The New Hampshire Municipal Energy Assistance Program

Decision Grade Audit Report

Whitney Hall
23 Main St., Enfield, NH 03748

Prepared for:

Town of Enfield, NH

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Sustainable Energy Resource Group

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The following report was generated as part of the NH Municipal Energy Assistance Program (MEAP). MEAP is made possible through the New Hampshire Public Utilities Commission and the Greenhouse Gas Emissions Reductions Fund. The program is a collaborative effort to carry out a sequence of greenhouse gas emissions inventories and energy audits for between 24 and 48 geographically diverse communities in New Hampshire, setting the stage for these communities to perform renovations to selected buildings that would reduce energy consumption and greenhouse gas emissions. This report has been generated as a result of the Town of Enfield being selected to participate in this program.

To follow MEAP updates and activities please visit www.nhenergy.org.

Additionally, this report would not be possible without the assistance and input provided by municipal employees and volunteers. We are grateful for the time provided to us by the Town of Enfield.

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Introduction:

MEAP partners are pleased to provide this Decision-Grade Audit Report for the Town of Enfield and the Whitney Hall (hereinafter "the building"). This report discusses the findings and subsequent recommendations for energy efficiency and occupant health and safety improvements at the building. Included within this report are details regarding the inspection of the building, and examples that illustrate recommended building alterations and improvements that can reduce energy costs, occupancy health risks, and the building's natural resource footprint. In this report we will provide a set of options that can help achieve real energy savings and carbon dioxide reductions. These recommendations should be viewed as initial avenues to making capital investments, and participating in Federal and State level funding opportunities for municipal energy projects.

Prior to receiving an energy audit, each selected municipality must carry out the MEAP Energy Inventory process. The Energy Inventory, and subsequent energy audit, reports relied on data provided to the MEAP team by municipally appointed /authorized elected officials, employees, or community volunteers. These initial findings, along with a further review by SDES staff, helped determine the most appropriate building to provide an energy audit. The intent of the building selection process is to maximizing the potential energy savings, while at the same time catering to municipal goals and objectives. Any municipally owned building that has received any level energy audit or energy assessment prior to this program will be considered ineligible to receive a MEAP energy audit.

The Audit

It is important to know that there a few types, or levels, of energy audit. This audit, described by SDES Group as a Decision Grade Audit (DGA) is a first step towards making investments in the examined building. It is entrenched within the SDES method to begin with this baseline understanding of "how" and "why" a given building is performing, and state some of the many approaches to reducing energy consumption, while increasing occupancy health and comfort. This, along with the Town's goals, objectives and project funding capabilities are the foundation of sorting through the many available technologies to form a solid Level II audit.

We have found that this approach eliminates wasted time estimating energy savings and project implementation costs for energy efficiency measures and/or alternative energy systems that may never fall within the objectives of the investor. This DGA serves to aid in "deciding," or sorting through, potential projects to be further examined for investment consideration.

Two examples of the many benefits to taking this approach are these: The classic case of a building owner funding a very expensive window replacement project under the mislead assumption that it will save a substantial amount of money in heating costs. The fact is, window replacement projects most often fall quite low on a prioritized list of recommended energy efficiency measures as they usually have high cost and low savings (unfavorable ROI). The benefit in this case is the basic guidance towards long term upgrades with a staged approach. The second example is the time (hourly rate) of an energy auditor to examine the cost benefit of replacing an inefficient oil-fired heating system with *all* the available options. Some of the

options may include (but not limited to) a high-efficiency LP gas boiler or furnace, a geothermal system, a biomass systems (pellet vs. cordwood vs. woodchip) an integrated solar thermal storage system, a cogeneration system of varying fuel types, etc. The distribution system could vary for all of these systems as well. One could provide the "cost/benefit" for burning any of these fuels with a forced air system, a radiant floor system, hydro-air, baseboard radiators, etc. Any of these heating plant, fuel types, and distribution system combinations will have a varying cost in installation, fuel price, efficiency, and maintenance. The benefit here is avoided consulting costs by using the DGA as a tool to hone in, or help define, the objectives needed to carry out intended goals.

A community's goals and objectives may be environmentally or economically based. Regardless of motivation, both goals can be reached in tandem by implementing any set of objectives aimed to reduce energy usage. Given that these are public buildings and facilities, comfort and safety are primary concerns that help guide our analysis and recommendations.

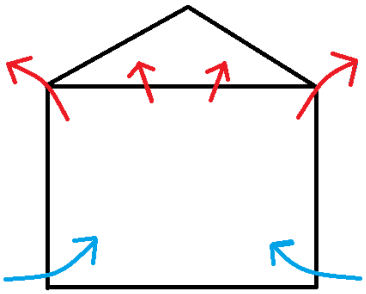
This DGA involves a quantification of energy usage (electrical and heating fuel), a description of existing heating/cooling and distribution systems, thermal barrier inefficiencies, potential electric savings through lighting/appliances upgrades and behavior change, occupancy health and safety concerns, a prioritized list of recommended improvements, and a look at current 15 year projected energy expenses vs. a 30% annual energy usage reduction for the examined building. This savings estimate is not based on a specific set of projects instead of a reasonable average goal for work and is used to illustrate the effectiveness of upgrades.

Many of any energy auditor's recommendations will be based on their knowledge and experience with particular products, techniques, and technologies. SDES has worked with all major forms of alterative/renewable/conventional high-efficiency heating and cooling systems, has planned for and constructed many types of different high-performance (super-insulated) building envelope systems in an effort to create some of the most healthy, comfortable and efficient private and public spaces in NH. Our prioritized list of recommendations is based on our "what works" experience. Our list will not include detailed "spec" information on how exactly each item should be carried out, nor will it include estimated energy savings. This type of detail would be presented in an IGA (Level II equivalent) in order to receive estimates for the cost of implementation, and return on investment. These details will be needed to participate and many of the State and Federal loan and incentive programs.

Basics of Heat Loss:

Though we are typically used to measuring heat in temperature, it can be measured in a variety of other units. For the purpose of measuring how much heat is produced to condition a space, and how we measure the rate at which heat leaves a structure, we measure in British Thermal Units (BTUs). One BTU is roughly the same amount of heat produced from a kitchen match. Another good reference to have is that there are about 138,500 potential BTUs in 1 gallon of heating oil. During the winter months, we cannot keep BTUs from leaving our buildings. Hot always goes to cold, or, areas of high pressure are always trying to go to areas of low pressure. What we can do is try to slow the process. We do this by using an **air barrier** and **insulation** at the building envelope to create a thermal barrier.

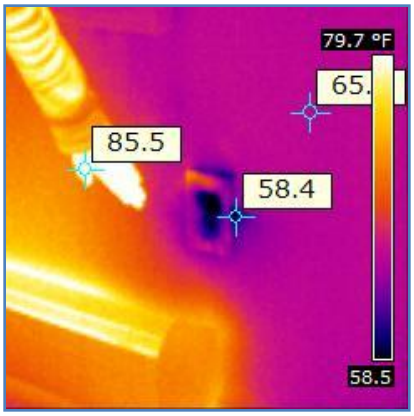
Heat moves through and leaves a building by three different means: *convection, conduction, and radiation*. One way to think of **convective** heat loss is by air movement into and out of a structure. One of the forces causing this to happen is the "stack effect".



The stack effect describes, on a macro level, the natural way in which air moves through a building. As warmed air leaves through the upper levels of a building, cold air infiltrates through the lower sections. In most cases, this pulls air from less than desirable areas of a building, such as basements, crawl spaces and mechanical rooms, which are often damp and unmaintained. These spaces can be the source of exhaust fumes from heating equipment, mold and mildew, as well as a number of other air contaminants, such as radon. Without an effective air barrier between the conditioned (heated and/or cooled) space and the attic, warm air will exit the building. For every 1 cubic foot of air that leaves a building, 1 cubic foot of air will infiltrate at a different location. Gaining control of the air movement through a building not only has a positive effect on efficiency, but also contributes to increased comfort and improved indoor air quality.

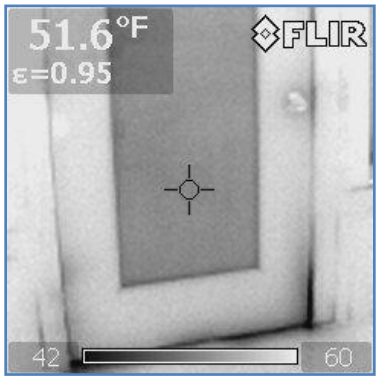
Conduction is the foremost way in which heat travels through a solid building material. R-value is one way to describe a given materials resistance to transfer heat. Materials with a high R-value, such as foams, cellulose, or fiberglass batts are used for insulation. At any location in the building envelope where there is solid building material and no insulation, "**thermal bridging**" will occur. For example, a 2x6 inch wood stud in an exterior wall has an R-value, or insulative value, of about R-7, while the 5-½ inch fiberglass insulation in the wall cavity is rated at R-19. Solid material in the exterior wall of a typical structure built with 2-inch stock, 16 inches on center (O.C.), will usually make up 20-25% of the wall surface area. This, in combination with any doors and windows, means that a significant percentage of the building envelope has an R-value of less than 10. Even a wall with a high R-value cavity insulation, such as spray foam, is subject to these weak points in the thermal boundary. Employing methods to reduce or eliminate thermal bridging in our built

environment will dramatically reduce energy costs and emissions over the long term as we move towards a new generation of energy and environmental challenges.



Radiant heat loss describes how heat waves, or infrared radiation, pass through space from one surface to another. For example, the heat from a hot copper pipe will radiate towards cooler surfaces around it, like an exterior wall. The heat can then conduct through building materials to the exterior.

With regards to the building envelope, **gaining control of convective heat loss is the main priority, and usually the easiest to address through air sealing**. After this is done, increasing insulation levels, or R-value, of the building envelope is the next step to gain better control of conductive heat loss. In many cases, a significant amount of a structure's radiant heat loss will be addressed with added insulation, either to ceilings, floors, walls, ductwork or piping. Treating the whole building as a system, and addressing all the issues of heat loss, will produce optimum savings and comfort.



