

NYISO 2025-2029 ICAP Demand Curve Reset (DCR)

5-Minute Real-Time Battery Modeling Enhancements, Evaluation of SCR/Dual Fuel, and Preliminary Reference Point Prices

ICAP Working Group

May 20, 2024

Agenda

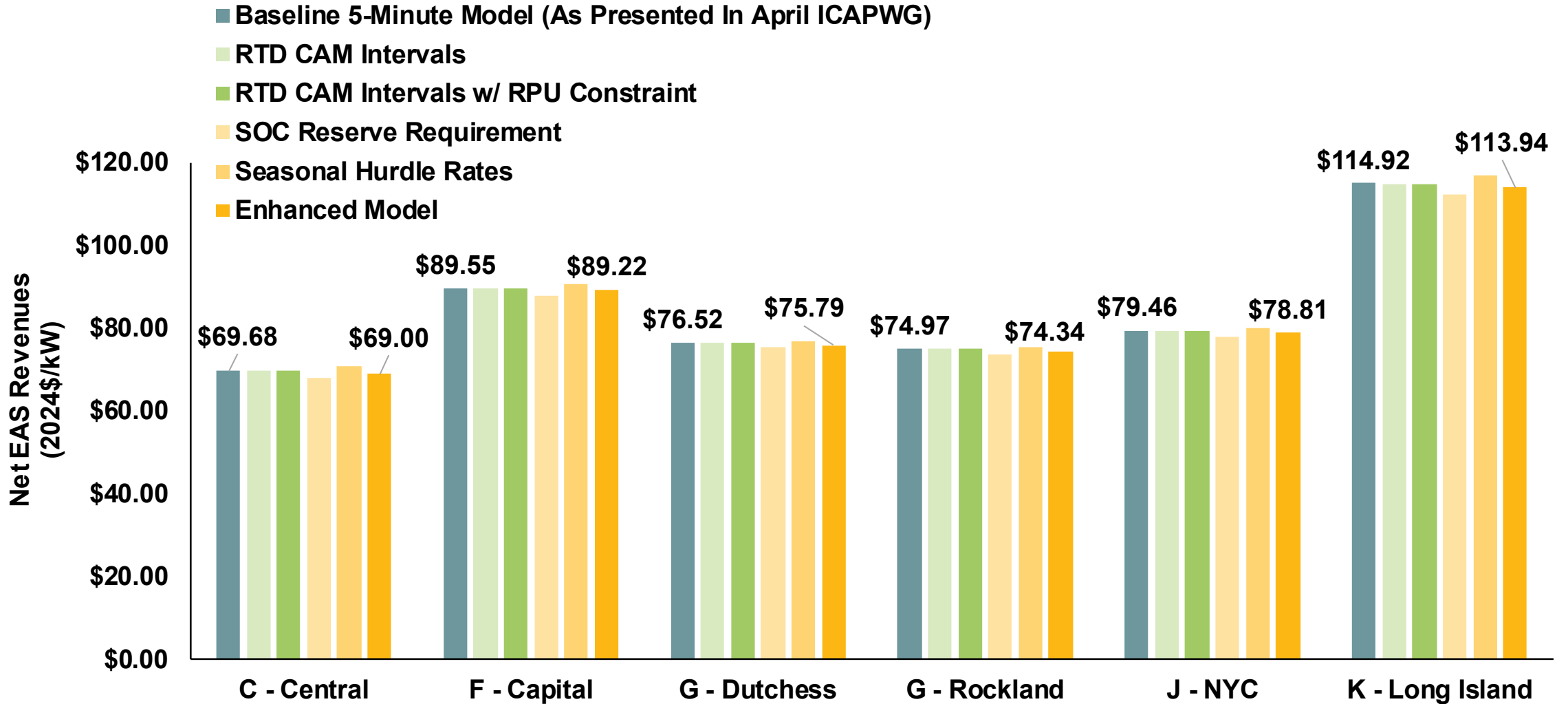
- 5-Minute Real-Time Battery Modeling Enhancements
- Evaluation of Selective Catalytic Reduction (SCR) Emission Controls and Dual Fuel
- Preliminary Reference Point Prices
- Ongoing Analysis

