Exeter Multigenerational Community Center

10 Hampton Rd, Exeter, NH

Level II Energy Audit

June 30, 2023

Prepared by: *Resilient Buildings Group, Inc.*

Resilient Buildings Group, Inc. 46 South Main St, Suite 7 Concord, NH 03301 (603) 226-1009	**CDFA** 14 Dixon Ave, Suite 102 Concord, NH 03301 (603) 226-2170 smaslansky@nhcdfa.org

Contents

EXECUTIVE SUMMARY

Resilient Buildings Group (RBG) conducted a Level II Energy Audit of the Exeter Multigenerational Community Center building in Exeter, NH. Community Development Finance Authority (CDFA) provided funding for 75% of the audit cost. During the audit, RBG examined the building's shell and all pertinent electrical and natural gas systems.

The assessment shows that the energy performance of the building can be improved. This report will give the building owners an overview of its 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 Exeter Multigenerational Community Center

Site

Size: 4,578 ft²

Sewer: Municipal

Water: Municipal

Year built: The building was originally constructed in 1890. The rear addition was added in 1992.

Function: This building will be a multigenerational community center and office space for the Recreation Department. The facility will typically operate 9 hours a day, Monday through Friday.

Occupancy: Occupancy will vary depending on use.

Shell

Number of Levels: Two full levels with a basement and crawlspace.

Foundation and Insulation: The original foundation is constructed of stone and brick with a dirt floor. The rear addition foundation and floor are poured concrete. The basement's thermal barrier is located at the ceiling and consists of R-19 fiberglass batt insulation. The rear foundation perimeter is insulated with 1" foam board.

Exterior Wall Construction and Insulation: The exterior walls are 2" x 6" wood studs with a mix of wood clapboard and vinyl siding. The walls of the original section are partially insulated with blown-in rock wool, which has a rated thermal resistance of R-19. The walls of the addition are insulated with R-19 fiberglass batt insulation.

Roof Type and Insulation: The roof is wood framed with asphalt shingles. The original attic is insulated with 6” of blown rockwool insulation, which has a rated thermal resistance of R-19. The slopes and attic flat of the addition are insulated with 8” fiberglass batt covered with 1” of polyisocyanurate insulation board. The total rated thermal resistance is approximately R-36.

Windows: The windows are double-pane, vinyl-clad units in average condition. Some latches do not work and the seal around the double pane glass has failed on one window.

Doors: The exterior doors are insulated metal doors.

Heating, Plumbing, Ventilation, and Air Conditioning

Heating Fuel: Natural gas and electricity.

Heating Equipment: The original section of the building is heated with a 400,000 Btuh, natural gas-fired, one-pipe, steam boiler that has a rated thermal efficiency of 81% AFUE. The heat is supplemented by electric baseboard heat in the first-floor bathroom and two, 1-ton air source heat pumps with a rated SEER of 23. The rear addition is heated by two, 90,000 Btuh, natural gas-fired, sealed combustion furnaces each with a rated thermal efficiency of 92% AFUE.

Figure 2: Existing Furnace

Figure 2: Existing Steam Boiler

Heating Controls: The zones are controlled by a combination of standard, bi-metal, dial thermostats, and digital programmable thermostats.

Domestic Hot Water (DHW): The building receives DHW from a 40,000 Btuh, natural gas-fired, atmospherically vented tank with a thermal efficiency of 80%.

Air-Conditioning Equipment: The building is cooled by three, 4-ton, outdoor condensing units that each have a rated SEER of 10.

Ventilation Equipment: The bathrooms are vented with point source, exhaust fans.

Notable Issues

Basement moisture: Both the original basement and the rear addition crawlspace experience high moisture levels due to groundwater intrusion. Although the existing sump pumps can remove bulk water, the basement floor does not provide an adequate air and moisture barrier.

