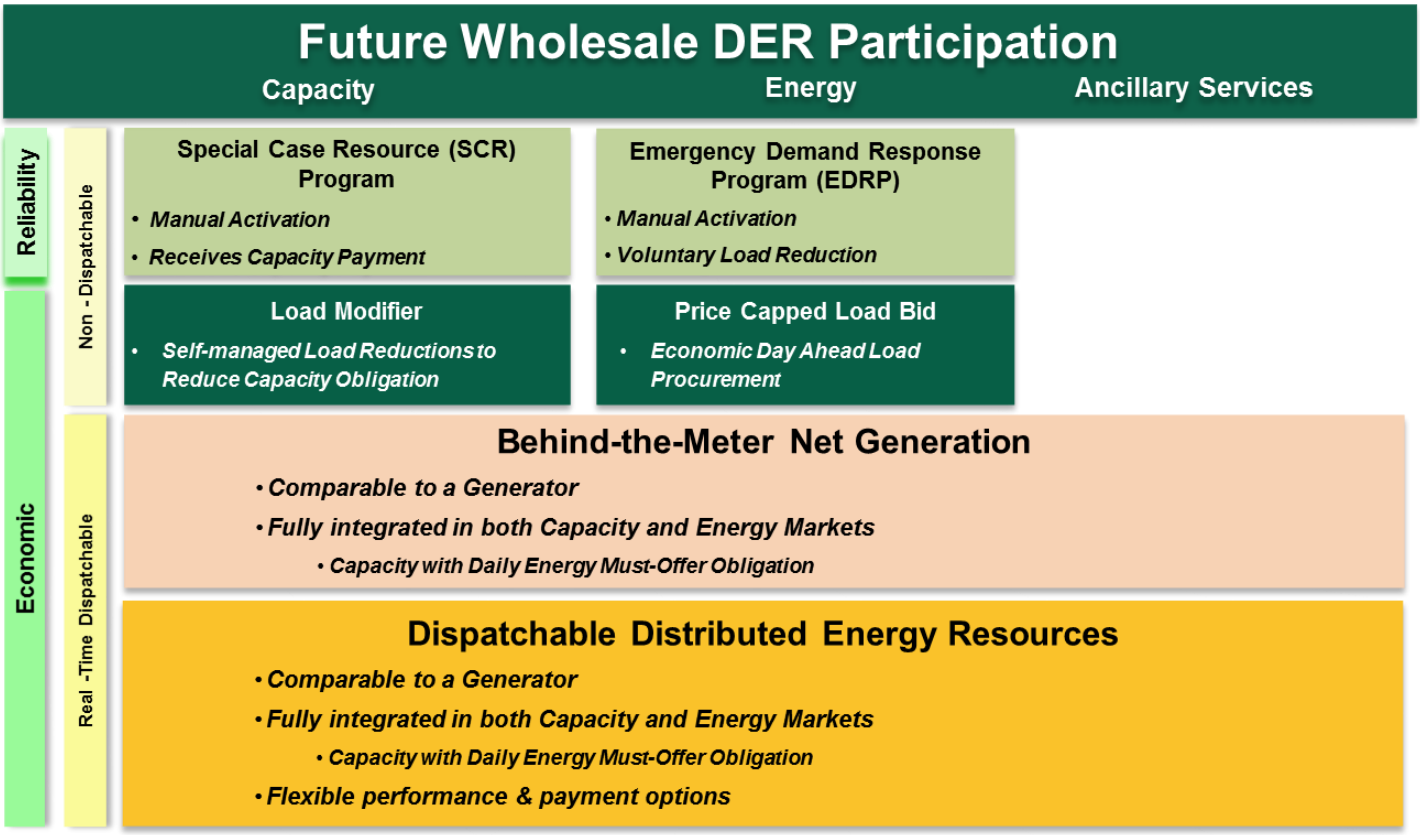


Figure 7 - Future Wholesale DER Participation

The NYISO is not proposing to change the existing SCR program, EDRP, or BTM:NG Resource rules in conjunction with this Roadmap at this time. The NYISO does not propose to add any new rules for LSE use of load modifiers to reduce Load and capacity obligations, nor is it altering existing Price-Capped Load Bidding rules in conjunction with this with this Roadmap at this time.

On November 17, 2016 FERC issued a Notice of Proposed Rulemaking (NOPR) on Electric Storage Participation in Markets Operated by Regional Transmission Organizations and Independent System Operators that included proposed rules for DER.[19] The NOPR describes FERC's current vision for the development of rules regarding DER in the organized markets. The NYISO recognizes that some of the proposals contained in this Roadmap do not perfectly align with those contained in the NOPR. FERC's decisions in that rulemaking proceeding may ultimately impact the NYISO's final market design. The NYISO is and will continue monitoring this proceeding and will revisit specific areas of the dispatchable DER market design if necessary.

[19] *Electric Storage Participation in Markets Operated by Regional Transmission Organizations and Independent System Operators*, Notice of Proposed Rulemaking, 157 FERC ¶ 61,121 (Nov. 17, 2016).

VII. Aggregation and Modeling

The NYISO recognizes that allowing Market Participants to aggregate individual DER to meet wholesale market eligibility and performance requirements is beneficial to both market participants and the markets. The NYISO proposes to aggregate DER similar to its existing demand response programs, with certain modifications to reduce the minimum aggregation size and to limit the geographical footprint of aggregations to less than a Load Zone. Each aggregation is expected to be modeled and represented by a PTID in the NYISO systems.[20]

A. DER Aggregation and Aggregators

The rules related to DER aggregation will be the foundation upon which the remaining concepts and rules are built, and will be the first concept developed in the market design process. As part of the effort to open the wholesale markets up to all resource types, the aggregation rules will be technology agnostic. Therefore, a single DER aggregation could include a heterogeneous mix of different technologies such as load reduction, generation, and storage technologies that, when combined, meet NYISO dispatch instructions. The NYISO currently does not believe that aggregations must be homogeneous (*i.e.*, consisting of DER with the same technology), but the NYISO will explore whether homogenous aggregations can provide additional or different services than heterogeneous aggregations and therefore be valued differently. This will be explored further in the market design process.

We expect to allow DER aggregations of at least one resource. The DER Coordination Entity (DCE) will be the Market Participant interfacing with the NYISO. A DCE may be a direct customer, a third-party aggregator (similar to a Responsible Interface Party in the SCR Program), or a DSP.

B. Granularity

Unlike the traditional wholesale generators, which are primarily connected to the transmission grid, many DER will be connected to distribution networks. To ensure bulk power system reliability, it is important to accurately represent DER impacts at their corresponding interface to the bulk power system, which is typically at a transmission node (substation load bus transformer/PTID) associated with a distribution network. Therefore, we propose at this time, and subject to further study and development in the stakeholder process, to limit the geographical footprint of DER aggregations to only those resources connected to the same bulk transmission node. This geographical limit to DER aggregations will help ensure DER compensation in the wholesale markets reflects the locational and temporal value of the DER aggregation on the bulk power system.

Figure 8, below, is an example of a transmission substation with two transmission nodes, where the transmission nodes are at each of the two step down transformers.

[20] The NYISO updates its power system model on multiple occasions throughout the year. 60-90 days advanced notice is typically required in order for a new resource to be incorporated into the power system model.

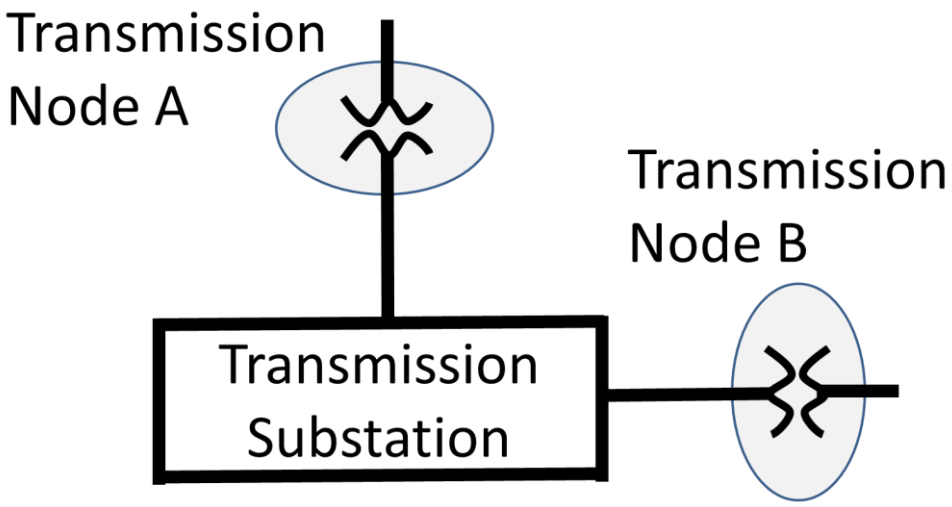


Figure 8 - Transmission Substation with two transmission nodes

Aggregating DER on a broader level (such as zonally) could create operational issues. To illustrate this point, consider two generators connected on the opposite ends of a constrained transmission line (as depicted in Figure 9). Due to the constraint, injections from Generator 1 will further aggravate the overloaded transmission line. Injections from Generator 2, however, will help alleviate the constraint. In this example, to effectively and efficiently manage the constraint the NYISO would dispatch Generator 1 and Generator 2 separately (*i.e.*, dispatch Generator 1, down and Generator 2 up).

