



# Town of Brighton

## VERMONT

**Town of Brighton, Vermont**

**Request for Proposal**

**Heat Pump Installation for Railroad Depot Building**

**Issued:** March 12, 2026

**Proposals Due:** April 6, 2026 – 5:00 PM EDT

### 1. Introduction

The Town of Brighton is seeking proposals from qualified contractors to install a new cold-climate heat pump system that will cover the occupied space. Due to the extreme cold temperatures experienced in Brighton during the winter months, the existing boiler system will be retained to provide ambient temperature control with the heat pump system serving as the primary heating and only cooling option. Additionally, install remotely accessible, fully programmable thermostats for the heat pump system.

This project builds on recommendations identified in the Municipal Energy Resilience Program (MERP) Level II Energy Audit prepared by CX Associates (March 2024), and is included as Appendix B. Funding for this work is provided through the Vermont Department of Buildings & General Services (BGS) under the Municipal Energy Resilience Program.

### 2. Project Overview

**Building Summary:** Brighton Railroad Depot Building

**Year Built:** 1850, Renovated 1980s

**Size:** The Brighton Railroad Depot is an old train station. The facility is two stories (plus basement and attic) and comprises approximately 7,000 square feet. The building was originally constructed in the 1850s and was acquired by the town of Brighton after the railway closed in 1965. It is no longer used as a train station but is now leased to various entities. The Community National Bank occupies most of the first floor; other building occupants include the Sheriff's office on the first floor and the non-profit Underdog Foundation on the second floor.

**Occupancy:** 15-20 people – 5 days per week plus

**Current Heating:** Two Ek2 Frontier Premier fuel oil boilers(installed in 2025) supply hot water for the hydronic loop system consisting of cast iron radiators. A TRANE TWE060A100BA air handling unit (AHU) installed in 1993 with a direct expansion (DX) cooling coil provides space cooling and mechanical ventilation to the first floor of the Brighton Railroad Depot. This is a 2,000-cfm 5-ton unit, with the outdoor condensing unit located just outside the building on the north side. Cool air is provided to the building by floor registers on the first floor. Cooling appears to be controlled by a thermostat in the bank lobby.

**Energy Audit Recommendations:**

1. Replace existing mechanical systems(except new boilers) with ductless mini-split or multi-split air-source heat pumps throughout the building. This would also have the ancillary benefit of providing cooling for the second floor. Alternatively, the existing air handler could be used to provide heating to the space with a ducted heat pump system on the first floor and ductless mini-split heat pumps on the second floor. *The Town intends to retain the boiler system to maintain ambient temperatures throughout the building given the extremely cold winter temperatures experienced in the Brighton area while utilizing the more efficient heat pump system as the primary heating and cooling source.*
2. Installing remote accessible and programmable thermostats to better control the equipment's operating hours will yield additional energy savings and is also recommended.

**3. Scope of Work**

A. Heat Pump Installation

- Provide and install cold-climate, ENERGY STAR® rated air-source heat pump system, sized OR design system to meet needs of the space and occupants.
- Include both indoor and outdoor units with necessary refrigerant and electrical connections.
- Provide condensate management and all associated control wiring.
- Test, balance, and commission systems upon completion.
- Ensure all work complies with NFPA 70, Vermont State Building and Electrical Codes, and manufacturer specifications.

B. Replace/Install Smart Thermostats

- Replace/Install building thermostats with remotely-accessible, 24-hour fully programmable smart thermostats.

**4. Contractor Qualifications**

- Demonstrated experience installing cold-climate heat pumps.
- Licensed and insured to work in Vermont.
- Familiarity with Efficiency Vermont incentives preferred

## 5. Proposal Requirements

Proposals must include:

- Company Information: Name, address, contact person, and proof of licensing and insurance.
- Project Approach: Work plan and proposed schedule.
- Equipment Specifications: Manufacturer, model numbers, and performance ratings (HSPF/SEER).
- Cost Proposal: Itemized pricing for: - Heat pump system (equipment, installation, controls) – Smart Thermostat (materials and labor)
- References: At least two recent similar projects.

## 6. Site Visit

Site visits are optional but encouraged. Contractors should contact the Town Manager, Mike Strait at (802) 266-1054 or [townmanager@brightonvt.gov](mailto:townmanager@brightonvt.gov) in order to schedule your visit so that access can be provided to all areas of the building.

## 7. Evaluation Criteria

Proposals will be evaluated based on:

- Cost competitiveness (40%)
- Technical approach and understanding of project goals (25%)
- Experience and references (20%)
- Schedule and availability (15%)

## 8. Submission Instructions

Submit proposals electronically (PDF) or mail envelope marked “Brighton Railroad Depot HVAC RFP” to:

Michael Strait  
Town Manager  
Town of Brighton  
PO Box 377  
49 Mill St. Ext.  
Island Pond, VT 05846

[TownManager@brightonvt.gov](mailto:TownManager@brightonvt.gov)

Late submissions will not be accepted.

**9. Schedule**

<b>Milestone</b>	<b>Date</b>
RFP Issued	March 12, 2026
Site Visit	March 16, 2026 – April 6, 2026
Proposals Due	April 6, 2026
Contractor Selected	April 15, 2026
Work Begins	Spring/Summer 2026
Work Completed By	September 30, 2026

**10. Questions**

Questions must be submitted in writing by March 26th to [TownManager@brightonvt.gov](mailto:TownManager@brightonvt.gov) . Responses will be shared with all bidders.

This RFP is issued in accordance with Municipal Energy Resilience Program regulations. The selected contractor will be expected to comply with all applicable laws, codes, and standards. The Town reserves the right to waive any formalities or minor defects, or to accept any or reject all bids.

# Appendix A: Bid Form

## Town of Brighton Railroad Depot HVAC Project Bid Form

Item	Description	Quantity/Model	Unit Cost	Total Cost
1	Heat Pump Installation			
2	Smart Thermostats			
<b>Total Bid Price</b>				\$ _____

**Company Name:** \_\_\_\_\_

**Address:** \_\_\_\_\_

**Contact Person:** \_\_\_\_\_

**Phone:** \_\_\_\_\_

**Email:** \_\_\_\_\_

**Signature:** \_\_\_\_\_

**Date:** \_\_\_\_\_

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### Contractor Checklist

- Completed Bid Form (Appendix A)
- Project approach and proposed timeline
- Proof of insurance and licensing
- Equipment specifications (model, efficiency ratings)
- References from at least two similar projects
- Proposed total project cost (itemized)
- Signed and dated proposal

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### Issued by:

Town of Brighton, Vermont

Municipal Energy Resilience Program Project

**Contact:** Mike Strait, TownManager@brightonvt.gov



**Town of Brighton**  
VERMONT

# APPENDIX B

**March 14, 2024**

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# MERP Level 2 Energy Assessment for

**Municipal Energy Resilience Program  
Brighton Railroad Depot  
Brighton, Vermont**



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Burlington, VT 05401  
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www.cx-associates.com

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## I. Executive Summary

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Cx Associates has performed a MERP<sup>1</sup> Level 2 energy assessment for the Brighton Railroad Depot in Brighton, Vermont. This assessment included a detailed building survey and energy analysis of the building systems to identify and quantify savings opportunities.

The energy assessment consisted of a comprehensive review of the building systems and controls, analysis of historical utility data, a mechanical and building envelope on-site assessment, a blower-door measurement, and a detailed investigation of the energy consumption of the building by end use.

Based on this in-depth analysis, Cx Associates developed a recommended package of building envelope improvements and energy saving measures that will:

- Cost-effectively reduce energy consumption
- Reduce building air leakage
- Extend equipment life
- Increase comfort
- Improve resiliency

Table 1 provides an overview of recommended measures, the implementation of which would significantly improve occupant comfort due to the improved building envelope as well as achieve an estimated energy cost savings of nearly \$10,000 annually<sup>2</sup>. Measures investigated but not recommended are also documented<sup>3</sup>.

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<sup>1</sup> Municipal Energy Resilience Program

<sup>2</sup> Energy cost savings use assumed 2024 rates for electricity and fuel oil.

<sup>3</sup> Measures are generally listed as not recommended if the simple payback period exceeds the expected measure life. However, these measures can still be considered if included as part of a larger upgrade package or upon failure of existing equipment.

