The New Hampshire Municipal Energy Assistance Program

Decision Grade Audit Report

Rye Safety Complex
555 Washington Rd, Rye, NH 03870

Prepared for:

Town of Rye, NH

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Clean Air Cool Planet

Sustainable Energy Resource Group

Vital Communities

Carbon Solutions New England

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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 Rye 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 Rye.

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Introduction:

MEAP partners are pleased to provide this Decision-Grade Audit Report for the Town of Rye and the Safety Complex (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. A cost:benefit ratio can be determined for burning any of these fuels with a forced air system, a radiant floor system, hydro-air, baseboard radiators or various other heating systems. Any of these heating plants, 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.

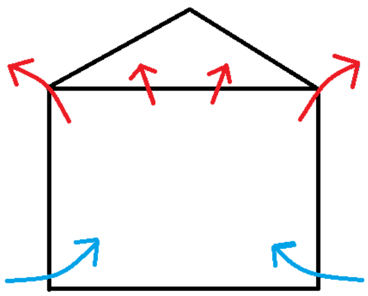
This DGA involves a quantification of energy consumption (electrical and heating fuel), a description of existing heating/cooling and distribution systems, thermal barrier inefficiencies, potential electric savings through lighting/appliances upgrades and behavior change, occupancy health and safety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

Many of an 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 conventional, alternative and renewable high-efficiency heating and cooling systems, has designed 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 specification 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.

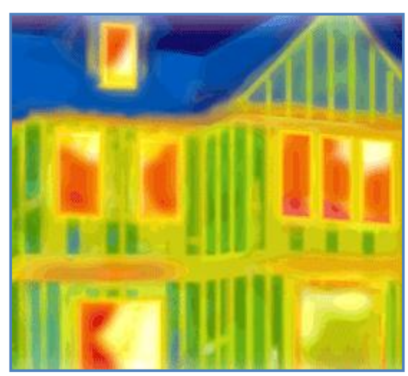
Basics of Heat Loss:

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.

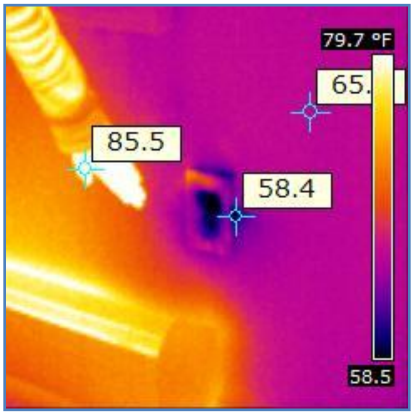
Heat moves through and leaves a building by three different means: *convection, conduction, and radiation*. One way to think of **convective** heat loss is by air movement into and out of a structure. One of the forces causing this to happen is the "stack effect".



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.

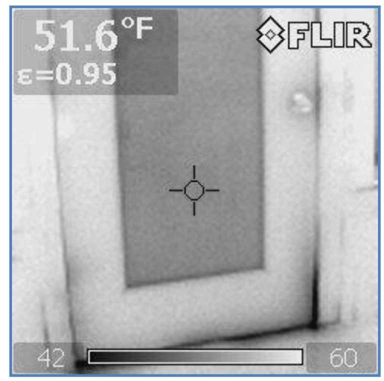


Conduction is the foremost way in which heat travels through a solid building material. R-value is one way to describe a given materials resistance to transfer heat. Materials with a high R-value, such as foams, cellulose, or fiberglass batts are used for insulation. At any location in the building envelope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



Basics of Moisture Control:

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.

<u>Building Description:</u>

This building was constructed in 2006. This new 19,818ft^2 facility has a large, single story garage (seen to the right) with in-slab radiant heat and tall cathedral ceilings. The portion of the building seen to the left of this photo has a full height finished basement and 2nd floor.

In general, this building seems to have been designed and built with not only great structural durability, but with efficiency in mind. There are some areas for improvement that we will highlight. Maximizing the potential efficiency for this building will help see it through the future of energy prices. We had a very limited amount of time with this building, therefore we have relied heavily on captured images of the blue prints.