Figure 3: Existing Sump Pump

To remedy this issue, install a poly-vapor barrier across the basement and crawlspace floors to equip this area with a moisture barrier. Furthermore, install a dehumidifier if the area experiences high humidity levels after the poly vapor barrier is installed.

Second floor settling: The second floor of the original section is settling. This appears to be related to the prior removal of a second chimney.

Ventilation: The existing bathroom exhaust fans are weak and reaching the end of their life. Replace these fans with energy-efficient exhaust fans capable of exhausting a minimum of 50 CFM each.

Basement Insulation. The basement insulation is not adequately fastened to the ceiling. Many portions of the ceiling are missing insulation entirely. Fiberglass Insulation Batts (FGBs) are falling in sections, which means that there is no thermal barrier for parts of the building envelope. Furthermore, there is no vapor barrier, which means that high moisture loads could result in condensation and water damage.

Figure 4: Failing FGB Insulation

Blower Door Testing

Blower Door Information

An effective building envelope provides a barrier between the outside and inside air while retaining a high percentage of the energy used to condition the inside air (heating or cooling energy). This is achieved only when the envelope is well insulated and a continuous air barrier is implemented. The best way to properly investigate the current condition of a building envelope or shell is to perform a full blower-door test. The blower-door test quantifies the amount of uncontrolled outside air that enters the building through cracks, gaps, and poorly sealed penetrations, etc. Shell shortcomings, such as a lack of air sealing and lack of insulation, further compromise the temperature of the indoor air which the owner has paid to condition (heat or cool).

Blower door testing creates a measurable building pressure and airflow that allows us to evaluate a building's air leakage. ACH50 is the number of Air Changes per Hour at -50 pascals (created by the fan). CFM50 is the cubic feet per minute of air being pulled into the building while it is depressurized to 50 pascals. Natural air changes per hour (ACHn) represents infiltration into the building under normal conditions and tells how many times the entire volume of air in the building is replaced (by infiltration through building imperfections) per hour. These values allow for comparison of the leakiness of different sized buildings.

	Volume (Ft^3)	CFM @ -50 pascals	ACHn	ACH_{50}
Exeter Multigenerational Community Center	**36,624 ft^3**	**7,156 CFM**	**0.78**	**11.7**

Goal:	**6.0**

The findings of the blower door test suggest that there is ample room to air seal the building and reduce the amount of air infiltration through the envelope. RBG recommends a target ACH50 of 6.0, which can be achieved by implementing some of the recommendations in this report.

.

Preliminary Building Benchmarking

Typically, an energy audit delves into the historical usage of the building and conducts a building benchmarking calculation. However, there is no accurate usage information because of the building's recent change in ownership and its lack of occupants. To develop an accurate baseline of the building, RBG utilized an energy modeling tool that predicts the building's usage based on the mechanical systems, envelope, and predicted occupancy schedules.

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).

Our source EUI and CUI were calculated using energy modeling software based on the building's existing conditions and estimated occupancy schedules.

Predicted EUI/CUI Data:	
Site EUI:	87.00 kBtu/ ft^2/Year
Source EUI:	117.72 kBtu/ ft^2/Year
CUI:	$ 1.73 / ft^2/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
Public Services	Social Meeting Hall	**116.4**	**56.1**	CBECS – Social / Meeting

The Exeter Multigenerational Community Center has a higher site and lower source EUI compared to the national average. This is because the predicted usage has a comparatively low plug load to the national average. Furthermore, RBG's energy model of the building suggests that the major energy burden is a result of heating the building during the winter months. If there are plans to frequently occupy the building then there is significant 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 Envelope: One of the most important components 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.

a. **Attic stair cover:** The cover at the top of the walk-up stairs to the original attic is warped and does not seal tightly. Install an insulated cover that is hinged and can be latched against durable weather stripping.

b. **Basement doors:** There are no doors at the bottom of the bulk-head accesses to the basement and crawlspace. Build a frame with pressure-treated wood and install a custom-built insulated door with pressure-treated plywood and at least 2" of rigid foam insulation board.

c. **HVAC closet in addition:** The gable end wall of the HVAC closet on the second floor of the addition should be covered with sheetrock or rigid foam insulation with all seams and edges taped or spray-foamed.

d. **Skylight trim:** The sheetrock around the skylight of the addition is not sealed. Cover with sheetrock or wood trim and seal the edges with caulk.