**Table 1: Energy Efficiency Measure Summary**

ID	Measure Description	Electricity Savings	Fuel Oil Savings <sup>1</sup>	Wood Pellet Usage	Energy Cost Savings	Measure Cost	Return on Investment (ROI)	Recommended?
		kWh/yr	gal/yr	lb/yr	\$/yr	\$	%	Y/N
1	Insulation at Exterior Wall Assembly	-	1,251	-	\$ 4,879	\$34,660	14%	Y
2	Window Improvements	-	443	-	\$ 1,728	\$12,925	13%	Y
3	Weatherstripping at Exterior Doors	-	63	-	\$ 246	\$1,195	21%	Y
4	Sealing Penetrations at Exterior Walls	-	39	-	\$ 152	\$530	29%	Y
5	Seal the Fireplace in the Bank	-	12	-	\$ 47	\$260	18%	Y
6	Comprehensive LED Lighting Upgrade	1,717		-	\$ 355	\$4,880	7%	Y
7	Heat Pumps for Space Heating	(24,113)	1,829	-	\$ 2,153	\$28,500	8%	Y
8	Heat Pump Water Heater	913		-	\$ 189	\$3,000	6%	Y
9	Programmable Thermostats	-	75	-	\$ 293	\$1,300	23%	N
10	Wood Pellet Boiler for Space Heating	-	1,829	(31,571)	\$ 1,924	\$32,400	6%	N
	<b>Recommended Total</b>	<b>(21,483)</b>	<b>3,637</b>	<b>-</b>	<b>\$9,748</b>	<b>\$85,950</b>	<b>12%</b>	

<sup>1</sup> This assumes a Fuel Oil cost of \$3.90/gallon consistent with average fuel oil price in Vermont for January 2024.

## II. Introduction

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Cx Associates has been retained by the State of Vermont to provide building energy assessment services for municipal buildings across the state as part of the Municipal Energy Resilience Program (MERP).

This report focuses on the energy assessment performed for the Brighton Railroad Depot in Brighton, Vermont (Figure 1). The assessment team spent three days on site<sup>4</sup> gathering detailed information on all energy-using equipment in the building.



Figure 1: Building exterior

The report details the findings of the existing facility operating conditions, along with recommendations on energy efficiency opportunities and associated energy savings estimates and project implementation costs. These findings have been developed using the following sources:

- In depth conversations with facilities staff and occupants
- Detailed observations from the site visits
- Blower door and envelope assessment conducted on January 22, 2024
- Historical electricity and fuel oil data

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<sup>4</sup> The assessment team conducted the first site visit on 10/27/23 but was unable to perform the blower door test because the bank activities could not be disrupted. The team returned on 12/13/23 but was unable to perform the blower door test due to a power outage caused by a storm. Finally, the blower door test was performed successfully on 1/22/24.

## III. Facility Description

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### GENERAL INFORMATION

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The Brighton Railroad Depot is an old train station located at 23 East Brighton Road in Brighton, Vermont. The facility is two stories (plus basement and attic) and comprises approximately 7,000 square feet. The building was originally constructed in the 1850s and was acquired by the town of Brighton after the railway closed in 1965. It is no longer used as a train station but is now leased to various entities. The Community National Bank occupies most of the first floor; other building occupants include the Sheriff's office on the first floor and the non-profit Underdog Foundation on the second floor.

The primary functional space types in the building include open office areas, enclosed offices, and conference rooms. There are also hallways, a lobby, and kitchen area. Ancillary spaces include stairwell, restrooms, storage, and mechanical / electrical space in the basement.

The building is generally occupied from 8:00 a.m. to 5:00 p.m. on weekdays with some additional occupancy as needed on weekends and evenings. Typical occupancy is 15 – 20 people. The sheriff's office is used as needed, but is not regularly occupied.

### BUILDING ENVELOPE

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The foundation of the building is primarily stone and mortar, with brick masonry repairs visible in some locations. The superstructure is comprised of 4 wythes of brick masonry and wooden roof trusses, some locations also have interior wood stud wall framing to support finish materials. The roof is made up of wooden planks with an asphalt shingle finish.

Inspecting the foundation and exterior walls revealed that no insulation was present in either of these assemblies, resulting in very low effective R-values. On the other hand, the attic space was well insulated with about 16" of blown-in cellulose insulation providing an effective R-value of approximately R-50.

Portions of the exterior assemblies such as the stone and brick masonry and asphalt shingles appear to be in good condition with no major signs of damage or deterioration. Other portions of the assembly such as windows, doors, and the interior of the stone foundation are in relatively poor condition and will be discussed in further detail later in this report.

### ELECTRICAL SYSTEMS

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#### Electrical Distribution

Electrical service for the building consists of four separate meters and main panels. The two largest panels are in the basement. The Bank panel consists of 200 Amp service at 120/240 V, and the house panel has 125 Amp service at 120/240 V. There is a third panel on the second floor that has 70 Amp service. There is currently no back-up power at this facility.

#### Lighting

Interior lighting at the Brighton Railroad Depot is provided by a wide array of fixtures and lamp types. There are a variety of 48" T8 fixtures with T8 lamps, some round T9 fixtures with T9 lamps, and a mix of dome, downlight, and sconce lighting with LED, CFL, or incandescent bulbs. Interior

lighting is on switch controls (no occupancy or daylighting controls were observed during the site visit).

Exterior lighting consists of pendant lights under the covered exterior portion of the building and two additional fixtures above the bank entrance. Exterior lighting appears to be on a timer control.



Figure 2: Examples of three different fixtures at the facility, from left to right, a suspended fixture with CFL bulbs, a surface mounted wraparound 48" T8 Fixture, and pendant fixture

### Plug Loads

Plug loads observed during the site visits consist primarily of office loads. Five computers were observed as well as monitors, a space heater, kitchen equipment, and IT equipment.

## MECHANICAL SYSTEMS

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### Space Heating

Space heating is provided by a 460 MBH Smith fuel oil fired boiler installed in 1993 and located in the mechanical area of the basement. The most recent combustion efficiency test from October 2022 indicated an efficiency of 86.2%. The boiler is in average condition – the site contact indicated that it occasionally needs to be repaired, and that there is currently not annual preventive maintenance performed<sup>5</sup>.

During the site visit the boiler was providing water at 170°F. Hot water is distributed to cast iron radiators in the building by two 1-hp pumps. These pumps are plumbed in a redundant configuration with one of them being powered off during the site visit. Heating is controlled manually by thermostatic radiator valves on each radiator (Figure 3).

There is an old Johnson Controls (JCI) boiler controller with outdoor air temperature reset control, which resets the hot water supply temperature of the boiler based on outdoor air temperature.

Additionally, the air handling system (described below) appears to have electric heating coils. It is unclear if this electric heating is used currently, but analysis of the monthly electricity usage

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<sup>5</sup> Cx Associates recommends that in the future the town engage a contractor to perform annual preventive maintenance for all mechanical equipment serving the building.

indicates that there is likely some space heating happening with electricity. There were also a few electric space heaters observed throughout the building.



Figure 3: A thermostatic radiator valve on a radiator

### Space Cooling and Ventilation

A TRANE TWE060A100BA air handling unit (AHU) installed in 1993 with a direct expansion (DX) cooling coil provides space cooling and mechanical ventilation to the first floor of the Brighton Railroad Depot. This is a 2,000-cfm 5-ton unit, with the outdoor condensing unit located just outside the building on the north side. Cool air is provided to the building by floor registers on the first floor. Cooling appears to be controlled by a thermostat in the bank lobby<sup>6</sup>.

This air handling unit provides 400 cfm of outdoor air to the first floor of the building with a ¾-hp supply fan. It is controlled through an AHU controller installed as part of a controls upgrade in 2009.

Three portable air conditioning units were observed on the second floor during the site visit (Figure 4). Two units are 10 MBh units from 2021 with a CEER of 6.9. One unit is a 14 MBh unit with a CEER of 12.9.

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<sup>6</sup> A building occupant indicated that the thermostat did not seem to work properly.



Figure 4: Portable air conditioning unit

### Domestic Hot Water

Domestic hot water is provided by a 40-gallon 4,500-watt electric resistance Reliance water heater located in the mechanical area of the basement. During the site visit the temperature set point for this water heater was set at 120°F. Distribution pipes that were visible from the domestic hot water tank were insulated.

## IV. Historical Energy Consumption

### DESCRIPTION OF METERS AND TARIFFS

There are four electric meters serving the building. The electric utility is the Vermont Electric Coop. Electric rate structure details for the Small Commercial tariff starting in 2024 are shown in Table 2. There is a monthly customer charge, an energy charge, and an energy efficiency charge. The marginal electric cost for 2024 is \$0.20652 per kWh (this value is used in future analysis).

Fuel oil is delivered by Oil Supply Corp. For future analysis in this report fuel oil cost is assumed to be \$3.90 per gallon consistent with average Vermont prices from January 2024.

