

NYISO's Distributed Energy Resource and Energy Storage Market Integration

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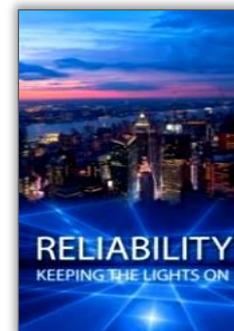
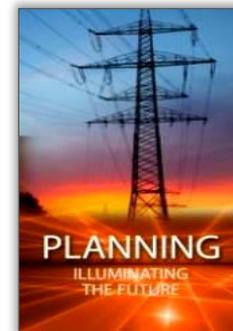
MANAGER, OPERATIONS PERFORMANCE & ANALYSIS (NYISO)

ESIG 2019 Spring Technical Workshop



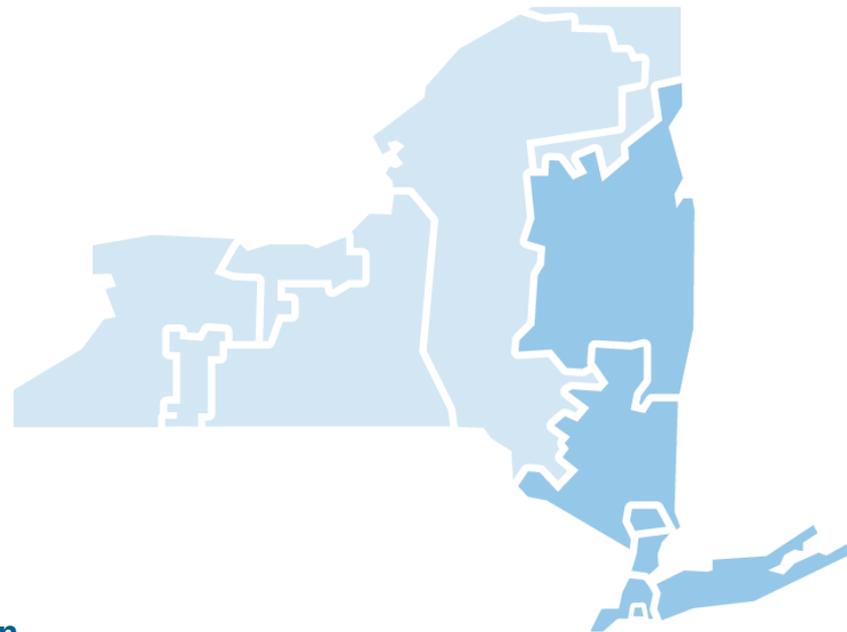
Roles of the NYISO

- **Reliable operation of the bulk electricity grid**
 - Managing the flow of power on 11,000 circuit-miles of transmission lines from hundreds of generating units
- **Administration of open and competitive wholesale electricity markets**
 - Bringing together buyers and sellers of energy and related products and services
- **Planning for New York's energy future**
 - Assessing needs over a 10-year horizon and evaluating projects proposed to meet those needs
- **Advancing the technological infrastructure of the electric system**
 - Developing and deploying information technology and tools to make the grid smarter



NYISO by the numbers

- New York population: **19.75 million**
- 2017 Energy Demand: **156,370 GWh**
- 2018 Required Installed Capacity: **42,839 MW**
- 2017 Peak: **29,699 MW**
- Record peak: **33,956 MW (July 19, 2013)**
- Transmission: **11,173 circuit miles**
- Power Generation: **700+ units**
- Wholesale Market Participants: **434**
- Average Annual Market Transactions: **\$5.3 billion**

