ELCC Rules at other ISO-RTOs

Andrew Levitt, Applied Innovation

April 7, 2020

PJM Capacity Capability Senior Task Force

ELCC in California

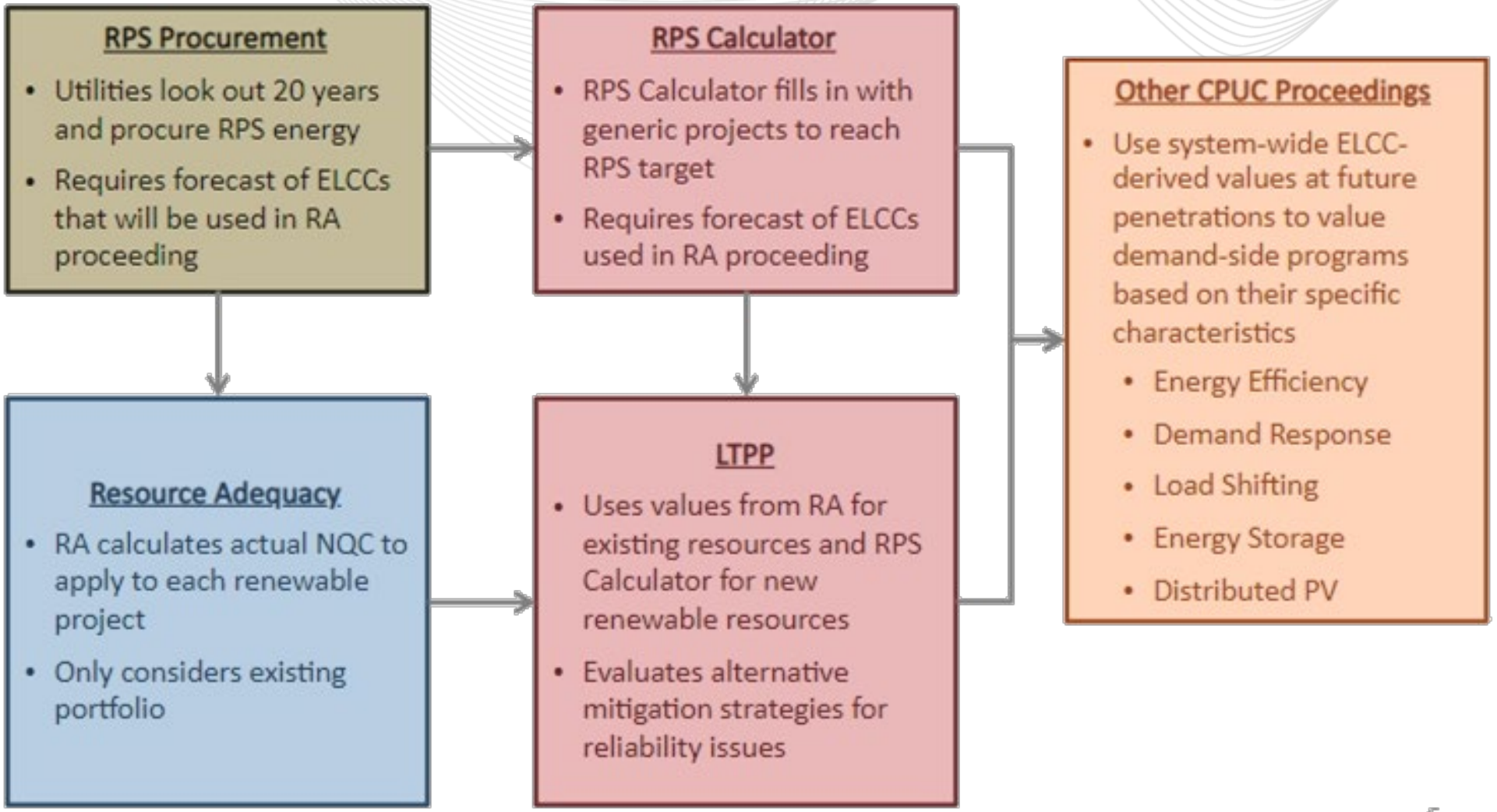
ELCC in California: Multiple Applications and Policy Contexts

Resource Adequacy	LTPP	RPS Procurement
• ELCC is used to assign capacity credit to renewable resources for RA procurement	• Establishes total renewable capacity contribution to calculate residual system need	• Estimates contribution from new resources in order to inform renewable procurement
• Calculate portfolio wide ELCC and allocate to individual projects	• Calculate portfolio wide ELCC-based capacity contribution	• Marginal contribution from new resource depends on portfolio
• Short-term focus: 1-3 years out	• Long-term focus: 10-20 years out	• Long-term focus: 10-20 years out
• Historical data from resources in the ground	• Need historical and projected data	• Need historical and projected data
• *Model: SERVM*	• *Model: SERVM and RPS Calculator*	• *Model: Utility models*

5

See the RPSCalcWkshp_0500RoleofRPSCalc.pptx *file located in the 02_RPS Calculator 6.0 Workshop_Feb2015 folder in the ZIP file at:*
http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=9366