B2. Attic Insulation: The existing attic is only insulated to R-19 which is well below the industry target of R-60. To improve the assembly, pull back the insulation and seal all plumbing, wiring, and chimney penetrations through the attic floor with one part spray foam.

After the attic receives air sealing work, install 12" of blown cellulose to bring the attic to a thermal resistance of R-60. This will significantly reduce the amount of heat loss through the assembly, reducing energy loss and improving thermal comfort.

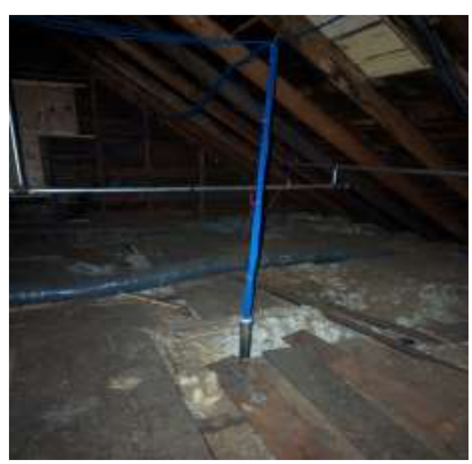

Figure 5: Existing Condition of the Original

B3. Insulate Portions of the Original Walls: The exterior walls of the original section were previously retrofitted with blown-in insulation. Thermal imaging indicates the walls were not dense packed fully and some areas were missed entirely. RBG recommends conducting an IR-guided insulation application, which will target the uninsulated areas and insulate them.

B4. Basement Insulation: As discussed in the Notable Issues section of this report, the ceiling of the basement and crawlspace are currently insulated with fiberglass insulation that has not been adequately installed.

To improve this assembly, install a 20-mil vapor barrier from the top of the foundation walls down across the basement floor. After, tape all seams of the vapor barrier to ensure that it is continuous. This will control moisture intrusion into space and reduce humidity levels. Next, install 3” of closed-cell spray foam from the rim joist down to the bottom of the foundation walls. This will provide a thermal resistance of R-21 and significantly reduce the amount of air leakage through the building.

Mechanical Recommendations:

M1. Air Source Heat Pumps (ASHP). The building already has a ducted air conditioning system and furnace, which could be perfect for an ASHP installation. Remove the air conditioning system and furnace and replace it with multiple ducted heat pumps that can utilize the existing ductwork for both heating and cooling. In areas that can’t be met with the existing ductwork, install ductless heads.

Additionally, leave the steam boiler in place to be used as backup or during extremely cold periods if the heat pumps are not able to keep up with the building’s demands. Once the envelope upgrades are completed, we estimate that the building could be served by a 7-ton heat pump system. The proposed system would almost eliminate the building’s gas usage and add 23,888 kWh of electric usage each year. The NHSaves program could offer an incentive for this measure of up to $1,750, based on the current $250 per ton incentive offers.

M2. Hybrid Electric Hot Water Heater. The existing natural gas water heater is only three years old. However, electric hybrid-heat pump water heaters are energy efficient and have the added benefit of providing dehumidification.

Replace the natural gas water heater when it reaches the end of its service life with a hybrid electric water heater. The NHSaves Program could provide an incentive of up to $750 towards this measure.

M3. Low-flow Aerators and Showerheads: Reducing the volume of water through fixtures, while maintaining comfortable pressure will reduce the water heating demand and could result in noticeable savings across the whole building. Install low-flow aerators and showerheads throughout the building. This measure has a low implementation cost and savings are based on occupant hot water usage demands.

