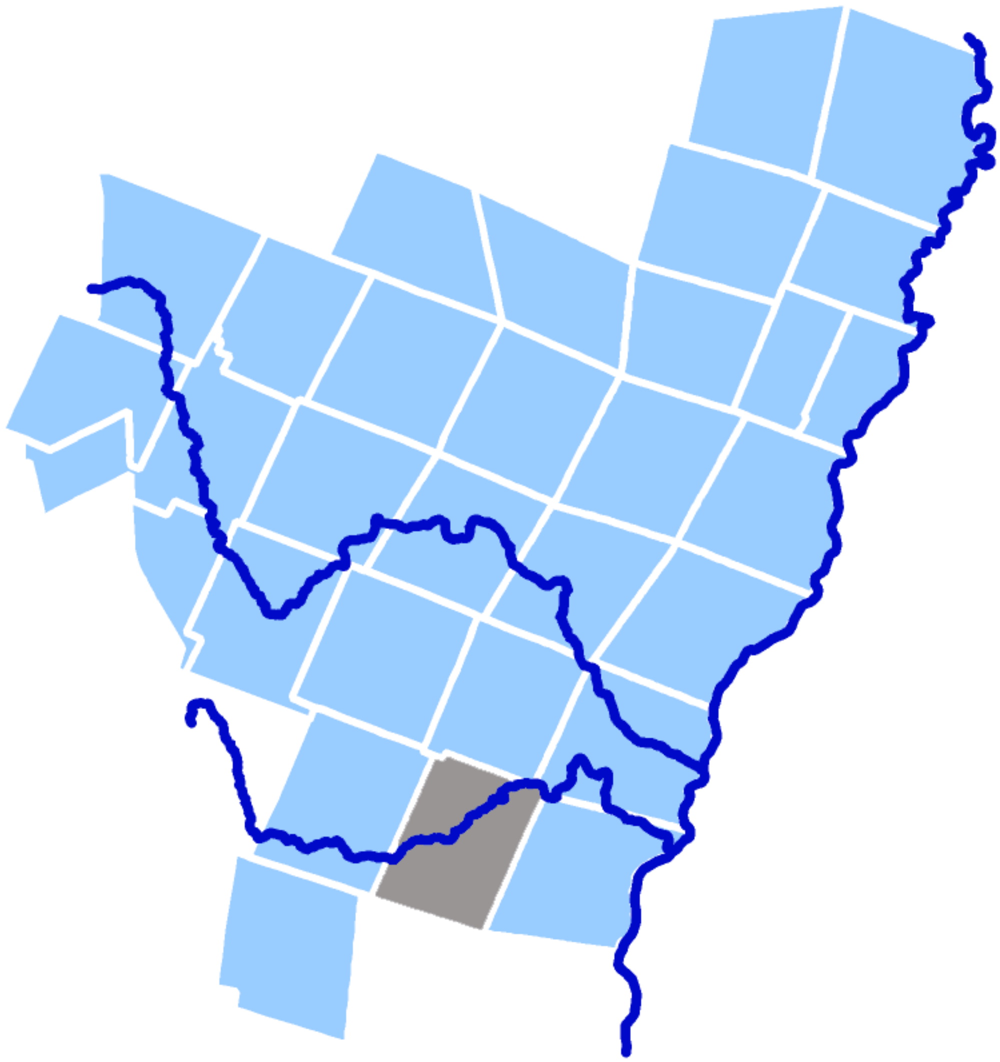
Two Rivers-Ottauquechee Regional Commission



Woodstock Town Hall

Building Energy Plan

Provided for the Town of Woodstock by the Two Rivers-Ottauquechee Regional Commission's Energy Efficiency and Conservation Program.
Funded through a grant from the US Department of Energy.

This Building Energy Plan was provided for your community at no charge with help from an Energy Efficiency and Conservation Block Grant through the US Department of Energy.

For Questions about the Two Rivers Ottauquechee Energy Efficiency and Conservation Program, please contact:

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Jon Haehnel
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Zero by Degrees LLC

Energy Independence in Affordable Steps

Building Energy Plan

January 17, 2011

To: Mr. Philip Swanson and Mr. Chris Sargent, TRORC
From: Jon Haehnel, Zero by Degrees LLC

RE: Energy Audit Conducted October 30, 2010 on the Woodstock Town Hall.

Thank you for inviting Zero by Degrees LLC to help with your building energy needs. The following report presents our findings and recommendations from our diagnostic visit(s). It is our hope that this report can be the basis for a long term energy plan for the building. Z by D would like to thank Chris Miller, Barbara Barry, Norwood Long, Sally Miller, Stephen Carter, John Biglow, Nigel Hollis, Marian Koetsier, and Barry Milstone for their help in collecting the data for the audit. Parts of this report are provided by Chris Hebb of Dynamic Integrations LLC, a sub consultant to Zero by Degrees.

Purpose

To identify potential building retrofits and operational practices to reduce energy use.

Executive Summary

The most significant energy saving opportunities at the Woodstock Town Hall are in improving the heating system controls, turning off outside lights in the day, preheating the fuel oil, and in isolating the offline boilers. There are a few envelope improvements that can easily be made right now but most of the major improvements to the envelope should be made in coordination with renovations to the building.