<u>Basics of Moisture Control:</u>

The issue of moisture control in buildings is very complex and essential to maintaining structural durability and occupant health. The mismanagement of moisture can lead to a multitude of negative effects. Some of these include mold growth, poor indoor air quality, and the early degradation of building materials and equipment. It can also contribute to potentially serious health issues for the people who live and work in our buildings.

The two basic forms of moisture in need of managing are bulk moisture (fluid) and water vapor. Two ways to manage bulk moisture are to keep rain and ground water from entering the building and to quickly fix any water leaks from sources within the building, such as leaking pipes.

Managing relative humidity and water vapor is a challenge. At some points of the year, occupants want more humidity in the air to maintain comfort and less at other times. For example, in the winter months we want more humidity indoors because it helps occupants experience greater comfort. In many situations, we increase the relative humidity mechanically with humidifiers. When indoor air is too dry during the winter, we feel colder, develop dry skin and our upper respiratory system can become dry causing discomfort.

Conversely, in the summer we want the air to be dry. Just as hot goes to cold, wet goes to dry. We cool ourselves by perspiring. As we produce this moisture on our skin, it evaporates into the air, drawing heat away from our bodies. The temperature of a room may not be very high, but if the relative humidity is high, we will feel hot because our perspiration is evaporating at a slower

rate. Much of the comfort we achieve from using an air conditioning system (AC) is by removing the moisture from the air, allowing our skin to dry more quickly.

In the winter, there will always be some level of moisture in a heated and occupied space. We want this moisture, or water vapor, to stay within the occupied space for many reasons. Two of the most important reasons are to help occupants feel more comfortable and to keep the water vapor from causing damage within the building envelope.

Just as BTUs conduct through solid materials, water vapor diffuses through solid materials. Some materials are more resistant to vapor diffusion, such as polyethylene, and we use these to form a vapor barrier on the inside of the thermal boundary in an attempt to slow the amount of vapor diffusion. Small amounts of vapor traveling through a properly constructed building envelope will diffuse all the way to the exterior, and not cause any damage**. If a large amount of vapor is allowed to enter a wall cavity, the molecules will condense on the nearest cold surface.** When this happens, moisture can build up on the inside of the exterior wall sheathing or on other surfaces. This will cause a number of problems including long-term damage to insulation and structural components, as well as the promotion of mold growth.

It is important to identify any current moisture problems and address them appropriately. This is always done by first finding and controlling the source of the moisture. Sometimes it can be quite difficult to see moisture damage, as it may be buried inside of wall cavities. It is also important to know that by making changes to a structure and its envelope, we can change the way in which moisture can negatively affect the building.

Building Description:

Front

Rear

This is a three story wooden structure that was built in the early 1900's. There have been several major renovation projects in this building over the past several decades. The basement has been finished and now serves as the Town Offices, the second floor (Public Library) was almost entirely gutted and refinished, a two story concrete block vault now stands on the back side of the building, a three story elevator was installed on the rear of the building, etc. The third floor of this building is a theatre which is still well in use.

Conditioned space, for the purpose of measuring energy usage or creating energy models of a building, should be measured from exterior points in order to include the thermal envelope. Our measurements indicate that the total square footage of conditioned space in the structure is approximately 10,072ft².

At some point in the building's history there was a fire, which by the extent of evidence still present in the more hidden areas of the structure, is seems as though this building is quite lucky to still be standing today.

1st Floor Area
3327.0079 Feet ²

2nd Floor Area
3502.3469 Feet ²

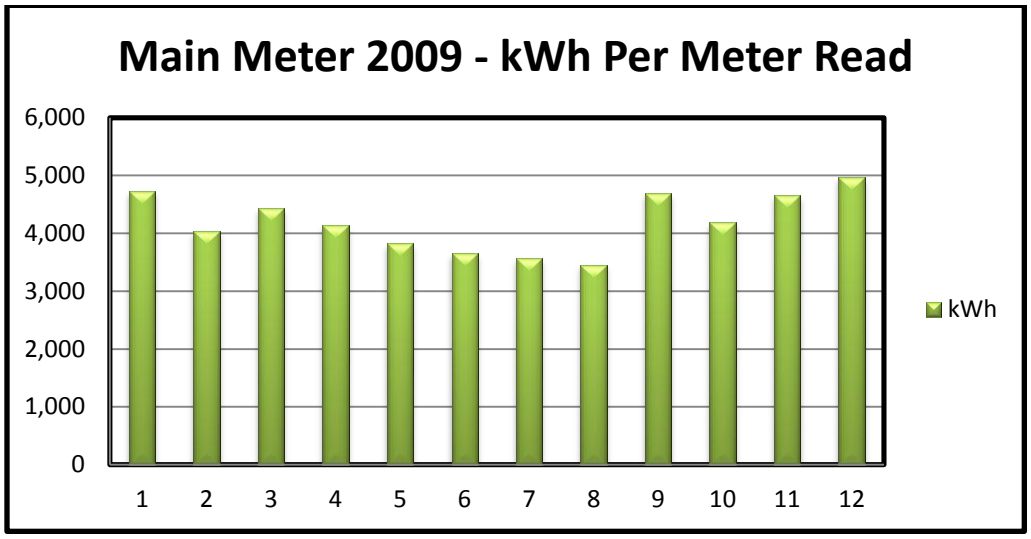
3rd Floor Area
3242.6411 Feet ²

Energy Data Collection:

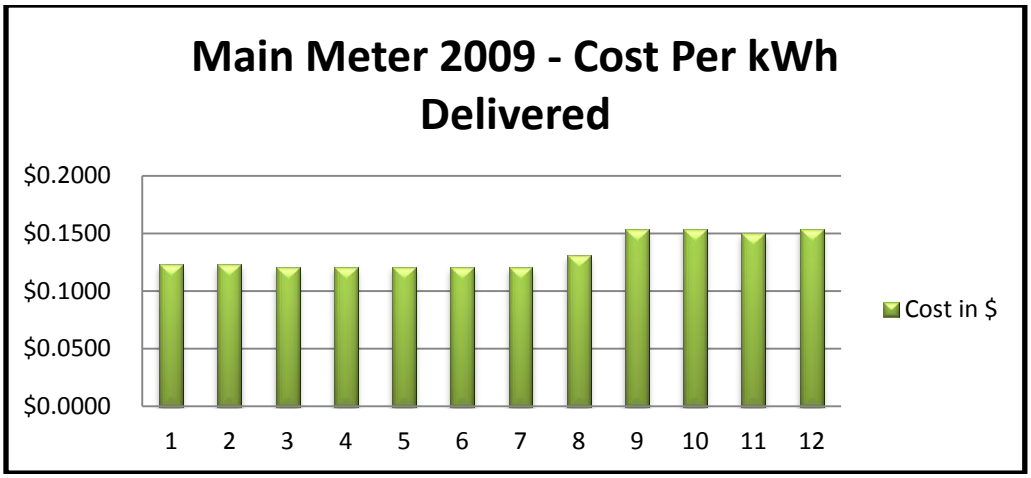
Analysis from provided utility bills for 2009 produces the following snapshot in electricity consumption. Monthly consumption is designated low to high, red being the lowest and green being the highest consumption months in the table below.

Electric -Main Meter			
Utility			
Date	**KWH**	**Total $/mo**	**Cost Per kWh**
12/1/2009	4,726	$581.42	$0.1230
11/1/2009	4,032	$496.04	$0.1230
10/1/2009	4,432	$534.63	$0.1206
9/1/2009	4,137	$499.40	$0.1207
8/1/2009	3,825	$461.76	$0.1207
7/1/2009	3,648	$440.08	$0.1206
6/1/2009	3,557	$429.23	$0.1207
5/1/2009	3,453	$452.63	$0.1311
4/1/2009	4,686	$720.28	$0.1537
3/1/2009	4,183	$643.57	$0.1539
2/1/2009	4,652	$697.80	$0.1500
1/1/2009	4,964	$763.73	$0.1539

Average $/kWh: $0.1327
Total kWh: 50,295



Annual electricity consumption for Whitney Hall



Cost of delivered electricity for Whitney Hall

Heat Source 1			
No. 2 Oil			
Date	**Fuel Units**	**$**	**Cost Per Unit**
12/1/2009	540	$1,444.17	$2.674
11/1/2009	327	$879.92	$2.691
10/1/2009	202	$519.28	$2.571
9/1/2009	142	$393.20	$2.769
5/1/2009	70	$194.66	$2.781
4/1/2009	220	$608.07	$2.764
3/1/2009	513	$1,420.77	$2.770
2/1/2009	668	$1,849.14	$2.768
1/1/2009	778	$2,153.18	$2.768

Total Gallons Delivered: 3,460
Total Paid in 2009: $9,462.39
Average Cost per Gallon: $2.73

Blower Door Test Results:

A blower door test was not performed on this building because of one or more of the following reasons.

- Hazardous building materials were found on site. SDES staff did not want to risk disturbing this material and potentially spreading it to occupied areas of the building.
- Mold was discovered in the building. SDES staff did not want to risk disturbing the mold or spreading spores to occupied areas of the building.
- Though lead paint tests were not performed, SDES felt there may be a threat of disturbing lead paint dust with the potential of spreading it to occupied areas of the building.
- Excessive amounts of bat and/or rodent droppings were discovered. SDES staff did not want to encourage the migration of hazardous gases and associated diseases to occupied areas of the building.
- The risk of spreading materials which are not considered to be hazardous such as fiberglass insulation, dust, etc., was too high. Exposure to such materials can cause respiratory, skin, eye and other irritations to individuals working in or conducting business in this building.
- For security purposes, it was logistically not possible during our building inspection to open all interior doors of the building in order to get accurate test readings.
- Business hours at this building conflicted with the scheduled SDES building inspection, rendering it not possible to keep exterior doors closed during the test.
- It was not possible to shut down heating equipment during the SDES building inspection.

