MUNICIPAL ENERGY RESILIENCE PROGRAM
LEVEL I ENERGY AUDIT

prepared for

Vermont Department of Buildings & General Services
133 State Street, 5th Floor,
Montpelier, Vermont 05633-5801

Mr. Brian Sewell

And

The Town of Johnson

Town Garage
663 Railroad Steet
Johnson, Vermont 05656

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BV PROJECT #:
161246.23R000-063.267

DATE OF REPORT:
April 8th, 2024

ON SITE DATE:

DECEMBER 20, 2023

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Certification

Bureau Veritas has completed an MERP Level I Energy Audit in accordance with the State of Vermont ACT 172 at Town Garage located at Town Garage in Johnson, Vermont. Bureau Veritas visited the site on December 20, 2023.

The assessment was performed at the Client's request using methods and procedures consistent with MERP Level I Energy Audit and using methods and procedures as outlined in Bureau Veritas's Proposal.

This report has been prepared for and is exclusively for the use and benefit of the Client identified on the cover page of this report. The purpose for which this report shall be used shall be limited to the use as stated in the contract between the client and Bureau Veritas.

This report, or any of the information contained therein, is not for the use or benefit of, nor may it be relied upon by any other person or entity, for any purpose without the advance written consent of Bureau Veritas. Any reuse or distribution without such consent shall be at the client's or recipient's sole risk, without liability to Bureau Veritas.

Estimated installation costs are based on Bureau Veritas's experience on similar projects and industry standard cost estimating tools including *RS Means and Whitestone CostLab*. In developing the installed costs, Bureau Veritas also considered the area correction factors for labor rates for Johnson, Vermont. Since actual installed costs may vary widely for particular installation based on labor & material rates at time of installation, Bureau Veritas does not guarantee installed cost estimates and shall in no event be liable should actual installed costs vary from the estimated costs herein. We strongly encourage the owner to confirm these cost estimates independently. Bureau Veritas does not guarantee the costs savings estimated in this report. Bureau Veritas shall in no event be liable should the actual energy savings vary from the savings estimated herein.

Bureau Veritas certifies that Bureau Veritas has no undisclosed interest in the subject property and that Bureau Veritas's employment and compensation are not contingent upon the findings or estimated costs to remedy any deficiencies due to deferred maintenance and any noted component or system replacements.

Any questions regarding this report should be directed to Ivan Meneses, PE, CEM, at 800.733.0660, ext. 7296267.

Prepared by: Mike Doheny
Project Manager

Reviewed by:

Ivan MENESES, PE, CEM
Sr. Energy Project Manager

1. Executive Summary

The purpose of this MERP Level I Energy Audit is to provide Vermont Department of Buildings & General Services and Town Garage with energy efficiency opportunities at the facility and specific recommendations for Energy and water Conservation Measures (ECM's). Information obtained from these analyses may be used to support a future application to an Energy Conservation Program, Utility grants towards energy conservation, or as a basis for replacement of equipment or systems.

Building Type / Name	# Bldgs	# Stories	Year Built/ Renovated	Building Size	Estimated Occupancy
Town Garage	1	1	1975	7,000 SF	10

The study included a review of the building's construction features, historical energy and water consumption and costs, review of the building envelope, HVAC equipment, heat distribution systems, lighting, and the building's operational and maintenance practices.

Summary of Existing Energy Performance	
Percentage Area Cooled	20%
Percentage Area Heated	100%

1.1. Energy Conservation Measures

Bureau Veritas has evaluated 5 Energy Conservation Measures (ECMs) for this property. The savings for each measure is calculated using standard engineering methods followed in the industry. A 10% discount in energy savings was applied to account for the interactive effects amongst the ECMs. In addition to the consideration of the interactive effects, Bureau Veritas has applied a 15% contingency to the implementation costs to account for potential cost overruns during the implementation of the ECMs.

For this site we did not receive utility data. Therefore, we estimated the energy consumption shown in Section 2.2.

Below is a general description of the recommended energy conservation measures:

HVAC SYSTEM: Bureau Veritas has evaluated replacing the existing 305 MBH no.2 oil boiler with a 12.5-ton air cooled heat pump system. Installing a programmable thermostat to better control the equipment's operating hours will yield additional energy savings and is also recommended.

SOLAR AND BATTERY STORAGE SYSTEMS: Bureau recommends installing a 72 kW Photovoltaic system with an annual capacity of 84,194 kW/Hour. The array should BE INSTALLED on the roof . A 77 kilo-watt/hour battery storage system with an eight-hour energy storage capacity should also be installed. The battery storage system should be installed near the main electric panel. These recommendations are for planning purposes. Qualified electrical and structural engineers must be consulted to determine the electrical requirements and to evaluate the load-bearing capacity of the roof structure.

ELECTRICAL VEHICLE CHARGING STATIONS: Bureau Veritas recommends installing an EV charging station. There appears to be sufficient electrical capacity to add a 40-AMP breaker to accommodate an EV charging station. However, a qualified electrician must be consulted to determine to verify the electrical requirements.

WEATHER STRIPPING: Bureau Veritas recommends installing door and window sweeps that will reduce air leakage. Caulking the doors, windows and wall joints is also recommended.

ATTIC INSULATION: Bureau veritas recommended adding insulation to the current R-10 level in the interior walls to equal the ASHRAE standard of R-49.

. 1.2. Other Considerations

- ASHRAE LEVEL 2 AUDIT- Consider completing an ASHRAE Level 2 assessment to further evaluate additional energy conservation options such as lighting and water conservation measures among others.
- BMS SYSTEM- Consider installing a Building Management System (BMS) to control the HVAC system and lighting thought the building. A BMS system can provide substantial savings and improve occupant comfort.
- OTHER SOURCES OF ENERGY: Consider conducting a study for evaluation of alternative sources of renewable energy such as geothermal, wind and hydrogen.
- LED LIGHTING: Consider evaluating the feasibility of replacing all lighting with LED and installing lighting controls.
- WATER CONSERVATION: Consider replacing all inefficient faucets and aerators with water sense labeled models.
- The following table summarizes the recommended ECMs in terms of description, investment cost, energy consumption reduction, and cost savings..

Evaluated Non- Renewable Energy Conservation Measures: Financial Impact	
Total Projected Initial ECM Investment	$341,782
Estimated Annual Cost Savings Related to ECMs	$21,442
Estimated Annual Cost Savings- Electricity	$8,587
Estimated Annual Cost Savings- Propane	$0
Estimated Annual Cost Savings- Natural Gas	$0
Estimated Annual Cost Savings- Fuel Oil	$12,755
Net Effective ECM Payback	16 Years
Estimated Annual Energy Savings	76%
Estimated Annual Utility Cost Savings *(excluding water)*	70%

Onsite Renewable Energy Generation Solar Photo Voltaic Analysis	
Estimated number of panels	180
Estimated kW Rating	72 kW
Potential Annual kWh Produced	84,194 kWh
% of Current Electricity Load	100%
Investment Cost	$254,526
Estimated Energy Cost Savings	$15,155
Payback without Incentives	17 Years
Payback with All Incentives	17 Years

Battery Size	77 KW-hr
Battery Cost	$ 99,726

Energy Conservation Measures Sorting:

1. Simple Payback Period –The number of years required for the cumulative value of energy or water cost savings less future non-fuel or non-water costs to equal the investment costs of the building energy or water system, without consideration of discount rates. ECMs with a payback period greater than the Expected Useful Life (EUL) of the project are not typically recommended, as the cost of the project will not be recovered during the lifespan of the equipment. These ECMs are recommended for implementation during future system replacement. At that time, replacement may be evaluated based on the premium cost of installing energy efficient equipment.

$$Simple\ Payback = \frac{Initial\ Cost}{Annual\ Savings}$$

1.2. Assumptions

Bureau Veritas has made the following assumptions in calculation of the Energy Conservation Measures.