Summary of Analyzed Measures

Measure	Total Savings	Approx. Cost of Measure	Possible Rebate	Cost with Rebate	Lifecycle (Years)	Simple Payback (Years)	SIR
O&M #1 - Improve Heating Controls	$357	$300	$0	$300	15	0.8	17.9
O&M #2 - Turn Off Outside Lights in Daytime	$32	$10	$0	$10	15	0.3	47.3
ECM #1 - Preheat Fuel Oil	$1,213	$3,500	$0	$3,500	15	2.9	5.2
ECM #2 - Isolate Offline Boilers	$901	$5,500	$0	$5,500	15	6.1	2.5
ECM #3 - Simple Improvements in Insulation and Air sealing	$3,016	$19,459	$0	$19,459	30	6.5	4.6
ECM #4 - Upgrade Lighting	$890	$12,975	$2,560	$10,415	20	14.6	1.4

O&M - Operation & Maintenance Measure- low or no cost measures that involve changes in how the building is used or operated.

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ECM - Energy Conservation Measure - measures that involve some expense to make a change to the building.

Simple Payback – The number of years the energy improvement will take to pay back the investment.
SIR - Savings to investment ratio, is the present value of savings divided by the cost. It is considered the most meaningful criteria for ranking measures. The higher the SIR the better the return on investment. Generally, an SIR less than 1 is considered a poor energy investment although there may be other reasons besides savings for going ahead with the measure.

Measures Analyzed but Not Recommended

1. Changing the outside metal halide lights in the ceiling over the main entrance was considered. Although it will save energy to switch to energy efficient LED lights, the cost for the new lights, even with rebates from Efficiency VT, and the relatively low use at night makes the SIR too low.
2. There are several insulation measures discussed in the section "Simple Improvements in Insulation and Air sealing" that are not cost effective to implement as standalone improvements but make sense to implement in coordination with a major renovation.
3. The four ton Bryant air conditioner serving the conference rooms is located in the unventilated attic. This unit is rated for up to 125°F ambient air. It operates 63% more efficiently at 85° than at 125° and the attic is very likely above 125° in summer with the combination of solar gain and the heat of the condenser. Because the conference rooms are used only about 30 hours per month the efficiency savings for ventilating the attic are small. It is suggested that the attic temperature be checked on hot days when the conference room is in use. If the temperature is above 130°F consult the manufacturer, Carrier, as to the maintenance implications of operating above the rated temperature. If needed install a condenser interlocked exhaust fan and inlet dampers.

Notes for Understanding this Report

1. Cost estimates in this report typically include the cost for materials and labor to implement the energy efficiency measure. There can be many hidden costs associated with any building improvement that are beyond the scope of this energy audit report. The following costs may apply to the energy efficiency measures listed but have not been specifically accounted for in this report: design, demolition, temporary staging or masking beyond the normal measures of the installation crew, temporary storage or moving costs, increased maintenance costs, historic preservation review, permitting, state and federal regulations for lead, asbestos, radon, and the like. There may also be salvage value for old equipment or reduced maintenance that could reduce the cost of an energy improvement. Salvage values and reduced maintenance are not accounted for in the cost estimates in this report. Cost predictions in this report are not estimates or fixed quotes. They only indicate the approximate cost for the recommended upgrade assuming that you hire an outside contractor for the upgrade and are meant to aid in making preliminary decisions. Especially for complex and large projects, a detailed review of the costs and maintenance implications is recommended.

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2. There are several "wild cards" in predicting energy savings. Among them, the weather from year to year, occupant behavior, changes in levels of occupancy and environmental factors that are difficult to quantify. For these reasons, predicted savings are guidelines and not guarantees.
3. When viewing thermographs, lighter colors indicate higher surface temperatures than darker colors. What is considered "heat loss" is dependent upon the perspective from which it is viewed.
4. Some infrared images are taken under depressurization. Depressurization causes all outdoor air to flow inward and is not the normal operating state of the building. It is done to reveal conditions that would not normally be detected or to enhance thermographic images. Depressurization is also used to mimic the environment a building would be under in conditions of high wind or very cold temperatures. The building was depressurized to about –45 Pascals during the last part of the imaging.
5. Air leaks are detected by the infrared camera when cooler air "washes" across a surface. The pattern of air leakage is typically dark wispy lines emanating from the air leakage site.
6. Rebates, incentives, and tax credits may change or have termination dates. Verify that the suggested rebates/credits in this report are still in effect and look for additional programs that may have come into effect at http://www.dsireusa.org/ and http://www.efficiencyvermont.org/pages/ when you are ready to implement your energy conservation measures. Lighting, motors, heating, cooling, and ventilation system rebates may be applied for directly through Efficiency Vermont's website http://www.efficiencyvermont.com/pages/. Insulation and air sealing rebates through Efficiency Vermont may require that the work be done through a Certified Home Performance with Energy Star contractor and that all health and safety recommendations be completed in order to qualify for the rebate.
7. **Important note:** The energy model for the Woodstock Town Hall was reconciled to actual fuel and electricity consumption and then modified to account for changes in theatre lighting that happened in 2010 that will change energy consumption but have not yet been reflected in a full year of energy bills. These changes had to be accounted for in the energy model because they reduce the total energy consumption and they reduce the remaining amount of energy that can be saved with other measures. A model based just on energy use prior to the changes described above would over predict energy savings for new measures.