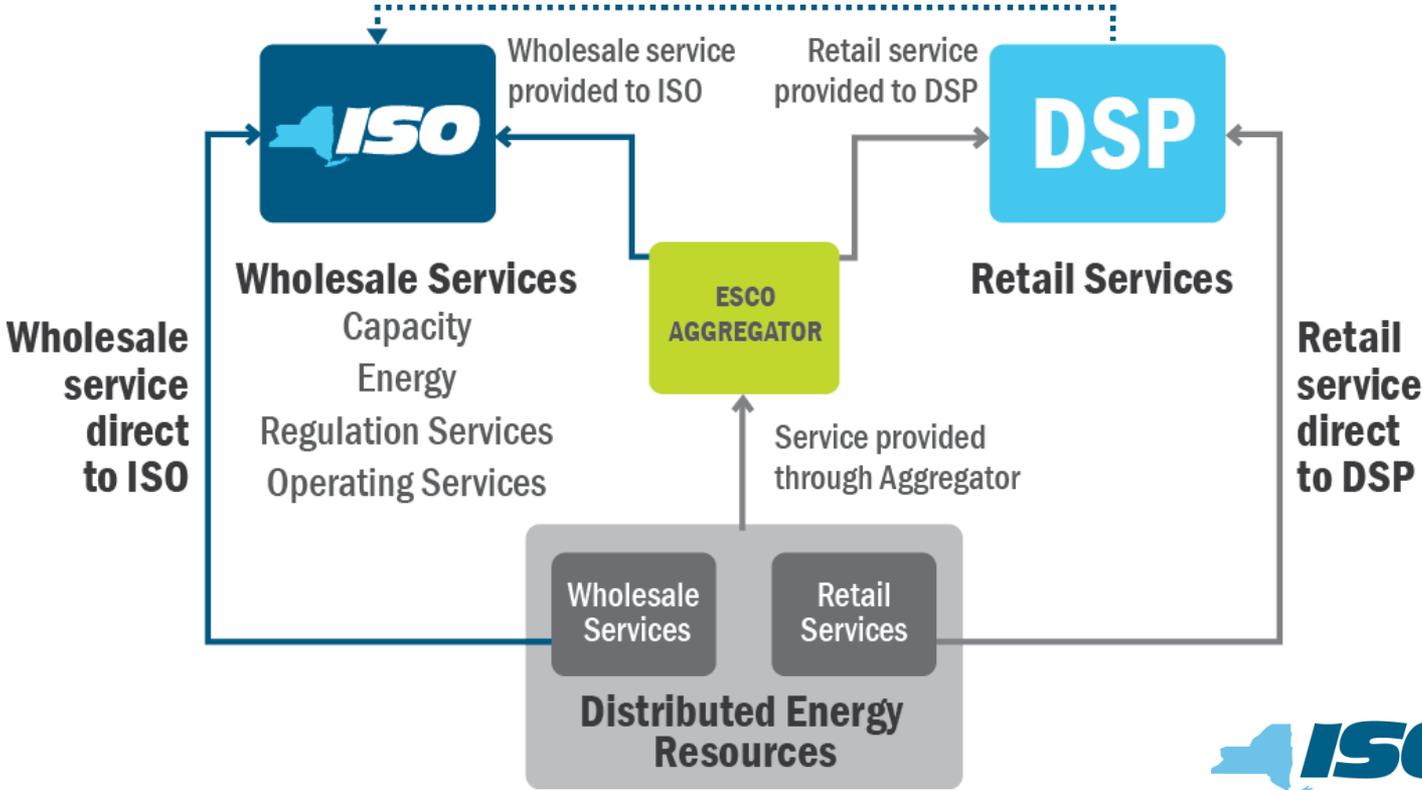


Distributed Energy Resources (DER)

DER Definition for the NYISO Market

- **Distributed Energy Resource (DER): A Generator, Energy Storage Resource, Intermittent Power Resource, Energy Limited Resource, or Capacity Limited Resource participating in an Aggregation whose maximum physical injection is 20 MW or less and Demand Side Resources (including facilities that can reduce Load and inject Energy) that respond to the ISO's instructions**
 - Dispatchable DER are a subset of DER that are capable of responding in real-time to NYISO dispatch instructions

Integrating DER in Wholesale Markets



DER Market Integration Objectives

- Integrate dispatchable DER into Capacity, Energy, and Ancillary Services Markets