Foundations, Floors, Crawl Spaces, and/or Basements:

The foundation of this building was constructed with a combination of large granite slabs and brick. The fully finished basement, referred to as the 1st floor in this report, has full height suspended ceilings.

Overall, the foundation of this building is in great shape, although there are a couple of issues that need to be addressed. In some areas the mortar between the brick has deteriorated and has been filled with mortar patching material. Eventually, all the brick and granite will have to be repointed.

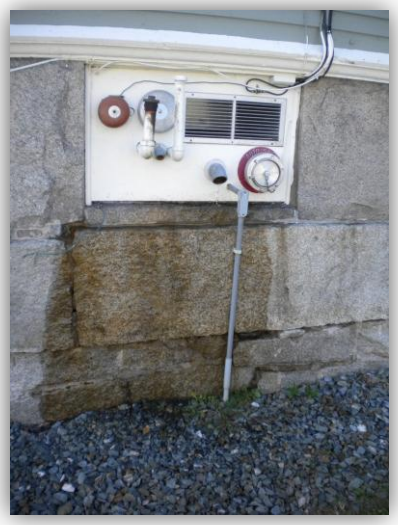
It was mentioned during our building inspection that there is a problem with mice.
If a mouse can fit its head into a hole, it can squeeze its entire body through. Typically, a ¼ inch hole or larger is an opportunity. Any potential passageway should be filled in order to deal with the source of this problem.

This photo not only shows potential passageways for rodent but also ways for moisture to enter the space. Spaces between the granite like this should be cleaned out and sealed with mortar.

This photo shows the most challenging issue that needs to be addressed in the basement: Moisture. Dealing with moisture in a basement with finished walls is just about impossible without tearing everything out and starting over again. If the bottoms of the stud walls throughout the basement look like this one, it will not be much longer before the bottom plates and the bottoms of the studs are completely rotted away. This is promoting the growth of mold and mildew, which are harmful to the occupants of this building. But the harmful pollutants will not be limited to the basement—the stack effect in this building is most likely pulling air, and any pollutants, from the basement up through the spaces above.

In fact, the photos below indicate that the stack effect is already having an impact. The rust in the left photo is an obvious reason for why these ventilation holes were made. Air is meant to enter in the hole at the bottom of this exterior wall and then flow upward in an attempt to bring some of the moisture away from the floor.

Some of the moisture issues may be coming from human sources inside the building. For example, this picture shows the floor of a cleaning closet. There is a sink in the closet that may be dripping water on the floor, and mildew is growing on the walls. After the floors are mopped, the mop is left to dry in this closet. There was a strong smell of mildew and cleaning product coming from the closet. This closet should have a small exhaust fan that continuously puts the space under negative pressure. This will exhaust excess moisture and fumes from cleaning products, which can also have negative long term health effects.



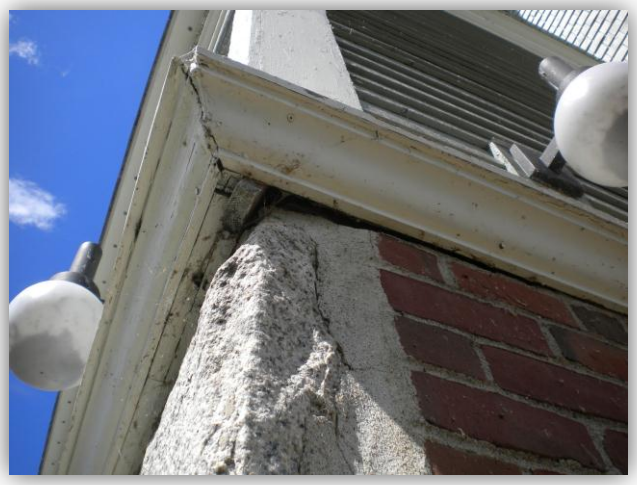
Sources of moisture like the drain seen in this photo should be addressed as well. Also, a more effective drainage system could be put in place along the full length of the exterior of the foundation. This will help move rain and snow melt away from the building.

This picture shows the access hatch to the bottom of the chimney. Because the top of the chimney is not covered, rain is able to enter and settle in this lower region. These bricks, that is, the foundation of this chimney, are deteriorating. There is a lot of debris in the bottom of this chimney that is acting like a sponge holding in the moisture. This should be cleaned out, which will let the bricks dry faster.

The left photo shows the uninsulated band joist that runs the length of the perimeter of the building. The pipes abutting the band joist are also uninsulated. It is important to note that if the band joist above the stud wall is not insulated, then the effectiveness of the stud wall's insulation is greatly diminished. The photo to the right shows that a vapor barrier was placed on the inside of these walls prior to the sheetrock being laid; however, if it is not continuous and well-sealed, it will not be very effective. Finally, the dark areas on the insulation are proof of moisture and subsequently the fiberglass's inability to impede air flow.

Exterior Walls:

Inefficiencies with the exterior walls begin right at base of the walls just above the foundation. Any cracks and gaps, as the ones shown in this photo, are sources for the upward movement of air through the exterior wall cavities.



The siding on this building is a combination of clap boards and wooden shingles (shakes). The siding is in pretty good shape given its age. It is unknown if there was any tar paper or other type of material in place under the siding. If there is not, then there is likely a lot of air movement between the exterior and the wall cavities.

If there is no material behind the siding, then the wooden shakes may be the worst source of air movement owing to the multitude of cracks in its structure.

This picture was taken from above the suspended ceiling in the library on the 2nd floor. This space was renovated some years back and an effort was made to insulate the exterior walls, though the quality or thoroughness of that effort is questionable. This photo clearly shows the top inch of the wall without any insulation. This is a similar inefficiency to the basement walls—if the critical tops of the walls are not insulated, the overall benefit is diminished.

This picture was also taken from above the library ceilings. This shows how fiberglass insulation was stuffed between the floor joists where they meet the balloon framing in order to try and slow upward air flow. Fiberglass does little to impede air flow and instead acts more like an air filter as is evident by the amount of dust gathered on the face of this piece.

We removed one of these pieces of fiberglass to confirm that the 3rd floor walls of this building are not insulated at all. This picture looks up toward the top of the building. These empty wall cavities are not just an inefficiency of the 3rd floor walls—they affect the entire building, because they act like individual chimneys drawing heat quickly to the attic space.

This picture was taken from a storage closet on the 3rd floor on the street end of the building. This insulation was put in place to try and keep heat in the main area of the 3rd floor. This is a small amount of the total wall area, the remainder of which is uninsulated; thus, this small effort may as well have not been made. Furthermore, the craft face should have been against the heated area, and there are large gaps everywhere—which further renders this minimal insulation as pointless.

Ceilings and Attic:

This picture shows the underside of the 3rd floor (above the library suspended ceilings). The entire perimeter of this floor system should be sprayed with closed-cell foam insulation replacing the fiberglass. Then, given that the space above is not used very often, it may be beneficial to insulate this floor to try and keep heat intended for the library in the library.

The cathedral ceilings above the stage on the 3rd floor have been insulated with this foil-faced rigid foam board. This was a great option for the space but could pose potential problems in the rafter cavities depending on the conditions between this insulation and the roof. It would be beneficial to cut holes in a couple of sample areas to make sure that water vapor from the building is not condensing on the underside of the roof sheathing boards.

This is a picture of the door leading to the tower. This door should be replaced with an insulated door, and the side walls should be sealed and insulated.

These two photos show a ventilation duct that extend from a screened vent in the ceiling of the 3rd floor and terminates the roof at the hood vent seen in the photo to the right. As the amount of dead insects on the screen shows, this is open to ambient conditions. If that was not evidence enough, one of the many pigeons seen in the photo loitering around the hood vent fell into the duct during our building inspection. Judging by the sounds of its fruitless struggles to fly out, it probably died inside the duct—there may be other bird carcasses present. This needs to be sealed off on both ends and insulated at the ceiling.

The ceiling above the 3rd floor was found to be insulated with loose-fill cellulose. This appeared to be a job well done, and though adding additional insulation to this would increase the R-value, we would only recommend this after many of the other inefficiencies were addressed.

Doors and Windows:

The doors and windows of the 1st floor have been replaced with more efficient units, but the rest of the windows in the building are originals. Given the historic importance of these windows, the town may decide that they should not be replaced. This is fine because replacing them would be much less beneficial than spending funds on air sealing and insulation projects and would be a futile effort to save money with the building envelope in its current condition. Even if the walls were insulated, it would likely take a long time to recoup the expense of a window replacement project. What would be beneficial is to replace the storm windows with modern high efficiency units that have a low-e coating.

Mechanical:

This building is heated with a single oil fired boiler seen below. This boiler supplies hot water to several zones throughout the building. This boiler has a relatively efficient burner and service tags show it to be combusting at about 85% efficient. There is a combustion air duct seen to the left of the boiler to ensure adequate supply.

There have been some comfort issues in the library. One of the thermostats was believed not to be working. We turned up this thermostat and the boiler fired. We then used an IR camera to determine which radiators were associated with this zone. What we found was that this thermostat is located on the opposite side of the building from where the radiators are located. This indicates the following problem: One zone in the library supplies heat to just one side, and the other zone supplies heat to the other side of the room; however, instead of having thermostats in both sides of the room, both thermostats are located on the same side, leaving the other side uncomfortable. More can be explained about this zoning issue during the presentation of this report.

We found an outdoor reset installed with this system, which is a great way to help boost the efficiency of an oil fired hydronic heating system. This unit measures outdoor temperatures and automatically adjusts the output temperature of the boiler. The warmer the outside temperature is, the less hot the distributed water needs to be.

The potable water for this building is provided by this stand-alone electric hot water heater. Given the large distance between this unit and the points of use, it would be better to have on demand (also known as "point of use") hot water heaters.

None of the pipes in this building were found to be insulated, even these heating pipes running along the uninsulated exterior wall underneath the stage in the 3rd floor. All pipes in this building should be well insulated, including those in the insulated sections of the building. Doing this alone should prove to save a great deal of money.

