WHEN TRUST MATTERS

BESS M&A Technical Due Diligence

February 27, 2024

Agenda

- Introduction
- M&A transaction landscape
- Platform characteristics
- Technical due diligence
- Financial Model
- Q&A

BESS M&A transaction landscape

- Types
- Counterparties
- Volume
- Locations

Development of Standalone or Hybrid BESS has occurred most dramatically in California and Texas as of 2022.

California (CAISO)

- 15.9 GWh storage capacity online
- Average BESS market revenues: $179.2/kW-year

Texas (ERCOT)

- 2.7 GWh storage capacity online
- Average BESS market revenues: $137.4/kW-year

Active BESS projects greater than 10 MW by region

Sources: LBNL, Online Hybrid and Energy Storage Projects | Electricity Markets and Policy Group (lbl.gov), Energy Information Agency (EIA): Energy_Storage_2022, CPUC: 2021 Resource Adequacy Report (ca.gov); CAISO DMM: Battery Storage (caiso.com), Gridmatic: https://www.gridmatic.com/ercot-storage-2022-full-report/

Platform characteristics

- Revenue
  - PPA or merchant
- ISO/RTO
  - Mostly in ERCOT and California
- Technologies
  - Standalone BESS, Solar + storage
  - Overwhelmingly lithium-ion batteries
- Project stages
  - Development, near construction, in-construction and operational (repowering)

Technical due diligence – development stage

- Development progress review
- Interconnection
- Environmental and permitting
- Site constraints
- Developer qualifications
- Markets assessment
- [Safety requirements]

Technical due diligence – Near construction

- All of the above
- Agreements review
  - Offtake, Supply, LTSA, BOP EPC, O&M, asset management and energy management
- Technology review
  - BESS system
  - Safety review
  - Degradation and useful modelling
- Design review
  - Electrical BOP
  - Civil BOP
- BESS dispatch/ revenue modelling

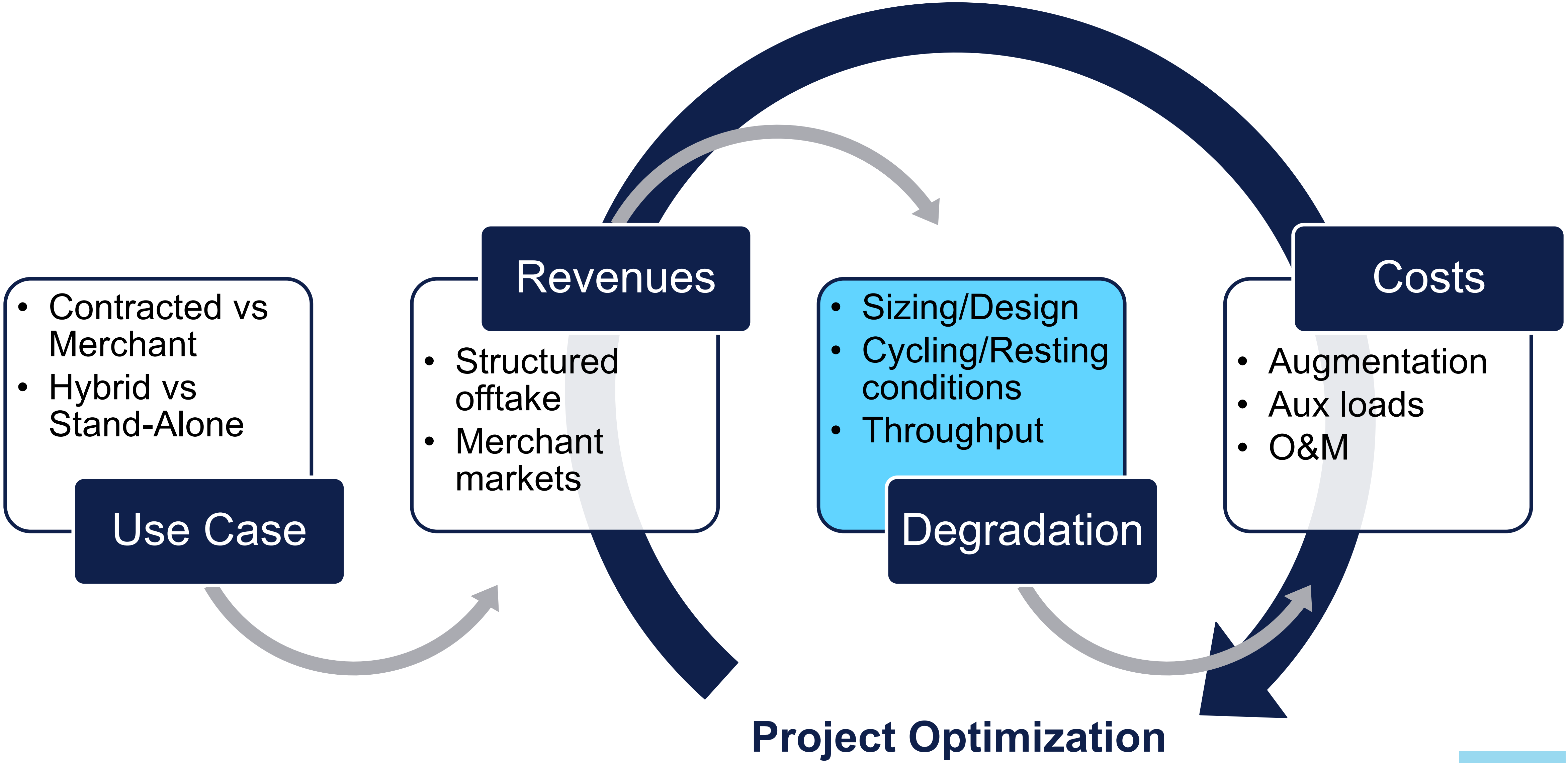
Technical due diligence – In-construction/Operational