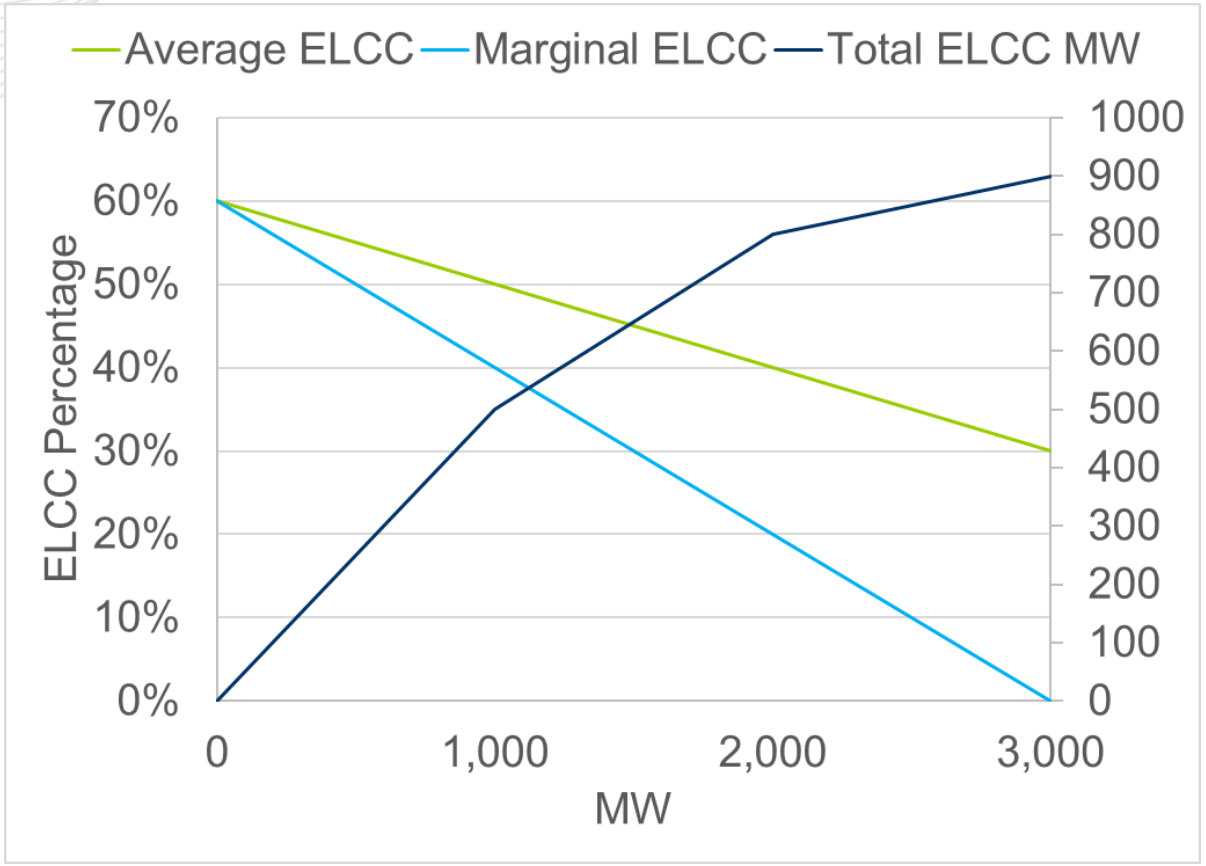
ELCC in California: Multiple Applications and Policy Contexts



See the RPSCalcWkshp_0500RoleofRPSCalc.pptx *file located in the 02_RPS Calculator 6.0 Workshop_Feb2015 folder in the ZIP file at:*
http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=9366

(Example of marginal vs. average ELCC)

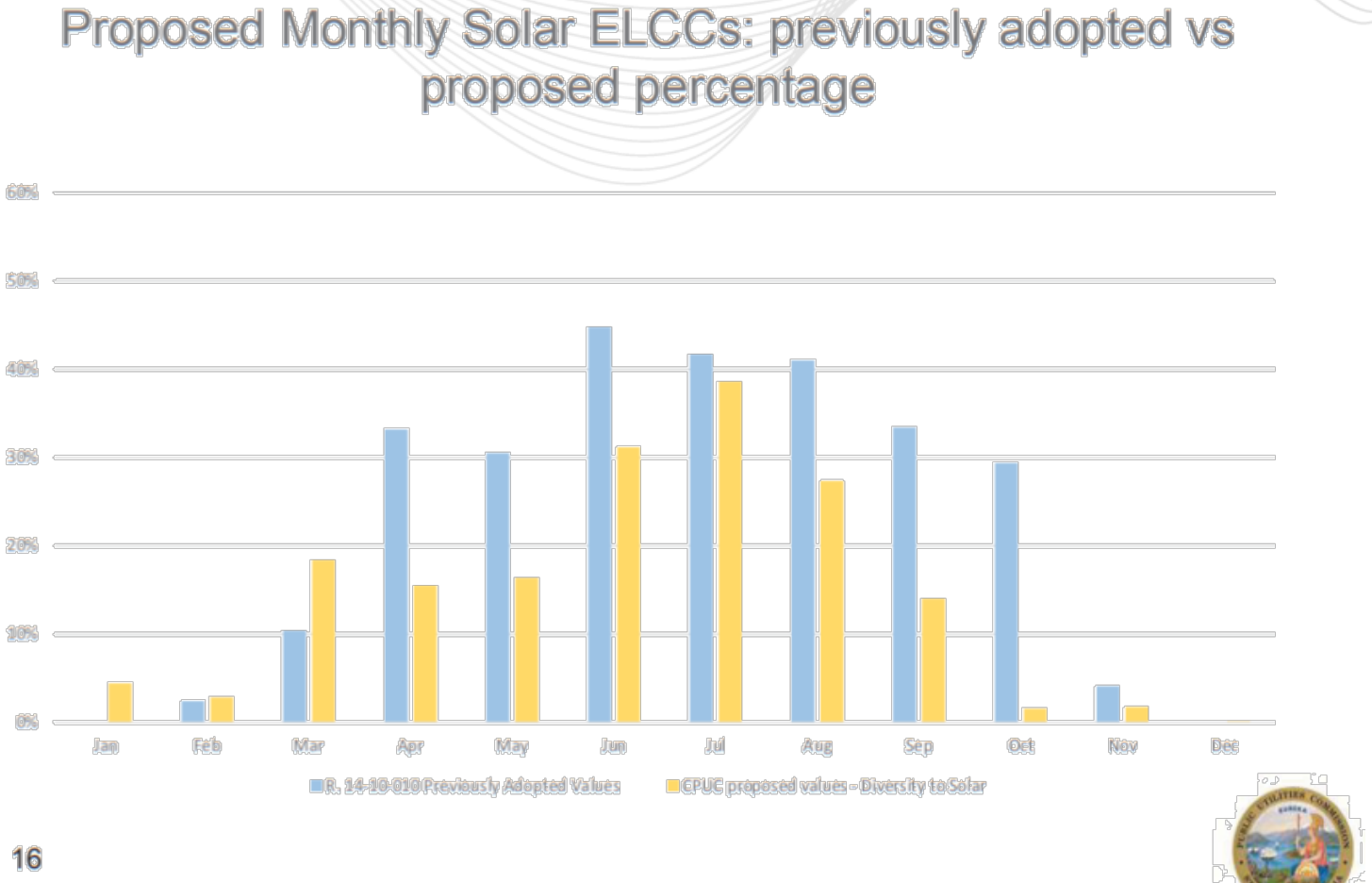
	Total ELCC of Fleet	Average ELCC	Marginal ELCC
1 MW	0.6 MW	60.00%	60%
1,000 MW	500.0 MW	50.00%	40%
1,001 MW	500.4 MW	49.99%	40%
2,000 MW	800.0 MW	40.00%	20%
2,001 MW	800.2 MW	39.99%	20%
3,000 MW	900.0 MW	30.00%	0%
3,001 MW	900.0 MW	29.99%	0%