5-Minute Real-Time Battery Modeling Enhancements

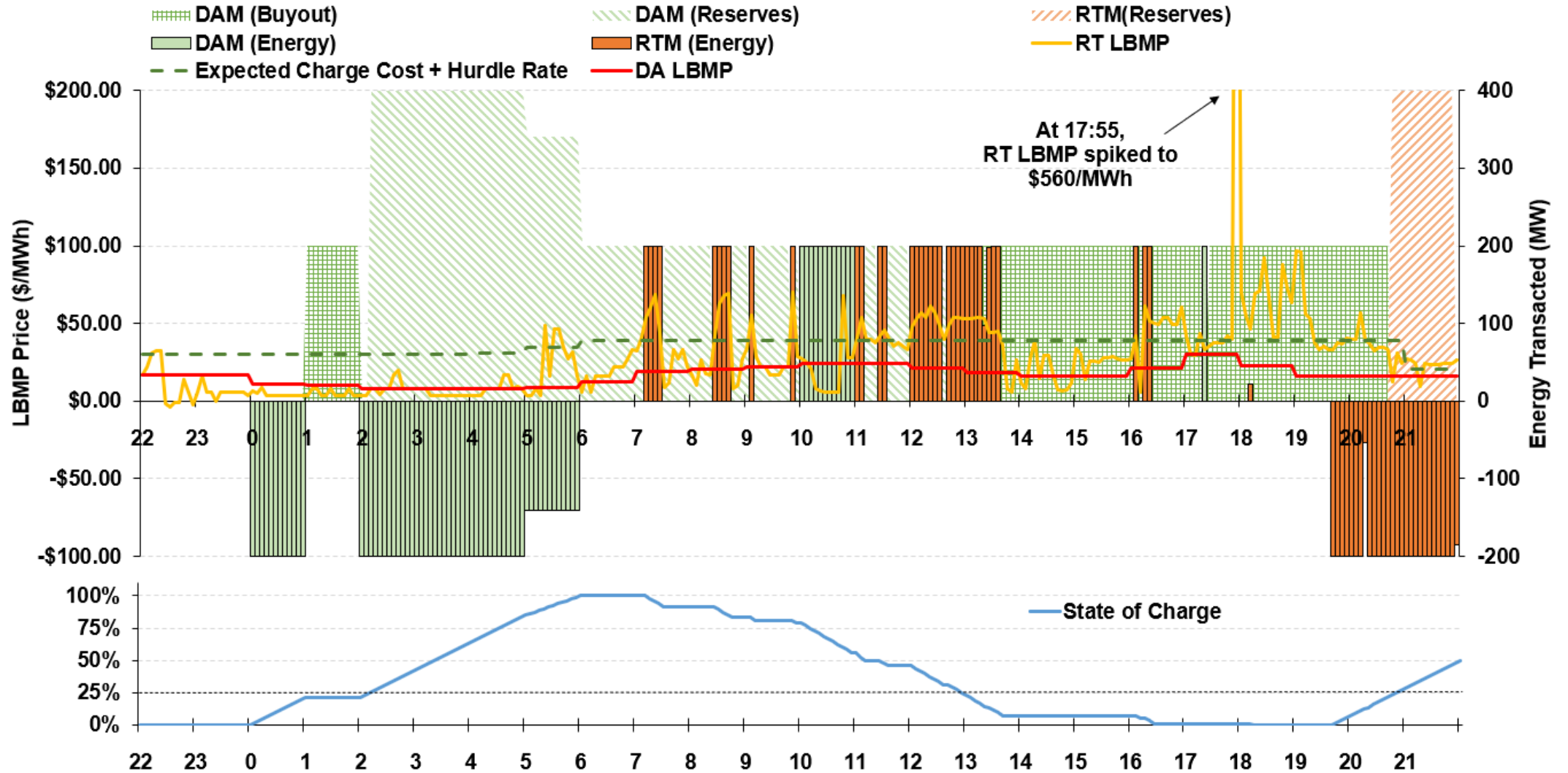
5-Minute Battery Modeling Enhancements

- In response to stakeholder feedback, AG has implemented three modeling enhancements to the 5-minute battery model for battery energy storage systems (BESS):
 1. To earn reserve revenue, batteries require at least one hour of stored energy (e.g. 25% state of charge [“SOC”] for a 4-hour battery)
 - In practice, the model will buy out of Day-Ahead Market (DAM) reserve positions whenever $SOC < \frac{1}{\text{Rated Battery Duration}}$
 2. RTD-CAM Intervals
 - Addition of RTD-CAM intervals reflecting activation of corrective action mode (CAM) during sub-5-minute intervals.
 - For reserve pick-up (RPU) events, the generation schedule of a battery is limited to what the battery could sustain for at least one hour. However, RPU events reflect a very small percentage of total RTD-CAM intervals.
 - In practice, the treatment of RTD-CAM intervals has negligible impact on net Energy and Ancillary Services (EAS) revenues.
 3. Seasonal hurdle rates
 - Hurdle rates are separately optimized in three distinct seasons (winter, summer, and shoulder)

Impact of 5-Minute Battery Modeling Enhancements (4-Hour BESS)



Example day for the enhanced 5-minute battery model



Evaluation of SCR Emission Controls and Dual Fuel

Evaluation of SCR Emissions Controls for Simple Cycle Gas Turbines (SCGTs)

- Load Zones J and K are in non-attainment for ozone and will require SCR emissions control technology and oxidation catalyst
- GE does not offer a version of the SCGT 7HA.03 without SCR emissions controls. As such, configurations without SCR emissions controls are assumed to use a SCGT 7HA.02.
