The New Hampshire Municipal Energy Assistance Program

Decision Grade Audit Report

Public Works Facility
240 West Main St., Littleton, NH 03561

Prepared for:

Town of Littleton, NH

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Sustainable Energy Resource Group

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3/3/2011

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 Littleton 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 Littleton.

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Introduction:

MEAP partners are pleased to provide this Decision-Grade Audit Report for the Town of Littleton and the Public Works Facility (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.

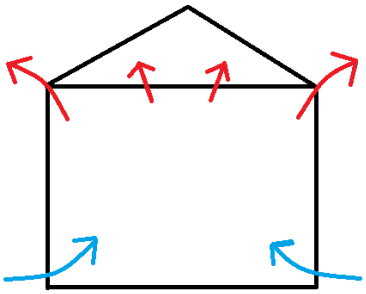
This DGA involves a quantification of energy usage (electrical and heating fuel), a description of existing heating/cooling and distribution systems, thermal barrier inefficiencies, potential electric savings through lighting/appliances upgrades and behavior change, occupancy health and safety concerns, 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.

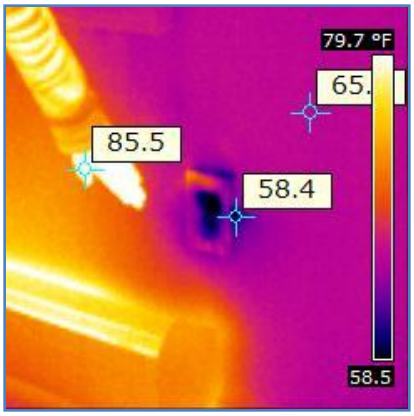
Heat moves through and leaves a building by three different means: *convection, conduction, and radiation*. One way to think of **convective** heat loss is by air movement into and out of a structure. One of the forces causing this to happen is the "stack effect".



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.

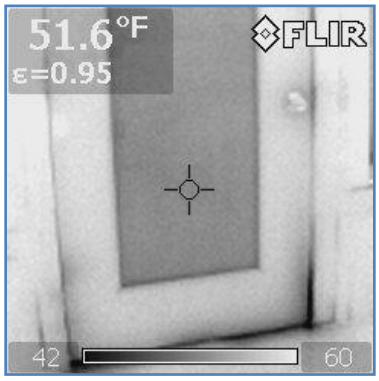
Conduction is the foremost way in which heat travels through a solid building material. R-value is one way to describe a given materials resistance to transfer heat. Materials with a high R-value, such as foams, cellulose, or fiberglass batts are used for insulation. At any location in the building envelope 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.

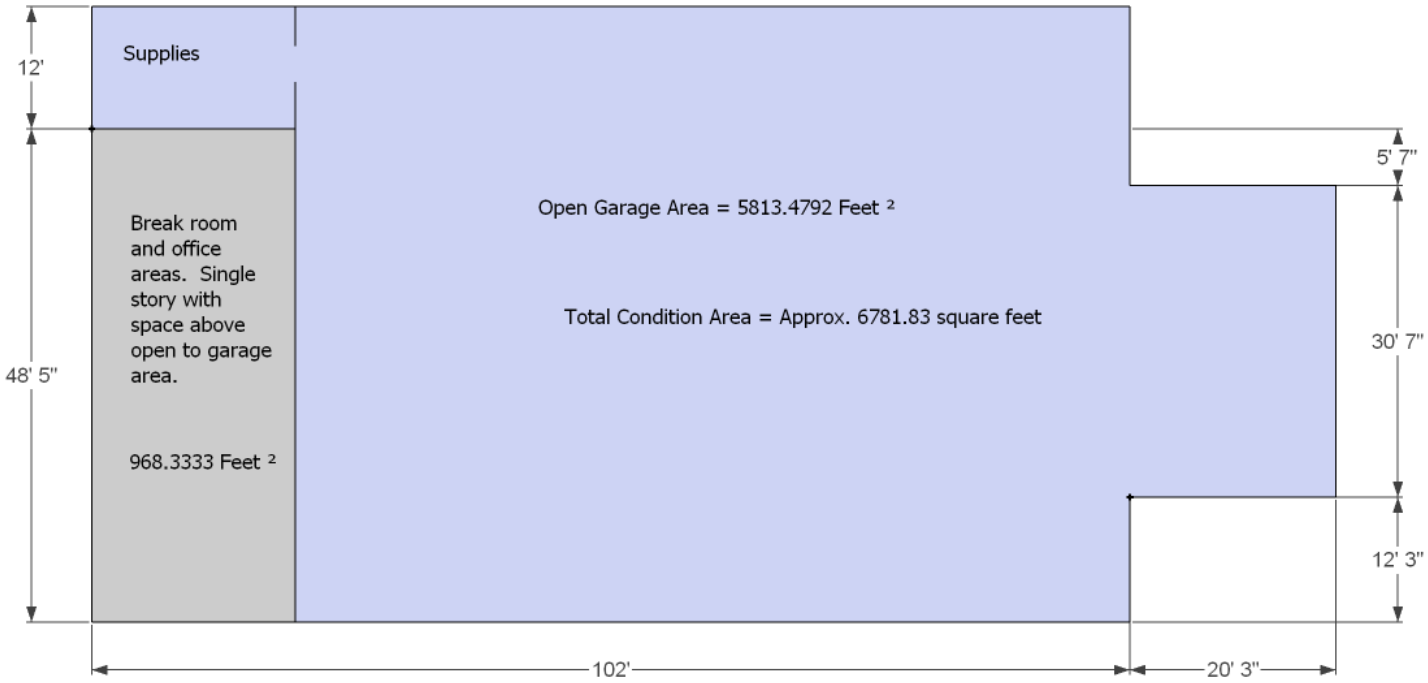
Just as BTUs conduct through solid materials, water vapor diffuses through solid materials. Some materials are more resistant to vapor diffusion, such as polyethylene, and we use these to form a vapor barrier on the inside of the thermal boundary in an attempt to slow the amount of vapor diffusion. Small 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.

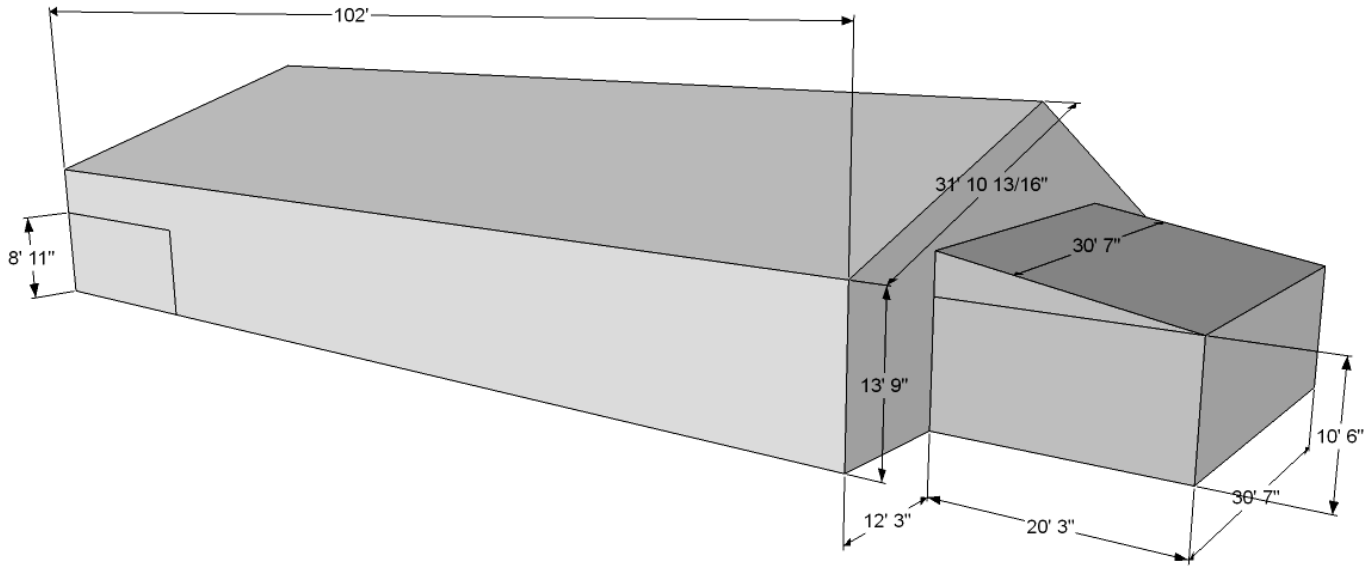
It is important to identify any current moisture problems and address them appropriately. This is always done by first finding and controlling the source of the moisture. Sometimes it can be quite difficult to see moisture damage, as it may be buried inside of wall cavities. It is also important to know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

