Market Assessment for Accommodating Public Policy

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Market Issues Working Group
December 20, 2017, Rensselaer NY

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Integrating Public Policy Project

Harmonizing Public Policy

Carbon Pricing:

Study whether incorporating a state policy defined cost of carbon in the wholesale market would improve the overall efficiency of the NYISO energy and capacity markets

Market Assessment for Accommodating Public Policy

Market Impact Assessment of 50% Renewable Generation:

Study the impacts of decarbonization goals on the current NYISO energy and capacity markets from the high penetration of low carbon or carbon-free resources

Market Structure Assessment of 50% Renewable Generation:

Study whether other market products or changes to the existing market structure will be necessary to meet the anticipated reliability needs

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Agenda

- Background
- Study Results
- Next Steps
- Market Design Concepts

Accommodating Public Policy

The NYISO remains focused on reliability through markets. The purpose of these efforts is to identify market changes or enhancements that must be considered to support reliable grid operations in a future with large amounts of intermittent, renewable generation

1. **Market Study** - The NYISO's goal is to provide stakeholders with information regarding potential market conditions with the incorporation of renewables resources to meet 50% of the NYCA load.
2. **Market Concepts** - The NYISO is considering a broad spectrum of market product and/or structure enhancements that may be necessary to incent resource characteristics or behaviors needed to manage 50% renewable generation by 2030.

Energy Market Study

Examples of Findings from the 50% Renewable Resource Penetration Study

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Days Modeled for Energy Market Study

Study Day	Peak Load Forecast (MW)	Peak Load Hour	High-Low Temp. ALB/LGA*	Gas Prices TNZ6/TZ6NY**	Other
Tuesday, January 19, 2016	22,168	18:00	23-13/29-18	$4.20/$6.25	Winter Peak
Tuesday, March 22, 2016	18,638	20:00	51-27/55-35	$2.02/$1.30	IP2 Refueling***
Monday, July 25, 2016	31,401	16:00	89-68/91-81	$2.91/$2.83	High Load
Thursday, November 10, 2016	19,131	17:00	51-31/57-43	$2.45/$1.90	High Wind

*High and Low temperatures were recorded at Albany International Airport (ALB) and LaGuardia International Airport (LGA).
**TNZ6 prices apply to zones F-I, while TZ6NY prices apply to zones J-K.
***Indian Point 2 is a large (~1,000 MW) nuclear generator located in zone H. It was offline for refueling on March 22, 2016.

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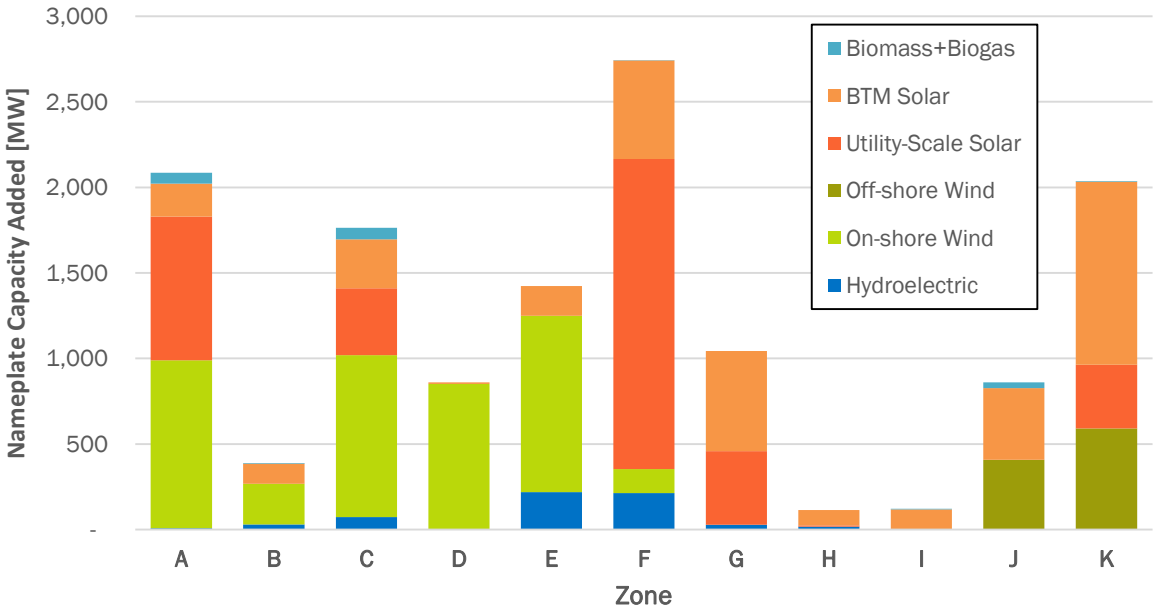
Incremental Renewables Added for Energy and Capacity Market Studies



- Renewables modeled as Virtual Supply
- -$47/MWh offer floor
- Quantities based on projections made in NYS Final Environmental Impact Study*

*PSC Case 15-E-0302, Proceeding on Motion of the Commission to Implement a Large-Scale Renewable Program and a Clean Energy Standard, Final Supplemental Environmental Impact Statement (May 19, 2016).

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Total Renewables per zone in Energy and Capacity Market Studies

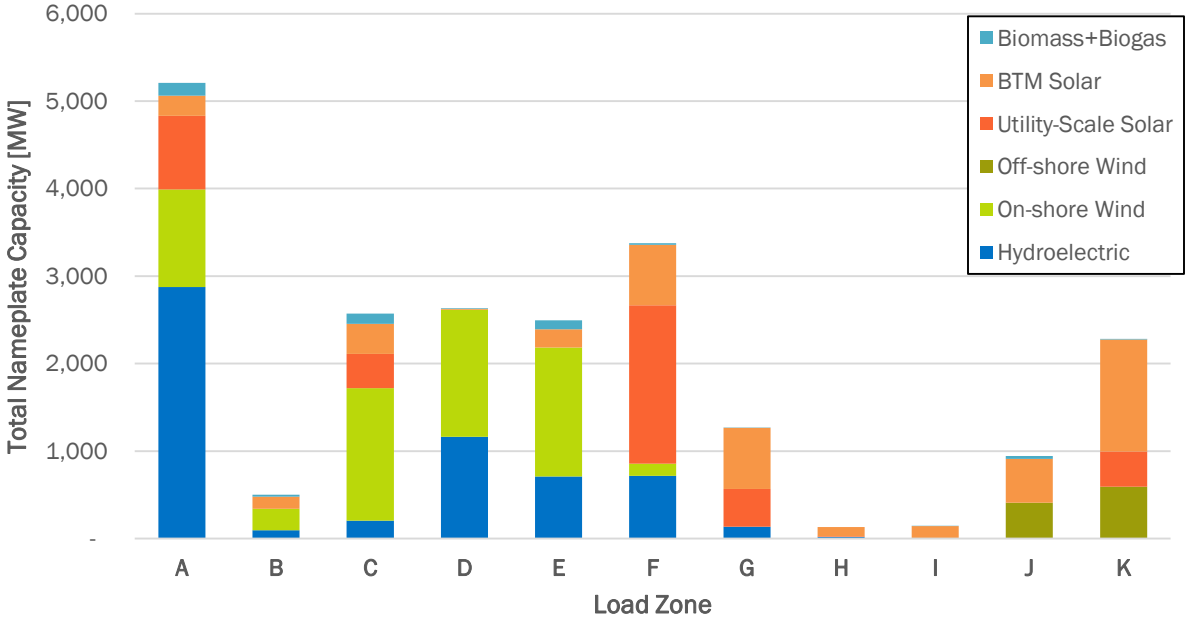
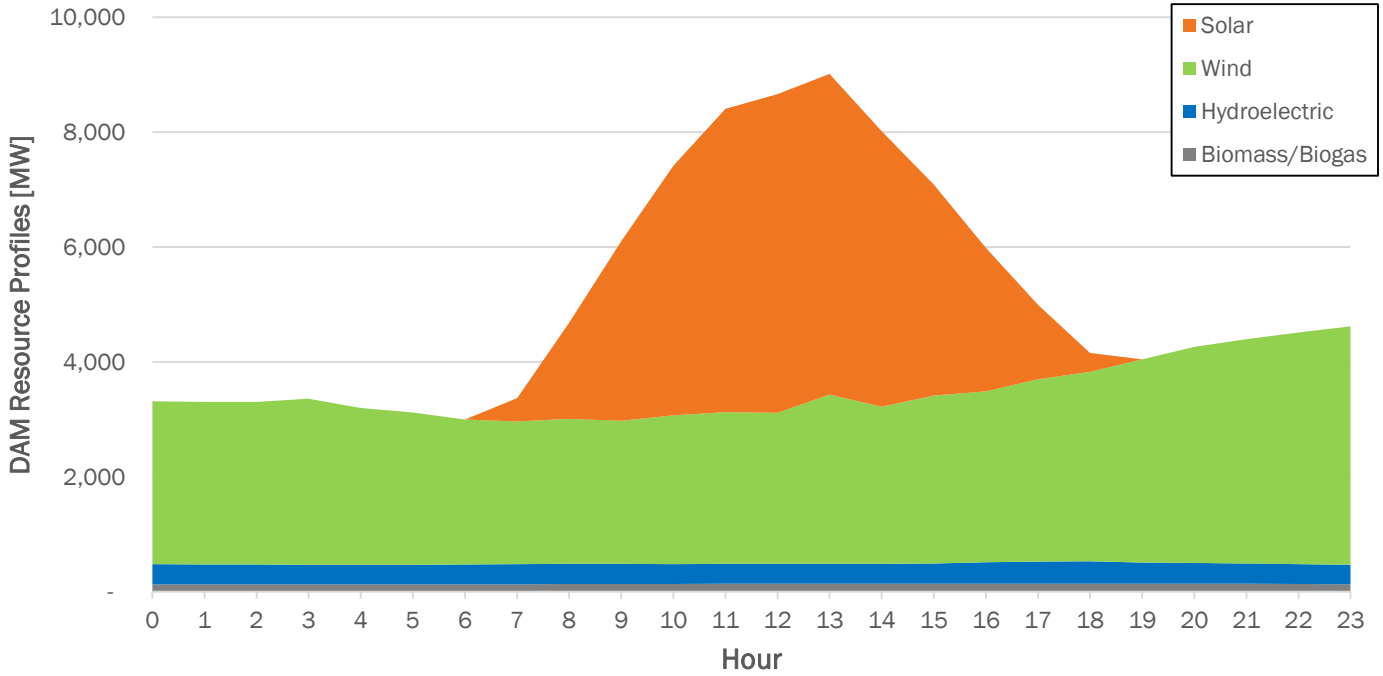