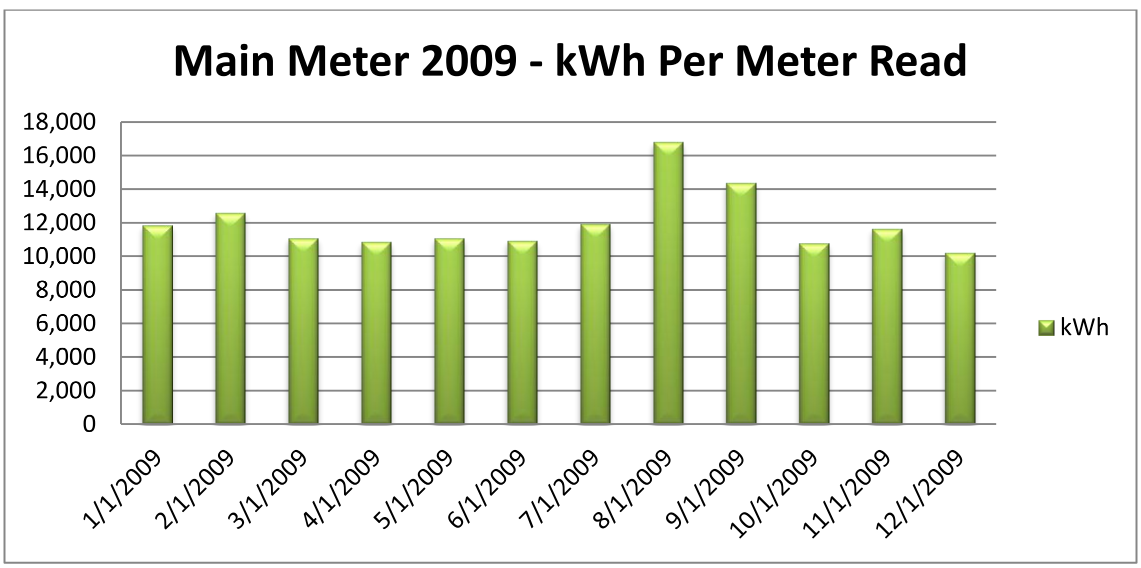
This image was retrieved from Bing™ Maps

Energy Data Collection:

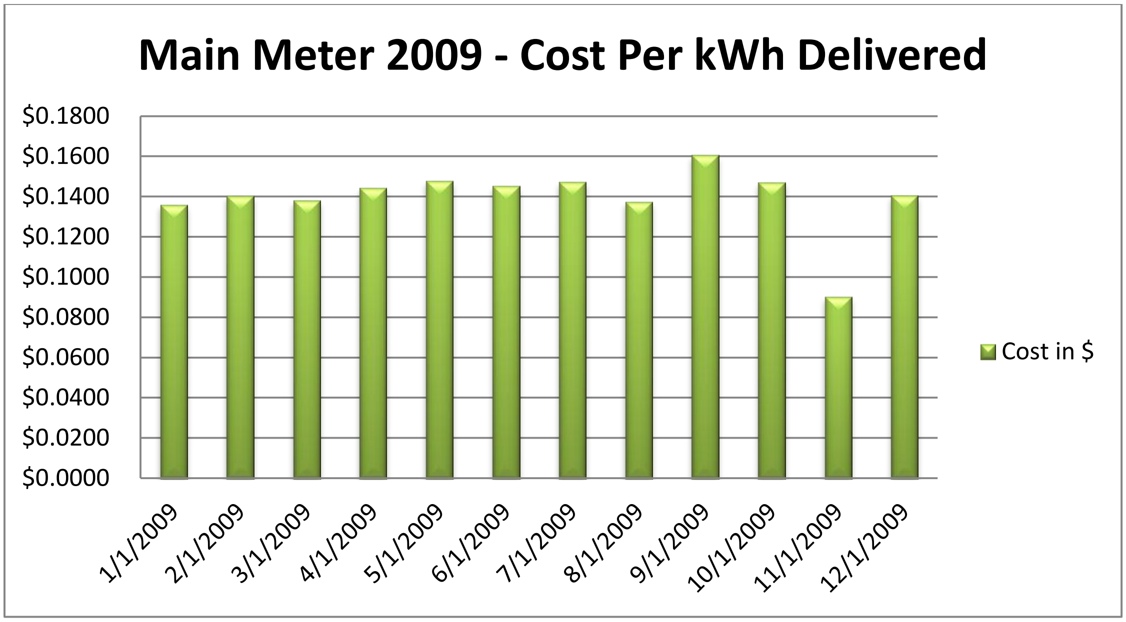
Analysis from provided utility bills for 2009 produces the following snapshot in electricity consumption. Monthly consumption is designated low to high, red being the lowest and green being the highest consumption months in the table below.