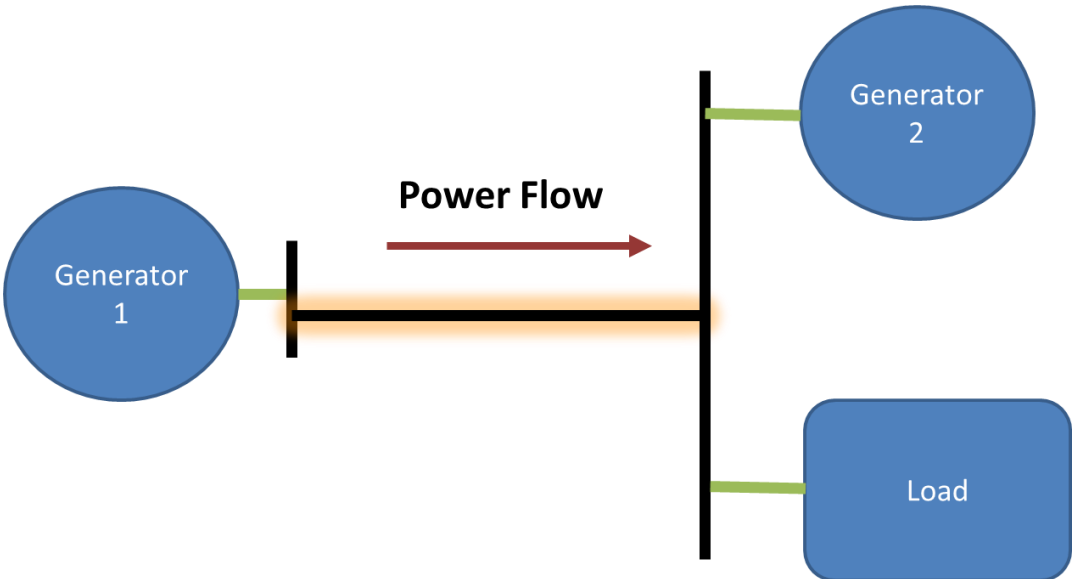


Figure 9 - Example of DER Dispatch

If Generator 1 and Generator 2 were aggregated, they would be modeled and dispatched as an aggregated single unit in the NYISO system. If the aggregation is dispatched up, the constraint will get

further aggravated due to injections from Generator 1. If the aggregation is dispatched down, NYISO would not be effectively using Generator 2 to relieve congestion.

The NYISO believes granular monitoring and control of DER aggregations at the transmission substation load bus level is needed to effectively and efficiently manage transmission system congestion and reliability. Therefore, the NYISO proposes that dispatchable DER aggregation boundaries to be limited to all DER interconnected to, and having direct impact on, the same transmission substation load bus.

C. Sizes and Types

Aggregations represented by a DCE will be known as a DCE Aggregation (DCEA). The NYISO is not proposing a minimum size restriction for the individual DER that are part of the DCEA, however DCEAs must be a minimum of 100 kW in total size. DCEAs will be allowed to participate in Capacity markets and be able to set Capacity prices.

The NYISO runs Security Constrained Economic Dispatch (SCED) nominally every five minutes. SCED is a complex mathematical optimization to dispatch resources to meet load for the least total production cost while respecting transmission constraints. Adding a multitude of smaller resources below a certain size to this already complex problem adds significant computational time with each small resource having little to no impact on the total production cost. The NYISO believes this minimum DCEA size appropriately balances the additional computational complexity of integrating small resources with the benefits to total production cost. The NYISO will integrate DCEAs based on the service provided:

1. Energy, Operating Reserves and/or Regulation

DCEAs that are 1 MW or greater will be eligible to provide Energy, Operating Reserves and/or Regulation. DCEAs that are qualified to provide Operating Reserves and/or Regulation are expected to be treated and modeled as a single PTID for scheduling and optimization purposes. Such DCEAs will be optimized by SCED, and they will be eligible to set prices in NYISO's Energy, Operating Reserves and/or Regulation markets.

2. Energy Only

DCEAs that are less than 1 MW can still participate in the NYISO wholesale market but can provide energy only. In order to maximize DER participation opportunities while minimizing impact to SCED, the NYISO will combine the offers of all DCEAs less than 1 MW into a "Super Aggregation" (SA) with the offers of all other such DCEAs at the same transmission node. SAs will be optimized by SCED, and they will be eligible to set prices in NYISO's Energy markets. After the schedule for the SA is determined, NYISO will disaggregate the schedule among individual DCEA.

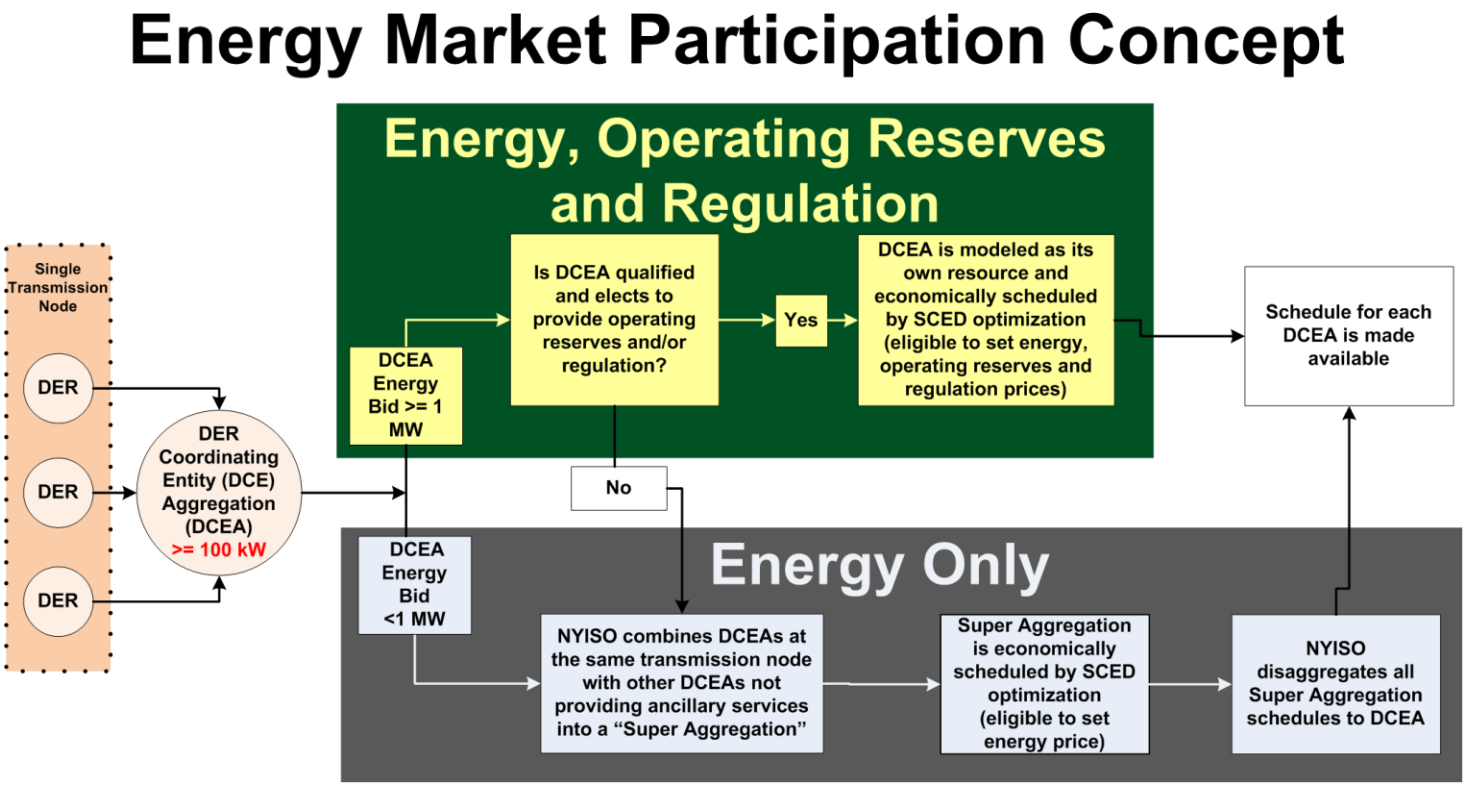


Figure 10 - Concept for DCEAs in Energy, Operating Reserves and Regulation

D. Coordination between the NYISO, Utilities, and DCEs

In order to facilitate the participation of DER in the NYISO's wholesale markets, it will be important that the NYISO establish seamless coordination practices with the NY utilities and the DCEs. This will ensure that the participation of DERs in the wholesale market does not compromise the reliability or safety of the transmission and distribution systems.

To allow for the accurate accounting of individual DER on the system and to ensure that all parties are aware of potential obligations for the DER and potential risks to the grid, the NYISO will establish registration processes that coordinate with the utilities and DCEs. This will allow the NYISO to verify that all DER part of the DCEA are capable of providing services to the NYISO and accurately map the DCEA to the correct transmission location. Additionally, this coordination will provide the utilities an opportunity to (i) review all individual DER, (ii) assess the DER impact on the distribution system, including mapping the individual components of the DCEA to the correct distribution location, and (iii) inform the NYISO if the DER or DCEA will present any reliability risk to the distribution system.

Further coordination will be required between NYISO, the utilities, and the DCEA to facilitate real-time electric system reliability and improved electric system planning processes. For example, the NYISO will expect that any offer provided by the DCEA account for any operational restrictions of the DER in the aggregation, as well as the distribution system that the DCEA is connected to. This obligation will require the DCEA and the utility to work closely with the NYISO ensuring that any dispatch instruction provided by the NYISO is a valid and executable instruction by the DCEA and maintains safe and reliable operation of the distribution system.

VIII. Measurement and Verification

Dispatchable DER participating in the NYISO's Energy or Ancillary Services markets will be scheduled and dispatched in a manner comparable to traditional Generators. DER will also be held to comparable compliance obligations as traditional Generators. Failure of DER to perform as scheduled may result in higher costs to consumers and may impact grid reliability. Therefore, the NYISO will work to develop performance criteria and compliance metrics for dispatchable DER. These criteria and metrics will be developed once greater clarity and consensus is reached on market rules related to aggregation. The NYISO has identified the following high-level topics it expects to address more fully in stakeholder discussions.

A. Metering and Telemetry Requirements

1. Real-time Telemetry for DCEA

DCEAs will be required to have 6-second real-time telemetry. The NYISO's current meter data infrastructure supports PTID-level data, primarily collected through real-time telemetry for real-time operations and monitoring functions, and after-the-fact uploads to support settlement. The integration of dispatchable DER into Capacity, Energy, and Ancillary Service markets is expected to follow a comparable model. DCEAs will be required to provide PTID-level (*i.e.,* aggregation level) real-time telemetry data for operations and monitoring functions. More granular circuit location data may be requested by the utilities as outlined in the individual utility interconnection requirements and the Supplemental Distributed System Implementation Plan (SDSIP). In addition, DCEAs will be required to provide, and after-the-fact meter data from individual resources for settlements which may not be as granular as the 6-second real-time requirement.