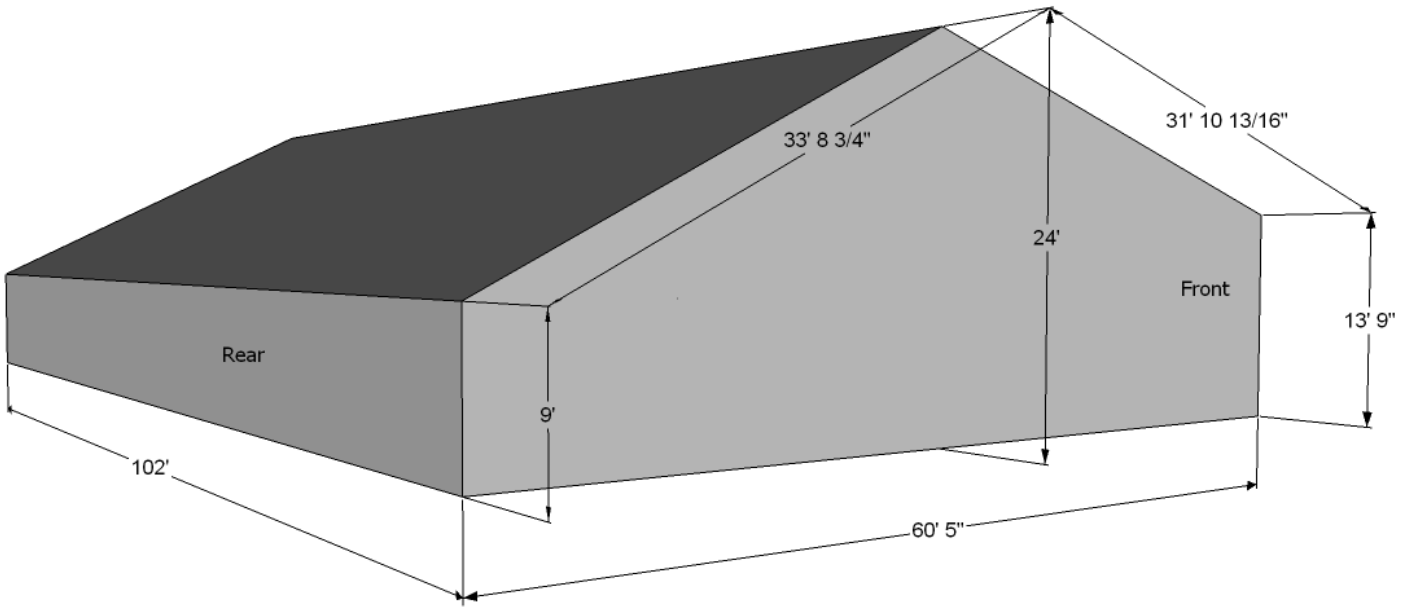
Building Description:

This is a slab on grade structure, and with the exception to storage space above the offices and break room, it is a single story building.

Originally built in 1957, the main structure has had two additions built, including a 12 foot long stretch that runs the entire length of the rear of the building.




102'
31' 10 13/16"
30' 7"
8' 11"
13' 9"
10' 6"
30' 7"
12' 3"
20' 3"

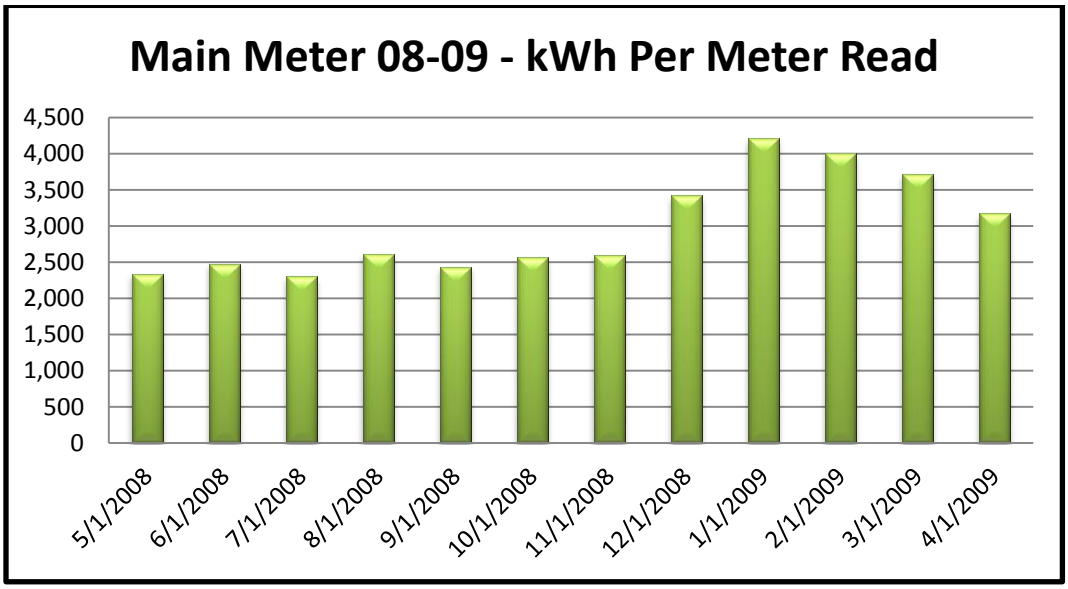

33' 8 3/4"
31' 10 13/16"
24'
Front
13' 9"
Rear
9'
102'
60' 5"

Energy Data Collection:

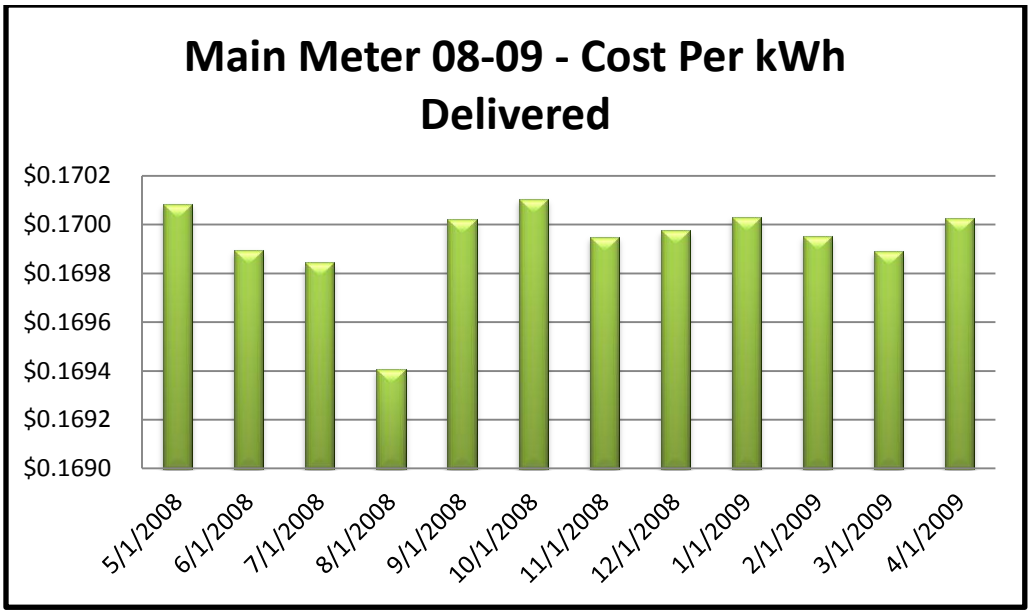
Analysis from provided utility bills for 2008-2009 produces the following snapshot in electricity consumption. Monthly consumption is designated low to high, red being the lowest and green being the highest consumption months in the table below.

