New York ISO
Independent System Operator

LCR Optimizer Enhancements: Update

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ICAPWG/MIWG

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Previous Presentations on LCR Optimizer

Date	Working Group	Topic/Link to Materials
2/7/2023	ICAPWG/MIWG	LCR Optimizer Enhancements - Kickoff
4/27/2023	ICAPWG/MIWG	LCR Optimizer Enhancements - Update
9/18/2023	ICAPWG/MIWG	LCR Optimizer Enhancements - Update
6/27/2023	ICAPWG/MIWG	LCR Optimizer Enhancements- Proposed Consumer Impact Analysis Methodology
10/19/2023	ICAPWG/MIWG	LCR Optimizer Enhancements – Update (Revision 1)
11/10/2023	ICAPWG/MIWG	LCR Optimizer Enhancements – Update
11/10/2023	ICAPWG/MIWG	LCR Optimizer Enhancements Consumer Impact Analysis: Part 1
12/13/2023	BIC	LCR Optimizer Enhancements Market Design
10/29/2024 (Latest)	ICAPWG/MIWG	LCR Optimizer Enhancements: Update

Agenda

- Purpose of today's discussion
- Background
- Recommendation
- Concerns with Revised LCR Optimization Function
- Next Steps

- In Appendix:
  - Overview of enhancements to Locational Minimum Installed Capacity Requirement (LCR) Optimizer and associated tariff revisions
  - Links to previous discussions
  - Initial Results presented at 10/29/24 ICAPWG

Purpose of today's discussion

- NYISO recommends pausing work on the LCR Optimizer Enhancements project until the trajectory of the Capacity Market Structure Review project is clear.

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Background

Background

- Since 2019, the NYISO has utilized the LCR Optimizer, an economic optimization software to establish the LCRs for Load Zone J (NYC), Load Zone K (LI) and the G-J Locality (LHV). The LCR Optimizer is designed to produce least cost LCRs while maintaining the New York State Reliability Council's final Installed Reserve Margin (IRM) and the corresponding resource adequacy criterion for Loss of Load Expectation (LOLE).
- Since implementing the LCR Optimizer, multiple concerns have been raised regarding the year over year stability of the LCRs and the transparency of the optimization function.
- Re-examining this process and the methodology could lead to improvements in the stability and transparency of the LCRs.
- At the end of 2023, the NYISO brought forward a proposed design for a new LCR optimization function.
  - This new LCR optimization function was unanimously approved at the 12/13/2023 BIC with the understanding the NYISO would continue its work to implement the revised LCR optimization function and return to stakeholders to assess the results of the revised LCR optimizer function prior to seeking approval from the MC.
- At the October 29, 2024 ICAPWG, the NYISO presented initial testing results for the new LCR optimization function.

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Recommendation on LCR Optimizer Enhancements Efforts

Recommendation

- The NYISO recommends pausing work on the LCR Optimizer Enhancements project until after completion of the Capacity Market Structure Review effort in 2025.
- While the revised optimization functionality is working, the NYISO has concerns with the revised LCR optimization functionality and the qualities of solutions provided.
- One of the NYISO's objectives in the Capacity Market Structure Review is the delivery of transparent and predictable market outcomes. This coincides with the original intentions of reviewing the LCR Optimizer for transparent results with year over year stability.
  - Once the path for the Capacity Market Structure Review becomes clear, the NYISO recommends revisiting the status of the LCR Optimizer Enhancements project.
- The MMU supports the recommendation to pause the effort and recommends evaluating the LCR optimization in tandem with more Granular Capacity Zones and reevaluating the use of the Net CONE curves.

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Concerns with the Revised LCR Optimization Function

Rationale for Recommendation

- **The NYISO has three main concerns with the revised optimization function that support the recommendation to pause efforts in 2025:**
  - Concerns about the Optimization Objective.
  - Concerns about the Solution Space Costs.
  - Concerns about the Sensitivity to Inputs and Stability.

