Highlights from the 2021 State of the Market Report for the NYISO Markets: Capacity Markets and State Policy

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May 24, 2022

Introduction

- As the Market Monitoring Unit for NYISO, we produce an annual State of the Market (SOM) Report to:
  - ✓ Evaluate the performance of the markets;
  - ✓ Identify market flaws or market power concerns; and
  - ✓ Recommend improvements in the market design.
- Given the breadth of the report, this presentation covers highlights from our 2021 SOM Report related to capacity market performance and state policy in the NYISO markets

Schedule

- The 2021 SOM is being presented at several meetings:
  - ✓ May 24: MIWG/ICAPWG
    - – Capacity Market & Policy focus – 75 minutes
  - ✓ May 25: Market Committee
    - – Overview – one hour
  - ✓ May 26: MIWG/ICAPWG
    - – Energy and Ancillary Services focus – 75 minutes
  - ✓ Additional slots can be scheduled if there is interest.

Review of Capacity Market Outcomes

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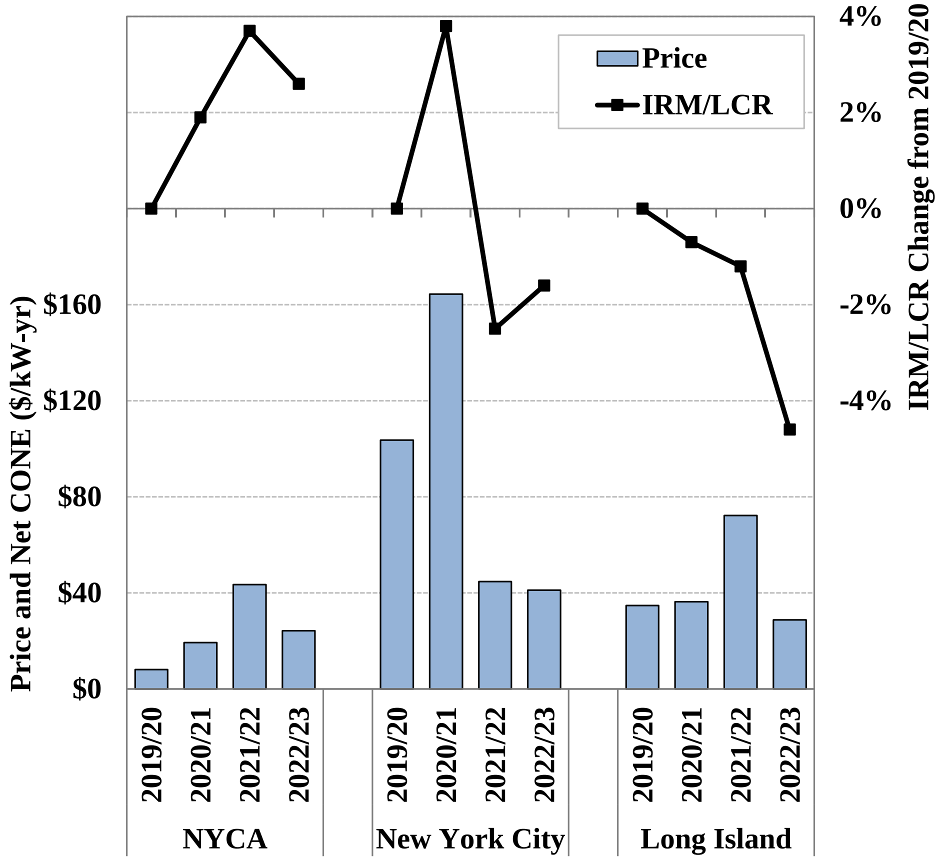
Capacity Price Trends



- Prices have been volatile primarily because of:
  - ✓ Volatile requirements (IRM and LCRs)
- The current IRM and LCR processes for setting requirements:
  - ✓ Are not well-coordinated
  - ✓ Do not account for shifting transmission bottlenecks and technology mix

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Evaluation of Capacity Market Performance

Capacity Market Performance

- The market has maintained reliability with minimal OOM investment for 20 years. However, the changing resource mix reveals major challenges:
  - ✓ Capacity prices do not provide adequate locational signals
  - ✓ The IRM and LCR processes produce results that are inefficient and overly volatile
  - ✓ Resource adequacy modeling improvements are needed for efficient capacity accreditation
  - ✓ Capacity prices do not reflect seasonal differences in the value of capacity
- These issues are illustrated in the following slides.

