NYISO Introduction

E- Learning Module

NYISO Introduction

MODULE OBJECTIVES:

- Explain the formation history of the NYISO
- Describe the Shared Governance process at the NYISO
- State NYISO's Mission, Vision and Key roles

NYISO History

NYISO History

Important Events in the timeline

1966

Formation of the New York Power Pool

1992

Energy Policy Act (EPACT)

1996

FERC Order 888/889

1999

Formation of the New York ISO

NYISO History

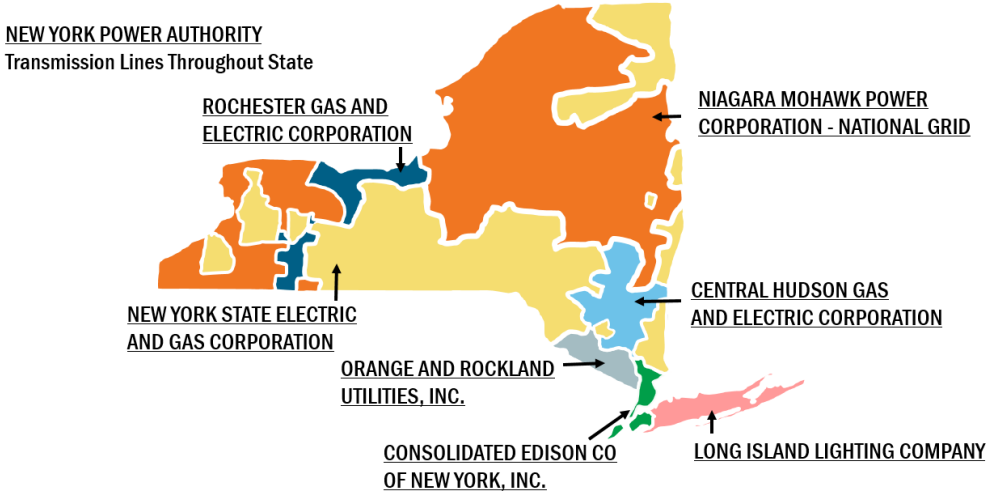
New York Power Pool (NYPP) - 1966

- Predecessor to NYISO
- Created in response to the Northeast Blackout of 1965
- Established by New York's utility companies to improve system and operational reliability
- Coordinated power reliability and managed the statewide wholesale grid
- Dispatched power from generators to balance supply and demand in the electric system

NYISO History

New York Power Pool (NYPP) - 1966

- Created by six investor-owned utility companies and two state-owned power authorities, which owned and operated New York's electric system



NYISO History

- The Energy Policy Act of 1992 (EPACT)
  - Federal law aimed at improving energy efficiency, due to rising electricity prices
    - Beginning of restructuring of the electric industry by opening transmission lines to competition
- FERC Orders 888/889 of 1996
  - Public utilities to provide open access for all electricity suppliers to the US power transmission grid
  - Restructuring of the electric industry in New York
    - Divesture of generating assets from the NY utilities
    - Creation of competitive energy markets

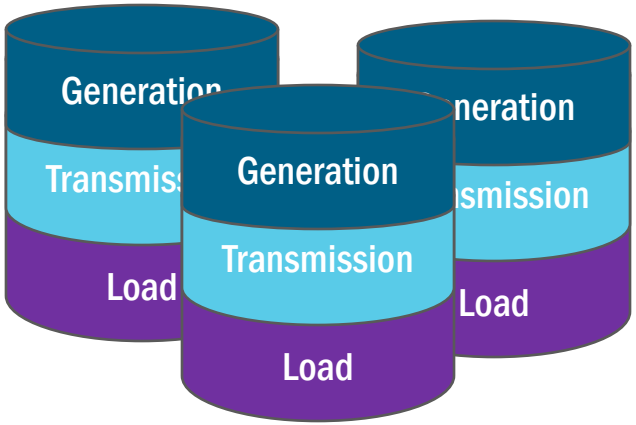
NYISO History

Electric Industry Restructuring

Utility World

Pre-FERC Order 888/889

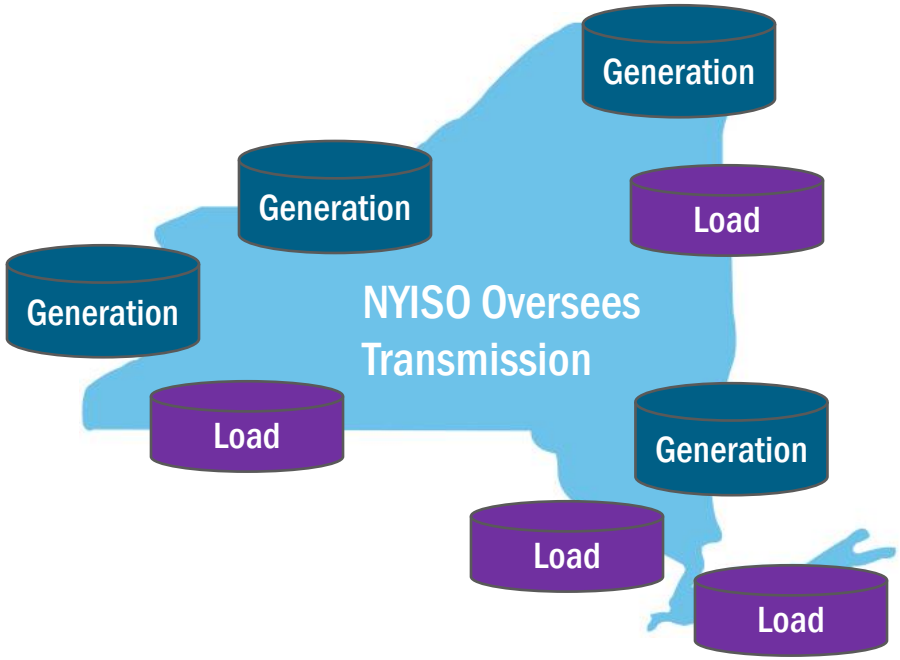
Vertically Integrated



Restructured World

Post-FERC Order 888/889

Open Access to Transmission



NYISO Formation

- The NYISO Began Operations on December 1st of 1999
- Independent and Non-Profit
  - Designed to provide objective and impartial operation of the bulk power grid and administration of the wholesale electricity markets serving New York
  - Independent of power generators and the utilities that sell power to consumers

NYISO Governance

NYISO Governance

- NYISO was created as an independent, not-for-profit organization to serve the best interests of New York's electric system and its customers
- NYISO independence comes with accountability; NYISO work is overseen by:
  - Government
  - Electricity Reliability Organizations
  - Market Participants

NYISO Governance

Government Oversight

Federal Energy Regulatory Commission (FERC)

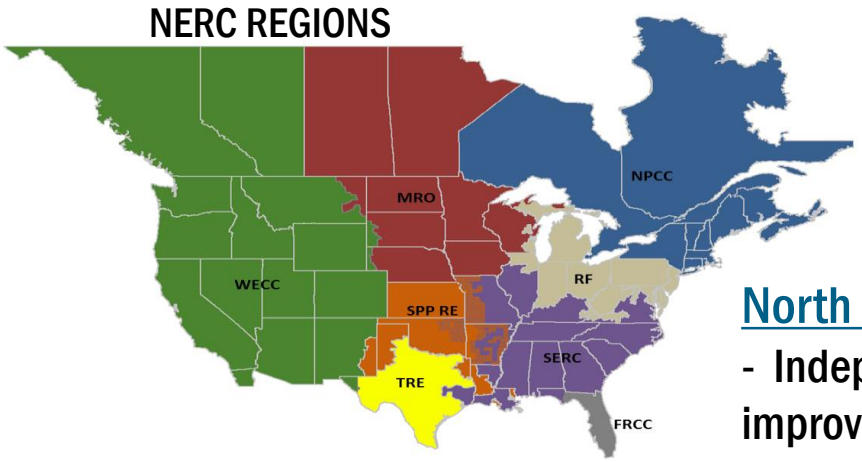
- Jurisdiction over transmission service and wholesale power sales
- Regulates the NYISO and other ISO/RTOs in the United States

New York State Public Service Commission (NYS PSC)

- Jurisdiction over generation, transmission siting, resource adequacy, compliance with NYSRC rules, and local electric distribution within New York
- Active participant in the NYISO's shared governance process

NYISO Governance

Reliability Regulation



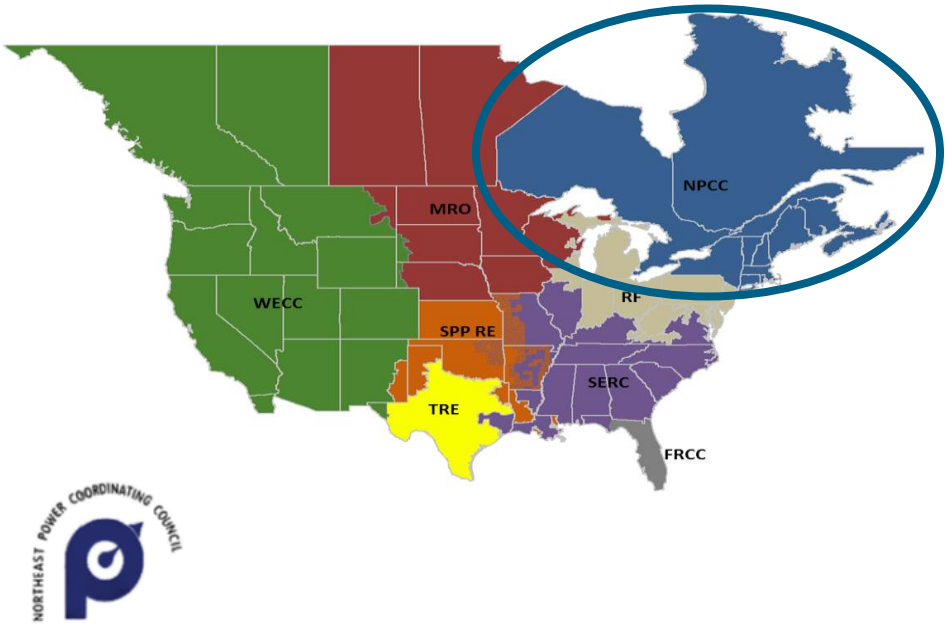
NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

North American Electric Reliability Corporation (NERC)

- Independent, not-for-profit organization with mission to improve the reliability and security of the bulk power system in the U.S., Canada and part of Mexico
- Compliance with NERC Reliability Standards became mandatory and enforceable in the U.S. in 2007

NYISO Governance

Reliability Regulation

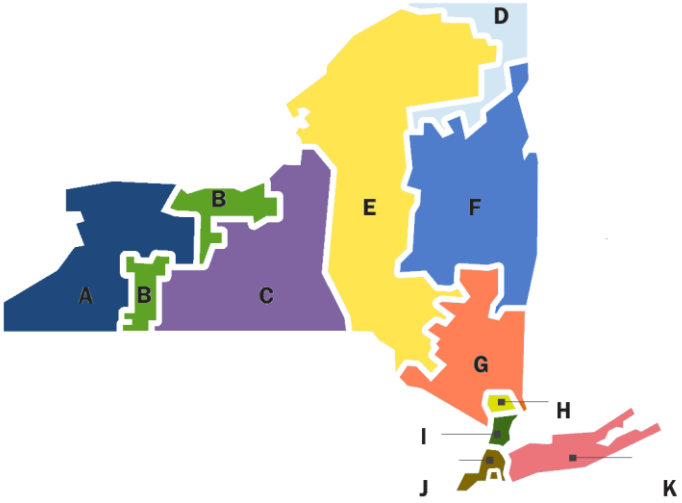


[Northeast Power Coordinating Council (NPCC)]

- Includes New York, New England, Ontario, Québec, and the Maritimes
- Formed as voluntary, not-for-profit, regional reliability organization in 1966
- Restructured in 2007

NYISO Governance

Reliability Regulation

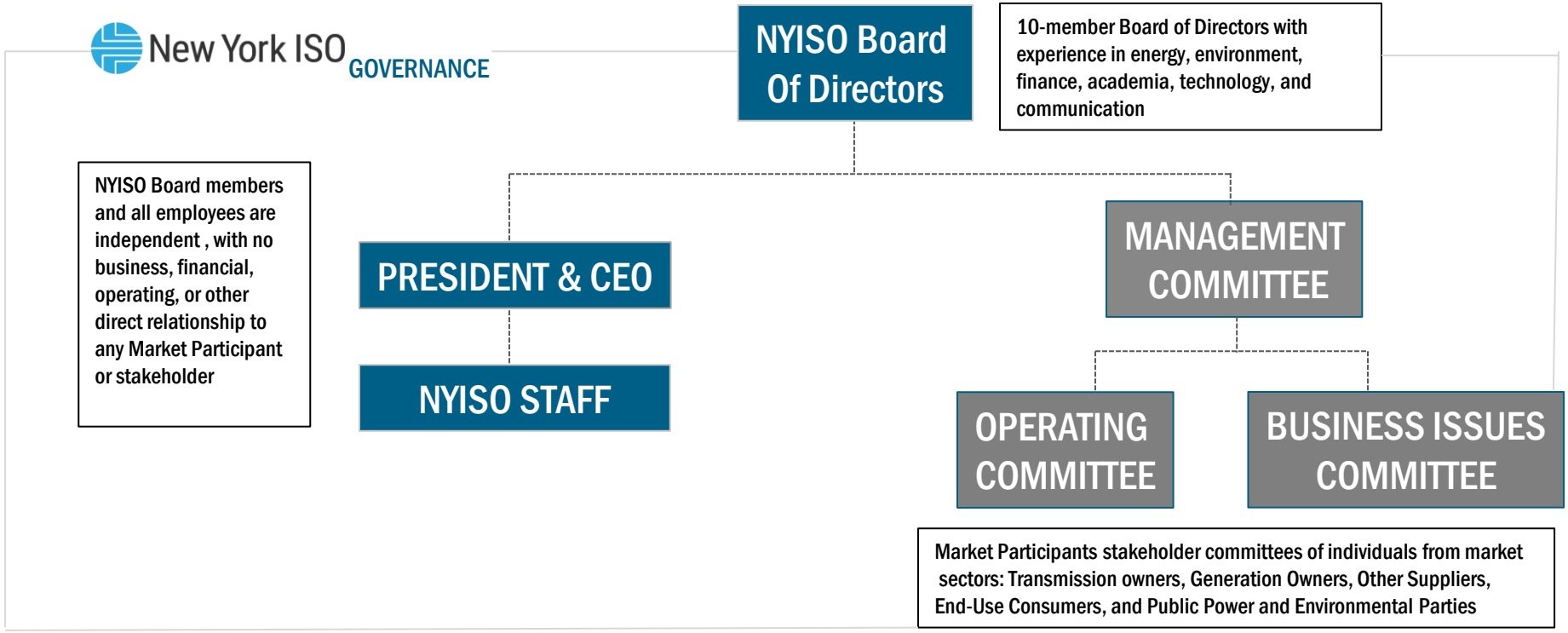


[New York State Reliability Council (NYSRC)]

- Not-for-profit organization established in 1999
- Responsible for Reliability Rules specific to the New York State Power System
- U.S. law authorizes New York State to impose more stringent reliability standards

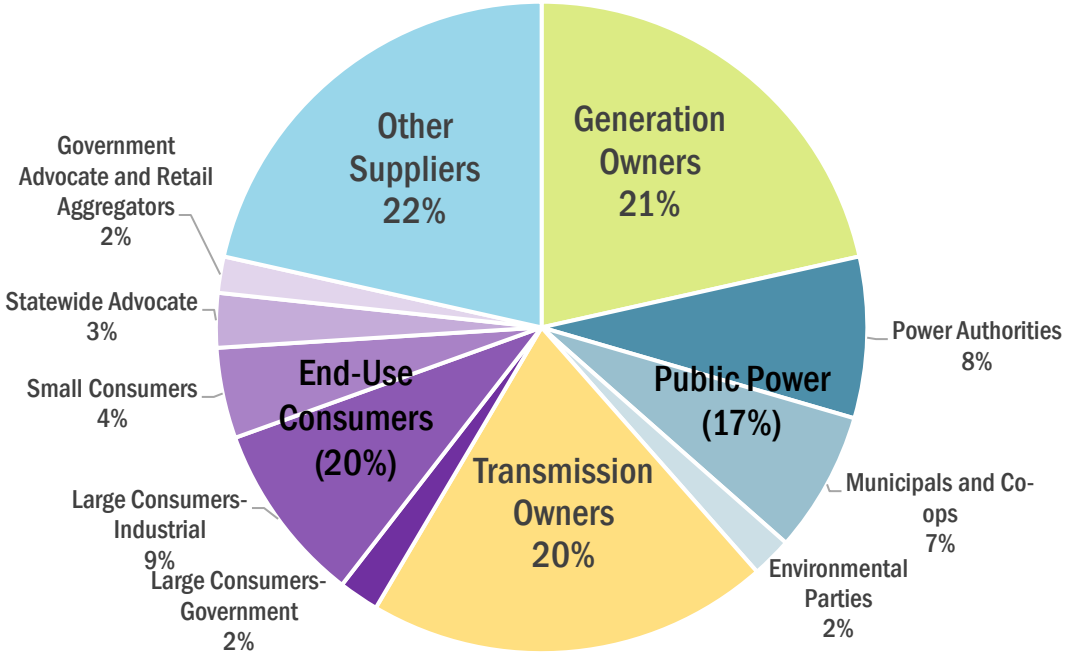
NYISO Governance

Shared Governance



NYISO Governance

Sector Voting System



58% Approval Required

NYISO Governance

NYISO Tariffs

- Open Access Transmission Tariff (OATT)
  - Provides Transmission Services on an Open Access Basis
- Market Administration and Control Area Services Tariff (MST)
  - Provides all other Market & Control Area Services
- Both Tariffs are approved by the Federal Energy Regulatory Commission (FERC)

NYISO Mission and Key Roles

NYISO Mission & Vision

Mission

Ensure power system reliability and competitive markets for New York in a clean energy future

Vision

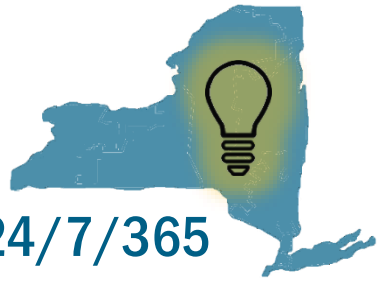
Working together with stakeholders to build the cleanest, most reliable electric system in the nation

Key Roles NYISO Plays

- In keeping with NYISO's mission and vision to serve :
  - Maintaining and enhancing regional reliability
  - Operating open, efficient 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
  - Advancing the technological infrastructure of the electric system

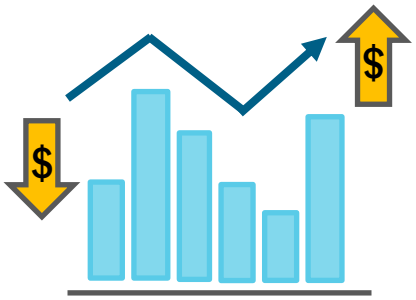
NYISO's Key Roles: Reliable Operations

- "Keeping the lights on" requires:
  - Managing the flow of power of nearly 11,000 circuit-miles of transmission lines from more than 400 generating units
  - Balancing New York's electrical supply with consumer demand every few seconds, all day long, every day of the year
  - Complying with approximately 1,000 reliability standards and requirements that govern NYISO operation of New York's grid



NYISO's Key Roles: Efficient Markets

- NYISO administers open and competitive wholesale electricity markets:
  - Energy Market
  - Ancillary Services Market
  - Installed Capacity Market
  - Demand Response Programs
  - Other Markets (financial)
    - Transmission Congestion Contracts
    - Virtual Trading

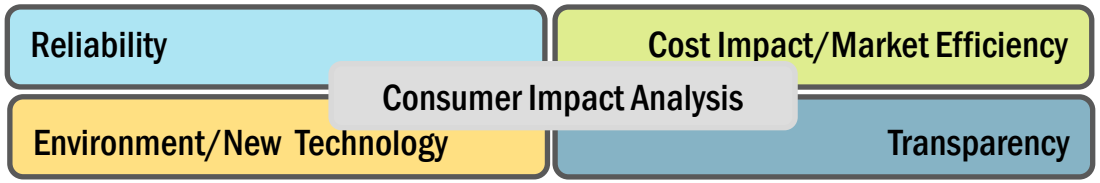


NYISO's Key Roles: Comprehensive Planning

- Planning future needs over a 10-year horizon and evaluating projects proposed to meet those needs
- NYISO's Comprehensive System Planning Process
  - Local Transmission Planning Process
  - Reliability Planning Process
  - Economic Planning Process
  - Public Policy Transmission Planning Process

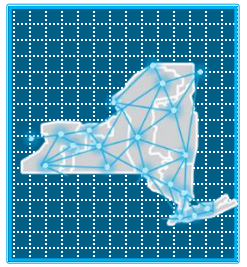
NYISO's Key Roles: Authoritative Information Source

- Source of reliable, authoritative information for energy consumers, stakeholders, and public and private decision makers in New York
  - NYISO accomplishes this by providing thorough consumer analyses and by undertaking a variety of information and education activities
    - Training & Education in Grid Operations and Market Orientation Sessions
    - Consumer Impact Analysis



NYISO's Key Roles: Advancing Technological Infrastructure

- NYISO's Technology Strategy:
  - Developing and deploying information technology and tools to make the grid smarter
  - Deliver capabilities that allow the NYISO to adapt to the dynamic operational and planning requirements of managing a more complex grid with increase renewables and distributed generation
  - Invest in technologies that provide a new level of flexibility and scalability
  - Continue to advance cyber security protections to stay ahead of the evolving cyber threat landscape



NYISO Market Overview Suite: Contents

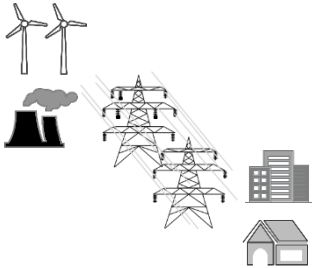
- Power Systems Fundamentals
- Energy Marketplace
- Locational Based Marginal Pricing
- Energy Market Transactions
- Transmission Services
- Ancillary Services
- Installed Capacity
- Demand Response

Questions?

For any future assistance, please contact NYISO Stakeholder Services at stakeholder_services@nyiso.com or by phone at (518) 356-6060

Power System Fundamentals

E-Learning Module



Power System Fundamentals

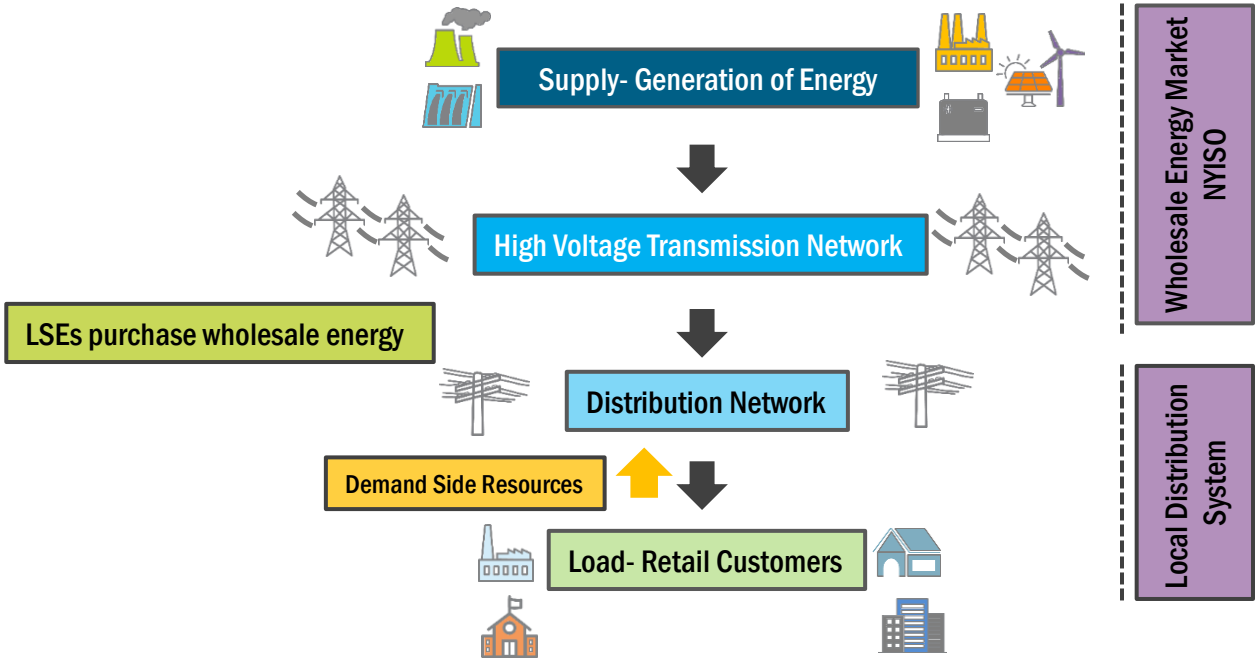
MODULE OBJECTIVES:

- Identify the difference between Bulk Power Transmission vs. Distribution Systems
- Name Physical Components of NYCA Power System
- Explain the Purpose behind Operational Ancillary Services

Bulk Power Transmission vs. Distribution vs. Retail Load

- Bulk Power Transmission
  - NYISO is responsible for controlling the transmission of power across the high-voltage transmission network, which is maintained by the Transmission Owners
- Distribution System
  - Transmission Owners are responsible for distributing power across the lower voltage transmission network to consumers
- Management of Retail Load Consumption
  - Load Serving Entities buy power at the wholesale level to sell to consumers at the retail level

Energy Production and Delivery



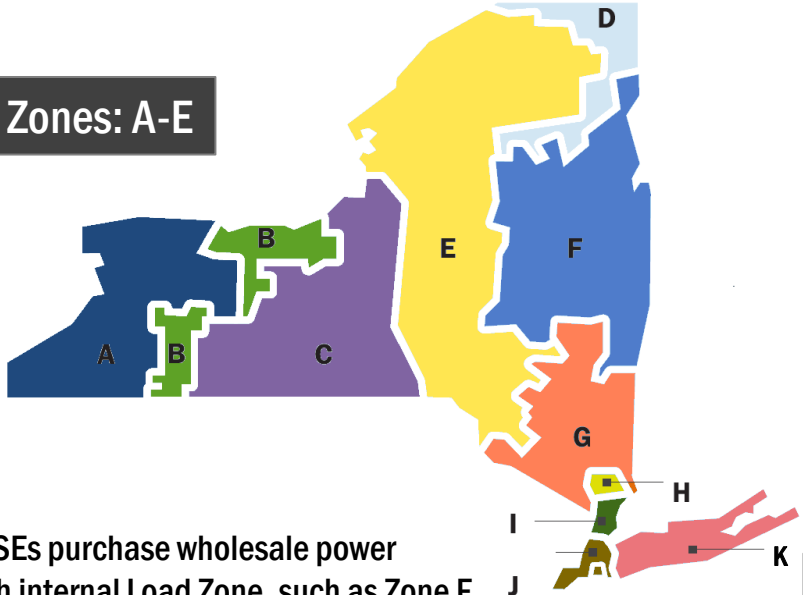
The New York Control Area

NYCA Power System

- NYCA Load Zones
- Neighboring Control Areas
- NYCA Transmission Owners

New York Control Area Internal Load Zones

Upstate Zones: A-E

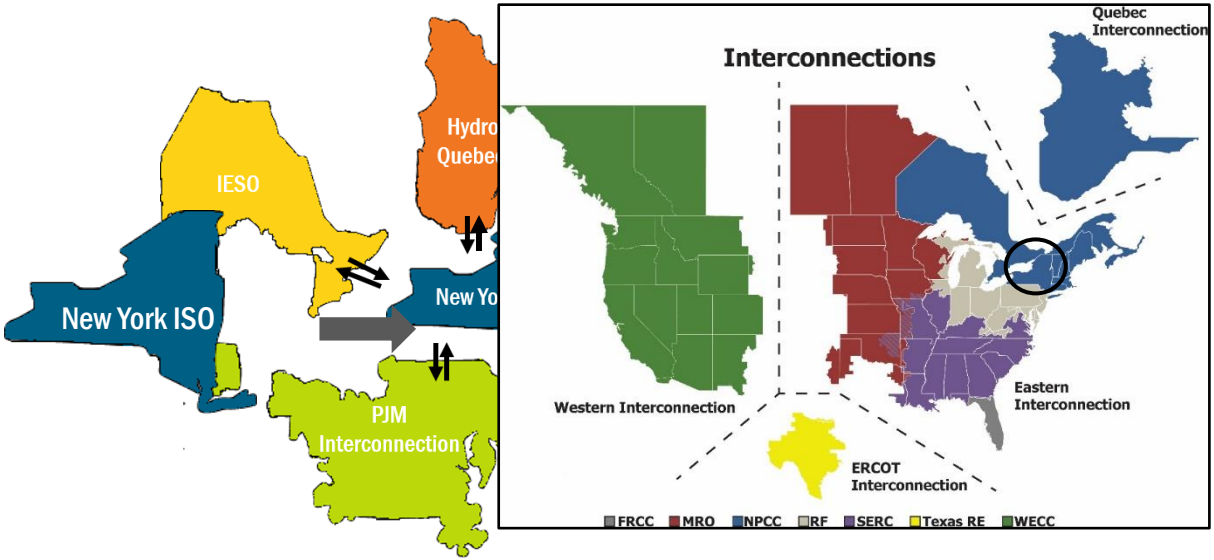


A	West
B	Genesee
C	Central
D	North
E	Mohawk Valley
F	Capital
G	Hudson Valley
H	Millwood
I	Dunwoodie
J	NYC
K	Long Island