Electric -Main Meter			
Date	**KWH**	**Total $/mo**	**Cost Per kWh**
12/1/2009	10,200	$1,434.00	$0.1406
11/1/2009	11,640	$1,051.00	$0.0903
10/1/2009	10,760	$1,583.00	$0.1471
9/1/2009	14,360	$2,306.00	$0.1606
8/1/2009	16,800	$2,307.00	$0.1373
7/1/2009	11,920	$1,756.00	$0.1473
6/1/2009	10,920	$1,585.00	$0.1451
5/1/2009	11,080	$1,638.00	$0.1478
4/1/2009	10,840	$1,565.00	$0.1444
3/1/2009	11,080	$1,529.00	$0.1380
2/1/2009	12,600	$1,769.00	$0.1404
1/1/2009	11,840	$1,610.00	$0.1360

Total kWh This Year =	**144040**
Total Paid For Year=	**$20,133.00**
Ave Cost Per kWh =	**$0.1396**



Annual electricity consumption for Rye Safety Complex



Cost of delivered electricity for Rye Safety Complex

Heat Source 1			
NO.2 Oil			
Date	**Fuel Units**	**$**	**Cost Per Unit**
12/1/2009	1,215	$2,757.00	$2.269
11/1/2009	451	$1,021.00	$2.264
10/1/2009	317	$720.00	$2.271
9/1/2009	194	$672.00	$3.464
8/1/2009	293	$1,013.00	$3.457
6/1/2009	281	$974.00	$3.466
5/1/2009	147	$510.00	$3.469
4/1/2009	493	$1,754.00	$3.558
3/1/2009	1,056	$3,758.00	$3.559
2/1/2009	1,017	$3,620.00	$3.559
1/1/2009	1,658	$4,910.00	$2.961

Total Units Used =	**7122**
Total Paid For Year =	**$ 21,709.00**
Ave Cost Per Gal =	**$ 3.05**

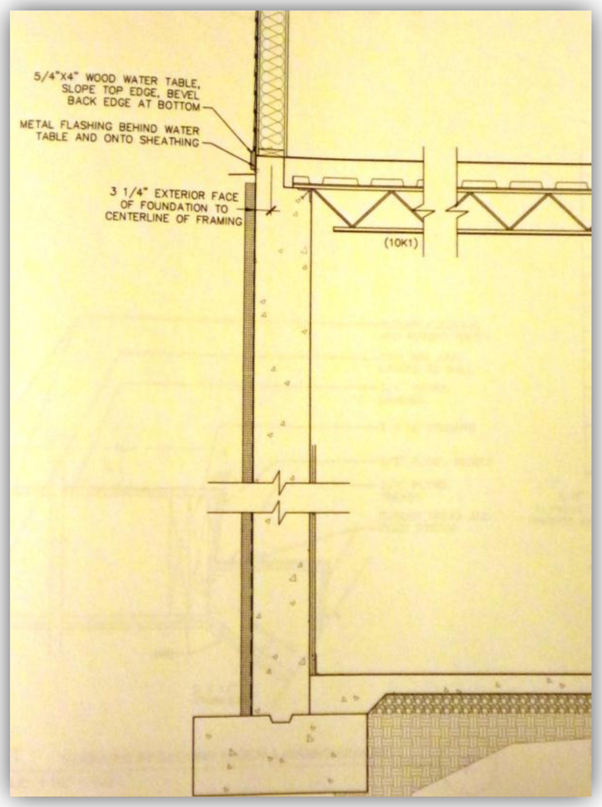
Blower Door Test Results:

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.

