# 670 Albany Street

This case study is part of the MassCEC BETA: Project Planning program, committed to helping a representative selection of commercial building types in Massachusetts reach net zero emissions by 2050.

| | |
|---|---|
| **Building type** | Lab/Office |
| **Location** | Boston |
| **Year built** | 2005 |
| **Stories** | 8 |
| **Square footage** | 171,216 |
| **Energy use intensity (EUI)*** | 383 kBtu/sf/yr |
| **Carbon emission intensity (CEI)*** | 26 CO2e kg/sf/yr |
| **Decarbonization goals** | Occupant comfort, lower utility costs, regulatory compliance |

The medical BL3 lab-office facility is estimated to house roughly 60% lab and 40% office space. Built in 2005, the building has not undergone major renovations since its construction. The building enclosure consists of a glazed curtain wall on the south façade and pre-cast concrete panels on the remaining façades. The building enclosure is in fair condition, with a thermal performance that aligns with the 2005 energy code.

## Existing Conditions

| | Walls | Roof | Windows |
|---|---|---|---|
| **Enclosure** | Fair | Fair | Fair |
| **Heating** | A district steam heat exchanger's hot water loop is serving as the primary heating source for multiple air handling units (AHUs), as well as hydronic reheat at variable air volume (VAV) systems | | |
| **Cooling** | Chilled water from centrifugal chillers to VAVs | | |
| **Ventilation** | The main ventilation is provided through AHUs. Ventilation air is exhausted through a separate exhaust fan system | | |
| **Hot water** | 370-gal storage tank sourced through a steam heat exchanger | | |
| **Lighting** | Approximately 30% LED lighting, 70% fluorescent lighting | | |
| **Controls** | No demand control ventilation (DCV), limited temp set back capability (not optimized) | | |
| **Other** | High process and plug loads assumed, as typical with lab usage | | |
| **Renewable energy** | None | | |

*EUI represents the annual energy usage of the building divided by the total area. CEI is the amount of greenhouse gas (GHG) emissions divided by the total area.


## Key Challenges & Solutions

High ventilation demands and energy usage

**Install energy recovery coils in the exhaust air stream to capture significant savings**

Limited mechanical space due to district steam connection

**Prioritize foundational energy efficiency and load reduction measures to lower energy demand for mechanical equipment electrification**

Steam heating connection requires rework of system infrastructure

**Prepare system to operate on lower heating temperatures. Take advantage of replacement timeline to incorporate a heat recovery chiller to provide both heating and cooling**

## Core Decarbonization Strategy

- The hydronic reheat and cooling creates an opportunity for minimal piping infrastructure upgrades with limited occupant disruption when switching to air cooled heat pump heat recovery chillers
- New equipment replacement is phased over 15 years to align with end-of-life and manage upfront costs
- Install on-site battery storage for peak load reduction and resilience

# Retrofit Measures and Energy Impacts

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## Measures

### Energy Efficiency & Load Reduction

**Foundational Efficiency and Load Reduction:**

- LED lighting upgrades
- DCV system
- Advanced controls
- Air-sealing and weatherstripping

**Advanced Load Reduction:**

- Roof replacement

### System Electrification

**Electrification Enablers:**

- Electrical service upgrade
- Energy recovery coils in the exhaust air stream
- Low temperature hot water infrastructure

**System Electrification:**

- Heat pump heat recovery chiller (HPC)
- Phased AHU replacement including heat recovery
- Heat pump domestic hot water (DHW) heater