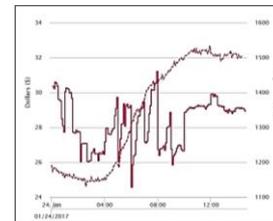
- Align with New York State's REV Goals



- Enhance Measurement and Verification



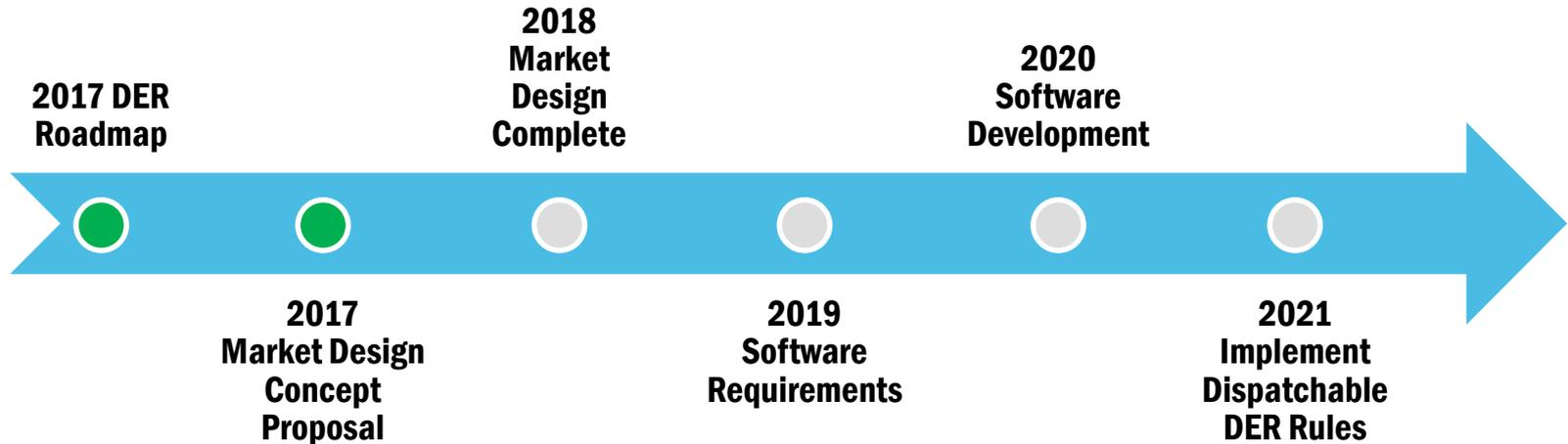
- Align Compensation with System Requirements



- Focus on Wholesale Market Transactions



Timeline



Distributed Energy Resources Roadmap for New York's Wholesale Electricity Markets:

<https://www.nyiso.com/documents/20142/2261851/2017-Distributed-Energy-Resources-Roadmap.pdf/9afac12f-6d55-7855-2689-c377b0577304>

NYISO Distributed Resources Market Design Concept Proposal:

http://www.nyiso.com/public/webdocs/markets_operations/market_data/demand_response/DER_Roadmap/DER_Roadmap/Distributed-Energy-Resources-2017-Market-Design-Concept-Proposal.pdf

DER Aggregations

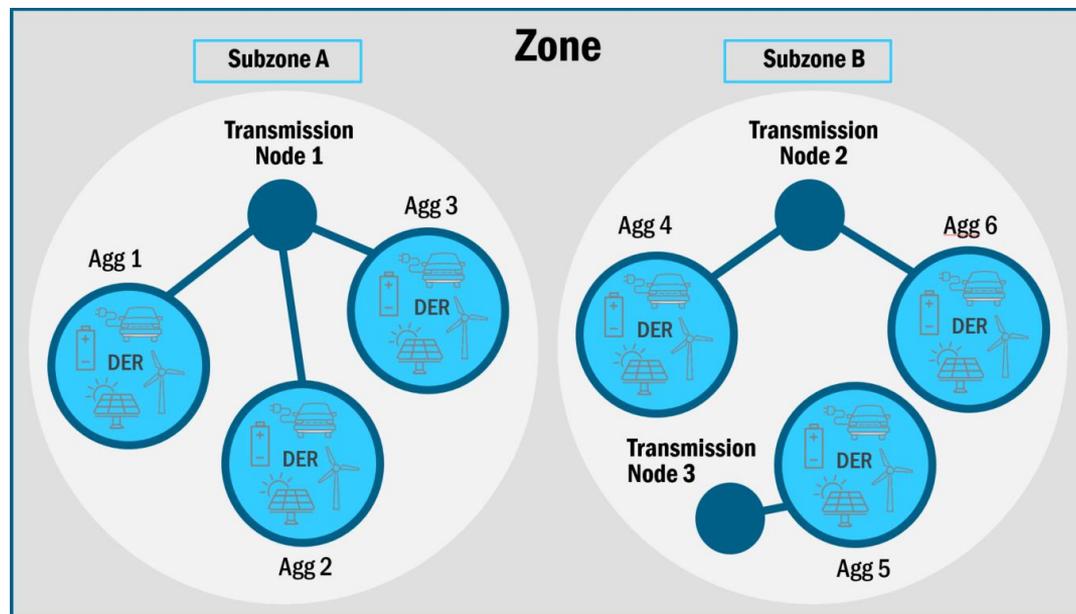
- Aggregation allows for the participation of smaller distributed resources to act in concert to meet minimum eligibility requirements and performance obligations for eligible participation models
- The Aggregator will be the NYISO Market Participant
- The Aggregation will be a group of one or more individual resources participating in the NYISO Market
 - Bids will represent the offer of the Aggregation
 - Performance will be measured in aggregate
 - Financial settlements will be in aggregate
 - NYISO intends to separately process the injection, withdrawal and load reduction data for accurate settlements

