Market Overview Introduction

Gina E. Craan

Manager, Market Training, NYISO

Market Overview Webinar

June 23, 2020
Remote Learning

NYISO in Operations

- **The NYISO Began Operations in December 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

Mission & Strategy

- **The NYISO's mission, in collaboration with its stakeholders, is to serve the public interest and provide benefit to consumers by:**

NYISO Governance

- **NYISO work is overseen by:**
  - Federal & State Government Regulators
    - Federal Energy Regulatory Commission (FERC)
    - New York State Public Service Commission (PSC)
  - Electricity Reliability Organizations
    - North American Electric Reliability Corporation (NERC)
    - Northeast Power Coordinating Council (NPCC)
    - New York State Reliability Council (NYSRC)

NYISO Shared Governance

NYISO Board Of Directors

10-member Board of Directors with experience in energy, environment, finance, academia, technology, and communication

NYISO Board members and all employees are independent, with no business, financial, operating, or other direct relationship to any Market Participant or stakeholder

PRESIDENT & CEO

NYISO STAFF

MANAGEMENT COMMITTEE

OPERATING COMMITTEE

BUSINESS ISSUES COMMITTEE

Market Participants stakeholder committees of individuals from market sectors: Transmission Owners, Generation Owners, Other Suppliers, End-Use Consumers, and Public Power and Environmental Parties

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 approved by the Federal Energy Regulatory Commission (FERC)**

New York ISO
Independent System Operator

Power System Fundamentals

Mathangi Srinivasan Kumar
Senior Market Trainer, NYISO

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Session Objectives

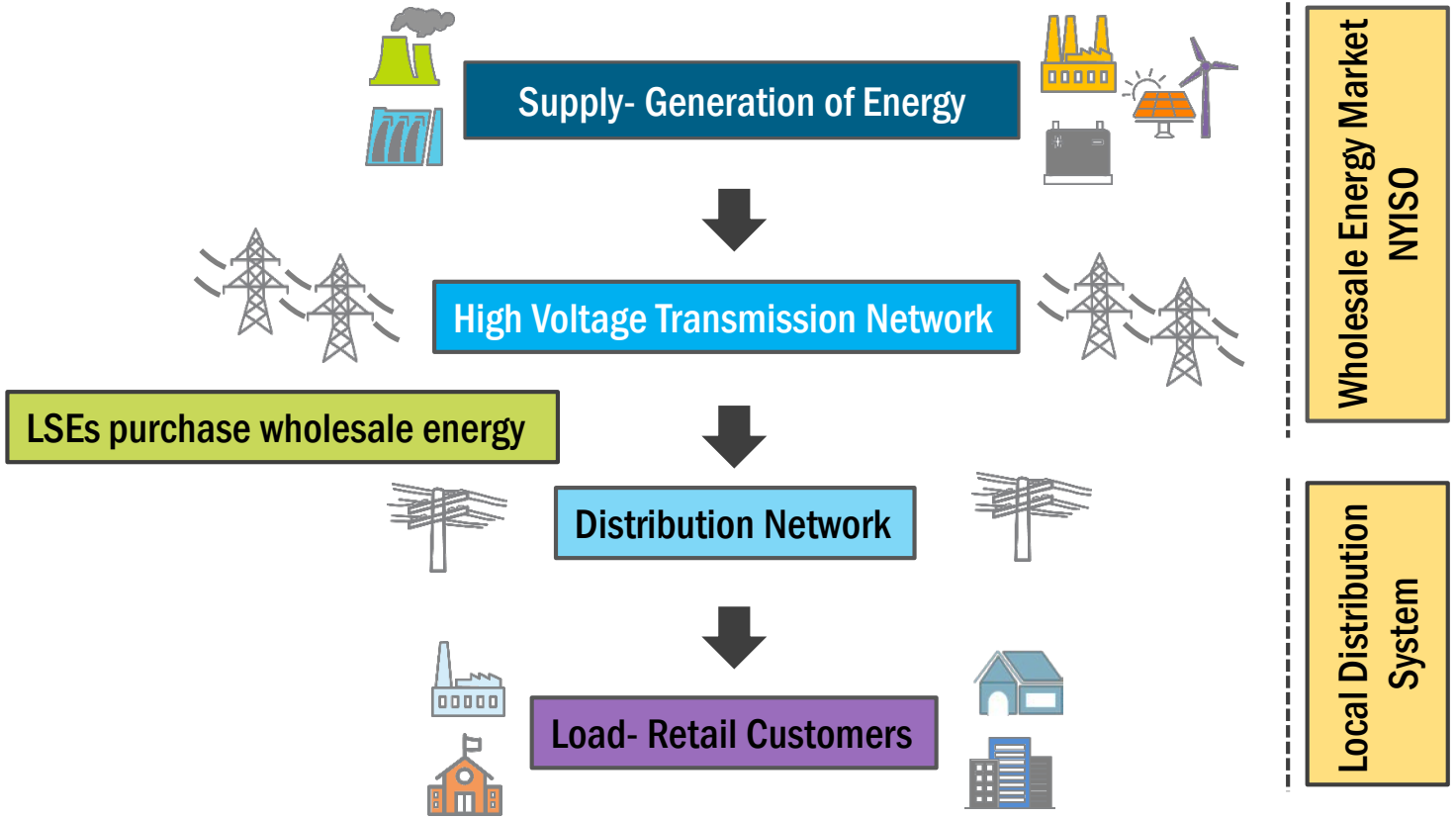
- At the end of this session attendees will be able to:
  - Recognize the difference between Bulk Power Transmission vs. Distribution Systems
  - Identify the New York Control Area (NYCA) Power System
  - Identify Physical Components of NYCA Power System
  - Explain the Purpose behind Operational Ancillary Services

Bulk Power Transmission vs. Distribution vs. Retail Load

New York ISO
Independent System Operator

- 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

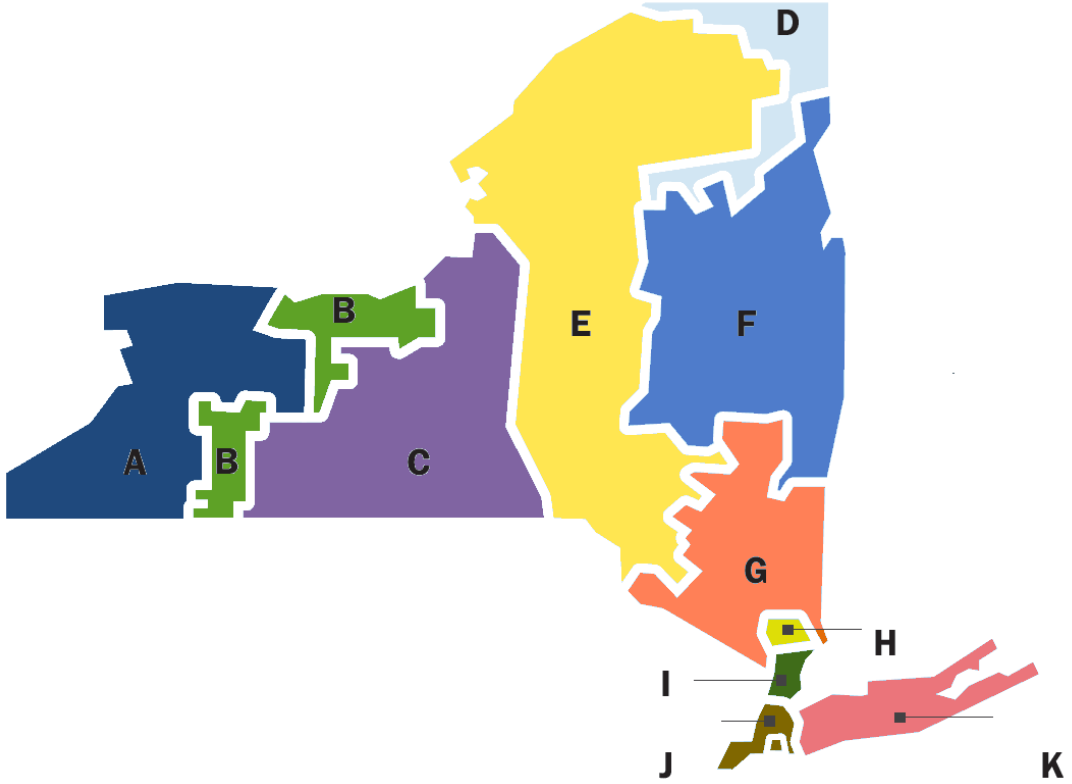
NYCA Power System

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

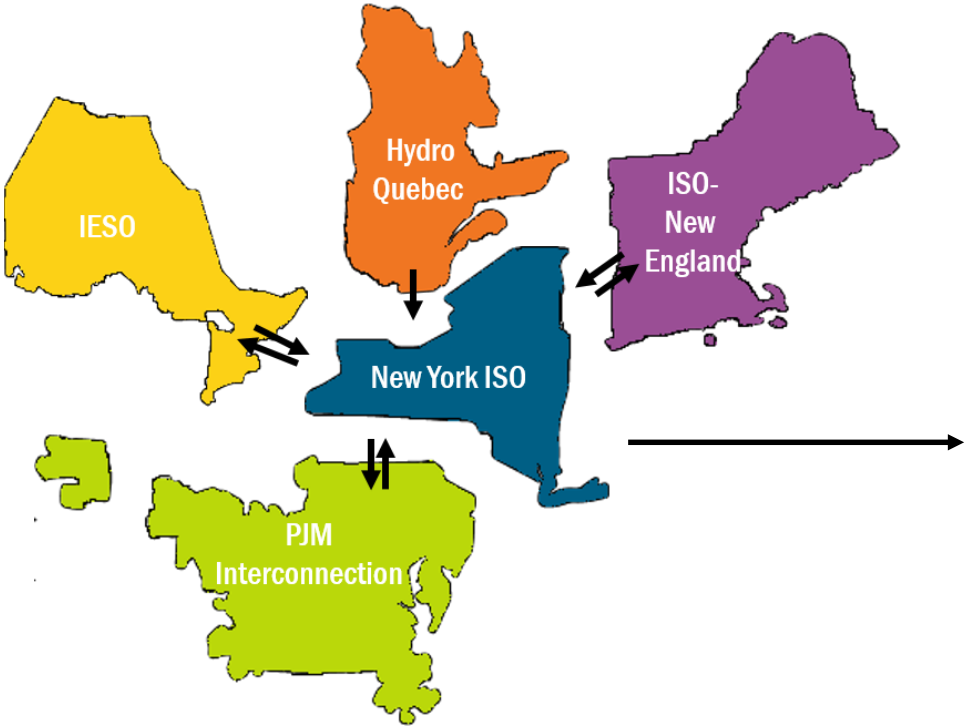
New York Control Area Load Zones

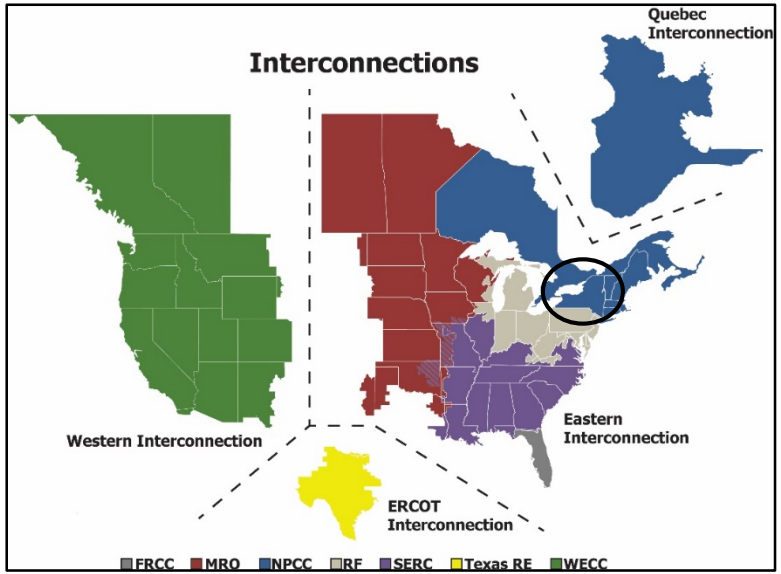
<u>NY Load Zones</u>

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



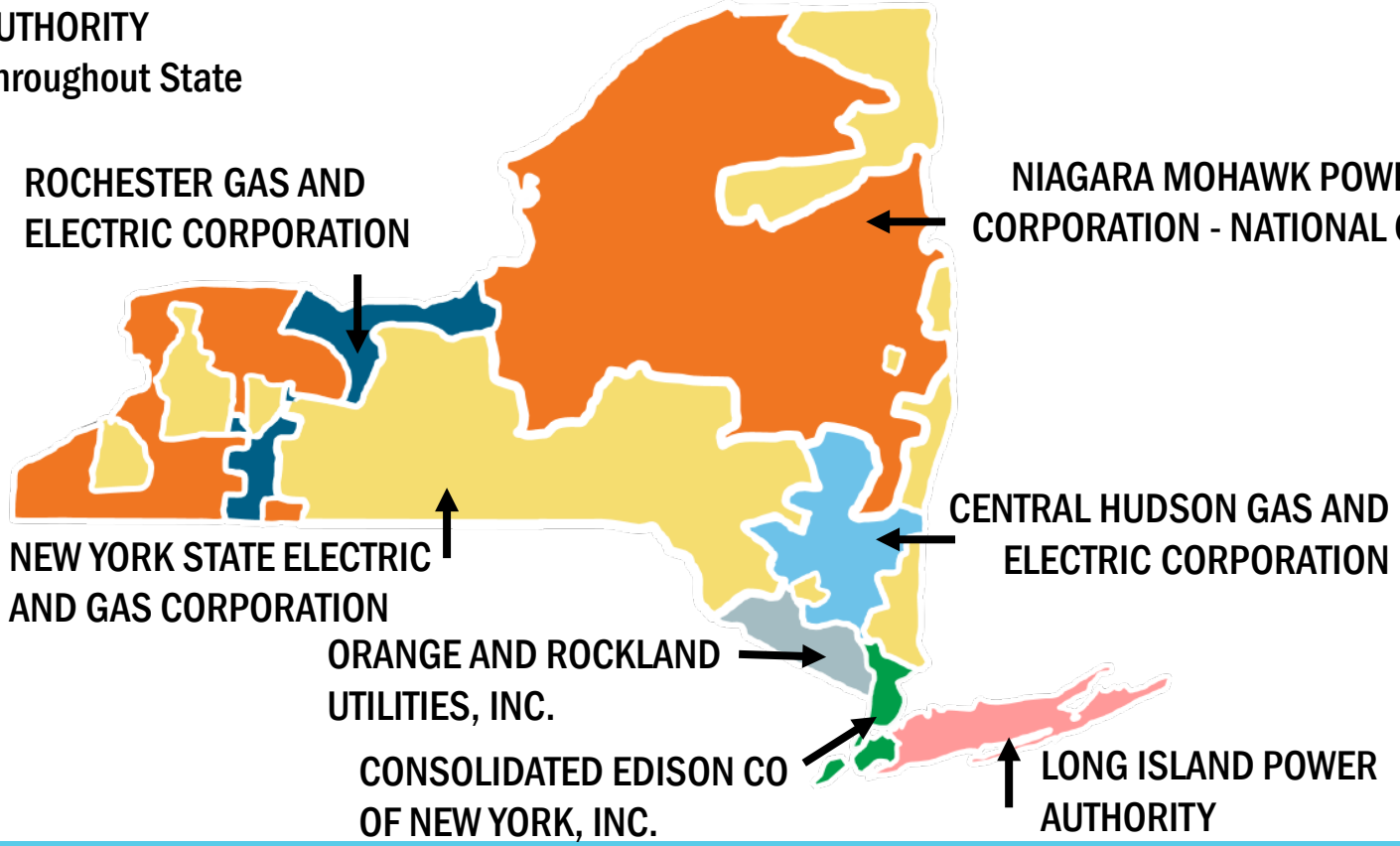
Neighboring Control Areas





NYCA Transmission Owners

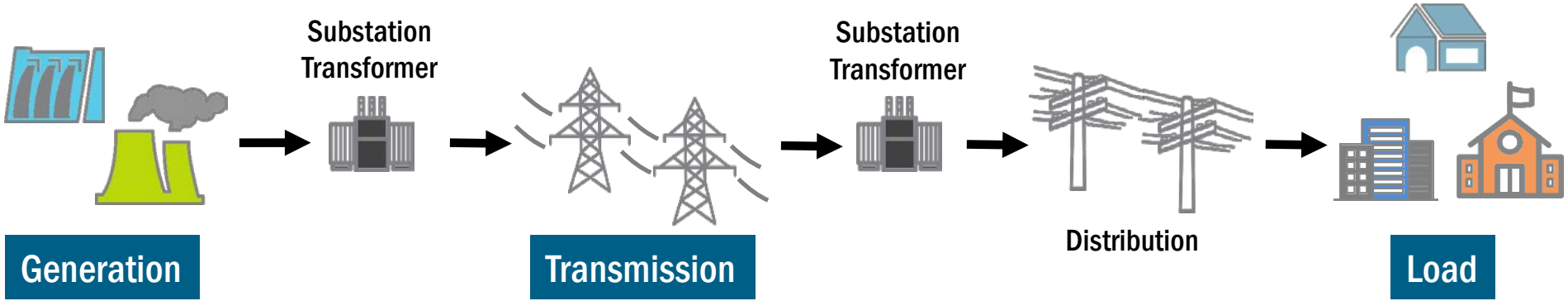
NEW YORK POWER AUTHORITY
Transmission Lines Throughout State



Physical Components of the NYCA Power System

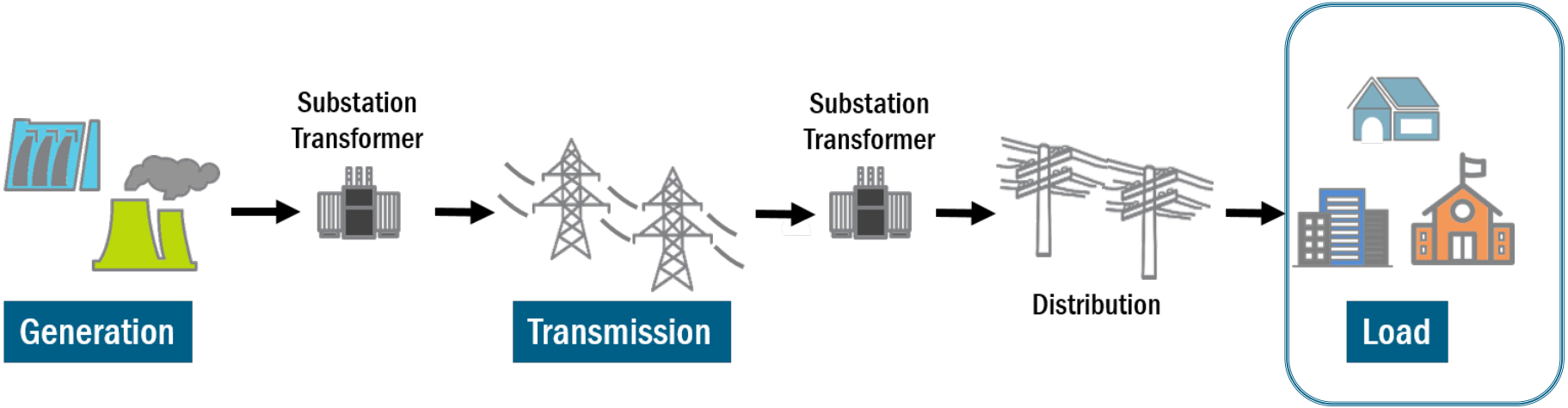
Physical Components of NYCA Power System