Chart shows all existing (2016) front of the meter renewables in the NYCA and all front of the meter and behind the meter Incremental Renewables added for the Market Study.

DAM Output Profile, March Day



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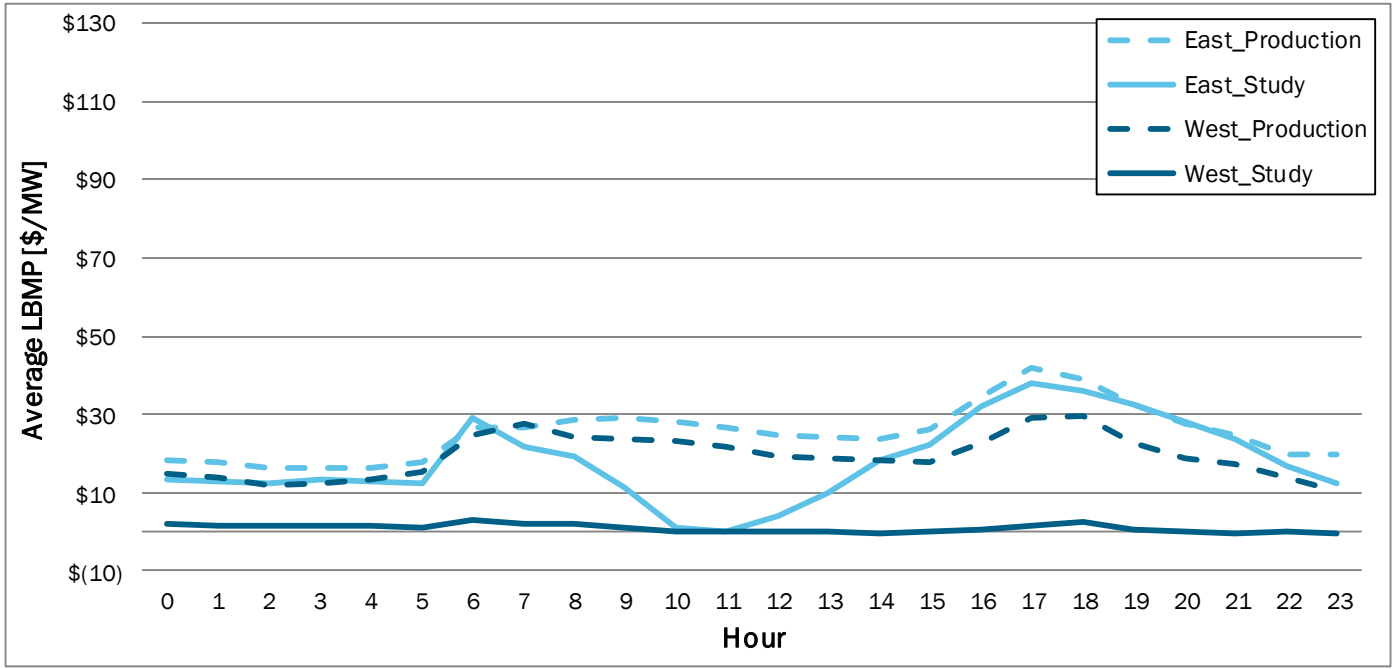
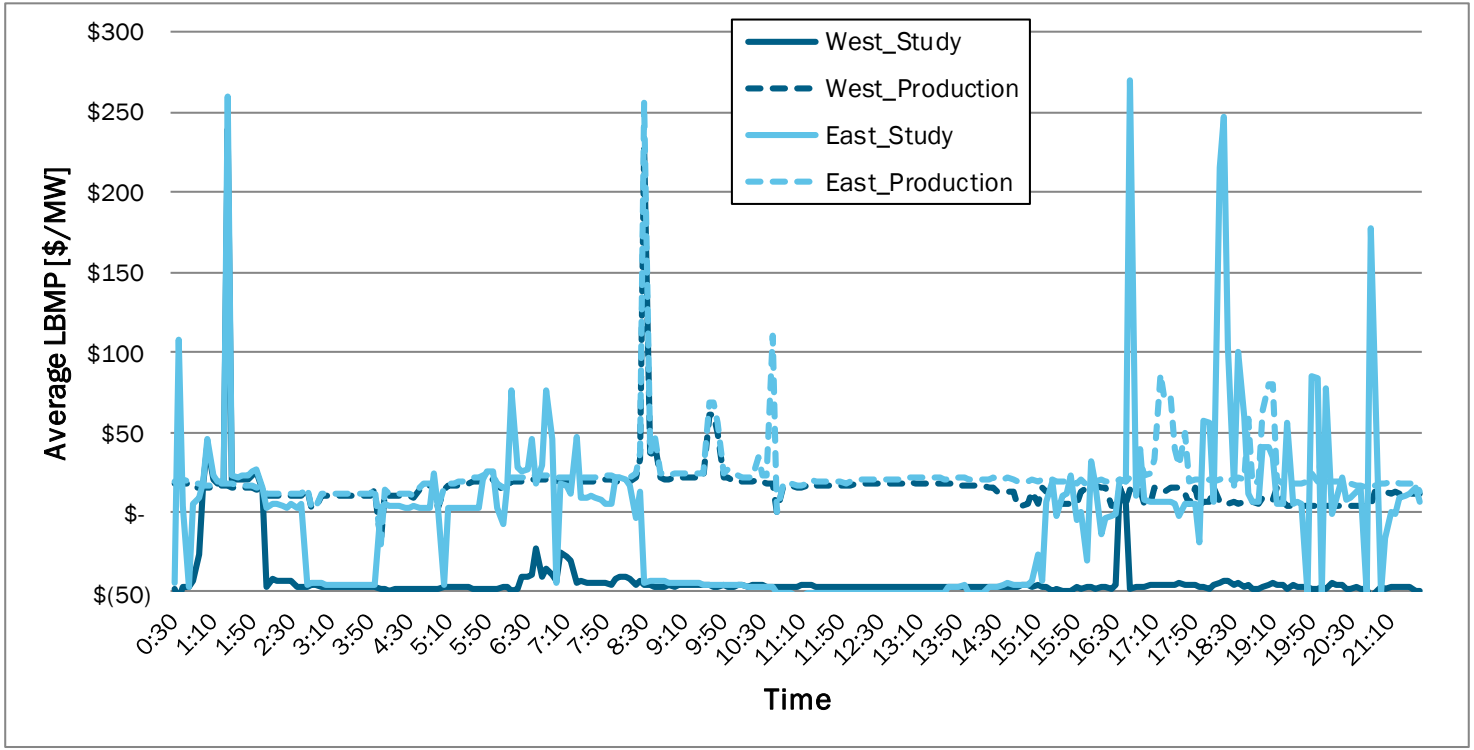
DAM Prices: November Day