To ensure that NYISO and the utility have situational awareness, all real-time telemetry communications will be either through the utility (who then communicates with the NYISO), or, alternatively, to the utility and NYISO at the same time.

2. After-the-fact Meter Data for DER

All DCEAs will be required to have revenue-quality (minimum of ANSI C12 hourly interval metering) meter data for settlement and billing purposes, and for quality assurance of real-time data. The NYISO will use the same timelines for after-the-fact meter data submission for DCEA as that of traditional generators. Meter data for settlements and billing will be collected per DCEA.

The NYISO will require DCEs to provide the net meter data for each DER for verification purposes. If such a DER has on-site generation and/or storage, the NYISO will consider requiring after-the-fact meter data from two of the following: net meter, load meter, and generator/storage meter. The NYISO recognizes that the New York utilities are undertaking an effort to install Advanced Metering Infrastructure (AMI) meters in their service territories and NYISO intends to leverage this meter data to the extent possible.

3. DCEA Sampling

The NYISO is considering permitting aggregations of less than 1 MW to use real-time telemetered data from a sample set (at least 30%) of DER in a DCEA. This is primarily intended for residential and small C&I customers. The purpose of sampling is to provide a representative view of the real-time performance of the entire DCEA without subjecting small DER to onerous metering requirements. The NYISO will explore whether this sampled data can be used for settlement, billing, audit/verification and telemetry. The feasibility and associated requirements of this approach will be developed as part of the detailed market design phase of this initiative.

4. Meter Data Service Providers

The NYISO's existing demand response program rules require demand response resources to have the utility or a New York PSC-certified Meter Data Service Provider or Meter Service Provider read the interval meters used for wholesale market participation. The NYISO recognizes that this is a potential barrier to entry for DER and will explore options to address this barrier as the DER program evolves. This will be evaluated as part of the 2017 study on meter data requirements for DER.

B. Baselines

A baseline is the estimated amount of energy use expected by a facility if a load reduction had not occurred in response to the NYISO instruction or schedule. The NYISO currently uses baselines to measure performance of demand response resources, and expects to use baselines for DER that are net loads.

1. Recommendations from the 2014 Baseline Study

The NYISO and DNV GL conducted a Baseline Study in 2014 to investigate baseline methodologies for the SCR program.[21] Notably, the study recommended that the Average Coincident Load (ACL) baseline should be used to determine the upper limit on the amount of capacity a SCR could offer, and that a Customer Baseline Load (CBL) should be used to measure resource performance in the Energy market. The NYISO plans to draw on conclusions of that study for dispatchable DER relying on a baseline methodology to measure performance. DER participating in the Ancillary Services market will be measured by the current DSASP baseline to evaluate performance for the ancillary product. The NYISO will work on establishing detailed market rules to measure the performance of a net load DER that is simultaneously providing energy and reserve products.

The study also recommended potential enhancements for the CBL methodology. The enhancements were specifically related to the exclusion rules and the caps on in-day weather adjustments. The NYISO intends to incorporate these recommendations in the baseline methodologies used for DER.

2. Baselines for Different Technology and Load Types

The NYISO plans to adapt these general baseline methodologies to accommodate different technologies and load types. For example, a CBL methodology for a highly variable load may be different from the CBL methodology for a load with a high load factor. The NYISO also recognizes that existing baseline methodologies may not accurately represent the load profile of small customer, weather-sensitive loads, and intends to explore different baseline measurement methodologies for such resources. Similarly, the NYISO recognizes that the existing methodologies may not be appropriate for behind-the-meter energy storage devices and intends to evaluate baseline methodology options that account for the unique characteristics of behind-the-meter energy storage. Although the NYISO intends to use CBL methodology to measure Energy market performance in instances when DER are net-loads (*i.e.*, consuming energy from the grid) and net meter data when DER are net injectors (*i.e.*, injecting energy into the grid), the NYISO is evaluating whether baselines may still be needed for net injectors in special situations.

[21] NYISO SCR Baseline Study, New York Independent System Operator, Inc. (prepared by DNV KEMA, Inc.) (Mar. 2014), http://www.nyiso.com/public/webdocs/markets_operations/market_data/demand_response/Demand_Response/Special_Case_Resource_ICAP_Program/NYISO%202013%20SCR%20Baseline%20Study%20Report-final.pdf.

C. Settlements

The NYISO expects DER settlements to be comparable to the existing settlements processes for traditional generators. Dispatchable DER will be measured at their applicable PTID and will be subject to the same settlement timelines for meter data submissions as that of traditional generators.

The NYISO currently has special settlement provisions for the electricity consumed to charge the storage devices participating as Limited Energy Storage Resources (LESR). The NYISO will consider evaluating if additional settlement rules would be required for the electricity consumed to charge behind-the-meter storage devices participating in the dispatchable DER program.

IX. Performance Obligations

A. DER that are ICAP Suppliers

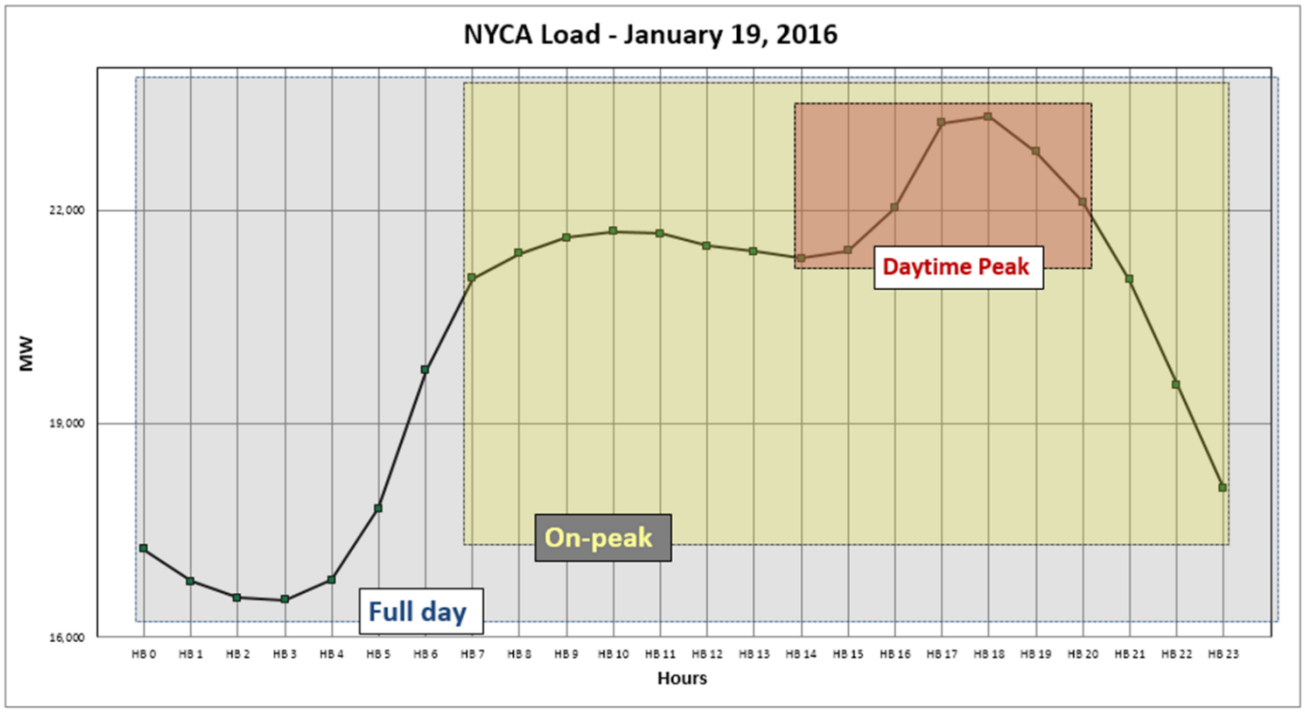
Traditional generators participating in the NYISO Capacity market are required to submit Day-Ahead Market bids for at least the amount of capacity they sold in the Capacity market. The NYISO proposes to require dispatchable DER to submit Day-Ahead Market bids for at least the amount of capacity they sell in the Capacity market. At this time the NYISO believes DER desiring full capacity payments will be expected to be capable of delivering its full capacity for a full 24 hour period, comparable to what is expected of traditional generators.

The NYISO recognizes that some DER will be unable to deliver capacity in all 24 hours due to its physical characteristics (*e.g.*, DER aggregations consisting of load curtailment assets that have a typical "9 to 5" load profile). These DER are still valuable to the system, but perhaps less than a full 24 hour DER. In order to determine the varying degree of operational benefit that different DER can provide to the grid, the NYISO intends to develop options for service tiers that dispatchable DER can provide to help the NYISO meet its daily load. The NYISO currently proposes three such tiers - full day service, on-peak service and daytime peak service, where:

1. Full day service is the provision of wholesale service for all 24 hours in a day;
2. On-peak service is the provision of wholesale service to help the NYISO meet its load during early morning through late evening hours; and
3. Daytime peak service is the provision of wholesale service to help the NYISO manage its daily peak hours.

