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Energy Storage Technology Advancement Partnership
(ESTAP) Webinar:

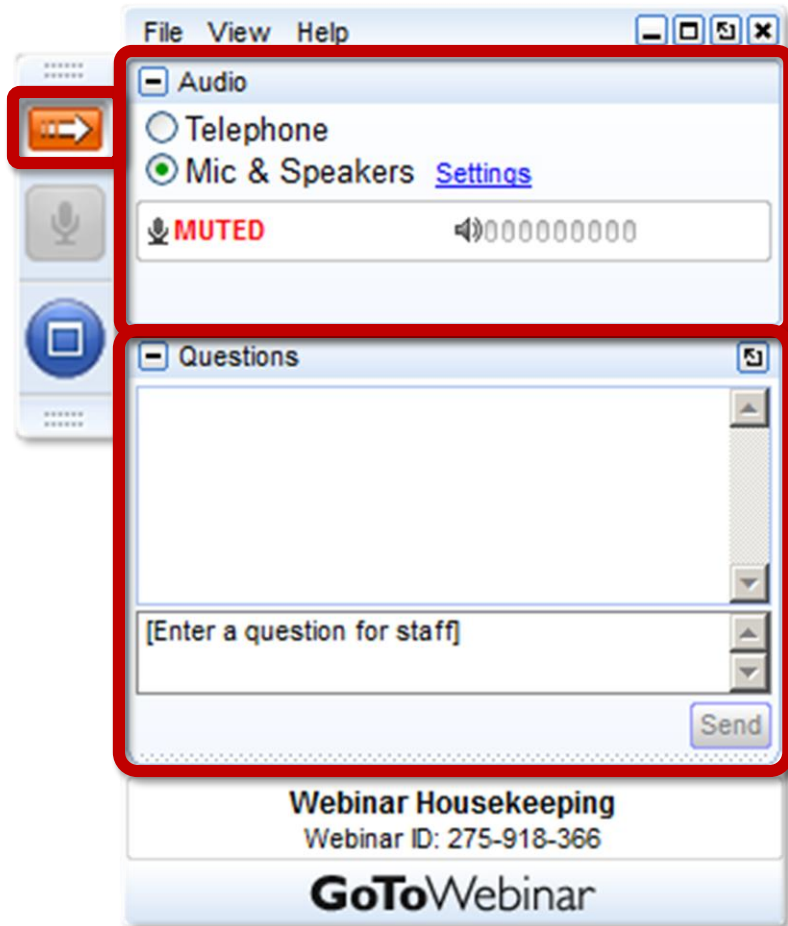
FERC Order 841: Leveling the Playing Field for Energy Storage Resource Market Participation

April 4, 2018



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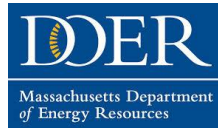
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Energy Storage Technology Advancement Partnership (ESTAP)

ESTAP is supported by the U.S. Department of Energy Office of Electricity and Sandia National Laboratories, and is managed by CESA.

ESTAP key activities:

- 1) Disseminate information to stakeholders through:
 - The ESTAP listserv (>4,000 members)
 - Webinars, conferences, information updates, surveys
- 2) Facilitate public/private partnerships at the state level to support energy storage demonstration project development.
- 3) Support state energy storage efforts with technical, policy and program assistance

Thank You:

Dr. Imre Gyuk

U.S. Department of Energy, Office of Electricity Delivery and Energy Reliability

Dan Borneo

Sandia National Laboratories



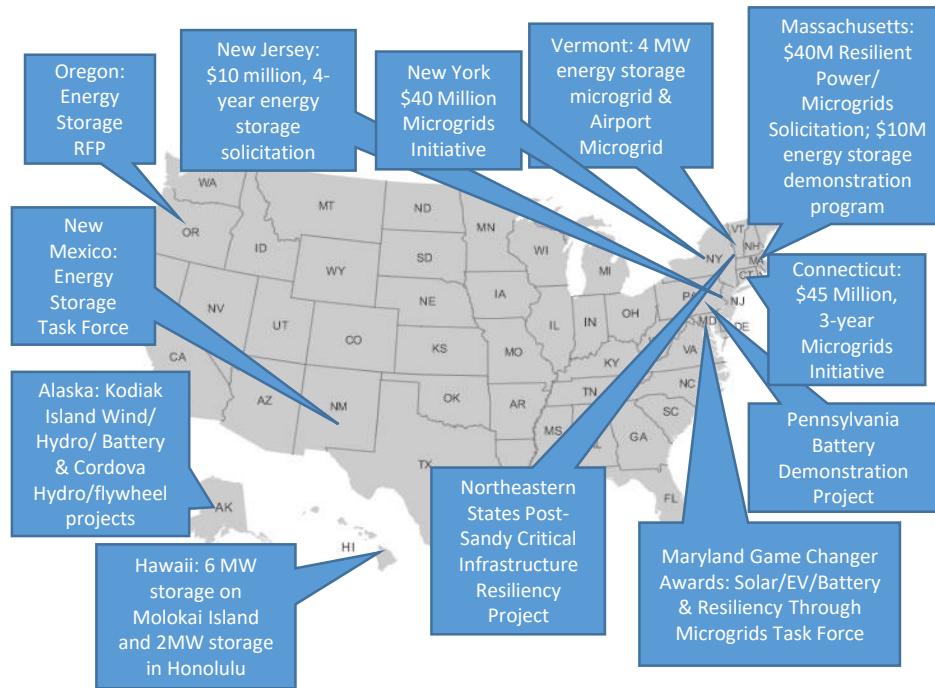
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Speakers

- **Mike Berlinski**, Director, Emerging Technologies, Customized Energy Solutions
- **Jacqueline DeRosa**, Vice President, Emerging Technologies, Customized Energy Solutions
- **Patrick Shoop**, Manager, Emerging Technologies, Customized Energy Solutions
- **Todd Olinsky-Paul**, Clean Energy States Alliance (Moderator)



FERC Order 841: Leveling the Playing Field for Energy Storage Resource Market Participation

April 4, 2018

Jacqueline DeRosa
Mike Berlinski
Patrick Shoop

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Agenda

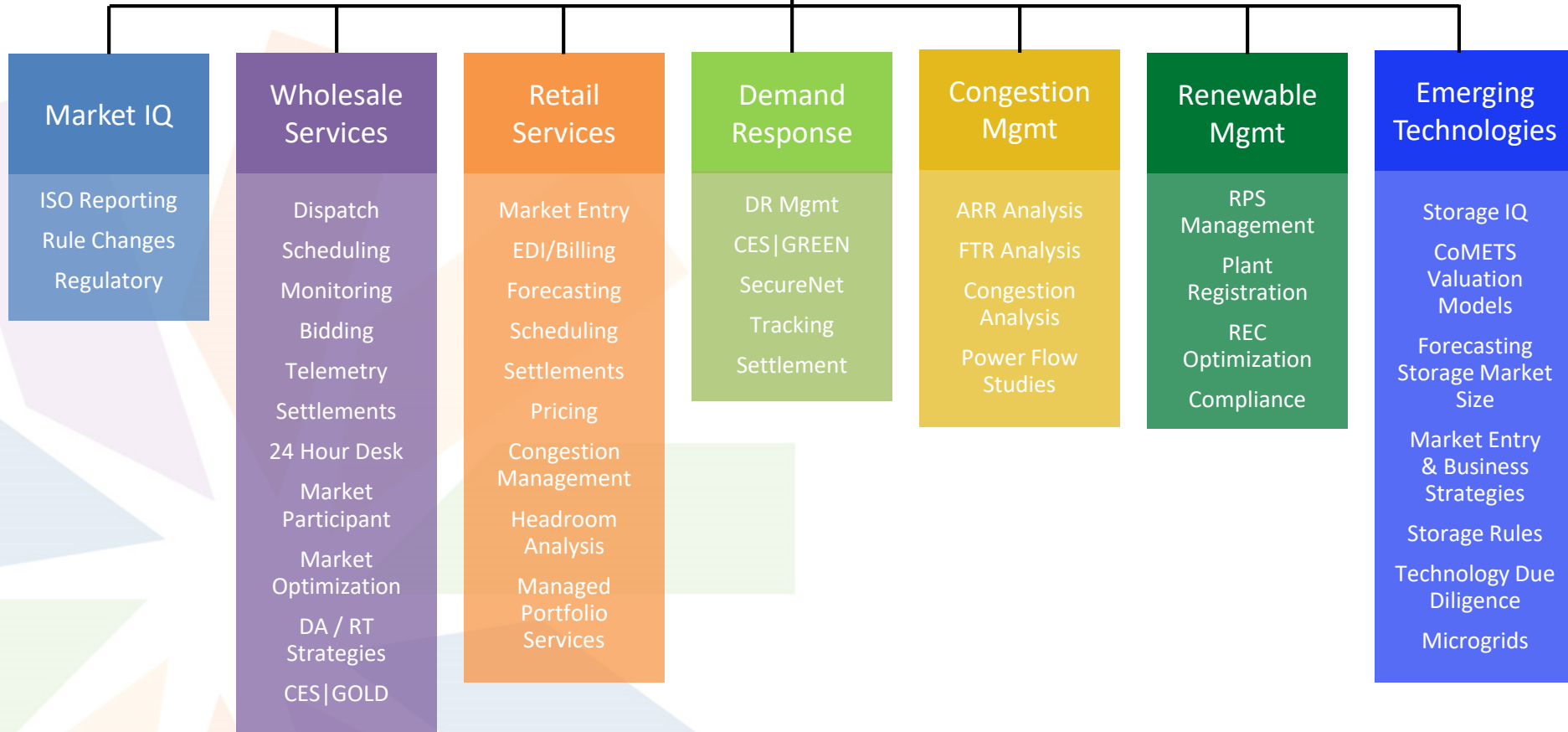
- Overview of CES
- FERC Order 841
 - Where are we?
 - How did we get here?
 - Where are we going?