This building relies mostly on natural ventilation for fresh air, though there are several small exhaust fans throughout the building. This unit is in one of the 1st floor offices and is controlled by a switch.

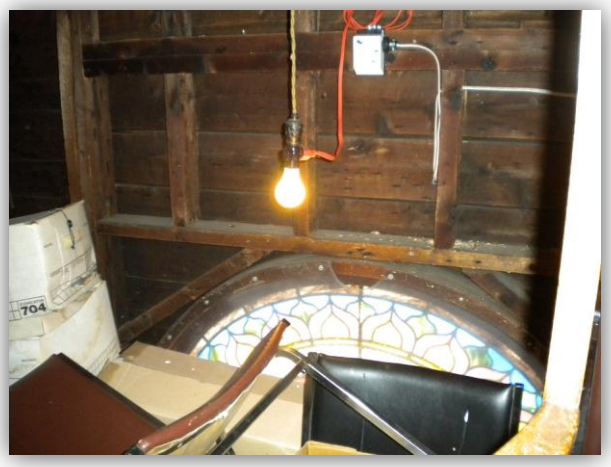
The exhaust grill seen in the photo to the left is associated with the vent in the photo to the right. As one can see, this flexible round vent empties air into the space above the 1st floor suspended ceiling, solving the mystery of why the whole office knows when the toast is burning.

Electrical:

There are several window AC units in the library which could be replaced with higher efficiency models, and the cost to keep this space cool would certainly be reduced by the improvements to the building envelope. However, the highest electric use months for the measured year were during the winter. This is likely owing to several factors including the more limited number of daylight hours, greater use of hot water, the circulation pumps of the heating system, etc.

Some of the easiest things to do to reduce electric costs do not involve initial investment. Some of these things are making sure lights are out in spaces not being used. If there are employees in the building an hour before or after times of business, keep as many of the lights off as possible. Eliminating one hour of electric usage at either the beginning or end of each day for an entire year can amount to substantial savings.

Most modern electronic equipment draws a small amount of electricity even when powered down, which can equal a sizable amount in cost at the end of the year. Using power strips and fully cutting the power to electronics will reduce this unintended electric usage.



Updating florescent tube fixtures while using T8 tubes instead of T12 and replacing any incandescent bulbs with compact florescent (CFL) or LED units is a great first step toward addressing electric usage tied to lighting needs. Also, invest in outdoor LED options for safety lights that are left on year round during the night. The more a light is used, the more important it is to use the most efficient source available.

For example, there is a local business in Enfield that sells LED bulbs that could replace this incandescent bulb, which is on all night every night to illuminate the stained glass window. Reducing this with an LED option would reduce this cost by 90%.

Health, Safety and Comfort:

There are always multiple benefits to making a building more energy efficient. Saving on the cost to operate a building while reducing its environment impact are the two most thought of. The third benefit is greater comfort. Making improvements to the building's envelope and addressing zoning issues will leave occupants of this building feeling warmer in the winter, and cooler in the summer.

Though we did not test for lead paint, this building given its age should be assumed to contain lead paint unless otherwise proven. Information about the risks of lead paint can be found at the EPA's website: http://www.epa.gov/lead/

Any health concerns found in this building relate mostly to indoor air quality. Addressing moisture problems, as well as sealing off the building from any potential rodent, batt and pigeon intrusion will be essential to controlling the source of the potential problems. With the building well air sealed, installing an energy efficient, balanced ventilation system will be necessary.

Any building, whether a residence or a place of business, needs to offer regular fresh air to the people living and working in these structures. The standards for how much fresh air to introduce vary depending on the use, size, and number of occupants in the structure. In some cases, this means introducing a continuous amount of air measured in cubic feet per minute (CFM). Other cases require a measured number of times per hour that the total volume of air is changed. If air-sealing and insulation work is completed on an existing building, it may leave the building providing inadequate amounts of fresh air. If an existing fresh air supply system was designed and installed well, meeting the requirements for the particular building based on square feet, use type, and number of occupants, than air-sealing projects should only serve to eliminate excessive ventilation. A blower door test would determine how tight the building is as a result of the efficiency upgrades, if there is a need for additional fresh air, and how much air to introduce.

Whether installing a fresh air supply system for the first time in a building, or wanting to make an existing system more energy efficient, the most effective way to provide fresh air in either case would be with a heat recovery ventilator (HRV) or an energy recovery ventilator (ERV). These units can be installed in a few different ways which vary where they pull stale air from, and where the fresh air is introduced to. In the case of integrating HRVs or ERVs into an existing forced-air distribution system, they will function by removing a percentage of the stale air from the return plenum, and then introducing charged, fresh air to the return plenum right before the air-handler. In the winter, warm/stale air being removed from the building will charge the incoming fresh air with a heat exchanger located inside the device. Conversely, in the summer months the exhausted cool/stale air from the interior will cool down the hot/humid air from the exterior before entering the air-handler. An ERV has a desiccant wheel as well. This allows for the transfer of moisture and recovery of some of the latent energy otherwise lost by expelling the moisture in the air. In the winter months, some of the moisture in the exhaust air will be transferred to the incoming dry air to help maintain occupancy comfort. In the summer, dry/conditioned air from the interior will remove, at least a portion of, the moisture from the humid incoming air - see Figure 1. Typically, the benefits of an ERV are best realized in areas of high summertime humidity such as in the Southern and Southeastern regions of the

US. Subsequently, HRVs are usually installed in the Northeast where humidity levels are generally lower. There are however conditions that may warrant an ERV such as in cold climates if there are few occupants (sources of humidity) in a large drafty building. The ERV may help to maintain more comfortable humidity levels.

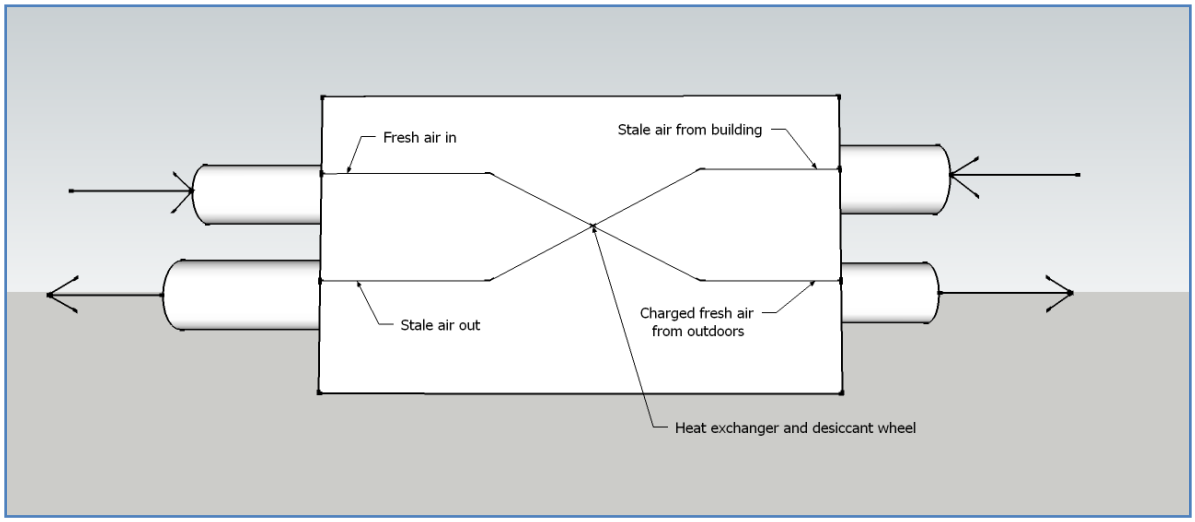


Figure 1

Recommendations:

The following list of recommendations will include steps for improving the performance of this building. Though further analysis is needed to give reasonable estimates of the effectiveness for the energy improvement recommendations, the health and safety concerns should be addressed regardless of whether or not they will reduce energy consumption. Some may in fact increase energy consumption.

This list will focus on each part of the building. Some sections may list the highest impact items first (large initial investment/large energy savings), others may be lower impact improvements that have a low implementation cost (may only require behavior change). These lists will be well explained during the presentation of this report.

Our prioritization is based on our "what works" experience. This list will not include detailed "spec" information on how exactly each item should be carried out. This type of detail would be presented in an IGA (Level II equivalent) in order to receive estimates for the cost of implementation, and return on investment.

Foundation and Basement:

- The gaps and cracks in the foundation should be well sealed in order to keep air, bulk moisture, and rodents from entering the basement. Re-point the brick and granite when necessary.
- From the exterior, air seal where the foundation meets the frame and siding of the wood framed walls.
- Consult with a drainage specialist about ways to improve the drainage from around the foundation.
- Spray the entire band joist with 2 inches of closed-cell spray foam insulation. This will need to then be sprayed with a fire retardant paint.
- Install a low CFM exhaust fan in the cleaning closet and set it to run continuously.
- Reattach the vent from the kitchen exhaust.
- Clean out the bottom of the chimney and install a cap on the chimney to keep bulk moisture out.

Exterior Walls:

- Blow loose-fill cellulose into any empty wall cavity of the Library.
- Spray the top of the Library walls with 2 inches of closed-cell spray foam insulation. This will need to then be sprayed with a fire retardant paint.
- Air seal any major gaps and cracks that allow air flow from above the suspended ceilings of the library to the 3rd floor, then insulate the underside of this floor. There are many types of insulation that could be used for this. Because this insulation would be exposed to the Library space below (suspended ceilings do not constitute an air barrier) we would recommend using a type of insulation that would not drop irritable fibers. Cotton fiber insulation would be a great choice. Another option would be to staple foil-faced bubble wrap insulation to the underside of the floor joists. With all the seams well sealed with metalized tape, this would provide an air barrier, a radiant barrier, and some R-value all at the same time and could prove to be quite affordable.

- Blow loose-fill cellulose into the empty wall cavities of the 3rd floor.
- Exposed cavities, such as underneath the stage and in the storage closet to the front of the building, should be sprayed with closed-cell spray foam insulation, making sure to cover the wooded frame and not just areas between it.