2008-2009 Electric -Main Meter			
Municipal Electric Department			
Date	**KWH**	**Total $/mo**	**Cost Per kWh**
4/1/2009	3,176	$540.00	$0.1700
3/1/2009	3,720	$632.00	$0.1699
2/1/2009	4,007	$681.00	$0.1700
1/1/2009	4,211	$716.00	$0.1700
12/1/2008	3,424	$582.00	$0.1700
11/1/2008	2,589	$440.00	$0.1699
10/1/2008	2,569	$437.00	$0.1701
9/1/2008	2,435	$414.00	$0.1700
8/1/2008	2,615	$443.00	$0.1694
7/1/2008	2,308	$392.00	$0.1698
6/1/2008	2,478	$421.00	$0.1699
5/1/2008	2,340	$398.00	$0.1701

Total kWh: 35,872
Total paid for this period: $6,096.00
Average $/kWh: $0.1699



Annual electricity consumption for Littleton Highway Garage



Cost of delivered electricity for Littleton Highway Garage

Heat Source 1			
No. 2 Oil			
Date	**Fuel Units**	**$**	**Cost Per Unit**
12/1/2009	230	$469.00	$2.039
11/1/2009	131	$267.00	$2.038
5/1/2009	52	$106.00	$2.038
4/1/2009	435	$1,849.00	$4.251
3/1/2009	418	$1,777.00	$4.251
2/1/2009	716	$3,043.00	$4.250
1/1/2009	1,084	$4,604.00	$4.247

Total Gallons Delivered: 3,066
Total annual payment: $12,115
Average cost per gallon: $3.95

This usage data does not account for an unmeasured amount of waste oil being burned by a suspended furnace in the garage area.

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 main section of this building and the smaller addition on the east end have a slab on grade foundation. The long addition on the north side of the building also has a slab on grade foundation, but it also has a frost wall that extends about two feet above grade.

It is important to remember that concrete has almost no insulative value and that heat loss from concrete slabs and foundations can be substantial.

We performed our inspection of this building during a warm month and were therefore unable to take effective IR images. To help illustrate the amount of heat that is likely occurring from the foundation and slab of this building, we have included a photo and IR image of a slab on grade building in the same region as Littleton taken during cold weather (see Figure 1). Heat loss from a slab or foundation, showing as orange in this IR image, can account for 20% of a building's total heat load. See Figure 2 for further illustration.

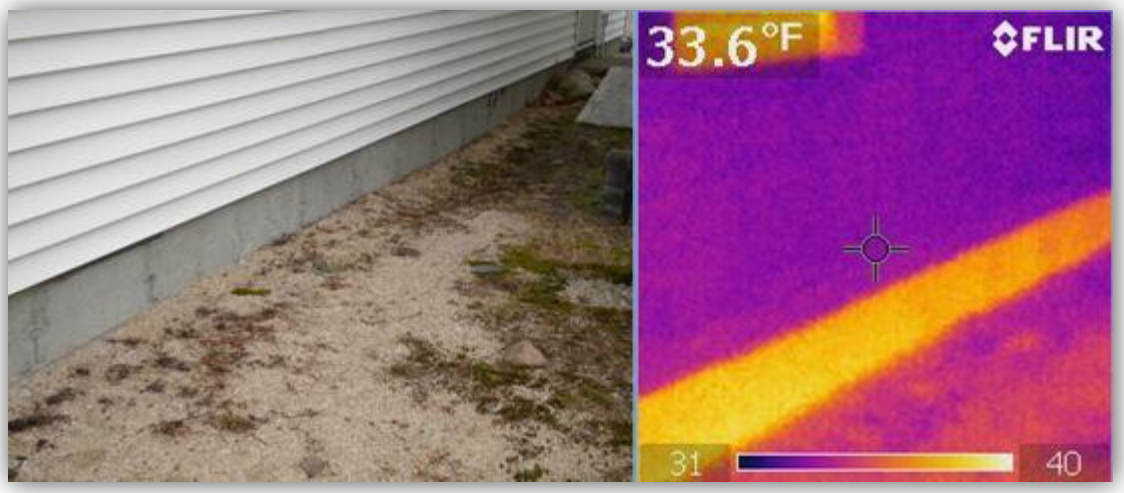


Figure 1

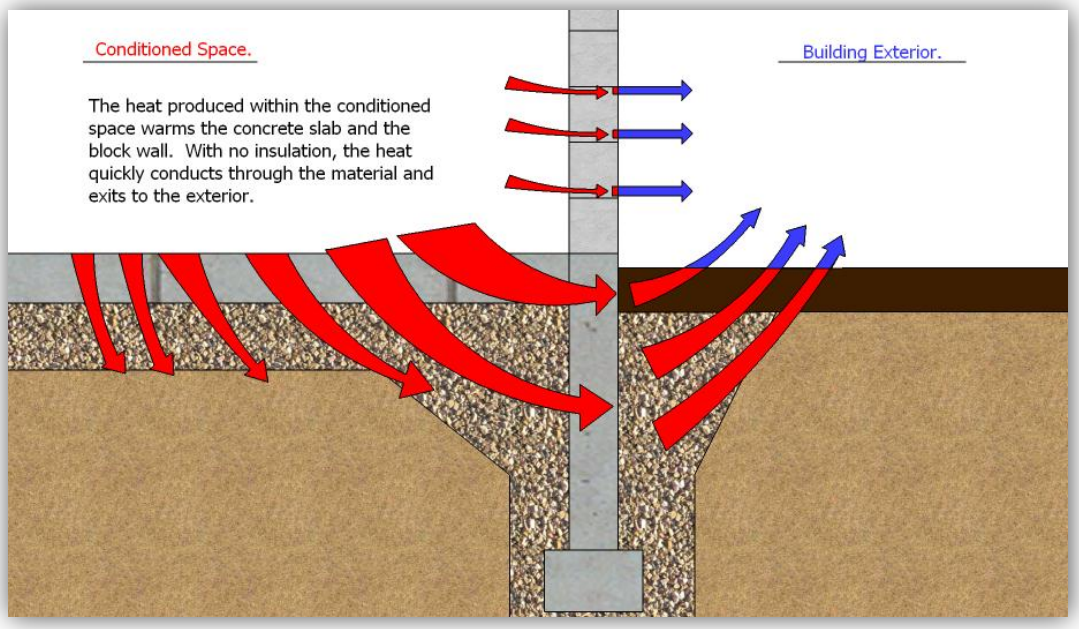


Figure 2

Addressing this heat loss by insulating the foundations and slab will produce substantial long term energy savings and can usually be done at a relatively low upfront cost. A project of this type could coincide with an exterior insulation and finish system (EIFS)—should that prove to be the best way to better insulate the exterior walls.

Exterior Walls:

The exterior walls of this building are for the most part uninsulated concrete with exception to the framed portion of the north addition and the gable ends of the main structure.

The framed walls of the north addition were constructed with 2x6" studs and insulated with R-19 fiberglass insulation. The foundation of this addition is uninsulated and makes up a fairly large percentage of the exterior wall area. The section that is framed, as seen in this image, appears to lack a building wrap and offers many ways in which for air to infiltrate the wall cavities.

The west gable end has been insulated with the same insulation as the entire main ceiling structure. This fibrous blanket insulation is only about 1 ½ inches thick and has a vapor diffusion retardant face. The positive effects of this insulation are negligible relative to modern energy prices.