Health and Safety Recommendations

All building systems interrelate and occasionally improvements to one building system can create problems in another. Measures to improve energy efficiency should be regarded in the context of the health and safety of occupants and in the long term durability of a building. Careful consideration of the following and testing before and after efficiency improvements will help to prevent conditions that could have a negative impact on the building.

1. There are no CO detectors in the building. At least 1 should be installed per floor.
2. Have the boilers tuned to reduce CO levels (See "Combustion testing" below).
3. Many of the emergency lights have not been tested in a long time and may have failed batteries.

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Energy Plan - Energy Efficiency Measure Descriptions
The following measures with predicted savings, predicted costs, and implementation notes can be used as the foundation for a long-term energy plan for this building. The energy plan has the potential to save the most energy at the least cost if consulted at least once a year and before every renovation, addition, and equipment or building upgrade.

1. O&M #1 – Improve Heating Controls

The listers office runs hotter than the job bank office resulting in the use of electric heaters to balance temperatures in this zone. Block radiation in the warmer room to balance the heat. If necessary add radiation to the cooler room.

The hot water circulator, CP-3, in the boiler room serves as a primary circulator for circulator CP-1 serving Rm 113, theater office, and CP-2 serving Rm112, Town Clerk. This circulator runs continuously in winter. Rewire CP-3 to operate only when either CP-1 or CP-2 are running.

In general room temperature control throughout the building is very efficient with manual control of fans and temperature settings predominating. Any further reduction in unoccupied temperature settings will save fuel and electricity. Consider turning down the heat in the stage and theater areas to 55F when unoccupied. Keep the lobby at 50°F unless occupied for ticket sales. This will reduce heat loss through the entry doors and create a buffer to the outside. Replace any older thermostats that are not consistently set back manually, with programmable thermostats.

If the theater and stage air handlers will operate on a call for heat from the thermostats let the thermostats control these units in cold weather and use the override timers only in mild weather to force the fans on for ventilation.

Reduce the domestic hot water temperature to 115°F.

The exhaust fan serving the basement bathrooms are not operating. This fan was designed to come on with the bathroom lights. Repairing the fan will probably add less than $50 worth of oil to the present use.

Gallons saved	kWh saved	Savings Heating	Savings Electricity	Total Savings	Approx. Cost of Measure	Possible Rebate	Cost with Rebate	Lifecycle (Years)	Simple Payback (Years)	SIR
105	2100	$179	$178	$357	$300	$0	$300	15	0.8	17.9

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2. O&M #2 – Turn Off Outside Lights in Daytime

This light and the one around the corner both were on in the daytime.

There are 2 outside lights that I found on in the daytime both times I was on site. I found a timer that controls these lights and it appears to be set for 4pm to 11pm but the override switch may be working because the lights were on at 2:04 pm. Verify the switch and timer are working and adjust the timer seasonally so the lights do not stay on in the daytime.

Gallons saved	kWh saved	Savings Heating	Savings Electricity	Total Savings	Approx. Cost of Measure	Possible Rebate	Cost with Rebate	Lifecycle (Years)	Simple Payback (Years)	SIR
0	372	$0	$32	$32	$10	$0	$10	15	0.3	47.3

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3. ECM#1 - Preheat Fuel Oil

It is recommended that a fuel oil preheater be installed on each boiler. This electric heater reduces the viscosity of the fuel improving the atomization and combustion efficiency. The heater uses 65 Wh per gallon heated and typically improves efficiency by 10%.

The recommended heater is made by Shor-burn Equipment:

Shor-Burn Equipment
PO Box 677
Searsport, ME 04974
207-548-6114
http://www.shor-burn.com/
wmshorey@myfairpoint.net

Gallons saved	kWh saved	Savings Heating	Savings Electricity	Total Savings	Approx. Cost of Measure	Possible Rebate	Cost with Rebate	Lifecycle (Years)	Simple Payback (Years)	SIR
743	-593	$1,263	($50)	$1,213	$3,500	$0	$3,500	15	2.9	5.2

4. ECM#2- Isolate Offline Boilers

Boiler plant standby losses can become significant when several boilers are kept hot unnecessarily. The existing boilers have no automatic isolation valves to stop flow through a boiler if it is in stand-by mode.

Set the 330 MBH (large boiler) as the lead and install motorized valves on the other two.
Provide two-position isolation valves for each of the two smaller boilers. Provide controls to close the valve when a boiler is not needed for building heat. This will prevent water from flowing through the lag boilers and decreasing system supply water temperature. It will also reduce standby radiant losses of the lag boilers and their breechings.

Keep the boilers on the hot water reset schedule as overriding this control causes inefficient operation.

