

Market Impact Assessment: Preliminary DAM Results Overview

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Market Issues Working Group

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Agenda

- **Overview of the Integrating Public Policy Project and Phase 2**

- IPP Project Description
- Phase 2 Market Impact Assessment
- Market Impact Assessment Assumptions for the Day Ahead Market simulations

- **Preliminary DAM Study Results**

- The preliminary simulation results are consistent with expectations:
 - Peak days (winter and summer) are impacted less by the additional renewables than shoulder days (spring and fall)
 - The Central East and UPNY/SENY interfaces bind more in the Study case than in the Production case
 - The new renewable resources in the Study case are displacing fossil generation and also displacing existing renewable (e.g. hydro) generation.

- **Next steps**

- **Summary**

- **Q&A**

- **Appendix**

Background

Date	Working Group	Discussion points and links to materials
08-17-16	Business Issue Committee (BIC)	First discussion of the possibility of an Integrating Public Policy Project
09-12-16	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 -- consultant selection and goals of Phases 1 and 2
12-14-16	Market Issues Working Group (MIWG)	Consultant's Project Introduction and solicitation of input (Phase 1)
01-31-17	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

Overview of the Integrating Public Policy Project

With a focus on the Market Impact Assessment
(Phase 2)

Integrating Public Policy

Integrating Public Policy Project

The Brattle Group Work

PHASE 1: Incorporating the Cost of Carbon Study 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

NYISO Work

PHASE 2: Market Impact Assessment 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

PHASE 3: Market Rule Assessment Study whether other market products or changes to the existing market structure will be necessary to meet the anticipated reliability needs

Phase 2: Market Impact Assessment

- **NYISO's goal is to provide stakeholders with information regarding potential market conditions with the incorporation of renewable resources to meet 50% of the NYCA load.**
 - This will provide insight into what will be needed for the Phase 3: Market Rule Assessment.
- **The NYISO will study the impact on today's market of adding sufficient renewable resources to meet the CES 50% renewable by 2030 goal.**
 - This study will be looking at how today's market rules and markets would lead to different results if, in addition to the existing generation fleet, there are sufficient additional renewable resources to reach the state's CES goal.
- **The study will be using the NYISO's market software in study mode.**
 - We have completed preliminary Day Ahead Market simulations
 - Day ahead unit commitments will be used for simulations of real-time commitment and dispatch
 - Commitment and dispatch results can be used to inform capacity market impacts
- **This study is not a planning study. The question of underlying transmission upgrades to support CES is an important one but is not part of the scope of this work.**
 - We will not be making any assumptions on generator retirements, new transmission etc.

Assumptions used in the preliminary DAM simulations

- The study assesses the system impacts of injecting incremental generation into the “as is” system.
- The study focuses on four days in 2016: a summer peak day, a winter peak day and two shoulder days (one spring, one fall).
- How much incremental generation and where?
 - The primary source of projections for the quantity and location of qualified CES renewable generation is the NYSDPS Final Supplemental Environmental Impact Statement (“Final EIS”) in CASE 15-E-0302 using the “Blend Base Case.”
- How is the 24 hour profile of the different resources determined?
 - DAM: Actual forecast data, where available, used to create the 24-hour generation shapes.
 - RT: Actual data from that day, where available, used to create 24-hour generation shapes.
- See the Appendix and the MIWG presentations on 2-16-17 and 3-28-17 for a detailed discussions of the assumptions.

Assumption Detail: Summary of Days Modeled

Day-Ahead for:	Peak Load Forecast	Peak Hour	High-Low Temp. ALB/LGA	Gas Prices TNZ6/TZ6NY	Other
January 19	22,168	18:00	23-13/29-18	\$4.20/\$6.25	Winter Peak
March 22	18,638	20:00	51-27/55-35	\$2.02/\$1.30	IP2 Refueling
July 25	31,401	16:00	89-68/91-81	\$2.91/\$2.83	Summer Peak
November 10	19,131	17:00	51-32/57-43	\$2.45/\$1.90	High Wind

Key Caveat

- The design of this study focuses on what happens on the “highways” between the load zones. The load weighted distribution of the new renewable resources (in front of and behind the meter) avoids issues that will be addressed in the interconnection process but it also means that the appearance or disappearance of intra-zonal congestion is solely an artifact of the modeling method.
 - What happens on Central East is relevant and will be reported, but we will not report on spurious congestion changes.
 - For the same reason, we will report on Zonal LBMPs and not on nodal (PTID) level prices.

