RESILIENT BUILDINGS
GROUP
Superior energy performance

Warner Community Center

49 W. Main St, Warner

Level II Energy Audit

December 16, 2022

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Executive Summary

Resilient Buildings Group (RBG) conducted a site visit of the Warner Community Center building in Warner, NH on Friday, September 23rd. The Community Development and Finance Authority helped fund the Audit. During the audit, RBG examined the building's shell and all other pertinent building systems.

The assessment shows that the energy performance of the building can be improved. This report will provide an overview of the building's existing conditions and an initial outline of problem areas and recommendations for cost-effective ways to reduce energy use and costs.

Existing Conditions at the Warner Community Center Building

Site

- **Size:** 10,800 ft²
- **Sewer:** Municipal
- **Water:** Municipal
- **Year built:** The building was originally constructed in the early 1920's
- **Building Type:** Municipal

Shell

- **Number of Levels:** 3 levels
- **Foundation and Insulation:** The foundation is uninsulated concrete masonry units.
- **Exterior Wall Construction and Insulation:** The exterior walls are comprised of concrete masonry units with stucco exterior and are uninsulated.
- **Roof Type and Insulation:** The roof is a wood frame with asphalt shingles. The floor of the attic space is insulated with 16" of blown cellulose insulation (R-50).
- **Doors and Windows:**
    - **Windows:** The windows in the lower level are aluminum, double-framed windows in good condition. The windows on the second floor are vinyl, double pane, double hung units in good condition.
    - **Doors:** The main entry doors are solid wood doors, with plexi-glass windows, with single pane windows above. The main entry doors are due to be replaced soon. There are various metal framed doors throughout the building. Weatherstripping and door sweeps should be installed on all remaining doors.

Heating, Plumbing, Ventilation, and Air Conditioning

- **Heating Fuel:** Oil
- **Heat Generation Equipment:** The building is heated by two oil-fired non-condensing boilers that are atmospherically vented. The boilers send warm water through baseboard radiators. The radiator in the pantry is not currently operable. The boilers are approximately 5-7 years old and have a maximum output of 294 MBH and a tested efficiency of 86.7% each. The boilers are serviced annually.
- **Domestic Hot Water (DHW):** The building receives DHW from an electric 40-gallon storage water heater manufactured in 2014 with a Uniform Energy Factor (UEF) of 0.93.
- **Air-Conditioning Equipment:** There are various window air conditioners installed in the pantry,

homeschool and community action agency offices.

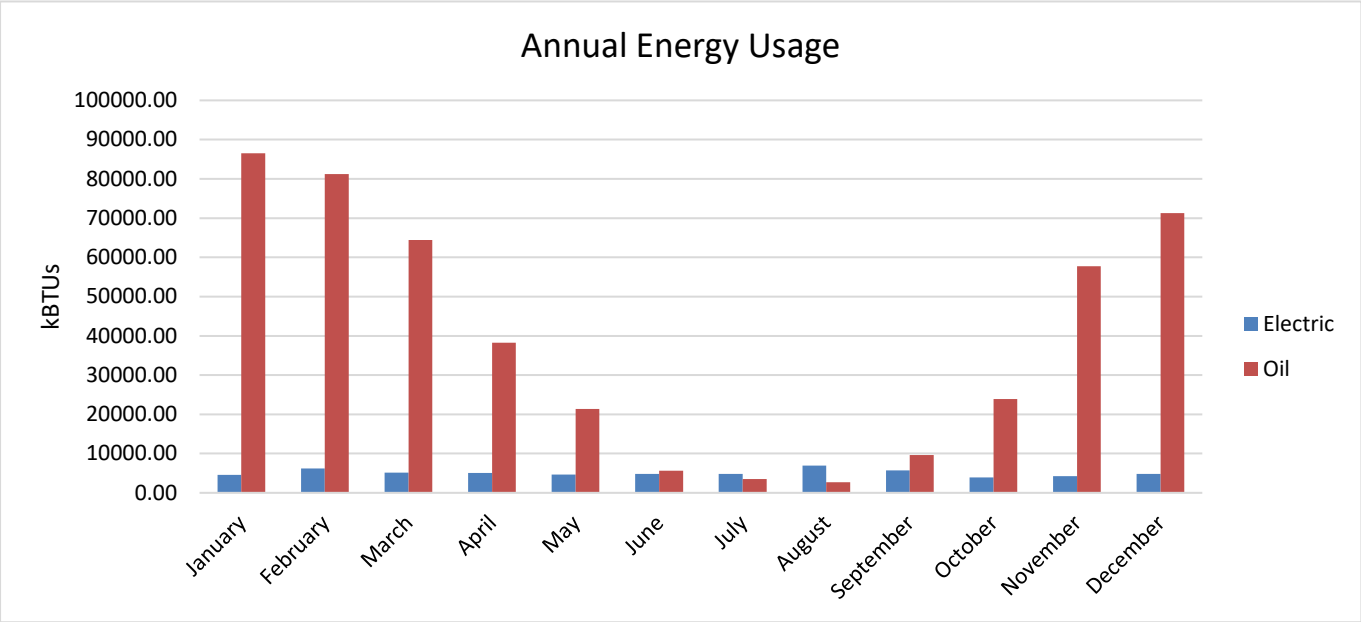
- **Temperature Controls:** There is a single circulator pump off each boiler. The heating zones for the building were recently updated with dial thermostats that control the radiators. There is not a regular schedule for temperature set points.
- **Ventilation Equipment**: The bathrooms are equipped with exhausts fan that are vented to the attic. The office/living space bathroom exhaust fan appears outdated and is vented to the attic. There is also a passive vent that provides combustion air to the mechanical room.