The east gable insulation was replaced with this rigid insulation board. This was likely done at the same time as the new ventilation system visible in this photo. This may be the most insulated surface in this building but still has room from improvement.

Ceilings and Attic:

The ceiling insulation of the main building, as previously mentioned, is a very thin layer of fibrous blanket with a vapor diffusion retardant face.

This image shows a metal rafter above the storage area on the west side of the building. The water stains stemming from the rafter and running down the face of the insulation were caused by condensation during the colder months. This is not only an indication of a weak thermal barrier but also serves to illustrate how water can enter the concrete blocks of the exterior walls, which can lead to mold growth and structural instability in deteriorating metal components.

We conducted our building inspection during a warm time of the year and were therefore unable to capture an example photo of how ineffective the ceiling insulation is. Figure 3 is an imaged captured directly from Google Maps. The melted lines across the roof indicate metal structure components and long icicles on the eves of any building are always indicative of a poorly insulated roof.

Figure 3

The roof of the east addition has rigid foam board insulation, which has been fastened to the interior. As this photo illustrates, a similar condensation problem as the main roof may be occurring. These rusty water stains against the white of the foam board give a clearer picture of how moisture issues of this type can serve to deteriorate the metal structure from the inside, even if a roof is water tight from weather.

In addition to the destructive condensation issue occurring from cold temperatures, both the main roof and the roof of the east addition were found to have significant leaks. The leak seen in the photo to the left was the worse leak observed during this rainy day and should be addressed immediately. Taking the time to mend leaks when they are minor will avoid a much larger fix in the future.

The photo to the right shows the top of one of the main chimneys. This, and other roof penetrations, was found not to be water tight during our building inspection, which should be addressed before more damage is sustained.

This photo shows the plywood interior finish of the north addition and not only illustrates the need for a more effective ventilation system in this building but also shows that even this new addition needs thermal envelope improvements. Given the nature of this wall assemble, it may be less apparent than other areas to determine how moisture may be entering the wall and rafter cavities; however, water may be condensing and causing moisture damage to the wooden frame and insulation. The darker areas (greater concentration of vehicle exhaust and other particulate matter) are concentrated where there is no air seal. This confirms the norm that air will almost always enter into a structure in the lower elevated surfaces and exit via the higher levels. Until a more sophisticated ventilation system is installed in this building, this air infiltration should be considered a positive contribution to a healthier work environment.

This photo indicates the depth of the ceiling cavity between the offices and break room and the storage space above. The offices and break room are heated with a separate heating system than the rest of the building and, given the layout and type of building, should have a separate thermal envelope. The cavities between the two spaces can and should be insulated.

Doors and Windows:

This building does not have many windows or doors with the exception of the large garage doors in the front of the build.

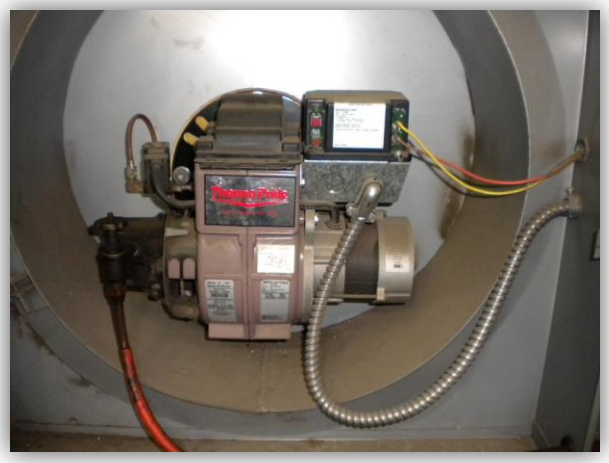
It would not be very beneficial to replace the windows of this building, but it is important to make sure that they do seal well when closed. Also, make sure that any gaps between the window frame, trim, and exterior walls are sealed.

Ensuring that doors, like the door in this photo, are sealed when shut is recommended. This can easily be done with well installed whether stripping. This door likely has a greater R-value than the wall around it; therefore, only if the entire building shell was reinsulated would replacing doors and windows reach a higher spot on the list of energy improvement recommendations.

Mechanical:

This building has three separate heating systems: two heat the main garage area, and the third heats the office and break room.

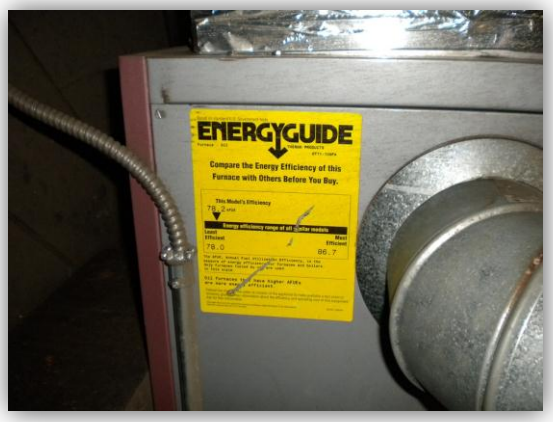
Seen in the photo to the right is a larger oil fired furnace. This unit operates by drawing in air from the bottom of the unit at the floor and, with a large fan, blows air across a heat exchanger then out the top in all directions. There was not a lot of information available about this furnace, but it appears to have a designed combustion efficiency of around 78%-80%. The two pipes coming from the unit are the exhaust (top) and the combustion air duct below that, which is connected to a box on the side of the unit.



Seen here is the burner for this furnace. A fair amount of dust and residue was found on the inside of this box. It was apparent that dust and air are entering from both around the door of this box and from the supply air duct, which is not sealed.
There was little known about a maintenance schedule for this unit, but as far as we determine it does not include cleaning the heat exchanger. We could not see the inside of the heat exchanger but were able to see a small portion of the exterior. As this unit draws air from the floor of this space, it did appear to be quite dirty. As a heat exchanger becomes more and more dirty, the rate at which heat can be drawn from it lessens. The dust, residue, and combustion particulate form a layer of what effectively acts as a thin layer of insulation. The end result may be a furnace rated at 80% combustion efficiency, but the seasonal efficiency may be much less.

This photo shows the motor at the base of the furnace which turns a large fan. The way this tower furnace is designed is that it is meant to produce heat in the space but also circulate the heat as well. As hot air will inevitably rise toward the ceiling, this unit helps to pull some of the heat back to lower working areas. The result of this function is that this fan starts to blow in the beginning of the heating season and runs 24 hours a day for the rest of the winter. When looking at the kWh usage graph for the measured year, it is easy to see how a fair portion of the winter time spike in electric use could be due to the building's furnaces. This type of electric usage is important to consider when analyzing the cost benefit of implementing energy efficiency measures to reduce oil consumption. If overhead infrared heaters were to replace this unit, for example, the eliminated electric usage may have a substantial impact on the return of such an investment.

The two images below show the furnace that heats the offices and break room. This unit is located in the storage area on top of these spaces. This furnace is only rated with a combustion efficiency of 78.2% but, like the tower furnace, the maintenance of this unit is lacking. This, combined with several other inefficiencies, translates to a much lower seasonal efficiency for the system. As one can see in the image to the left, none of the ductwork is sealed or insulated. This is not only an efficiency concern but a health concern as well.



Any ductwork on the return end of this system is under negative pressure. Thus, the air, and any pollutants from the space around the ductwork, is drawn into the blower compartment and sent through the heat exchanger where it is delivered to the office, break room, locker room, and any other space this furnace conditions. The filter seen to the right was completely saturated with dust. It is troubling to think of what the composition of this dust may be.

The filter in the above image is not meant to clean the air for the occupants of the building, but instead its purpose is to collect larger particles of dust that may be harmful to the blower unit, which serves to dirty the heat exchanger, thus lowering its efficiency. In fact, this old filter, which may be the original filter that came with the unit, is very unproductive at capturing dust compared to modern filters, as it is very much like a large steel scrubbing pad—it will do little to stop dust particles of any size. This is all evident when looking at the blower motor seen in this photo.

