Alternative Methods for Determining LCRs: Final Market Design

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Agenda

- **2017 Project**
- **Final Market Design**
  - Design Objective
  - Methodology
  - Results
  - Cost Allocation
  - Timeline
- **Next Steps**
  - 2018 Project Scope
- **Questions**
- **Propose for vote as guidance for 2018 efforts**
- **Appendix**

2017 Project Presentations

2017 ICAPWG Presentations

Date	Discussion points and links to materials
2-15-17	Recap of 2016 Effort, 2017 Plan, and Current Status
4-04-17	2017 Commitment and Base Case
5-11-17	Proof of Concept and Refining Methodology
6-01-17	Sensitivities and Cost Curves
6-29-17	Sensitivity Results and Refining Methodology
7-25-17	Refining Methodology
8-22-17	Refining Methodology and Transmission Security
9-28-17	Transmission Security, Results, and Timeline
10-30-17	Transmission Security and Results

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Final Market Design

Design Objective

Market Design Statement

Develop a robust, transparent, and intuitive (predictive) process for developing proper capacity requirements that maintain reliability while producing a lower cost solution

Market Guiding Principles

Efficient allocation of capacity

- Maintains reliability
- Cost effective
- Proper investment incentives

Transparent and predictable

- Simple, stable, robust
- Predictable

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Methodology

Optimization Methodology

- Determine LCRs for the Localities that minimize total cost of capacity at the level of excess (LOE) condition while maintaining the reliability criterion (LOLE ≤ 0.1 days/year), the NYSRC approved IRM, and not exceeding transmission security limits (TSL)
- Cost defined by Unit Net CONE used to develop each ICAP Demand Curve

Minimize:

$$\textit{Total Cost of Capacity}$$

$$= \left[\sum_{X} (Q_X + LOE_X) \cdot P_X(Q_X + LOE_X)\right]$$

$$+ \left[\sum_{Y} (Q_Y + LOE_Y) \cdot P_Y\left(Q_Y + LOE_Y + \sum_{Z} Q_Z + LOE_Z\right)\right]$$

$$+ \left[\left(Q_{NYCA} + LOE_{NYCA} - \left(\sum_{X} (Q_X + LOE_X) + \sum_{Y} (Q_Y + LOE_Y)\right)\right)\right.$$

$$\left. \cdot P_{NYCA}(Q_{NYCA} + LOE_{NYCA})\right]$$

P = Price (*i.e.,* Unit Net CONE curves)

Q = Quantity at 100% requirement (MW)

LOE = Quantity associated with Level of Excess (MW)

X = Single Load Zone that is a Locality (*i.e.,* Zone J and Zone K)

Y = Locality minus any Single Load Zone Locality located within it (*i.e.,* GHI)

Z = Single Locality located within a larger Locality (*i.e.,* Zone J)

$NYCA$ = New York Control Area

Subject to:

$LOLE \leq 0.1$ days/year

$LCR_J \geq TSL_J$

$LCR_K \geq TSL_K$

$LCR_{G\text{-}J} \geq TSL_{G\text{-}J}$

$IRM =$ NYSRC Approved IRM (i.e., 18%)

Computational Method: Linear Approximation

- Iterative process between Linear Program wrapper and MARS that approximates the objective function and constraints to find least cost solution
- Currently uses the Constrained Optimization By Linear Approximation (COBYLA) algorithm available through Python's scientific computing package

MARS Modeling Assumptions

- Utilize the same process as currently used to develop the final LCR base case
  - Update the NYSRC approved final IRM topology to account for the updated load forecast
- Optimize with the appropriate NYSRC final approved IRM

NYSRC

- Presented to the NYSRC ICS throughout 2017 to provide information and discuss the methodology and progression of this project
- The proposed methodology will enable the NYISO to meet its compliance obligations under the NYSRC rules

Cost of Capacity

- Based upon ICAP Demand Curve peaking plant net cost of new entry ("DC unit net CONE") of capacity within each Locality and the NYCA
- Based upon the FERC accepted Demand Curve parameters
- Elasticity is represented by expressing the DC unit net CONE of each Locality and NYCA as a function of the minimum installed capacity requirement

Development of DC unit net CONE Curves

- Evaluate Net EAS at different levels of installed capacity using data from the 2016 Demand Curve Reset process
  - Net EAS for each Locality was evaluated at +6%, +3%, 2016 requirement, -3%, and -6% of the installed capacity requirement
- Results are used to develop a Net EAS curve
- The Net EAS at each point on the curve is used to calculate a corresponding Net CONE
- Net CONE values are used to develop a DC unit net CONE curve for each Locality and NYCA

Transmission Security Methodology

- N-1-1 analysis is conducted to determine the transmission security import limits into each Locality
- These import limits are used to determine the minimum available capacity required for each Locality
- To translate this minimum available capacity into a market requirement the methodology needs to account for capacity unavailability
- To account for capacity unavailability, the 5-year zonal EFORd is used to calculate minimum locational capacity requirements

N-1-1 Transmission Security Limit (TSL) Analysis

- Analyzes the N-1-1 thermal transfer limits for the NYCA interfaces associated with the G-J, Zone J, and Zone K Localities
- Use an updated Summer Operating base case
  - Inclusion of transmission and generation facility additions and retirements
  - All system elements modeled as in service
  - Appropriate load forecast
- Report with N-1-1 import limits will be posted prior to October 1st of each year
- Final TSLs for the optimization will be established and posted in January each year

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Example Calculation

Transmission Security Requirements	Formula	Zone X
Load Forecast (MW)	[A] = Given	12,000
Transmission Security Import Limit (MW)	[B] = Given	1,500
Transmission Security UCAP Requirement (MW)	[C] = [A]-[B]	10,500
Transmission Security UCAP Requirement (%)	[D] = [C]/[A]	87.5%
5 Year EFORd (%)	[E] = Given	8.0%
Transmission Security ICAP Requirement (MW)	[F] = [C]/(1-[E])	11,413
Transmission Security LCR Floor (%)	[G] = [F]/[A]	**95.1%**

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Results

Base Case

Scenario	Zone J LCR	Zone K LCR	G-J LCR	Cost ($ million)
Current LCR Methodology	81.4%	103.2%	91.3%	$4,441.90
Optimized Methodology without Transmission Security Limits (TSL)	78.0%	105.3%	91.5%	$4,402.89
Optimized Methodology with Transmission Security Limits (TSL)[1]	**80.16%**	**104.15%**	**90.71%**	**$4,424.37**

[1]Uses TSL – preliminary results

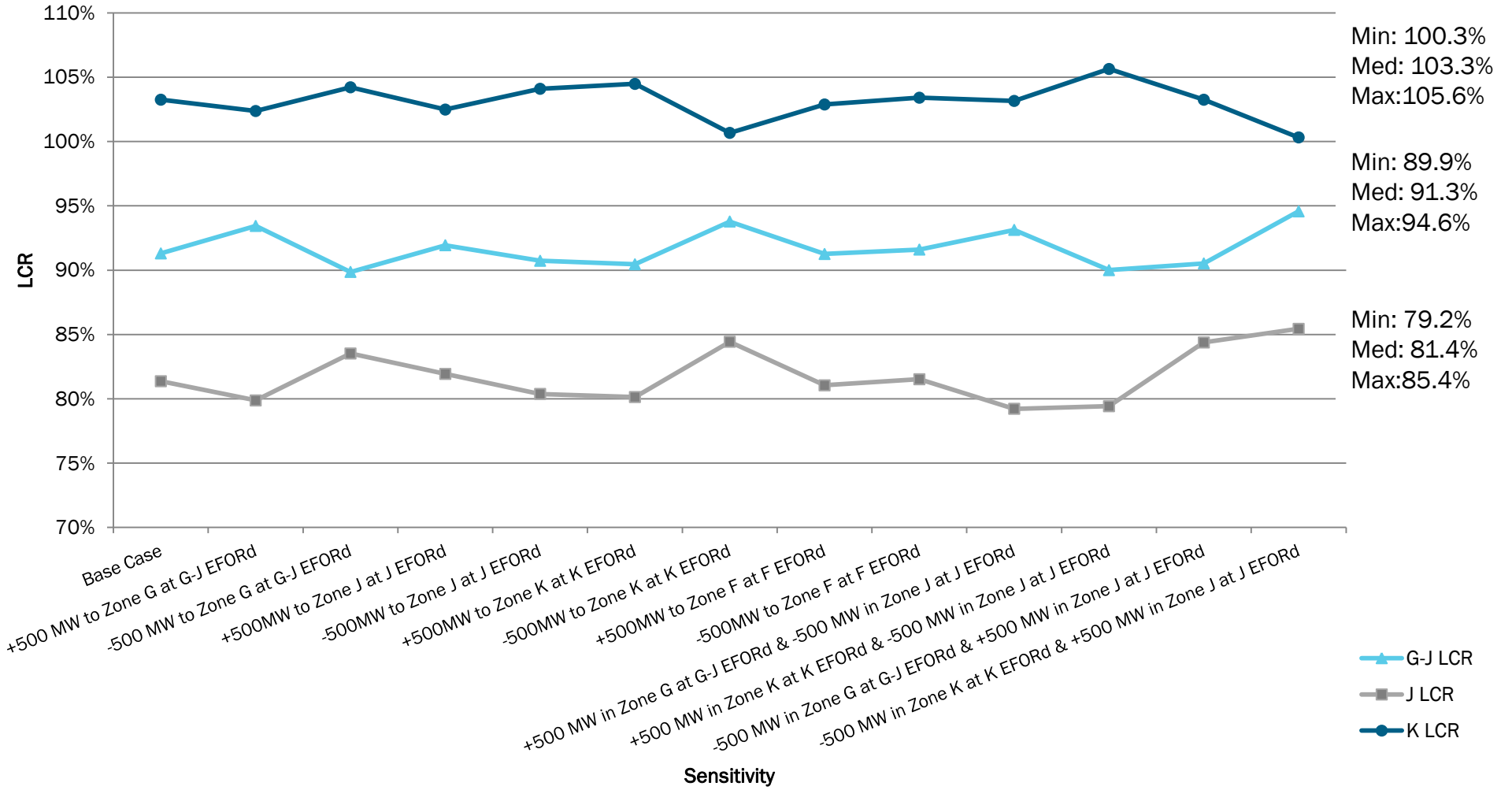
Base Case

Scenario	Zone J LCR	Zone K LCR	G-J LCR
Current LCR Methodology	9,495 MW	5,603 MW	14,664 MW
Optimized Methodology without Transmission Security Limits (TSL)	9,102 MW	5,715 MW	14,696 MW
Optimized Methodology with Transmission Security Limits (TSL)[2]	**9,355 MW**	**5,652 MW**	**14,570 MW**

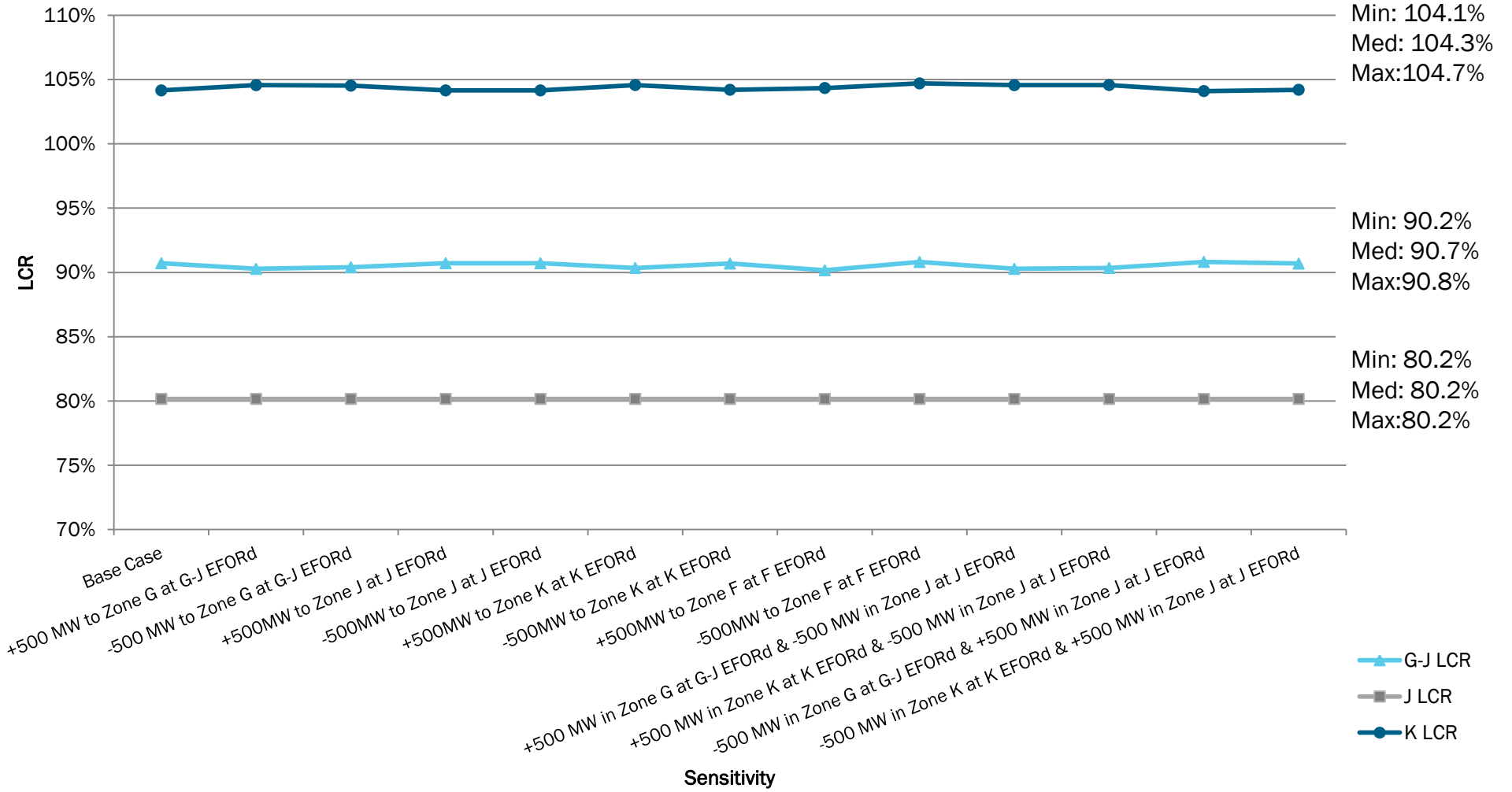
[2]Uses TSL – preliminary results

Market Stability with Changes in Generation

Current LCRs Methodology for Changes in Generation



Optimized LCRs with TSL for Changes in Generation



Stability of LCRs

- The optimization methodology results in an increase in stability as generation changes occur within the system

Methodology	Range of LCRs in Change in Generation Sensitivities		
	Zone K	Zone J	G-J
Current LCR Methodology	5.3%	6.2%	4.7%
Optimized with TSL[3]	0.6%	0.0%	0.7%

[3]Sensitivities based on TSL – preliminary results

Stability of LCRs

Methodology	Range of LCRs		
	Zone K	Zone J	G-J
Current LCR Methodology	289 MW	725 MW	756 MW
Optimized with TSL[4]	32 MW	0 MW	104 MW

