

Clean Nova Scotia

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Energy Efficiency Assessment Report For Shambhala Meditation Centre



Date of Audit: January 15, 2007
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1. Introduction & General Comments

The Shambhala Centre has been identified as a forward thinking organization. They have an awareness of environmental responsibility and the potential financial gains from increased energy efficiency. The energy audit performed by Clean Nova Scotia is only a preliminary examination of the issues that this non-profit faces with regards to energy efficiency. The comments and recommendations in this report are based on limited observations and should be regarded as a starting point in a total energy management plan.

This energy audit was conducted to draw attention to potential energy reduction areas to save money. Due to the limitations of the Small Business Energy Efficiency (SBEES) program, certain generalizations and assumptions have been made. Cost and savings estimates have been made where possible. This report is intended to be used only as an information guide regarding specific opportunities to become more energy efficient.

Buildings operate as a system. For example, changes in lighting have an effect on heating costs. Better air circulation improves air quality while increased insulation reduces heating costs. Heat given off by processes should be taken into account when planning the location of machinery with respect to heaters, air conditioners, and other machinery. In addition, as a building becomes more air tight, moisture levels are bound to increase unless proper mechanical ventilation is utilized. It is essential to consider all of the effects that any retrofit might have to prevent potential unwanted or damaging results.

This report outlines specific energy reduction opportunities. Saving energy translates directly into saving money. This helps to keep your costs low as well as be environmentally responsible. In addition to bolstering your reputation and saving you money it has the intrinsic benefit of making our environment a better place to live. The remainder of this report outlines specific areas where we have identified opportunities. Please note that for any energy efficiency upgrades contact a qualified professional before making any changes.

Summary of Estimated Savings

Building Envelope Upgrades: 35% savings on energy consumption and 20.3 tonnes reduced greenhouse gas emissions per year.

Lighting Upgrades: Save up to \$1358 per year in electricity costs and 10 tonnes reduced greenhouse gas emissions per year.

Heating and Ventilation and other: 10% to 15% savings on energy costs.

2. Building Envelope

General

Please see *Appendix A for the Energuide for Houses Report* which is the report generated that shows the energy lost in your building. Your building has the potential to move from a current rating of **49 to a potential rating of 67** (out of 100). **This means your Estimated Annual Energy Consumption & Savings is 35%. You could also save another 10% to 15% from heating and ventilation improvements (these savings are in addition to the 35% savings from the building envelope).**

Points per Upgrade – “Energy Savings from Upgrades”

Please note that all EnerGuide upgrade points listed on the following table are estimations only and serve as guidelines so you are aware of the approximate point increase and percentage of total energy savings attributed for each upgrade you implement. These estimations assume that all recommendations will be fully completed. I also suggest you look at the bar graph on the second page of the report in *Appendix A*. Here is a summary of how the 35% building envelope energy savings and the 18 points are distributed:

	Savings %	EGH points
Insulate Flat Ceiling	9.2%	1.7
Insulate Main Walls	25.8%	4.6
Insulate Foundation	26.8%	4.8
Upgrade Front Windows	2.0%	0.4
Upgrade Right Windows	1.4%	0.3
Upgrade Left Windows	1.8%	0.3
Air Seal Building	28.3%	5.1
Upgrade Doors	4.6%	0.8
TOTALS	100.0%	18

What’s a good score?

- Old, unimproved houses score 0-50.
- Older houses can be raised into the 60s or 70s.
- New construction is typically in the low 70s and very efficient new houses score over 80.
- Houses which use no purchased energy would score 100.
- Row houses and semi detached houses score higher than fully detached homes.
- The average score is 62.

The Building as A System: We have recommended an approach to improving your buildings' energy performance based on the principle of a "the house as a system". This principle recognizes that a change made to one component of a building can affect other components and that the comfort, health and safety of occupants, as well as the long-term integrity of the structure, must be primary considerations in housing construction and renovation.

Recommended Improvements

You will find below a list of all the items that will help improve your buildings' energy efficiency. Each of these items, unless otherwise indicated, makes up the savings shown in the **Estimated Heat Loss and Total Energy Use** chart on page 2 of *Appendix A*. Your next step is to prioritize the suggested upgrades based on:

- the cost of that upgrade;
- how much that upgrade will improve your comfort;
- how much that upgrade will protect the structure of your building; and
- how much energy--and money--the upgrade will save you.

For example: If an upgrade has the potential to reduce your energy use by 10% and heating your building costs \$2500 per year, then you could achieve a \$250 savings each heating season. If you spent \$1000 on that upgrade then your payback would be 4 years for your investment. That's a 25% annual return on your investment! As well, that upgrade should make you warmer in winter and cooler in summer and reduce condensation that leads to mold, moist insulation and structural decay.

Air Sealing Opportunities

Air leakage control is the single most important retrofit activity, and should be considered first in any retrofit strategy. In this report draft proofing does not always have the highest percentage of increasing your Energuide rating when compared to other upgrades. However, draft proofing is inexpensive, protects the building envelope, increases comfort and is in fact more important than this percentage suggests, and should be part of any renovation project.

In your building we have assessed that a considerable amount of air leakage control can be done before automated mechanical ventilation (such as a heat recovery ventilator) would be required. The building presently tests at 4.7 Air Changes per Hour (ACH). The results shown here are based on reducing that to about 3.5 ACH. This should be easily done by implementing the air sealing recommendations listed below.

Bathroom Exhaust Fans

Exhaust fans are important. When you have access into the attic space, check to ensure that the exhaust duct/pipe running in the attic is well insulated and is vented to the outside. If ductwork runs through exterior walls it should also be insulated. Don't forget to seal between the unit itself and the drywall from the inside (remove plastic grille to access). The bath exhaust fan had some air leakage around the grilles into the attic on the second floor. The vent louvers/dampers outside on exterior walls should be checked to ensure efficient operation. Please read the enclosed brochure *Ventilation for Older Homes* for more information on bath exhaust fans.