Overview of CES

Overview of CES

- **CES is a privately held corporation headquartered in Philadelphia, PA**
- **Began in 1998**
- **The forefront of competitive electricity markets and emerging technology trends with focus on DR, energy storage and smart grid.**
- **Active 24/7 management of over 6000 MWs of resources which include conventional, renewable, demand response, and energy storage resources**
- **Nine Regional North American Offices in the US and Canada**
 - **Office in Pune, India, and the India Energy Storage Association (IESA)**
 - **Offices in Japan and Mexico**
- **Over 400 different clients company wide**

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CES Manages Advanced Energy Storage Resources into the RTOs in US and Canada

- Over 140 MWs in PJM, NYISO, California, IESO (Canada), and ISO-NE
- CES also manages ~ 6,000 MWs of Conventional Generation, Solar, Wind, Demand Response and Retail Load at the ISOs/RTOs
- CES provides telemetry to ~25 MWs of Telemetry for both in front and behind the meter energy storage resources in PJM



We offer bidding strategies, state of charge management, scheduling, and dispatch.

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CES Energy Storage Consulting Services



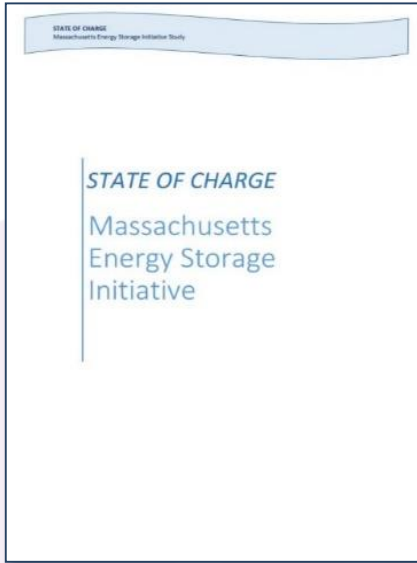
- **Energy Storage Strategic Consulting**
 - Technology
 - Due Diligence
 - Market Entry
- **Regulatory and Market Rules for Storage**
 - Storage IQ
 - Market Overview Reports
 - Market Sizing Analysis
 - Hybrid Resources
- **CoMETS**
 - Price forecasts
 - Optimization of product configuration
 - Renewables and Storage
- **Microgrid services**
- **RFP Support**

CES assists clients from concept to market implementation

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CES is a Leader in the Global Storage Industry



Prime
Contractor:



- “State of Charge” and the Energy Storage Initiative
- The Winner of the Brad Roberts Award 2016
 - For recognition of role played by CES over past 12 years in helping growth of energy storage opportunities through competitive electricity markets and range of services
- IRENA
 - Renewable Power and Energy Storage Global Evaluation Framework
- India Energy Storage Association and MICRO
 - Currently engaged in developing India’s “National Energy Storage Mission” and “National EV Policy”
- Advisors to the Energy Storage Association (ESA)
- India Smart Grid Forum (ISGF) President’s Award for contribution to growth of Smart Grid in India - 2018
- And Much More....

