New York ISO
Independent System Operator

Storage as Transmission

A Report by the
New York Independent System Operator

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Executive Summary

Energy storage resources may provide many potential services and have positive impacts on the transmission system due to their operating characteristics and favorable development considerations. Under the NYISO tariff, energy storage is currently treated as a Generator and, therefore, may not be considered as a solution to an identified transmission need. Utilizing storage as a regulated asset to meet a transmission system need, rather than participating as a Generator in wholesale markets, is known as storage as transmission or "SAT".

The NYISO has engaged with stakeholders and studied the potential impacts of implementing storage as transmission, and this analysis identified many areas that must be addressed to incorporate SAT. This includes the treatment of storage as transmission within the NYISO's Comprehensive System Planning Process, which necessitates modeling the resources and assessing the proposed storage as transmission, when offered to address an identified need, as the more efficient or cost-effective solution compared to traditional transmission assets or other solutions. The NYISO must also consider how to study storage as transmission within the interconnection process.

Operating storage as transmission has many complicating factors. Despite being a regulated asset, storage as transmission must charge from and inject onto the grid to perform as a transmission resource. This inherent participation in the wholesale markets results in costs and revenues in addition to regulated rate recovery. The NYISO must determine how these costs and/or revenues are treated in relation to the resource's regulated rate recovery. Additionally, the operation of the regulated transmission asset must not adversely impact the NYISO-administered markets or the reliable operation of the power system.

Stakeholders proposed many potential use cases for storage as transmission. These include N-1 contingency response, reduced local capacity requirements, and curtailment reduction, among others. The NYISO will continue to evaluate use cases for storage as transmission, accounting for reliability rules and the ability of a Generator participating in wholesale markets to meet the identified need. A resource should not receive regulated cost-recovery if a market-based Generator effectively resolves the transmission system need.

Based on the analysis to date, the NYISO recommends continued exploration of Storage as Transmission in 2024. A potential NYISO model would (1) address the eligibility of a storage resource to address a transmission need and receive cost-based rate recovery, (2) consider how SAT will be assessed in the NYISO planning process, and (3) address the expected operation of a storage resource to address a transmission need.

Introduction and Background

Possible Benefits of Storage as Transmission

The characteristics of energy storage allow these assets to provide many potential services to grid operators. When operating as a market Resource, storage can have positive impacts on transmission systems by shifting demand, providing ancillary services including but not limited to reserves, regulation, and voltage support, and managing transmission congestion. Currently, the NYISO tariffs treat storage as a Generator that is capable of injecting and withdrawing to shift demand and/or manage transmission congestion and provide ancillary services. In some select instances, storage used exclusively as a regulated transmission asset, instead of a market Resource, could provide similar services as traditional transmission solutions. Because storage requires scheduling of power to consume or supply, the current market rules do not contemplate evaluating storage as a regulated transmission asset in the planning process. Additionally, the NYISO's current market rules consider storage to be a market-based Generator that competes and is scheduled in parallel with other suppliers. The current rules do not allow assets that are suppliers, such as Generators, pumped hydro, or energy storage to be eligible for cost-of-service rate recovery.

Transmission upgrades will be necessary to deliver more clean energy across New York's electric grid. However, transmission development is often difficult, expensive, and on extended development time frames. Utilizing storage as regulated transmission assets may provide an alternative that delivers or enhances these services on a shorter timescale and potentially at lower cost. However, storage does not create transfer capability on the grid, and thus it may not be the appropriate solution in many cases. Without fully vetting the opportunities and risks for considering whether storage can offer viable and reliable alternatives to traditional transmission, the marketplace will not have certainty on whether there is value to these potential projects, and market rules changes would not be pursued that could unlock these benefits.

Issue Background

On January 19, 2017, the Federal Energy Regulatory Commission ("FERC") issued Policy Statement No. 158[1], which provided guidance on the ability of energy storage resources to provide transmission services and to seek cost recovery through both cost-based and market-based rates. FERC acknowledged, however,

[1] Federal Energy Regulatory Commission, Utilization of Electric Storage Resources for Multiple Services When Receiving Cost-Based Rate Recovery, January 19, 2017 https://www.ferc.gov/sites/default/files/2020-04/E-2_34.pdf

that should an energy storage resource seek to act as a transmission asset while also providing market services, additional design and implementation details must be considered and developed, including:

- The potential for double recovery of costs;
- Adverse market impacts; and
- Maintaining regional transmission organization ("RTO")/independent system operator ("ISO") independence from market participants.