California ELCC Rules

- **Near term--**CPUC: monthly **Resource Adequacy (RA)** assessment of existing portfolios.
  - Average ELCC for wind and solar, 4-hour rule for storage
  - CAISO RA assessment piggybacks off these rules
  - Re-run annually
- **Mid term--**CPUC: **Renewable Portfolio Standard (RPS)** rules for PPA bid ranking and selection
  - Marginal ELCC for wind and solar, 4-hour rule for storage
  - Re-run annually
- **Long term--**CPUC: Integrated Resource Planning (**IRP**) aka Long Term Procurement Planning (**LTPP**)
  - Marginal ELCC for wind, solar, and 4-hour storage
  - Re-run every two years
- Geographical and technology classes vary by application
- Time horizon varies by application: RA is a snapshot, RPS evaluated 2018 and 2026, IRP assesses multiple years over decades with ELCC calculated as a function of MW of deployment (not by year).
- Use of Astrape SERVM tool to produce ELCC results
- Historical performance and weather data does not influence these ELCC results

CPUC **RA** ELCC for Solar



https://www.cpuc.ca.gov/uploadedFiles/CPUCWebsite/Content/UtilitiesIndustries/Energy/EnergyPrograms/ElectPowerProcurementGeneration/DemandModeling/ELCC_2_13_19.PDF

CPUC **RPS** ELCC Results

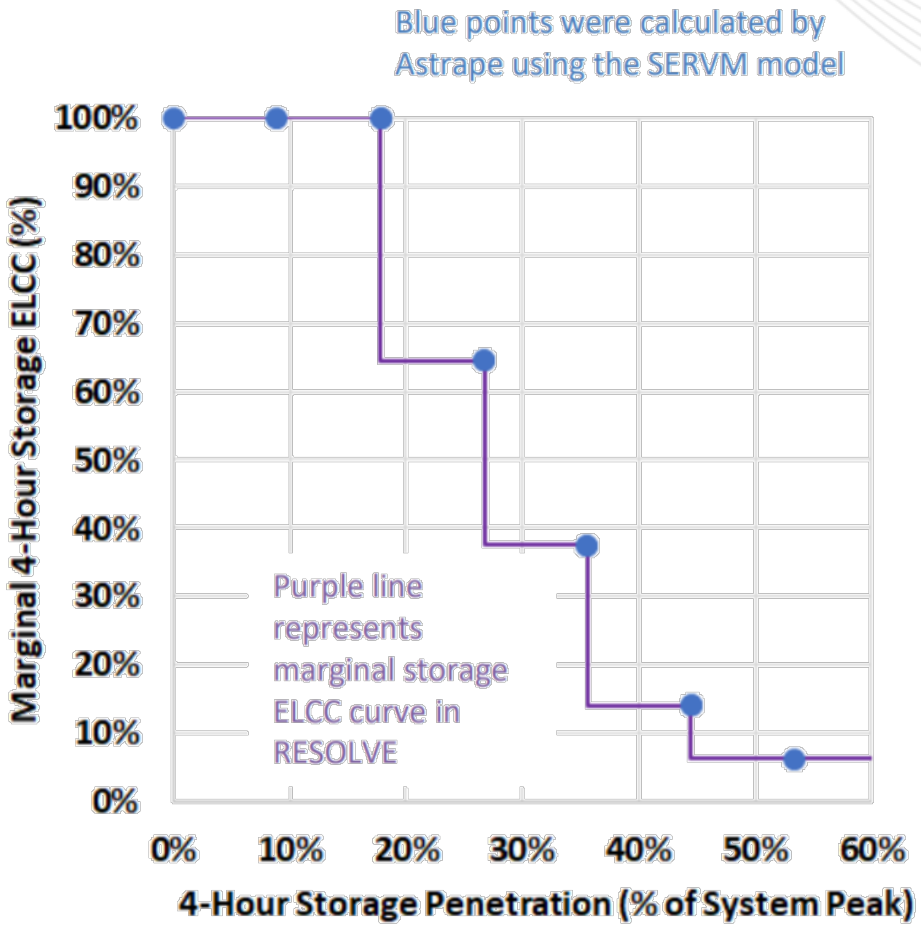
Table 6: Marginal ELCC Values by Region and Technology