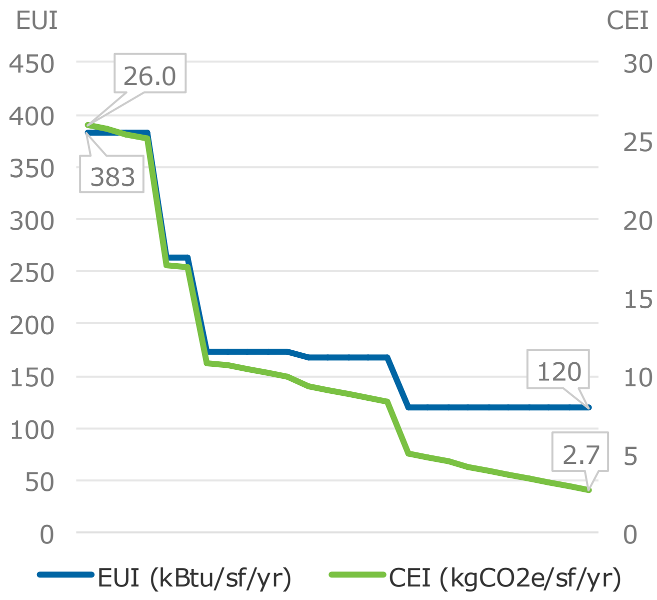
### Renewable Energy

**Battery Storage:**

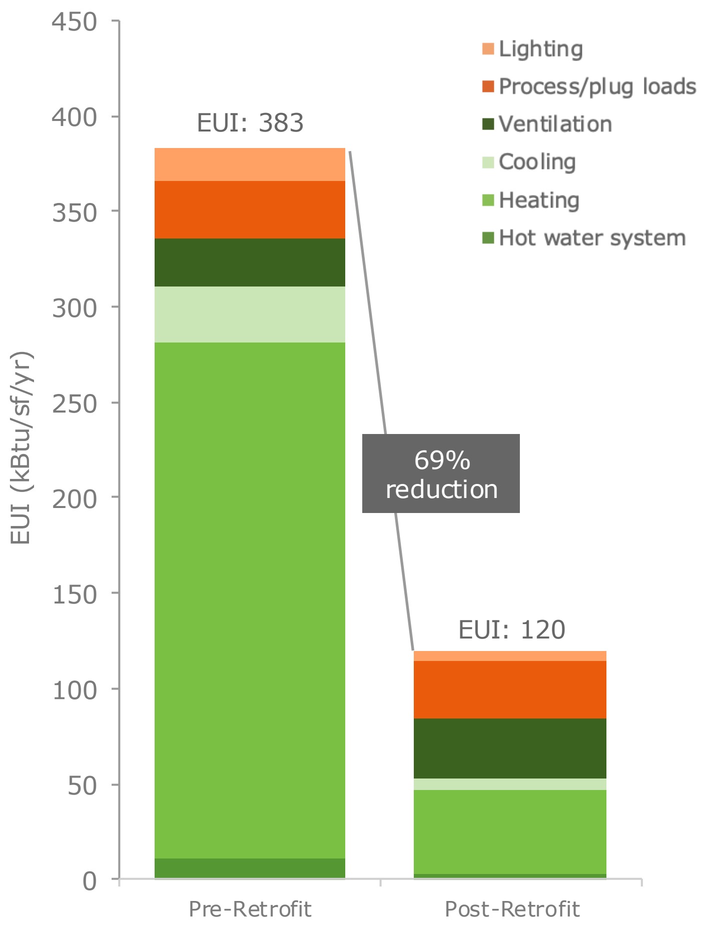
- Install ~200kW battery storage system

## Performance Targets

The decarbonization approach prioritizes an all-electric mechanical system over a 15-year timeline (2025-2040). The recommended measures enable the property to reach a 69% EUI reduction and up to 81% GHG reduction to align with impending BERDO regulations. These efforts would yield the following results over time:




## Annual Energy Use Impacts*




*The annual energy use impacts graphic illustrates an EUI before and after once all recommended measures are implemented, except for any renewable energy. The CEI and EUI shown in the performance targets account for the added benefits of renewable energy.

# Project Planning

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The graphic below presents a decarbonization pathway, organizing measures into bundled actions that are best implemented together. The expected cumulative carbon reduction potential from each bundle is noted on the right. The strategy to reach zero GHG emissions by 2050 focuses on maximizing energy efficiency, electrifying on-site combustion systems within a cleaning grid, and cost-effective battery storage. Key considerations or triggers are listed along a timeline to support informed decision-making, with bolded dates indicating recommended implementation years.

## Triggers

Foundational energy efficiency improvements are not time dependent and/or may implemented prior to the electrification of systems to support right sizing and energy costs savings

Perform testing and air sealing to enclosure. The measure is not time dependent and may be implemented prior to electrification