Table 2: Electric rate description

<b>Utility:</b>	Vermont Electric Co-op
<b>Tariff:</b>	Small Commercial
<b>Customer Charge:</b>	\$22.62/month
<b>Energy Charge:</b>	\$0.19629/kWh
<b>Energy Efficiency Charge:</b>	\$0.01023/kWh

## ENERGY USAGE AND COST ANALYSIS

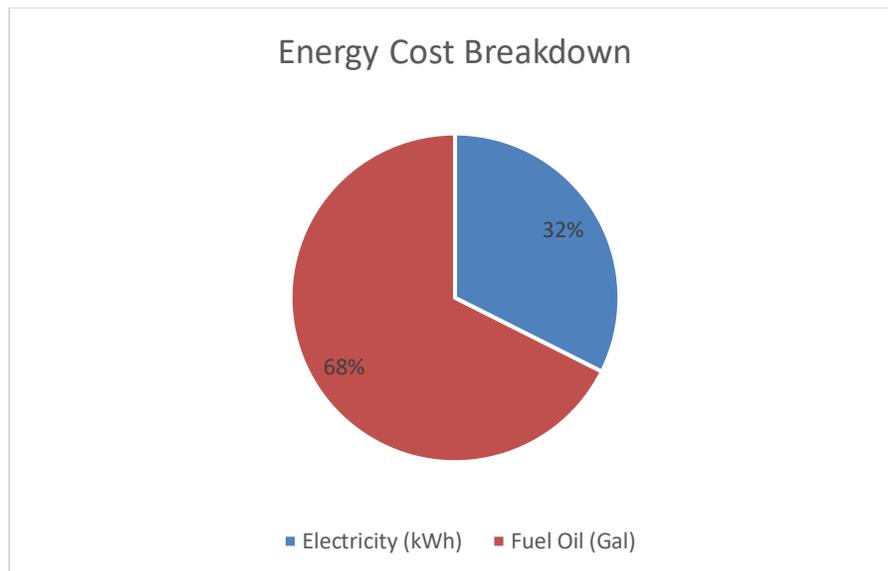
### Utility Data

Analyzing historical utility data can yield valuable insight into how the building is operating and can help to identify and address any issues that may improve energy performance and/or reduce costs. Table 3 shows the annual utility summary for the year ending August 2021 (this was the last full year for which Cx Associates was confident in the data. Annual energy cost is around \$8,500 per year (and higher now given that this was for 2020/2021), with an energy cost index (ECI) of \$1.23/sf-yr.

**Table 3: Annual energy consumption and cost**

Commodity	Consumption	Cost
Electricity (kWh)	10,871	\$2,799
Fuel Oil (Gal)	3,816	\$5,833
Total		<b>\$8,631</b>

Figure 5 and Figure 6 show the energy cost breakdown by commodity. While fuel oil provides over 90% of the energy used by the facility, it accounts for only 68% of the cost. The cost of electricity paid by the facility is much higher, per unit of energy, than that of fuel oil. Looking at bills from this time the municipality was paying \$1.50/gal for fuel oil which is much lower than the current cost – data from the State of Vermont shows that the average price paid for fuel oil in January 2024 is \$3.90. While electricity prices have also gone up during this period, the increase is much less and a similar plot today would indicate that while the cost per energy of fuel oil is still a bit lower than that of electricity, it is not as drastic as it was during 2020/2021.



**Figure 5: Energy cost breakdown**

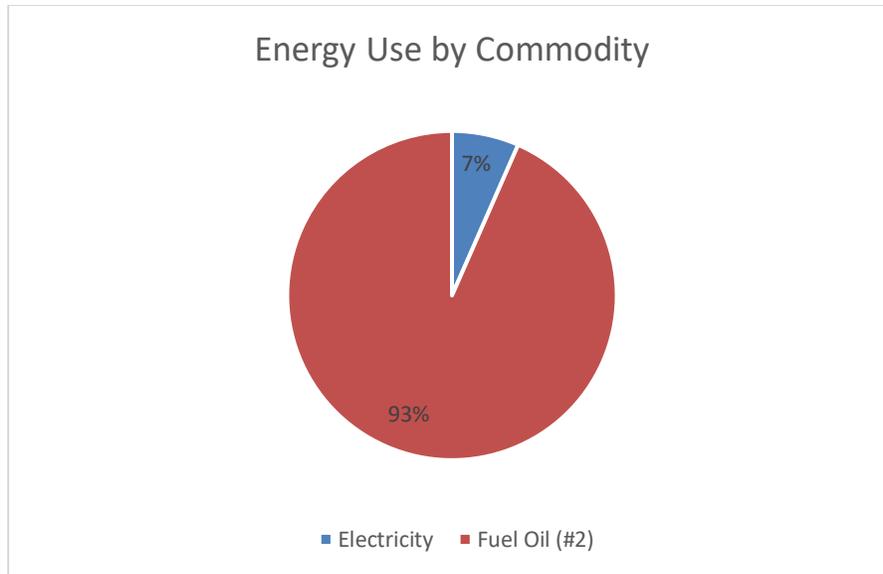


Figure 6: Energy use by commodity

Figure 7 shows monthly electric consumption over the past three years. Electricity use over these years has been relatively constant, and the trend remains similar. Peak electricity use occurs during the winter months, consistent with the pumps and fans associated with the heating system increasing electricity use during this time as well as some electric resistance heat being used. This peak is two to three times the summer electricity, which is the lowest electricity use time of year. This indicates that while cooling may be used it is not currently a significant energy consumer. The portable air conditioning units on the second floor observed during the site visit were manufactured in 2021 indicating that energy use of these units may not be present in the data from 2020 and 2021, and from the monthly trends energy use in the summer was slightly higher in 2023 than 2021 and 2022.

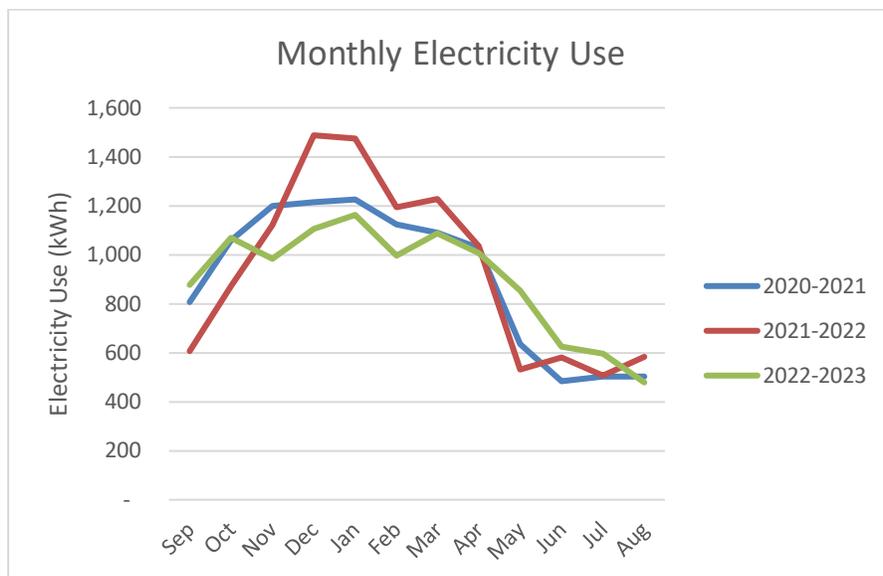


Figure 7: Monthly Electric Consumption

## BENCHMARKING

Benchmarking involves comparing a building’s energy performance to other buildings of similar type in a similar climate. The utility data for the year ending August 2021 was used to calculate the overall building performance in ENERGY STAR Portfolio Manager (Figure 8). The site Energy Use Intensity (EUI) is 77.1 kBtu/sf/yr, which compares to the national median of 174.2 kBtu/sf/yr for buildings with a primary property type of “Mixed Use Property” located in similar climates. This results in an ENERGY STAR score of 92, indicating the building is performing better than 92% of similar peer buildings. However, there are still opportunities available for improvement, as discussed in Section V.