Notable Issues

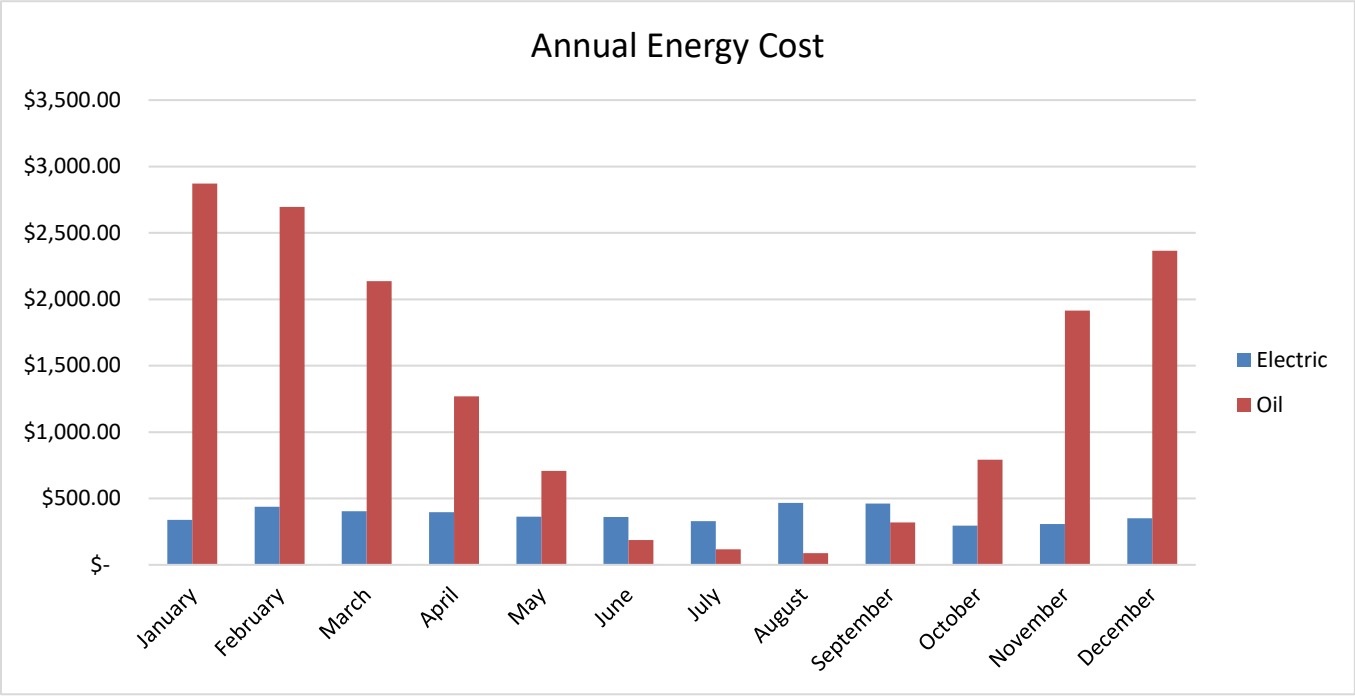
- **Heat distribution:** Occupants of the building reported the right wall and back walls of the pantry are noticeably colder than the rest of the building and has experienced moisture issues. The radiator serving this area is not working.
- **Outlets:** Occupants of the building indicated that many of the outlets are shared among various appliances, due to a lack of outlets throughout the building. This causes the breakers to trip frequently.
- **Occupant Comfort:** In several offices, there were space heaters set up in office and cubicle spaces.
- **Previous Weatherization:** It appears insulation was added to the attic around 2010.
- **Possible Roof Leak:** During our inspection, there is evidence of an active roof leak above the corner office of the homeschool.
- **Pantry Foundation:** Occupants reported that there have been repairs made to the foundation multiple times.