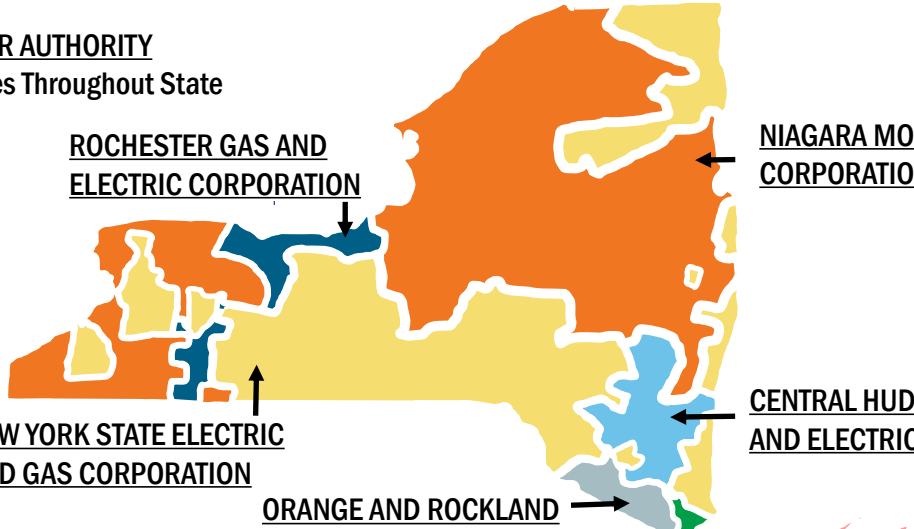
Multiple LSEs purchase wholesale power within each internal Load Zone, such as Zone F

Downstate Zones: F-K

Neighboring Control Areas



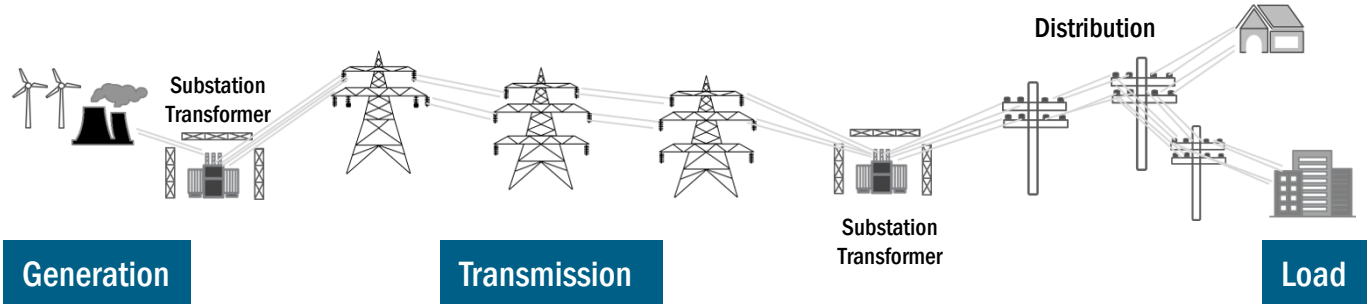
NYCA TRANSMISSION OWNERS



Physical Components of the NYCA Power System

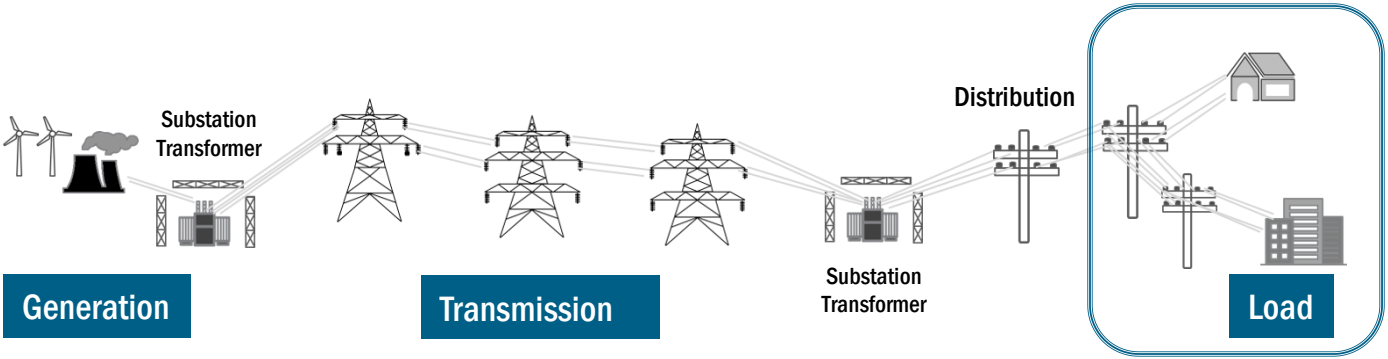
Physical Components of NYCA Power System

- Load
- Generation
- Transmission

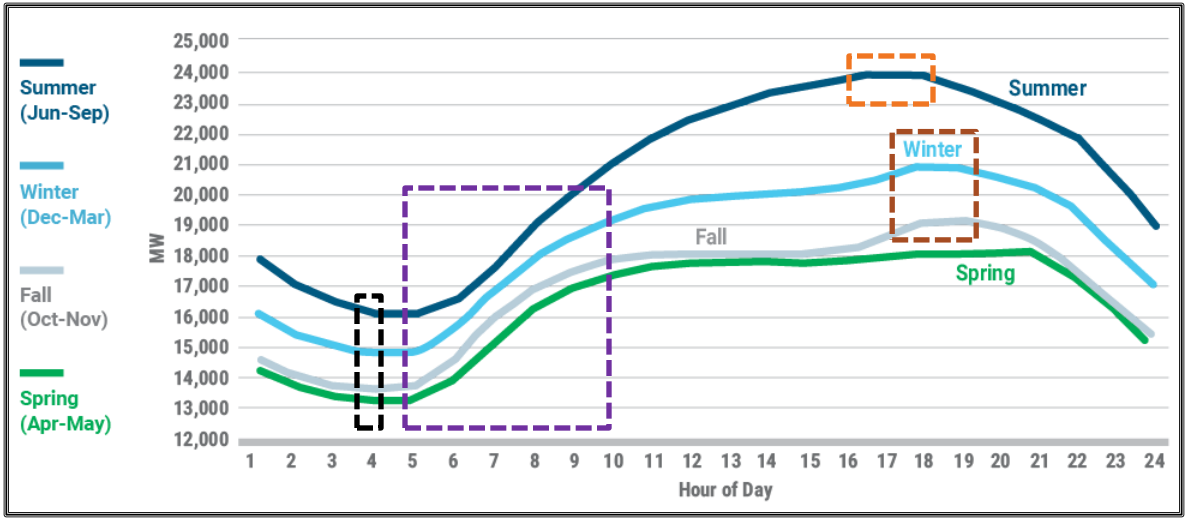


Load

- Power consumed from NYCA Grid



Illustrative NYCA Load Profile – Seasonal and Hourly



Low Points

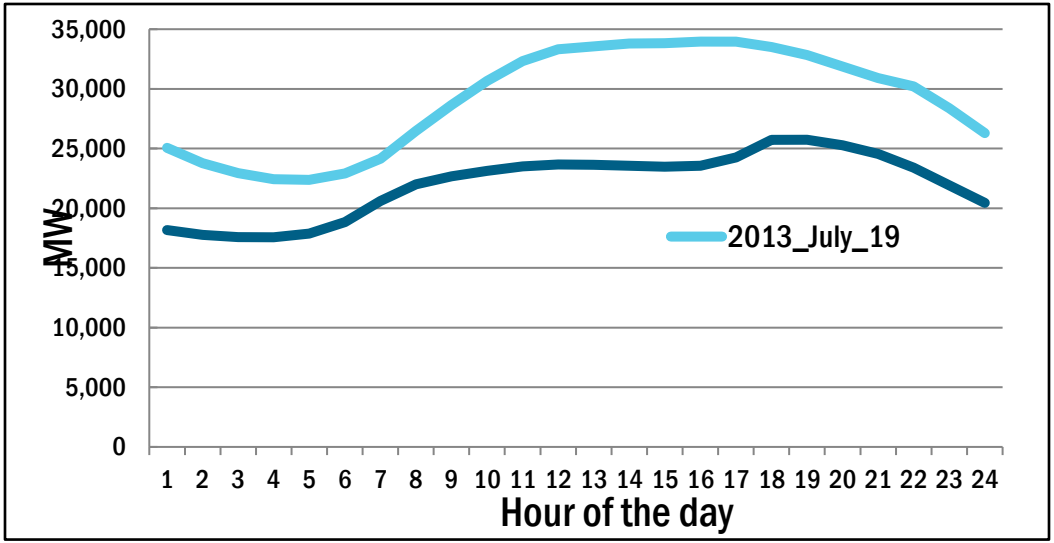
Morning Pickup

Summer Peak

Fall/Winter Peak

***Seasonal Hourly Demand Patterns, Power Trends 2019

NYCA Load Profile: Record Summer and Winter Peaks

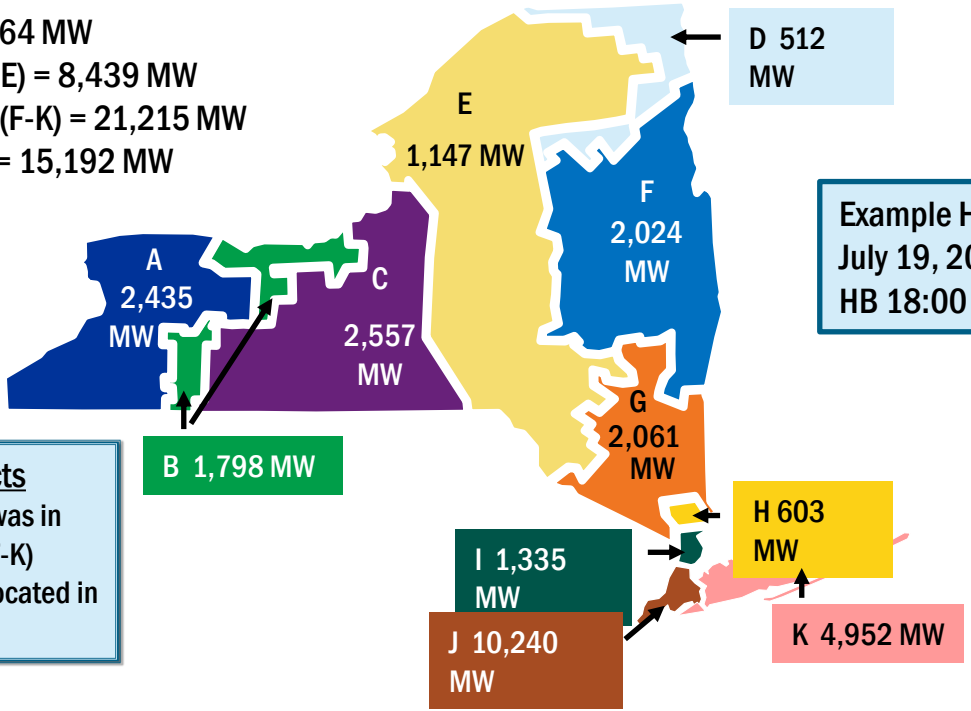


Record Summer Peak
33,956 MW - 2013

Record Winter Peak
25,738 MW - 2014

Load Profile by NYCA Zones

Total Load = 29,664 MW
Upstate Zones (A-E) = 8,439 MW
Downstate Zones (F-K) = 21,215 MW
NYC and LI (J+K) = 15,192 MW



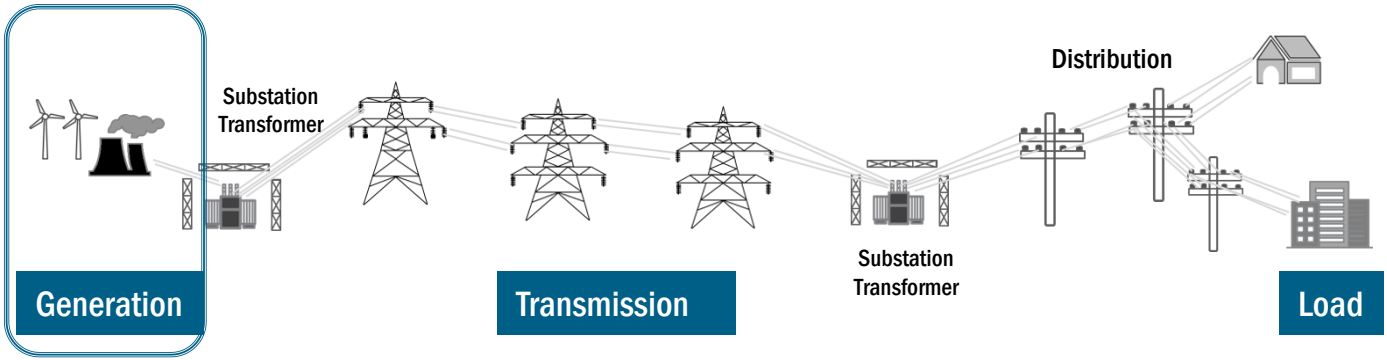
Example Hour:
July 19, 2017
HB 18:00

Important Facts

- 71.5% of the Load was in Downstate Zones (F-K)
- 51.2% of the load located in NYC & LI

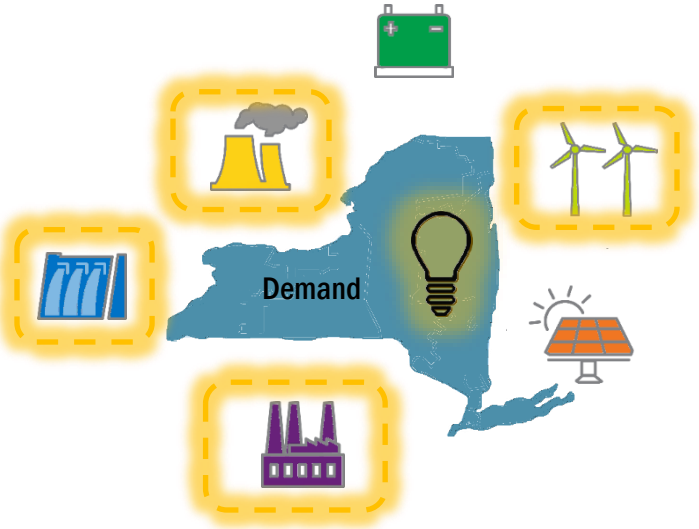
Generation

- Electrical energy for load consumption



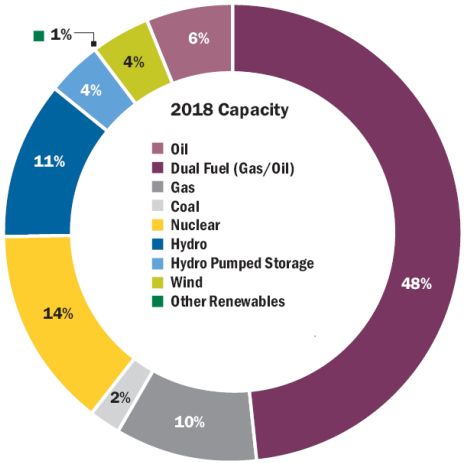
Capacity vs. Energy

- Two very different commodities
- Capacity – *measured in MW*
  - Refers to the electric power output for which a generating system, plant, or unit is rated
  - Capability to produce power
- Energy – *measured in MWh*
  - Is the amount of energy produced (from capacity) over time

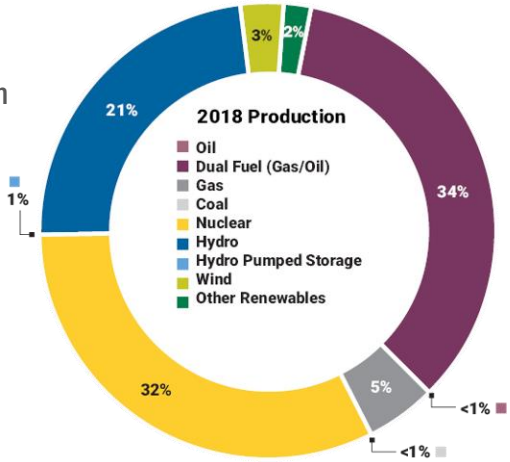


Generating Capacity vs. Energy

New York Statewide Capacity by Fuel Source: 2018



New York Statewide Energy Production by Fuel Source: 2018

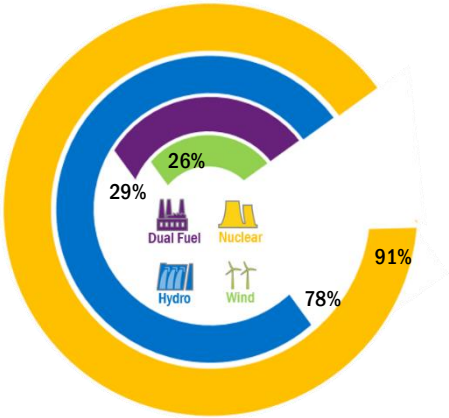


Generating Capacity vs. Energy

Capacity Factor: Ratio of Actual Generation to Maximum Generation Potential

For one example hour in 2018,

	Capacity	Capacity Factor	Energy
Nuclear	14% (5,402 MW)	91%	32% (4,916 MW)



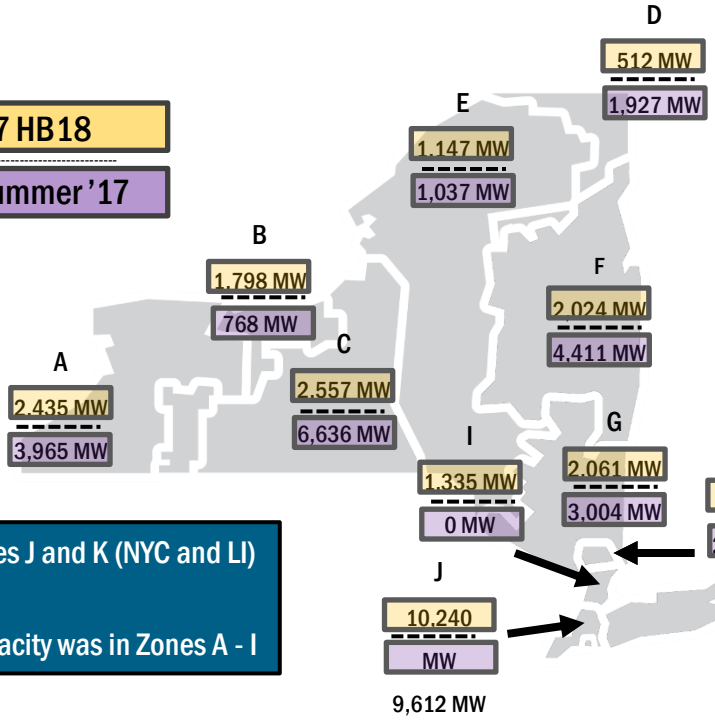
2018 Annual Capacity Factors

NYCA Load vs. Generation

Representative day

LOAD 7/19/17 HB18

GEN CAPACITY Summer '17



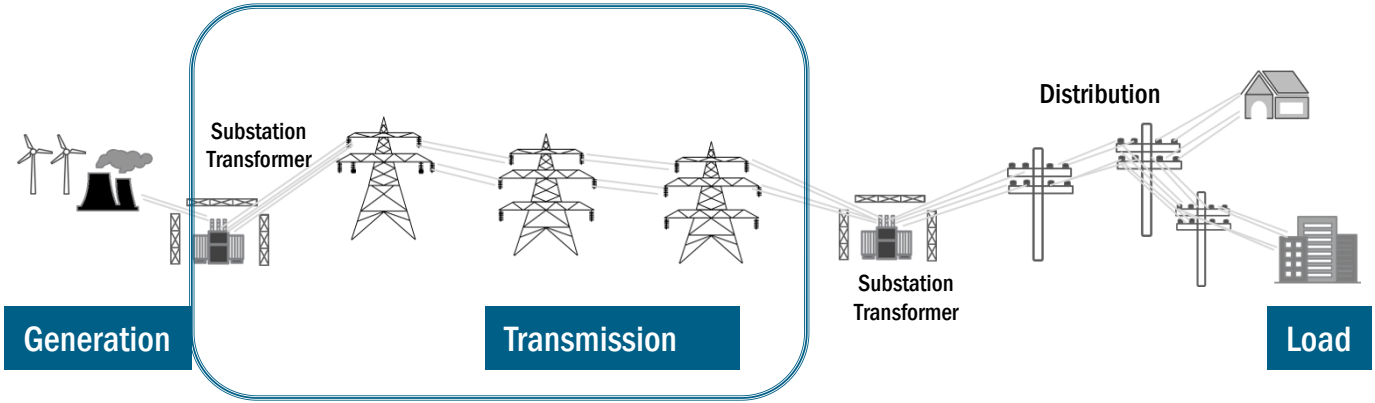
A- West
B- Genesee
C- Central
D- North
E- Mohawk Valley
F- Capital
G- Hudson Valley
H- Millwood
I- Dunwoodie
J- NYC
K- Long Island

51% of NYCA load was in Zones J and K (NYC and LI)

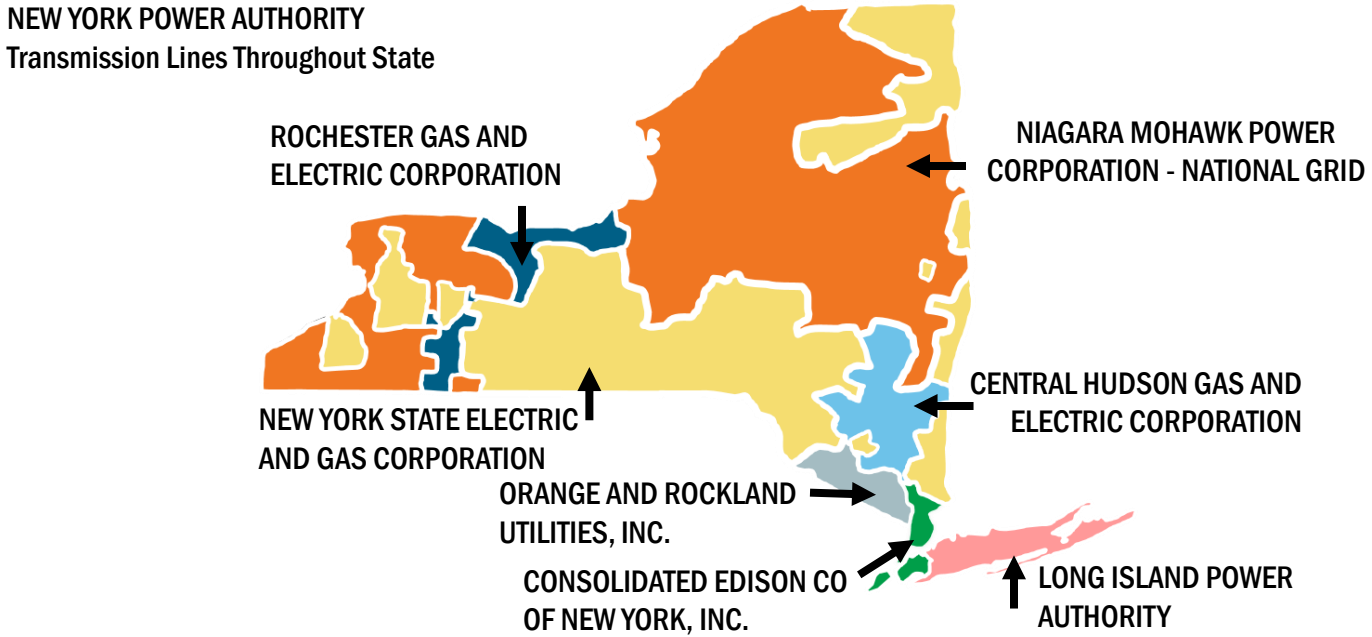
62% of NYCA Generation Capacity was in Zones A - I

Transmission

- Bulk transfer of electrical energy



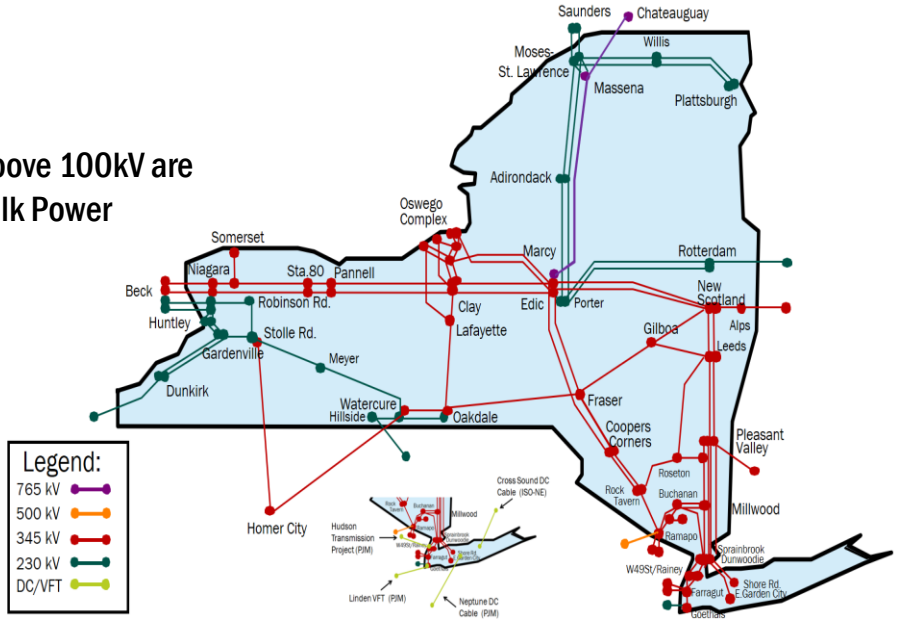
NYCA Transmission Owners



NYCA Transmission System

Bulk Transmission

Note: All transmission lines above 100kV are now considered part of the Bulk Power System