RTD Prices: November Day



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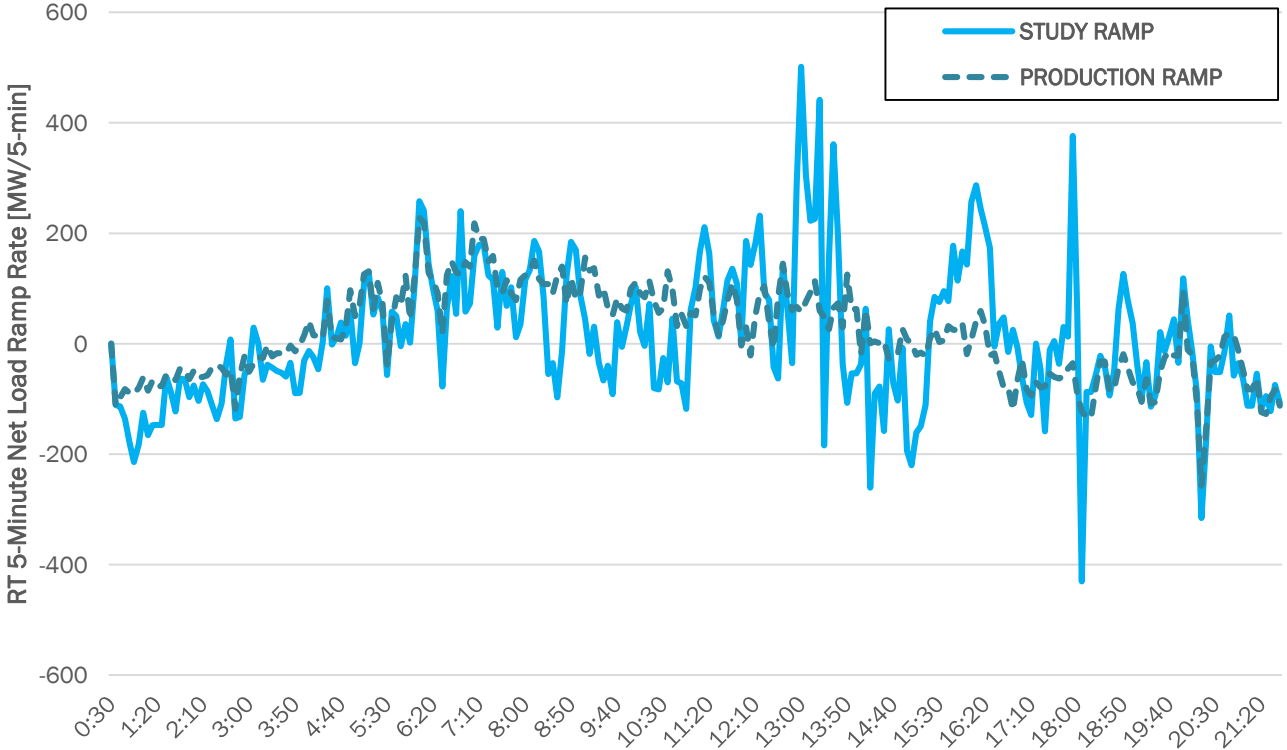
Net Load Ramp, July Day



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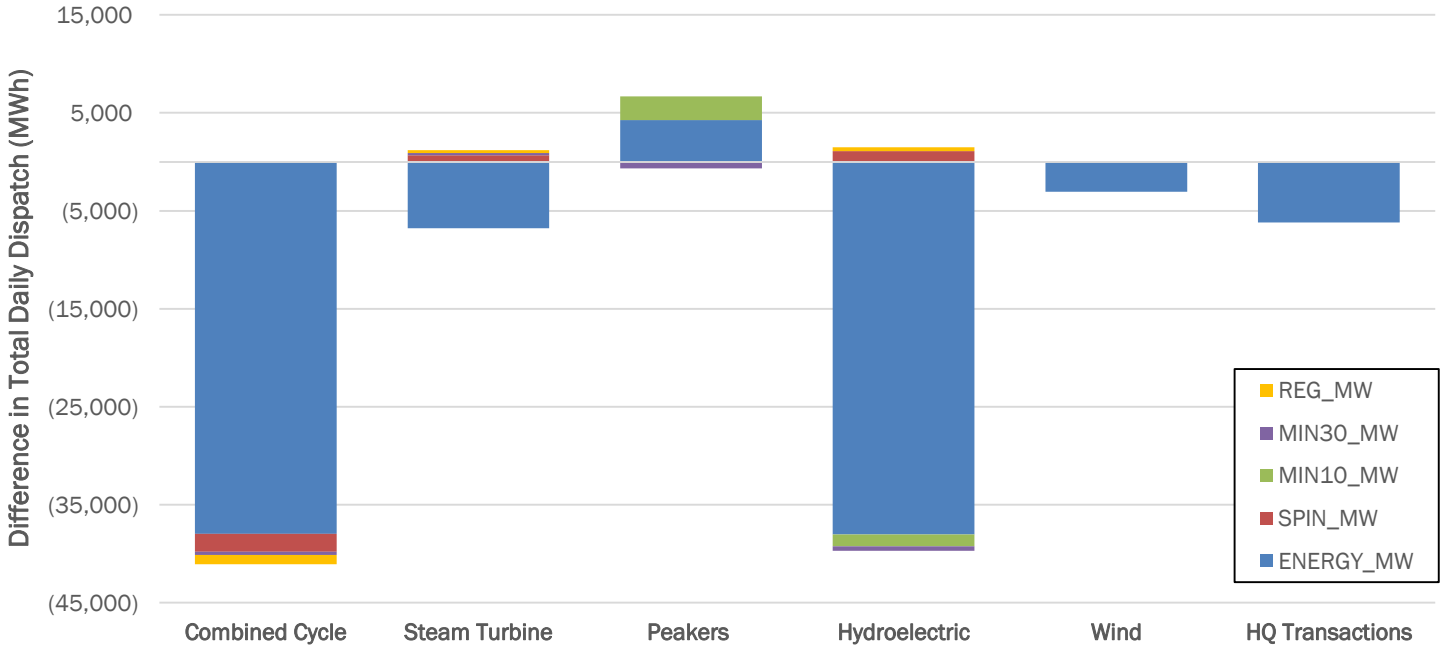
Increase in Cycles in the RT Market Study

Ratio of Real-Time Starts per Day in the Market Study to Production Baseline

Resource Type	March	July	Nov
Combined Cycle	2.2	1.6	2.7
Peakers	1.4	1.1	3.3
Hydroelectric	3.5	2.2	3.0

Change in Real-time Unit Dispatch (Market Study- Production Baseline), July



Changes in unit dispatch displayed above are changes in internal generation. External transactions were held constant except for HQ Transactions, which were economically evaluated.

