Thornton Tomasetti

Project

Building Decarbonization Advisor Program (BDAP)
Zero-Over-Time (ZOT) Plan

Prepared For

Prepared By

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On Behalf Of

Environment Department
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APPENDICES

Revision History:

Revision	Date	Document Ref.	Comments
Rev 0	10/14/2025	2025.10.14_ZOT Plan_ .docx	Draft report
Rev 1	10/27/2025	2025.10.27_ZOT Plan_ .docx	Draft report
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1.00 EXECUTIVE SUMMARY

The City of Boston's Building Emissions Reduction and Disclosure (BERDO) is a local law that aims to reduce air pollution and greenhouse gas (GHG) emissions generated by large buildings in Boston. Owners of buildings subject to BERDO are required to report their buildings' annual energy and water consumption. Starting in either 2025 or 2030, depending on the building size, they will also need to comply with building emissions standards (limits). The emissions standards set by BERDO decrease over time, with all buildings expected to reach net-zero emissions by 2050.[1]

This Zero-Over-Time (ZOT) Plan provides a long-term decarbonization strategy for the following property:

- ; sf)

The emissions standard for this building is based on the building type per the BERDO emissions compliance table, given in kilograms of carbon dioxide equivalent per square foot ($kgCO_2e/sf$).[2] Because is a non-residential site between 20,000 – 34,999 sf, emissions compliance begins in 2030. Additionally, because the property has more than one primary use type that occupy 10% or more of the total square footage, the site is eligible for a blended emissions standard.[3]

	2030-2034	2035-2039	2040-2044	2045-2049	2050+
	4.2	3.2	2.1	1.1	0

BERDO Blended Emissions Standard in $kgCO_2e/sf$ for with Office (86%) and Food Sales & Service (14%) use types.

Multiplying the emissions standard by the floor area of the site gives the emissions limit. This is then compared to the GHG emissions from natural gas and electricity use to see if the building stays below the limit over time. If building emissions are greater than the limit, action must be taken to maintain BERDO compliance. Baseline analysis shows that will exceed the emissions limit from 2040 onward.

To maintain compliance, building owners may choose to reduce emissions through energy conservation measures (ECMs), obtain renewable energy, or make alternative compliance payments (ACPs). ACPs are payments to the Equitable Emissions Investment Fund, a program designed to support decarbonization across environmental justice populations and communities in Boston, at a rate of $234 per year per 1,000 $kgCO_2e$ above the emissions limit.[4] The following table shows the ACPs that would have to consider making under a business-as-usual (BAU) case where no ECMs are completed.

business-as-usual ACPs (assumes no energy conservation).

Target Year	Emissions Over Limit ($kgCO_2e$ per year)	Annual ACP ($ per year)
2030 – 34	-35,788	$0
2035 – 39	-15,653	$0
2040 – 44	4,437	$1,038
2045 – 49	26,460	$6,192
2050+	49,662	$11,621

Note: Totals may not sum due to rounding. Negative values mean below the limit.

[1] BERDO 101 Quick Guide: https://www.boston.gov/sites/default/files/berdo/BERDO_Basics.pdf
[2] BERDO Emissions Compliance: https://www.boston.gov/sites/default/files/berdo/BERDO_EmissionsCompliance.pdf
[3] BERDO Flexibility Measures: https://www.boston.gov/sites/default/files/berdo/BERDO_FlexibilityMeasures.pdf
[4] Equitable Emissions Investment Fund: https://www.boston.gov/departments/environment/equitable-emissions-investment-fund

This ZOT Plan focuses on the ECMs available to directly reduce energy use and GHG emissions, creating a path to zero at both facilities that can reduce or eliminate the ACPs. This is just one of several possible pathways for to reduce emissions – further analysis will be needed to refine the pathway.

Energy conservation measures to decarbonize over time.

Target Year (Complete by)	**ECMs**
2030	Improved air sealing Updated water-to-air heat pumps Retro commissioning (RCx) of all building systems and controls
2035	Air Sealing (Aero Barrier) with Energy Recovery Ventilation HVAC system electrification Skylight repair or removal
2040	Roof upgrade Improved exterior walls and windows
2045	Kitchen electrification
2050	Continue energy efficient operations and track progress

Completing the ECMs on this timeframe may substantially lower the emissions at and help reduce or avoid ACPs.

Emissions impact of energy conservation measures for .

Target Year	**Projected Emissions from Latest Reported Data** ($kgCO_2e/yr$)	**Emissions Limit** ($kgCO_2e/yr$)	**Emissions Reductions from Projects** ($kgCO_2e/yr$)	**Estimated Emissions After Reductions** ($kgCO_2e/yr$)	**Under or Over Emission Limit** ($kgCO_2e/yr$)	**Potential Alternative Compliance Payment with Reductions** ($)
2030-34	87,400	123,200	16,800	70,600	-52,600	$0
2035-39	76,100	91,700	27,700	48,300	-43,400	$0
2040-44	65,800	61,400	28,200	37,600	-23,800	$0
2045-49	57,200	30,700	36,600	20,500	-10,200	$0
2050+	49,700	0	37,500	12,100	12,100	$2,800

Note: Totals may not sum due to rounding. Negative values mean below the limit.

The combined effect of these ECMs is an emission reduction pathway that stays near or below the emissions limits for every five-year period through 2050. Some ACPs may remain at the end due to GHG emissions from electricity, but these emissions can be eliminated by obtaining 100% renewable energy.

2.00 INTRODUCTION

The City of Boston's Building Emissions Reduction and Disclosure (BERDO) is a local law that aims to reduce air pollution and greenhouse gas (GHG) emissions generated by large buildings in Boston. Owners of buildings subject to BERDO are required to report their buildings' annual energy and water consumption. Starting in either 2025 or 2030, depending on the building size, they will also need to comply with building emissions standards (limits). The emissions standards set by BERDO decrease over time, with all buildings expected to reach net-zero emissions by 2050.[5]

The goal of this Zero-Over-Time (ZOT) Plan is to provide a strategic, long-term decarbonization roadmap that is tailored to the building and aligned with the BERDO emission reduction targets. The recommendations in this Plan aim to:

- Improve energy consumption in the building.
- Align the building's operation with BERDO emissions standards over time.
- Create economic and environmental benefits for the building owners and occupants.

2.01 Decarbonization Approach

Decarbonization follows a five-step approach to selecting projects, illustrated in Figure 1.