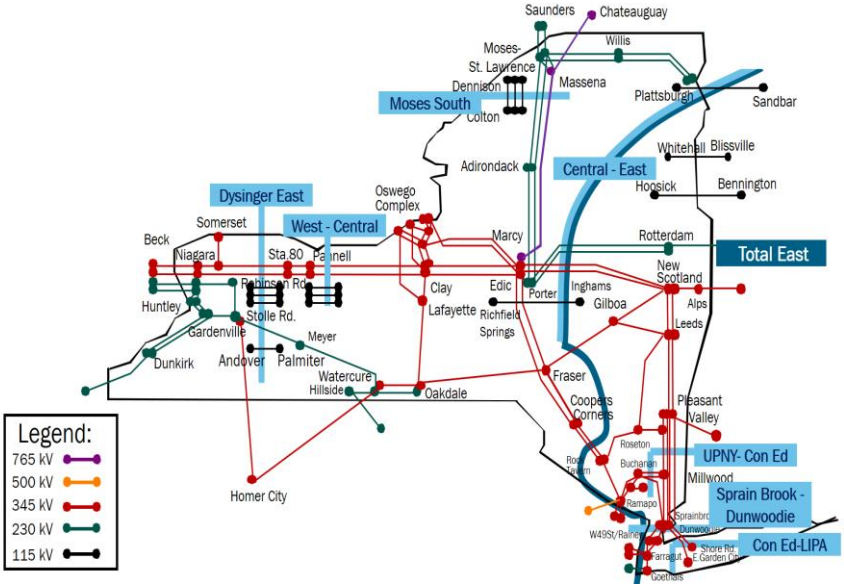


Transmission Interfaces

- Definition of Interface
  - A defined set of transmission facilities that separate Load Zones and that separate the NYCA from the adjacent Control Areas
- Internal Interface
  - Obey transfer limitations across the internal interface to deliver generation to load within NYCA
- External Interface
  - Comply with transfer limitations across the external interface to import or export scheduled power transactions between RTO/ISOs

NY Internal Transmission Interfaces

- Multiple transmission lines make up an interface
- Interface limits can create constraints on the flow of power
- Some interfaces are more impacting on the flow of power



* Not all NYCA internal interfaces are shown

Interface Transfer Limits

- Transfer limits create constraints on the flow of energy
- Types of Transfer Limits
  - Thermal Limits
  - Voltage Limits
  - Stability Limits

Total Transfer Capability = Min(Thermal Limit, Voltage Limit, Stability Limit)

- Real time transfer limits vary with system conditions and are posted at the 5 minute level, both positive and negative limits

Operational Ancillary Services

Operational Ancillary Services

Ancillary Services support the transmission of energy from generation resources to loads, while maintaining reliable operation of NYS Power System

- Voltage Support Service
- Regulation and Frequency Control
- Operating Reserves
- Black Start Service

Voltage Support Service

Voltage: Force that moves electricity through transmission lines

Garden Hose: Transmission cable
Water flowing through hose: Electrical current flow
Water pressure: Voltage

↓ Water Pressure → ↓ Water flow
↓ Voltage → ↓ Electricity flow

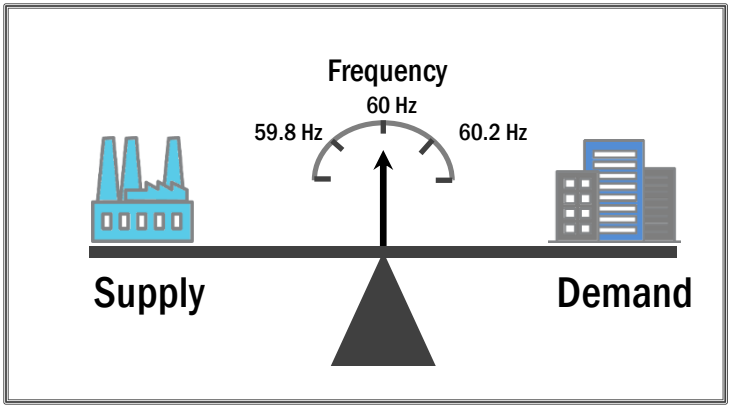
- Voltage Support is needed to:
  - Transfer power from the generation to the load
  - Prevent equipment damage from high voltages
  - Prevent voltage collapse during high load periods

Voltage Support Service

- System Voltage Control is a Continuous Process
- System Voltage Control is provided by the Voltage Support Service providers on a voluntary basis
  - Includes:
    - Generators
    - Synchronous Condensers
    - Static VAR Compensators
    - Shunt Capacitor banks
    - Static Compensators
- Transmission Owners (TO) are responsible for Local Control within their Network

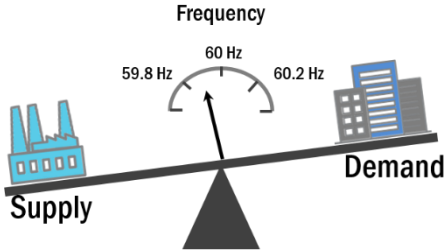
Regulation and Frequency Control

- Regulation and Frequency control service
  - Is necessary for the continuous balancing of resources with load
  - Assists in maintaining scheduled Interconnection Frequency at 60 Hz

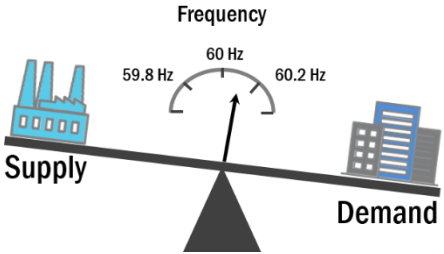


Regulation and Frequency Control

System Frequency Changes



Load Increases without Generation Increase



Generation Increases without Load Increase

Operating Reserves

- Backup Generation in the event of a System Contingency
  - NYSRC Total Operating Reserve Requirement:
    - Must Procure ≥ to 1.5 x times the Largest Single Contingency (in MW)
      - Largest Single Contingency is 1310 MWs
  - NYISO Procures 2 x Largest Single Contingency
    - 2 x 1310 = 2,620 MWs of Total Reserves each Market Day
      - Regional/Locational Requirements
      - Time/Product Type Requirements

Example: Operating Reserve Pickup

1. If there is a large and sudden loss of generation

2. The Operating Reserves being held for the Market Day would be dispatched to make up the shortfall

3. New reserve units would need to be selected to maintain Operating Reserves

Black Start Service

- Generators capable of starting without an outside electric supply, following a system-wide blackout
- Identified by NYISO as part of the Restoration plan
- 14th August 2003 – Most recent use of Black Start units

Summary – Power System Fundamentals

- NYISO Responsible for NYCA Bulk Power Operations
- Three Primary Components to Power System
  - Load, Generation, & Transmission
- Operational Ancillary Services in place to meet the following System Requirements:
  - Maintaining power transfer capability of the transmission system (Voltage Support)
  - Maintaining balance between Generation and Load (Regulation and Frequency Support)
  - Securing System for Contingencies & Constraints (Reserves)
  - System Restoration (Black Start Service)

Additional Resources

- Tariffs – MST and OATT
- Transmission & Dispatching Operations Manual
- Day Ahead Scheduling Manual
- Transmission Services Manual
- Ancillary Services Manual
- Market Participant User's Guide
- Technical Bulletins

Questions?

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New York ISO

NYISO Energy Marketplace

E-Learning Module

Energy Marketplace

Module Objectives:

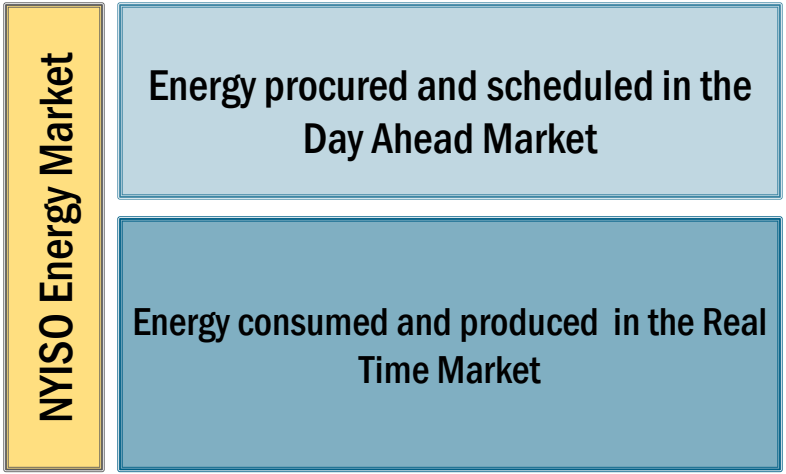
- Explain the function and features of the NYISO Energy Market
- Identify the differences between the Day Ahead and Real Time Markets and associated settlements
- Describe the Energy Market Processes including
  - Load Bids and Supply Offers
  - Commitment and Dispatch of Resources
  - Market Timeline

Market Features and Two Settlement System

NYISO's Energy Market

- Function and Features
  - Maintains Reliability Rules while satisfying system constraints
  - Allows for competitive bid-based process
  - Sales and procurement of electrical energy at the wholesale level
  - Provides load and supplier schedules
  - Produces prices for settlement mechanism

Energy Market: Two Settlement System



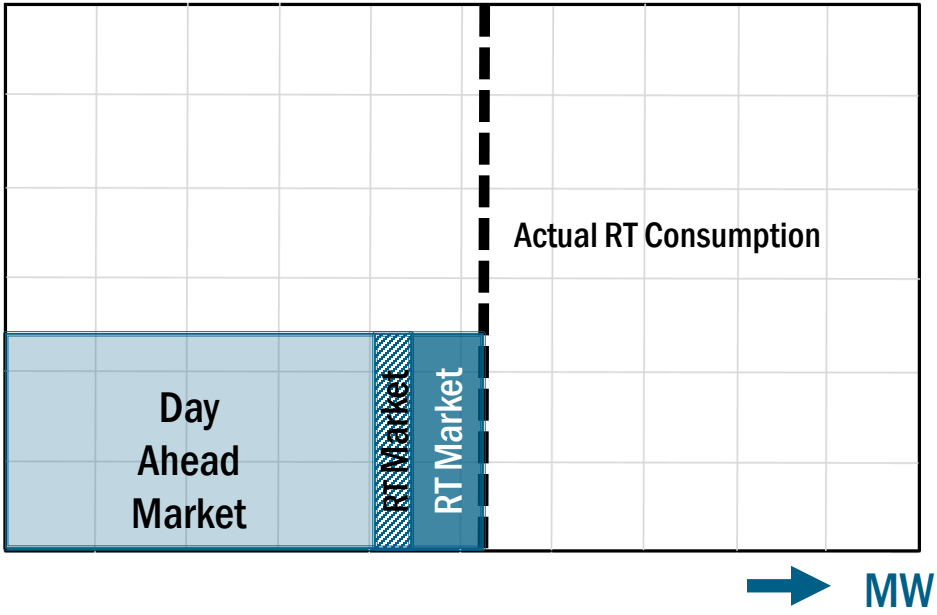
Day Ahead vs. Real Time Market Two Settlement System

- Day Ahead Market
  - Buy and Sell Energy the day prior to actual consumption or production
  - In preparation for actual energy consumption
  - Financially Binding
- Factors that influence the Day Ahead Market:
  - Forecasted Load
  - Load Bids from Load Serving Entities (LSEs)
  - Supply offers from resources
- Benefits:
  - Adequate resources identified to meet forecasted load
  - Price certainty against real time volatility

Day Ahead vs. Real Time Market Two Settlement System

- Real Time Market
  - Buy and Sell the difference during the consumption day
  - Real Time Market Balances DAM Schedule to actual consumption
  - Balancing Market
- Factors that influence Real Time Market:
  - Changes in load
  - Changes in generation availability
  - Neighboring control area system changes
- Benefits:
  - Dispatches resources to meet actual consumption

Energy Market – Two Settlement System



DAM + RT = Actual Consumption

DAM - RT = Actual Consumption

Two Settlement System – Example 1

Power Suppliers (for example hour):

Day Ahead Market

DAM MWh	75 MWh
DAM LBMP $/MWh	$50
DAM LBMP Settlement	75 x 50 = $3750

Real Time Market

RT MWh	85 MWh
Balancing MW (RT -DAM)	85-75 = 10 MW
RT LBMP $/MWh	$60
RT LBMP Settlement	10 x 60 = $600

Total Settlement for example hour (DAM$ + RT$) = $4350

Two Settlement System – Example 2

Power Suppliers (for example hour):

Day Ahead Market

DAM MWh	75 MWh
DAM LBMP $/MWh	$50
DAM LBMP Settlement	75 x 50 = $3750

Real Time Market

RT MWh	65 MWh
Balancing MW (RT - DAM)	65-75 = -10 MW
RT LBMP $/MWh	$60
RT LBMP Settlement	10 x -60 = -$600

Total Settlement for example hour (DAM$ + RT$) = $3150

Two Settlement System – Example 1

Load Serving Entities (LSEs) (for example hour):

Day Ahead Market

DAM MWh	-25 MWh
DAM LBMP $/MWh	$50
DAM LBMP Settlement	-25 x 50 = -$1250

Real Time Market

RT MWh	-30 MWh
Balancing MW (RT-DAM)	(-30)- (-25) = -5 MW
RT LBMP $/MWh	$60
RT LBMP Settlement	-5 x 60 = -$300

Total Settlement for example hour (DAM$ + RT$) = -$1550

Two Settlement System – Example 2

Load Serving Entities (LSEs) (for example hour):

Day Ahead Market

DAM MWh	-25 MWh
DAM LBMP $/MWh	$50
DAM LBMP Settlement	-25 x 50 = -$1250

Real Time Market

RT MWh	-20 MWh
Balancing MW (RT-DAM)	(-20)-(-25) = 5 MW
RT LBMP $/MWh	$60
RT LBMP Settlement	5 x 60 = $300

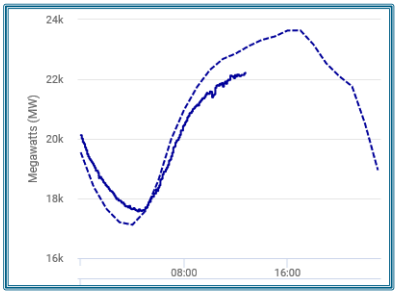
Total Settlement for example hour (DAM$ + RT$) = - $950

Energy Market Process : Load Forecasting and Bidding

Load Forecasting

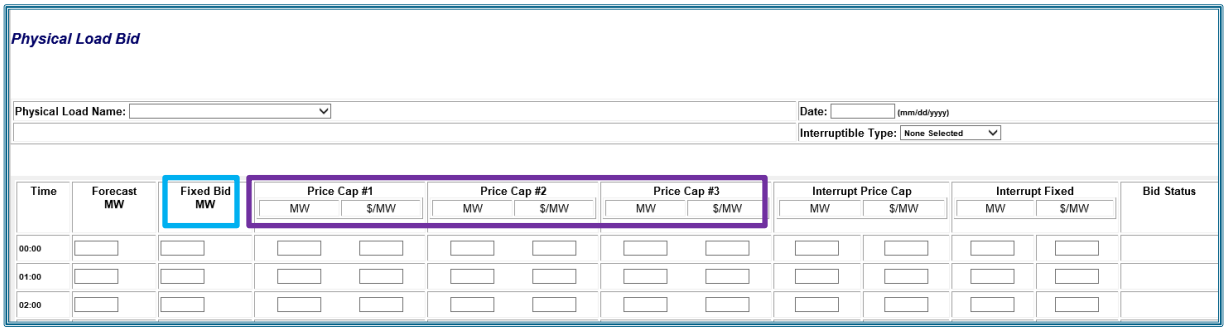
- Two Components:
  - NYISO's Load forecast
  - LSE's Load Forecast
- NYISO's Load Forecast is used for scheduling resources/reliability needs
  - Historical Data
  - Weather
  - TO Forecast Submittals
  - Zonal basis, then summed
- LSE Load Forecast used for initial billing purposes
  - LSEs submit estimated consumption to NYISO

NYISO Load forecast vs. Actual Load



Load Bidding/Purchasing Options

- LSE can enter bid (in the DAM only) to procure energy from NYISO
  - Fixed Bids
  - Price Capped Load Bids
  - Any accepted bids lock-in a DAM price



Physical Load Bid

Physical Load Name: Date: (mm/dd/yyyy)

Interruptible Type: None Selected

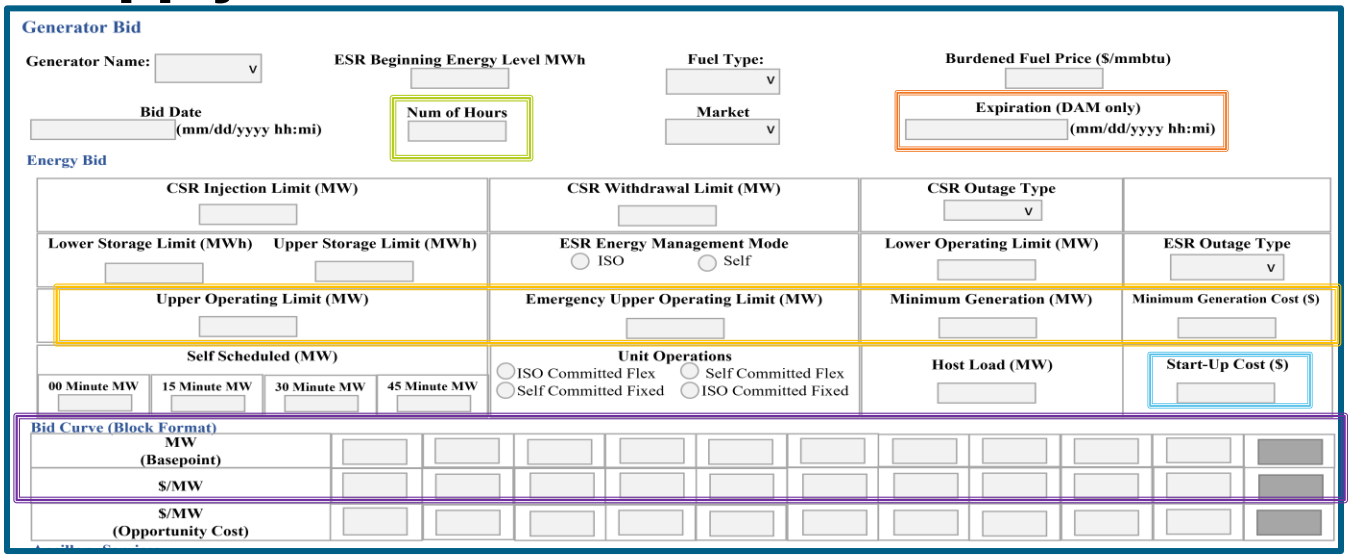
Time	Forecast MW	Fixed Bid MW	Price Cap #1		Price Cap #2		Price Cap #3		Interrupt Price Cap		Interrupt Fixed		Bid Status
			MW	$/MW	MW	$/MW	MW	$/MW	MW	$/MW	MW	$/MW	
00:00													
01:00													
02:00													

Energy Market Process: Supply Offers and Parameters

Submission of Supply Offers

- Suppliers submit offers to sell energy in the DAM or RT Market
- Supply Offer Submissions include:
  - $/MWh Offer
  - Unit Parameters
  - Operating Mode

Supply Offers: Unit Parameters



Incremental Energy Offer ($/MW)

Duration

Expiration date

Min Gen

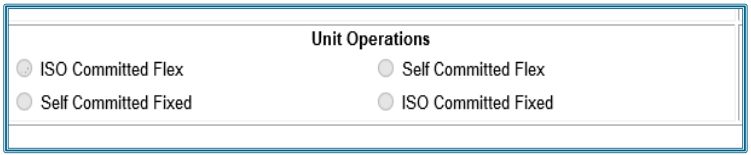
Upper Operating Limit

Start-Up Cost

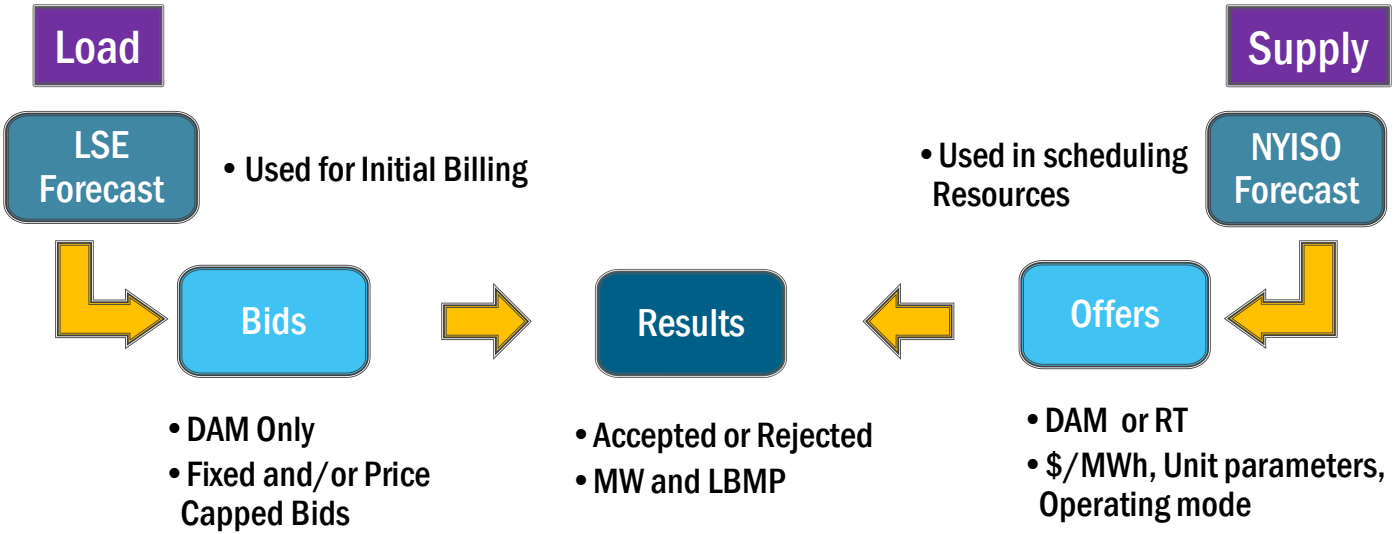
Supply Offers – Unit Operating Modes

Economics	MWs

• ISO Committed
  • Economically Selected
• Self Committed
  • Price taker
	• Fixed
	  • Fixed output/Operating levels
	  • No changes to in-hour schedule
	• Flexible
	  • Flexible Output
	  • Following NYISO base Point Fluctuation



Energy Market Process - Summary



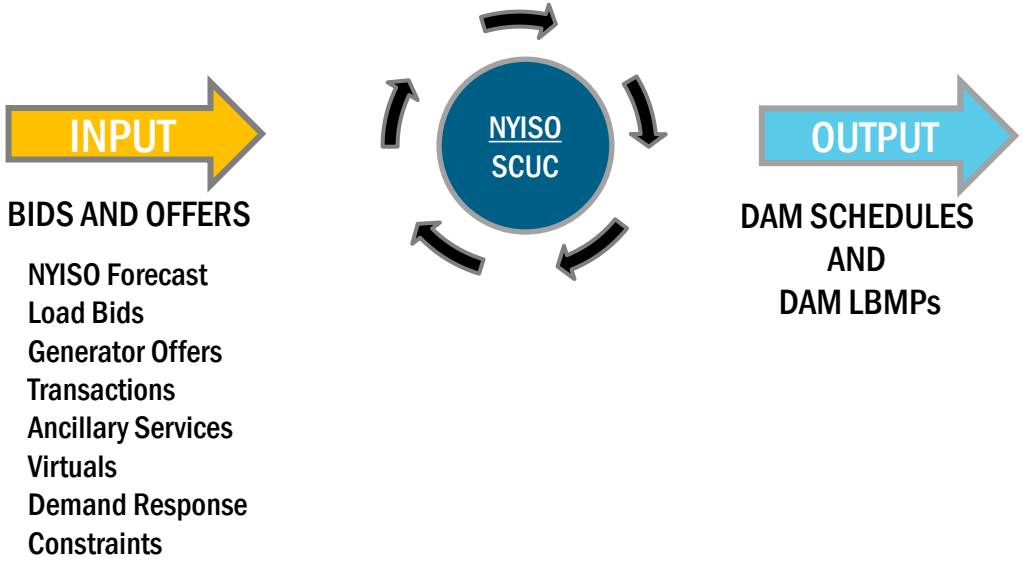
Energy Market Process: Commitment, Dispatch and Market Timelines

Commitment and Dispatch

- Minimize the as-bid production cost
- Satisfy system constraints and reliability rules
- Time Line
  - Day Ahead Market
  - Real Time Market

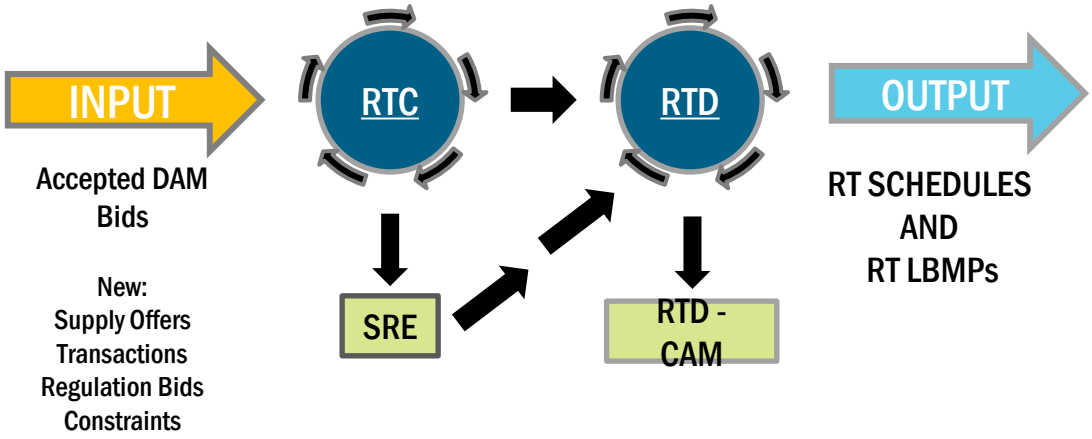
Commitment and Dispatch -DAM

- DAM uses Security Constrained Unit Commitment (SCUC)
  - DAM Schedules
  - DAM LBMP



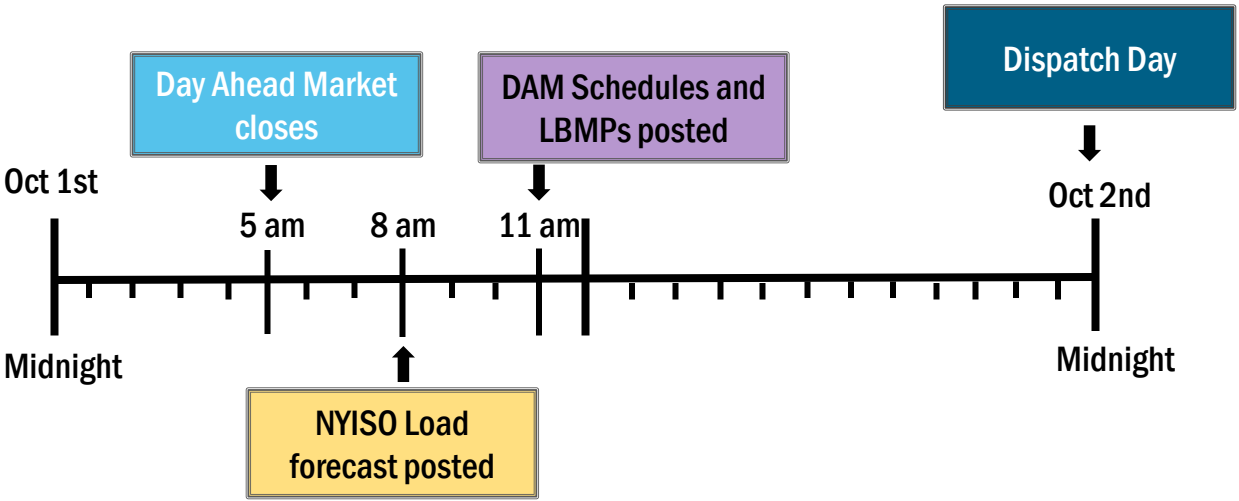
Real Time Commitment and Dispatch – RTC and RTD