**2025-2029:** End of service life for existing DHW equipment

**2030:** End of service life for existing AHU equipment

Heat recovery installation is required by current code standards

**2033-2035:** The battery storage system may be installed in alignment with the electrical infrastructure upgrades

**2034:** End of service life for existing roof

**2035-2039:** Current chillers reach end of service life

## Order of Implementation

**Lighting System Upgrade**
Install LED lights in remaining 70% of building

**DCV System**
Install ventilation rate reduction measures in all applicable spaces (~80% of the building)

**Advanced Controls**
HVAC and lighting controls (i.e., occupancy and daylight controls)

**Infiltration Reduction**
Air sealing and weatherstripping

Cumulative Carbon Reduction Potential*: 34%

**DHW Electrification**
Install heat pump DHW heater to replace current steam water heating system

**AHU Replacement**
Replace current AHUs at end of service life, with accommodation for heat recovery (hot water coil)

**Heat Recovery System Installation**
Install energy recovery in the exhaust air stream (Konvekta type)

Cumulative Carbon Reduction Potential*: 58%

**Electrical Distribution Panel Upgrade**
Upgrade electrical for mechanical system electrification

**Battery Storage**
Install on-site battery storage for peak load reduction

**Roof Replacement**
Increased insulation level on roof

**Low Temperature Hot Water Infrastructure**
Upgrade VAVs for mechanical system electrification

Cumulative Carbon Reduction Potential*: 64%

**Chiller Replacement**
Heat pump HRCs to replace current chillers

Cumulative Carbon Reduction Potential*: 81%

**Zero on-site fossil fuel combustion**
(With the exception of any backup power)

*GHG calculations are based on BERDO Version 2.3 emissions factors. Full decarbonization is dependent on statewide renewable energy adoption. GHG calculations include direct onsite combustion (Scope 1) and purchased electricity (Scope 2). For any renewable energy measures included in this plan, it is assumed that the owner will retain the Renewable Energy Credits (RECs) to claim the GHG reduction for reporting.

# Cost Analysis

## Annual Utility Impacts

| Measure description | Changes in annual utility costs | | |
|---|---|---|---|
| | Electricity | Fossil fuel (steam) | Net total changes |
| Lighting | ($150,990) | - | ($150,990) |
| Process/plug loads | ($13,488) | - | ($13,488) |
| Ventilation | $59,823 | - | $59,823 |
| Cooling | ($297,221) | - | ($297,221) |
| Heating | $37,462 | ($593,894) | ($556,432) |
| Hot water system | $35,023 | ($26,900) | ($8,123) |
| **Total from recommended measures** | **($329,391)** | **($620,794)** | **($950,185)** |
| Renewable energy | ($98,055) | - | ($98,055) |

A 200kW battery storage system may reduce peak load energy use by up to 13%.

## Lifecycle Costs*

Realizing the full value of decarbonization requires a long-term outlook that weighs upfront investments, operating costs, and financial incentives. BETA assessments identify the retrofit pathway that most effectively reduces emissions, maintains comfort, and improves performance relative to upgrades an owner would already make (the business-as-usual (BAU) scenario). This comparison highlights long-term avoided costs and risks, as well as opportunities—such as incentives—that support pursuing the optimized pathway.

| Costs | BAU retrofit | Optimized decarbonization pathway | |
|---|---|---|---|
| Base building and envelope costs | $1,123,000 | $2,966,000 | Foundational efficiency and load reduction |
| | | $1,210,000 | Advanced load reduction |
| Mechanical costs | $23,246,000 | $2,739,000 | Electrification enablers |
| | | $23,639,000 | System electrification |
| Renewable energy costs | $0 | $838,000 | Renewable energy |
| Soft costs | $8,529,000 | $10,028,000 | |
| **Total upfront costs** | **$32,898,000** | **$41,420,000** | |
| Utility incentive opportunities | $0 | $1,530,000 | |
| 25-year total accrued utility costs | $108,226,000 | $61,030,000 | |
| 25-year accrued total operating costs | $110,211,000 | $64,227,000 | |
| **25-year LCCA** | **$143,109,000** | **$104,117,000** | |

