ENERGY AUDIT REPORT

by ABC Energy Savings, LLC

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Woodstock, NH

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FINDINGS:

The building is a 2 story unit build back in 1900 with 10,266 square feet of living space. Heated with oil boiler. There is attic space above the entire second floor with part of the attic floored. The attic space is accessed thru a walk-up stair case. The attic is used for storage with a number of large cabinets, bins, shelving and personal items (like snowboards). There are 3 corridors used for storage, with an average of 14' width of plywood/wood flooring used for walkways and storage on top.

The majority of space below first floor living is crawlspace with minimal height. OSHA requires a height of at least 36" (3 feet) for a crew to work in the area. There are 2 areas of basement with stand-up height – a workshop by the basement steps and the mechanical room under the lounge/bar area. Reminder is crawlspace.

Number of bathrooms do not have bathroom fans that exhaust to the outside.

Basic kitchen appliances and number of refrigerators and freezers.

Several common areas like lounge (street side), bar area, and hallways.

Mix of lighting on manual switches.

Windows in need of improvement to slow down heat loss.

RECOMMENDATIONS:

AIR SEALING: Air infiltration is a significant contributor to heat lose and for a building that feels cold and drafty. Most cost-effective energy improvement to do.

The priority is the attic first to prevent the warm air from leaving the living space and flowing up into the attic. The results are heat loss and pulls cold in from below to replace it – know as the air stack effect (cold drafty feeling too). Seal the upper level and less cold air will be pulled into the building. Second priority is to seal the lower level. Typically, along the basement and crawlspace rim joists have plenty of gaps, cracks, and crevices to allow cold air to flow in, this includes electrical, plumping, exhaust piping and other holes to the outside.

Traditional older buildings in New Hampshire have plenty of excess air infiltration resulting in significant heat loss and discomfort. Air sealing is the most cost-effective improvement to reduce heat loss.

ATTIC INSULATION:

The building is in Climate Zone 6 and **should have at least R49** of insulation when insulating the attic flat/floor.

The attic currently has fiberglass batt insulation installed between the joists and in some places a second layer installed on top crosswise. The effectiveness of fiberglass batt insulation for slowing down heat loss is the quality of the installation. The joists need to be perfectly aligned the 16" off center or there will be a slight gap between insulation and the joist, allowing heat to easily transfer thru the "layer" of batt insulation. If there are gaps or spaces between the installed batt, the same issue. It should be level and flat layers of fiberglass batt and not bumpy and unlevel (see Attic Pictures). If the insulation is compressed, that decreases its effectiveness too. If the insulation was higher than the joist, the installed flooring would press the insulation down and decrease its effectiveness.

Based on observations, the effectiveness of the attic insulation is about R15-R18. Fiberglass batt is best used when installed inside a cavity, not compressed, no gaps and enclosed on all six sides.

Attic Pictures:

Uneven Install and Gaps. Insulation over exterior wall plate?
No blocker to prevent wind wash into insulation

Kraft/Paper side is wrong side up and very uneven install with gaps

Gaps between rolls of fiberglass batt

See the table below for the effectiveness rating of fiberglass batt based on the install quality.

EFFECTIVE R-VALUES FOR BATT INSULATION*

1. Measure the insulation thickness.
2. Determine the condition of the installation using the following criteria:
   - Good—No gaps or other imperfections.
   - Fair—Gaps over 2.5% of the insulated area. (This equals ⅜ inch space along a 14.5 inch batt.)
   - Poor—Gaps over 5% of the insulated area. (This equals ¾ inch space along a 14.5 inch batt.)
3. Look up the effective R-value of the installed insulation using the condition and measured inches.

	"Good"	*"Fair"*	*"Poor"*
Measured Batt Thickness (inches)	**Effective R-value (2.5 per inch)**	**Effective R-value (1.8 per inch)**	**Effective R-value (0.7 per inch)**
0	0	0	0
1	3	2	1
2	5	4	1.5
3	8	5	2
4	10	7	3
5	13	9	3.5
6	15	11	4
7	18	13	5
8	20	14	5.5
9	23	16	6
10	25	18	7
11	28	20	8
12	30	22	8.5

**Derived from ASHRAE document "Heat Transmission Coefficients for Walls, Roofs, Ceilings, and Floors" 1996*

There are 2 approaches to air seal and upgrade the insulation in the attic:

1.) First is to convert the whole attic space into living space.

This is accomplished by applying closed cell spray foam to the attic slopes and attic gable walls. An application of spray foam provides for excellent air sealing and very effective insulation. As the attic space is used for storage with people coming and going routinely, a layer of fire rated intumescent paint should be applied to cover all spray foam (but when talking/verbal to the Woodstock building inspector – he said the intumescent paint is not required). The walls should have 3" of closed cell spray foam and the slopes should have 4" to 5". This is referred to as a "hot roof".

Costs range from $36,000 to $47,000 for closed cell spray foam depending on thickness of spray foam and rated R value. Includes intumescent paint applied over all spray foam.

2.) Second is to keep the attic flat/floor as the thermal boundary.

This would require a crew/people to manually seal all the electrical/plumping penetrations, vents, and the tops of all the wall plates (interior walls and exterior walls. This means getting underneath the existing fiberglass batt insulation and flooring to perform the work. Crew to re-install fiberglass batt as best as possible (no gaps, level and have kraft/paper side touching towards warm side/living space).

Next: Soffit propa-vents/chutes with blockers need to be installed to insulate above the exterior wall plates, prevent wind from blowing into insulation ("wind wash") and force the air to flow up thru the chutes. Rigid foam board is best for a blocker and foamed used to seal to attic flat, sides to joists and seal to chute. These chutes need to extend about 6"+ above insulation level.