	Northern Cal	Southern Cal	Northwest	Southwest
33% RPS Case Marginal ELCC Values *[2018]*				
Wind	21%	14%	40%	24%
Tracking PV	21%	15%		12%
Fixed Axis PV	13%	10%		8%
Distributed PV	12%	8%		
43.3% RPS Case Marginal ELCC Values *[2026]*				
Wind	27%	22%	43%	20%
Tracking PV	8%	4%		3%
Fixed Axis PV	4%	4%		1%
Distributed PV	5%	2%		

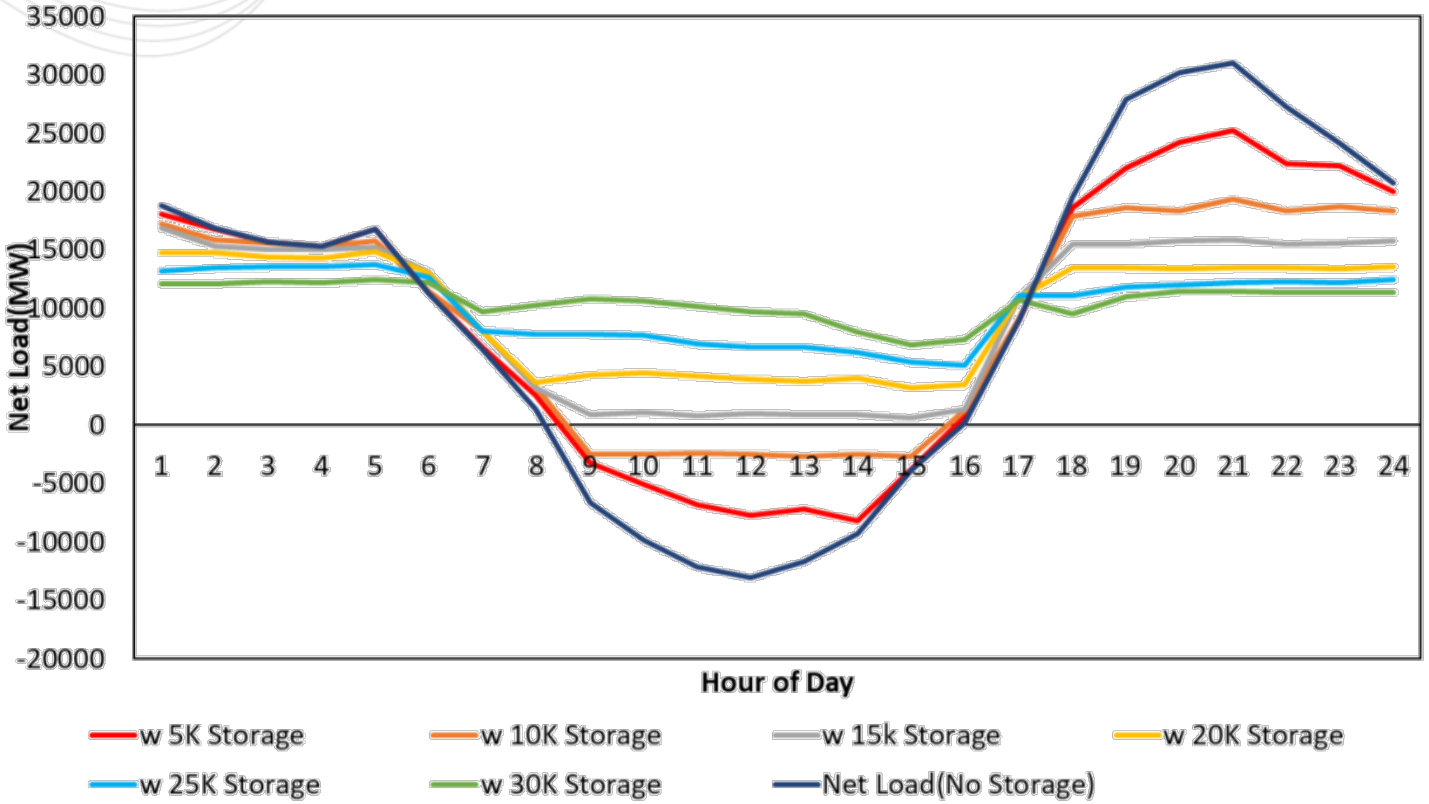
http://www.astrape.com/wp-content/uploads/2019/01/Joint-IOUs-Update-on-ELCC.pdf

California **IRP** ELCC for Storage

ELCC Results



Storage Dispatch



https://www.cpuc.ca.gov/uploadedFiles/CPUCWebsite/Content/UtilitiesIndustries/Energy/EnergyPrograms/ElectPowerProcurementGeneration/irp/2018/2019-20%20IRP%20Astrape%20Battery%20ELCC%20Analysis.pdf