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Inadequate Locational Signals

- Marginal value of capacity varies within existing zones/regions
  - ✓ Process to create new capacity zones is slow and impractical
- Recent examples in MARS exhibit bottlenecks between:
  - ✓ Staten Island and NYC
  - ✓ Zones A/B and ROS
  - ✓ Zones G and H
- Market consequences:
  - ✓ Capacity at some locations is over- or under-compensated; inefficient incentives for additions/retirements
  - ✓ Acts as a barrier to new resources and favors existing resources through interconnection process (next slide)

Inadequate Locational Signals
Long Island Additional SDU Study Example

- Deliverability bottlenecks within zones/regions result in large interconnection upgrade (SDU) costs for new entrants
- Projects likely have positive MRIs, but are unable to earn capacity payments without funding uneconomic upgrades
- Existing generators behind the same constraints get full payment

Queue #	Name	Tech	ICAP MW	Initial SDU Allocation ($ million)	$/kW Summer UCAP	Developer's Decision	Final SDU ($ million)
Q612	South Fork Wind Farm	Offshore Wind	96	11.6	356	Accept SDU	0.0
Q738	El Melville	Offshore Wind	816	67.5	243	Reject SDU, withdraw from study	N/A
Q746	Peconic River Energy Storage	Storage	150	36.6	277	Reject SDU, complete study without receiving CRIS	N/A

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Problems with LCR-Setting Process

- LCR Optimizer is inefficient and overly volatile because of the following design flaws:

1. Flawed objective function
   - ✓ Does not optimize marginal cost of reliability, leading to unstable outcomes
2. Sensitive to changes in Net CONE unrelated to reliability
3. Misaligned with IRM process
   - ✓ Different treatment of TSLs, strongly constrained by Tan 45 outcome
4. Misaligned with Demand Curves
   - ✓ Calculated 'at criteria' but demand curve targets 'level of excess'

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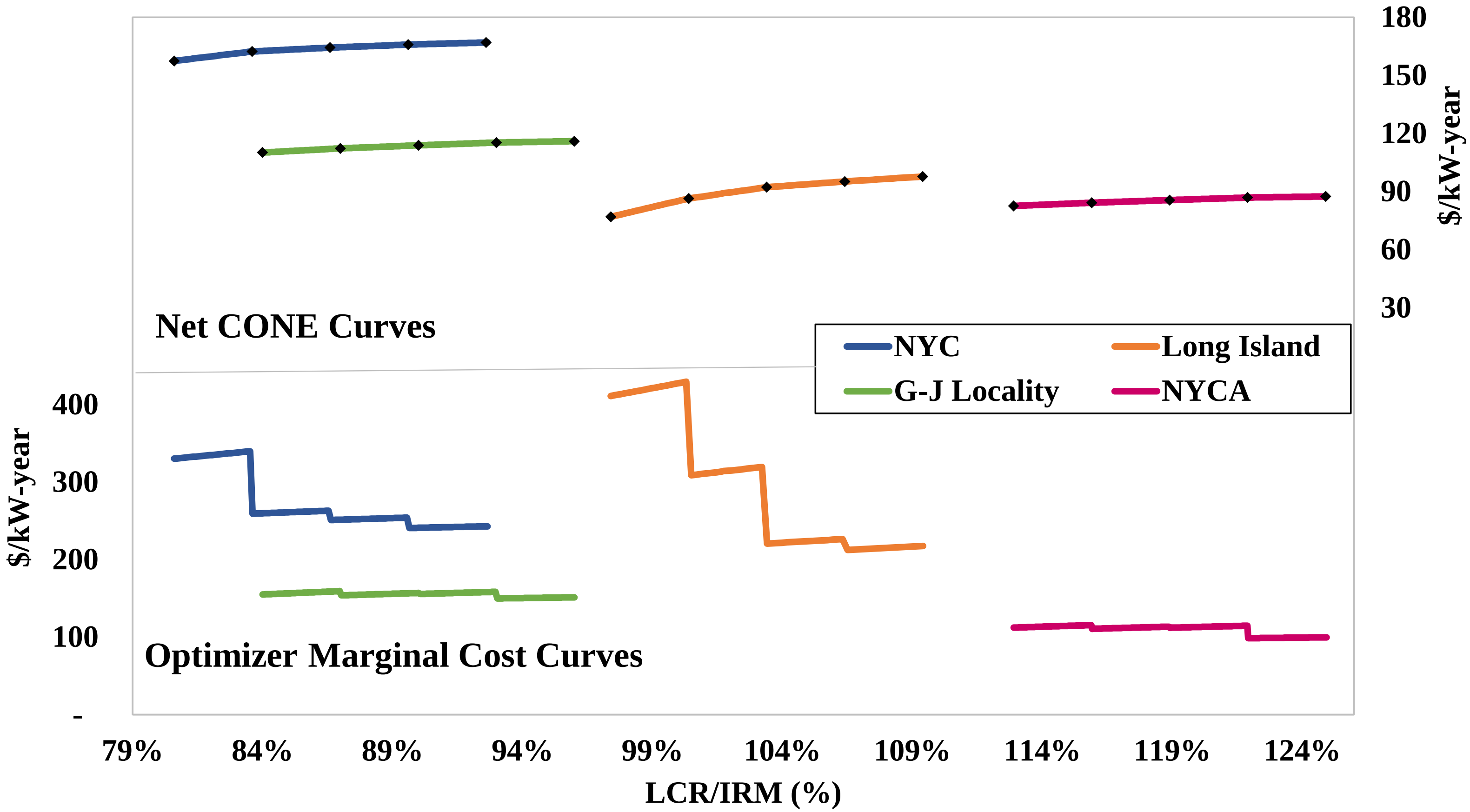
Problems with LCR-Setting Process
Cost Curve used in Objective Function



