New York ISO
Independent System Operator

Consumer Impact Analysis: Hybrid Storage Participation Model

Reposted in Response to Stakeholder Feedback

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Agenda

- Project Description
- Proposed Options
- Potential Benefits
- Overview
- Energy Market Impact
- Capacity Market Impact
- Other Impacts
- Appendix I
- Feedback
- Next Steps

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Project Description

- This project seeks to develop interconnection and market participation rules for front-of-the-meter renewable generators co-located with Energy Storage Resources by developing market rules that integrate large-scale weather dependent and energy storage resources co-located behind a single interconnection point
- This presentation addresses the consumer impact analysis of Hybrid Storage Resources

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Proposed Options for Hybrid Storage Resources (HSR) Participation

- **Hybrid Option 1 (Co-located Storage Resource or CSR) : Each resource component within the CSR will have a distinct PTID/bid/schedule/settlement. The injection limit for the CSR can be less than the combined capability of the component resources[1]**
  - The NYISO is pursuing this option with stakeholders for Market Design Complete in 2020
- **Hybrid Option 2 (Aggregated Hybrid Storage Resource (HSR)): HSR will have a single PTID/bid/schedule/settlement.1 The injection limit for the HSR can be less than the combined capability of the component resources. The NYISO is evaluating the feasibility of allowing HSRs that include a combination of Intermittent Power Resources (IPR) and Energy Storage Resources (ESR) to provide ancillary services**
  - The NYISO is pursuing this option with stakeholders for Market Design Concept Proposal in 2021

1. For more details on the options, please refer to 4.14.20 ICAPWG/MIWG discussions on "Hybrid Storage Model – Initial Market Design Concept Overview" https://www.nyiso.com/documents/20142/11904936/Hybrid%20Storage%20Model%20MIWG%2004142020%20Final.pdf/08841944-5251-4497-c52b-105151f150ad

Potential Benefits

- Developing a market participation model for front-of-the-meter generators plus storage will better align the NYISO's market procurement with State and Federal efforts to integrate more clean energy into the grid
- Hybrid resources have the potential to reduce output volatility and improve the availability of intermittent resources
- Developers may avail themselves of State and Federal initiatives/incentives such as Federal Investment Tax Credit (ITC), REC procurements, to couple storage and intermittent renewable assets

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Overview

- To compute consumer impacts, a spreadsheet analysis was conducted to test the impact of CSR/HSR penetration on energy market LBMPs
- Due to a lack of experience with actual CSR/HSR in operation, sensitivity analysis was performed on the amount of CSR/HSR penetration, the impact of CSR/HSR on LBMPs and the availability of CSR/HSR in the market
- With regards to duration, we computed the impact of 4 hour duration CSR/HSR
- For the capacity market, in addition to the sensitivities discussed above, we also provide a sensitivity analysis for the assumed comparability of CSR/HSR with traditional Resources to account for the impact of CSR/HSR on IRM and LCRs (0%, 25% and 50% impact on capacity requirements)
- Uncertainty remains with respect to where CSR/HSR will locate, how they will bid, their penetration and availability
  - These factors and others will ultimately shape the impact that CSR/HSR have on consumer costs
- The purpose of this analysis is to provide a range of possible outcomes based on the sensitivities discussed here

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Consumer Impact Analysis (IA) Evaluation Areas

- Summary of potential impact on all four evaluation areas

RELIABILITY

From an operational perspective, additional supply could be a reliability benefit, however, properly determining the capacity value of CSR/HSR and their impact on IRM/LCRs is important to avoid unintended adverse impacts to reliability

COST IMPACT/ MARKET EFFICIENCIES

The wholesale energy market consumer impact varies widely from an estimated savings of roughly $1.6 million to $15.5 million based on CSR/HSR penetration and availability.

The short-term analysis shows significant capacity market savings, however, these savings may not be sustainable as retirements and other changes will result from the influx of CSR/HSR penetration.