- All of the above
- Construction schedule review

Example:

- Commissioning tests review
- Operational review
- Merchant market benchmarking
- Budget review
- Site visit

BESS operational techno-economic cycle



Battery degradation

- Degradation is a key variable that brings together all aspects of BESS design and investment
- Use Case determines revenue expectations
- Use Case also determines degradation abuse factors: **SOC** (cell voltage), **C-rate** (cell current), **Throughput** (full cycles), **Temperature**
- Return on investment
  - Usage philosophy
    - Degrading capacity
    - Capacity maintained
  - BESS design
    - Duration
    - Capacity overbuild
  - Service life

CAPEX
- Power (MW)
- Energy (MWh)

OPEX
- O&M
- Augmentation

Revenues
- Use case

Initial sizing and overbuild to meet contractual requirements

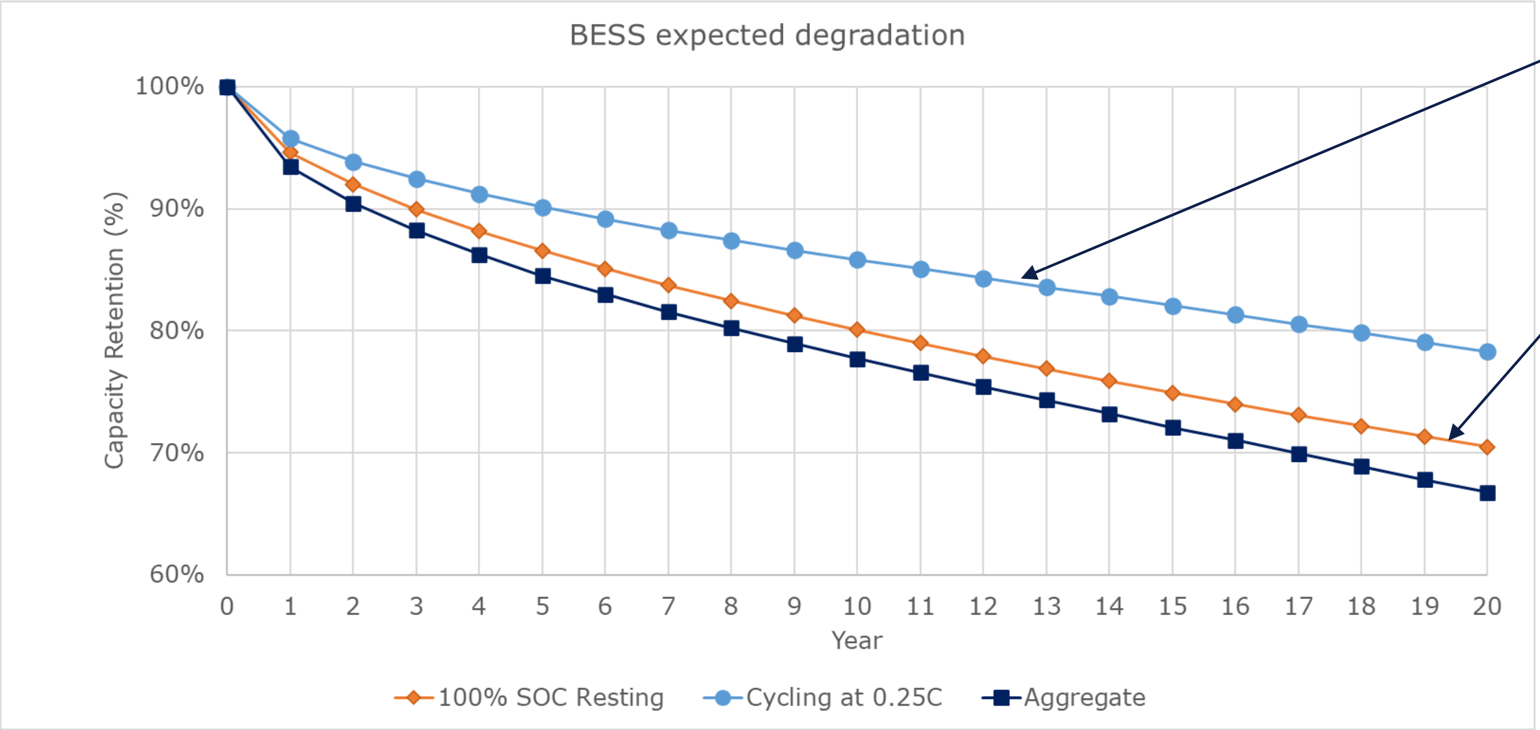
Usage drives revenues and degradation/augmentation