[4]Sensitivities based upon TSL – preliminary results

Review of Potential Inclusion of Cost Allocation Provision

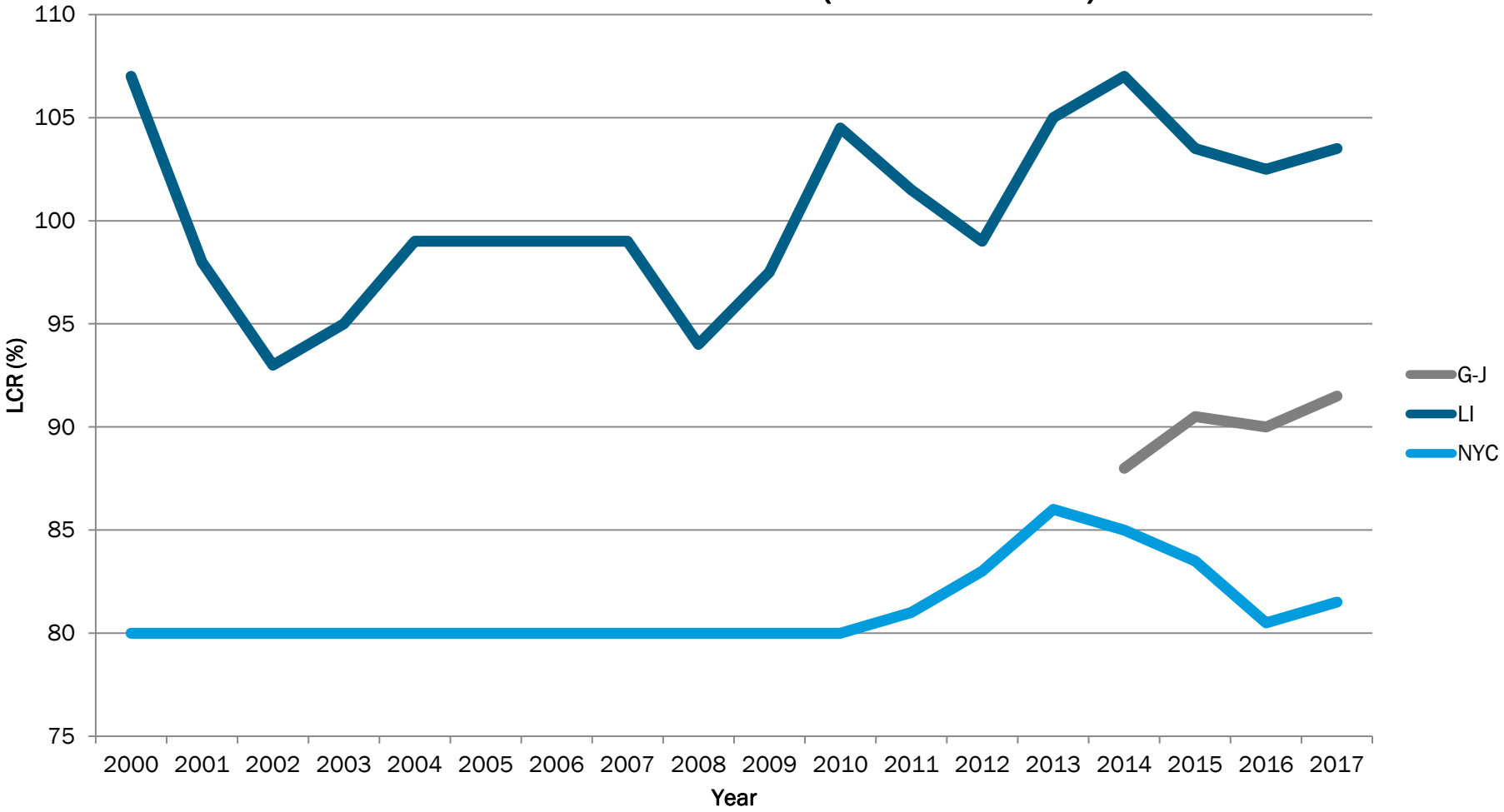
Historic LCR Values for last 5 years (2013-2017)

	Zone J	Zone K	G-J[5]
Minimum	80.5%	102.5%	88.0%
Average	83.3%	103.4%	90.0%
Maximum	86.0%	107.0%	91.5%
Optimized Methodology with Transmission Security Limits (TSL)[6]	80.16%	104.15%	90.71%

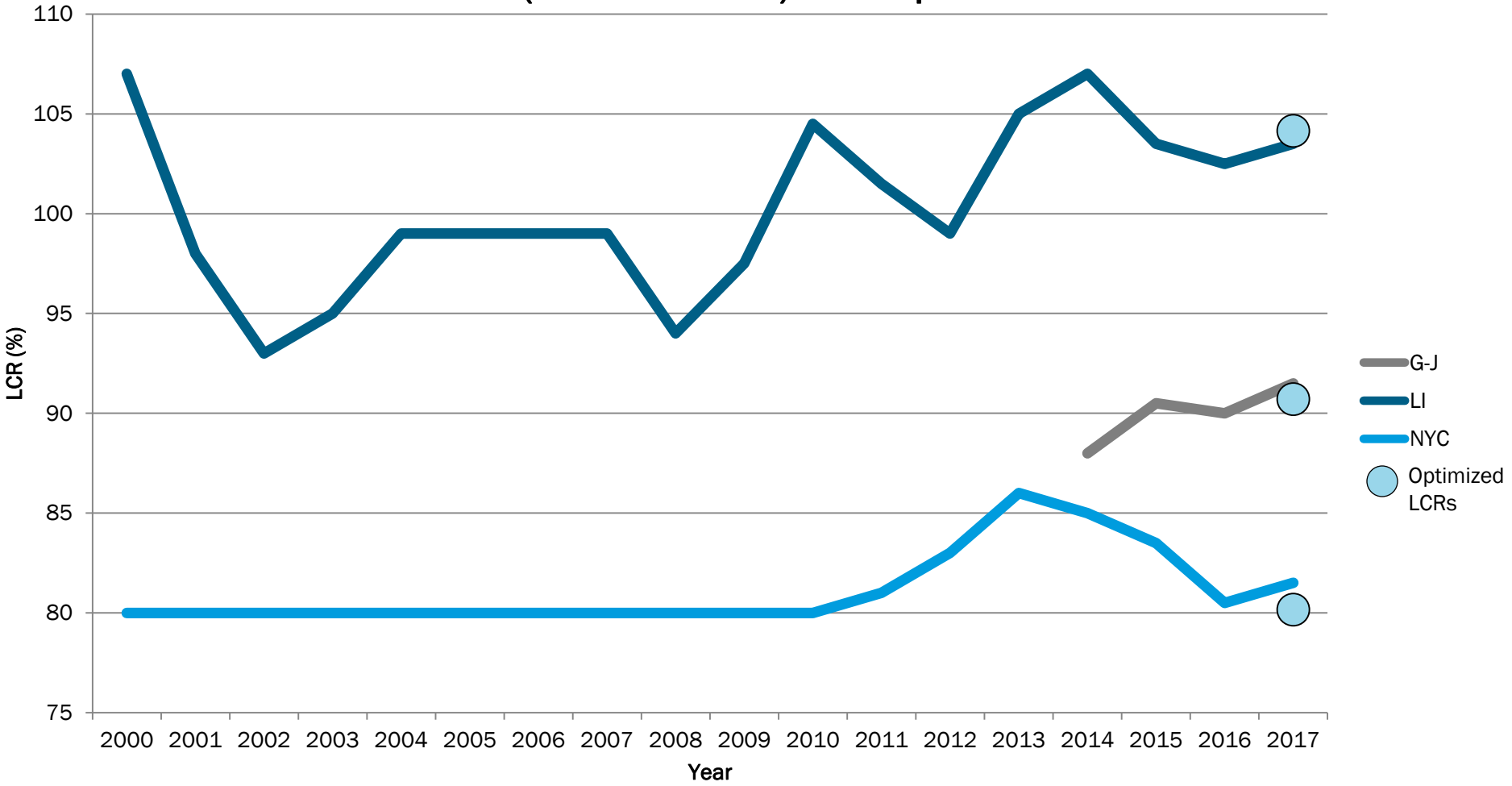
[5] LCRs were established for G-J starting in 2014

[6]Based upon TSL – preliminary results

Historic LCR Values (2000 – 2017)



Historic LCR Values (2000 – 2017) with Optimized LCRs with TSL

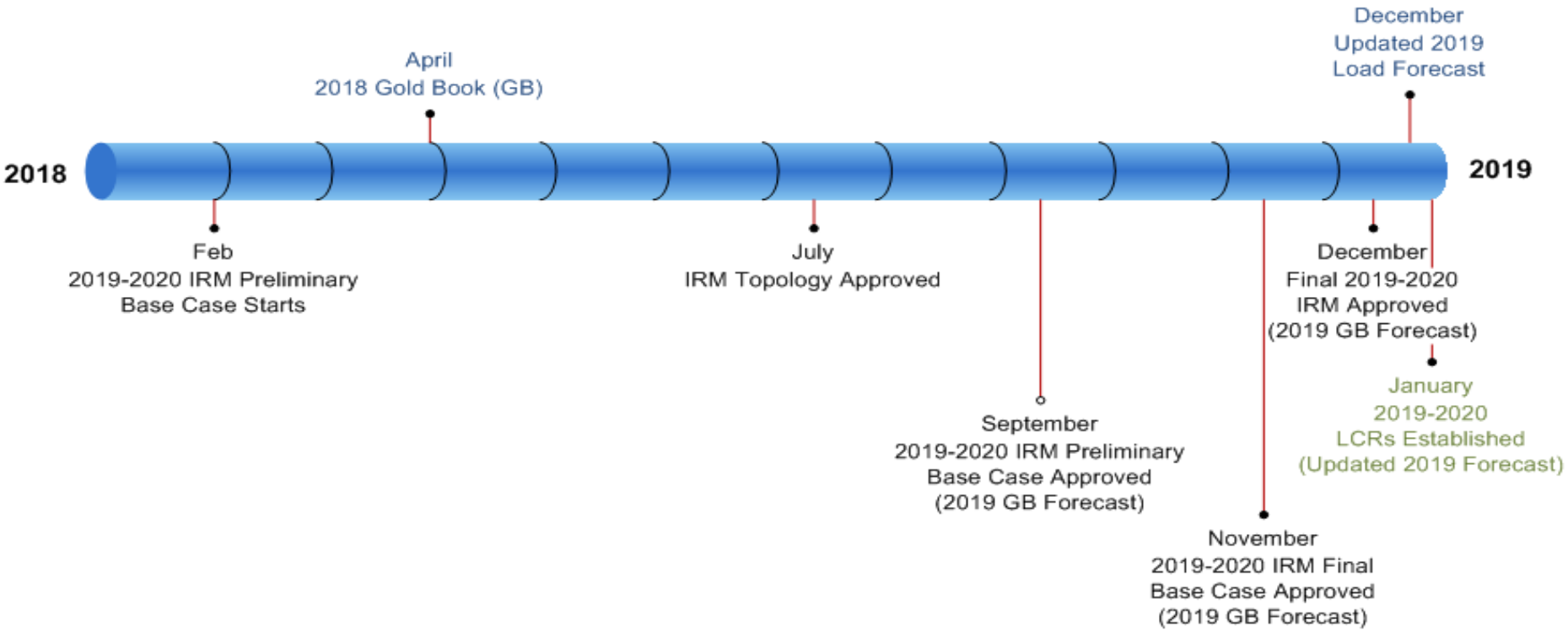


Cost Allocation

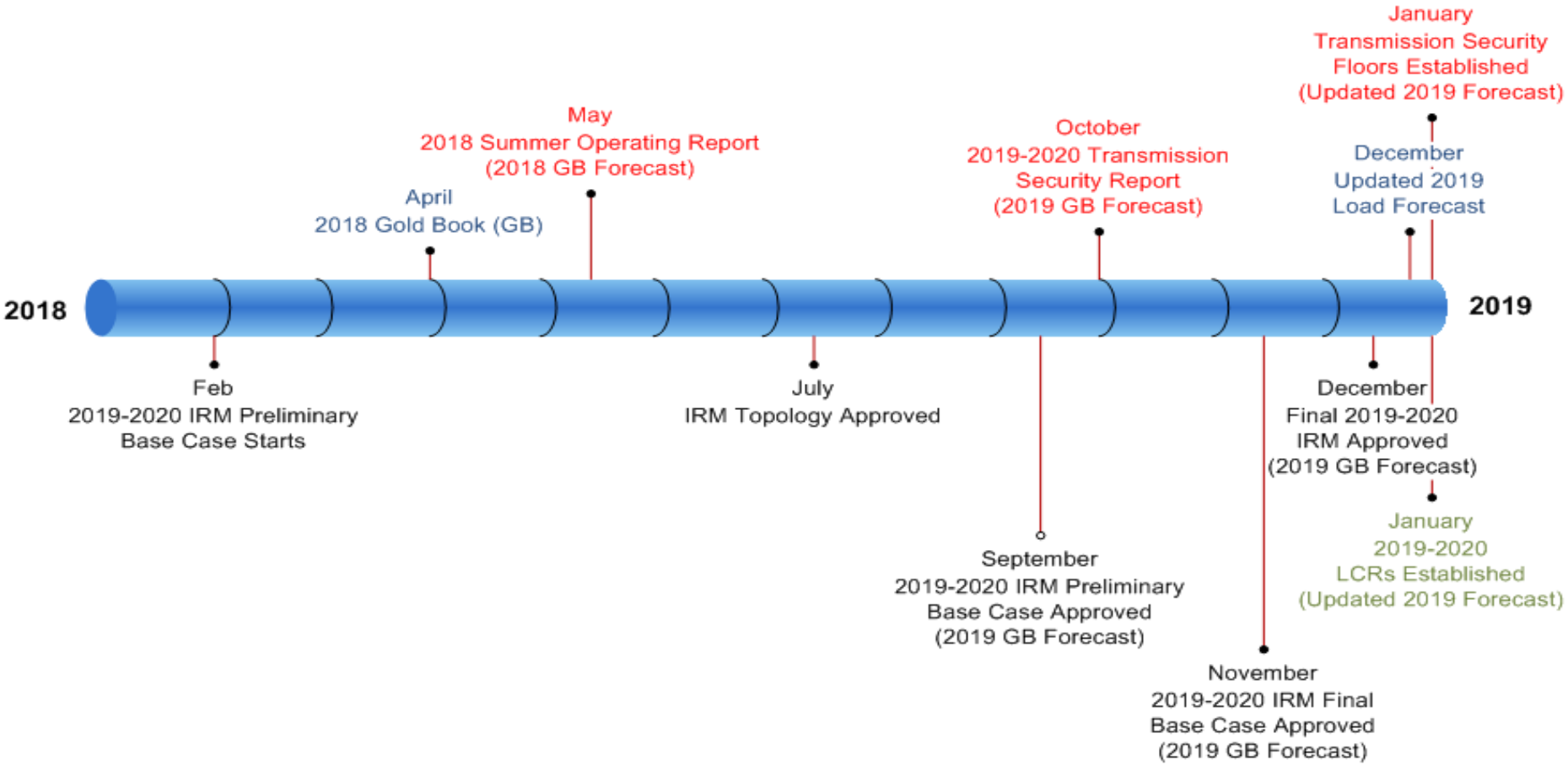
- Since the optimization methodology results in LCRs within the historic range, an evaluation of a potential revision to the cost allocation that results appears to be unnecessary
  - In addition, the optimization is providing increased market stability with respect to changes in generation
- If conditions should occur that warrant reviewing and revising cost allocation methodology, the NYISO and stakeholders could take it into consideration. In addition, stakeholders may prioritize it in a future BPWG process as a future project

Timeline

Current Timeline



Timeline Additions



LCR Setting Timeline

- No alterations to the current timeline are needed to accommodate the alternative methodology for determining LCRs
- Transmission security analysis used in the alternative methodology would be conducted and reported prior to October 1st
  - This analysis would utilize an updated base case used in the Summer Operating Report

Next Steps

2018 Project Scope

- Review existing Tariff language and draft Tariff language to reflect new methodology as necessary
  - Work with stakeholders in ICAP Working Group, and then present to BIC and MC for action, and Board approval
- File revised Tariff language with FERC
- Revise LCR methodology documentation and any manual revisions required
- Develop internal process for implementation
- Address any administrative issues (ongoing)

Questions?

