MASSACHUSETTS CLEAN ENERGY CENTER

Hathaway Mills

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	Manufacturing/industrial
Location	New Bedford
Year built	1910
Stories	3
Square footage	357,921
Energy use intensity (EUI)*	22 kBtu/sf/yr
Carbon emission intensity (CEI)*	1.2 CO_2e kg/sf/yr
Decarbonization goals	Eliminate natural gas usage, reduce utility costs, end-of-life equipment replacement

The building was constructed in 1910, with administrative areas renovated and windows upgraded in 2001. The facility includes limited manufacturing space, with most areas used for storage or inactive former manufacturing space.

Existing Conditions

Enclosure	**Walls**	**Roof**	**Windows**
	Poor	Poor	Poor
Heating	Gas-fired steam boilers with fan coil units (FCUs) and gas fired unit heaters. Small amount of electric baseboard heating		
Cooling	Direct expansion (DX) cooling from rooftop units in select areas		
Ventilation	Ventilation is supplied by rooftop units (RTUs) and infiltration		
Hot water	Minimal use electric storage domestic hot water (DHW) heater for hand washing		
Lighting	95% LED lighting with about 10% controlled with occupancy		
Controls	None		
Other	Production equipment in tenant spaces		
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

Variation in space use, including some underutilized areas

Phased approach which starts with foundational efficiency serving entire building then focused on transitioning spaces to heat pumps with high occupancy first

Limited solar potential due to aging roof

A structural assessment of the roof will be required to confirm it can support the additional loads from a solar PV array, including existing and snow loads

Aging electrical structure

Align required updates with mechanical system retrofits. Electrical service upgrades to be evaluated by a licensed electrical engineer

Core Decarbonization Strategy

- Focus on energy efficiency needs first including controls which can reduce demands across entire building when use is limited
- Install all-electric heating and cooling heat pump system in phased sections with hybrid gas backup heating
- Install 850kW rooftop solar PV system to offset increased electric usage

Retrofit Measures and Energy Impacts

MASSACHUSETTS CLEAN ENERGY CENTER

Measures

Energy Efficiency & Load Reduction

Foundational Efficiency and Load Reduction:

- LED lighting
- Setback temperatures
- Demand control ventilation (DCV) installation
- Exhaust fan controls
- Dual enthalpy controls on existing cooling RTUs
- Steam trap repair and compressed air leak repair
- Door weatherstripping

Advanced Load Reduction:

- Roof insulation
- White roof installation

System Electrification

Electrification Enablers:

- Structural roof assessment
- Existing service capacity to be evaluated

System Electrification:

- RTU to heat pump RTU
- Electric storage DHW to heat pump DHW
- Phased air source heat pump (ASHP) installation with gas boiler backup heating

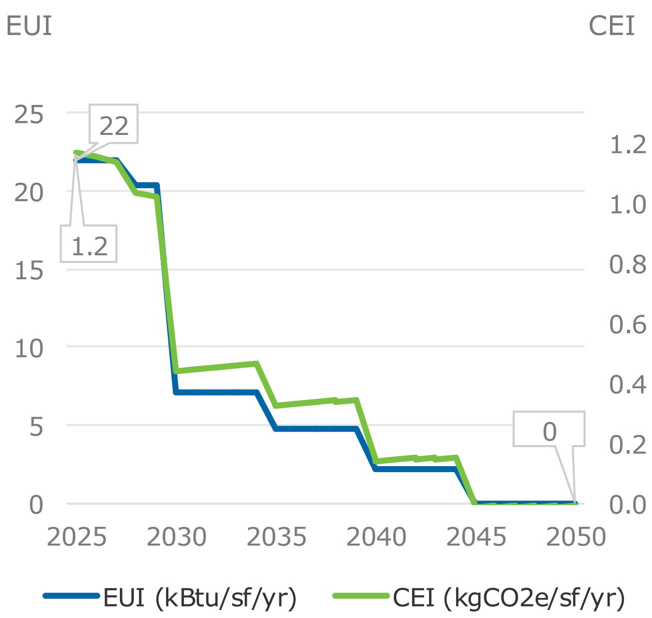
Renewable Energy

Solar:

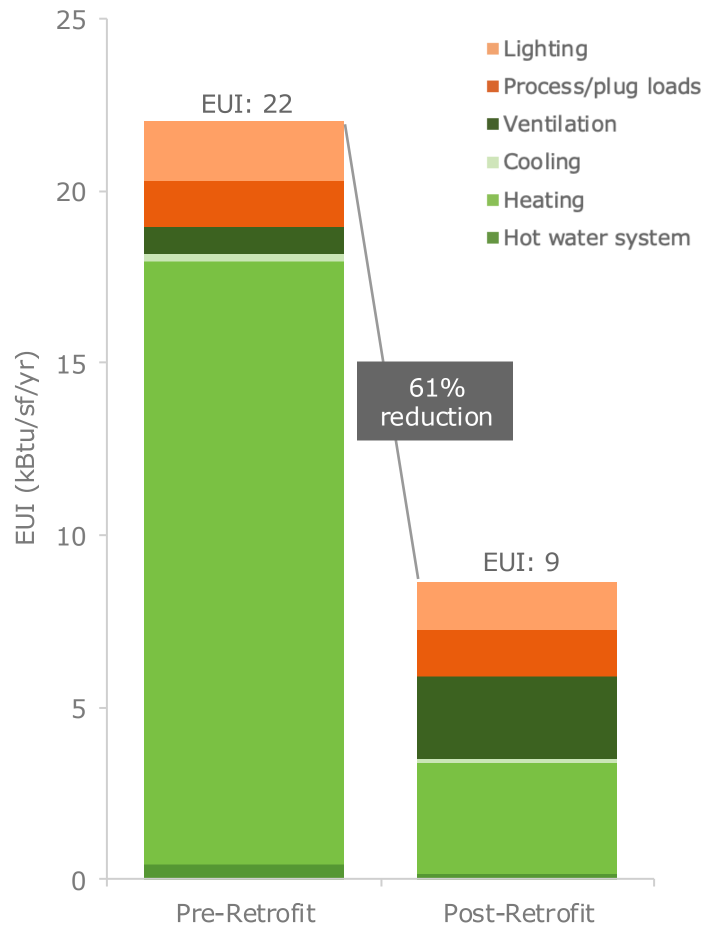
- Install ~850 kW rooftop solar PV array

Performance Targets

The decarbonization approach prioritizes installing an all-electric heating and cooling system in phased sections with hybrid gas backup heating. This includes installation of rooftop solar PV system to offset increased usage. 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

MASSACHUSETTS CLEAN ENERGY CENTER

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

Foundational efficiency improvements are not time dependent and may be based on the end-of-life of systems

2030: Existing roof is past useful life. Align roof replacement with solar PV array and heat pump RTU installation

Solar system generation will help offset heat pump usage

2033-2035: Renewable energy tax credits from the IRA expires

2035: DHW heater installation is not dependent on other systems and can be installed independent of other measures

2040: Phased installation of ASHPs allows site to install as existing equipment reaches end of life or to serve high use spaces

Order of Implementation

Cumulative Carbon Reduction Potential*

Setback Temperature
Outdoor air temperature reset on boiler

DCV System in RTUS

Dual Enthalpy & Exhaust Fan Controls

LED Lighting

Steam Trap Repair & Compressed Air Leak Repair

Door Weatherstripping

→ 6%

Roof Replacement
Install additional insulation and white roof membrane

Rooftop Solar PV System
Install ~850 kW solar PV array

Electrical Switchgear Update

Heat Pump RTUs
Replace RTUs (6) with heat pump RTUs

Phase 1 ASHP Installation
Install ASHPs to select tenant spaces with hybrid backup boiler heating

→ 37%

DHW Electrification
Replace DHW system with heat pump DHW heater

Phase 2 ASHP Installation
Install ASHPs in 3rd floor production area (with hybrid backup boiler heating) & Building 33

→ 55%

Phase 3 ASHP Installation
Install full load ASHPs in remaining (storage) spaces

Full HVAC Transition Off Backup Heat
Transition Ph.1 & Ph.2 ASHPs off hybrid backup boiler heating to fully electric operation

Decommission Boiler

→ 98%

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	Net total changes
Lighting	($7,800)	-	($7,800)
Process/plug loads	-	-	-
Ventilation	$36,800	-	$36,800
Cooling	($3,300)	-	($3,300)
Heating	$58,700	($79,300)	($20,600)
Hot water system	($6,600)	-	($6,600)
Total from recommended measures	**$77,800**	**($79,300)**	**($1,500)**
Renewable energy	($210,300)	-	($210,300)

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	$774,000	$39,000	Foundational efficiency and load reduction
		$1,168,000	Advanced load reduction
Mechanical costs	$1,552,000	$500,000	Electrification enablers
		$6,908,000	System electrification
Renewable energy costs	$0	$2,550,000	Renewable energy
Soft costs	$233,000	$1,117,000	
Total upfront costs	**$2,559,000**	**$12,282,000**	
Utility incentive opportunities	$0	$1,821,000	
25-year total accrued utility costs	$7,675,000	$973,000	
25-year accrued total operating costs	$10,686,000	$3,671,000	
25-year LCCA	**$13,245,000**	**$14,132,000**	