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Concerns about Optimization Objective

- The revised Optimization Objective is more aggressive than previous versions in attempting to move capacity to low Net CONE areas, due to the nature of the cost optimization function.
- For example, the revised optimization for 2022 shows a 14% higher LCR in Zone K, for a marginal improvement in lowering total procurement costs.

2022	Historical	Revised Optimization
IRM	119.60%	119.60%
LHV	89.20%	81.30%
NYC	81.20%	78.20%
LI	99.50%	113.30%
Procurement Costs ($M)	$1,174.40	$1,131.70

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Concerns about Solution Space Costs

- In addition, testing has shown that there are multiple "optimal" solutions, with instances of very different LCRs producing very similar procurement costs.
- The next two slides visually support the revised LCR optimization function "getting stuck" at separate optimal solutions.

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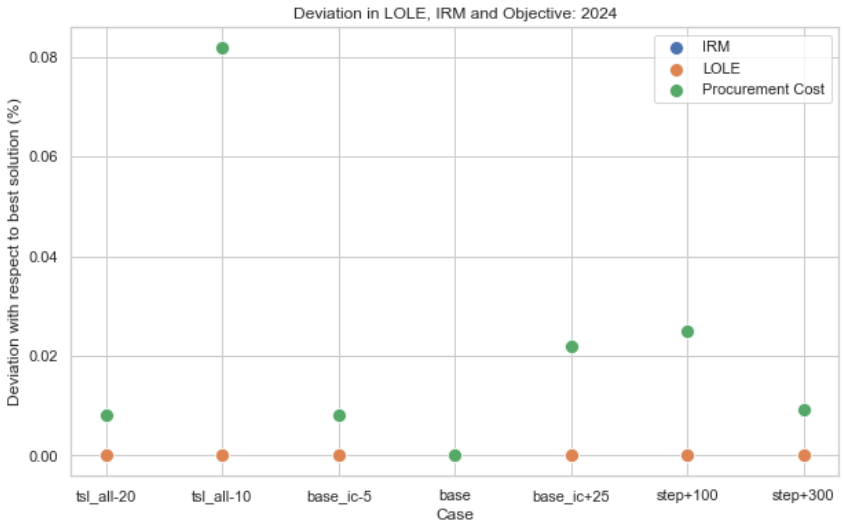
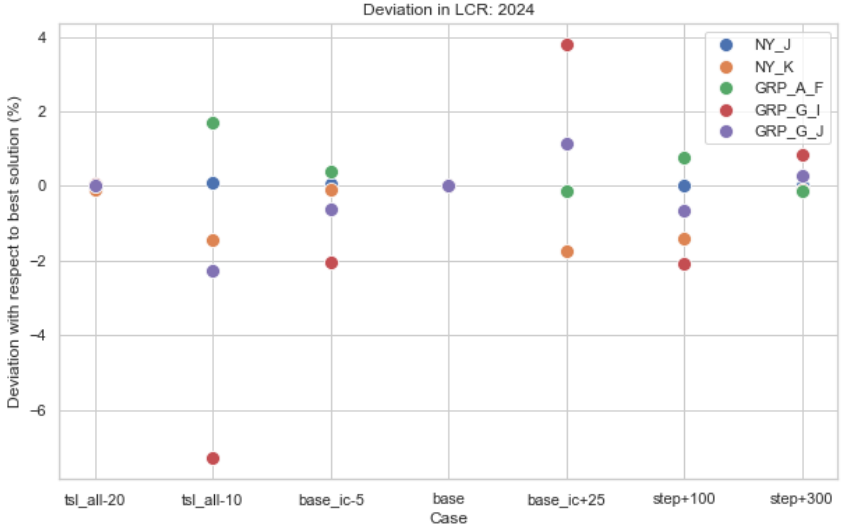
Summary: Impact of Non-binding Transmission Security Limit (TSL), Initial Conditions, and Step Size





- The chart on the left shows that for each case the IRM, LOLE, and total procurement costs are nearly identical with the largest deviation across all cases being less than 0.1%.
- However, the chart on the right shows that the LCR values deviate appreciably between each case.
- This discrepancy supports the presence of multiple optimal solutions that prevent the revised LCR optimization function from providing consistent results for each LCR across all cases.