Photo 1. Signs of possible roof leak

Energy Usage and Cost Analysis



Using past oil and electricity bills, we calculated an average yearly consumption of 3,362 gallons of oil and 17,847 kWh of electricity, which translates to a total of 263,585 kBtus of energy consumed per year on average.



The building's average annual cost is $15,465 for oil and $4,551 for electricity which equates to a combined average of $19,976.00.

*Based on two years of electric data and one year of fuel oil data. The analysis includes one building with a square footage of 10,800 ft2.

Preliminary Building Benchmarking

RBG analyzed the historical energy consumption of this building to calculate a Building Benchmarking rating. Building Benchmarking rates your building's performance on two metrics: Energy Use Intensity (EUI) and Cost Use Intensity (CUI).

EUI is the annual energy use in Btus (British thermal units, usually displayed as kBtus to signify thousands of Btus) per square foot of conditioned space in the building (kBtu/ft^2/yr). CUI displays the annual energy cost per square foot in the building ($/ft^2/yr).

EUI is often split into two numbers, one providing the annual Btus used at the site for all purposes (as used in the previous energy tables), and the other combining the site use figure with the additional Btus required to generate and transmit electrical energy from its source. At RBG, we are chiefly interested in the source number because it provides the most accurate accounting for the total greenhouse gas emissions associated with a building's energy consumption. RBG accounted for both Site and Source kBtus in the EUI numbers given below.

Our source EUI and CUI are calculated using the 1- year average of electric and 2-year average of oil use and cost data with the stated conditioned floor area of 10,800 ft².

Current EUI/CUI Data:	
Site EUI:	48.8 kBtu/ ft²/Year
Source EUI:	60.0 kBtu/ ft²/Year
CUI:	$ 1.84 / ft²/Year

ENERGY STAR® PortfolioManager® Technical Reference

Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft^2)	Site EUI (kBtu/ft^2)	Reference Data Source - Peer Group Comparison
Office		**116.4**	**56.1**	CBECS – Social / Meeting

The Warner Community Building's site and source EUIs are lower than the national average. However, the cost to run the building is quite high at $1.84 per square foot per year. If there are plans to utilize the building even more, than there is even more potential to improve the building's energy efficiency.

Energy Efficiency Measures

Three major areas of activity were examined for energy-saving opportunities: building envelope, mechanical systems, and electrical systems. The proposed energy efficiency recommendations could qualify for the energy efficiency incentives offered by NHSaves.

Building Envelope Recommendations:

- **B1. Air seal:** The most important component of any energy efficiency retrofit is controlling or slowing down the migration of air from conditioned to unconditioned spaces. To reduce this uncontrolled air exchange, the following measures should be implemented before any insulation is installed. Although a blower door test was not performed, a visual inspection determined the following recommended air sealing efforts.
    - The loading window in the pantry on the lower level is blocked by a piece of plywood. If this access is required, RBG recommend constructing an insulated panel with a durable gasket and latching mechanism be installed.