- Load
- Generation
- Transmission

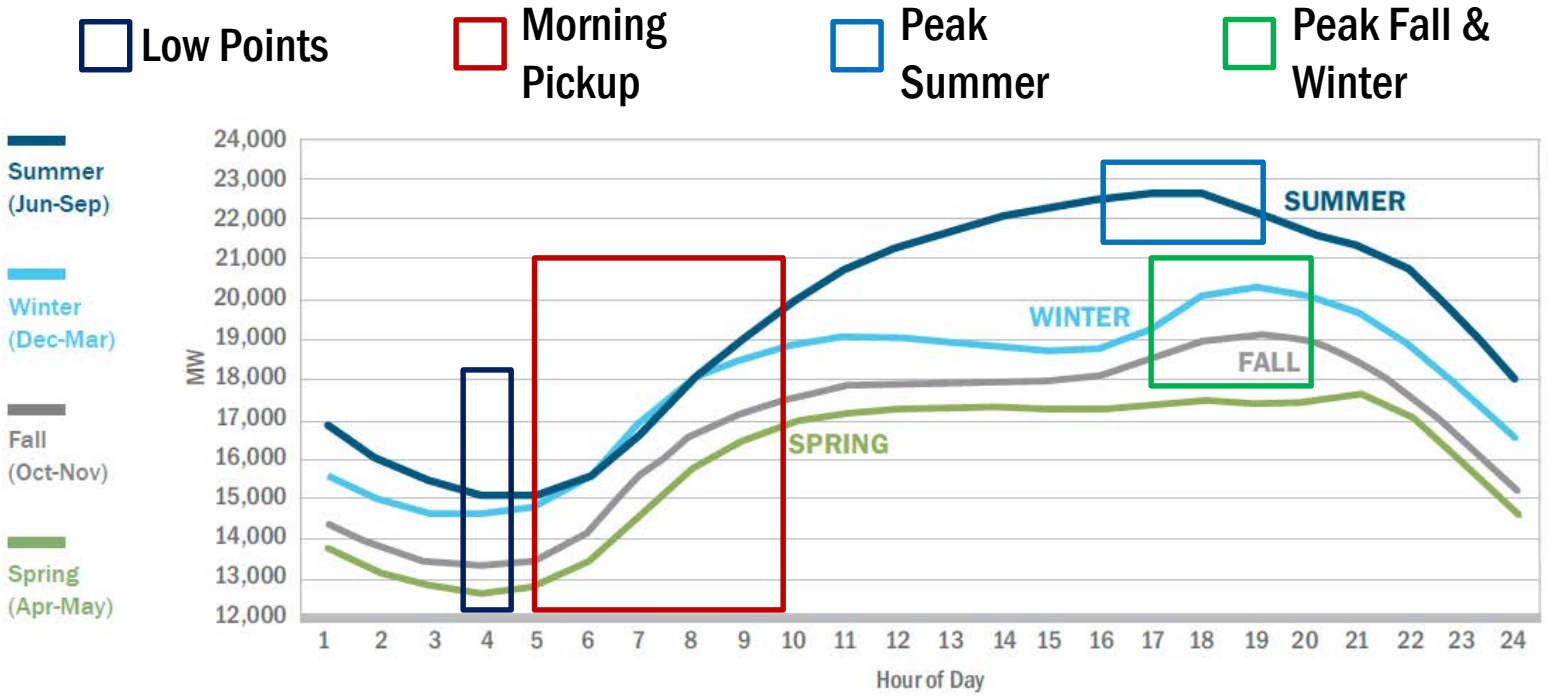


Load

- Power Consumed off of NYCA Grid

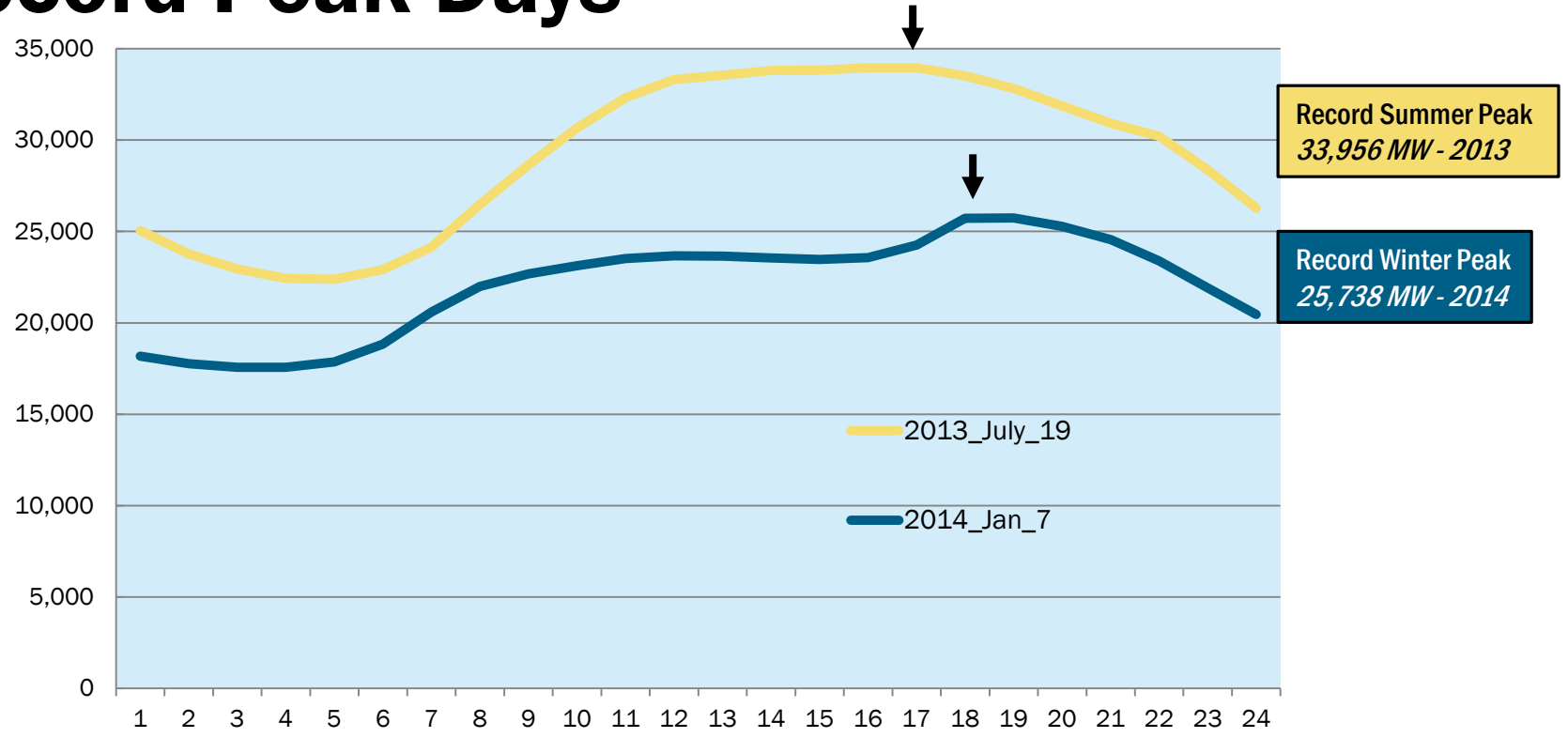


Illustrative NYCA Load Profile – Seasonal and Hourly



***Seasonal Hourly Demand Patterns, Power Trends 2017

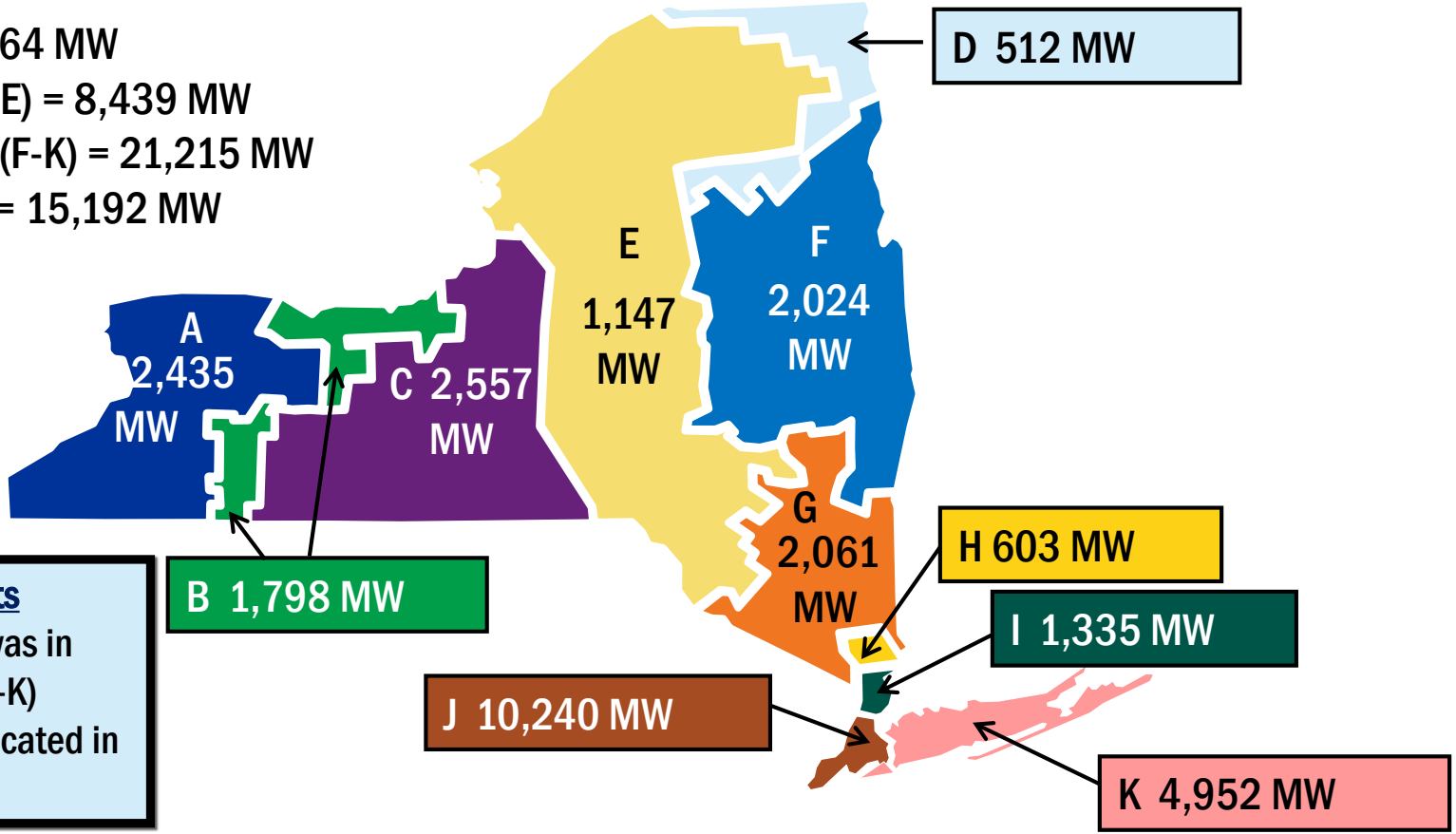
NYCA Load Profile – Historical Record Peak Days



NYCA Load by Zone July 19, 2017 HB 18:00

New York ISO
Independent System Operator

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

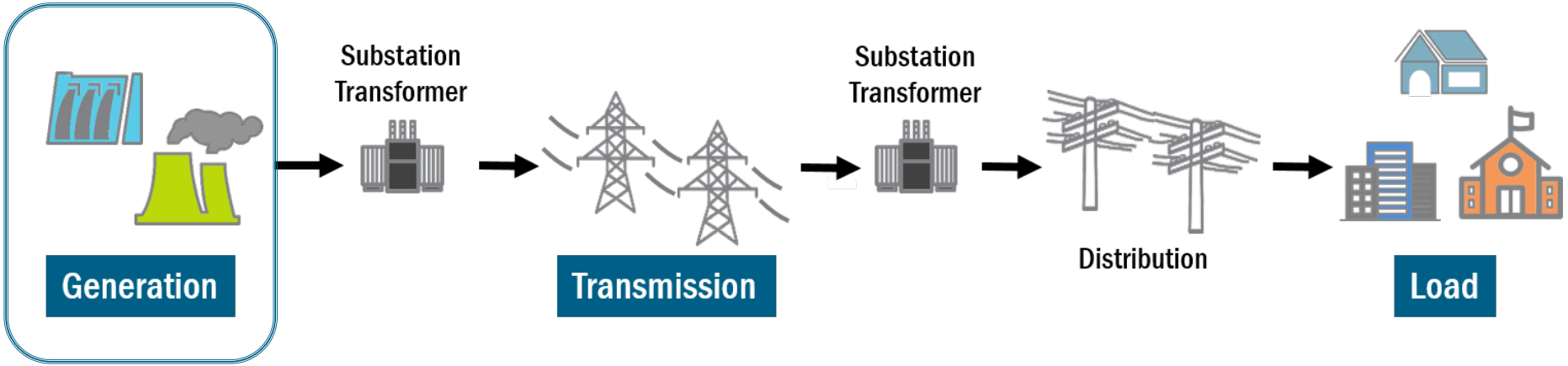


Important Facts

- 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

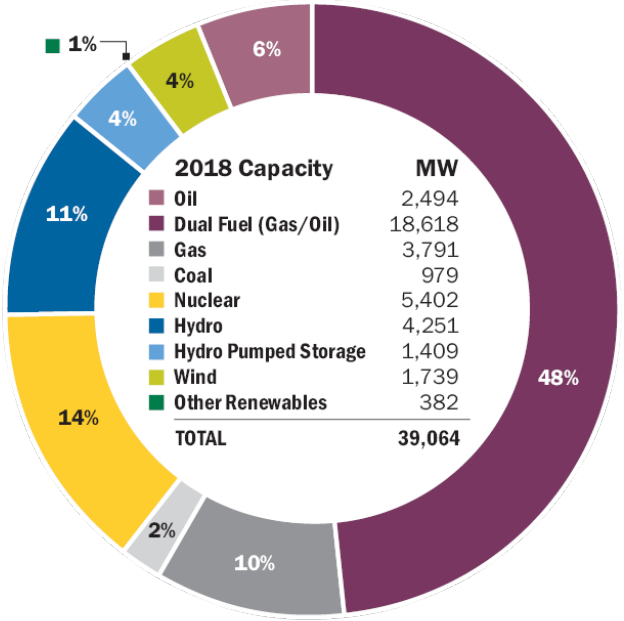


Capacity vs. Energy

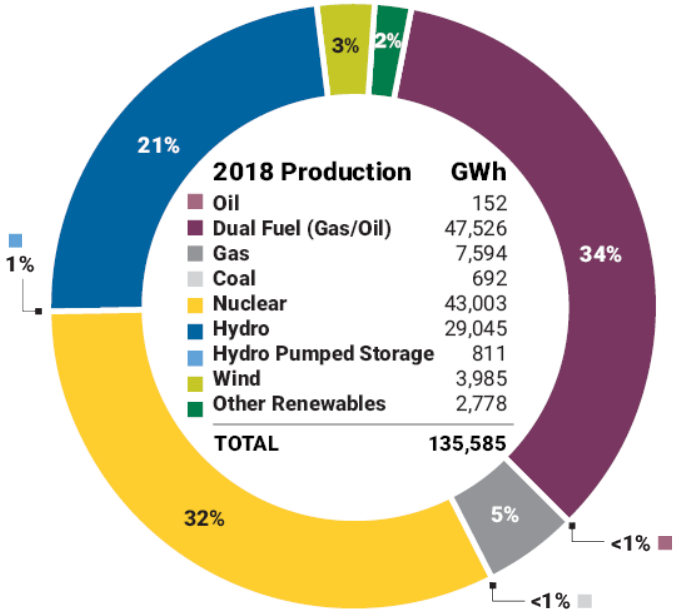
- Two very different commodities
- Capacity – *measured in MW*
  - Refers to the electric power output for which a generating system, plant, or unit is rated
- Energy – *measured in MWh*
  - Is the amount of energy produced (from capacity) over time

Generating Capacity vs. Energy

New York Statewide Capacity by Fuel Source: 2018



New York Statewide Energy Production by Fuel Source: 2018



*If Nuclear ran at full capacity for a year: 5402 MW x 24 hrs x 365 days = 47,321 GWh Produced

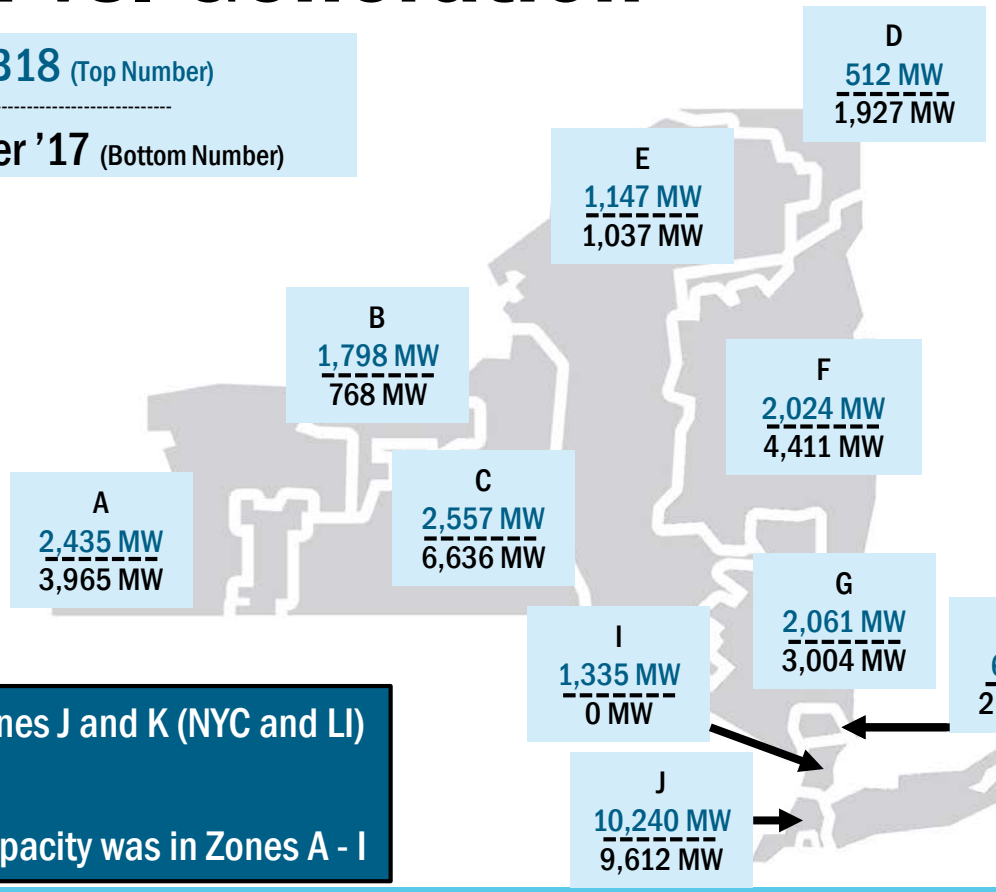
Source: 2018 and 2019 Power Trends Report – New York Independent System Operator

NYCA Load vs. Generation

LOAD 7/19/17 HB18 (Top Number)

GEN CAPACITY Summer '17 (Bottom Number)

Representative day



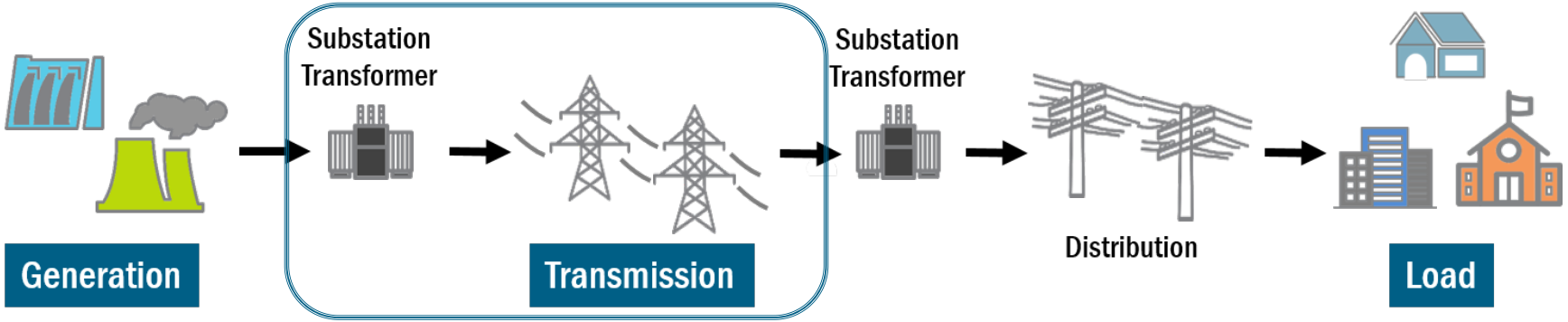
A- West
B- Genesee
C- Central
D- North
E- Mohawk Valley
F- Capital
G- Hudson Valley
H- Millwood
I- Dunwoodie
J- NYC
K- Long Island