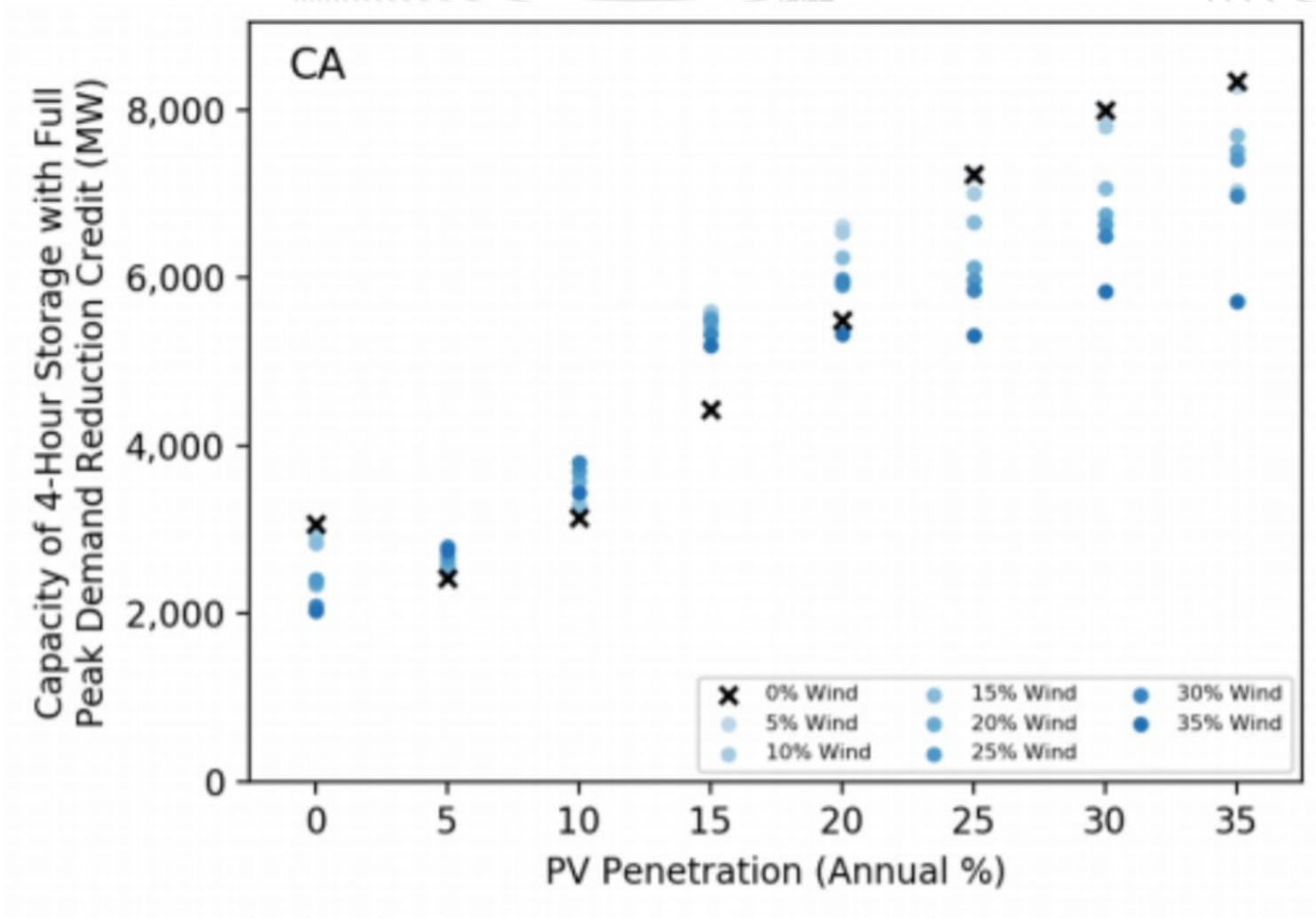
CPUC **IRP**: Marginal vs. Average ELCC for Storage

Table 2: Energy Storage Capacity Value

Battery Capacity (MW)	Average Capacity Value	Incremental Capacity Value	Marginal Capacity Value
5,265	100.0%	100.0%	100.0%
7,674	100.0%	99.8%	98.2%
10,530	98.6%	94.8%	90.7%
13,034	95.6%	83.1%	71.3%
15,795	89.8%	62.6%	48.5%
18,426	82.3%	36.9%	32.2%
21,060	75.3%	26.4%	23.5%
23,960	68.7%	20.8%	17.4%
26,325	63.8%	14.0%	11.0%
29,498	57.8%	8.3%	5.2%
31,590	54.2%	3.1%	1.9%

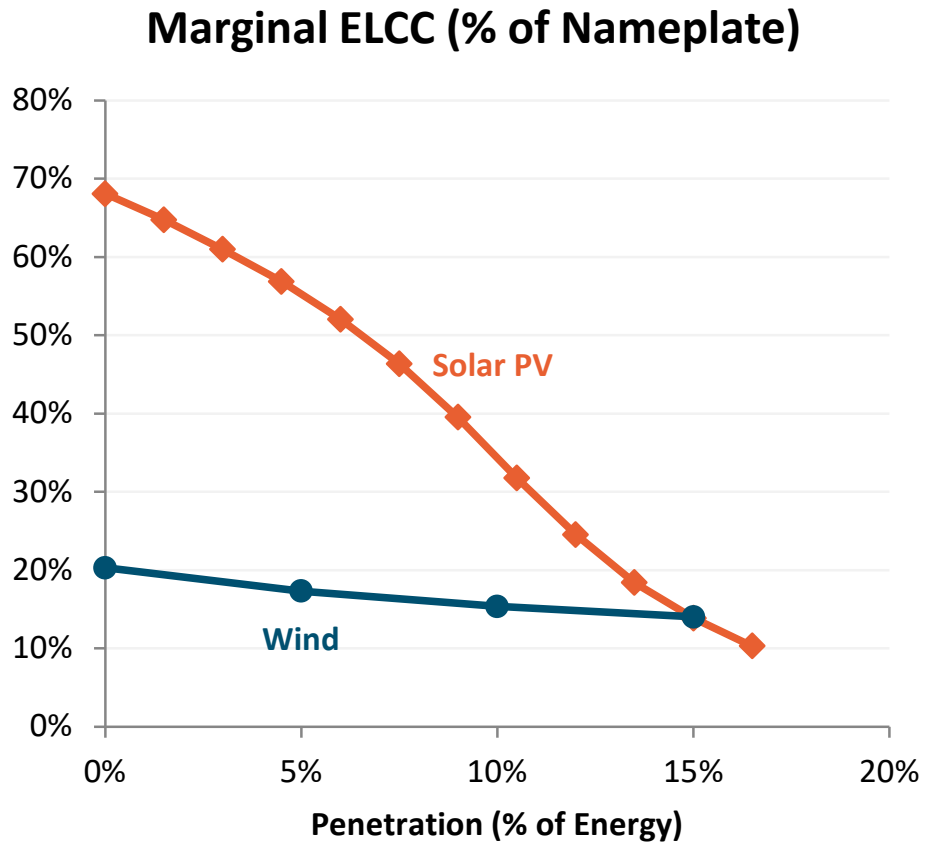
https://www.cpuc.ca.gov/uploadedFiles/CPUCWebsite/Content/UtilitiesIndustries/Energy/EnergyPrograms/ElectPowerProcurementGeneration/irp/2018/2019-20%20IRP%20Astrape%20Battery%20ELCC%20Analysis.pdf