Leaders in the Global Storage Industry

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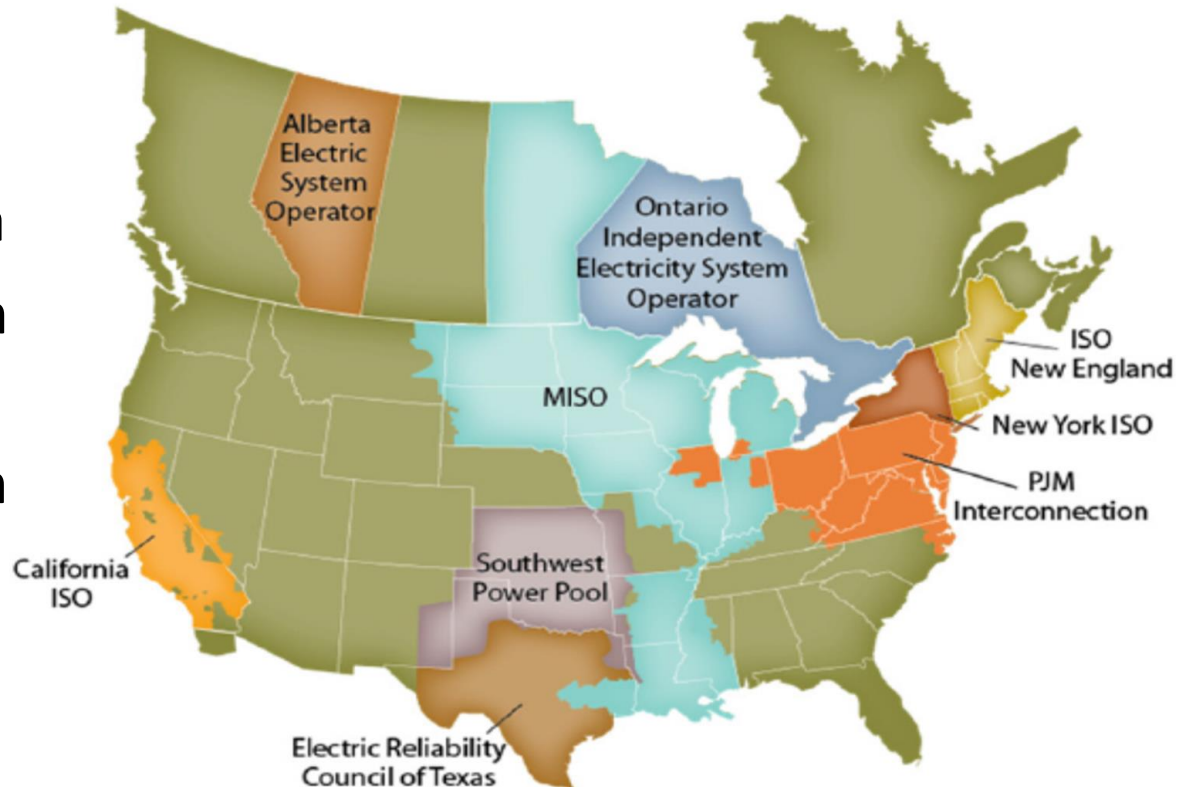
How Order 841 Came to Be

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FERC and Wholesale Electricity Markets

- Federal Energy Regulatory Commission (FERC) is an independent agency that regulates the interstate transmission and wholesale sales of electricity
- ISOs and RTOs cover two-thirds of North America
 - Grid operation
 - Market administration
 - Power system planning



FERC Orders Related to Energy Storage

- **Order 890** (RM05-17 and RM05-25)
 - Preventing Undue Discrimination and Preference in Transmission Service
- **Orders 719** (RM07-19) and **745** (RM10-17)
 - Demand Response Compensation in Organized Wholesale Energy Markets
- **Order 755** (RM11-7)
 - Frequency Regulation Compensation in the Organized Wholesale Power Markets
- **Order 784** (RM11-24)
 - Third-party provision of ancillary services and the accounting and financial reporting for new electric storage facilities
- **Order 792** (RM13-2)
 - Small Generator Interconnection Agreements and Procedures
- **Order 842** (RM16-6)
 - Essential Reliability Services and the Evolving Bulk-Power System – Primary Frequency Response

Order 841 History

- Energy storage industry discussion prompts panel on storage at Nov '15 FERC Open Meeting
- Motivated opening of administrative proceeding AD16-20, Apr '16 data request to ISOs, and stakeholder comments
- Motivated opening of rulemaking proceeding RM16-23, Nov '16 Notice of Proposed Rulemaking (NOPR), and stakeholder comments
- Ruling at Open Meeting Feb '18