Attic Hatch

There was some air leakage around your attic hatch. Treat the attic hatch like an outside door. That means adding weather-stripping (such as closed cell foam gasketing) to the frame that the hatch sits on. You should also add hook and eye latches to hold the hatch firmly in place. Finish the job by caulking the outside frame to prevent air from circumventing the seal you've made. Please see page 29 of *Sealing Caulking and Weather-Stripping* for more information.

Electrical Switches, Outlets and Wall Lights

Another area of air leakage is the power outlets, lights and switches on exterior walls. We also found some air leakage on interior/common wall outlets/switches and light fixtures, so don't forget these as well. Please see page 27 of *Sealing Caulking and Weather-Stripping* for sealing directions of your switches and outlets. You should install outlet gaskets under the faceplates of each outlet. In addition to the gaskets, install child guards in all plugs not in use.

Upgrade Doors

I modeled your energy upgrade based on replacing the older existing doors with new insulated steel doors. We found moderate air leakage around your doors. If you wish to keep your existing doors, caulking and sealing trim and applying new weather stripping in this area will reduce air leakage. You can also set back the door strike plate to get a tighter seal when closing the door. Please see page 24 of *Sealing Caulking and Weather Stripping* for information on air sealing your doors.

Fireplace

We found considerable air leakage through the fireplace(s). With any fireplace you need to address the air leakage around the flue and this includes making sure the dampers are properly functioning (they are expensive to replace). *The junction between the fireplace mantle or brick and the side drywall/plaster is another area often overlooked and should be caulked/sealed (clear latex works well).*

Fireplaces are meant to draw air, which means that while not in use they are sucking the expensive warm air out of the building. You can apply high temperature gasketing over the frame perimeter of existing glass fireplace screens. Alternatively, you could plug the flue while not in use to reduce air infiltration. This involves stuffing fiberglass insulation into a plastic garbage bag(s) and pushing it up into the flue or damper opening as tight as possible. Tie a string to hang down into the fireplace so that you won't forget that the plug is there. This plug can be removed whenever you want to utilize the fireplace.

You can also try to plug the opening. This involves cutting a piece of wood to fit approximately 1 inch larger than the opening. This one-inch overlap can be weather-stripped. Glue rigid styrofoam insulation, cut to fit the opening, to the back and wedge the plug into the opening. You can add handles and artistic painting to make it more attractive.

Kitchen/Bath Sinks

Seal around pipes as they enter walls and floors under kitchen/bath sinks.

Windows Upgrade (as an example)

As we discovered, there was a little air leakage around your windows (between the panes and around the jamb, trim and casings). Please see page 14 of *Sealing Caulking and Weather Stripping* for information on air sealing windows.

New Windows (a discussion)

Normally we don't recommend replacing windows unless they are single paned (with no storms or inserts). However, I modeled the upgrade on your retrofit report with new low E/argon vinyl windows to the entire buildings' older wooden windows for demonstration purposes. As you can see from the bar graph in the report, the upgrade "Windows and Doors" adds marginal energy efficiency gains to your Energuide upgrade rating and therefore does not make replacing windows a viable option.

However, effectively air sealing the gap between the window frame and wall framing will dramatically increase energy efficiency. This can be achieved whether the windows are old or new. See next section.

Window Upgrade Options

There are several options for improving windows and I suggest you explore this upgrade area thoroughly to identify the most cost-effective approach that suits your budget, retrofit skills and aesthetic needs.

As you can see from the bar graph in the report, the upgrade "Windows and Doors" adds marginal energy efficiency gains to your Energuide upgrade rating. However, effectively air sealing the gap between the window frame and wall framing will dramatically increase energy efficiency. This can be achieved whether the windows are old or new. Window thermal efficiency can be improved by adding a second permanent rigid layer to single pane windows (not a flexible sheet plastic layer). Having effective house ventilation will protect wooden frames from rot and mold. Monitor window condensation.

The least expensive option to improve windows is temporary or permanent clear caulking (don't permanently seal windows used as fire escapes). Secondly, flexible plastic kits are readily available in hardware stores but are not cost-effective long term solutions to poorly sealed windows. They consist of clear plastic, which is stretched tightly over the inside of the window. A more long term

and cost-effective solution would be interior or exterior storms. This upgrade also improves the thermal efficiency of single pane windows. Rigid plexi-glass with a magnetic sealed frame is a convenient, but often expensive method to seal windows from the interior. The next option would be to have a good exterior storm window. The most expensive capital expenditure (but effective long-term solution) would be to install new lowE/argon vinyl windows.

For effective air sealing, please see page 14 of *Sealing Caulking and Weather-Stripping*. Insulating foam is probably the most efficient option for sealing gaps around windows. Using a clear acrylic latex caulk (interior grade) can be an option for air sealing window trim and casings. For window frames you could use temporary caulking (“Draftseal”). Some windows may only have fiberglass stuffed in the jamb/framing area and air-barrier tape (red) or rolled foam gasket with caulk works well. You can install new weather-stripping to make the seal on frames more effective. Closed cell foam gasketing (black) at the bottom of hung windows and plastic V- strip or rubber weather-stripping around the frame is a good retrofit option.

Recessed Lighting

As we discovered there was a lot of air leakage coming from these lights, particularly in places where they are open to the attic above. Some building stores sell flat round metal plates with a glass centre and attached sealing gasket that can be screwed over the existing lighting fixture to the ceiling drywall. This will cover the existing lighting fixture and isolate it from the exterior cold air.