- Building operating hours are assumed to be 168 hours per week.
- The facility occupancy is assumed to be 20 people.
- Annual Heating Equipment Operating Hours are derived from actual consumption and equipment input rates to be 2500 hours/year.
- Annual Cooling Equipment Operating Hours are derived from actual consumption and equipment input rates to be 500 hours/year.

List of Recommended Energy Conservation Measures For Town Garage

		Description of ECM	Projected Initial Investment	Estimated Annual Energy & Water Savings			Total Estimated Annual Cost Savings	Simple Payback
			(a)	No.2 Oil	Electricity	Water		
			($)	(Gallons)	(kWh)	(kGal)	($)	(Yrs.)
1	Title:	Install Fixed Tilt Solar Photovoltaic System	$254,526	0	84,194	0	$15,155	16.79
	Attribute:	Install fixed tilt 72KW Solar Photovoltaic System consisting of 72kW Rooftop Fixed Array PV System;						
2	Title:	Improve Attic Insulation Levels	$14,581	429	0	0	$1,206	12.09
	Attribute:	Improve existing attic insulation from R-10 to R-49 by adding Batt Insulation						
3	Title:	Replace HVAC Units With Electric /Heat Pump HVAC Units	$26,290	3,579	-41,421	0	$2,492	10.55
	Attribute:	Replace (1x) 305MBH - 0 Ton RTU With (1x) 12.5 Tons - Heat Pump RTU System;						
4	Title:	Control External Air Leakage In Commercial Buildings	$1,248	716	0	0	$2,089	0.60
	Attribute:	Perform air sealing of building through Installing 76x linear feet of door sweeps						
5	Title:	Reduce HVAC Hours of Operation	$556	374	10,234	0	$2,882	0.19
	Attribute:	Self Learning Smart Thermostat - (2x) Sensors						
6	Title:	#N/A	$0	0	0	0	$0	#DIV/0!
	Attribute:	#N/A						
		Totals for No/Low Cost Items	**$556**	**374**	**10,234**	**0**	**$2,882**	**0.19**
		Total For Capital Cost	**$296,645**	**4,724**	**42,773**	**0**	**$20,942**	**14.16**
		Interactive Savings Discount @ 10%		-510	-5,301	0	-$2,382	
		Total Contingency Expenses @ 15%	$44,580					
Total for Improvements			**$341,782**	**4,588**	**47,706**	**0**	**$21,442**	**15.94**

2. Site Utilities

2.1. Utility Rates

The following utility rates were used for the purposes of savings analysis.

Average Utility Rates				
Electricity	Natural Gas	Wood	Propane / No.2 Oil	Water & Sewer
Average Rate	Average Rate	Average Rate	Average Rate	Blended Rate
$0.18 /kWh	$1.20/therm	$0.10/lbs	$1.96Gal/2.78Gal	$ 16.11/kgal

2.2. Site Utility Analysis

	Utility Analysis					
UTILITY TYPE	UTILITY PROVIDER	METER QUANTITY	ENERGY / WATER USES	ANNUAL CONSUMPTION	EST / ACT	ANNUAL COST
Electric	Vermont Electric Co-op	1	Includes lighting and appliances.	84,000 kWh	EST	$15,120
No. 2 Oil	Bournes Energy	-	Includes boiler, and space heaters	5,505 gallons	Est	$15,304

2.3. On-site Utility Storage

Onsite Utility Storage	
Fossil Fuel Storage	
No.2 Oil	1X – 240 Gal Above Ground Tanks

2.4. On-site Generation

Site Utilities	
Facility Electric Service Size	200 AMPS
Onsite Transformer	Pole-mounted

Electric Meter Location	Electrical Room

Emergency Backup Generators	
Generator Capacity	17 kW
Year Installed	Approximately 2010
Location Installed	Ground Mounted behind the old mill building
Space Served	Entire Building
Generator Fuel	Propane
Make	Generac

2.5. On-site Electric Vehicle Charging

Onsite Electric Vehicle Charging	
Onsite EV Charging Potential	
Spare AMPS at Main Electrical Panel	20 AMPS
Proposed Location of EV Charger	East end of the building
Recommended Charger Type	Type II
Proposed Quantity of Chargers	1 (40AMPs / Charger)
Potential Initial Investment	$4,500 / Charger

3. Introduction

The purpose of this Energy Audit is to provide Vermont Department of Buildings & General Services and Town Garage with a baseline of energy usage, the relative energy efficiency of the facility, and specific recommendations for Energy Conservation Measures. Information obtained from these analyses may be used to support a future application to an Energy Conservation Program, Federal and Utility grants towards energy conservation, as well as support performance contracting, justify a municipal bond-funded improvement program, or as a basis for replacement of equipment or systems.

The energy audit consisted of an onsite visual assessment to determine current conditions, itemize the energy consuming equipment (i.e. Boilers, Make-Up Air Units, DWH equipment); review lighting systems both exterior and interior; and review efficiency of all such equipment. The study also included interviews and consultation with operational and maintenance personnel. The following is a summary of the tasks and reporting that make up the Energy Audit portion of the report.

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Energy and Water Using Equipment

- Bureau Veritas has surveyed the common areas, offices, maintenance facilities and mechanical rooms to document utility-related equipment, including heating systems, cooling systems, air handling systems and lighting systems.

Building Envelope

- Bureau Veritas has reviewed the characteristics and conditions of the building envelope, checking insulation values and conditions. This review also includes an inspection of the condition of walls, windows, doors, roof areas, insulation and special use areas.

Recommendations for Energy Savings Opportunities

- Based on the information gathered during the on-site assessment, the utility rates, as well as recent consumption data and engineering analysis, Bureau Veritas has identified opportunities to save energy and provide probable construction costs, projected energy/utility savings and provide a simple payback analysis.

Energy Audit Process

- Interviewing staff and review plans and past upgrades
- Performing an energy audit for each use type. Performing a preliminary evaluation of the utility system
- Making preliminary recommendations for system energy improvements and measures
- Estimating initial cost

Reporting

The Bureau Veritas Energy Audit Report includes:

- A comprehensive study identifying all applicable Energy Conservation Measures (ECMs) and priorities, based on initial cost.

4. Facility Overview and Existing Conditions

4.1. Building Occupancy and Point of Contact

Facility Schedule	
Hours of Operations /Week	168
Operational Weeks/Year	52
Estimated Facility Occupancy	10

Facility Schedule	
Point of Contact Name	Jason Whitehall
Point of Contact Title	Building Manager
Point of Contact – Contact Number	802-635-2301

4.2. Building Envelope

The building envelope consists of the exterior shell, made up of the walls, windows, roof, and floor. The envelope provides building integrity and separates the exterior from the interior conditioned space.