The Midcontinent Independent System Operator ("MISO"), Southwest Power Pool ("SPP"), and ISO New England ("ISO-NE") have developed and filed proposals for storage as transmission-only models with FERC, all of which have been accepted. In these models, the regulated storage as transmission asset is not eligible to participate in wholesale markets, except to the extent necessary to act as a transmission asset. Therefore, as a transmission-only asset, the asset will not bid into any of the wholesale markets, and it will be dispatched only to resolve the transmission need it is designed to address. However, storage by nature will charge from and inject onto the grid, so the costs and revenues that result from the storage operation will be passed on to consumers through the regulated rate. In the storage as transmission-only models, the storage resource is selected as the more efficient or cost-effective solution to meet an identified transmission need.

In the MISO and ISO-NE models, a regulated storage resource will not be selected to address a routine transmission issue and instead will only be selected to address needs resulting from N-1-1 contingencies. Similarly, in each of the models, a storage resource will not be selected as a regulated transmission asset when a resource participating in the wholesale markets could effectively resolve the need. Additionally, in order to limit the potential for sudden impacts on area control error and generation dispatch, as well as to reduce the burden on operators manually dispatching the regulated storage resources, ISO-NE implemented caps on the selection of storage as transmission-only assets. In aggregate across ISO-NE, a maximum of 300 MW of charging capability and 300 MW of discharging capability may be deployed, with a similar maximum of 30 MW of charging capability and 30 MW of discharging capability at a single substation.

Stakeholder Engagement

The 2023 Storage as Transmission project has been discussed at the joint Installed Capacity Market Working Group and Market Issues Working Group ("ICAPWG/MIWG"), as seen in Figure 1 below.

Figure 1: Stakeholder Engagement

Date	Working Group	Discussion Points and Link to Materials
July 11, 2023	ICAPWG/MIWG	Storage as Transmission https://www.nyiso.com/documents/20142/38699263/Storage%20as%20Transmission%20-%20Introduction.pdf/c5458a07-4be6-fe57-bef6-514abdcb725c
September 18, 2023	ICAPWG/MIWG	Storage as Transmission – Use Cases and Recommendations https://www.nyiso.com/documents/20142/40044890/2%20Storage%20as%20Transmission%20Use%20Cases_20230918.pdf/0ee0027e-d194-24ff-68fd-1dee041d14c5

Issues Identified

Through an analysis of storage as transmission models across various regions and discussions with developers and other stakeholders, key issues have been identified that may need to be addressed should the NYISO develop a feasible model for energy storage to act as a transmission asset and receive cost-based rate recovery.

Market Impacts

The NYISO-administered wholesale markets provide the foundation for supplying consumers in New York with reliable electricity in the most cost-effective manner. Therefore, it is critical to ensure the integrity of the markets while also maintaining the reliability of the transmission system so this electricity may be delivered. This becomes increasingly relevant with the introduction of storage as transmission, and it is important to consider the consumer impacts of implementing SAT. Storage inherently interacts with the wholesale markets, regardless of whether it receives regulated rate recovery, as it could in a SAT model.

Merging regulated, cost-based rate recovery with wholesale market participation introduces many challenges and impacts. Complications arise if a regulated SAT also seeks to participate in wholesale markets beyond what is required from a transmission resource, including potential double compensation and price suppression. Alternatively, the market price may increase if the addition of a resource adds constraints to the system. If a SAT were to be eligible to bid in the NYISO-administered markets as a supplier, there is potential for the resource to be paid twice for providing the same services. At the same time, a resource receiving a guaranteed revenue stream through the regulated rate could offer Energy into

the wholesale market in a manner that negatively impacts the overall market prices.

Artificially decreasing market prices reduces the revenue that Resources receive from participating in the ISO-administered wholesale markets. This may cause projects to no longer be economic, subsequently artificially halting the development of new Resources or accelerating the retirement of existing ones. This may create reliability risks by reducing the amount of available supply on the system. Conversely, increasing market prices drives up the costs for ratepayers. Therefore, it is crucial to maintain the balance of the markets, providing accurate price signals for the development of necessary supply while delivering the most cost-effective and reliable electricity to consumers.