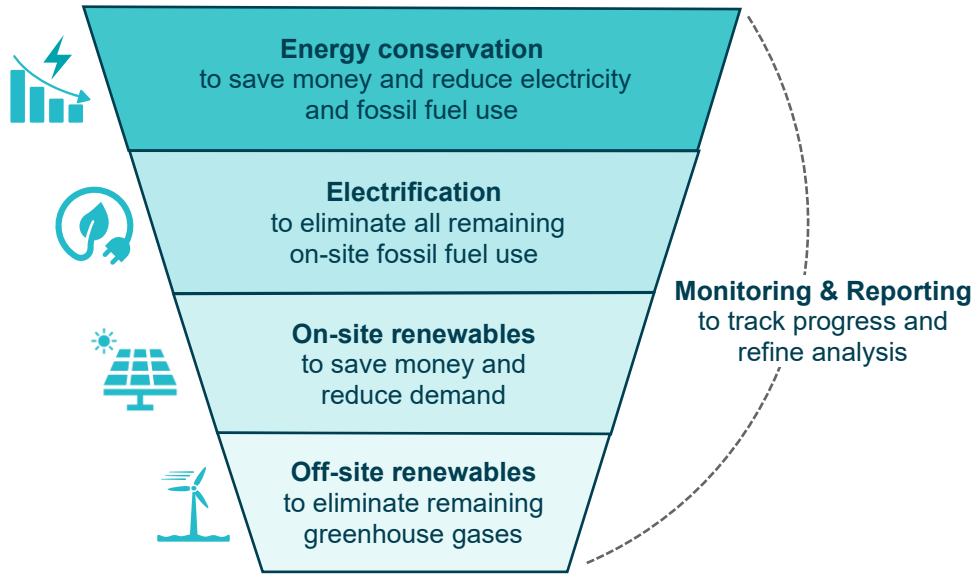

Figure 1: Five-step approach to decarbonizing buildings.

Approaching decarbonization in this way drives success through prioritizing energy savings, reducing Scope 1 emissions, and appropriately sizing carbon-free energy procurement. For any given site, the order of projects may change depending on the needs and constraints of the facility.

[5] BERDO 101 Quick Guide: https://www.boston.gov/sites/default/files/berdo/BERDO_Basics.pdf

2.02 Property Overview

This ZOT Plan considers , a property, summarized in Table 1. The property is described in detail in the following section. Appendix A provides an outline of the property data and documentation provided by to inform the property overview and analysis.

Table 1: property information summary.

Owner	
Building Address	
Floor Area (sf)	Total Office (86%) Restaurant (14%)
BERDO ID	
BERDO Blended Use Types	Office Food Sales & Service
2030 BERDO Emissions Standard (kgCO2e/sf/yr)	4.2
Site EUI (kBtu/sf/yr)	69.9

The site is located at , Boston, MA. The property is six (6) stories. The building was built in the 19th century, originally as two structures that were combined in a prior renovation which results in a split level within each floor. The building exteriors primarily consist of clay brick and stone masonry walls. The buildings consist of office spaces on levels 2-6, a restaurant on the ground floor, and retail in the basement. The total building area is square feet, of which square if office space and is the ground floor Restaurant. Figure 2 shows a photo of from the southeast corner of the site, as viewed from .

Figure 2: Photo of (Source: Daniel Perez, TT).

2.03 Existing Conditions

The following existing conditions summary is based on the documentation provided by . The summary may be subject to inaccuracies due to limitation of the documentation and shall be confirmed by the Owner.

Based on a review of photographs and discussion with , the building appears to be in moderate condition. Table 2 summarizes the current condition of building envelope and energy systems.

Table 2: Existing condition of energy systems at .

Building Envelope	
Walls	The exterior walls consist of red brick and stone masonry construction. The interior side of the exterior walls appear to consist of metal studs with minimal cavity insulation.
Windows	The windows are operable, double-pane, aluminum-framed, and poorly weather-sealed. The windows are in poor condition.
Roof	The roof assembly consists of steel roof deck with then code-compliant insulation (assumed R-15) dating back to roof updates done in 2007.
Skylights	The existing skylights are in poor condition with cracked film and peeling membrane which indicate high thermal losses and possible water intrusion.
HVAC & Domestic Hot Water	
Space Heating & Cooling	The building has a condenser loop served by a boiler and cooling tower. Each floor is provided with 4 water-to-air heat pumps, a total of 28 heat pumps in the building, each providing both space heating and cooling. About 60% of the water-to-air heat pumps have been replaced with newer models in recent years. Each new heat pump is a 4-ton unit from Daikin. The boiler preheats the condenser loop to 70˚F. The boiler dates to the rehabilitation of the building in the 1990s, is in poor condition, and requires frequent maintenance. The cooling tower supplying the condenser loop is located on the roof and rejects heat down to 90˚F during summer months. The cooling tower is also reaching its end-of-life and requires frequent maintenance.
Ventilation & Exhaust	Every floor appears to have fresh air intake from the rear of the building, but the fresh air fan motors appear to be non-operational. It appears that the building is currently only served by natural ventilation and infiltration of fresh air through cracks in the windows and envelope. Exhaust on each floor is provided through the bath fans, 80 cfm in each bathroom. Exhaust for the restaurant kitchen is paired with a make-up air unit located at the rear of the building.
Domestic Hot Water (DHW)	There are small electric storage water heater units above the ceiling on each floor. The massage/nail salon has instantaneous water heaters (208 VAC Commercial electric tankless water heaters). The restaurant has its own electric water heater. The dishwasher in level 5 is supplied by a separate water heater (Eco smart Eco mini 2.5-gallon mini tank water heater).
Controls	Levels 1 through 4 have analogue thermostats. Levels 5 and 6 have been updated to Nest brand thermostats.

Note: Table 2 continued on following page.

Table 2 continued: Existing condition of energy systems at .

Lighting & Equipment	
Facility wide Lighting	Levels 1 and 3 through 6 have been updated to LED lighting. Incandescent bulbs are still in place on Level 2.
Cooking	The restaurant on Level 1 includes a Sunfire gas range with two ovens, as well as two Pitco fryers which may be gas- or electric-powered (to be verified).
On-site Energy Generation	
Rooftop Solar	No rooftop solar or on-site energy generation is in place.
Maintenance	
Facility-wide	Maintenance staff generally keep the facility in good working order. The roof and back of house spaces may require additional maintenance and repair. The roof has stagnant water issues.

3.00 BERDO EMISSIONS COMPLIANCE

The BERDO emissions standards (i.e., limits) are the annual GHG emissions permitted to be released by buildings subject to BERDO. The standards are set in terms of carbon intensity and measured in kilograms of carbon dioxide equivalent per square foot per year ($kgCO_2e/sf/yr$) and vary by building type.[6] As shown in Figure 3, each standard decreases over time, reaching zero emissions by 2050.