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Concerns about Sensitivity and Stability

- **Due to the aggressiveness coupled with multiple "optimal solutions," the revised LCR optimization function is expected to be sensitive to inputs.**
  - The compound effect may affect the initial guess and subsequent iterations leading to a different solution.
- **Given these new characteristics, the LCR Optimizer is expected to be very responsive to small inputs and modeling changes and is therefore not stable to year over year changes.**
  - The revised optimization function does not consider the "value" of stable market signal in meeting longer term reliability needs.

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Next Steps

Next Steps

- The NYISO shall pause efforts until the Capacity Market Structure Review path is clear.

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Questions?

Our Mission & Vision

Mission

Ensure power system reliability and competitive markets for New York in a clean energy future

Vision

Working together with stakeholders to build the cleanest, most reliable electric system in the nation

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Appendix

Overview of Enhancements

(Note: Material Previously Presented to Stakeholders)

Scope

- **Deliverable: 2023 – Market Design Complete**

- **Investigate the need for enhancements to the LCR Optimizer (and, if warranted, develop the necessary modifications) to improve the stability and transparency of the LCRs, with the following two focuses:**
  - Reviewing the format of cost curves used in the LCR Optimizer
  - Reviewing the appropriateness of the objective function in the LCR Optimizer

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Scope (cont.)

Transmission security limit (TSL) floor values

- Procedures for determining and applying TSL floor values in the LCR Optimization are NOT in scope for this project.
- The proposed changes to the LCR Optimizer in this project assume that TSL floor values continue to establish the lower bound on the LCR values and may constrain the solution for one or more capacity zones.
- The next steps for addressing transmission security in the capacity market and alignment with NYISO Planning Department studies will be discussed separately from this project.

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Recommendation #1

Implement the investment cost (or “area under the curve”) objective function change in the LCR Optimizer

This represents local installed capacity as an “investment” (or supply) cost to be minimized versus the current single-buyer “procurement” cost. This also mathematically yields a better conditioned optimization problem and promotes more consistent results from the solver.

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Revised Objective Function

What should the LCR optimization minimize?

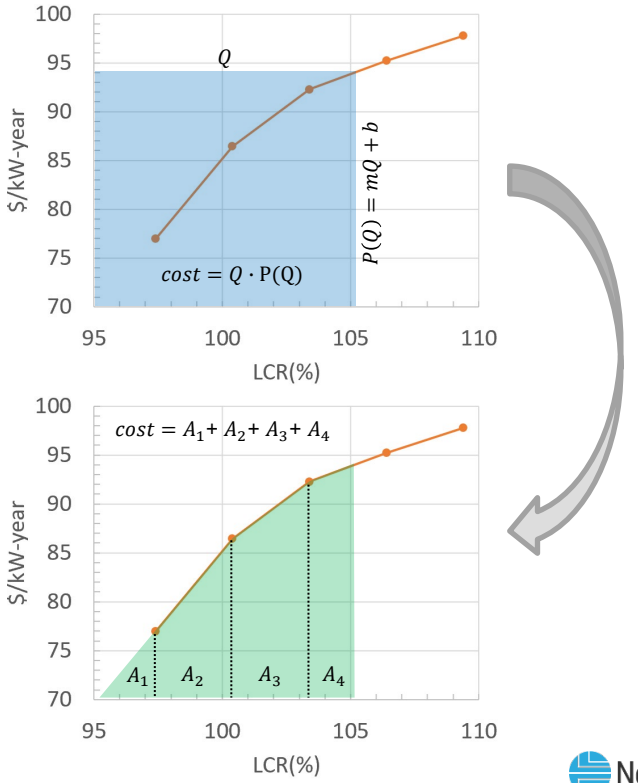
- Current: Total Procurement Cost – Every MW of capacity is priced like the last MW. The cost from a single buyer perspective is minimized, with potential substitution of the competitive "product" (LCR) with another to minimize those costs to the buyer.