What Order 841 Says and Does

Order 841 – What it Says

- Directs RTOs/ISOs to establish a “participation model” for “electric storage resources” that recognizes physical and operational characteristics
 1. Eligibility to Participate in All Markets
 2. Eligibility to Bid, Be Dispatched, and Set Prices as Wholesale Seller and Buyer
 3. Bidding Parameters and State of Charge Management
 4. Minimum Size Requirement
 5. Treatment of Energy Used to Charge
- Timeline: 9 months for RTO/ISO compliance filings (12/1/18), then 12 months for implementation (12/1/19)

Order 841 – Participation Model

- To comply, RTOs/ISOs will have to file a tariff that establishes a “participation model” for Storage
- A set of market rules (tariff and manual language, and software) - that enables the participation - of resources with particular physical and operational characteristics - in the RTO/ISO markets
- Examples of RTO/ISO participation models:
 - Non-Generator Resource (NGR) in CAISO
 - Alternative Technology Regulation Resource (ATRR) in ISO-NE
 - Generation Resource in MISO
 - Energy Limited Resource (ELR) in NYISO
 - Economic Load Response resource in PJM
 - Variable Energy Resource (VER) in SPP

Order 841 – What it Should Do

- Facilitate the participation of Storage in ISO markets
- How?
- Storage is eligible to provide all capacity, energy, and ancillary services that it is technically capable of providing
- Storage can be dispatched and can set the wholesale market clearing price as both a wholesale seller and wholesale buyer
- RTOs/ISOs account for the physical and operational characteristics of electric storage resources through bidding parameters or other means
- Minimum size requirements do not exceed 100 kW
- Storage will pay wholesale LMP for charging energy
- But, much flexibility given to RTOs/ISOs

Order 841 - Justification

- “To remove barriers to the participation of electric storage resources in the capacity, energy, and ancillary service markets operated by Regional Transmission Organizations (RTO) and Independent System Operators (ISO).”
- “To enhance competition and, in turn, help to ensure that the RTO/ISO markets produce just and reasonable rates.”
- “Furthermore, due to electric storage resources’ unique physical and operational ... our actions here will help support the resilience of the bulk power system.”

What this Means in Specific RTOs/ISOs

CAISO Participation Models: Non-Generator Resource

- » Functions like a generation resource and can provide Energy and Ancillary Services.
- » Minimum Size is .5 MWs
- » Continuous operating range from a negative to a positive power injection; seamlessly switch between generating and consuming electrical energy.
- » Does not have minimum load operating points, state configurations, forbidden operating regions, or offline status (unless on outage). No startup, shutdown, minimum load, or transition costs.
- » CAISO incorporates specific parameters in its MasterFile to be able to optimize and dispatch NGRs.
 - Energy Limits, SOC, Ramp Rates (for charging and discharging), minimum and a maximum capacity

CAISO Participation Models: Proxy Demand Resource

- » PDRs cannot yet export onto the grid
- » Can participate in the energy and ancillary services markets – energy, spin, and non-spin.
- » The minimum size requirement for PDR is 0.1 MW (100 kW) for Day-Ahead and Real-Time energy, and .5 MW (500 kW) for Ancillary Services (Spin and Non Spin).
- » PDRs can be a single site or comprised of an aggregation of locations, or “sub-resources” (SubLap)
- » PDR settlements is determined by measuring performance. This is done through via baseline calculations.

CAISO Filed for Clarification or Rehearing

- Three Issues:
 - Unnecessary for the RTO/ISO *itself* to directly meter storage resources;
 - The RTO/ISO can either (1) require the storage resource to use a participation model designed for retail customer participation (such as demand response), or (2) continue settling the storage resource's charging demand under the wholesale LMP.
 - Charging a storage resource pursuant to RTO/ISO dispatch provides a service such that the storage resource should not incur transmission charges

CAISO 841 Compliance Needs

- Compliance Issues:
 - Lower the minimum size threshold for Non-Generator Resources to 100 kW
 - Settlement mechanisms should reflect applicable local regulatory authority auxiliary power rules while also avoiding ‘double payment’ concerns of behind-the-meter exporting energy storage systems