Gallons saved	kWh saved	Savings Heating	Savings Electricity	Total Savings	Approx. Cost of Measure	Possible Rebate	Cost with Rebate	Lifecycle (Years)	Simple Payback (Years)	SIR
526	87	$894	$7	$901	$5,500	$0	$5,500	15	6.1	2.5

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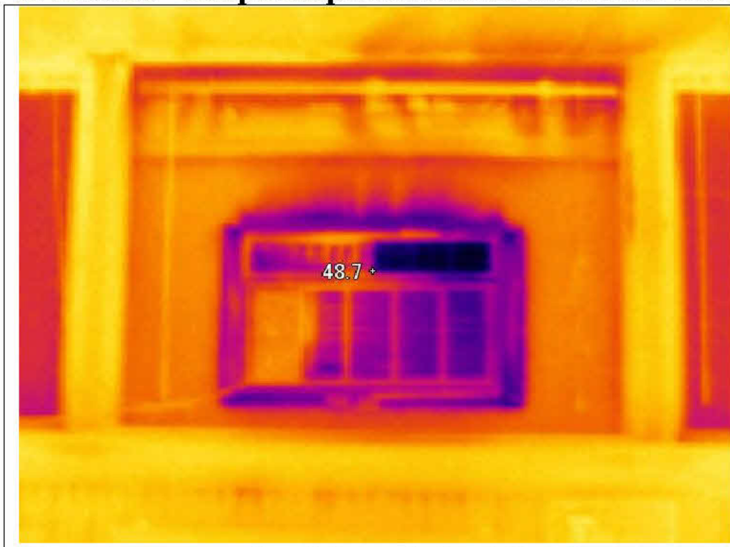
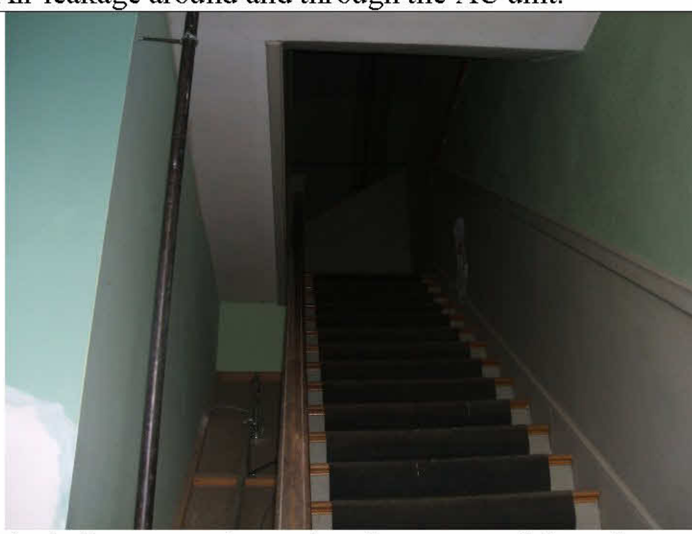
5. ECM#3 - Simple Improvements in Insulation and Air sealing



Air leakage around and through the AC unit.

Visual reference for the IR picture



The hallway to attic needs to be separated from the heated space that surrounds it. The easiest way to do this may be to install an insulated and weather stripped door where the stairs pass though the flat ceiling rather than to try to insulate the walls and stairs.

This hallway is a difficult space to separate from the rest of the building because at one time it was just part of the heated space. A ceiling was put in by the stairwell in an attempt to separate it that should be insulated if it is meant to separate the attic from the rest of the building.

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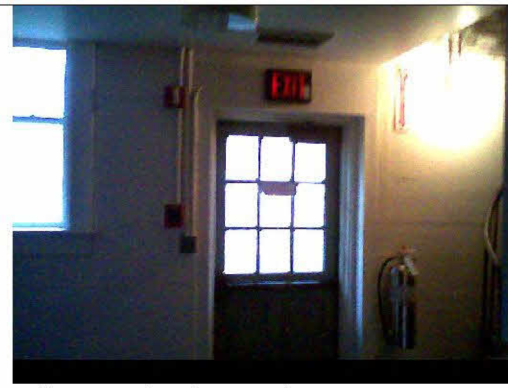
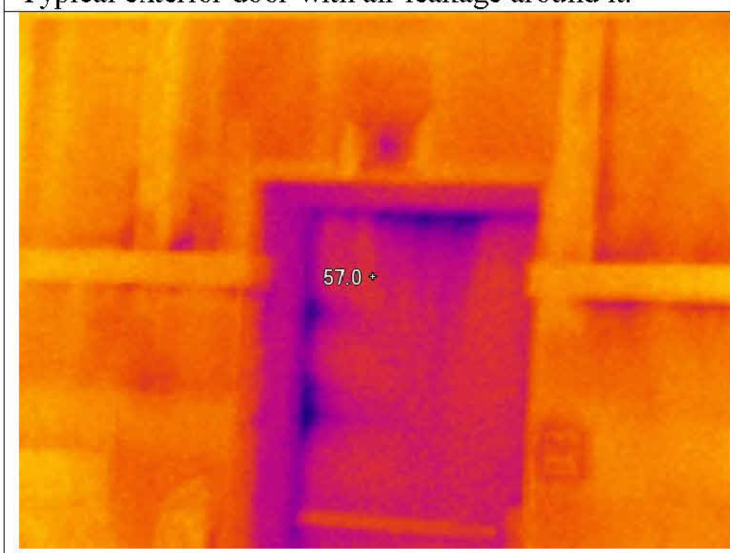
<table>
<tr>
<td>Typical exterior door with air leakage around it.</td>
<td>Visual reference for the IR picture</td>
</tr>
<tr>
<td>The door to the emergency stairwell door showing air leakage. This might be viewed as an “interior” door.</td>
<td>Visual reference for the IR picture</td>
</tr>
</table>

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 Basement conduit that is open to the outside. This is at the front of the building.	 The elevator shaft is not insulated at the top and sides in the cold attic.
 The stage ceiling has an air leak that can easily been seen from the stage. This should be sealed as part of an insulation scope for the whole ceiling and walls	 The stage ceiling hatch is not weather-stripped or insulated.