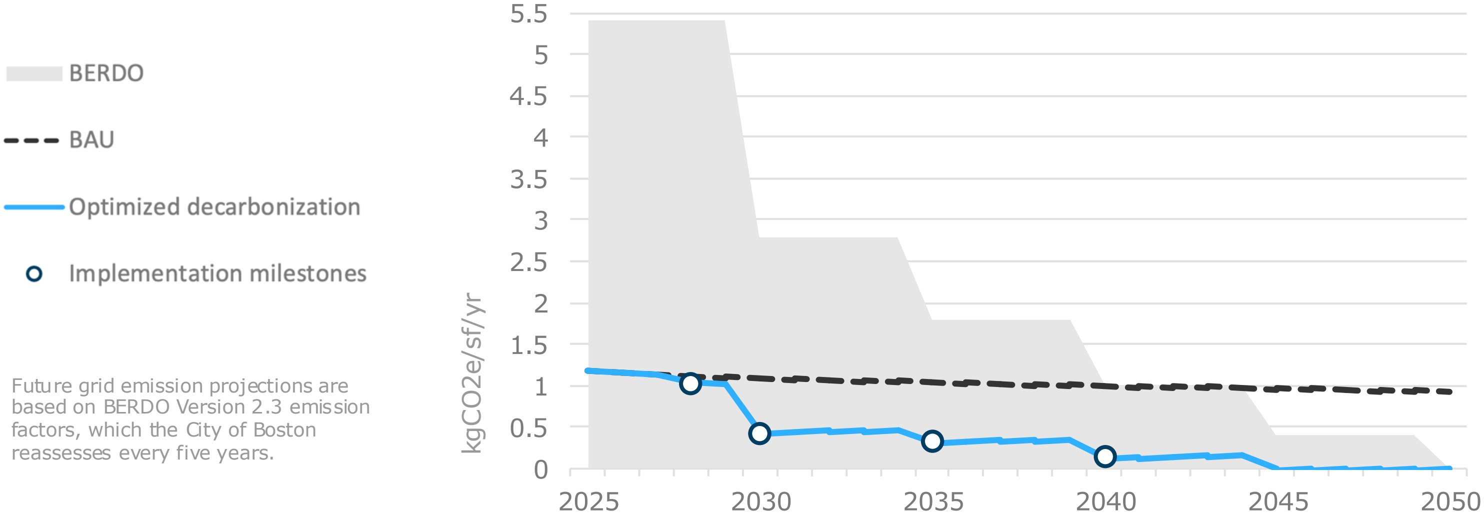
BAU scope:
- Roof replacement
- RTU replacement
- Boiler replacement
- 30-gal electric water heater replacement
- 6-gal electric water heater replacement
- LED lighting upgrade completion
- Furnace replacement
- Air handling unit replacement

*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

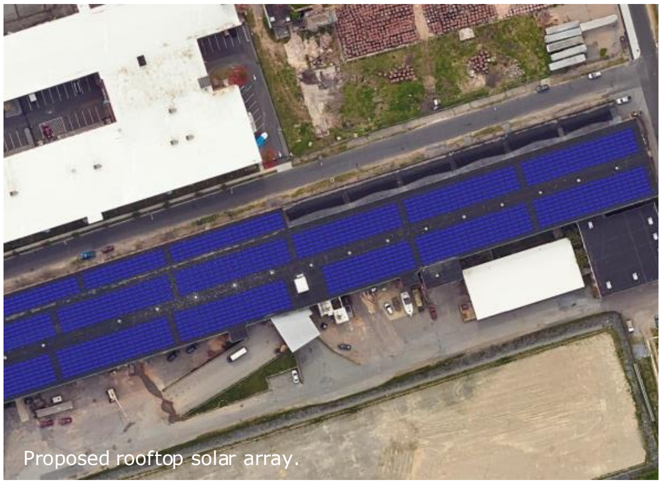
Boston's Building Emissions Reduction and Disclosure Ordinance (BERDO) applies to large existing buildings in the city and, outside Boston, serves as a useful benchmark for owners to proactively align upgrades with statewide goals. As Massachusetts targets net-zero emissions by 2050, similar policies 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 in an area with reduced flood risk due to levee protection; however, adjacent portions of the property remain within higher-risk flood zones subject to 1% annual chance coastal flooding and storm surge impacts, indicating continued need for flood resilience considerations for equipment siting and insurance. Future climate conditions are projected to impact building electric use, with an estimated 5% reduction. Future solar PV installation (with battery storage) on site may be a consideration for additional resiliency.



Proposed rooftop solar array.

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
  - Structural roof assessment
  - Existing service capacity evaluation
- [ ] Emergency protocols
- [ ] Assemble project team
- [ ] Structure financing stack