NYISO – Storage History

- Since NYISO began, it has had Energy Limited Resource (ELR) asset type (for hydro pumped storage)
 - Provide any product, including Capacity, with at least 4-hour duration
 - Schedules pumping/charging and discharge, theoretically battery/advanced storage can participate as ELR
- In 2009 it created new asset type: Limited Energy Storage Resource (LESR)
 - NYISO manages state of charge, on 5-minute basis, to maximize capability
 - Minimum resource size: 1 MW
 - Limited to short duration (under 1 hour)
 - Can only provide Regulation
 - Settle net energy at wholesale price (LMP)
 - 20 MW LESR (flywheel operating since 2011) is only advanced storage in ISO
- Multiple DR programs allow BTM resources, including storage, to provide Energy, Capacity, and Ancillary Services

NYISO – Current Initiatives

- New York State and FERC actions on storage and DERs have pushed NYISO to act
 - NYISO now leads many other ISOs and has a head start on compliance for Order 841
- In 2016 began work on Energy Storage Resource (ESR) asset design
 - Will allow individual and aggregated storage to sell all products it can technical qualify to provide
 - Includes new bidding parameters and state-of-charge telemetry in first phase
 - Will add ISO-controlled optimization in second phase
 - Heavily influenced by industry input and FERC NOPR AD16-23
- NYISO also began working on a new DER Roadmap in 2016 to establish generator-like participation options for various types of DER aggregations
 - Will create “Dispatchable DER” resource type
 - Many aspects follow AD16-23 guidance
 - NYISO moving ahead despite no order on DER from FERC yet

NYISO – 841 Compliance

- ESR asset design is already close to compliant with 841
- Two possible issues exist:
 - Deployment timeline – NYISO expects to implement ESR design sometime in 2020 (maybe even 2021)
 - ESR rules technically apply to resources ≥ 100 kW, but some features of ESR design only for resources ≥ 1 MW
 - State-of-charge monitoring and consideration in dispatch only for resource ≥ 1 MW with 1 hour of duration
 - NYISO may only allow Ancillary Services from ESRs ≥ 1 MW
 - Not part of 841, but NYISO proposes restricting Dispatchable DER participation in Ancillary Services to ≥ 1 MW resources as well

Storage Resources have Options in ISO-NE

- Nov. '08 - Alternative Technology Regulation Pilot Program
 - Expected to last 18 months, 6 ½ yrs later concluded with Order 755 (3/31/15)
- Created testing environment for new technologies
- Asset class: Alternative Technology Regulation Resource (ATRR) – for electric and thermal storage, DR, etc.
 - Regulation-only; minimum size = 1 MW
 - Energy-neutral Regulation dispatch signals
- Storage must register as generator and load resources separately
- Energy settlement options – can settle net energy at wholesale prices
- New bidding parameters for “DARD Pumps” in March 2017 - to better optimize dispatchable pumping load at pump storage resources
- Paper in early 2016 “How Energy Storage Can Participate in New England’s Wholesale Electricity Markets” offered a summary of options
- Training webinars in spring 2017

ISO-NE has Options in Storage Resources

- Regulation market clearing peculiarity – “lumpiness” – only whole offers are selected -> partially fixed in July 2017
- Assessment of “Enhanced Storage Participation” planned for ~~2Q17~~
~~3Q17~~ 4Q17 1Q18 2Q18
 - Dispatchability requirement
- Forward Capacity Market (FCM) – annual, 3-year forward auctions – one- or two-hour audit for storage resource capacity qualification – but “Pay for Performance” starting June 2018
- Integrating Markets and Public Policy (IMAPP) began in 2016 – supplemental Capacity auction “Competitive Auctions with Sponsored Policy Resources” (CASPR) June 2018
- DR integration – “Price Responsive Demand” (PRD) June 2018
- Ramping challenges (i.e. uplift) -> ramping product or multi-interval dispatch and pricing?

ISO-NE 841 Compliance

- Minimum size lower from 1 MW to 100 kW
- Participation model for all storage resources?
- Bidding parameters?
- Energy settled at LMP vs. zonal
- Storage should not be charged transmission charges when dispatched by the ISO to consume energy to provide a service
- Metering and accounting practices?

Order 841 - Next Steps

- Thirteen requests for clarification and rehearing - FERC to acknowledge (or not), by mid April
- ISOs are holding stakeholder meetings to discuss Order and plans for compliance
- ISOs must file tariffs by December 1, 2018
- Implementation by December 1, 2019



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FERC and Clean Energy

Thursday, April 26, 1-2pm ET

Income Trends of Residential Solar Adopters

Wednesday, May 2, 1-2pm ET

Read more and register at www.cesa.org/webinars