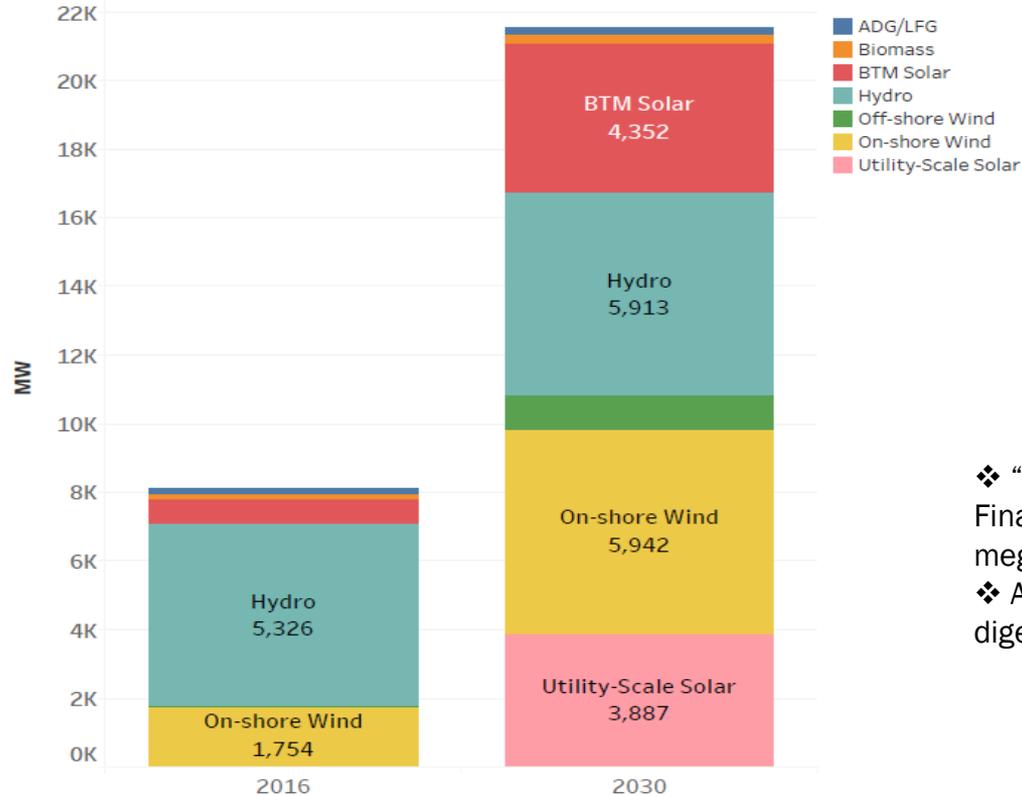


Overview of the DAM Modeling Assumptions:

■ Preliminary DAM Assumptions:

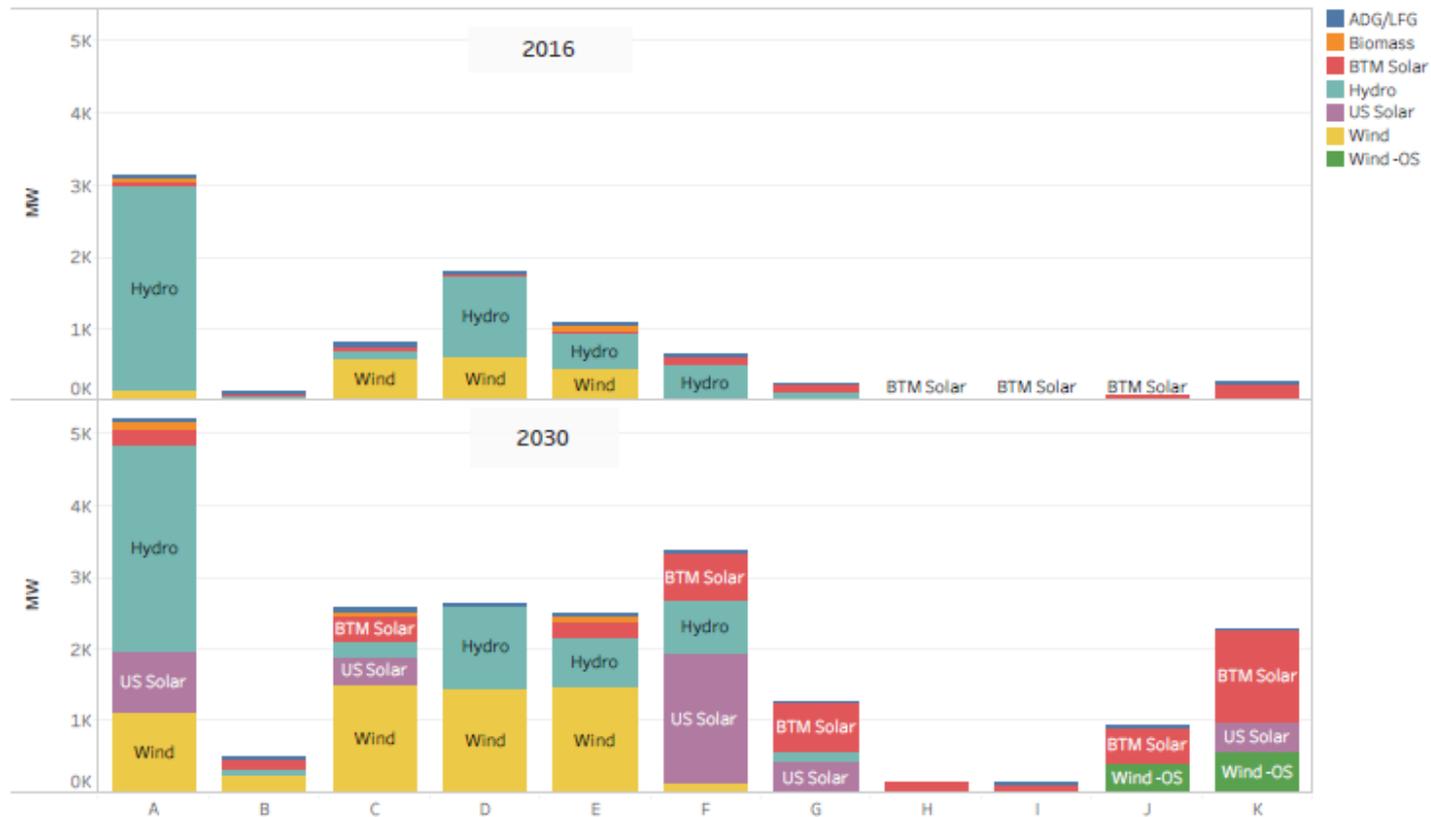
- Bid pass & forecast pass
 - New Behind The Meter (BTM) Solar resources are modeled as fixed load modifiers
 - New utility-scale renewables are modeled as virtual supply (with -\$10/MWh incremental bid in the bid pass)
 - Existing resources and existing virtuals are modeled as bid in production, except for resources bidding opportunity costs
- External Transactions
 - Fixed at production cleared quantities
- Regulation, reserves
 - Current production requirements
- Resources bidding at opportunity cost
 - Scaled and shifted based on zonal LBMP

Today's renewables and modeled renewables



- ❖ “2030” case represents NYDPS Final Supplemental EIS installed megawatt (MW) projections.
- ❖ ADG/LFG = anaerobic digester/landfill gas generators.

Distribution of Renewable Capacity



“2030” case represents NYDPS Final Supplemental EIS installed megawatt (MW) projections.