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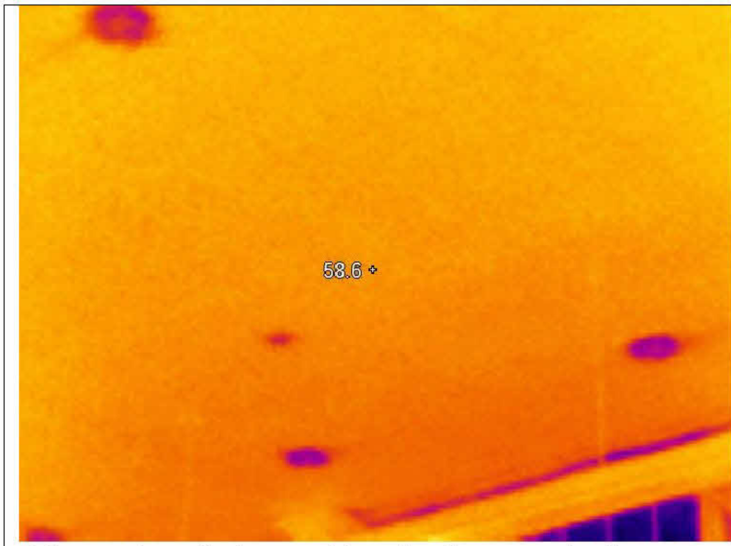
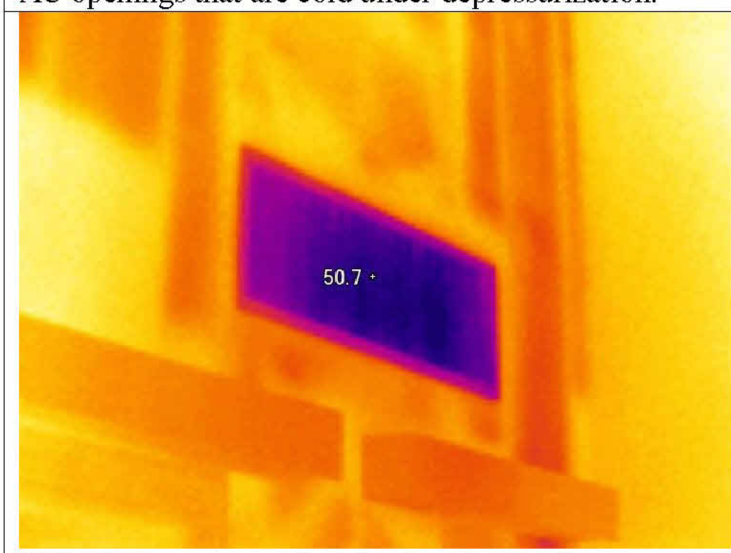


AC openings that are cold under depressurization.


Visual reference for the IR picture



This return grows cold under depressurization because air is being drawn in from the cold attic. Under normal conditions warm air would exit through this path when the system is off. Note also the cold interior wall bays around the return. This is an air pathway to the attic above.


Visual reference for the IR picture

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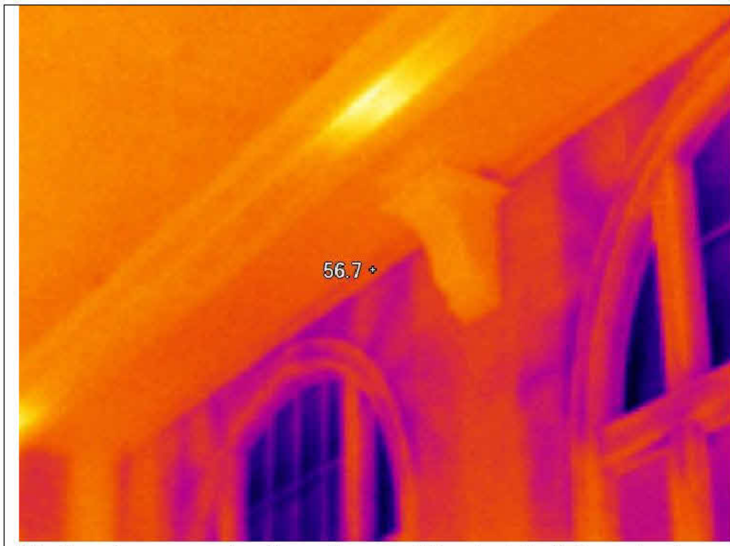
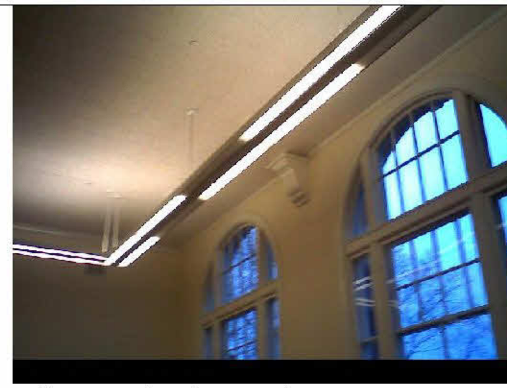


Under depressurization the cavities behind the plaster grow colder indicating that air able to travel behind the plaster.



