Fulton Street Condominiums

Building Performance Exchange

MASS CLEAN ENERGY CENTER

This case study is part of the MassCEC Building Electrification and Transformation Accelerator (BETA): Project Planning program, committed to helping a representative selection of commercial building types in Massachusetts reach net zero emissions by 2050. This MassCEC funded resource and more are available via the Building Performance Exchange.

Building type	Multifamily housing
Location	Boston
Year built	1850
Stories	7
Square footage	54,639
Energy use intensity (EUI)*	40.3 kBtu/sf/yr
Carbon emission intensity (CEI)*	2.0 CO2e kg/sf/yr
Decarbonization goals	BERDO regulatory compliance, eliminate gas piping, utility cost savings

This multifamily building was built in 1850 and renovated into condos in 1978. The building enclosure is in good condition, and the windows maintain aesthetic significance. During 2012 HVAC renovations, the central boiler/cooling tower plant was installed. This plant serves in-unit water source heat pumps (WSHPs) of varying ages, the DHW system, and hallway air handling unit (AHU), at various temperatures. Units are individually owned and controlled, and the site has various space constraints for further mechanical equipment.

Existing Conditions

Enclosure	**Walls**	**Roof**	**Windows**
	Fair	Good	Fair
Heating	Central boiler system servings hallway AHU and in-unit water source heat pumps (WSHPs)		
Cooling	Central cooling tower serves in-unit WSHPs		
Ventilation	Hot water heating-only AHU serves hallways		
Hot water	Central boiler serves medium temperature water for DHW loads with storage tanks		
Lighting	Majority LED lighting		
Controls	In-unit thermostat controls		
Other	Various units have gas stoves, gas fireplaces, or in-unit gas dryers		
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

Condo ownership reduces ability to carry out large projects at once

Phase installation of measures starting with cost effective efficiency elements then move towards systems under individual ownership like condo units

Limited rooftop and ground space

Site solutions that only utilize current equipment footprint and infrastructure

Multiple fluid temperatures required to heat building and hot water

Decouple current hydronic piping based on temperature needs to enable conversions when equipment reaches end of life.

Core Decarbonization Strategy

- Existing WSHP terminal units creates an opportunity to maintain existing hydronic space heating infrastructure due to low water temperatures
- Upgrade skylight and roof to minimize heat loss while upgrading the windows with thermal windows to maintain historical integrity

Retrofit Measures and Energy Impacts

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Measures

Energy Efficiency & Load Reduction

Foundational Efficiency and Load Reduction:
- LED lighting upgrade
- Interior thermal windows

Advanced Load Reduction:
- Triple-pane, low-e skylight upgrade
- White roof installation

System Electrification

Electrification Enablers: Condo electrical panel upgrade

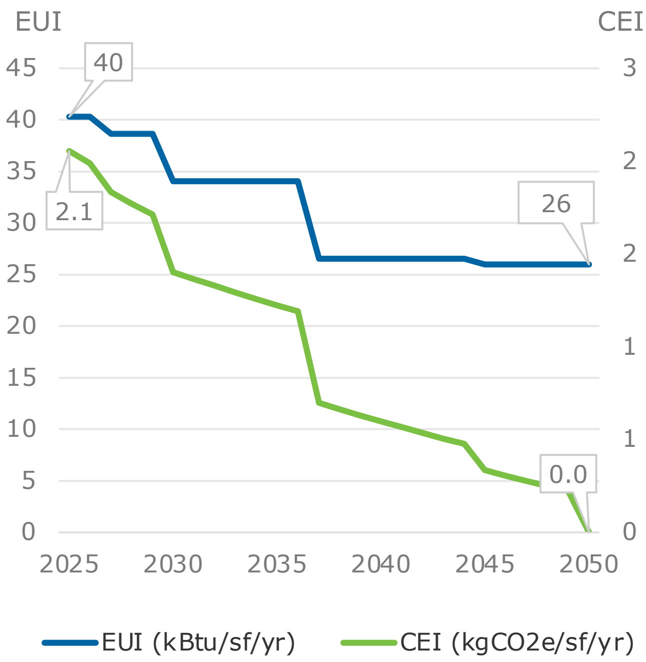
System Electrification:
- Air-to-water heat pump (AWHP) system (glycol low water temperature (LWT) replacing hot water coil)
- Heat pump DHW (decoupled)
- Electric in-unit appliances