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. RBG recommends upgrading all of the building's lighting to LED. Most of the fixtures in the building have screw-in bulbs, which are perfect for LED bulb replacements. The fixtures that have fluorescent bulbs should be replaced with LED fixtures to maximize energy savings. NHSaves could provide an incentive for the work if the fixtures installed are either Energy Star Certified or DLC listed.

Type	Quantity	Average Wattage	Replacement Type	Estimated Savings (kWh)*	Estimated Implementation Cost
Light Bulbs	53	32	LED Bulbs	1,763 kWh	$335
Fluorescent Fixtures	6	64	LED Fixtures	798 kWh	$2,100
*Based on a 40 Hour per Week Run Time					

Renewable Energy

The use of renewable energy to meet buildings' thermal and electrical needs is expanding rapidly. Incentives or tax credits 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 is an excellent way to reduce the building's energy expenses, as well as its carbon footprint. RBG recommends installing a 9 kW roof-mounted solar array on the east-facing portions of the building's roof. The proposed 9 kW array is expected to generate 10,111 kWh of electricity per year, which is 50% of the building's predicted electric load.

If an Air Sourced Heat Pump System is installed to cover the building's heating and cooling needs, then the building's estimated electric usage is 44,497 kWh per year. This means that the proposed solar system could cover up to 22% of the building's total annual electric usage.

Figure 6: Proposed PV System

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 cenetr 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:

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

➋ **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

➌ **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.

➍ **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 Modeling

The following table identifies each EEM’s projected cost, **estimated** annual energy savings and cost savings, simple payback, internal rate of return, and net present value.

The estimated energy usage for the building is based on an eQuest energy model with savings calculations that were conducted using the NHSaves Technical Reference Manual, Cost estimates were derived from several sources: The Utility Contractor Pricing Database, RS Means construction estimating tools, and RBG staff with field knowledge of installed work.

Financial Model

Assumptions:	Electric		Natural Gas		Total Estimated Energy Use per Year	
Baseline Energy Usage:	20,610	kWh	3,279	Therms	398,221	kBTU
Baseline Energy Cost:	$3,916	Cost	$5,509	Cost	$9,424.62	Cost
Baseline Unit Cost:	$0.19	($/kWh)	$1.68	($/Gallon)		

EEM #	Building Envelope Upgrades	CAPITAL INVESTMENT	ANNUAL ENERGY COST SAVINGS	ANNUAL ENERGY SAVINGS kBTU	SIMPLE PAYBACK	IRR	NPV
B1	Air Sealing Work	$1,050	$161	9,600	6.5	20.1%	$3,389
B2	Attic Insulation	$3,200	$279	16,600	11.5	12.7%	$4,541
B3	Insulate Portions of the Original Walls	$4,322	$312	18,600	13.8	10.8%	$4,387
B4	Foundation Insulation	$14,550	$454	27,000	32.1	4.2%	($1,514)

EEM #	Mechanical System Upgrades	CAPITAL INVESTMENT	ANNUAL ENERGY COST SAVINGS	ANNUAL ENERGY SAVINGS kBTU	SIMPLE PAYBACK	IRR	NPV
M1	ASHP System (5.7 Ton)	$38,000	$970	246,398	39.2	3.0%	($9,791)
M2	40 Gallon Hybrid Electric Hot Water Heater	$5,500	$281	23,767	19.5	7.8%	$2,417

EEM #	Electrical System Upgrades	CAPITAL INVESTMENT	ANNUAL ENERGY COST SAVINGS	ANNUAL ENERGY SAVINGS kBTU	SIMPLE PAYBACK	IRR	NPV
E1	LED Light Bulbs & Fixtures	$2,435	$487	8,738	5.0	24.9%	$10,921