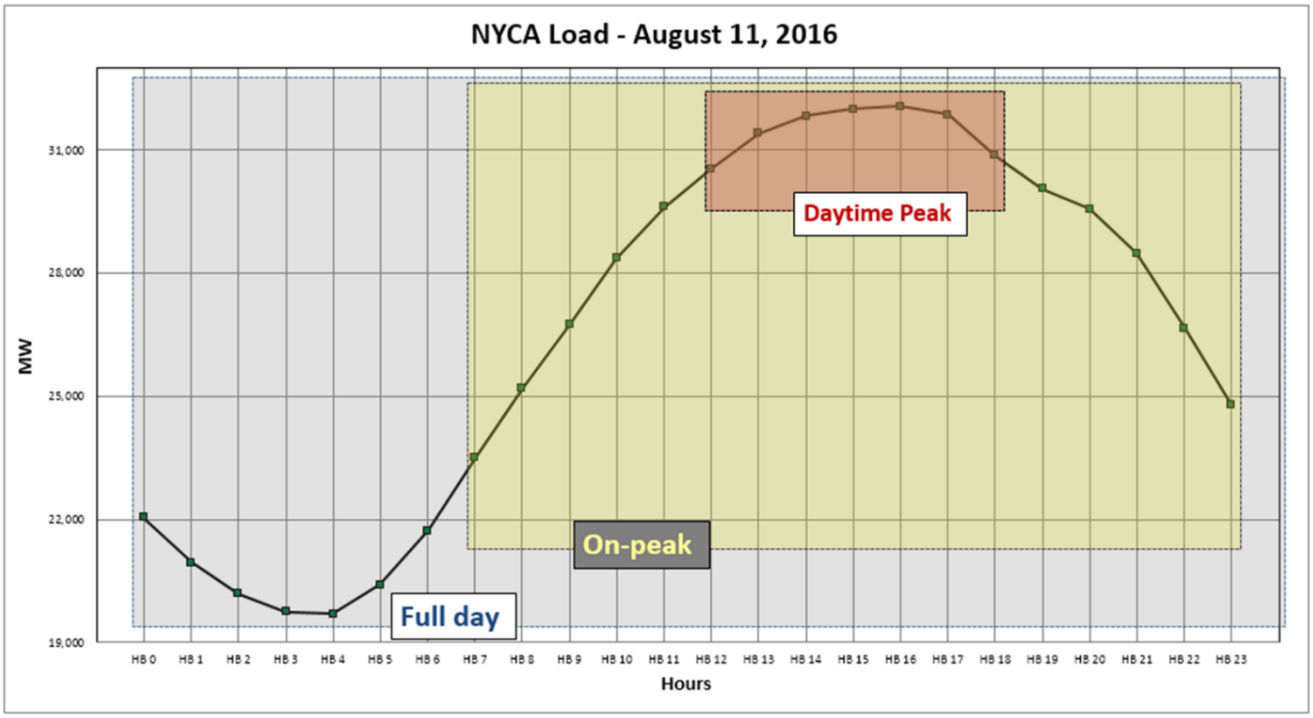
Consistent with the key principle of aligning payments with system requirements, the NYISO believes that Capacity market compensation commensurate with a DER's capabilities and performance is appropriate, and, therefore, the NYISO expects to develop market rules through the stakeholder process to prorate capacity and associated capacity payments.

As part of this effort, the NYISO also plans to look at establishing a window of time in which the DER must offer for those providing fewer than 24 hours of service. This window is expected to be consistent with the service that DER is intended to perform for the NYISO to balance supply and demand.



Note: NERC defines "On-peak" as 7am to 11pm (HB 7 to HB 22) for the Eastern Interconnection

Figure 11 – Example of Winter Load



Note: NERC defines "On-peak" as 7am to 11pm (HB 7 to HB 22) for the Eastern Interconnection

Figure 12 – Example of Summer Load

The purpose of NYISO's DAM is to procure enough supply to meet the load bid in the NYISO's DAM. All 10-minute-capable traditional generators east of Central East have an obligation to offer into the real-time market. The NYISO intends to apply the same obligation to dispatchable DER to offer in the real-time market. If more supply resources are required due to system condition changes in real-time, NYISO operations can initiate its Supplemental Resource Evaluation (SRE) process. All NYISO capacity resources are eligible for selection and are required to respond to a SRE request in real-time regardless of whether they received an award/schedule in the DAM. Consistent with the obligations of traditional generators, DER with a Capacity obligation must also be available in real-time for the amount of capacity sold into the capacity market. Because SRE is a manual operator action and inherently involves operator judgment, it does not guarantee lowest production cost. Given the expected size and number of DER, it is operationally challenging to SRE these resources in real-time if they do not clear in the DAM, and therefore will necessitate additional operator tools to facilitate the most economic SRE process for such resources. The NYISO also intends to evaluate whether to extend these obligations to the Day-Ahead Reliability Unit process as well.

As part of this effort, the NYISO also plans to evaluate the feasibility of market software and NYISO system operators making commitment decisions for DCEAs. This could potentially involve evaluation of DER-specific thresholds of existing offer parameters, such as minimum down time,[22] minimum run-time, response rate, and to introduce a new DER offer parameter, maximum commitments per day. The threshold for the minimum run-time for DER is the minimum time a resource will be committed by the Real-Time Commitment software. Response rate is the speed with which a resource can reach its upper operating limit within the minimum run-time.

DER will be required to be available during all intervals in which they submit offers to provide wholesale service. If DER is derated or unavailable, it must report its unavailability to NYISO. Given the expected size and number of DER, the NYISO expects to modify its outage software to accommodate DER.

Because aggregations are likely to include multiple technologies, the NYISO expects to develop market rules that will allow DCEs to manage the performance from various resource types in order to meet the requirements discussed above. For example, an aggregation with a 24-hour capacity obligation might rely on load curtailment assets to provide performance during the day and generation assets when sufficient load curtailment capability is not available to meet the aggregation's obligation. In another scenario, if an aggregation is scheduled for four hours, the DCE may choose to meet its obligation by discharging storage devices for two hours and by load curtailment for the remaining two hours. Importantly, the NYISO intends to establish performance obligations at the aggregation level, and not at individual resource level.

[22] Minimum down time in the context of load curtailment assets would mean the time between consecutive interruptions.

	Traditional Generator with Capacity Obligation	DER with Capacity Obligation
Products (if qualified)	***Energy, Capacity and Ancillary Services***	***Energy, Capacity and Ancillary Services***
Day-Ahead Market	***Must-offer for 24 hours***	***Must-offer for 24 hours for Full Day service (Prorated capacity and associated payments for on-peak and daytime peak service)***
Real-Time Market	***Must be available in real-time***	***Must be available in real-time***
Activation	***Economic Dispatch or Self-Schedule***	***Economic Dispatch or Self-Schedule***

Figure 13 – Capacity Resource Obligations

NYISO has received stakeholder feedback requesting consideration of additional performance attributes when we begin the market design process. Stakeholders have indicated such attributes include service duration, operational flexibility, and response rate. The NYISO anticipates exploring these three additional attributes, as well as others recommended by stakeholders.

B. DER that are not ICAP Suppliers

DER that are not ICAP Suppliers may offer into the Energy and Ancillary Services markets and be scheduled by the NYISO. DER that are participating only in the Energy and Ancillary Service market will be expected to have similar obligations as traditional generators when they are only participating in the Day-Ahead and/or Real-Time Markets.

X. DER Integration into System Planning

Integration of DER into the NYISO's Energy, Ancillary Services, and Capacity markets will likely require changes to the existing planning, interconnection and forecasting rules and procedures. These changes, however, will be dependent on market design details that will be determined through the upcoming stakeholder process. Once the NYISO has more clarity and consensus on these details, revisions to existing rules and process will be proposed.

XI. Simultaneous Participation in Retail/Distribution-Level Programs

The NYISO expects that many DER will be connected to the distribution networks and capable of providing distribution level services to the extent its utility seeks such services. The NYISO recognizes that DER would like to provide wholesale service and retail service, thereby accessing multiple revenue streams. With the exception of certain demand response programs, simultaneous participation is a new concept to the NYISO, and is being explored to determine impacts to the markets and grid operations.

Currently, resources participating in NYISO SCR program and EDRP have the option to participate in utility level demand response programs. The NYISO intends to continue allowing DER participating in utility level Demand Response programs to participate in the NYISO SCR program and EDRP. The NYISO is also in ongoing conversations with utilities to explore the possibility of additional dual participation opportunities (*e.g.*, NYISO will explore whether Non-Wire Alternative (NWA) resources are eligible to participate in the dispatchable DER program), but many operational, market, and legal challenges must be addressed prior to defining further opportunities for dual participation. Some of the outstanding issues that need to be addressed include:

- Whether the NYISO or DSP has operational control over a DER in a given interval, and whether that changes depending on the services provided?
- What are the appropriate communications paths when participating in wholesale and retail programs?
- How do the NYISO and utilities address conflicting market signals? A market signal from NYISO may be in direct conflict with the market signal from the DSP and vice versa. If the resource has obligations to both markets, does the DER make the decision as to which signal to follow causing uncertainty for NYISO and distribution system operators? The resource's response to these multiple signals could lead to wholesale or retail/local operational and reliability issues.
- Can individual DER in an aggregation participate in both wholesale and retail markets, or is such participation on an aggregation-wide basis (and if it is on an individual DER basis, who is responsible for non-performance, the aggregation or the DER)?
- If a storage resource charges at a wholesale rate and discharges to an end-use customer through a retail program, does the electric storage resource become a LSE by engaging in sales for resale? What regulatory issues are implicated by occasional sales for resale?
- What is the FERC's view of simultaneous participation?

The NYISO and the utilities are collaborating and discussing these challenges. Enhanced planning, operational, and market coordination will be required between all involved. As these challenges are new they may best be handled by establishing some initial concepts and validating them as Pilot Projects. Once the NYISO has determined a particular project is feasible, it can be included in the full market design. Testing new ideas as Pilot Projects allows the NYISO and its stakeholders to determine whether a project is valuable and viable while minimizing financial and reliability impacts to the entire transmission and distribution systems.

XII. Other Considerations

The NYISO has identified several other considerations it will need to address as part of its future detailed market designs. These issues include:

- Consider receiving the electric storage resource "State-of-Charge" (SOC) level from individual DER through real-time telemetry in order for the NYISO to provide State-of-Charge management, similar to the way NYISO provides State-of-Charge management for LESR. The NYISO is also reviewing other tools to facilitate electric storage resource participation in its Energy Storage Integration and Optimization project. Although this effort is aimed at front-of-the-meter resources, the tools would be made available to DER if they are found practical and useful for DER energy management.