Beyond direct impacts to price, there are a number of operational concerns associated with SAT participating in wholesale markets. The purpose of SAT is to utilize energy storage to maintain reliability of the transmission system, and therefore the resource must be available and at the required state of charge whenever it is needed for transmission services. If the resource operates in response to both market signals and transmission needs, it may not be at the state of charge necessary to respond to an unpredictable, immediate transmission need. This unavailability of the SAT would then result in taking more costly actions to maintain electric system reliability in response to the transmission need.

Regardless of whether the resources are explicitly eligible to recover costs through wholesale markets in addition to cost-based rate recovery, there will be market impacts as well as resulting costs and/or revenues from operating SAT. Because of this, the NYISO does not draw a clear distinction between SAT and wholesale market participation. Due to the complexities and potential for adverse market impacts, the NYISO does not see a model in which the resource recovers costs through both cost-based rates and wholesale market participation beyond what is required to act as a transmission asset as a viable option.

SAT may provide a number of services as a solution to an identified transmission need, potentially enhancing the reliability of the system. However, there may also be adverse impacts by subverting the markets in favor of a regulated resource that will still interact with the markets. In developing a model for assessing energy storage as a viable and effective solution to transmission needs, the NYISO must ensure that the implementation of a SAT model and the operation of each SAT minimizes the impact on wholesale markets. SAT may be considered as a solution to enhance the reliability of the transmission system, but it should not in turn result in adverse market impacts.

Interconnection Process Requirements

Interconnection is the process by which new facilities are connected to the New York State Transmission System or the capabilities of an existing facility are materially modified. The NYISO's

interconnection process consists of three components: large generating facility, small generating facility, and load interconnection. Additionally, there is a process for interconnecting transmission facilities, known as the Transmission Interconnection Process ("TIP"). The NYISO may determine how to incorporate and study a storage resource that is seeking to act as a regulated transmission resource within the interconnection processes. Despite acting as a transmission resource, storage will inherently be charging and injecting energy and, therefore, may need to be studied in a similar manner to a market-based energy storage resource.

Eligibility and Use Cases

The NYISO's Comprehensive System Planning Process ("CSPP") is comprised of the following components: Local Transmission Planning Process ("LTPP"), Reliability Planning Process ("RPP"), Economic Planning Process ("EPP"), Public Policy Transmission Planning Process ("PPTPP"), and Interregional Planning Process. Currently under the NYISO tariffs, energy storage is not eligible to be considered as a transmission solution within the components of the CSPP to receive regulated rate recovery. Therefore, the tariff would have to be updated to incorporate energy storage within the CSPP as a resource eligible to be a regulated asset. The NYISO may consider how to incorporate SAT within the CSPP components and how it may be evaluated as a solution, including how the asset would be assessed compared to other types of resources. In addition to the CSPP, there are other associated interregional planning processes in which the NYISO may need to consider the role and treatment of storage as transmission.

Within the discussion of incorporating SAT into the CSPP, the types of transmission issues that regulated storage may address must be considered. Energy storage is a resource that can provide many potential services, yet there are many complexities with its operation, including limitations of the quantity of energy that can be injected and the duration over which a storage asset can inject before re-charging. These complexities may dictate the types of needs that SAT can address.

While there may be a number of potential use cases through which SAT can provide services to the system, a regulated transmission asset should not be selected if a market-based Resource can also effectively meet that need. If a storage or other Resource can effectively resolve the transmission need through participation in the NYISO's wholesale markets, no regulated solution should be selected.