Building Foundation	
Item	Description
Foundation	Concrete spread footings
Basement and Crawl Space	None
Basement Wall Insulation	None

Primary Roof			
Finish	Single-ply EPDM membrane	Coatings	None
Type / Geometry	Pyramid	Roof Drains	Gutters and downspouts
Maintenance	Outside Contractor	Main Ventilation Source	Power vents

Primary Roof			
Insulation	Fiberglass batts	Roof / Attic Insulation	R10 (EST)

Exterior Walls	
Type	Location
Primary Finish	Metal siding
Secondary Finish	None
Wall Insulation	None

Exterior Windows		
Location	Window Framing	Glazing
Garage	Vinyl-framed, operable	Double glaze

Exterior Doors		
Building Doors		Quantity
Main Entrance Doors	Metal, insulated	2
Overhead Doors	Aluminium	2

Door Comments:

The *Condition* field in the chart above refers to the condition of the perimeter weatherstripping and/or caulking around the doors and frames. *Caulking and weather stripping are in good condition.*

4.3. Building Heating, Ventilating, and Air-Conditioning (HVAC)

Overall System Description: The central fuel oil fired boiler serves the suspended garage heaters.

Building Central Heating System	
Primary Heating System Type	Hot water boilers
Heating Fuel	Fuel oil

Building Central Heating System	
Location of Major Equipment	Mechanical rooms
Space Served by System	Entire building
Heating System Input Capacity	305 MBH
Manufacturer's Rated Efficiency	80%
Heating Plant Age	1994
Heating Plant Condition	Fair

4.4. Building Lighting

Space Lighting:

Industrial light fixtures containing LED bulbs provide interior lighting in the buildings. The garage is observed to have both suspended low bay LED and surface mounted strip linear LED fixtures. The restroom has a recessed fan/light combo LED fixture.

Lighting Controls:

The facility doesn't have any automatic lighting controls on internal light fixtures

Emergency Lighting:

The EXIT signs in the facility consist of LED based fixtures.

Exterior Lighting:

Property-owned surface-mounted light fixtures on the exterior walls provide the exterior building with site illumination.

The exterior lighting primarily consists of LED fixtures.

4.5. Building Appliances & Laundry

Appliances are typically replaced on as needed basis:

Breakroom Appliances		
Item	Type	Estimated Age & Condition *(per sampling)*
Refrigerator	Frost-free 14 cubic feet Freezer location: Top Manufacturer/s: Hotpoint Estimated Annual Consumption: Indeterminable	100% 20+ years (Poor)

4.6. Building Domestic Water

Central Domestic Hot Water	
Components	Water heaters
Fuel	Electric
Distribution Pumps	None
Supplementary Storage Tanks	1 unit at 26 gallons
Domestic Hot Water System Input Capacity	9 MBH
Manufacturer’s Rated Efficiency	0.6 EF
Hot Water Piping	Not insulated
Quantity	1

4.7. Recommended 5 year Phased Approach Table.

Recommended 5 Year Plan			
Description of ECM	Priority	**Net Projected Initial Investment**	**Projected Completion Term**
Install Fixed Tilt Solar Photovoltaic System	Priority 2	$ 254,526	1-3 years
Improve Attic Insulation Levels	Priority 1	$ 14,581	< 12 months
Replace HVAC Units With Electric /Heat Pump	Priority 1	$ 26,290	< 12 months
Control External Air Leakage In Commercial Buildings	Priority 1	$ 1,249	< 12 months
Reduce HVAC Hours of Operation	Priority 1	$ 556	< 12 months

4.8. Recommended Energy Conservation Measures Scope of Work.

- **Replace Package Units With Electric /Heat Pump Package Units:** The objective is to replace the current fosil fuel HVAC system by a heat pump system. Perform commercial load calculation in accordance with the current version of ANSI/ACCA Manual N (Commercial Load Calculation) or equivalent using interior design temperatures of 75 degrees for cooling and 70 degrees for heating . Room by room load calculations will be performed when installing a new duct system or in retro-commissioning projects. Select commercial equipment in accordance with the current version of ANSI/ACCA Manual CS (Commercial Applications, Systems and Equipment) or equivalent. Select cooling equipment capable of meeting the sensible and latent load of the building that is not sized more than 115% of total load or next available size. Select heating equipment of the lowest capacity required to meet the design heating load and provide the air movement required by any air conditioning equipment installed. Select system that is ENERGY STAR® certified or equivalent. Select outdoor units that are corrosion-protected for marine climate zonesDemolish existing HVAC units. Procure and install new like-for-like high efficiency Heat Pump units (SEER 15). If on the roof, reuse existing curbs on the roof, provide curb adapter if necessary. Install new disconnect switch and conduit to the new units in accordance with NFPA 70. Locate unit to provide clearance on all sides and top according to manufacturer specifications and service access according to applicable code. Situate outdoor unit on a non-wicking equipment pad. Install exterior ductwork using rigid, corrosion-resistant metal insulated to a minimum of R-12. Test and balance all modified systems. Perform duct leak remediation as required per SMACNA standards. Install smoke detector if required by local State Code. Connect new HVAC equipment to new Thermostat. Commision equipment and controls. Install smoke detectors inside the supply duct plenum of systems that move more than 2,500 cubic feet per minute (CFM) in accordance with the applicable building code.
- **Control External Air Leakage In Commercial Buildings**: The objective is to control external air leakage in commercial buidlings. Weatherstripping: Place weatherstripping around all openings. Where external vents are used – such as for a clothes dryer – select vent covers that are as airtight as possible. Apply weatherstripping snugly against both surfaces. The material should compress when the window or door is shut. Choose the appropriate door sweeps and thresholds for the bottom of the doors. Weatherstrip the entire door jamb. Apply one continuous strip along each side.Make sure the weatherstripping meets tightly at the corners. Use a thickness that causes the weatherstripping to press tightly between the door and the door jamb when the door closes without making it difficult to shut. Replace all caulking on windows. Caulking: Most caulk is designed to fill a joint that is no more than ½-inch deep and ½-inch wide, although products called elastomeric caulks can fill larger gaps. Joints that are the correct width, but too deep, such as the gap between a window frame and the rough opening, can be packed with backer rod or stuffed with fiberglass insulation first and the remaining space filled with caulk. For larger gaps, expanding foam is an effective sealant. Dispensed from canisters through a gun, foam will fill gaps up to a couple of inches wide. However, larger gaps may need to be covered with a scrap of solid wood or OSB first and then foam applied in the remaining gaps.Install mastic on electrical boxes, wired penetrations and unsused knockouts. Window and door frames should be sealed to the wall frames with caulk, foam or flexible tape depending on the size of the gap. Casement and awning windows are preferable from an air leakage standpoint because the sash presses against the gasket when closed. When possible locate attic hatches and crawl space access doors in places where they will not penetrate the air barrier. For example, the attic hatch can often be located in a garage or gable end wall. Crawl space access can be placed in an outside wall below the level of the insulated floor.