Usage conditions that drive degradation

- Order of sensitivity: Temperature > SOC > C-Rates
- Temperature – Extended operation at elevated temperatures, e.g., near or above 40°C or below 10°C, will result in accelerated degradation. BESS thermal management systems are designed to maintain cells within temperature ranges beneficial for cell life.
- State of charge (SOC)
  - High average SOC is generally known to accelerate degradation. Operating batteries in a manner that lowers annual average SCO and avoids resting at or near 100% SOC will be beneficial for battery life.
  - Larger SOC swing cycling will also be more degrading than shallow SOC swing.
- C-rate – High C-rate operation is generally considered to accelerate degradation. C-rate is limited by the equipment design – e.g., 4-hour BESS will have a maximum C-rate close to 0.25C. Energy capacity overbuilds lower C-rate.
- Throughput – High throughput indicates high utilization of a BESS. BESS warranties and performance guaranties typically include throughput limits; e.g., 365 annual full cycles. Cycling a BESS beyond warrantied throughput limits may also have adverse consequences since balance of system components such as the thermal management system may not be sized to adequately remove the heat generated from the extra cycling.

Compounding degradation factors

- Cycling {0.25C, 50% Avg SOC, 100% DSOC} or idling at 0% SOC, for 85% of time
- Resting at 100% SOC for 15% of time



Expected capacity retention (Cycle life) for 1 cycle per day usage under Use Case