Additionally, when determining use cases for which SAT may be eligible, Special Protection Systems ("SPS"), also known as Remedial Action Schemes ("RAS"), should be excluded. According to the North

American Electric Reliability Corporation ("NERC") Glossary of Terms[2], an SPS/RAS is defined as: "A scheme designed to detect predetermined System conditions and automatically take corrective actions that may include, but are not limited to, adjusting or tripping generation (MW and MVAr), tripping load, or reconfiguring a System(s)." Additionally, the New York State Reliability Council ("NYSRC") has a rule regarding the use of an SPS within its Reliability Rules & Compliance Manual[3], which is as follows:

> "A Special Protection System (SPS) may be employed to provide protection for infrequent contingencies or for temporary conditions that may exist such as project delays, unusual combinations of system demand and equipment outages or unavailability, or specific equipment maintenance outages. An SPS may be applied to preserve system integrity in the event of severe facility outages and extreme contingencies. The decision to employ an SPS should take into account the complexity of the scheme and the consequence of correct or incorrect operation as well as benefits. An SPS should be used judiciously and when employed, should be installed consistent with good system design and operating policy. Although there are no specific NYSRC Reliability Rules that cover SPS requirements, NPCC maintains criteria providing SPS requirements that must be observed."

As described in the above rule, implementing an SPS/RAS is typically viewed as a temporary solution to a transmission need, and it often adds complications to grid planning and operations. Therefore, SAT should not be selected as a solution that is classified as an SPS/RAS, due to the nature of this type of solution.

Additionally, in 2018, the New York Public Service Commission ("PSC") issued the Order Establishing Energy Storage Goal and Deployment Policy[4], which outlined the state's energy storage deployment goal and provided guidance towards achieving it. Within this order, the PSC directed utilities to assess the procurement of energy storage and other resources, including energy efficiency and demand response, to address a combination of local reliability, local load relief, local environmental benefits, and wholesale services. These procurements are known as retail non-wires alternatives ("NWAs"), and the NWAs may be

[2] North American Electric Reliability Corporation, Glossary of Terms Used in NERC Reliability Standards, March 8, 2023
https://www.nerc.com/pa/Stand/Glossary%20of%20Terms/Glossary_of_Terms.pdf

[3] New York State Reliability Council, Reliability Rules & Compliance Manual, January 1, 2015
https://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7B88B4CDB4-C09E-41B3-9EBD-896F2ECDD777%7D#:~:text=The%20NYSRC%20Reliability%20Rules%20and,of%20NYSRC's%20compliance%20monitoring%20responsibilities.

[4] State of New York Public Service Commission, Case 18-E-0130 – In the Matter of Energy Storage Deployment Program, Order Establishing Energy Storage Goal and Deployment Policy, December 13, 2018
https://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={FDE2C318-277F-4701-B7D6-C70FCE0C6266}

sited anywhere in the utility's distribution or transmission system. Because NWAs and SAT aim to provide many of the same system benefits, the NYISO may need to consider use cases for SAT to avoid conflicts with existing policies and programs.

Stakeholder-Proposed Use Cases

In addition to presentations at the ICAPWG/MIWG, the NYISO has engaged with a number of developers and other stakeholders to discuss potential use cases for SAT, including:

- Response to N-1 contingencies;
- Reduced local capacity requirements; and
- Curtailment reduction.

In the first proposed use case, SAT would be dispatched in response to an N-1 contingency, therefore allowing system operators time to react to the contingency event. This may reduce congestion, as well as reduce the need to redispatch generation before a contingency event. This SAT use case is currently being implemented by German Transmission System Operators through projects known as Grid Boosters (or Netzbooster in German). The Grid Booster assets are located near areas of high renewable generation or load centers and due to their rapid response time, can be dispatched quickly following an N-1 contingency to charge from the renewable resources or to serve load. To prepare the system to respond to contingencies, the storage near the renewable resources is generally empty, and the storage near load centers is generally fully charged to be able to rapidly absorb or inject energy as needed. However, after the immediate overload is resolved by the storage devices additional generation must be dispatched to keep the system operating within limits as the storage devices reach storage limits.

The second SAT use case proposed by stakeholders is to reduce the local capacity requirements, particularly in Southern New York. Adding a SAT may increase the transmission security limit for a locality such as New York City, therefore increasing the capacity that can be purchased from upstate New York. This deployment could reduce the installed capacity requirement. Reducing the local capacity requirement may subsequently reduce costs for consumers and improve local reliability.

With growing levels of renewable development concentrated in certain regions of New York, the third stakeholder-proposed use case would aim to reduce curtailment of renewable resources in these regions. In this SAT use case, the storage would be on a set daily schedule for charging and discharging, with the time periods varying each season. The SAT would charge during periods of high renewable generation or low prices. It would then discharge during periods of low renewable generation, therefore seeking to unbottle the renewable resources.