- Proposed: Total Investment Cost – A rollup of incremental investment cost (area under the curve). A competitive market form, where the total cost of supply itself is minimized.

The LCR Optimizer minimizes total procurement cost today, but minimizing total investment cost is more appropriate to:

- Solve for LCRs considering the equilibrium marginal investment cost that meets the reliability metric, and
- Improve solver ability to find the global minimum consistently.

An example with Load Zone K is shown here.



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Revised Objective Function (cont.)

The proposed change to the objective function is as follows

$$\textit{Minimize:}$$

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

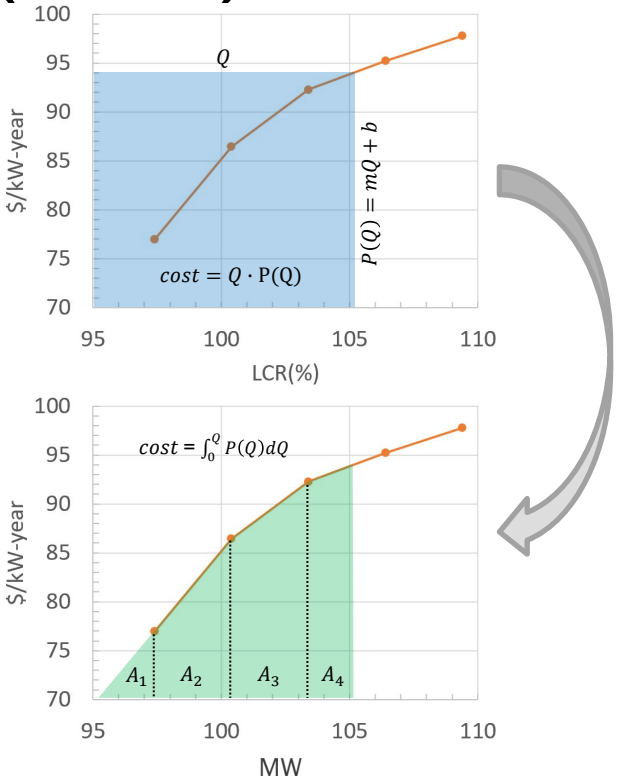
$$+[Q_{(G-J)} + LOE_{(G-J)} - Q_J - LOE_J] \times P_{(G-J)}(Q_{(G-J)} + LOE_{(G-J)})$$

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

$$OBJ = \int_0^{Q_K+LOE_K} NetCONE_K(Q_K)\, dQ_K + \int_0^{Q_J+LOE_J} NetCONE_J(Q_J)\, dQ_J$$

$$+ \int_{LOE_J}^{Q_{GHI}+LOE_{GHIJ}} NetCONE_{GHI}(Q_{GHI})\, dQ_{GHI}$$

$$+ \int_{LOE_{GHIJ}+LOE_K}^{Q_{ROS}+LOE_{NYCA}} NetCONE_{ROS}(Q_{ROS})\, dQ_{ROS}$$



Recommendation #2

Determine the net cost of new entry (CONE) curves without the level of excess (LOE) adder

Omitting the LOE adder from the net CONE curves makes the revised LCR Optimizer formulation simpler.

The timing between the LCR Optimizer software revision deployment and 2025-2029 ICAP Demand Curve reset (DCR) is such that the LCR study for the 2025-2026 Capability Year may be the first to incorporate these changes. An interim solution should not be needed.

Note: Information relating to the net CONE curves for use in the LCR process is developed as part of each quadrennial DCR

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Revised Net CONE Curves

Currently, net CONE curves are defined as a function of %LCR to cost with the LOE MW adder included implicitly.

As a result, some of the LOE MW adder terms in the objective function are implied, but not actually coded, as these are “baked in” to the development of the net CONE points.