The long-term analysis shows no capacity market savings as the market moves towards equilibrium

ENVIRONMENT/ NEW TECHNOLOGY

CSR/HSR could enable greater adoption of renewables and that should further increase decarbonization

TRANSPARENCY

No impact expected

Potential Energy Market Impact Estimate

Energy Market Impact Estimate Assumptions

- **Since we don't know how much CSR/HSR capability will be available, we provide estimates over a range of expected values.**
  - Assumed a range of CSR/HSR penetration of 100MW, 250 MW and 500MW added to the fleet.
- **The impact to the Day-Ahead NYISO reference bus historical energy prices for all intervals in 2019 was calculated using the assumptions outlined on this and the next slide.**
  - The short run energy market impact of CSRs/HSRs was approximated using:
    - Day-ahead NYISO reference bus prices
    - Real time actual time weighted integrated load
- **The consumer impact of CSR/HSR resources for both upstate (Zones A-F) and downstate (Zones G-K) was estimated for multiple scenarios as shown in the table below. A diminishing impact for additional MWs is considered, as outlined in the table below:**

MW	Impact	Percent impact calculation
100	1.0%	1% x 100 = 1.0%
250	1.75 %	0.5% x 150 + 1.0% = 1.75%
500	2.375%	0.25% x 250 +1.75%%= 2.375%

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Energy Market Impact Estimate Approach

- **The study considered a 4 hour duration for CSRs/HSRs.**
  - Injections were assumed to take place during two sets of seasonal hours:
    - Summer (May through October) from HB12:00 to HB19:00
    - Winter (November through April) from HB14:00 to HB21:00
  - The consecutive hours of production with the highest revenue was used in the analysis for the 4 hour duration calculations.
- **The hourly price impact was multiplied by its respective hourly load for both upstate and downstate.**
  - A constant resource availability factor of 20%, 50%, or 80% was then be applied to provide the estimated consumer impact range.

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Potential Energy Market Impact Estimate Analysis

- **Computed the hours expected to be impacted by CSR/HSR MW for each day.**
  - For example, if the highest revenue 4 hour range on one summer day was 13, 14, 15, 16, then this set of hours for the given day was included when calculating the impact from a 4 hour duration CSR/HSR.
- **Adjusted the prices of the DA hours by the percentage associated with the CSR/HSR MW (100 MW, 250 MW or 500 MW).**
  - See the prior slide
  - This is used to calculate a price delta (for example, -1.75% times a $30 price equals a savings of $0.525).
  - The analysis essentially assumes that hybrid resources are inframarginal
- **Multiplied the price delta with its respective hourly RT TWI (Time Weighted Integrated) load value to compute the consumer impact for both upstate and downstate locations.**
- **Applied an availability factor (20%, 50%, or 80%) to the above calculation.**

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Potential Energy Market Impact Estimate Results- Conclusion

- Considering the assumptions used for availability, total CSR/HSR MW, and a four hour duration, the potential statewide energy market consumer impact estimate can vary widely from an estimated savings of roughly $1.6 million to $15.5 million if Hybrid resources and CSRs are added to the NYCA.

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Potential Energy Market Impact Estimate

- The table below shows the potential Energy market impact estimate for various levels of CSR/HSR MW additions (100MW, 250MW, or 500MW).

Based on Pricing Data from the NYISO Reference Bus: For list of detailed assumptions, see slides 9, 10 and 11

Percent Price Reduction	Estimated Potential Consumer Impact (Upstate)	Estimated Potential Consumer Impact (Downstate)	Estimated Potential Consumer Impact (Statewide)
1% (100 MW)	$0.7 Million to $2.7 Million	$1 Million to $3.9 Million	$1.6 Million to $6.5 Million
1.75% (250 MW)	$1.2 Million to $4.7 Million	$1.7 Million to $6.8 Million	$2.9 Million to $11.5 Million
2.375% (500 MW)	$1.6 Million to $6.3 Million	$2.3 Million to $9.2 Million	$3.9 Million to $15.5 Million