- **Improve Attic Insulation Levels**: The objective is to install batt insulation in the attic space. Ensure space can be safely insulated. Verify that installation area is intact, able to support insulation weight, and air sealed. Remove any existing insulation or vapor barrier materials from the installation area that are installed improperly. Select insulation materials that have a flame spread and smoke development index of 25/450 or less when tested in accordance with *ASTM* E84 or *UL* 723. Install batt insulation to prescribed R-value in every joist bay in full contact with the air barrier and all sides of the cavity without gaps, voids, compressions, or misalignments, if batt contains a facing material install it in contact with the conditioned space.
- **Install Fixed Tilt Solar Photovoltaic System:** The objective is to properly install a photovoltaic system. Verify current electrical panel and service line infrastructure is in good condition, compliant with codes, and of sufficient electrical capacity (Amps) to accommodate interconnection of solar power. Verify position of spare (unused) breaker or space to install new breaker in panel for solar power interconnection. If a roof installation is planned, verify that the roof will support the installation (e.g., dead load, wind load) and that the current roof covering is less than 5 years old. Verify that the type of roof is suitable for solar installation (e.g. not slate or wood shingle). The roof understructure shall be inspected and evaluated for support of PV system. Any reinforcements, such as blocking between rafters, shall be completed before load of PV system is applied. If a roof installation is planned, the roof shall be inspected, cleaned and any necessary repairs shall be made. Design the size of PV system to serve the prescribed load. Prepare electrical one line drawing. Prepare layout drawings showing location and connections of all equipment. Provide list (make, model) of all equipment.Design PV system layout to provide safe access around PV modules as required by codes and standards, and required clearances around balance-of-system components such as inverter and switchgear. Locate PV Modules to minimize shading factor and maximize solar gain, but not interfere with existing systems or appliance operation (e.g., chimneys, vents, exhaust terminations). Secure approval of design by utility and secure interconnection agreement to operate utility-connected PV system. Secure electrical permit to install and operate PV system from Authority Having Jurisdiction (AHJ) (e.g. County building Dept.).Installer shall meet the requirements of AHJ. Secure the mounting structures to the roof following manufacturer instructions. Install flashing to make all roof penetrations weather-tight and leak-proof using instructions and materials specified by manufacturer. Install inverters and disconnects in a safe and accessible location, inverter shall be located in the shade when specified by manufacturer's instructions. Install solar panels on the mounting structures according to the manufacturer's instructions. The installation shall comply with all applicable codes and standards adopted by Authority Having Jurisdiction, including but not limited to: National Electric Code (NEC), International Residential Code (IRC), IEEE 1547 Standard for Interconnecting Distributed Resources with Electric Power Systems, UL 1703 Standard for Flat-Plate Photovoltaic Modules and Panels , Manufacturer's installation and operation manuals. nstall all electrical components according to the NEC and authority having jurisdiction. Fasten wires with wire ties and conduit as per design and installation instructions. The system shall be connected to the electrical grid at a location and in a method approved by the utility. Monitor the system energy delivery for a minimum of 12 months and compare results with predicted energy production. Provide documentation to the building owner, including: copy of the installation and operation manual, electrical diagrams and schematics, certificate of inspection and approval, system performance benchmark data. Perform electrical tests to verify proper operation and system performance. Tests include open circuit voltage, operating current, resistance of grounding system (should be <25 ohms), and resistance of electrical insulation (should be

>1 Megohm). Measured voltage shall be compared to reference voltage corrected for temperature. Measured current shall be compared to reference current corrected for insolation (sunlight level). The PV modules and inverter shall be warranted by the manufacturer. Provide occupants/owners with user's manual, warranty information, installation instructions, and installer contact information. Whole system shall be warranted by the installer for a period of at least 1 year. The warranty shall cover defects in materials and workmanship.

- .
- **Replace Water Heater:** The objective is to select a water heater system that is eficient, durable and properly sized. Select a water heater that: has an Energy Factor (EF) of 0.93 or better fits in the installation space with required clearances and provides sufficient hot water for the home and occupants. Ensure that old equipment is permanently removed from service, in accordance with federal and local laws and regualtions. Install water heater in compliance with applicable code (e.g., NFPA 70, IRC, IBC, IMC) and manufacturer specifications. Provide a level working space not less than 30" in length and 30" in width in front of the control side of the appliance. Install appliance and plumbing to allow for inspection, maintenance, and replacement of the appliance and its components, without disturbing other installed equipment, controls, piping, and components, other than what requires repair/replacement. Ensure that anode rod is accessible for replacement. If appliance is installed in or above conditioned space or in a location where water damage could occur, install a drain pan according to local plumbing code. Drain pan to the exterior of the building. Install a separate water cut-off valve for both the hot and cold water lines. Set discharge temperature to not exceed 120 degrees or as prescribed by local code.
- **Replace Thermostat / Reduce Hours of Operation:** The objective is to replace thermostat by a 24 hour fully programable unit. Verify that sufficient number of thermostat wires is available to meet the needs of the replacement unit and the existing system. Select a double-setback programmable thermostat that allows for full functionality of the installed system (supplementary heat, emergency heat, fan only, ventilation control, etc.). Install thermostat where it accurately reflects the temperature and humidity of the zone which it controls (i.e., not exposed to extreme temperatures, radiant heat sources, warm/cold walls, or drafts). Connect supplementary heat to second-stage heating terminal in accordance with manufacturer specifications. Install and connect outdoor temperature sensor that is compatible with the thermostat in accordance with manufacturer specifications. Calculate and select an optimum thermal balance point for supplementary heat operation in accordance with ANSI/ACCA Manual S and manufacturer specifications. Program the thermostat to match the equipment and control board settings per manufacturer specifications. Set time delay for fan start in accordance with manufacturer specifications and as appropriate for the climate zone (e.g., no time delay for hot humid climates, longer time delay for cold climates). Program the thermostat setbacks to a schedule that accommodates the occupant and reduces overall run time.

5. Recommended Operations and Maintenance Plan

The quality of the maintenance and the operation of the facility's energy systems have a direct effect on its overall energy efficiency. Energy-efficiency needs to be a consideration when implementing facility modifications, equipment replacements, and general corrective actions. The following is a list of activities that should be performed as part of the routine maintenance program for the property.

Building Envelope

- ✓ Ensure that the building envelope has proper caulking and weather stripping.
- ✓ Patch holes in the building envelope with foam insulation and fire rated caulk around combustion vents
- ✓ Inspect building vents semiannually for bird infestation
- ✓ Inspect windows monthly for damaged panes and failed thermal seals
- ✓ Repair and adjust automatic door closing mechanisms as needed.

