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# ENERGY STORAGE MARKET PARTICIPATION MODELS

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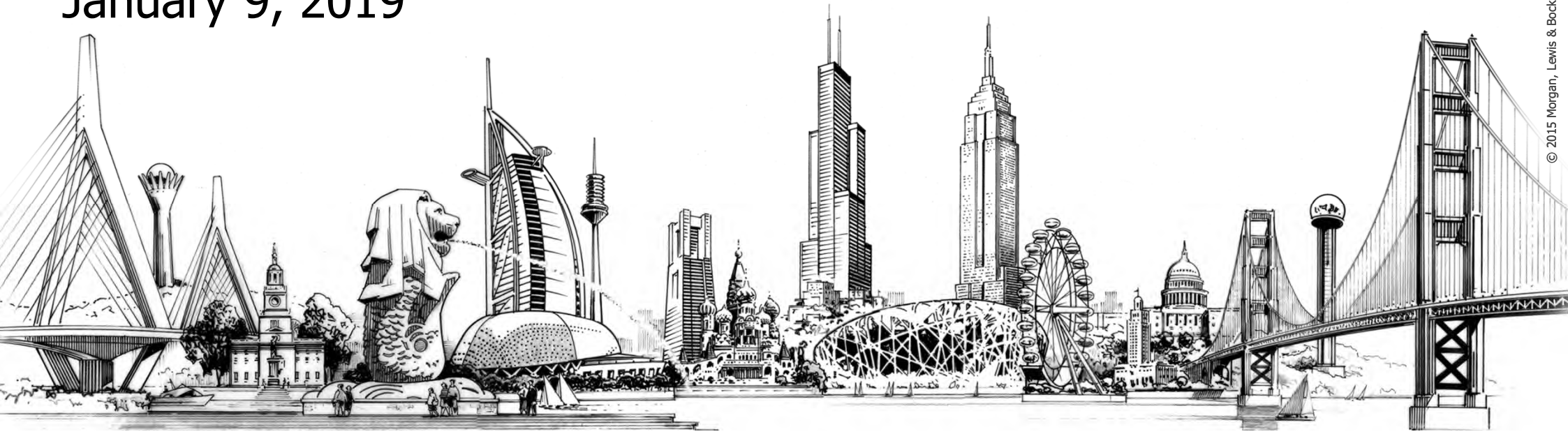


# ORDER NO. 841
# BACKGROUND

# FERC Focus on Storage

- FERC has long recognized the potential for storage to bring economic and reliability benefits to consumers.
- Various FERC rulemakings and administrative issuances have focused on issues relevant to storage since at least 2011.
- Notable examples:
  - Order No. 755: Frequency Regulation Compensation in the Organized Wholesale Power Markets
  - Order No. 784: Third Party Provision of Ancillary Services; Accounting and Financial Reporting for New Electric Storage Technologies
  - Order No. 792: Small Generator Interconnection Agreements and Procedures
  - Order No. 819: Third-Party Provision of Primary Frequency Response Service
  - Policy Statement: Utilization of Electric Storage Resources for Multiple Services When Receiving Cost-Based Rate Recovery

# Need for Reform

- FERC had been evaluating the need for reforms to better accommodate storage participation in wholesale markets.
  - In November 2015, FERC hosted a panel to discuss electric storage resources.
  - In April 2016, FERC Staff issued data requests to ISOs and RTOs and a Request for Comments to determine whether electric storage resources face barriers to participating in the capacity, energy, and ancillary service markets that potentially lead to unjust and unreasonable wholesale rates.
  - In November 2016, FERC issued a Notice of Proposed Rulemaking (NOPR) preceding Order No. 841 proposing to amend its regulations to remove barriers to the participation of electric storage resources in the RTO/ISO markets.
- Efficiency and competition concerns arise when resources that are capable of providing services are precluded from participating.