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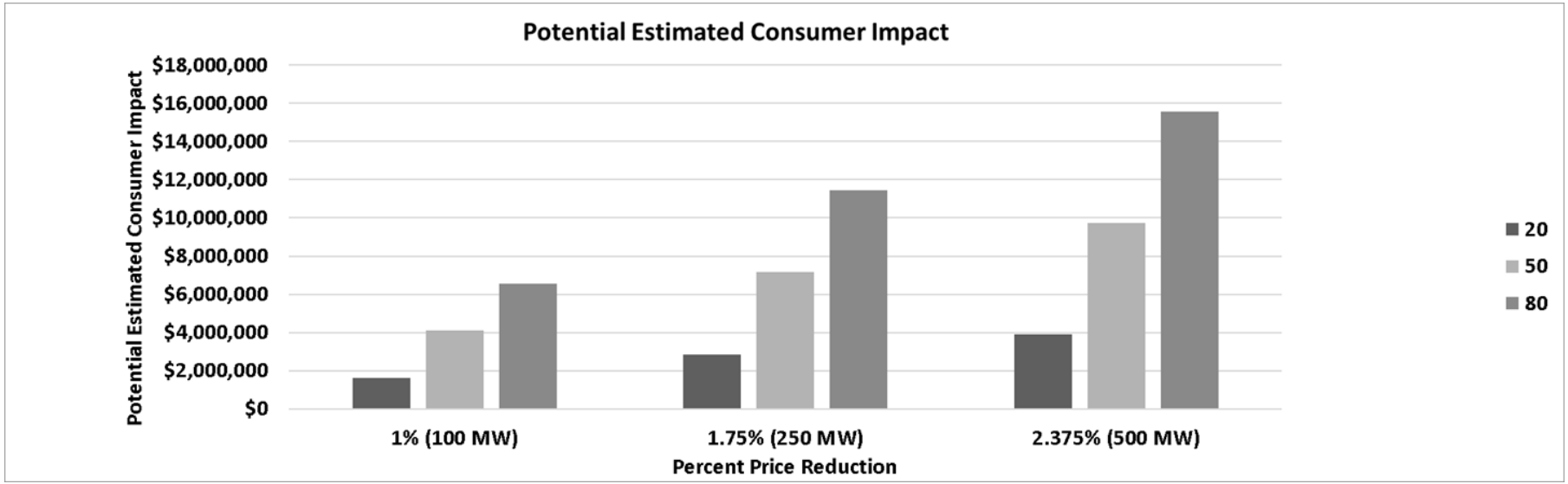
Potential Energy Market Impact

Estimate Results - Statewide

Based on Pricing Data from the NYISO Reference Bus: For list of detailed assumptions, see slides 9, 10 and 11

- Statewide estimate with Availability: 20%, 50%, or 80%



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Potential Capacity Market Impact

Capacity Market Impact Assumptions

- Consistent with the energy market impact analysis, the capacity market impact scenarios used 100 MW, 250 MW and 500 MW of CSRs/HSRs
- Assumed 90% of CSRs/HSRs Upstate (Zones A-F) and 10% Downstate (Zone J)
  - Assumed 80% intermittent and 20% storage in all scenarios and zones
  - Assumed 75% of the upstate intermittent components were wind and 25% were solar
  - 100% of the downstate intermittent components were assumed to be solar
- Production factors for intermittent units within CSRs/HSRs were the default values from the ICAP Manual
  - Wind: 10%(summer), 30%(winter)
  - Solar: 46%(summer), 2%(winter)
- Used the five-year average NERC EFORd for pumped storage of 6.02% as the derating factor for storage units within CSRs/HSRs, which is consistent with the ESR consumer impact analysis
- Derates on CSR/HSR injection limits are expected to be infrequent and therefore were not included in the analysis

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Capacity Market Impact Assumptions (cont'd)

- Sensitivities modeled CSRs/HSRs having a 25%, 50%, and 75% impact on capacity requirements for each CSR penetration level modeled
  - These different impact levels provide a range of comparisons between CSR/HSRs and traditional Resources to account for potential impacts of CSR/HSRs on IRM and LCRs
- CSRs/HSRs were modeled consistent with the capacity supplier payment structure proposed in the CSR/HSR project and ultimately adopted as part of the stakeholder process
- Assumed that most of the CSRs/HSRs will participate in the wholesale market as capacity providers
- Impacts of the Tailored Availability Metric project were not included in this analysis