EEM #	Renewable System Upgrades	CAPITAL INVESTMENT	ANNUAL ENERGY COST SAVINGS	ANNUAL ENERGY SAVINGS kBTU	SIMPLE PAYBACK	IRR	NPV
R1	9 kW Solar Array	$27,000	$1,921	34,499	14.1	10.6%	$26,560

EEM Package	CAPITAL INVESTMENT	ANNUAL ENERGY COST SAVINGS	ANNUAL ENERGY SAVINGS kBTU	SIMPLE PAYBACK	IRR	NPV
All Building Measures with LED Upgrade (B1 – B4 & E1)	$25,557	$2,210	86,005	11.56	12.6%	$35,800
Recommended Electrification Package (B1 – B4, M1, M2, & E1)	$69,057	$1,701	259,528	40.59	9.7%	$76,005
Recommended Electrification Package with Solar PV (B1 – B4, M1, M2, E1, & R1)	$96,057	$3,622	294,026	26.52	5.5%	$7,088

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 Town of Exeter should consider potential next steps to take advantage of the recommended energy-saving and comfort-improving opportunities. Both the NHSaves program and CDFA could provide grants and incentives that will reduce the implementation cost of many of the proposed energy efficiency measures in this report.

We have outlined a few steps that can be taken to leverage the NHSaves program for your upcoming projects.

Prescriptive Incentives

Prescriptive incentives are pre-determined incentive amounts for qualifying equipment. Equipment such as lighting & controls, natural gas and electric HVAC systems, and food service equipment are eligible for prescriptive rebates.

Custom Incentives

Custom incentives are available for measures that exceed the prescriptive equipment size, and efficiency ratings, or for measures not covered by the prescriptive path. Engaging with your respective utility about complex projects is key to leveraging all available incentives. For custom projects, connect with your utility early in the planning process. Fill out a custom application and reach out to your utility provider to discuss possible next steps. The NHsaves program can cover up to 75% of the incremental costs for new equipment and construction and up to 50% of the project cost for retrofit projects.

Technical Assistance

NHSaves utility partners offer technical assistance, including project evaluation, identification of energy-saving measures, energy audits, building commissioning, and retro-commissioning to ensure energy savings are being maximized and the greatest incentives are available for your project. The program can provide recommendations for turnkey vendors for direct install opportunities such as programmable thermostats, low-flow faucet aerators, shower heads, LED lighting and controls, and more!

Project Management

Resilient Buildings Group would be happy to assist in the development of any energy efficiency upgrades as indicated in this report. If you would like to discuss our project management services, please reach out to us and we can work with you to develop a plan that aligns with the long-term goals of the building.

NHSaves Utility Contacts To engage with your utility contacts about upcoming projects, contact your respective utility providers at the contacts listed below:

Eversource: www.eversource.com | (866) 554-6025 | efficiencynh@eversource.com

Unitil: www.unitil.com | (888) 201-7700 | efficiency@unitil.com

Disclaimer: This report is delivered without any warranties, expressed or implied. This report contains information about the Exeter Multigenerational Community Center. – and is based upon our observations and analysis and upon information that we received from employees. RBG has used care, its best professional judgment, and the services of qualified vendors and sub-contractors to research and prepare this report. We believe we are presenting an accurate and complete assessment of your building and the opportunities present for energy improvements. Please note that no project pricing displayed within this report includes the cost of the design, plans, or specifications for construction.

Furthermore, RBG shall not be liable for any inaccuracies in this report, for any damages that may result from the implementation of measures recommended in this report, or for discrepancies between the avoided energy cost estimates listed in this report and those which the building realizes from the implementation of the outlined plan.

Rebates, grants, and low-interest loans often affect the financial results of energy-related improvements. As these opportunities often change, we have not included these advantages in our financial results. Efforts to define their availability should be made when the decision to implement the recommended energy measures is made.

Confidentiality Restrictions: This report contains data and information submitted to fulfill an Agreement between RBG and the Town of Exeter and is provided in full confidence. The recipient shall have a limited right as outlined in the Agreement to disclose the data herein.