- The SCGT 7HA.02 is older and less efficient than the SCGT 7HA.03. As a result, on a \$/kW basis, the SCGT 7HA.02 *without* SCR emissions controls is more expensive than the SCGT 7HA.03 *with* SCR emissions controls.
- Due to higher efficiency and operating limits, net EAS revenues are higher for the SCGT 7HA.03 than SCGT 7HA.02.
- As such, the annual net cost is lower for the SCGT 7HA.03 with SCR emissions controls than the SCGT 7HA.02 without SCR emissions controls in all applicable locations.
- AG continues to recommend SCR emissions controls for the SCGT technology in all locations.

Net EAS Revenues (Historical Data Period: 9/1/2020-8/31/2023)

Unit	Zone	SCR	Gas Only	Net EAS Revenues (\$/kW-year)
SCGT 7HA.02	C	No	Yes	\$61.34
SCGT 7HA.03	C	Yes	Yes	\$64.19
SCGT 7HA.02	F	No	Yes	\$81.29
SCGT 7HA.03	F	Yes	Yes	\$85.19
SCGT 7HA.02	G (Dutchess)	No	Yes	\$47.11
SCGT 7HA.03	G (Dutchess)	Yes	Yes	\$51.21
SCGT 7HA.02	G (Rockland)	No	Yes	\$48.17
SCGT 7HA.03	G (Rockland)	Yes	Yes	\$52.35

Total Project Costs Per kW (2024\$)

	Zone C	Zone F	Zone G - Dutchess	Zone G - Rockland
SCGT 7HA.03 (w/ SCR)	\$1,673	\$1,652	\$1,655	\$1,750
SCGT 7HA.02 (no SCR)	\$1,756	\$1,734	\$1,730	\$1,832
Percentage Difference	4.96%	4.91%	4.55%	4.70%

Evaluation of Dual Fuel Capability for SCGTs

Net EAS Revenues (Historical Data Period: 9/1/2020-8/31/2023)

Unit	Zone	Net EAS Revenues without Dual Fuel (\$/kW-year)	Net EAS Revenues with Dual Fuel (\$/kW-year)	Percentage Difference	Oil Run Hours (with Dual Fuel)
SCGT 7HA.03	C	\$64.19	\$64.19	0.0%	0
SCGT 7HA.03	F	\$85.19	\$85.74	0.7%	111
SCGT 7HA.03	G (Dutchess)	\$51.21	\$58.00	13.3%	85
SCGT 7HA.03	G (Rockland)	\$52.35	\$59.64	13.9%	80

Notes: Net EAS revenues calculated over the 2021-2023 historical period.

