# The Stationery Factory

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** | Mixed-use |
| **Location** | Dalton |
| **Year built** | 1889 |
| **Stories** | 4 |
| **Square footage** | 108,000 |
| **Energy use intensity (EUI)*** | 35.6 kBtu/sf/yr |
| **Carbon emission intensity (CEI)*** | 1.89 $CO_2e$ kg/sf/yr |
| **Decarbonization goals** | Occupant comfort, lower utility costs |

The original building was manufacturing space but after renovations is split by tenant needs ranging from alcohol distillery, manufacturing, small retail, restaurant, and assembly spaces. Despite the building's age, it is not under any Historical Commission's regulations. The tenant usage is regularly changing but maintains a mix of process and occupant driven loads with decentralized usage throughout.

## Existing Conditions

| | | | |
|---|---|---|---|
| **Enclosure** | **Walls** | **Roof** | **Windows** |
| | Poor | Good | Fair |
| **Heating** | Decentralized system with main areas served by various rooftop units (RTUs), gas heaters, and some split heat pumps in select spaces. | | |
| **Cooling** | Direct expansion (DX) cooling for select areas | | |
| **Ventilation** | Partial building ventilation is supplied by rooftop outdoor air handling units (AHUs). | | |
| **Hot water** | Electric water heaters (7) ranging from 6-80-gal and gas fired water heaters (2) of 40- and 50-gal all for domestic water heating or kitchen needs. | | |
| **Lighting** | LED lighting throughout | | |
| **Controls** | Minimal | | |
| **Other** | Full commercial kitchen with gas appliances.<br>Gas fired brewery and gas fired distillery | | |
| **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 tenant variability/turn over

Maintain zone based decentralized HVAC system to best serve current tenants

Varied equipment ages

Phased equipment upgrades to align with end of useful life and optimize limited budget

Limited building resiliency

Install battery storage and rooftop solar to reduce utility bills and increase resiliency and building independence

## Core Decarbonization Strategy

- Maintain decentralized equipment aligned with space use type and needs allowing for easy tenant changeouts and limited disruption
- New equipment installation staged to align with system end-of-life and spread upfront costs over time
- Use large available roof space to install solar PV array and increase functionality with battery storage

# Retrofit Measures and Energy Impacts

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## Measures

### Energy Efficiency & Load Reduction

**Foundational Efficiency and Load Reduction:**

- Lighting controls upgrade
- Demand control ventilation (DCV)
- Kitchen hood controls
- Single-pane window replacement

### System Electrification

**Electrification Enablers:**
Existing service capacity to be evaluated

**System Electrification:**

- Electrified HVAC system: Heat pump RTUs & split heat pumps
- Electric process boiler
- Kitchen electrification
- Heat pump DHW system

### Renewable Energy

**Solar:**

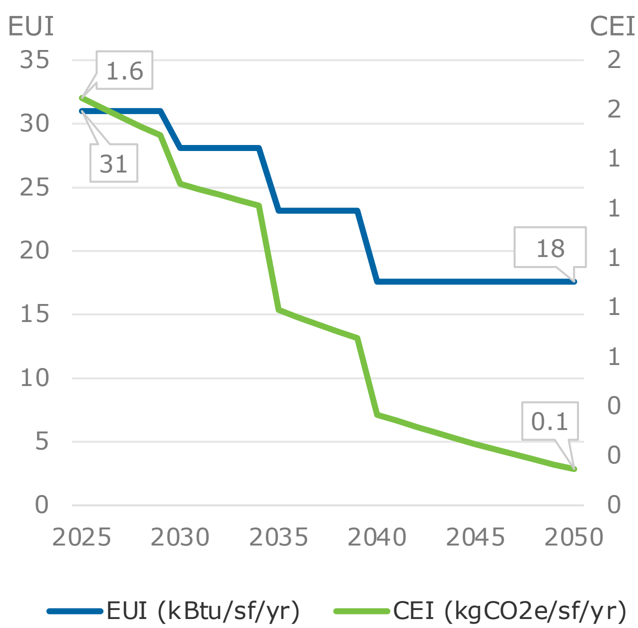
- Install solar PV array on open roof space