The NYISO will continue to evaluate use cases for SAT, taking into consideration the potential classification of a solution as an SPS/RAS, any overlap with NWA opportunities or other programs, and the potential for a system need to be addressed by a Generator participating in the wholesale markets. The NYISO believes that each of the proposed use cases addressed above could be effectively addressed by market-based Resources and may conflict with existing reliability rules. A regulated solution, such as SAT, should not take priority over wholesale markets if an effective market-based solution exists. Favoring a regulated resource may result in greater costs for consumers than a comparable market-based Resource. The competitive nature of wholesale markets incentivizes the development and retention of supply at the least cost or highest efficiency through every step in the process, resulting in benefits to consumers that may not appear for a resource with a guaranteed cost recovery. Therefore, competitive wholesale markets are the most efficient and cost-effective way to provide electricity and maintain the reliability of the grid, and this should not be undermined by using a regulated resource to address the same issue as a Generator participating in the NYISO-administered markets.

Evaluation

If storage is proposed as a solution to meet a transmission need, criteria may be developed to determine that the asset effectively and reliably meets the need and system requirements, including an evaluation if it fails to operate as intended. Such criteria may include modeling the resource as well as an assessment of the proposed capacity (MW) and duration (MWh) of the storage relative to the identified need that the asset is addressing to determine that the resource is appropriately sized to meet the transmission need.

Consistent with the current NYISO planning processes, SAT should be evaluated in a similar manner as all other solutions to determine the more efficient or cost-effective solution to address an identified need. When comparing the cost and performance of the storage to a traditional wires solution or other transmission alternatives to identify the more efficient or cost-effective solution, the NYISO may determine the need to develop new methodology and criteria. This analysis may include a direct comparison of the cost of the useful life of the resources as well as the ability to meet the identified need.

Additionally, energy storage resources have a number of capabilities that are technologically unique that may be considered when comparing the storage asset to traditional wires solutions. These may include a rapid response time or development considerations, such as the lead time required to implement the resource. These attributes may be valuable qualities to consider when comparing SAT to a traditional wires solution. Therefore, the NYISO may need to develop a methodology for incorporating these additional characteristics into the evaluation.

Size and Duration

When evaluating proposed SAT, the NYISO may assess whether the proposed size (MW) and duration (MWh) of the storage resource will effectively meet the required need and not cause other reliability issues due to the operation of the asset for its intended purpose. In the storage as transmission-only model developed by MISO, the eligibility for cost recovery is limited to the capacity of the resource that is necessary to address the transmission need. The cost for excess capacity installed beyond what is required to meet the identified need will therefore not be eligible to be recovered through regulated rates. The NYISO may need to consider a similar process to ensure that the proposed SAT is appropriately sized to meet the reliability need and to address any excess capacity built.

In addition to sizing the asset to meet the need, degradation of the asset over time may be considered as part of the resource's rate recovery. Degradation of the storage resource may require initial overbuild of the asset or an augmentation or replacement of the resource during the project lifetime. As a result, the NYISO may need to determine if overbuild or future augmentation of the system would also be eligible as part of cost recovery of the asset. If so, further discussions must consider the allowable amount of excess capacity, as well as how to account for this augmentation, replacement, and/or overbuild in the analysis of the asset, and how to treat the related costs.

Operation of Assets

The operation of SAT comes with challenges, as a storage resource has a limited capacity and duration. The energy storage resource may also be required to be at a specific state of charge to perform its role as a transmission asset. As a regulated asset, the energy storage resource does not submit bids or receive schedules to participate in the wholesale markets; however, the storage must still charge from and inject onto the grid, resulting in market impacts and associated costs and/or revenues. Therefore, requirements may need to be developed for when the regulated storage resource can charge and discharge in order to maintain the necessary state of charge. This may also include any cycling of the battery that is required for maintenance of the system. Because of the inherent interaction of SAT with wholesale markets, market rules may be necessary to avoid or minimize the market impact of the SAT.