Ask a qualified professional for this retrofit sealing plate at larger building or lighting stores and ensure that the cover plate is rated to cover your existing light fixture (caution of heat build up). There are also recessed lighting plastic “canopies” that can be caulked over the light from the attic access above or you can make one out of a fire rated material (drywall). Please read “**Sealing, Caulking and Weather-Stripping**” guide for information on sealing recessed lights.

Basement “header spaces”

In your basement, seal the “header spaces” (top of basement wall that floor joists rest on). They should also be insulated, see below for more information. Seal headers using rigid foam board insulation and caulk or spray foam seal around the perimeter to reduce air infiltration (see *Keeping the Heat In* guide and “**Sealing, Caulking and Weather- Stripping**”).

Basement Miscellaneous Air Sealing

Air seal the following areas in your basement where leakage was detected: the boiler breech pipe (flue pipe as it enters the chimney), the fan in the electrical room and any wall or header penetration from ducts, wires or pipes. The boiler room, electrical room and walls in the older part require air sealing. The basement stone foundation walls no doubt have air leaks due to deteriorating mortar joints.

To prevent air infiltration from the stone walls, one option (other than parging the stone walls) is to air seal the inner wall. This involves air sealing the drywall which should be sealed from the bottom of the floor (caulk or spray foam) to the top of the ceiling). This will prevent cold air infiltration into the basement. The inside drywall from the floor to ceiling headers should be one continuous air barrier with wall penetrations from pipes, wires and other holes sealed against the drywall from the inside. Please read the enclosed information in **Worksheet 6.3 and Worksheet 7.5** regarding the retrofitting of stone and brick foundations. It will provide some insight into the special considerations for sealing and insulating stone and rubble walls.

The artifact room could benefit from air sealing the drywall which would help to lower the humidity by limiting the exchange of air between the moist stone walls and the indoor air. See the draft sealing guide: ***Sealing, Caulking and Weather-Stripping***.

Second Floor Miscellaneous Air Sealing: Air seal the following areas where leakage was detected: the doors need weather stripping fixed or replaced (emergency exit door), the window trim (use clear latex caulking) and the double pane wooden “Pella” windows should have the interior removable pane of glass air sealed to the wood frame by using Vaseline along the perimeter edge or clear latex caulk. This will reduce air infiltrating between the two panes of glass and condensing between the glass which will lead to rot and decay of the wood frame. The many ceiling grilles and registers for ventilation and heating should be air sealed between the duct and the drywall using caulk or foil tape. Remove the grille and air seal from the interior or spray foam or caulk from the attic above. See the draft sealing guide: ***Sealing Caulking and Weather- Stripping***.

Insulating Opportunities

General Information

If you encounter a level of insulation that is substantially different than any assumptions made in this report, proceed with the work and advise the energy advisor of your findings before the retrofit second evaluation. All recommendations in this report are ***not intended to be prescriptive***. Any retrofit techniques and suggestions mentioned are intended to act as generalizations for air sealing and insulating that some people have found to be effective under certain conditions. Successful retrofit upgrades are dependent on your (or your trades persons’) existing skills, building knowledge and previous experience.

Caution: each upgrade has unique and specialized technical issues particular to your building. For best results, consult a qualified professional and see the *Keeping the Heat In* guide book for more options.

- **Insulation:** Protect and cover any foam insulation you may use with a minimum of 0.5” drywall on the interior to reduce flame spread and smoke generation in the case of a fire. Some people have used a wood panel such as plywood as well. Ask your local building inspector for code compliance regulations pertaining to fire barriers over foam. To reduce skin and eye irritation and inhaling fibers and dust when working with all insulation materials, wear loose-fitting clothes with long

sleeves and tight cuffs, work gloves, a hard hat and proper footwear. Use a half-mask respirator with a particulate filter and goggles while handling insulation and wash clothing separately after use.

- **Vermiculite and Renovation:** Some older vermiculite insulation installed in homes may contain amphibole asbestos. If it is contained in walls or attic spaces and is not disturbed, it poses very little risk to occupant health. However, if vermiculite is detected in the course of a renovation, or if you suspect it might be in your home and you plan to remodel or renovate (including insulation or air sealing work), contact professionals who are trained and qualified to handle asbestos before proceeding. Before doing any work you should consider getting it tested to see if asbestos is present. Disturbing vermiculite with asbestos may make particles airborne and increase likelihood of inhalation. For a listing of qualified professionals, look in the Yellow Pages under “Asbestos Abatement and Removal”.

Basement Headers (un-insulated)

The basement headers (rectangular area boxed in by the floor joists that rest on the foundation wall) are currently un-insulated in the older area of the basement. I modeled your energy upgrade based on filling the header space with R12 fiberglass. For an effective sealing and insulation measure I recommend adding 1.5 inches of rigid polystyrene board insulation and sealing effectively by caulking or spray foam. This would give you a total header space insulation level of about R20. Please read *Keeping the Heat In* and *Worksheet 6.3 and Worksheet 7.5* regarding the retrofitting of stone and brick foundations for more information and for effectively sealing header spaces. How you treat the header spaces depends on your choice in methods of insulating the basement.

Basement Insulation (stone/rubble foundation area)

The following are some techniques people use for insulating basements with stone foundations and moisture problems, however, *the following suggestions are not intended to be prescriptive and we recommend you talk to a qualified professional regarding this upgrade.*

The older area of the house with stone walls appears to be un-insulated based on the few areas we examined. Stone walls typically have some moisture problems (ensure that exterior surface drainage and downspouts are diverted from the building). If you are unsure about the current state of your basement regarding moisture seepage through the walls/floor, consult a qualified professional. Ideally, it is best to insulate stone, brick or wet foundations from the exterior (often prohibitively complicated or expensive). Any foundation cracks must also be fixed before installing insulation.