Visual reference for the IR picture

The infrared image of the walls shows the wood framing behind the plaster as the warmest objects. This indicates that there is no insulation behind the plaster and this is true of most of the walls.

Visual reference for the IR picture

The air leakage of the building is higher than average, the ceilings are underinsulated, and the walls generally lack insulation. Unfortunately, only some of these problems can be addressed cost effectively

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The following locations require air sealing, weather-stripping, and/or insulation and are relatively easy to access. The energy savings predictions and cost estimate are based on these measures:

1. Seal the large air leak through the basement conduit with foam from a can. Weather strip and insulate the attic hatch above the stage with rigid foam board that is at least 4" thick. Remove AC units from windows sooner in the fall and install them later in the spring to reduce air leakage when the heating system comes on. There is a large air leak at the stage ceiling that can be addressed at the same time as other work but if not, should be foam sealed immediately.
2. Weather-strip the exterior doors at the head, jambs and especially at the threshold with commercial grade weather-stripping. Don't forget the door to the boiler room which is especially bad and "interior" doors that open into cold spaces such as the emergency stairs, the attic, and the basement under the theatre.
3. The ceiling above the stage is up so high people tend to forget it because it cannot be seen. It appears to have no insulation. Insulate it to at least R30, R50 preferred. A self adhering insulation like spray foam is recommended because it has excellent air sealing properties in addition to R-value but other products may suffice. At the same time, insulate down the side walls of the stage as far as you can to decrease heat loss through the brick walls. Use an insulation that is vapor permeable so the brick has vapor transfer inside and out. Unfaced fiberglass, special order expanded polystyrene boards, and open cell spray foam are options. The insulation on the walls and ceiling may need a fire protective coating (consult the local fire Marshall) and historic preservation may dictate that the insulation be "reversible".
4. Install an insulated and weather stripped hatch at the plane of the ceiling in the hallway that goes to the attic. Currently the hallway is treated like cold space but it is not insulated in the walls or floor so as to separate it from the rest of the building. The best compromise is to make this hallway a semi conditioned space by separating it for the cold attic with a hatch. At the same time insulate and air seal over and around the elevator shaft in the attic with spray foam and cellulose.
5. The theatre windows are single pane windows and they are covered to keep the theatre dark. Make tight fitting "plugs" to cover the theatre windows out of plywood and 2" rigid foam board. The plywood can be thin, it is only used to protect the foam board against the sun and it should be painted black. Secure the plugs in place and then seal them with caulking or foam so they are airtight. Apply the same plugs to the 2 disused doors on the 2nd floor.

Check with a certified home performance contractor to see if some of the insulation and air sealing work can qualify for rebates. Technically this building is too large (must be under 10,000 sf) to qualify for envelope related rebates but Efficiency VT may make exceptions when working through a home performance contractor.

Advanced insulation and air sealing

These additional locations require air sealing, weather-stripping, and/or insulation but are not cost effective to insulate as standalone projects but may be cost effective in coordination with maintenance or

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renovation work on the building. A major renovation to the theatre that might happen within 2 years would be a good time to implement some of these measures.

1. Sealing and insulating heating and ventilation ducts and adding mechanical dampers so they close when not in use. There are AC ducts upstairs that do not see use all winter but allow warm air to escape to the attic.
2. Insulate the theatre walls at the time of renovation and any other exposed brick walls such as in the basement and under the theatre. This will help a great deal in energy savings even if the insulation thickness can only be 2". For brick walls use an insulation that is vapor permeable so the brick has vapor transfer inside and out. Unfaced fiberglass, special order expanded polystyrene boards, and open cell spray foam are options. Exposed insulation on the walls may need a fire protective coating (consult the local fire Marshall) and historic preservation may dictate that the insulation be "reversible".
3. Add more storm windows to reduce the amount of single pane glass on the large historic windows.
4. Air seal electrical and HVAC penetrations and the tops of interior walls inside the main attic with spray foam. After that, increase the insulation in the attic. Presently there is 7-10" (~ R25) of cellulose on the attic floor and 3.5" of fiberglass (~R11) on the walls of the conference room which is a start but not enough. Add another 10" to the attic floor and layer of unfaced fiberglass to the walls going horizontally across the studs. Unfortunately, because there is at least some insulation it makes it less cost effective to add more.

Gallons saved	kWh saved	Savings Heating	Savings Electricity	Total Savings	Approx. Cost of Measure	Possible Rebate	Cost with Rebate	Lifecycle (Years)	Simple Payback (Years)	SIR
1769	158	$3,007	$9	$3,016	$19,459	$0	$19,459	30	6.5	4.6

6. ECM#4 - Upgrade Lighting

Much of the lighting in the town hall is T12 fluorescent lighting and there are many incandescent bulbs in regular use. Replace all the T12 fluorescent lighting with high performance T8 lighting. The extra incentives for switching to T8 lighting are good through 2011 and T12 lighting is being phased out of production. T8 bulbs are readily available and have a longer life than most T12 bulbs. High performance T8 lighting with low ballast factor should be used for maximum energy savings.