Aggregations

- Aggregations may qualify to provide Energy, Capacity and Ancillary Services
- Minimum offer requirements for all Aggregations are 100 kW

Aggregations and Transmission Nodes

- Transmission Nodes reflect the collection of electrically similar facilities to which individual DER may aggregate as an Aggregation with a single PTID
- All resources within a Aggregation will be required to be electrically behind the same NYISO modeled Transmission Node



Aggregations and Transmission Nodes

- Aggregations grouped at a Transmission node allow NYISO to effectuate dispatch in a manner that both sends correct price signals and effectively relieve transmission constraints on the system
 - This transmission node level granularity, instead of Load Zone level, will effectively relieve transmission constraints thereby resulting in lower overall total production cost

Scheduling & Pricing

- **DER Aggregations will be scheduled consistent with their bids and capabilities**
 - Aggregators will be allowed to balance individual DER response within the Aggregation to achieve aggregate dispatch
- **DER Aggregations will be eligible to set prices for the programs/participation models in which they are Scheduled & Dispatched**
- **Day-Ahead and Real-Time prices will be calculated at the Transmission Node**

Dual Participation

- **The NYISO's market design allows resources that provide Wholesale Market services to also provide services to another entity (e.g., the utility or a host facility)**
 - Providing resources with the flexibility to meet wholesale and distribution system needs will deliver the maximum benefit to New York electricity consumers

Dual Participation Requirements

- **Dual participating resources will be required to:**
 - Comply with all NYISO market rules for the services offered to the wholesale market
 - Non-compliance may result in financial penalties
 - Appropriately offer into the wholesale markets to reflect any non-wholesale (e.g., retail) obligations
 - Resources will be required to follow NYISO dispatch instructions at all times;
 - Resources will submit offers to NYISO when providing non-wholesale service
 - Resources will receive payments for Energy or Ancillary Services scheduled through these offers

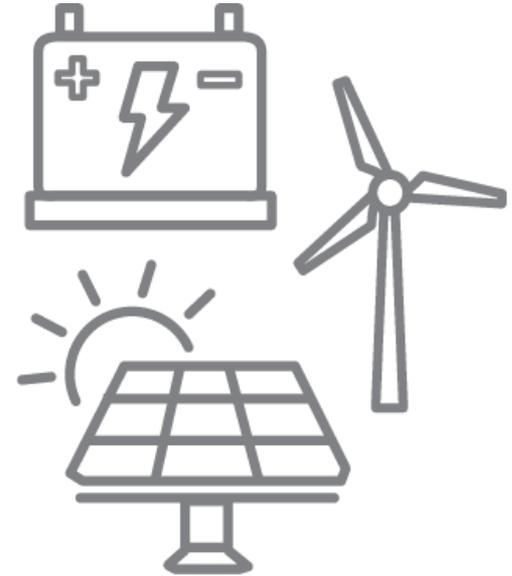
NYISO-DSP Coordination

- **All Aggregators, including Aggregators with dual participating Resources, will need to comply with the NYISO-DSP-Aggregator operational coordination framework to ensure that NYISO and DSP have accurate information on the operational status and availability of the Aggregations and individual DER within the Aggregation**
 - NYISO's operational decisions will primarily be at the Aggregation-level; DSP may need individual DER-level information to assess DER's impact on specific distribution feeders and on the distribution system
- **Communication between the NYISO and the DSP is expected to remain similar to existing communication between the NYISO and the NY Utilities**