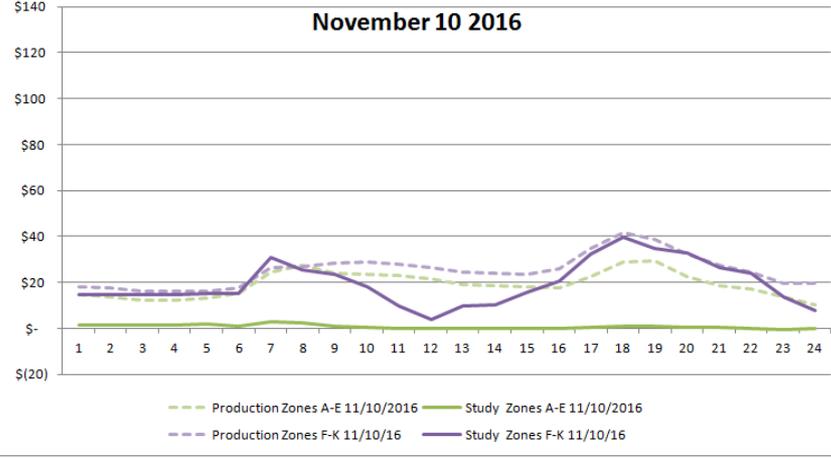
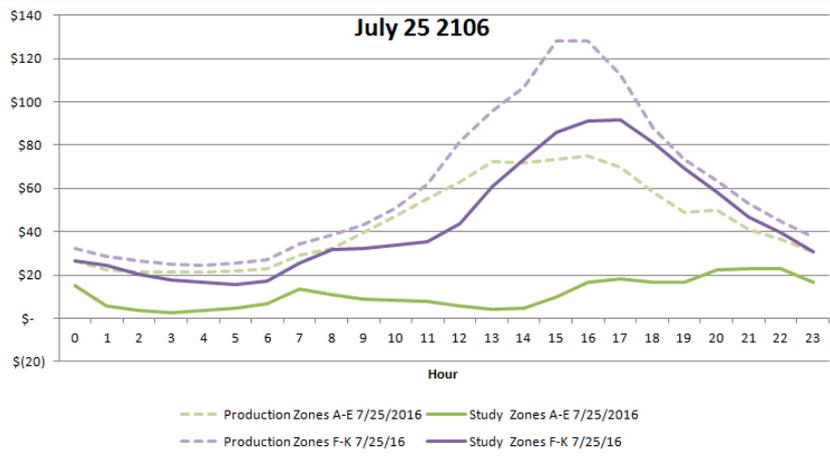
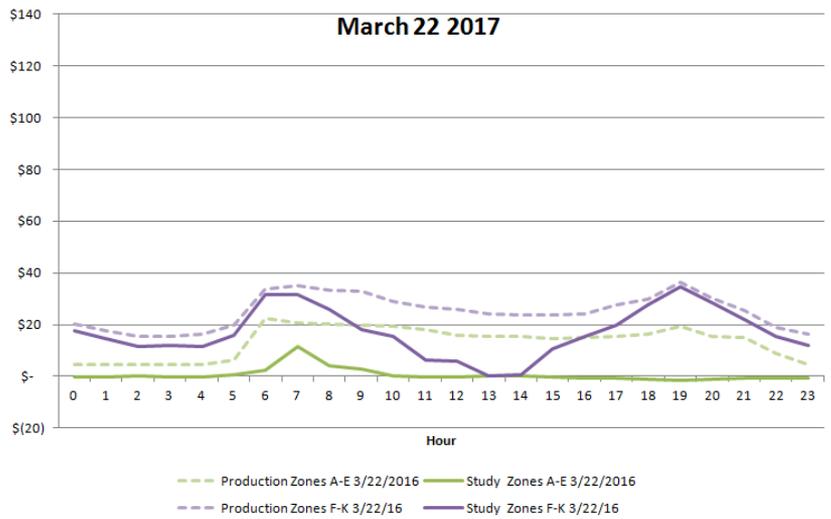
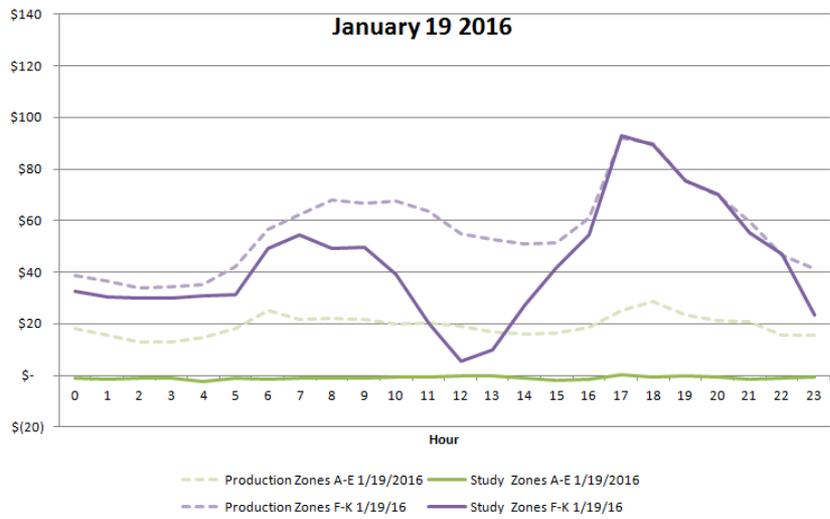
Preliminary DAM Results

No surprises so far.

Peak days (winter and summer) and shoulder days (spring and fall) are different

- The following slide shows West/North (load zones A-E) and East/South (load zones F-K) hourly LBMPs for the four study days.
 - The dashed lines show the Production LBMPs.
 - The darker solid lines show the Study LBMPs.
- Prices in the West/North fall to around zero most hours.
- Prices in the East/South decline less dramatically and also not in all hours.
- Peak days (winter and summer) are less impacted by the additional renewables than shoulder days (spring and fall).