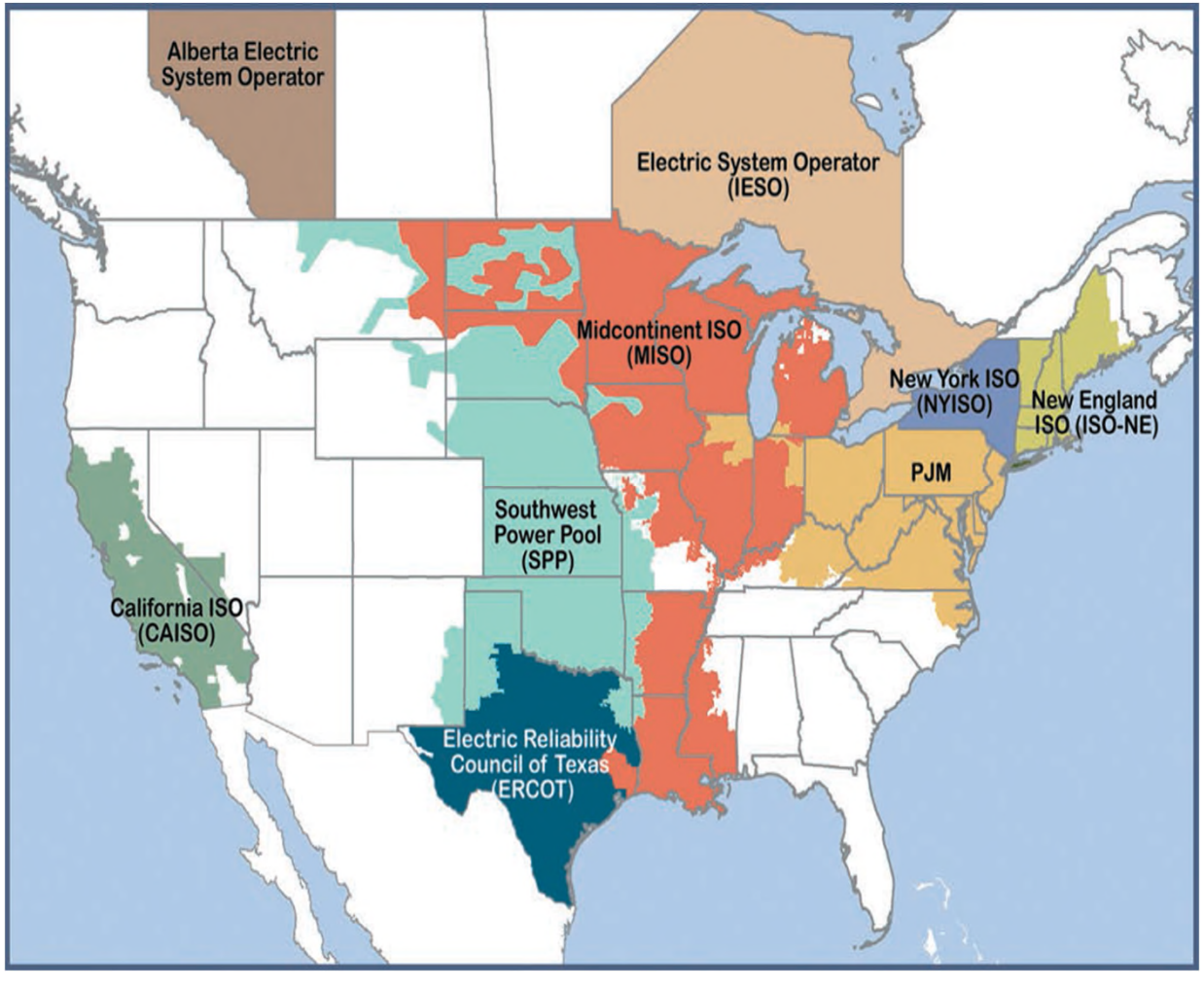
# Order No. 841

- On February 28, 2018, FERC issued its long-awaited final rule addressing electric storage resource participation in capacity, energy, and ancillary service markets operated by RTOs/ISOs
  - *Electric Storage Participation in Markets Operated by Regional Transmission Organizations and Independent System Operators*, Order No. 841, 162 FERC ¶ 61,127 (2018)
- Followed a lengthy stakeholder process that attracted significant industry attention.
- Significant focus on ensuring efficiency and competition in RTO/ISO markets