- Includes Supplemental Resource Evaluation (SRE) and RTD Corrective Action Mode (RTD CAM)



Day Ahead Market - Timeline

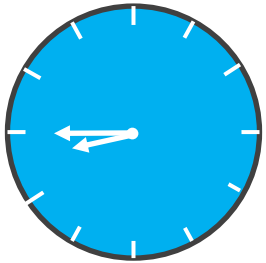
One Day before Dispatch Day (Oct. 2nd)



RT Market -Timeline

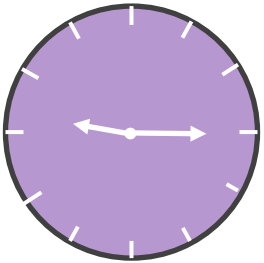
Operating Day – Oct. 2nd HB 10

8:45 AM



RT Bidding Closes
(75 minutes prior to operating hour)

9:15 AM



RT Results Posted
(45 minutes prior to operating hour)

10:00 AM

RTD - Operating Hour
(5 minutes intervals)

NYISO provides advisory commitment information for a 2.5 hour optimization period

Energy Marketplace Summary

- Energy Market function and features
- DAM vs. RT Market and the Two Settlement System
- Market Process
  - Submission of bids/offers
  - Commitment and Dispatch of Resources
  - Market time line

Additional Resources

- Tariffs: MST and OATT
- Day Ahead Scheduling Manual
- Transmission and Dispatching Operations Manual
- Market Participant User's Guide

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Locational Based Marginal Pricing

E- Learning Module

Locational Based Marginal Pricing

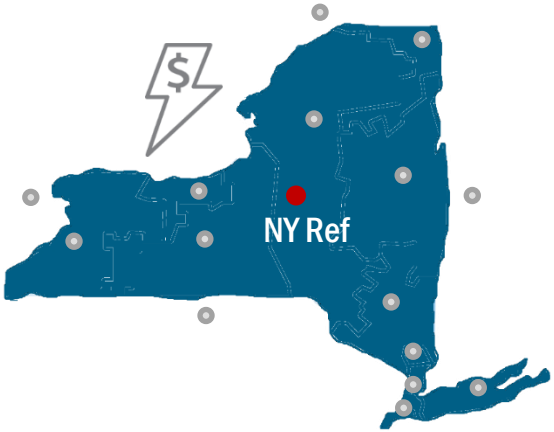
Module Objectives:

- Explain the Basics Behind LBMP
- Complete Simple LBMP Examples
- Identify the Impacts of Congestion

LBMP – The Basics

- LBMP is

  Cost to supply the Next MW to Load at a Specific Location in the grid

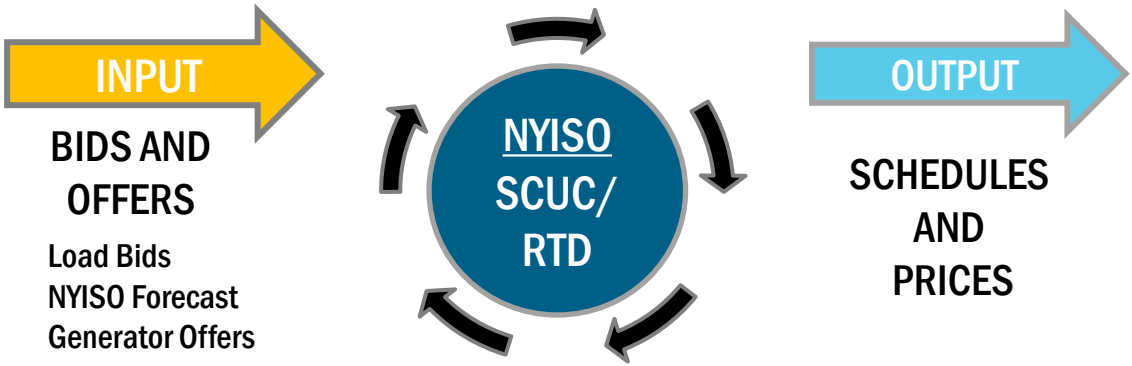


LBMP – The Basics

- LBMP is established for the Day Ahead Market and the Real Time Market

Day Ahead Market	Real Time Market
Software: Security Constrained Unit Commitment (SCUC)	Real Time Dispatch (RTD)
Hourly Prices	5 Minute Interval Prices

LBMP: Co-Optimized Based on Bids and Offers

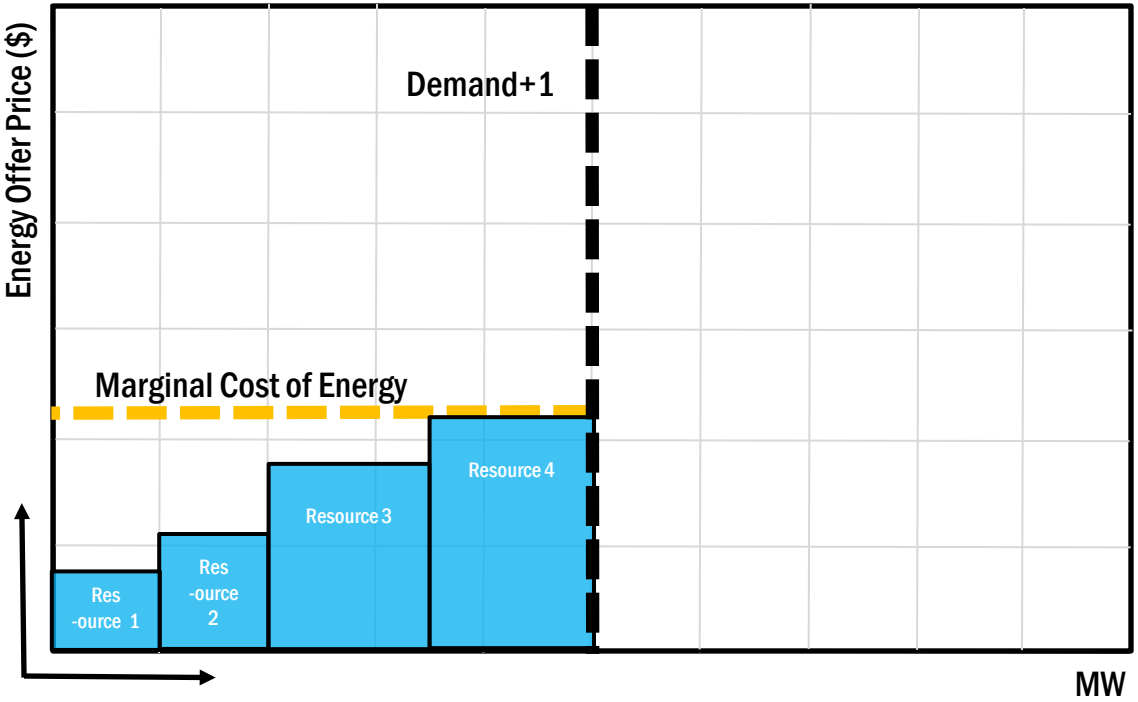


LBMP – The Basics

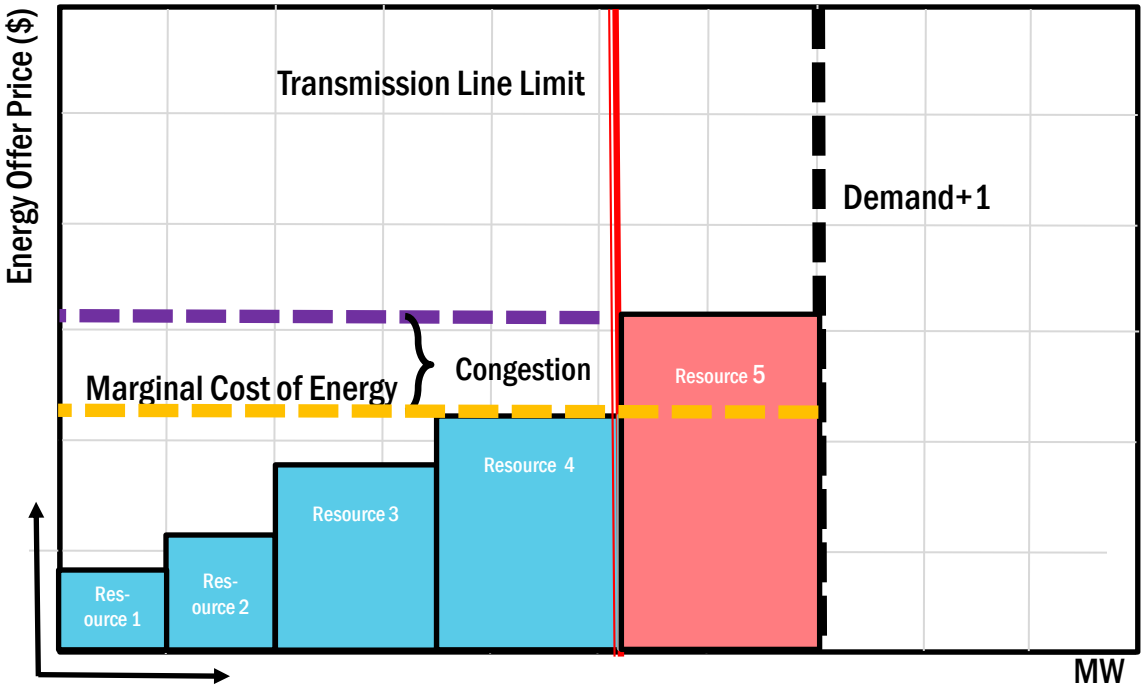
- LBMP is made up of three components:
  - Marginal Energy Price
    - Basic Component of LBMP, calculated at Marcy
  - Marginal Loss Price
    - Captures Losses along path to Load
      - Transmission Losses
  - Marginal Congestion Price
    - Costlier units Dispatched to avoid exceeding Transmission Limits

LBMP = Energy + Loss - Congestion

Determining the Marginal Energy Price

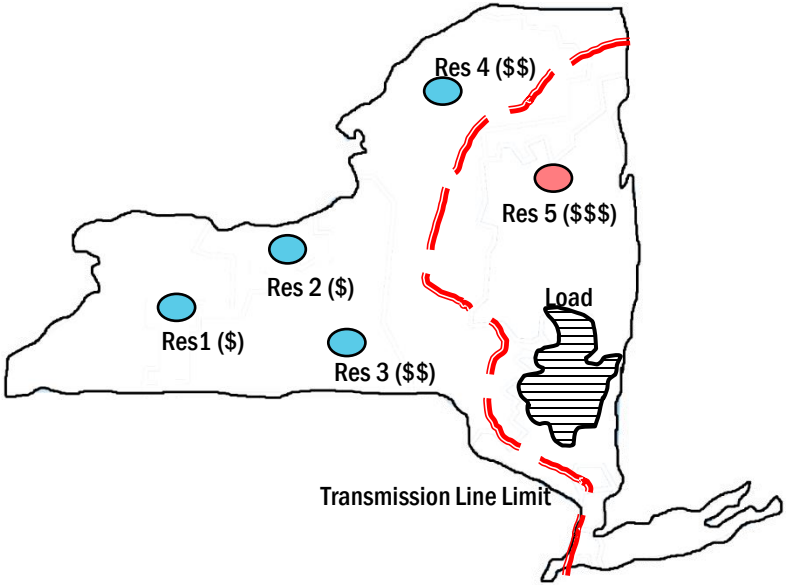


Determining the Marginal Congestion Price



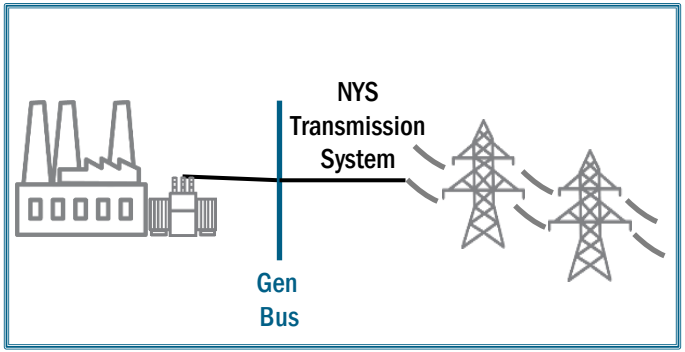
LBMP - Congestion

- Marginal Congestion Price Component
  - Difference between 2 marginal prices creates congestion component



LBMP for Generators

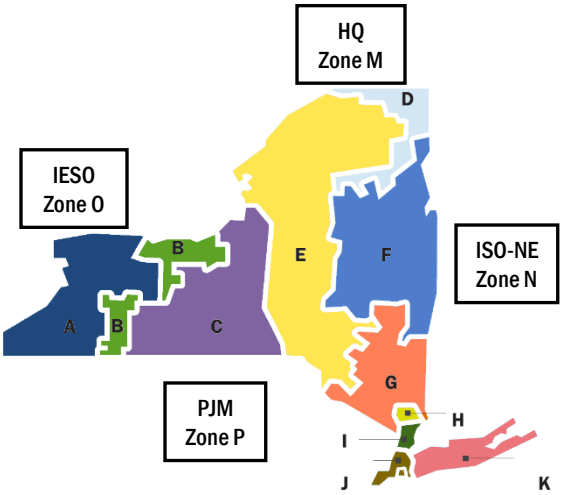
- Based on Generator Bus
  - LBMP calculated at Bus where Generator injects power



LBMP for Loads (LSEs)

- Based on Zone where Load is Located
  - One Zonal LBMP for entire Zone
  - Load Weighted Average

NYCA Load Zones		
A- West	E- Mohawk Valley	I- Dunwoodie
B- Genesee	F- Capital	J- NYC
C- Central	G- Hudson Valley	K- Long Island
D- North	H- Millwood	

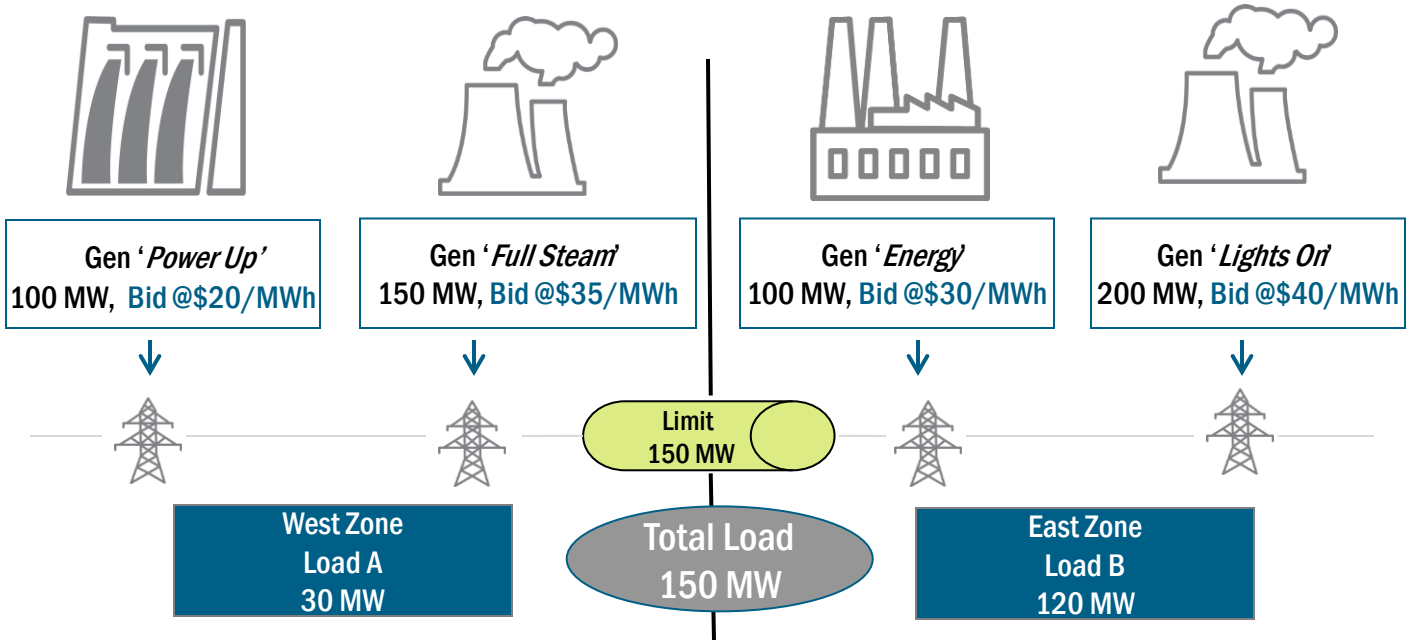


LBMP - Examples

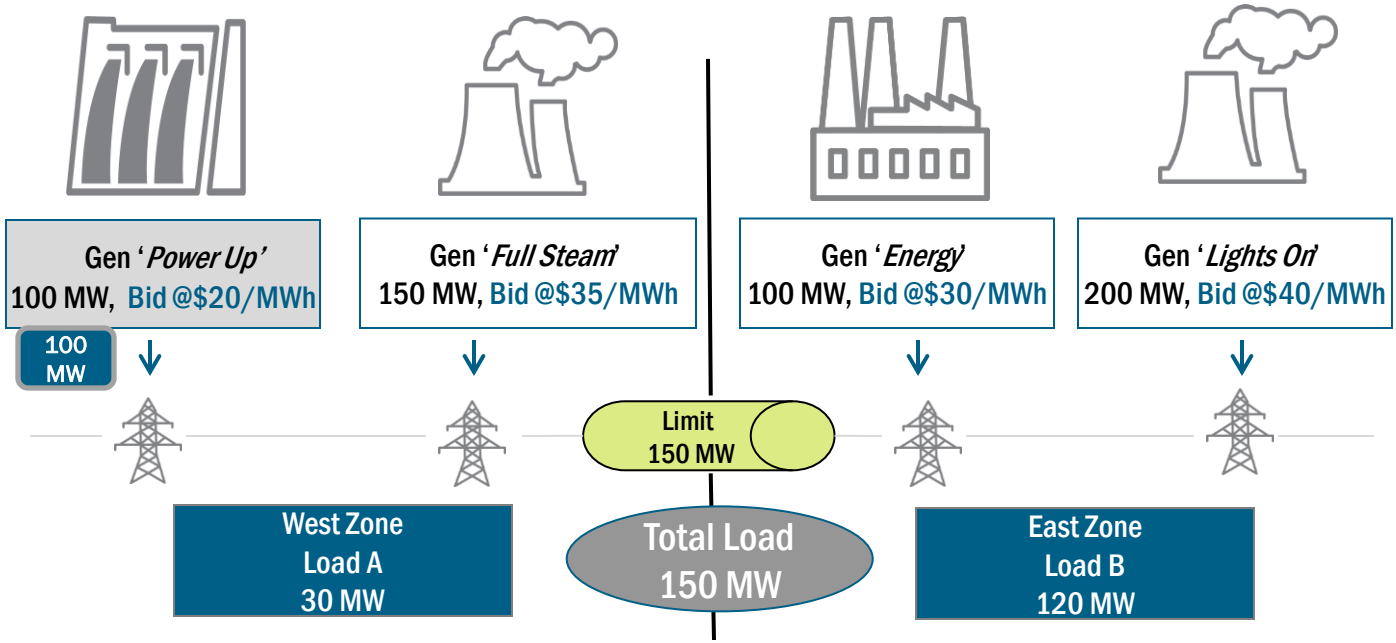
Example 1: Energy Only
No Losses and No Congestion

Total Load = 150 MW

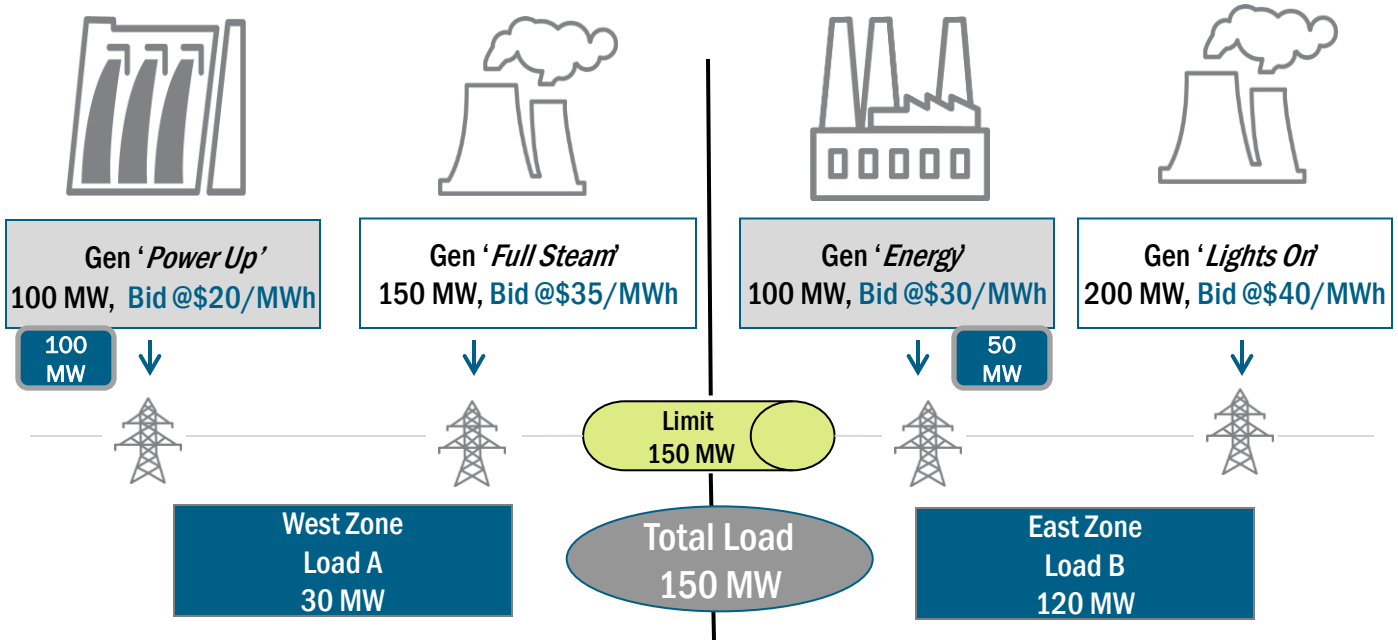
Example 1: Energy Only



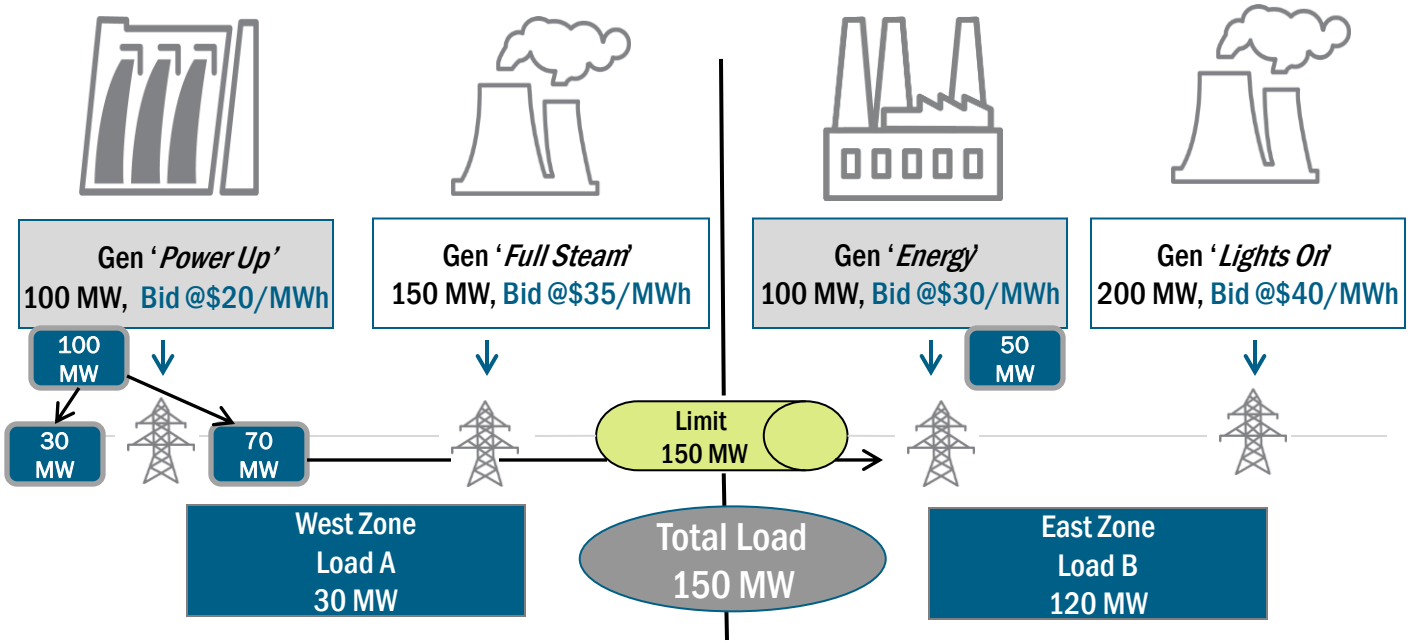
Example 1: Energy Only



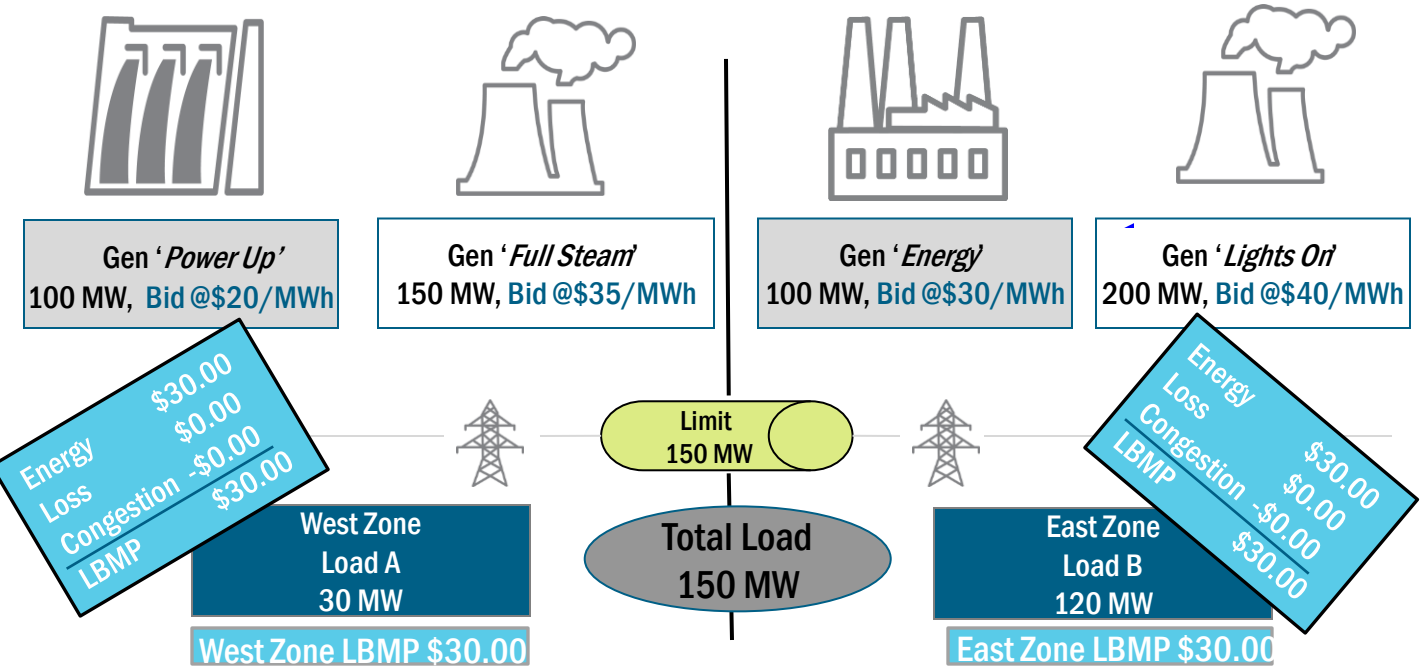
Example 1: Energy Only



Example 1: Energy Only



Example 1: Energy Only - Results



Example 1: Energy Only - Results

Gen '*Power Up*'
Bid $20, Paid $30

Gen '*Full Steam*'
Bid $35, Paid $0

Gen '*Energy*'
Bid $30, Paid $30

Gen '*Lights On*'
Bid $40, Paid $0

West Zone

East Zone

Generators receive $30/MWh (LBMP)

