Envision Hotel

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	Lodging
Location	Mansfield
Year built	1979
Stories	3
Square footage	209,097
Energy use intensity (EUI)*	83.5 kBtu/sf/yr
Carbon emission intensity (CEI)*	4.4 CO_2e kg/sf/yr
Decarbonization goals	Eliminate natural gas, reduce utility costs, improve thermal comfort

The hotel was constructed in 1979 and underwent renovations in 2001. The building includes 202 guest rooms and offers a range of amenities, including in-house laundry, a restaurant with a full-service commercial kitchen, an indoor pool, and multiple event spaces.

Existing Conditions

	Walls	Roof	Windows
Enclosure	Poor	Good	Fair

Heating	Gas heating from rooftop units (RTUs), packaged terminal air conditioners (PTACs) with electric heat for exterior guest rooms, boiler serves interior guest rooms
Cooling	Direct expansion (DX) cooling from RTUs, PTAC cooling for exterior guest rooms, chiller serves interior guest rooms
Ventilation	RTUs support ventilation
Hot water	Various gas-fired domestic hot water (DHW) heaters for different uses
Lighting	90% LED lighting
Controls	Standalone programmable thermostats
Other	Full commercial kitchen with gas appliances, full commercial laundry with 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

Focus on quick-payback measures has delayed major upgrades

Electrification should be integrated into the end-of-life equipment replacement schedule while continuing to pursue near-term, cost-effective improvements

Aging electrical infrastructure

Electrical infrastructure should be evaluated by a licensed electrical engineer before or as part of electrification efforts

Roof nearing the end of its useful life

A structural assessment will be required to ensure the roof structure can support the addition of a solar PV system

Core Decarbonization Strategy

- Reduce baseline energy use through controls, HVAC optimization, and targeted envelope upgrades
- Replace fossil-fuel systems with high-efficiency electric heat pump technologies
- Offset remaining energy loads with on-site solar and battery storage.

Retrofit Measures and Energy Impacts

Measures

Energy Efficiency & Load Reduction

Foundational Efficiency and Load Reduction:
- Demand control ventilation (DCV), occupancy controls, HVAC setbacks
- Variable frequency drive (VFD) pumps and electronically commutated motors (ECMs)
- Low-flow sink fixtures
- Pipe insulation & pool cover
- LED lighting
- Kitchen hood controls

Advanced Load Reduction:
- Window film on S/SW walls
- Single-pane window replacement
- Weatherstripping
- Roof & skylight insulation

System Electrification

Electrification Enablers: Further assessment required

System Electrification:
- Heat pump RTUs
- Heat pump PTACs
- Heat pump pool heater
- Replace chiller/boiler with air-to-water heat pump (AWHP) system
- Heat pump DHW system
- Electric laundry & kitchen appliances