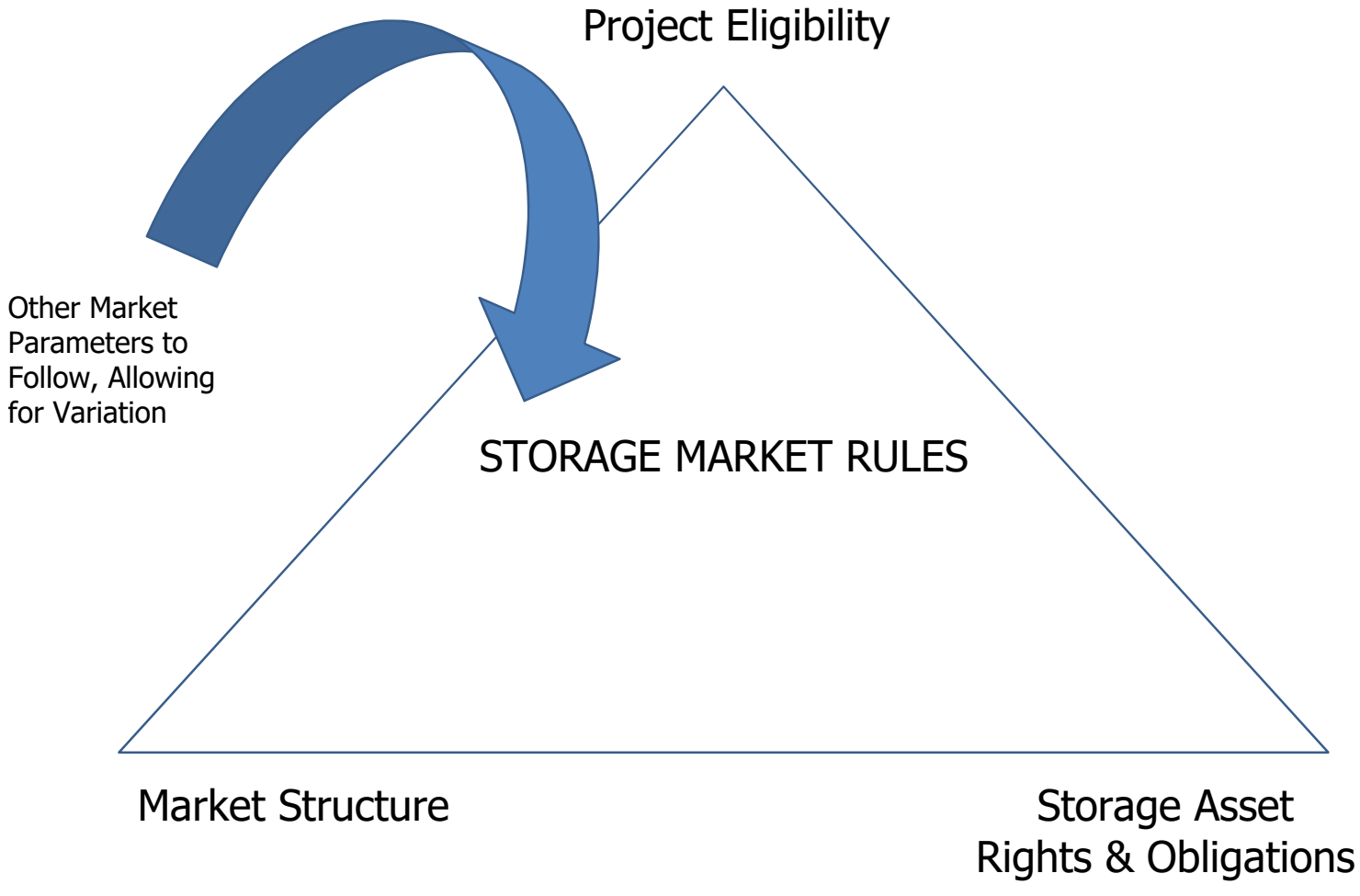
# Order No. 841

- FERC has authority under the Federal Power Act to ensure that the rates, terms, and conditions of jurisdictional service are **just and reasonable**.
- RTO/ISO market activities are conducted pursuant to FERC-jurisdictional tariffs and market rules.
- Mandates that RTOs/ISOs come into compliance to facilitate storage resource participation.
  - Certain electric storage resources have been participating in the RTO/ISO markets for many years.
  - Even so, FERC found that those existing models limit the scope of services electric storage resources may provide or are designed for electric storage resources with very specific characteristics (e.g., pumped-hydro facilities).