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

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

Transmission

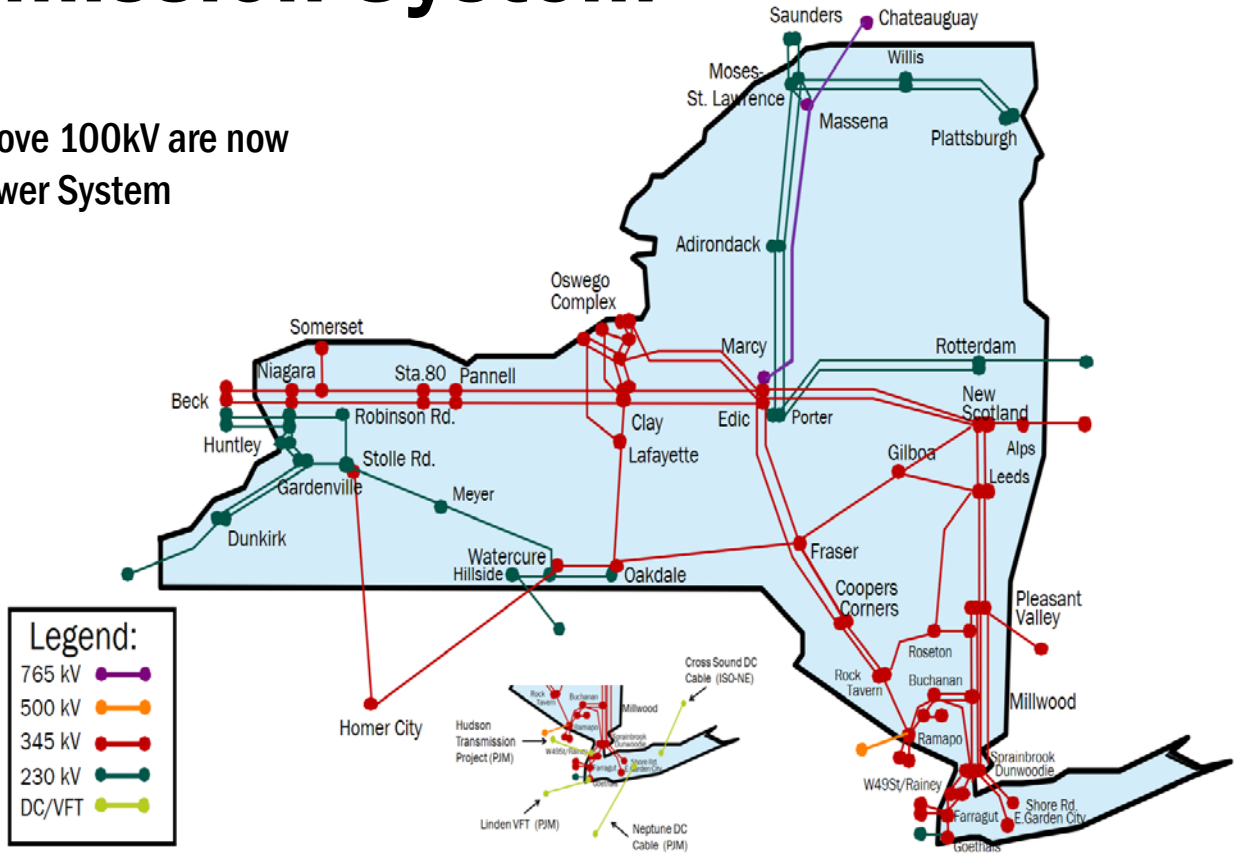
- Bulk transfer of electrical energy



NYCA Transmission System

Bulk Transmission

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

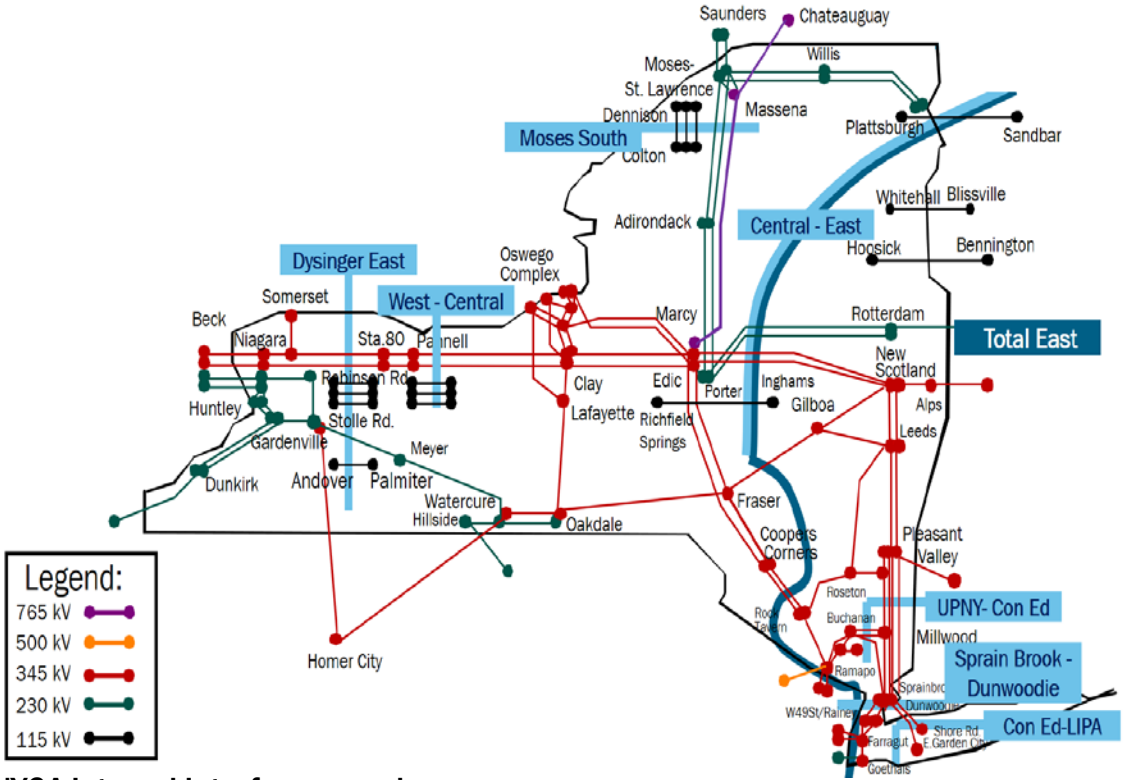


Transmission Interfaces

- 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

New York ISO
Independent System Operator

- Transfer limits create constraints on the flow of energy
- Types of Transfer Limits
  - Thermal Limits – Summer and Winter Ratings
  - Voltage Limits – Varies on equipment in-service
  - Stability Limits – Varies on lines in-service or load on selected lines

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
  - Regulation & Frequency Control
  - Black Start Service
  - Operating Reserves

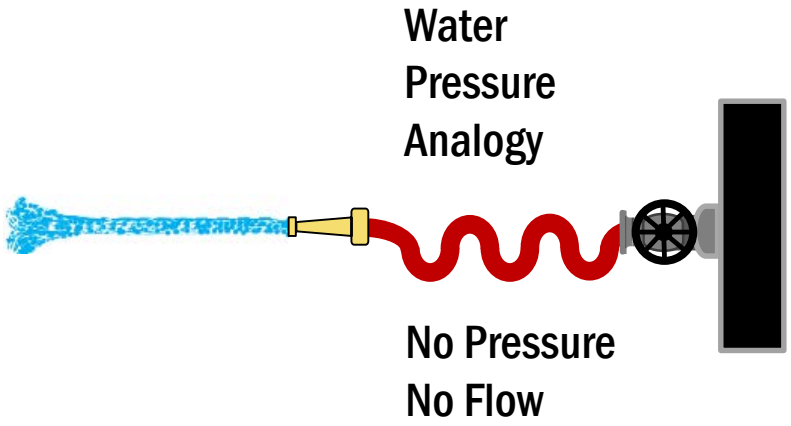
Voltage Support Service

- 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

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

↓ Water Pressure → ↓ Water flow

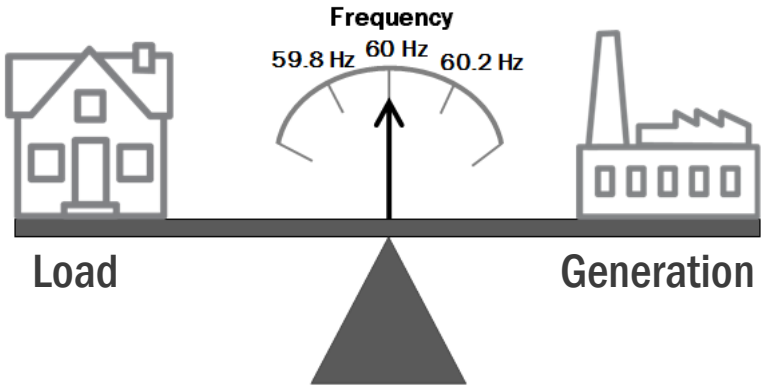
↓ Voltage → ↓ Electrical current flow



Regulation and Frequency Control

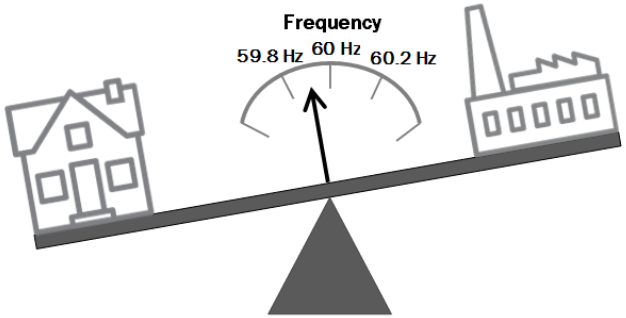
- Regulation and Frequency Control is needed to:

  Instantaneously Balance Load and Generation throughout the Eastern interconnection to sustain 60 Hz Frequency

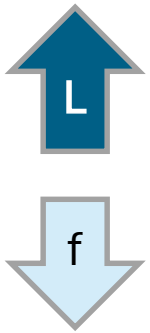


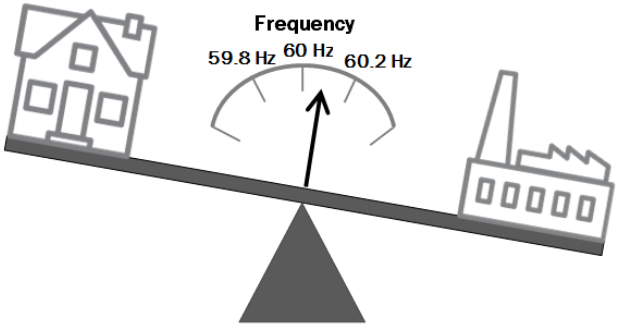
Regulation and Frequency Control

- System Frequency Changes

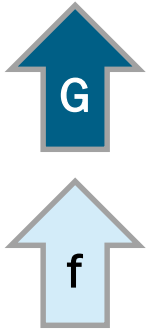


Load Increases without Generation Increase





Generation Increases without Load Increase

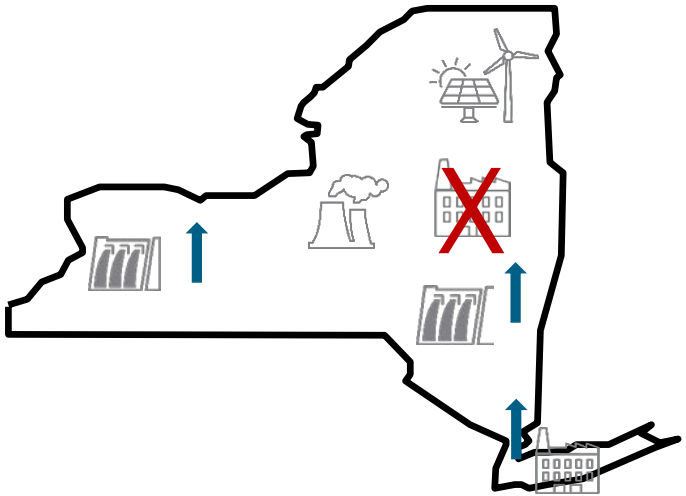


Operating Reserves

- 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)
  - NYISO Procures 2 x Largest Single Contingency each Market Day
    - Regional/Locational Requirements
    - Time/Product Type Requirements

Operating Reserves

- Operating Reserves come into play when there is a system contingency such as a large and sudden loss of generation



Black Start Service

- Generators capable of starting without an outside electric supply, following a system-wide blackout

  - 9 Nov 1965
  - 13 July 1977
  - 14 August 2003

Summary

- Power Systems 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

New York ISO
Independent System Operator

NYISO Energy Marketplace

Gina E. Craan
Manager, Market Training, NYISO

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Energy Marketplace Objectives

- Explain the function and features of the NYISO Energy Market
- Distinguish between the Day Ahead and Real Time Markets and associated settlements
- Develop an understanding of the Energy Market Process including
  - Load Bids and Supply Offers
  - Commitment and Dispatch of Resources
  - Market Timeline

Market Features and Two Settlement System

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 generator schedules
  - Produces prices for settlement mechanism

Day Ahead vs. Real Time Market Two Settlement System

- **Day Ahead Market**
  - Buy and Sell Energy the day prior to actual consumption or production
  - DAM Settlement based upon Schedules
  - Financially Binding
- **Real Time Market**
  - Buy and Sell the difference during the consumption day
  - Real Time Market Balances DAM Schedule to Actual Usage
  - Balancing Market

Day Ahead vs. Real Time Market
Two Settlement System – Example

Customer Type	DAM MWh	DAM LBMP $/MWh	*DAM LBMP Settlement*
Power Supplier	75 MWh	$50	$3,750
Load Serving Entity (LSE)	- 25 MWh	$50	- $1,250

Day Ahead vs. Real Time Market
Two Settlement System – Example cont'd

Customer Type	RT MWh	Balancing MW *(RT-DAM)*	RT LBMP $/MWh	RT LBMP Settlement
Power Supplier	85 MWh	*(85 -75)* 10	$60	**$600**
Load Serving Entity (LSE)	- 30 MWh	*(- 30) - (- 25)* -5	$60	**- $300**

- Supplemental supplier payments may apply if RT schedule is adjusted at the direction of NYISO

Day Ahead vs. Real Time Market
Two Settlement System – Example cont'd

Customer Type	DAM LBMP Settlement	RT LBMP Settlement	Total Settlement $ (DAM$ + RT$)
Power Supplier	$3,750	$600	$4,350
Load Serving Entity (LSE)	- $1,250	- $300	- $1,550

Load Forecasting and Bidding

Energy Market Process

- **Load Forecasting**
  - NYISO Load Forecast
  - LSE Load Forecast

- **Load Purchasing / Bidding**

Energy Market Process

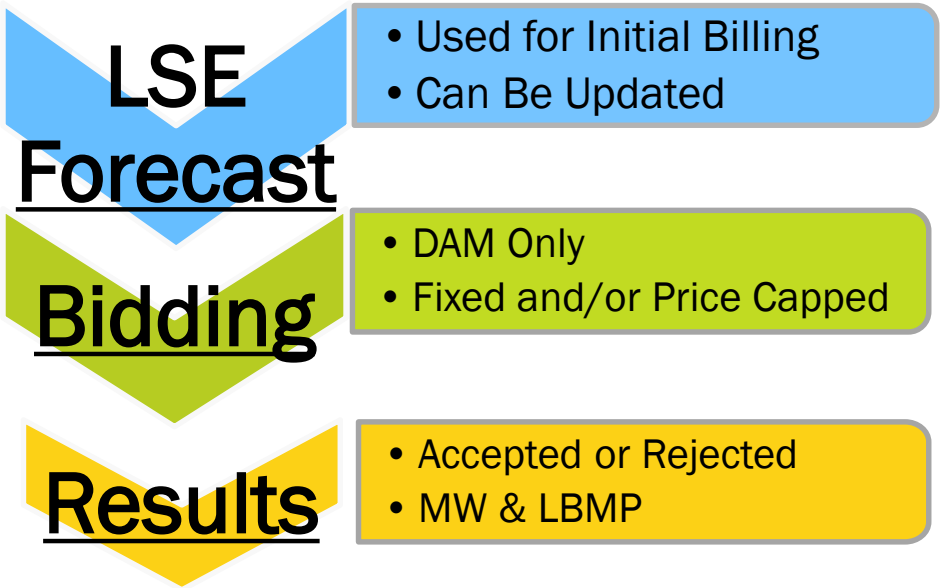
- **Load Forecasting**
  - NYISO's Load Forecast is used for scheduling resources / reliability needs
    - Historical Data
    - Weather
    - TO Forecast Submittals
    - Zonal basis, then summed
  - LSE Load Forecast used for initial billing purposes
    - LSEs submit estimated consumption to NYISO

Energy Market Process

- **Load 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
  - Real Time Energy Purchase
    - Done automatically by NYISO
    - Pay RT Price

Energy Market Process

- Load Bidding Summarized



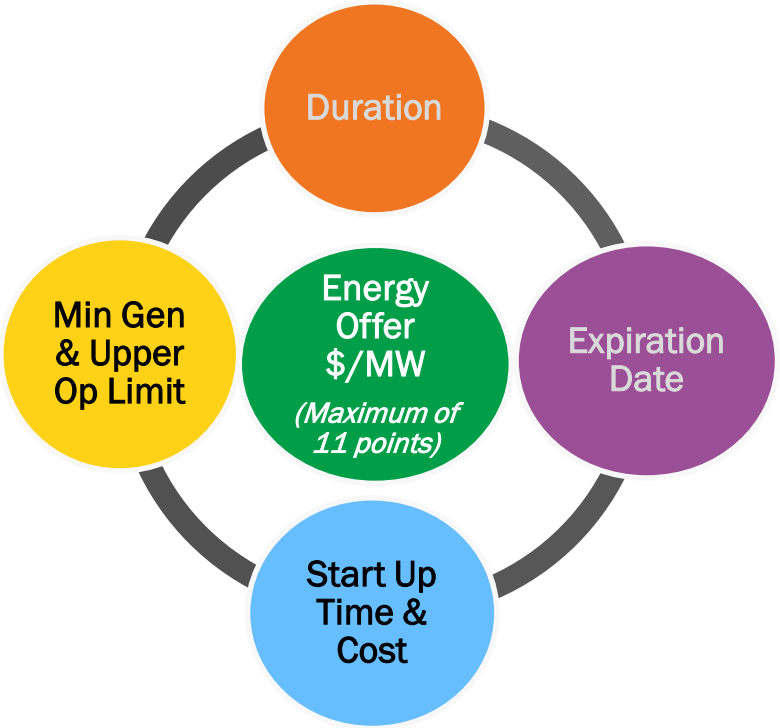
Supply Offers and Parameters

Energy Market Process

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

Energy Market Process

- Supply Offers – Some Unit Parameters



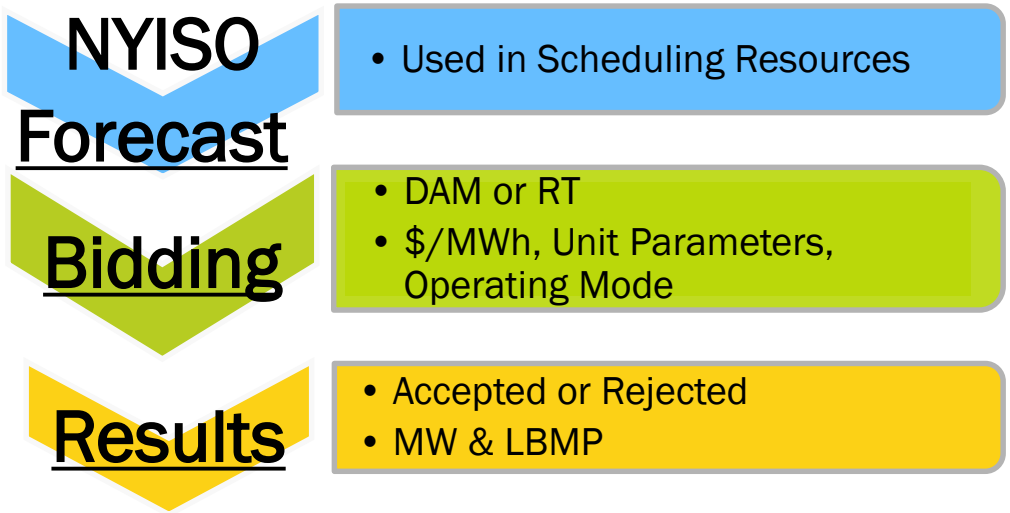
Energy Market Process:
Supply Offers – Unit Operating Modes

Economics	MWs
– ISO Committed • Economically Selected – Self Committed • Price Taker	– Fixed • Fixed Output/Operating Levels • No Change to in-hour Schedule – Flexible • Flexible Output • Following NYISO Base Point Fluctuation

- ISO Committed Flex
- Self Committed Flex
- Self Committed Fixed
- ISO Committed Fixed

Energy Market Process

- Supply Offer Process Summarized



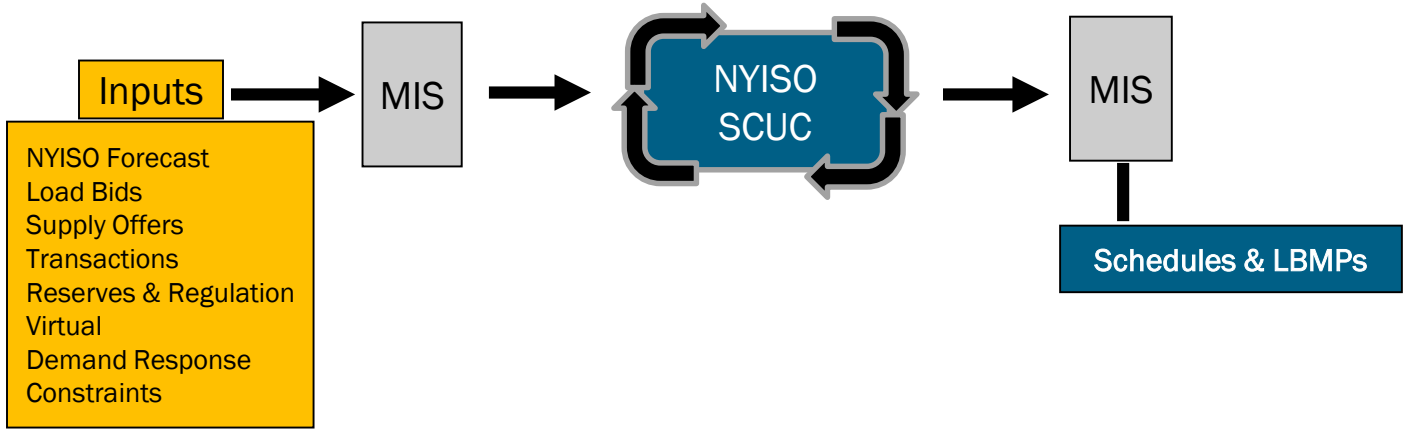
Commitment, Dispatch and Market Timelines