<u>Foundations, Floors, Crawl Spaces, and/or Basements:</u>

According to the plans (see Figure 1) for this building, the foundation walls of the administrative wing have two inches of rigid insulation from grade to the foundation footer. The image to the right helps confirm this.
An improvement to this would be to continue the insulation upward to meet the framing. Ideally, it would also cover the bottom plate of the stud wall.



With a durable finish, it could be sealed to the frame or trim to help eliminate potential air infiltration.

Figure 1

The image to the right shows the foundation of the Fire Department's garage. Figure 2 indicates that there is insulation under the slab and behind the siding but not separating the slab from the foundation. This could be an area of great heat loss.

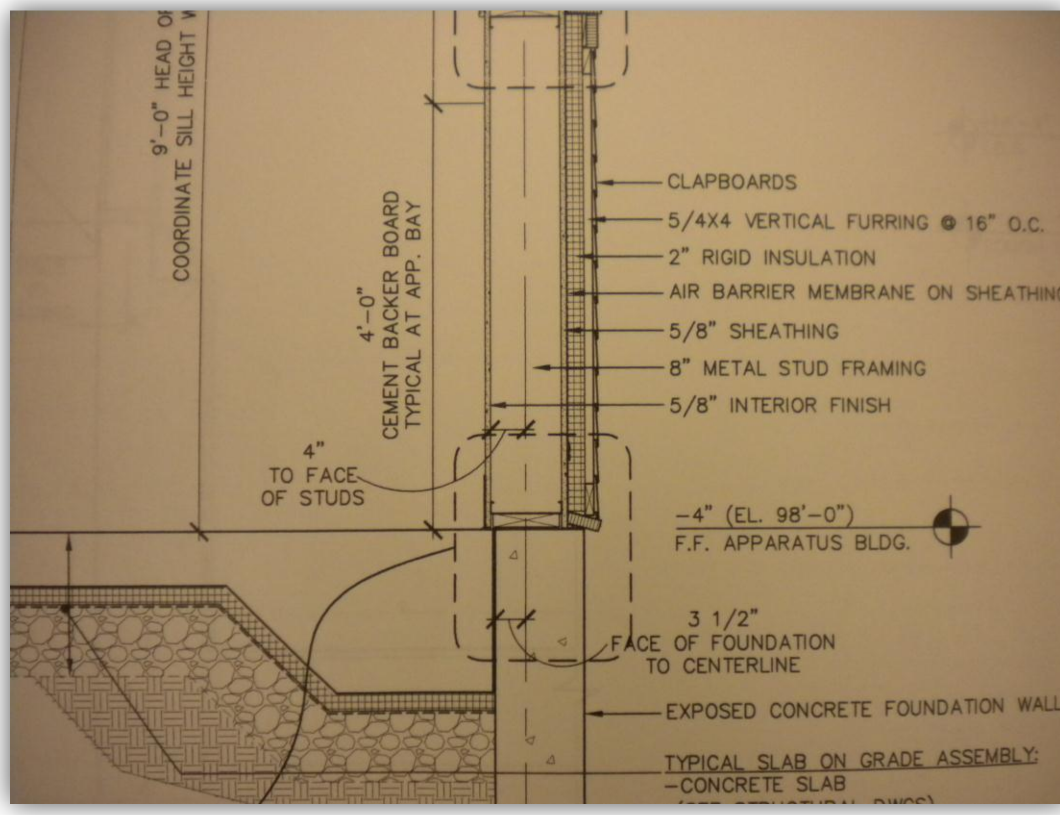


Figure 2

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 climate region as this building, taken during cold weather (see Figure 3). 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. It is especially important that slabs containing radiant tubing have continuous R-value, most importantly along the perimeter as this will be the greatest area of heat loss.