Energy Storage Resources (ESR)

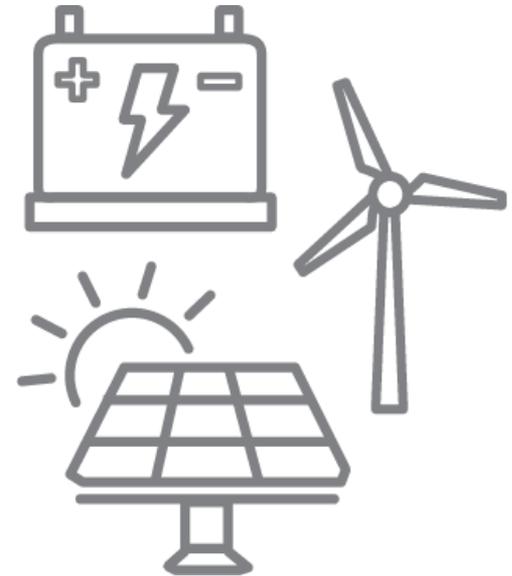
ESR Energy Market Design Overview

- **Technology neutral participation model**
 - Accommodates all storage types (e.g. flywheel, battery, pumped storage)
- **Minimum offer size for Energy, Capacity, and Ancillary Services: 100 kW.**
 - Energy and A/S will be scheduled following the same principles used for other suppliers
 - ESRs will be eligible to provide Reserves and Regulation while withdrawing
- **While withdrawing from the grid, Energy consumed by ESRs will be treated as negative generation rather than Load**
 - Consistent with treatment of ELRs and LESRs today and directives in FERC Order No. 841



ESR Energy Market Design Overview (Cont.)

- **Key new concepts for ESRs**
 - Roundtrip efficiency
 - Beginning Energy Level
 - Upper/Lower Storage Limits
 - Energy Level Management Mode
 - Offers to withdraw and inject in the same hour