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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DRAFT – FOR DISCUSSION PURPOSES ONLY

Appendix

CONFORMANCE WITH NYSRC REQUIREMENTS

The NYISO confirms that the new proposed methodology for calculating minimum locational installed capacity requirements ("LCRs") is designed to satisfy the following criteria:

- A LOLE of 0.1 days/year, as specified by NYSRC Reliability Rule A.2: R1, shall be maintained.
- The NYISO shall use the software, load and capacity data, and models consistent with that utilized by the NYSRC for its preparation of the IRM, as described in Sections 3.2 and 3.5 of NYSRC Policy 5-12.
- The NYISO shall use the final Installed Reserve Margin established by the NYSRC.
- The NYISO shall document the procedures used to calculate LCRs.

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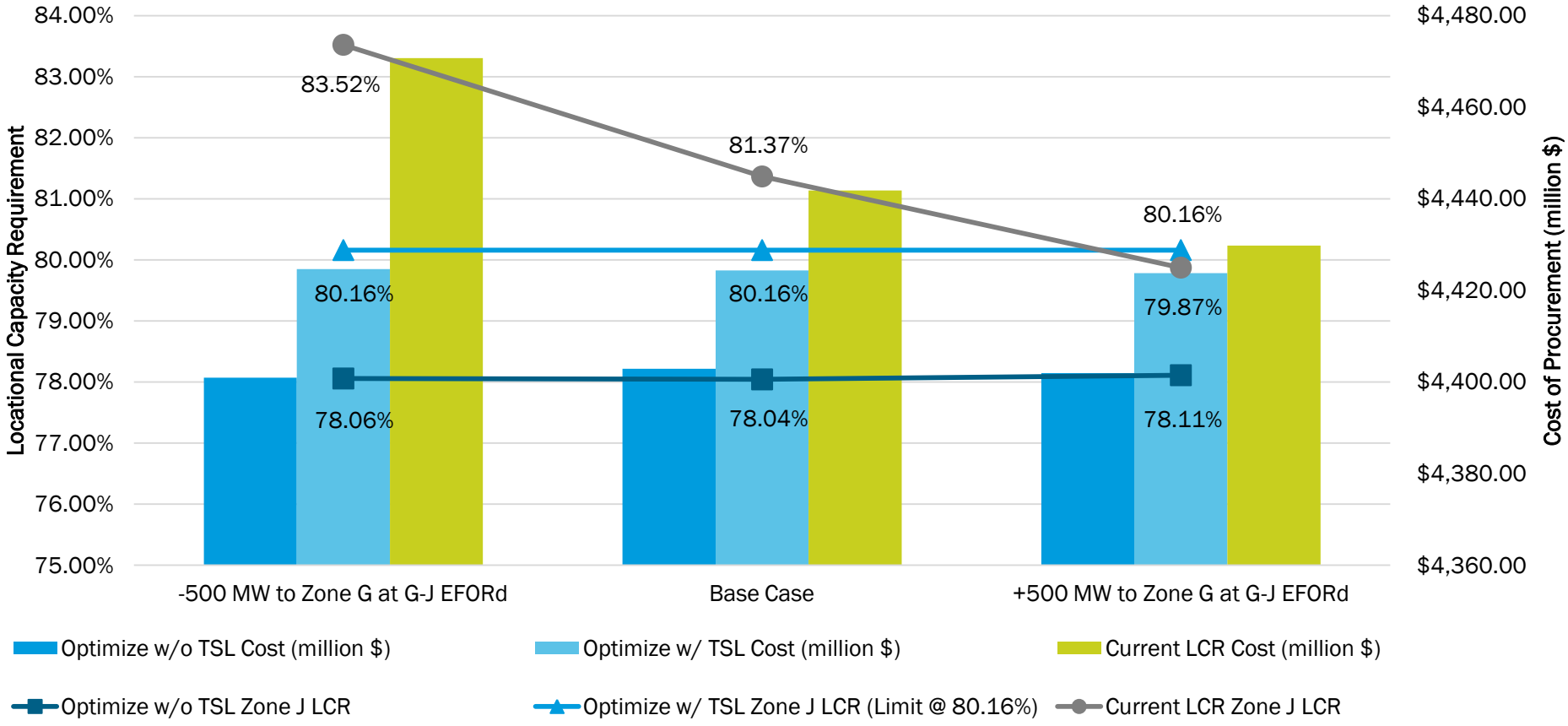
Market Simulations

Single Change in Generation

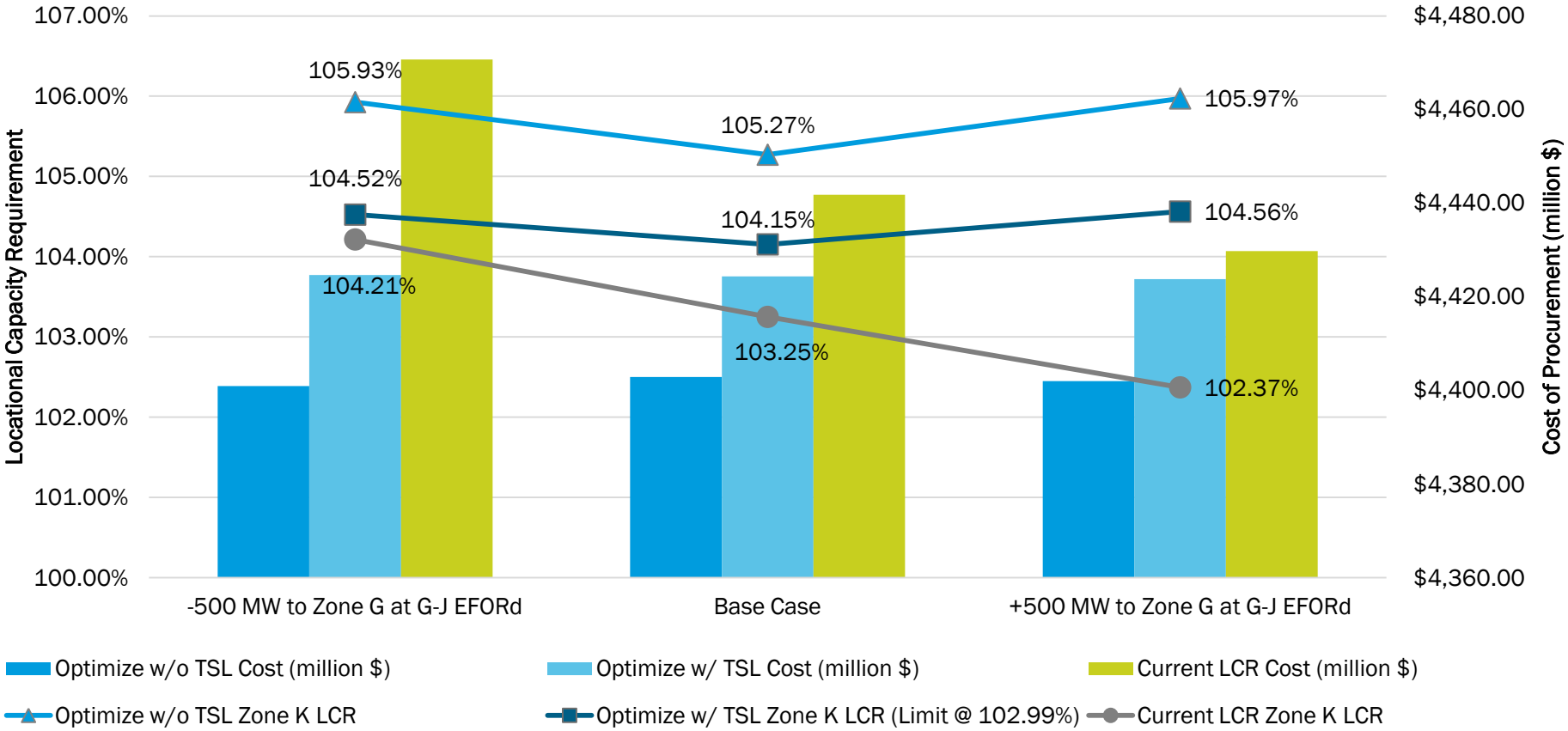
- +/- 500 MW to Zone G at G-J EFORd
- +/- 500 MW to Zone J at J EFORd
- +/- 500 MW to Zone K at K EFORd
- +/- 500 MW to Zone F at F EFORd

Market Simulations: +/- 500 MW to Zone G

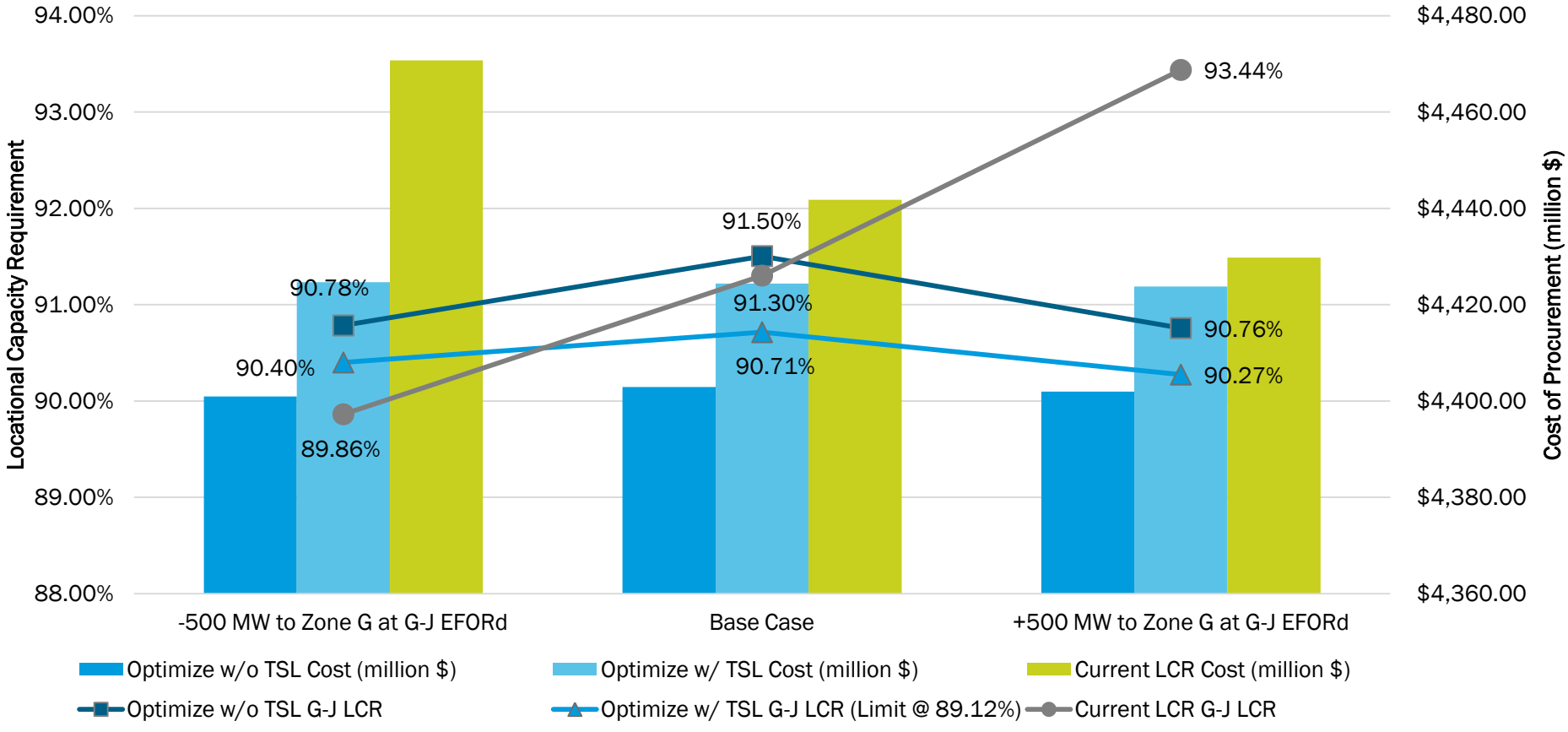
Addition and Removal of Capacity from Zone G Zone J LCR



Addition and Removal of Capacity from Zone G Zone K LCR



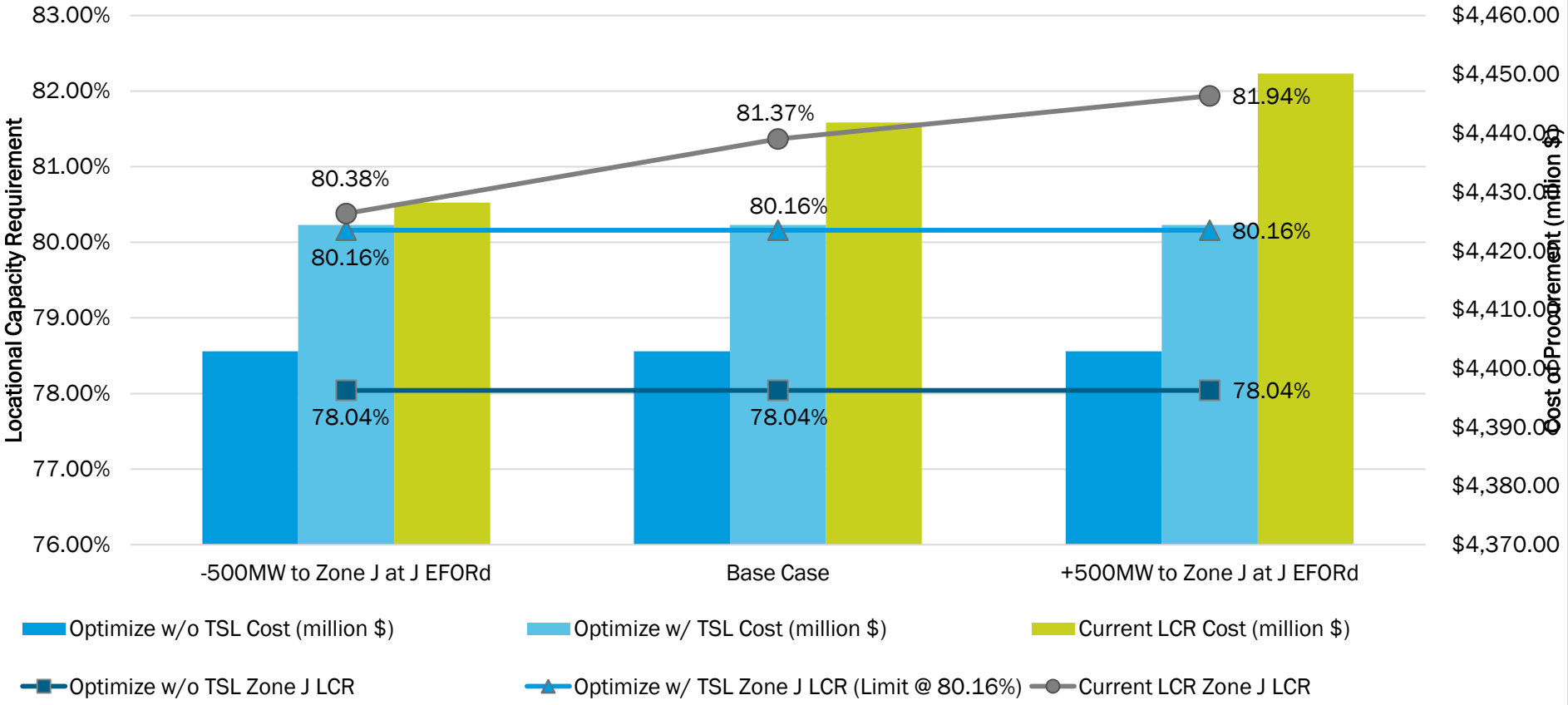
Addition and Removal of Capacity from Zone G G-J LCR