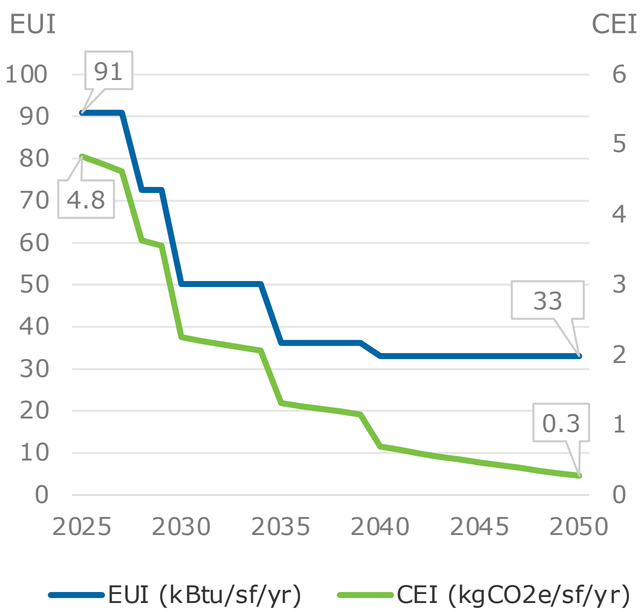
Renewable Energy

Solar:
- Install ~375 kW rooftop solar PV array

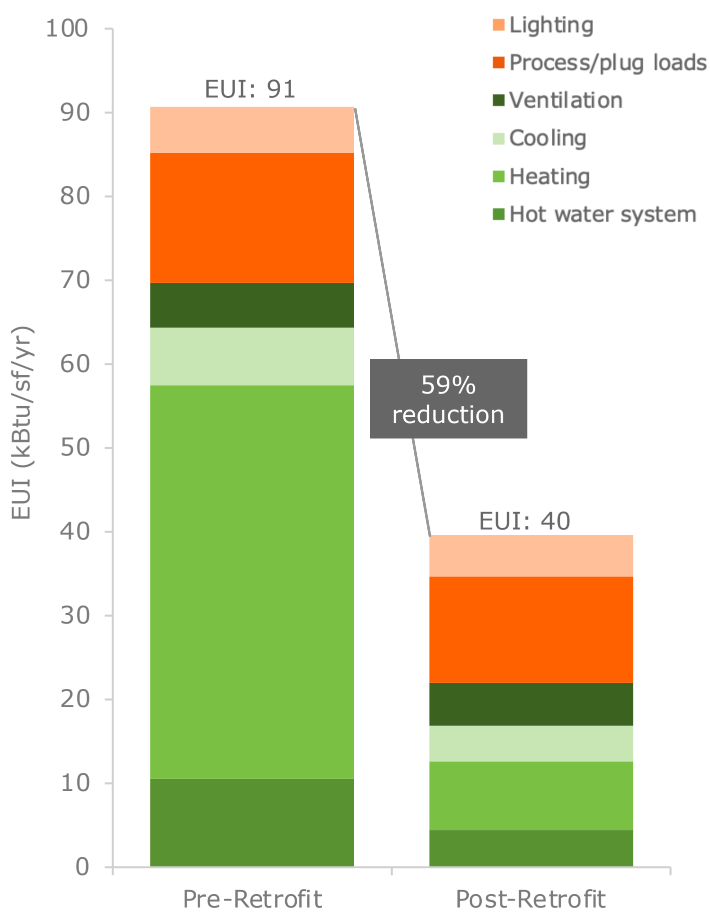
Battery Storage:
- Install ~105 kW battery storage system

Performance Targets

The decarbonization approach prioritizes upfront load reduction and efficiency measures, followed by all-electric heating and cooling systems, with rooftop solar and battery storage to help offset increased electric demand. 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

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

Various foundational measures can be installed by in-house staff to reduce costs such as the pool cover, pipe insulation, window film, weatherstripping, HVAC setbacks, and heat pump PTACs

2030: RTU replacement based on current equipment end-of-life

Solar and battery installation will help to offset large electrification. Peak shaving significantly reduces demand charges

2035: Electrification of water side equipment

2040: Electrification of hard to electrify equipment, ideally after battery installation

Order of Implementation

Cumulative Carbon Reduction Potential*

Sink Faucet Aerators

DCV System & HVAC Setbacks

VFD Pumps/ECM Motors

LED Lighting

Kitchen Hood Controls

Pool Cover

Pipe Insulation

Window Treatments
Install window film on S/SW facing windows, replace single-pane windows in the atrium, and insulate and cover roof skylights

Weatherstripping

Heat Pump PTACs
Phased installation of heat pump PTAC units

25%

Heat Pump RTUs
Replace RTUs with heat pump RTUs with energy recovery ventilators (ERVs)

Electrical Analysis
Assess electrical panel capacity and solar installation feasibility requirements

Solar PV System & Battery Storage
Install rooftop PV system & battery storage to support peak demand management

53%

Heat Pump Chiller Electrification

DHW Electrification

73%

Pool Heater Electrification
Electrify pool heater including dehumidification system

Appliance Electrification
Electrify existing gas equipment in laundry rooms and commercial kitchen

86%

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	($4,600)	-	($4,600)
Process/plug loads	$69,800	($22,600)	$47,200
Ventilation	($2,400)	-	($2,400)
Cooling	($21,400)	-	($21,400)
Heating	$9,900	($81,100)	($72,500)
Hot water system	$43,100	($21,400)	$15,900
Total from recommended measures	**$87,400**	**($125,100)**	**($37,800)**
Renewable energy	($93,100)	-	($93,100)

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	$754,000	$285,000	Foundational efficiency and load reduction
		$776,000	Advanced load reduction
Mechanical costs	$5,275,000	TBD	Electrification enablers
		$5,309,000	System electrification
Renewable energy costs	$0	$1,539,000	Renewable energy
Soft costs	$603,000	$791,000	
Total upfront costs	**$6,632,000**	**$8,700,000**	
Utility incentive opportunities	$0	$1,173,000	
25-year total accrued utility costs	$13,406,000	$9,544,000	
25-year accrued total operating costs	$30,263,000	$26,400,000	
25-year LCCA	**$36,895,000**	**$33,927,000**	