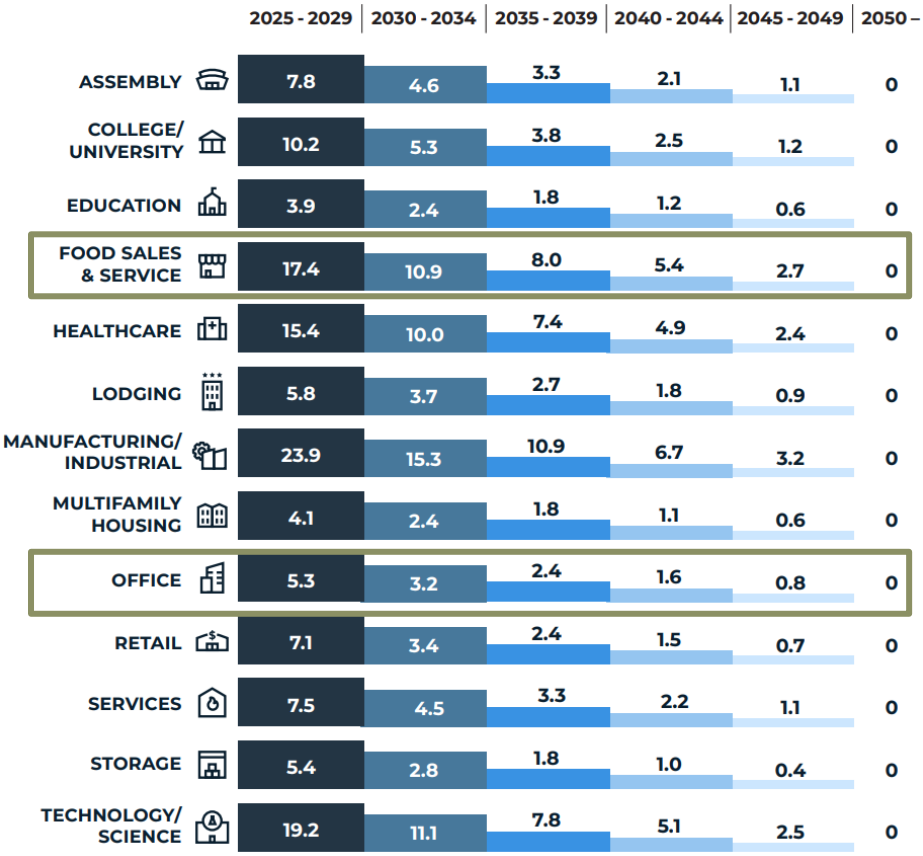

Figure 3: BERDO emissions standard by building type (in $kgCO_2e/sf$), highlighting Office and Food Service & Sales.

To comply with BERDO, total building emissions must stay below the emissions limit. To calculate the emissions limit, the BERDO emissions standard is multiplied by the total floor area of the building. This gives the total emissions limit in $kgCO_2e/yr$ that the building must stay below every year.

To calculate total emissions, building energy use is converted to $kgCO_2e$ using the emissions factors provided in the BERDO Emissions Factor List.[7] This ZOT Plan uses 2024 emissions factors to calculate the emissions of energy used in the building in 2024. The emissions factors used in this analysis are:

- Natural gas emissions factor: **53.11 $kgCO_2e/MMBtu$**
- Calculated electric grid emissions factor: **269 $kgCO_2e/MWh$** in 2024
- Projected electric grid emissions factor: **213 $kgCO_2e/MWh$** in 2030 to **71 $kgCO_2e/MWh$** in 2050

A building complies with BERDO if the total building emissions are less than the emissions limit.

[6] BERDO Emissions Compliance Guide. https://www.boston.gov/sites/default/files/berdo/BERDO_EmissionsCompliance.pdf
[7] BERDO Emissions Factors List: https://docs.google.com/document/d/1bIfWwuPSBevuTFo6T6iQkLYYIybWLdSjPa-JGKDnFeA

3.01 Compliance Mechanisms

Three compliance mechanisms are available to comply with BERDO, summarized in Table 3. Refer to the BERDO Emissions Compliance Guide for more details about the requirements and limitations to these compliance mechanisms.

Table 3: BERDO compliance mechanisms.

Reduce energy use	Reduce the building's overall and direct GHG emissions through building retrofits or improvements. This can include installing more efficient appliances and lighting, replacing fossil fuel using equipment with electric alternatives, improving building envelope, etc.
Obtain renewable energy	Reduce the building's indirect GHG emissions from electricity by buying electricity from eligible renewable sources. **Renewable energy may only be used to reduce emissions from electricity**. Eligible renewable electricity sources include: - Boston Community Choice Electricity (BCCE) Green 100 Plan[8] - Solar energy generated on-site or anywhere in Boston - MA Class I Renewable energy certificates (RECs) - Power purchase agreement (PPA)
Alternative compliance payments (ACP)	Pay into the Equitable Emissions Investment Fund at $234 per metric ton of CO_2e (mtCO2e) above the building's emissions limit.[9] The fund supports decarbonization projects in Boston's environmental justice communities.

If neither emissions reductions nor any of these compliance mechanisms are completed, the property may be subject to a penalty or fine. The penalties and fines that may apply are described in Section XV of the BERDO Compliance Guide.[10]

In some situations, a building owner may be able to **apply for a flexibility measure**. Owners that meet certain eligibility criteria may apply for flexibility measures to adjust their emissions limits and/or emissions reduction timelines.[11] Flexibility measures include:

- **Blended Emissions Standard:** For buildings with multiple primary uses, this allows the owner to set a Blended Emissions Standard that is based on the size of the different primary uses, which may increase the missions limit. **This applies to .**
- **Building Portfolio:** For owners with more than one building subject to BERDO, owners may group them into a portfolio-level Blended Emissions Standard, allowing emissions to be reduced as a portfolio rather than building-by-building to help align BERDO compliance with capital planning.
- **Individual Compliance Schedule:** This option allows owners to create a custom emissions reduction timeline based on building-specific historical emissions, allowing owners to count emissions reductions prior to 2021 and adjust the building emissions obligations accordingly.
- **Hardship Compliance Plans:** Owners may be able to demonstrate eligible technical or financial hardships for reducing building emissions, allowing owners to request an alternative emissions reduction timeline and/or more flexible emissions reduction targets.

