Rochester Vermont

Town Building Audit

October 5, 2021

EEI has been requested to audit the Town buildings in Rochester Vermont for energy efficiency, fossil fuel reduction and building systems conditions.

The following Town buildings were reviewed:

- Town Hall
- High School
- Fire Department
- Public Works Department
- Water treatment facility
- Library

Building HVAC systems, general building construction and the integrity of building components were noted during the walkthroughs. This audit excludes complete design documents, and complete code compliance of all spaces.

This audit addresses the condition of equipment, fossil fuel reduction, general building functions and recommendations for addressing each building.

Town hall

The town hall building is an old build that has been added on to on several occasions. The building is heated by a 30 plus year old single zone oil hot air furnace located in the basement. The air passes through ductwork routed through the building to the local zones. No measurable outside air was noticed in the existing furnace system. While reviewing the building with town staff many issues were discussed such as equipment age, serviceability, zone comfort and efficiency.

Building Issues

- Town meeting space is not large enough for large crowd accommodation. Meetings frequently are held in other locations to accommodate larger crowds.
- Existing town vault is not large enough for records and record expansion.
- The records vault is cold in the winter and does not have humidity control. The vault essentially sits outside the building envelope and has no heating inside the space. The open door to the clerk's office is to only means of heat.
- Building heating system is old. The 1980s era oil furnace has single zone control and has lower efficiencies then systems available today.

- Heating system does not have adequate zoning for occupant comfort. The existing system over heats areas and does not provide efficient system control.
- Building does not have any ventilation for occupants.
- Existing structure has minimal insulation in the fenestration of the structure.
- Old garage area is not being used and is connected to the hot air furnace.

Mechanical solutions

The main objectives for the Town hall are to improve occupancy accommodations and to improve the building heating systems. While addressing these two issues building energy efficiencies are improved and the elimination of fossil fuels is achieved.

Replacing the oil-fired heating system with a significantly more efficient heat pump system will provide better zone comfort and provide energy savings. The heat pump system provides heating and cooling needs and more independently controlled zones.

The below grade oil tank should be removed. The tank is located on the north west side of the building and looks to be partially under some communications panels. The location of the tank should be verified and coordination with the communications company should take place for tank removal.

We recommend that the building have an active mechanical ventilation system installed for outside air requirements. By installing an air-to-air heat recovery unit, the spaces can be ventilated and heating/cooling energy can be improved.

Part of the building that is being heated and not fully utilized is the garage area. The reason for the space needing heating is to prevent water piping in this area from freezing. This space should be removed from the heating system and have the piping removed to prevent any freezing issues.

Domestic water heating can be provided by a heat pump water heater for further energy and fossil fuel reduction.

Building Solutions

The garage area at the back of the building does not get very much use and it is located in an area that is remote and harder to reach. The removal of this structure should be considered.

The vault area does not have good wall and roof insulation and is not heated. The structure should be insulated and a heating system should be installed.

An overall encompassing solution would be to provide a 2,500 to 3,000 square foot building addition in the front at grade level that would include a large community room and new restroom group. The addition would also incorporate enclosing the records room with an insulated enclosure. The addition would improve large community gatherings, ADA access and energy improvements.

For additional energy improvements the existing doors and windows at the lower level should be improved and insulation added to the walls.

Option #1 Outline

1. Upgrade the mechanical systems to a Heat-pump system
2. Install air-to-air heat recovery units for ventilation
3. Insulate and seal up existing building fenestration
4. Provide addition to building for town meeting room
5. Include ADA restrooms in new addition
6. Incorporate and expand the archive vault into new addition
7. Install domestic heat pump water heater
8. Install LED lighting throughout facility
9. Remove garage area at the back
10. Consider the installation of solar panels on new addition roof.

Option#2 Alternate solutions

An additional solution to the Town Hall would be to move the function to the high school and renovate that building to fit this purpose. There is plenty of space at the high school, but a significant amount of renovation is required. Moving to this location would task the town to maintain a larger space than is needed for the town general functions. The energy use and the maintenance cost per square foot would be much more than the space it currently occupies.

High School

The high school has been sitting unused for 2 years and is not occupied at this time by a permanent occupant. The existing heating and air handling system is over 30 years old and at the end of life. Work required to repurpose this facility would be extensive. If the remaining part of the building not used by the town hall is to be renovated, a significant amount of floor space would need to be repurposed to deem it economically beneficial.