Energy Market Process

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

Energy Market Process - DAM

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

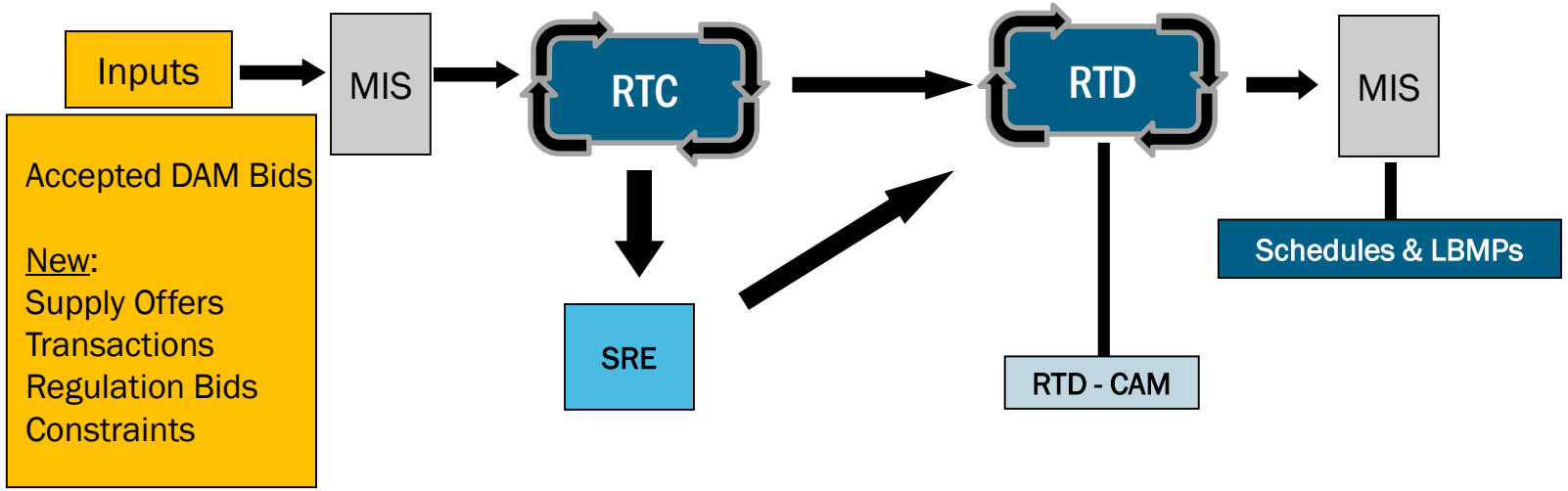


Energy Market Process – Real Time

- **Commitment and Dispatch**
  - RT Market uses
    - Real Time Commitment (RTC)
      - Hour Ahead Market (HAM)
      - Commitments
      - Advisory Scheduling and Prices
    - Supplemental Resource Evaluation (SRE)
      - Additional Resource Committal
    - Real Time Dispatch (RTD)
      - Corrective Action Mode
      - Dispatches Units in RT
      - Real Time LBMP

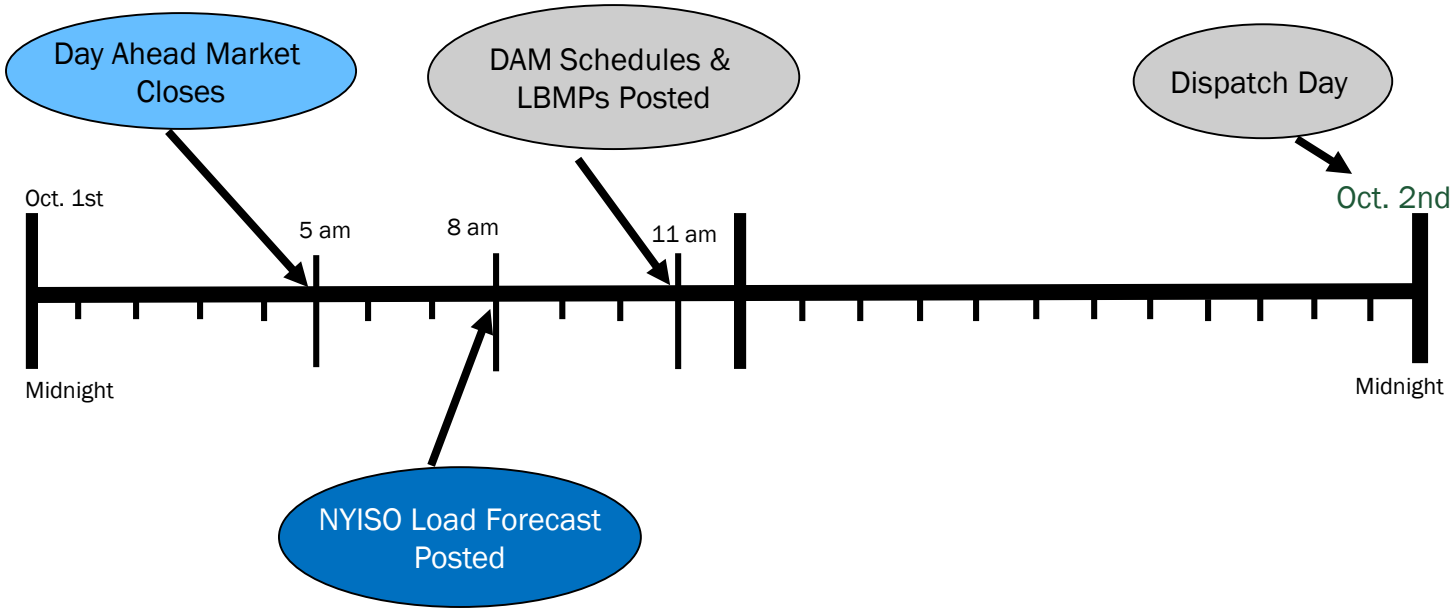
Energy Market Process – Real Time

- **Real Time Commitment and Real Time Dispatch**
  - Includes Supplemental Resource Evaluation (SRE) and RTD Corrective Action Mode (RTD CAM)



Energy Market Process
DAM Time Line

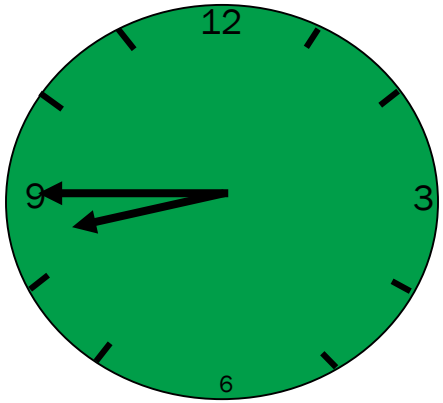
One Day before Dispatch Day



Energy Market Process
RT Market Time Line

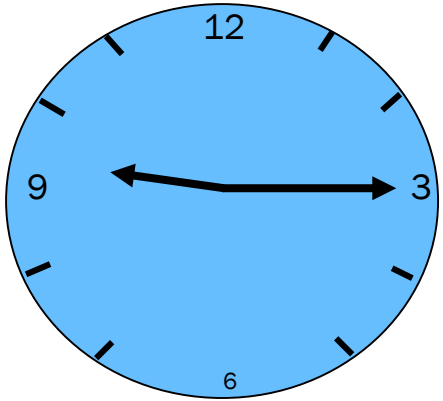
Operating Day – Oct. 2nd HB 10

8:45 AM



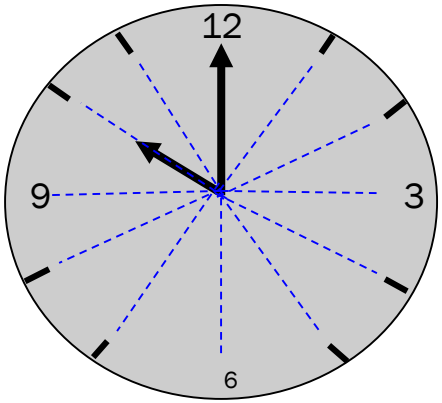
RT Bidding Closes
(75 minutes prior to operating hour)

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

New York ISO
Independent System Operator

Locational Based Marginal Pricing

Mathangi Srinivasan Kumar

Senior Market Trainer, Market Training, NYISO

Market Overview Webinar

June 23, 2020

Remote Learning

Locational Based Marginal Pricing

- Attendees will be able to
  - Explain the Basics Behind LBMP
  - Complete Simple LBMP Examples
  - Identify the Impacts of Congestion

LBMP – The Basics

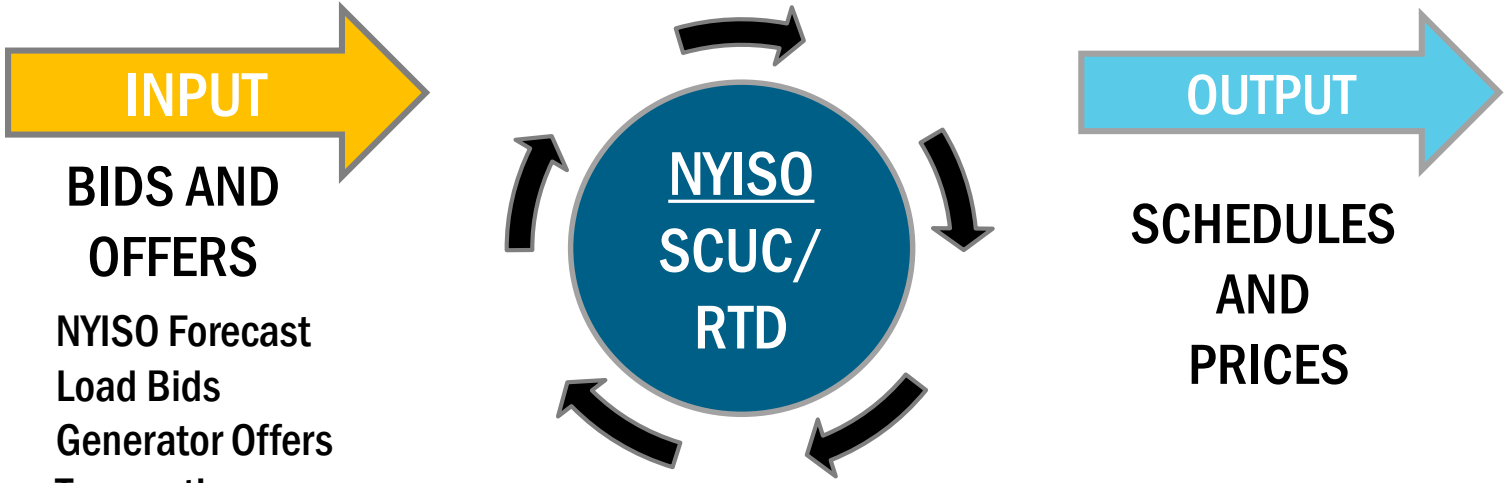
- LBMP is

  Cost to provide the Next MW of 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
    - Security Constrained Unit Commitment (SCUC)
    - Hourly Prices
  - Real Time Market
    - Real Time Dispatch (RTD)
    - 5 Minute Interval Prices

LBMP: Co-Optimized Based on Bids and Offers

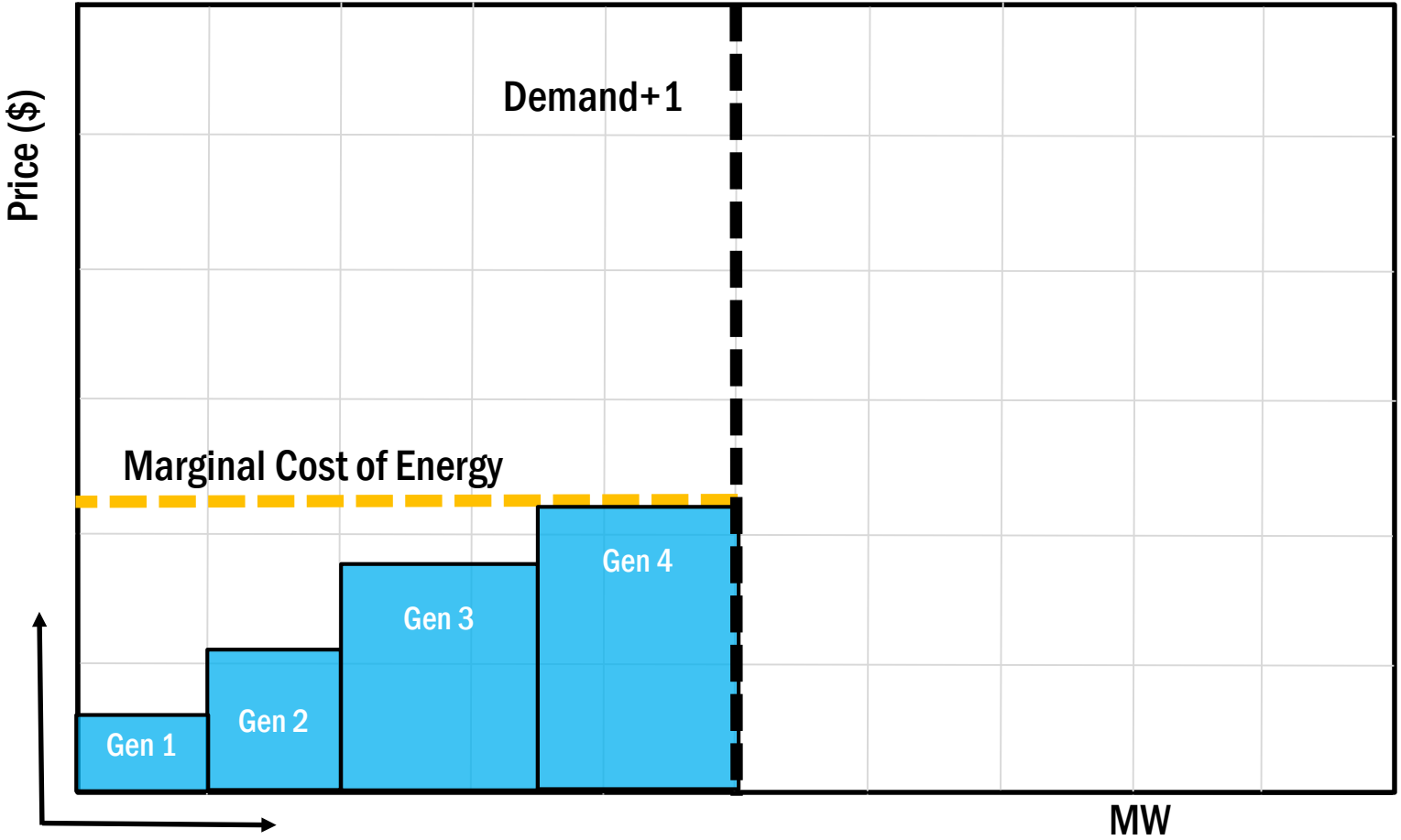


LBMP – The Basics

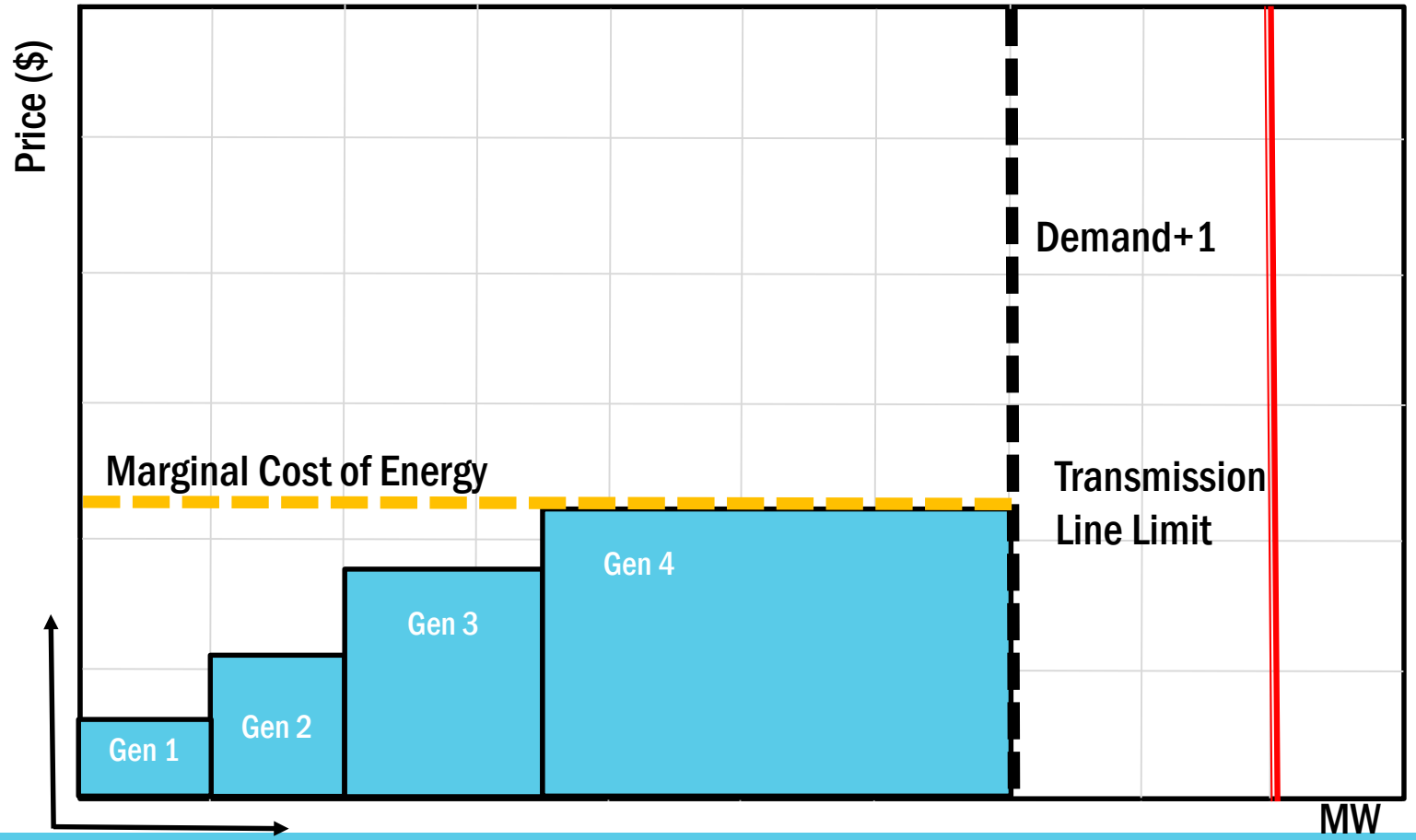
- LBMP is made up of three components:
  - Marginal Energy Price
    - Basic Component of LBMP, calculated at Marcy
  - Marginal Loss Price
    - Captures Losses along path to Load
      - Transmission Losses
  - Marginal Congestion Price
    - Costlier units Dispatched to avoid exceeding Transmission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