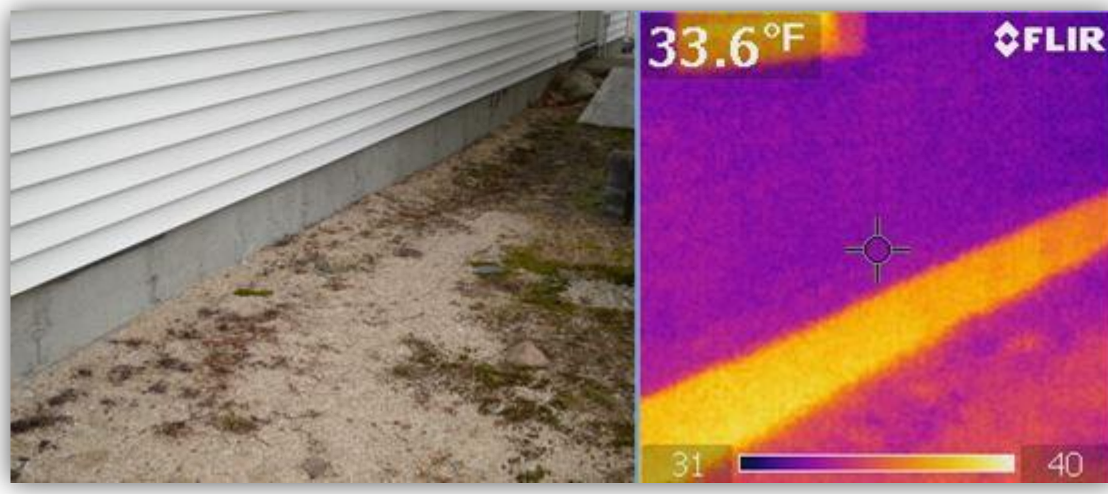
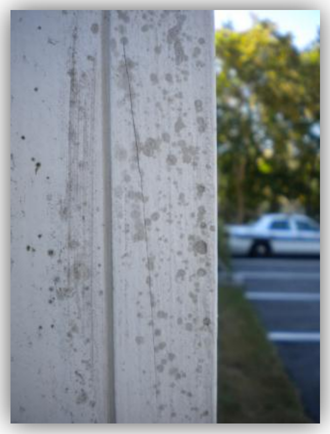


Figure 3

Conveniently, the existing water table around the garage provides an ideal cap for exterior rigid foam board to be sealed to.

Exterior Walls:

The siding if this building is covered with what appears to be a type of mildew or mold. We were told that there is an on-going search for the answer as to why this is occurring, but no solid answer has been found yet.



Though we cannot offer a sure explanation, we can try to point out some clues. Where this growth does not appear to be occurring may be in the areas of greatest heat loss. Note the above right photo and how the area directly beneath the eve is free of growth. At first it seemed that the eves may be protecting this much of the wall from wind driven rain. However, the vertical lines that are also visibly clear of growth are likely from strapping that was fastened through the foam board before the siding went up. Also note that there is not growth where the antenna bracket is fastened to the wall or where the wires terminate the building. We suspect that if a thermal image was taken of this wall during cold months that all the areas clear of growth would also be areas of the highest heat loss. This makes us think that there is moisture build-up behind the siding that is only drying fast enough where there is thermal conductivity.

The walls of the administrative wing seem to have been constructed with 2x6 inch studs and insulated with R-19 fiberglass. The rigid foam board along the band joist (see Figure 4) is not that common and a great efficiency detail. There is little to be done to improve the efficiency of these walls.