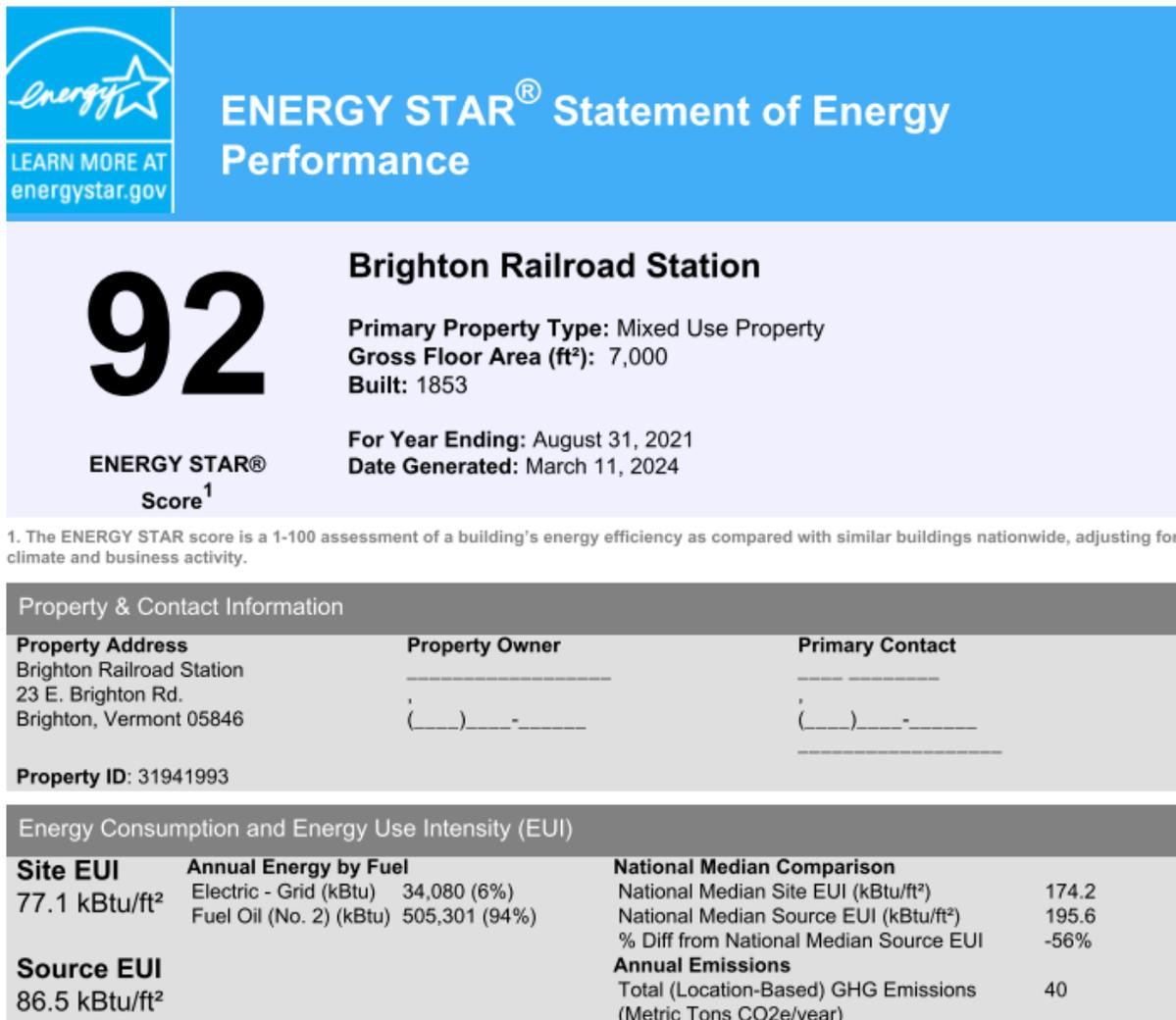


Figure 8: ENERGY STAR Statement of Energy Performance

## END USE BREAKDOWN

An energy model was created to disaggregate energy end uses at the building. The model is informed by historical utility data, equipment nameplate and data gathered on site, and engineering estimates. An energy end use breakdown is useful for identifying the end uses with the largest consumption and thereby targeting those areas for improvements. Additionally, the model can be

used as a baseline to which energy savings estimates can be compared to ensure reasonability. Figure 9 shows the percentage attributable to each end use. The major electric end uses for the building are lighting, space heating, plug loads, domestic hot water, hot water distribution pumps, fans, and space cooling.

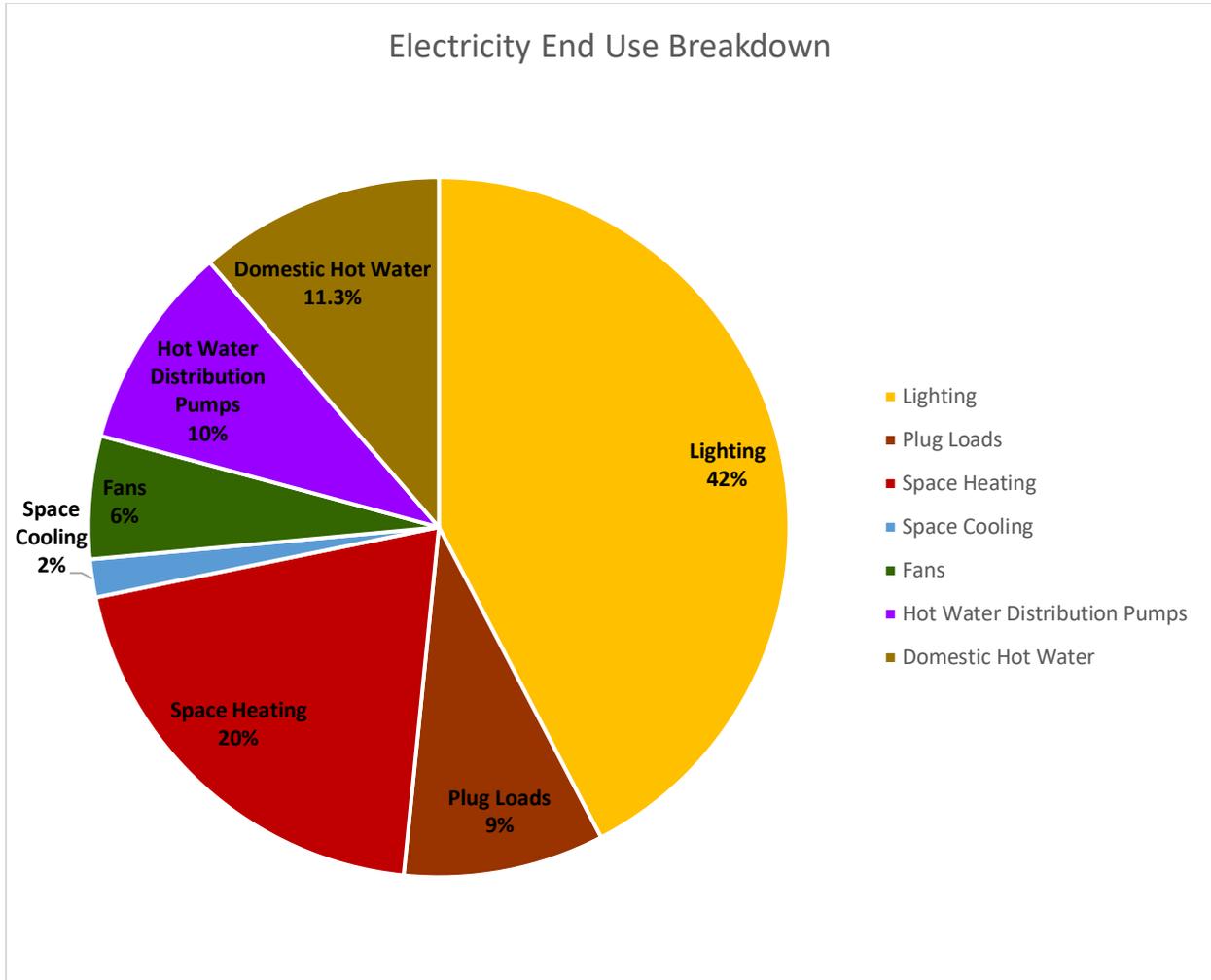


Figure 9: Annual Electric End Use Breakdown

## V. Energy Efficiency and Resiliency Opportunities

As presented in Table 1 (shown again below), if all recommended energy efficiency opportunities are implemented, there would be an estimated energy cost savings of nearly \$10,000/yr<sup>7</sup>.

**Table 4: Energy Efficiency Measure Summary**

ID	Measure Description	Electricity Savings	Fuel Oil Savings <sup>1</sup>	Wood Pellet Usage	Energy Cost Savings	Measure Cost	Return on Investment (ROI)	Recommended?
		kWh/yr	gal/yr	lb/yr	\$/yr	\$	%	Y/N
1	Insulation at Exterior Wall Assembly	-	1,251	-	\$ 4,879	\$34,660	14%	Y
2	Window Improvements	-	443	-	\$ 1,728	\$12,925	13%	Y
3	Weatherstripping at Exterior Doors	-	63	-	\$ 246	\$1,195	21%	Y
4	Sealing Penetrations at Exterior Walls	-	39	-	\$ 152	\$530	29%	Y
5	Seal the Fireplace in the Bank	-	12	-	\$ 47	\$260	18%	Y
6	Comprehensive LED Lighting Upgrade	1,717		-	\$ 355	\$4,880	7%	Y
7	Heat Pumps for Space Heating	(24,113)	1,829	-	\$ 2,153	\$28,500	8%	Y
8	Heat Pump Water Heater	913		-	\$ 189	\$3,000	6%	Y
9	Programmable Thermostats	-	75	-	\$ 293	\$1,300	23%	N
10	Wood Pellet Boiler for Space Heating	-	1,829	(31,571)	\$ 1,924	\$32,400	6%	N
	<b>Recommended Total</b>	<b>(21,483)</b>	<b>3,637</b>	<b>-</b>	<b>\$9,748</b>	<b>\$85,950</b>	<b>12%</b>	

<sup>1</sup> This assumes a Fuel Oil cost of \$3.90/gallon consistent with average fuel oil price in Vermont for January 2024.