The energy costs for maintaining the high school are greater than any other building and as fuel and electrical prices continue to climb the cost of maintaining a large facility will always increase.

In order for the building HVAC system to continue to function as it currently does the systems will need to be upgraded.

Heating system

High School Option #1

The existing boilers are lower efficiency oil fired boilers that are beyond the industry standard of life (25yrs) and should be replaced with energy compliant boilers such as condensing boilers. The piping system has not been as active and there are concerns about pipe integrity. Localized rusting of the piping will have occurred and the system should be tested to see if extensive work on the piping system is needed or piping replaced. The budgetary cost to address the piping alone could be approximately $250,00 to $500,000 for testing, demolition, pipe upgrades, insulation, flushing and water treatment depending on the depth of work required.

The existing building HVAC controls are pneumatic with some mixed electric. These are outdated and parts are nonexistent or difficult to find. The existing Building Automation System (BAS) should be removed and upgraded to a new Direct Digital Control (DDC) system. The DDC system will be able to provide better energy efficiency and comfort control and provide remote access for systems observation and troubleshooting.

Oil fired boilers at High School.

The existing pumps and hydronic appurtenances are old and should be removed and replaced with new more efficient equipment. New pumps with VFD's (Variable Frequency Drives), air separators, expansion tanks, gauges, and isolation valves should be part of the new boiler system upgrade.

New condensing boilers should be installed to replace the existing boiler system. The existing oil tank and piping system should be removed and new LP gas tanks installed.

The existing air handling systems in the building are the original equipment and are past the industry standard useful life (15 to 20 years). The existing outside air ventilation system does not incorporate a HRU (Heat Recovery Unit) which is essential to comply with current energy codes. Replacing the existing air handling systems will require extensive work and additional cost to upgrade. Some areas do not have maintenance access for removal and installation of the new equipment. Additional work will be needed to cut into the building to create access doors or panels for equipment transfer.

If the existing ductwork systems are to be salvaged, all of the supply, return and outside air ductwork should be cleaned and inspected. Additional work and costs for this activity can occur if there are portions of the ductwork that are internally lined. Old duct liner does not clean and it is not National Air Duct Cleaners Association (NADCA) approved.

High School Option #2

Option #1 does not move the building away from fossil fuel use, but it provides a perspective on the items needing to be addressed. Option #2 is a Variable Refrigerant Volume (VRV) heat pump system approach that would replace the existing air handling systems and infrastructure. The existing air handlers and supporting ductwork would be removed and a new VRV system installed with zone fan-coil units providing heating and cooling needs for each zone. In conjunction with the VRV system an HRU system would be required to provide outside air ventilation to the spaces. This system is able to ventilate the spaces and simultaneously heat/cool as needed. These systems typically are more expensive than traditional HVAC systems and the existing systems in this case would be removed completely which adds cost to this option.

For these types of VRV systems with buildings having large exterior surface areas that are not insulated well, a backup heating system is advised. Extreme winter conditions and areas of high outside air infiltration such as exterior doors also would require additional heat. A small condensing boiler plant can be installed to provide heat to outside air units, entryway cabinet unit heaters, and remote fin-tube wall heaters. This would assist the HP system in maintaining the building heating during extreme winter demands and would serve as a secondary heating system.

There are large volumes space at the facility that are not occupiable and need to be heated only to prevent freezing. For example, the mezzanine and mechanical rooms. These spaces use energy with no benefit to the end user and are significantly larger in comparison to other town buildings such as the town hall.

Building components needing upgrades.

1. Roofing
2. Siding
3. Doors and windows
4. Boiler heating systems upgrades
5. Air handling and ventilation systems upgrades
6. Interior walls and ceilings needing modification for new tenants
7. Lighting upgrades.

In either case of option #1 or #2 for the descriptions above the town will commit to:

1. Maintaining a larger HVAC building system.
2. Providing energy to a larger building square footage than is needed by town activities.
3. Maintaining a larger building including building surface areas that will need to be maintained or replaced over time such as roofing, siding, walls, ceilings and parking lots.
4. Providing insurance on buildings and for liability.
5. Providing cleaning and maintenance services.
6. Management services for keeping the remaining building areas occupied or rented to other organizations.

Another option that has been proposed would be to remove the high school classrooms, mezzanine, kitchen and office areas and preserve only the auditorium and shop areas. This reduced area option (#3) would greatly reduce the floor area commitment and concentrate the town functions to the shop

areas, auditorium, the 'music room' and offices behind the auditorium. The same recommendations would still be proposed as in options #1 or #2 above for heating and ventilation only on a smaller scale. Option #3 would have the additional burden of the site demolition of the other building and reconstruction of the grade or landscaping added to the cost.