Incremental Dual Fuel Costs

	ZONE C	ZONE F	ZONE G - Dutchess
Dual Fuel Breakout Costs (\$ Millions)	26.90	26.90	26.90
Total Project Costs (\$ Millions)	650.94	661.46	657.57
% of Total Project Costs	4.13%	4.07%	4.09%

Evaluation of Dual Fuel Capability for SCGTs

- Local electric reliability rules require dual fuel capability in Load Zones J and K.
- Several LDC gas tariffs require dual fuel capability for generators, including National Grid in Load Zones C, F and K; Orange & Rockland and Central Hudson in Load Zone G; and Con Edison in Load Zone J.
- For other locations, additional up-front capital costs are balanced against potential for increased net EAS revenues from greater fuel flexibility, as well as other relevant considerations (reliability, siting, gas availability/constraints, etc.)
- Preliminary economic evaluation supports the inclusion of dual fuel in Load Zone G (Rockland) and Load Zone G (Dutchess). Consistent with previous DCRs, the economic argument for dual fuel is weaker in Load Zones C or F.
 - This preliminary evaluation is based solely on a single three-year historical period (9/1/2020-8/31/2023)
- However, an economic assessment of dual fuel must also consider the risks associated with the potential for lower capacity accreditation factors for generators without firm fuel (or alternatively, the risks of penalties if firm fuel is elected but not acquired), as well as a longer-term assessment the opportunities for additional revenue earnings over the assumed life of the asset.
- In our view, with the additional considerations of the potential impact from fuel availability capacity accreditation rules, in addition to other risks associated with gas-only peaking operation and opportunities for additional revenues, developers in Load Zones C and F would more likely than not decide to include dual fuel capability.
- AG continues to recommend dual fuel for the SCGT technology in all locations.

Preliminary Reference Point Prices

Reminder: Background on ICAP/UCAP Reference Point Prices

- AG will calculate seasonal monthly ICAP/UCAP reference point prices consistent with the new methodology approved by FERC for implementation beginning with the 2025-2026 Capability Year
- The metric actually transacted in the ICAP market is UCAP
- ICAP to UCAP translation methodology, as specified in the Installed Capacity Manual:
“[E]ach price on each ICAP Demand Curve shall be converted into a price on the corresponding UCAP Demand Curve by dividing it by the product of: (a) the Capacity Accreditation Factor of the peaking plant used to establish the applicable ICAP Demand Curve, and (b) one minus the applicable derating factor of such peaking plant.”
- Selection of the peaking technology by minimizing the cost of ICAP would fail to account for variation in Capacity Accreditation Factors (CAFs) or derating factors across technologies, and thus could result in selecting a technology that does not supply UCAP at the lowest cost
- AG will consider the relevant UCAP reference point prices for each technology option in selecting the appropriate peaking unit technology for each demand curve