Photo 2. Uninsulated, leaky loading window

    - The front doors are scheduled to be replaced. RBG concurs with this measure. Daylight is visible around the door and the plexi-glass is not secure. When replacing the front doors, include the transom windows above doors.
    - The plywood panel where the bathroom exhaust fan exits, and the oil fill lines enter appears in need of repair. RBG recommends using pressure treated plywood and sealing the perimeter of the panel and the oil fill line penetrations.
    - Install a gasket around the attic access or caulk the access closed.
    - The rear door roof access in the thrift store should be weather-stripped.

Photo 3. Plywood panel needing air sealing

Mechanical Recommendations:

- **M1. Replace Boiler:** The existing oil boilers are rated at 86.7% efficiency. The existing boilers are non-condensing, which are less efficient than condensing models and can lead to increased operational costs. RBG recommends replacing the boilers with one of the following options:
    - **Option A. Wood-Pellet Boiler:** Install a wood pellet-fired boiler. This option has the advantage of using the existing network of unit heaters and baseboard radiators. RBG recommends this option if the Community Center does not plan on installing roof mounted solar PV and electrifying the building's HVAC systems. This system is also eligible for annual Renewable Energy Certificate (REC) payments.
    - **Option B. Air Sourced Heat Pumps (ASHP):** Cold climate air source heat pumps are an excellent option for the building. RBG recommends installing a 16.5-ton (198,000 Btu/Hr) system with ductless heads to serve each space. RBG recommends leaving the existing oil boiler in place to serve as a backup heat source in case there is a mechanical failure with the heat pump system or if there is an abnormally cold period in the winter months. This option is best paired with a solar PV system. With the potential change in increased occupancy and higher temperatures, introducing this ASHP option is a more energy efficient option than the existing window air conditioners.
- **M2. Combustion air damper:** Currently, there is a passive combustion air vent to the boiler room. To ensure the vent is introducing fresh air only when the boiler is running, we recommend installing a damper with a control tied to the thermostat connection at the burner. This will minimize unwanted outdoor air cooling or warming the basement.

Fuel Type	Cost	Efficiency	Annual Consumption	Cost per Unit[1]	Annual Cost*
Oil (Existing System)	$0	83%	3362 Gallons	$4.6 / Gallon	$15,465
A.) Wood Pellet Boiler	$42,000	83%	28.2 Tons	$300 / Ton	$8,466
C.) ASHP System	$82,500	3.0 COP	37,757 kWHs	$0.24 / kWh	$9,061

1. Calculations are based on the building's annual usage and current energy costs provided by the U.S. Energy Information Administration (www.eia.gov)

2. Wood pellet boiler could qualify for up to $13,037.00 in renewable energy credits.

3. ASHP could be eligible for NHSaves rebate of $4,125.00. Savings do not include air-conditioning loads.

- **M3. Heat Pump Hot Water Heater:** RBG recommends replacing the electric water heater with a hybrid electric water heater with a capacity of 40 gallons. This will improve the efficiency and reliability of the system. Additionally, a hybrid water heater will also dehumidify the space if there is enough of a hot water demand.

Electrical System

Improving electrical systems includes analyzing the electrical demands, or the loads, in a building – lighting, appliances, computers, the electrical portion of the operation of mechanical equipment, etc. – and devising ways to reduce their requirements for energy and make them more efficient. Installation of all demand reduction techniques should be implemented first.

After envelope and mechanical improvements, installing high-performance, efficient electricity using devices, remains a high priority in any building retrofit. The cheapest kilowatt hour is the one you do not need to buy.

Electrical Recommendations

E1. LED Lights: The existing lighting throughout the building consists of fluorescent tubes. Lighting appears to account for significant portion of the electricity consumption. RBG recommends upgrading the entire lighting system with LED fixtures. In addition to the new fixtures, RBG recommends installing lighting controls and occupancy sensors, along with a networked lighting system to allow for daylight harvesting and occupancy scheduling.

E2. Energy Star appliances: The refrigerator in the food bank pantry was manufactured in 2012. The chest freezers in the food bank appear to be manufactured in 2019. The upright freezers in the food bank were manufactured in 2010. A refrigerator in the community action office appears to be manufactured in 1998 and another is more than 12 years old and not Energy Star rated. At the end of life, replace these units with Energy Star rated refrigerators and freezers. Typically, the cost delta between an Energy Star model and a non-efficient model is around $200. The estimated annual savings for the Energy Star refrigerator is about $46, leading to a simple payback of fewer than 5 years.