# Scope of Application



# Storage Market Structure



# Resource Eligibility

## What is an Electric Storage Resource?

A resource that:

- Is capable of receiving electric energy from the grid and
- Is capable of storing electric energy for later injection back to the grid

The resource can be located on:

- the interstate transmission system
- a distribution system
- Behind the meter

*But once the resource injects electric energy back to the grid, that is interstate commerce and subject to FPA and FERC regulation.*

# Market Structure *highlights*

MUSTS

- Characteristics must include:
  - state of charge
  - min/ max state of charge
  - min/max charge limit
  - min/max charge time
  - min/max run time
  - min discharge limit
  - min charge limit
  - charge/ discharge ramp rate

MUSTS

- Storage can be dispatched as supply and demand and can set the wholesale market clearing price. But it must be dispatchable.
- Rules cannot require storage to be a price taker.
- Storage must have the same ability to self-schedule.
- Rules cannot require storage to participate as supply and demand simultaneously and must not allow conflicting supply offers and demand bids from the same resource for the same market interval.

# Storage Asset Rights/Obligations

- Storage can be dispatched as supply and demand and can set the wholesale market clearing price. But it must be dispatchable.
- Rules cannot require storage to be a price taker.
- Storage must have the same ability to self-schedule.
- Rules cannot require storage to participate as supply and demand simultaneously and must not allow conflicting supply offers and demand bids from the same resource for the same market interval.

# OVERVIEW OF MARKET PARTICIPATION MODELS

# RTO/ISO Implementation

- RTOs/ISOs granted wide latitude to tailor participation models as they see fit.
- Potential for variation across RTOs/ISOs
  - RTOs/ISOs may account for physical and operational characteristics of electric storage resources in very different ways.
  - Market participation requirements, settlement, and counterparties already vary by market.
  - Some Order 841 provisions require significant changes to accounting and metering practices for storage resources on the distribution grid or behind-the-meter.
  - Metering may also depend on the metering configurations local to those storage resources.

# CAISO

- Among the grid operators that has amassed considerable experience incorporating energy storage resources into its markets.
- Various storage-specific programs
  - Energy Storage and Distributed Energy Resource ("ESDER"), intended to lower barriers and enhance the abilities for energy storage and distribution-connected resources (i.e., rooftop solar, energy storage, plug-in electric vehicles, demand response)
- ESRs can qualify as sellers in the CAISO energy and ancillary service markets if they meet the appropriate technical criteria.
  - ESRs generally participate in the CAISO markets as nongenerator resources, pumped storage hydro units, or as one of the CAISO's two demand response entities, i.e., proxy demand resources or reliability demand response resources.
  - Distribution-connected ESRs within the CAISO BA are also able to participate in CAISO markets.
    - Participating generator through a wholesale distribution access tariff.

# CAISO Compliance Filing

- Highlighted existing tariff provisions that already implement technology-agnostic participation models for storage resources at different interconnection levels
  - Main participation framework for traditional battery technologies is the "non-generator resource" or "NGR" model.
    - Allows resources to be dispatched as generation or load and operate continuously across their entire capacity range.
  - Separate model for pumped-storage hydro resources
  - Demand response framework suitable for BTM and smaller-scale resources
  - Some participation opportunities for virtual resource aggregation
- CAISO requested clarification, or rehearing in the alternative, on several issues that are still pending before the Commission.
  - Concerns could be moot if FERC approves compliance filing.

# MISO

- MISO storage participation initially limited to mostly short-term storage assets.
  - Stored Energy Resource (SER): designed as short-term storage, limited to Regulating Service
- *Indianapolis Power & Light Co. v. MISO* complaint proceeding resulted in expanded storage participation category.
  - Stored Energy Resource Type II (SER - Type II): capable of providing Energy, Capacity, Spinning Reserve, Supplemental Reserve, and/or Regulating Reserve; behind- or front-of-meter; state of charge managed by market participant.

# MISO Compliance Filing

- New ESR category to eventually replace SER - Type II.
- Proposed model facilitates participation in MISO's Energy and Operating Reserve Markets.
  - Ability for storage resources to participate as supply and demand.
- Eight different dispatch commitment statuses
  - Dispatch status allows storage resource to dictate product being offered.
  - Exclusionary "Not Participating" energy dispatch status will allow storage resource to providing only ancillary services or energy, if desired.
- Technical eligibility based on service provided by the energy storage resource.
- Size requirement at Order No. 841 maximum of 100 kW
- Distribution-sited resources will need to execute new *pro forma.*