Another option for insulating stone walls from the interior is by using rigid Styrofoam. This option always presents the risk of cutting off heat to the wall and freezing mortar joints, which expand and deteriorate over time. Please read the enclosed information on *Worksheet 6.3 and Worksheet 7.5* regarding the retrofitting of stone and brick

foundations. With drier stone foundations, some people insulate to an R12 level about 2 feet below grade and leave the bottom portion of the wall un-insulated so that it can absorb heat from the room and distribute the heat within the stone walls. This ensures that the walls mortar joints will not freeze. Cover the foam board with a tightly sealed poly vapor barrier, foam sealed to the foundation wall and the headers to provide a continuous air barrier. Then cover any styrofoam used with drywall (a fire rated barrier). The most common option (and often cost effective and most risky in terms of maintaining adequate mortar joint temperatures) is a wood framed wall with fiberglass insulation 2 feet below grade and covered with a 6 mil. poly plastic air/vapor barrier.

I modeled your upgrade based on increasing the insulation level in the older area of the basement, with an R12 level of insulation, from the top of the ceiling to 2 feet below grade. Keeping a wall area open to periodically monitor moisture and temperature levels against the wall and within the insulation is recommended. A basement insulation upgrade represents substantial energy savings if you complete upgrades to the entire area (see bar graph on report in *Appendix A*).

Caution: each basement has unique and specialized technical issues. For best results, consult a qualified professional; see the *Keeping the Heat In* guide book for more options for insulating basements and see *Worksheet 6.3 and 7.5* for stone and brick foundations.

Main Wall Insulation Upgrade (some insulation present)

Based on our investigation of a few wall outlets and the age of the house and discussions with staff/personnel, we estimate that about 60% of your total wall area is presently insulated. We estimate R20 fiberglass in the newer back addition and un-insulated (or very little seaweed) in the older original main floor and second floor walls (the other 40 % wall area). Verify this to make sure this is indeed the situation.

For our climate R20 is used in conventional modern construction. I modeled your upgrade to a level of about R 16 by adding blown cellulose to the estimated 40% un-insulated walls (high density blown in at R3.6 per inch). You may also investigate other insulating options available (see *Keeping the Heat In* guide, “Insulating Walls”). This upgrade will also help to air seal the walls and insulate any heating supply ducts or boiler pipes that may run through the walls. Please read *Keeping the Heat In* to investigate other options for wall insulation.

Ensure that your blown cellulose contractor is aware that some areas may have been upgraded during interim renovations and have him identify wall sections that may not need insulating (so you don’t pay him for areas he did not insulate). Also, keeping track of the number of bags of cellulose used can ensure you only pay for un-insulated wall sections.

Insulating Flat Ceiling Attic (some insulation present)

The older part of your attic is presently insulated to an average level of about R16 with some seaweed and blown fiberglass with patchy areas. In the newer area I found two

batts of R20 fiberglass. However, the new area had been altered by trades workers and there were large patchy areas and even areas without insulation. The average insulation value for the newer area was about R28. For cold climates it is advisable to increase the level to R40 and I modeled your upgrade report based on this improvement.

In the older area (50% of total ceiling area) you have the option of adding another R20 fiberglass batt (placed perpendicular to present insulation) or using blown-in insulation (R value of 3.4 per inch). In the newer area you could fix the patchy areas by adding fiberglass to ensure there is R40 everywhere. If you are getting the walls blown in it may be cost effective to do the attic areas as well in blown cellulose. However, in the newer area there is an abundance of communication wiring that may need accessing and blown cellulose in this area may be a bit messy if future repairs or changes are made to wiring or heating equipment. I suggest you investigate blowing in cellulose and any other materials/techniques.

Blown-in insulation works well for filling voids and cracks (good for the older area). If using blown cellulose, you have the option of exceeding the R40 level to higher insulation levels (R40-R50) usually for a modest surcharge. Ask your insulating contractor and See *Keeping the Heat In*, “Roof and Attics”, page 59. There are some things you should keep in mind however when talking to contractors about insulating with blown cellulose:

- Confirm the area is indeed partially insulated
 - The cavity must be completely filled to the proper density with no gaps.
 - The skill and thoroughness of the contractor is very important. Pick your contractor with care, as this job needs to be well done.
 - Exterior drilled holes should be sealed.
 - Install an adequate amount of **insulation baffles** to facilitate soffit ventilation
- Keeping the Heat In* guide book has more information for you on pages 96 and 97.

General Recommendations

The following are general recommendations which may help save energy but do not add points to your potential energy efficiency rating.

De-icing Heat Cables

There are heat cables that run across the front eaves of the roof (and perhaps the back?) and if you look at the picture of the front of the building in this report you will see the pattern of melted snow they produce. De-icing cables are effective in reducing the build up of icicles and preventing ice damming (see enclosed information on this principle).

However, the build up of ice at the roof edge is a sign of either inadequate insulation levels of insulation at the eaves in the attic or sloped ceilings or a wall cavity that is not sealed from the interior and is allowing warm air to travel up the wall and exit at the eaves. To reduce ice build up at the eaves it is advisable to effectively air seal the interior wall, ensure the wall cavity is insulated (blown cellulose works well) and increase the insulation level at the eaves with the inclusion of insulation baffles to allow air movement from the soffits. Operating de-icing cables for six months a year is an energy drain and is

considered a symptom of poor air sealing and insufficient insulation levels. See information included.

Back Drafting of Combustion Appliances Is A Safety Concern!

It is important to have adequate ventilation in your building, particularly with the presence of combustion appliances (gas or oil furnace, woodstove, fireplaces, etc.). The potential net effect of operating multiple exhaust devices (dryer, kitchen and bath exhaust fans and even opening top floor windows), simultaneously in a building can result in the back drafting of combustion gases down the chimney and back into the house. Back drafting of combustion appliances is a safety concern that you can learn more about by reading *Keeping The Heat In* pages 118-121.