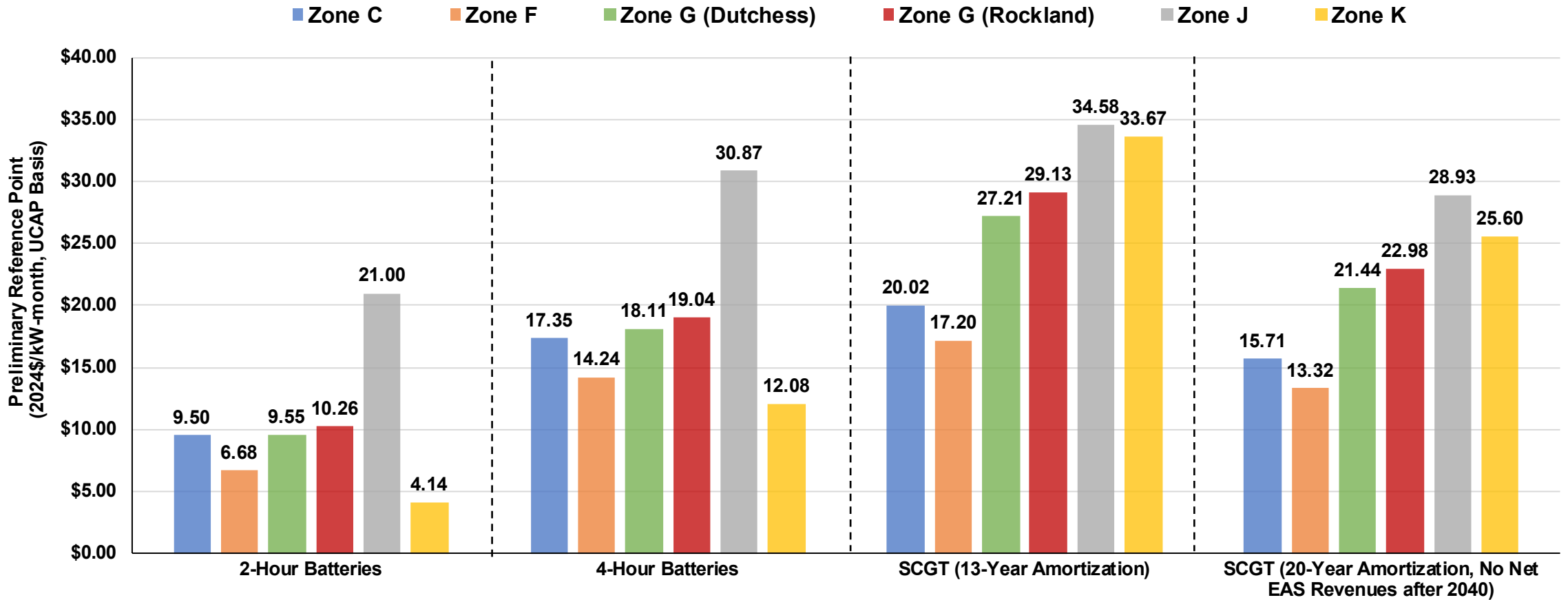
Key Assumptions for Calculation of Potential Monthly ICAP/UCAP Reference Prices

- Key assumptions (subject to change):
 1. H/J-class SCGT represented by GE 7HA.03
 2. Updated natural gas hub recommendations for the SCGT (see 4/17/2024 ICAPWG presentation)
 3. 5-minute battery modeling, including all enhancements (see Slide 3)
 4. PILOT rate of 0.6 percent outside of Load Zone J for both the SCGT (all years of the applicable amortization period) and energy storage (years 16-20 of the preliminary recommended 20-year amortization period), and property tax rate equal to 4.77 percent in Load Zone J for the SCGT for any period not qualifying for a tax abatement and for energy storage (years 16-20 of the preliminary recommended 20-year amortization period)
 5. 15-year tax abatement for energy storage facilities statewide, potential 15-year tax abatement for SCGT units in Load Zone J (depending on effectiveness of such abatement for the 2025-2029 DCR)
 6. SCR emissions control technology and dual fuel capability for SCGT in all locations
 7. 2021-2025 DCR level of excess adjustment factors (“LOE-AFs”) as placeholders
 8. Updated net EAS results; historical data period: 9/1/2020 through 8/31/2023

Key Assumptions for Calculation of Potential Monthly ICAP/UCAP Reference Prices (cont.)