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Short Term Capacity Cost Impact Approach

- **Used the 2020 as-found system as a base case, for both short term and long term consumer impact analyses**
  - 2020 as-found system with additions of 100MW, 250MW and 500MW of HSR penetration (MWs additions consistent with earlier discussion)
- **The short-run impact analysis assumed no additional changes to generation**
- **The impacts shown in the short run may not be sustainable, as retirements and other changes will result from the influx of capacity additions**
  - We address this in the long run analysis, that assumes a supply level based on the historic level of excess

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Short Term Capacity Cost Impact

- The last three columns of slide 20 show the MW impact of different levels of CSR/HSR penetration with varying impacts on capacity requirements
  - The MW impacts drive the change in capacity market impacts relative to the base case
- For Example, in slide 20 the first row shows an increase of 25 MW in the ICAP requirement reflecting the 25% comparability case (100 MW * .25), which translates to a decrease in Summer UCAP requirement of 26 MW
- Summer UCAP supply on the other hand, increases by 34 MW, which accounts for the 4 hour duration ESRs within the CSR/HSRs that have a 90% capacity value
- The increase in summer UCAP supply combined with the decrease in summer UCAP requirement, along with a similar result in the winter, results in a decrease in annual capacity cost of $30 million relative to the base case

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Potential Estimated Short Term Capacity Cost Impact

Short Term Results Summary														
		Annual Capacity Cost ($M)						MW Impacts						
% Impact on ICAP Requirements	CSR/HSR Penetration (ICAP MW)	ROS	GHI	NYC	LI	Total	Total Minus Base	NYCA ICAP Requirement	NYCA Summer UCAP Requirement	NYCA Summer UCAP Supply	Net Summer UCAP Impact	NYCA Winter UCAP Requirement	NYCA Winter UCAP Supply	Net Winter UCAP Impact
25	100	469	146	2229	432	3275	-30	25	-26	34	60	-28	34	61
25	250	444	138	2214	432	3228	-78	63	-64	86	149	-69	84	153
25	500	402	125	2191	432	3149	-156	125	-126	171	298	-138	168	306
50	100	475	148	2233	432	3288	-18	50	-4	34	38	-5	34	39
50	250	461	143	2225	432	3260	-45	125	-9	86	95	-12	84	96
50	500	437	135	2212	432	3216	-89	250	-18	171	189	-24	168	192
75	100	482	150	2237	432	3301	4	75	18	34	16	18	34	16
75	250	478	149	2235	432	3294	11	188	46	86	40	45	84	39
75	500	472	146	2233	432	3283	22	375	91	171	80	90	168	78