LBMPS – Zones A-E and F-K

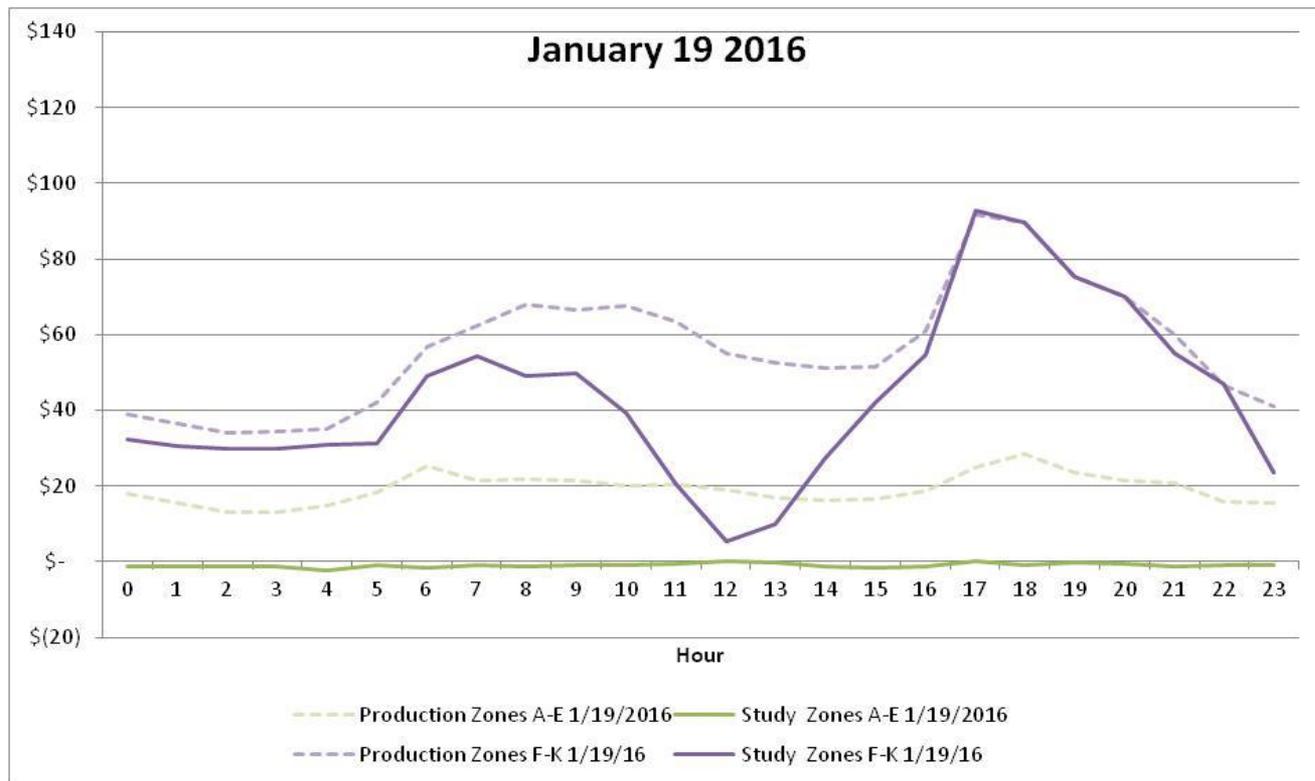


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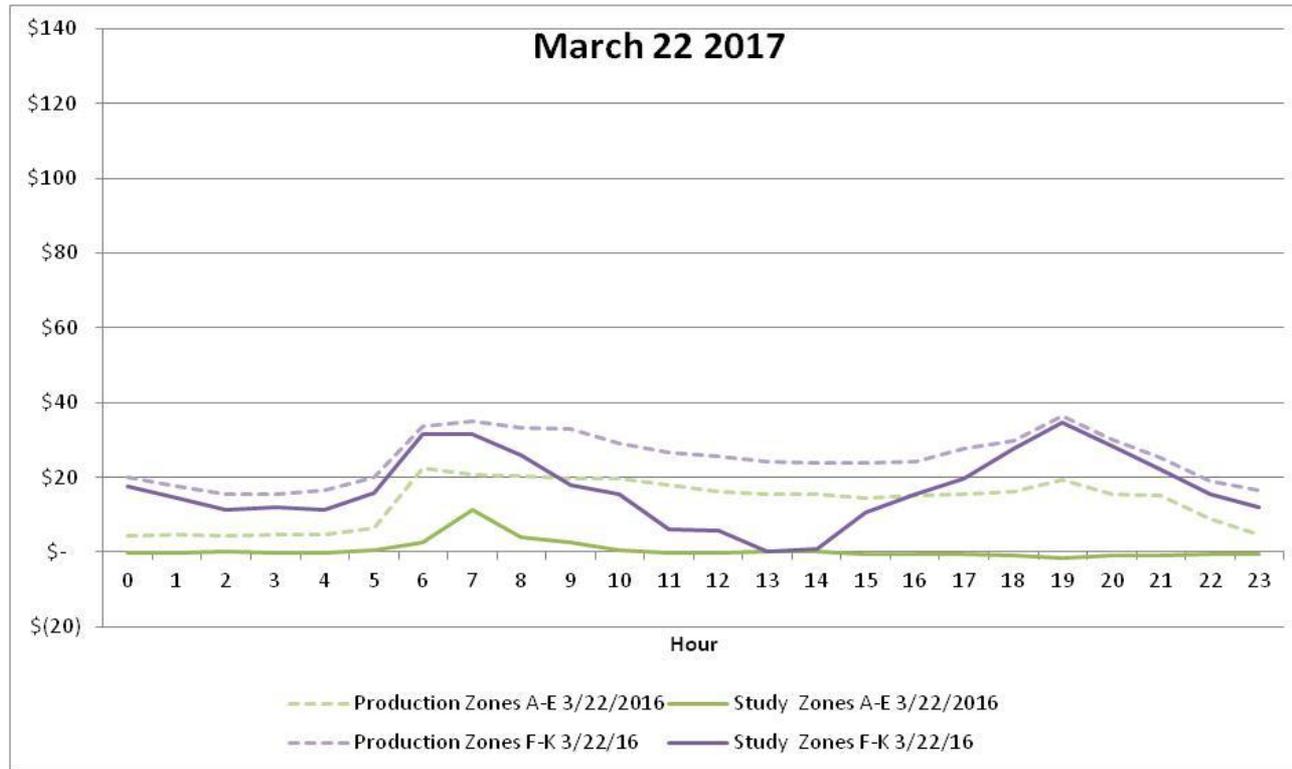
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OR