Ceilings and Attic:

- Replace the hatch door seen on page 20 with a well-sealed and insulated door. Insulate the side walls of this stairwell leading to this door.
- Seal and insulate the vent in the ceiling on the third floor, and seal the associated hood in order to keep pigeons out.

Doors and Windows:

- Make sure that all doors and windows provide a good air seal when closed.
- Replace old storm windows with high efficiency units. Order units with a low-e coating for added insulative value.
- Air seal and insulate any gaps between window and door frames and the surrounding wall framing with spray foam. This may not be possible with some of the older windows that operate using window weights. These windows could be retrofitted with systems that would allow the window weights to be removed but leaving the windows operable.
- Air seal any gaps or cracks between the window and door trim and the finished wall surfaces.

Mechanical:

- Insulate all of the piping in the building.
- Seal any mechanical penetrations between the 1st, 2nd, and 3rd floors.
- Move the thermostat, located in the back of the library, to an appropriate spot on the same side as its associated radiators. This may fix comfort issues, but it may also be needed to install additional zones on this floor.
- There are several options for replacing the current potable water system with a more efficient means of producing the hot water. Point of use systems installed on each floor of the building would eliminate the distance currently between the hot water source and the use point. This will save both energy and water resources.
- Consult with a ventilation specialist on the most energy efficient means for meeting the ventilation requirements of this building. This might be able to be done by installing a series of residentially sized HRV's.

Electrical:

- Make use of smart power strips, and be sure to cut the power to any equipment when it is not in use.
- Replace any out dated florescent tube fixtures, and only use T8 florescent tubes.
- Replace any incandescent bulbs with either CFL or LED units. Be sure to focus any investment in LED lights to those lights that are used the most.
- Be sure to invest in the highest efficiency, Energy Star rated equipment when buying new items or replacing the old. Pay special attention to the highest energy users like air conditioning units and refrigerators.

- After efficiency matters have been addressed, install a photovoltaic solar system to provide onsite generation of electricity in order to supplement or eliminate what electric needs remain.

Health and Safety:

- Take all necessary steps to reduce the source of indoor air pollutants. Major steps will include moisture and pest control.
- Consult with a ventilation specialist on the most energy efficient means for meeting the ventilation requirements of this building. This might be able to be done by installing a series of residentially sized HRV's.

Financial Considerations and Options:

A common occurrence across many communities within New Hampshire is the challenge of obtaining the necessary capital funds to carry out the recommended retrofits found within the audit. The following information is an attempt to provide some assistance with understanding some concepts and pathways to acquiring public or private funds to carry out an energy efficiency or generation project. Also, portions of the following information have been taken from the New Hampshire Handbook on Energy Efficiency and Climate Change – Volume II.

New Hampshire Energy Technical Assistance and Planning (ETAP):

ETAP is a NH specific program funded by the American Recovery and Reinvestment Act (ARRA). This federally funded program is being administered by the NH Office of Energy and Planning, and is designed specifically to aid NH municipalities as they plan for and implement measures to reduce municipal energy costs.

The highly experienced ETAP team is eager to provide this assistance to your community, but you must sign into the program before mid-2012. Your community will not be required to write a proposal, and there are not charges for these services. It is important to remember that participating in any program will require time from municipal staff. The hours needed would likely run parallel to the size and complexity of the project your community wants to endeavor.

For inquiries on how your community can receive assistance from this valuable program, you will need to contact the ETAP Technical Assistance Coordinator, Eric Halter, at 603.225.3060. You can also get started by directly contacting the Upper Valley Lake Sunapee Regional Planning Commission (RPC). **Upper Valley Lake Sunapee RPC** - 603.448.1680

NH Community Development Finance Authority (CDFA) – Municipal Energy Reduction Fund:

The NH CDFA was awarded $1.5 million through the Regional Greenhouse Gas Initiative (RGGI) to establish a revolving loan program in order to aid NH municipalities wishing to make their building stock more energy efficient. These loans are structured based on the amount of energy a given project will reduce, and terms/rates are flexible.

Municipalities can register and apply online at:
www.nhcdfa.org/web/erp/merf/merf_overview.html

For questions regarding this program, contact Cassandra Bradley at 603.717.9114 – cbradley@nhcdfa.org

NH PUC – Commercial and Industrial Renewable Energy Rebate Program:

The NH Public Utilities Commission has created a rebate program for renewable energy systems that is available to Local Governments. Participants will need to have a “Level II” audit performed, and some of the energy efficiency measures implemented prior to being eligible for receiving the final rebate. This is a great opportunity for municipalities who are interested in

installing a renewable energy system to receive a similar type of aid previously only available in residential and commercial applications.

There is a maximum incentive, and funding is limited, which means that municipalities will have to carry much of the cost. Participants need to fully understand and follow the project guidelines.

For questions regarding this program contact:
Kate Epsen
NH PUC
603.271.2431
kate.epsen@puc.nh.gov

More information can be found online at:
http://www.puc.nh.gov/Sustainable%20Energy/RenewableEnergyRebates-CI.html

Utility Programs:

Enfield is served by both NH Electric Coop and National Grid (Granite State). Both NH utilities provide technical and financial assistance for various types of efficiency measures that can be carried out at a municipal facility. Some programs offer the opportunity for municipalities to go forward with the installation of approved measures at no up front cost to the municipality. A town simply pays for the energy improvements with the savings from reduced energy usage until the project is paid off. Contact your utility provider to discover ways in which they can assist your municipality in reaching its energy efficiency goals.

For NH Electric Coop Customers:

- Contact Member Solutions at 1.800.698.2007
- Visit - www.nhec.com/energy_efficiency_programs.php

For National Grid:

- Call - 1.800.843.3636
- Gas - https://www.powerofaction.com/newhampshirecigasnaturalgasheating/
- Electric - https://www.nationalgridus.com/granitestate/business/energyeff/3_small.asp

National Grid - Small Business Program For business customers with an average demand use of 200 kilowatts or less (or 40,300 kilowatt-hours or less) per month, we can help you reduce your company's energy costs by installing energy efficient equipment.

- We can provide a free energy audit and report of recommended energy efficiency improvements
- We pay 50% of the cost of the installation of energy efficient equipment and you can finance the remaining 50% interest free for up to 24 months.
- Cost-cutting, energy efficient equipment available through this program include:

- Lighting Upgrades
- Energy Efficient Time Clocks
- Photo Cells For Outdoor Lighting
- Occupancy Sensors
- Programmable Thermostats
- Walk-in Cooler Measures

Additionally, a terrific resource for monitoring and understand what type of incentives are available for both energy efficiency and generation is the "Database of State Incentives for Renewables & Efficiency", or DSIRE. This site, funded by the US Department of Energy, provides a list of the potential financial incentives found within New Hampshire and the Federal Government. To see what is available within New Hampshire go to www.dsireusa.org and click on New Hampshire.

Third-Party Financing Options:

The most important part to understanding the potential in third-party is the ability to address up front capital costs and access tax benefits. Additional benefits are potential operations and maintenance savings where the implementation is owned by a third-party. In the three-party model, new businesses create an income stream and take over the insurance, performance assurance, and maintenance of the renewable energy system. New jobs and local investment follow. The business secures stable and long-term funding enabling expansion to other facilities for similar projects.

There are several benefits that appear for the municipality that is considering a third-party financing strategy.

Ability to Monetize Federal Tax Incentives. Federal tax incentives for some projects can equal 30% of the installed capital cost. Under the current law, this 30% is payable in the form of a grant from the Department of Treasury. In addition, businesses can accelerate the depreciation of the cost of some systems and installations using a five-year schedule. Together, these two incentives can have a tremendous impact on both the cost of and the financial returns on a project. Local governments, however, cannot directly benefit from these incentives. The third-party ownership model introduces a taxable entity into the structure that can benefit from the federal tax incentives, lowering the overall cost to the non-taxable entity.

*Low/No Up-front Cost*s. Even with programs to provide support to municipalities, such as rebates and grants, the need to reduce this amount, the up-front cost is significant. Given the current economy and budget constraints, a large initial investment is difficult to achieve regardless of the return on the investment. A third-party structure places the responsibility of the increased initial cost on to the investor/developer of the project.

Predetermined Energy Pricing. In a project that involves efficiency or distributed generation, the portion of conservation or generation that is met by the project can be

considered "fixed" at a particular price in the terms of the contract. This can be in the form of a fixed-priced power purchase agreement (with a predetermined escalation rate). This predictability offers stable pricing for the portion of the entity's load served by the project. In most cases, the price of electricity in power purchase agreement is usually set at or below the customer's current retail rate for the first year, and then escalates annually for term of the contract (in a solar PPA, these terms are usually 20 – 25 years). For solar projects, an annual price escalator of 3-3.5% is common.

Operations and Maintenance. Another attractive feature of the third-party ownership structure is the fact that new equipment can result in lower operation and maintenance expenses and in the case of some systems, the entire cost and responsibility can shift to the project developer.

Eventual Ownership. As a final issue, third-party structures can be pre-crafted to permit and even encourage local government buyout provisions. This allows the municipality to consider advanced purchase options if circumstances change in a way that makes this pathway more beneficial. If for instance a grant program becomes available, such funds can be used to accelerate the ownership path and provide for a more immediate "vesting" of full savings opportunities.

Otherwise, these arrangements usually provide for a number of options at the end of the term, the three likely scenarios for the host would be to: 1) extend the arrangement, 2) purchase the facility, or 3) ask that the improvements be removed.

Energy Price Stability –

The second most important concern about energy costs is the volatility. Municipalities budget on a yearly cycle and must predict energy costs over the year – sometimes over pricing the cost in the case of high lock in prices or subjecting the municipality to risk where a cost (+ some percentage) contract is used for the year. When prices go up budgets go up, when the go down, budgets tend to go down. Changes result is wide variation in predictability and thus lead to fund shortages or balances, and general frustration on all sides of the discussion.