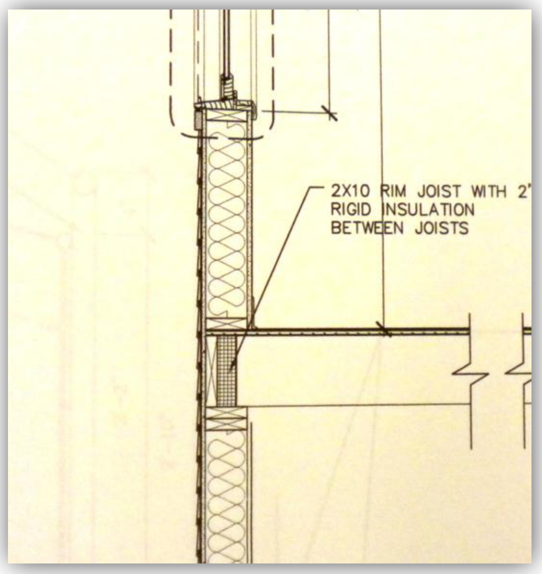


Figure 4

The walls of the garage appear to be wrapped in two inches of rigid foam board. Having this continuous R-value is an enormous benefit. What we would suggest is potentially filling the 2x8 inch wall cavities with cellulose insulation. If this can be done, it would bring these walls to "super-insulated" status.

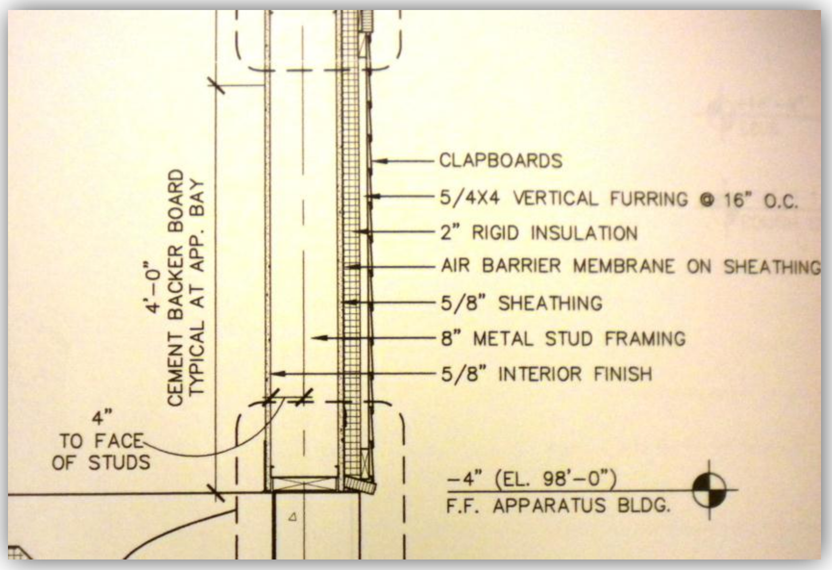


Figure 5

<u>Ceilings and Attic:</u>

The below drawing of the top of the garage wall indicates that there is a void of insulation between the rigid foam of the wall and that of the roof. If the wall was in fact constructed this way, adding foam insulation to the space would certainly increase efficiency.