CA **IRP:** Storage ELCC Sensitive to Solar Deployment



https://www.cpuc.ca.gov/uploadedFiles/CPUCWebsite/Content/UtilitiesIndustries/Energy/EnergyPrograms/ElectPowerProcurementGeneration/irp/2018/2019-20%20IRP%20Astrape%20Battery%20ELCC%20Analysis.pdf

CPUC **IRP** Solar and Wind ELCC Results



https://www.cpuc.ca.gov/uploadedFiles/CPUCWebsite/Content/UtilitiesIndustries/Energy/EnergyPrograms/ElectPowerProcurementGeneration/irp/2018/Prelim_Results_Proposed_Inputs_and_Assumptions_2019-2020_10-4-19.pdf
See the RPSCalcWkshp_0203ResourceValuation.pptx file located in the 02_RPS Calculator 6.0 Workshop_Feb2015 folder in the ZIP file at: http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=9366

ELCC in MISO

Overview of MISO ELCC

- Step 1: use of Astrape SERVM tool to calculate ELCC of entire wind fleet
- Step 2: allocate fleet ELCC value to individual wind units based on share of actual output on 8 daily peak hours for the last 15 years (or fraction thereof).
- Annual determination of ELCC for a delivery year set in prior year. Study has 1-year horizon.
- E.g., ELCC of 16.6% for delivery year 2020/21 is based on wind deployment level in Q2 of 2019.
- ELCC only applies to wind; no sub-classification.

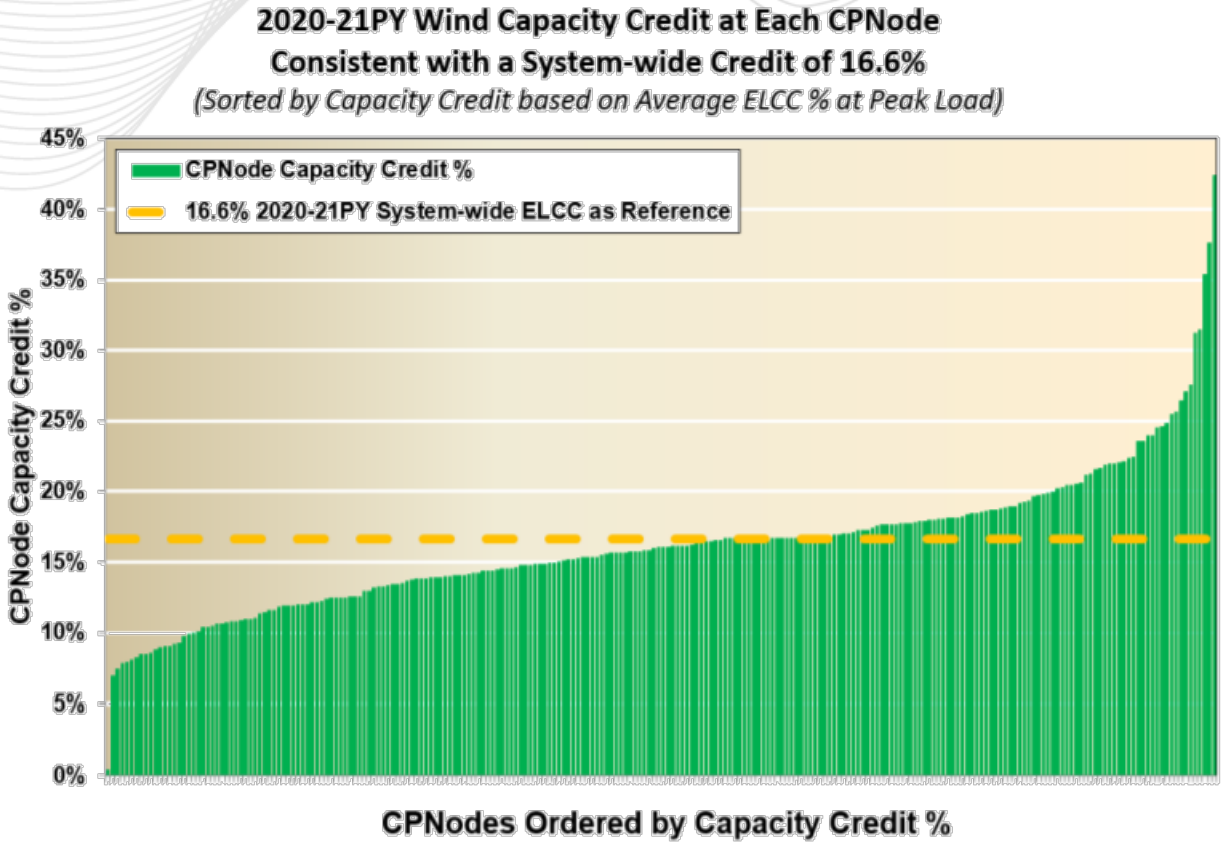


Figure 3-1 – Allocation of Capacity Credit % over 222 CPNodes
Consistent with a System-Wide Credit of 16.6%

https://cdn.misoenergy.org/2020%20Wind%20&%20Solar%20Capacity%20Credit%20Report408144.pdf