**Battery Storage:**

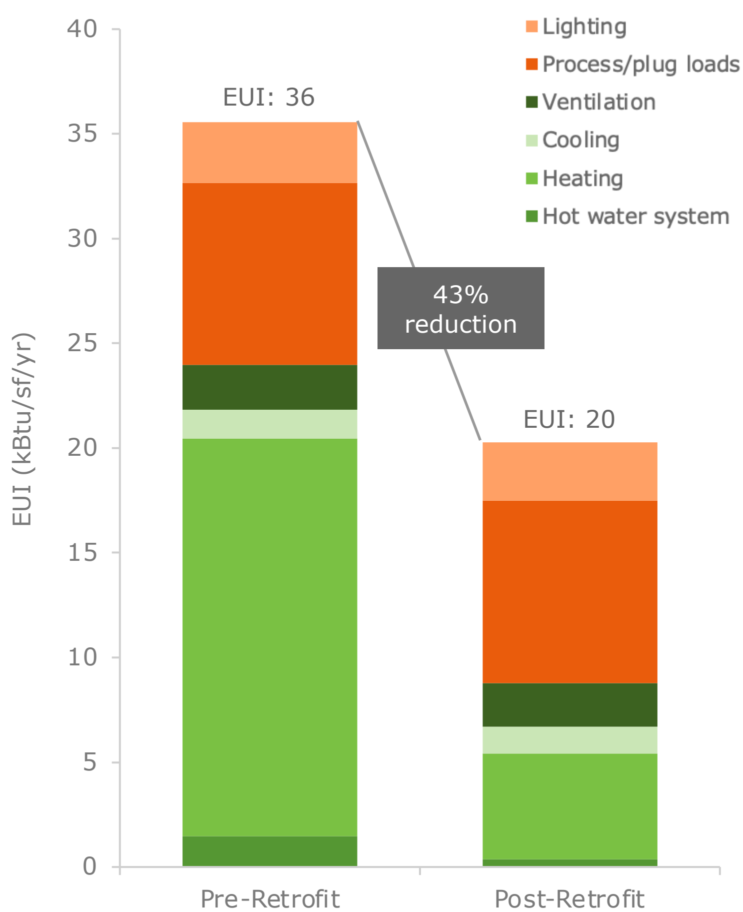
- Install battery storage solution for load shifting

## Performance Targets

The decarbonization approach prioritizes maintaining decentralized systems aligned with tenant needs, staging equipment replacement at end-of-life to reduce disruption and distribute costs and utilizing available roof space for solar PV and future battery storage. These efforts would yield the following results over time:




## Annual Energy Use Impacts*

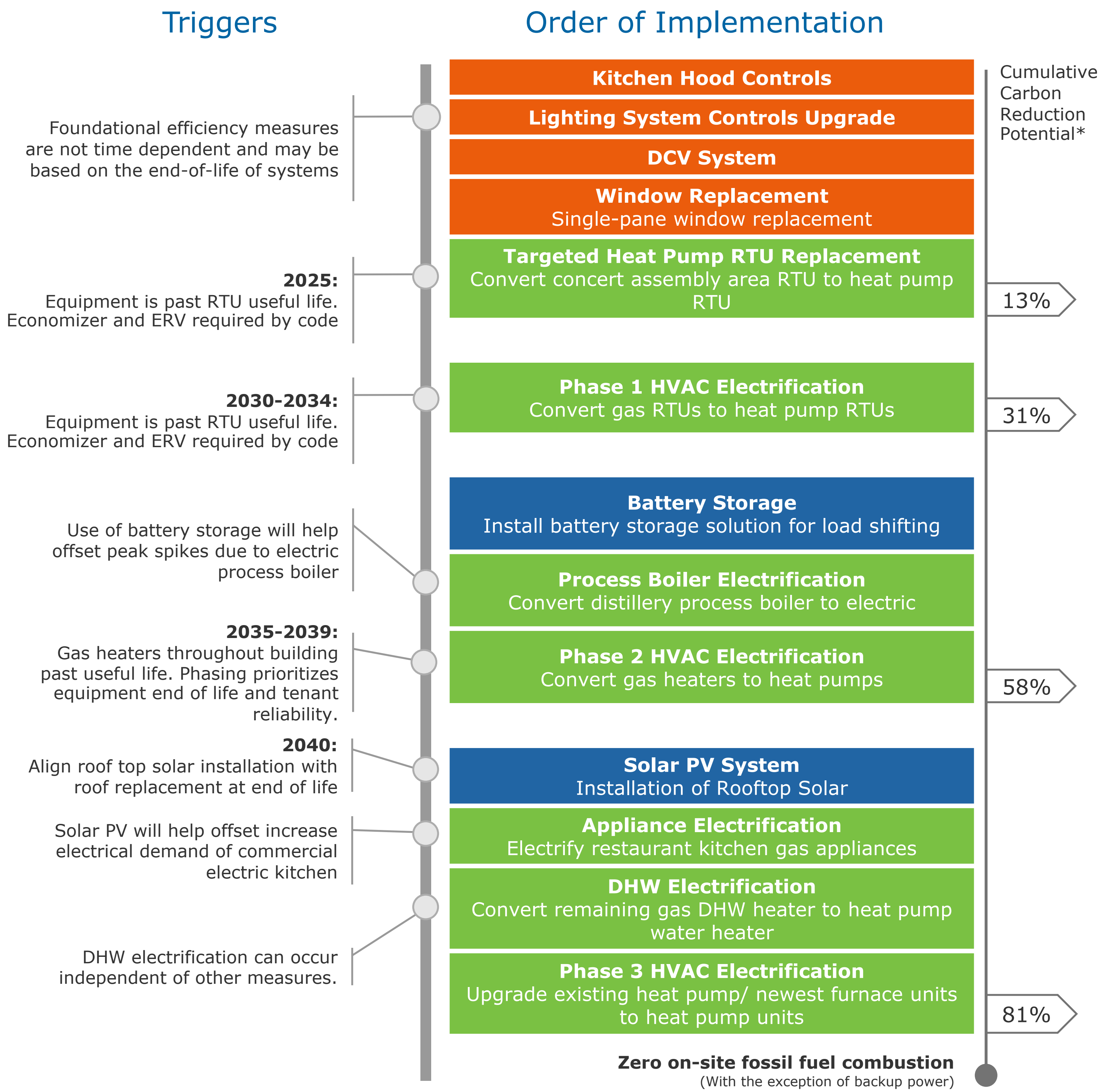



*The annual energy use impacts graphic illustrates an EUI before and after once all recommended measures are implemented, except for any renewable energy. The CEI and EUI shown in the performance targets account for the added benefits of renewable energy.