Protocols must be developed that detail the dispatch and operation of the SAT in response to a contingency or system contingency occurring. This may vary based on the use case of the asset. Additionally, whether the SAT may be dispatched in emergency conditions outside of limited pre-determined situations and the implications of doing such may be considered. At the same time, other considerations may be weighed, such as how the SAT will be modeled in the market systems to provide the expected benefit, how to model the SAT if it is unavailable due to an outage or a lack of charge until it

can get back to the state of charge needed for the next event, and who bears the cost if the SAT is unavailable.

Finally, after the conclusion of the contract term for the SAT, a process may be needed to describe the retirement of the asset as a regulated resource. This may include a procedure for the energy storage resource to transition to wholesale market participation, and the requirements needed to support this transition. Examples of topics that may be addressed are the interconnection requirements for energy storage resources to participate as market Resources as well as ownership requirements for the Resource to be a market Resource. Such requirements may differ from the processes and obligations that apply to regulated resources.

Roles of Entities

Consideration must be given for build and ownership requirements for SAT, including eligibility of entities to receive rate recovery. For example, whether the SAT owner must either be or become a Transmission Owner. This assessment may also include whether the entity that owns SAT may procure a resource that is in development through agreements such as build transfer or tolling agreements. A SAT model must identify which party is responsible for maintenance of the asset, including maintaining the state of charge required to perform its function as a transmission asset and resolve the identified transmission need.

Modeling and Treatment of Storage as Transmission

When storage is proposed as a potential regulated solution to a transmission need, it must be capable of sufficiently addressing the need. To date, storage resources are eligible as a market-based solution, but are not eligible to be proposed as a regulated solution through the CSPP and, therefore, there is not an established method for evaluating storage resources in comparison to transmission solutions.

Beyond the modeling required to determine the ability of the regulated storage to address an identified transmission need, the NYISO must consider how to model the asset once it is in operation. In order to maintain state of charge and to perform its functions as a transmission asset, the regulated resource must charge from and inject onto the grid. Therefore, the NYISO may need to determine how to treat these assets in various studies and models that assess resources. This includes incorporation of the assets into the Installed Reserve Margin ("IRM") and the Locational Minimum Installed Capacity Requirements ("LCRs").

Treatment of Market Revenues

While operating as a transmission asset, the resource will be charging from and discharging onto the

grid, resulting in potential costs and/or revenues for the regulated storage resource from the NYISO-administered Energy market. Similarly, the storage resource may need to charge or discharge energy to maintain state of charge in order to perform its function as a transmission asset, and there will be additional costs and/or revenues associated with this action. Therefore, the NYISO may need to consider the treatment of such costs and/or revenues in connection with the resource's rate recovery. For example, in the MISO model the storage as transmission-only asset is a price taker when charging and injecting, and the costs and revenues are netted and passed through the regulated rate to the ratepayers.

There may also be opportunities for SAT to provide voltage support service ("VSS") despite receiving cost recovery as a regulated transmission asset. VSS would not impact the state of charge of the SAT, but providing significant reactive power may limit the capabilities of the SAT to respond to a transmission need. Additionally, VSS is not a bid-based product, which means that all VSS suppliers receive the same rate. Because of this, the VSS compensation signals would not be impacted by the SAT receiving regulated rate recovery. Therefore, the NYISO may consider the ability of SAT to provide VSS and how the revenues earned from providing this service will be treated.

Recommendation

As a result of the issues discovered, analysis on stakeholder-proposed use cases, and additional stakeholder feedback, the NYISO recommends the continuation of the project through 2024 to explore a model for SAT. While exploring a proposal, a number of details must be addressed, including, but not limited to:

- How SAT may be considered in the CSPP;
- Ownership requirements for being a regulated asset (i.e., whether the SAT owner must be a Transmission Owner);
- Operating and reliability considerations;
- Scheduling and dispatch; and
- Treatment of market revenues that result from SAT operation.

A NYISO SAT model proposal would (1) address the eligibility of a storage resource to address a transmission need and receive cost-based rate recovery, (2) consider how SAT will be assessed in the NYISO planning process, and (3) address the expected operation of a storage resource to address a transmission need. Where other models delineate the participation of storage as transmission in the wholesale markets, the NYISO does not see a clear divide, as any storage resource will have an impact on the markets when charging and injecting while acting as a transmission resource. Therefore, the proposal

will need to consider the treatment of SAT operation and the resulting costs and/or revenues.