This is a picture of the supply plenum for this system. The fact that this ductwork is not at all sealed or insulated translates to large heat distribution losses, that is, a substantial amount of heat produced by this furnace is lost to this storage area before reaching its intended destination.

What is most concerning about this photo is the location where the residue is accumulating the most. At the top left of the boot seen connected to the plenum there is a screw fastened tightly. The fact that residue has not built up here, but instead where there are leaks in the duct, is an indication of how polluted the air may be that is being delivered to the spaces below.

This waste oil furnace, suspended from the ceiling on the east side of the garage, is a fairly new addition to this building. It is unknown how much oil this unit is burning per winter, but we were told that it does not turn on often. Monitoring the amount of oil burned by this unit would be extremely beneficial when trying to gain an understanding of total BTU's currently needed to meet the building's heating needs.

Electrical:

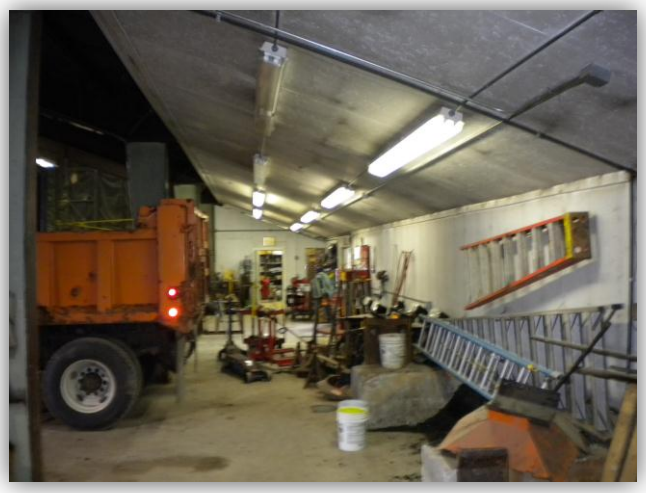
When looking at the kWh usage by month for the measured year, it is clear that there is a spike in usage during the winter months. Some of the factors contributing to this may be as follows: There are fewer hours of daylight and likely more hours worked in the evening due to snow plowing and so forth. The garage doors are being opened and closed more often to try and keep the heat in the building. The blower units of the furnaces, air circulation, and air exhaust systems are running more. Hot water usage is almost always greater in the winter months. Separating this type of electric use from baseline usage can give a clear look at what items are using relatively consistent amounts of energy throughout the year and can be useful when trying to determine the best investments for electric use reduction projects.

Much of the baseline electric usage is likely due to the use of power tools, compressors, welding machines, and other equipment used to maintain Town vehicles and equipment. There is little to be done about reducing this usage. There are, however, other components of baseline usage that can be reduced.

The electric water heater seen here is not especially inefficient for its type. This unit could be replaced with a high efficiency tank containing an electric element that could receive most of its heat from solar hot water panels mounted to the roof of the building.

Old refrigerators can use twice the amount of electricity as a newer Energy Star rated model, and soda machines can use the same amount of electricity as an old refrigerator. Replacing the refrigerator in the break room with a high efficiency model and using it to hold soda cans, which would eliminate the soda machine, would have a large impact on reducing electric usage over the course of a year.

There is also opportunity in this building to save on the cost of lighting. The two main light sources in this building are T12 florescent tubes and high bay metal halide fixtures. There certainly is opportunity to invest in more efficient lighting in this building, though it may be best to first focus on the lower hanging fruit.



Health, Safety and Comfort:

There are many safety concerns in a building of this type and use. Injuries can be a common occurrence in a mechanical garage; therefore, following all necessary safety procedures is a must.

The greatest health concern in this building seems to be poor air quality. Investing in air pollutant monitoring systems, which control building exhaust, in combination with individual overhead hose systems may come at a sizable initial cost, but such an expense should not come before the health of Town employees.

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 4. 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.

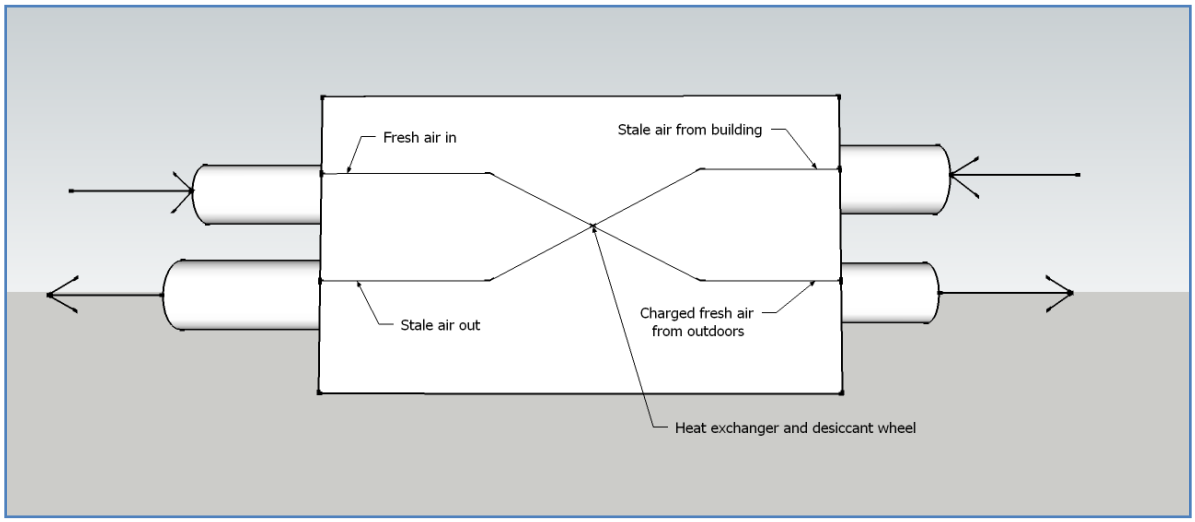


Figure 4

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.

Foundations and Slabs:

- Insulate the foundations and slabs of this building and its additions. This should be done with 2 inch extruded polystyrene foam board, which should extend below grade 2-4 feet. 4 Feet would be the preferred depth should conditions allow. The foam needs to be protected from the elements and pests with either a durable cement type finish or with coated sheet metal that is well sealed at all seams.

Exterior Walls:

- An exterior insulation and finish system (EIFS) would likely work well with this structure. This would allow for the block walls, which currently have little R-value, to serves as thermal mass, drastically reducing the rate of heat loss.

Ceilings:

- Repair any leaks in the metal roof.
- Remove all of the current ceiling insulation, and spray closed-cell foam to the underside of the roof system. The foam should be applied at a minimum of 2 inch thickness in all areas, covering steal structural components and may need to be sprayed with a fire retardant paint. Assessing the amount of remaining roof life will be part of this process. If it is determined that the roof has a limited number of years before it needs to be replaced, then an alternate strategy with need to be put in place.
- Insulate the ceilings above the office/locker/break rooms. This may be able to be done quite easily with blown-in cellulose.

Doors and Windows:

- Make sure that all doors and windows provide a good air seal when they are closed. This is particularly important for the garage doors. If the entire building shell were to be reinsulated to a high R-value, then it may at that point prove to be worth replacing the garage doors. At this point, however, the garage doors have more insulative value than many other building surfaces.

Mechanical:

- There are many system and fuel types that could replace the current heating systems, which would allow for tremendous long term savings. Two options that stand out in a building of this type are: (1) Over head LP fired infrared heaters with a separate high efficiency LP furnace for the office/locker/break room area, and (2) pellet boilers that would supply hot water to a series of fan coils in the garage and to an air handling unit for the office/locker/break room area.
- If the current systems are to remain in place, make sure that they are serviced and cleaned well at least every fall before the heating season begins. Replace filters often, and install an air filtration system to the supply side of the smaller furnace. Air seal any ductwork with mastic, and insulate the ductwork with foil-faced R-8 duct insulation. Install an HRV to the return end of the ductwork. Check and clean the HRV filter once every week or as needed.