[8] BCCE Green 100 Plan Rates in 2025 are $0.17195/kWh, compared to $0.14805/kWh for the Standard (default) plan. Source: https://www.boston.gov/departments/environment/community-choice-electricity#rates
[9] Equitable Emissions Investment Fund: https://www.boston.gov/departments/environment/equitable-emissions-investment-fund
[10] BERDO Compliance Guide: https://docs.google.com/document/d/19fewKPA4LOwNGvrr4l5tAZCCx2ODOeEBl09XaDVp9gA/
[11] BERDO Flexibility Measures: https://www.boston.gov/sites/default/files/berdo/BERDO_FlexibilityMeasures.pdf

3.02 Current Energy Use

Current energy use at is based on calendar year 2024 data from Energy Star Portfolio Manager (ESPM). As Figure 4 shows, the energy use intensity (EUI) is 69.9 kBtu/sf/yr, comprising about 64% electricity (1,300 mmBtu or 380,992.3 kWh) and 36% natural gas (730 mmBtu).

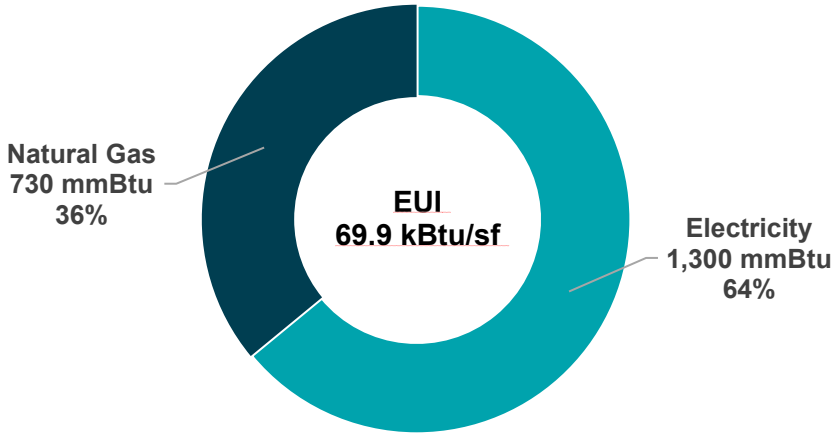

Figure 4: energy use breakdown for calendar year 2024.

Natural gas is used in the boilers that provide hot water (HHW) to the condenser loop. The electric water heaters provide domestic hot water (DHW). Restaurant kitchen equipment contributes towards natural gas usage. Electric water heaters to air heat pumps provide space level heating and cooling. Electricity is used for all other end-uses including lighting and plug loads.

An energy performance benchmark puts energy use in context. Figure 5 uses the BERDO database to compare the energy performance of to other Office buildings of similar size. Note that the BERDO database includes buildings of varying ages and conditions. Most properties are expected to need some level of decarbonization to meet the BERDO emissions standards.

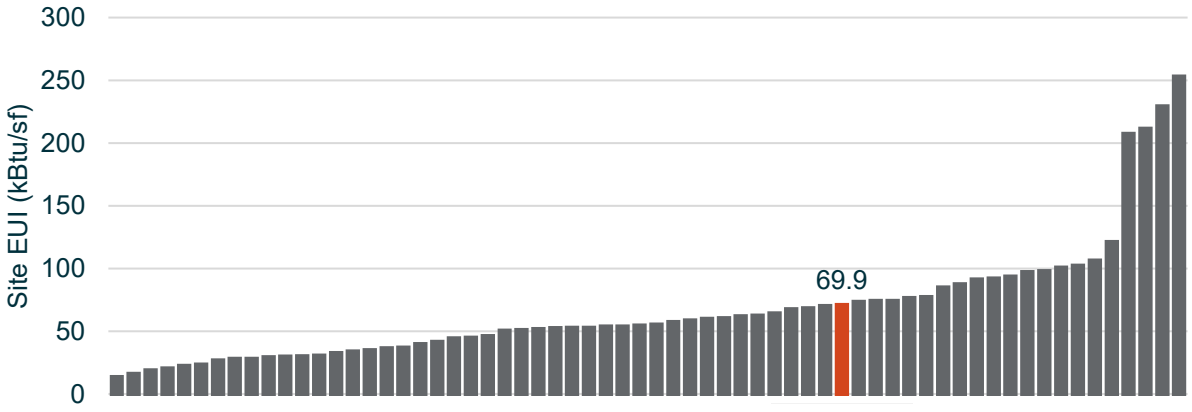

Figure 5: Energy performance benchmark of to similar properties.
(Source: BERDO 2024 Reported Energy and Water Metrics)

Based on 2024 data, the reported EUI of each property ranges from roughly 13 – 250 kBtu/sf. The EUI for falls within this range, slightly on the higher end.

3.03 Business-as-Usual Emissions

A business-as-usual (BAU) emissions estimate helps to check if is on track to comply with BERDO. Compliance is checked by comparing the property's projected emissions over time to the property's emissions limit. The property's emissions limit ($kgCO_2e$ per year) is calculated by multiplying the emissions standard ($kgCO_2e$/sf per year) times the property's floor area (sf).

Because is greater than 20,000 sf and less than 35,000 sf, emissions compliance begins in 2030. As a mixed-use facility, also qualifies for a blended emissions standard: Office and Food Sales & Service spaces occupy more than 10% of the property's total square footage – 83% and 17%, respectively. The blended emissions standard is calculated from a weighted average between the emissions standards for these two use types. Table 4 shows the emissions limits at from 2030 onward.

Table 4: Emissions Limits.

Target Year	**Emissions Standard** ($kgCO_2e$/sf per year)	**Emissions Limit** ($kgCO_2e$ per year)
2030 – 2034	4.2	123,218
2035 – 2039	3.2	91,722
2040 – 2044	2.1	61,412
2045 – 2049	1.1	30,706
2050+	0.0	0

Figure 6 shows BAU emissions over time at compared to the emissions limit. This estimate assumes no energy conservation measures (ECMs) are completed and converts annual electricity and natural gas use to GHG emissions per the BERDO Emissions Factor List.