LBMP = Energy + Loss - Congestion

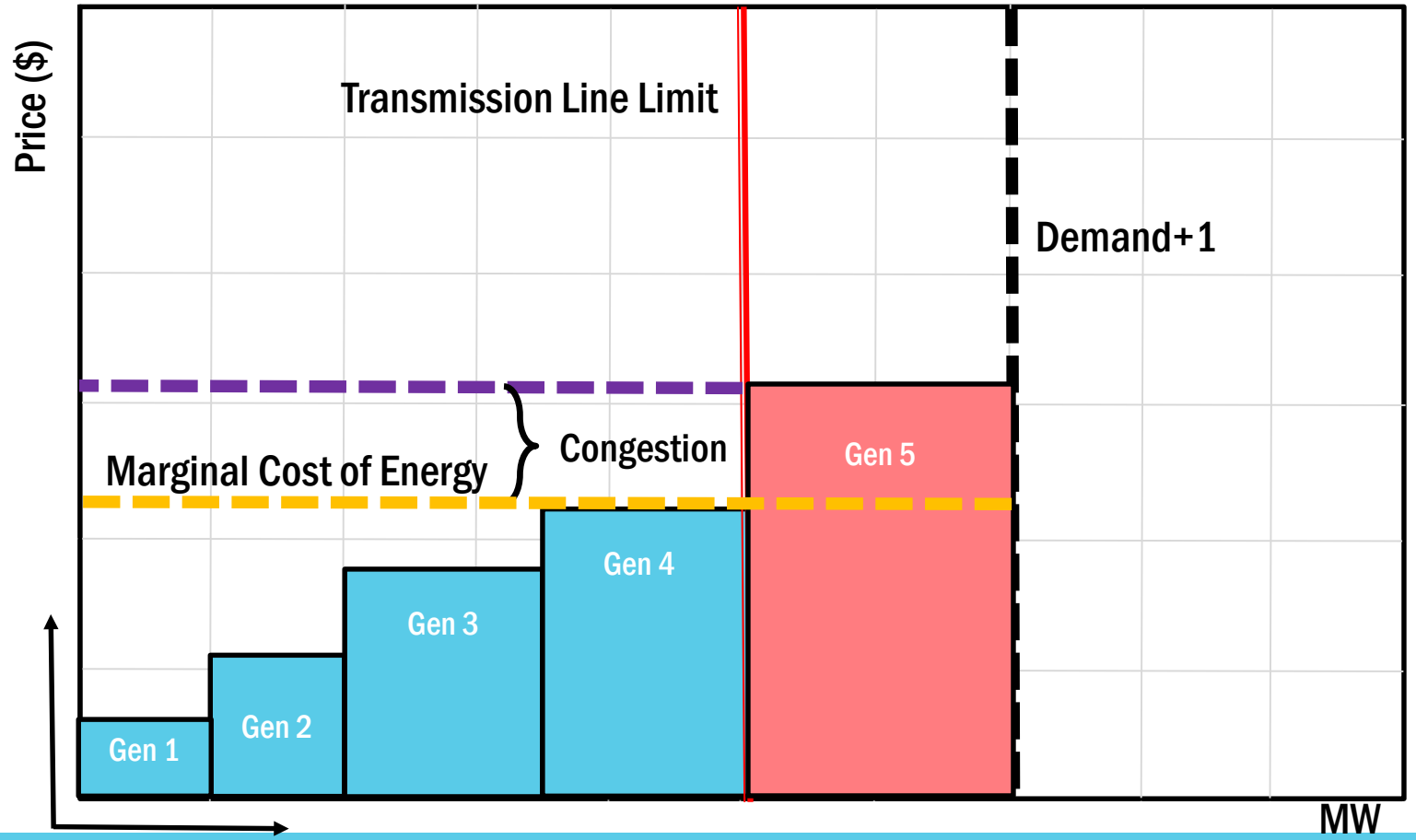
Determining the Marginal Energy Price



Determining the Marginal Congestion Price

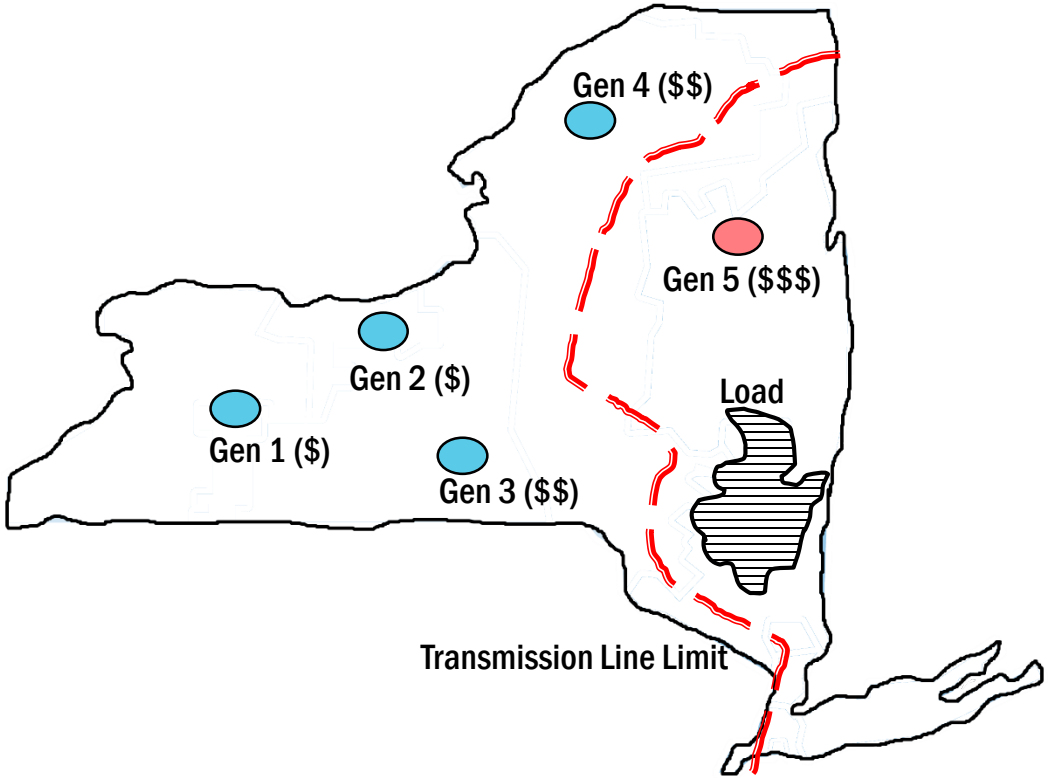


Determining the Marginal Congestion Price



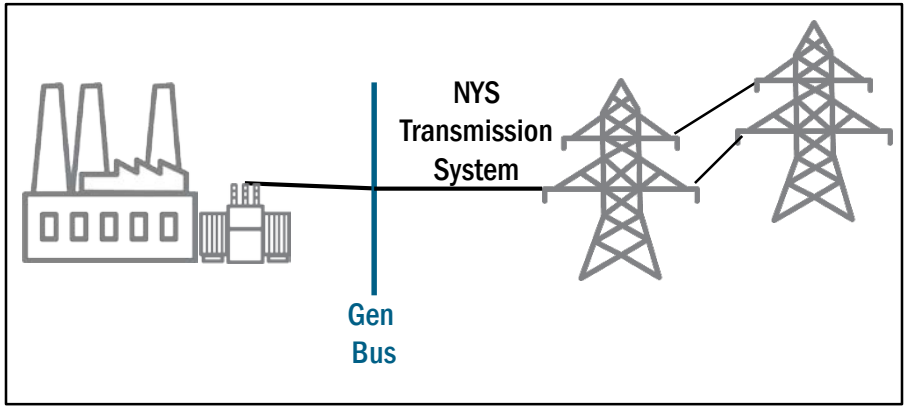
LBMP - Congestion

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



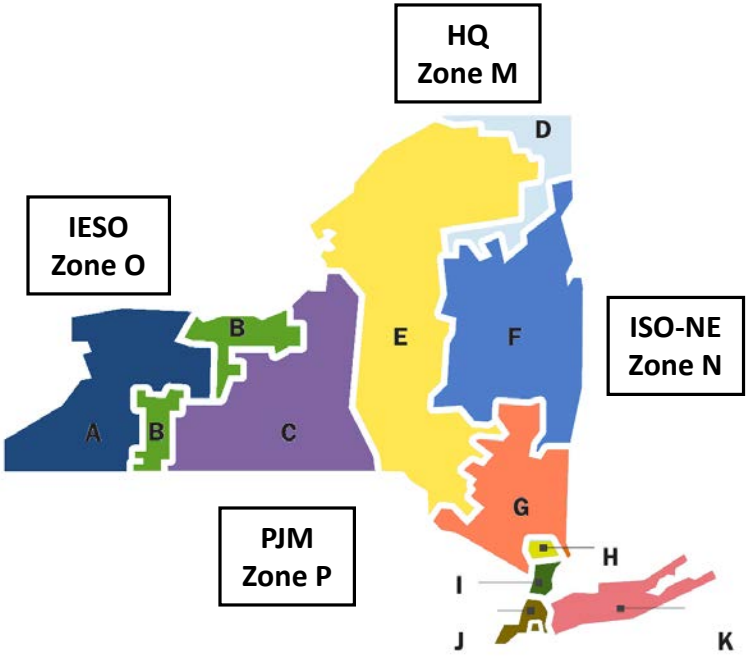
Generators – Gen Bus LBMP

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



Load Serving Entity – Zonal LBMP

- LBMP for Load
  - 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	

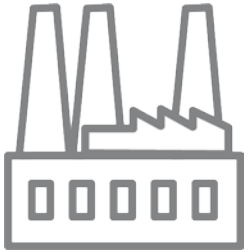
Example 1: Energy Only
No Losses and No Congestion

Total Load = 150 MW

Example 1: Energy Only

Gen '*Power Up*'
100 MW, Bid @$20/MW

Gen '*Full Steam*'
150 MW, Bid @$35/MW



Gen '*Energy*'
100 MW, Bid @$30MW

Gen '*Lights On*'
200 MW, Bid @$40/MW

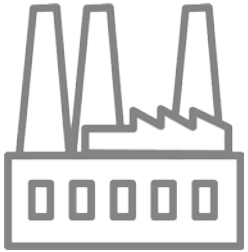
Limit
150 MW

West Zone
Load A
30 MW

Total Load
150 MW

East Zone
Load B
120 MW

Example 1: Energy Only



Gen '*Power Up*'
100 MW, Bid @$20/MW

Gen '*Full Steam*'
150 MW, Bid @$35/MW

Gen '*Energy*'
100 MW, Bid @$30MW

Gen '*Lights On*'
200 MW, Bid @$40/MW

100 MW

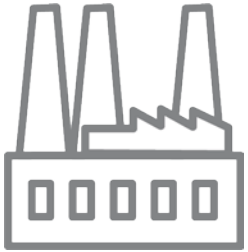
Limit
150 MW

West Zone
Load A
30 MW

Total Load
150 MW

East Zone
Load B
120 MW

Example 1: Energy Only



Gen '*Power Up*'
100 MW, Bid @$20/MW

Gen '*Full Steam*'
150 MW, Bid @$35/MW

Gen '*Energy*'
100 MW, Bid @$30MW

Gen '*Lights On*'
200 MW, Bid @$40/MW

100 MW

50 MW

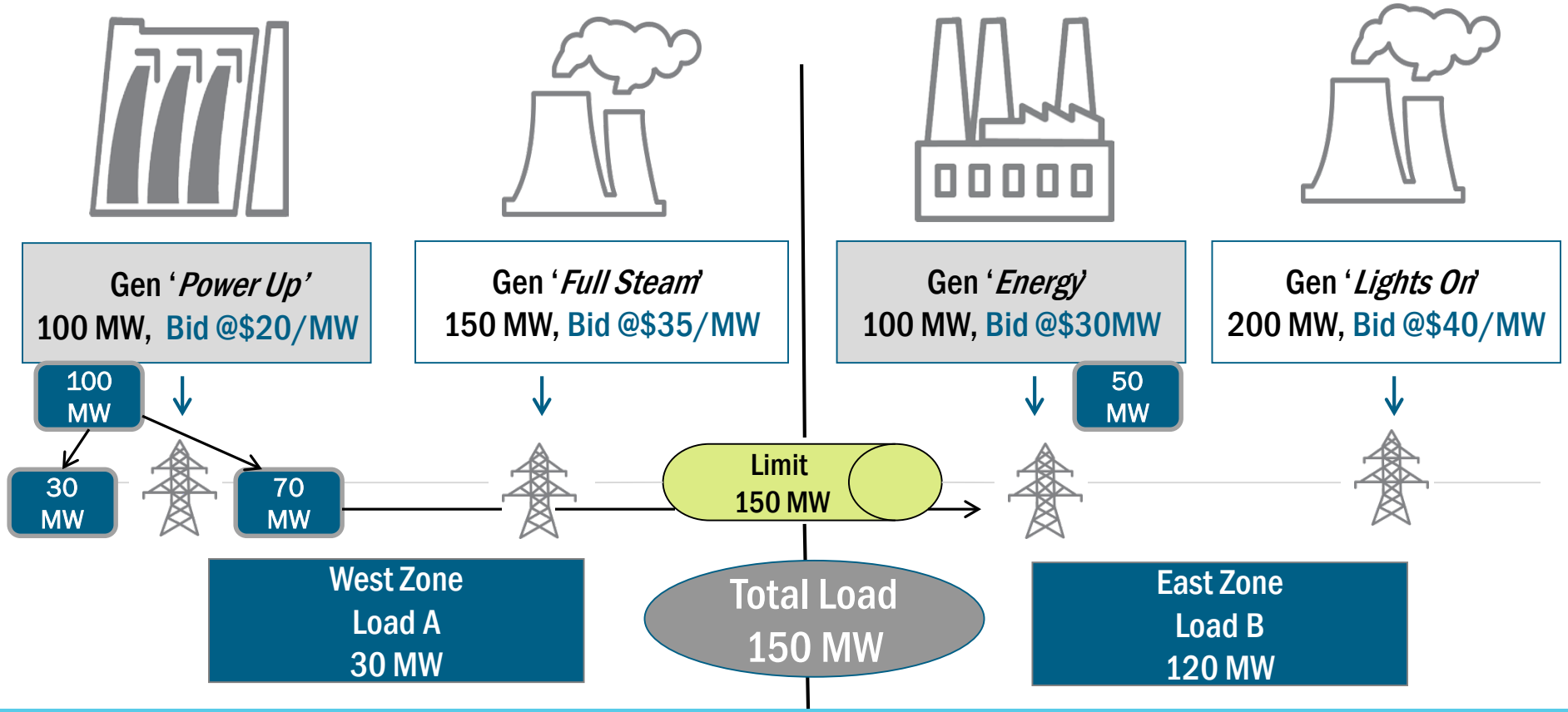
Limit
150 MW

West Zone
Load A
30 MW

Total Load
150 MW

East Zone
Load B
120 MW

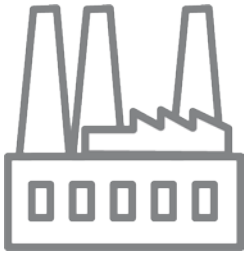
Example 1: Energy Only



Example 1: Energy Only - Results

Gen '*Power Up*'
100 MW, Bid @$20/MW

Gen '*Full Steam*'
150 MW, Bid @$35/MW



Gen '*Energy*'
100 MW, Bid @$30MW

Gen '*Lights On*'
200 MW, Bid @$40/MW

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

Limit
150 MW

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

West Zone
Load A
30 MW

Total Load
150 MW

East Zone
Load B
120 MW

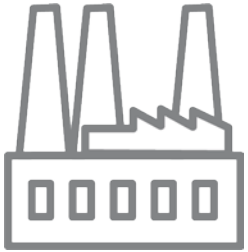
West Zone LBMP $30.00

East Zone LBMP $30.00

Example 1: Energy Only - Results

Gen '*Power Up*',100 MW
Bid $20, Paid $30

Gen '*Full Steam*' ,150 MW
Bid $35, Paid $0



Gen '*Energy*' ,100 MW
Bid $30, Paid $30

Gen '*Lights On*', 200 MW
Bid $40, Paid $0

West Zone

East Zone

Generators receive $30/MW (LBMP)

Example 1: Energy Only - Results

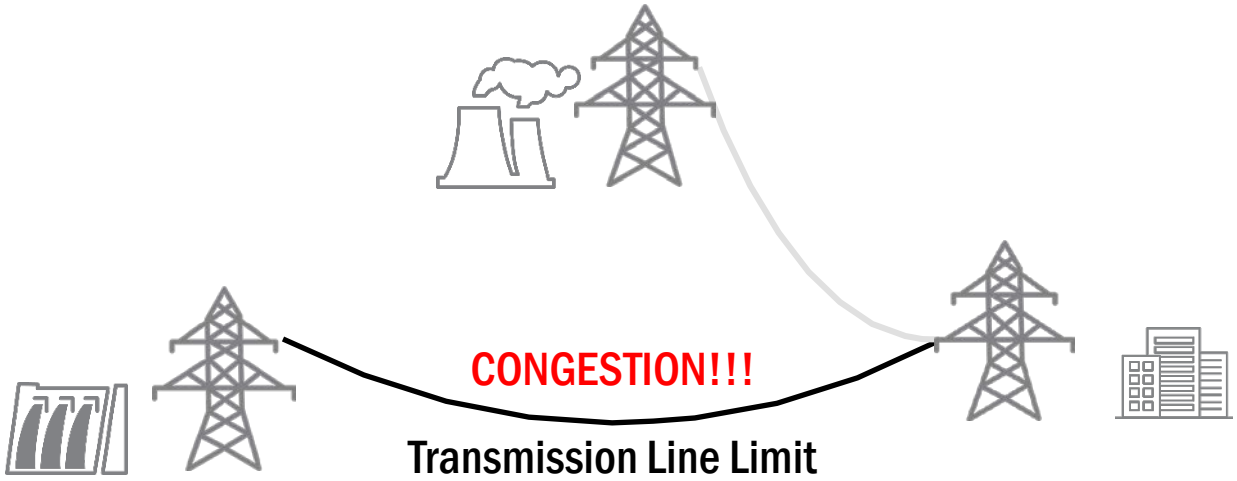
Loads Charged $30/MW (LBMP)

West Zone
Load A
30 MW

East Zone
Load B
120 MW

Congestion

Congestion occurs when the Power flow reaches the Transmission Limit



Congestion

- 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

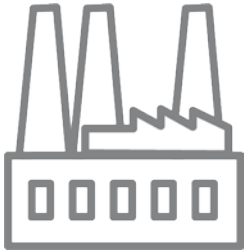
Example 2: Energy and Congestion No Losses

