

Energy Storage Integration and Optimization

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Overview

- **Background**
 - Energy Storage Integration and Optimization, 2016 Market Design
 - FERC Notice of Proposed Rulemaking (NOPR) on Energy Storage Participation in Markets Operated by Regional Transmission Organizations and Independent System Operators⁽ⁱ⁾
- **Bidding parameters for Energy Storage Resources**
- **Summary**
- **Next Steps**

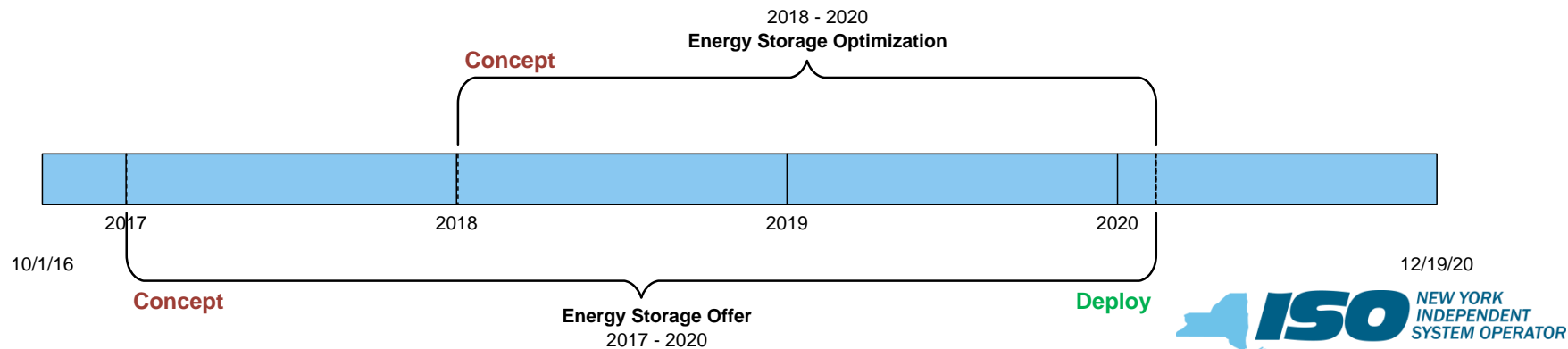
i. Electric Storage Participation in Markets Operated by Regional Transmission Organizations and Independent System Operators, 157 FERC ¶ 61,121 (Nov. 17, 2016).

Background

- Existing market structure could be improved to allow for better integration of energy storage resources in the NYISO-administered markets
 - Full integration of energy storage resources can increase market efficiency
 - Including energy storage resource specific attributes in the optimization software will help realize that integration
- The Energy Storage Integration and Optimization market design concept improves market integration and optimization of storage resources 1 MW or larger
 - Energy storage resources < 1 MW will be addressed through the DER Roadmap projects

Background

- The market design includes two tracks:
 - Energy Storage Integration (2017-2020) will develop the participation model for storage resources
 - Energy Storage Optimization (2018-2020) will develop the optimization methodology for storage resources

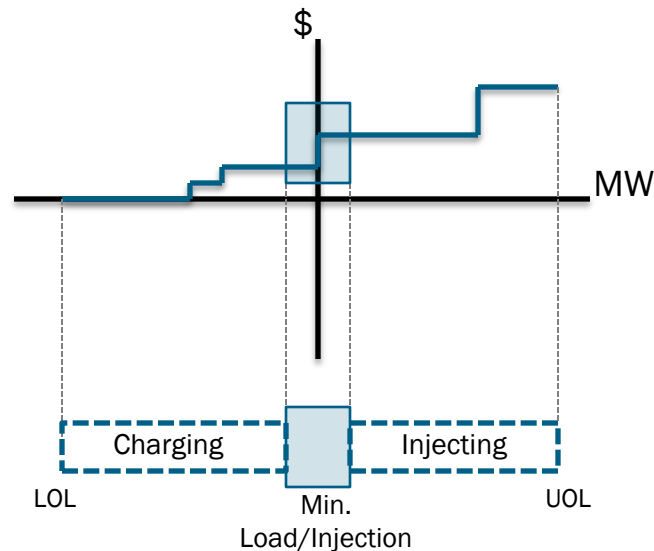


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2016 Market Design

- **Single Incremental Hourly Offer**
 - Will allow energy storage resources to include intra-hour withdrawal or injection price points in its offer
 - This provides RTC/RTD with flexibility to energy storage resource capabilities
- **Energy storage resource offers will also include**
 - Transition time parameters
 - Minimum load/injection parameters