# 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.




*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 | ($900) | - | ($900) |
| Process/plug loads | $35,400 | ($8,500) | $26,900 |
| Ventilation | ($200) | - | ($200) |
| Cooling | ($400) | - | ($400) |
| Heating | $24,600 | ($25,500) | ($900) |
| Hot water system | $600 | ($1,700) | ($1,100) |
| Total from recommended measures | **$59,100** | **($35,700)** | **$23,400** |
| Renewable energy | ($15,700) | - | ($15,700) |

## 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 | $9,000 | $82,000 | Foundational efficiency and load reduction |
| | | $0 | Advanced load reduction |
| Mechanical costs | $925,000 | $0 | Electrification enablers |
| | | $1,238,000 | System electrification |
| Renewable energy costs | $0 | $225,000 | Renewable energy |
| Soft costs | $93,000 | $154,000 | |
| **Total upfront costs** | **$1,027,000** | **$1,699,000** | |
| Utility incentive opportunities | $0 | $514,000 | |
| 25-year total accrued utility costs | $3,510,000 | $3,920,000 | |
| 25-year accrued total operating costs | $11,665,000 | $11,958,000 | |
| **25-year LCCA** | **$12,692,000** | **$14,171,000** | |

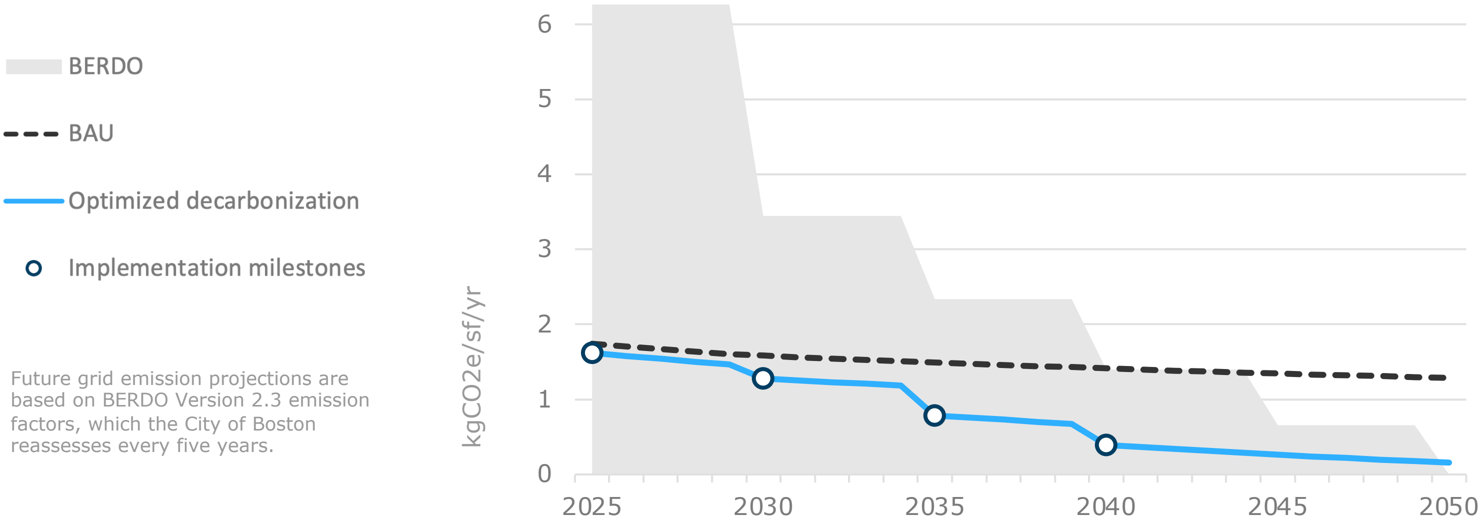
**BAU scope:**

- Gas furnaces
- Gas water heaters
- Gas kitchen appliances
- Gas rooftop units
- Lighting installation
- Ductless ASHP where already installed
- Process steam boilers 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

The building is located outside of the current FEMA flooding zones. Berkshire County overall has future potential for intense weather events though it is designated as "Relatively Low" risk by FEMA compared to other counties nationally. There is Relatively Moderate risk for ice storms, landslides, lightning, and riverine flooding. The site noted flooding issues due to building design, and this should be taken into consideration when designing equipment location. This risk can apply to the electrical service, generator, and other energy systems equipment located at ground level. Solar installation and battery storage will help build site operation resiliency.


## 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