- The NYISO requested clarification from the Northeast Power Coordinating Council (NPCC) on whether resources that rely on inverter technology (such as batteries) can provide synchronous reserves. The NPCC has confirmed that inverter based technologies are eligible to provide synchronous reserves. NYISO intends to use this clarification from NPCC as it formulates the DER eligibility requirements for providing synchronous reserves.
- Some DER may utilize technologies that are capable of supplying leading and lagging VARs to the bulk system. If a DER wishes to qualify for Voltage Support Service (VSS), they will be subject to all of the tariff and manual requirements that apply to current service providers.
- The NYISO will consider establishing generic reference prices for DER offering in the energy market. If a resource or aggregation can demonstrate differing costs, they can consult with the NYISO's Market Mitigation and Analysis Department for an adjusted reference price.
- The NYISO will also evaluate how load served by DER operating at the time of the system peak will be incorporated into load forecasts and LSE capacity obligations.
- The NYISO will be evaluating the appropriate penalty structure for DER, including penalties for non-performance.
- The NYISO believes that energy efficiency is compensated by energy savings and reducing the load's cost to procure capacity. Therefore the NYISO will not be addressing energy efficiency in the DER Roadmap at this time.
- The dispatchable DER program design will need to consider FERC Order No. 745 compliance, including but not limited to the application of Net Benefits Test concept for load reduction based resources.

XIII. Transition plan

The DER roadmap is intended to be a starting point for conversations with stakeholders to develop the detailed market rules, requirements, and software. This effort will take several years to develop and implement. The programs currently in place will continue "as is" for the immediate future. As the market design evolves in collaboration with stakeholders, there may be interim or transitional changes made to the existing demand response programs. Ultimately, the dispatchable DER rules will supersede the economic demand response programs (DSASP and DADRP), as the new rules will offer similar benefits with increased features and flexibility. The reliability-based Demand Response programs (SCR and EDRP) are expected to continue, with some changes to better align these programs with the DER market rules. Any changes to the SCR program, including eligibility, obligations, or payments, will be addressed after the development of the dispatchable DER program concepts. If NYISO determines future changes to the SCR program are warranted, NYISO will work with stakeholders to develop an appropriate transition plan from the current rules.

XIV. Other Supporting Initiatives

A. NYISO Pilot Framework

The NYISO has a 2017 initiative to develop a framework in collaboration with its stakeholders to enable small, limited scope pilot projects to be tested in the wholesale markets to help the NYISO gain an understanding of how the integration of various new technologies will affect NYISO systems. The

expectation is that the NYISO will use that understanding to develop detailed market rules and tariff changes to fully integrate these technologies into NYISO markets and operations.

Pilot projects will allow NYISO and its stakeholders (DSPs, Aggregators and Individual Resources) to test the concepts developed to address challenges discussed in this Roadmap. By testing these concepts as pilot projects potential wholesale market integration issues can be identified and mitigated, reducing or eliminating system impacts.

To ensure that there is minimal impact on the larger transmission and distribution systems, and to prevent potential harm to other Market Participants, pilot projects will not be eligible to set prices in the NYISO markets.

B. REV Demonstration Support

The PSC's REV proceeding requires distribution utilities to propose, develop, and implement demonstration projects to advance the goals of the proceeding. The NYISO is working with the utilities as they develop these demonstration initiatives to support any efforts that require coordination or integration with bulk power system operations or wholesale markets.

C. Granular Pricing

Price transparency is a critical element of animating markets and encouraging economically efficient decision-making. The dispatchable DER market rules will automate DER activation based on price signals and the participant's economic willingness to consume electricity from the grid. This economic willingness needs to be informed by actionable information.

The NYISO currently delivers real-time load bus price signals, calculated every five minutes, at the zonal level. These price signals are comprised of sub-zonal price signals that reflect differing conditions within a given zone. Sub-zones and load pockets within a zone may experience real-time conditions that are not fully reflected in the zonal price. Pricing at the zonal level, therefore, dilutes incentives for DER to locate in areas that could provide significant benefits to the grid and the market. To facilitate more economically efficient DER benefits, the NYISO will provide more granular price signals reflecting location specific system conditions. These granular price signals are available to the NYISO, but have not been publicly available. To provide more locationally accurate pricing data to DER, resources that choose to participate in the NYISO's Energy and Ancillary Services markets will be mapped to their appropriate electrical buses and settled at the nodal price associated with the bus. The NYISO's goals are to deliver real-time nodal LBMPs, calculated every five minutes, to reflect more localized system conditions. The NYISO is currently posting a limited set of these nodal load prices at select locations around the state as part of a pilot initiative.

These granular prices will not be used for wholesale Load settlements.

D. Market Price Delivery

The NYISO will continue to post pricing data on its website, as well as in maps and graphical forms. The NYISO plans to explore other options including Automated Programmatic Interfaces (API) for sharing and transfer of nodal pricing.

E. Meter Data Policy

One of the key challenges to participation of DER in NYISO markets is accurately measuring and verifying resource performance in order to compensate resources appropriately. DER participating in the NYISO's Energy and Ancillary Services markets will require well-defined metering configurations as well as processes for calculating baseline load levels from which to measure performance. Establishing the baseline will require estimating a participant's load based on data from time periods in advance of DER

dispatch to establish an average load profile. The participant's performance, and ultimately compensation, will reflect the deviation of its load from that estimated baseline.

Behind-the-meter generators and storage devices further complicate these calculations because operation of such generation or storage for local needs alters the baseline demand making it more difficult to assess DER performance. A policy for meter data and metering requirements will be critical to ensuring the integrity of the market. The ability for the NYISO to measure gross generation and gross native load at DER sites participating in NYISO markets will be necessary to ensure that the market is properly compensating DER for their contribution to system needs. The NYISO proposes to work with stakeholders to devise and specify acceptable metering configurations and reporting requirements in compliance with meter data protocols.

Currently, the NYISO requires Market Participants to have the utility or a PSC-certified Meter Data Service Provider or Meter Service Provider to read interval meters. The NYISO recognizes that this is a potential barrier for DER to enter the market and hopes to explore options to address this barrier as the DER program evolves.

XV. Next Steps

The fundamental premise behind the NYISO's proposed dispatchable DER program initiative is straightforward: competitive markets and system operations will benefit from access to emerging technologies that can adjust demand on an economic basis in response to price signals from the market. However, developing and implementing such an initiative will entail a considerable amount of time, effort, and stakeholder engagement. The NYISO will use this roadmap over the next three to five years as a framework to develop the market design elements, functional requirements, and tariff language necessary to implement its vision to integrate dispatchable DER.

XVI. Appendix A – Use Cases for DER in Wholesale Markets

A. Fixed Load Consumers

A consumer that can be thought of as the consumer of today, where there is little ability to change their power consumption based on price/dispatch signals. This consumer prefers to simply use power when they want, how they want, and will pay for their usage as is. They prefer to not think about or be inconvenienced by any type of load reduction or shifting due to power prices at that time.

Fixed load
Small residential customer, no controls, may have solar panels, pays weighted zonal price, no advanced metering.

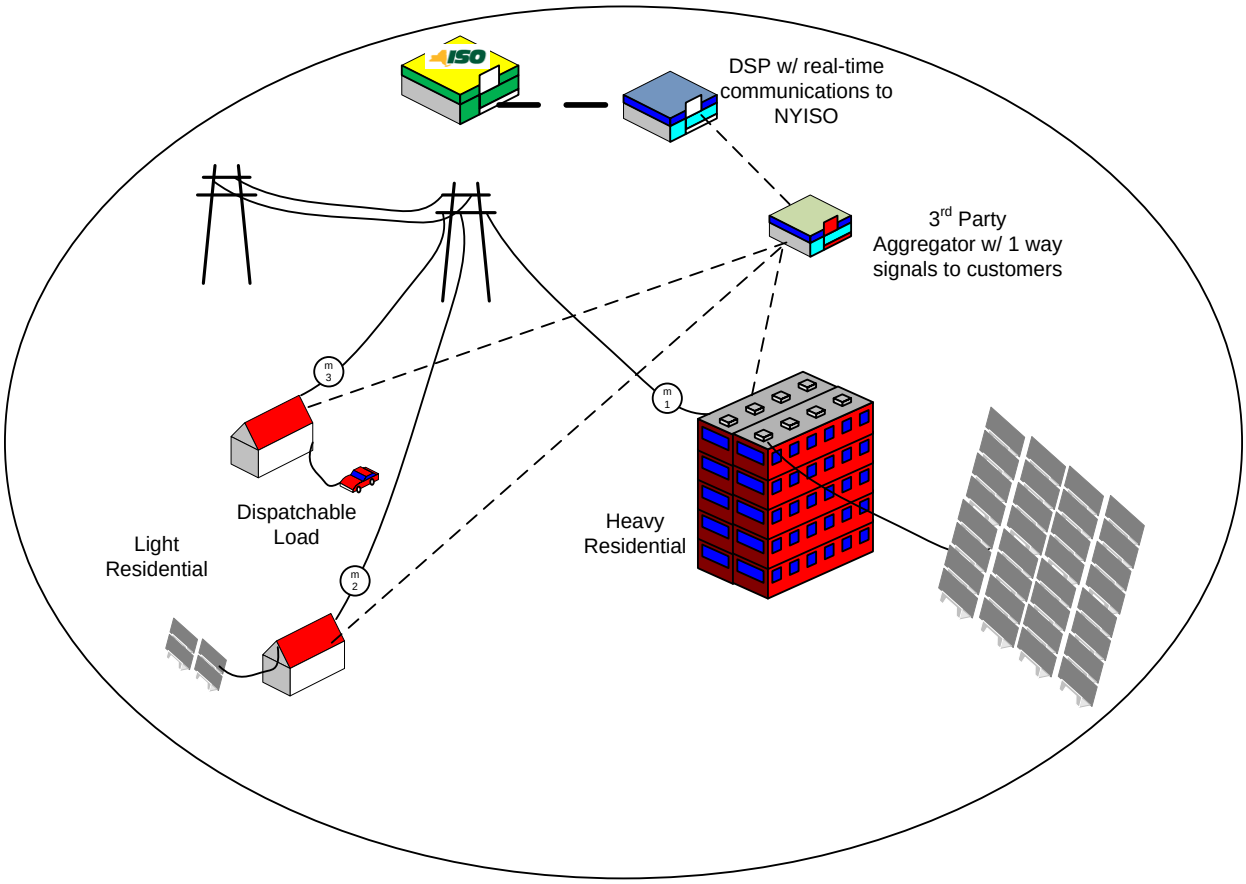
B. DER Prosumers

This prosumer is price conscious and is willing to make investments of time and/or money to generate cost savings by reacting to a price signals.