Replace immediately all incandescent bulbs that are on for several hours a day with comparable light quality CFLs or LED bulbs. Replace the incandescent bulbs that are rarely used when the old bulbs burn out since they not used often enough to warrant immediate replacement. Light quality in the green room may favor incandescent lights over CFLs. Given that this space is not used often it is OK to leave incandescent lights in where they are needed most.

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Add occupancy sensors to the public restrooms in the basement and on the second floor.

Gallons saved	kWh saved	Savings Heating	Savings Electricity	Total Savings	Approx. Cost of Measure	Possible Rebate	Cost with Rebate	Lifecycle (Years)	Simple Payback (Years)	SIR
-79	9395	($135)	$1,025	$890	$12,975	$2,560	$10,415	20	14.6	1.4

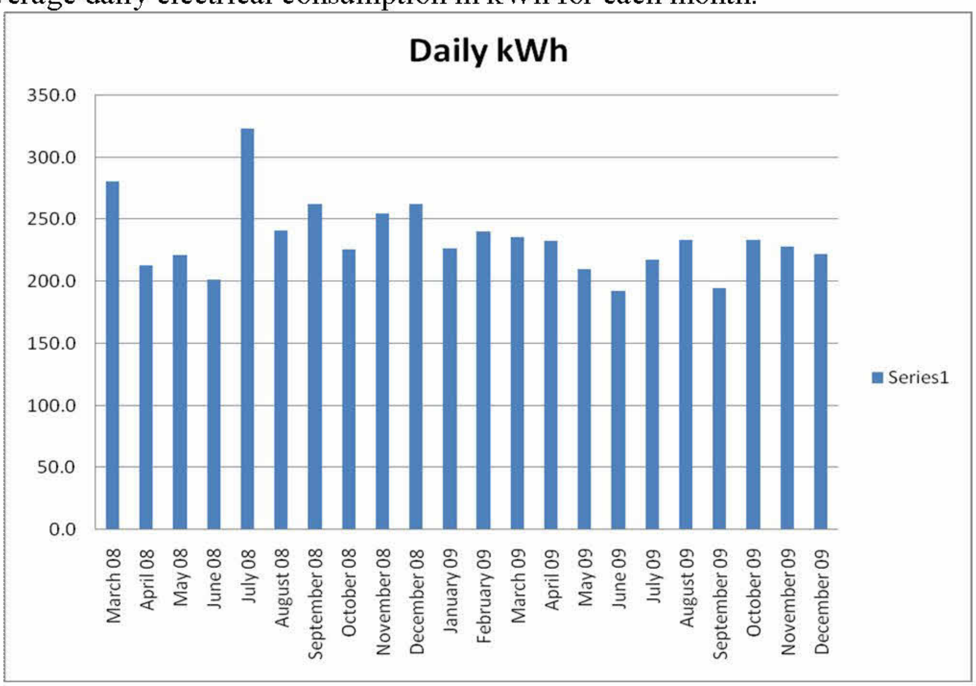
Existing Energy Use

Below is a summary of the energy use for the building in recent years. When possible, the total loads are divided into base load (energy loads that are consistent month to month) and seasonal load (energy loads that spike seasonally). The designation "NA" indicates data that was not made available for this study.

Energy Use Summary for Woodstock Town Hall

Energy type	Unit	Total 2009	Total 2008	Total 2007	Average	Annual Base load	Annual Seasonal load
Electricity	kWh	80839	NA	NA	80839	70044	10795
Heating Oil	Gallons	10759	11507	NA	11133.05	0	11133

Below is the average daily electrical consumption in kWh for each month.



Electric power consumption is between 200 and 250 kWh/day all year long. The day to day base load is about the same regardless of the season. This is probably due to the year round use of the theatre and air conditioning in the warmer months.

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It is also important to note that the electric demand (especially Pentangle Arts) exceeds the 5 KW threshold every month by a wide margin and with that level of use there may be a rate structure that CVPS can offer with a lower demand rate. Load sequencing to reduce peak demand is another possible way to reduce demand charges but beyond the scope of this report.

Energy intensity is energy consumption per square foot of floor area. The table below compares the energy intensity of this building with buildings of similar size and type in the North East (NE). Energy intensity per square foot of floor area does not account for differences in building volume or shell surface area so comparisons between buildings are not precise but are still useful.

Energy Intensity Benchmarks					
Building Name	**Floor Area sq. ft.**	**Electricity kWh/sf**	**Heating Oil gallons/sf**	**Heat Energy kBTU/sf**	**Total Energy kBTU/sf**
Woodstock Town Hall	15715	5.1	0.71	98.3	115.9
Similar TYPE Buildings in NE		6.9	0.24	33.3	79.8
Similar SIZE buildings in NE		9.6	0.50	69.4	75.3

This table is showing that electrical consumption for this building is below average and fuel consumption is much higher than average. This makes sense, large parts of the building are not used every day so the electricity use is low but those areas still need some heating/cooling and the walls and some ceilings are not well insulated and the air leakage rate (see "Blower Door Test Results" below) is high.