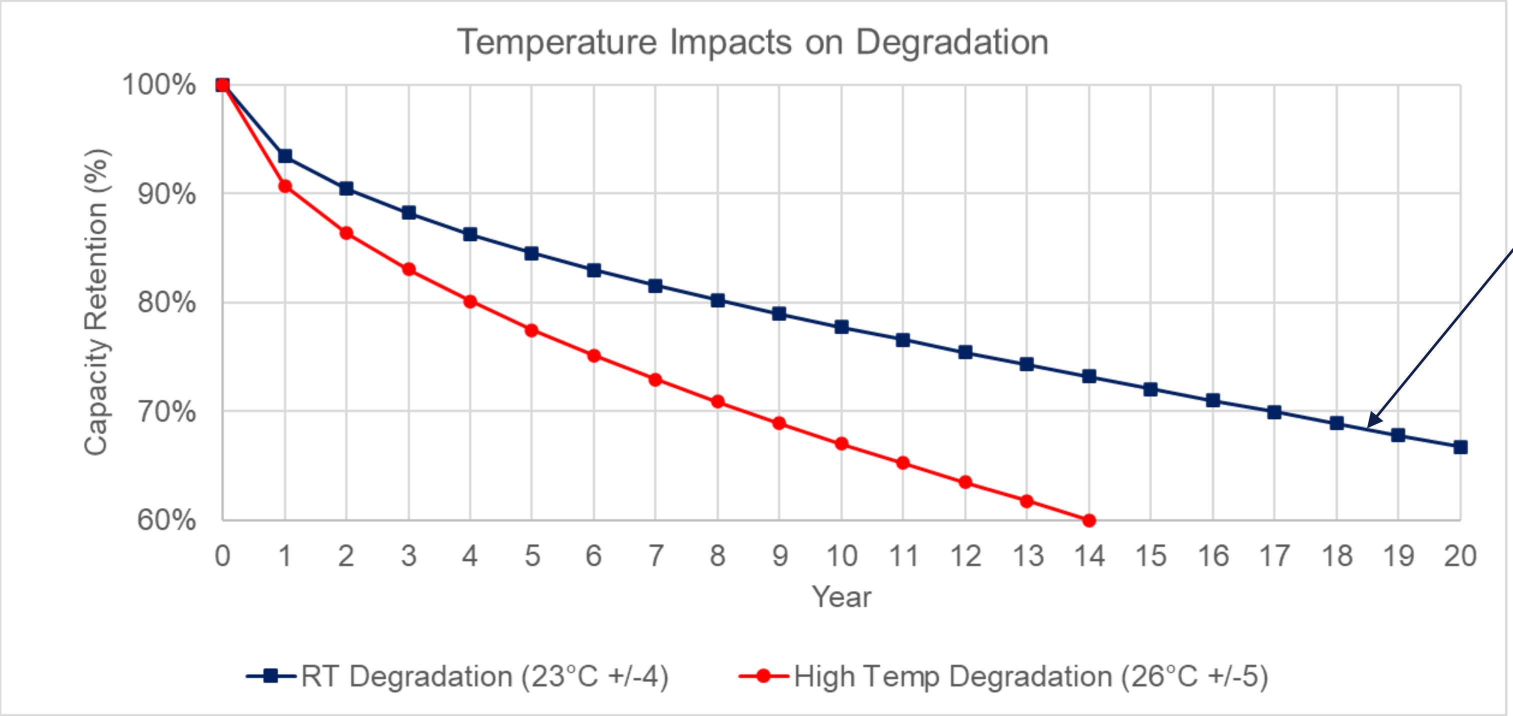
Calculated using cycle life testing data

Expected capacity retention (Calendar life) if purely idled at 100% SOC

Aggregate degradation evaluated based on fatigue (cumulative damage) functions such as Miner’s Rule or analytical tools like DNV’s Battery AI