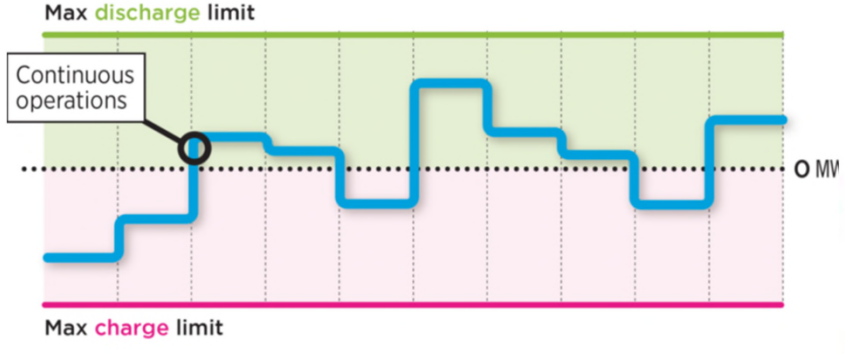
# PJM

- PJM Market Rules allow all resources to participate, regardless of technology classification, so long as resource meets eligibility and performance criteria.
- ESRs can be offered as generation resources or demand-side resources.
  - PJM has both transmission and distribution ESR, but no behind-the-meter injecting back onto grid.
  - Examples of ESR participation in PJM include battery/flywheel participation (regulation), pumped-hydro (reactive power, long-duration capacity).

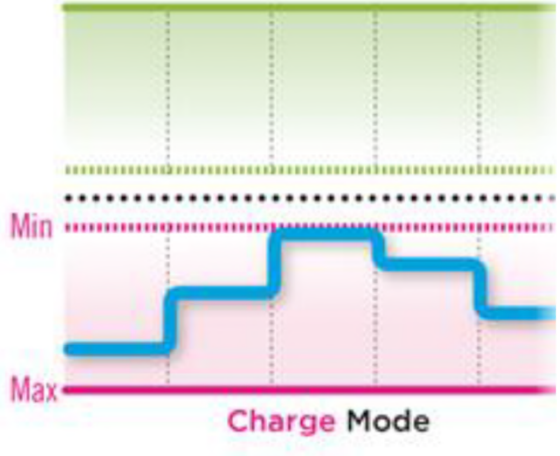
# PJM Compliance Filing

- Two-tiered compliance proposal
  - Markets and Operations Proposal
  - Accounting Proposal
- Broadened ESR participation
  - ESR Participation Model explicitly addresses each available product to ensure energy storage participation
- Three operational modes: continuous, charge, or discharge.