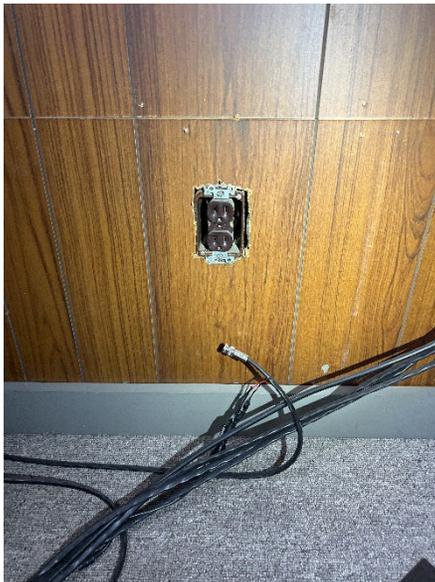
This section provides a description of the energy efficiency measures that have been analyzed. For each measure, high-level implementation costs were estimated by Cx Associates using RS Means and/or previous project experience. The measures are quantified in the previous summary table and described in the text below.

<sup>7</sup> Energy cost savings use assumed 2024 rates for electricity and fuel oil.

## MEASURES RECOMMENDED FOR INCLUSION IN AN UPGRADE

### 1: Insulate Exterior Walls

The largest issue identified during this assessment was the lack of insulation present at the exterior wall assemblies. These wall assemblies are primarily brick masonry on the exterior with wood stud framing/strapping to support drywall or wood paneling on the interior, with air spaces of various depths. No insulation was found at any location within the exterior wall assembly. Without performing more destructing sampling it was difficult to determine the exact depth of framing and air spaces between the interior finish and the back of brick masonry, but this was typically approximately 3".



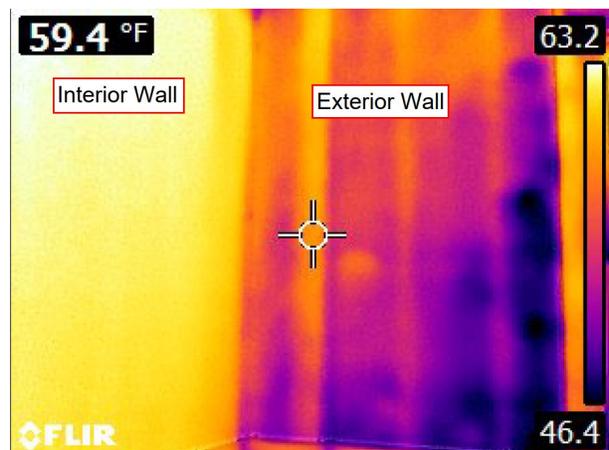
*A typical outlet on an exterior wall on the 2<sup>nd</sup> floor.*



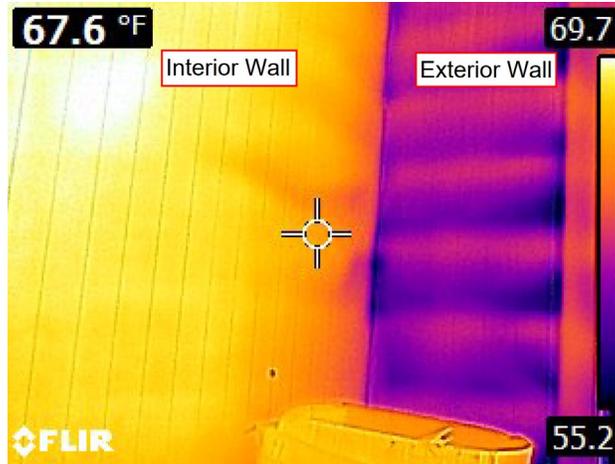
*Looking around this outlet the back of brick is visible, no insulation is present.*



*Looking behind another outlet on an exterior wall, similar findings with the back of brick visible.*



*An example of a location where an exterior wall meets an interior wall, the exterior wall is visibly much cooler.*



*Another example of an exterior wall compared to an interior wall.*

### Recommended Actions

Considering there is currently no insulation in the exterior wall assemblies, there is tremendous opportunity to increase the R-value here and reduce the overall energy usage. However, this assembly does present a number of challenges which are listed below.

### Access

As mentioned previously, without performing destructive sampling it was difficult to verify the exact makeup of the exterior wall assembly in all locations. This leaves some unknowns regarding the total cavity depth, and the presence of any obstruction in the cavity such as blocking. Because the walls within this building are completely finished it would require massive demolition to remove the finishes and expose the wall cavities and insulate with a material such as spray foam or batt insulation. To avoid this, a blown-in insulation approach is recommended to minimize the impact on the existing finishes.

### Moisture

As described above, there does not appear to be any exterior sheathing on the building, the back of brick masonry is exposed to the wall cavity. Because there is no dedicated weather barrier or drainage plane behind the brick this cavity is much more susceptible to moisture and bulk water. This makes installing insulation types such as cellulose and fiberglass risky since they may absorb some of this moisture. When these insulation types become wet their R-value decreases, they settle and leave voids, and can grow mold. To avoid these types of issues, a water-resistant insulation such as mineral wool should be used. Mineral wool insulation is considered hydrophobic and does not absorb water like fiberglass or cellulose. Mineral wool insulation is available as a blown-in product, so can be installed without completely removing interior finishes.

### Impact on Exterior Brick

Blown-in mineral wool insulation may be acceptable given the access and moisture challenges, however an analysis would still need to be performed to determine the impact additional insulation and R-value would have on the exterior brick. Adding insulation into these wall cavities would increase the R-value of the wall assembly while also preventing warm air from migrating to the back side of the exterior brick. This not only makes the brick colder, but reduces its ability to dry out in the colder winter months as there is no longer warm air reaching the back side. This increases the potential for the bricks to become saturated and potentially spall during freeze/thaw

cycles. Before any insulation is added a density assessment of the brick should be conducted to verify its current condition, and a full analysis (such as a WUFI) should be done to verify if insulation is acceptable. A WUFI analysis uses variables such as temperature, moisture levels, R-value, permeability of materials, and other factors to provide insight into the performance and durability of construction assemblies. This analysis will be critical in determining if a ~3" cavity filled with blown-in mineral wool insulation can be achieved without potentially compromising the exterior brick.

To summarize, while there is a great opportunity to improve the performance of this assembly the challenges of access, moisture, and the impact on the exterior brick must be assessed before any action is taken.

## **2: Window Improvements**

There are two main types of windows present at this building. The 1<sup>st</sup> floor windows are all wood framed single pane windows with an exterior wood framed single pane storm window fastened in place. The 2<sup>nd</sup> floor windows are primarily aluminum framed single pane windows which have an exterior aluminum framed single pane storm as well. There are also some wood framed windows on the 2<sup>nd</sup> floor with aluminum storms. The 3<sup>rd</sup> floor (attic) windows appear to be wood framed but are outside of the thermal boundary, so they were not closely inspected.

Overall, the windows of this building were not performing well with significant air leakage visible, and poor insulating R-value. Single pane glass has an R-value of approximately 0.9 and the aluminum frames have a high thermal conductivity compared to other window framing materials such as wood, vinyl, or fiberglass which contributes to the heat loss. Exterior storms improve the R-value by adding an additional pane of glass and an insulated air space, however this improved R-value is dependent on a tightly fitting storm window. If the storm window is left open or if it is poorly sealed, cold exterior air is able to bypass it and virtually eliminate its effectiveness. Several of the storm windows on the 2<sup>nd</sup> floor were found to be open, and many of the aluminum framed storms & windows were found to be very leaky. A mix of results was found at the first-floor windows. Some units were found to have significant air leakage while others performed relatively well. The performance of each unit appeared to be connected to the condition of the gasketing of the exterior storm windows. Those with continuous gasketing that was well compressed performed much better than those with damaged or poorly fitted gasketing. The window rough openings also appeared to be very leaky, as cold air could be seen consistently entering around the wood trim.

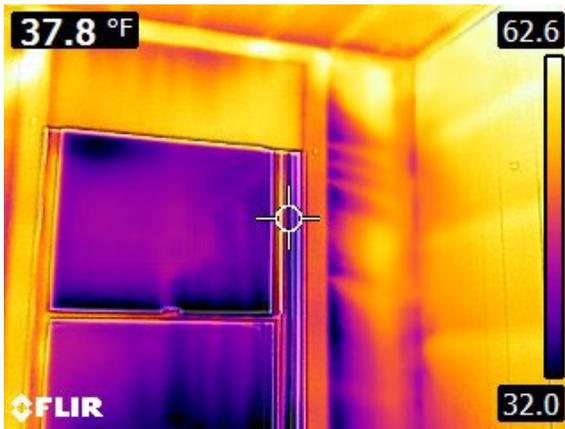
Many of the windows were also in poor condition regarding operability, as some of the hardware was missing on the wood frame windows and the ropes for the weighted systems were cut. Since the storm windows on the first floor are sealed in place, the windows are assumed to be no longer operable.