Next: Open blow of R38 to R50 cellulose insulation over top of existing insulation. It's not that much more money to apply R50, as the cost is in the labor and equipment. This works for the areas that are not floored as there is space to allow for an additional 12+" of insulation over top of fiberglass batt. The floored areas really need to be raised up 11.5" to allow R38 of open blow to be applied and then floored added back on top of raised platform. This is costly and time consuming.

The wall and ceiling that protrude up into the attic for the walk-up stair case, needs to be insulated and sealed, with an exterior door installed. Use 2" R14 fire rated polyiso for the walls and ceiling.

The attic flat needs a continuous equal amount of insulation over the whole floor/flat to maximize effectiveness. For example, take an area of say 1,000 sq ft with 75% at R49

and 25% at R18 – the overall effectiveness is R34. 50% R49 and 50% R18 would be at R26.

BASEMENT and CRAWLSPACE

All dirt flooring (mostly in crawlspaces) should be cover with 6mm ploy with intersections sealed, and then extended 12" up walls and sealed to walls. This is to keep the moisture from evaporating and moving into living space. There may be plenty of air flow now that this moisture quickly dissipates outside the building, but as the air flow is reduced this may result in mold and other moisture issues.

Ideally, spray foam used to seal and insulate the crawlspace rim joists and walls, but not enough height in most areas for this work be performed safely.

For the basement walls in the mechanical room, 3" (R20) of closed cell spray should be used to air seal and insulate the rim joists and then extend coverage down to the floor level on exterior walls. The boiler gives off significant heat waste and that heat can now easily transfer through the surrounding basement walls to the outside. Best to slow down the heat loss and have the heat transfer/move upward into bar/lounge area. The bulkhead door needs to be insulated and weather-striped. Same should be done for the exterior walls in the workshop area, but 3" spray foam down to grade level and then 2" spray foam down to floor level.

WINDOWS:

To reduce air flow between windows and building framing, apply caulk between the window trim and wall/drywall on all fours sides. Same for exterior doors, seal top and sides – and install weather-strip kits and door sweeps.

Alternative to replacing windows for energy efficiency are interior "storm" double pane windows, like InnerGlass or Indow. They offer custom windows that can easily be installed from the inside and removed easily. Highly recommend for common spaces (like lounge & bar areas) where rooms are heated on a regularly basis. Both increase the R value of the window area and provide air sealing.

Innerglass: http://stormwindows.com/index.php/storm-window-products

InDow: https://indowwindows.com/

Option is to use interior insulating/air sealing shades like "Energy Efficient Shades" from Symphony Shades: https://symphonyshades.com/27-energy-efficient. But you are now dependent on human behavior to make sure shades are closed to reduce heat loss through windows.

Use clear weatherization tape to seal gaps between window sashes.

With a number of occupants and number of windows, windows might be left open when the building/rooms are vacated. Occupants may also be leaving windows open over night as they like “fresh cold air”. This all leads to heat loss and cold drafts. There is a solution to install sensors on all exterior doors and windows to track activity and notify management with very customizable notifications – like if window left open more than 10 minutes between 10pm and 6am – send an alert/notification. Also assist when locking up the building to see any windows or doors left open. Also, be the security/alarm system for the building.

Example: Omega Six Security https://www.omegasixsecurity.com/

Owners can install the sensors themselves and Omega Six will assist with setting up and commissioning.

For exterior outlets (electrical boxes and wall switches), remove face plates and install gaskets. Then use kids safety plugs for outlets not in use. Use fire rated caulk between electrical box and drywall.

Electrical:

Install LED lighting whenever possible (interior and exterior). Standard 65watt type light bulbs for LED versions now cost $1 or less.

Phantom loads can account for 10-20% of electrical usage. Unplug devices when not in use (like TVs, Entertainment Centers, Chargers, game devices).

When replacing appliances – invest in Energy Star branded and check NHSaves for rebates.

Use a device like “Kill-A-Watt” to meter and measure kWh usage of a device/appliance.

Use motion sensors to automatically turn lights on and off. Sense by motion and/or heat.

HEALTH and SAFETY

Bathroom fans need to be exhausted to the outside using dedicated exhaust hoods. Use hard pipe to connect fan to exhaust hoods. Smooth hard pipe creates very little friction for air to travel through. In the "Large Dorm" room there is a bathroom with shower with no bathroom fan, this should be first 1 to vent outside. Same should be done for dryer exhausting to outside, use hard pipe.

Great bathroom fans are the Panasonic Whisper Green, and has options like humidity sensors, LED night light, and motion. Very quiet and energy efficient.

Make sure kitchen exhaust fan is utilized to get moisture out of the kitchen/dining area.

As mentioned in crawlspace section of report – cover dirt floors with 6mm poly and seal.

Recommend installing a low flow CFM bathroom fan in Boot Room to exhaust moisture to the outside. Run in continuous mode or on a schedule.

Hot water:

Install low flow shower heads and aerators for bathroom sinks. Instant saving measures.

Other:

Please see attached document for DIY air sealing and other relevant documents.

Thank you for the opportunity to assist in reducing the energy usage of this Club and making it more comfortable and healthier for your owners.

I do have a network of experienced and trusted insulation installing contractors that can be used for the non- DIY projects. I can collect estimates for you depending on what is needed.

The NH Electrical Co-Op does have rebates up to 35% for insulation projects that pass their cost effectiveness test, and ABC Energy Savings can assist you in the process to apply.

Thanks

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