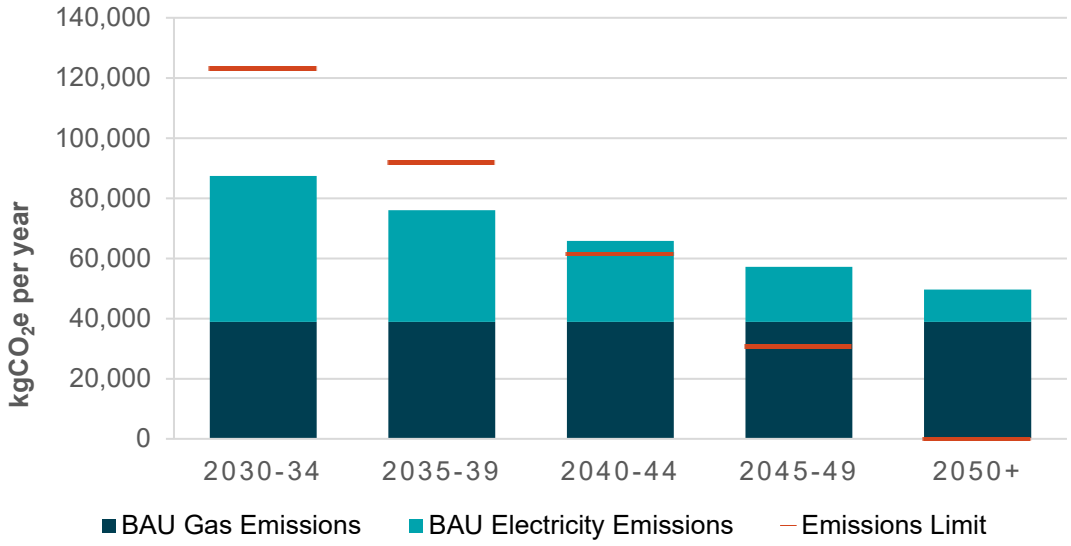

Figure 6: business-as-usual emissions over time compared to BERDO Emissions Limit, assuming no decarbonization measures are completed.

Based on 2024 energy data, if no additional ECMs are completed, is expected to exceed the limit from 2040 onward. This means future action is required for to remain compliant. If no action is taken, they may be subject to fines from the City.

3.04 Business-as-Usual Alternative Compliance Payments

To maintain compliance, may choose to make alternative compliance payments (ACPs) to the Equitable Emissions Investment Fund at a rate of $234 per 1,000 $kgCO_2e$ above the emissions limit per year.

Table 5 summarizes the ACPs that would have to consider making under a BAU case where no new ECMs are completed at .

Table 5: Business-as-Usual ACPs (assumes no energy conservation).

Target Year	Emissions Over Limit ($kgCO_2e$ per year)	Annual ACP ($ per year)
2030 – 34	-35,788	$0
2035 – 39	-15,653	$0
2040 – 44	4,437	$1,038
2045 – 49	26,460	$6,192
2050+	49,662	$11,621

Note: Totals may not sum due to rounding. Negative values mean below the limit.

If no further action is taken, is expected to remain below the emissions limit through 2039.

Besides alternative compliance payments, may consider energy conservation measures (ECMs) at each facility to save energy and reduce GHG emissions below the BERDO limit. may also consider signing up for 100% renewable electricity, such as through the Boston Community Choice Electricity (BCCE) Green 100 Plan or similar options.

The following section focuses on the ECMs available to directly reduce energy use and GHG emissions, creating a path to zero at both facilities that can reduce or eliminate the ACPs.

4.00 PATH TO ZERO EMISSIONS

There are many ways to reduce emissions at . The following section describes one recommended pathway for each site to achieve zero GHG emissions over time. Some details of the pathways may need further analysis or refinement before implementation.

4.01 Path to Zero Emissions

Table 6 lists the recommended ECM bundles to implement at by the end of each five-year BERDO Compliance period and the estimated energy savings from each bundle. The combined effect of the ECMs is a pathway to stay near or below the Emission Limits for every BERDO compliance period through 2050.

Table 6: Recommended energy conservation measure bundles for .

Target Year (Complete by)	**ECMs**
2030	Improved air sealing Updated water-to-air heat pumps Retro commissioning (RCx) of all building systems and controls
2035	Air Sealing (Aero Barrier) with Energy Recovery Ventilation HVAC system electrification Skylight repair or removal
2040	Roof upgrade Improved exterior walls and windows
2045	Kitchen electrification
2050	Continue energy efficient operations and track progress

Table 7 summarizes the estimated emissions for for each five-year period. Completing each ECM bundle by the target year helps lower emissions and reduce or avoid making ACPs.

Table 7: Emissions impact of energy conservation measures for .

Target year	**Projected Emissions from Latest Reported Data** ($kgCO_2e/yr$)	**Emissions Limit** ($kgCO_2e/yr$)	**Emissions Reductions from Projects** ($kgCO_2e/yr$)	**Estimated Emissions After Reductions** ($kgCO_2e/yr$)	**Under or Over Emission Limit** ($kgCO_2e/yr$)	**Potential Alternative Compliance Payment with Reductions** ($)
2030-34	87,400	123,200	16,800	70,600	-52,600	$0
2035-39	76,100	91,700	27,700	48,300	-43,400	$0
2040-44	65,800	61,400	28,200	37,600	-23,800	$0
2045-49	57,200	30,700	36,600	20,500	-10,200	$0
2050+	49,700	0	37,500	12,100	12,100	$2,800

Note: Totals may not sum due to rounding. Negative values mean below the limit.

4.02 Energy Project Descriptions

The ECM bundles listed above are suggested for each target year based on the overall impact they would have on BERDO compliance. Most projects need further study to refine energy savings and confirm constructability.

Based on initial estimates, it may be possible to spread out the electrification projects. This can help lower per-year capital cost of electrification and retain the gas supply as backup while gains familiarity with the new systems.

A full electrification plan for should be developed before electrifying any one system. This includes engineering to confirm equipment sizing (including constructability, space availability, and required electric load), and coordination with the utility provider for an electric service upgrade. Even if the electrification projects are spread over time, it is best to design for full electrification once.

Table 8, organized by five-year period, summarizes these projects and describes some of the details that will factor into their implementation. This timeline emphasizes project phasing based on reducing emissions over time, but other factors such as equipment condition may accelerate certain projects.

Table 8: Energy project descriptions at , by Target Year.

Target Year 2025-2029
Improved Air Sealing Many areas have improper sealing, leading to conditioned air leakage and infiltration (draftiness). Improve air tightness of the building by applying caulking and sealants to smaller cracks, openings, and windows and/or using a whole building weather membrane. This is a relatively simple and affordable action that can be taken early to reduce emissions and improve BERDO compliance before completing the larger ECMs which require more time to finish.
Updated water-to-air heat pumps Many of the water-to-air heat pumps have already been updated to more efficient models, lowering electricity demand for both heating and cooling. Continue replacing the remaining older models throughout the facility. Note: Given the age and condition of the existing boiler and cooling tower, HVAC System Electrification (described below) may need to happen sooner than described in this timeline. The decisions made for that project may impact updates to the floor-level water-to-air heat pumps.
Retro Commissioning of HVAC controls Given the moderate age and condition of the HVAC systems at the facility, especially the boiler and cooling tower, retro-commissioning is a promising opportunity to create near-term and cost-effective energy savings. Retro-commissioning is a systematic approach to fine-tuning the energy systems of a building, bringing it closer to optimum operations. Typical focus areas include temperature setpoints and schedules, repairing faulty components like thermostats and valves, and improving controls. Like manual air sealing, this relatively simple and affordable action can be taken early to reduce emissions before completing the larger ECMs which require more time to finish.