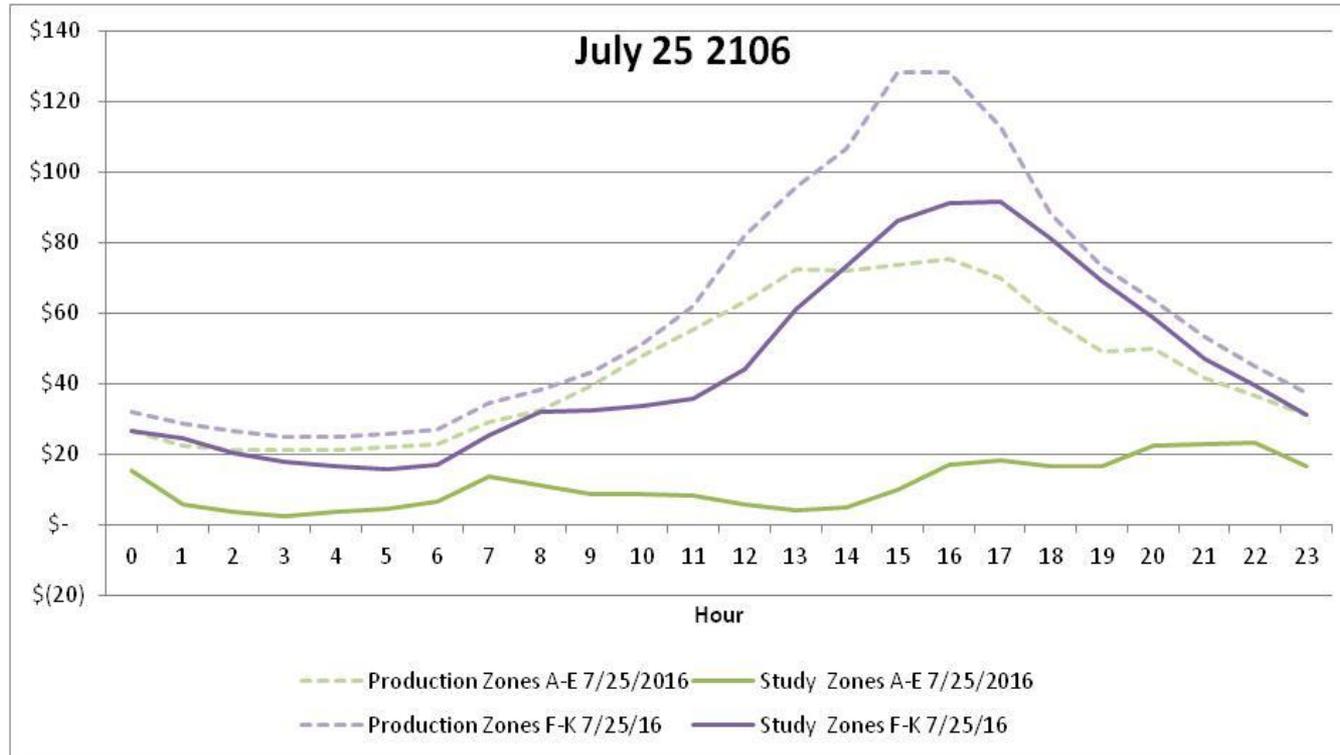
January 19 Average LBMPs



March 22 Average LBMPs



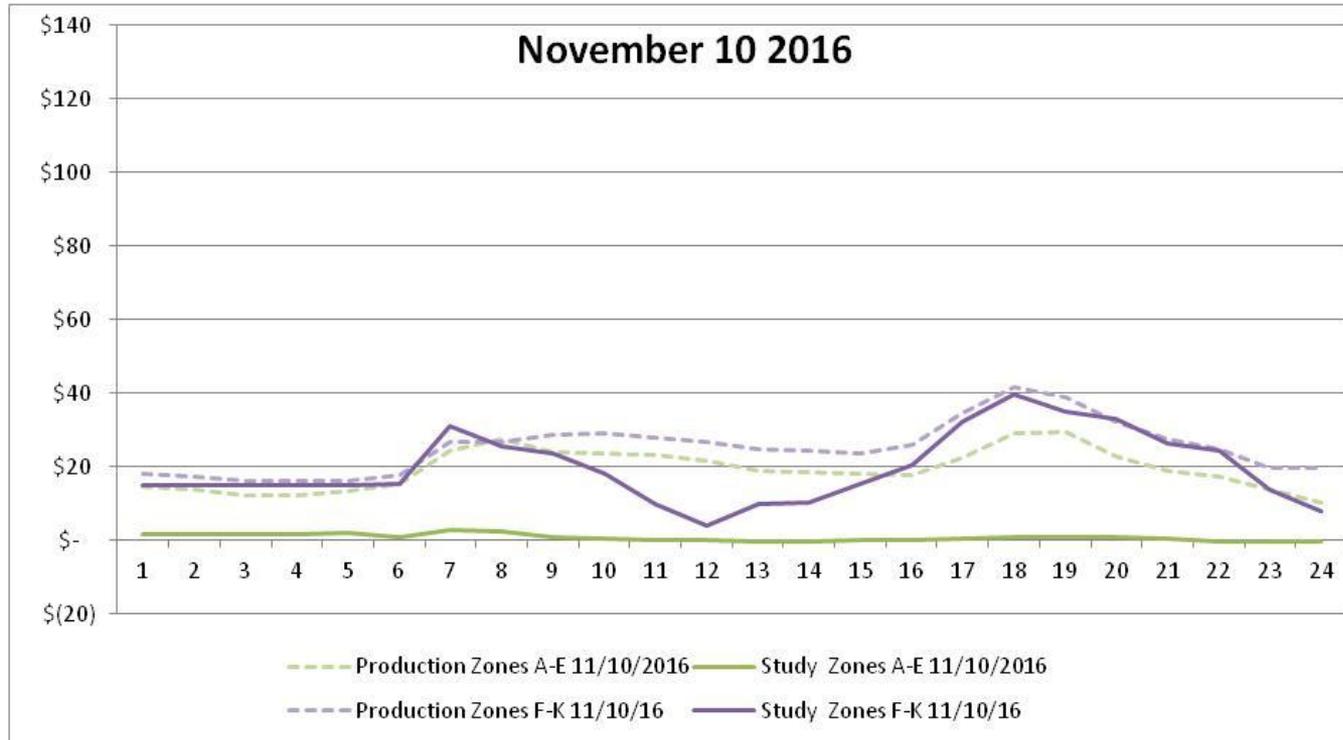
July 25 Average LBMPs



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November 10 Average LBMPs



Transmission Binds More

- In the Study cases Central East binds in more hours than occurred in Production, and at higher shadow prices
- UPNY/SENY also binds more on the peak summer day