- Key assumptions (subject to change):
 9. Updated preliminary gross cost of new entry (“CONE”) estimates from 1898 & Co for both SCGT and BESS
 10. Preliminary ATWACC (8.67% in NYC, 8.92% everywhere else) based on information presented at the 4/17/2024 ICAPWG
 11. Updated AFUDC reflecting preliminary ATWACC and longer construction periods
 12. 13-year amortization period for fossil fuel-fired thermal generator
 13. 20-year amortization period for energy storage technologies
 14. 30% federal ITC for energy storage technologies
 15. Updated summer and winter peak capacities
 16. Updated derating factor for fossil units
 17. Updated derating factor for battery units
 18. Final Capacity Accreditation Factors (CAFs) for the 2024-2025 Capability Year

Reference Point Prices by Candidate Technologies (\$/kW-month UCAP)



Notes: All results presented on a UCAP basis in 2024\$. For clarity, annual rather than seasonal reference point prices are presented. 2-hour battery results reflect 1898 & Co.'s preliminary estimates of the capital and fixed O&M costs for a 2-hour BESS, net EAS results for a 2-hour BESS, and applicable CAFs for a 2-hour energy duration.

Impact of Load Zone J Property Tax Abatement for SCGT on Preliminary RP Prices

- The New York Real Property Tax Law Section 489-BBBBBB provides a 15-year tax abatement in New York City for the peaking plant underlying the NYC ICAP Demand Curve, which currently ceases to apply for construction activities after April 1, 2025.
- Status of this NYC specific tax abatement and any potential extension thereof through the 2025-2029 DCR reset period materially impact monthly reference point prices for the SCGT option in Load Zone J.

<u>Unit</u>	<u>Monthly RP Price Annual UCAP (\$/kW-month)</u>	<u>Monthly RP Price Summer UCAP (\$/kW-month)</u>	<u>Monthly RP Price Winter UCAP (\$/kW-month)</u>
<i>Zone J - New York City w/ Property Tax Abatement Extension</i>			
SCGT ¹	\$34.58	\$34.66	\$36.27
<i>Zone J - New York City w/o Property Tax Abatement Extension</i>			
SCGT ¹	\$48.51	\$48.63	\$50.90

¹Utilizing a 13-year amortization period

Discussion

- As presented by 1898 & Co., capital and construction costs are significantly higher today than in the 2021-2025 DCR.
- 4-Hour BESS yields a lower preliminary reference point price (on a UCAP basis) than SCGT in all locations.
- Even accounting for reduced CAFs and net EAS revenues compared to a 4-hour BESS, 2-Hour BESS results in lower preliminary reference point prices (on a UCAP basis) than 4-Hour BESS in all locations.

Ongoing Analysis

Work in Progress

Analysis Group

1. Implement ramping constraint enhancement for 5-minute battery modeling
 - Batteries may only charge/discharge at most 50% of their rated capacity during the first and last 5-minute interval of each distinct charging/discharging sequence. This constraint reflects that NYISO's Automatic Generator Control linearly ramps units across 5-minute intervals. These ramping constraints impact both net revenues and SOC.
2. Development of updated level of excess adjustment factors (LOE-AFs) for the 2025-2029 DCR (see 2/29/2024 ICAPWG presentation)
3. Development of voltage support service (VSS) adder for 2025-2029 DCR

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Appendix – Preliminary Reference Point Prices

Preliminary Reference Point Prices: Load Zones C and F

Load Zone C

Unit	Gross Cone	Net EAS	Annual Reference Value	Monthly RP Price Summer ICAP (\$/kW-month)	Monthly RP Price Winter ICAP (\$/kW-month)	CAF Values	Monthly RP Price Annual UCAP (\$/kW-month)	Monthly RP Price Summer UCAP (\$/kW-month)	Monthly RP Price Winter UCAP (\$/kW-month)
SCGT J-Class ¹	\$258.89	\$72.34	\$186.54	\$21.79	\$15.91	100.00%	\$20.02	\$22.72	\$16.59
SCGT J-Class ²	\$218.72	\$72.34	\$146.38	\$17.10	\$12.49	100.00%	\$15.71	\$17.83	\$13.02
BESS 2-Hour	\$111.77	\$61.04	\$50.73	\$5.74	\$4.34	55.42%	\$9.50	\$10.58	\$7.99
BESS 4-Hour	\$179.01	\$71.22	\$107.79	\$12.21	\$9.22	64.47%	\$17.35	\$19.32	\$14.60
BESS 6-Hour	\$248.79	\$74.42	\$174.38	\$19.75	\$14.92	91.77%	\$19.72	\$21.96	\$16.59
BESS 8-Hour	\$314.53	\$76.55	\$237.98	\$26.95	\$20.36	100.00%	\$24.70	\$27.50	\$20.78