- Optimizer's cost curves are irregular/discontinuous because strongly affected by slight changes in Net CONE curve steepness

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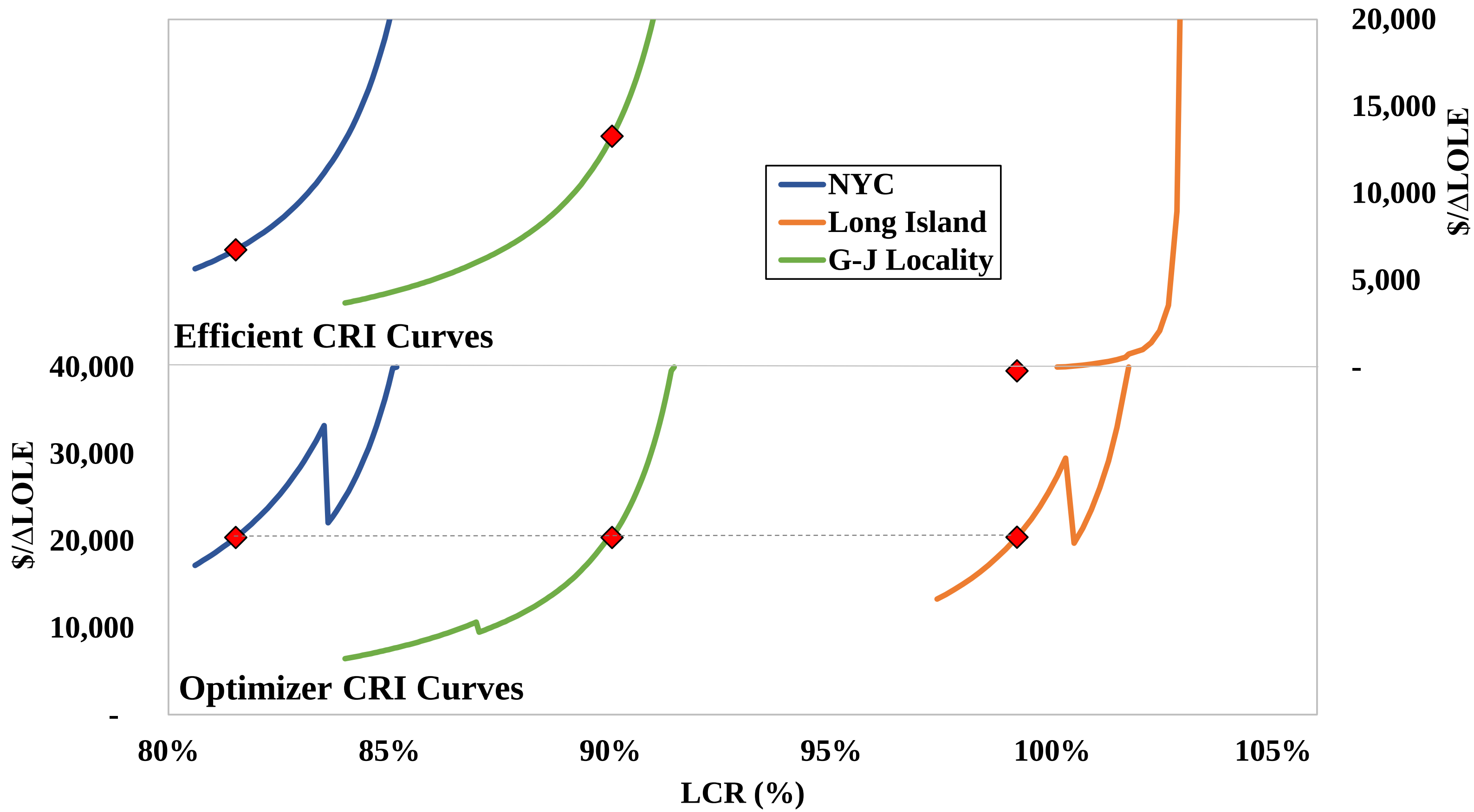
Problems with LCR-Setting Process
Cost of Reliability Improvement (CRI)