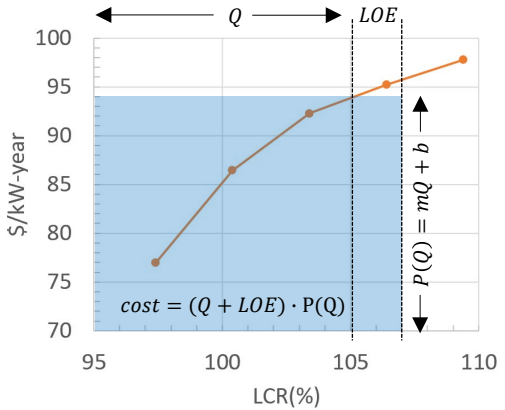
In the Load Zone K term, cost is a function of Q (%LCR). The LOE adder is implicit to the curve.

$$\textit{Minimize:}$$

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

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

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



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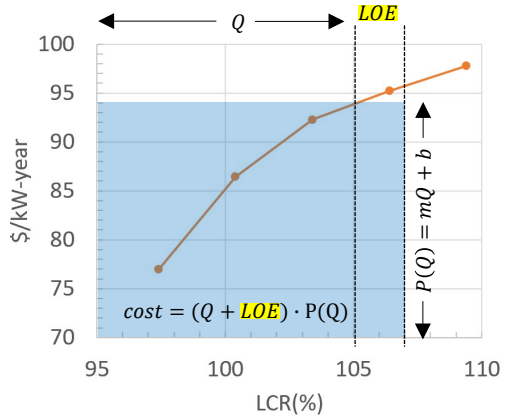
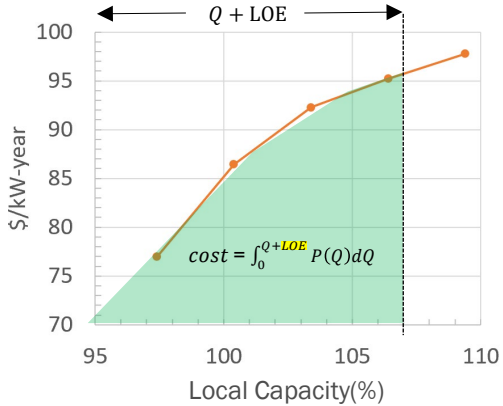
Revised Net CONE Curves (cont.)

If the net CONE curve LCR points were to exclude the LOE adder in the curve development, the relation to the revised LCR Optimizer objective function is simpler to implement.

This modification is needed because while the current optimization can include the LOE adder in the quantity term and exclude it in the cost lookup, the new method can only include it into the integration bounds.





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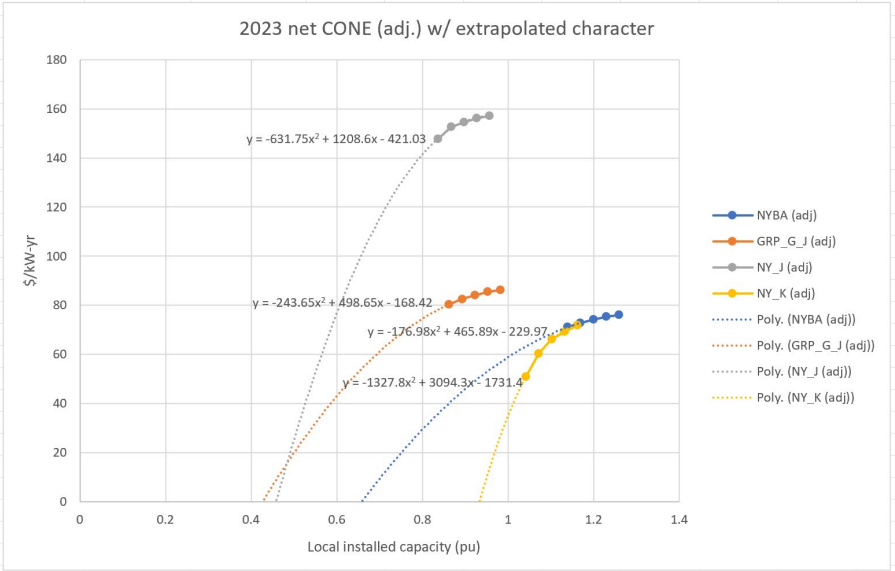
Recommendation #3

Development of additional net CONE test points in the current DCR project

Knowing the character of the net CONE curves beyond the range of plausible LCR values becomes important with the proposed objective function modification as it is a view of total investment.