Compounding degradation factors

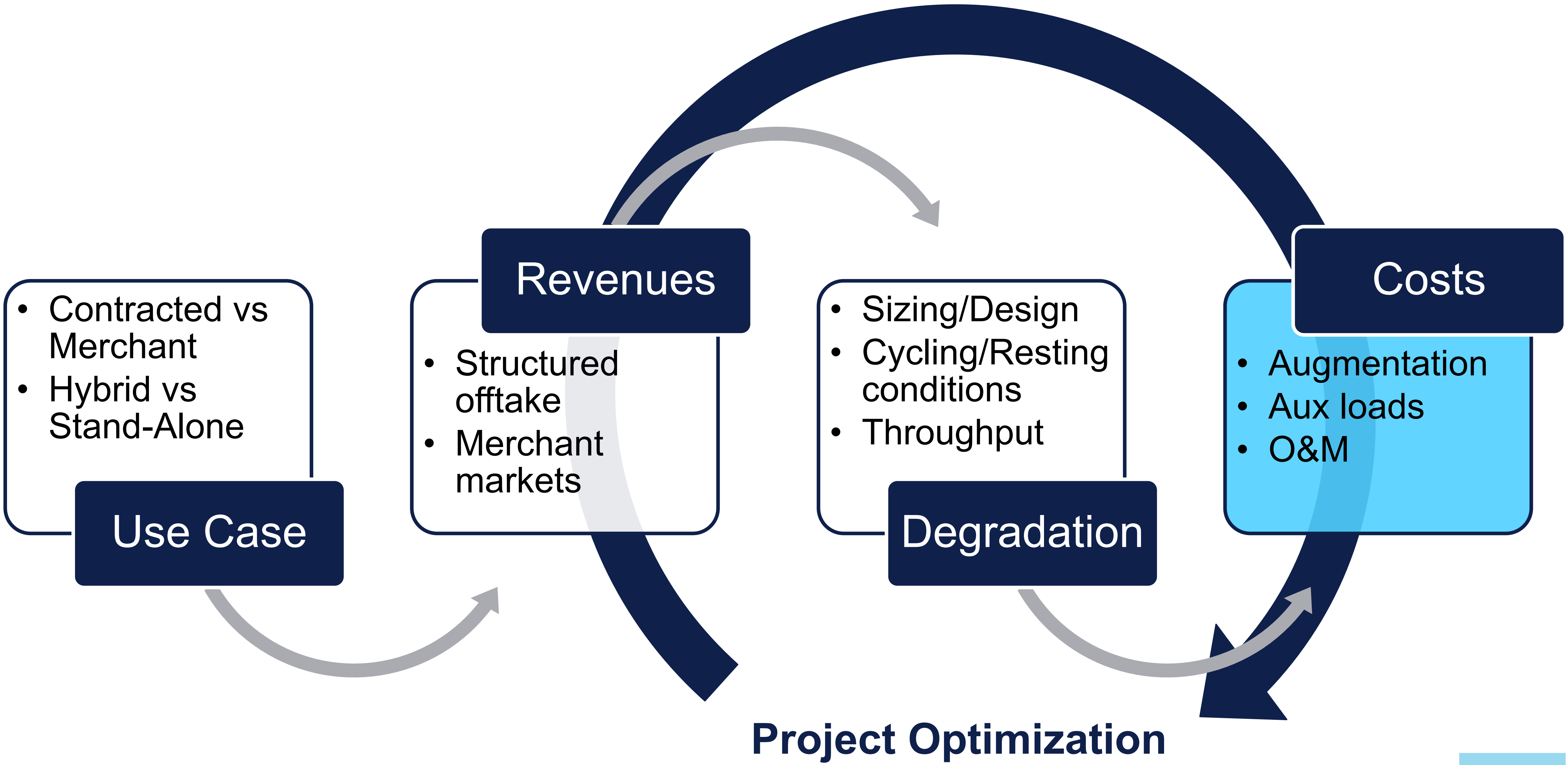
- Base case modeling assumes appropriate thermal management system operation
- Operation at elevated temperatures for extended periods will cause accelerated capacity degradation