- Objective function equalizes cost of reliability improvement (CRI) based on cost curves from previous slide; resulting solution is unstable

Problems with LCR-Setting Process Misalignment from Demand Curves

- Optimizer's <u>cost function</u> C uses level of excess quantity to calculate total procurement cost
  - ✓ Each locality i has (Q_i+LOE) of ICAP where Q_i is the requirement
  - ✓ Each locality i has a clearing price = $NetCONE_i(Q_i+LOE)$
- Optimizer's <u>MARS case</u> is solved at criteria without level of excess
  - ✓ Each locality i has Q_i of ICAP
  - ✓ Output of MARS LCR Case has LOLE of 0.1
- Optimizer equalizes marginal rates of substitution across localities:
  - ✓ Marg. Rate of Substitution: $CRI_i = \frac{MC(Qi+LOE)}{MRI(Qi)} = \frac{\frac{d}{dQ_i}C(Qi+LOE)}{\frac{d}{dQ_i}LOLE(Qi)}$
  - ✓ Takeaway: Optimizer calculates marginal *cost* of capacity at LOE but marginal *benefit* of capacity at criteria, so the quantity procured at LOE is not optimized

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Problems with LCR-Setting Process
Optimizer cost function

Minimize:

$$\text{Cost of Capacity Procurement} = [Q_J + LOE_J] \times P_J(Q_J + LOE_J) + [Q_K + LOE_K] \times P_K(Q_K + LOE_K)$$

$$+[Q_{(G-J)} + LOE_{(G-J)} - Q_J - LOE_J] \times P_{(G-J)}(Q_{(G-J)} + LOE_{(G-J)})$$

$$+[Q_{NYCA} + LOE_{NYCA} - Q_{(G-J)} - LOE_{(G-J)} - Q_K - LOE_K] \times P_{NYCA}(Q_{NYCA} + LOE_{NYCA})$$

Subject to:

$$\text{NYCA system LOLE} \leq \text{target LOLE}$$

$$Q_{NYCA} = \text{NYCA system peak load forecast} \times (1 + \text{NYSRC approved IRM})$$

$$Q_J \geq Q_{TSL(J)}$$

$$Q_K \geq Q_{TSL(K)}$$

$$Q_{(G-J)} \geq Q_{TSL(G-J)}$$

- For more detail, see https://www.nyiso.com/documents/20142/21537892/LCR-determination-process-2021.pdf/1bac4189-7bc1-5aa5-a00d-4f178074b5e8