Renewable Energy

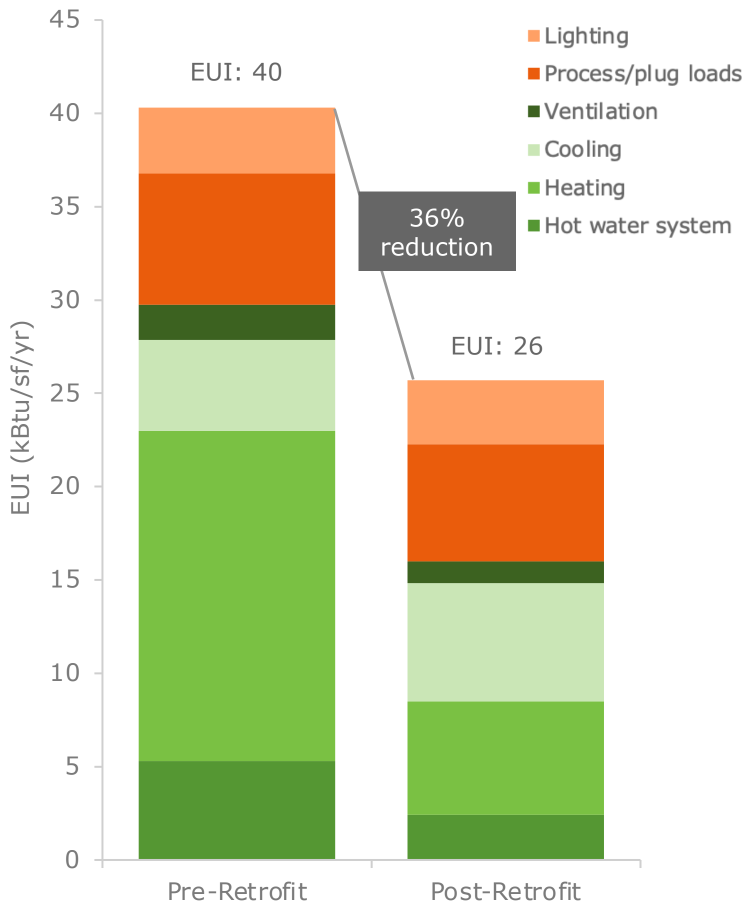
Electric Vehicle (EV) Charging:
- Install EV charging station for residents

Performance Targets

The decarbonization approach prioritizes phased, cost-effective efficiency and envelope upgrades, maintains existing low-temperature hydronic systems, and plans for end-of-life equipment conversion within existing space and ownership constraints. 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

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 on-site renewables. Key considerations or triggers are listed along a timeline to support informed decision-making, with bolded dates indicating recommended implementation years.

Triggers	Order of Implementation	Cumulative Carbon Reduction Potential*
	LED Lighting Upgrade	
Window upgrades may trigger ventilation requirements	**Interior Thermal Windows** Add/upgrade thermal windows on front facing facade	
	Triple-Pane Skylight Installation	
2027: Energy efficiency and load reduction upgrades are recommended prior to major system electrification	**White Roof Installation**	15%
2030: End of service life for existing hallway ventilation equipment	**LWT Glycol Coil** Replace hot water coil in hallway AHU for AWHP integration	
2032**:** End of service life for existing DHW heater equipment	**DHW Electrification** Decouple DHW from boiler system and install heat pump DHW heater	
	Electric Infrastructure Panel Upgrade Upgrade electrical for mechanical system electrification	26%
2032: End of useful life of existing boiler and cooling tower **2035**: HVAC is fully electrified	**AWHP System** Replace central cooling tower and boiler system serving existing in-unit WSHP and new LWT AHU	39%
2045: Appliance improvements are not time dependent and may be based on the end-of-life of systems	**Appliance Electrification** Upgrade in-unit gas appliances with electric units	
	EV Charging Station Install EV charging station for residents	68%

Zero on-site fossil fuel combustion
(With the exception of 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.