To best capture this, we plan for additional energy and ancillary services revenue modeling test points to be conducted. This additional modeling would first be performed in connection with the ongoing 2025-2029 DCR

* The figure to the right depicts an example of what the full shape of the net CONE curves may look like.



Proposed Tariff Change

(Note: Material Previously Reviewed with Stakeholders)

Proposed Tariff Change

MST 5.11.4(a) - LSE Locational Minimum Installed Capacity Requirements

- The NYISO proposes a clarifying edit (as shown below) to account for the proposed change to the objective function (i.e., minimizing of total investment cost instead of procurement cost).

"The ISO shall compute the Locational Minimum Installed Capacity Requirements in accordance with ISO Procedures:

(a) to minimize the total investment cost of capacity at the prescribed level of excess…."

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Previous Discussions

Previous Discussions

Date	Working Group	Links to Materials
February 7, 2023	ICAPWG/MIWG	https://www.nyiso.com/documents/20142/36079056/3%20LCROpt_MIWG_020723_final.pdf
April 27, 2023	ICAPWG/MIWG	https://www.nyiso.com/documents/20142/37254128/LCROpt_MIWG_042723_1%20(002).pdf
October 19, 2023	ICAPWG/MIWG	https://www.nyiso.com/documents/20142/40696384/LCROpt_MIWG_101923_2.pdf
November 10, 2023	ICAPWG/MIWG	https://www.nyiso.com/documents/20142/41130653/LCR%20Optimizer%20Enhancements%2011102023.pdf
November 10, 2023	ICAPWG/MIWG	https://www.nyiso.com/documents/20142/41130653/LCR%20Optimizer%20Enhancements%20CIA%20Draft%20FOR%20POSTING2.pdf
December 13, 2023	BIC	https://www.nyiso.com/documents/20142/41671891/05%20LCR%20Optimizer%20Enhancements%20Market%20Design.pdf

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Initial Results Reviewed 10/29/24

Initial Testing Results

- **The NYISO applied the updated LCR optimization function to the LCR cases for the last three years, with the original constraints of the corresponding LCR study**
  - The original IRM
  - The original TSL floor values
  - The original targeted LOLE
  - The **revised** net CONE curves including additional data beyond the original points for each of the Localities
- **Results are shown in the following slides**

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2022-2023 LCRs

2022-2023	Historical Results	TSL Floors	Revised Optimization Results
IRM	119.6%		119.6%
LHV	89.2%	80.7%	80.7%
NYC	81.2%	77.2%	78.4%
LI	99.5%	94.4%	115.1%
Procurement Costs ($M)	$1,174.40		$1,131.84

2023-2024 LCRs

2023-2024	Historical Results	TSL Floors	Revised Optimization Results
IRM	120.0%		120.0%
LHV	85.4%	85.4%	85.4%
NYC	81.7%	81.7%	81.7%
LI	105.2%	100.6%	105.2%
Procurement Costs ($M)	$947.50		$947.50

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2024-2025 LCRs

2024-2025	Historical Results	TSL Floors	Revised Optimization Results
IRM	122.0%		122.0%
LHV	81.0%	81.0%	81.0%
NYC	81.7%	81.7%	81.7%
LI	105.3%	105.3%	105.3%
Procurement Costs ($M)	$941.60		$941.60

*Note: 2024-2025 test cases were run using the originally determined TSL floor value of 81.7% for NYC and not the corrected value of 80.4%

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