Existing generation is backed down and flexible generation is moving more

- In most hours existing conventional (non-nuclear / non-renewable) generators in both upstate and downstate produce less MW-hours and are committed for fewer hours.
- Existing renewable generation in upstate (West of Central-east) is partially displaced by new renewable generation.
- Flexible units are observed moving up and down more to balance load and generation, with the largest changes on shoulder days
- Detailed analysis of generation commitment coming in the next update

Summary

Today's Presentation

- **Presented preliminary DAM simulation results**
 - These will change as assumptions are refined
- **The takeaways from the preliminary results are**
 - As expected, there would be lower LBMPs if approximately 13.5 GW of renewables are added to the system
 - Peak days (winter and summer) are less impacted by the additional renewables than shoulder days (spring and fall)
 - Given the locations expected in the EIS, prices in the West will be around zero in most hours
 - The Central East and UPNY/SENY interfaces are binding more in the study than in the Day Ahead Market (“production”)

Feedback

- Email additional feedback to:
IPP_feedback@nyiso.com

Questions?

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

Appendix

Assumptions Detail

■ On-shore wind

- Total MWs from EIS, Exhibit 4-1. Zonal distribution based on current NYISO Interconnection queue.
- Day Ahead wind profiles from actual production forecasts for the study day.
 - Zone F profile based on Zone C.
- Real-time wind profiles will be based on actuals
- Total GWh in EIS requires a capacity factor 50% higher than historical average for wind generators in NYCA. To match GWhs to MWs installed profiles were scaled up MW-hour profiles, respecting upper operating limits, using the following scalar:

$$\bullet \text{ MWh}_{\text{scaled}} = (2 * \text{MWh}_{\text{actual}}) - (\text{MWh}_{\text{actual}} * (\text{MWh}_{\text{actual}} / \text{MW}_{\text{nameplate}}))$$



Assumptions Detail

■ Offshore wind

- Total MWs for J and K based on EIS, Exhibit 5-20.
- Daily profiles from NREL Wind Prospector, 2012 case
 - Site south of NYC chosen for Zone J, and a site chosen off the Eastern tip on Long Island for Zone K.
- Hourly MWs scaled to annual GWh projection in the EIS

■ Behind-the-meter Solar

- MWs scaled to Final EIS assumption of 5,000 GWh
- Profile shape based on actual metered output from vendor
- July 25 to use “clear sky” profile in the DAM
- Zonal distributions based on current zonal distributions provided by NYSERDA, net of existing BTM solar

Assumptions Detail

- **Large-Scale Solar**
 - Zonal MWs directly from the Final EIS, Exhibit 5-8
 - Profile shapes based on actual metered output from vendor
 - July 25 to use “clear sky” profile in the DAM
- **Biomass**
 - New Zonal MWs from Final EIS.
 - Daily profiles based on existing facilities.
- **Anaerobic Digesters/LFG**
 - Zonal MWs from Final EIS, Exhibit 5-27.
 - Hourly profiled as flat based
- **Run-of-river Hydro**
 - Zonal MWs based on Final EIS, Exhibit 5-24.
 - Daily profiles based on like days.

Assumptions: EIS

- Final EIS projects MWs and GW-hours based on three procurement scenarios. The Blend case represents the average (50/50). Proposing to use the Base-Blend case (highlighted).

Renewable Resource	Renewable Generation (GWH)						Renewable Generation (MW)					
	Base Case			High Load			Base Case			High Load		
	PPA	Blend	Fixed REC	PPA	Blend	Fixed REC	PPA	Blend	Fixed REC	PPA	Blend	Fixed REC
Land-based Wind	6,251	5,853	5,455	8,311	7,570	6,829	1,811	1,691	1,572	2,445	2,221	1,996
Utility-scale Solar	0	151	301	354	766	1,177	0	124	248	291	632	974
Hydro	591	565	539	605	576	546	131	123	114	135	126	116
Biomass/ADG	286	485	684	732	1,098	1,464	47	75	103	111	163	215
Offshore Wind	0	0	0	0	0	0	0	0	0	0	0	0
Imports	579	654	729	1,776	1,769	1,762	154	173	192	463	463	463
Total	7,707	7,708	7,708	11,778	11,779	11,778	2,143	2,186	2,229	3,445	3,605	3,764
To 2030												
Land-based Wind	13,651	14,326	15,002	19,802	19,276	18,749	4,000	4,188	4,375	5,905	5,738	5,570
Utility-scale Solar	3,274	4,582	5,889	6,144	7,127	8,110	2,736	3,855	4,974	5,200	6,032	6,865
Hydro	2,809	2,720	2,630	2,867	2,837	2,808	608	587	566	624	616	609
Biomass/ADG	722	1,179	1,637	732	1,602	2,472	110	175	240	111	235	359
Offshore Wind	6,839	4,275	1,711	7,826	6,646	5,467	1,599	1,000	400	1,830	1,554	1,278
Imports	1,759	1,972	2,185	2,879	2,761	2,644	455	516	576	834	777	721
Total	29,054	29,054	29,054	40,250	40,249	40,250	9,508	10,321	11,131	14,504	14,952	15,402