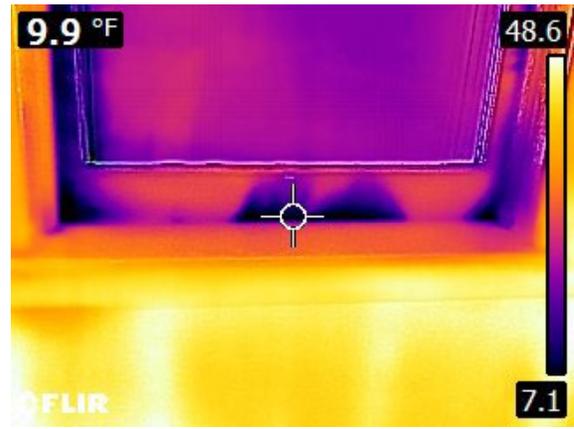
*An example of wood framed windows on the 1<sup>st</sup> floor with wood framed storms.*



*Aluminum framed windows on the 2<sup>nd</sup> floor.*



*Air leakage visible around the wooden trim at the window jamb.*



*Air leakage under a window sill, the air entering is ~10 degrees.*



*An example of an aluminum framed window that is unable to close fully. This was found in several locations.*



*An example of foam gasketing present at the wood storms on the first floor. This helps provide a much tighter seal than what was found at the aluminum storms.*

Recommended Actions

Full window replacements are typically extremely costly and result in very long payback periods, preventing them from being a cost-effective solution. Given the performance of the wood framed windows on the 1<sup>st</sup> floor and the condition of their exterior storms, replacement at these locations is not recommended at this time. However, Cx Associates would recommend improving the gasketing at the exterior storms where damage or voids are present.

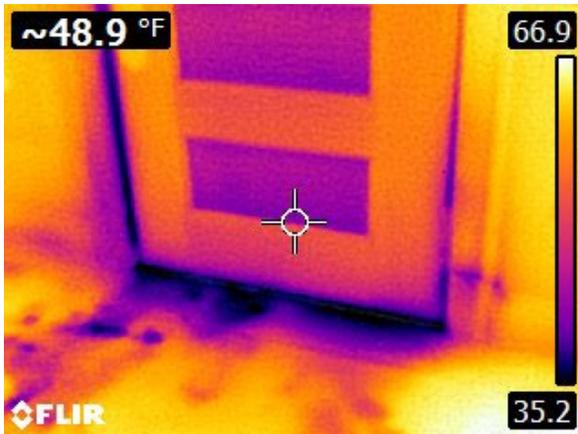
The windows at the 2<sup>nd</sup> floor (both wood framed and aluminum framed) performed much worse and would benefit from some modifications. Again, a full replacement is likely not a cost-effective solution especially given the relatively low use the upstairs portion of the building appears to receive. At these 2<sup>nd</sup> floor windows, Cx Associates would recommend someone is hired to perform basic repairs as needed to ensure all windows are able to fully close, and broken glass is replaced. In addition to this, interior window inserts could be installed to reduce the air leakage around the window unit and improve the R-value. This window insert would be very similar to the exterior storms present at the first floor. They can be framed with wood, fiberglass, acrylic, or other materials, are typically a single pane of glass, and have foam/rubber gasketing around the perimeter. They can be custom sized and installed around the interior trim of the existing window openings without any major demolition. While in place they will prevent the windows from being operable, but they are also removable if they are not desired in the warmer months. At pricing of around \$35/square foot, they are much more affordable than a full replacement.

The air leakage around the rough openings of the windows can be improved by removing the interior trim and applying low-expanding canned spray foam around the perimeter. If installed continuously without voids this foam will drastically reduce the air leakage around the rough opening and provide some improved R-value. If the wood trim is removed without major damage, it can also be re-installed without replacement trim needed.

The historical classification of this building is also another factor that must be considered prior to making any changes to the exterior assembly. If this is a historical building, the ability to replace or modify windows is typically limited. However, the presence of aluminum framed windows at the 2<sup>nd</sup> floor indicates this is not a factor for at least this floor of the building.

### 3: Improve Weather Stripping at Exterior Doors

Several exterior doors are present on the 1<sup>st</sup> floor of this building, most of which were poorly sealed and allowed air leakage as shown in the photos below. In some instances weather stripping such as brush seals were present, however they were loose and did not create a tight seal. The majority of the leakage appeared to be around door thresholds where no door bottoms or sweeps were present.



*An example of air leakage at the threshold of the bank entry door.*



*Another example of air leakage around the threshold of an exterior door.*



*Daylight is visible at the bottom of several exterior doors.*



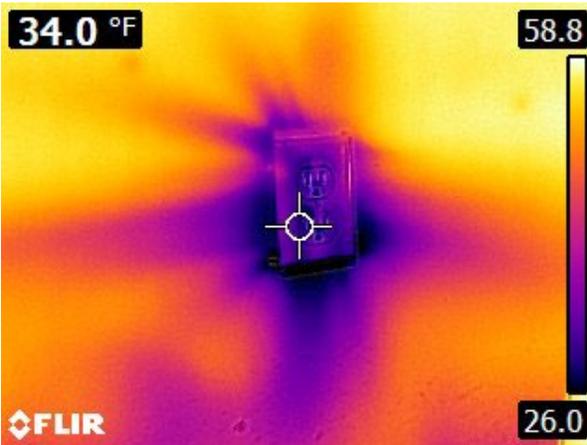
*Weatherstripping is in place at the ATM vestibule doors, but do not provide a tight seal.*

#### Recommended Actions

To reduce the air leakage around these exterior doors Cx Associates recommends installing or replacing weather stripping around the perimeter. Where they are missing, door bottoms should be installed to establish a tight seal between the door and threshold. Neoprene, rubber, or foam gasketing around the head and jambs will also reduce the air leakage. After this weatherstripping is installed, doors should be adjusted as needed to ensure they fit tightly against the gasketing when closed.

#### 4: Sealing Penetration on Exterior Walls

Without a dedicated air barrier layer in the exterior wall assembly, the interior finish materials such as drywall and wood paneling act as this barrier. Electrical boxes such as outlets and switches were the most common penetrations in the exterior wall, and they consistently showed significant air infiltration. As shown in the photos below, the air entering around outlets was typically around 30 degrees colder than the surrounding surfaces.



*An example of an outlet on and exterior wall with air leakage visible.*



*Another example of an outlet with cold air leakage.*

#### Recommended Actions

Air leakage at these switches and outlets could be reduced by removing the cover plates and caulking the perimeter of the outlets to the drywall/wood paneling, eliminating the gap around the boxes. Another option would be to install foam pads behind the cover plates to create a better seal. Some air leakage will likely be present through the box itself where wire penetrations are present, but this cannot be improved without removing finishes to expose the back of these boxes.

#### 5: Seal the Fireplace in the Bank

The fireplace located at the first floor bank was found to have cold air infiltration around the damper/connection to the chimney. This fireplace is no longer in use and the damper has been stuffed with fiberglass insulation. While this fiberglass provides some R-value, it does not provide an air seal and still allows heat to escape or cold air to enter.



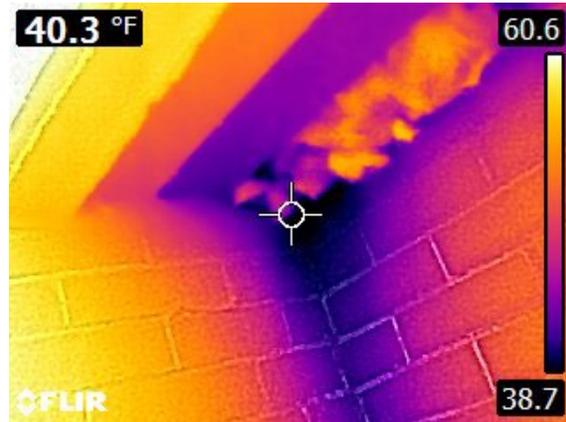
*A view of the fireplace in the bank, it is no longer in use and only for aesthetics.*



*IR imaging of the fireplace, the brick in this opening is much cooler than the surrounding areas.*



*Looking up into the chimney, some fiberglass is present but this is not creating an air-tight seal.*



*IR imaging looking up into the chimney.*

**Recommended Actions**

Since this fireplace is no longer in use, Cx Associates recommends installing a more permanent and airtight seal around the damper and chimney. Closed cell spray foam would be the best material for this, as it will seal the space and provide some R-value. If the damper is able to be removed to access the chimney, a small enclosure could be constructed in the shaft to create a backstop to support rigid foam insulation, with spray foam around the perimeter. As it is currently, spray foam could be added in the small gap to replace the fiberglass, but it could likely not cover the metal damper entirely without being visible from the interior and impacting aesthetics.