The food bank is considering replacing the chest and upright freezers with a single, walk-in freezer. A single, walk-in freezer could be logistically more efficient. However, the electric consumption might be greater than the existing freezers combined. We recommend metering the appliances for a week to determine their actual consumption and then searching for Energy Star walk-in freezers here:

https://www.energystar.gov/productfinder/product/certified-commercial-refrigerators-and-freezers

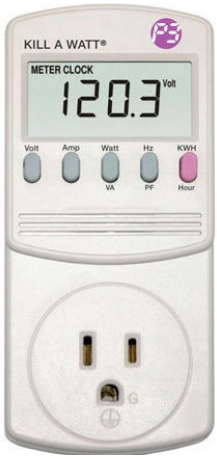


Photo 4. Affordable, easy to use meter to measure freezer electric consumption

Renewable Energy

The use of renewable energy to meet buildings' thermal and electrical needs is expanding rapidly. Incentives are now in place at the federal, state, and even local government levels. Any building upgrade project under consideration today should take advantage of the opportunities presented by renewable energy technologies including stabilizing energy supply costs, reducing the environmental impact of the greenhouse gas emissions from buildings, and cost savings.

A key goal for RBG in building upgrade projects is to recommend and help implement measures that will dramatically reduce a building's reliance on fossil fuels. Renewable resources can help building owners achieve independence from fossil fuels.

Renewable Recommendations:

- **R1. Solar PV:** Solar PV could be an excellent option for the Community Center building if the heating system is converted to electric air source heat pumps. However, additional analysis may be needed to determine if the roof can handle the added weight load and whether the adjacent trees shade the panels too much.

  If these concerns are addressed, RBG proposes a 13.7 kW PV Array. This array is projected to generate 16,818 kWh/year assuming the installation of high-efficiency panels and limited shading. The building's electric consumption averages 17,847 kWh per year. This means the proposed PV system would generate 94% of the building's average annual electric usage. If the Community Center plans to electrify the HVAC systems, RBG recommends installing addition panels on the west facing roof to account for that additional consumption.

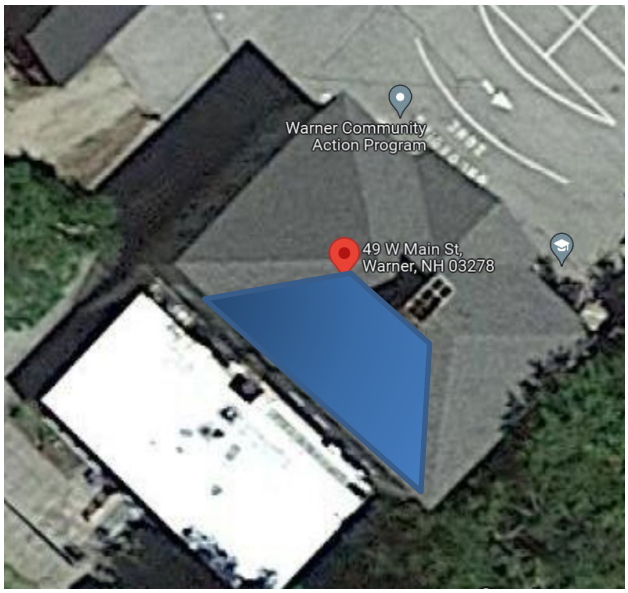


Photo 5. Proposed solar PV

No Cost/Low-Cost Energy Savings Opportunities

There are Energy Efficiency Measures (EEMs) that will cost little or no money to implement at the community building. It is important to encourage building occupants to slightly change their behavior. This is not easy, but such efforts will produce energy savings without any other investment. For this reason, RBG provided these initiatives as part of this analysis. By encouraging the building's occupants to alter routines, energy can be saved regardless of energy-saving investments. These No-Cost /Low-Cost Initiatives are:

❶ **Refrigerator replacement:** We recommend replacing refrigerators more than 15 years old with Energy Star-rated refrigerators.