DER Prosumer Use Cases

#	Type	Description
i	Dispatchable Load	An DCEA of small to large size residential customers with dispatchable load only
ii	Dispatchable Load	Similar to #1 but there is no DCEA
iii	Dispatchable Load and Generation	An DCEA of small to large size residential customers with dispatchable load and generation with electronic communications going through an aggregator
iv	Dispatchable Load and Generation	Similar to #3 but there is no DCEA and electronic communications are direct to the DSP
v	Dispatchable Load and Storage	Similar to #3 except generation is replaced with storage
vi	Dispatchable Load and Storage	Similar to #4 except generation is replaced with storage
vii	Dispatchable Load, Storage and Generation	Similar to #3 except it includes storage
viii	Dispatchable Load, Storage and Generation	Similar to #4 except it includes storage

1. Use Case 1 -– Dispatchable Load



Participant(s)	Small to large size residential customers
Features	Partially sophisticated load
Metering	Interval metering
Signaling	Partially sophisticated notifications to curtail load
Dispatchable	Partial load
Aggregated	Yes
Services	Energy and possibly Capacity (EDRP or SCR)
Telemetry Communications Path	N/A
Notes	

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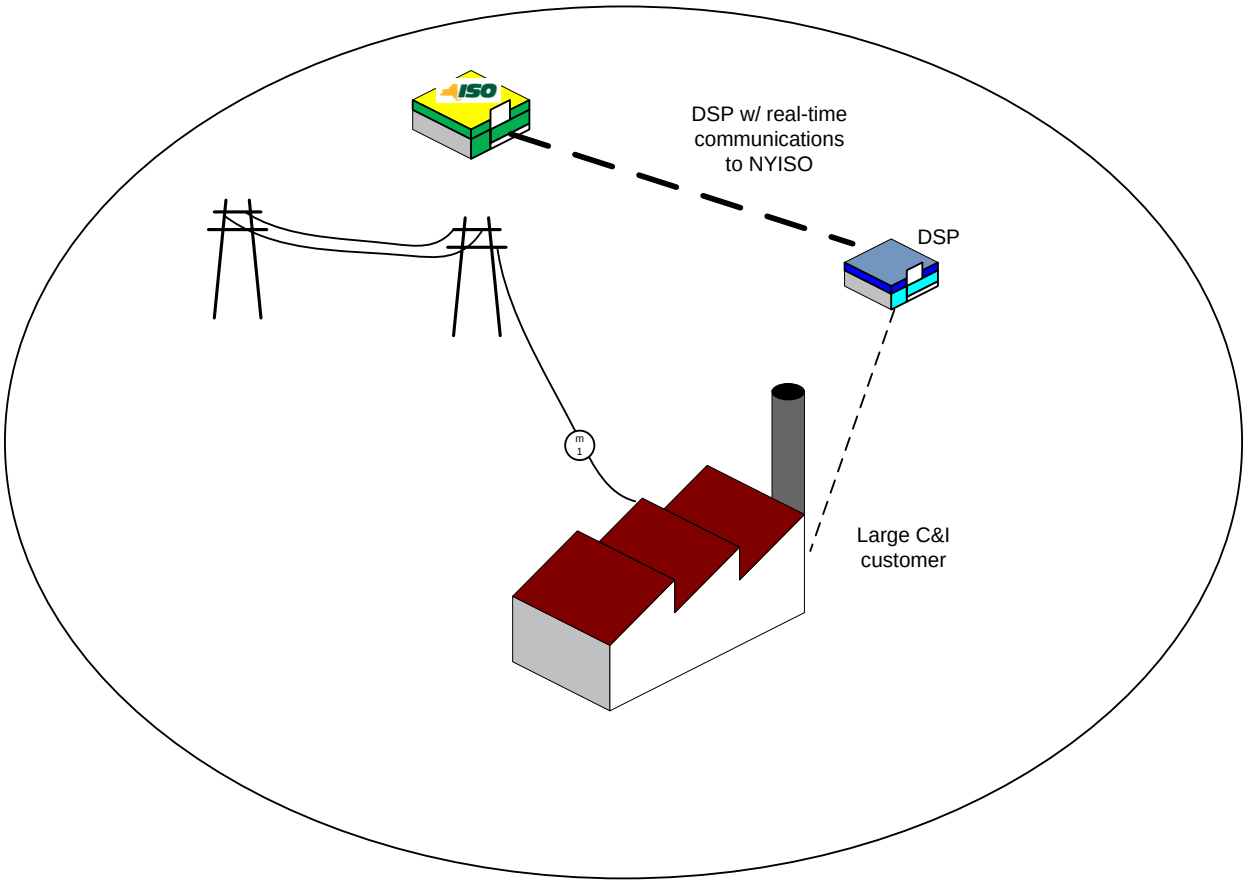
2. Use Case 2 - Dispatchable Load



Participant(s)	Medium to large size C&I customers
Features	Partially sophisticated load
Metering	Interval metering
Signaling	Partially sophisticated notifications to curtail load
Dispatchable	Partial load
Aggregated	No
Services	Energy (EDRP)
Telemetry Communications Path	N/A
Notes	Similar to #1 but there is no aggregation

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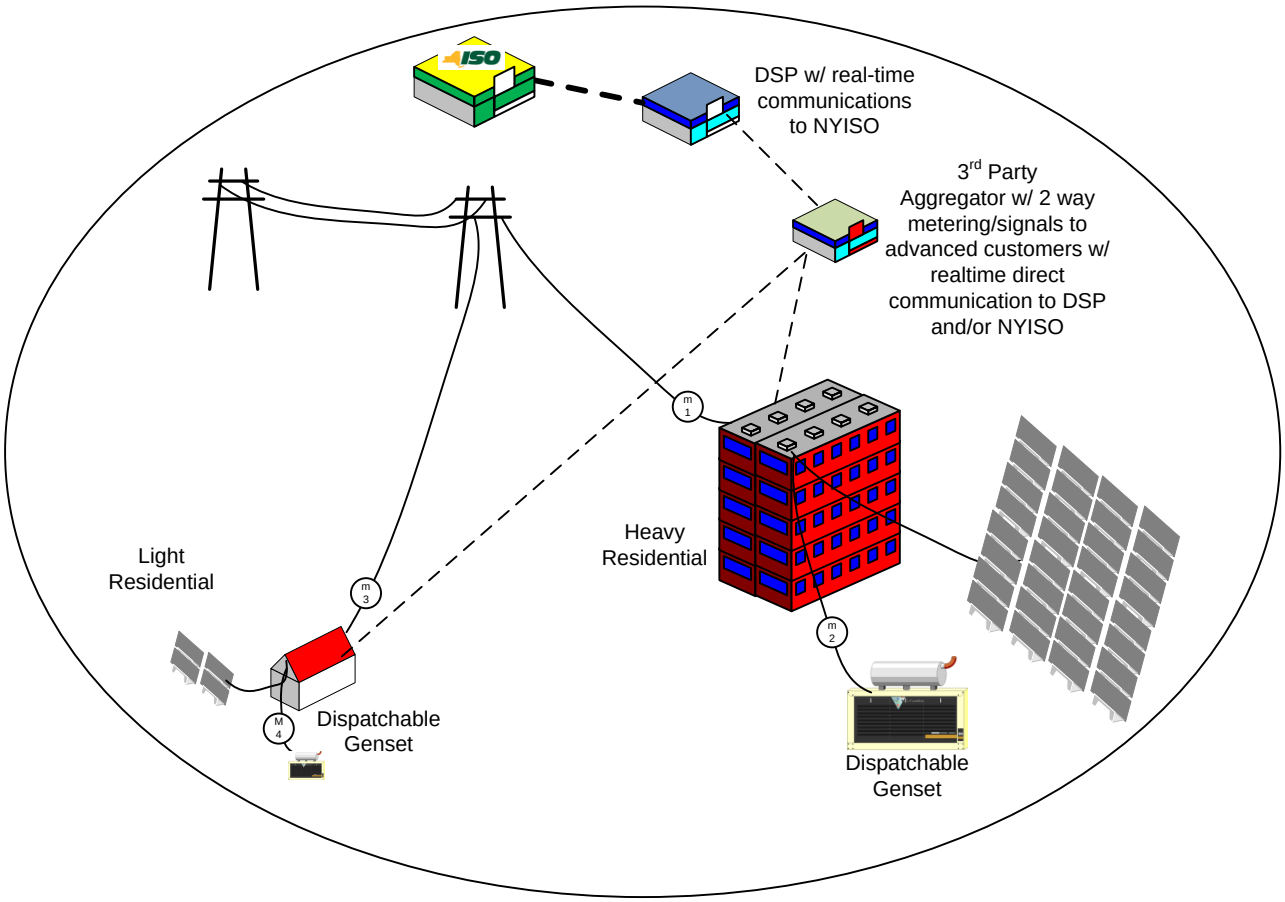
3. Use Case 3 - Dispatchable Load and Generation



Participant(s)	Small to large size residential customers
Features	Sophisticated load and sophisticated generation
Metering	Real-time metering with telemetry
Signaling	Capable of sophisticated notifications to curtail load and/or activate other services as instructed
Dispatchable	Load, storage & generation
Aggregated	Yes
Services	Energy, Capacity and Reserves
Telemetry Communications Path	Aggregator -> DSP -> NYISO
Notes	