Electrical:

- Replace the refrigerator with a high efficiency model and use this to store soda instead of the soda machine. A coin bucket could be used to collect money for the soda.
- Replace the current hot water heater with a solar hot water system piped to a high efficiency storage tank that contains an electric element as back up.
- Any magnetic ballast florescent tube fixtures should be replaced with electronic ballast fixtures and should be used with T8 tubes.
- Consider replacing the metal halide fixtures with LED options. The initial investment would be substantial but so would the savings be over the long term.
- Install a photovoltaic system on site to help mitigate the cost associated with electric use.

Health and Safety:

- Consult with an air quality specialist to develop options for increasing the air quality of this facility.

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 your Regional Planning Commission (RPC). A full list of NH RPC's is provided below.

Central New Hampshire RPC - 603.226.6020

Lakes RPC - 603.279.8171

Nashua RPC - 603.424.2240

North Country Council - 603.444.6303

Rockingham RPC - 603.778.0885

Southern New Hampshire RPC - 603.669.4664

Southwest RPC - 603.357.0557

Strafford RPC - 603.742.2523

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:

Littleton is served by both NH Electric Coop and Littleton Water and Light. Many 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

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.

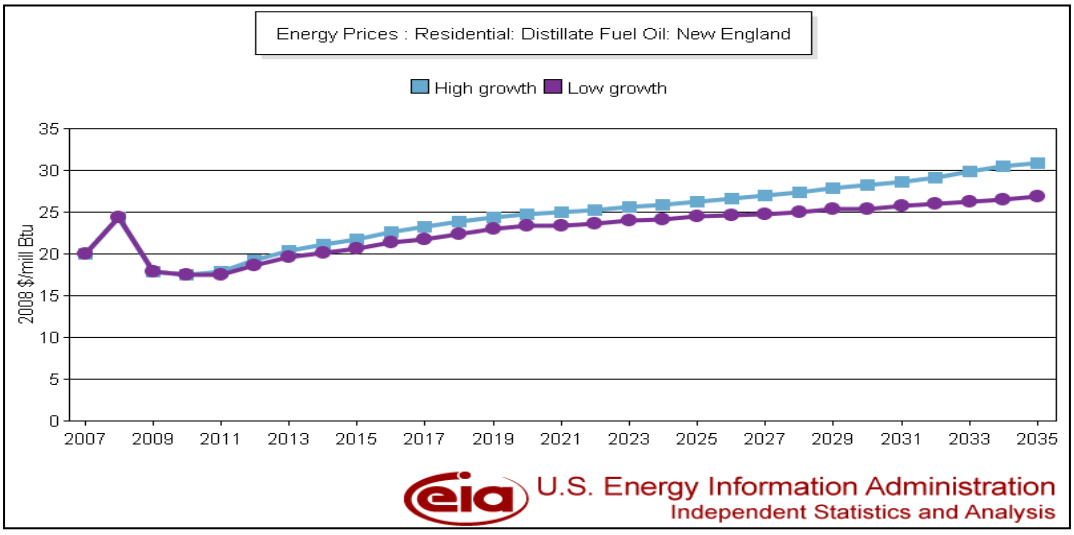
For more information on the history of energy prices and how energy cost projections are calculated, please visit: http://www.eia.doe.gov/analysis/

Price Summary

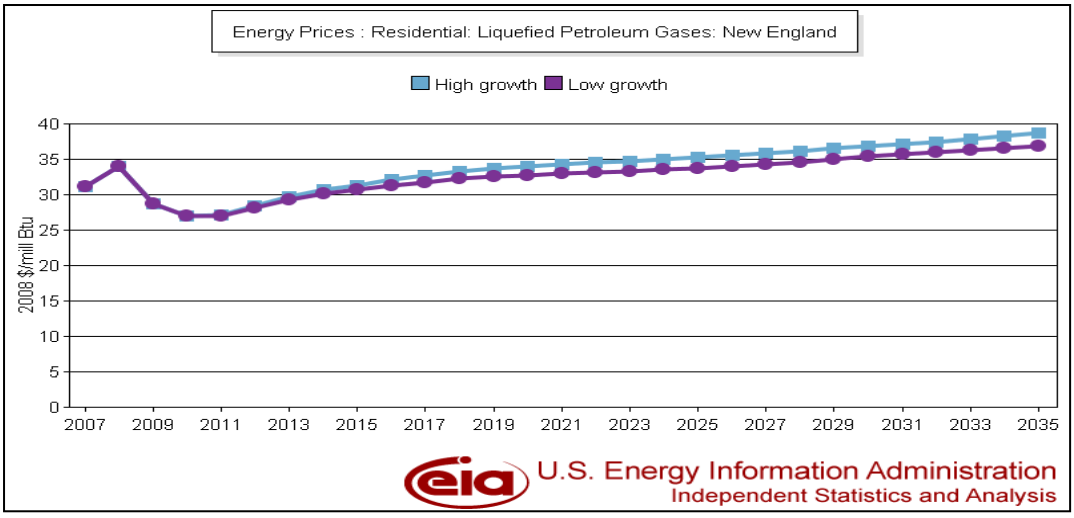
	Year				Percent Change		
	2009	2010	2011	2012	09-10	10-11	11-12
WTI Crude[a] ($/barrel)	61.65	79.40	93.26	97.50	28.8	17.5	4.5
Gasoline[b] ($/gal)	2.35	2.78	3.15	3.30	18.4	13.4	4.8
Diesel[c] ($/gal)	2.46	2.99	3.43	3.51	21.5	14.7	2.4
Heating Oil[d] ($/gal)	2.52	2.97	3.41	3.55	17.5	14.8	4.3
Natural Gas[d] ($/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.