The concept of stability in the context of energy prices is achieved through on-site distributed generation with effective predictive modeling and most importantly, efficiency. The cheapest energy available is the energy you don't need. The less you buy the less amount of appropriations are subject to the price swings.

The follow Table and three Graphs were retrieved from the U.S Energy Information Administration website, were included in the 2010 Annual Energy Outlook, and are a clear indications of the fact that energy costs will continue to rise over the long term. It is extremely difficult to predict how quickly the cost of energy will escalate as there are too many economic, political, resources, etc. variables that influence these prices. Some years energy cost may be much lower than predicted, and some years may be much higher. The one thing that appears to be certain is that the cost of energy in the decades to come will pose great financial burdens on NH municipalities and their tax payers if no steps are taken to prepare for this forecast.

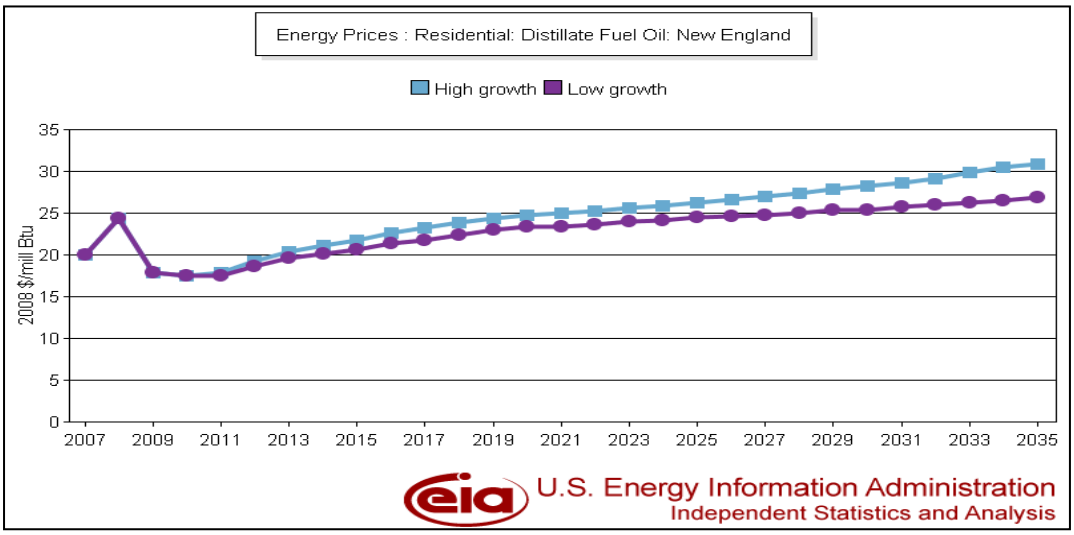
For more information on the history of energy prices and how energy cost projections are calculated, please visit: http://www.eia.doe.gov/analysis/

Price Summary

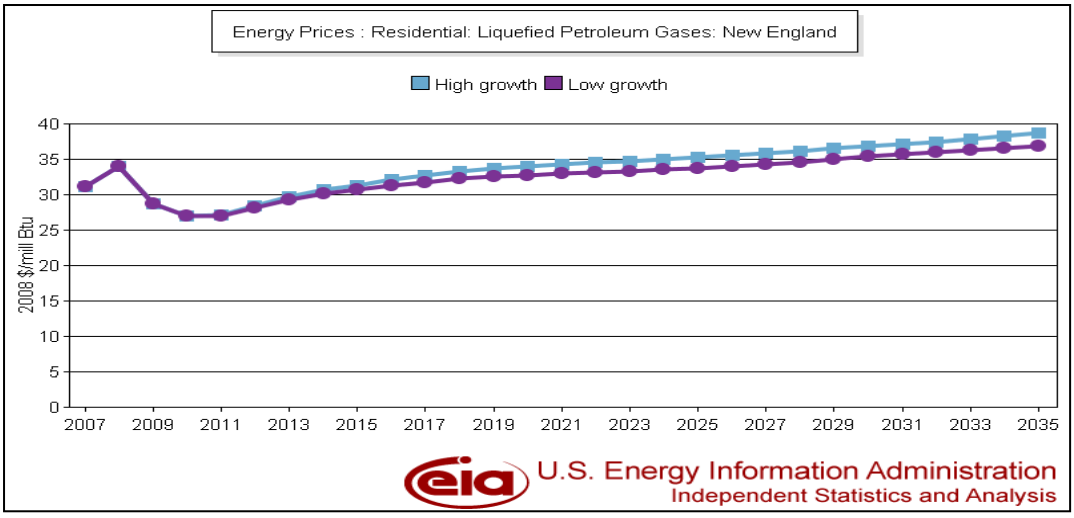
	Year				Percent Change		
	2009	2010	2011	2012	09-10	10-11	11-12
WTI Crude[a] ($/barrel)	61.65	79.40	93.26	97.50	28.8	17.5	4.5
Gasoline[b] ($/gal)	2.35	2.78	3.15	3.30	18.4	13.4	4.8
Diesel[c] ($/gal)	2.46	2.99	3.43	3.51	21.5	14.7	2.4
Heating Oil[d] ($/gal)	2.52	2.97	3.41	3.55	17.5	14.8	4.3
Natural Gas[d] ($/mcf)	12.12	11.17	11.29	12.01	-7.8	1.1	6.3
Electricity[d] (cents/kwh)	11.51	11.58	11.65	11.74	0.7	0.6	0.7

[a] West Texas Intermediate. [b] Average regular pump price.
[c] On-highway retail. [d] U.S. Residential average.

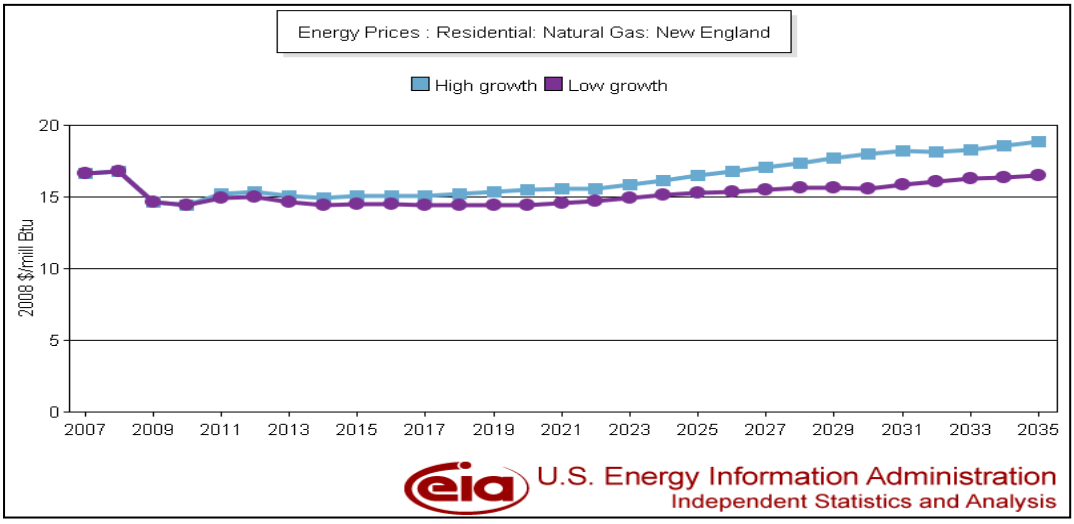
Table 1 – Retrieved from US EIA website



Graph 1 - Retrieved from US EIA website



Graph 2 - Retrieved from US EIA website



Graph 3 - Retrieved from US EIA website

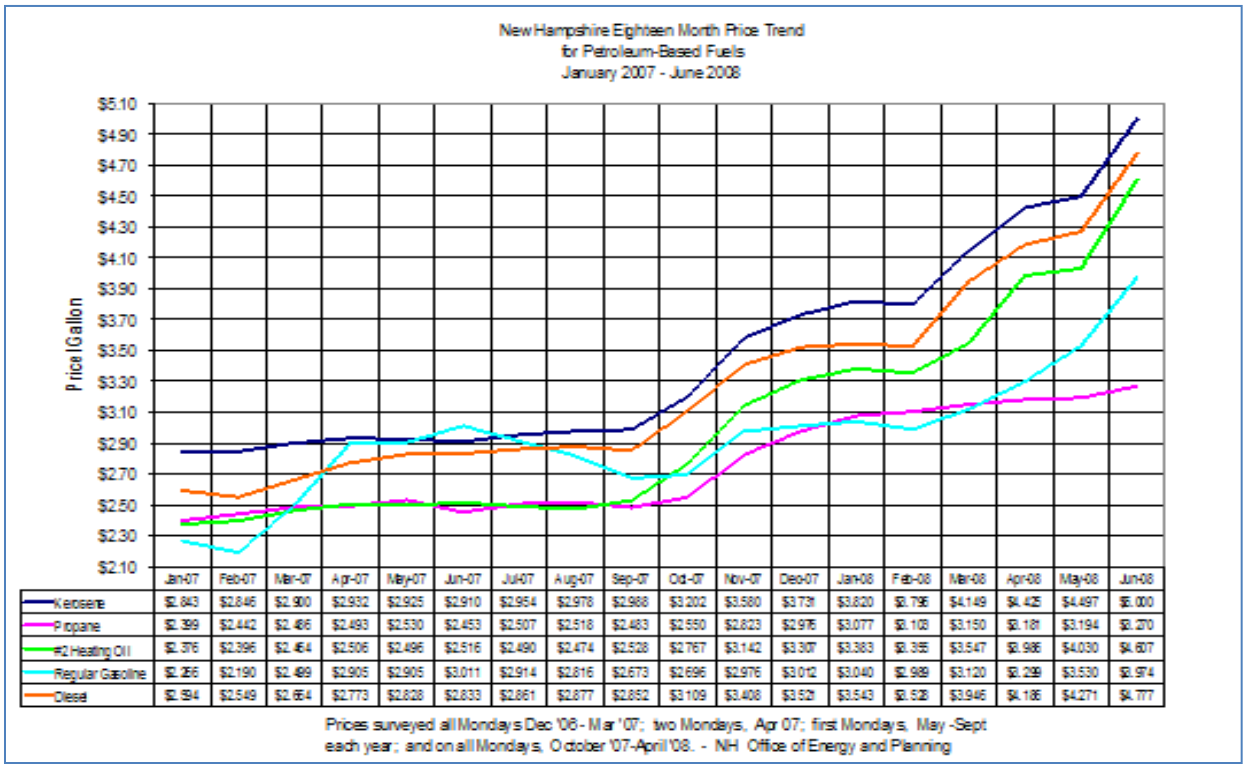
The following three Graphs (retrieved from the NH OEP website) show average prices in NH for liquid fuels beginning in January of 2007 and end in December 2010. These graphs help to illustrate just how volatile the cost of energy is, and the steady rise of price regardless of occasional "spikes" or "dips" in the market. As unfortunate as the 2008 energy prices were, these types of events only serve to shorted the Return on Investment for those who implemented energy efficiency measure prior to their occurrence.