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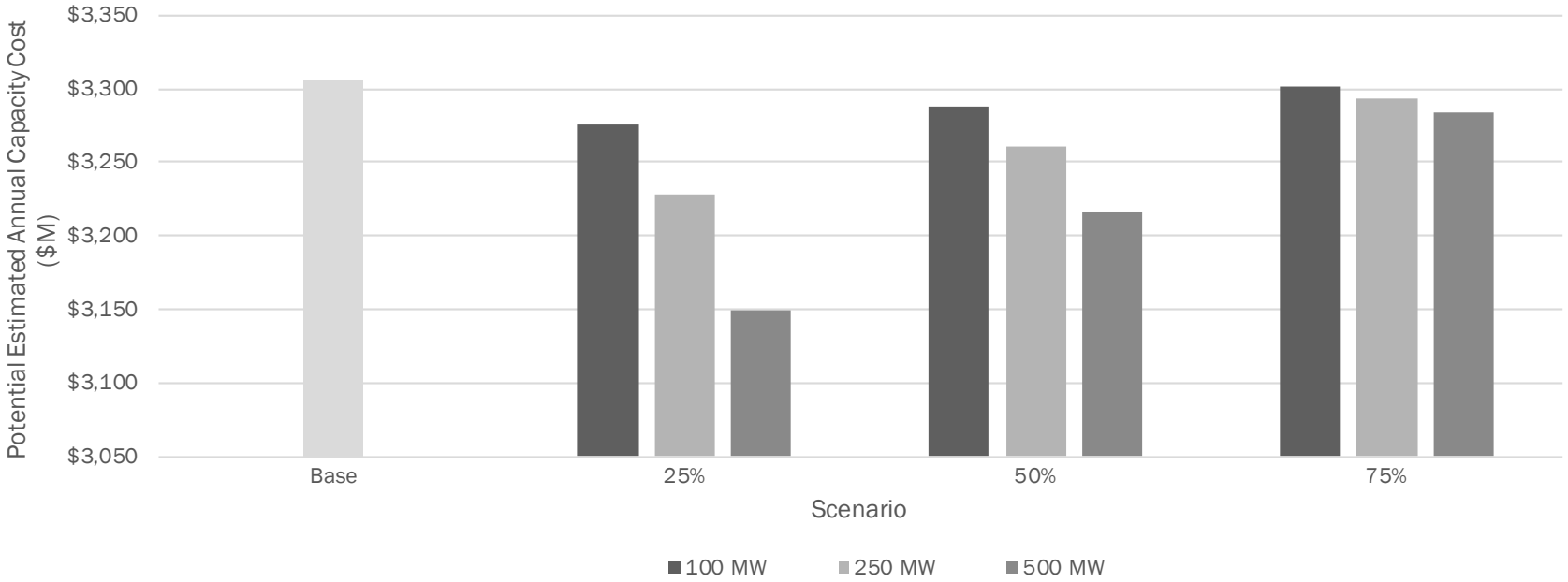
Potential Estimated Short Term Capacity Cost Impact



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Long Term Capacity Cost Impact Approach

- **Use the 2020 as-found system as a base case**
  - Use the same MW additions and requirement impact percentages developed in the short term impact analysis
  - Use the 2020 Demand Curve values
- **For the supply level, we used the historic excess defined as a percentage of excess above the requirement observed within the last three Capability Years in each of the different Localities**

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Potential Estimated Long Term Capacity Cost Impact

Long Term Results Summary							
		Annual Capacity Cost ($M)					
% Impact on ICAP Requirements	CSR/HSR Penetration (ICAP MW)	ROS	GHI	NYC	LI	Total	Total Minus Base
25	100	313	235	893	297	1738	1
25	250	314	235	893	297	1738	1
25	500	313	235	894	297	1739	2
50	100	314	235	893	297	1738	1
50	250	314	235	893	297	1739	3
50	500	315	235	895	297	1742	5
75	100	314	234	894	297	1739	-2
75	250	315	235	894	297	1741	-4
75	500	317	235	896	297	1745	-8