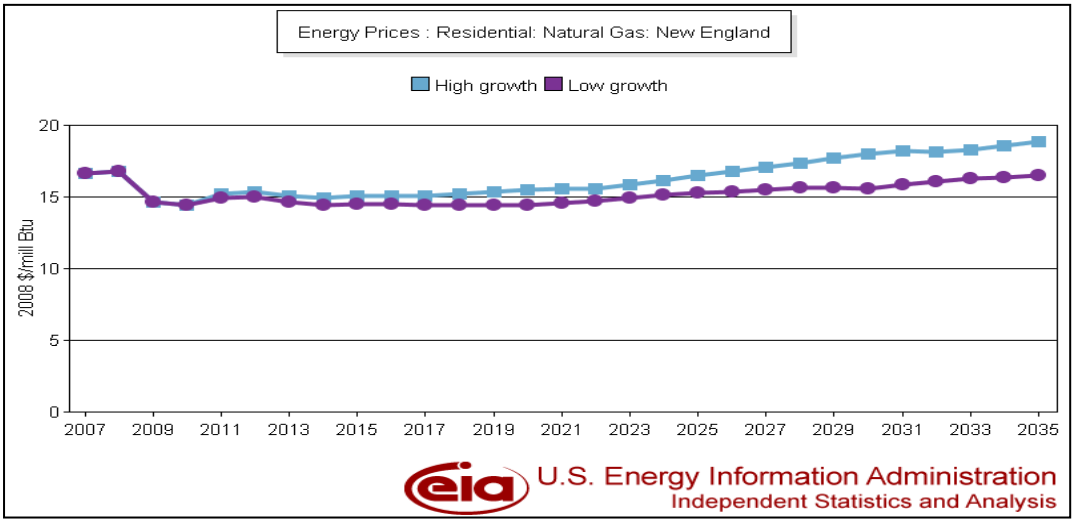
Table 1 – Retrieved from US EIA website



Graph 1 - Retrieved from US EIA website



Graph 2 - Retrieved from US EIA website



Graph 3 - Retrieved from US EIA website

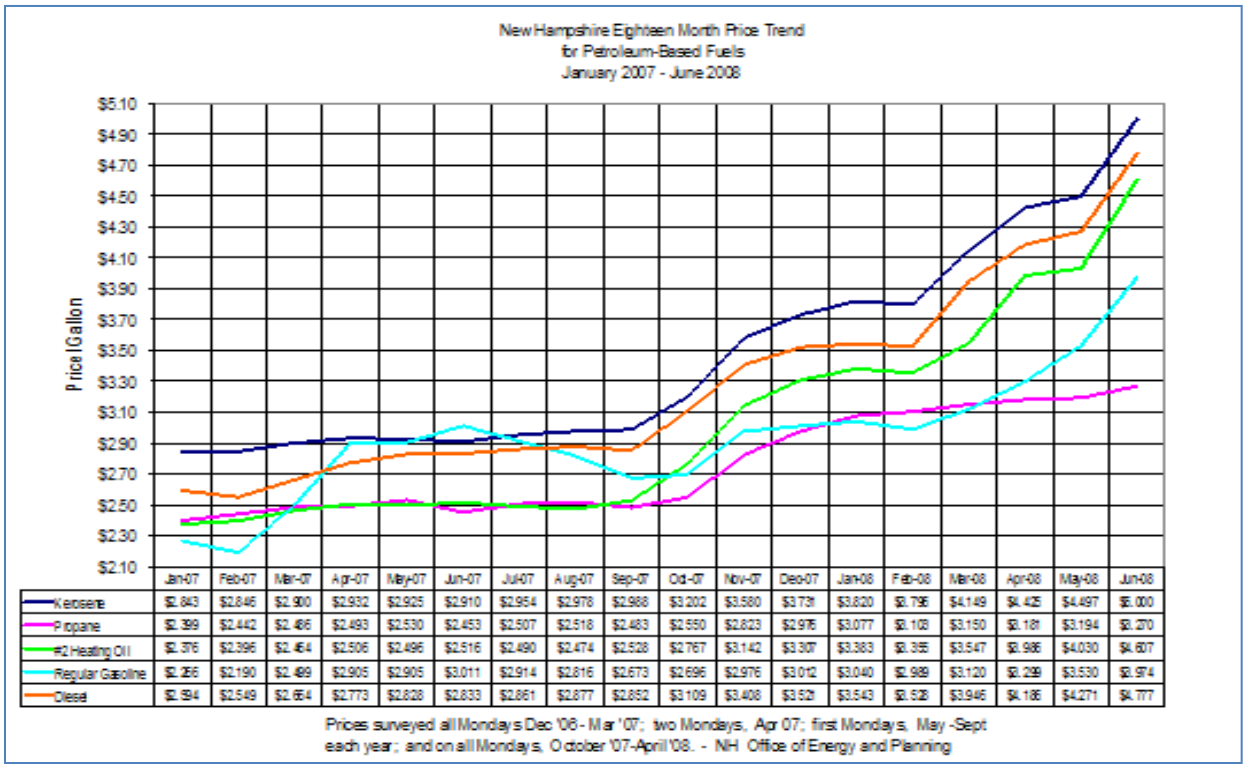
The following three Graphs (retrieved from the NH OEP website) show average prices in NH for liquid fuels beginning in January of 2007 and end in December 2010. These graphs help to illustrate just how volatile the cost of energy is, and the steady rise of price regardless of occasional "spikes" or "dips" 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

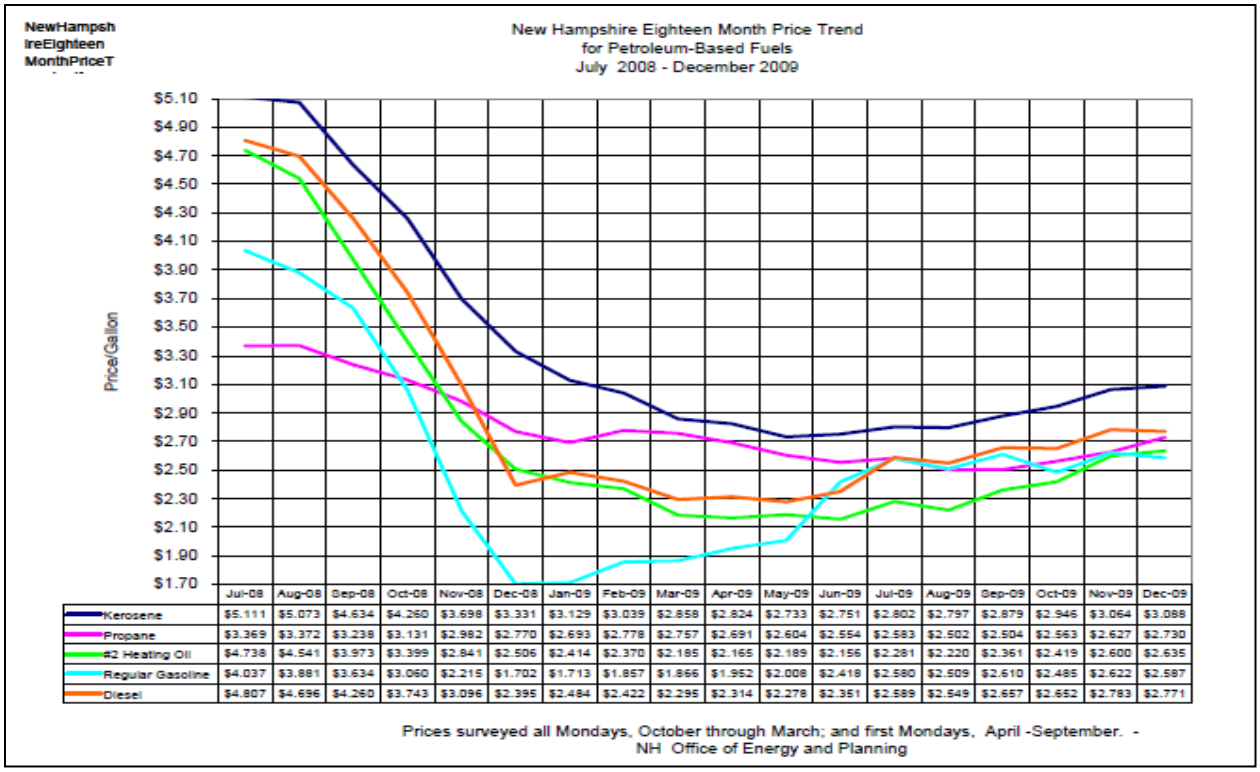
maintenance and care. This is an important consideration when factoring in the true life cycle cost of the implemented solution.

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.