Also, understand that if you implement any of the following air sealing upgrades listed above, this will also affect the potential for back drafting. Therefore, ***close monitoring is important*** to ensure you have not created a potentially hazardous situation. If you notice odors or see smoke from back drafting combustion appliances, contact a qualified professional for advice.

*Carbon Monoxide is a dangerous colorless, odorless gas! Ensure that your building is protected by CSA approved Carbon Monoxide and Smoke Detectors to protect you against combustion spillage from combustion appliances. More information can be found on page 10 of *Air Leakage Control* and speak to a qualified ventilation specialist.

Exterior Weather Proofing

The caulking generally around the exterior of your building should be updated every three to five years. Caulking on the exterior of the home reduces the potential for moisture to enter the wall cavity (caulking the interior reduces air leakage). The most important thing to remember when applying caulking is to select the correct type of caulking for the job, table 1 on page 39 in *Sealing, Caulking, and Weather-Stripping* describes the types of caulking compounds that are commonly available. There are many types of caulking that are suitable for both indoor and outdoor use. Never apply outdoor caulking on the interior as they produce off-gas which can be harmful.

3. Electricity Savings Opportunities

Demand Side Management

Examining demand side management provides many ways to save on an electricity bill. “Demand is the rate at which electricity is being used at any one given time. This differs from energy use, which reflects the total amount of electricity consumed over a period of time. Demand is often measured in kilowatts (kW = 1 kilowatt = 1000 watts), while energy use is usually measured in kilowatt hours (kWh = kilowatts x hours of use = kilowatt hours). Peak demand is the maximum amount of power drawn through your meter during a billing period.” – Nova Scotia Power. Simply examining when peak demand is achieved and then shifting part of the electrical load to a different time (by working with operators, installing timers, etc.) can save a substantial amount of money and would be in your best interest to do. All other suggested recommendations will lower your total electricity usage and thus your demand charges as well.

Lighting

Electrical savings estimates were calculated using the hours of operation we discussed. The hours lights are on vary depending on which floor of the building we are discussing. For example, lights are 'on' for an average of 9 hours per day, seven days a week, fifty weeks a year (3150 hours/year) for the main floor of the building. A typical energy cost of 0.10 \$/kWh is used to provide a savings estimate.

One of the most common, simplest ways to save on lighting is upgrading exit signs bulbs. Assuming there are eleven exit signs; and each with two 15 Watt bulbs to be switched to LED (light emitting diodes), the savings are very significant. Payback for upgrading exit signs is usually less than one year.

All incandescent bulbs (which include recessed lighting, desk lamps and other fixtures using incandescent bulbs) used for more than 3 hours per day should be replaced by compact fluorescent bulbs (CFL's). CFL's are available in a wide range of light intensity.

For more information regarding lighting fixtures and bulbs, please refer to **Lower Costs, Greener Profits** in the accompanying information package. Inside you will find descriptions of the lights discussed in this document. I have also included an additional information piece on lighting.

Turning lights off completely when not being used is the a good way to save electricity. This could be accomplished with motion sensors or simply by educating employees.

The results below are based on an estimated number of lighting fixtures (not all parts of the building were accessible) and an estimated energy usage. The table provides a general idea of types of savings in energy and greenhouse gases that can be achieved.

Sample Calculation for lighting savings

of fixtures * Watts/fixture * hrs/year * (rate/kWh) / 1000 Watts/kW = \$/year

Potential Lighting Savings Summary					
Lights/Hours Lights are On	Type	# of Bulbs	Current W per bulb	Potential W (per bulb)	\$/year Saved
Exit Signs/8760	Incandescent	22	15	2	251
T12 basement/2750	Fluorescent	24	40	34	40
Incan.Fixtures/2750	Incandescent	40	60	17	473
Main Floor/ 3150	Incandescent	15	60	17	203
Large Room/2750	Incandescent	30	60	17	355
Basement/2750	Fluorescent	10	13	13	0
Total Energy Savings					\$1321
Demand Savings					\$37
Total GHG Savings					10 tonnes

The above savings include energy use only. Savings are compounded when you examine the fact that all of the recommended lighting improvements have a longer life; especially LED's and compact fluorescent bulbs. Thus, you will have to replace them less often

saving both on capital replacement costs and the amount of labour required to replace the older bulbs on a regular basis.

Computers

Shutting off computers when they are not in use saves a considerable amount of energy over the course of a year. The following calculations were done assuming that computers are left on for evenings and weekends in sleep mode. With ten computers, including monitors, left on overnight it costs \$200 per year. Simply turning off monitors when they are not in use reduces electrical expenditures for computers by approximately 65%.

Computer Interference

This is not part of our energy evaluation; however, we noticed that the building has a 3-phase transformer located a few feet from the communication system controls in the basement. Based on discussions with a communication system specialist, it could be possible that the electro-magnetic fields created by such a large transformer within close proximity, could induce interference in the communication system. If you have occasional interference in IT systems (losing data on transmission) this could be a source. Consult a qualified professional should you need to investigate this matter further.

General

Appliances which are in constant use, such as refrigerator or freezer, consume a large amount of electricity. Look for the EnerGuide sticker for appliance efficiency when buying a new appliance, the lower the kilowatt hours per year the more efficient. The second price tag is how much money it will cost to operate in the long run.

Appliances such as televisions and VCRs with a stand-by function use electricity constantly. Refrigerators work at highest efficiency when they are relatively empty, freezers when they're full. Remember to shut down computers when not in use (sleep modes and screen savers still use electricity).

Please see *Guide to an Energy-Smart Office* for more information.