Table 8 continued: Energy project descriptions at , by Target Year.

<table>
<tr><th colspan="2">Target Year 2030-2034</th></tr>
<tr><td colspan="2">Improved Envelope: Air sealing with Energy Recovery Ventilation
To prepare for HVAC electrification by reducing outdoor air infiltration beyond manual caulking, consider applying an AeroBarrier type solution to the vertical spaces of the interior. With proper site preparation, AeroBarrier can be installed within a day and piecemeal (one tenant suite at a time).
This more enhanced type of air sealing is recommended to occur alongside other ventilation upgrades, because it can be so effective at air sealing that more mechanical ventilation may be required to provide fresh air. This may entail repairing the fresh air fan motors or may require a more involved ventilation upgrade. Energy recovery ventilation (ERV) is recommended to pre-condition the fresh outdoor air using waste heat from the exhaust air. ERV can be central to the building or installed per space or floor. The units would replace the bathroom exhaust fans and use the recovered energy to supply fresh filtered air to the space.</td></tr>
<tr><td colspan="2">Improved Envelope: Skylight repair or removal
The existing skylights are in poor condition. Replacing them with double or triple glazed skylights with better thermal values would improve weatherproofing and reduce heating and cooling demand, especially on the top floor. Alternatively, the skylights could be removed entirely which would reduce natural daylight but also reduce energy consumption and may be lower cost to install.</td></tr>
<tr><td colspan="2">HVAC System Electrification
The existing HVAC system, comprised of a condenser loop served by a boiler and cooling tower which delivers energy to floor-level water-to-air heat pumps, is aged and in need of either major refurbishment or replacement with an alternative type of system. Two primary options are available and presented here.
Lifecycle cost analysis of each alternative is recommended before making a final selection, to compare both the upfront and lifetime operating costs of the alternatives.</td></tr>
<tr><td>Approach 1: Condenser loop refurbishment
Retain the condenser loop.
Continue replacing the remaining older water-to-air heat pumps with newer, more efficient models.
Replace the aged rooftop cooling tower with a packaged air-cooled heat pump that can provide either chilled or hot water to maintain the condenser loop between 70-90˚F. Size the packaged heat pump to the maximum capacity able to be supported by the existing roof.
Keep the existing boiler as long as practical, to be used as peak supply for condenser loop hot water on very cold days. When needed, replace the existing boiler with a new, right-sized condensing or electric boiler.
This approach may retain some gas use, but this is estimated to be very low relative to BERDO requirements and may balance with cost and resilience considerations.</td><td>Approach 2: Rooftop VRF systems
Install a large central or series of smaller semi-decentralized VRF heat pump condensers on the rooftop that supply indoor units in each zone. To be sized appropriately for future building improvements, the units should have a wide compressor operating range to be capable of meeting current and future loads.
Decommission or abandon-in-place the existing condenser loop system.
This approach can be installed all at once or phased over time, considering constructability of the refrigerant piping and the age of the existing system.</td></tr>
</table>

Table 8 continued: Energy project descriptions at , by Target Year.

Target Year 2035-2039
Improved Envelope: Roof The roof was updated in 2007 based on the local code requirement at the time (assumed R-15). It is in good condition today, and major refurbishment is not anticipated for many years. When a major roof upgrade is eventually needed, leverage the project as an opportunity to reduce heat transfer through roof by upgrading the insulation across roof deck (assumed R-30 or what may be code required at the time).
Improved Envelope: Exterior Walls The existing exterior walls are in moderate condition, with minimal existing insulation apparent in the interior-side cavities between the metal studs. Over time, there is an opportunity to improve the thermal performance of the exterior walls by retrofitting with additional interior batt insulation between the metal studs and continuous insulation on the interior of the studs (assumed R-21.7). To optimize cost-effectiveness, it is recommended to install this additional insulation over time, in line with other facility upgrades such as tenant improvement retrofits when the existing interior gypsum/plaster would be removed/replaced for other reasons.
Improved Envelope: Exterior Windows The existing double-pane, aluminum-framed exterior windows are in poor condition, with apparent thermal bridging and poor weather sealing. Over time, there is opportunity to improve the thermal performance of the existing windows by replacing them with new windows that have triple-pane, low-emissivity glazing and non-conductive frames. This would reduce drafts, annual energy consumption and peak loads, and improve occupant comfort. Alternatively, secondary glazing on the interior side of the existing windows may be considered as a nonintrusive approach with similar outcomes (if non-operable windows are permissible per ventilation requirements). To optimize cost-effectiveness, it is recommended to replace the windows over time, in line with other facility upgrades such as tenant improvement retrofits when zones are non-occupied and other construction is already being performed for other reasons.
Target Year 2040-2044
Kitchen Electrification The ground floor restaurant uses a Sunfire gas range with two ovens and two Pitco fryers which may be gas- or electric-powered (to be verified). All-electric alternatives to these equipment exist and can be replaced over time (e.g., as equipment fails) or all at once (e.g., during tenant improvement upgrades). An upgrade to the local electrical subpanel may be needed to enable the restaurant to accommodate new all-electric appliances. In addition to conserving energy and reducing GHG emissions in line with BERDO requirements, converting commercial kitchens from gas-fired to all-electric can have numerous benefits for chefs and cooks. This may include: a cooler work environment due to lower waste heat; a quieter work environment due to lower ventilation requirements; a safer work environment due to reduced burn risk; and saved labor hours due to induction cooktops being easier to clean than gas burners.
Target Year 2045-2049
No more decarbonization projects needed. Continue energy efficient operations and track progress.

4.03 Alternative Compliance Payments After ECMs

The ECMs described above can result in a pathway to zero emissions over time for . Figure 7 shows the combined effect of all ECMs applied to both facilities over time.