Heating and Cooling

- ✓ Pilots lights on furnaces and boilers be turned off in summer
- ✓ All preventive maintenance should be performed on all furnaces and boilers, which would include cleaning of burners and heat exchanger tubes.
- ✓ Ensure that the combustion vents exhaust outside the conditioned space and the vent dampers are functional
- ✓ Ensure that the control valves are functioning properly before start of every season
- ✗ Ensure steam traps are functional before start of each heating season
- ✓ Ensure use of chemical treatment for boiler make up water
- ✓ Ensure boiler outside temperature re-set is set to 55F
- ✗ Ensure use of chemical treatment for Cooling tower water to prevent corrosion
- ✓ Ensure the duct work in unconditioned space is un-compromised and well insulated
- ✓ Duct cleaning is recommended every 10 years. This should include sealing of ducts using products similar to 'aero-seal'
- ✗ Ensure use of economizer mode is functional and used
- ✓ Ensure that the outside air dampers actuators are operating correctly
- ✓ Ensure air coils in the AHU and FCA's are pressure washed annually
- ✓ Return vents should remain un-obstructed and be located centrally
- ✓ Temperature settings reduced in unoccupied areas and set points seasonally adjusted.
- ✗ Evaporator coils and condenser coils should be regularly cleaned to improve heat transfer
- ✗ Refrigerant pipes should be insulated with a minimum of ¾" thick Elastomeric Rubber Pipe Insulation
- ✗ Ensure refrigerant pressure is maintained in the condensers
- ✓ Change air filters on return vents seasonally. Use only filters with 'Minimum Efficiency Rating Value'(MERV) of 8

Central Domestic Hot Water Heater

- ✗ Never place gas fired water heaters adjacent to return vents so as to prevent flame roll outs
- ✗ Ensure the circulation system is on timer to reduce the losses through re-circulation
- ✓ Ensure all hot water pipes are insulated with fiberglass insulation at all times
- ✓ Replacement water heater should have Energy Factor (EF)>0.9

- ✓ Tank-type water heaters flushed monthly

Lighting Improvements

- ✓ Utilize bi-level lighting controls in stairwells and hallways.
- ✓ Use LED replacement lamps
- ✓ Clean lighting fixture reflective surfaces and translucent covers.
- ✓ Ensure that timers and/or photocells are operating correctly on exterior lighting
- ✓ Use occupancy sensors for offices and other rooms with infrequent occupancy

Existing Equipment and Replacements

- ✓ Ensure that refrigerator and freezer doors close and seal correctly
- ✓ Ensure kitchen and bathroom exhaust outside the building and the internal damper operates properly
- ✓ Ensure that bathroom vents exhaust out
- ✓ Office/ computer equipment either in the “sleep” or “off” mode when not used

Key

x	Maintenance Measure is Not Applicable For the Given Facility
✓	Maintenance Measure is Applicable For the Given Facility

6. Appendices

APPENDIX A: Photographic Record
APPENDIX B: Site and Floor Plans
APPENDIX C: Mechanical Inventory
APPENDIX D: Abbreviated Energy Checklist
APPENDIX E: Other Supporting Documents