4. HVAC Savings Opportunities

Proper heating and ventilation systems offer superior control over the temperature and air quality in a building. Your building has good potential for savings generated by improvements to the HVAC systems.

Heating and Hot Water Systems

Oil Fired Boiler

It appears you have an older boiler system that heats the older part of the building. It has a burner that is operating at about 81% efficiency which is adequate considering that new technology for boilers operates at 84-87% efficiency. The next time you have an oil boiler technician come in for maintenance check, ask him about increasing the boiler efficiency by reducing the burner nozzle size. Often this is an easy upgrade that allows the boiler to operate for longer periods (approaching steady state conditions) and thus peak efficiency.

The boiler pipes are un-insulated as well as the basement walls and headers in the boiler room which results in unnecessary heat loss to the outdoors. Properly insulating the boilers, hot water tanks, and hot water lines will save fuel oil.

Oil Fired Boiler Maintenance

You should ensure that you have a maintenance visit from a qualified technician every year. The visit should include, but is not limited to:

- Cleaning the flue pipes
- Cleaning, vacuuming of the furnace
- Inspection and cleaning of burner
- Replacement of burner nozzle (where required)
- Efficiency test
- Inspection of oil tank

Maintenance of your furnace can result in 5-10% lower energy consumption

You should also ensure that your chimney is routinely cleaned and maintained by a W.E.T.T. certified qualified professional.

Electric Furnaces

Based on our observations and discussions with personnel, it appears that there are two electric furnaces supplying heat to the newer area of the building (see the “Carrier” website for more information in identifying your model). For simplification purposes, I could describe an electric furnace as a metal box with electric elements inside combined with a fan to blow the air out. Imagine a big toaster, with a fan, located outdoors providing heat to the inside of your building. It is almost without exception more energy efficient to have heating systems contained within the heated building envelope and to have a furnace in the attic is unconventional.

There is one furnace in the attic (above the newer area) and one in the “crawl space” area between the main and second floors, above the coat closet on main floor. It was difficult to obtain nameplate data from the furnace to establish specific sizing information. However, if these are indeed electric furnaces there are a few issues that need addressing. First of all, the network of ductwork extending from the furnace in the unheated attic is a major source of heat loss since a large proportion of ducts are un-insulated, under-insulated or have insulation removed and torn. The insulation that is wrapping the main branches and trunks is about R5 in value. I would suggest you ensure a minimum of R10 is wrapped around the ductwork. Keep in mind that R40 insulation level in attics is common to prevent heat loss in our climate. Also, ensure that all ductwork joints are sealed with duct mastic or foil tape at the least before adding insulation.

Wrapping the electric furnace itself would be a good idea but **IT IS VERY IMPORTANT TO CHECK NAMEPLATE AND MANUFACTURER’S SPECIFICATIONS BEFORE INSULATING, FOR SETBACK AND INSULATION CLEARANCE INFORMATION.** This upgrade will not increase your Energuide rating and I have no way of determining the actual amount of heat that is currently being lost to the outdoors, but based on my experience, I would estimate 10 –

20% of the heat produced from the electric furnace in the attic is being lost before it is distributed within the building (not so with the furnace in the main floor crawlspace because it is inside the building).

On another matter, both of the furnaces have summer and winter damper settings that need to be thoroughly investigated for their function and time of year switching. Otherwise, they could be drawing in air from the cold outside during the cooler spring and fall days when summer ventilation settings are still not adjusted to winter settings. The electric furnace in the main floor crawlspace should have the exterior walls and header spaces in the area sealed with poly plastic, since the return air duct is “sucking” air in this space from outside due to the poor air sealing of the walls in this area. See *Keeping the Heat In* book for sealing walls and headers.

Future Upgrade Options

It was suggested by a staff member, that the oil tanks may need upgrading and this oil based infrastructure investment will probably influence your decision of what fuel to choose for your next heating upgrade.

I highly suggest you look into the prospects of gas coming to your area and co-ordinate the future heating upgrades to the gas line schedule if possible. Modern gas technology is more cost effective for heating and hot water needs (and more environmentally friendly too). Consult a qualified gas heating contractor for more information.

Another option to consider that would reduce energy bills may be an air source heat pump. This would probably require you install additional ductwork to the older parts of the building. Heat pumps require back up heating systems for cold temperature operation. One option for a back up heating system is to replace the older existing oil fired boiler (with radiators in each room), with an oil fired warm air furnace, with ductwork/grilles to each room. You may be able to co-ordinate upgrades to existing heating equipment that may work out to be cost-effective. Air to air heat pumps also provide affordable summer cooling. See guide included in package.

Planning and investigating your options beforehand will save money down the road when the boiler breaks down. Please see *Space Heating Fuel Cost Comparisons September 2006*.

Furnace and Ventilation Controls

Having furnace thermostats with setback options that are used will save 2% off your total heating costs for every 1 degree you turn the setting down over an 8 hour period. Having ventilation and thermostats labeled with trained personnel that are aware of their proper functioning is advised if you want to optimize comfort and energy savings.

Domestic Hot Water

Your hot water is supplied by the oil fired boiler in the winter and electric in the summer based on our observations. Operating an electric hot water tank in the summer is a common approach to reduce high energy costs associated with “tankless coils” from oil

boilers. Insulating the electric hot water tank with an insulating blanket and pipes is a logical upgrade. **Please see *Hot Water Answers* for more information on insulating electric hot water tanks.**

Ventilation System

Existing Ventilation System

Presently, you do not have a tight building envelope and winter humidity levels are being adequately maintained by point of use exhausts and a powerful and continuously operating exhaust system for the second floor bathrooms.