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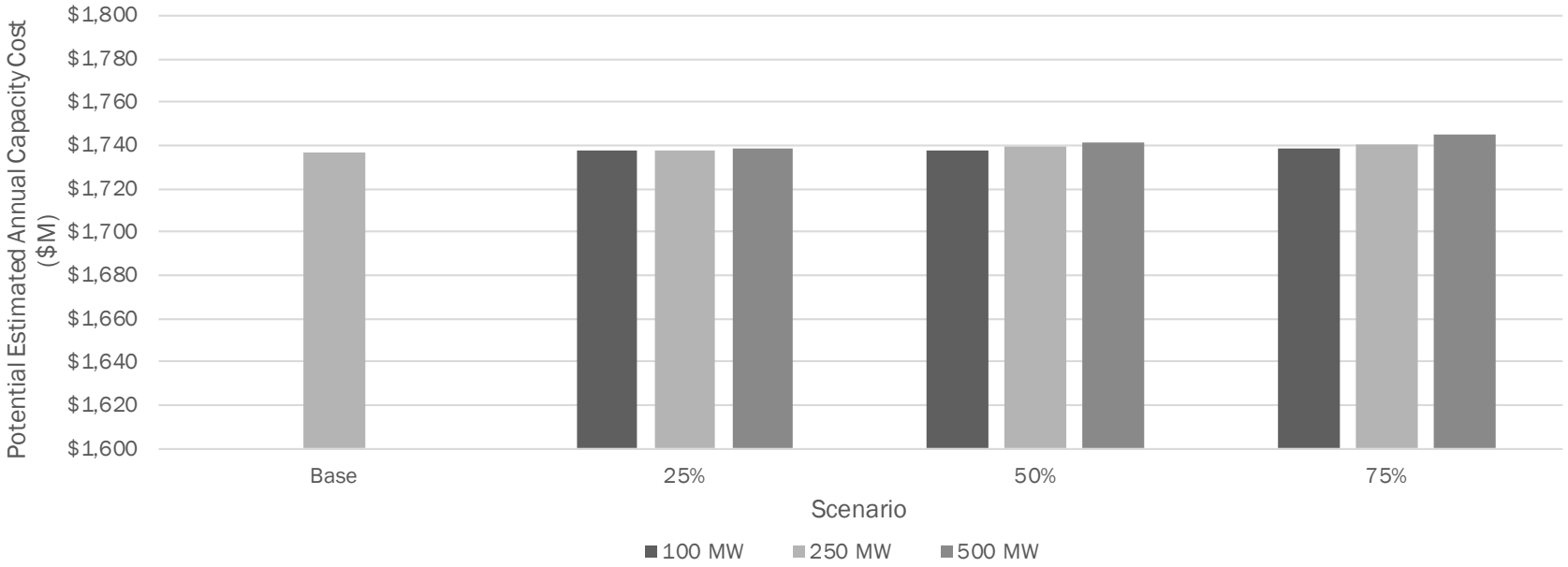
Potential Estimated Long Term Capacity Cost Impact



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Additional Impacts

Potential Environmental Impacts

- CSR/HSR could enable greater adoption of renewables and that should further increase decarbonization
- Pairing storage with renewables could also reduce renewable curtailment and have a positive environmental impact
- Increased use of CSR/HSR to provide ancillary services may add to carbon reduction
- Co-locating and/or hybridizing an intermittent resource with energy storage could enable the CSR/HSR to provide low emission energy to the grid at times of high load volumes

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Reliability Impacts

- From an operational perspective, additional supply could be a reliability benefit, however, properly determining the capacity value of CSR/HSR and their impact on IRM/LCRs is important to avoid unintended adverse impacts to reliability
- Depending on location within the system, CSR/HSR may be in a position to provide local reliability services
- The dispatch flexibility of CSR/HSR could be a reliability benefit