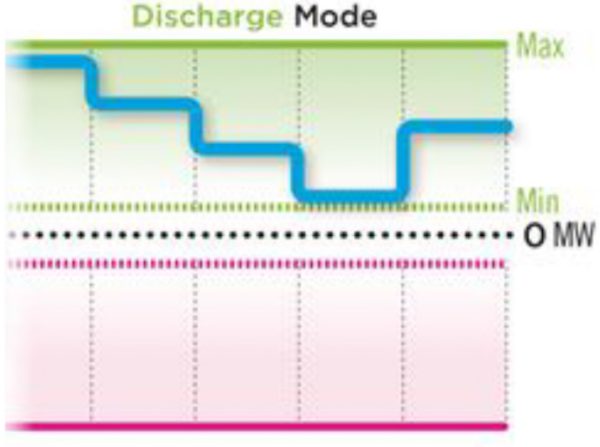
*Continuous*




*Charge*

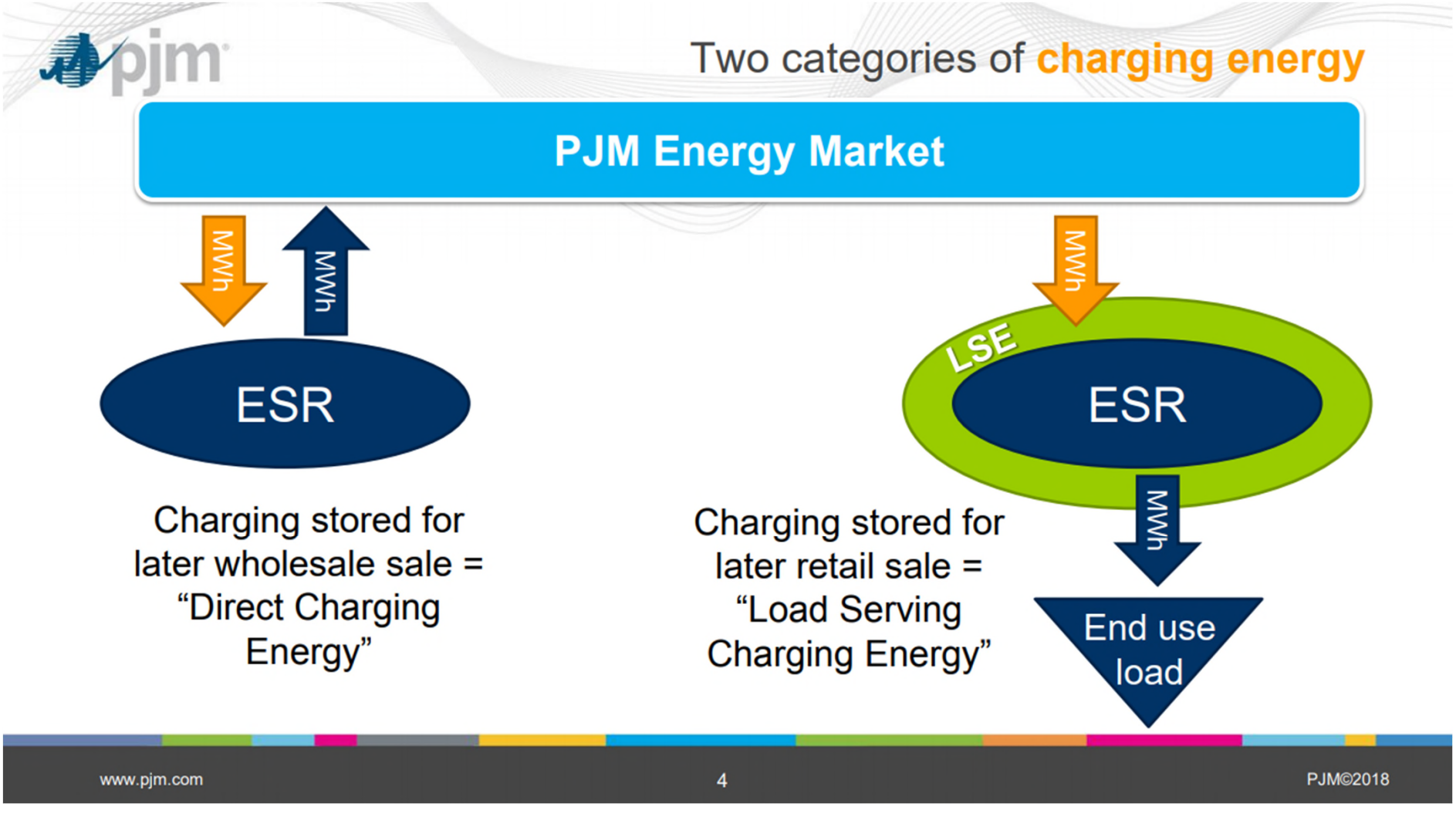



*Discharge*




*Source:* PJM Order 841 Compliance Filing, Docket No. ER19-469 (Dec. 3, 2018).

# PJM Compliance Filing




*Source:* Andrew Levitt, PJM, "Order 841 and Energy Storage/DER" (Nov. 8, 2018).

# PJM Compliance

- Forward capacity market (Reliability Pricing Model (RPM))
  - Minimum 10-hour duration not feasible for most resources
- Earlier effective date requested for separate Accounting Proposal
  - Ability to test proposed metering and accounting methodology before model implementation

# ISO-NE

- Storage representation traditionally skewed toward older pumped-hydro storage.
- Registration types:
  - Alternative Technology Regulation Resource (ATRR) and/or non-dispatchable Generator Asset,
  - Dispatchable Generator Asset and Dispatchable Asset Related Demand (DARD)/DARD Pump
  - Non-dispatchable Settlement Only Resource, or
  - Demand Response Resource, On-Peak or Seasonal Peak Resource



*Source: *Catherine McDonough*, *Enhanced Storage Participation, ISO-NE / NEPOOL Markets Committee (Apr. 10, 2018).*

