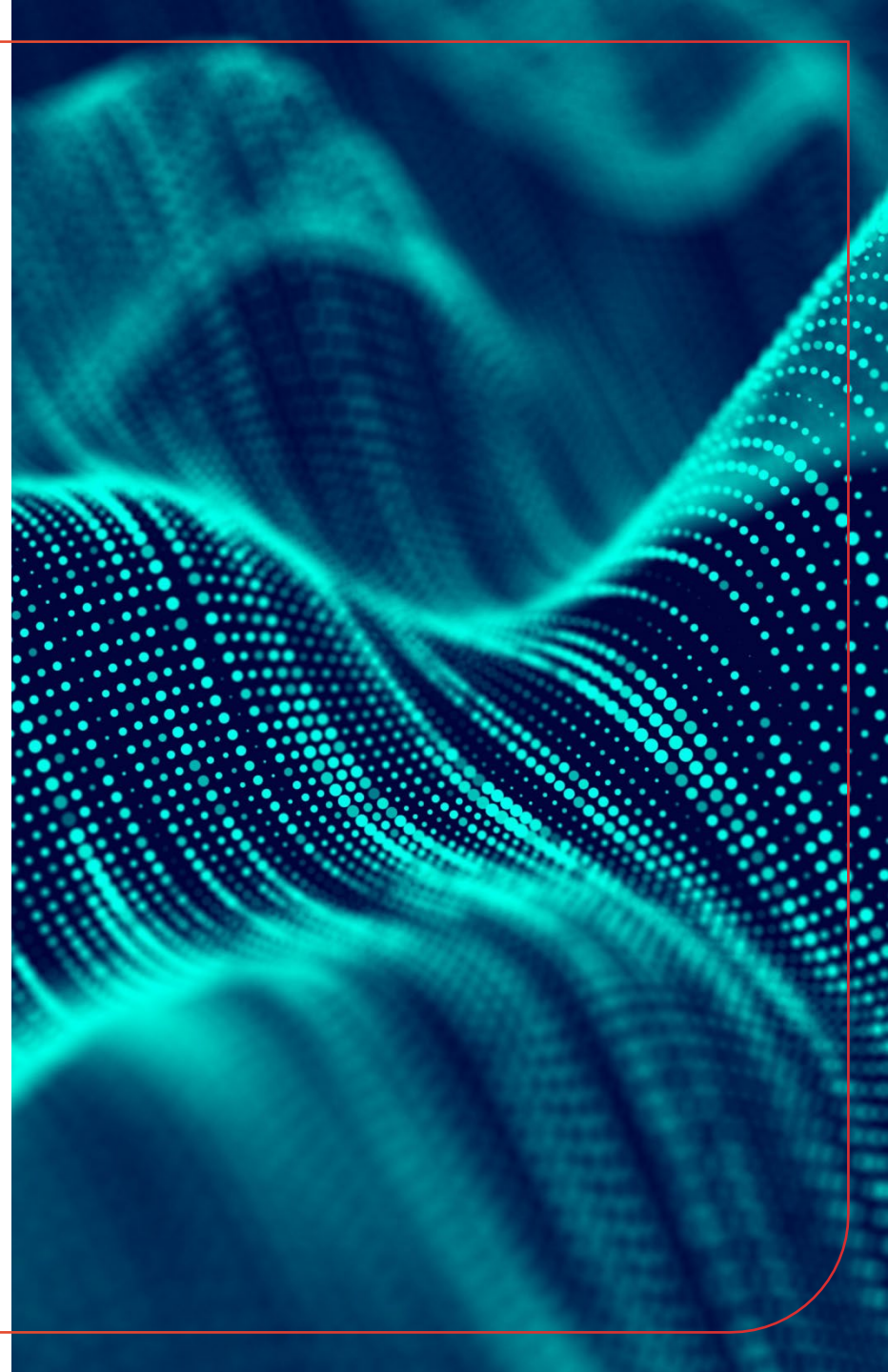
# NYISO 2025-2029 ICAP Demand Curve Reset

ICAP Working Group Meeting

November 8, 2023



# Generation Technologies

# Proposed Technology Screening Criteria

- As discussed on 9/26/2023, propose the following initial screening criteria that are consistent with the 2021-2025 Installed Capacity Demand Curve reset (DCR):
  - Standard resource technology – available to most market participants
  - Proven technology – operating experience at a utility power plant
  - Unit characteristics that can be economically dispatched
  - Ability to cycle and provide peaking service
  - Can be practically constructed in a particular location
  - Capable of meeting environmental requirements and regulations