Problems with LCR-Setting Process
Misalignment from Demand Curves

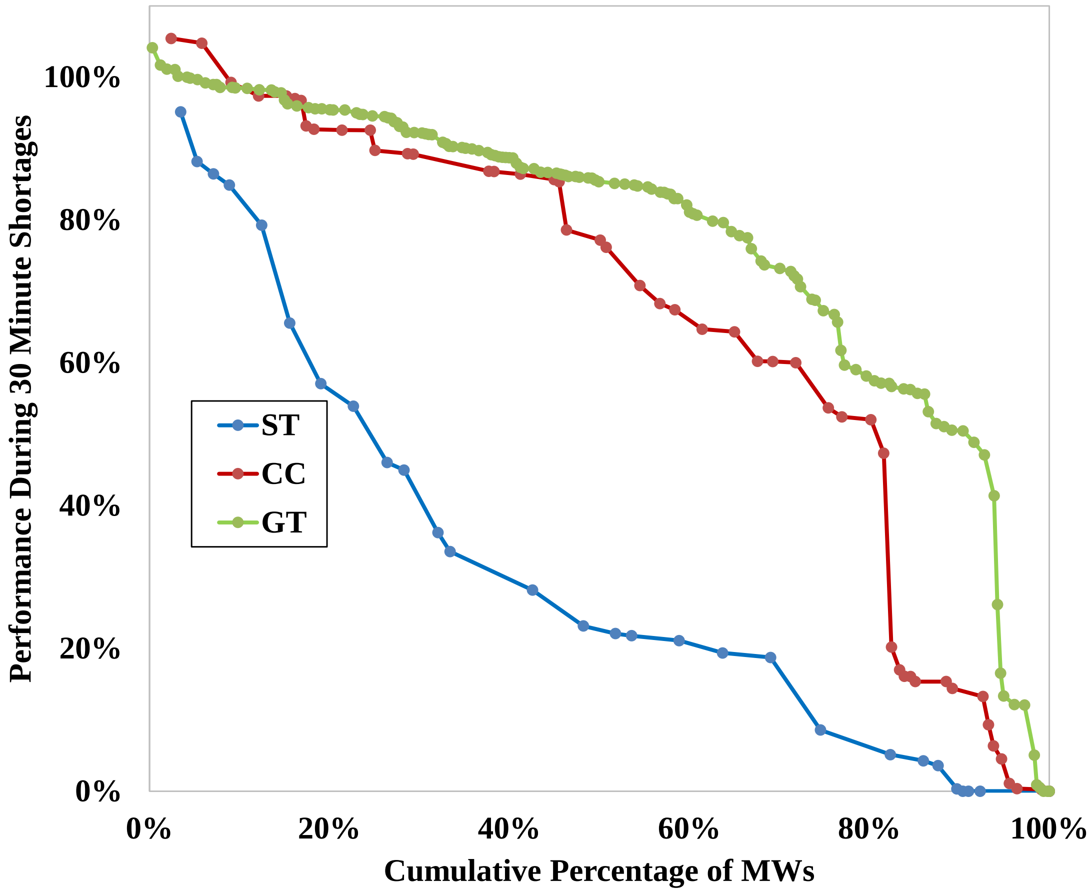
- Optimizer calculates cost of capacity in ICAP terms
  - ✓ Assumes all ICAP in a zone is paid the ICAP Net CONE
- In the capacity market, demand curves are translated to UCAP terms using zonal average derating factors
- As a result, Optimizer overestimates the ‘cost’ of capacity in areas with higher average derating factors
  - ✓ Does not actually ‘optimize’ total consumer costs
  - ✓ Will become more misaligned, contribute to volatility as resources with high derating factors enter localities
- This is only an issue when optimizing based on total cost instead of marginal cost of capacity

Enhancements to Capacity Value Modeling

- Modeling changes to MARS are needed for accurate marginal capacity accreditation
  - ✓ Limit joint output of non-firm gas-only generators
  - ✓ Model common weather years for renewables, load, BTM-PV
  - ✓ Account for storage deployed before/after reserves
  - ✓ Modeling characteristics of inflexible generators and SCRs
- Other categories of generators have overstated capacity value:
  - ✓ Generators with portion of ICAP that is functionally unavailable
  - ✓ EFORd overstates reliability of some generators in critical hours due to frequent off-peak operation

Enhancements to Capacity Value Modeling Inflexible Resources

- Less flexible resources have performed worse during shortages
- Resources might be more available at criteria than in recent surplus conditions
- Preferred approach is to consider options for modeling in MARS



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Enhancements to Capacity Value Modeling Functionally Unavailable Capacity

- Some installed capacity is functionally unavailable during peak conditions
- Emergency Capacity
  - ✓ Capacity above a generator’s normal UOL that is only activated under emergency operations
  - ✓ However, activation is risky if it increases trip risk of the unit
  - ✓ Approx. 475 MW, all in downstate areas
- Ambient Water Limitation
  - ✓ Some generators have lower availability due to higher water temperatures when temperature exceeds testing conditions
  - ✓ Not considered in adjustment to ICAP conditions or in EFORd
  - ✓ Approx. 110 MW systemwide during the summer