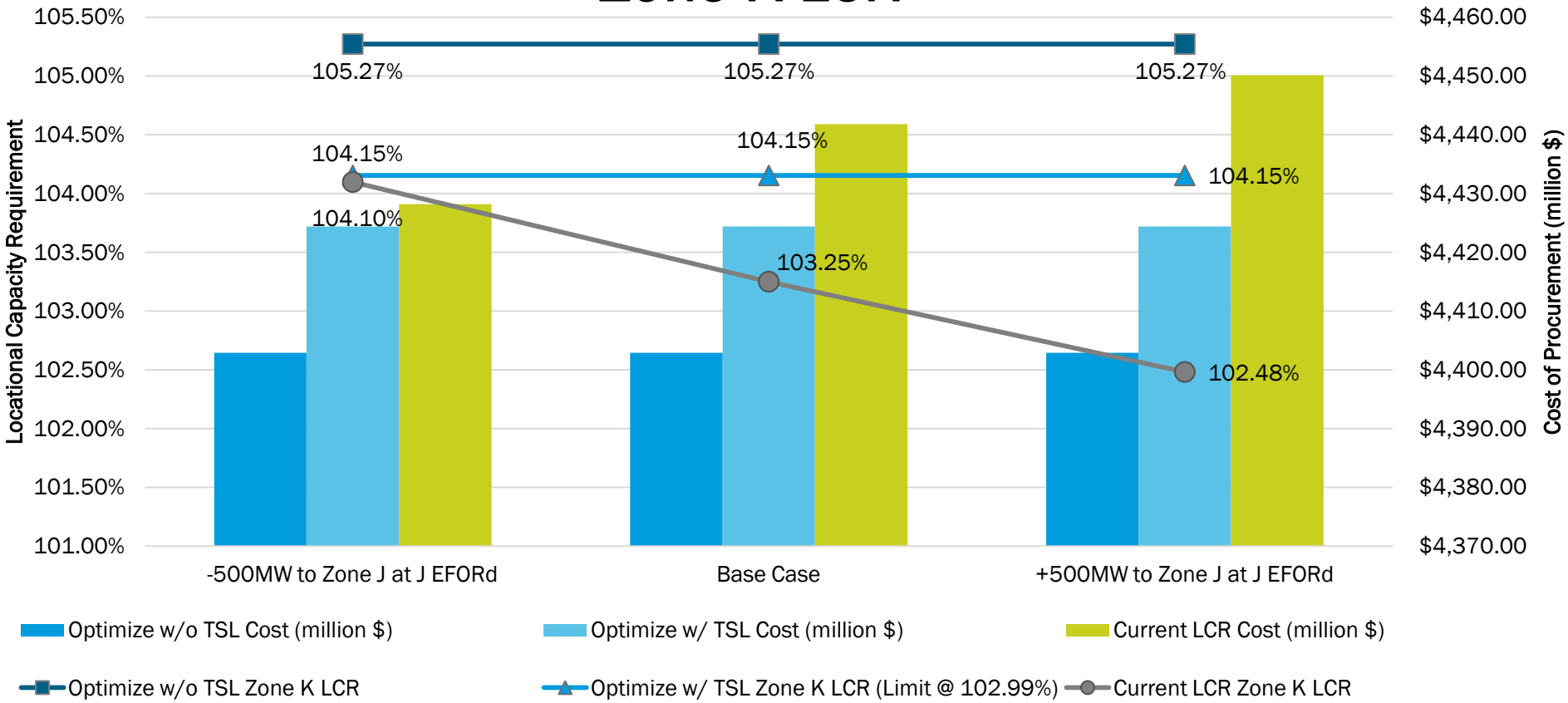
Market Simulations: +/- 500 MW to Zone J

Addition and Removal of Capacity from Zone J

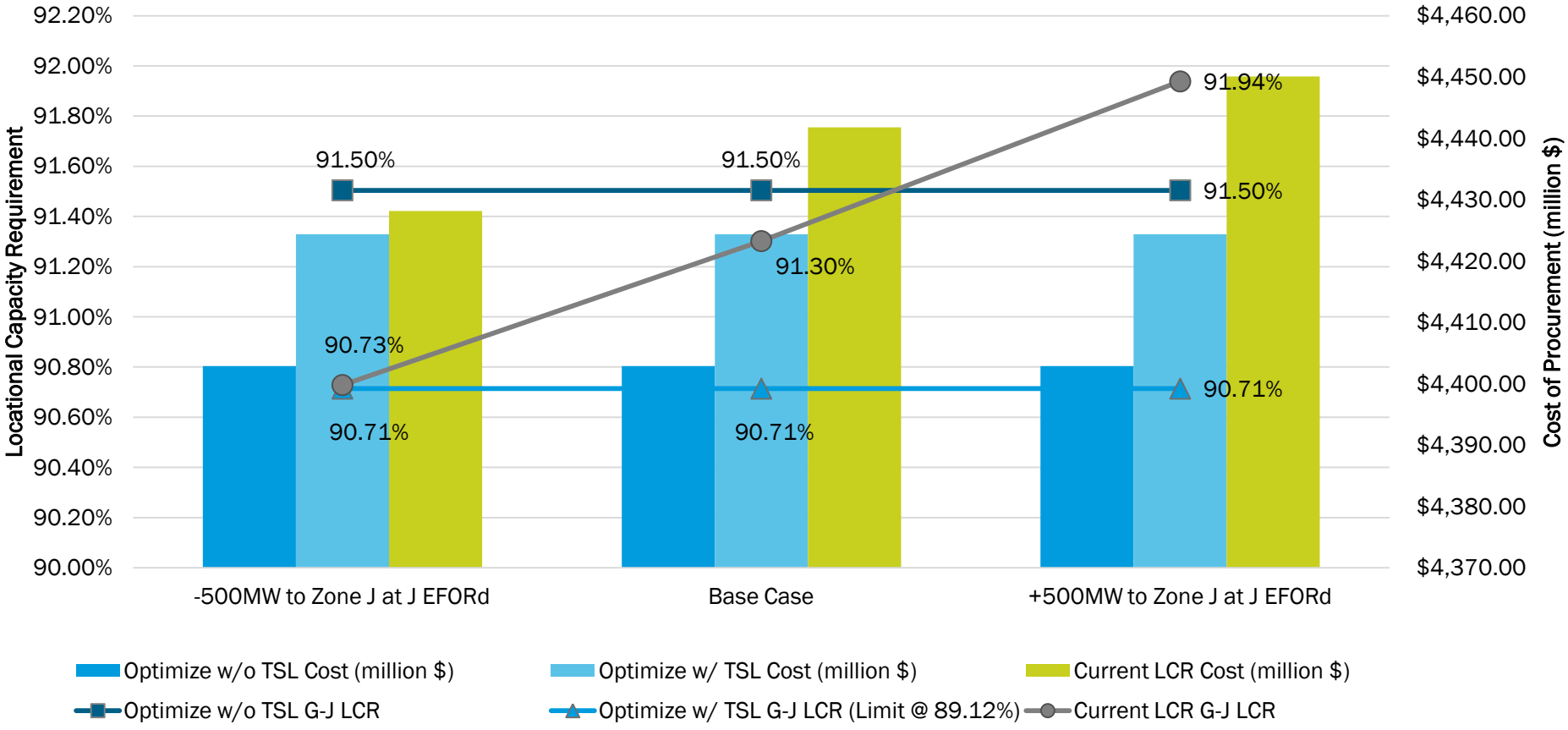
Zone J LCR



Addition and Removal of Capacity from Zone J Zone K LCR



Addition and Removal of Capacity from Zone J G-J LCR



Market Simulations: +/- 500 MW to Zone K

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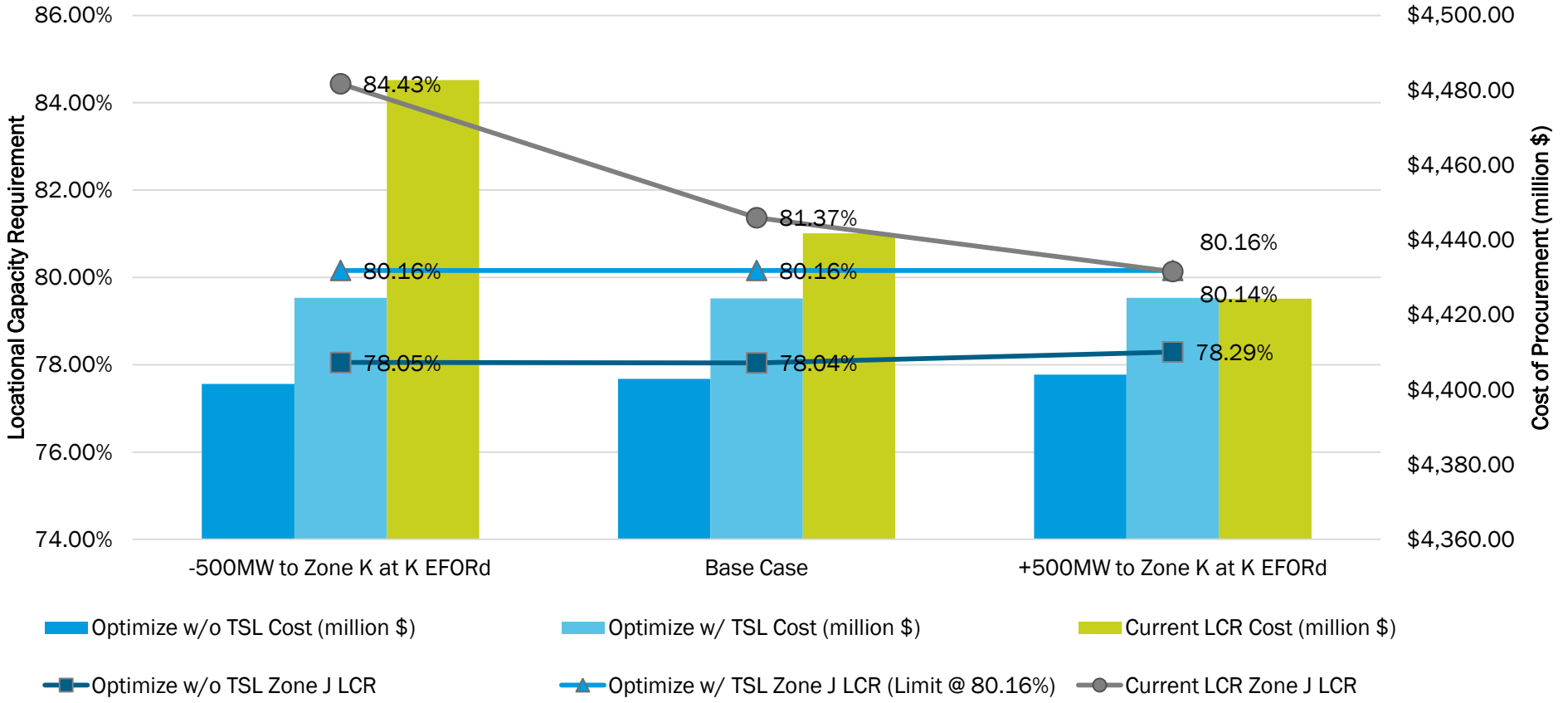
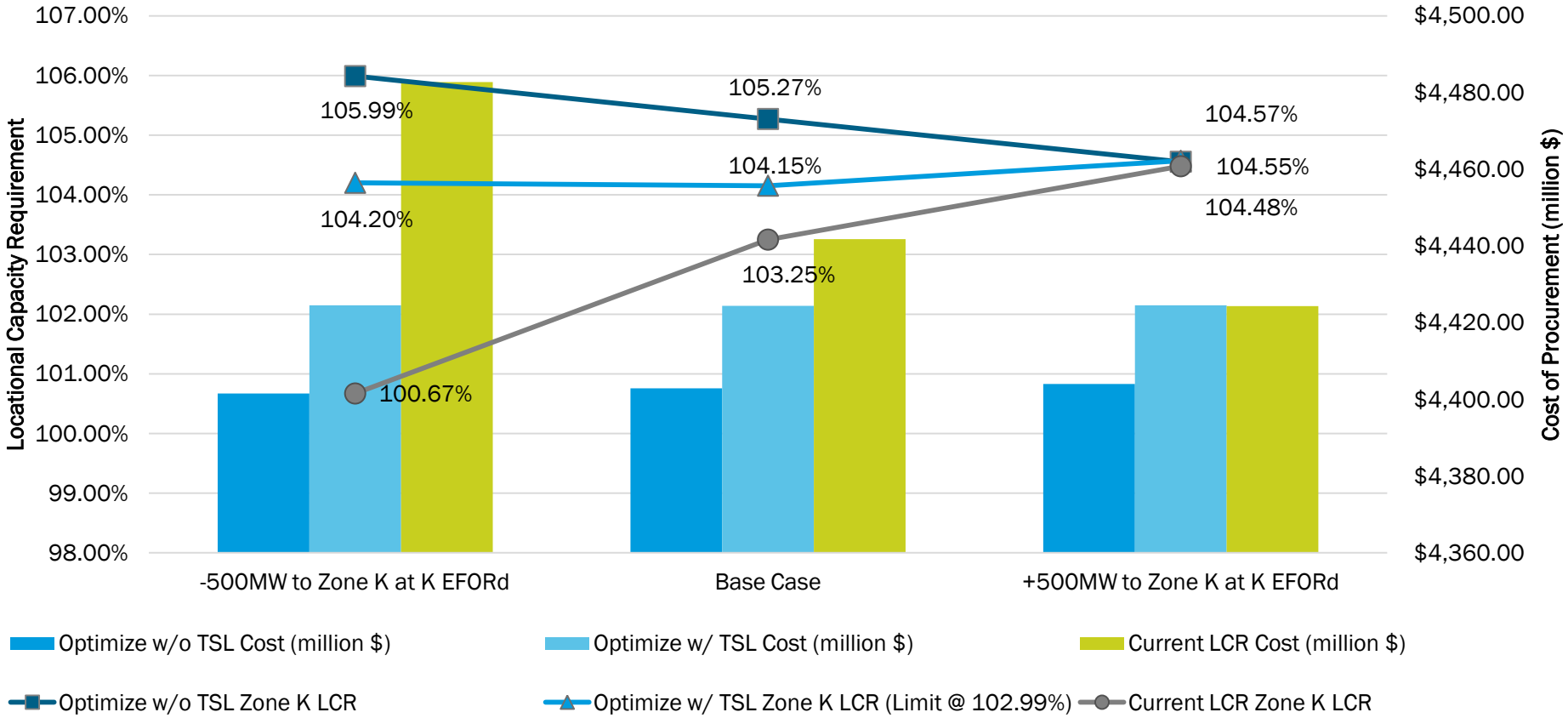
Addition and Removal of Capacity from Zone K Zone J LCR