Background: FERC NOPR

- In November 2016, FERC issued Notice of Proposed Rulemaking addressing Energy Storage Resource participation in wholesale markets
- FERC proposed to require ISO/RTOs to:
 - Permit energy storage resources to provide all the services they are capable of providing (i.e. Capacity, Energy and Ancillary Services)
 - Include bidding parameters that reflect energy storage resource physical and operational characteristics
 - Permit energy storage resources to set clearing price (load, generation)
 - Set minimum size requirement to no larger than 100 kW
 - Set the price for energy storage resource charging and discharging at the applicable LBMP

*Main
target for
this
effort*

Energy Storage in the NYISO markets going forward

The NYISO's Approach

- In 2017, the NYISO will work with Stakeholders to refine a market design concept that will add new modeling parameters to allow Storage Resources to better represent their capability.
- Building upon those lessons, the NYISO will address Energy Storage Resources optimization improvements beginning in 2018 (Energy Storage Optimization).
 - The NYISO intends to draft a whitepaper addressing the potential benefits of the proposed optimization alternatives involving Energy Storage Resources.

The NYISO's Approach

- **Other NYISO projects will inform the market design for Storage Resources.**
 - *Distributed Energy Resources (DER)*: Developing concepts for behind-the-meter resources and aggregations
 - *Integrating Public Policy*: Evaluating the need for new market products

Bid Parameters: Initial NYISO Design

- **NYISO proposes to add the following bid parameters for energy storage resources:**
 - Transition Time: Time that a resource would require for switching between injection/withdrawal states
 - Minimum Load: Minimum withdrawal level at which the resource can operate
 - Minimum Generation: Minimum injection level at which the resource can operate
- **The NYISO seeks feedback regarding additional Storage bidding parameters that Market Participants believe will be beneficial.**

Bid Parameters: FERC Proposal

- **Mandatory bid parameters proposed by FERC:**
 - Upper Charge Limit: Maximum quantity of energy that the resource can store
 - Lower Charge Limit: Minimum quantity of energy that the resource must maintain
 - Maximum energy charge rate: How quickly the resource can withdraw electricity from the grid
 - Maximum energy discharge rate: How quickly the resource can inject electricity into the grid

Bid Parameters: FERC Proposal

- **“Discretionary” bid parameters proposed by FERC:**
 - Minimum charge time: Minimum time that the resource can receiving electricity from the grid
 - Maximum charge time: Maximum time that the resource can inject electricity onto the grid
 - Minimum run time: Minimum time that the resource can stay on
 - Maximum run time: Maximum time that the resource can stay on

Bid Parameters:

Additional NYISO Proposals

- **The NYISO is considering whether to include the following bid parameters:**
 - Number of cycles per interval: The maximum number of times that the Storage resource can go through full Upper-Lower charge limits cycles in an interval
 - Roundtrip Efficiency: Efficiency of the resource for a charge/discharge cycle after accounting for conversion losses
- **The NYISO will also consider the following parameters in the Optimization phase of this project:**
 - Ending State of Charge: Level of energy the resource desires by the end of the interval with an associated cost for deviations
 - Beginning State of Charge: Level of energy the resource desires at the beginning of the interval with an associated cost for deviations

Additional Considerations

- Energy storage resource rules may require NYISO to creating a new Resource type to streamline the implementation process and Tariff amendments
 - NYISO will assess the creation of a new Resource type for Energy Storage Resources as a part of this effort.

Summary of Proposed Bid Parameters

<i>NYISO 2016 Proposal</i>	<i>FERC NOPR</i>	<i>NYISO 2017 Additional Proposals</i>
<u>Resources allowed to inject and withdraw with a single offer.</u>	<i>Required</i>	Storage as a Resource Category
Transition Time	Upper Charge Limit	Number of Cycles per Interval
Basepoint Selection	Lower Charge Limit	Roundtrip Efficiency
Min. Load	Charge Rate	Ending State of Charge
Min. Generation	Discharge Rate	Beginning State of Charge
	<i>Discretionary</i>	
	State of Charge	
	Min. Charge Time	
	Max. Charge Time	
	Min. Run Time	
	Max. Run Time	

Next Steps

- The NYISO will evaluate additional bidding parameters to incorporate into the Energy Storage Integration Market Design Concept.
- The NYISO is currently reviewing the operational feasibility of the proposal and identifying potential additional requirements.

Feedback

- The NYISO seeks feedback on the materials presented today, including any additional bid parameters for energy storage resources
- Email additional feedback to: Daniel F. Noriega
dnoriega@nyiso.com

Questions?

We are here to help. Let us know if we can add anything.

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