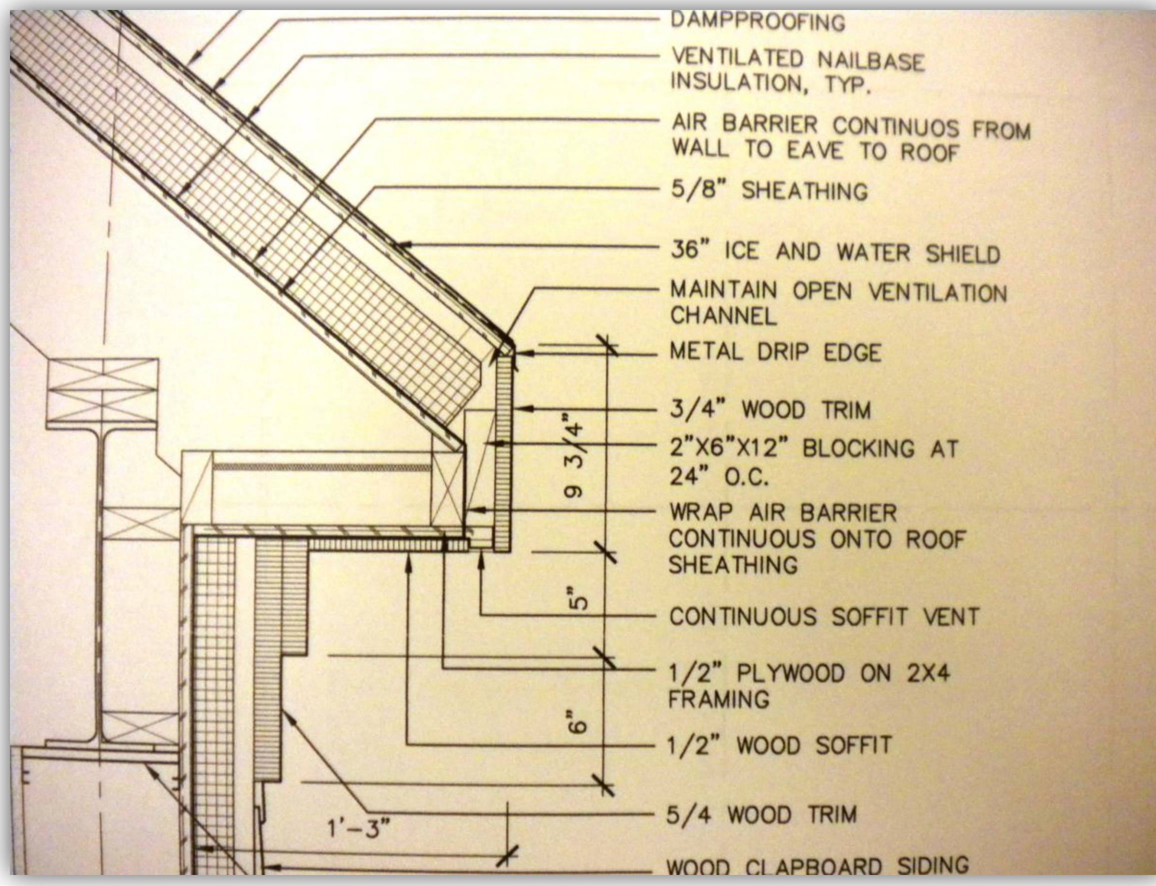


Figure 6

Having the tall ceiling in the garage gives a great "open" feel to the space, and because there is in-slab radiant tubing, the heat will tend to remain in the bottom half of this space. One thing that could prove to be effective would be to install a radiant barrier above the white painted steel frame seen in the photo to the right. This would eliminate the open space feel, but should prove very effective at reflecting much of the radiated heat back toward the occupied volume of this space.

It was brought to our attention before we visited the building that there had been problems with ice dams on the edges of the administrative wing roof. Ice dams are always an indication that there is an excessive rate of heat flow into an attic space, coupled with an inadequate amount of ventilation. The drawing in Figure 7 indicates a strategy that may or may not have been effective in this circumstance, regardless of how well it was done. This is largely due to the fact that it would be very difficult to create an effective air barrier with foil-faced fiberglass insulation between the rafters. Also note the blocking standing on end on the exterior of the top plate. Not only did this not appear to have been done but using rigid foam board, well-sealed to the proper vent/rafters/top plate would have been much more effective at slowing heat loss. If wood blocks were required for structural purposes, a combination of the two could be appropriate.