**6: Comprehensive LED Lighting Upgrade**

Lighting in the Brighton Railroad Depot is provided by an array of fixture types and lighting technologies. Many of the fixtures already use LED bulbs or LED lamps, but many fixtures are T8, CFL, incandescent or T9 technology. Cx Associates recommend replacing all fixtures with LEDs. For most CFL and incandescent bulbs straight LED bulb replacement is appropriate. For T9 Cx Associates recommends a complete fixture replacement. For the T8 fixtures there are several

options for LED upgrades, including the following, listed in order from lowest to highest capital cost and potential energy savings:

- Lamp-only replacements that leave the ballast in place (TLEDs)
- Fixture retrofits that include integral LED lamps and drivers installed in the existing fixture housing
- Complete fixture replacements

Cx Associates recommends using retrofit kits as a minimum, as lamp-only replacements are less efficient, along with the fact that fluorescent ballasts vary and not all ballasts will work with all TLEDs.

Along with the benefit of lower wattage compared to fluorescents, most LED fixtures have advanced control capabilities, including options for continuous dimming and integration of occupancy sensors and daylighting control. Incorporating these controls could result in additional energy savings, as well as allowing for adjusting light levels to exactly meet illuminance requirements. LED lamps also have a longer life than fluorescent lamps, leading to maintenance savings on lamp and ballast replacements. We recommend procuring LED products with dimming capability, so that light levels can be fine-tuned as needed, and ensuring that any retrofits meet the rating requirements of ENERGY STAR or the Design Lights Consortium (DLC), which set criteria for minimum efficacy levels and equipment life.

While building occupants appear to be diligent about turning off lights when not in use, we also recommend installing occupancy sensors in areas that are used intermittently such as restrooms and storage rooms. This way, lights will turn off automatically when no occupants are present. These can also be configured as “vacancy” sensors (i.e. manual on, auto off), so that manual input is required to turn on the controlled lighting, but the control automatically turns the lighting off, potentially leading to additional energy savings.

Savings and costs for this measure were estimated based on assuming one-for-one fixture retrofits. Some areas of the building may be underlit currently and the cost of a retro fit may increase if the overall lighting levels are increased. A more detailed lighting design analysis and illumination study may be warranted prior to implementation to ensure illuminance targets are met, but not exceeded, and occupant visual comfort is maintained.

## **7: Heat Pumps for Space Heating**

It is important to note that before exploring any major heating system upgrades, we recommend first implementing any feasible building envelope improvements that are described above. By reducing the building heating load as much as possible through air sealing and insulation, any new equipment can be sized appropriately to meet the reduced load, potentially resulting in a lower first cost.

The existing mechanical systems (hot water boiler for heating and split system AHU for cooling) were installed in 1993 (31 years old) and are most likely approaching the end of useful life. We recommend replacing this system with ductless mini-split or multi-split air-source heat pumps throughout the building. This would also have the ancillary benefit of providing cooling for the second floor. Alternatively, the existing air handler could be used to provide heating to the space with a ducted heat pump system on the first floor and ductless mini-split heat pumps on the second floor.

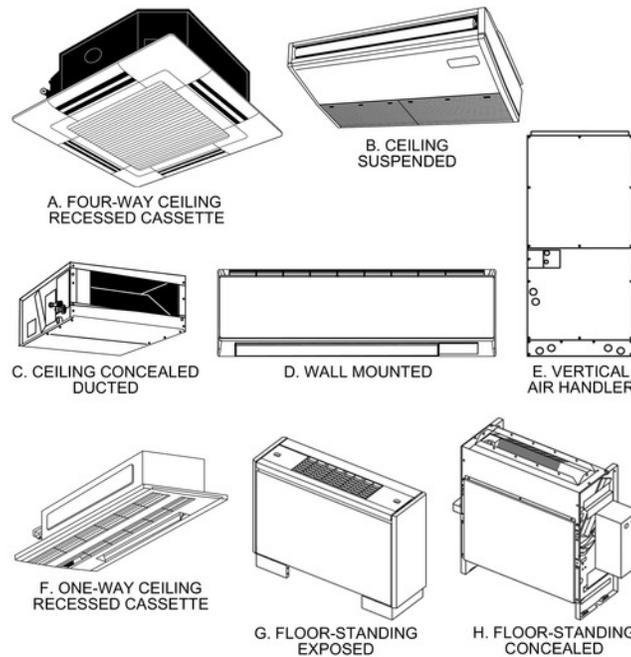


Figure 10: Heat pump indoor unit types

While air-source heat pump systems lose capacity and efficiency as outdoor air temperature decreases, major strides have been made in recent years to mitigate these effects in cold climates. Heat pumps designed for cold climates utilize technology that allows for operation at 100% nominal heating capacity down to 5°F and can operate at temperatures as low as -13°F. Therefore, while a heat pump could meet the heating requirements for most of the year, in a climate like Vermont's it is important to have some form of backup or supplemental heating. The existing boiler, while over 30 years old, is still functioning and could provide this back-up heat, as is the air handling system that has electric resistance heating installed. Alternatively, the existing systems could be decommissioned altogether, and a separate back-up system could be installed. This could be electric resistance heat or wood heat. Electric resistance heat can require significant electrical panel capacity and is more expensive to operate but tends to have a lower up-front cost. The annual number of hours a backup heating system would be required to operate is expected to be quite low. Note that an upgrade to electrical service may be required to accommodate the installation of heat pumps, the cost of which is not included in the implementation cost estimate.

## 8: Heat Pump Water Heater

The existing domestic hot water heater is a 40-gallon electric model. We recommend replacing this domestic hot water heater with a heat pump water heater. Heat pump water heaters are much more efficient than electric resistance water heaters, and can also help dehumidify and cool the surrounding space. For the type of use in this building, the unit could operate in heat pump only mode, which has a slower recovery time but is three times more efficient than an electric water heater. Hybrid mode uses the heat pump for most hours but will also use an electric resistance element to achieve faster recovery times if required. We recommend procuring a heat pump water heater that exceeds the minimum ENERGY STAR requirements.

## 9: Programable Thermostats

Currently, space heating temperature setpoints are controlled manually through thermostatic radiator valves, which are not compatible with programable thermostats. If heat pumps, or other controllable heating technology is installed as recommended in Measure 7, then set-backs could be used for the less occupied second floor of the building. We recommend installing programmable thermostats to automatically enable unoccupied temperature setbacks unoccupied times. Note that temperature setbacks are not recommended with heat pump systems for regularly occupied spaces.

Many mini-split heat pump systems come with built-in programable thermostats. These may not require any additional hardware, eliminating the upfront cost of this measure.

## MEASURES INVESTIGATED BUT NOT RECOMMENDED

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The measures described below were investigated but ultimately not recommended due to poor economic performance, whereby the simple payback period exceeds the expected life of the measure.

### 10: Wood Pellet Boiler

Another heating alternative that was investigated is a wood pellet boiler. This could provide either primary or back-up heat to the building. CxA recommends pursuing this option for back-up heat with the ductless mini-split system above when the existing boiler reaches its end of life. Modern wood pellet boilers can be almost entirely automated requiring regular fuel delivery of pellets and occasional cleaning of ash. Wood pellets are cheaper per unit energy than fuel oil and while the upfront cost of wood pellet boiler is typically higher than oil boilers the long-term savings often outweigh this initial cost difference. In our analysis we used \$0.165/lb of delivered wood pellets as the cost seen by another municipality that has a wood pellet boiler.

We recommend working with a mechanical contractor to identify the best system balancing cost, existing infrastructure, and desired outcome at the Brighton Railroad Depot.

## OTHER COMMENTS

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### 1. Insulation at Attic

It is worth noting that the attic space is very well insulated, with approximately 16" of blown-in cellulose insulation resulting in an R-value of approximately 50. As shown in the photos below, there were some signs of water damage in the attic space in several locations. Water drops and staining could be seen on the cellulose insulation. It was unclear if this is the result of previous leaks that have since been repaired, or if these are active leaks. The roof was not available to safely inspect from the exterior during this assessment. Cx Associates recommends these locations are reviewed with maintenance staff to determine if they were known and previously repaired. Water infiltration will reduce the effectiveness of the insulation and eventually cause damage to the structure and interior finishes.



*A view of the attic with good insulation coverage.*



*Approximately 16" of blown-in cellulose insulation.*



*An example location where water staining is visible on the insulation below a rafter.*



*Another location where there was evidence of water dripping into the insulation.*

## **2: Energy Recovery Ventilator**

Energy recovery ventilators (ERVs) use heat from exhaust air to preheat incoming outdoor air, reducing the amount of energy needed to condition the outdoor air (Figure 11). These can recover up to 80% of the heat being exhausted. They can also work to cool incoming air during the summer. At the Brighton Railroad Depot the existing AHU could be replaced with an ERV. This will require increasing the fan power to remove exhaust air from the building but will decrease the heating and cooling loads.