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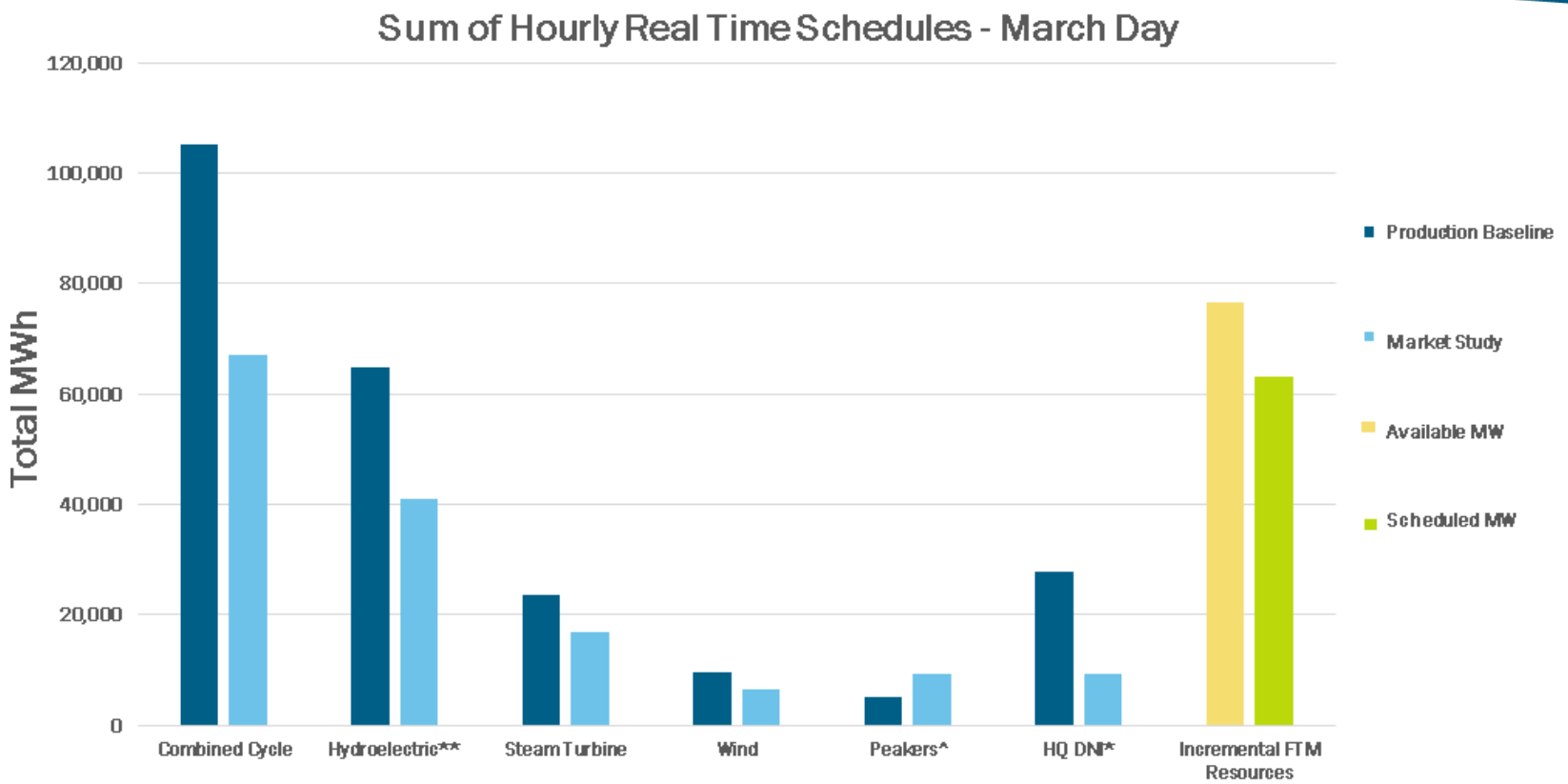

*Schedules were importing into the NYCA throughout the Production Baseline and Market Study; this figure excludes Wheels Through

**Includes pumped storage

^For the purposes of this comparison, "Peakers" were defined as the summation from Gas Turbine, Internal Combustion, and Jet Engine resource types

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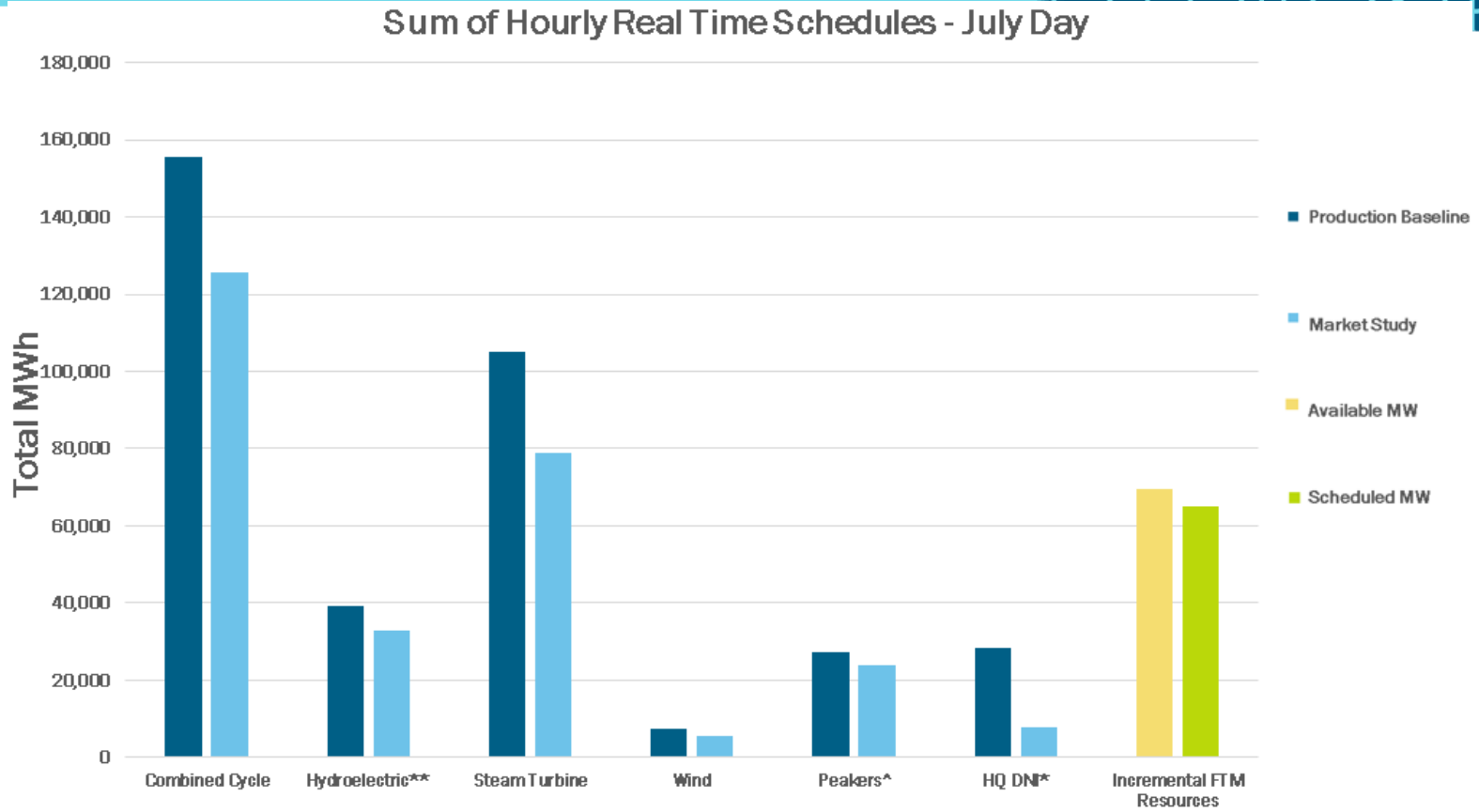