Total Load
400 MW

Example 2: Energy and Congestion

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

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



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

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

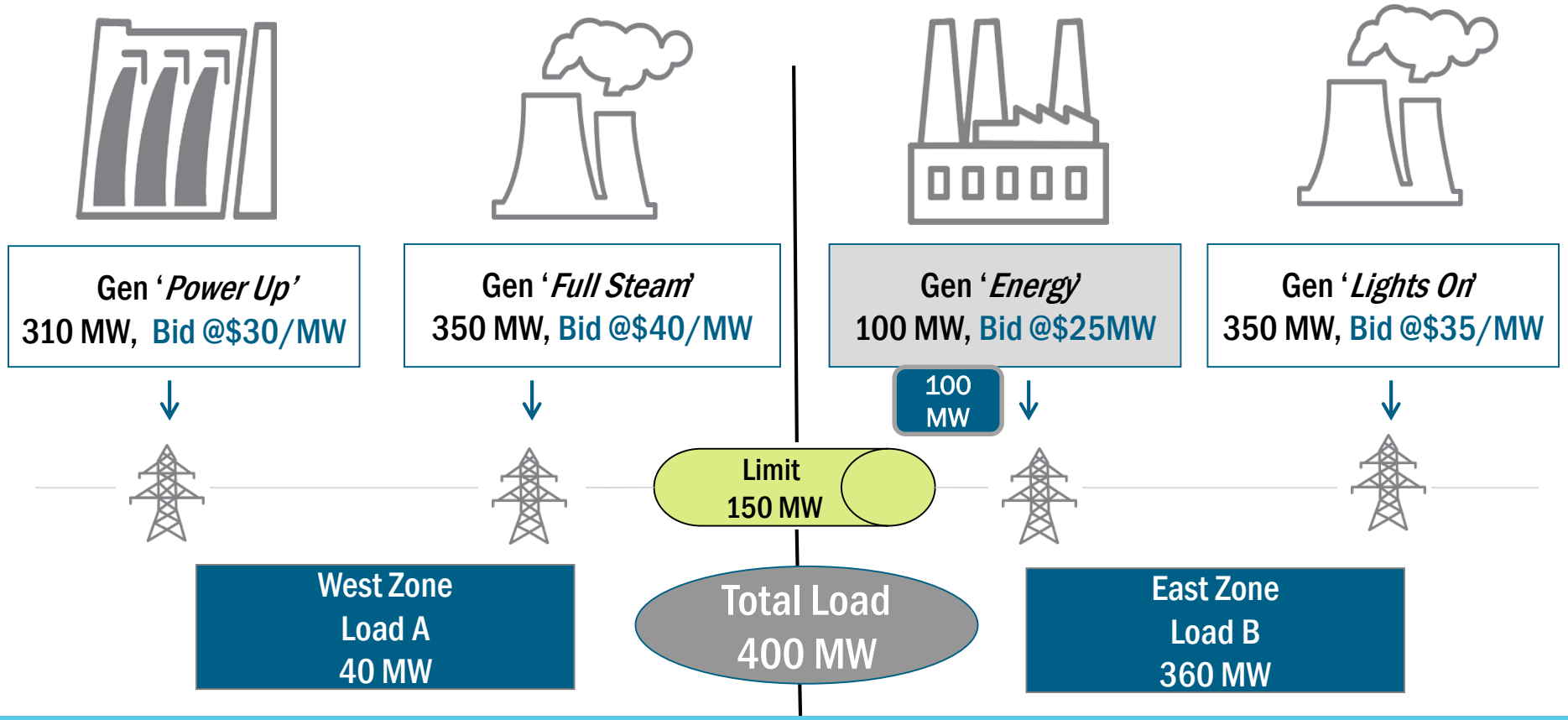
Limit
150 MW

West Zone
Load A
40 MW

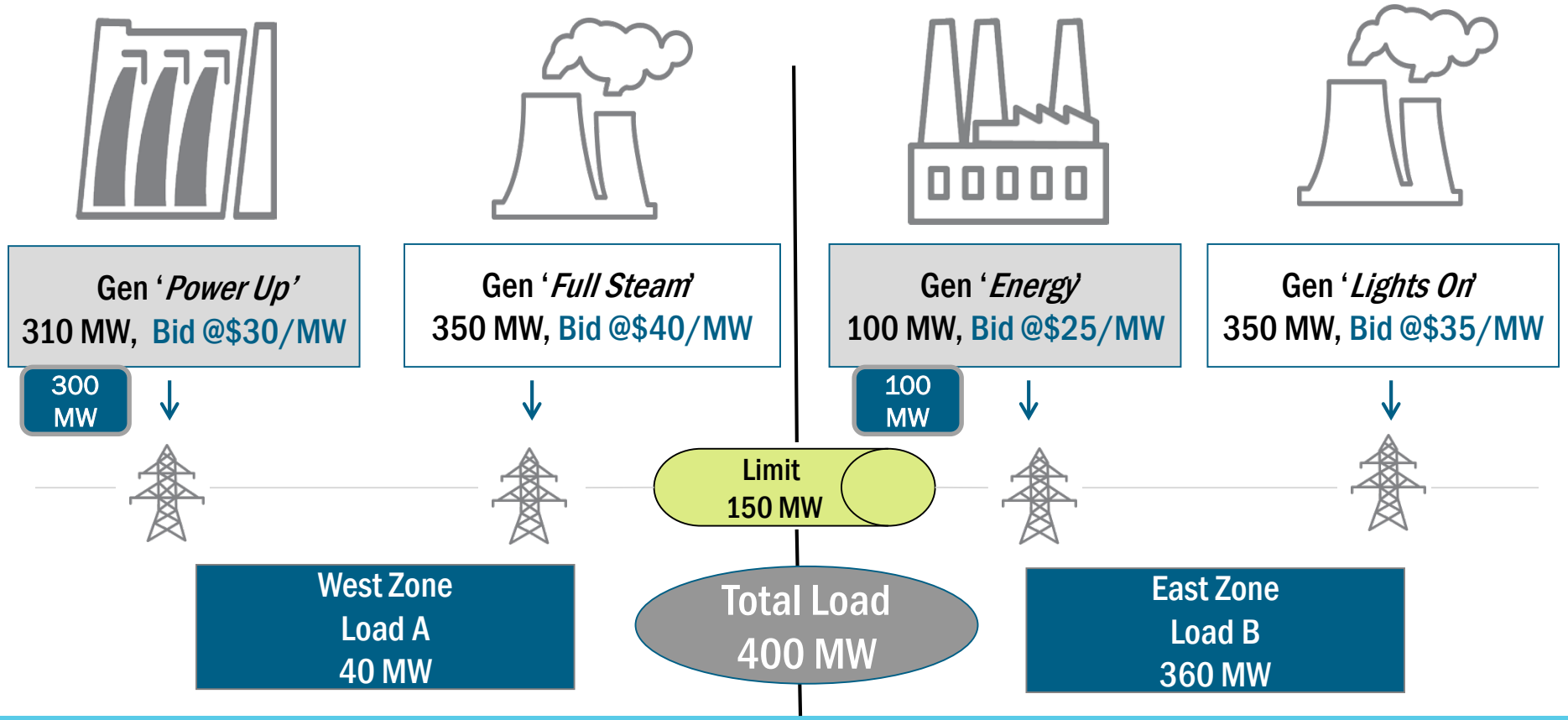
Total Load
400 MW

East Zone
Load B
360 MW

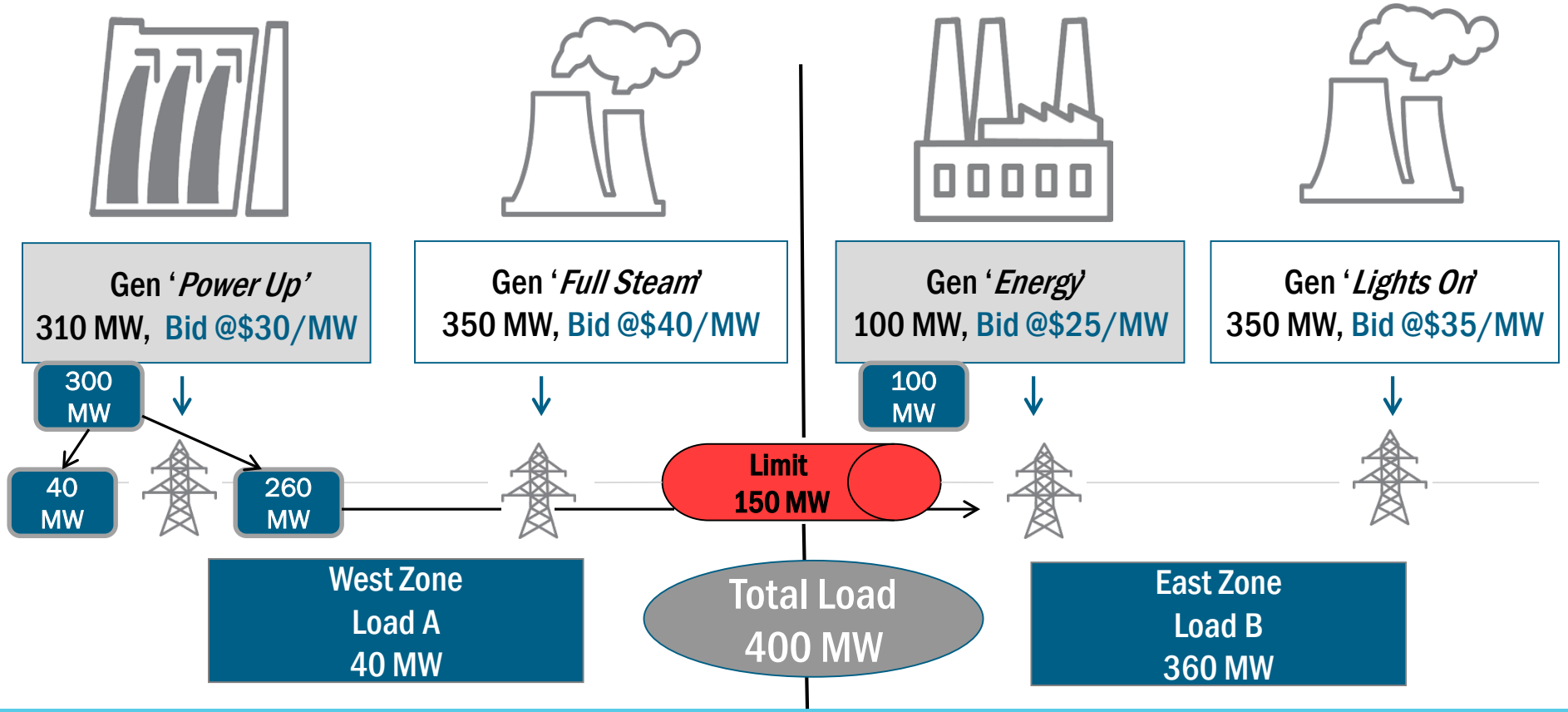
Example 2: Energy and Congestion



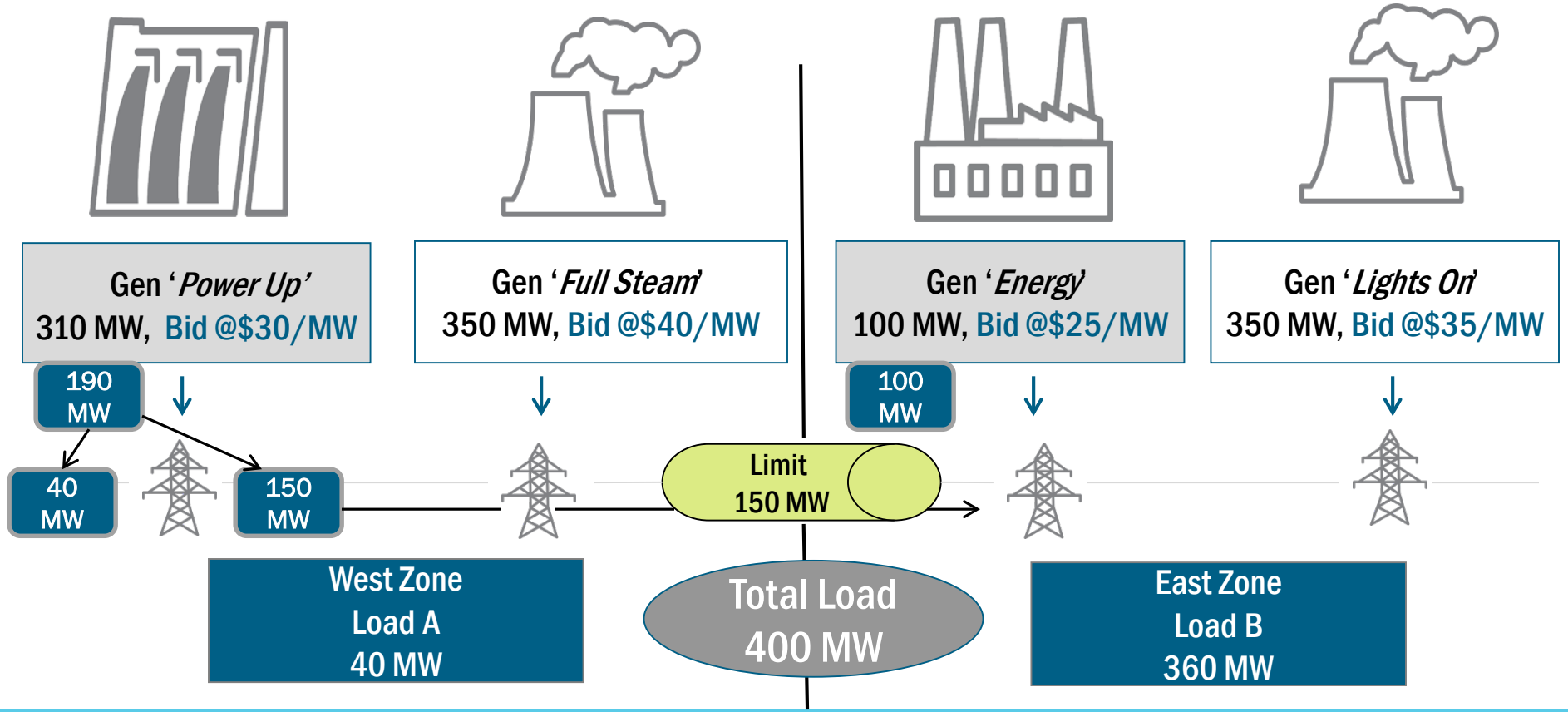
Example 2: Energy and Congestion



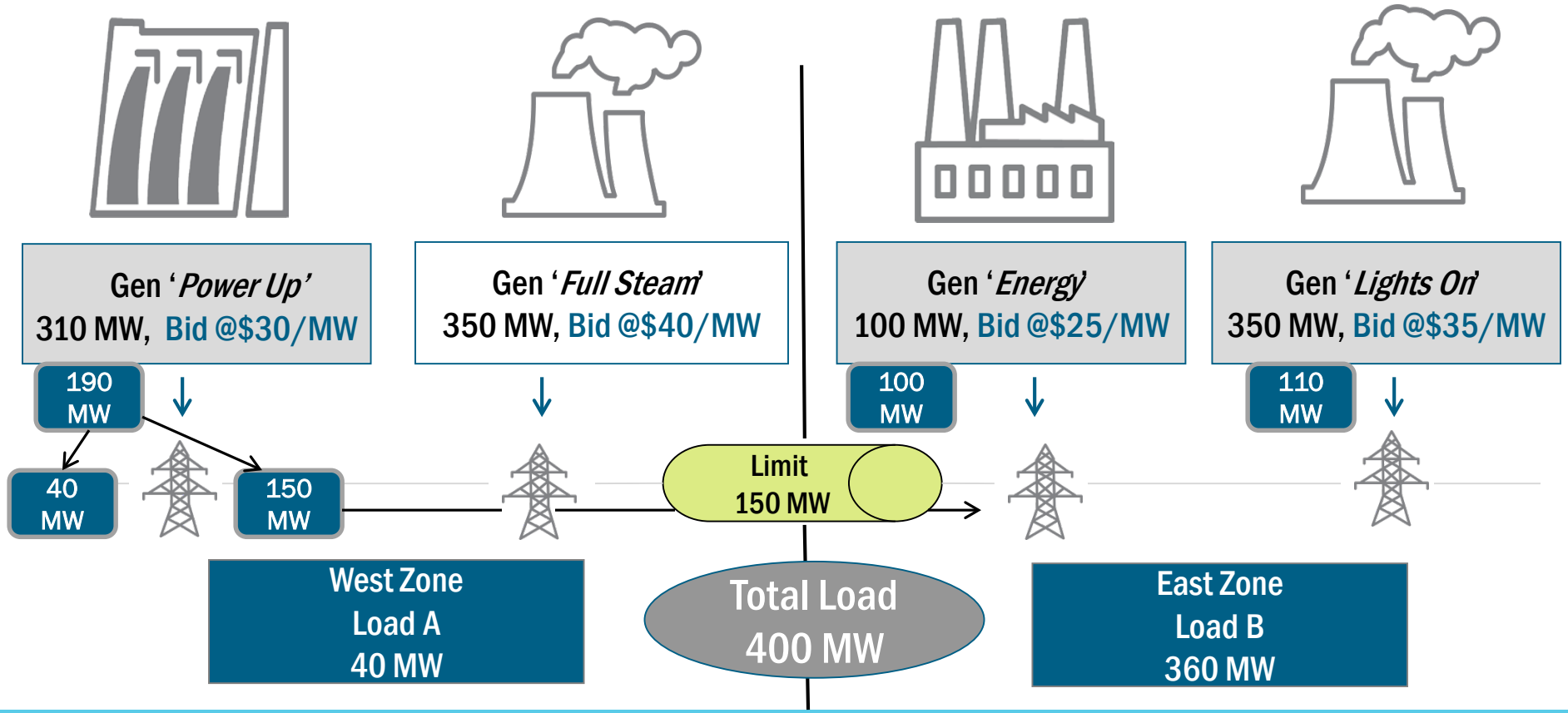
Example 2: Energy and Congestion



Example 2: Energy and Congestion



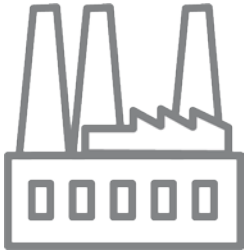
Example 2: Energy and Congestion



Example 2: Energy and Congestion - Results

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

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



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

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

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

Limit
150 MW

West Zone
Load A
40 MW

West Zone LBMP $30.00

Total Load
400 MW

East Zone
Load B
360 MW

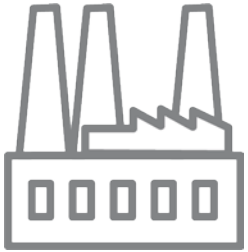
East Zone LBMP $35.00

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

Example 2: Energy and Congestion -Results

Gen '*Power Up*',310 MW
Bid $30, Paid $30

Gen '*Full Steam*' ,350 MW
Bid $40, Paid $0



Gen '*Energy*' ,100 MW
Bid $25, Paid ?

Gen '*Lights On*', 350 MW
Bid $35, Paid ?

West Zone

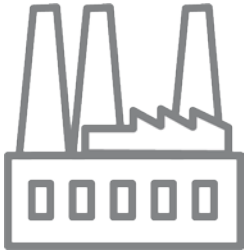
East Zone

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

Example 2: Energy and Congestion -Results

Gen '*Power Up*',310 MW
Bid $30, Paid $30

Gen '*Full Steam*' ,350 MW
Bid $40, Paid $0



Gen '*Energy*' ,100 MW
Bid $25, Paid $35

Gen '*Lights On*', 350 MW
Bid $35, Paid $35

West Zone

East Zone

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

Example 2: Energy and Congestion – Results

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

West Zone
Load A
40 MW

Loads in East Zone
Charged $35/MW (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

New York ISO
Independent System Operator

Energy Market Transactions

Mathangi Srinivasan Kumar
Senior Market Trainer, NYISO

Market Overview Webinar

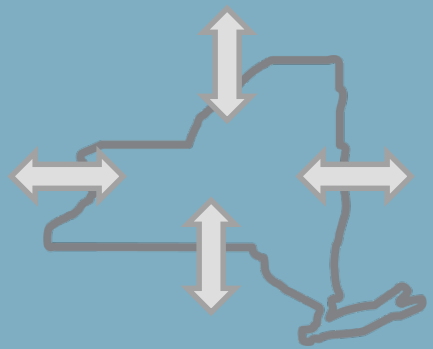
June 23, 2020
Remote Learning

Module objectives

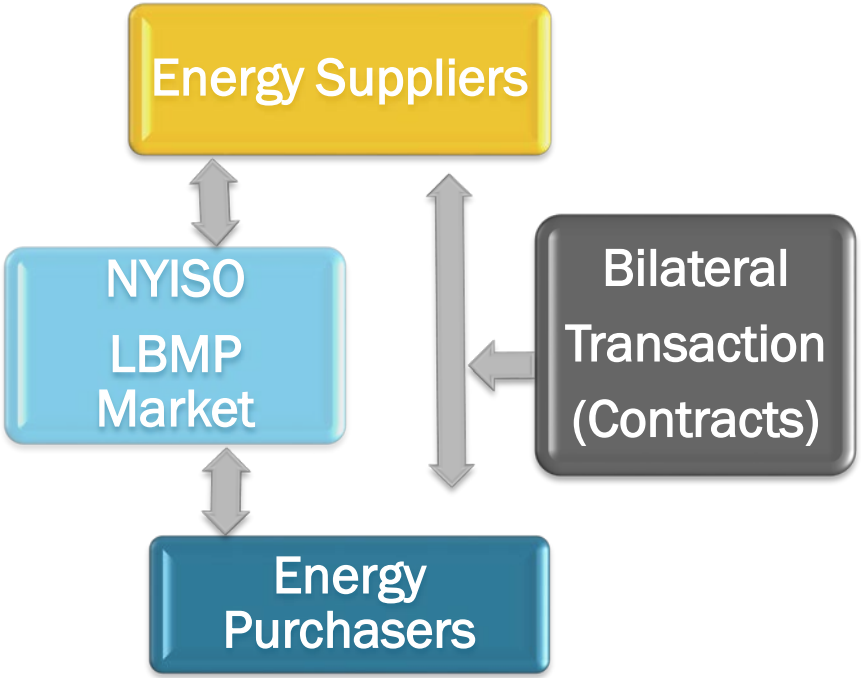
At the conclusion of this module, participants will be able to:

- 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 Transactions

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
  - Makes financial sense: 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

- 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

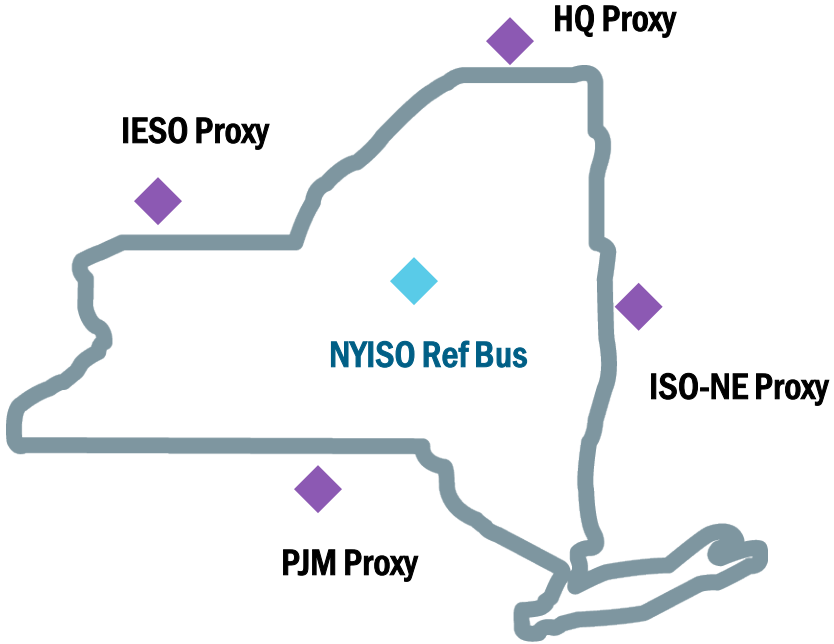
Transaction Terms

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
- aka the Marcy Ref Bus (NYPA Marcy 345kV transmission substation)
- Possible source / sink point

Transaction terms

External Proxy Bus



- Location outside the NYCA that is selected by the ISO to represent a load/gen bus in an adjacent Control Area
- LBMP prices for external proxy buses are calculated with reference to the NY reference bus
- NYISO designated for PJM, HQ, IESO, and ISO-NE

Transaction Categories

New York ISO
Independent System Operator

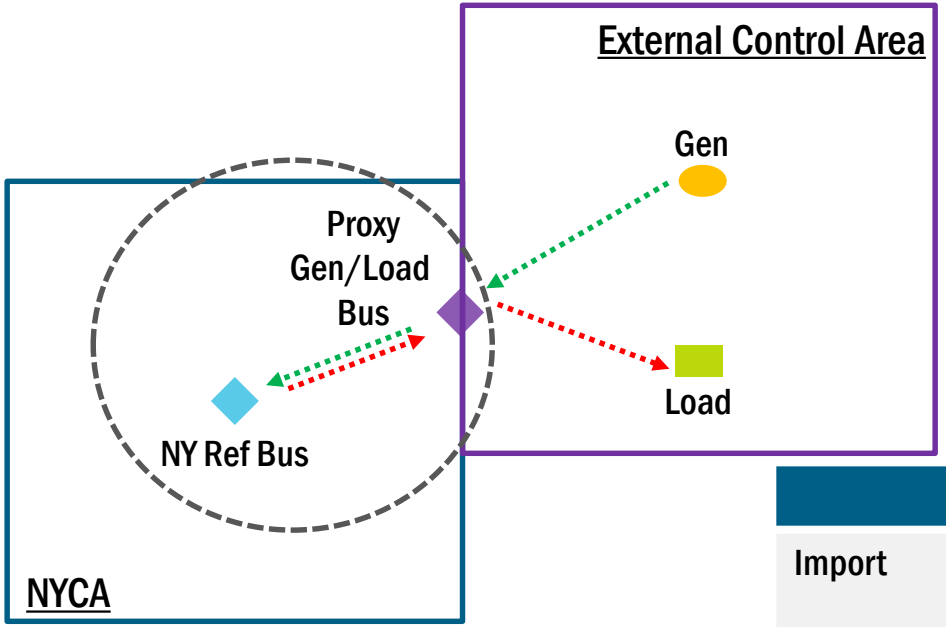
LBMP transactions

- Buys from/sells to - the NYISO Energy Market
- Two types:
  - Imports
  - Exports