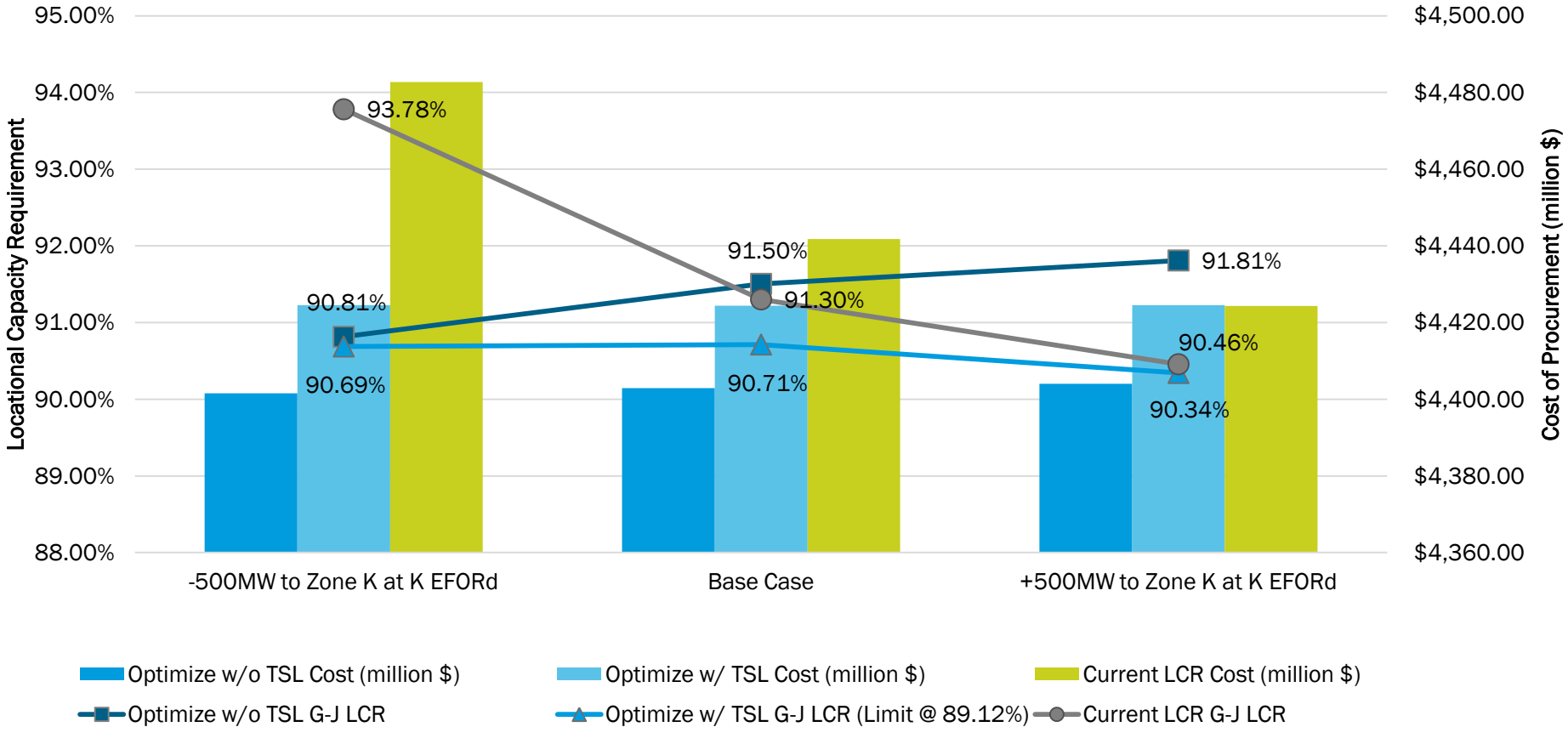


Addition and Removal of Capacity from Zone K

Zone K LCR

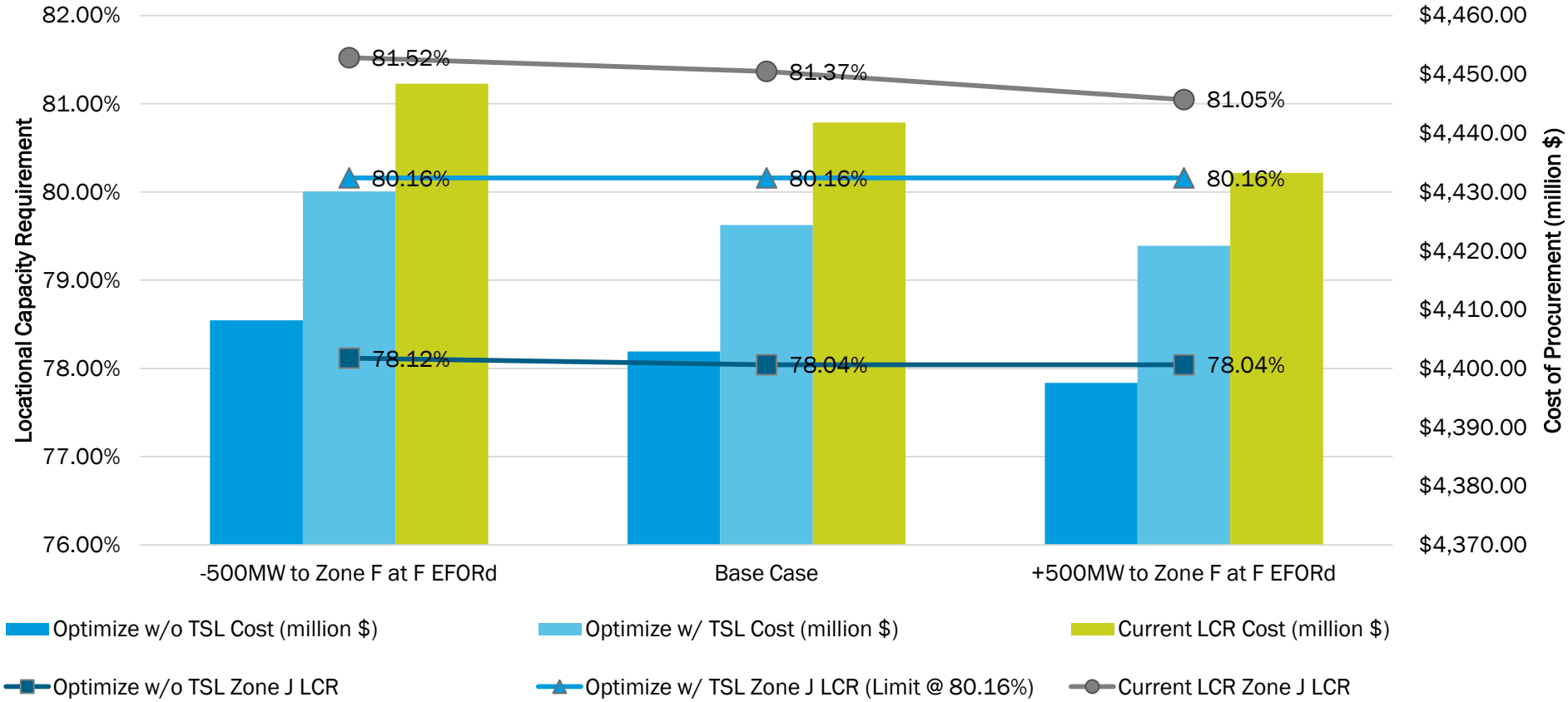


Addition and Removal of Capacity from Zone K G-J LCR

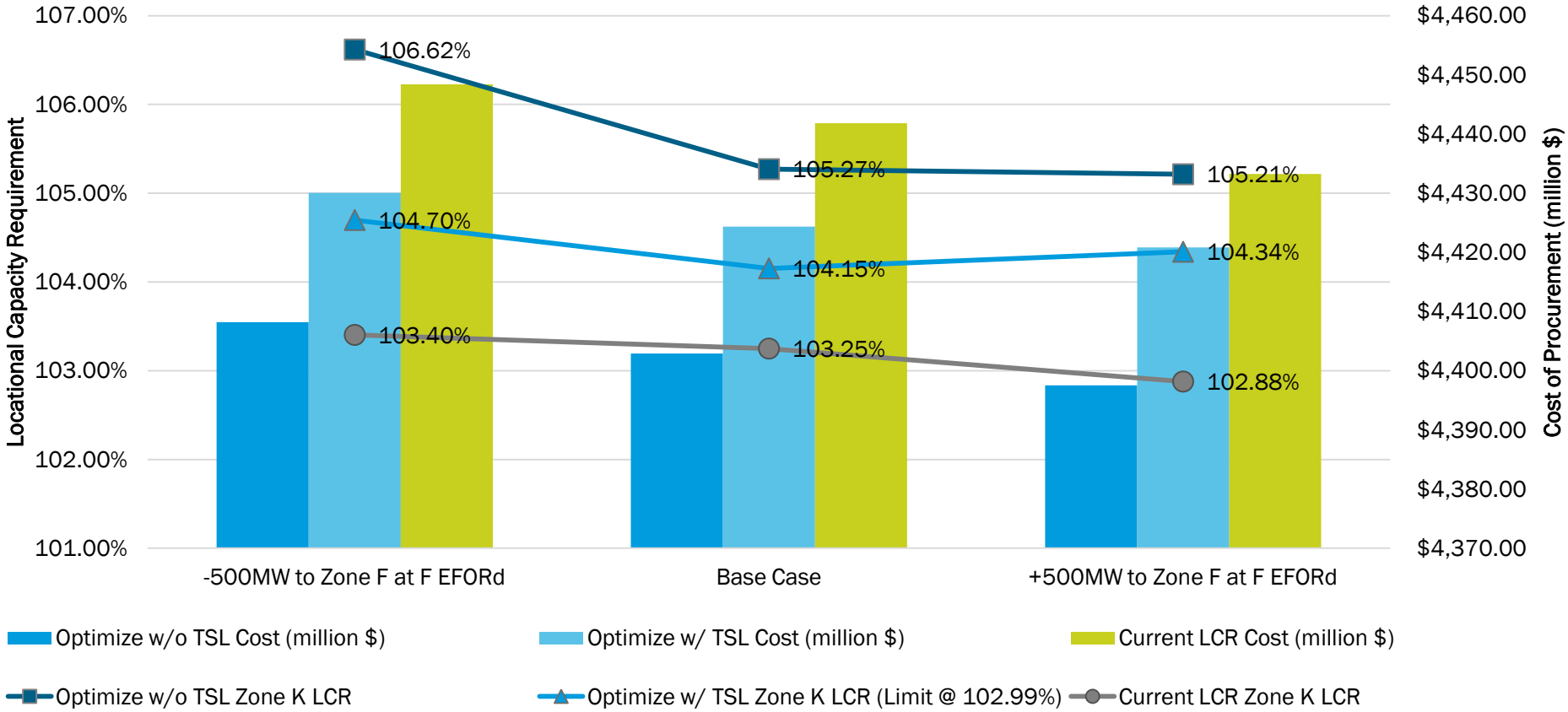


Market Simulations: +/- 500 MW to Zone F

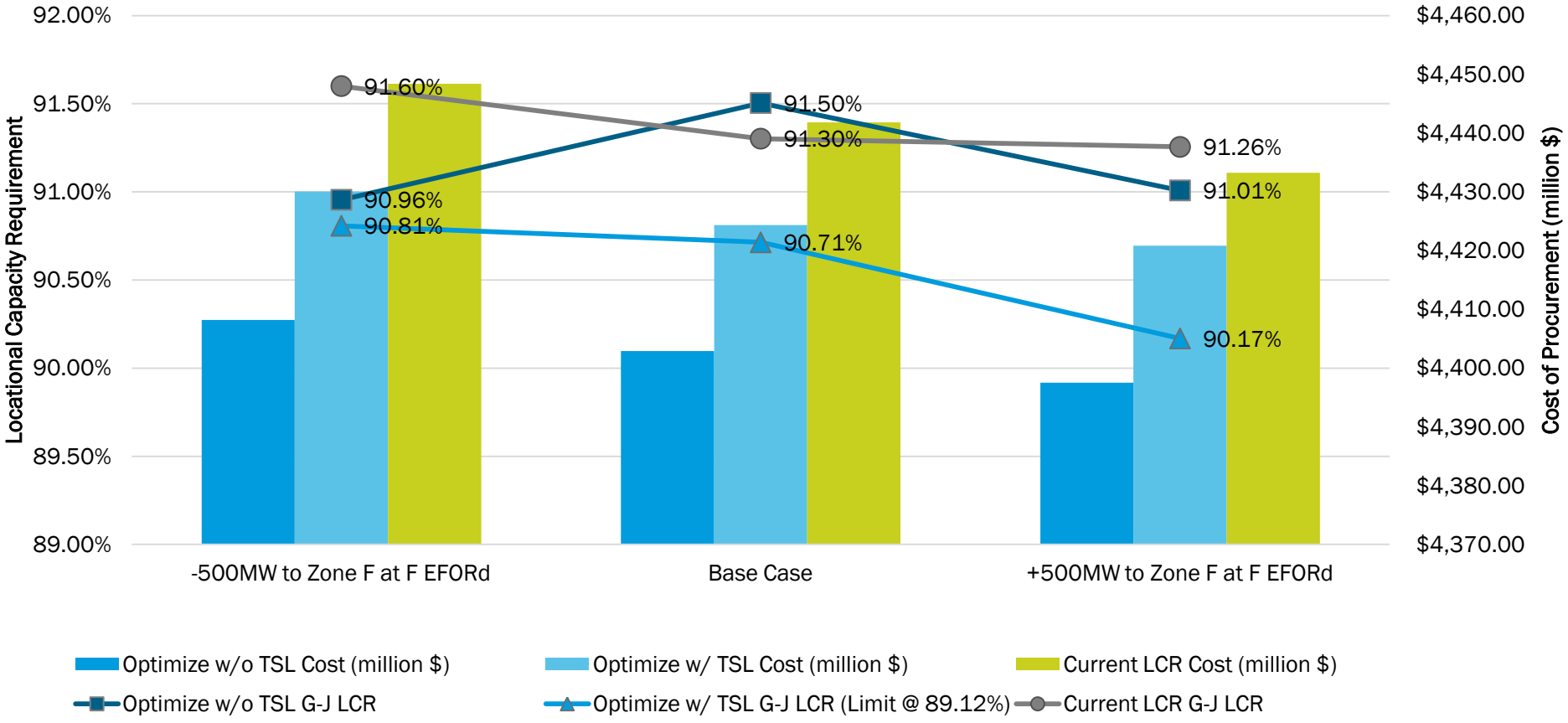
Addition and Removal of Capacity from Zone F Zone J LCR