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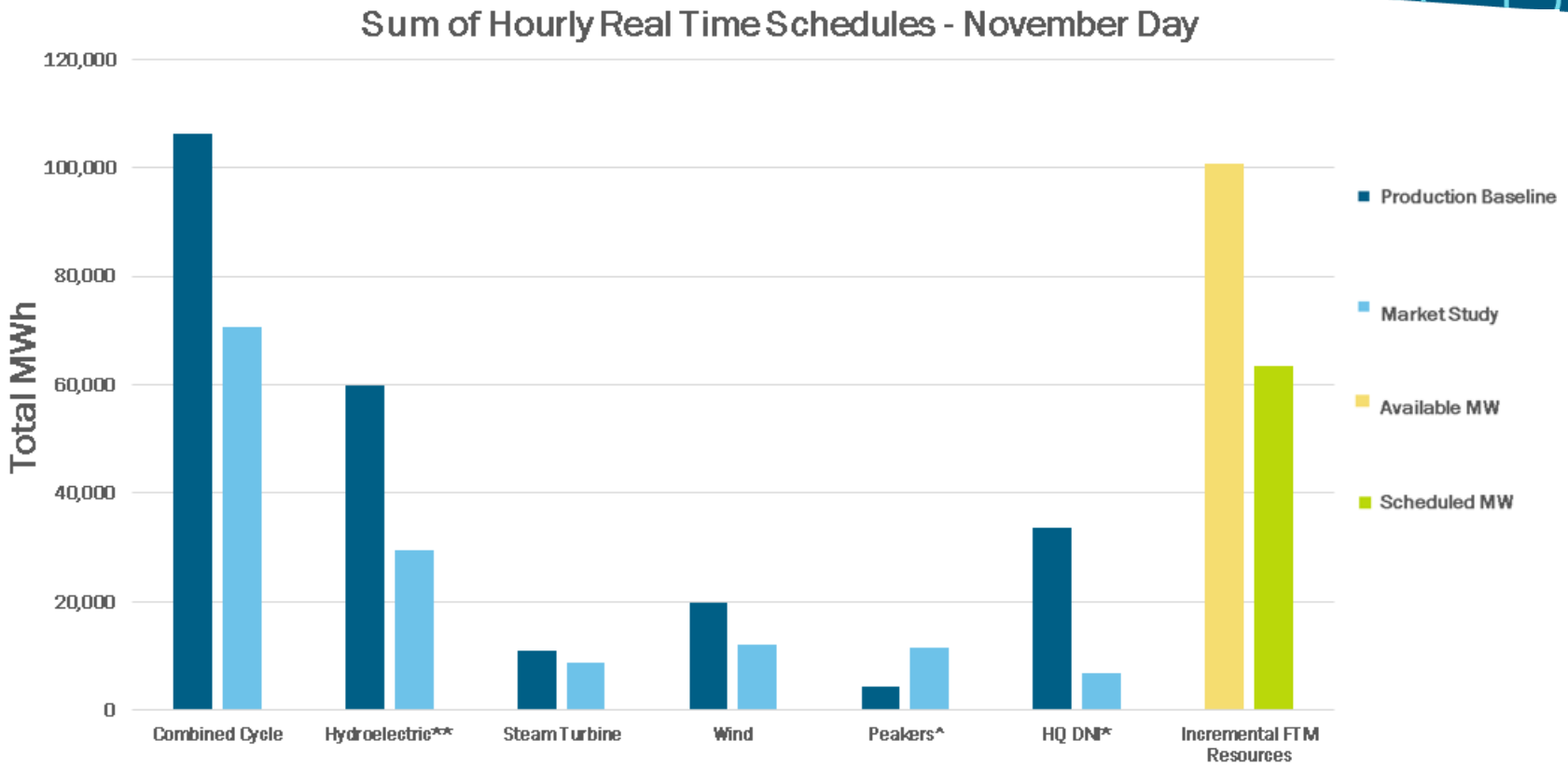

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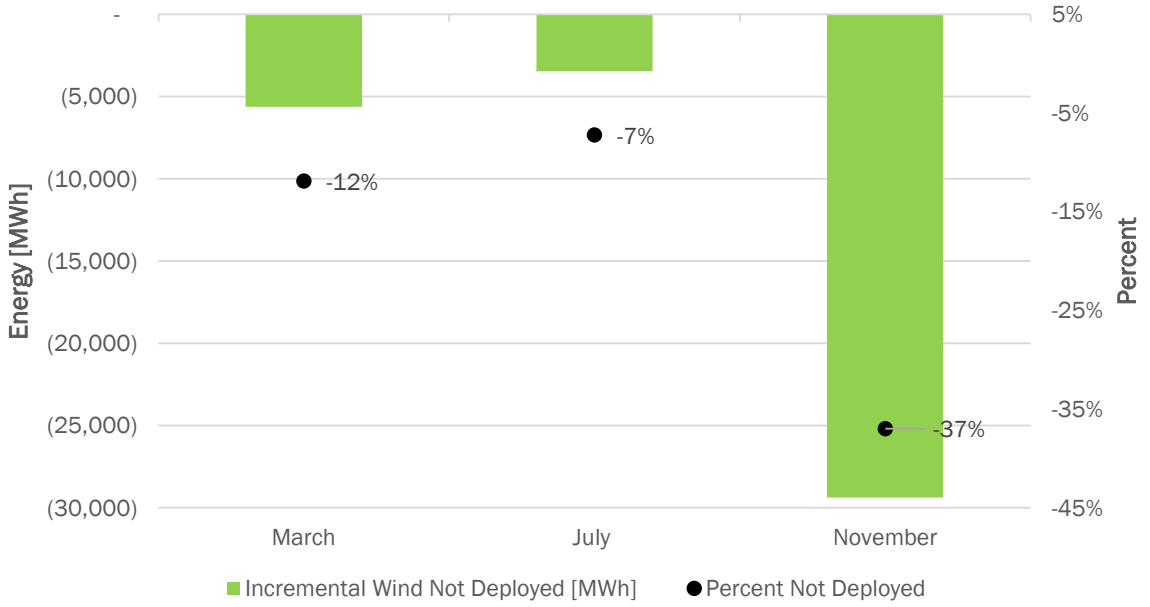
Incremental Wind Energy Not Deployed in RT

Difference between available incremental wind [MWh] and deployed incremental wind [MWh] in the real time market study



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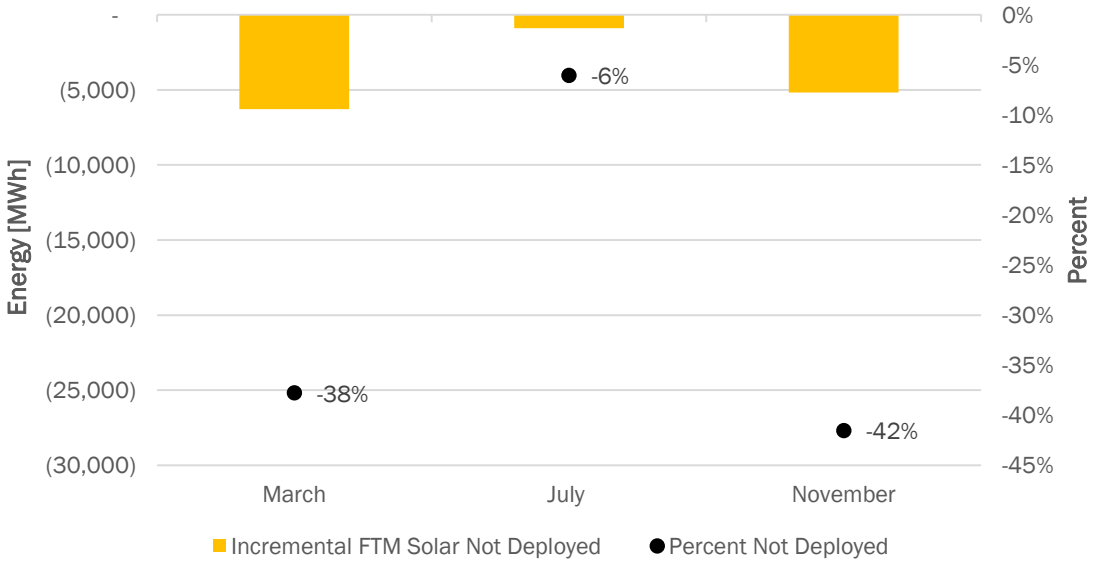
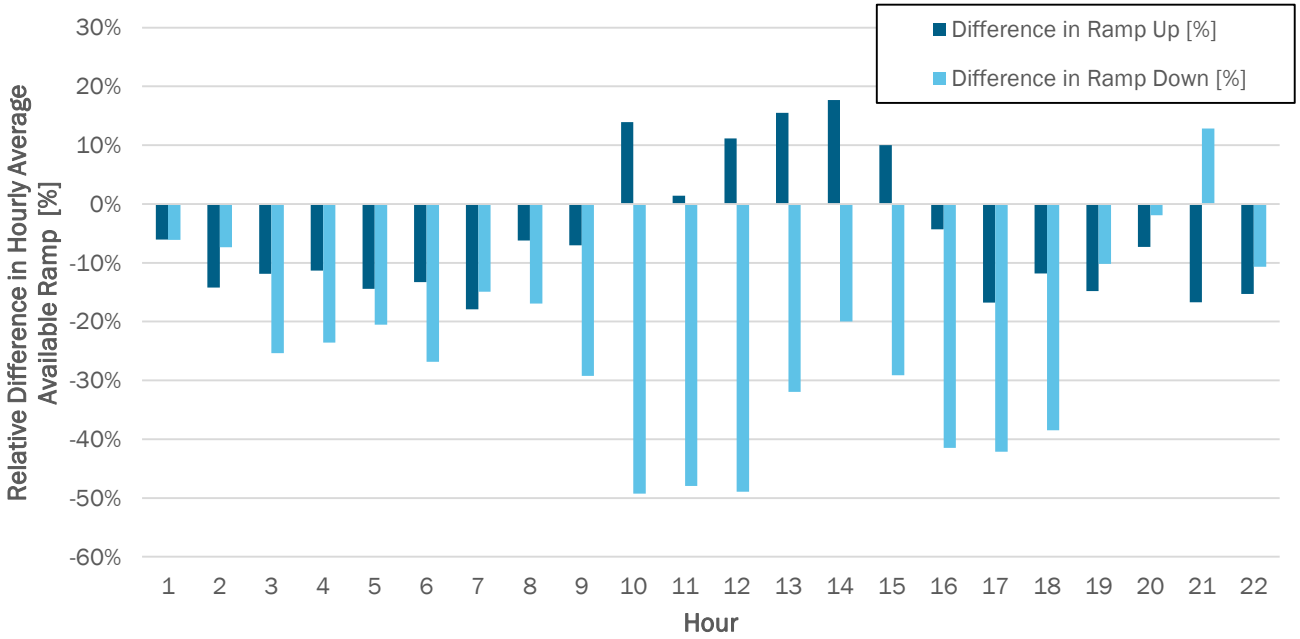
Incremental Utility-Scale Solar Energy Not Deployed in RT