# ISO-NE Compliance Filing

- Introduction of the terms "Binary Storage Facility" and "Continuous Storage Facility"
  - Proposed reforms differentiate between pumped-storage hydro (the predominant storage technology in the ISO-NE region) and other electric storage technologies
- Binary Storage Facilities (i.e., pumped-storage hydro facilities)
  - Allowed to be either on line to charge or on line to discharge, but not both simultaneously
  - Must be capable of switching on within 30 minutes.
- Continuous Storage Facilities (e.g., batteries)
  - Can continuously transition between charging and discharging.
  - Must be capable of switching between a charging state and a discharging state rapidly and continuously.
- Continuous Storage Facilities will be eligible to participate in ISO-NE markets as:
  - Generator Asset type, which submits offers to supply energy;
  - Dispatchable Asset Related Demand asset type, which submits bids to consume energy; and
  - Alternative Technology Regulation Resource, which allows the resource to provide regulation services.

# NYISO

- NYISO currently allows ESRs to participate in energy, ancillary, and capacity markets under different categories of resources:
- Energy Limited Resources (ELRs):
  - Receive capacity payments, can operate at the level represented by their capacity obligations for some but not all of the day because of limiting factors like ambient air temperature.
  - Must be capable of maintaining one MW of injection for a minimum four consecutive hours, are not permitted to aggregate, and have their energy withdrawals offer as negative MW value generation offers.
- Limited Energy Storage Resources (LESRs):
  - Cannot inject maximum output for an hour (e.g., flywheels, batteries, fuel cells).
  - Offer regulation service and are compensated for regulation capacity and movement.
  - At least 1 MW; cannot be aggregated.
- Demand response programs:
  - Load reduction and demand-side resources.

# NYISO Compliance Filing

- New framework for participation in the Day-Ahead and Real-Time Markets tailored specifically to energy storage resources.
  - Applicable to resources capable of injecting energy on to the grid for longer durations than Limited Energy Storage Resources.
- Proposed model contemplates that participating energy storage resources will be dispatch-only.
  - Ability to bid energy across their entire operating ranges
- Treated by NYISO as always "on" and available for dispatch, with no need for a start-up period.
  - This is markedly different than other categories of NYISO market resources that can also bid commitment parameters (e.g., minimum run time), in addition to dispatch parameters.
  - No proposal for resources that cannot quickly toggle between charging and discharging.

# SPP

- SPP Integrated Marketplace allows any Resource type to provide Operating Reserves or Energy.
  - No capacity market.
- Must sustain an output for at least one hour to participate in so long as the Resource can sustain energy level output for one hour or longer
  - When a Resource is committed, SPP expects that Resource to be available for at least one full hour. Full hour may be in a single direction (charging or discharging).
- Energy storage resources are capable of participating as any category of Resource except Variable Energy Resource.
- Rules for participation do not vary by type of resource. Participation is based on meeting relevant performance requirements for the market product.

# SPP Compliance Filing

- Multiple new avenues for participation in SPP's Integrated Marketplace
- Introduction of Market Storage Resource ("MSR") participation model
  - Exclusive to energy storage resources.
  - MSR registration option will allow SPP to dispatch the MSR to withdraw energy from the market, include the physical and operational characteristics of MSRs in the market dispatch
  - Transmission charges will not apply for MSR withdrawals when those withdrawals are a result of the MSR responding to an SPP dispatch.
  - Unlike other types of resource categories, MSRs will also be able to submit financial and operational offers to both inject and withdraw in the Day-Ahead Market and Real-Time Balancing Market.
- No capacity market
  - But, rules do not currently prevent LSEs from using storage to meet Resource Adequacy requirements.

# PENDING REGULATORY ISSUES

# Pending Regulatory Issues

- Storage as a transmission asset
- Jurisdictional concerns
  - Impact to the distribution grid; associated costs
  - State opt-out
- Transmission access charges
  - Charging energy
  - Provision of ancillary services
- Ability to provide all services
  - Sufficiency of registration options
  - Metering and accounting challenges

# Biography

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Levi McAllister advises clients subject to regulatory oversight in the natural gas, petroleum, and electric power sectors of the energy industry. Levi's practice largely focuses on compliance with regulatory provisions administered by the Federal Energy Regulatory Commission (FERC), the Commodity Futures Trading Commission (CFTC), and state public utility commission that affect the energy industry. Levi also advises clients on transactional matters concerning acquisitions, divestitures, mergers, and development of gas, petroleum, and electric generating infrastructure.