When considering the type of energy reduction project to implement, it is very important for Local Governments to look far into the future of energy costs, as municipalities will own and operate most of their building stock for as long as they may stand.

Projects such as air-sealing and insulating can be thought of as a different species of project and investment when compared to items like heat systems, appliances, and alternative energy systems. In the case of the latter, these types of energy investments have a shelf life. A boiler and a PV system may only last 30 years before it is time to replace them, even with careful

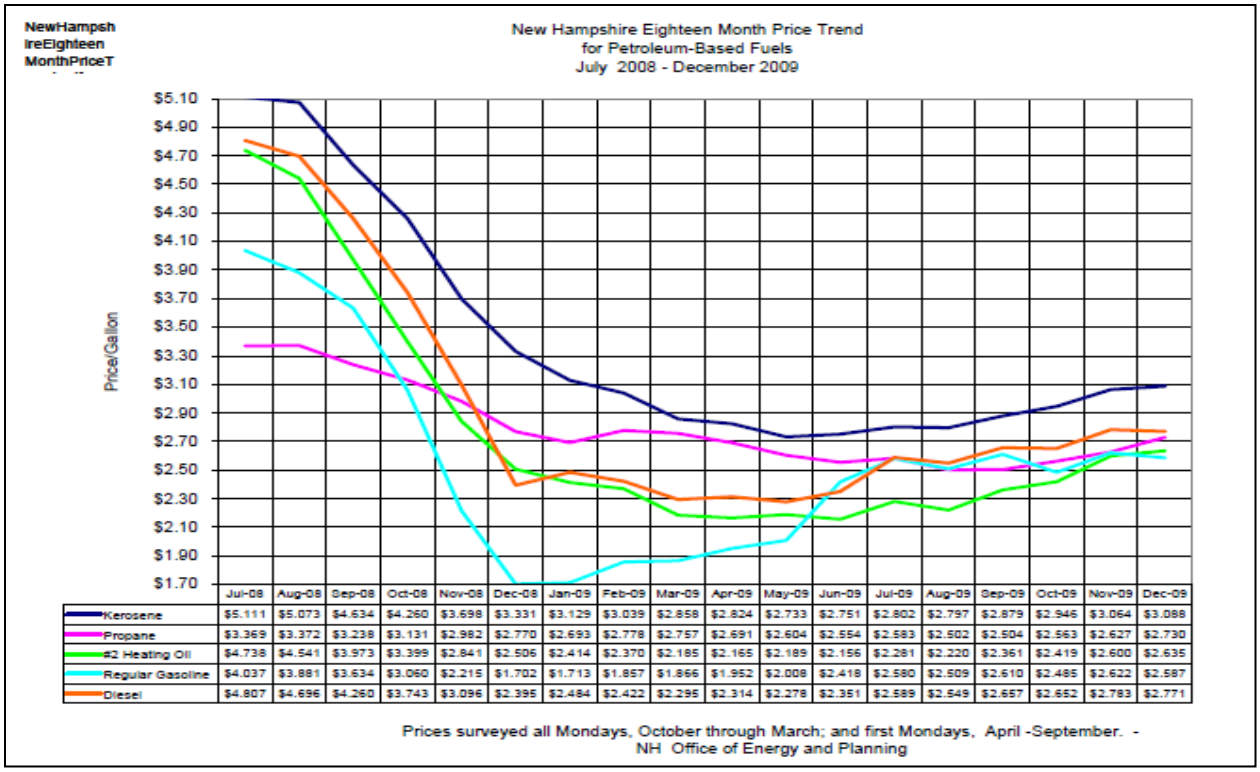
maintenance and care. This is an important consideration when factoring in the true life cycle cost of the implemented solution.

Insulation and other building envelope projects are investments that are permanent, require little or no active maintenance, and will stand with the building during its lifetime. These investments secure baseline improvements that in turn provide a foundation for other investments. Lowering the amount of heat needed for a building is the best way to insure that a new and efficient heating plant is as small as it can be, providing the most savings.



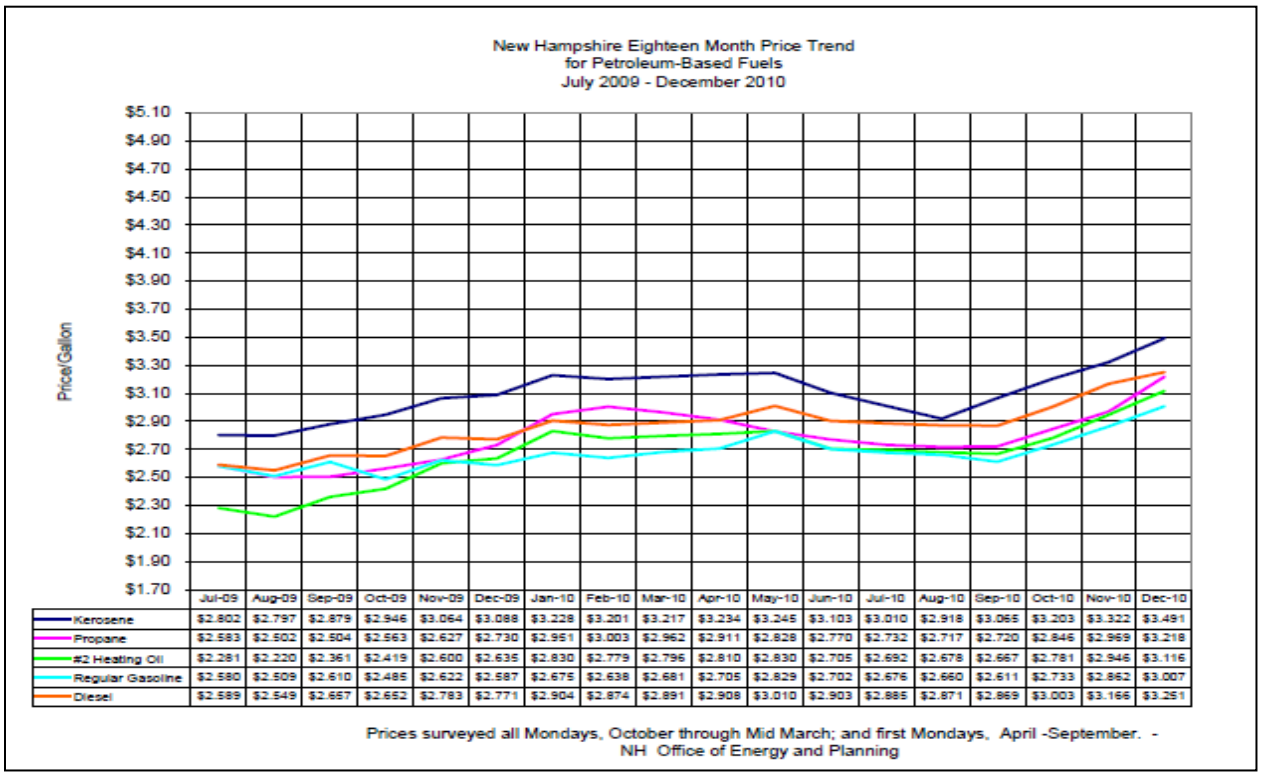
	Jan-07	Feb-07	Mar-07	Apr-07	May-07	Jun-07	Jul-07	Aug-07	Sep-07	Oct-07	Nov-07	Dec-07	Jan-08	Feb-08	Mar-08	Apr-08	May-08	Jun-08
Kerosene	$2.843	$2.846	$2.900	$2.932	$2.925	$2.910	$2.954	$2.978	$2.988	$3.202	$3.580	$3.731	$3.820	$3.796	$4.149	$4.425	$4.497	$5.000
Propane	$2.399	$2.442	$2.486	$2.493	$2.530	$2.453	$2.507	$2.518	$2.483	$2.550	$2.823	$2.976	$3.077	$3.108	$3.150	$3.181	$3.194	$3.270
#2 Heating Oil	$2.376	$2.396	$2.454	$2.506	$2.496	$2.516	$2.490	$2.474	$2.528	$2.767	$3.142	$3.307	$3.383	$3.355	$3.547	$3.986	$4.030	$4.607
Regular Gasoline	$2.256	$2.190	$2.499	$2.905	$2.905	$3.011	$2.914	$2.816	$2.673	$2.696	$2.976	$3.012	$3.040	$2.989	$3.120	$3.299	$3.530	$3.974
Diesel	$2.594	$2.549	$2.664	$2.773	$2.828	$2.833	$2.861	$2.877	$2.852	$3.109	$3.408	$3.521	$3.543	$3.528	$3.946	$4.186	$4.271	$4.777