MISO Wind Fleet ELCC Results Over Time

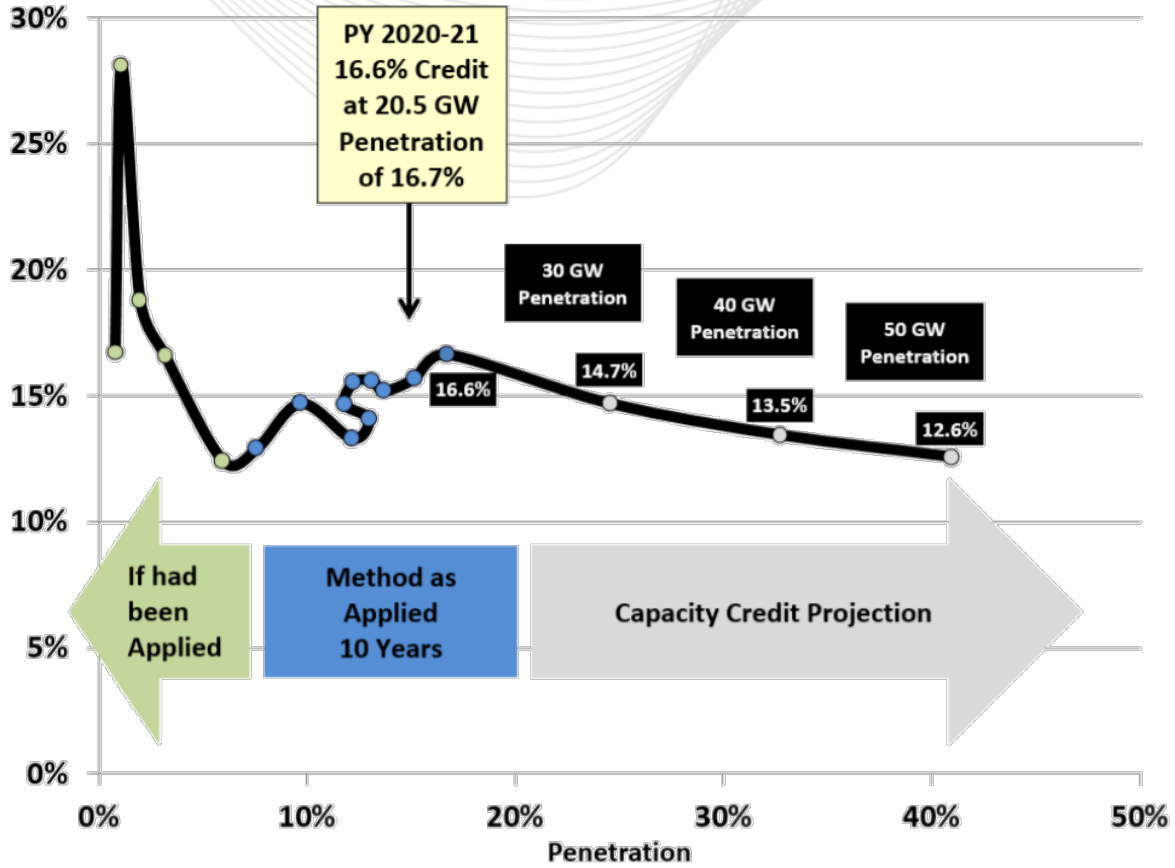


Figure 2-4: Demonstration of Applying Capacity Credit Method Starting with PY 2005

https://cdn.misoenergy.org/2020%20Wind%20&%20Solar%20Capacity%20Credit%20Report408144.pdf

Unit-Specific ELCC in MISO

- MISO allocates the system-level ELCC to individual resources as follows
  - For existing resources, the system-wide capacity credit is calculated as the ELCC (in %) times the total existing nameplate.
    - This system-wide MW capacity credit is then allocated to individual units based on the average output of an individual wind unit during the top 8 daily peak hours in each of the last 15 years that the unit was in-service.
  - For New resources, the capacity credit corresponds to the system-wide ELCC (in %) times the nameplate of the new unit.

ELCC in NYISO

NYISO

- Tiered capacity values for limited duration resources (including storage but also others) based on ELCC analysis.
  - ELCC is *not* used for wind or solar.
- Approved by FERC on Jan. 23, 2020, now pending implementation.
- Values are meant to be used for many years, may be revisited in the future.
- GE ELCC study looks at the value of the limited-duration fleet under various deployment levels and duration abilities (in hours).
- Extensive stakeholder discussions on dispatch of limited-duration fleet and locational considerations.