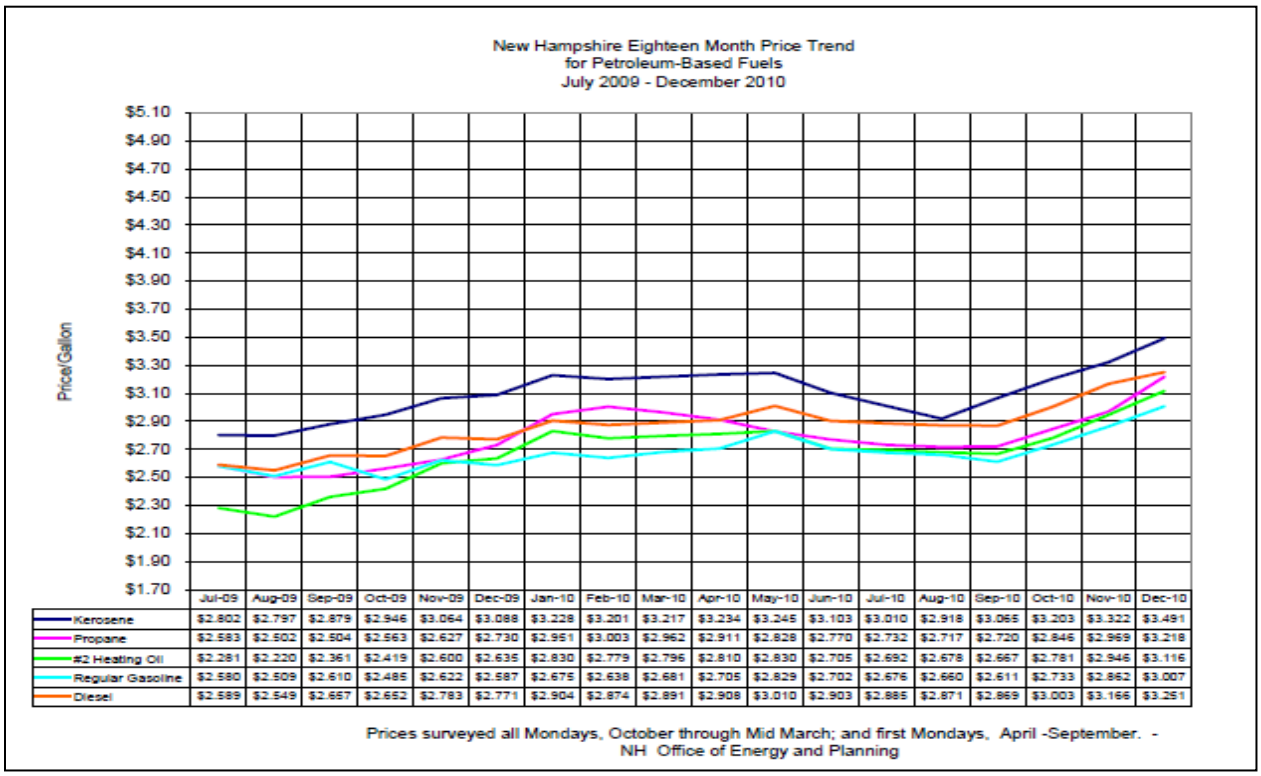
	Jan-07	Feb-07	Mar-07	Apr-07	May-07	Jun-07	Jul-07	Aug-07	Sep-07	Oct-07	Nov-07	Dec-07	Jan-08	Feb-08	Mar-08	Apr-08	May-08	Jun-08
Kerosene	$2.843	$2.846	$2.900	$2.932	$2.925	$2.910	$2.954	$2.978	$2.988	$3.202	$3.580	$3.731	$3.820	$3.796	$4.149	$4.425	$4.497	$5.000
Propane	$2.399	$2.442	$2.486	$2.493	$2.530	$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 5 - 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 6 – 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.

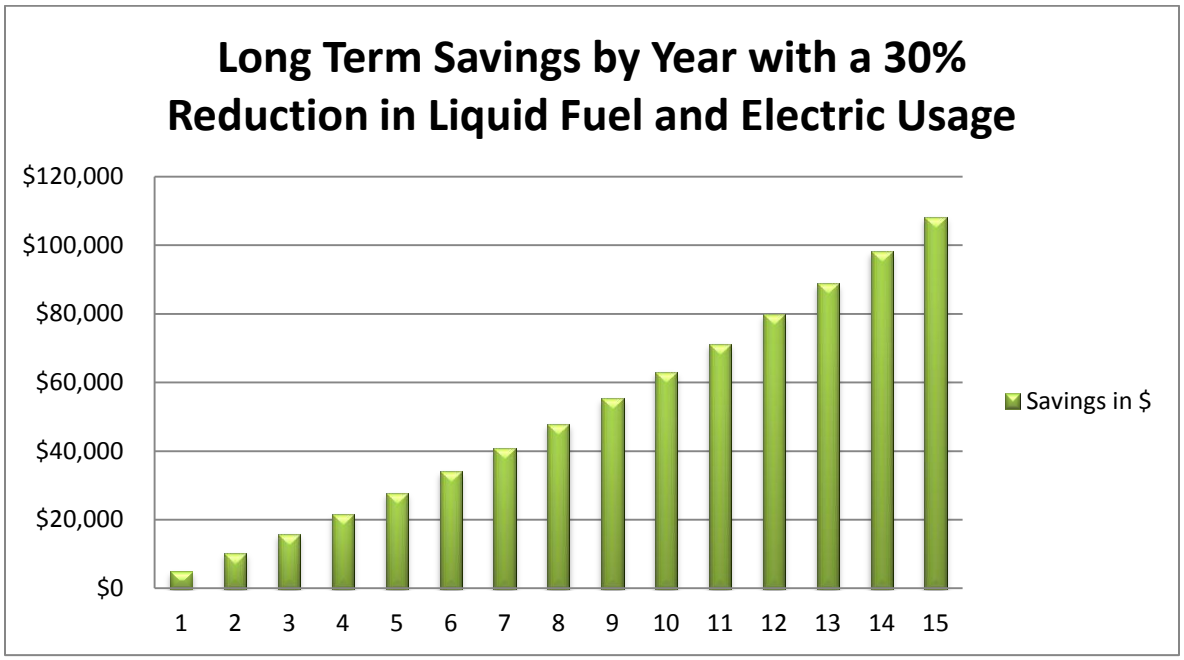
Current Fuel Usage				
Year	Energy Cost By Year	Yearly Increase	Total Accumulated Cost by Year	
		Escalation Rate	5.00%	
Year 1	$10,617.56	$ 530.88		$10,618
Year 2	$11,148	$ 557.42		$21,766
Year 3	$11,706	$ 585.29		$33,472
Year 4	$12,291	$ 614.56		$45,763
Year 5	$12,906	$ 645.29		$58,669
Year 6	$13,551	$ 677.55		$72,220
Year 7	$14,229	$ 711.43		$86,448
Year 8	$14,940	$ 747.00		$101,388
Year 9	$15,687	$ 784.35		$117,075
Year 10	$16,471	$ 823.57		$133,547
Year 11	$17,295	$ 864.74		$150,841
Year 12	$18,160	$ 907.98		$169,001
Year 13	$19,068	$ 953.38		$188,069
Year 14	$20,021	$ 1,001.05		$208,090
Year 15	$21,022	$ 1,051.10		**$229,112**

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	$6,096.00	$ 304.80		$6,096
Year 2	$6,401	$ 320.04		$12,497
Year 3	$6,721	$ 336.04		$19,218
Year 4	$7,057	$ 352.84		$26,275
Year 5	$7,410	$ 370.49		$33,684
Year 6	$7,780	$ 389.01		$41,464
Year 7	$8,169	$ 408.46		$49,634
Year 8	$8,578	$ 428.88		$58,211
Year 9	$9,007	$ 450.33		$67,218
Year 10	$9,457	$ 472.84		$76,675
Year 11	$9,930	$ 496.49		$86,605
Year 12	$10,426	$ 521.31		$97,031
Year 13	$10,948	$ 547.38		$107,978
Year 14	$11,495	$ 574.75		$119,473
Year 15	$12,070	$ 603.48		**$131,543**

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	**$5,014**	**$ 250.70**		**$5,014**
Year 2	**$5,265**	**$ 263.24**		**$10,279**
Year 3	**$5,528**	**$ 276.40**		**$15,807**
Year 4	**$5,804**	**$ 290.22**		**$21,611**
Year 5	**$6,095**	**$ 304.73**		**$27,706**
Year 6	**$6,399**	**$ 319.97**		**$34,105**
Year 7	**$6,719**	**$ 335.97**		**$40,825**
Year 8	**$7,055**	**$ 352.76**		**$47,880**
Year 9	**$7,408**	**$ 370.40**		**$55,288**
Year 10	**$7,778**	**$ 388.92**		**$63,066**
Year 11	**$8,167**	**$ 408.37**		**$71,234**
Year 12	**$8,576**	**$ 428.79**		**$79,810**
Year 13	**$9,005**	**$ 450.23**		**$88,814**
Year 14	**$9,455**	**$ 472.74**		**$98,269**
Year 15	**$9,928**	**$ 496.38**		**$108,196**



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 Public Works Facility. 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.