Load Zone F

Unit	Gross Cone	Net EAS	Annual Reference Value	Monthly RP Price Summer ICAP (\$/kW-month)	Monthly RP Price Winter ICAP (\$/kW-month)	CAF Values	Monthly RP Price Annual UCAP (\$/kW-month)	Monthly RP Price Summer UCAP (\$/kW-month)	Monthly RP Price Winter UCAP (\$/kW-month)
SCGT J-Class ¹	\$255.82	\$95.89	\$159.93	\$18.71	\$13.70	100.00%	\$17.20	\$19.51	\$14.28
SCGT J-Class ²	\$219.70	\$95.89	\$123.81	\$14.48	\$10.60	100.00%	\$13.32	\$15.10	\$11.06
BESS 2-Hour	\$112.23	\$76.56	\$35.68	\$4.04	\$3.05	55.42%	\$6.68	\$7.44	\$5.62
BESS 4-Hour	\$179.88	\$91.45	\$88.43	\$10.01	\$7.57	64.47%	\$14.24	\$15.85	\$11.98
BESS 6-Hour	\$250.01	\$95.72	\$154.29	\$17.47	\$13.20	91.77%	\$17.45	\$19.43	\$14.68
BESS 8-Hour	\$316.08	\$96.68	\$219.40	\$24.84	\$18.77	100.00%	\$22.77	\$25.35	\$19.16

Notes: [1] SCGT 7HA.03 with SCR and dual fuel in all zones. 13-year amortization period. [2] SCGT 7HA.03 with SCR and dual fuel in all zones. 20-year amortization period with no net EAS revenues after 2040.

Preliminary Reference Point Prices: Load Zone G (Rockland and Dutchess)

Load Zone G (Rockland)

Unit	Gross Cone	Net EAS	Annual Reference Value	Monthly RP Price Summer ICAP (\$/kW-month)	Monthly RP Price Winter ICAP (\$/kW-month)	CAF Values	Monthly RP Price Annual UCAP (\$/kW-month)	Monthly RP Price Summer UCAP (\$/kW-month)	Monthly RP Price Winter UCAP (\$/kW-month)
SCGT J-Class ¹	\$272.13	\$67.38	\$204.75	\$28.07	\$29.03	100.00%	\$29.13	\$29.27	\$30.27
SCGT J-Class ²	\$228.94	\$67.38	\$161.56	\$22.15	\$22.90	100.00%	\$22.98	\$23.10	\$23.88
BESS 2-Hour	\$113.82	\$66.47	\$47.35	\$5.75	\$5.47	56.16%	\$10.26	\$10.45	\$9.93
BESS 4-Hour	\$182.85	\$76.56	\$106.29	\$12.91	\$12.27	67.95%	\$19.04	\$19.39	\$18.43
BESS 6-Hour	\$254.17	\$77.73	\$176.44	\$21.43	\$20.37	91.92%	\$23.37	\$23.79	\$22.62
BESS 8-Hour	\$321.40	\$79.08	\$242.32	\$29.43	\$27.98	100.00%	\$29.50	\$30.04	\$28.55

Load Zone G (Dutchess)