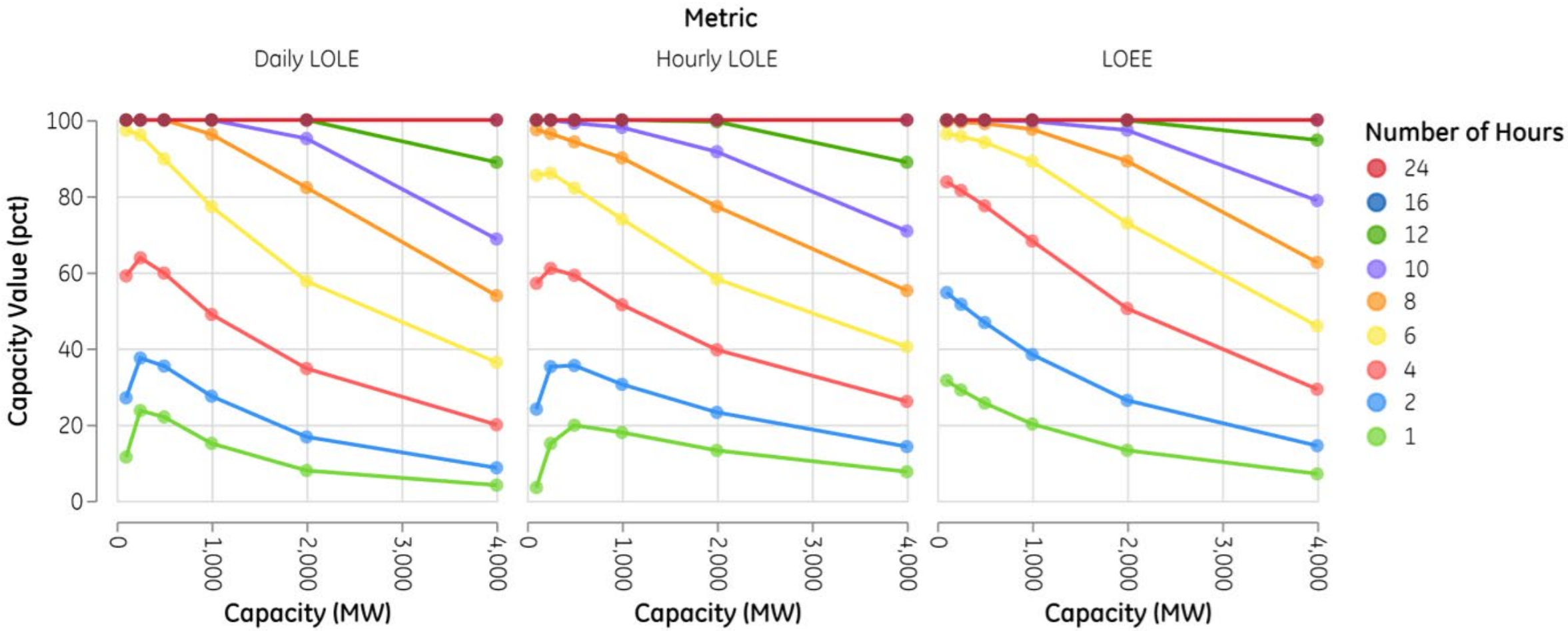
	Incremental Penetration of resources with duration limitations	
Durations (hours)	Less than 1000 MW	At and Above 1000 MW
2	45%	37.5%
4	90%	75%
6	100%	90%
8	100%	100%

NEW YORK INDEPENDENT SYSTEM OPERATOR

Penetration

Fractional Capacity Value (%)

GE ELCC of NYISO for NYISO



https://www.nyiso.com/documents/20142/4358080/01082019%20Capacity%20Value%20of%20Resources%20with%20Energy%20Limitations_v2.pdf

Comparison of MMU & NYISO Study Approaches

- The table below provides a high-level summary of differences among the MMU's and NYISO's estimates of fractional capacity value and the NYISO's proposal.
  - ✓ See slides 32-35 for additional detail on the MMU's estimates.
  - ✓ NYISO values based on slide 117 of GE's October 9 presentation.
- ELRs' value under the MMU approach is:
  - ✓ Higher at low penetration levels; but
  - ✓ It drops more rapidly as penetration increases because the marginal value falls more quickly than the average value of ELRs.

	500 MW Penetration		2 GW Penetration		NYISO
	MMU	NYISO	MMU	NYISO	Proposal
4-Hr ELRs	95-96%	77%	76-78%	68%	75%
2-Hr ELRs	66-68%	61%	38-41%	52%	37.5%

https://www.potomaceconomics.com/wp-content/uploads/2019/04/MMU-Capacity-Value-Analysis.pdf

Drivers of Differences from GE Study

Driver	Astrapé Approach	GE Approach
Treatment of Load Uncertainties	Use 38 Years of Historical Weather Patterns; 5 Economic Load Forecast Uncertainties	Scale Weather Shapes Using the Same Multiplier Every Hour; 3 Weather Shapes; 7 Load Forecast Uncertainties
Diversity with Neighbors	38 Years of Historical Diversity	Artificial Diversity for Top 3 Load Days
Treatment of Resource Interactions	Endogenous Treatment of all Interactions	Post-Processing of Energy Limited Dispatch
Commitment Method	Economic Commitment and Dispatch	Must-Run Commitment
Internal Transmission Constraints	IRM Base Case with Slight Relaxation	IRM Base Case with Generator Relocation

17

ASTRAPÉ CONSULTING
innovation in electric system planning

Comparison

Name	Scope	Sub-classes	Actual output aspect	Marginal vs. Average	Timing
CA RA	Wind, solar	None	N/A	Average	Annual, 1yr horizon
CA RPS	Wind, solar	Several	N/A	Marginal	Bi-annual, multi-year horizon
CA IRP	Wind, solar, 4-hour storage	None	N/A	Marginal	Bi-annual, multi-year horizon
MISO	Wind	None	8CP	Average	Annual, 1yr horizon
NYISO	Limited-duration resources	Several	N/A	Average	Infrequent, multi-year horizon