Difference between available incremental utility-scale solar [MWh] and deployed incremental utility-scale solar [MWh] in the real time market study

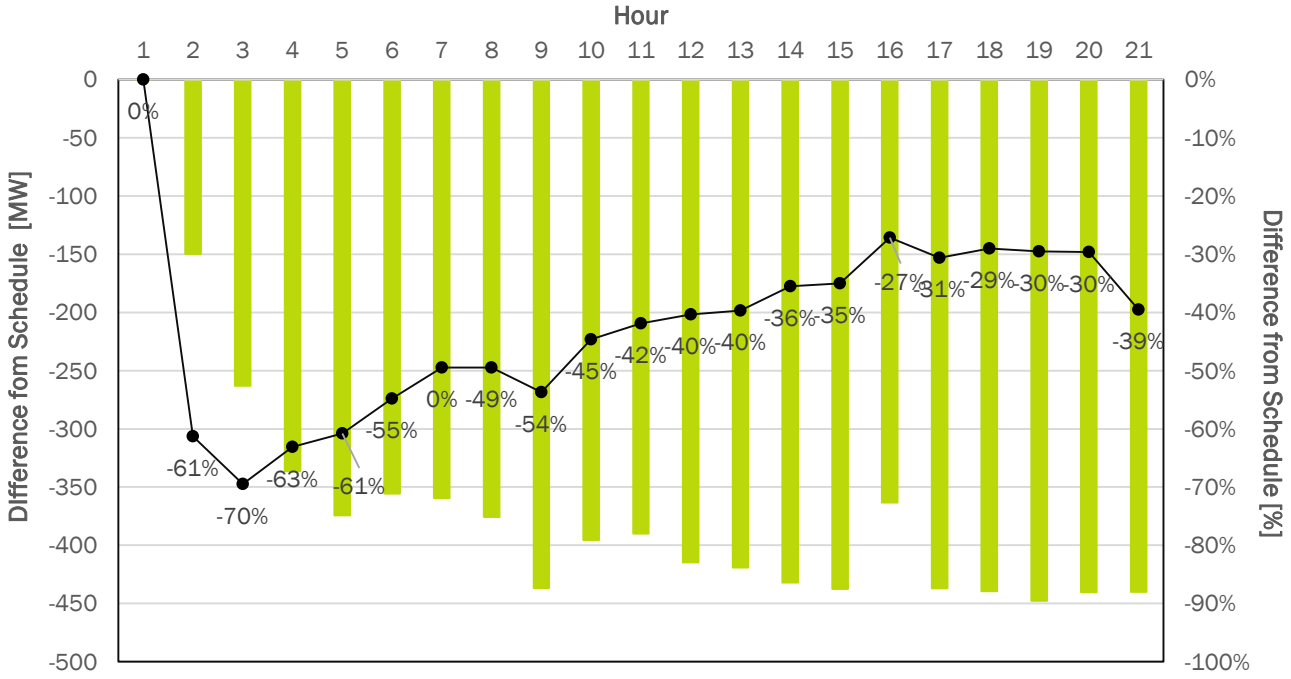


Relative Change in Flexible Generator Ramp from Production Baseline to Market Study, July Day



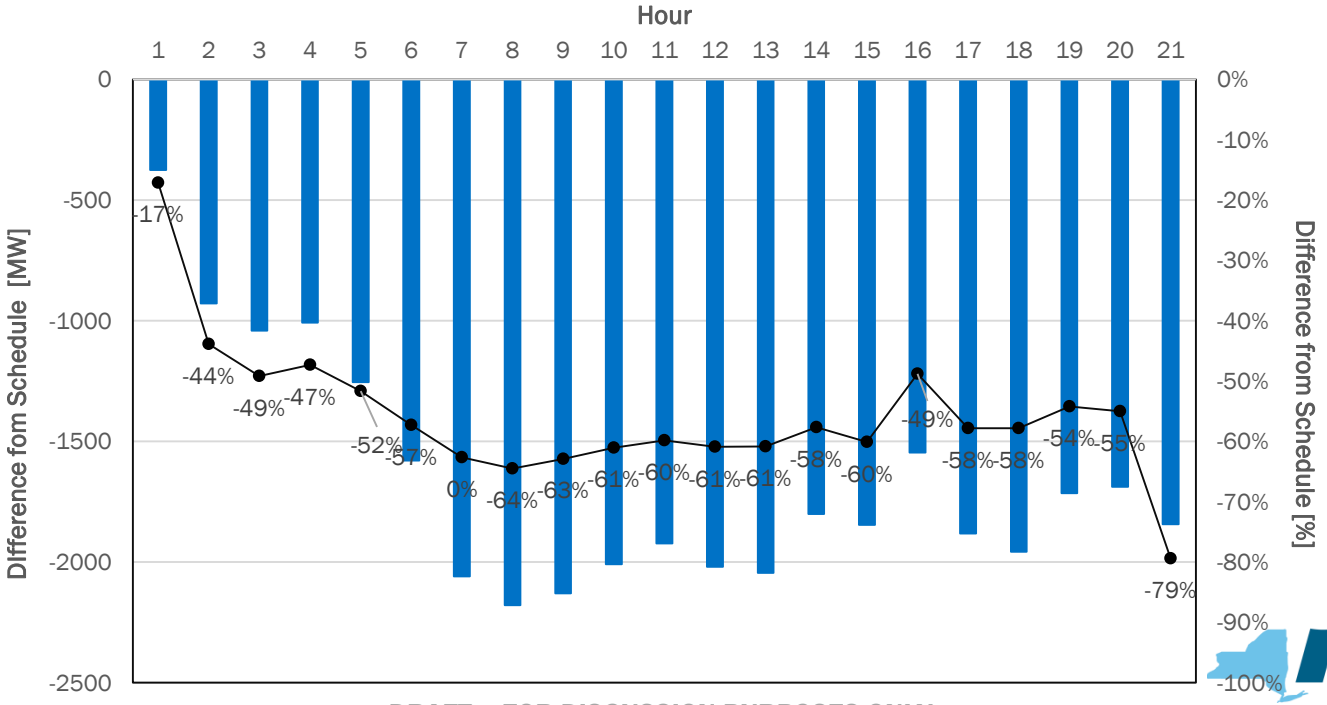
Curtailments of Existing Renewables

Difference in Real-Time Average Hourly Wind Output, November Day
(Market Study-Production Baseline)