Example 1: Energy Only - Results

Loads Charged $30/MWh (LBMP)

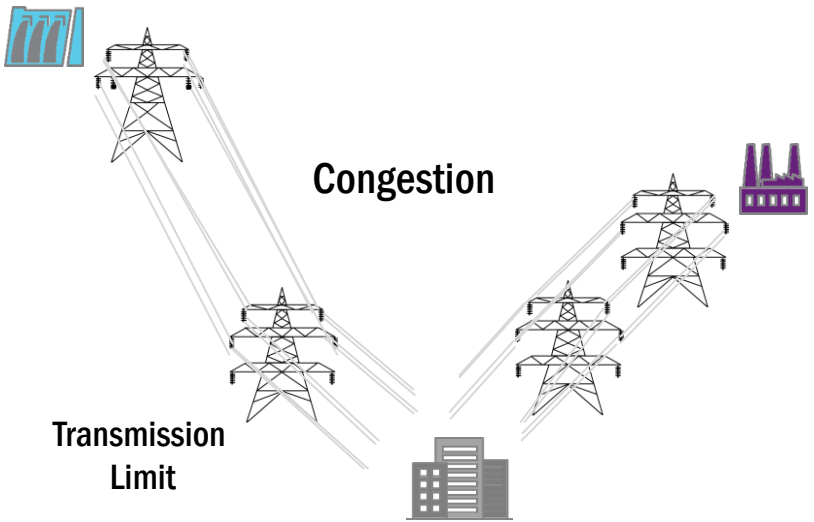
West Zone
Load A
30 MW

East Zone
Load B
120 MW

Congestion

Congestion occurs when the Power flow reaches the Transmission Limit

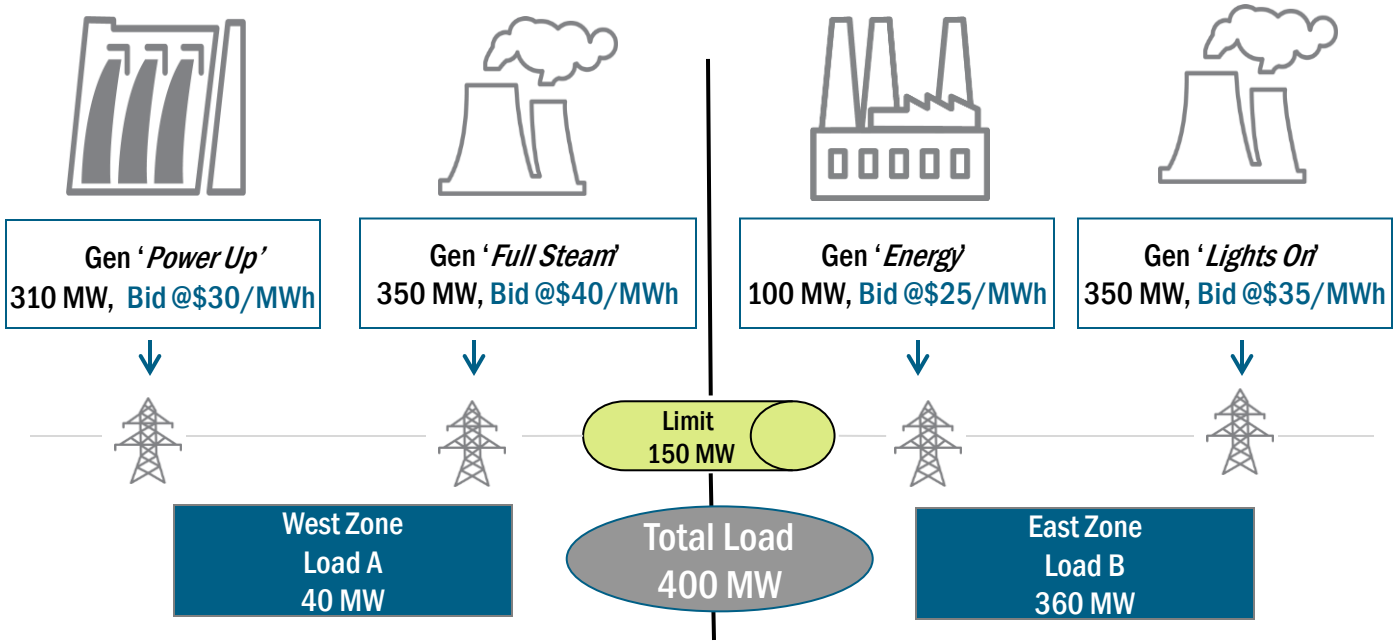
- To maintain efficient and reliable Transmission system
  - Transmission limits cannot be exceeded
  - When Transmission limits reached, generators from different buses are dispatched to meet load
- When there is congestion, LBMPs can differ between buses



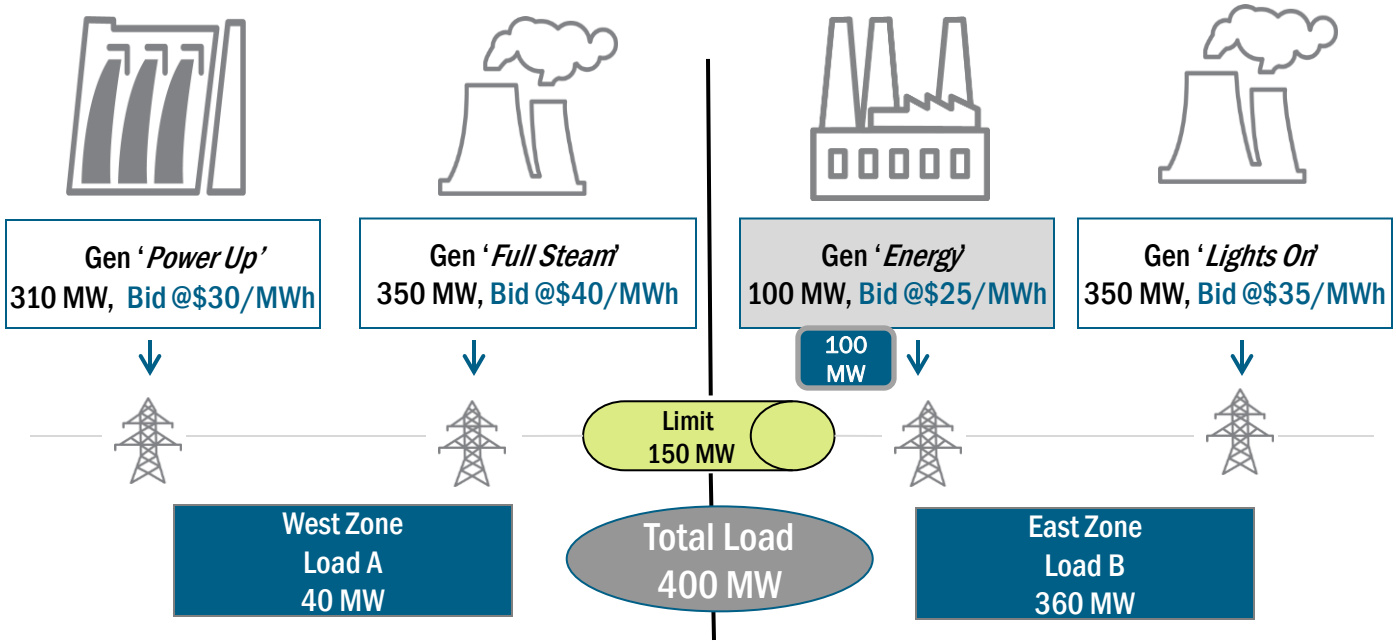
Example 2: Energy and Congestion No Losses

Total Load
400 MW

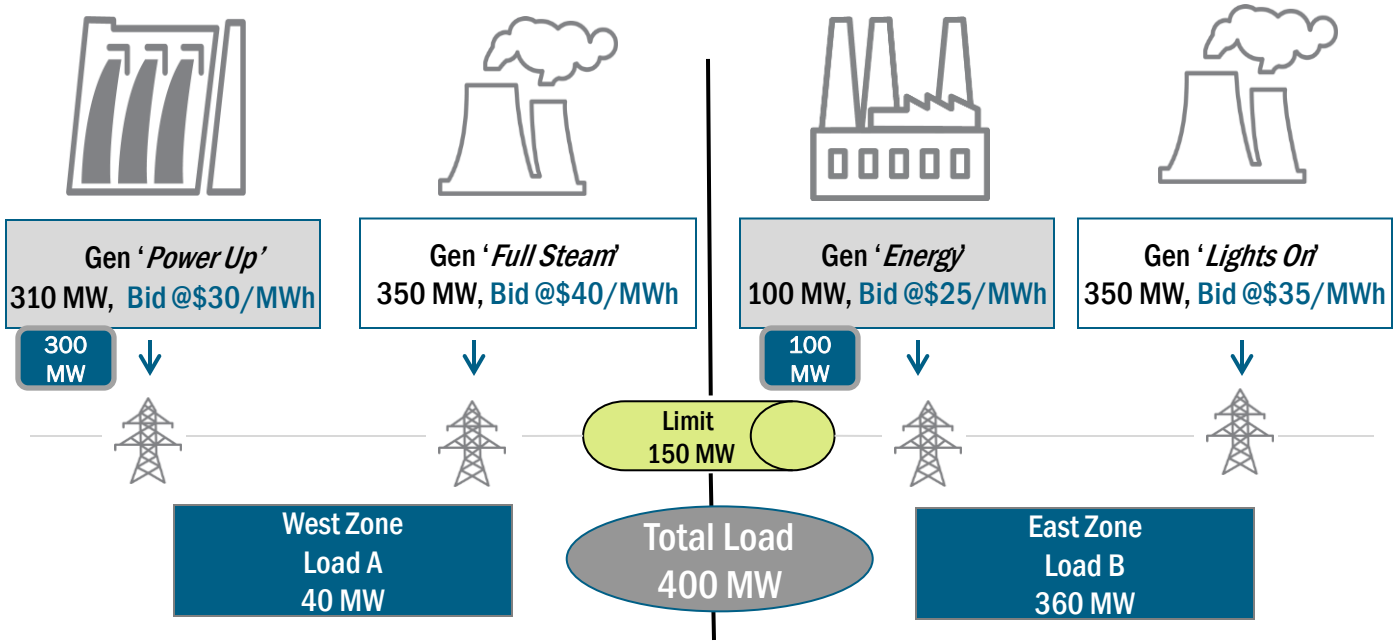
Example 2: Energy and Congestion



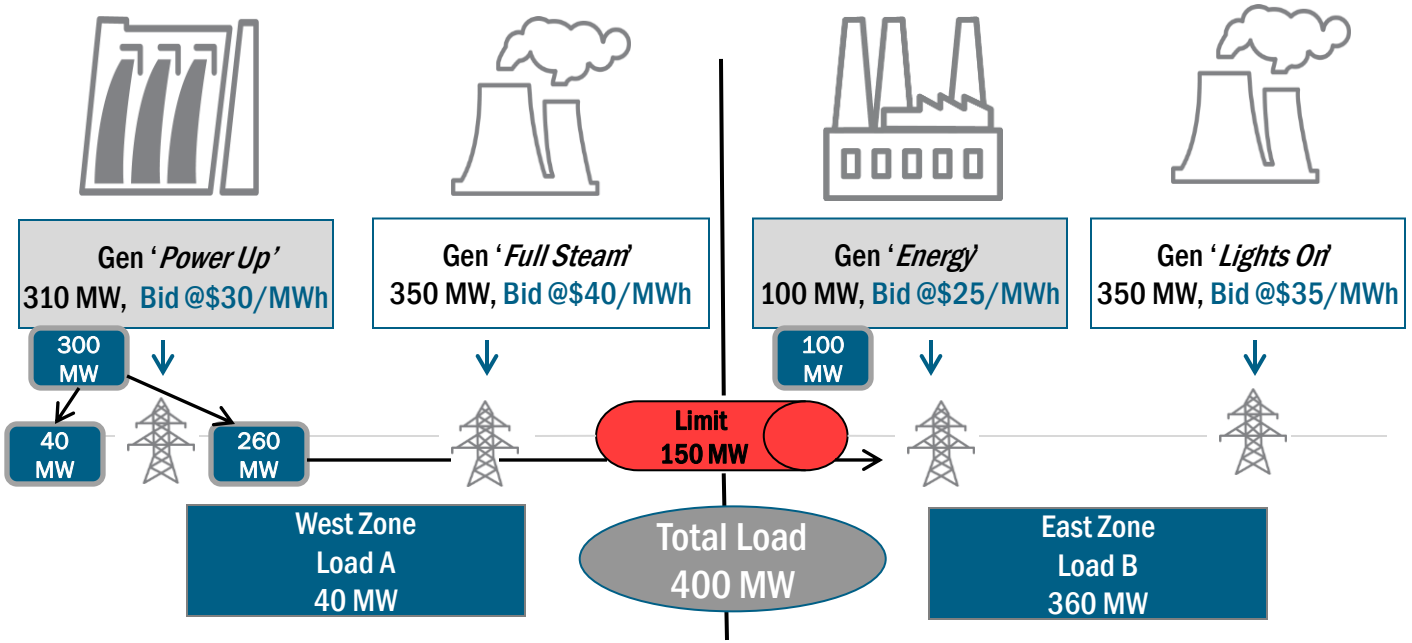
Example 2: Energy and Congestion



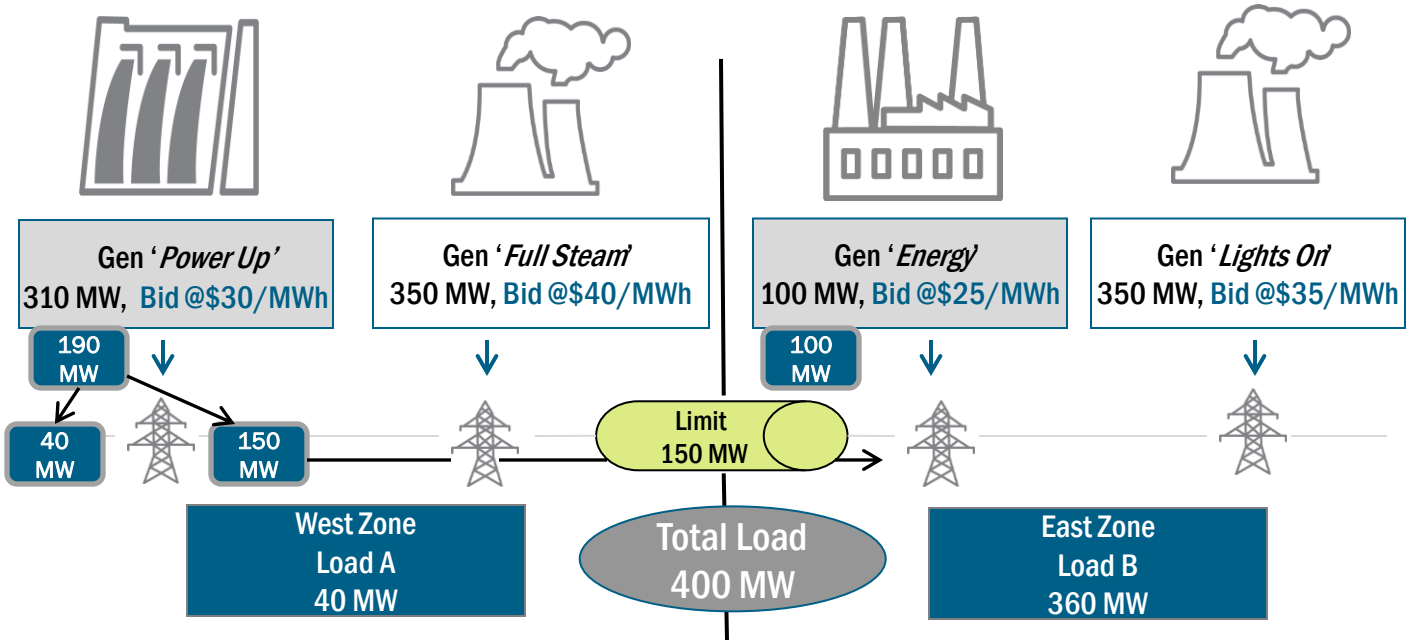
Example 2: Energy and Congestion



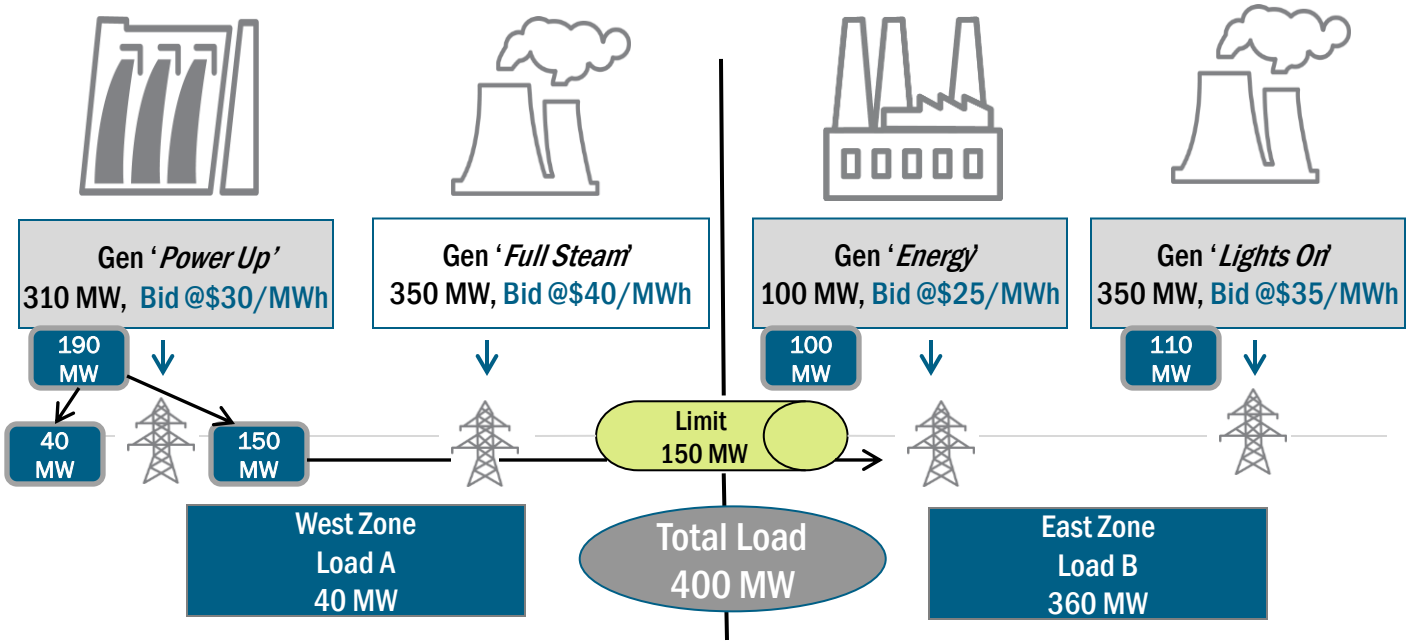
Example 2: Energy and Congestion



Example 2: Energy and Congestion



Example 2: Energy and Congestion



Example 2: Energy and Congestion - Results

Gen '*Power Up*'
310 MW, Bid @$30/MWh

Gen '*Full Steam*'
350 MW, Bid @$40/MWh

Gen '*Energy*'
100 MW, Bid @$25/MWh

Gen '*Lights On*'
350 MW, Bid @$35/MWh

Energy	$30.00
Loss	$0.00
Congestion	-$0.00
LBMP	$30.00

West Zone
Load A
40 MW

West Zone LBMP $30.00

Limit
150 MW

Total Load
400 MW

East Zone
Load B
360 MW

Energy	$30.00
Loss	$0.00
Congestion	-$5.00
LBMP	$35.00

East Zone LBMP $35.00

Example 2: Energy and Congestion - Results

Gen '*Power Up*'
Bid $30, Paid $30

Gen '*Full Steam*'
Bid $40, Paid $0

Gen '*Energy*'
Bid $25, Paid ?

Gen '*Lights On*'
Bid $35, Paid ?

West Zone

East Zone

Generator "Power Up "receives $30/MWh (LBMP)

Example 2: Energy and Congestion - Results

Gen '*Power Up*'
Bid $30, Paid $30

Gen '*Full Steam*'
Bid $40, Paid $0

Gen '*Energy*'
Bid $25, Paid $35

Gen '*Lights On*'
Bid $35, Paid $35

West Zone

East Zone

Generators, East of the interface receive $35/MWh (LBMP)

Example 2: Energy and Congestion - Results

Loads in West Zone
Charged $30/MWh (LBMP)

West Zone
Load A
40 MW

Loads in East Zone
Charged $35/MWh (LBMP)

East Zone
Load B
360 MW

Additional Resources

- Tariffs - OATT & MST
- Day Ahead Scheduling Manual
- Transmission and Dispatching Operations Manual
- Market Participant User's Guide
- Technical Bulletins

Questions?

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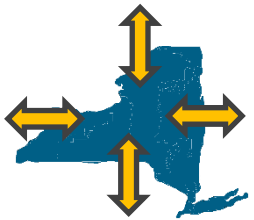
Energy Market Transactions

E – Learning Module



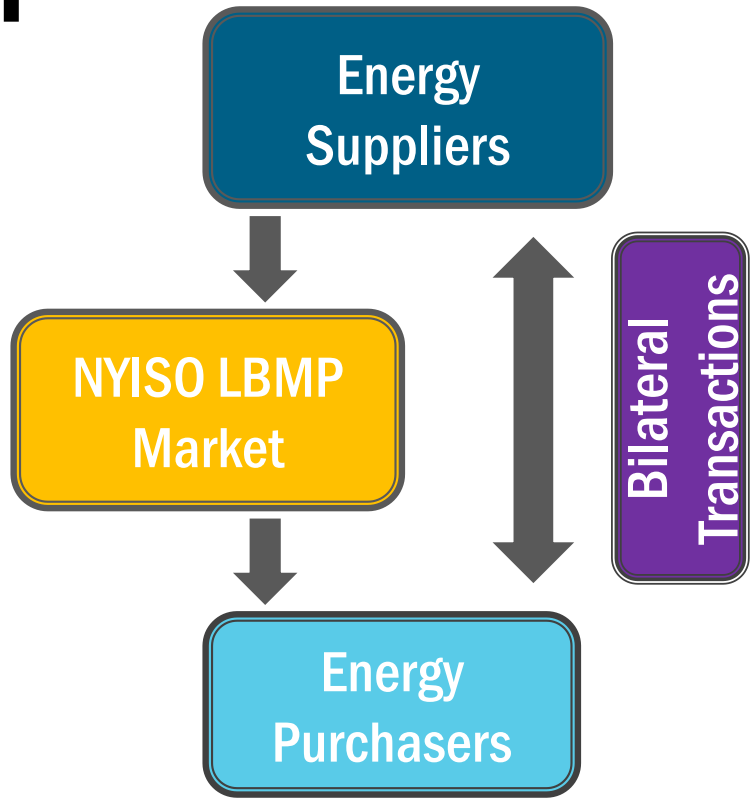
Energy Market Transactions

MODULE OBJECTIVES:

- Describe the purpose of Transactions
- Distinguish between the different types of transactions
- Identify source and sink points of transactions
- Describe how Transactions are evaluated
- Calculate the Settlement for Each Transaction Type

Transactions – An Introduction

Buying and Selling Wholesale Energy in NY



Energy Market Transactions

- **Why would an MP choose the Transaction option?**
  - Direct contract between supplier and purchaser with fixed long term price for energy
  - External supplier may get a better price for energy sold to NY than other control areas
  - Internal suppliers could get a better price for energy sold out of NY

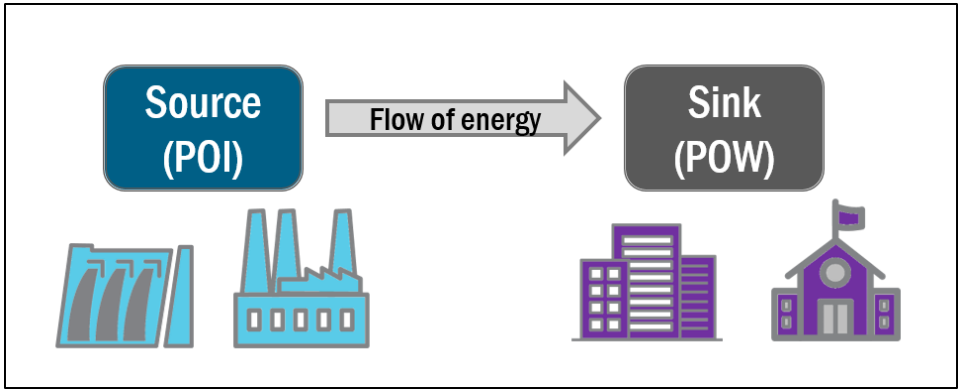
- **Who can utilize the transaction scheduling option?**
  - Any MP (*e.g.*, Generators, Loads and 3rd party marketer/trader) can register to utilize transaction scheduling

Transaction Terms

- Source/Sink Points
- NY Ref Bus-Marcy
- External Proxy Bus
- Financially Responsible Party

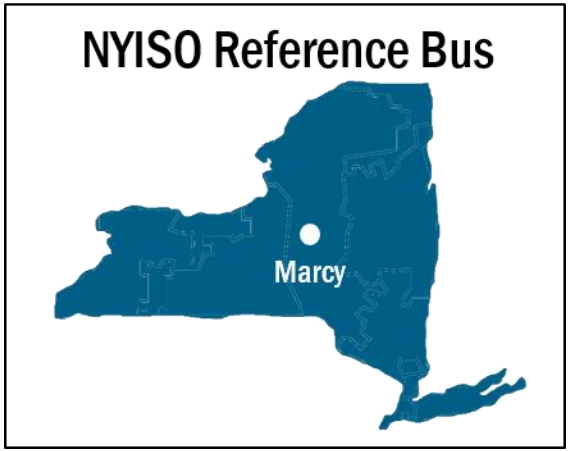
Source/Sink Points

- Source: Point of Injection (POI); where the power is coming from, *e.g.*, Generators
- Sink: Point of Withdrawal (POW); where the power is going to, *e.g.*, Loads
- Important role in distinguishing transactions



