Energy Storage in the Wholesale Markets

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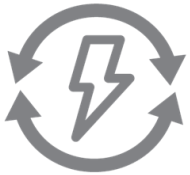
Integrating Energy Storage

Energy Storage takes many forms, but its versatility provides many benefits to grid operators

Capacitors

Flow Batteries

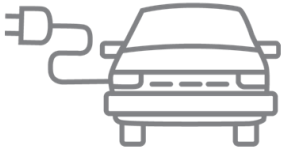
Superconductors



Potential Storage Concepts in New York

Fuel Cells

CAES



V2G

Thermal

Energy Storage Resources such as flywheels and batteries **can supply** electricity to meet demand **and withdraw** electricity to alleviate excess supply

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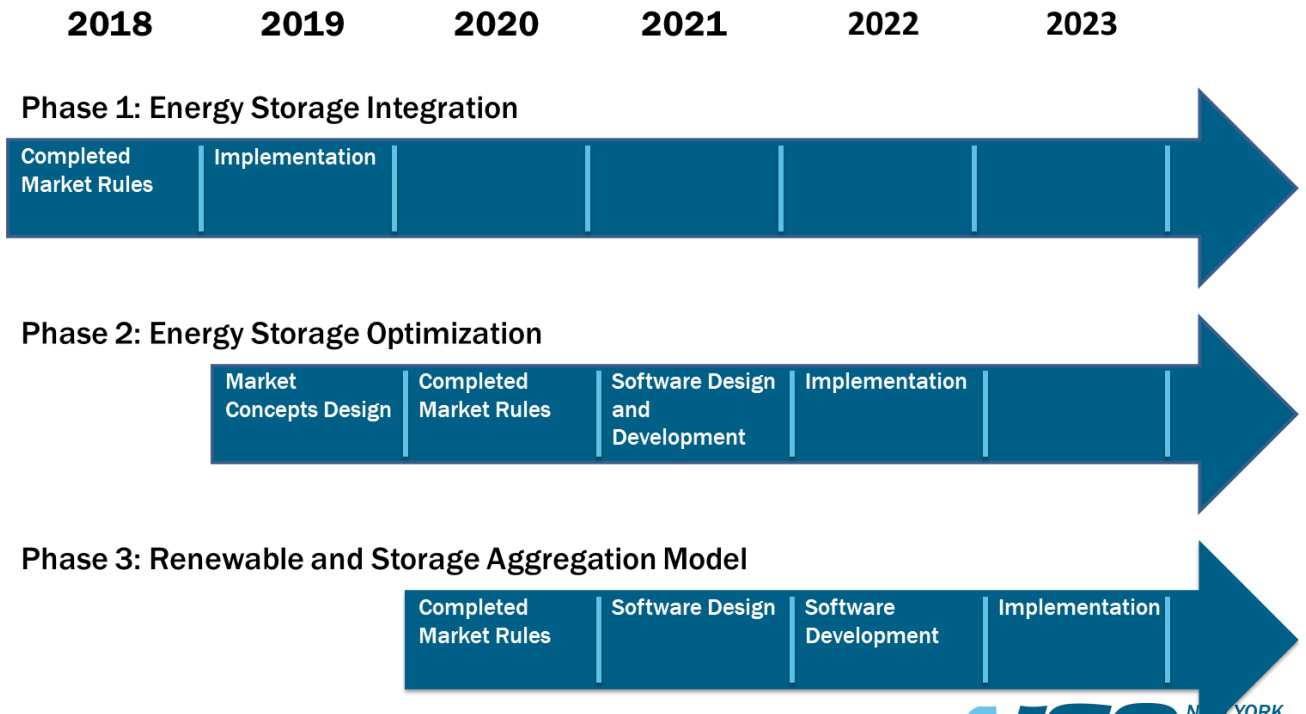
The Path Forward for Storage

The NYISO is charting a course that will harness the value energy storage resources can bring to the grid by fully integrating these resources into its wholesale electricity markets.



The NYISO's Approach

- The NYISO set out in late 2016 to develop a comprehensive set of market rules to fully enable Energy Storage to participate in the wholesale electricity markets.
  - Energy Storage Integration project
  - DER Roadmap
- In 2017, the NYISO worked with Stakeholders to develop a market design concept that will allow Energy Storage Resources (ESRs) to offer their full capabilities into the NYISO's wholesale Energy, Capacity, and Ancillary Services markets.

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FERC Order 841

On February 15, 2018, FERC issued Order No. 841, directing "each RTO/ISO to revise its tariff to establish a participation model consisting of market rules that, recognizing the physical and operational characteristics of electric storage resources, facilitates their participation in the RTO/ISO markets."[1]

Tariff revisions must:

1) "ensure that a resource using the participation model for electric storage resources is eligible to provide all capacity, energy, and ancillary services that it is technically capable of providing in the RTO/ISO markets;
2) "ensure that a resource using the participation model for electric storage resources can be dispatched and can set the wholesale market clearing price as both a wholesale seller and wholesale buyer consistent with existing market rules that govern when a resource can set the wholesale price;
3) "account for the physical and operational characteristics of electric storage resources through bidding parameters or other means; and
4) "establish a minimum size requirement for participation in the RTO/ISO markets that does not exceed 100 kW."[2]

1. Electric Storage Participation in Markets Operated by Regional Transmission Organizations and Independent System Operators, Order No. 841, 162 FERC ¶ 61,127, at P3 (Feb. 15, 2018) ("Order No. 841") as amended by the Feb. 28, 2018 Errata Notice ("Order No. 841 Errata").
2. Order No. 841 Errata at P 4.