Any of the high school options presented above would move the Town Clerk's office closer to the flood zone.

Fire Station

The fire station is a new structure with a new heating system and is in good condition. To reduce the dependency on fossil fuels, multiple air-to-air heat pumps can be installed in the office spaces and the gathering room. This would provide better zoning of the area and a benefit of cooling/dehumidification of the spaces.

Installation of a small system for this building would be $18,000 for a 4ton heat pump with 3 remote wall mounted fan-coil units.

Public Works Department

The PWD building is an old concrete block building in need of some repairs. There is no exterior wall insulation or perimeter grade insulation on the building. These buildings are very typical for having large air infiltration loads due to the opening and closing of overhead doors and general openings around the structure in the winter. This function alone contributes 60% or more of loss of heat. Normal space temperatures usually range from 45F to 55F during winter use.

Improvements to the building to reduce infiltration would be to install tighter insulated overhead doors, tighter side doors and windows. Additionally, sidewall exhaust fans and intake louvers with dampers should be upgraded to include insulated plenums, and installing Class-1 low leak insulated dampers (IECC-2015).

To reduce the dependency on fossil fuels, multiple commercial grade air-to-air heat pumps can be installed in the apparatus bay. This would provide heating in the early fall and late spring and supplement heating in the winter running in conjunction with the existing heating system.

Installation of a heat pump system for this building would be approximately $30,000 for an 8 ton heat pump system with 2 remote ceiling mounted fan-coil units. Running refrigerant piping and electrical is easy to access.

Library Building

The library is a wood structure with central hot air furnaces with a sheet metal ductwork distribution system that supplies air to the first and second floor.

To reduce fossil fuel use, a new heat pump system could replace the two hot air furnaces. Site observations indicate that the existing ductwork system is not insulated up through the building. Insulation would need to be installed to prevent condensation on the ductwork in cooling mode and to conserve energy. This option would be challenging due to the fact that the ductwork is concealed behind finished walls throughout. To access the ductwork would require a significant removal of finished walls and ceilings.

A second option would be to install remote wall mounted or concealed heat pumps in the occupied spaces which would have a far less impact to the building finished surfaces. This would provide heating and cooling in conjunction with the existing system with the heat pumps being a primary source for heating and cooling. The existing system would remain in place to provide ventilation and backup heating. Budgetary cost for installing 4 remote 2 ton heat pumps would be approximately $75,000.

Library Envelope

The building envelope has issues with water damage and decay. There are several areas around windows where the sill has completely rotted out and water is infiltrating into the structure of the building. A continued cycle of water infiltration will rot out the supporting structure and cause mold and mildew issues. Air is also infiltrating the walls in these areas and causing energy loss and additional condensation in the winter time. The exterior paint is now flaking off the siding which leads to the wood to be exposed and additional water penetration into the wall structure. The existing paint is likely to have lead in it and should be tested. Appropriate steps should be taken ASAP to handle the work.

Library window sill and siding on north side.

The exterior walls should be addressed and made weather tight. The decayed wood sills around windows and base boards should be removed and the inside structure should be inspected for damage. If no significant damaged is found it should be treated. The siding and window trim should be replaced and made water tight. The exterior siding of the entire building should be cleaned and prepped for painting and sealing of all joints to protect the building.

Library Basement Walls

It was noted that there was an attempt to prevent air infiltration and to insulate the basement walls with spray foam and plastic membranes. This should be removed from the walls for inspection in the event of the water seeping in from above through the compromised siding. The spray foam and vapor

barrier tend to hold and conceal moisture in the wood and walls. This prevents the materials from drying out and will aid in additional rotting and mold growth. These barriers should be removed when the exterior work is done and to further determine the extent of water migration into the building. Additional work should be done in the basement to seal up the walls and to help dry out the structure.

Pricing to address the library siding is unknown as contractors to address this are hard to find.

Water treatment plant

The water treatment plant on the south side of town is a small structure with a small heat load demand. The building could easily be heated by a heat pump and a backup electric heater. Budget cost for this would be approximately $12,000.

Town Energy Usage

The largest town energy use is the high school with more than 10 times the energy use of any other building. This makes this facility by far the largest fossil fuel use and carbon footprint source if it remains as is. The fiscal years of 2017- 2018 and 2018-2019 were used for reliable data for energy use. The table below has data taken from compiled utility bills.