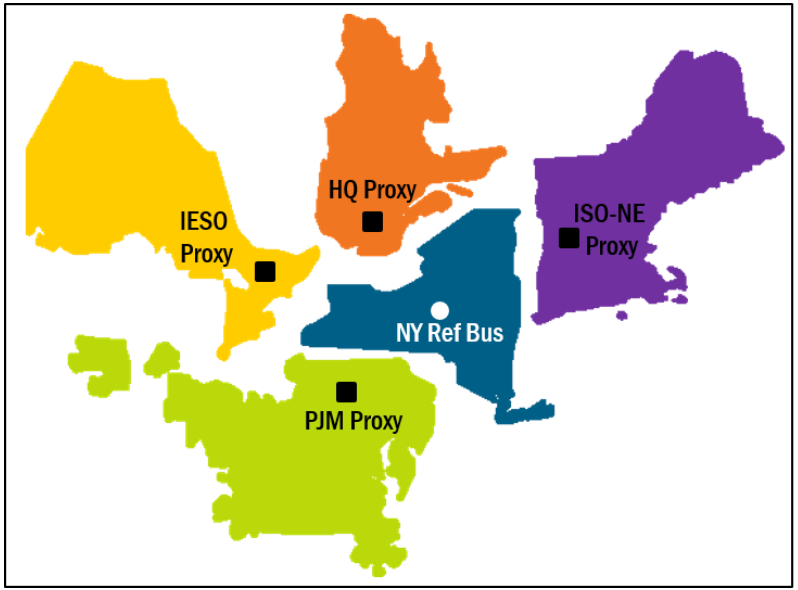
NY Reference Bus -Marcy

- NYISO point of reference for marginal cost of energy (Ref Bus LBMP) calculation
- Congestion and Losses are zero at this location
- Possible source / sink point



External Proxy Bus

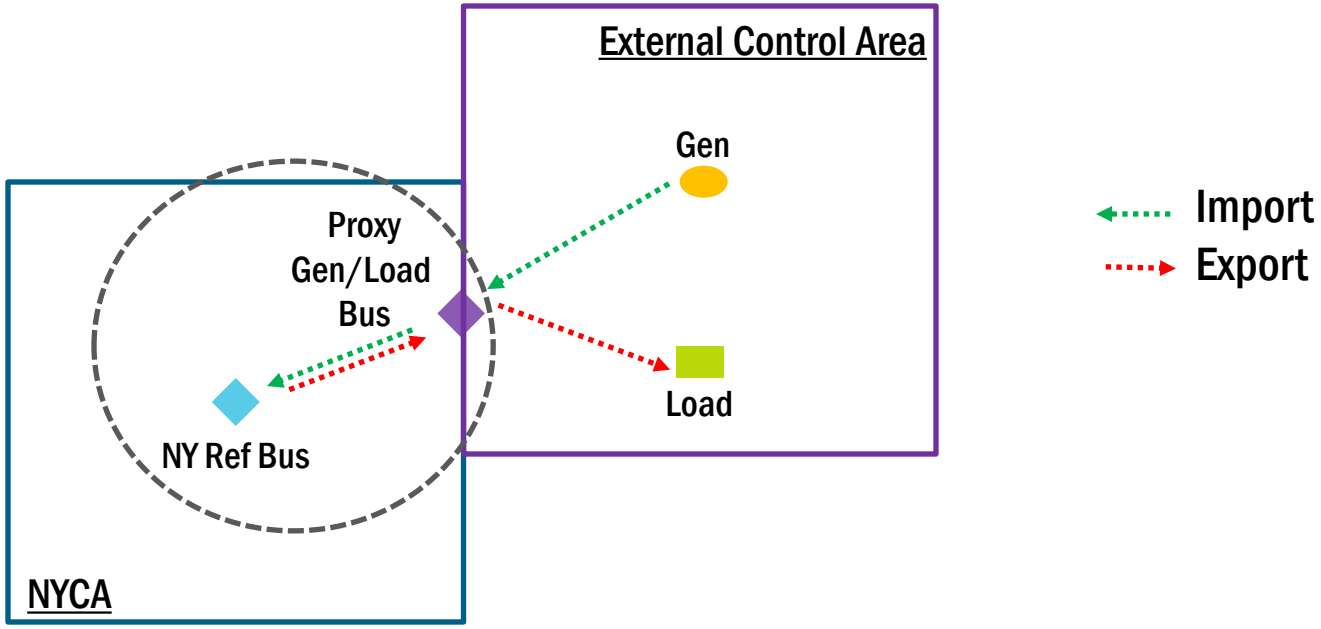
- Location outside the NYCA that is selected by the ISO
  - to represent a Load or Gen bus in each of the adjacent Control Areas
- LBMP prices for external proxy buses are calculated with reference to the NY reference bus
- NYISO designated for PJM, HQ, IESO, and ISO-NE



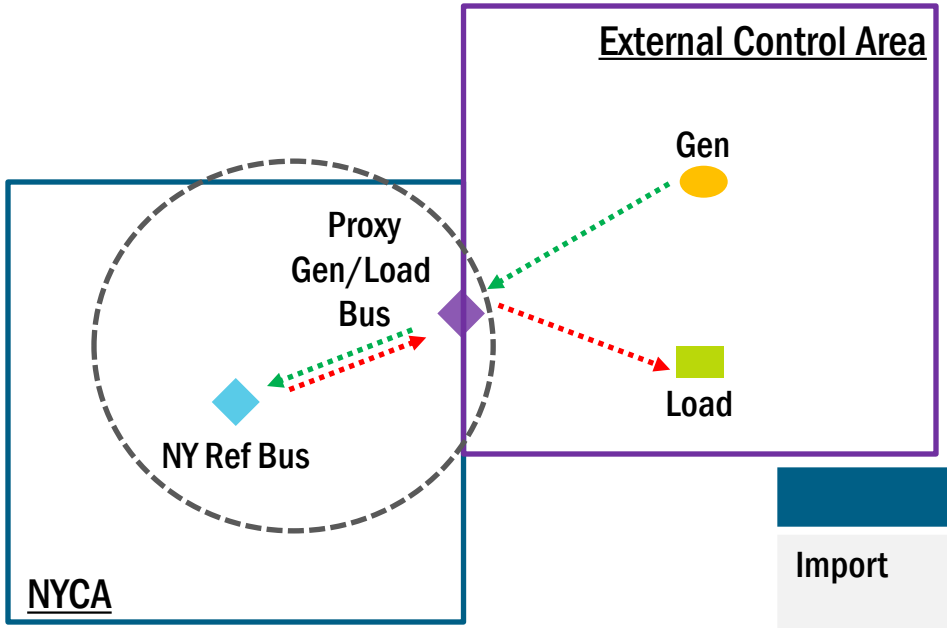
Financially Responsible Party

- The transaction contract owner
- The party initially creates the transaction contract in the MIS/JESS
- Financially responsible for the charges associated with the transactions
- Can be a source organization (gen), sink organization (load) or a third party (Marketer)

LBMP Transactions

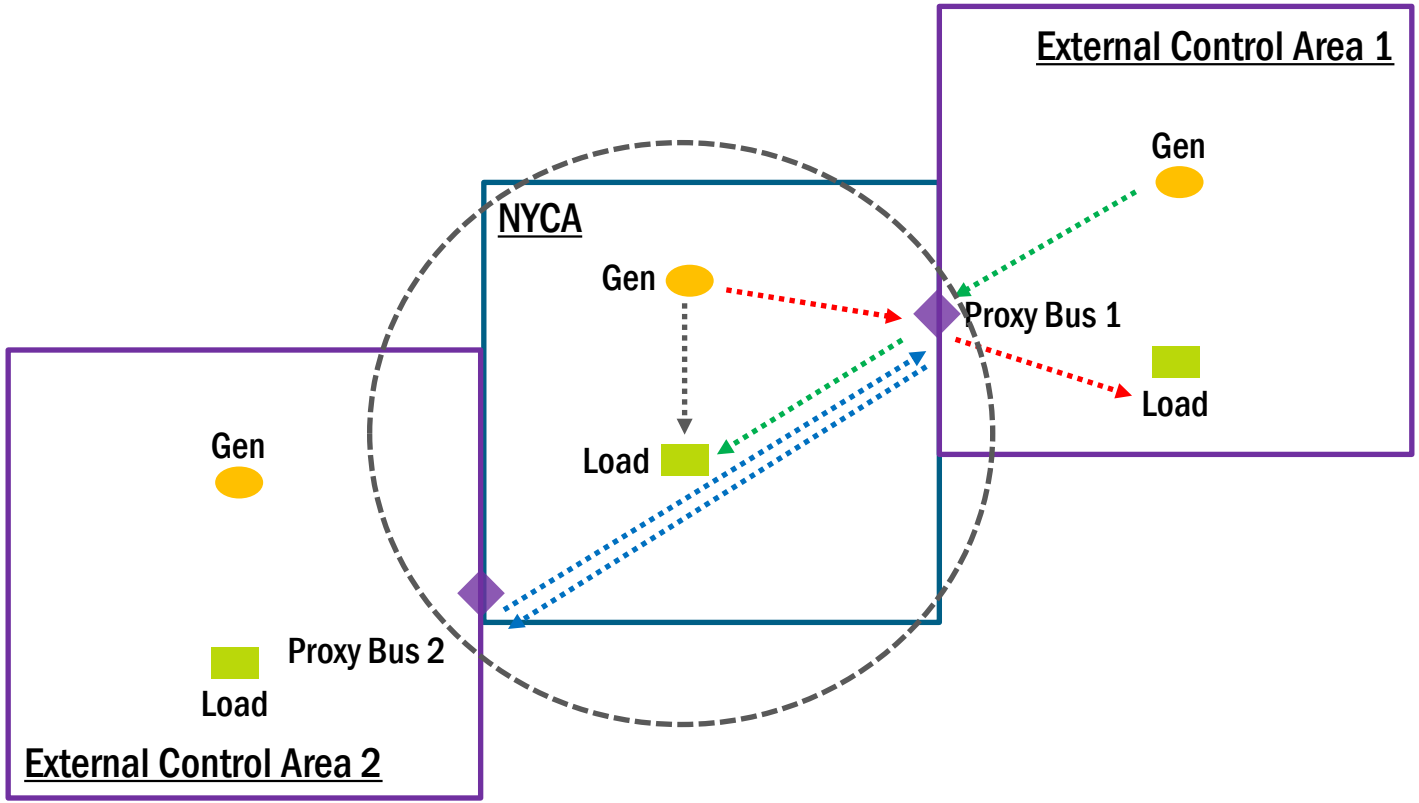


LBMP Transactions



	Source or POI	Sink or POW
Import	External Proxy Gen Bus	NY Reference Bus
Export	NY Reference Bus	External Proxy Load Bus

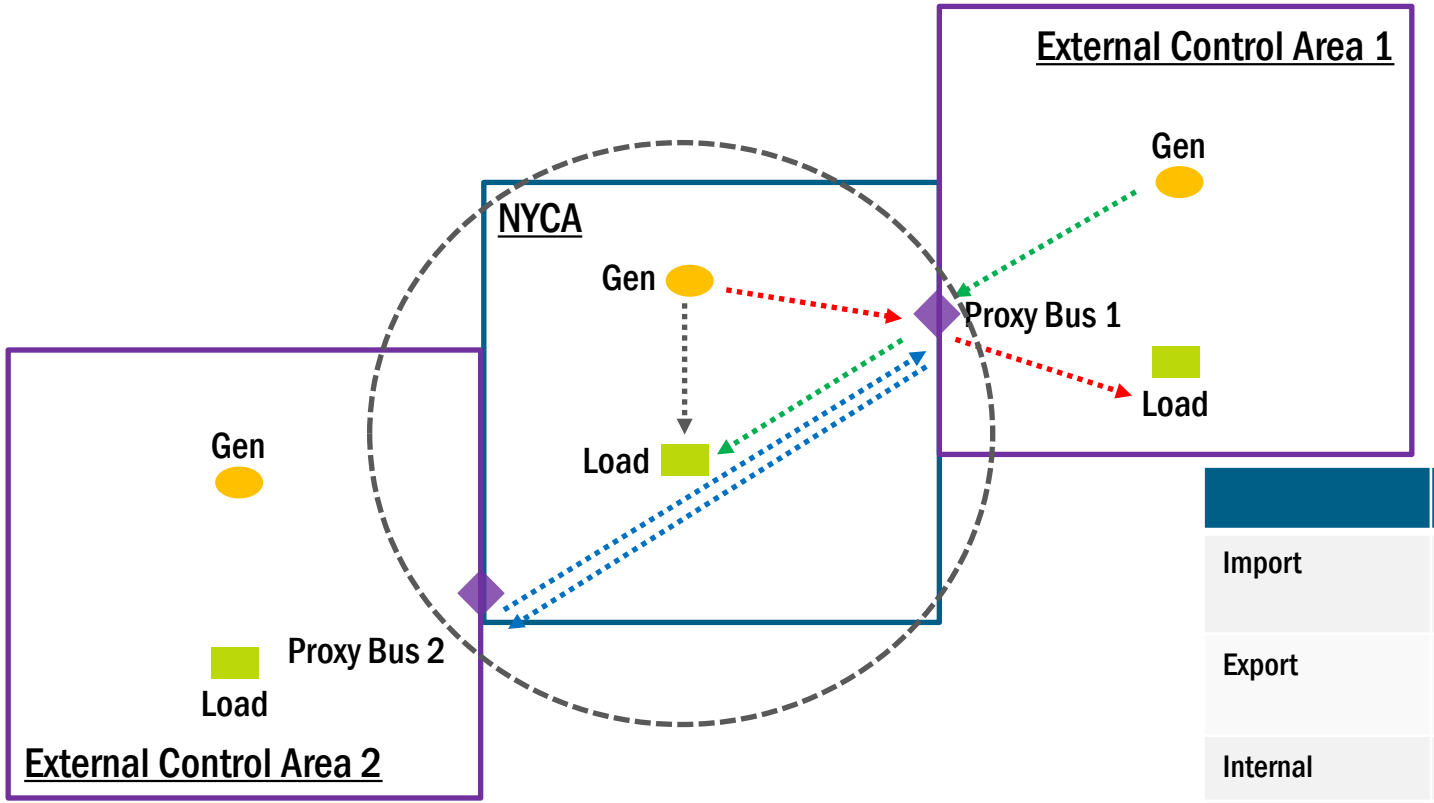
Bilateral Transactions



Import
Export
Internal
Wheelthrough

Bilateral Transactions

New York ISO



Import
Export
Internal
Wheelthrough

	Source or POI	Sink or POW
Import	External Proxy Gen Bus	NY Load Bus
Export	NY Gen Bus	External Proxy Load Bus
Internal	NY Gen Bus	NY Load Bus
Wheelthrough	External Proxy Gen Bus	External Proxy Load Bus

Transactions – Bids and Evaluations

Internal Bilateral Transactions

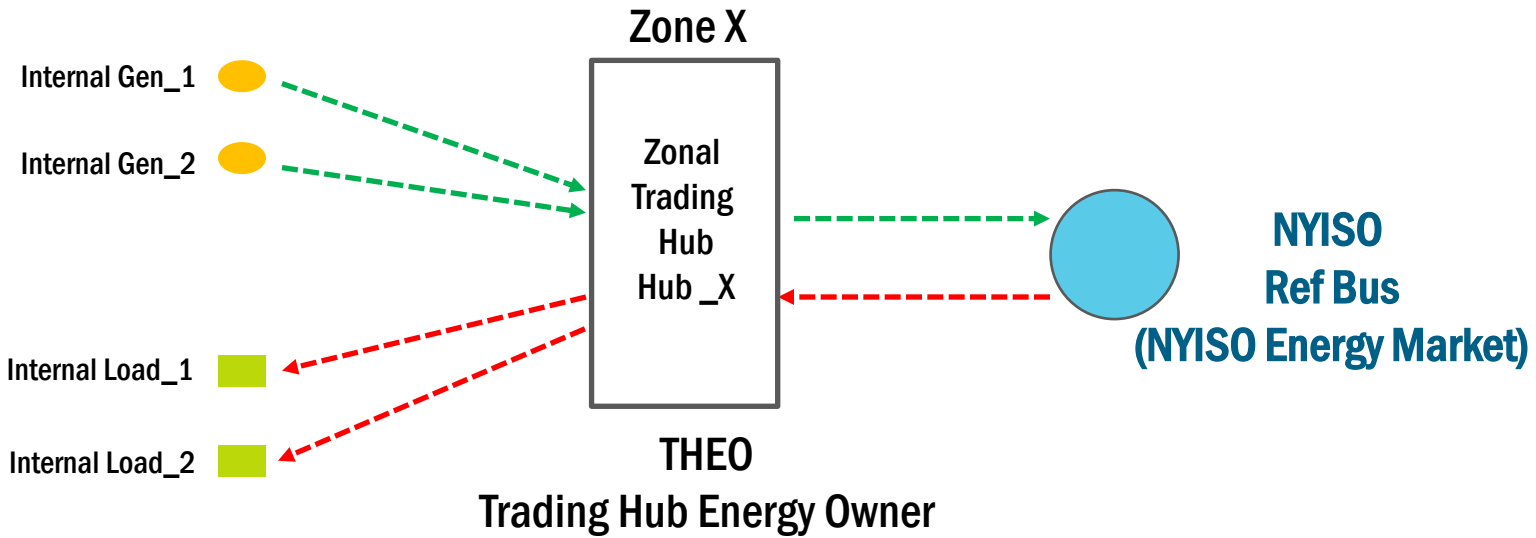
- Scheduled automatically regardless of economics
- Bid ($/MW) is not submitted
  - NYISO needs to be aware of MWs only
- Types
  - Gen Bus to Load Bus
  - Gen Hub to Load Bus
  - Gen Bus to Load Hub

Trading Hubs

Trading Hubs – Internal Bilateral Transactions

- Trading Hub – a virtual location in a given Load Zone, modeled as a Generator bus or Load bus for scheduling internal bilateral transactions
- Trading Hub Energy Owner (THEO) – NYISO customer who, purchases/sells energy from/to the NYISO and in turn has a Bilateral contract with a load/gen
  - Responsible for paying the trading hub LBMP settlements
- Advantages of trading hubs: Market Accessibility

Trading Hubs - Illustration

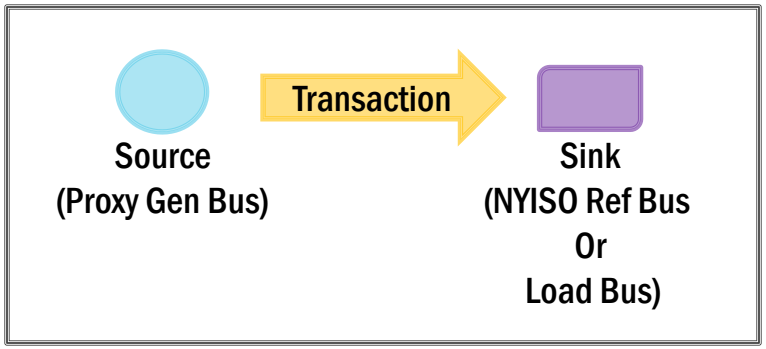


External Transactions –Bids and Evaluations

New York ISO

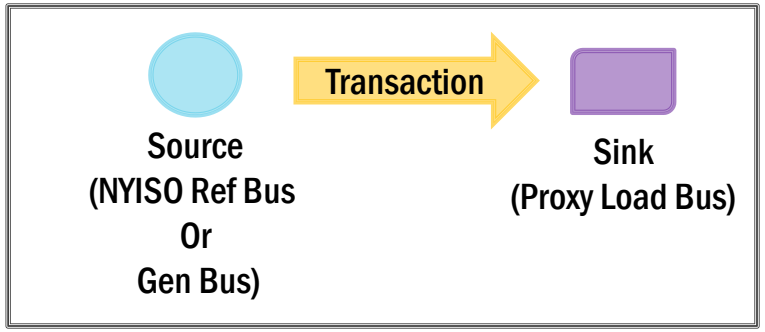
External Import LBMP Bilateral	• Decremental Bid • Coordinated Transaction Scheduling (CTS)
External Export LBMP Bilateral	• Sink Price Cap Bid • Coordinated Transaction Scheduling (CTS)
Wheelthrough	• Congestion Cost Bid

Import - Decremental Bid Evaluation



- Bid = $ / MW using up to a 11-point Bid curve
- Bid signifies: Minimum price MP is willing to be paid for energy (MP is willing to accept no less than Bid price)
- Bid evaluated as an external gen bid, against the Proxy (Source) LBMP

Export - Sink Price Cap Bid Evaluation



- Bid = $ /MW using up to a 11 pt. Bid Curve
- Bid signifies: Maximum MP is willing to pay for the energy (MP is willing to pay no more than Bid price)
- <u>Bid evaluated as an external load bid, against the Proxy (Sink) LBMP</u>

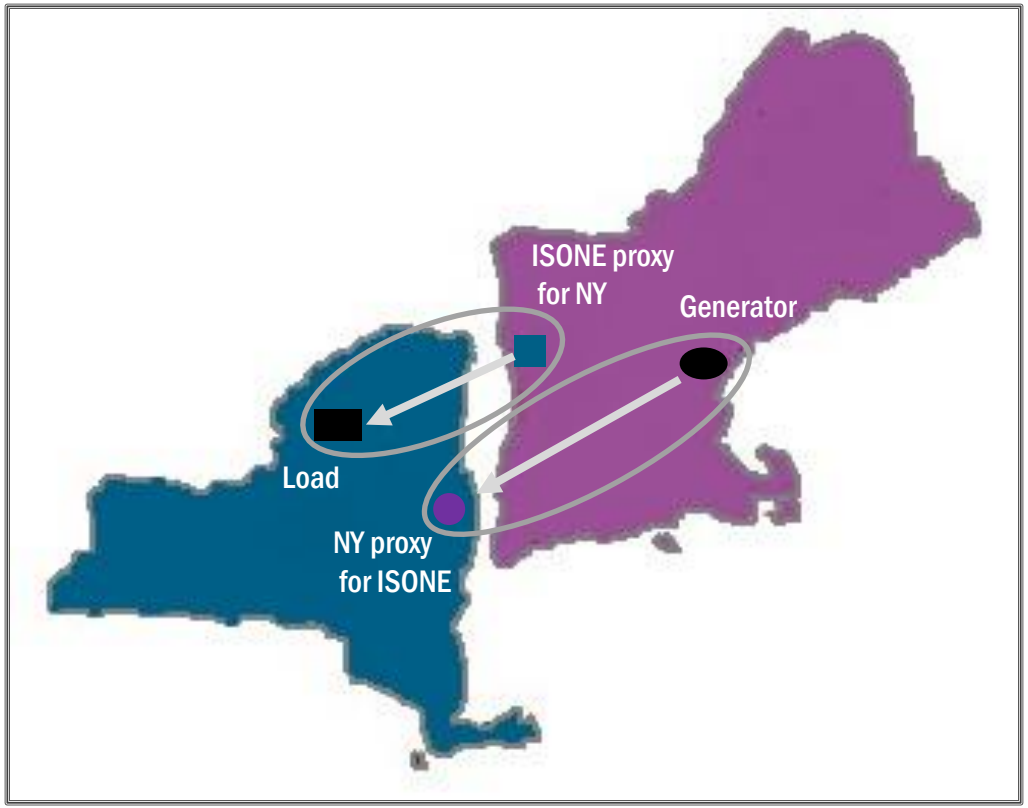
Coordinated Transaction Scheduling

- Mechanism to bid RT external transactions at CTS enabled interfaces
- Applicable to certain NY-PJM and NY-ISO-NE transactions
- Only available in the Real-Time Market
- Applicable for Imports and Exports
- Bids represent the spread or difference between the NYISO and PJM/ISO-NE forecasted Proxy Bus prices

Coordinated Transaction Scheduling - Illustration

Traditional Transaction Bid – Import:

Two bids entered for each leg of transaction



Coordinated Transaction Scheduling - Illustration

Coordinated Transaction Scheduling Bid – Import:

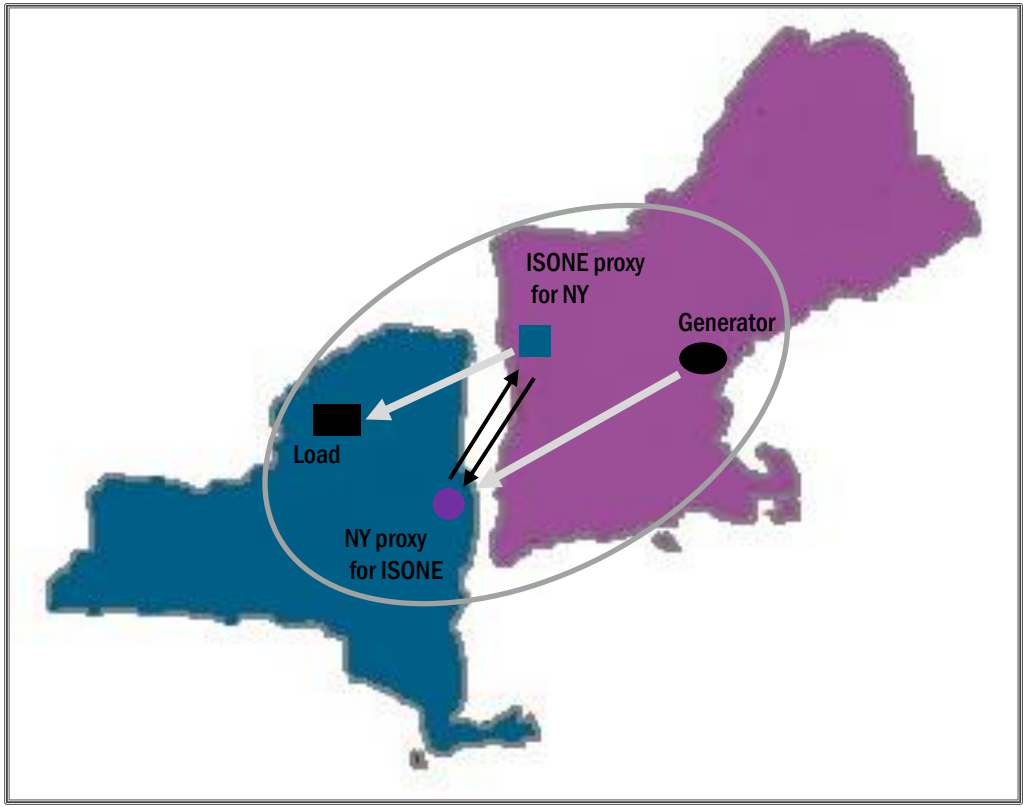
NYISO calculates forecast price for ■

ISONE calculates forecast price for ●

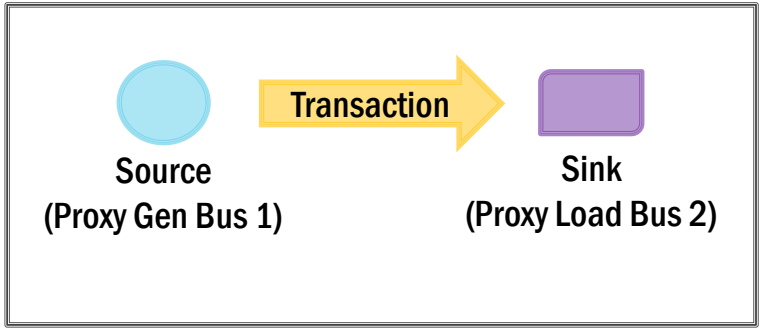
CTS Import Bid compared to delta between the two forecast prices (dependent on direction of flow)