Curtailments of Existing Renewables

Difference in Real-Time Average Hourly Hydroelectric Output, November Day (Market Study-Production Baseline)



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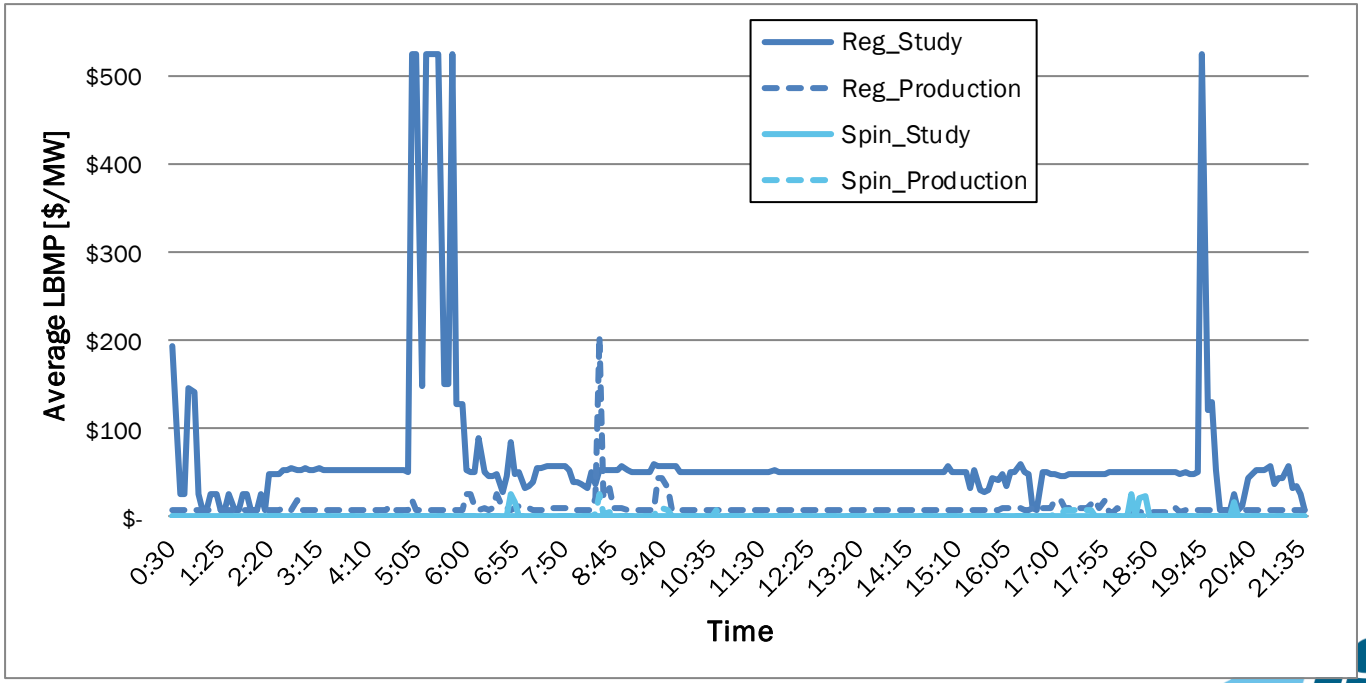
Average RTD Regulation and East Spinning Reserve, November Day



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Observations from Energy Market Study:

- Existing flexible resources were dispatched down, replaced by behind the meter resources and the renewables modeled as virtual supply.
- Reduced ramp capability observed (ramp-up and ramp-down).
- Persistently low Energy LBMP's.
- Increased net load volatility in RT.
- Incremental Renewables were not fully deployed.
- Existing renewables were curtailed.
- Regulation shortages.

Capacity Market Study

Modeling the effect on the ICAP market of additional renewable resources

- ✓ **Identify the additional resources**
  - Quantity
  - Location
  - Characteristics (*e.g.*, Unforced Capacity as a percentage of ICAP)
- ✓ **Model the effect of these resources on resource adequacy requirements**
  - Installed Reserve Margin (IRM), NYCA Minimum Installed Capacity Requirement
  - Locational Minimum Installed Capacity Requirements (LCRs)
  - http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={039DE249-C6D9-4A80-8183-349261546F1B} (See NYISO comments in the NYS Clean Energy Standard Docket, including IRM discussion)
- ✓ **Model the effect of these resources on peak demand**
  - ICAP Load forecast
- ✓ **Model the effect of these resources on Demand Curve parameters**
  - Demand Curve reference points
    - Net Energy and Ancillary Services revenues of the Demand Curve peaking unit (*i.e.*, assumed to be $0/kW-y)
    - Winter-to-Summer ratio
  - NYCA and Locality translation factors

Renewable Capacity Added by Load Zone(s)

Load Zone(s)	Nameplate MW Added
A-F	8,978
GHI	905
J	1,235
K	2,326
A-K (NYCA)	13,444

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Effect of Incremental Renewable Resources – ICAP Demand Curves

- **ICAP reference points increased**
  - Driven by the use of the assumption that the Demand Curve peaking plant receives 0$/kW-y net Energy and Ancillary Services (EAS) revenue (see the sensitivity analysis for alternate assumptions)
- **ICAP minimum requirements increased for the NYCA, remained nearly flat for the Localities**
  - Adding renewable resources increases the derating factor (locational EFORd) and thus increases the requirement
  - Adding behind the meter solar decreases peak load and thus decreases the requirement
- **Demand Curves became steeper**
  - Driven by higher reference points
- **The NYCA results are shown on the next slide**
  - Locality results are shown in the spreadsheet posted with this presentation

NYCA Final Results

UCAP SALES	NEW YORK CONTROL AREA							
			G-J Locality					
					New York City		Long Island	
[UCAP MW]	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Spot Auction Price ($/kW-Month)	$4.24	$0.00	$0.00	$0.00	-$4.24	$0.00	$4.24	$0.00
Load Forecast 2017	33,177.8	33,177.8	31,503.5	31,503.5	-1,674.3	-1,674.3	33,177.8	33,177.8
LCR/IRM Percentage	118.00%	118.00%	138.80%	138.80%	20.80%	20.80%	118.00%	118.00%
Demand Curve ICAP Ref Point	$9.08	$9.08	$12.19	$12.19	$3.11	$3.11	$9.08	$9.08
ICAP/UCAP derating factor	9.68%	7.90%	21.64%	20.95%	11.96%	13.06%	9.68%	7.90%
UCAP Ref Point	$10.05	$9.86	$15.56	$15.42	$5.51	$5.56	$10.05	$9.86
UCAP Requirement	35,361.4	36,058.8	34,264.2	34,565.0	-1,097.2	-1,493.8	35,361.4	36,058.8
Demand Curve Zero Crossing	112.00%	112.00%	112.00%	112.00%	0.00%	0.00%	112.00%	112.00%
UCAP at $0	39,604.8	40,385.9	38,375.9	38,712.8	-1,228.9	-1,673.1	39,604.8	40,385.9
Demand Curve Slope	(0.0024)	(0.0023)	(0.0038)	(0.0037)	(0.0014)	(0.0014)	(0.0024)	(0.0023)
Generation/SCR UCAP Available**	36,647.7	39,805.0	39,617.9	41,971.9	2,970.2	2,166.9	36,647.7	39,805.0
Imports	1,413.7	1,172.9	1,413.7	1,172.9	0.0	0.0	1,413.7	1,172.9
Exports	138.3	146.1	138.3	146.1	0.0	0.0	138.3	146.1
Unoffered MW	101.7	177.5	101.7	177.5	0.0	0.0	101.7	177.5
Unsold MW	4.6	164.1	4.6	164.1	0.0	0.0	4.6	164.1
Total MW Cleared***	37,816.8	40,490.2	40,787.0	42,657.1	2,970.2	2,166.9	37,816.8	40,490.2
MW Cleared Above Requirements	2,455.4	4,431.4	6,522.8	8,092.1	4,067.4	3,660.7	2,455.4	4,431.4
% Cleared Above Requirements	6.94%	12.29%	19.04%	23.41%	12.10%	11.12%	6.94%	12.29%