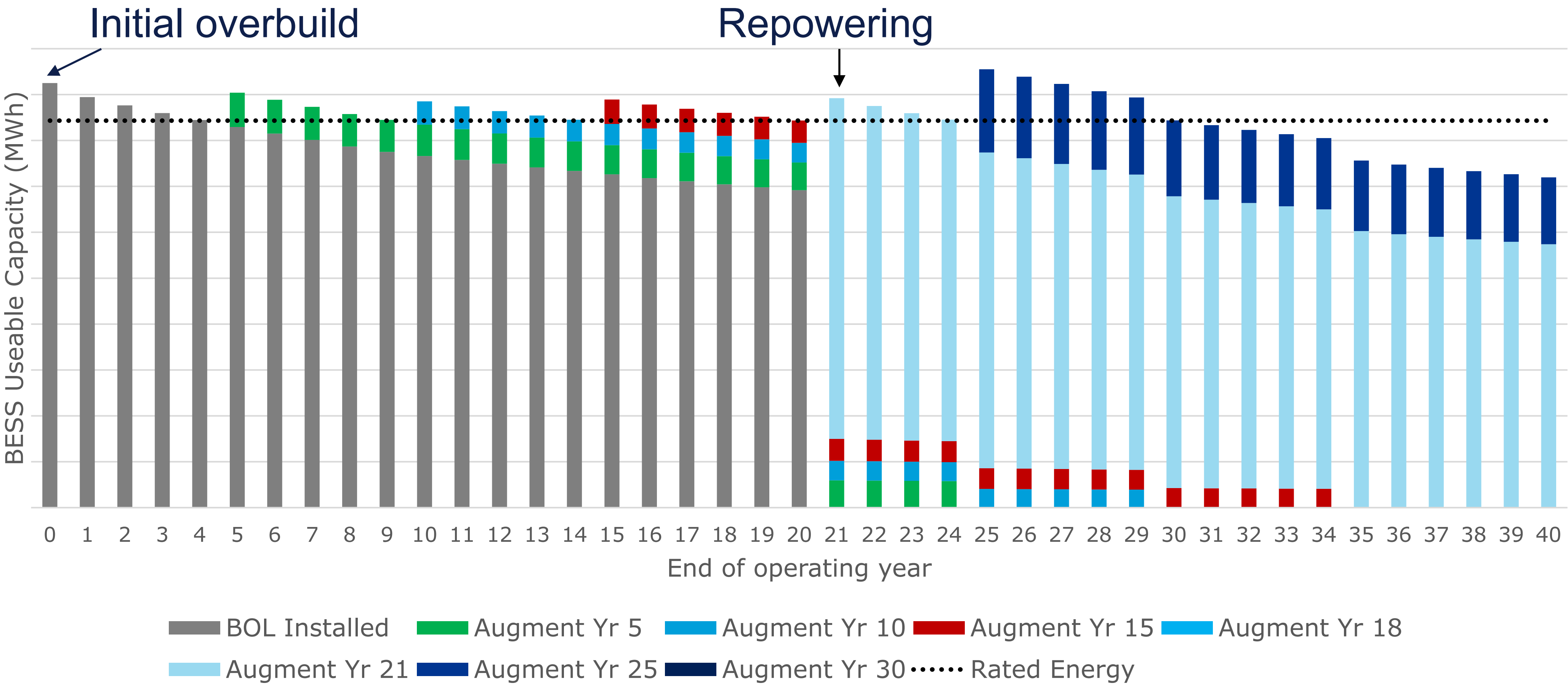
Base case BESS degradation estimate that considers the Use Case and assumes adequate thermal management to maintain cells within least degrading temperature range, ~25°C