Only one bid entered for whole transaction

CTS Export Bids evaluated similar to Import Bids



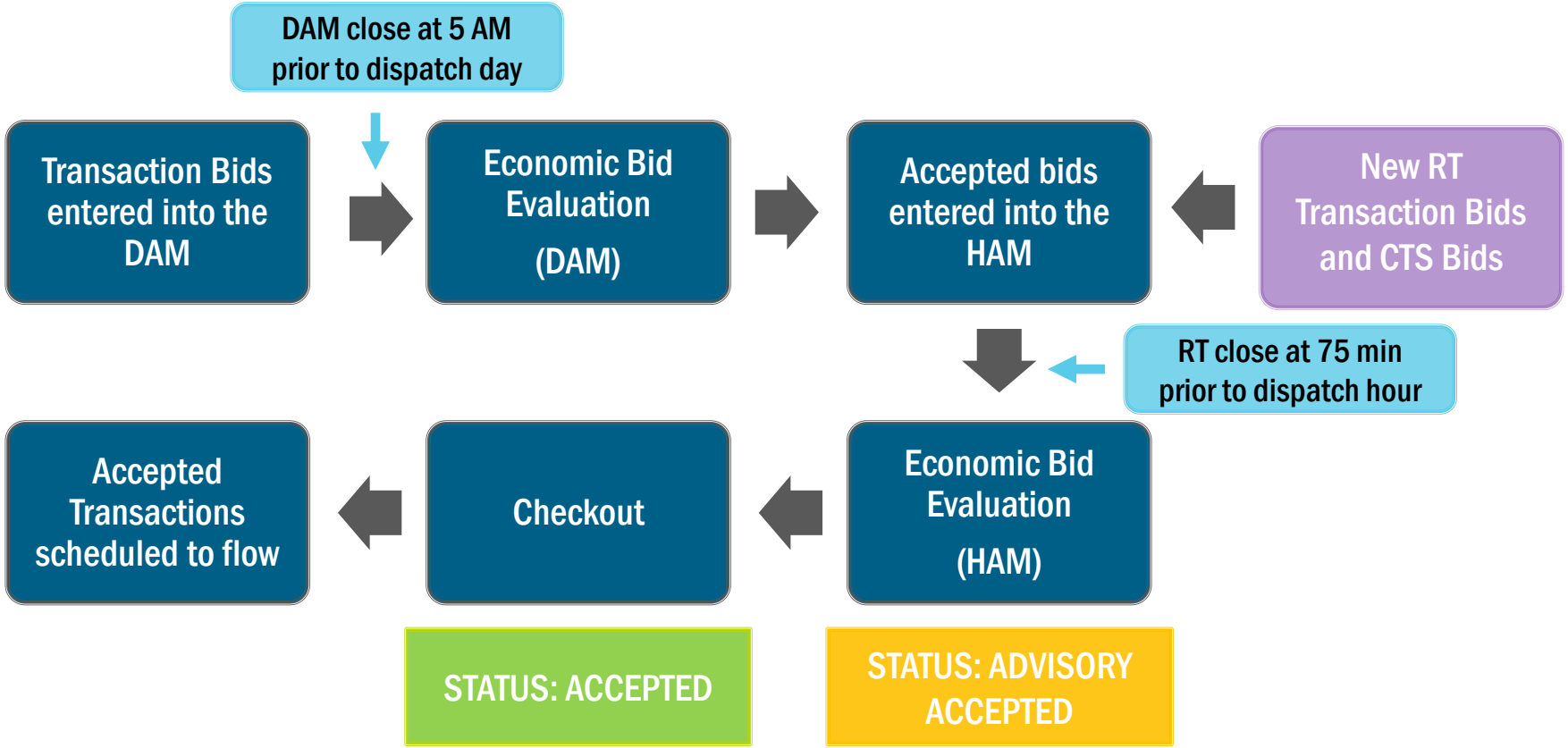
Wheel-through Bilateral Transactions



- Bid = $ / MW using up to a 11-point Bid curve
- Bid is evaluated against the Congestion Cost of the transaction
- Congestion Cost is difference between congestion at the Sink and the congestion at the Source

Congestion Cost = Congestion at Proxy (Sink) LBMP – Congestion at Proxy (Source) LBMP

Transaction Scheduling – Process Flow



Transactions - Settlements

Transaction Settlements

LBMP -Import -Export	• Proxy LBMP($/MW)*MWs
Bilateral -Internal -External	• Transmission Usage Charge (TUC) • Energy price negotiated directly

Settlement of LBMP Transactions

- Purchasing or selling energy at the external proxy LBMP
- For both Imports and Exports:

LBMP Transactions:

Import
Export

Day Ahead Market (DAM) Settlement =

DAM LBMP (Proxy Bus) x DAM MWh

(DAM LBMP = hourly price)

Balancing Market or Real Time Market (RT) Settlement =

RTD LBMP (proxy bus) x RT MWh

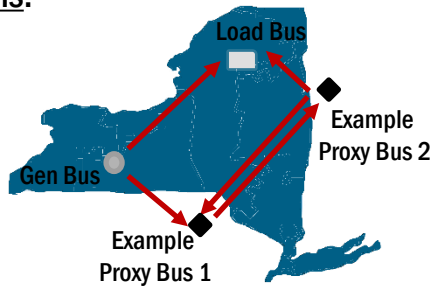
(RTD LBMP = ~ 5 min level interval price; interval settlements summed up to the hourly level)

Settlement of Bilateral Transactions

- Transmission Usage Charge (TUC) is the cost of moving the power from source to sink
- Component of LBMP

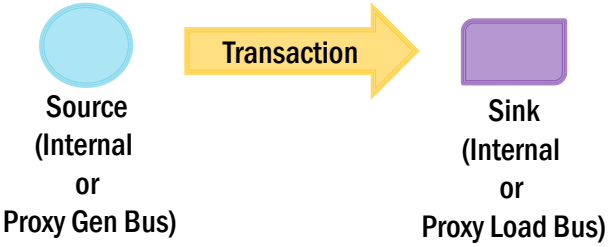
Bilateral Transactions:

Internal
Import
Export
Wheelthrough



LBMP = Marginal Energy Price + (Loss) – (-Congestion)

- Marginal Energy Price → NY Reference Bus Energy Price
- (Loss) – (-Congestion) → Transmission Usage Charge (TUC)



For all Bilateral Transactions:

TUC = [Sink LBMP ($/MW) – Source LBMP ($/MW)]* MWs

Transaction Settlements - Summary

- Imports (injections) – are typically paid
  - LBMP Transactions: Energy, Loss and Congestion
- Exports (withdrawals) – are typically charged
  - LBMP Transactions: Energy, Loss and Congestion
- Bilateral Transactions: Transmission Usage Charge – typically assessed to the Transaction owner
  - (Δ Loss and Congestion)

Additional Resources

- Tariffs - MST and OATT
- Market Participants User's Guide
- Joint Energy Scheduling System User's Guide
- Accounting and Billing Manual
- Transmission and Dispatching Operations Manual
- Technical Bulletins

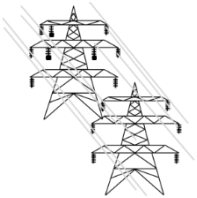
Questions?

For any future assistance, please contact NYISO Stakeholder Services at stakeholder_services@nyiso.com or by phone at (518) 356-6060

New York ISO

Transmission Charges

E-Learning Module



Transmission Charges

MODULE OBJECTIVES:

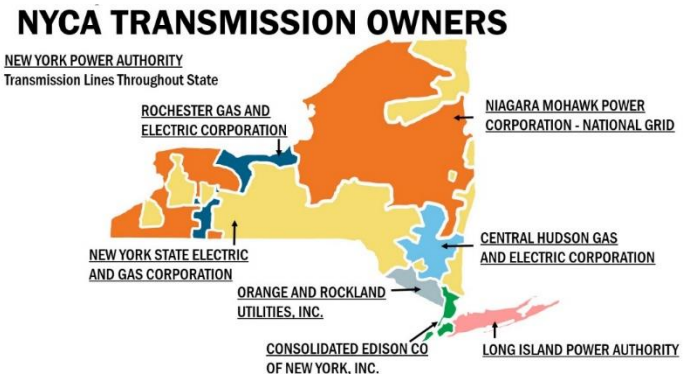
- Name the two types of transmission charges and distinguish between the two
- Identify entities assessed these transmission charges

Transmission Charges

- Charges associated with maintaining and operating the Transmission lines
  - Cost-based charges
  - Adjusted monthly
- Two different Transmission Charges:
  - Transmission Service Charge (TSC)
  - NYPA Transmission Adjustment Charge (NTAC)

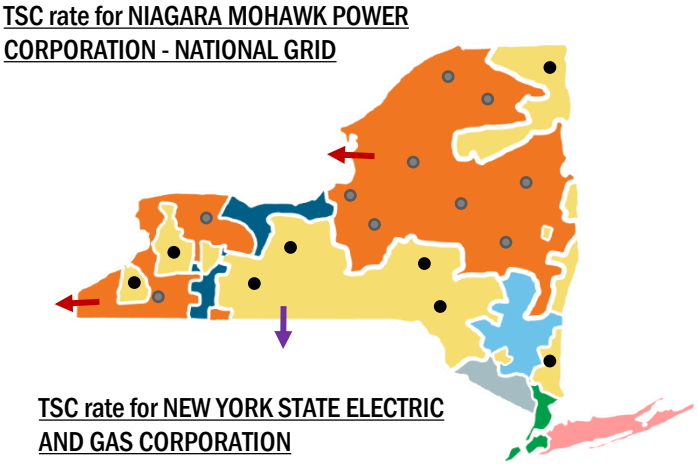
Transmission Service Charge (TSC)

- Transmission Service Charge (TSC)
  - Cost recovery of Transmission System embedded costs
  - Specific to each NY Transmission Owner
  - Billed directly by Transmission Owner



Transmission Service Charge (TSC)

- TSC Assessed to
  - Internal Load in respective Transmission Owner district
  - Specific export and wheelthrough transactions withdrawing power from the NY grid
    - Transactions involving ISO-NE are exempt

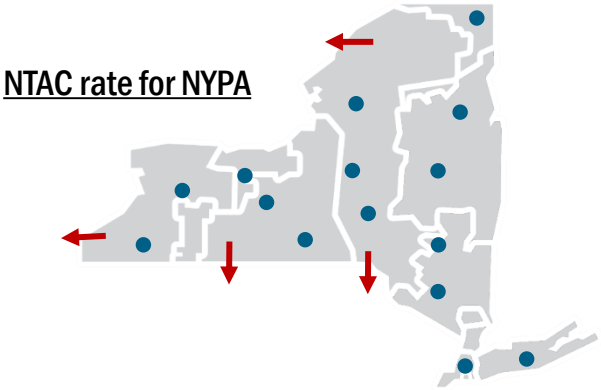


NYPA Transmission Adjustment Charge (NTAC)

- NYPA Transmission Adjustment Charge (NTAC)
  - Cost recovery of NYPA Transmission System revenue requirement
  - Embedded costs not recovered through NYPA's TSC
  - Billed by NYISO on behalf of NYPA

NYPA Transmission Adjustment Charge (NTAC)

- NTAC Assessed to
  - NYCA Internal Load
  - Specific export and Wheelthrough transactions that involve withdrawing power from the NY grid
    - Transactions involving ISO-NE are exempt



Additional Resources

- Tariffs – MST and OATT
- Transmission Services Manual
- Technical Bulletin #39: Using Distribution Factor Tables to Estimate Transmission Charges

Questions?

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New York ISO

Ancillary Services

E -Learning Module

Ancillary Services

Module Objectives:

- Identify Three Cost Based Ancillary Services
- Identify Three Market Based Ancillary Services
- Explain the Purpose of Each Service
- Name the types of Suppliers & Recipients of Each Service

Ancillary Services - Introduction

- In the NY State Wholesale Energy Market, Ancillary Services
  - Support transmission of energy from resources to loads
  - Maintain reliable operation of NY State power system
- NYISO Coordinates
  - Provision of Ancillary Services
  - Arranges for Supply of Ancillary Services
  - Directs Actions of Ancillary Service Suppliers

Ancillary Services - Introduction

Ancillary Service	OATT Rate Schedule
Scheduling, System Control and Dispatch Service	OATT Rate Schedule 1
Voltage Support Service	OATT Rate Schedule 2
Regulation Response Service	OATT Rate Schedule 3
Energy Imbalance Service	OATT Rate Schedule 4
Operating Reserve Service	OATT Rate Schedule 5
Black Start Capability Service	OATT Rate Schedule 6

Ancillary Services - Introduction

Cost Based

- Includes:
  - -Scheduling, System Control and Dispatch Service
  - -Voltage Support Service
  - -Black Start Capability Service
- Fixed rate for pre-determined time periods based on cost associated with having given service
  - Calculated using rules set forth in the tariff, specific to each ancillary service

Market Based

- Includes:
  - -Operating Reserve Service
  - -Regulation and Frequency Response Service
  - -Energy Imbalance
- Variable rates based on the market clearing price
  - Calculated for the appropriate time interval (DAM – Hourly price, RT – 5 minute price)
  - Based on the offers ($/MW) of the units selected to supply specific service

Cost Based Ancillary Services

Scheduling, System Control, and Dispatch (S,SC, & D)

- Rate Schedule 1
  - Purpose : Recovering NYISO Cost of Operations
    - Costs Associated with the Operation of the NYS Transmission System by the NYISO
    - Costs Associated with the Administration of the Tariffs by the NYISO
      - OATT (Open Access Transmission Tariff)
      - MST (Market Administration and Services Tariff)
    - FERC fees

Rate Schedule 1

Rate Schedule 1

Part 1

Allocation of NYISO Embedded Costs

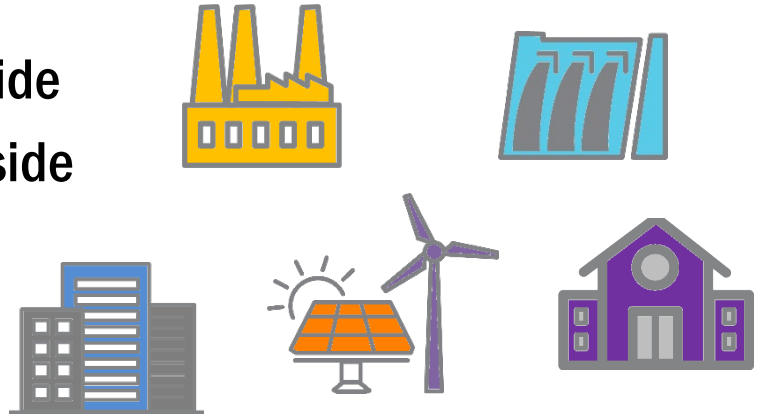
$$\text{NYISO Embedded Costs (\$/MWh)} = \frac{\text{NYISO Costs to be Recovered}}{\text{Forecasted MWh Volumes}}$$

-72% allocated to withdrawals

- 28% allocated to injections

Injections: Represents Supply side

Withdrawals: Represents Load side



Rate Schedule 1

Rate Schedule 1

Part 1

Allocation of NYISO Embedded Costs

$$\text{NYISO Embedded Costs (\$/MWh)} = \frac{\text{NYISO Costs to be Recovered}}{\text{Forecasted MWh Volumes}}$$

-72% allocated to withdrawals

- 28% allocated to injections

Part 1a

Costs assessed to Non-Physical Market Activity

- Virtual Trading
- Transmission Congestion Contracts (TCC)
- Demand Response: SCR/EDRP

Collection from Part 1a is used to address under-collection of Part 1 collection from the previous year

Rate Schedule 1

New York ISO

Rate Schedule 1

Part 1

Allocation of NYISO Embedded Costs

$$\text{NYISO Embedded Costs (\$/MWh)} = \frac{\text{NYISO Costs to be Recovered}}{\text{Forecasted MWh Volumes}}$$

- 72% allocated to withdrawals
- 28% allocated to injections

Part 1a

Costs assessed to Non-Physical Market Activity

- Virtual Trading
- Transmission Congestion Contracts (TCC)
- Demand Response: SCR/EDRP

Part 2

Allocation of Uplift Charges and Residual Adjustments

- 100% allocated to withdrawals

Voltage Support Service (VSS)

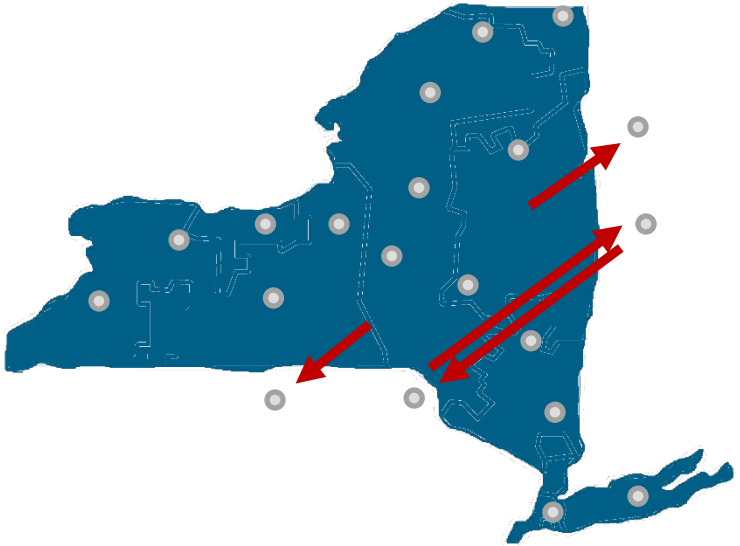
- Rate Schedule 2
  - Purpose: Ensures sufficient supply of Reactive Power to maintain desired voltage levels (Force/Pressure) on the NYCA Transmission System in real time operations
  - Must be provided to support delivery of electrical energy on the NYS Transmission System
  - VSS Accomplished Through use of
    - Generators
    - Other Qualified VSS Providers

Rate Schedule 2

- Supplier's MVAr Capability
  - VSS Suppliers
    - Must meet Service Requirements:
      - Perform Reactive Power Capability (MVAr) Testing
      - Submit MVAr Test Data to NYISO
      - Have Automatic Voltage Regulator (AVR)
      - Maintain specific voltage level as directed
    - Receive Weekly Payments
      - Based on Annual VSS Rate
      - Lag and Lead Var Capability

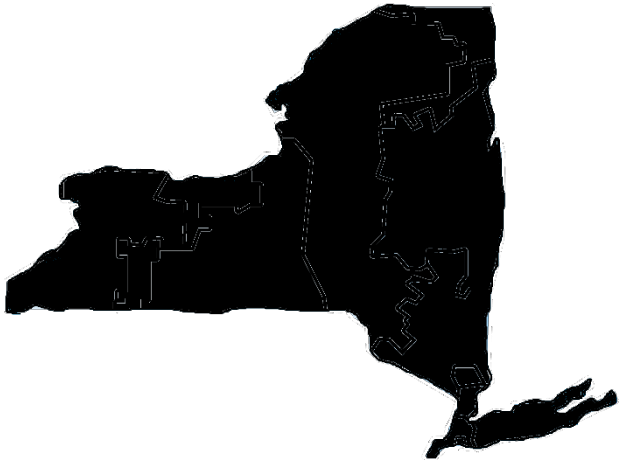
Rate Schedule 2

- Recipients of Service
  - VSS Costs Allocated to:
    - Internal Load
    - Exports
    - Wheels-through
  - Charges Assessed are Based on:
    - Estimated Annual VSS Costs



Black Start Service

- Rate Schedule 6
  - Purpose: NYCA System Restoration
    - Represents generators capable of starting without an outside electric supply, following a system-wide blackout
  - Resources Selected According to Following Considerations:
    - Location in grid
    - Startup time
    - Response rate
    - Maximum output



Rate Schedule 6

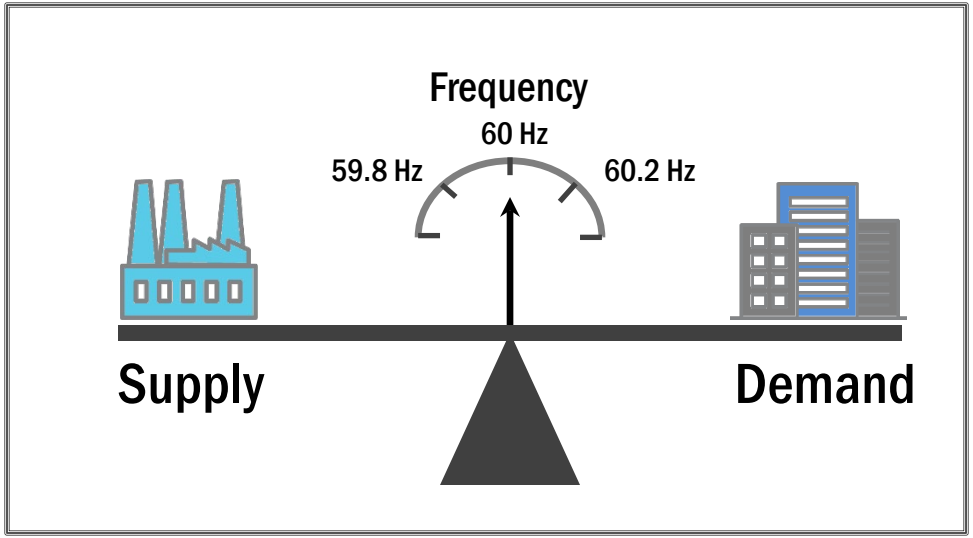
- **Black Start Suppliers**
  - Submit to performance testing as requested
  - Provide embedded cost information annually
  - Receive Black Start Payment for availability

- **Black Start Service Costs**
  - Allocated to Internal Load Withdrawal

Market Based Ancillary Services

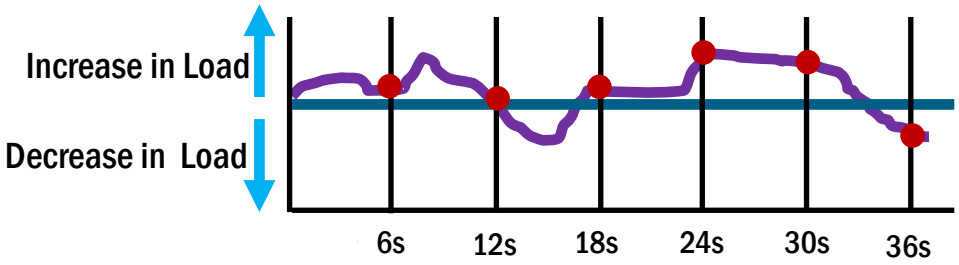
Regulation and Frequency Response Service

- Rate Schedule 3
  - Purpose: Necessary for the continuous balancing of resources with load - supply and demand balance
  - Assists in maintaining scheduled Interconnection Frequency at 60 Hz



Rate Schedule 3

Regulation may be accomplished by:	
Dispatching on-line generators	Generation output maybe raised or lowered to follow 6 second changes in load
Demand Side Regulation Providers	Resource's load maybe lowered or raised to follow 6 second changes in load
Energy Storage Resources and Limited Energy Storage Resources	Flywheels or batteries that could withdraw or inject energy to follow 6 second changes in load

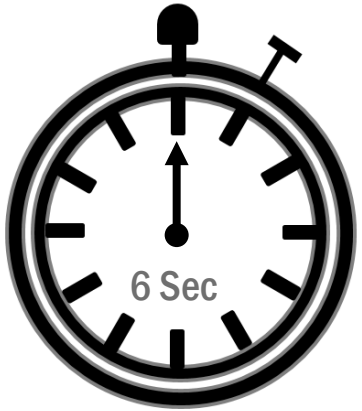


- RTD Base Load
- 6 second signals for Regulation providers to balance Load

Rate Schedule 3

- Regulation is bid in by units that:
  - Have installed equipment capable of responding to six second signals
  - Bid as ‘Flexible’ Supplier

- Criteria considered in Co-Optimization
  - Energy Bids
  - Regulation Service Bids
    - Capacity Bid MW & Price
    - Movement Bid Price

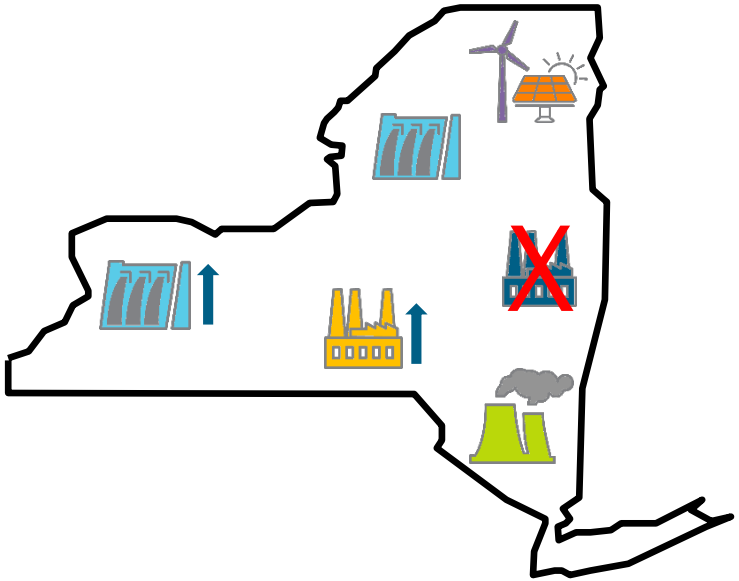


Rate Schedule 3

- Payment for Service
  - Suppliers Scheduled to Provide Regulation service are eligible for Regulation Capacity Settlements
  - Suppliers Instructed to Regulate in Real Time are eligible for Regulation Movement Settlements
- Regulation Service Charges
  - Regulation Service Assessed to
    - Internal Load

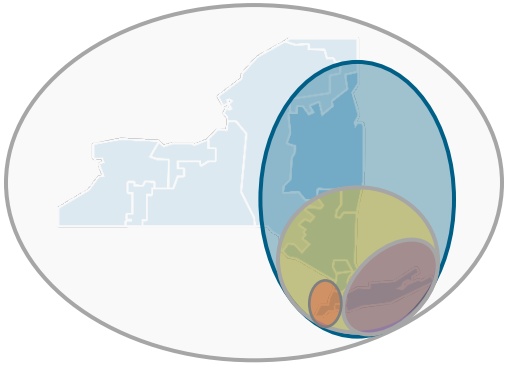
Rate Schedule 5

- Operating Reserve Service
  - Purpose: Backup Generation in the Event of a System Contingency



Rate Schedule 5

- Reserves Must be from:
  - Units in NYCA and within Specific Regions
  - Demand Side Resources within NYCA
- Suppliers of Service
  - Reserve Providers must bid in DAM as a ‘Flexible’ Supplier
    - Flexible output; follow NYISO base points
  - Criteria considered in Co-Optimization
    - Energy Bids
    - Reserve Availability Bids
      - Response Rate
      - Upper Operating Limit

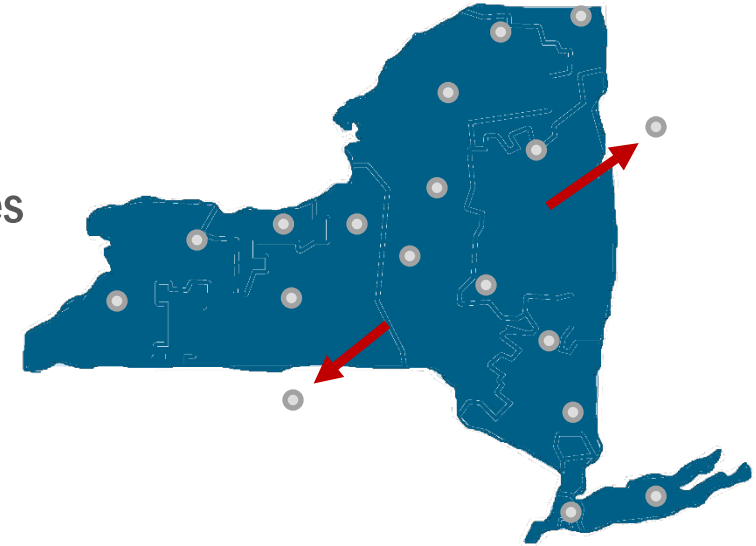


Market Based - Rate Schedule 5

- Activation of Service
  - Reserve Pickup
    - Large Event RPU - Initiated if Load exceeds current energy dispatch opportunities
    - Dispatch-able resources receive new base points w/ 10 min. ramp time
    - Small Event RPU – used to reduce transmission line loading
  - Maximum Generation Pickup
  - Regulation is suspended during Reserve and Max Gen. Pickup

Rate Schedule 5

- Payment for Service
  - Suppliers Scheduled to Provide Operating Reserves
    - Eligible for Operating Reserve Settlements
  - Suppliers Instructed to Convert Reserves to Energy in Real Time
    - Eligible for Real Time LBMP Energy Settlements
- Operating Reserve Recipient Charges
  - Operating Reserves Assessed to
    - Internal Load
    - Exports



Rate Schedule 4

- Energy Imbalance Service
  - Internal Energy Imbalances
    - Addresses differences between Supply and Demand within the NYCA
      - Resolved through the RT Market Process
  - External Energy Imbalances
    - Addresses differences in energy exchange (Transactions) between NYCA and Other Control Areas
      - Resolved through the Inadvertent Energy Accounting Process

Ancillary Services: Summary

New York ISO

Ancillary Service	Injection	Non-Physicals (Virtuals, TCCs, & EDRP/SCR)	Internal Loads	Exports	Wheels-through
Rate Schedule 1 (S,SC and D)	✓	✓	✓	✓	✓
Rate Schedule 2 (VSS)			✓	✓	✓
Black Start Service			✓		
Regulation Service			✓	✓	
Operating Reserve			✓		
Energy Imbalance	✓		✓	✓	✓

Additional Resources

- Tariffs - OATT & MST
- Ancillary Services Manual
- Accounting & Billing Manual
- Technical Bulletins
- Miscellaneous Pricing Files

Questions?