Overall Observations

- **Summer supply and demand balances shift most dramatically in the NYCA and Long Island**
  - Due to additional MW of renewable capacity (both wholesale and behind the meter) in these locations
- **Winter supply exceeds the zero crossing point in all locations**

Next Steps

Market Participant Engagement

Next Steps

- **2018 Deliverable: Market Design Concept Proposed, "Master Plan"**
- **Process to select and prioritize market design concepts:**
  - MIWG, January 2018:
    - Kickoff 2018 project
    - Discuss stakeholder feedback regarding whitepaper
    - Review list of proposed market design concepts
    - Review "Parking Lot" of suggested items for further analysis
  - MIWG, February 2018
    - NYISO will use stakeholder feedback and internal review to propose prioritization of:
      - » A subset of items for further analysis.
      - » A subset of concepts from the full set of concepts identified in the 2017 report.
  - Q1 2018: Begin developing concepts for further exploration.
  - Q2 2018: Propose 3-5 year vision for market design changes to accommodate Public Policy (MDCP).

Market Concepts

Examples of Market Themes & Potential Concepts
50% Renewable Resource Penetration

General Themes Driving Market Concepts:

- Availability
- Dispatchability (ramping)
- Predictability (forecast of load and supply)
- Flexibility (cycling)

- The NYISO has not prioritized these market design concepts.
- Some were proposed by stakeholders.
- Evaluation and prioritization will begin in 2018 with stakeholder input.

Capacity Market Concepts

- **Capacity market rules that it might be appropriate to enhance:**
  - DA bidding obligations
  - Output duration requirements
  - Initial performance factors for new resources

Energy Market Concepts

Flexible Ramping Product:

- Would enable the NYISO to procure additional ramp-up and ramp-down capability to mitigate increased load forecast uncertainty.
- Could be split into two distinct products: ramp-up and ramp-down.

Operating Reserve and Regulation Service Shortage Pricing

- Shortage pricing could incent market participants to offer more flexibility and responsiveness in RT.

Real-Time Operating Reserve Offer Cost Rules

- Allowing non-zero reserve offers in RT could provide a better price signal to flexible units to stay online to help manage load forecast uncertainty.

Operating Reserve Procurement

- Operating reserves could be procured beyond the minimum requirements at lower price points.

Energy Market Concepts

Changes to Offline Fixed Block Pricing

- Offline fast-start units are eligible to set prices without being committed.
- Current price signals may not accurately reflect the severity of future supply shortage conditions and/or whether sufficient resources are physically available to manage grid volatility.

Inertia, Primary Frequency Response, and Voltage Support

- Future reliability needs due to increase renewable energy production may necessitate a review of these products.

Transaction Scheduling

- DNI ramp is the change in import or export MW achievable within 10 minutes that the NYISO agrees to with a neighboring Control Area.
- The NYISO's existing DNI ramp limit may need to be modified to address load ramp volatility like that observed in the Market Study.
- More frequent transaction scheduling could help the NYISO manage real-time uncertainty and provide increased flexibility

Energy Market Concepts

Review Operating Reserve Areas and Minimum Requirements

- The amount of 10-minute total reserve procured in the NYCA is equal to the most severe contingency under normal transfer conditions, defined today as the loss of the largest single generator (~1,000 MW).
- The future most severe contingency could be related to loss of intermittent generation.

Dynamic Procurement of Reserves

- Today, Reserves are procured regionally (NYCA, EAST, SENY, and LI) based on a static requirement.
- Reserves could be procured dynamically based on changes in available transmission capability.

Review Incentives for Operating Reserve Performance

- Review financial obligations for resources that are unable to convert from reserves to energy.

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Energy Market Concepts

Constraint Specific Transmission Shortage Pricing

- Would allow price signals to form that are important for investment in and reliable operation of incremental renewable resources.

Revisions to LBMP-Based Penalties when LBMPs are Negative

- Under-generating resources that have to buy out at negative LBMPs may not be appropriately incented to follow dispatch instructions from the NYISO.

Scheduling Energy, Reserves, and Regulation on a 15-Minute Basis in the DAM

- The DAM currently procures energy, reserves, and regulation at an hourly level.
- Scheduling the DAM on a more granular basis, such as 15-minute, may improve the efficiency of the DAM commitment of resources when intermittent renewable schedules are constantly changing in RT.

Cycling Product

- The energy market clearing price paid to generators today may not account for all of the costs that a generator incurs to operate.

Energy Market Concepts

Review Regulation Capacity Requirement

- Regulation shortages can result in reliability impacts if unresolved. The NYISO periodically reviews its requirements to ensure that adequate Regulation Capacity is procured.

Separate Regulation Up and Regulation Down

- Resources may only provide Regulation today if they can move both up and down from their current Base Point.
- Resources operating at Minimum Generation cannot provide Regulation, even though they could move up.
- Likewise, intermittent resources operating at their maximum capacity cannot offer Regulation today, even though they could move down.

Regulation Movement

- When the Regulation Capacity requirement is not met, the bid of the last dispatched resource is used to set the Regulation Movement price.
- It may be necessary to rethink the optimization of Regulation Movement and to set the Regulation Movement price by a demand curve during times of shortage.

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Other Energy Market Design Concepts

- Many of the market design ideas mentioned in the whitepaper were submitted by NYISO stakeholders.
- The NYISO will continue to discuss potential market rule changes and product enhancements that prepare the wholesale energy markets to accommodate the entry of large amounts of renewable resources at future stakeholder working group meetings
  - In January, we will kickoff the 2018 project with a discussion of stakeholder feedback on the whitepaper, review the list of potential market design concepts, and review the "Parking Lot" of suggested items for further analysis
  - In February, the NYISO will propose prioritization of
    - a subset of the items identified for further analysis; and
    - a subset of the market design concepts for further consideration.

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Questions?

We are here to help. Let us know if we can add anything.

Previous Presentations

Date	Working Group	Discussion points and links to materials
9-12-16	Budget & Priorities Working Group (BPWG)	Presentation of stakeholder feedback, proposed scope of the project
10-19-16	Market Issues Working Group (MIWG)	Presentation providing more detail on the scope and timeline of the project
11-22-16	Market Issues Working Group (MIWG)	Presentation updating project status
1-31-17	Market Issues Working Group (MIWG)	Integrating Public Policy Update (Phases 1 and 2)
2-16-17	Market Issues Working Group (MIWG)	Phase 2: Study Description and Assumptions Review
3-28-17	Market Issues Working Group (MIWG)	Phase 2: Study Description and Assumption Update
4-24-17	Market Issues Working Group (MIWG)	Phase 2: Preliminary DAM Results
6-21-17	Market Issues Working Group (MIWG)	Phase 2: Real-time Study Description and Assumptions
7-13-17	ICAP Working Group (ICAP WG)	The ICAP Market - Preliminary Findings (Phase 2)
8-22-17	ICAP Working Group (ICAP WG)	IPP Phase 2 Capacity Market Results and background information
8-25-17	Market Issues Working Group (MIWG)	IPP Phase 2: Simulation Progress
9-25-17	Market Issues Working Group (MIWG)	IPP Phase 2: RT Energy Market Simulation Results
10-3-17	Market Issues Working Group (MIWG)	Presentation discussing market assessment paper
10-16-17	Market Issues Working Group (MIWG)	IPP Phase 3: Initial Concepts under Consideration
11-02-17	Market Issues Working Group (MIWG)	IPP Phase 3: Stakeholder Feedback Posted
12-5-17	Market Issues Working Group (MIWG)	IPP Phase 3: Review of Potential Market Product and/or Structure Enhancements

The Mission of the New York Independent System Operator, in collaboration with its stakeholders, is to serve the public interest and provide benefits to consumers by:

- Maintaining and enhancing regional reliability
- Operating open, fair and competitive wholesale electricity markets
- Planning the power system for the future
- Providing factual information to policy makers, stakeholders and investors in the power system

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