**BAU scope:**

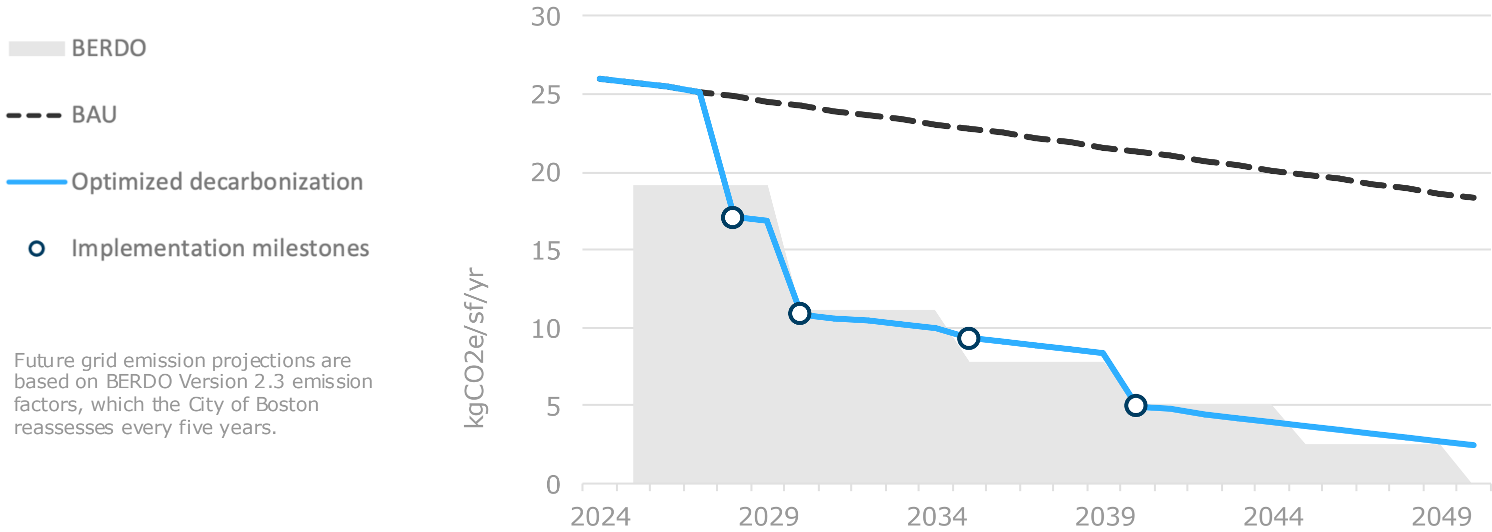
- Cooling tower replacement
- Refurbish chillers in 2025 with full chiller replacement in 2035
- AHU replacement
- Roof replacement
- Electrification ready infrastructure based on code requirements (fossil fuels are maintained as the primary heat source)

*All cost and incentive values are estimated based on industry data and rounded to the nearest $1,000. All incentives values are based on currently available programs and are subject to change over time. Forecasted operating costs include utility costs, maintenance costs, and noncompliance fees if relevant. Utility and maintenance costs reflect a 3% annual escalation rate. The BAU approach assumes necessary repairs and replacements that meet code compliance. In this case study, BAU represents the conventional gas or code-compliant versions of the decarbonization measures listed.

# Decarbonization Benefits

## Emissions Goals and Benchmarking

Boston's Building Emissions Reduction and Disclosure Ordinance (BERDO) applies to large existing buildings in the city and, outside Boston, serves as a useful benchmark for owners to proactively align upgrades with statewide goals. As Massachusetts targets net-zero emissions by 2050, similar policies may be adopted statewide. Achieving "zero" depends on the pace of statewide renewable energy adoption, with any remaining gaps addressed through RECs or clean electricity aggregation programs.




Future grid emission projections are based on BERDO Version 2.3 emission factors, which the City of Boston reassesses every five years.

## Resiliency Considerations

The facility is outside current FEMA flood zones but within areas identified on MassDOT's coastal flood risk maps. Given the increasing risk of intense rainfall and extreme weather, a climate vulnerability assessment is recommended, including floodproofing of ground-level equipment such as electrical service, generators, and other energy systems. Future peak load reduction measures, such as on-site battery storage, could also improve resilience.

## Next Steps and Best Practices

There are many potential strategies to reduce the operational GHG emissions of buildings. As a starting point, owners are encouraged to have a solid understanding of base building information, including current energy use, carbon emissions, and long-term property goals through 2050. The data and scoping developed through this assessment can be used by design teams, including architects and engineers, to begin shaping project plans and construction timelines, while also strengthening financing strategies and incentive applications. To move from assessment to action and ensure a clear, strategic path toward decarbonization, the following next steps are recommended.

- [x] Existing building conditions
- [x] Decarbonization assessment
- [ ] Supplemental assessments
  - Thermal stress test for hot water infrastructure
  - Evaluation of existing electrical infrastructure
- [ ] Emergency protocols
- [ ] Assemble project team
- [ ] Structure financing stack