Source: Final Environmental Impact Statement, Exhibit 4-1

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Assumption Detail

- Summary of Final EIS GWh & NY Sun for BTM Solar used in Modeling Assumptions

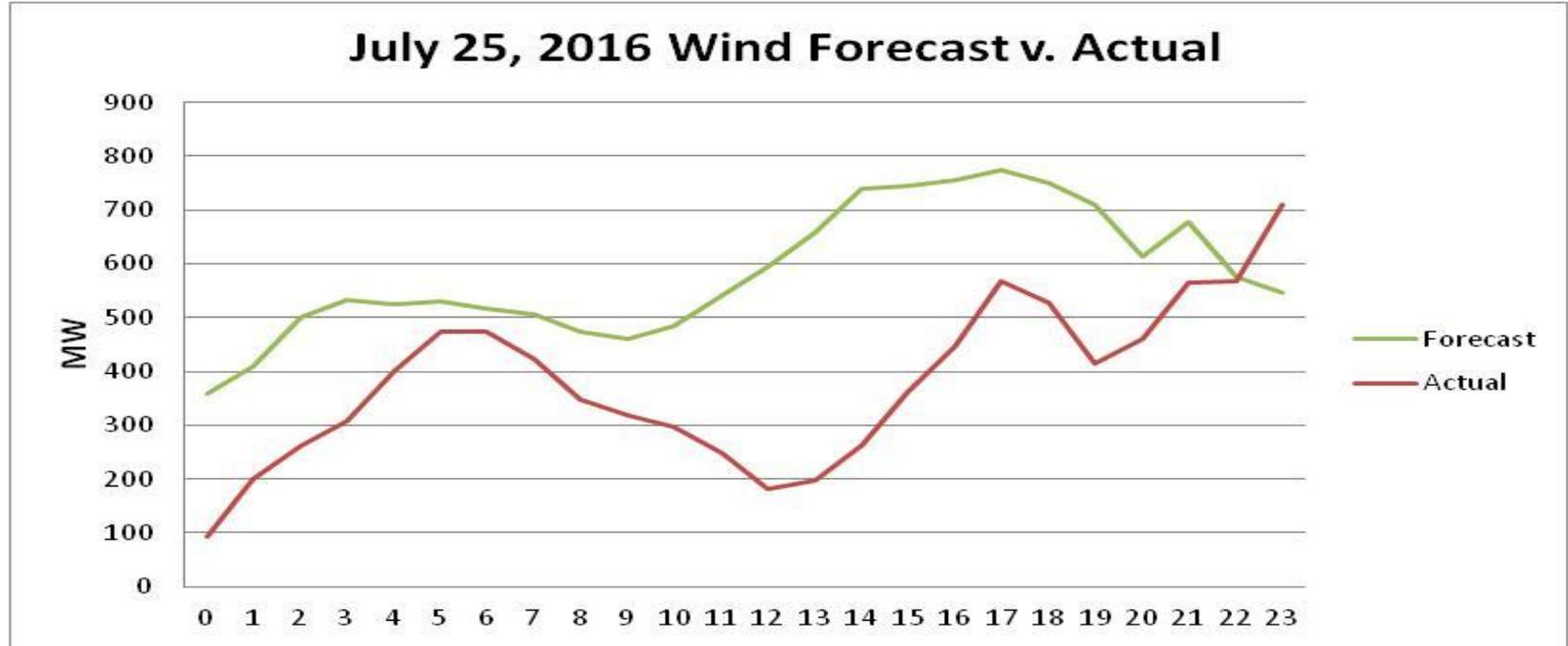
Incremental Energy GWh in Assumptions from Final EIS 2030 Blend Case						
	Incremental		Existing		Total	
	GWH	MW	GWH	MW	GWH	MW
Land-based Wind	14,326	4,188	3,984	1,754	18,310	5,942
Utility-scale Solar	4,582	3,855	52	32	4,634	3,887
Hydro	2,720	587	26,704	6,727	29,424	7,314
Biomass/ADG	1,179	175	422	148	1,601	323
Offshore Wind	4,275	1,000	-	-	4,275	1,000
BTM Solar	5,000	4,350	811	712	5,811	5,062
Total	32,082	14,155	31,973	9,372	64,055	23,527
"Existing" here is based on 2016 Gold Book. Existing in Final EIS uses 2015 Gold Book						

Assumptions: Incremental Energy by Zone

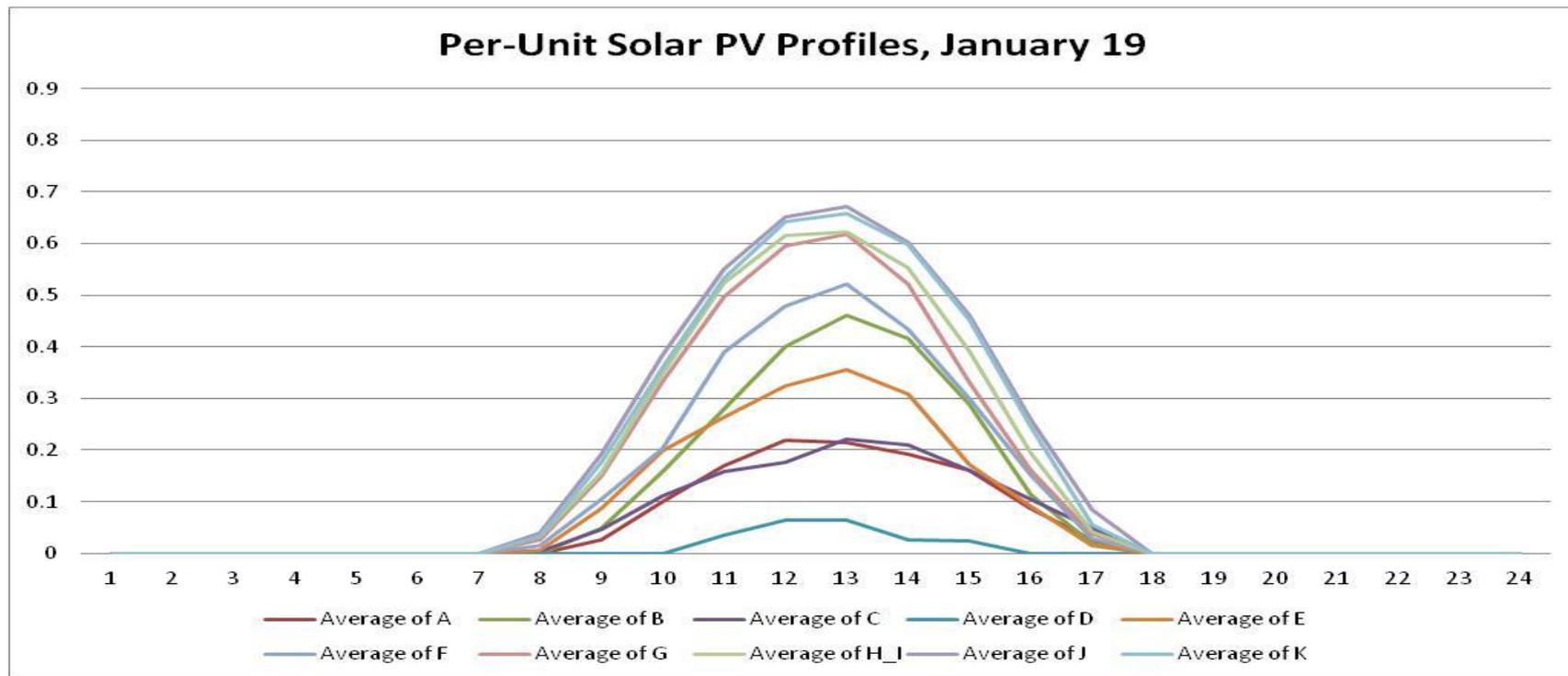
- For incremental energy, assessment uses Final EIS projected MWs, plus behind-the-meter solar based on GWh target in Final EIS (matching GW-hours shown in appendix of presentation).