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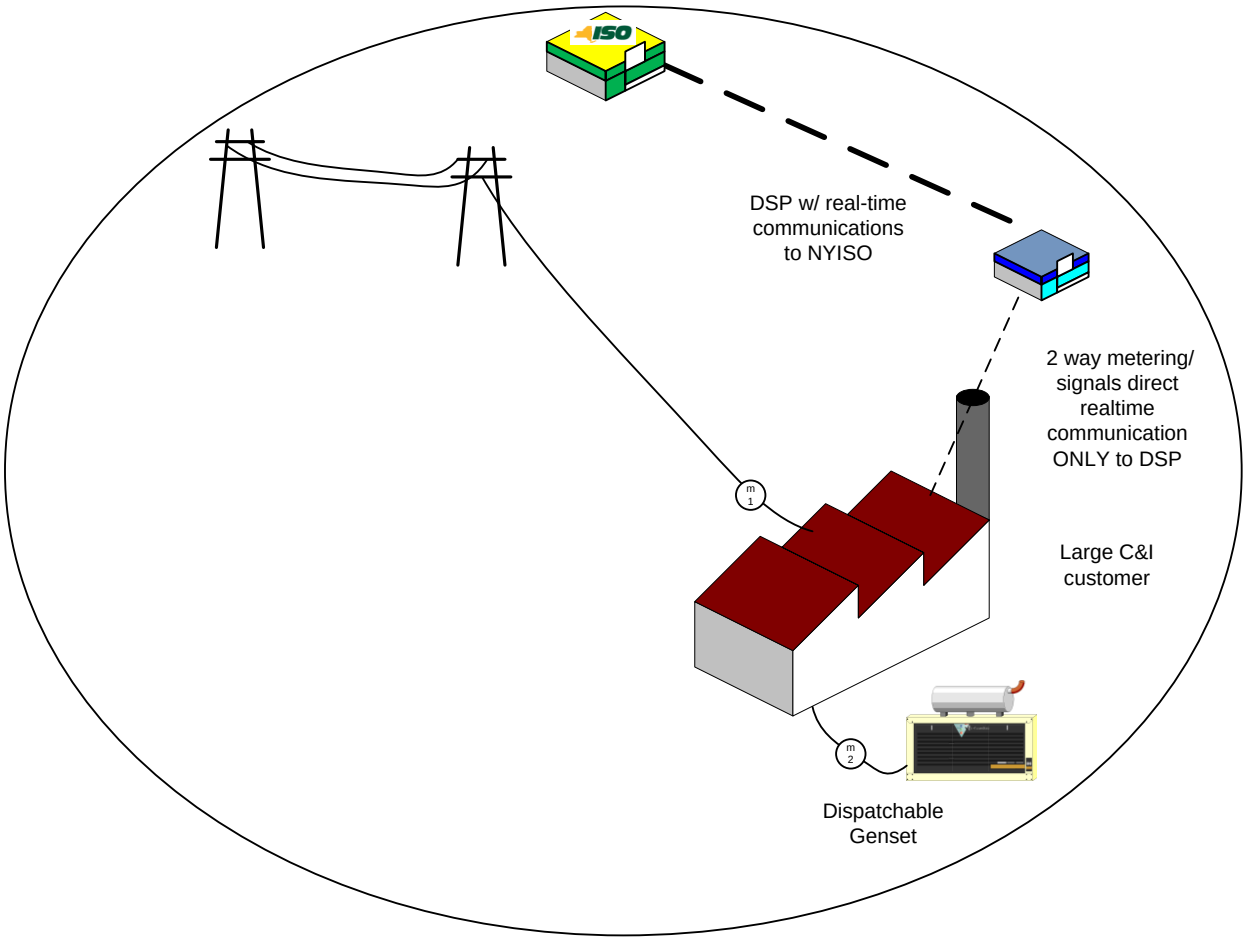
4. Use Case 4 - Dispatchable Load and Generation



Participant(s)	Medium to large size C&I customers
Features	Sophisticated load and sophisticated generation
Metering	Real-time metering with telemetry
Signaling	Capable of sophisticated notifications to curtail load and/or activate other services as instructed
Dispatchable	Load & generation
Aggregated	No
Services	Energy, Capacity, Reserves
Telemetry Communications Path	Aggregator -> DSP -> NYISO
Notes	Similar to #3 but there is no aggregation and electronic communications are direct to the DSP

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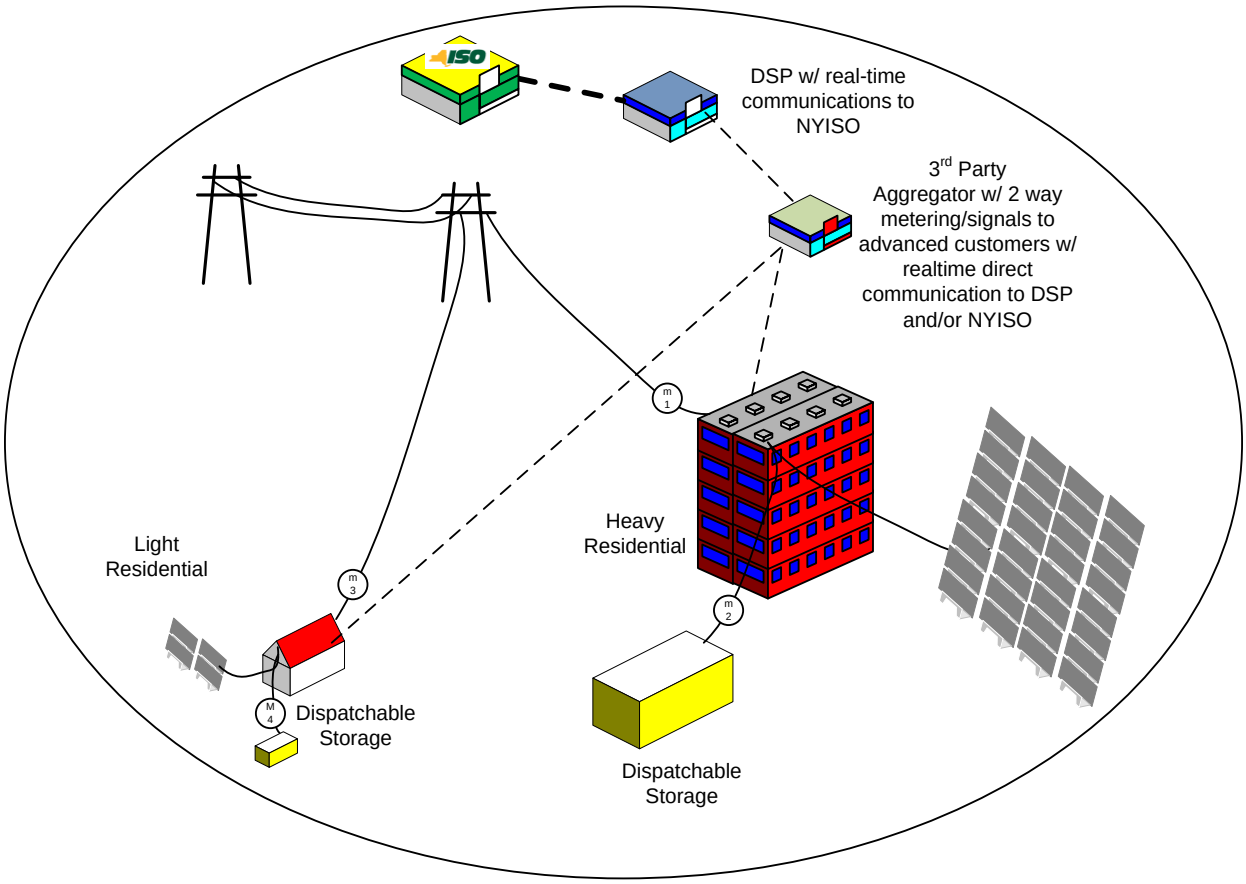
5. Use Case 5 - Dispatchable Load and Storage



Participant(s)	Small to large size residential customers
Features	Sophisticated load and sophisticated storage
Metering	Real-time metering with telemetry
Signaling	Capable of highly sophisticated notifications to curtail load and/or activate other services as instructed
Dispatchable	Load & storage
Aggregated	Yes
Services	Energy, Capacity, Reserves, Regulation
Telemetry Communications Path	Aggregator -> DSP -> NYISO
Notes	Similar to #3 except generation is replaced with storage

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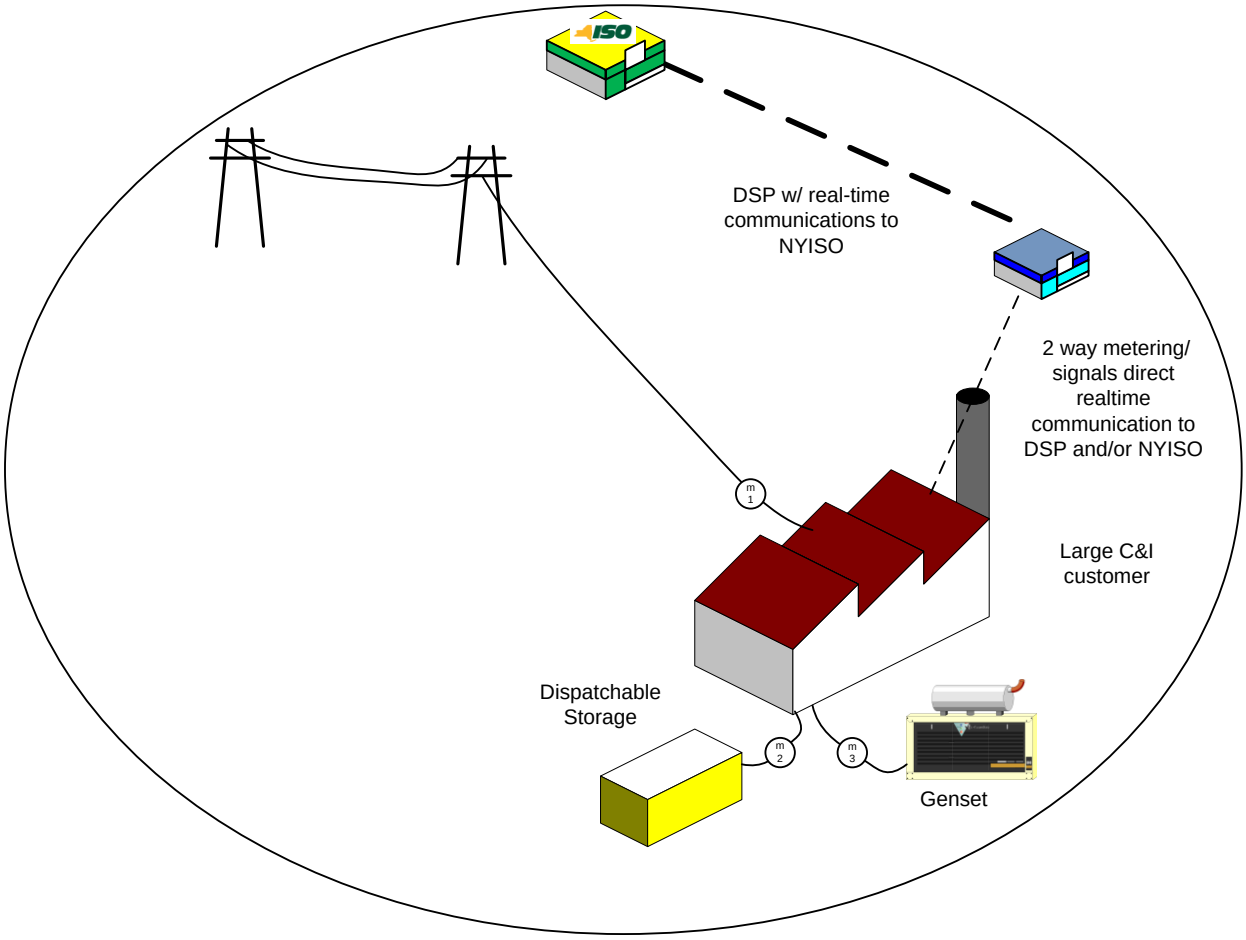
6. Use Case 6 - Dispatchable Load and Storage