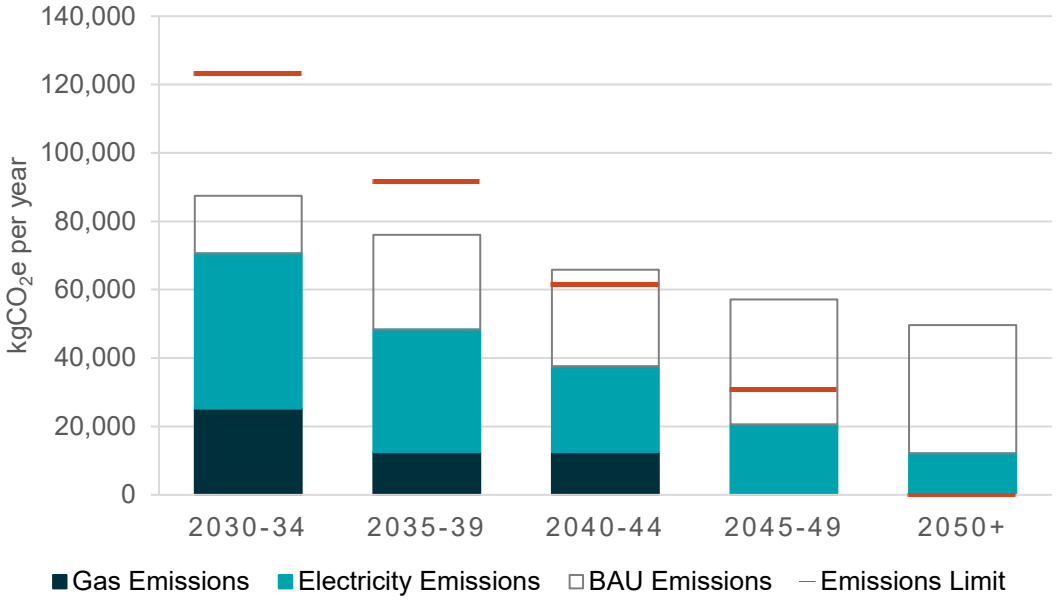

Figure 7: emissions after reductions, compared to BERDO Emissions Limit and Business-as-Usual.

Table 9 summarizes the ACPs that would have to consider making if all ECMs are completed in the recommended timeframe, compared to what the ACPs would be if no action is taken. Some ACPs may remain at the end due to GHG emissions from electricity, but these can be eliminated by obtaining 100% renewable energy.

Table 9: ACPs after emission reductions, compared to Business-as-Usual.

Target Year	Emissions Over Limit ($kgCO_2e$ per year)	Annual ACPs after ECMs ($ per year)	Annual ACPs before ECMs ($ per year)
2030 – 34	-52,600	$0	$0
2035 – 39	-43,400	$0	$0
2040 – 44	-23,800	$0	$1,000
2045 – 49	-10,200	$0	$6,200
2050+	12,100	$2,800	$11,600

Note: Totals may not sum due to rounding. Negative values mean below the limit.

Actual building emissions may differ from this estimate due to changes in weather (e.g., very cold winter) and occupant behavior. A more detailed analysis would lead to more precise emissions estimates.

5.00 CONSIDERATIONS AND NEXT STEPS

While the goal of a Zero-Over-Time Plan is to comply with BERDO by reducing on-site emissions, other compliance mechanisms are possible:

1) Eliminate GHG emissions from electricity by signing up for a 100% renewable energy plan, such as the BCCE's Green 100 Plan.
2) Choose to make alternative compliance payments in lieu of completing ECMs.
3) Apply for a flexibility measure[12] for help with emissions compliance.

It is up to to decide which pathway to choose for BERDO compliance. To support this decision, some considerations and next steps include areas of further study, phasing alignment with maintenance and capital improvement plans, impact on tenants, and funding alignment with other energy programs.

5.01 Areas of Further Study

To finalize the ECM recommendations at , detailed energy audits and engineered all-electric designs are recommended.

Detailed Energy Audits
These include a facility assessment to gather complete data of existing conditions; energy analysis to refine the energy savings potential; and financial analysis to identify which ECM bundles have the greatest financial and emissions benefit. Special attention should be given to building envelope opportunities to reduce peak heat demand such as air sealing, weatherization, and insulation upgrades.

Engineered All-Electric Design
This includes right sizing the heating equipment (HHW heat pumps) to the new peak load after accounting for ECMs, preparing the building for lower HHW distribution temperatures (e.g., changes to piping) and coordinating with the electric utility provider for a service upgrade (e.g., higher capacity electrical panels and/or utility service connection). Utility service upgrades may be mitigated though demand management strategies such as a building management system and battery/thermal energy storage.

If possible, given the remaining lifespan of the existing HVAC equipment, it is recommended to complete all "passive" improvements to the walls, windows, roof, skylights and air infiltration before upgrading the HVAC system. This would ensure right-sizing of the HVAC equipment and their optimal functioning in addition to occupant comfort. If the HVAC improvements are made before passive improvements, it is recommended to choose the HVAC equipment and sizing that is flexible with the future changes in peak loads owing to passive improvements. A VRF system may be an effective system in this case as it has a larger compressor operating range for cooling and may prevent any future oversizing issues due to passive improvements.

5.02 Phasing Alignment with Maintenance and Capital Improvement Plans

Wherever possible, it is recommended to align energy conservation and electrification projects with other maintenance and capital projects, such as replacing equipment at end of useful life. This was considered in the recommended timeframe for when to implement ECMs. The details of phasing alignment should be finalized in an engineered all-electric design.

[12] BERDO Flexibility Measures: https://www.boston.gov/sites/default/files/berdo/BERDO_FlexibilityMeasures.pdf

Both the HHW boilers and the Cooling towers are expected to reach their end of useful life in the near future. Assuming proper maintenance can help extend this equipment a few years beyond its expected useful life, electrification can happen around the same time when the equipment would need replacement anyway. As mentioned earlier, if HVAC electrification happens before passive upgrades, it is recommended to choose the HVAC equipment and sizing (such as inverter-driven VRF) that is flexible with the future peak load changes and mitigates occupant discomfort related to oversized equipment.

5.03 Impact on Tenants

Project planning should consider how to minimize impact on tenants. may be able to spread energy conservation measures over time in alignment with tenant turnover. An empty unit is an ideal time to weatherize existing windows, install ERV and apply Aero Barrier, and make other improvements.

For the restaurant, kitchen electrification should be planned when not disruptive to restaurant operations. This can mean replacing existing gas equipment with electric alternatives as they fail, or executing a full kitchen electrification retrofit when the restaurant space is changing tenants.