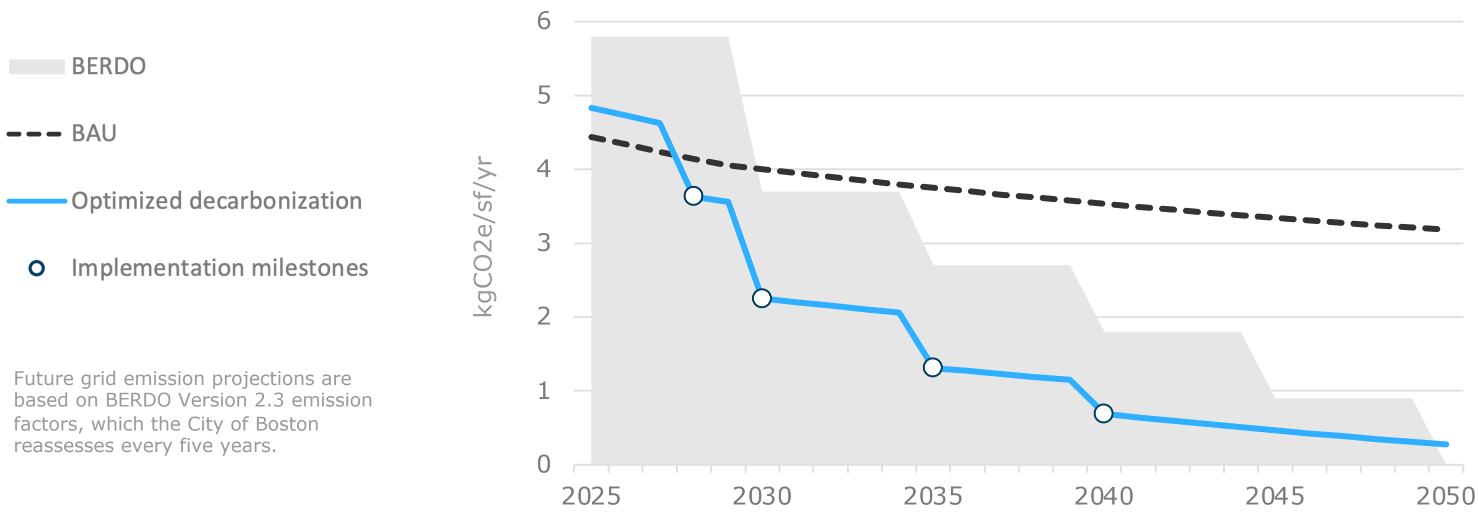
BAU scope:

- Roof replacement
- RTU system replacement
- LED upgrade
- PTAC unit replacement
- Chiller 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.

Emissions Goals and Benchmarking

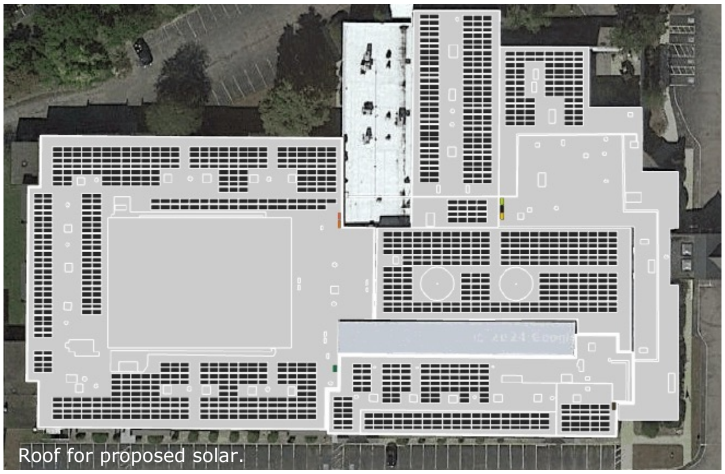
Boston's Building Emissions Reduction and Disclosure Ordinance (BERDO) applies to large existing buildings in the city and, outside Boston, serves as a useful benchmark for owners to proactively align upgrades with statewide goals. As Massachusetts targets net-zero emissions by 2050, similar policies 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

Mansfield sits at a relatively higher elevation than the surrounding area, so future flood risk is expected to remain low. Future weather patterns are likely to affect electricity consumption, system loads, as well as peak demand. As temperatures are projected to rise by 2050, analysis indicates that heating demand could decrease by approximately 6.5%, while cooling loads may increase by about 16.6%. During periods of extreme heat and extreme cold, building enclosure improvements and on-site solar generation are expected to help moderate energy demand.



Roof for proposed solar.

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
- [x] Supplemental assessments
  - Structural roof assessment
- [ ] Emergency protocols
- [ ] Assemble project team
- [ ] Structure financing stack