If thermal management system sizing and control allows BESS ambient temperatures to stay elevated, then useable energy capacity degradation and end of life will be accelerated

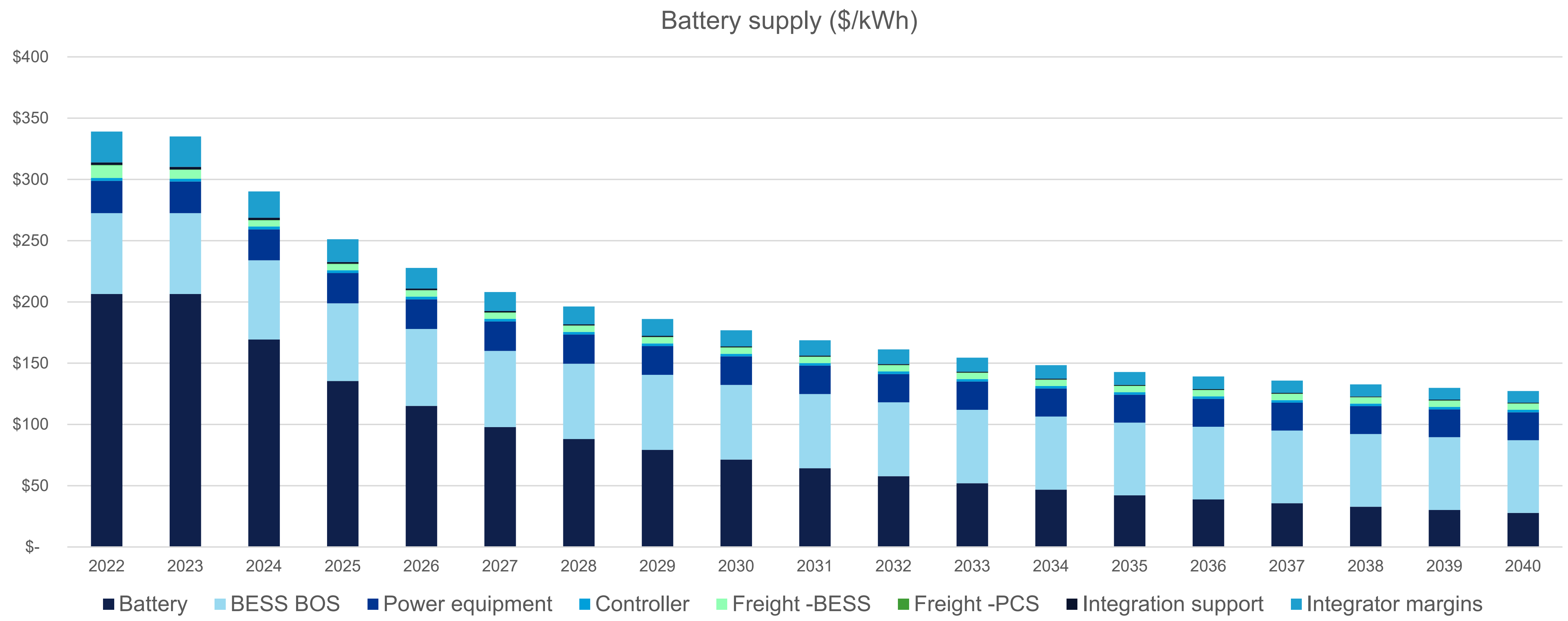
BESS operational techno-economic cycle



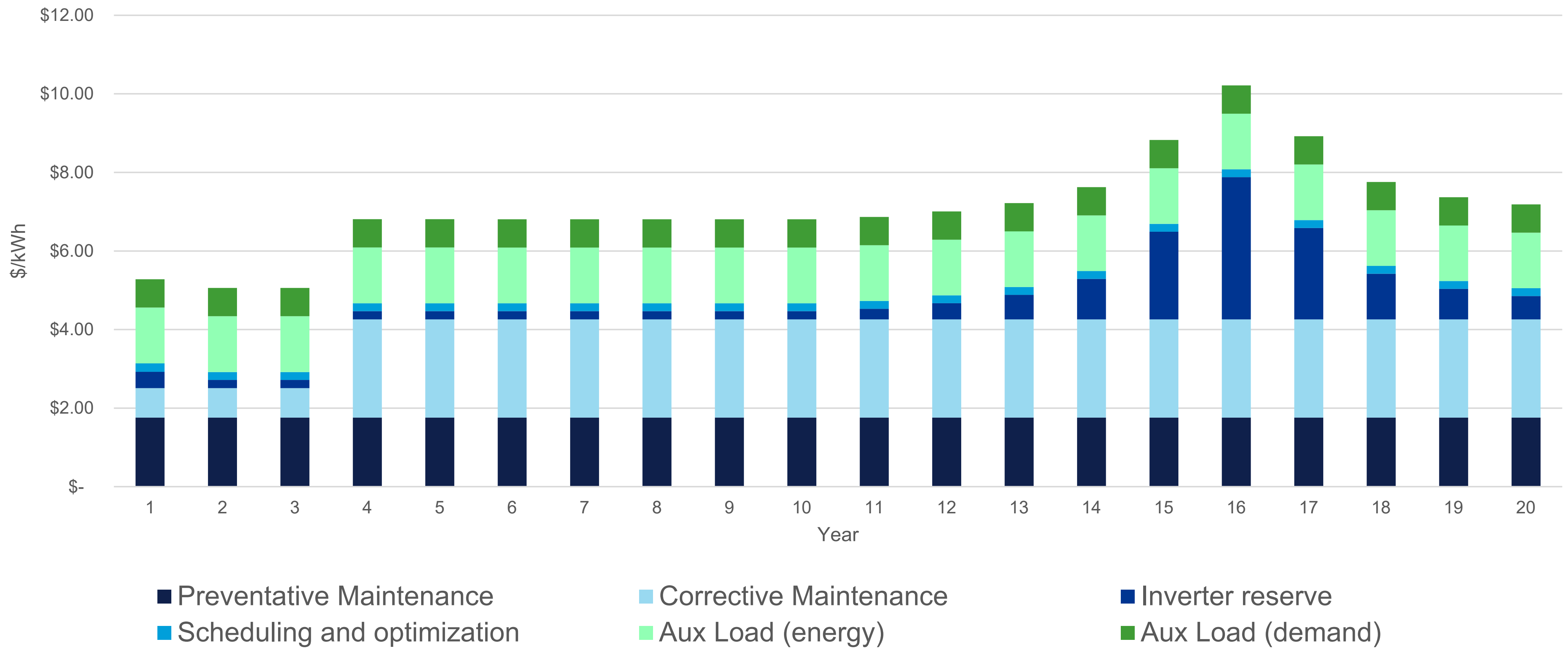
Augmentation plan – Capacity maintenance for 30 yrs



Battery costs projections (2022-2040)