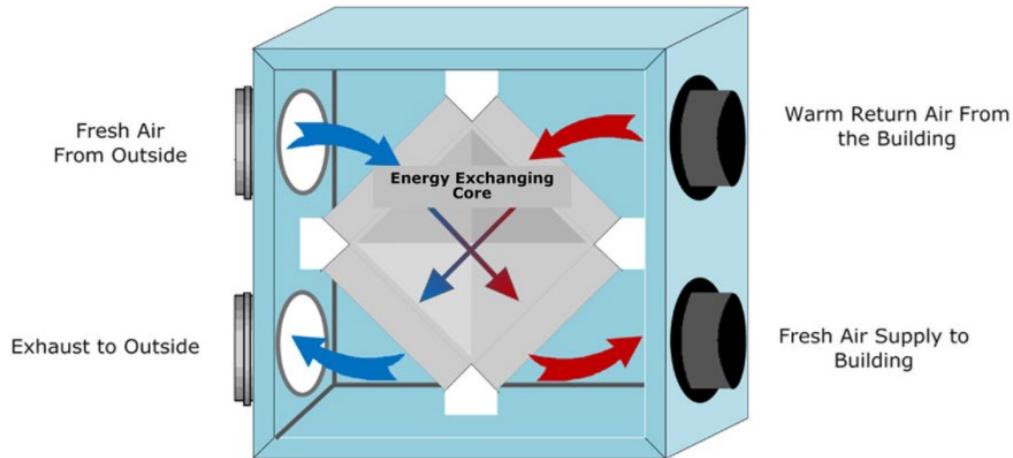


Figure 11: Energy recovery ventilation diagram

## RESILIENCY MEASURES

### Battery Storage

Battery storage is increasingly being used in buildings as costs decline and potential applications increase. Some of the benefits may not be immediately available, but it is worth considering installing battery storage so that the building can take advantage in the future. Potential applications include the following:

- During power outages, use battery storage to provide power to the building.
- Currently, the utility tariff does not include time-of-use or peak demand components, but this may change in the future. Batteries can be charged during off-peak hours when prices are lower, and then discharged during peak hours to save on energy costs.
- Batteries can contribute to grid stability, by providing power to the grid during periods of high demand, and absorbing power during periods of excess renewable energy production. Green Mountain Power, the largest utility in Vermont, is pursuing a strategy of installing battery storage in the buildings it serves in order to help manage power outages and the load on the grid.
- If on-site renewable energy generation is installed, excess energy can be stored in the battery.

There appears to be sufficient space in the basement to install a battery, but it may need to be placed on a different wall than the electric panels (Figure 13). A single lithium-ion battery has a capacity of around 14 kWh, which would be able to meet the facility's electricity needs for around a day during the summer and part of the shoulder seasons but less during winter<sup>8</sup>. Battery costs may amount to around \$1,200 per kWh, so an installation may cost around \$17,000.

<sup>8</sup> Based on existing conditions.



Figure 12: Electrical panels

### Electric Vehicle Charging

As electric vehicles become more common, it will be useful to have electric vehicle charging stations located at buildings for staff and visitors. There are three types of chargers available (Level 1, 2, and 3) – Level 2 chargers would be most appropriate for the facility, which charge at 240V and can typically add 10-20 miles per hour of range to the battery. There appears to be room in at least two of the main electric panels to add circuits for EV chargers, which typically require 40-amp circuits for Level 2 chargers. There is also room in the parking lot for chargers (Figure 14). Level 2 chargers cost around \$800 for just the hardware, but total installation costs can be significantly higher as electrical service will need to be provided through a trench from the main panel to the charging area (\$5,000-10,000).



Figure 13: Potential area for EV chargers

### On-Site Renewable Energy Generation

Photovoltaic panels for solar power generation may be placed on the south side of the building's roof amounting to around 5.0 kW DC system size (larger may be possible). This would result in an annual production of around 6,000 kWh. At a cost of \$3 per installed watt, the system cost would be around \$15,000.

## VI. Conclusion

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The Brighton Railroad Depot has multiple opportunities to reduce operating costs and concurrently upgrade aging infrastructure in a cost-effective manner.

Cx Associates' recommendations are based on a fundamental operational strategy to mitigate the equipment operating efficiency penalties while maintaining a very high level of indoor environmental quality. Cx Associates suggests the following fundamental core practices:

- Consider the building from a holistic perspective. The different systems must all work together.
- Size equipment based on current building loads and use.
- Establish a market opportunity practice of replacing failed equipment with new correctly-sized, high efficiency equipment.
- Include a quality assurance program (building commissioning) for building expansion/renovation and equipment replacement.

The steps necessary to begin to reduce energy use and improve comfort at the Brighton Railroad Depot are:

1. Select the desired measure package from this report and arrange for funding.
2. Retain the services of a design engineering firm<sup>9</sup> having the skills, knowledge and experience with efficient execution of high-performance systems.
3. Obtain specifications and engineering design for the opportunities and any other projects prioritized for immediate implementation.
4. Procure contractor and commissioning pricing, and review pricing with the designer.
5. Ensure thorough review of contractor-proposed equipment and control sequences to confirm the design intent is being fulfilled and all assumptions within the audit analysis are included. This review should be undertaken by Cx Associates to help ensure the building upgrades will deliver the expected savings.
6. Implement measures and commission installation to ensure equipment is optimized and operates as designed.
7. Perform measurement and verification of savings and survey occupants regarding thermal comfort.
8. Report out to stakeholders on the project outcomes.

End of report.

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<sup>9</sup> Cx Associates offers design engineering services for energy retrofits to building HVAC and control systems.

## VII. Appendix A: Building Envelope Test Results

### BLOWER DOOR TEST RESULTS

The whole-building air leakage was measured and normalized, resulting in an air leakage rate of **0.59** cubic feet per minute at 50 pascals of pressure per square foot (CFM50/SF) of exterior building shell, based on 6 quantified sides of the envelope.

Field Measured CFM @ 50 Pascals	Temperature adjusted CFM @ 50 Pascals*	Field Measured CFM @ 75 Pascals	Temperature adjusted CFM @ 75 Pascals*	Square Feet of Building Shell (6 sides)	CFM50/SF (6 sides)	CFM75/SF (6 sides)
9,602	9,003	11,872	11,130	15,166	<b>0.59</b>	<b>0.73</b>

\* Temperature adjusted CFM is a more accurate measurement of air flow as it accounts for air density differentials between conditioned and outdoor ambient space.

#### Environmental Conditions & Building Configurations

1. All exterior doors were closed.
2. All interior doors were propped open.
3. Attic hatch was closed.
4. Furnace was shut down.
5. All mechanical equipment was left unmasked.
6. One blower door setup was installed at the entrance of the 2<sup>nd</sup> floor stairs, another setup was installed at the east end of the building with the stairs to the basement.

Outside Temperature	<b>5 °F</b>
Inside Temperature	<b>69 °F</b>
Wind Conditions	<b>0-5mph</b>
Time of Test	<b>9:45am</b>

### RESULT BENCHMARKING

The table below is used to compare the results of this building to common whole-building air tightness benchmarks, as normalized by the indicated number of sides.

Air Tightness Benchmarks for Envelopes w/ 6-sided Surface Area Calculations	CFM50/SF of Shell	CFM75/SF of Shell
<b>Groundworks Collaborative – 60 South Main Street</b>	<b>0.59</b>	<b>0.73</b>
US Passive House (PHIUS+ 2021 – prescriptive)	0.06	0.08
Beyond High-Performance Air Barriers (approx.)	<0.11	<0.15
2020 VT CBES Reduced Air Infiltration (C406.9)		<0.25
High Performance Air Barriers (approx.)	<0.21	<0.25
US Army Corps of Engineers Air Leakage Test Protocol		0.25
2020 VT CBES Code Minimum (C402.4.1.1)		<0.30
2021 International Energy Conservation Code (C402.5.3)		0.40
Leaky Construction (approx.)	>0.45	>0.50

These results indicate that the building’s air barrier is very leaky when compared to today’s code standards. Drastic Improvements would be needed to reach 2020 VT CBES Code Minimum of 0.30 CFM75/SF of shell. This would require a reduction of 6,580 CFM of air leakage, approximately 59%.

## VIII. Appendix B: Project Stakeholder Information

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**Table B1: Contact Information for Project Stakeholders**

Name	Affiliation	Role	E-mail	Phone
Brian Sewell	State of Vermont Buildings and General Services	State Energy Program Manager	<a href="mailto:brian.sewell@vermont.gov">brian.sewell@vermont.gov</a>	(802) 622-4291
Daniel Tuhus-Dubrow	Cx Associates	Energy Assessor	<a href="mailto:daniel@cx-assoc.com">daniel@cx-assoc.com</a>	(802) 861-2715 x21
Alan Therrien	Cx Associates	Energy Assessor	<a href="mailto:alan.therrien@cx-assoc.com">alan.therrien@cx-assoc.com</a>	(802) 595-9478
Mike LaCrosse	Cx Associates	Energy Assessor	<a href="mailto:mike.lacrosse@cx-assoc.com">mike.lacrosse@cx-assoc.com</a>	(603)-545-1438
Noah Bond	Town of Brighton	Town Manager	<a href="mailto:noah@brightonvt.gov">noah@brightonvt.gov</a>	802-343-8947