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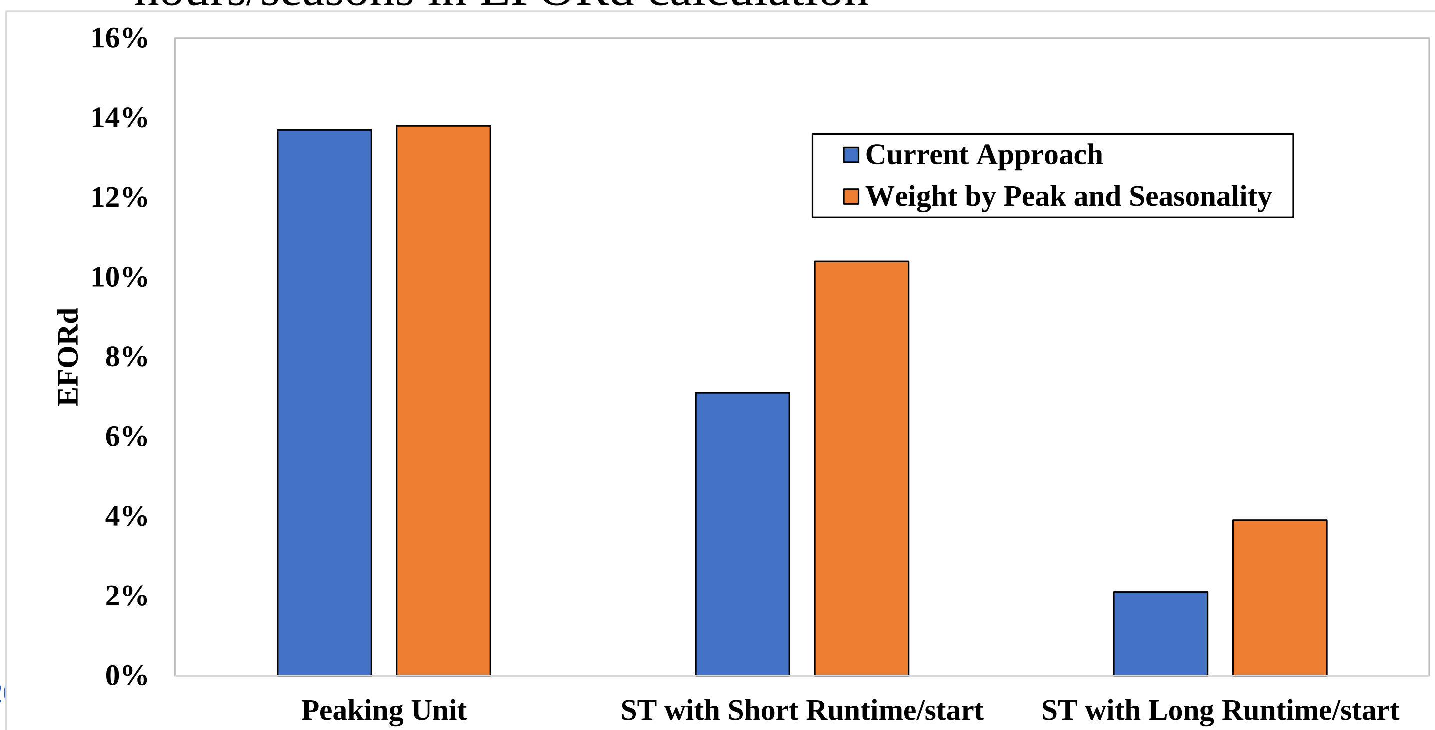
Enhancements to Capacity Value Modeling EFORd Calculation

- EFORd calculation is more favorable for resources with more run hours per start – overstates reliability at startup of units with long runtimes
- Chart: three hypothetical units with same # of starts and forced outages
  - ✓ Alt. approach shows impact of giving more weight to run hours in peak hours/seasons in EFORd calculation



Capacity Market Recommendations

- **High priority recommendations in 2021 Report:**
  - ✓ Improve capacity modeling and accreditation for specific types of resources (#2021-4)
  - ✓ Implement locational marginal pricing of capacity ("CLMP") that minimizes the cost of satisfying planning requirements (#2013-1c)
- **Other recommendations:**
  - ✓ Modify translation of the annual revenue requirement for the demand curve unit into monthly demand curves that consider reliability value (#2019-4)
  - ✓ Grant financial capacity transfer rights between zones for market-based transmission upgrades that help satisfy planning reliability needs (#2012-1c)

Locational Marginal Pricing of Capacity (C-LMP)

- Improved approach to locational pricing in capacity market
  - ✓ Set a price for each area in MARS instead of current capacity zones
  - ✓ Prices vary based on MRI of capacity at each location
- Advantages of C-LMP:
  - ✓ Efficiently compensate capacity suppliers at all locations
  - ✓ Eliminate overpayments to existing bottlenecked resources
  - ✓ Adapt more easily to changes in location of bottlenecks
  - ✓ Eliminate need for LCR Optimizer
  - ✓ Simplify administration of capacity market

Role of NYISO Markets in State Policy

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Role of NYISO Markets in Clean Energy Investment