Appendix A:
Photographic Record

Photographic Overview

1 - FRONT ELEVATION

2 - LEFT ELEVATION

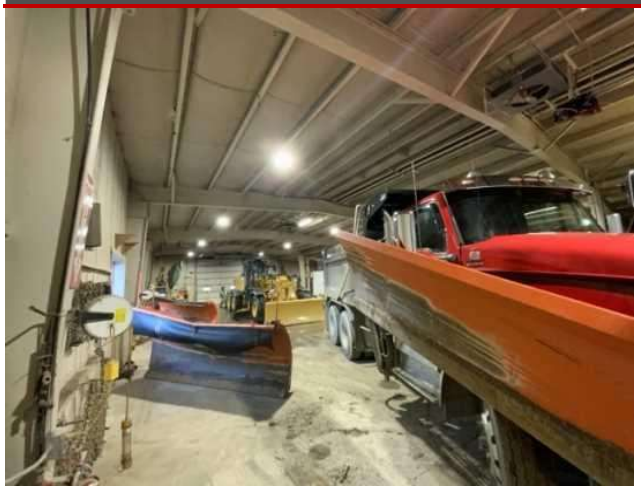
3 - REAR ELEVATION

4 - RIGHT ELEVATION

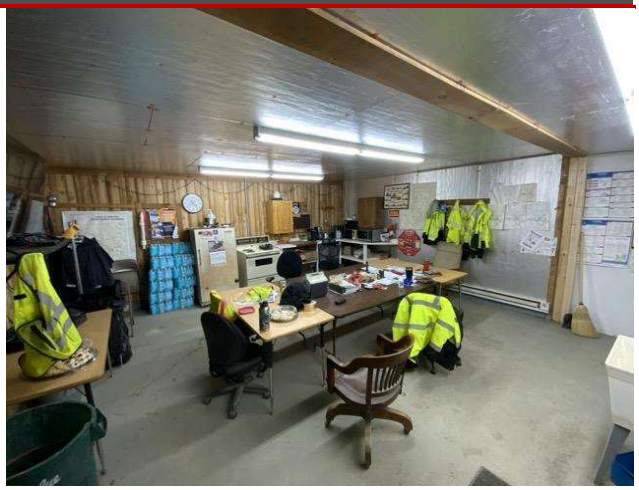
5 - ROOFTOP OVERVIEW

6 - INTERIOR INSULATION

Photographic Overview



7 - GARAGE OVERVIEW



8 - EMPLOYEE LOUNGE

9 - DOOR

10 - DOOR

11 - WINDOW

12 - WINDOW

Photographic Overview

13 - OIL STORAGE TANK

14 - BACKUP GENERATOR

15 - BOILER

16 - WATER HEATER

17 - ELECTRIC PANEL

18 - LIGHTING

Photographic Overview

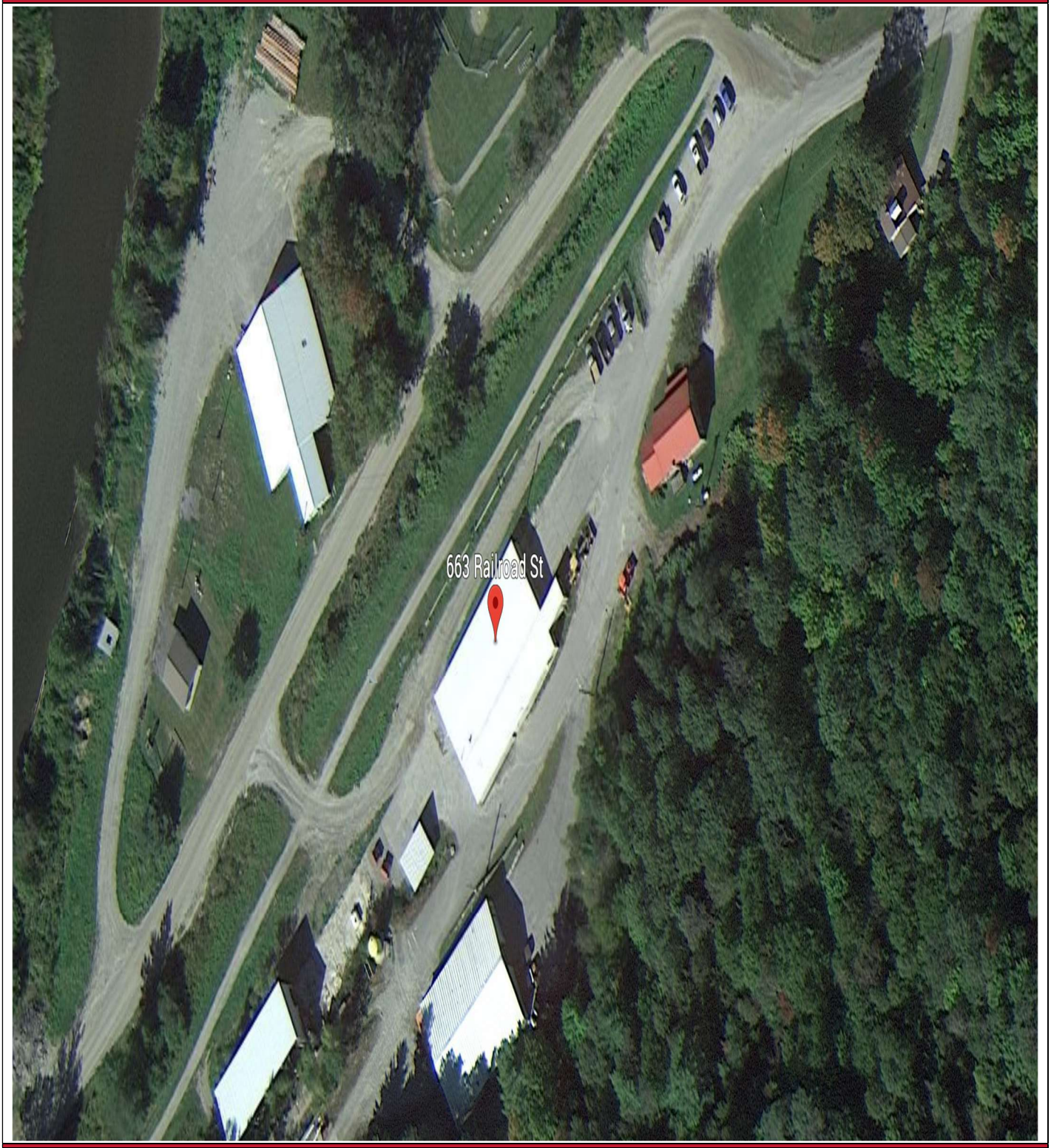
19 - LIGHTING

20 - LIGHTING

21 - RESTROOM

Appendix B:
Site and Floor Plans

Site Plan



Project Number	Project Name
161246.23R000-063.267	Town Garage
Source	**On-Site Date**
Google	December 20, 2023

BUREAU VERITAS

N

Appendix C:
Mechanical Equipment Inventory

Mechanical Equipment Inventory					
Equipment	**Manufacturer**	**Model/ Type**	**Serial**	**Capacity**	**Qty**
Boiler	Smith Cast Iron	G94-432	BB14A-S/W-6	305	1
Water Heater	Amtrol	WH- 9LDW	BM 153923 AA	9 Gal	1

Appendix D:
Abbreviated ECMChecklist

UIC	**Replace HVAC Units With Electric /Heat Pump HVAC Units**
EAH-15	**Location:**
Attributes:	**Replace (1x) 305MBH - 0 Ton RTU With (1x) 12.5 Tons - Heat Pump RTU System;**

	Specify Location		*Specify* Location		*Specify* Location		*Specify* Location	
Heating System								
Number of Heating Systems to be replaced	1	Qty		Qty		Qty		Qty
Heating Fuel:	**No. 2 Oil**		**Natural Gas**		**Natural Gas**		**Natural Gas**	
Heating System Capacity (Each)	305	MBH		MBH		MBH		MBH
De-rated AFUE rating For **Eac**h Heating System	65.00	%		%		%		%
Estimated Annual Operating Hours:	2,500	Hrs		Hrs		Hrs		Hrs
Estimated Annual Energy Use from All Heating Systems	3,579	Gallons	0	Therms	0	Therms	0	Therms
	5505.415162							
Cooling								
Unit has Cooling?	**No**		**Yes**		**Yes**		**Yes**	
Refrigerant in Cooling System								
Cooling Capacity for Each Unit		Btuh		Btuh		Btuh		Btuh
EER of the Existing Cooling System:		EER		EER		EER		EER
Estimated Annual Operating Hours:	500	Hrs		Hrs		Hrs		Hrs
Energy Consumption From All Existing Air conditioner:	0	kWh	0	kWh	0	kWh	0	kWh
Proposed System								
Proposed System:	**12.5 Tons - Heat Pump RTU**							
Proposed Cooling System Capacity	150,000	Btuh	0	Btuh	0	Btuh	0	Btuh
EER of Proposed Air-Conditioning System:	10.60	EER	0.00	EER	0.00	EER	0.00	EER
Total Energy Consumption For Proposed RTU - Cooling:	7,075	kWh	0	kWh	0	kWh	0	kWh
Proposed Heating System Input:	13.74	kW	0.00	kW	0.00	kW	0.00	kW
COP of Proposed RTU Heating System:	3.20	COP	0.00	COP	0.00	COP	0.00	COP
Total Energy Consumption For Proposed RTU Heat:	34,346	kWh	0	kWh	0	kWh	0	kWh
Estimated Annual Energy Consumption From All Systems:	41,421	kWh	0	kWh	0	kWh	0	kWh
Savings Analysis								
Annual Energy Savings From Heating Systems:	378,438	kBtuh	0	kBtuh	0	kBtuh	0	kBtuh
Annual kWh savings for all Air conditioner:	-7,075	kWh	0	kWh	0	kWh	0	kWh
Material Cost For All RTU(s):	$21,250		$0		$0		$0	
Labor Cost for All RTU(s):	$5,040		$0		$0		$0	
Installed Cost for all RTU(s):	$26,290		$0		$0		$0	
Total Investment	$26,290		$0		$0		$0	
Estimated Annual Energy Cost Savings:	$1,219		$0		$0		$0	
Estimated Annual Energy Savings:	354,296	kBtuh	0	kBtuh	0	kBtuh	0	kBtuh

	Natural Gas		Propane		No.2 Oil		Electric	
Total Utility Savings	0	Therms	0	Gal	3,579	Gal	-41,421	kWh

Total Initial Investment:	$26,290	**Total Annual Utility Cost Savings:**	$1,219
Simple Payback:	21.57	Yrs	
Type of Recommendation	Capital Cost ECM Recommendation		

UIC	Reduce HVAC Hours of Operation
EAC3	Location: Throughout BLDG Air Handlers
Attributes:	Self Learning Smart Thermostat - (2x) Sensors

No. of Sensors Affected : 2 Qty.

Select Type of Recommendation: Self Learning Smart Thermostat *(Select)*
(Selection Based on Type of Property)

Heating Load Calculation

Select Type of Heating Fuel: No. 2 Oil *(Select)*

Estimated Current Annual Energy Consumption For Winter Heating: 3,579 Gallons

	Weekdays	Weekends
Day Time Set Back Hours	8.00	
Night Time Set Back Hours	16.00	24.00
Hours Without Set Back	0.00	0.00

Typical Indoor Temp	72.00	°F
Temp Set Point With Set Back During Day Time	70.00	°F
Temp Set Point With Set Back During Night Time	65.00	°F
Average Heating Set Point	66.19	°F
Savings Per Degree Set Back For Heating Season *(Industry Standard, 2004)*	3%	
Estimated Annual Heating Energy Consumption	495,625	kBtu
Estimated New Annual Heating Energy Consumption	409,245	kBtu
Estimated Annual Heating Energy Savings	374	Gallons

Cooling Load Calculation

Select Type of Cooling Fuel: Electric *(Default)*

Estimated Current Annual Energy Consumption For Summer Cooling: 43,680 kWh

	Weekdays	Weekends
Day Time Set Back Hours	8.00	24.00
Night Time Set Back Hours	16.00	
Hours Without Set Back	0.00	0.00