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The NYISO's Plan for Order 841

- **The NYISO is currently reviewing its ESR market design concept to ensure compliance with FERC Order No. 841 directives.**
- **In 2018, the NYISO will complete the market design of the ESR participation model.**
  - FERC Order No. 841 requires the NYISO to file tariff revisions on or before December 3, 2018.
  - Implementation of the tariff revisions is required on or before December 3, 2019.
- **Market design elements that are outside the scope of FERC Order No. 841 compliance will not be part of the initial ESR participation model:**
  - The NYISO will not file tariff revisions in 2018 to address storage aggregations or dual participation.
  - Rules for dual participation and aggregations of all resource types are being developed as part of the DER Participation Model.

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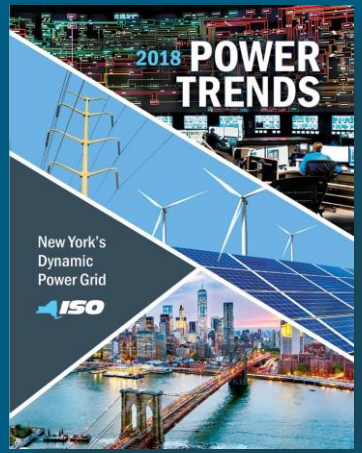
Shifting patterns of demand for electricity serve to influence how investors, policymakers, and consumers view electricity production, transmission, and consumption. These patterns include:



- Energy efficiency and distributed energy resources that shape energy usage.
- Infrastructure replacement and expansion to address risks to aging facilities, support of public policy goals, and meet the needs of a more dynamic grid.
- Economic influences led by low natural gas prices and changing consumption forecasts.
- Public policies aimed at reducing emissions and expanding the use of renewable power resources.
- Bolstering grid resilience through effective federal, state, and local reliability rules, effective grid operations and planning, and effective market design.

Power Trends 2018

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Markets for a Grid in Transition

Resource Flexibility

- Today, markets incent flexibility through Products, Pricing, and Settlements.
- Focusing on the integration DERs and Energy Storage, More Frequent Interchange Scheduling, and Price Formation.

Grid Resilience

- Includes: (1) the capacity to recover quickly from difficulties, and (2) the ability to anticipate, absorb, and adapt to the impacts of disruptive events.
- Focusing on ways that markets can incent investments that will support grid resilience.

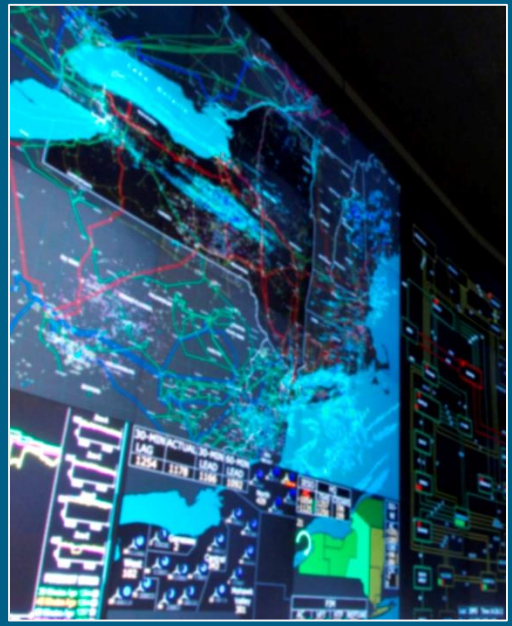
Great Expectations

"New York is on the cutting edge of this new energy future. Together, we are transforming the power grid as it strives to achieve the goals of cleaner energy, improved efficiency, and robust economic growth.

The NYISO is working to accommodate change while ensuring continuity.

We have great expectations that we can integrate the emerging power trends in a manner that benefits consumers and supports public policy goals."

Power Trends 2018



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More ESR Integration Background

Date	Working Group	Discussion points
08-04-16	Market Issues Working Group (MIWG)	Initial discussion on alternatives for Energy Storage in the NYISO markets
09-29-16	MIWG	Market Design ideas discussion
11-29-16	MIWG	Presentation providing more detail on the Market Design that the NYISO will pursue
05-05-17	MIWG	Presentation addressing the proposed modeling enhancements as the cornerstone of the Energy Storage Integration phase
07-19-17	MIWG	Presentation delving into the eligibility criteria and RT scheduling logic for Energy Storage Resources (“ESRs”).
08-25-17	MIWG	Discussion on the Settlements logic for ESRs.
10-03-17	MIWG	Day-Ahead scheduling logic and Mitigation framework
11-02-17	MIWG	Aggregations in the ESR model
12-20-17	MIWG	Market Design Concept Proposal Summary
02-21-18	MIWG	Ancillary Services Treatment in the ESR Participation Model

The Mission of the New York Independent System Operator, in collaboration with its stakeholders, is to serve the public interest and provide benefit to consumers by:

- Maintaining and enhancing regional reliability
- Operating open, fair and competitive wholesale electricity markets
- Planning the power system for the future
- Providing factual information to policy makers, stakeholders and investors in the power system

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