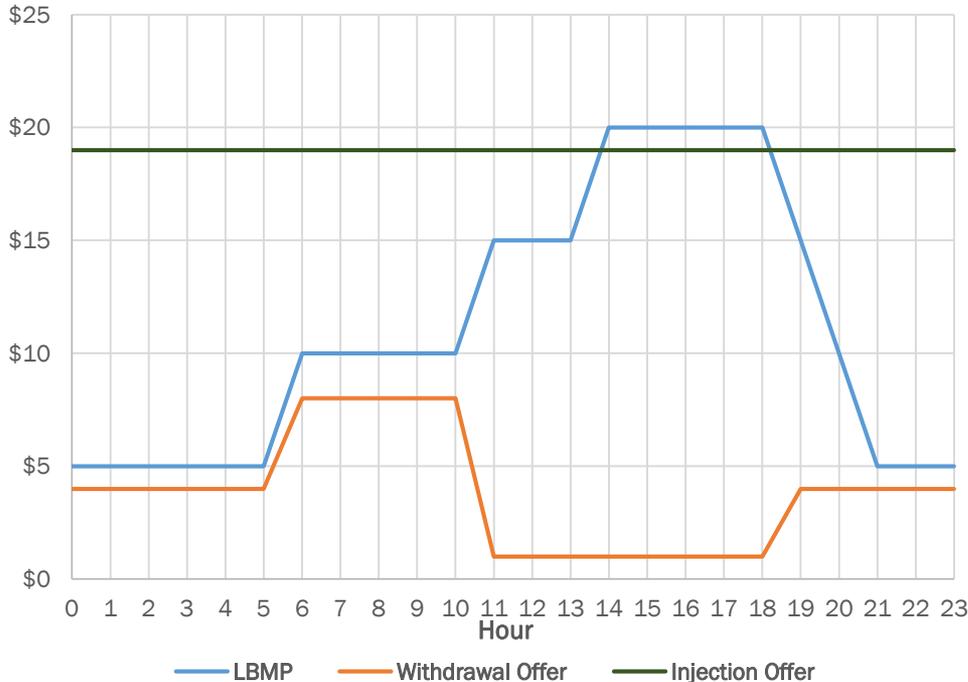


Energy Level Modes for ESRs

- **ESRs will be allowed to participate in one of two Energy Level Modes:**
 - **ISO-Managed:**
 - NYISO market optimization will use Beginning Energy Level, Roundtrip Efficiency, Lower and Upper Storage limits to ensure that ESRs receive physically feasible schedules in the DAM and RTM
 - For example: once an ESR reaches its Upper Storage Limit, it will not be scheduled to withdraw more energy, regardless of its bid
 - **Self-Managed:**
 - Beginning Energy Level, Roundtrip Efficiency, Lower and Upper Storage limits will not be considered in the market optimization
 - Energy Level telemetry will be evaluated as a pre-optimization step to ensure that Reserve schedules meet reliability requirements and Energy schedules are feasible (only in RTM- RTC & RTD)
 - Self-Managed ESR's will be responsible for managing their energy level constraints through their offers

NYISO Energy Level Management

- Example: Two identical ESRs offer into the DAM. One offers as ISO-Managed and the other as Self-Managed. Both have an Initial State of Charge of 0 MWh



- In the example at left, the ISO-Managed ESR would be scheduled to withdraw above its offered price of \$4/MWh during hours 0-4, and inject above its offered price of \$19/MWh during hours 14-17
- The Self-Managed ESR would never be scheduled to withdraw because its offer of \$4/MWh is below the LBMP for the entire day
- The Self-Managed ESR would be scheduled to inject above its offered price of \$19/MWh during hours 14-17
- The Self-Managed ESR will not be able to meet its DA schedule without changing its offers in RT

Scheduling ISO-Managed ESRs

- Assumptions for Example:
 - 2-hour day
 - Single bus system- no transmission needed
 - 3 generator model
 - ESR is 100% efficient
 - Load in hour 1 = 500 MW
 - Load in hour 2 = 1500 MW
 - Generator 1 offer for hour 1 and 2 = \$15/MWh
 - Generator 2 offer for hour 1 and 2 = \$50/MWh

Scheduling ISO-Managed ESRs: Example 1

- ESR is scheduled to withdraw and inject

- ESR offers to inject if the prices are \$30/MWh or above and withdraw if prices are \$10/MWh or below

	Injection Offer (\$/MWh)	Withdrawal Offer (\$/MWh)	Initial State of Charge (MWh)	Max State of Charge (MWh)	Hour 1			Hour 2			Bid Production Cost (\$)
					Max Hourly Injection (MWh)	Max Hourly Withdrawal (MWh)	Dispatch Signal (MWh)	Max Hourly Injection (MWh)	Max Hourly Withdrawal (MWh)	Dispatch Signal (MWh)	
Gen 1	15	N/A	N/A	N/A	1,000	N/A	600	1,000	N/A	1,000	24,000
ESR	30	10	0	100	-	(100)	(100)	100	0	100	2,000
Gen 2	50	N/A	N/A	N/A	1,000	N/A	-	1,000	N/A	400	20,000
Load							(500)			(1,500)	
Total							-			-	46,000

- In hour 1, LBMP is set by Generator 1 and is \$15
- In hour 2, LBMP is set by Generator 2 and is \$50

Scheduling ISO-Managed ESRs: Example 1 (Cont.)

- **ESR's Revenue:**
 - ESR is scheduled to withdraw 100 MW in hour 1 above its offered price.
 - ESR's bid = $(-100 * 10) = -\$1,000$
 - ESR pays = $(-100 * 15) = -\$1,500$
 - ESR is scheduled to inject 100 MW in hour 2 above its offered price.
 - ESR's bid = $(-100 * 30) = \$3,000$
 - ESR gets paid = $(100 * 50) = \$5,000$
- **ESR pays an additional \$500 in hour 1 and makes a profit of \$2,000 in hour 2**
- **ESR's net revenue is \$1,500**

Implementation Timeline

- In its Order 841 compliance filing to FERC, NYISO requested an effective date of its ESR rules no earlier than May 1, 2020

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 policymakers, stakeholders and investors in the bulk power system



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