Combustion Testing

The table below summarizes the testing on the boiler and furnaces. Cells in red indicate failure to draft, flue carbon monoxide (CO) levels above 25ppm, or ambient CO levels above normal levels. High CO levels are an indicator of incomplete combustion and a health risk. The N/A designation indicates that the test was not applicable to this combustion appliance either because the test data could not be obtained in a safe manner or testing could not be done in accordance with Building Performance Institute (BPI) protocols. The tests show that the boilers should be serviced to insure they are burning safely.

CAZ- combustion appliance zone, the area where a combustion appliance is and where pressure readings are taken to determine if conditions for back drafting may occur.
Worst case – turning on all fans and appliances that can make the building negatively pressurized to see if the potential for back drafting exists.
ppm- parts per million, the unit of measurement for gases like carbon monoxide.
Pascals- the SI unit for pressure.

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Combustion Testing- Boiler #1, Fuel #2 oil		
Baseline CAZ pressure	-3	Pascals
Worst case CAZ pressure	-2	Pascals
Worst Case Spillage	Passed, draft within 1 minute	
Steady State Stack Temperature	829	˚ F
Steady State Efficiency	69	%
Flue CO	75	ppm
Outside temp	35	˚ F
Minimum Acceptable draft	-1.875	Pascals
Draft	-20	Pascals
Ambiant CO	1	ppm
Combustion Testing- Boiler #2 , Fuel #2 oil		
Baseline CAZ pressure	-3	Pascals
Worst case CAZ pressure	-2	Pascals
Worst Case Spillage	Passed, draft within 1 minute	
Steady State Stack Temperature	794	˚ F
Steady State Efficiency	69.6	%
Flue CO	30	ppm
Outside temp	35	˚ F
Acceptable draft	-1.875	Pascals
Draft	-11	Pascals
Ambiant CO	1	ppm

Combustion Testing- Boiler #3 , Fuel #2 oil		
Baseline CAZ pressure	-3	Pascals
Worst case CAZ pressure	-2	Pascals
Worst Case Spillage	NA	
Steady State Stack Temperature	NA	˚ F
Steady State Efficiency	NA	%
Flue CO	NA	ppm
Outside temp	35	˚ F
Acceptable draft	-1.875	Pascals
Draft	NA	Pascals

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Ambiant CO	1	ppm

On the day of testing boilers 1 and 2 short cycled at about 4 minutes at a time and may not have reached steady state combustion. Boiler 3 never fired during testing. The efficiencies listed on the boiler maintenance tags (11/2008) were 82%, 81.75%, and 83.75% respectively.

Building Ventilation

The table below is a summary of the calculations used to determine the minimum ventilation required for the building compared to the ventilation rate determined by blower door testing. The Building Performance Institute (BPI) protocols that define the ventilation requirement are specifically designed for residential type structures and may not apply here. Based on our testing the Town Hall is sufficiently ventilated by natural ventilation at present but may need review by a HVAC engineer to determine the proper ventilation rate if air tightening measures are employed for the building. Consult with a HVAC engineer when planning improvements that will increase the air tightness of the building.

Minimum Building Airflow Standard (ASHRAE 62-89)		
Conditioned space floor area	15,715	square feet
Excluded areas	none	
Total conditioned volume	236,382	cubic feet
# of regular occupants	30	people
# of stories above grade	3	stories
Zone and Location	2	Woodstock, VT
N- factor and Adj. N- factor	19	13.7
Required Building ventilation	1379	CFM
Required Occupant ventilation	450	CFM
Minimum airflow standard	18863	CFM50
Blower door test result	24678	CFM50
Minimum airflow standard met?		Yes

Blower Door Test Results

Ambient conditions 10-30-10:
Outside temperature: 35 °F
Inside temperature: 65 °F
Wind conditions: calm
Time of day: 4:00 pm

Notes:

1. All interior doors were open except the doors to the vault, the emergency stairwell, and to the attic.

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2. All exterior doors and windows were closed and latched.
3. Heaters and fans were turned off.
4. Window AC units were still in at the time of the test.

Results:

Most buildings in the United States are tested at 50 Pascals (0.2" w.c. or 1.04 lbs./sq. ft) as a means of comparison. 50 Pascals is about 5 times the pressure a building might experience on a cold winter day. Temperature adjusted CFM50 accounts for the change in air density as it is drawn in through gaps and cracks from outside and is a more accurate measure of air flow under test conditions.

Temperature adjusted CFM @ 50Pa.	Cubic feet of Building Volume	Air changes per hour @ 50Pa.	Square Feet of Building Shell	CFM50/sf of shell
24,678	236,382	6.00	22,932	1.17

Air Leakage Comparison to Other Buildings:

Building	**Air Leakage Rate (CFM50/sf of exposed shell)**
Ultra tight construction	<0.10
High performance construction	<0.25
Typical existing construction	0.60 to 0.90
Typical new construction	0.40 to 0.80
Woodstock Town Hall	**1.17**
Leaky construction	> 0.60

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