A summation of your current system based on my cursory examination is as follows:

1. **Point Exhausts In Other Areas** (kitchen, other bathrooms) are provided by exhaust fans at point of use and vented to the outdoors.
2. **Second Floor Bath Exhaust** is provided by a large exhaust fan located in the attic.
3. **Ducted Central Exhaust System** for summer ventilation is provided by a large exhaust system located in the attic.

1. Point Exhaust Fans in Other Areas (for Bathroom and Kitchen Areas)

General sources of moisture include the outside air, kitchen, dryer, humans, and bathrooms. When air sealing your building, remember, as it is tightened humidity levels usually increase. This can cause condensation and moisture problems. Consequently, mechanical ventilation becomes more important. Although, when air sealing is done to ensure sufficiently **controlled ventilation**, air sealing will not only save you money on your heating bills it will also make your building more comfortable. Read chapter 3 in *Keeping the Heat In* to learn more about comprehensive air-leakage control.

Presently, you do not have a tight building envelope and winter humidity levels are being adequately maintained by point of use exhausts and a powerful and continuously operating exhaust system for the second floor bathrooms. Point of use exhausts that vent outdoors are an adequate method for ventilating as long as the fans are not left to run continuously, they vent outside and they are sized to be powerful enough to adequately vent stale, moist air. Please refer to the information piece on *Ventilation in Older Homes* for proper fan installation and testing of existing fans to see if you have adequate exhaust capacity. These fans do not have heat recovery capabilities and exhaust paid for, heated air outside.

Electrical Room Ventilation Fan

There is a fan that vents outside in this room and it appears to be running continually. I'm not sure of its purpose other than to provide ventilation for the communication and electrical equipment in this area. I inquired about operating temperatures for communication equipment and based on my basic inquiry, I learned conventional equipment could function at temperatures one would expect to find in an unheated basement in the winter. Insulating boiler pipes would help to reduce excess heat. This fan is simply dumping paid for heated air outside and should be limited by a room

temperature control switch at the least. Please consult a qualified professional for more accurate advice regarding this matter.

Automated Mechanical Ventilation For Point Exhausts (no heat recovery)

For automated mechanical exhaust ventilation (no heat recovery) one option is to use programmable humidistats that automatically turn on the bathroom exhaust ventilation system once a certain relative humidity has been reached (winter setting is about 40-50%). You can also use a timer switch which ensures that fans will run at least 15 - 30 minutes after an occupant leaves the bathroom to effectively exhaust all the stale air and moisture. With a timer, you can set it for 45 minutes when you enter the shower. After a 15-minute shower, when you exit and turn off the light the fan will exhaust for an additional 30 minutes. Please refer to the enclosed information piece on *Ventilation in Older Homes* for proper fan installation and testing of existing fans to see if you have adequate exhaust capacity.

2. Second Floor Bath Exhaust

The second floor exhaust fan is very powerful and appears to be operating continuously (verify this assumption). Based on my brief examination of the ventilation system, I feel that you could be over ventilating beyond the needs of the building and occupants. This exhaust system could also be contributing to heat loss through amplification of the “Stack Effect”. Please read the information I have written on “The Stack Effect” below and read *Keeping the Heat In* book (Chapter 3, Air Leakage Control) for more information on the pressure dynamics affecting heat loss in your building.

If left to run continuously, this system is extremely wasteful in terms of energy (it dumps large volumes of heated air outside) and crude in terms of its sophistication to adapt to indoor humidity levels, occupant density and time of use. Modern local or centrally located **controls** can adapt to the buildings’ and occupants’ ventilation needs. I think that modest upgrades to your current ventilation system design could be a cost effective energy upgrade. Extensive or elaborate modifications may not yield a short-term payback. I think you can work with what you have if you want to control the existing system and not replace it. Based on brief discussions with some key personnel in the building, I did not hear complaints about insufficient winter ventilation, moisture accumulation on windows, mold or other symptoms of an excessively humid indoor air environment. I suggest you have the system examined by a ventilation specialist to see if timer controls can be installed in each bathroom to reduce the operating time of the current system.

3. Ducted Central Exhaust System

I did not have time to evaluate this system properly. I did however have an indication that the “Tiger Room” in the basement was humid and musty in the summer until the ventilation system was turned on and in about a day the dampness would subside. I also saw a large exhaust fan in the old part of the attic. It appeared to be an air conditioner (name plate information and a condensate tube for draining water) however, based on information from personnel; I feel it may be an exhaust only

system that operates continuously during the summer. It is important to determine if this system is:

- providing fresh air from outside in the summer
- providing exhausting of indoor air to outside in the summer
- has the potential to re-circulate air within the building
- has sufficient controls to optimize the management of a cool indoor air temperature with minimal humidity levels.
- the location of exhaust and supply air grilles in various rooms (make a diagram)
- winter to summer damper switching on the existing system is maintained

I would suggest that the current system have upgraded controls that can take advantage of bringing in cooler air temperatures in the spring and fall or cooler summer days/nights if it has air intake capabilities. I also suggest that in the hottest humid periods in the summer you operate the system in a re-circulation mode in conjunction with de-humidifiers in the basement. A system with indoor re-circulation that is not pulling in warm humid air from outside could not only maintain air movement throughout the building (as it currently does) but also maintain cooler, less humid indoor conditions.

Upgrading insulation levels in the building and air sealing effectively could amplify the ability to maintain a more comfortable indoor environment. Timer controls on intake fans that can operate at night (when air is cooler) may also be an option. Opening the building at night and closing it during the hottest periods of the day combined with de-humidification is an alternative to air conditioning or continuous operation of your current summer ventilation system.

Dehumidification and Air Conditioning

I saw the presence of large residential style dehumidifiers in the artifact room and one other area. I also assume that the document room has the humidity reduced by the existing “Dynazone” system. (basically an air conditioner that removes humidity I would assume).