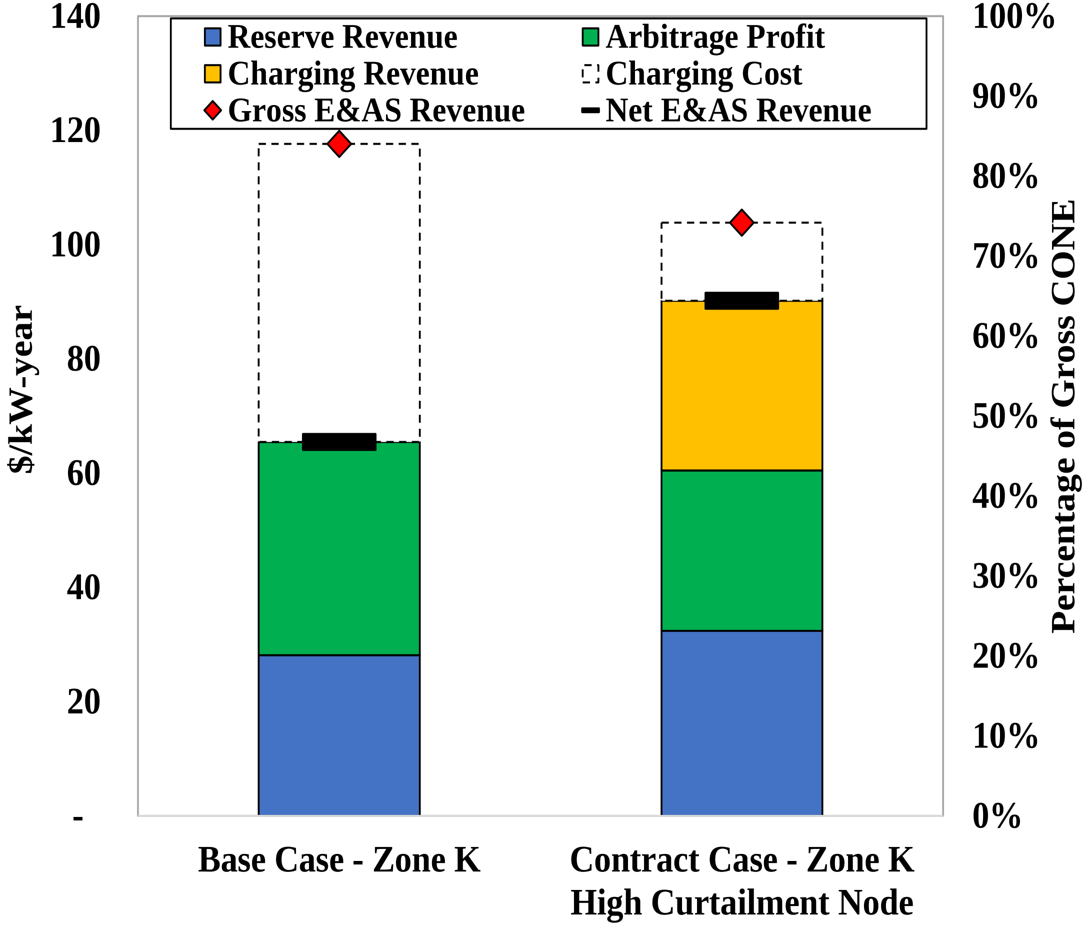
- New investments in New York's power sector are largely driven by state policy
- Pursuing clean energy targets efficiently will have massive implications for costs borne by consumers
- NYISO markets play an important role in helping meet state goals as efficiently as possible
  - ✓ Signal which policy-driven projects provide the most value to the power system and therefore require the least subsidy
  - ✓ Attract investment in complementary resources that provide reliability and flexibility
  - ✓ Reduce the informational burden of planning by promoting market-based investment and innovation