Annual Utility Impacts

Measure description	Changes in annual utility costs		
	Electricity	Fossil fuel	Net total changes
Lighting	($300)	-	($300)
Process/plug loads	$6,800	($2,000)	$4,800
Ventilation	($2,700)	-	($2,700)
Cooling	$5,600	-	$5,600
Heating	$1,100	($9,500)	($8,400)
Hot water system	$9,000	($4,200)	$4,800
Total from recommended measures	**$19,500**	**($15,700)**	**$3,800**

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	$96,000	$63,000	Foundational efficiency and load reduction
		$77,000	Advanced load reduction
Mechanical costs	$284,000	$129,000	Electrification enablers
		$468,000	System electrification
Renewable energy costs	$0	$15,000	Renewable energy
Soft costs	$38,000	$67,000	
Total upfront costs	**$418,000**	**$819,000**	
Utility incentive opportunities	$0	($132,000)	
25-year total accrued utility costs	$3,567,000	$3,586,000	
25-year accrued total operating costs	$5,494,000	$5,514,000	
25-year LCCA	**$5,912,000**	**$6,201,000**	

BAU scope:

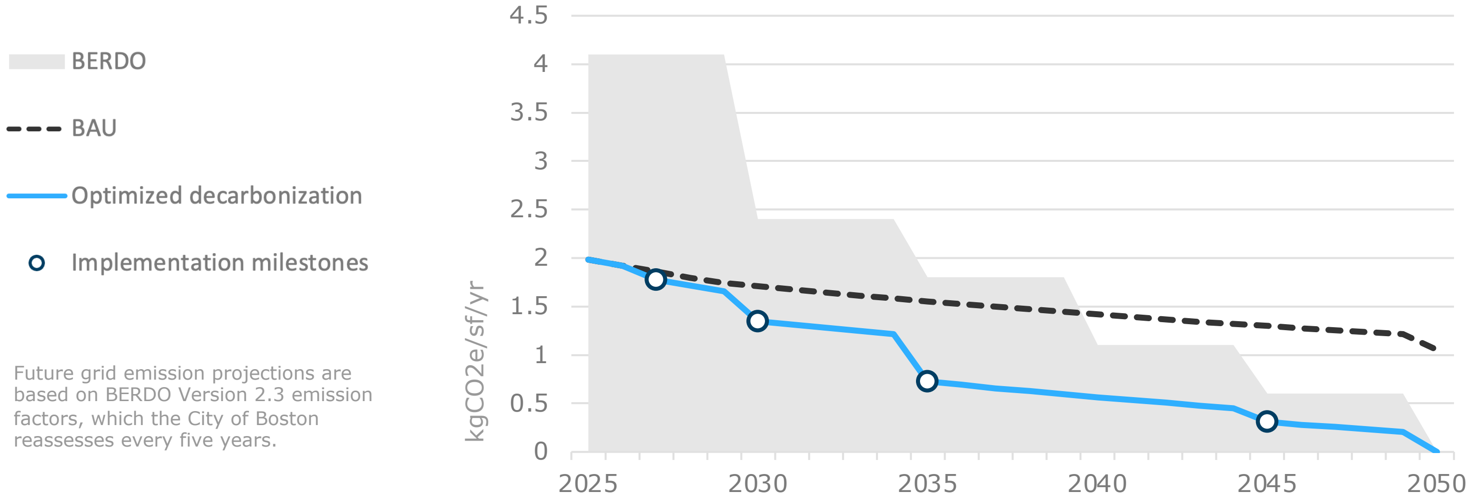
- Lighting replacement
- Window replacement
- Boiler replacement
- Cooling tower replacement
- Double-pane skylight replacement
- Gas appliance replacement (dryer, fireplace, cooktop)

*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 site is located outside of, but relatively close to, the current FEMA flooding zones (North End Waterfront). Considering the potential for intense weather events, including extreme rainfall in short time frames, a climate change vulnerability assessment is recommended, including flood proofing measures for the site and facility, such as the elevation of electrical service, generator, and other energy systems equipment located at ground level. Outside of flooding, Suffolk County is indicated as "Relatively moderate" level of overall risk from FEMA's National Risk Index.


Rooftop space and skylights.

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
    - Climate vulnerability assessment
- [ ] Emergency protocols
- [ ] Assemble project team
- [ ] Structure financing stack