MW 2016	A	B	C	D	E	F	G	H	I	J	K	Total
On-shore Wind	136	7	569	601	442							1,754
Off-shore Wind												-
Utility-Scale Solar											32	32
Hydro	2,865	65	132	1,163	492	502	107					5,326
Biomass	56				92							148
ADG/LFG	29	16	50	6	11	14	6				6	137
BTM Solar	38	23	56	2	34	113	114	18	23	82	209	712
EIS MW ("INCREMENTAL")												Total
On-shore Wind	981	238	947	851	1,031	141						4,188
Off-shore Wind										408	591	999
Utility-Scale Solar	841		391			1,812	431	7			373	3,855
Hydro	8	30	72		219	213	28	17				587
Biomass	57		65									122
ADG/LFG	5	4	2			2			3	34	3	53
BTM Solar	193	117	287	10	174	577	584	91	118	419	1,069	3,640
TOTAL MW ASSUMED FOR STUDY												Total
On-shore Wind	1,116	245	1,516	1,452	1,472	141						5,942
Off-shore Wind										408	591	999
Utility-Scale Solar	841		391			1,812	431	7			405	3,887
Hydro	2,873	95	204	1,163	711	715	135	17				5,913
Biomass	113		65		92							270
ADG/LFG	34	20	52	6	11	16	6		3	34	9	190
BTM Solar	231	140	343	12	208	690	698	109	141	501	1,278	4,352
TOTAL	5,208	500	2,570	2,633	2,495	3,374	1,269	133	144	943	2,283	21,552

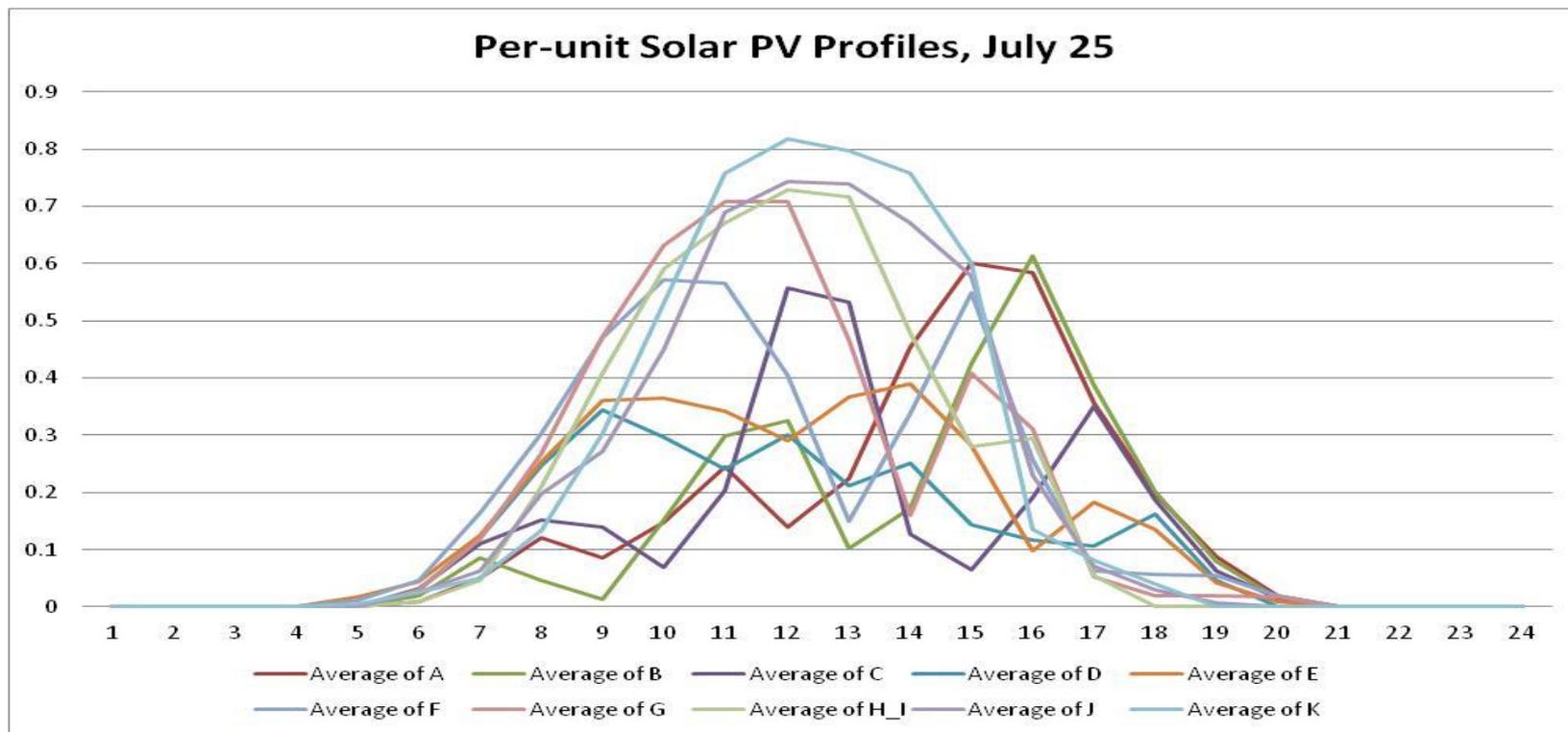
Wind Forecast v. Actual



Solar on January 19



Solar on July 25



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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