Participant(s)	Medium and large size C&I customers
Features	Sophisticated load and sophisticated storage
Metering	Real-time metering with telemetry
Signaling	Capable of sophisticated notifications to curtail load and/or activate other services as instructed
Dispatchable	Load & storage
Aggregated	No
Services	Energy, Capacity, Reserves, Regulation
Telemetry Communications Path	Aggregator -> DSP -> NYISO
Notes	Similar to #4 except generation is replaced with storage

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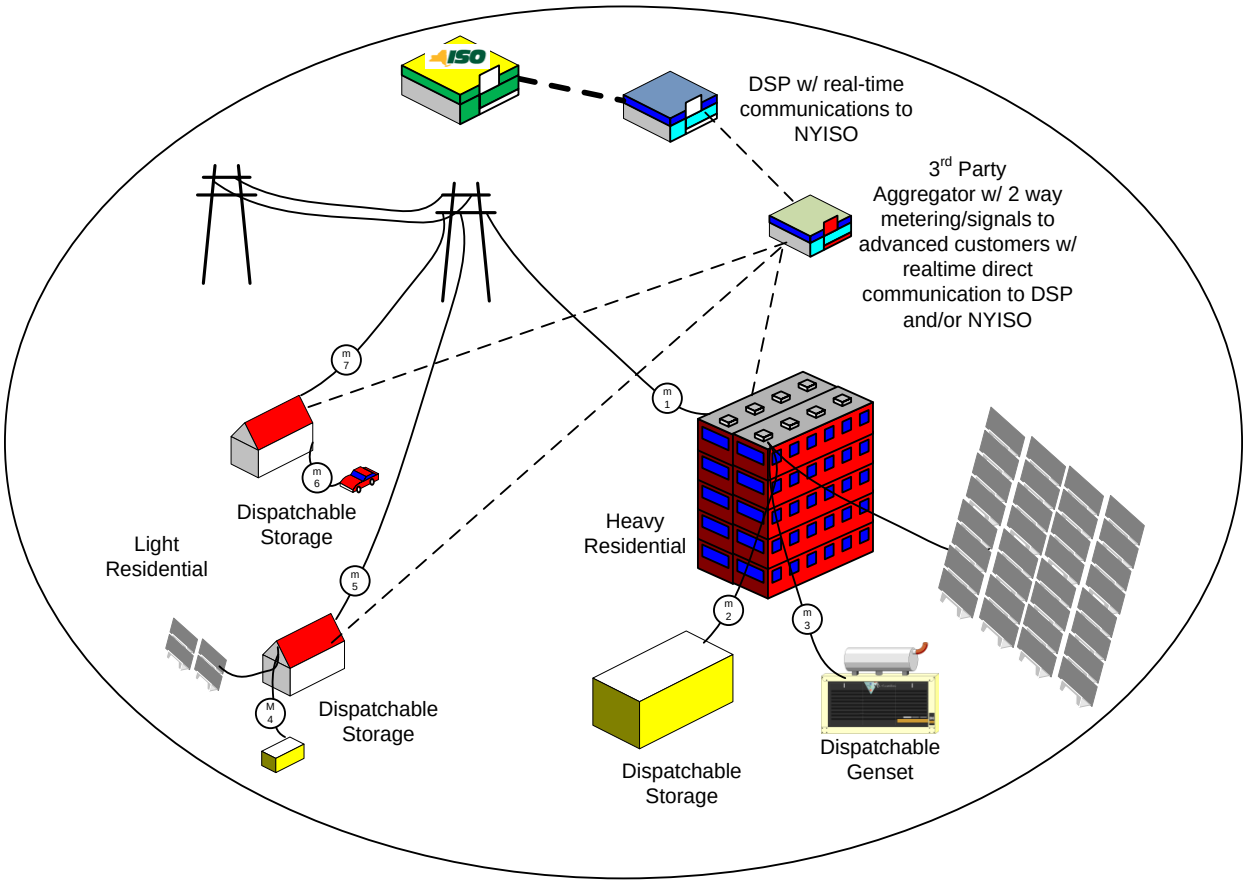
7. Use Case 7 - Dispatchable Load, Storage and Generation



Participant(s)	Small to large size residential customers
Features	Sophisticated load, sophisticated storage and sophisticated generation
Metering	Real-time metering with telemetry
Signaling	Capable of sophisticated notifications to curtail load and/or activate other services as instructed
Dispatchable	Load, storage & generation
Aggregated	Yes
Services	Energy, Capacity, Reserves, Regulation
Telemetry Communications Path	Aggregator -> DSP -> NYISO
Notes	Similar to #3 except it includes storage

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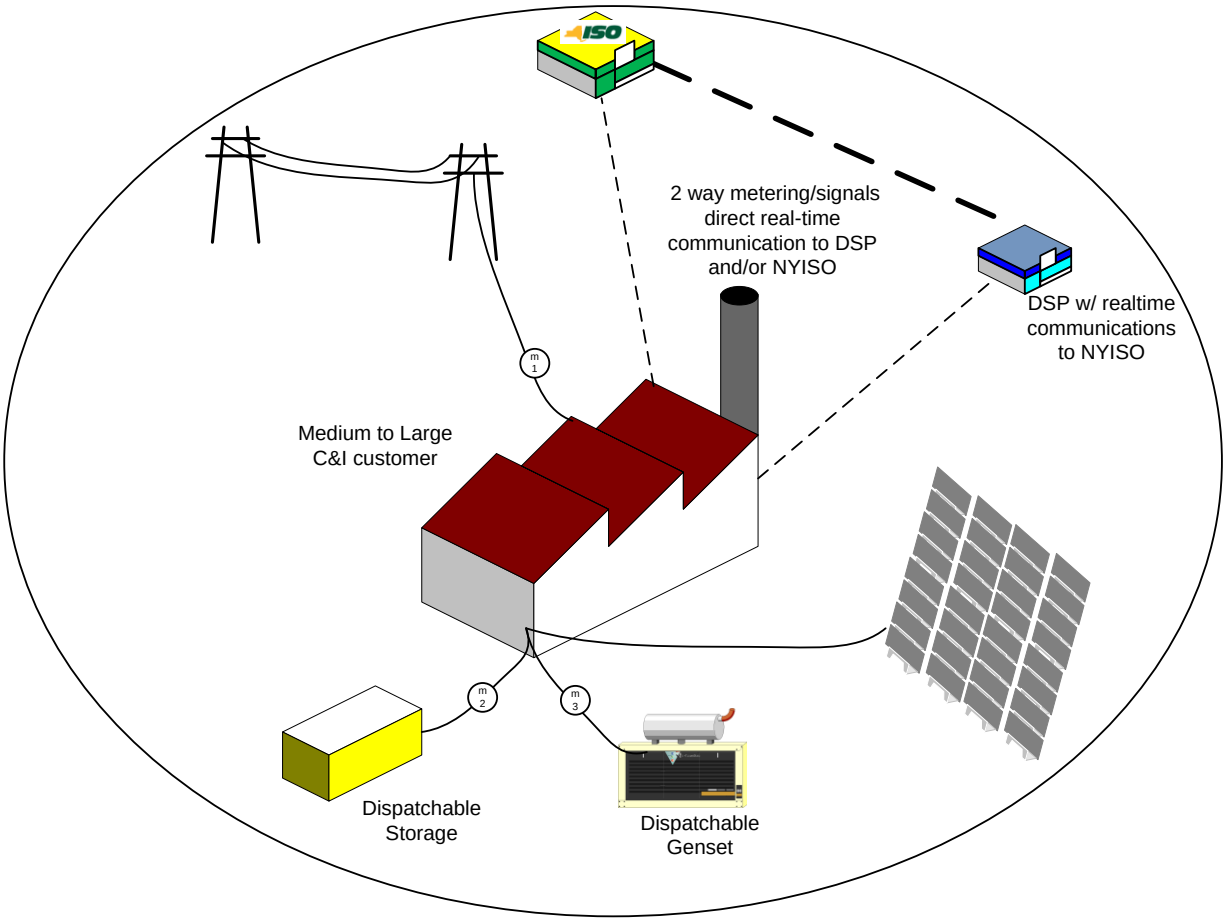
8. Use Case 8 - Dispatchable Load, Storage and Generation



Participant(s)	Medium to large size C&I customer
Features	Sophisticated load, sophisticated storage and sophisticated generation
Metering	Real-time metering with telemetry
Signaling	Capable of sophisticated notifications to curtail load and/or activate other services as instructed
Dispatchable	Load, storage & generation
Aggregated	No
Services	Energy, Capacity, Reserves, Regulation
Telemetry Communications Path	Aggregator -> (DSP and NYISO) OR (Aggregator -> DSP -> NYISO)
Notes	Similar to #4 except it includes storage

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