Typical Indoor Temp	72.00	°F
Temp Set Point With Set Back During Day Time	74.00	°F
Temp Set Point With Set Back During Night Time	78.00	°F
Average Cooling Set Point	75.90	°F
Savings Per Degree Set Back For Cooling Season *(Industry Standard, 2004)*	6%	
Estimated Annual Cooling Energy Consumption	149,036	kBtu
Estimated New Annual Cooling Energy Consumption	114,119	kbtu
Estimated Annual Cooling Energy Savings	10,234	kWh

Cost Analysis

Average Annual Cost of Heating Fuel:	$2.78	$/Gal
Average Annual Cost of Electricity:	$0.18	$/kWh
Estimated Annual Heating Cost Savings:	$1,040	$$
Estimated Annual Cooling Cost Savings:	$1,842	$$
Type of Recommendation	No/Low Cost ECM Recommendation	

Estimated Investment Per Sensor: *(Includes Material, Labor & Installation Costs)*	$207	$$
Total Estimated Cost For All Sensors:	$556	$$
Total Estimated Cost Savings From All Sensors:	$2,882	
Estimated Simple Pay Back Period	0.19	Yrs

ECM DESCRIPTION:

Turning off energy-consuming systems when they are not needed is the most basic energy conservation technique. When a building is occupied intermittently, energy savings can be realized by minimizing the time the heating or cooling system is operated when the building is closed. Building control algorithms should be implemented to delay startup until the last moment and to shut down as early as possible.

Because of the thermal inertia of both the building structure and its heating and cooling equipment, preheat or precool time is almost always required to raise or lower the space temperature to the desired level before the occupants return. This start-up time depends on the outdoor environment, the thermal response of the building, and the thermal performance of the space conditioning equipment. Similarly, the thermal inertia of the building maintains the indoor temperature at a comfortable level for a short period of time after the equipment is shut off. It allows the system to be turned off before the end of an occupied period. An optimum start/stop control accounts for these factors.

SUMMARY

Initial Investment:	$556	Simple Payback Period:	0.19 Yrs
Annual Energy Cost Savings	$2,882		

UIC	Control External Air Leakage In Commercial Buildings
EAE4A	**Location:**
Attributes:	Perform air sealing of building through Installing 76x linear feet of door sweeps

ENTER EXISTING CONDITION

Insert Existing Estimated Air Change Rate/Hr (ACH 1): *(Existing Air Changes Per Hour, 3 is very leaky and 0.35 ideal)*	1.70	Cubic Feet/Min (CFM 1):	198
Insert Proposed Estimated Air Change Rate/Hr (ACH 2):	0.60	Cubic Feet/Min (CFM 2):	70
Estimated Space Volume Under Consideration	7,000 Cu.Ft		

WINTER			SUMMER		
Select Type of Heating Fuel	No. 2 Oil (Select)		Is The Building Cooled?	No	
Estimated Annual Heating Plant Efficiency	65.00 %		Estimated Annual Cooling Plant Efficiency	0.00 EER	
Annual Heating Degree Days(HDD):	7,301		Annual Cooling Degree Days(CDD):	522	
Estimated Total Annual Input Heating Energy Savings	716 Gallons		Estimated Total Annual Input Cooling Energy Savings	0 kWh	
Cost/Unit of Heating Fuel:	$2.78 $/Gal		Cost/Unit For Electricity	$0.18 $$	
Estimated Annual Heating Cost Savings	$1,990 $$		Estimated Annual Cooling Cost Savings	$0 $$	

Cost Analysis

Install Flush Mounted, Vinyl Door Sweeps ?	Yes	Total Length of Door Sweeps to Be Installed: *(3.5' Standard Width Door)*	76 LF
Install Window Air Conditioner Covers For Winter:	No	Number of Air Conditioner Covers To Be Installed: *(Covers would meet HUD Chapter-12 Energ Conservation Compliance Section 329C)*	
Estimated Annual O&M Savings	$99	Estimated Length of Joints To Be Re-Caulked: *(Includes Demolition and Re-Caulking)*	LF
Total Estimated Annual Cost Savings	$2,089	Total Cost For Controlling Air Leakage	$1,248
Simple Pay Back Period	0.60 Yrs	*Type of Recommendation*	Capital Cost ECM Recommendation

ECM DESCRIPTION:

One of the most commonly used methods for reducing air leakage through building structures is caulking and weather stripping.
Particularly effective measures include caulking cracks around windows and door frames and weather stripping around windows and doors. Weather-stripping and caulking of doors and windows, helps in thermally isolating of the building with the outside atmosphere. This prevents the infiltration of external un-conditioned air along with moisture and humidity into the conditioned space at the same time, prevents the conditioned air from escaping out. A precisely thermally isolated building directly affects the cooling and heating load on the facilities HVAC system as it has to put in less effort in maintaining the desired temperature inside the facility. As per ASHRAE a well insulated and ventilated building should have an air change rate not more than 0.35 per hour.

In order to ensure proper thermal isolation of the property, BV recommends ensuring that the weather-stripping and caulking of all external doors and windows remains intact. Its also recommended that door sweeps be installed under all the doors opening into conditioned space. Any visible cracks between the window frame and wall should be plugged by caulking.

In case of building with window airconditioners, BV recommends use of interior/exterior window airconditioner covers so as to prevent cold air drafts into the conditioned space during the winter so as to save on heating costs.

SUMMARY:

Initial Investment:	$1,248	Simple Pay Back Perio	0.60 Yrs
Annual Energy Cost Savings:	$2,089		

UIC	**Improve Attic Insulation Levels**
EAE3	**Location:**
Attributes:	Improve existing attic insulation from R-10 to R-49 by adding Batt Insulation

ENTER EXISTING CONDITION

ASHRAE Climatic Zone	Zone-6		ASHRAE 90.1 Attic- Insulation Requirement:	R-49	
Enter Total Surface Area Under Consideration:	7,000	Sq.Ft	Existing Net Effective R-Value: (Sq.Ft deg F/btu)	10	
Proposed Type of Insulation To Be Added:	**Batt Insulation**	*(Select)*	Proposed Insulation Recommendation:	**Full Upgrade**	*(Select)*
Recommended Level of Insulation To Be Added:	R-49		Proposed Net Effective R-Value: (Sq.Ft deg F/btu) *(Post Retrofit-Final Net Insulation)*	49	

ENTER CLIMATIC & SYSTEM DATA

Annual Cooling Degree Days (CDD):	522		Estimated Annual Cooling Plant Efficiency (EER):		EER
Annual Heating Degree Days (HDD):	7,301		Estimated Annual Heating Plant Efficiency: %	90.00	%

WINTER

Select Type of Heating Fuel	**No. 2 Oil**	(Select)
Annual Conduction Losses From Existing Insulation	122,648	kBtu
Annual Conduction Losses From Proposed Insulation	25,030	kBtu
Savings In Conduction Losses After Adding Insulation	97,618	kBtu
Estimated Total Annual Input Heating Energy Savings	429	Gallons
Cost of Heating Fuel/Unit:	$2.78	$/Gal
Annual Heating Cost Savings	$1,194	$$

SUMMER

Is the Property Cooled ?	**No**	(Select)
Annual Conduction Losses From Existing Insulation	8,765	Kbtu
Annual Conduction Losses From Proposed Insulation	1,789	kBtu
Savings In Conduction Losses After Adding Insulation	0	kBtu
Estimated Total Annual Input Cooling Energy Savings	0	kWh
Cost of Electricity/Unit	$0.18	$$
Annual Cooling Cost Savings	$0	$$

COST ANALYSIS

Estimated O&M Savings	$12	$$	Estimated Cost To Add Insulation on	$10,850
Total Estimated Annual Cost Savings	$1,206	$$	Estimated Total Installation Cost	$14,581 $$
Simple Pay Back Period	12.09	Years	*Type of Recommendation*	Capital Cost ECM Recommendation

ECM DESCRIPTION:

The amount of heat conduction through ceiling and roof is proportional to its overall heat transfer coefficient (commonly called the U-factor) and the temperature difference between the conditioned space and its surrounding, modified by the effect of solar intensity and wind velocity on the exterior surfaces. One of the most effective ways to reduce heat transfer through ceilings and roofs is to retard heat conduction by adding insulation.