Bilateral Transactions

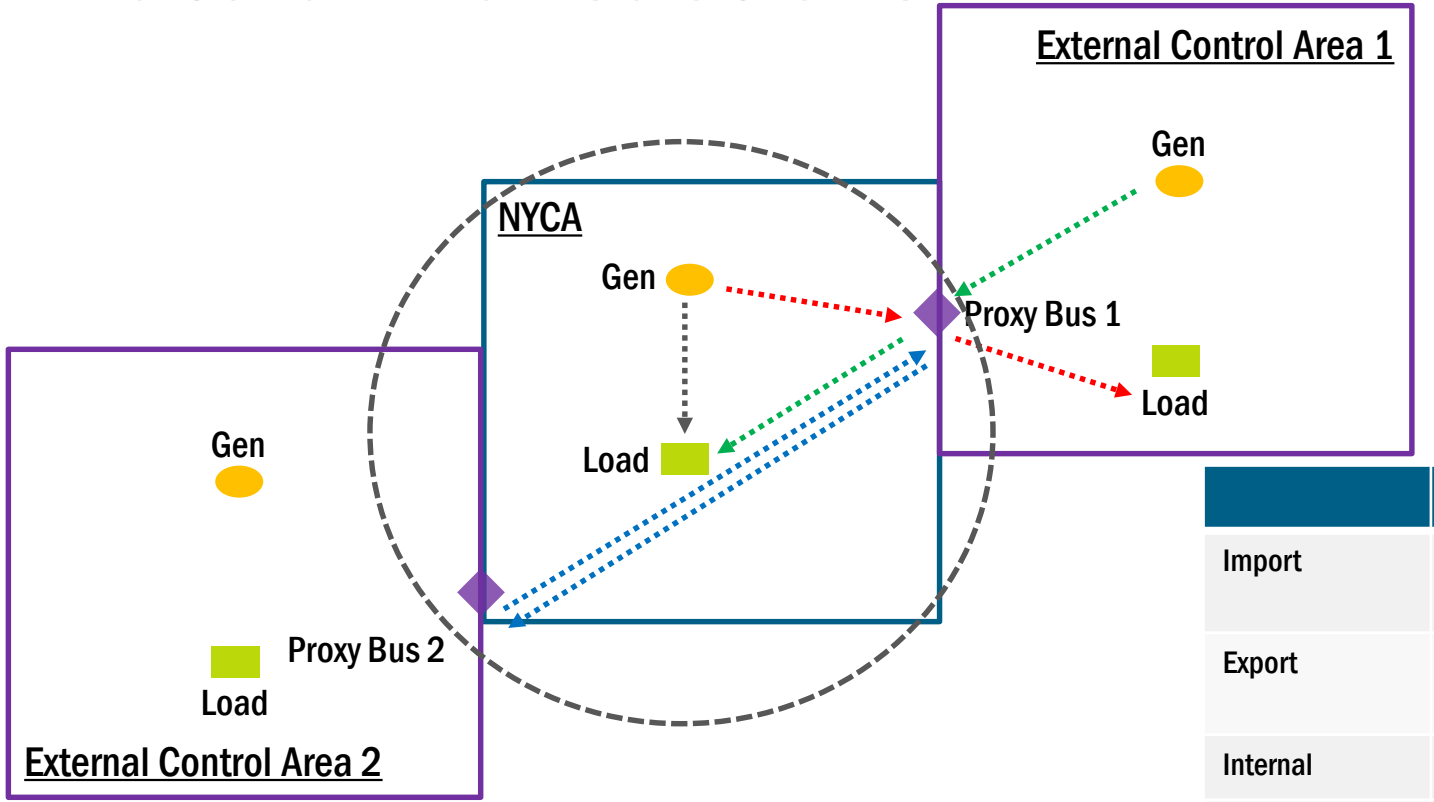
- Direct energy contract between parties
- Price of energy negotiated between buyer and seller, not part of NYISO Settlement
- Four types:
  - Internal Bilateral
  - Imports
  - Exports
  - Wheels Through

LBMP Transactions



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

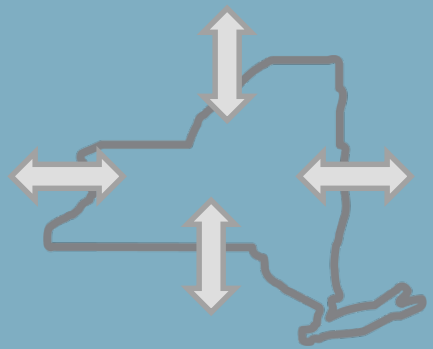
Bilateral Transactions



Import
Export
Internal
Wheelthrough

	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

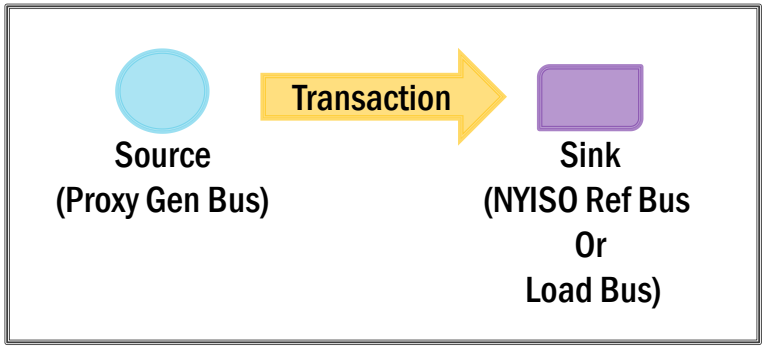
Transactions – Bids and Evaluations



Transaction Categories- BIDS

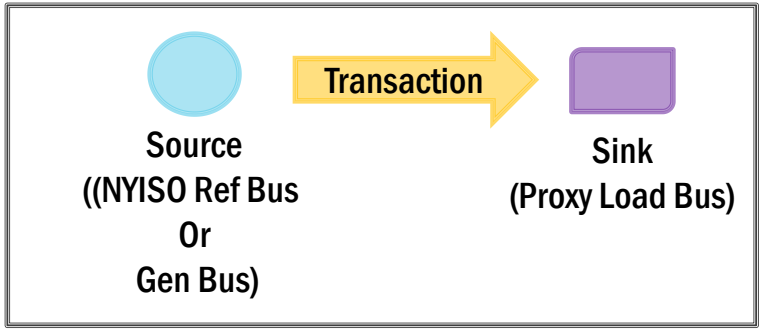
Internal Bilateral	• Bid ($/MW) not submitted • Scheduled automatically
External Import LBMP Bilateral	• Decremental Bid (or) • Coordinated Transaction Scheduling (CTS)
External Export LBMP Bilateral	• Sink Price Cap Bid (or) • Coordinated Transaction Scheduling (CTS)
Wheels Through	• Congestion Cost 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)
- Bid evaluated as an external load bid, against the Proxy (Sink) LBMP

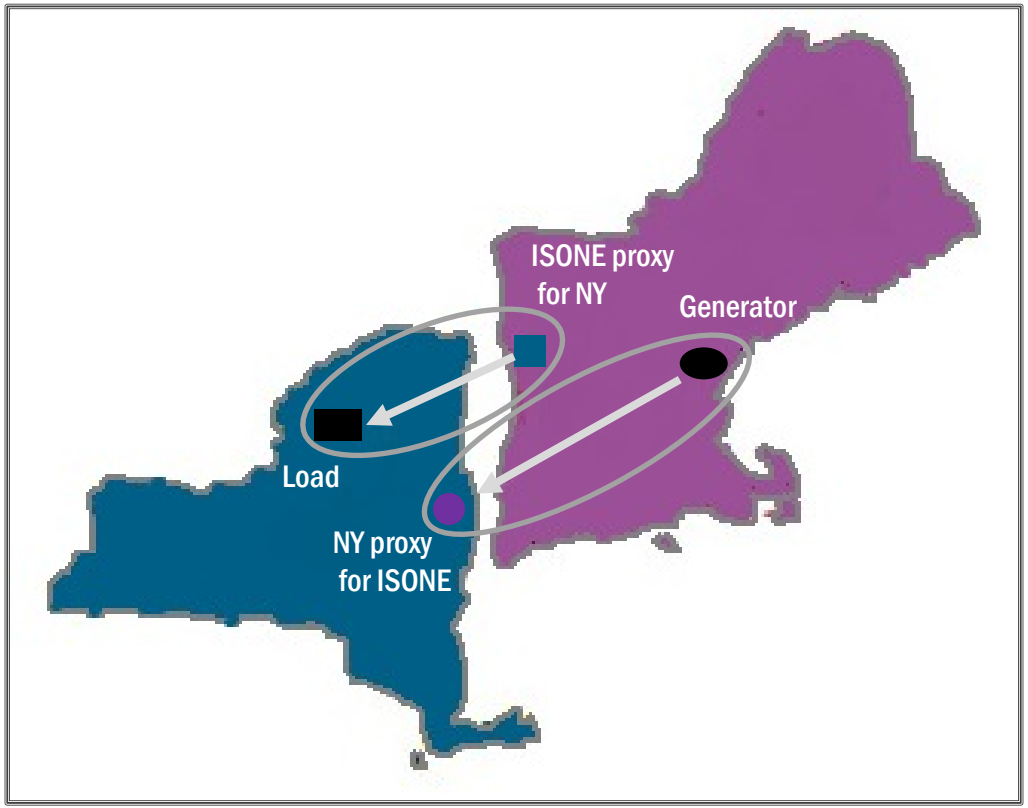
Coordinated Transaction Scheduling

- 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



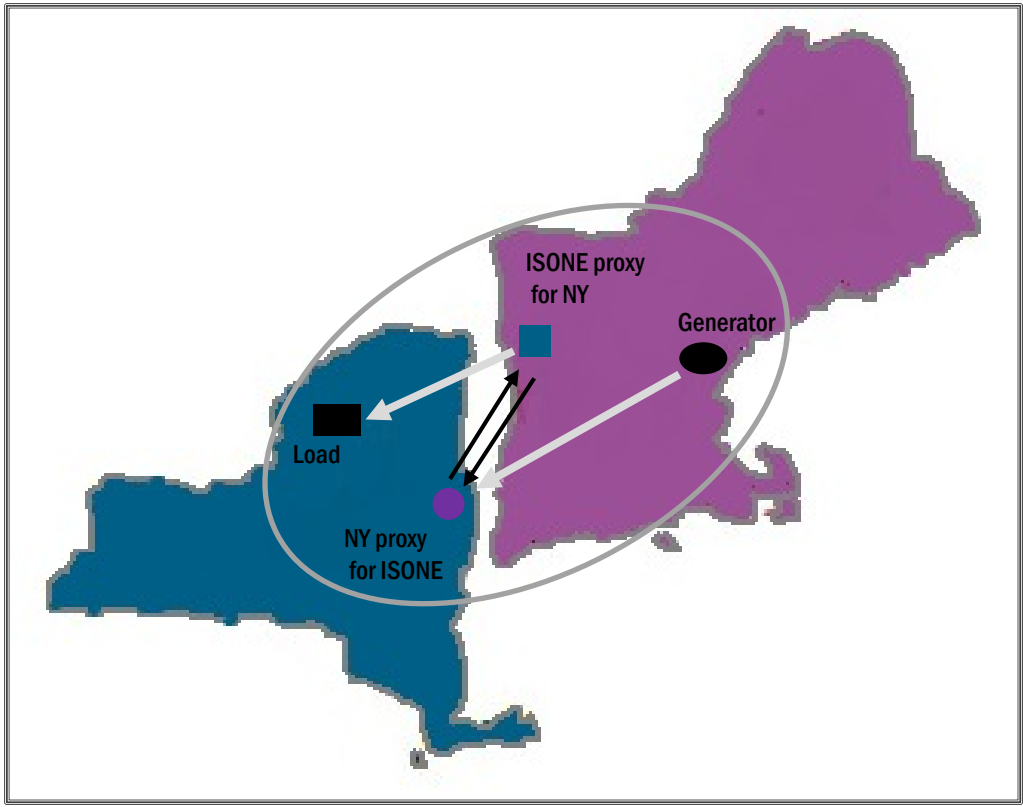
Coordinated Transaction Scheduling Illustration

Coordinated Transaction Scheduling Bid – Import:

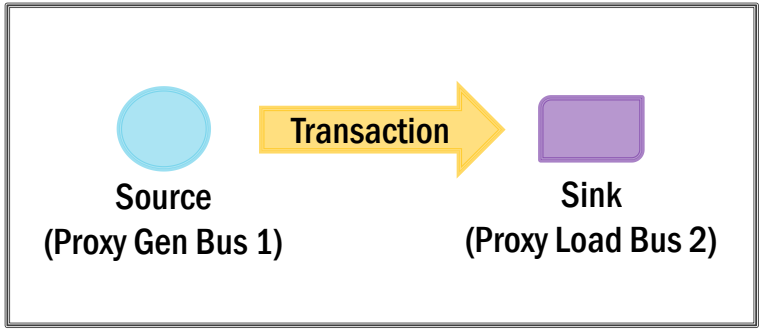
NYISO calculates forecast price for ■

ISONE calculates forecast price for ●

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



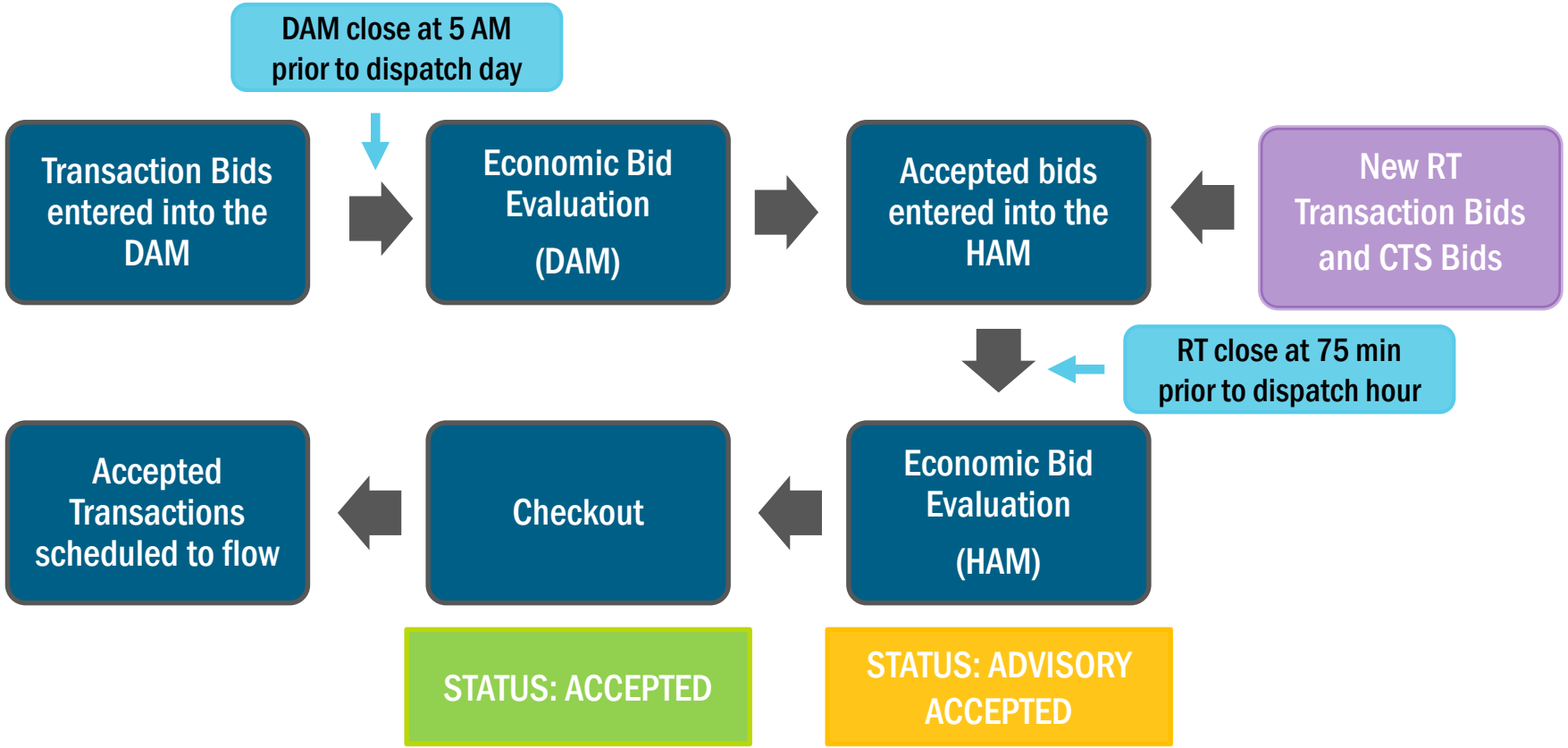
Wheel-through Bilateral Transactions



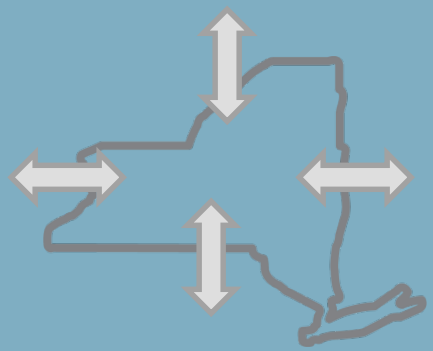
- Bid = $ / MW using up to a 11-point Bid curve
- Bid is evaluated against the Congestion Cost of the transaction
- Congestion Cost is difference between congestion at the Sink and the congestion at the Source

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- Import and Export

- Purchasing or selling energy at the external proxy LBMP

DAM – Settle as follows:

DAM LBMP (proxy bus) x DAM MWh

RT – Settle as follows:

RT LBMP (proxy bus) x RT MWh
(~5-minute level)

Transmission Usage Charge (TUC)

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

- Component of LBMP

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

(Reference Bus Energy Price) TUC

- For all Bilateral Transaction, TUC is calculated as

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

TUC Settlement for Bilateral Transactions

$$TUC = LBMP_{sink} - LBMP_{source}$$

TUC = $85/MWh – $40/MWh

=$45/MWh TUC

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)

Module objectives

At the conclusion of this module, participants will be able to:

- 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 Transactions

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

Transmission Charges

Mathangi Srinivasan Kumar
Senior Market Trainer, NYISO

Market Overview Webinar
June 2020
Remote Learning

Module objectives

At the conclusion of this module, participants will be able to:

- Name the two types of transmission charges and distinguish between the two
- Identify who is responsible for billing the transmission charges

Transmission Charges

- From the LBMP module you learned about the cost of Energy, Loss and Congestion
  - Market-based rate

- Additional charges associated with maintaining and operating the transmission lines that move the power form the Transmission Charge
  - Cost-based rate
  - Adjusted monthly

Transmission Charges

- Charges associated with maintaining and operating the Transmission lines
  - Transmission Service Charge (TSC)
  - NYPA Transmission Adjustment Charge (NTAC)

Transmission Service Charge (TSC)

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

- TSC Assessed to
  - Internal Load
  - Specific transactions that involve withdrawing power from the NY grid

NYPA Transmission Adjustment Charge (NTAC)

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

- NTAC Assessed to
  - Internal Load
  - Specific transactions that involve withdrawing power from the NY grid

Additional Resources

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

New York ISO
Independent System Operator

Ancillary Services

Gina Elizabeth Craan

Manager, Market Training, NYISO

Market Overview Webinar

June 23, 2020

Remote Learning

Ancillary Services Objectives

- **At the end of this session attendees will be able to:**
  - Identify…
    - Three Cost Based Ancillary Services
    - Three Market Based Ancillary Services
  - Explain…
    - Purpose of Each
  - Name…
    - Suppliers & Recipients of Each Service

Ancillary Services

- **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

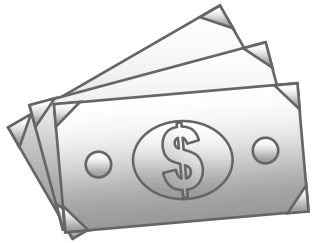
Ancillary Services

- **NYISO Coordinates**
  - Provision of Ancillary Services
  - Arranges for Supply of Ancillary Services
  - Directs Actions of Ancillary Service Suppliers

Ancillary Services

- **Some Ancillary Services are Provided at Cost-Based Prices**
  - Scheduling, System Control, and Dispatch

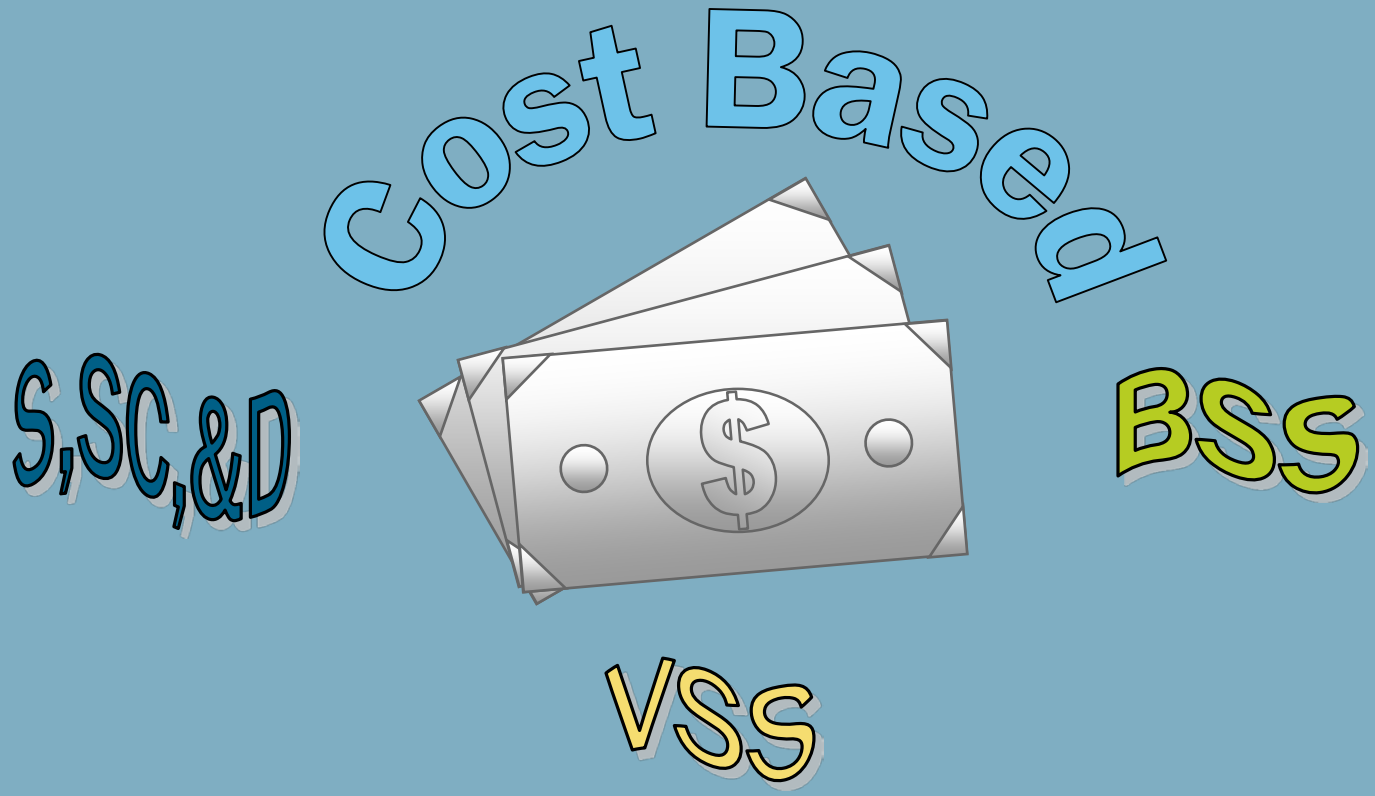
    (S, SC, & D)
  - Voltage Support Service (VSS)
  - Black Start Service Capability (BSS)