# Recommended Technologies to be Evaluated

- H/J-class Simple Cycle Gas Turbine (“SCGT”)
  - With and without CLCPA-compliant operations (i.e. zero-emissions production capability)
  - Viability of CLCPA-compliant alternate to serve as a peaking plant remains under review
- Battery Energy Storage System (“BESS”)
  - 4-hour Li-Ion BESS
  - 6-hour Li-Ion BESS
  - 8-hour Li-Ion BESS

# CLCPA Compliance

# CLCPA Compliance Timelines

- SCGT designed to burn only fossil fuels and assumed to retired in 2040.
  - Fossil-only option expected to utilize shortened amortization period to account for the CLCPA's 2040 zero-emission requirement.
  - Likely to use the same construct that was utilized for the 2021-2025 DCR
- SCGT designed to burn fossil fuels, but assumed to be retrofitted in 2040 to CLCPA compliant zero-emissions operations
  - Likely to use a 20-year amortization period
  - Considerations:
    - Viability (i.e., commercial operating experience)
    - CLCPA zero-emission compliance guidance
      - CLPCPA compliant fuel basis
      - CLCPA compliant fuel delivery basis
      - Alternative method to consider net energy and ancillary services (EAS) revenues beginning in 2040
- SCGT initially designed to burn CLCPA compliant fuels
  - Clarity of CLCPA compliant options other than renewable and storage remain uncertain
  - Not currently commercially available
  - Fuel supply infrastructure not in place

# CLCPA Compliant Fuel Considerations

- Given the current state of compliance guidance for the CLCPA's 2040 zero-emissions requirement, BMcD preliminarily recommends selecting a "zero emissions" fuel as a representative fuel for evaluation
  - Hydrogen
  - Ammonia
  - Renewable natural gas
  - Biofuels
- Zero emission fuel considerations
  - Fuel production
  - Fuel transportation
  - Fuel storage
- BMcD preliminarily recommends that direct air capture (DAC), carbon capture, utilization and storage (CCUS), nuclear (including small modular reactors [SMRs]), and fuel cells not be considered
  - Technology options may not have same flexibility of dispatchable operations and/or cycling capability

# BESS Technologies

# BESS Preliminary Recommendations for DCR

- 200 MW at 4, 6, 8-hour discharge durations
  - Consistent with 2021-2025 DCR
- Zones C, F, G, K:
  - Lithium-ion technology
  - Purpose-built enclosure form factor
  - Single elevation
  - Not specific to a particular chemistry or OEM
- Zone J
  - Lithium-ion technology
  - Purpose-built enclosure form factor
  - Single elevation
  - Not specific to a particular chemistry or OEM
  - Will need to account for FDNY requirements

# Anticipated BESS Technology Considerations

- BMcD/AG are investigating several anticipated considerations
  - We invite stakeholder feedback in Q4 2023 on these items (and others) to aid in development of assumptions and cost estimates.
- Storage technology type (lithium-ion vs. the field)
- Zone J specific considerations
  - Spatial and location constraints
  - Form factor / site energy density
  - FDNY requirements
- Consideration of capacity accreditation factors
- Capital cost volatility
- Overbuild and augmentation

# BESS Trends: Lithium-ion Technology

- Proven market dominance for utility-scale stationary storage in 1-4 hour discharge duration applications
- Competitive in longer duration applications (i.e., multiple 8-hour RFP awards to lithium-ion developments)
- Movement toward modular form factors
- General market preference for lithium-iron-phosphate (LFP) chemistry
- Investments in US manufacturing capability

# BESS Trends: Non-Lithium Technology

- Most non-lithium technologies are targeted for long duration
  - “Long duration” commonly means 8+ hour discharge duration at rated power
  - Battery systems (i.e., redox flow, hybrid flow, high temp, other electrochemical)
  - Mechanical storage
  - Thermal storage
- Increasing interest and activity from utilities, developers, investors
- Movement toward modular products/designs
- Investments in US manufacturing capability

# Commercial Maturity at Utility Scale

| BESS Technology | Typ. Discharge Duration (hours) | RTE AC (%)* | Approx. Installed in US (MWh)** | Capital Cost Source | O&M Cost Source | Maturity for DCR |
|---|---|---|---|---|---|---|
| Lithium-ion | 1 - 8 | 85% | >10,000 MWh | Market Info | Market Info | YES |
| Vanadium Redox Flow | 4+ | < lithium | ~100 MWh combined | Rely on OEM info | Rely on OEM info | No |
| Hybrid Flow | 4 - 12 | < lithium | | Rely on OEM info | Rely on OEM info | No |
| Other Electrochemical | 4 - 12 | < lithium | | Rely on OEM info | Rely on OEM info | No |
| High Temp BESS | 4 - 12 | < lithium | | Rely on OEM info | Rely on OEM info | No |
| Mechanical (non PH or CAES) | 6 - 12 | < lithium | | Rely on OEM info | Rely on OEM info | No |
| Multi Day Storage | 100 | < lithium | | Rely on OEM info | Rely on OEM info | No |

*RTE = Roundtrip Efficiency for BESS
**Intended to indicate the order of magnitude scale of known installations of BESS for utility scale, stationary storage applications through 2022.