Where the existing roof is sound and directly accessible from an attic or ceiling void, polyurethane foam or mineral fiber may be sprayed on the underside, with rigid batt or other applicable insulation for the inside surface. Insulation, typically fiber-glass batt, may also be laid on the top of a ceiling, taking care not to cover up light fixtures.

Unimembers can degrade the performance of the insulation up to 20%, and resultant condensation can cause insulated structural the structure to deteriorate. Therefore, care should be taken to properly insulate the structural members. Often more energy can be conserved by insulating the ceiling rather than the roof unless the attic is being used for special storage, frequent access is required, or a moderate attic temperature is desired. However, if only the ceiling is insulated, any ducting or piping should be insulated to avoid excessive heat transfer or freezing. It is important to be sure that the attic is ventilated by providing one to two inches of ventilation area per square foot of attic.

Summary:

Initial Investment:	$14,581	Simple Payback Period:	12.09 Yrs
Annual Energy Cost Savings:	$1,206		

UIC	Install Fixed Tilt Solar Photovoltaic System
EAR1	**Location:**
Attributes:	Install fixed tilt 72KW Solar Photovoltaic System consisting of 72kW Rooftop Fixed Array PV System;

Select State: Vermont **Electric Rate:** **$0.18** $/KWH Annual Electric Consumption: 84,000 KWh

Roof No.	Description	Location of the Array	DC System Size Per Roof	Estimated Battery Size	PV System Sizing For All Roofs	Estimated Number of 400 Watt PV Panels:	Total Estimated Annual Electricity Generated/ Roof	Total Estimated Electricity Generated (All Roofs)	Total Cost Savings	Installation Cost:	Simple Pay Back Period without Incentives	One Time Potential Utility or State Incentives	One Time Potential Federal Incentives	Annual Potential Incentives and Rebates		Simple Pay Back Period with All Incentives
			kW	KW-H	kW		kWh	kWh			Yrs		Federal Tax Credit	Federal REPI Incentive	Solar Renewable Certificates (SRECS)-($/MWH)	Years
													26%	$0.00	Varies by State	
1	Rooftop Fixed Array	Main Bldg	72	77	72	180	84,194	84,194	$15,155	$254,526	16.8	$0	$0	$0	$0	16.8
2					0	0		0	$0	$0		$0	$0	$0	$0	
3					0	0		0	$0	$0		$0	$0	$0	$0	
4					0	0		0	$0	$0		$0	$0	$0	$0	
5					0	0		0	$0	$0		$0	$0	$0	$0	
6					0	0		0	$0	$0		$0	$0	$0	$0	
7					0	0		0	$0	$0		$0	$0	$0	$0	
8					0	0		0	$0	$0		$0	$0	$0	$0	
9					0	0		0	$0	$0		$0	$0	$0	$0	
10					0	0		0	$0	$0		$0	$0	$0	$0	
		0			**72**	**180**	**84,194.0**	**84,194**	**$15,155**	**$254,526**	**16.79**	**$0**	**$0**	**$0**	**$0**	**16.79**

Solar Rooftop Photovoltaic Analysis		
Total Number of Roofs	0	
Estimated Number of Panels	180	
Estimated KW Rating	72	kW
Potential Annual KWh Produced	84,194	kWh
% of Current Electricity Load	100.2%	

Financial Analysis		
Investment Cost	$254,526	
Estimated Energy Cost Savings	$15,155	
Potential Rebates	$0	
Potential Annual Incentives	$0	
Payback without Incentives	16.8	years
Incentive Payback but without SRECS	16.8	years
Payback with All Incentives	16.8	years

Appendix E:
Other Supporting Documents

Glossary of Terms and Acronyms - Energy Audits

ECM – Energy Conservation Measures are projects recommended to reduce energy consumption. These can be No/Low cost items implemented as part of routine maintenance or Capital Cost items to be implemented as a capital improvement project.

Initial Investment – The estimated cost of implementing an ECM project. Estimates typically are based on R.S. Means Construction cost data and Industry Standards.

Annual Energy Savings – The reduction in energy consumption attributable to the implementation of a particular ECM. These savings values do not include the interactive effects of other ECMs.

Cost Savings – The expected reduction in utility or energy costs achieved through the corresponding reduction in energy consumption by implementation of an ECM.

Simple Payback Period – The number of years required for the cumulative value of energy or water cost savings less future non-fuel or non-water costs to equal the investment costs of the building energy or water system, without consideration of discount rates.

EUL – Expected Useful Life is the estimated lifespan of a typical piece of equipment based on industry accepted standards.

RUL – Remaining Useful Life is the EUL minus the effective age of the equipment and reflects the estimated number of operating years remaining for the item.

SIR – The savings-to-investment ratio is the ratio of the present value savings to the present value costs of an energy or water conservation measure. The numerator of the ratio is the present value of net savings in energy or water and non-fuel or non-water operation and maintenance costs attributable to the proposed energy or water conservation measure. The denominator of the ratio is the present value of the net increase in investment and replacement costs less salvage value attributable to the proposed energy or water conservation measure. It is recommended that energy-efficiency recommendations be based on a calculated SIR, with larger SIRs receiving a higher priority. A project typically is recommended only if the SIR is greater than or equal to 1.0, unless other factors outweigh the financial benefit.

Life Cycle Cost – The sum of the present values of (a) **I**nvestment costs, less salvage values at the end of the study period; (b) Non-fuel operation and maintenance costs: (c) Replacement costs less salvage costs of replaced building systems; and (d) Energy and/or water costs.

Life Cycle Savings – The sum of the estimated annual cost savings over the EUL of the recommended ECM, expressed in present value dollars.

Building Site Energy Use Intensity – The sum of the total site energy use in thousands of Btu per unit of gross building area. Site energy accounts for all energy consumed at the building location only not the energy consumed during generation and transmission of the energy to the site.

Building Source Energy Use Intensity – The sum of the total source energy use in thousands of Btu per unit of gross building area. Source energy is the energy consumed during generation and transmission in supplying the energy to your site.

Building Cost Intensity – This metric is the sum of all energy use costs in dollars per unit of gross building area.

Greenhouse Gas Emissions – Although there are numerous gases that are classified as contributors to the total for Greenhouse Emissions , the scope of this energy audit focuses on carbon dioxide (CO_2). Carbon dioxide enters the atmosphere through the burning of fossil fuels (oil, natural gas, and coal), solid waste, trees and wood products, and also as a result of other chemical reactions (e.g., manufacture of cement).