Markets and Policy
Energy Storage

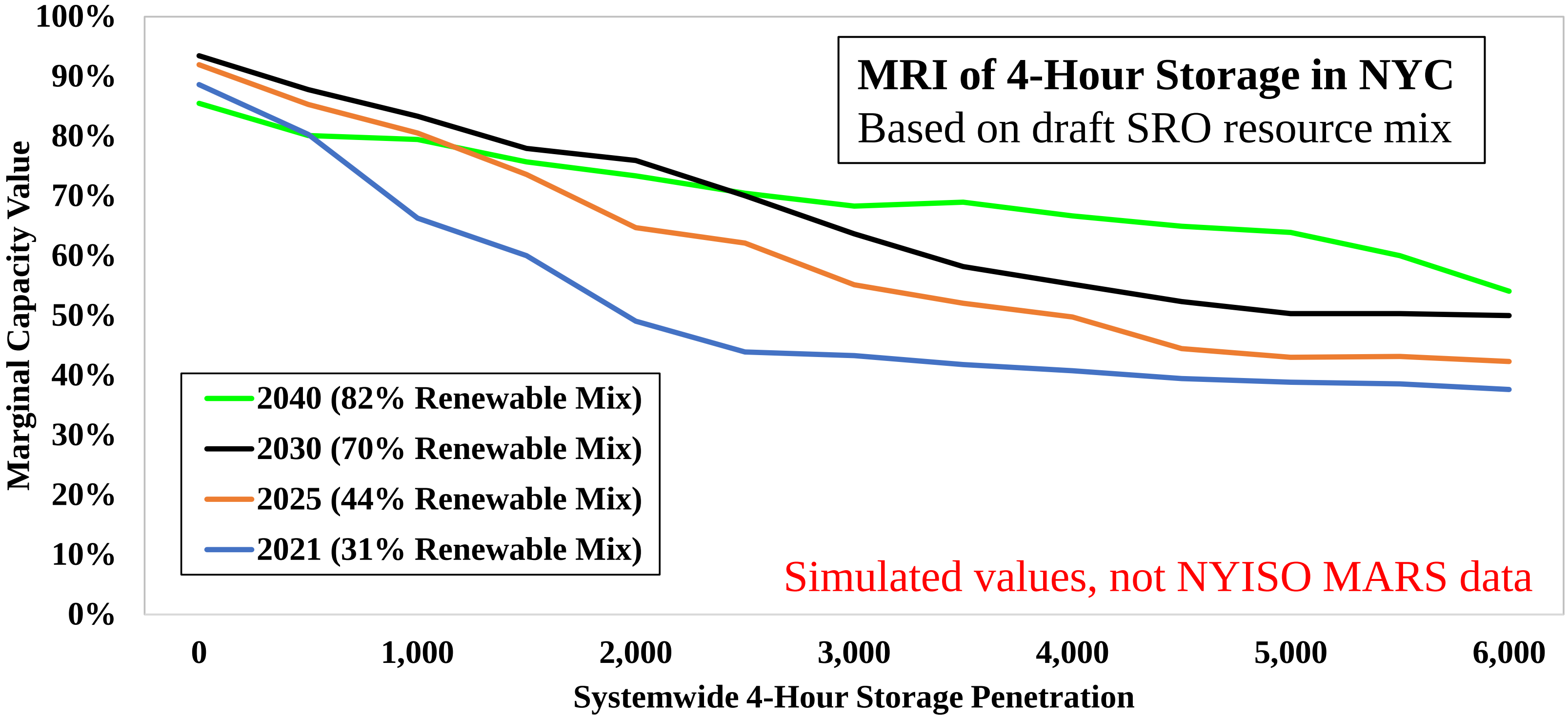
- 3 GW of storage required by CLCPA
  - ✓ More is likely beneficial in future to integrate renewables – how much more is an economic question
- Most storage projects appear uneconomic in today's markets
  - ✓ However, the value of storage will increase as renewables enter service
- Efficient market prices would encourage storage investment when its benefits (including policy benefits) outweigh costs
  - ✓ Is the value storage provides by complementing renewables priced in the market?

Markets and Policy
Energy Storage

- ESRs capture value of integrating wind and solar by charging when LBMP is negative (paid as if producing a REC)
- Chart compares storage E&AS revenues in status quo vs. 'policy case' from draft SRO
- When ESR can reduce curtailment, earns much higher revenue



Markets and Policy
Energy Storage



- Marginal capacity value of ESRs supported by renewables, especially solar
- ESRs earn higher payments when they can replace more thermal capacity
- Over-investment may provide little benefit, require high contract payments

Markets and Policy
Conclusions and Recommendations

- NYISO market design efficiently rewards storage for reducing curtailment of renewables and providing capacity value
  - ✓ Implication: markets can incentivize the level/types/locations of storage that efficiently complement renewables
- Recommended enhancements to E&AS markets would better value flexibility provided by storage
  - ✓ Reserves in NYC and Long Is. (#2017-1, #2019-1, #2021-2)
  - ✓ Compensate reserve providers that improve transmission system utilization (#2016-1)
  - ✓ Improve shortage pricing (#2017-2)
  - ✓ Dynamic reserves (#2015-16)
  - ✓ Longer duration reserve products (#2021-1)
  - ✓ Eliminate offline fast start pricing (#2020-2)

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