Building	2017-18	2018-19
	Total electrical & fuel Oil	Total electrical & fuel Oil
High School	$51,724	$59,753
Town Offices	$4,563	$5,099
Library	$3,500	$3,470

With improving building integrity and HVAC efficiencies at all facilities, these values can be reduced, but the larger facility will require a larger investment for a smaller energy reduction.

Year	High School		Town Offices		Library	
	Elec (KW)	Fuel (oil)	Elec (KW)	Fuel (oil)	Elec (KW)	Fuel (oil)
17-18	97,080	14,562 gallons	11,011	810 gallons	5,582	956 Gallons
18-19	74,480	18,306 gallons	11,439	1,102 gallons	5,598	776 Gallons

The overall comparison of the 3 available town building's energy consumption indicates that the high school would be good project to eliminate fossil fuels and reduce energy consumption in some fashion.

Below is a summary of rough budgetary construction costs associated with the proposed options for the high school.

	Demolition	HVAC & plumbing	DDC Controls	Arch fit up	Electrical	Misc-services	Total	
High School Option#1	$600,000	$1,200,000	$210,000	$550,000	$250,000	$250,000	$3,060,000	
High School Option #2	$600,000	$1,500,000	$210,000	$550,000	$250,000	$250,000	$3,360,000	
High School Option #3	$820,000	$700,000	$150,000	$350,000	$150,000	$150,000	$2,320,000	

Notes: Architectural fit up only includes finish work in the Town offices. All others spaces are cleaned to shell space with general lighting (no ceilings, flooring, finish work, wall trim, or painting).

As seen in the table above the rough budgetary numbers for all the options indicate that the investment made in the high school would require a considerable review to utilize the site.

Town Hall

The rough budgetary costs for the Town Hall additions and modifications are as follows.

	Demolition & Prep	Building Addition	HVAC	Plumbing	Electrical	Misc-services	Total
Town Offices	$120,000	$750,000	$180,000	$75,000	$120,000	100,000	$1,345,000

Greenhouse Gas Emissions

We can compare our options as described above for the Town Offices and the High School as it relates to energy costs and GHGe (Greenhouse Gas Emissions). Below is a comparative table reflecting actual energy use collected through billing and potential energy use through building improvements.

Town Office	Electrical	Fuel Oil	GHGe	Fuel & Electrical	GHGe Reduction
Year	(KW)	(Gallons)	(Tons)	Costs	
2017-18	11,011	810	8.34	$4,564	Base
2018-19	11,439	1,102	11.34	$5,099	
Otp#1	18,500	0	0.07264	$2,954	>95%

Note: Takes into account current electrical and fuel oil pricing.

The high school energy use and GHGe are shown below for the options presented above.

High School	Electrical	Fuel Oil	LP Gas	GHGe	Fuel & Electrical	GHGe Reduction
Year	(KW)	(Gallons)	(Gallons)	(Tons)	Costs	
2017-18	97,080	14,562	-	149.56	$51,724	Base
2018-19	74,480	18,306	-	187.79	$59,753	
Option #1	95,000	-	10,150	58.0	$47,149	60%
Option #2	116,496	-	7,650	43.9	$43,572	>65%
Option #3	32,000	-	4,000	22.83	$17,608	>80%

Note: Takes into account current electrical and LP gas pricing.

Summary

After reviewing the 6 town sites, it is apparent that high school dominates energy and fossil fuel usage which in turn emits the highest GHGe over the other town buildings. The town hall investment at its current site is less of an impact and provides a good energy reduction and significant reduction in fossil fuels. Investing at the current Town Hall site keeps the footprint of the building compact, useable, manageable and more efficient. While considering the High School site as an option opens opportunities for utilizing an existing facility and opening floor space for other uses.

The GHGe tables above clearly shows the use of Heat Pump equipment alone or incorporated with other cleaner heating systems has the best overall reduction of yearly greenhouse gas emissions. Other factors that can contribute to energy savings and lower GHGe is LED lighting upgrades and sealing up the building with better insulation and sealants. Additional options to consider for energy offset are solar panels. Building structures should be reviewed by structural engineers and roofing material conditions should be analyzed before this path is taken.

The most concerning building is the library which has continual damage to the structure and the integrity of the building itself. Comparably to the other buildings if nothing is done, significant damage will occur to the structure and as time goes on costs will escalate for the required reconstruction needed to protect it.

Thank you,

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For EEI, Inc.

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