Ancillary Services

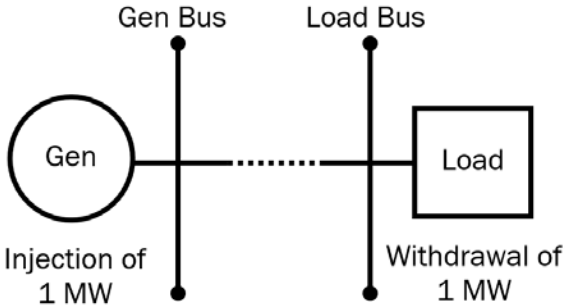
- Some Ancillary Services are Provided at Market-Based Prices
  - Regulation & Frequency Response Service
  - Operating Reserve
  - Energy Imbalance

Ancillary Services



Cost Based - Rate Schedule 1

- **Scheduling, System Control, & Dispatch (S,SC, & D)**
  - NYISO's Costs of Operation
    - Allocation of NYISO Embedded Costs
      - 72% allocated to withdrawals
      - 28% allocated to injections
    - Costs assessed to Non-Physical Market Activity
    - FERC Fees
    - Allocation of Uplift Charges & Residual Adjustments
      - 100% allocated to withdrawals



Cost Based - Rate Schedule 2

- **Voltage Support Service (VSS)**
  - VSS Accomplished Through use of
    - Generators
    - Other Qualified VSS Providers

  - Suppliers must meet Service Requirements:
    - Perform Reactive Power Capability (MVAr) testing & submit data to NYISO
    - Have Automatic Voltage Regulator (AVR) & maintain voltage as directed
  - Receive Weekly Payments
    - Based on Annual VSS Rate
    - Lag and Lead Var Capability

Cost Based - Rate Schedule 2

- **Voltage Support Service Payments**
  - Applies to suppliers participating in VSS program based on:
    - Lag and Lead Var Capability
    - Annual VSS Rate
- **Voltage Support Service Charges**
  - Assessed to Withdrawals
    - Internal NYCA LSEs
    - Export Transactions
    - Wheels Through
  - Based on estimated annual VSS costs

Cost Based - Rate Schedule 6

- **Black Start Service Suppliers**
  - Submit to performance testing as requested
  - Provide embedded cost information annually
  - Adhere to program timelines

Cost Based - Rate Schedule 6

- **Black Start Service Supplier Payments**
  - Based on embedded cost information
  - Applies to suppliers of Black Start Service for availability
- **Black Start Service Charges**
  - Assessed to internal NYCA LSEs

Ancillary Services

Market Based

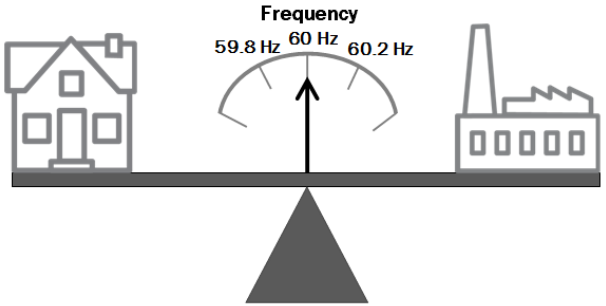
Regulation

Energy Imbalance

Reserves

Market Based - Rate Schedule 3

- **Regulation & Frequency Response Service**
  - Regulation is accomplished using:
    - On-line Generators
    - Demand Side Regulation Providers
    - Limited Energy Storage Resources
  - Regulation providers must:
    - Have installed equipment capable of responding to six second signals
    - Bid as 'Flexible' supplier
  - Energy & Regulation bid criteria considered in Co-Optimization

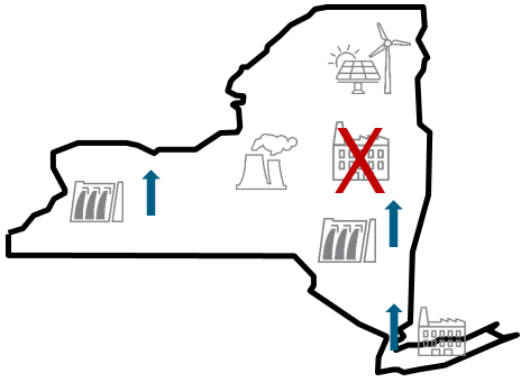


Market Based - Rate Schedule 3

- **Regulation Service Payments**
  - Regulation Capacity Settlement
    - Applies to suppliers scheduled to provide Regulation Service
  - Regulation Movement Settlement
    - Applies to suppliers instructed to Regulate by NYISO in RT
- **Regulation Service Charges**
  - Assessed to internal NYCA LSEs

Market Based - Rate Schedule 5

- **Operating Reserves Service**
  - Reserves must be from:
    - Units in NYCA and within Specific Regions
    - Demand Side Resources within NYCA
  - Reserve providers must bid as ‘Flexible’ supplier
  - Energy & Reserves bid criteria considered in Co-Optimization
  - Types of activation of service include:
    - Large and Small Event Reserve Pickups
    - Maximum Generation Pickup



Market Based - Rate Schedule 5

- **Operating Reserves Service Payments**
  - Reserves Availability Settlement
    - Applies to suppliers Scheduled to provide Operating Reserves Service
  - Real-Time LBMP Energy Settlement
    - Applies to suppliers instructed to convert Operating Reserves to energy by NYISO in RT
- **Operating Reserves Service Charges**
  - Assessed to Withdrawals
    - Internal NYCA LSEs
    - Export Transactions

Market Based - 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

- **Cost-Based Services**
  - Rate Schedule 1
    - NYISO cost of operations
  - Voltage Support
    - Force/Pressure necessary for energy delivery
  - Black Start
    - System Restoration

- **Market-Based Services**
  - Regulation & Frequency
    - Balances resources to load
    - Maintains 60 Hz
  - Operating Reserves
    - Backup Generation
  - Energy Imbalance
    - Addresses Energy Imbalances

Additional Resources

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

New York ISO
Independent System Operator

Installed Capacity (ICAP) Market

Kelly Stegmann
Senior Market Trainer, Market Training, NYISO

Market Overview Webinar
June 23, 2020
Remote Learning

ICAP Market Module Objectives:

- **Upon the completion of this module, trainees will be able to:**
  - 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

Two very different commodities!

- **Capacity**
  - Refers to the electric power output for which a generating system, plant, or unit is rated
- **Energy**
  - Is the amount of energy produced (from capacity) over time

ICAP Market Benefits

Benefits of the ICAP Market:

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

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

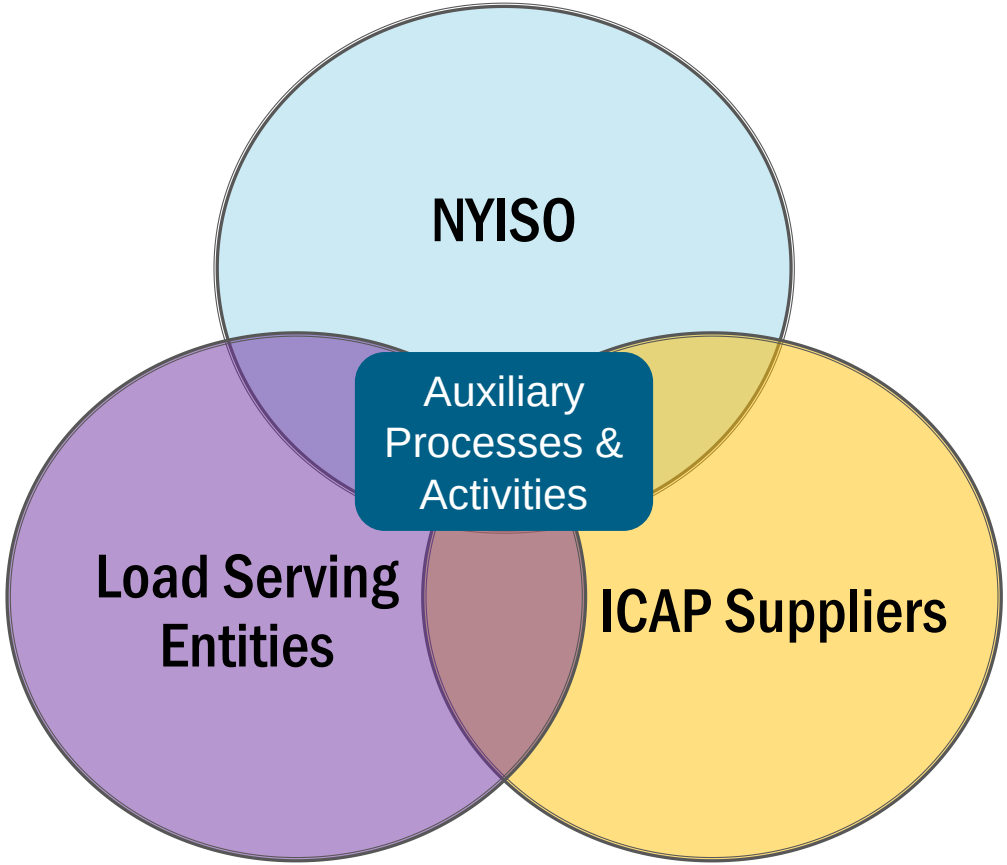
(Auction Clearing Prices)

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 Market Mechanics



ICAP vs UCAP

ICAP	UCAP
Installed Capacity describes the market as opposed to the product.	The measure by which Installed Capacity Suppliers will be rated, in accordance with formulae set forth in the NYISO Procedures, to quantify the extent of their contribution to satisfy the NYCA Minimum Installed Capacity Requirement, and which will be used to measure the portion of that NYCA Minimum Installed Capacity Requirement for which each LSE is responsible.

ICAP Market Mechanics

- Determining the amount of capacity required

  How much do we need?

- Determining the amount of capacity available

  How much do we have?

- Determining the amount of capacity suppliers are qualified to offer

  How much can be sold?

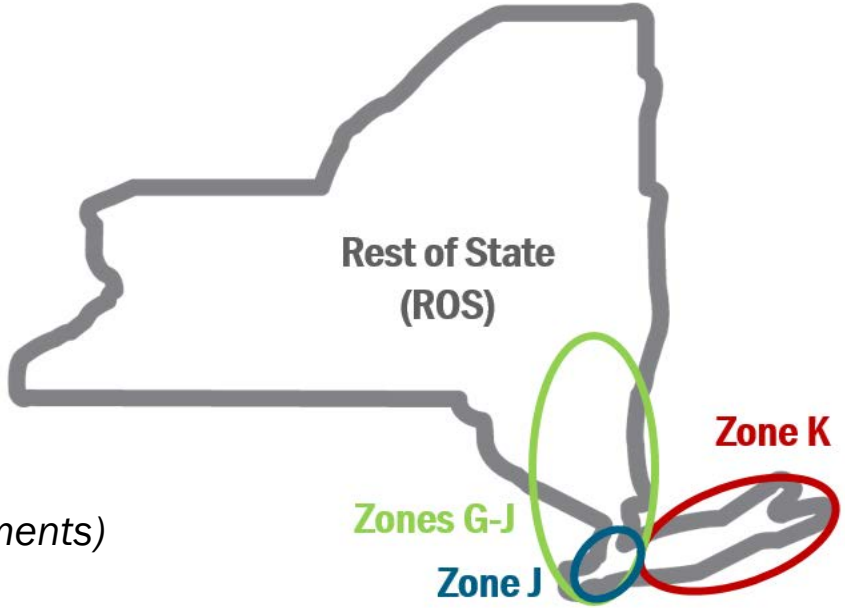
- Determining the amount of capacity obligation to be procured

  How much must be purchased?

ICAP Market Mechanics

- **Determining the amount of capacity required – <u>How much do we need?</u>**
  - Minimum Installed Capacity Requirement
    - Peak Load Forecast
    - Installed Reserve Margin (IRM)
    - Reliability Standards

(NYCA-wide and Locational Capacity Requirements)



ICAP Market Mechanics

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

ICAP

ICAP Market Mechanics

- Determining the amount of capacity suppliers are qualified to offer – How much can be sold?
  - Unforced Capacity (UCAP)
    - Past performance
    - How often is the unit available
    - How much can be delivered

UCAP

ICAP Market Mechanics

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

UCAP

ICAP Market Mechanics
Auxiliary processes and activities

- ICAP Market Auctions
  - Capability Period Auction (6 Month Strip)
  - Monthly Auction
  - Spot Market Auction

ICAP Market Mechanics
Auxiliary processes and activities

- Data Submittal
- Auction Process for awards
  - Strip, Monthly, Spot
- Certification Process
- Suppliers awarded capacity are required to offer MWs in Day Ahead Energy Market or notify NYISO of an outage
  - Bid, Schedule or Notify
- Settlement Process
  - Capacity payment uses applicable auction clearing price

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 Obligations
  - Supplier Obligations
  - ICAP Auctions and Awards
  - 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
- Technical Bulletin 201: Enrollment of Special Case Resources in the ICAP Market

New York ISO
Independent System Operator

Demand Response

Mathangi Srinivasan Kumar
Senior Market Trainer, NYISO

Market Overview Webinar

June 23, 2020
Remote Learning

Demand Response Module Objectives:

Upon completion of this module, trainees will be able to:

- Recognize the purpose of Demand Response at the NYISO
- Distinguish between the two categories of Demand Response programs at the NYISO
- Identify the four demand response programs and the basic features and functions of each program

Demand Response at the NYISO

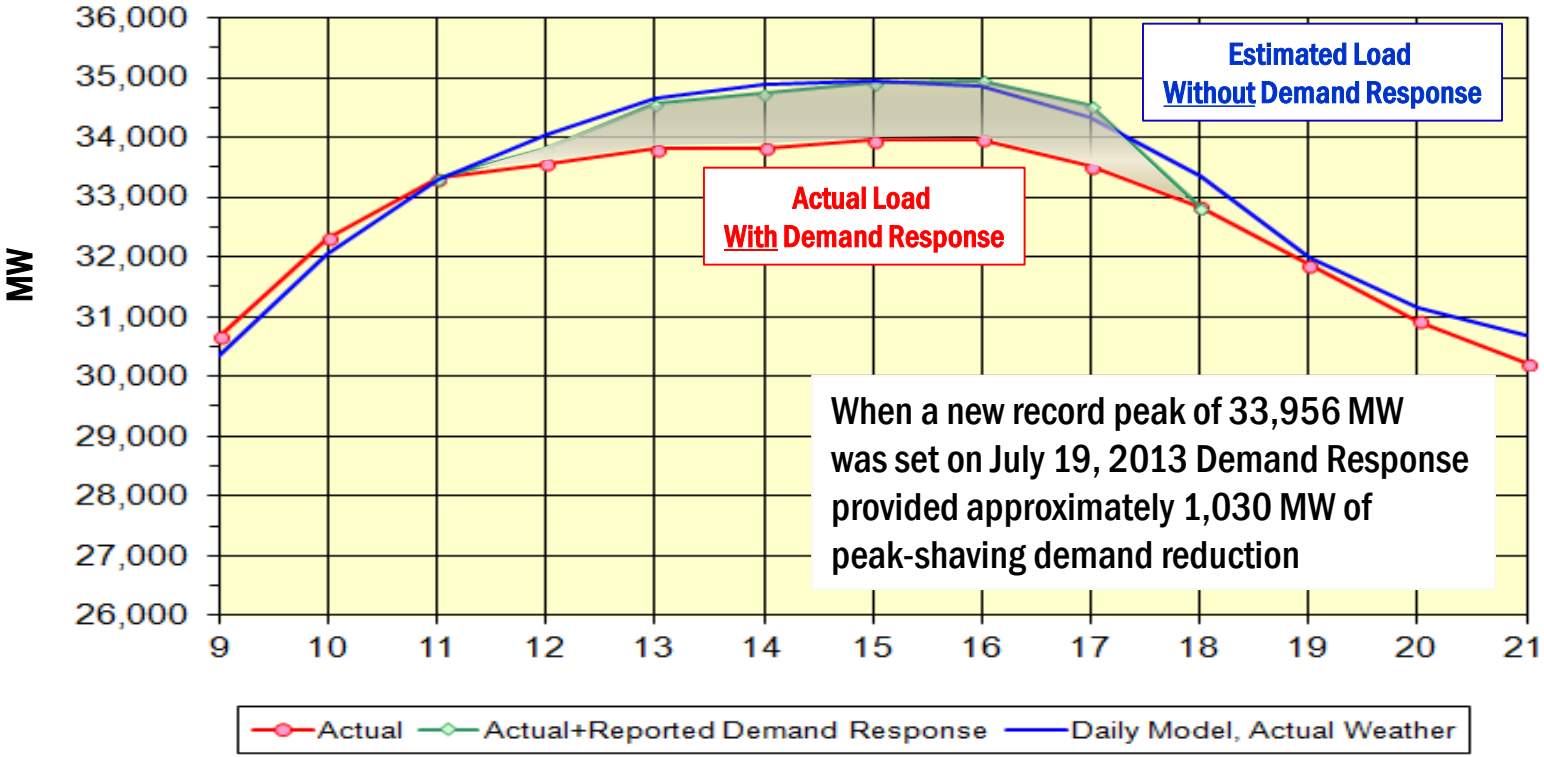
- What do Demand Response resources do?
  - Reduce their power use for discrete periods of time as directed by the NYISO

- Who are Demand Response resources?
  - Electricity consumers located in NYS that enroll to take part in a specific Demand Response program
  - Examples:
    - Industrial companies
    - Big box stores
    - Small retail stores
    - Hospitals
    - Colleges/Universities

Categories of Demand Response Programs

- Reliability-Based Programs
  - Purpose: provide load reductions for a discrete period of time, in response to NYISO Operations instructions, 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)

Demand Response for Reliability



Equivalent to the output of two medium-sized generating plants or the electricity needs of 300,000 - 400,000 households

Categories of Demand Response Programs

- Economic-Based Programs
  - Purpose: load reduction, competing with generation, is scheduled by NYISO based upon economic offers
  - Market driven / Not event driven
  - Resource determines when to participate (through supply offers)
    - Day-Ahead Demand Response Program (DADRP)
    - Demand-Side Ancillary Service Program (DSASP)

Summary of Demand Response Programs

New York ISO
Independent System Operator

Program Name	Program Type	Performance Requirement	Size Requirement	Number of calls	Metering	Payment Type	Penalties
EDRP	Reliability-based	Voluntary	• Minimum 100 kW Reduction	Unlimited	Hourly Interval Meter	Performance Payment	None
SCR	Reliability-based	Mandatory if notification timeline is met	• Minimum 100 kW Reduction • Grouping by zone allowed	Unlimited	Hourly Interval Meter	Performance Payment and Monthly Capacity Payment	May apply
DADRP	Economic-based	Mandatory when scheduled	• Minimum 1 MW Reduction • Grouping by zone and LSE allowed	MP decides when to make Load reduction available to the market	Hourly Interval Meter	Performance Payment	May apply
DSASP	Economic-based	Mandatory when scheduled	• Minimum 1 MW Reduction • Grouping by zone allowed	MP decides when to make Load reduction available to the market	Real-Time Metering	Reserve or Regulation Market Clearing Price	May apply

Demand Response Module Objectives:

- Recognize the purpose of Demand Response at the NYISO
- Distinguish between the two categories of Demand Response programs at the NYISO
- Identify the four demand response programs and the basic features and functions of each program

Additional Resources

- Tariffs – MST and OATT
- Day Ahead Demand Response Program Manual
- Emergency Demand Response Program Manual
- Installed Capacity Manual Section 4.12
- Demand Response Webpage
  - FAQs for Prospective Resources

Market Overview Closing Remarks

- Additional Training Resources

- NYISO Documentation
  - Tariffs
  - Manuals
  - User Guides
  - Technical Bulletins
  - Studies & Reports
  - Meeting Calendar
- NYISO Stakeholder Services
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  - Stakeholder_Services@nyiso.com