Addition and Removal of Capacity from Zone F Zone K LCR



Addition and Removal of Capacity from Zone F G-J LCR

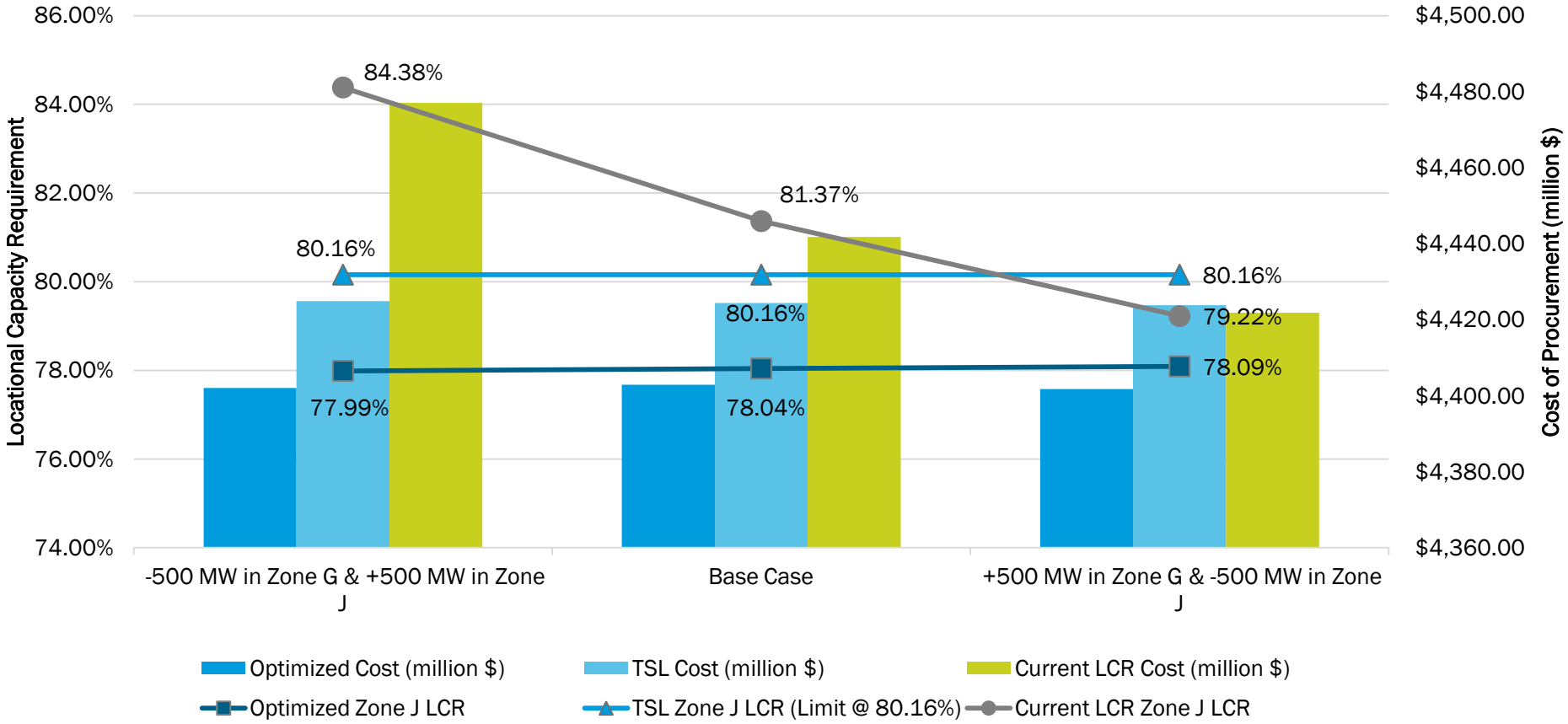


Multiple Changes in Generation

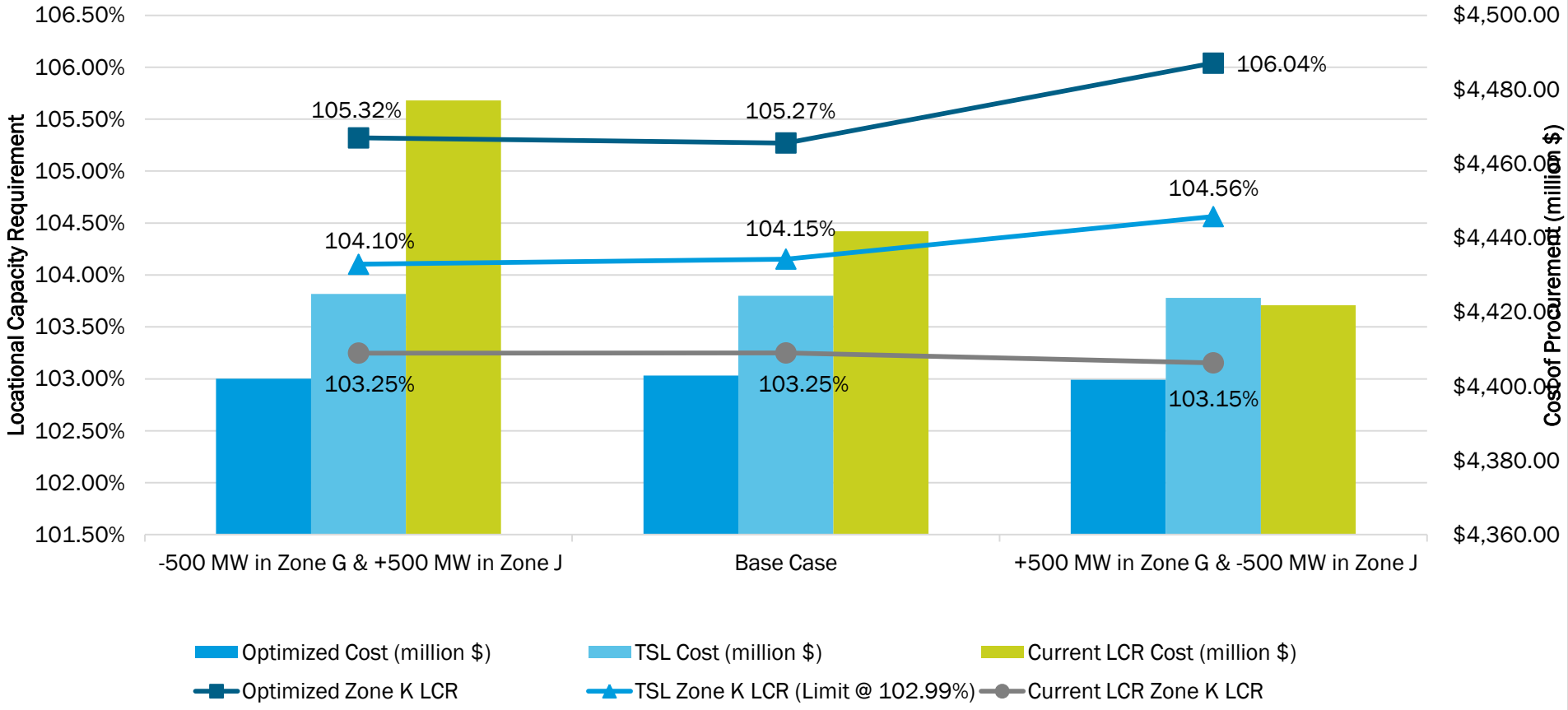
- +500 MW in Zone G & -500 MW in Zone J
- -500 MW in Zone G & +500 MW in Zone J
- +500 MW in Zone K & -500 MW in Zone J
- -500 MW in Zone K & +500 MW in Zone J

Market Simulations: +/- 500 MW to Zone G and +/-500 MW to Zone J

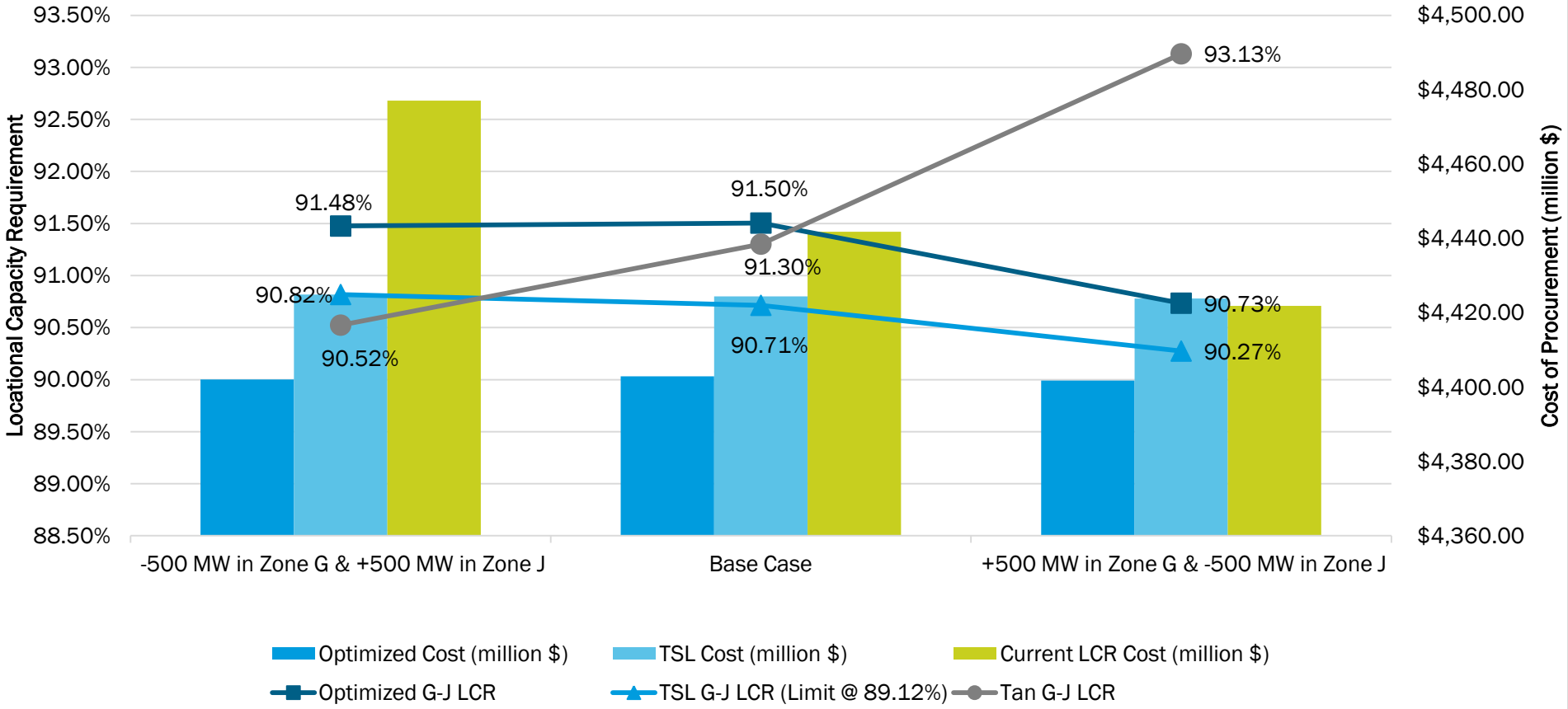
Addition & Removal of Capacity from Zone G & Zone J Zone J LCR