Figure 2 - Retrieved from NH OEP website



	Jul-08	Aug-08	Sep-08	Oct-08	Nov-08	Dec-08	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09
Kerosene	$5.111	$5.073	$4.634	$4.260	$3.698	$3.331	$3.129	$3.039	$2.858	$2.824	$2.733	$2.751	$2.802	$2.797	$2.879	$2.946	$3.064	$3.088
Propane	$3.369	$3.372	$3.238	$3.131	$2.982	$2.770	$2.693	$2.778	$2.757	$2.691	$2.604	$2.554	$2.583	$2.502	$2.504	$2.563	$2.627	$2.730
#2 Heating Oil	$4.738	$4.541	$3.973	$3.399	$2.841	$2.506	$2.414	$2.370	$2.185	$2.165	$2.189	$2.156	$2.281	$2.220	$2.361	$2.419	$2.600	$2.635
Regular Gasoline	$4.037	$3.881	$3.634	$3.060	$2.215	$1.702	$1.713	$1.857	$1.866	$1.952	$2.008	$2.418	$2.580	$2.509	$2.610	$2.485	$2.622	$2.587
Diesel	$4.807	$4.696	$4.260	$3.743	$3.096	$2.395	$2.484	$2.422	$2.295	$2.314	$2.278	$2.351	$2.589	$2.549	$2.657	$2.652	$2.783	$2.771

Graph 4 – Retrieved from NH OEP website



	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09	Jan-10	Feb-10	Mar-10	Apr-10	May-10	Jun-10	Jul-10	Aug-10	Sep-10	Oct-10	Nov-10	Dec-10
Kerosene	$2.802	$2.797	$2.879	$2.946	$3.064	$3.088	$3.228	$3.201	$3.217	$3.234	$3.245	$3.103	$3.010	$2.918	$3.065	$3.203	$3.322	$3.491
Propane	$2.583	$2.502	$2.504	$2.563	$2.627	$2.730	$2.951	$3.003	$2.962	$2.911	$2.828	$2.770	$2.732	$2.717	$2.720	$2.846	$2.969	$3.218
#2 Heating Oil	$2.281	$2.220	$2.361	$2.419	$2.600	$2.635	$2.830	$2.779	$2.796	$2.810	$2.830	$2.705	$2.692	$2.678	$2.667	$2.781	$2.946	$3.116
Regular Gasoline	$2.580	$2.509	$2.610	$2.485	$2.622	$2.587	$2.675	$2.638	$2.681	$2.705	$2.829	$2.702	$2.676	$2.660	$2.611	$2.733	$2.862	$3.007
Diesel	$2.589	$2.549	$2.657	$2.652	$2.783	$2.771	$2.904	$2.874	$2.891	$2.908	$3.010	$2.903	$2.885	$2.871	$2.869	$3.003	$3.166	$3.251

Graph 5 – Retrieved from NH OEP website

Potential for Savings:

(The following numbers are not meant to be accurate estimates. Such estimates are only provided in an Investment Grade Audit (IGA). Instead, these numbers are only meant to give a rough idea of what potential for savings there may be in regards to the current energy expenditures given a 30% reduction).

Average cost of various energy types in NH
Date - January 31st 2011

Heating Oil, credit	$3.463 per Gallon
Propane, credit	$3.549 per Gallon[1]
Kerosene, credit	$3.841 per Gallon
Electricity	$0.14260 per kilowatt-hour[2]
Natural Gas, first tier	$1.1305 per therm[3]
Natural Gas, second tier	$1.0622 per therm[4]

Figure 3 – Retrieved from NH OEP website

The table below estimates the cost of liquid fuel for this facility over a 15 year period. This is only an estimate, and is based on current yearly usage, NH price averages for January 31st 2011, with a 5% cost increase per year.

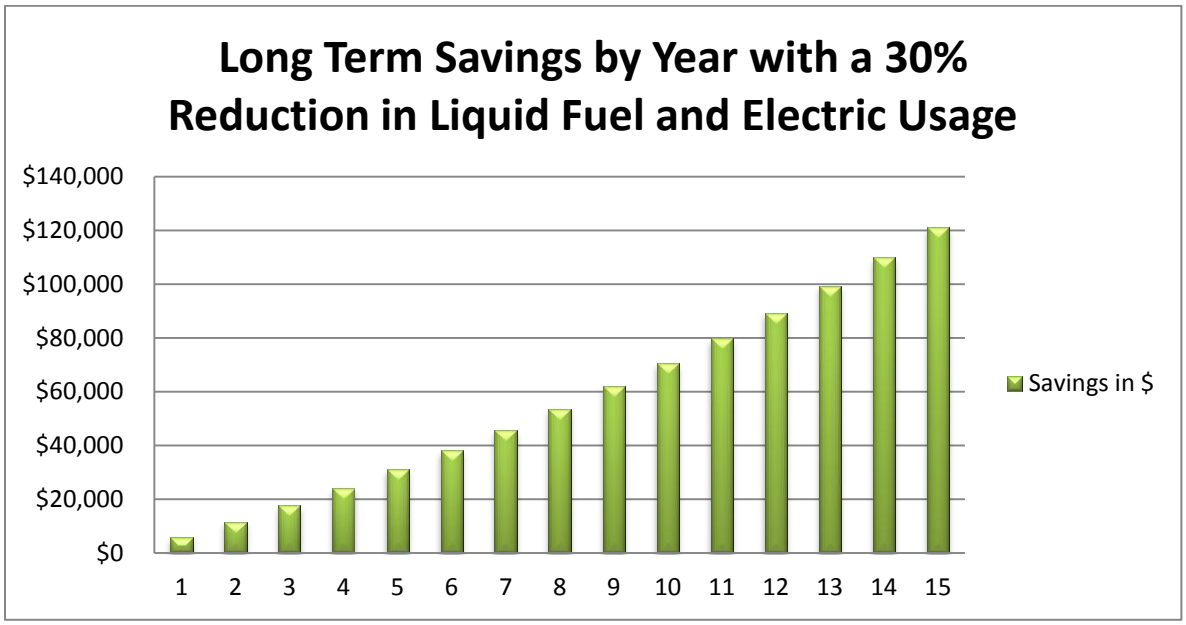
Current Fuel Usage				
Year	Energy Cost By Year	Yearly Increase	Total Accumulated Cost by Year	
		Escalation Rate	5.00%	
Year 1	$11,981.98	$ 599.10		$11,982
Year 2	$12,581	$ 629.05		$24,563
Year 3	$13,210	$ 660.51		$37,773
Year 4	$13,871	$ 693.53		$51,644
Year 5	$14,564	$ 728.21		$66,208
Year 6	$15,292	$ 764.62		$81,500
Year 7	$16,057	$ 802.85		$97,557
Year 8	$16,860	$ 842.99		$114,417
Year 9	$17,703	$ 885.14		$132,120
Year 10	$18,588	$ 929.40		$150,708
Year 11	$19,517	$ 975.87		$170,225
Year 12	$20,493	$ 1,024.66		$190,719
Year 13	$21,518	$ 1,075.90		$212,237
Year 14	$22,594	$ 1,129.69		$234,830
Year 15	$23,724	$ 1,186.18		**$258,554**

The table below estimates the cost of electricity for this facility over a 15 year period. This is only an estimate, and is based on current yearly usage, NH price averages for January 31st 2011, with a 5% cost increase per year.

Electric Use - Current Usage				
Year	**Energy Cost By Year**	**Yearly Increase**	**Total Accumulated Cost by Year**	
		Escalation Rate	**5.00%**	
Year 1	$6,720.57	$ 336.03		$6,721
Year 2	$7,057	$ 352.83		$13,777
Year 3	$7,409	$ 370.47		$21,187
Year 4	$7,780	$ 388.99		$28,966
Year 5	$8,169	$ 408.44		$37,135
Year 6	$8,577	$ 428.87		$45,713
Year 7	$9,006	$ 450.31		$54,719
Year 8	$9,457	$ 472.83		$64,175
Year 9	$9,929	$ 496.47		$74,105
Year 10	$10,426	$ 521.29		$84,531
Year 11	$10,947	$ 547.36		$95,478
Year 12	$11,494	$ 574.72		$106,972
Year 13	$12,069	$ 603.46		$119,041
Year 14	$12,673	$ 633.63		$131,714
Year 15	$13,306	$ 665.31		**$145,020**

The table below and graph are based on the previous two tables, and estimates the savings over a 15 year period if both fuel and electric usage is reduced by 30%.

Long Term Cost Avoidance - Heat and Electric				
Percent of Cost Reduction =			**30.00%**	
Year	**Avoided Cost By Year**	**Savings Gain By Year**	**Total Savings Over 15 Years**	
		Escalation Rate	**5.00%**	
Year 1	**$5,611**	**$ 280.54**		**$5,611**
Year 2	**$5,891**	**$ 294.57**		**$11,502**
Year 3	**$6,186**	**$ 309.29**		**$17,688**
Year 4	**$6,495**	**$ 324.76**		**$24,183**
Year 5	**$6,820**	**$ 341.00**		**$31,003**
Year 6	**$7,161**	**$ 358.05**		**$38,164**
Year 7	**$7,519**	**$ 375.95**		**$45,683**
Year 8	**$7,895**	**$ 394.75**		**$53,578**
Year 9	**$8,290**	**$ 414.48**		**$61,867**
Year 10	**$8,704**	**$ 435.21**		**$70,572**
Year 11	**$9,139**	**$ 456.97**		**$79,711**
Year 12	**$9,596**	**$ 479.82**		**$89,307**
Year 13	**$10,076**	**$ 503.81**		**$99,383**
Year 14	**$10,580**	**$ 529.00**		**$109,963**
Year 15	**$11,109**	**$ 555.45**		**$121,072**



As you can see, the potential savings are significant and can provide supplemental funds to carry out further energy savings within this facility, or another Town facility. While these are assumed savings, current market trends indicate the potential for significantly more savings as a result of the increasing energy costs currently being seen with the region and country as a whole.

Conclusion:

As a result of this audit, the Town has several options available to increase the efficiency of the Whitney Hall. Achieving 30% savings in energy cost for this building is well within reach, and as the above graph helps to illustrate, the initial investment for energy improvement projects can have an attractive return. Considering that this building will likely be owned and operated by the Town for a period much longer than the next 15 years, we highly encourage that the Town pursue these recommendations described in this report. More detail about our findings and recommendations can be given during the presentation of this report.