- Approximate information intended to represent utility scale maturity and preliminary technology characteristics
- Preliminary opinion is that lithium-ion is the only storage option that meets the screening criteria for “proven technology”
- Pumped hydro and compressed air not considered due to site-specific geographic / geologic requirements.

# Zone J Considerations

- Spatial Considerations
  - 2021-2025 DCR assumption for land: 9,12,15 acres for 4,6,8 hours.
  - ~100 MWh ROM energy density for lithium
  - Will need to consider whether to retain the 2021-2025 acreage assumptions
    - Could consider whether alternative assumptions are warranted based on currently proposed projects in NYC
- NYISO queue information for Zone J:

| Project Location for Zone J Interconnection | Qty |
|---|---|
| Queens | 11 |
| Brooklyn | 10 |
| Staten Island | 6 |
| Bronx | 5 |
| Manhattan | 1 |
| New Jersey | 1 |

| Zone J BESS | Value |
|---|---|
| Min MW | 15 |
| Avg.MW | 205 |
| Median MW | 100 |
| Max MW | 650 |

# Zone J Considerations (continued)

- Form factor
  - Not assumed for the 2021-2025 DCR
  - Preliminarily recommending assumption for purpose-built-enclosure for this DCR
- Other FDNY Considerations

# Other BESS Considerations for Discussion

BMcD/AG have discussed the following items internally and welcome feedback for further consideration.

- Consideration of Capacity Accreditation Factors (CAFs)
  - NYISO is evaluating CAFs for multiple storage durations.
  - Will consider preliminary information produced to date, as well as the results produced for the 2024/2025 Capability Year
- Market Price Volatility
  - Lithium-ion BESS equipment pricing is trending downward.
  - Equipment costs/assumptions would initially be based on indicative pricing from Q4 2023 - Q1 2024.
- Overbuild and Augmentation
  - Current IRS guidance is unclear about augmentation qualifying for investment tax credit (ITC).
  - Current tax credit environment may incentivize higher initial overbuild.

# Technologies Not Likely to be Evaluated

- F-class SCGT
  - H/J-class gas turbines evaluate better compared to F-class

| F-class SCGT | Commercial Operation in U.S. | ISO Capacity (MW) | HHV Heat Rate (Btu/kWh) | Initial Screening Cost ($/kW) |
|---|---|---|---|---|
| GE 7F.05 | ✓ | 239 | 9,850 | $1050/kW |
| Siemens SGT6-5000F | ✓ | 260 | 9,470 | |
| **G/H/J - Class SCGT** | **Commercial Operation in U.S.** | **ISO Capacity (MW)** | **HHV Heat Rate (Btu/kWh)** | **Initial Screening Cost ($/kW)** |
| GE 7HA.03 | ✓ | 430 | 8,750 | $750/kW |
| Siemens SGT6-9000HL | ✓ | 440 | 8,770 | |
| MPA M501JAC | ✓ | 453 | 8,610 | |
| GE 7HA.02 | ✓ | 384 | 8,890 | $800/kW |
| GE 7HA.01 | ✓ | 290 | 9,010 | $900/kW |
| Siemens SGT6-8000H | ✓ | 310 | 9,390 | |
| MPA M501GAC | ✓ | 283 | 9,470 | |

# Technologies Not Likely to be Evaluated

- Reciprocating Internal Combustion Engines ("RICE")
- Aeroderivative SCGT

| | Commercial Operation in U.S. | ISO Capacity (MW) | HHV Heat Rate (Btu/kWh) | Initial Screening Cost ($/kW) |
|---|---|---|---|---|
| Siemens SGT-A35 | ✓ | 33 | 9,510 | $2000/kW |
| GE LM6000PF+ | ✓ | 54 | 9,230 | $1800/kW |
| MPA FT8 SWIFTPAC 60 | ✓ | 61 | 10,300 | |
| MPA FT4000 SWIFTPAC 70 | ✓ | 72 | 9,140 | |
| GE LMS100PB | ✓ | 107 | 8,850 | $1200/kW |
| Wartsila 18V50SG | ✓ | 18 | 8,290 | $1,700 |