Semi-portable residential style dehumidifier/air conditioners are an affordable option to maintain cool, dry indoor air conditions. I would like to point out that your basement walls (older part of building) are not air sealed effectively and open to the stone foundation. Stone foundations and floor slabs hold a lot of moisture and release it to the indoors. I suggest that to reduce humidity in the basement you should consider air sealing drywall, holes, cracks, wall penetrations in the basement and the doors within the rooms that require lower humidity levels. It would reduce the operating time of existing dehumidifiers (save energy). Common air sealing techniques that are listed in the **Sealing, Caulking, and Weather-Stripping** guide book should be used in the basement. I included information on dehumidifiers.

General Ventilation Options and Recommendations

Automated Mechanical Ventilation (heat recovery)

Heat recovery is an integral part of becoming more energy efficient for many applications. Currently, most energy efficient ventilation systems employ a Heat Recovery Ventilator unit (HRV). These units recover up to 2/3 of the heat from the building's outgoing exhaust air and exchange the heat to the fresh air intake. These units are commonly used in modern buildings that have tighter building envelopes and require advanced ventilation to reduce indoor air moisture and provide high levels of indoor air quality. Should you in the future choose to upgrade to this more energy efficient option I suggest converting the second floor bathrooms and exhaust to an HRV system located above in the attic may be feasible. A large common household HRV may be adequate and more cost effective than a commercial grade system. For the main level bathrooms and kitchen an HRV located in the small crawl space above the closet room would be a logical location for an HRV with minimal installation costs.

HRV Information

About HRV'S Should you find that controlling moisture without an HRV is not effective, consult a ventilation specialist certified by HRAI (The Heating, Refrigeration and Air Conditioning Institute of Canada). I have included ***Heat Recovery Ventilator*** for your reference if other methods do not work.

During the heating season, an HRV recovers heat from the outgoing, stale household air and uses it to preheat incoming, fresh outdoor air. The HRV then distributes the incoming air throughout the house. You then have a source of fresh air for your home; you have an exhaust system for the moist, stale air, and are able to recover up to 80% (depending on the model) of the heat from the outgoing air.

Ceiling Fans

With regards to comfort levels, warm air can be pushed down to occupants by the use of ceiling fans in high ceiling rooms, such as the largest shrine/meditation hall. This upgrade can be simple and cost effective and can move the warmer air stratifications towards the normally cooler areas of the room. Ceiling fans could also provide air circulation and a cooling effect in the summer.

Consult a Ventilation Specialist

Choosing the proper sizing of exhaust, controls and ducting network options is a task that should be done by a ventilation specialist certified by the Heating, Refrigeration and Air Condition Institute of Canada (HRAI certified).

Therefore, hiring the services of a trained and experienced ventilation specialist that you can trust to provide the most basic and cost effective upgrade measures is of the utmost importance.

The Stack Effect and Your Building As A System

In large volume 2 storey buildings such as yours the stack effect is a principle that needs to be considered when deciding upgrades. In simple terms, the stack effect is a principle of air and pressure movements within a building. Warm air rises within a building (like a chimney stack) and has a propensity to stratify at the top of the ceiling on the top floor. This creates a high pressure zone in which air has a tendency to push out through any crack it can find (windows, outlets, ceiling lights, etc.). The air that escapes on the top floor is replaced by air infiltrating through various cracks in the basement. The more warm, paid for, heated air that escapes to the outside on the second floor, the more cold air (that you pay to heat) will be pulled in from the basement. This cycle can be amplified with powerful exhaust fans or windows open on the top floors. **This makes air sealing on the second floor and basement a priority** over the main level. The stack effect also explains the inter-relation between ventilation exhaust fans and heating costs. The dynamics of air movement and temperature works as a system. The “**building as a system**” is a principle that recognizes that a change made to one component of a building can affect other components. The trades people that work on your building should be aware of how the changes they make will affect other dynamics within the building. Having a general building maintenance supervisor that is aware of this principle will make renovations and upgrades more effective, safe and energy efficient. See *Keeping the Heat In* for more information.

5. Water Savings Opportunities

With the current cost of water, the following recommendations may not have a substantial financial impact, however, in some cases; it will save on the cost of heating excess water.

Toilet Dams

Toilets throughout the building of older vintage use at least one gallon of water per flush - more than is required. Newer design toilets use as little as one gallon per flush total. It is possible to reduce the volume of water used in your current toilets by installing toilet dams or other simple alternatives such as bricks in the tanks. Bricks or other similarly simple options can interfere with the flush mechanism when installed improperly, and are also not as effective as dams, which reduce the flow only at the end of the flush. Therefore dams are recommended even though they are considerably more expensive. They cost approximately \$10 each and savings depend upon usage.

Tap Aerators

Installing tap aerators is a simple, cost effective way to reduce water consumption. Tap aerators should have their flow rate imprinted on the side, which should be 2.75 gpm (gallons per minute) or lower.

6. Conclusion

Energy efficiency is not just having energy efficient equipment. It is a state of mind. Educating those who are in a position to save energy is the number one way to accomplish that goal. Employees who are energy conscious can save you a significant amount of energy (and money) simply by knowing how. We strongly recommend that you make an effort to convey the importance of energy efficiency to your employees.

The purpose of this report is to bring to your attention some of the major and minor issues regarding energy efficiency for your buildings. It is difficult to quantify the energy savings that will be realized. If you would like a more detailed report we recommend that you contact a professional consulting firm that has the time and resources to do a much more comprehensive audit. It is encouraging to see such a positive attitude regarding energy efficiency as it will provide benefits not only to budget, but to the community and the environment as well. If you have other questions regarding energy efficiency or environmental matters please do not hesitate to contact us at Clean Nova Scotia.