Addition & Removal of Capacity from Zone G & Zone J Zone K LCR

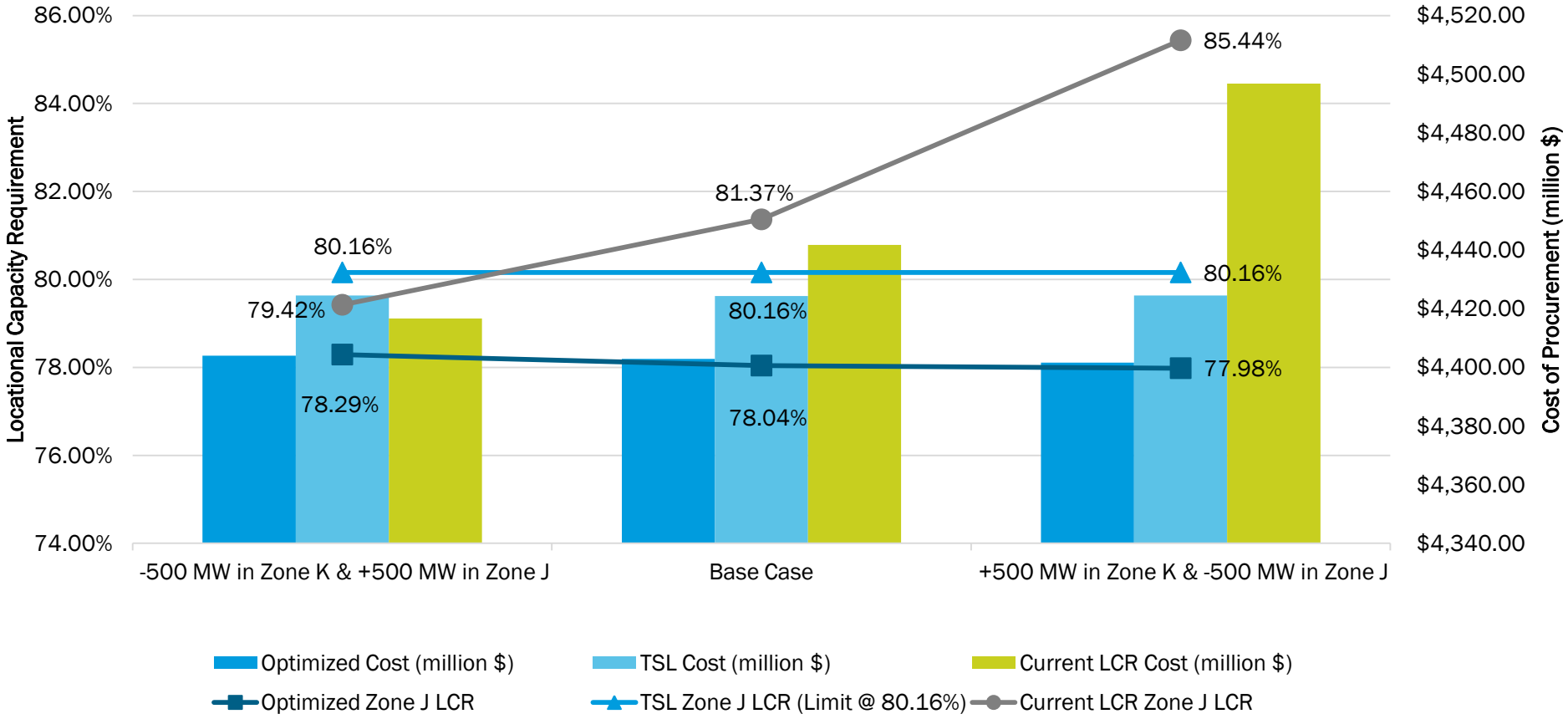


Addition & Removal of Capacity from Zone G & Zone J G-J LCR

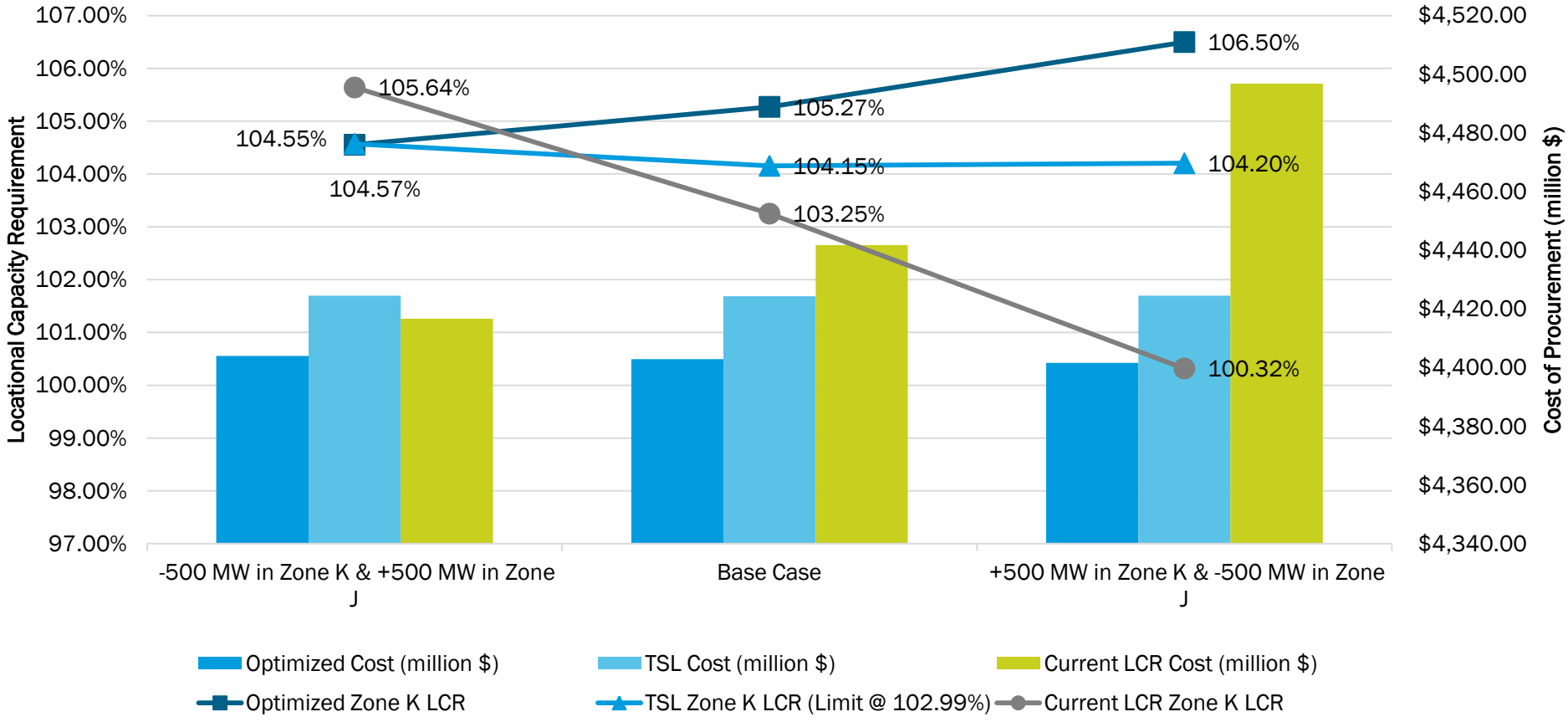


Market Simulations: +/- 500 MW to Zone K and +/-500 MW to Zone J

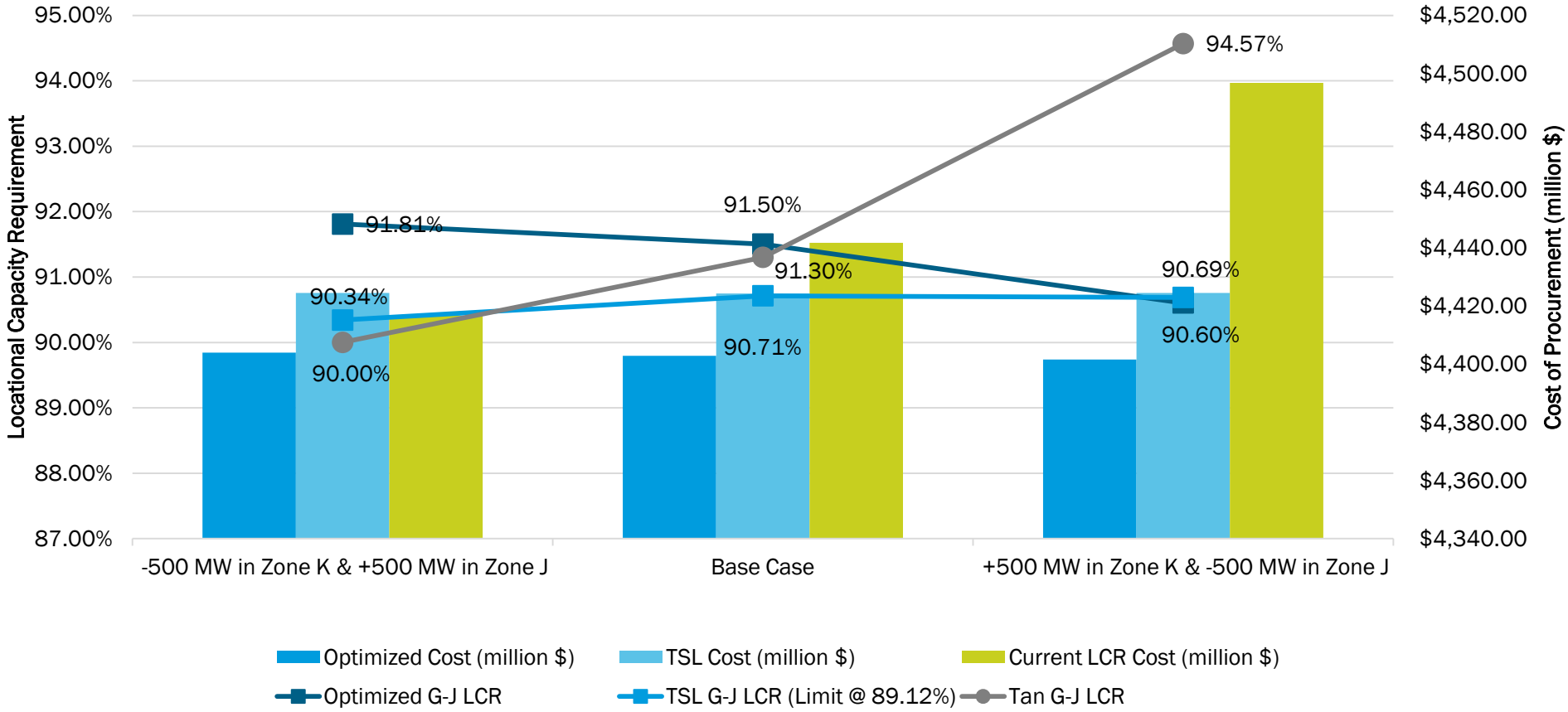
Addition & Removal of Capacity from Zone K & Zone J Zone J LCR



Addition & Removal of Capacity from Zone K & Zone J Zone K LCR



Addition & Removal of Capacity from Zone K & Zone J G-J LCR



Changes in Transmission

Changes in Transmission

- **+1000 MW to UPNY-SENY**
  - Transmission Security Limit for G-J was recalculated assuming an additional 1000 MW of import capability

+1000 MW to UPNY-SENY

Scenario	Zone J LCR	Zone K LCR	G-J LCR	Cost ($ million)
Current LCR Methodology	79.38%	101.94%	90.18%	$ 4,398.63
Optimized Methodology without Transmission Security Limits (TSL)	77.71%	107.44%	84.29%	$4,365.16
Optimized Methodology with Transmission Security Limits (TSL)	**80.16%**	**103.80%**	**84.96%**	**$4,388.00**

- **G-J import limit was increased by 1000 MW in the TSL calculation resulting in a reduction in the TSL from 89.12% to 82.17%**

+1000 MW to UPNY-SENY

Scenario	Zone J LCR	Zone K LCR	G-J LCR
Current LCR Methodology	9,263 MW	5,532 MW	14,484 MW
Optimized Methodology without Transmission Security Limits (TSL)	9,069 MW	5,831 MW	13,538 MW
Optimized Methodology with Transmission Security Limits (TSL)	9,355 MW	5,633 MW	13,645 MW

Change from Base Case to +1000 MW UPNY-SENY

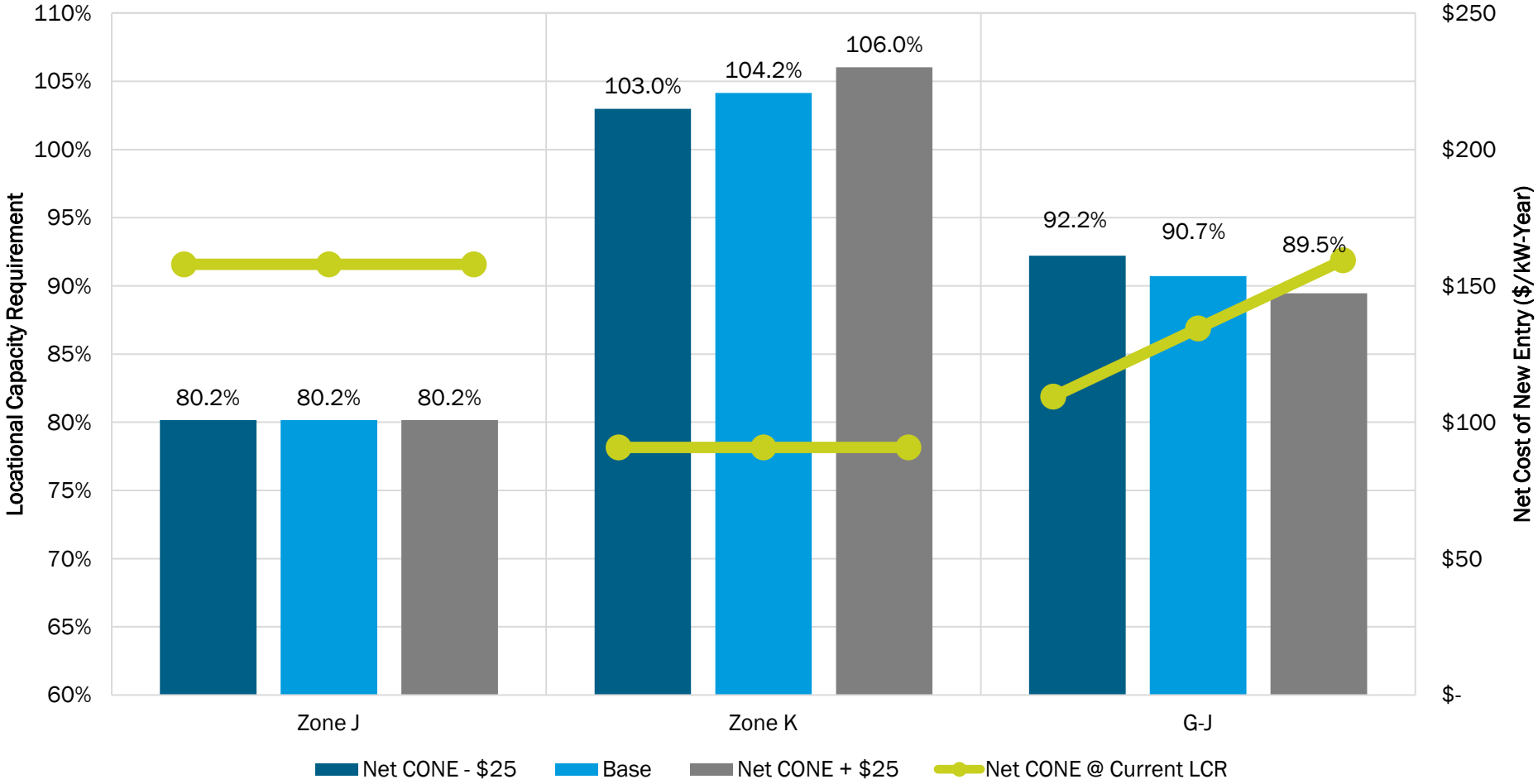
Scenario	Δ Zone J MW	Δ Zone K MW	Δ G-J MW	Δ Total Locality MW
Current LCR Methodology	-232.2	-71.1	-180.5	-483.8
Optimized Methodology without Transmission Security Limits (TSL)	-38.5	117.7	-1159.1	-1079.9
Optimized Methodology with Transmission Security Limits (TSL)	0.0	-19.2	-924.8	-944.1

Changes in Net CONE

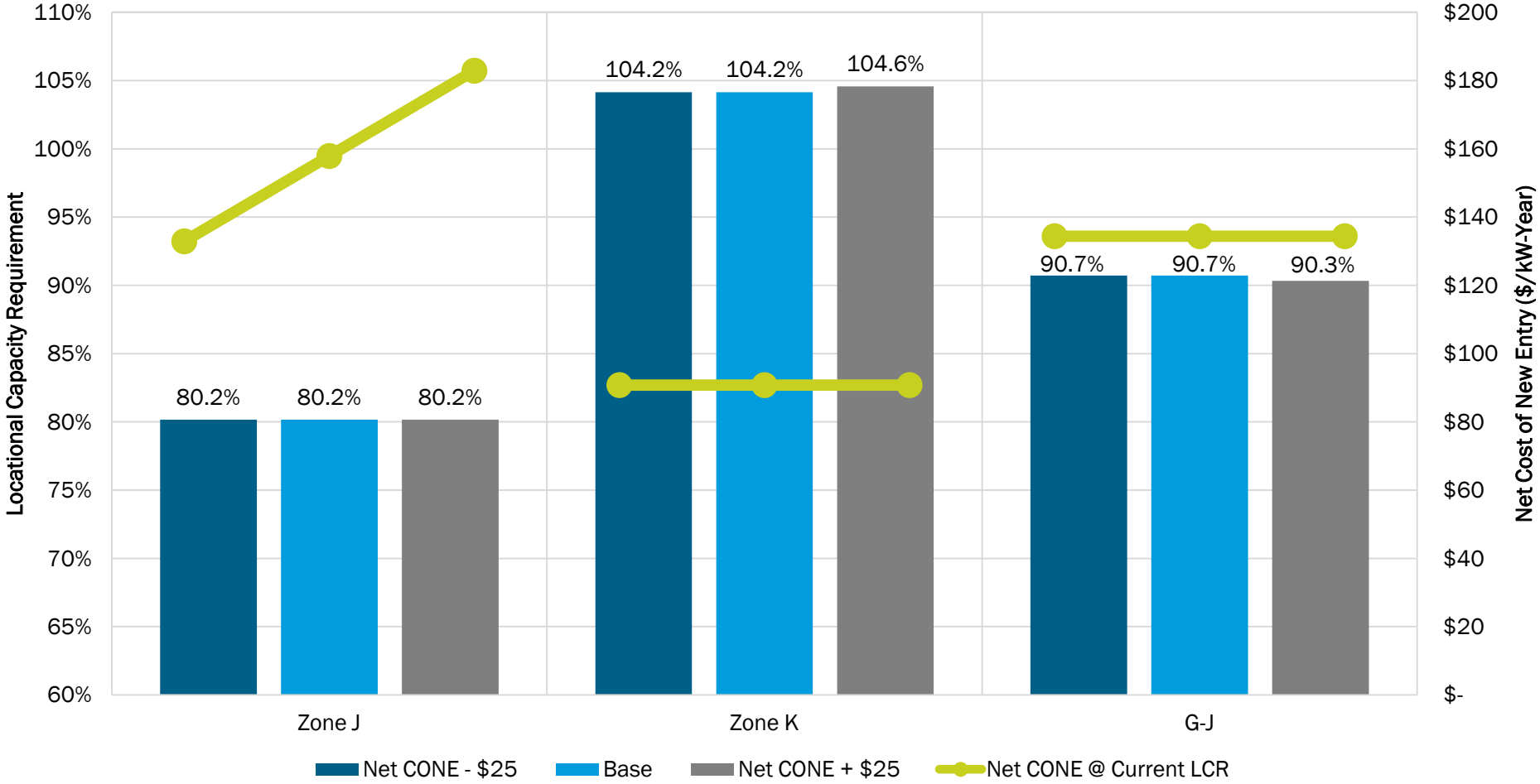
Changes in Net CONE

- +/- $25.00 to G-J Net CONE
- +/- $25.00 to Zone J Net CONE
- +/- $25.00 to Zone K Net CONE
- +/- $25.00 to NYCA Net CONE