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Installed Capacity (ICAP) Market

E-Learning Module

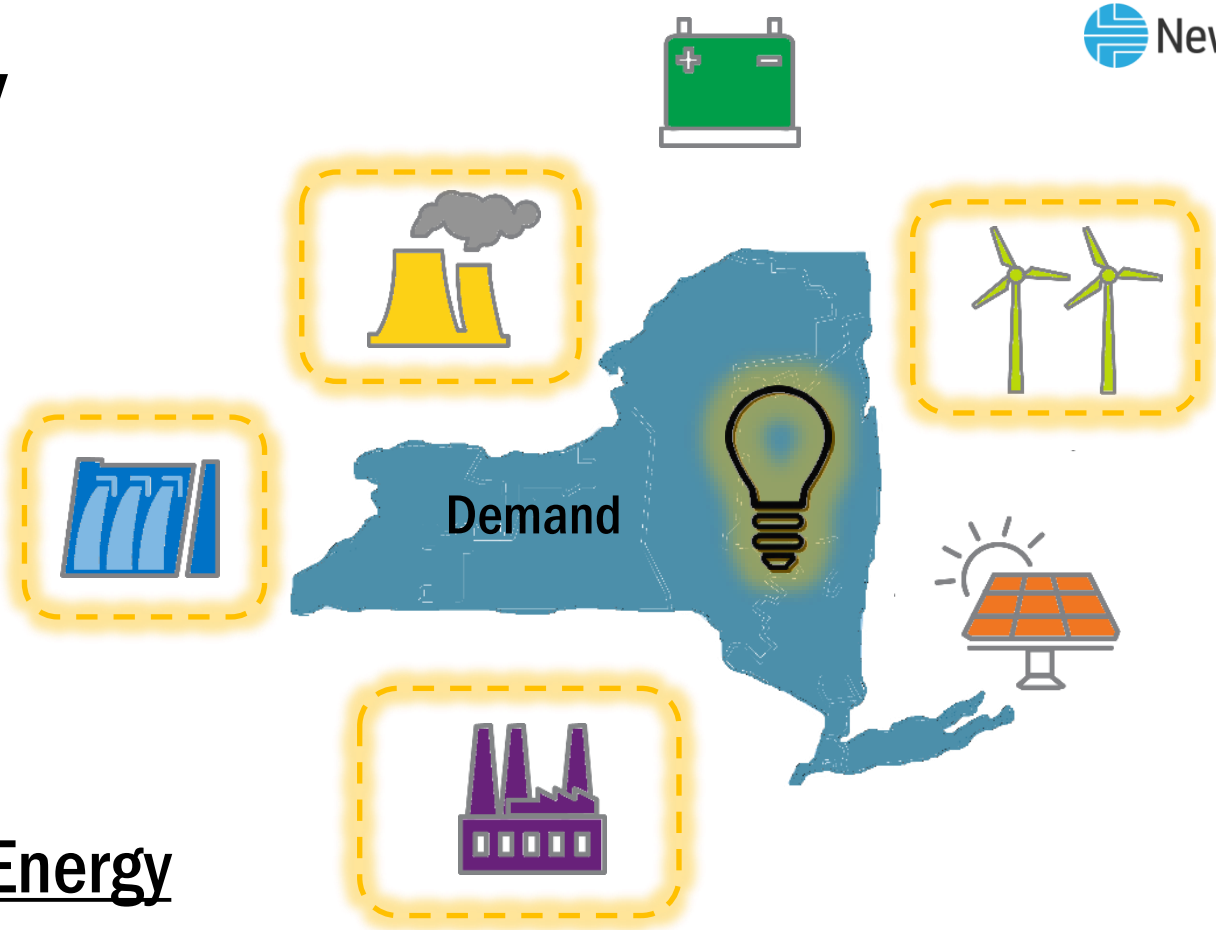
Installed Capacity Market

- **MODULE OBJECTIVES:**
  - Name three benefits of the NYISO Capacity Market
  - Describe the difference between Installed Capacity and Unforced Capacity
  - List the basic processes and activities associated with conducting NYISO's Capacity Market

Capacity vs. Energy

Capacity

- Actual or potential ability to perform
  - Refers to the electric power output for which a generating system, plant, or unit is rated
- Capacity required to meet expected maximum load + margin
- Capacity sold/purchased through NYISO's Installed Capacity Market



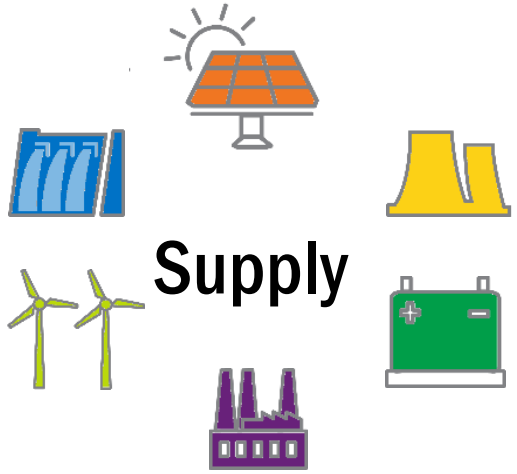
Energy

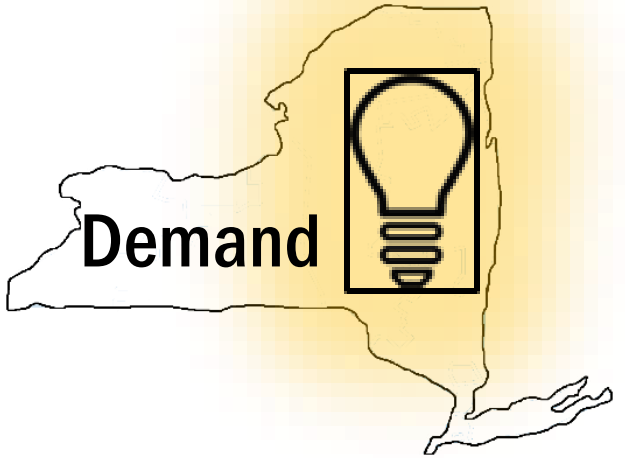
- Amount of actual energy produced over time
- Energy required to meet actual consumption or demand
- Energy sold /purchased through NYISO's Energy Markets

ICAP Market Benefits

Benefits of the ICAP Market

- Ensures resource adequacy
  - Do we have enough?
    - Supply is sufficient to meet load
    - Adhere to reliability standards





Benefits of the ICAP Market

- Recover portion of fixed costs

Variable Costs vs. Fixed Costs

Energy Market

(Market Clearing Prices - LBMPs)

Portion from ICAP Market

(Auction Clearing Prices)

Benefits of the ICAP Market

- Market signal for investment
  - Potential Investors:
    - Is it worth building a new plant?
    - Where should I build a new plant?
    - Do I have the technology to build a plant that is competitive?

ICAP Market Mechanics

ICAP vs. UCAP

- ICAP:

  - Installed Capacity describes the market as opposed to the product that is sold/purchased

- UCAP:

  - Unforced Capacity describes the measure by which
    - ICAP suppliers will be rated for the capacity that they are qualified to sell
    - LSEs procure capacity to satisfy their obligation

  in accordance with formulae set forth in NYISO procedures

ICAP Market – Capability Year and Capability Periods

- Capability Year: May 1st through April 30th
  - Summer Capability Period: May 1st to October 31st of each year
  - Winter Capability Period: November 1st of each year to April 30th of the following year

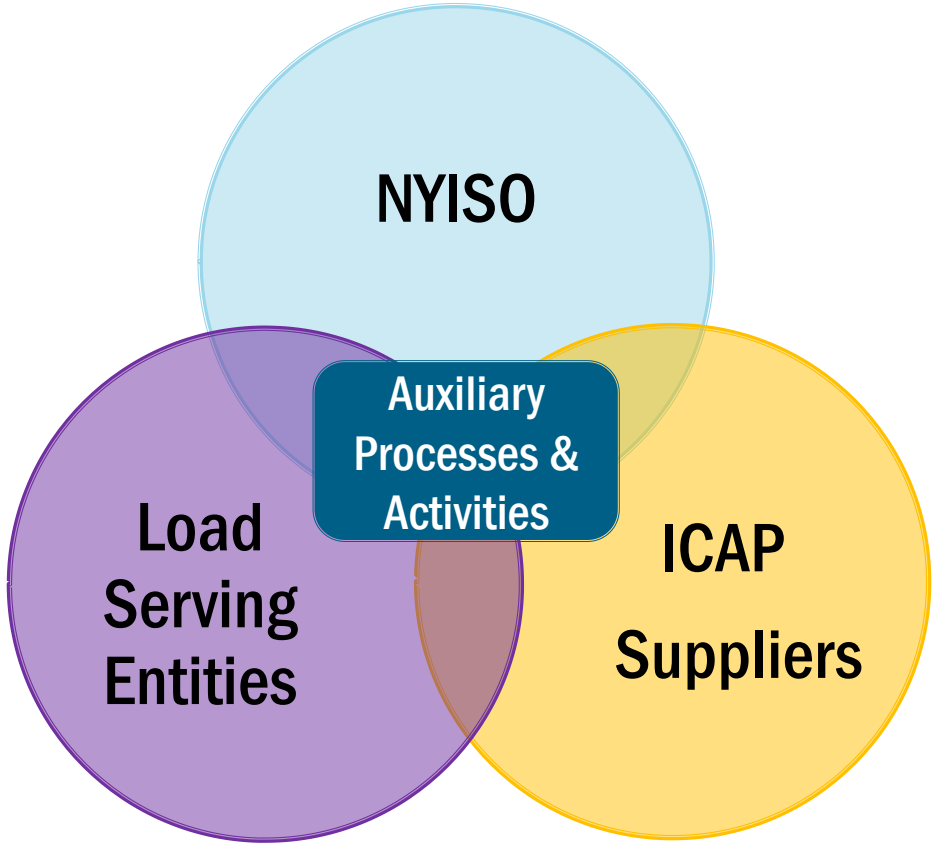
Winter Capability Period						Summer Capability Period					
Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct

Buying and Selling Capacity in NY

- Buying/selling capacity:
  - NYISO Auctions
  - Bilateral transactions
- Installed Capacity Suppliers (ICAP Suppliers):
  - Internal to NYCA
    - Generators
    - Special Case Resources (Demand Side Resource)
  - External suppliers in neighboring Control Areas

ICAP Market Mechanics

- How does it work?
  - Suppliers offer their capacity
  - Loads bid to procure capacity
  - NYISO runs auctions to match bids and offers to determine a clearing price
  - Auxiliary processes and activities



ICAP Market Mechanics

Auxiliary Processes and Activities

1) Determining the amount of capacity required

2) Determining the amount of capacity available

3) Determining the amount of capacity suppliers are qualified to offer

4) Determining the amount of capacity obligation to be procured

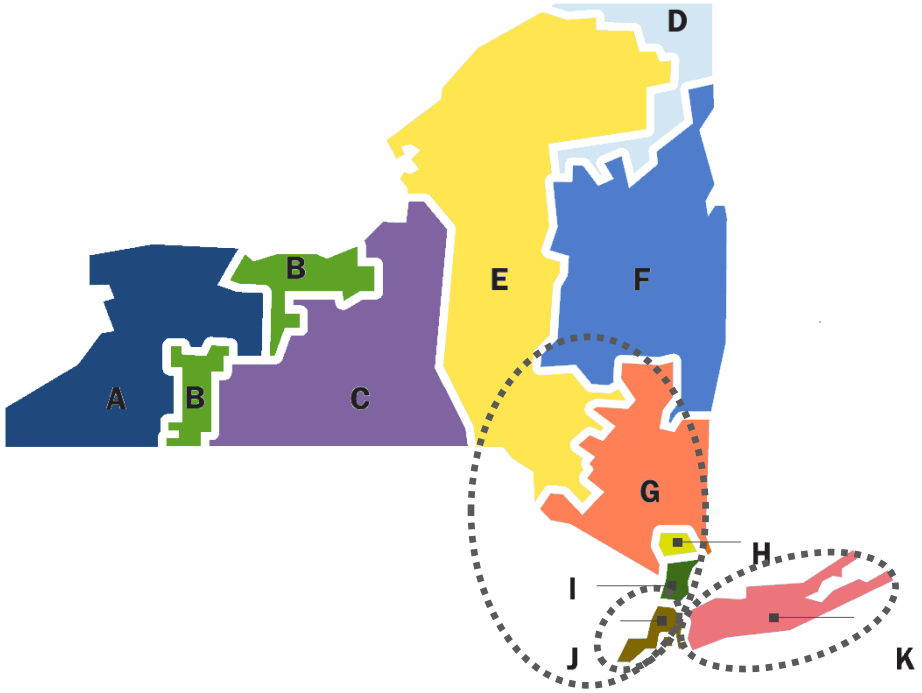
Auxiliary Processes and Activities

- Determining the amount of capacity required – How much do we need?
  - Calculated as the Minimum Installed Capacity Requirement each Capability year
  - NYCA Minimum Installed Capacity Requirement based on:
    - Peak Load Forecast
    - Reliability Standards
    - Installed Reserve Margin (IRM)

NYCA Minimum ICAP Requirement = Forecasted NYCA Peak Load x (1 + IRM)

Auxiliary Processes and Activities

- Minimum Locational Installed Capacity Requirements also calculated for the following localities:
  - Zone G-J
  - Zone J
  - Zone K



Auxiliary Processes and Activities

- Determining the amount of capacity available – How much do we have?
  - Installed Capacity (ICAP)
    - Suppliers provide data to support their capability to produce a certain number of MWs
    - Seasonal effects taken into consideration

ICAP

Auxiliary Processes and Activities

- Resource Capability determined by one of the following, depending on the type of unit
  - DMNC / DMGC Test
  - Performance Test
  - Resource Nameplate
  - Actual Production Data

ICAP

Auxiliary Processes and Activities

- Determining the amount of capacity suppliers are qualified to offer – How much can be sold?
  - Unforced Capacity (UCAP)
    - Components that determine UCAP for resources are
      - Maximum Demonstrated Output
      - Deliverability Limit
      - Duration Adjustment factor
      - Historical Availability

UCAP

Auxiliary Processes and Activities

UCAP for Resources:

A generator may sell Capacity equal to its maximum demonstrated output adjusted for the deliverability limit, duration adjustment factor and by its historical availability

UCAP = Adjusted ICAP * (1 – Derating Factor)

Adjusted ICAP = ICAP * Duration Adjustment Factor

ICAP = Min (CRIS, DMNC)

UCAP

*This formula is for Internal Generators that are not BTM:NG

Auxiliary Processes and Activities

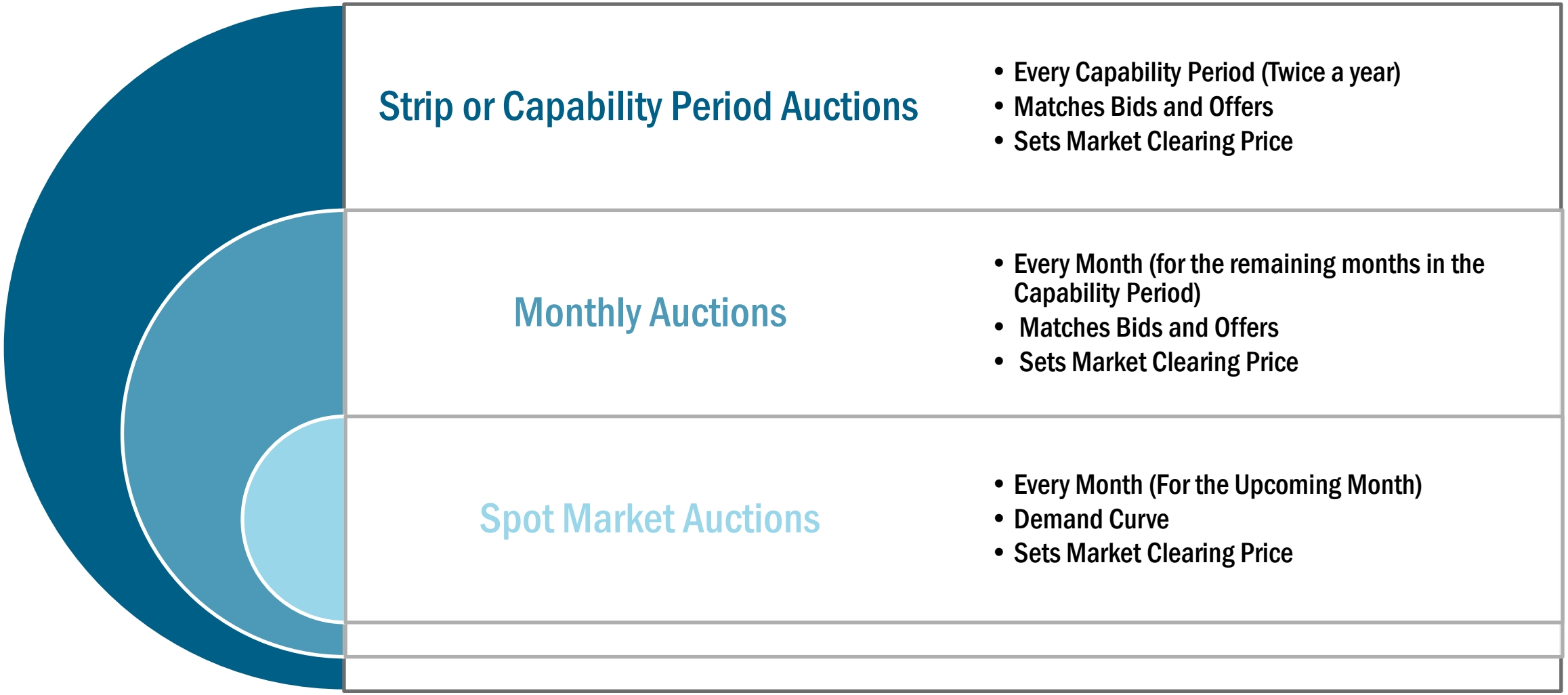
- Determining the amount of capacity obligation to procure - How much must be purchased?
  - Unforced Capacity (UCAP)
    - Three components that determine the UCAP for LSEs
      - Forecasted peak load for each LSE
      - Installed Reserve Margin (IRM)
      - Statewide outage rate

UCAP

Auxiliary Processes and Activities

- UCAP for LSEs:
  - All LSEs are required to purchase a specific amount of the Total NYCA Capacity Requirement
  - LSEs may also have Locational Capacity Requirements
    - (G-J Locality, LI and NYC)
  - Calculated every capability period by NYISO
  - Each month, every LSE must satisfy its minimum UCAP requirement

ICAP Market Auctions



ICAP Market Settlements

Monthly Capacity Auction Settlement ($)	=	Auction Award (MWs)	x	Applicable Auction Market Clearing Price ($/kW - month)

Multiplied by conversion factor 1000 to convert MW to kW

- Auction Awards appear in following weekly invoice
  - Monthly amount is prorated by the number of days on the weekly invoice divided by the number of days in the month
- Bilateral Transactions are settled between parties outside of NYISO

ICAP Market Summary

- Benefits of the ICAP Market
- Difference between ICAP and UCAP
- Processes and activities associated with the ICAP Market
  - Capacity Required
  - Capacity Available
  - Capacity Suppliers Qualified to Offer
  - LSE Obligation to Procure
  - ICAP Auctions and Awards
  - ICAP Settlements

Additional Resources

- Tariffs – MST and OATT
- Installed Capacity Manual
- NYISO Load Forecasting Manual
- ICAP Automated Market User's Guide
- Market Participant User's Guide

Questions?

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Demand Side Resources at the NYISO

E-Learning Module

Demand Side Resources

- MODULE OBJECTIVES:
  - Explain what Demand Side Resources are and benefits to their participation in NYISO markets and programs
  - Identify the various NYISO Markets and Programs that Demand Side Resources can participate in
  - List the basic participation requirements of Reliability Based Demand Response programs
  - Discuss participation of Demand Side Resources in the DER and Aggregation Participation Model

Demand Side Resources at the NYISO

What are Demand Side Resources?

Electric consumers located in New York State that enroll to take part in a specific DR programs or participation model

Examples:

- Industrial companies
- Commercial buildings
- Big box stores
- Small retail stores
- Hospitals
- Colleges/Universities

What do Demand Side Resources do?

Demand Side Resources reduce power consumed from the grid for discrete periods of time.

Demand Side Resources at the NYISO

How can Demand Side Resources participate in NYISO markets and programs*?

Qualified Demand Side Resources can participate as part of a DER Aggregation in the following markets:

- Energy Market
- Ancillary Services Market
- Installed Capacity Market

Alternatively, Demand Side Resources can participate in NYISO's Reliability based Demand Response Program

- Emergency Demand Response Program (EDRP)
- Special Case Resources (SCRs)

* DADRP and DSASP, the two Economic based Demand Response programs are being terminated

Demand Side Resources at the NYISO

What are some of the advantages offered by Demand Side Resource participation in NYISO markets and programs?

Contribute to maintaining system reliability by:

- Effectively increasing the supply available to manage peak demand periods
- Allow load to provide ancillary services to the wholesale electricity market

Maintain price stability in the market by:

- Allowing load to respond to wholesale market prices, which can moderate high prices in the NYISO's Day-Ahead and Real-Time market

Demand Side Resources at the NYISO

How do Demand Side Resources provide load reduction?

Reliability Based Demand Response

Resources can provide load reduction by:

- Decreasing power consumption in the facility - load curtailment
- Using a qualified behind-the-meter local generator to supply part of the resource's load
- Using both load curtailment and a local generator

DER Aggregations

Resources can provide load reduction by:

- Decreasing power consumption in the facility - load curtailment
- Using a qualified behind-the-meter local generator to supply part of the resource's load
- Using both load curtailment and a local generator
- Using curtailment and/or a Behind-the-meter generation with additional capability of injection onto the grid

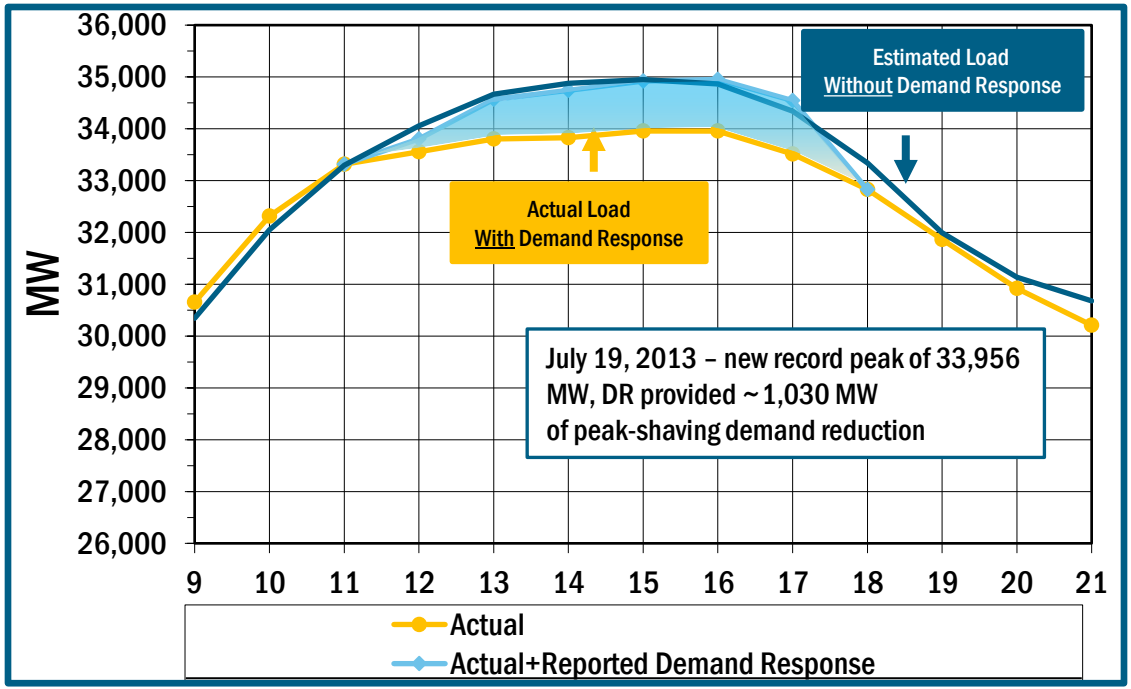
Reliability Based Demand Response Programs

- Purpose: Load reduction for discrete periods of time, in response to NYISO operations to supplement generation
  - When operating reserves are forecast to be short or
  - When there is an actual Operating Reserve Deficiency or
  - Other system emergency
- Event driven
- NYISO determines activation
  - Emergency Demand Response Program (EDRP)
  - ICAP - Special Case Resources (SCR)

Reliability Based Demand Response Programs – Basic Features

	EDRP	SCR
Performance Requirement	Voluntary	Mandatory if awarded capacity and if notification timeline is met
Size Requirement	Minimum 100kW reduction	- Minimum 100kW reduction - Grouping by zone allowed
Number of calls	Unlimited	Unlimited
Metering	Hourly interval metering	Hourly interval metering
Payment Type	Performance payment	- Capacity payment - Performance payment
Penalties	None	May apply

Reliability Based Demand Response in Action

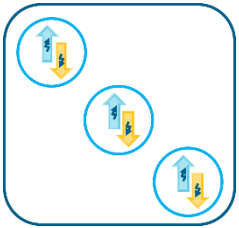


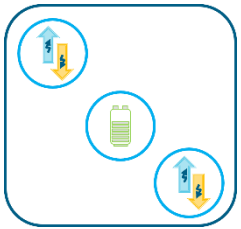
DER and Aggregation Participation Model

- One or more qualifying individual Demand Side Resource(s) can take part as a DER Aggregation in the following NYISO Markets:
  - Energy Market
    - Day-Ahead
    - Real-Time
  - Ancillary Services Market
    - Operating Reserves
    - Regulation
  - Installed Capacity Market

DER and Aggregation Participation Model

- Demand Side Resources can participate as a DER Aggregation in the following configurations:
  - Aggregation comprising only of Demand Side Resources
    - Example: One or multiple Demand Side Resources at separate points of Interconnection, mapping to the same Transmission node *
  - Aggregation comprising of Demand Side Resources and other resource types
    - Example: Demand Side Resource(s) and an Energy Storage Resources (ESR) at separate points of Interconnection, mapping to the same Transmission node *





* Transmission Nodes reflect a collection of designated load buses on which individual DERs are located and may participate together in an Aggregation

Additional Resources

- Tariffs – MST and OATT
- Emergency Demand Response Program Manual
- Installed Capacity Manual Section 4.12
- Aggregation Manual

Questions?

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