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As the US energy business continues to evolve, Arjun Prasad Ramadevanahalli represents key industry participants in regulatory, transactional, and litigation matters, including investigations and enforcement proceedings. Arjun represents electric power, natural gas, and other energy industry participants before the Federal Energy Regulatory Commission (FERC), the US Commodity Futures Trading Commission (CFTC), and the North American Electric Reliability Corporation (NERC). When necessary, his representations extend to court appeals.

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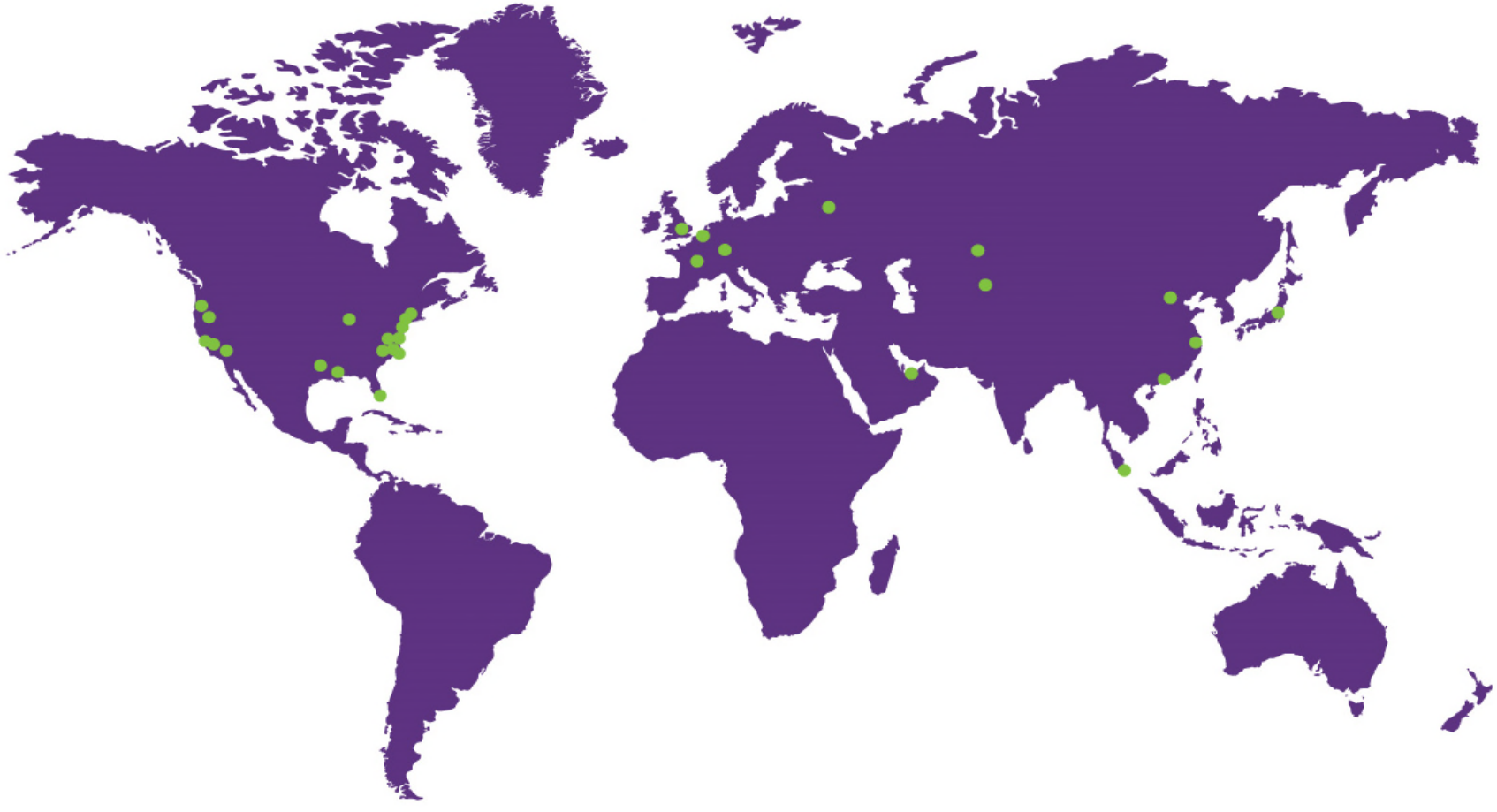

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