❷ **Thermostat Setback (3°F+/-):** To reduce demands on the heating source, thermostat settings can be cut back by 3°F when outside temperature allows. Studies have shown that when the average outside temperature is above 38°F, a slight adjustment of interior temperature settings does not influence comfort. Over an eight-hour workday, this practice can produce a noticeable energy use reduction. It is suggested that the maintenance staff perform a test to see if comfort levels are affected. Resource: https://www.energystar.gov/products/heating_cooling/programmable_thermostats

❸ **Task Lighting:** To reduce electrical demands from lighting, task lighting should be encouraged where appropriate. A task lighting initiative would encourage building occupants to shut off the ceiling-mounted lighting and utilize task lighting (portable desk lamps, workstation under-shelf lighting, etc.) to provide the illumination they need, whenever possible. Providing task lighting devices for spaces appropriate to their use may entail a small expense if task lights do not presently exist. Furthermore, we recommend replacing existing single bulb incandescent or CFL fixtures (such as the task lighting mentioned above, or ceiling-mounted lighting) with appropriate LEDs.

❹ **Computer Settings:** An easy way to reduce plug load and electricity use is to turn off all computers at night and when not in use for extended periods. Ensure that the building occupant's computer towers and monitors are shut off when not in use and at the end of each day.

Financial Model

Assumptions:	Electric		Fuel Oil		Total Energy per Year	
Baseline Energy Usage:	17,847	kWh	3,362	Gallons	527,171	kBTU
Baseline Energy Cost:	$4,551	Cost	$15,465	Cost	$20,016	Cost
Baseline Unit Cost:	$0.26	($/kWh)	$4.60	($/Gallon)		

EEM #	Building Envelope Upgrades	CAPITAL INVESTMENT	ANNUAL ENERGY COST SAVINGS	ANNUAL ENERGY SAVINGS kBTU	SIMPLE PAYBACK	IRR	NPV
B1	Air Sealing	$2,000	$168	5,052	11.9	7.5%	$375

EEM #	Mechanical System Upgrades	CAPITAL INVESTMENT	ANNUAL ENERGY COST SAVINGS	ANNUAL ENERGY SAVINGS kBTU	SIMPLE PAYBACK	IRR	NPV
M1	Hybrid water heater	$4,200	$273	3,654	15.4	8.9%	$2,192
M2A	Wood pellet boiler	$42,000	$6,999	0	6.0	21.2%	$118,707
M2B	ASHP's	$82,500	$6,321	341,116	13.1	10.5%	$64,759

EEM #	Electrical System Upgrades	CAPITAL INVESTMENT	ANNUAL ENERGY COST SAVINGS	ANNUAL ENERGY SAVINGS kBTU	SIMPLE PAYBACK	IRR	NPV
E1	Exterior Lights LED Conversion	$1,500	$338	4,517	4.4	27.0%	$4,696
E2	Interior Lights LED Conversion	$27,650	$1,202	16,088	23.0	3.2%	($4,522)

EEM #	Renewable System Upgrades	CAPITAL INVESTMENT	ANNUAL ENERGY COST SAVINGS	ANNUAL ENERGY SAVINGS kBTU	SIMPLE PAYBACK	IRR	NPV
R1	13.7 KW PV System	$41,100	$4,278	57,240	9.6	14.7%	$77,264

EEM Package	CAPITAL INVESTMENT	ANNUAL ENERGY COST SAVINGS	ANNUAL ENERGY SAVINGS kBTU	SIMPLE PAYBACK	IRR	NPV
Recommended Package with Pellet Boiler (B1, M1, M2A, E1 & E2)	**$77,350**	**$8,980**	**29,311**	**8.61**	**15.5%**	**$165,487**
Recommended Electrification Package (B1, M1, M2B, E1 & E2)	**$117,850**	**$8,301**	**370,427**	**14.20**	**9.7%**	**$76,005**
Recommended Electrification Package with PV (B1, M1, M2B, E1, E2 & R1)	**$158,950**	**$12,579**	**427,667**	**12.64**	**10.9%**	**$133,867**

IRR and NPV assume a 5% inflation rate and a 5% Cost of Capital, Utility rebates and tax credits are not included

Next Steps

With the completion of this Level II Energy Assessment, the Warner Community Center should consider potential next steps to take advantage of the recommended energy saving and comfort-improving opportunities. Both the NHSaves program and the USDA provide grants and incentives that will reduce the implementation cost of many of the proposed energy efficiency measures in this report.