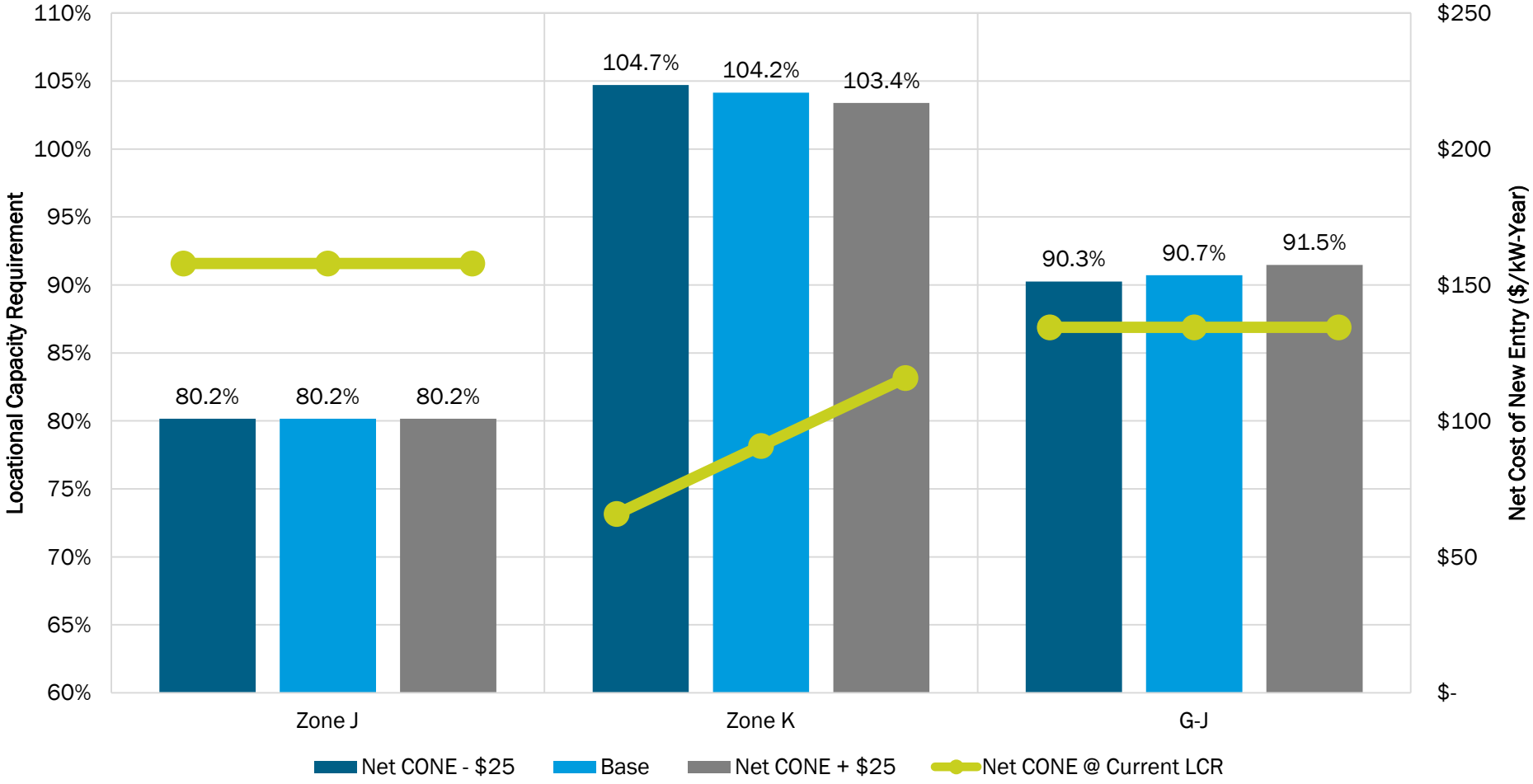
G-J Net CONE +/- $25



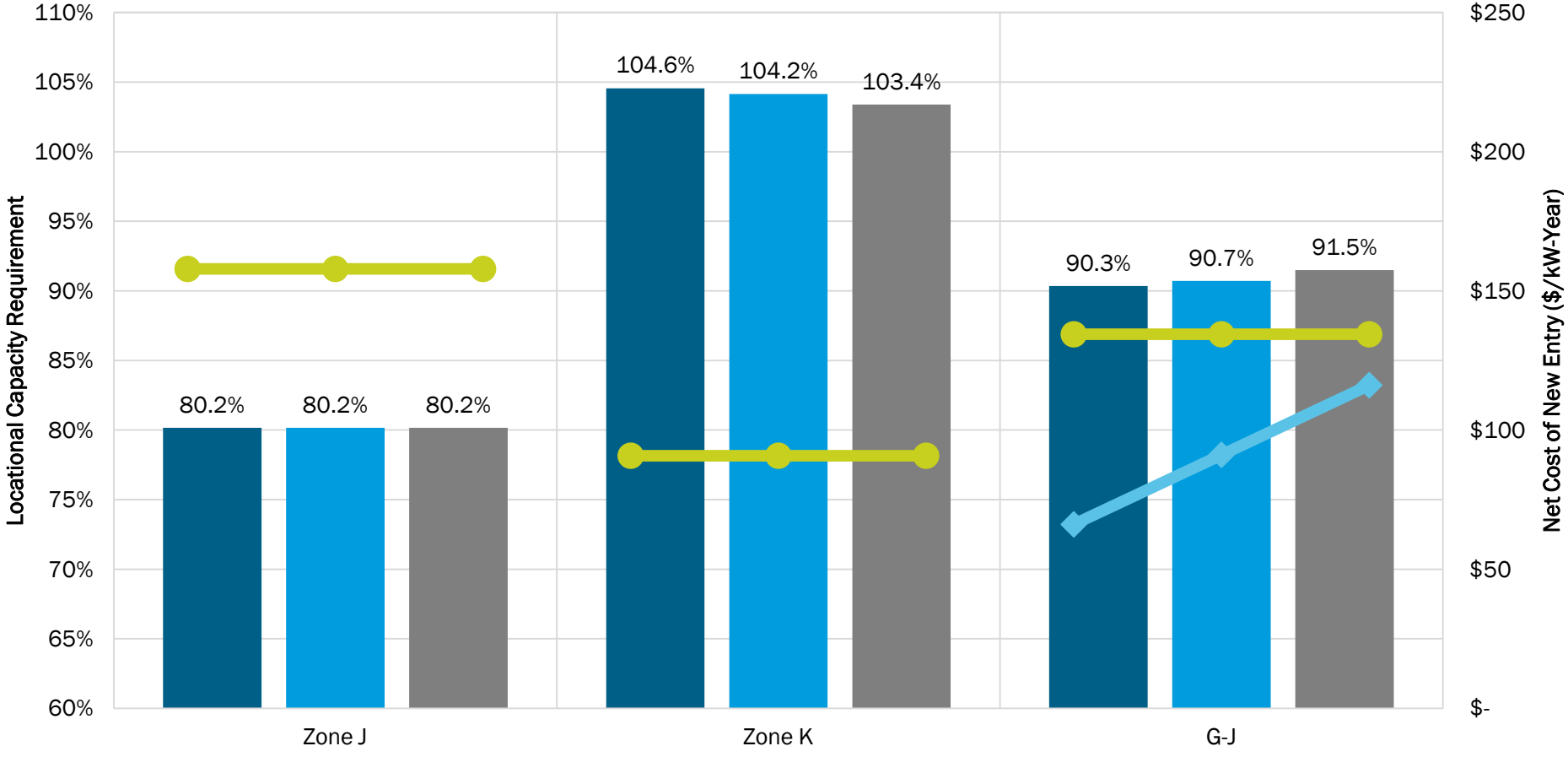
Zone J Net CONE +/- $25



Zone K Net CONE +/- $25



NYCA Net CONE +/- $25



All Sensitivities

Scenario	Optimized LCR without Transmission Security Floors (%)			Optimized Cost (million)
	Zone J	Zone K	G-J	
Base Case	78.04%	105.27%	91.50%	$ 4,402.89
+500 MW to Zone G at G-J EFORd	78.11%	105.97%	90.76%	$ 4,401.96
-500 MW to Zone G at G-J EFORd	78.06%	105.93%	90.78%	$ 4,400.95
+500MW to Zone J at J EFORd	78.04%	105.27%	91.50%	$ 4,402.89
-500MW to Zone J at J EFORd	78.04%	105.27%	91.50%	$ 4,402.89
+500MW to Zone K at K EFORd	78.29%	104.55%	91.81%	$ 4,404.03
-500MW to Zone K at K EFORd	78.05%	105.99%	90.81%	$ 4,401.55
+500MW to Zone F at F EFORd	78.04%	105.21%	91.01%	$ 4,397.54
-500MW to Zone F at F EFORd	78.12%	106.62%	90.96%	$ 4,408.19

Scenario	Optimized LCR without Transmission Security Floors (%)			Optimized Cost (million)
	Zone J	Zone K	G-J	
+1000 MW to UPNYSENY	77.71%	107.44%	84.29%	$4,365.16
+$25.00 to G-J	78.11%	106.76%	90.23%	$4,536.54
-$25.00 to G-J	77.57%	106.01%	91.76%	$4,260.14
+$25.00 Zone J	77.48%	107.46%	90.76%	$4,632.05
-$25.00 to Zone J	78.13%	104.90%	91.67%	$4,169.45
+$25.00 to Zone K	78.10%	104.55%	92.09%	$4,550.71
-$25.00 to Zone K	77.60%	107.18%	90.83%	$4,250.47
+$25.00 to NYCA	77.46%	106.73%	91.46%	$4,863.41
-$25.00 to NYCA	78.25%	105.62%	90.77%	$3,936.72

Scenario	Optimized LCR without Transmission Security Floors (%)			Optimized Cost (million)
	Zone J	Zone K	G-J	
+500 MW in Zone G at G-J EFORd & -500 MW in Zone J at J EFORd	78.09%	106.04%	90.73%	$4,401.78
+500 MW in Zone K at K EFORd & -500 MW in Zone J at J EFORd	78.29%	104.55%	91.81%	$4,404.03
-500 MW in Zone G at G-J EFORd & +500 MW in Zone J at J EFORd	77.99%	105.32%	91.48%	$4,402.07
-500 MW in Zone K at K EFORd & +500 MW in Zone J at J EFORd	77.98%	106.50%	90.60%	$4,401.59

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Scenario	Optimized LCR with Preliminary Transmission Security Floors (%)			Optimized Cost (million)
	Zone J	Zone K	G-J	
Base Case	80.16%	104.15%	90.71%	$4,424.37
+500 MW to Zone G at G-J EFORd	80.16%	104.56%	90.27%	$4,423.79
-500 MW to Zone G at G-J EFORd	80.16%	104.52%	90.40%	$4,424.65
+500MW to Zone J at J EFORd	80.16%	104.15%	90.71%	$4,424.37
-500MW to Zone J at J EFORd	80.16%	104.15%	90.71%	$4,424.37
+500MW to Zone K at K EFORd	80.16%	104.57%	90.34%	$4,424.52
-500MW to Zone K at K EFORd	80.16%	104.20%	90.69%	$4,424.55
+500MW to Zone F at F EFORd	80.16%	104.34%	90.17%	$4,420.83
-500MW to Zone F at F EFORd	80.16%	104.70%	90.81%	$4,430.07

Scenario	Optimized LCR with Preliminary Transmission Security Floors (%)			Optimized Cost (million)
	Zone J	Zone K	G-J	
+1000 MW to UPNYSENY	80.16%	103.80%	84.96%	$4,388.00
+$25.00 to G-J	80.16%	106.03%	89.45%	$4,553.59
-$25.00 to G-J	80.16%	102.99%	92.22%	$4,292.37
+$25.00 Zone J	80.16%	104.57%	90.34%	$4,663.81
-$25.00 to Zone J	80.16%	104.15%	90.71%	$4,185.05
+$25.00 to Zone K	80.16%	103.39%	91.48%	$4,570.88
-$25.00 to Zone K	80.16%	104.70%	90.26%	$4,277.37
+$25.00 to NYCA	80.16%	103.40%	91.50%	$4,890.94
-$25.00 to NYCA	80.16%	104.56%	90.35%	$3,955.84

Scenario	Optimized LCR with Preliminary Transmission Security Floors (%)			Optimized Cost (million)
	Zone J	Zone K	G-J	
+500 MW in Zone G at G-J EFORd & -500 MW in Zone J at J EFORd	80.16%	104.56%	90.27%	$4,423.79
+500 MW in Zone K at K EFORd & -500 MW in Zone J at J EFORd	80.16%	104.57%	90.34%	$4,424.52
-500 MW in Zone G at G-J EFORd & +500 MW in Zone J at J EFORd	80.16%	104.10%	90.82%	$4,424.92
-500 MW in Zone K at K EFORd & +500 MW in Zone J at J EFORd	80.16%	104.20%	90.69%	$4,424.55

Scenario	Current LCR Methodology (%)			Optimized Cost (million)
	Zone J	Zone K	G-J	
Base Case	81.4%	103.2%	91.3%	$ 4,441.80
+500 MW to Zone G at G-J EFORd	79.87%	102.37%	93.44%	$ 4,429.79
-500 MW to Zone G at G-J EFORd	83.52%	104.21%	89.86%	$ 4,470.71
+500MW to Zone J at J EFORd	81.94%	102.48%	91.94%	$ 4,450.11
-500MW to Zone J at J EFORd	80.38%	104.10%	90.73%	$ 4,428.17
+500MW to Zone K at K EFORd	80.14%	104.48%	90.46%	$ 4,424.31
-500MW to Zone K at K EFORd	84.43%	100.67%	93.78%	$ 4,482.72
+500MW to Zone F at F EFORd	81.05%	102.88%	91.26%	$ 4,433.26
-500MW to Zone F at F EFORd	81.52%	103.40%	91.60%	$ 4,448.38

Scenario	Current LCR Methodology (%)			Optimized Cost (million)
	Zone J	Zone K	G-J	
+1000 MW to UPNYSENY	79.38%	101.94%	90.18%	$ 4,398.63
+500 MW in Zone G at G-J EFORd & -500 MW in Zone J at J EFORd	79.22%	103.15%	93.13%	$ 4,421.80
+500 MW in Zone K at K EFORd & -500 MW in Zone J at J EFORd	79.42%	105.64%	90.00%	$ 4,416.64
-500 MW in Zone G at G-J EFORd & +500 MW in Zone J at J EFORd	84.38%	103.25%	90.52%	$ 4,477.06
-500 MW in Zone K at K EFORd & +500 MW in Zone J at J EFORd	85.44%	100.32%	94.57%	$ 4,496.80

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