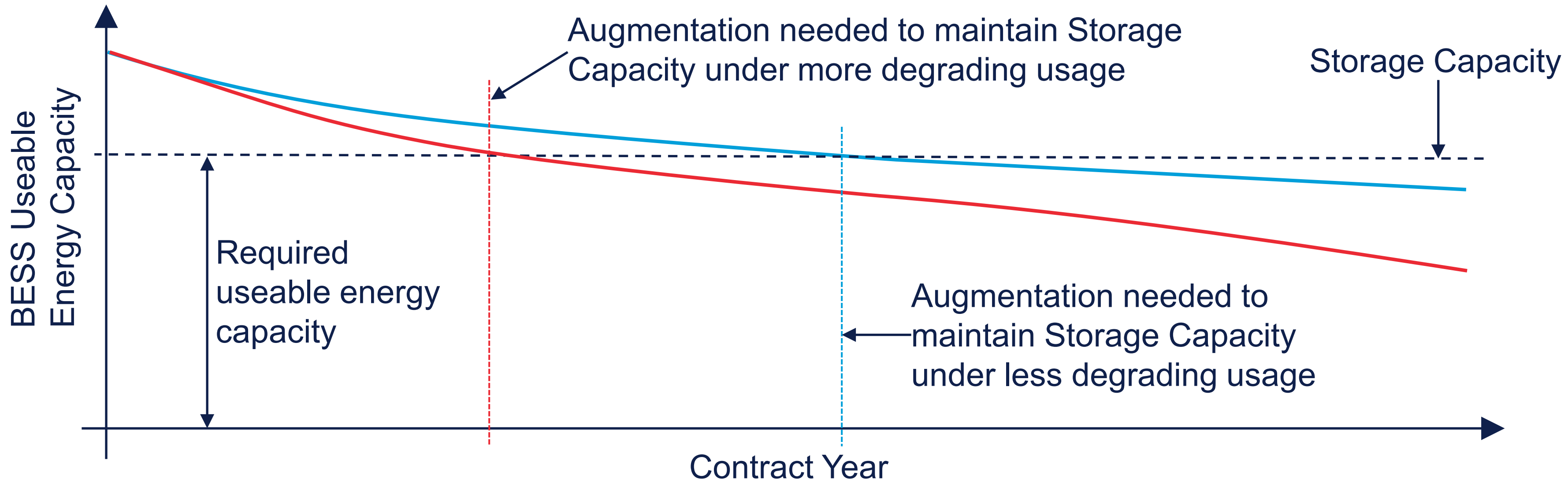


Annual operating expenditure



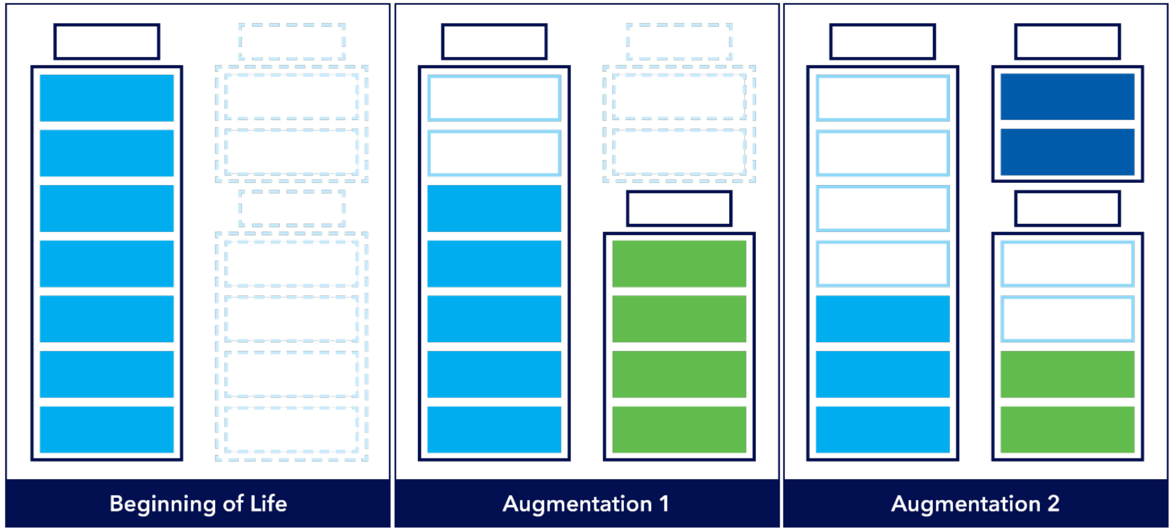
Use case → degradation → augmentation

- Battery degradation is driven by design and usage
  - Longer duration batteries will typically degrade slower
    - Lower charge/discharge rates
  - Higher throughput (cycling) will result in more degradation
  - Elevated temperatures will accelerate degradation
    - Majority of BESS auxiliary energy consumption is for thermal management



BESS augmentation planning

- Augmentation Plan for BESS energy capacity maintenance should be thought through in BESS design from a preliminary design stage
  - Space needs to be allocated if additional BESS containers or augmentation units need to be installed at a future time, or spaced reserved in containers for future batteries
  - BOP and auxiliary systems need to have sufficient headroom
- **Financial model impacts:**
  - Revenue impact of BESS energy capacity maintenance
  - Augmentation costs
  - Cost of additional auxiliary loads
- Augmentations could be done on an as-needed basis, based on observed degradation



Questions?

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