Unit	Gross Cone	Net EAS	Annual Reference Value	Monthly RP Price Summer ICAP (\$/kW-month)	Monthly RP Price Winter ICAP (\$/kW-month)	CAF Values	Monthly RP Price Annual UCAP (\$/kW-month)	Monthly RP Price Summer UCAP (\$/kW-month)	Monthly RP Price Winter UCAP (\$/kW-month)
SCGT J-Class ¹	\$256.86	\$65.59	\$191.27	\$26.23	\$27.12	100.00%	\$27.21	\$27.35	\$28.27
SCGT J-Class ²	\$216.29	\$65.59	\$150.70	\$20.66	\$21.36	100.00%	\$21.44	\$21.55	\$22.28
BESS 2-Hour	\$111.82	\$67.75	\$44.08	\$5.35	\$5.09	56.16%	\$9.55	\$9.73	\$9.25
BESS 4-Hour	\$179.08	\$78.01	\$101.07	\$12.28	\$11.67	67.95%	\$18.11	\$18.44	\$17.53
BESS 6-Hour	\$248.89	\$80.71	\$168.18	\$20.43	\$19.42	91.92%	\$22.27	\$22.68	\$21.56
BESS 8-Hour	\$314.65	\$82.65	\$232.00	\$28.18	\$26.79	100.00%	\$28.24	\$28.76	\$27.34

Notes: [1] SCGT 7HA.03 with SCR and dual fuel in all zones; 13-year amortization period. [2] SCGT 7HA.03 with SCR and dual fuel in all zones; 20-year amortization period with no net EAS revenues after 2040.

Preliminary Reference Point Prices: Load Zones J and K

Load Zone J

Unit	Gross Cone	Net EAS	Annual Reference Value	Monthly RP Price Summer ICAP (\$/kW-month)	Monthly RP Price Winter ICAP (\$/kW-month)	CAF Values	Monthly RP Price Annual UCAP (\$/kW-month)	Monthly RP Price Summer UCAP (\$/kW-month)	Monthly RP Price Winter UCAP (\$/kW-month)
SCGT J-Class ¹	\$310.14	\$79.92	\$230.22	\$33.24	\$34.79	100.00%	\$34.58	\$34.66	\$36.27
SCGT J-Class ²	\$272.52	\$79.92	\$192.60	\$27.81	\$29.10	100.00%	\$28.93	\$29.00	\$30.35
BESS 2-Hour	\$166.34	\$71.02	\$95.32	\$11.78	\$11.03	55.93%	\$21.00	\$21.50	\$20.13
BESS 4-Hour	\$253.50	\$81.03	\$172.47	\$21.32	\$19.96	68.84%	\$30.87	\$31.61	\$29.59
BESS 6-Hour	\$342.40	\$82.46	\$259.94	\$32.14	\$30.08	90.41%	\$35.43	\$36.27	\$33.95
BESS 8-Hour	\$430.98	\$84.18	\$346.80	\$42.88	\$40.14	100.00%	\$42.73	\$43.75	\$40.96

Load Zone K

Unit	Gross Cone	Net EAS	Annual Reference Value	Monthly RP Price Summer ICAP (\$/kW-month)	Monthly RP Price Winter ICAP (\$/kW-month)	CAF Values	Monthly RP Price Annual UCAP (\$/kW-month)	Monthly RP Price Summer UCAP (\$/kW-month)	Monthly RP Price Winter UCAP (\$/kW-month)
SCGT J-Class ¹	\$279.59	\$133.68	\$145.92	\$27.68	\$56.11	100.00%	\$33.67	\$28.86	\$58.51
SCGT J-Class ²	\$244.60	\$133.68	\$110.92	\$21.04	\$42.65	100.00%	\$25.60	\$21.94	\$44.47
BESS 2-Hour	\$111.53	\$96.36	\$15.17	\$2.08	\$2.27	52.76%	\$4.14	\$4.02	\$4.38
BESS 4-Hour	\$182.43	\$116.16	\$66.27	\$9.08	\$9.89	78.94%	\$12.08	\$11.74	\$12.79
BESS 6-Hour	\$255.47	\$127.96	\$127.51	\$17.47	\$19.03	91.53%	\$20.05	\$19.47	\$21.22
BESS 8-Hour	\$324.37	\$131.95	\$192.42	\$26.36	\$28.72	99.72%	\$27.77	\$26.97	\$29.39

Notes: [1] SCGT 7HA.03 with SCR and dual fuel in all zones. 13-year amortization period. [2] SCGT 7HA.03 with SCR and dual fuel in all zones. 20-year amortization period with no net EAS revenues after 2040.