5.04 Summary of Funding Alignment with Other Energy Programs

As a non-profit, may be eligible for multiple energy retrofit incentive programs. Most prominently, the Mass Save Program may be able to provide meaningful support for the ECMs recommended above.[13] Incentives include:

- **Energy assessment:** Small businesses using less than 1.5 million kWh in electricity or 40,000 therms of natural gas annually qualify for a no-cost energy assessment.
- **High Performance Buildings Incentive Program:** Energy conservation measures qualify for incentives of $0.35 per kWh or $2 per therm reductions compared to a baseline level. Heat pumps qualify for additional incentives.
- **Commercial Upstream Program:** Select qualifying commercial equipment and products, such as electric HVAC equipment, natural gas water heaters, food service equipment, lighting and fixtures, may be purchased at reduced prices.
- Other specialty equipment may be purchased with rebates and incentives:
    - **Commercial refrigeration:** Instant rebates on new, energy-efficient refrigeration equipment or incentives to upgrade existing equipment.
    - **Compressed air systems:** Incentives to upgrade air compressors, nozzles, low-pressure drop filters, zero-loss condensate drains.
    - **Food service equipment:** Incentives to upgrade kitchen equipment, such as ovens, dishwashers, refrigerators, freezers, ice machines.
    - **Electric forklifts and chargers:** Rebates on battery-powered forklifts and high-frequency battery chargers.
    - **Industrial air curtains:** Rebates on air curtains.

[13] Mass Save for businesses: https://www.masssave.com/en/business/rebates-offers-services/specialty-equipment

- **Laundry equipment:** Incentives to upgrade laundry equipment.
- **Pumps:** Incentives to upgrade pumping technologies, such as ECM circular pumps and PEI-rated efficient water pumps.
- **Steam systems:** Incentives to repair or replace steam traps, add insulation to steam traps, or participate in a steam survey.
- **Variable speed drives and motors:** Rebates on new variable speed drives or incentives to replace existing drives and motors.

may be eligible for loans offered by various utility providers.[14] For instance, National Grid offers up to $250,000 for energy retrofits with 24- to 84-month terms.[15] Additionally, National Grid covers up to 70% of LED upgrades for small businesses, as well as discounts on installing lighting and refrigeration upgrades.[16]

Alternatively, may be eligible for green loans and the Property Assessed Clean Energy (PACE) Program offered by Mass Development and DOER.[17] Green loans are between $50,000 and $500,000 for energy retrofits, such as HVAC replacements or improvements, solar panels, insulation, and/or windows. PACE financing is more flexible than a direct loan, allowing building owners to repay using savings from retrofits.[18]

DOER's Solar Massachusetts Renewable Target (SMART) Program offers base compensation rate between $0.17 to $0.28 per kWh depending on Solar Tariff Generation Units (STGUs).[19] Mass Clean Energy Center (CEC) provides further guidance on solar systems and incentives.[20]

Additional resources may be reviewed on DOER's guide to energy rebates and incentives within Massachusetts.[21] Federal and state tax incentives may be explored on the DSIRE database hosted by the NC Clean Energy Technology Center.[22]

[14] Financing for businesses: https://www.masssave.com/en/business/rebates-offers-services/financing-for-businesses
[15] National Grid financing for businesses: https://www.nationalgridus.com/financing-options
[16] National Grid incentives for small businesses: https://www.nationalgridus.com/MA-Business/Energy-Saving-Programs/Small-Business
[17] Mass Development financing: https://www.massdevelopment.com/products-and-services/financing/green-finance/
[18] PACE financing: https://www.massdevelopment.com/products-and-services/financing/green-finance/pace/
[19] SMART Program: https://www.mass.gov/info-details/smart-30-program-details
[20] Massachusetts solar systems and incentives: https://www.masscec.com/resources/commercial-solar-information-hub
[21] Massachusetts energy rebates and incentives: https://www.mass.gov/guides/massachusetts-energy-rebates-incentives#-rebates/incentives-for-your-business-or-institution-
[22] Massachusetts tax incentives: https://programs.dsireusa.org/system/program?state=MA

6.00 CONCLUSION

This ZOT Plan outlines suggested steps for to gradually lower their emissions in line with BERDO requirements. If the recommended energy-saving measures are completed on schedule, emissions could be significantly reduced, helping to minimize or avoid ACPs.

This plan represents just one possible approach for to cut emissions, with core themes focused on energy conservation through building envelop upgrades and electrification through HVAC system and kitchen upgrades. Further analysis and engineering design will be needed to refine the ZOT Plan.

Taken together, these energy-saving actions create a path that keeps emissions at or below the required limits for each five-year period through 2050.

APPENDIX A Property Documentation and Data Provided by

This report is based on energy use data reported in Energy Star Portfolio Manager (ESPM), documentation provided to Thornton Tomasetti by the Owner, and information provided during the project kick-off meeting on June 25, 2025, the site visit on July 15, 2025, and the preliminary findings discussion on September 16, 2025. The documentation provided that was utilized in this report is as follows:

documentation:

- Facility Review 12.3.04
- Restaurant Heat Pump - Technical Data
- - Energy Audit Report - World Energy
- _Energy Star_Electric+Gas_Monthly_All
- Checklist Template v1
- TT_Field Notes Scans
- _Site notes_250715
- Site Visit photos

APPENDIX B Energy Modeling Assumptions

The energy conservation measures (ECMs) evaluated at are based on the following energy modeling assumptions. Baseline assumptions are based on site photos; information obtained from , general estimation based on previous project knowledge in similar climate zones and calibration against utility data. Proposed ECM assumptions are based on industry best practices for existing building retrofits; values may change during the design and/or construction phases of implementing the ECMs.

Energy modeling assumptions for .

Category	Baseline (Existing) Value	Proposed Value
Roof insulation	R-15 (Steel deck)	R-30 (Continuous insulation)
Wall insulation	R-10 (Exterior stone cladding with metal stud wall on interior side with cavity insulation)	R-21.7 (Exterior mass wall/stone cladding with CCSF batt insulation in stud cavities and continuous insulation)
Glazing	U-0.40, SHGC-0.34 (Double-glazed)	U-0.20, SHGC-0.28 (Triple-glazed or equivalent secondary glazing)
Skylight	U-0.76, SHGC-0.62	U-0.44, SHGC-0.25
Air sealing	0.65 cfm/sf	Manual:0.4 cfm/sf Aero Barrier: 0.15 cfm/sf
Heating & Cooling system efficiency	75% (Natural gas boiler) WSHP old: 9.5 EER, 3 COP WSHP new: 11.1 EER, 4.5 COP	Electric Boiler: 98% (Backup) WSHP new: 11.1 EER, 4.5 COP ASHP new: 3.3 COP
Energy Recovery Ventilation (ERV)	None	75%