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Impact on Transparency

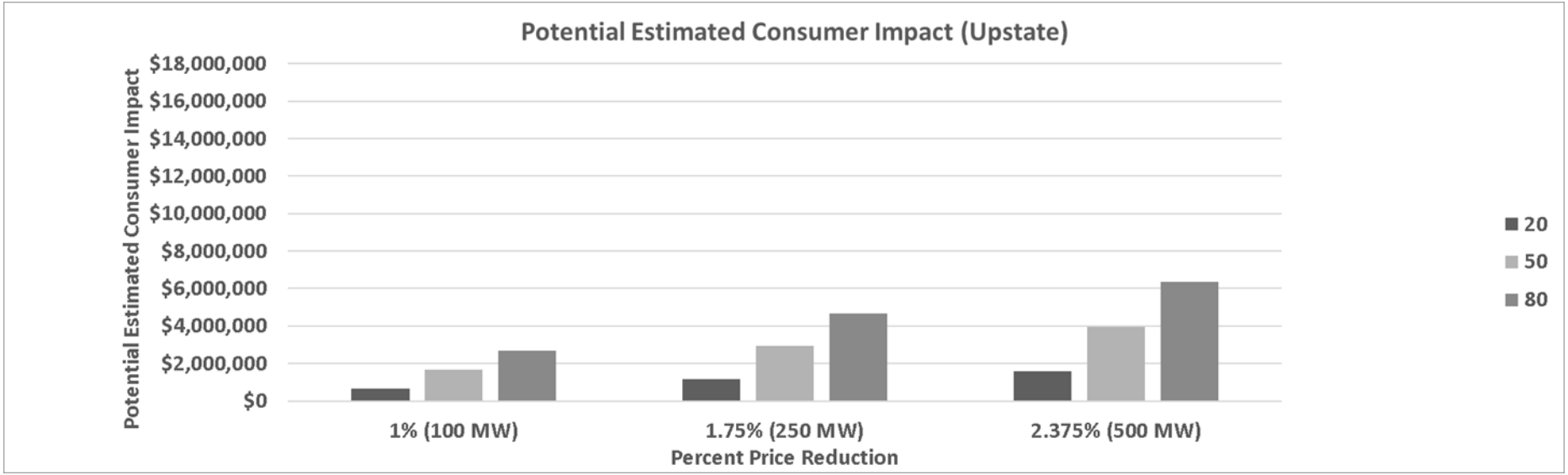
- No impact expected

Appendix I: Potential Energy Market Impact Estimate

Potential Energy Market Impact Estimate Results - Upstate

Based on Pricing Data from the NYISO Reference Bus: For list of detailed assumptions, see slides 7, 8 and 9

- Upstate estimate with Availability: 20%, 50%, or 80%



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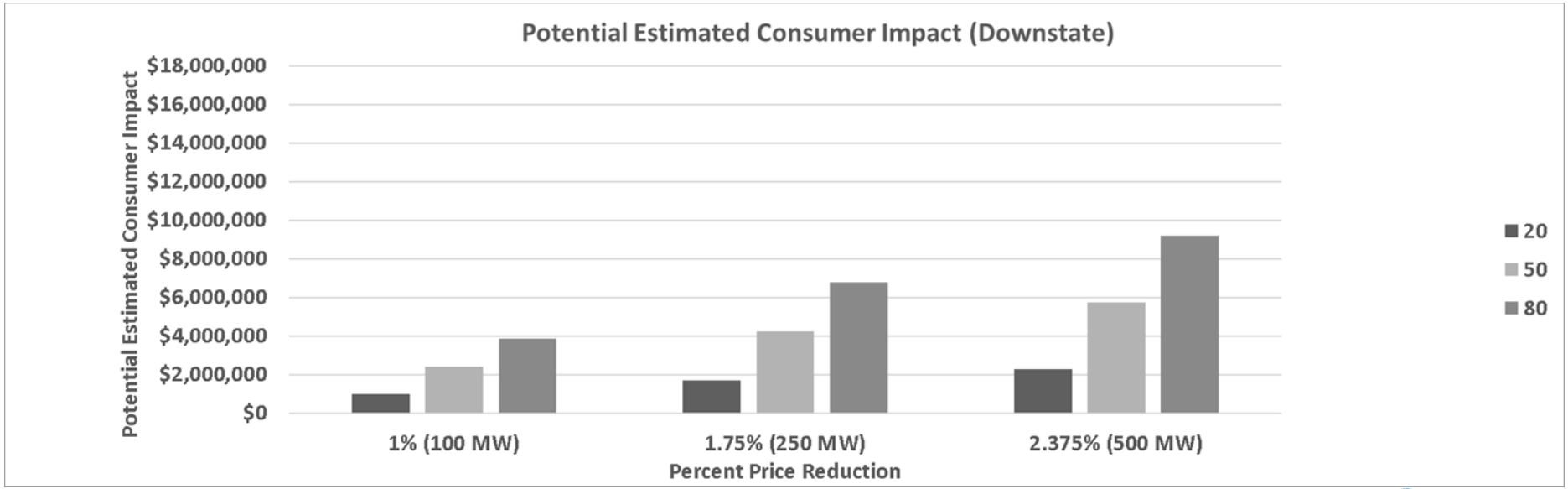
Potential Energy Market Impact Estimate Results - Downstate

- Downstate estimate with Availability: 20%, 50%, or 80%



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Feedback?

- Email additional feedback to:
- deckels@nyiso.com

Questions?

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

Our mission, in collaboration with our stakeholders, is to serve the public interest and provide benefit to consumers by:

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

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