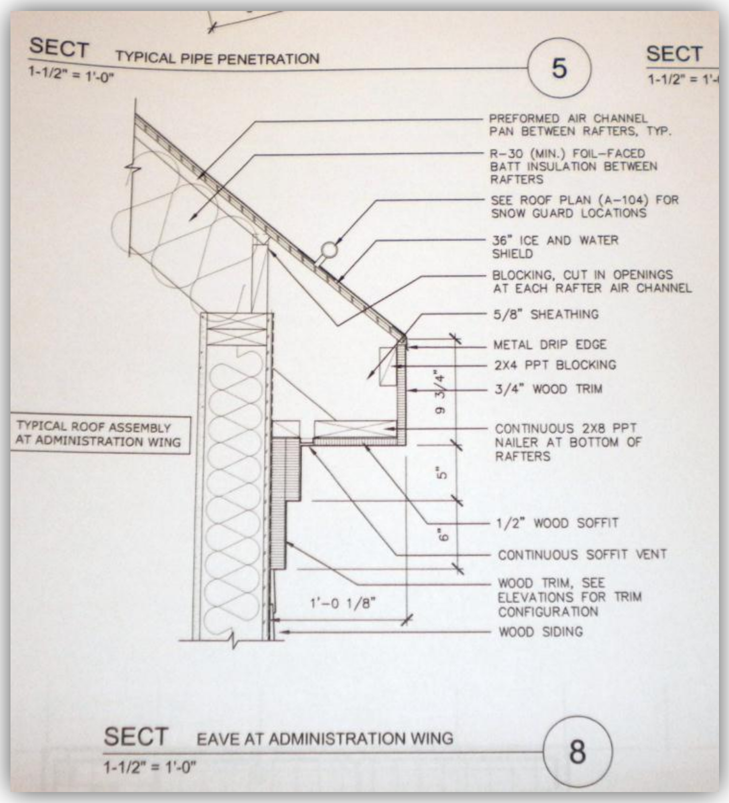
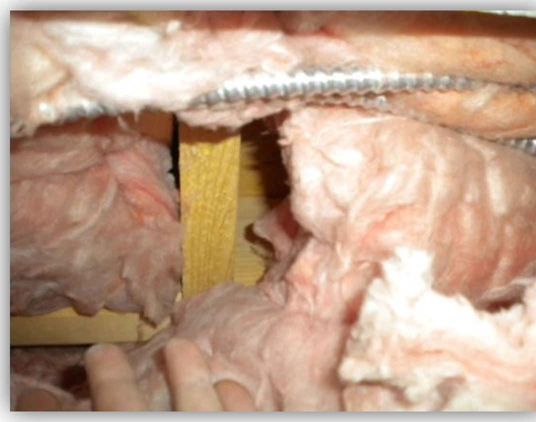


Figure 7

These two images show the inside of the administrative wing roof. Having the radiant barrier of the foil-face is a great asset, but as mention previously, this type of insulation would be very difficult to make air tight. Creating a "cold roof," either in the same way as the garage roof, or by spraying the underside of this roof with closed-cell spray foam would have been more effective.

The photo to the right shows an area towards where the rafters meet the exterior walls. The foil-face of the insulation has not been sealed to the sheetrock, and when we pulled away some of the fiberglass, we discovered that there was blocking between the rafters, but it was not installed as shown in the plans of Figure 7. Instead, it runs perpendicular to the roof plane. In the two areas that we accessed, this was done, and there was no proper vent.



<u>Doors and Windows:</u>

The doors and windows of the building are relatively new, efficient, and we would not recommend their replacement at this time. Making good use of shades on the sunny sides of the building during the summer would not only increase comfort but reduce the cooling costs as well.

<u>Mechanical:</u>

This building is heated with two oil-fired boilers that are being maintained at about 86% combustion efficiency. These boilers supply hot water to the radiant tubing in the garage and to several air handling units located in the basement and above the second floor of the administrative wing.
These boilers are relatively efficient for oil boilers, and if the plan is to keep with this type of fuel, than there is no recommendation to replace these at this time.
What can be done is to make sure that these units are running at their full efficiency potential. We recommend having a meeting with the service company to inquire about any and all control options for these units. For example, we did not notice an outdoor reset associated with these boilers. An outdoor reset, or modulating aquastat, functions by monitoring the outdoor temperatures and automatically adjusts the temperature set points of a boiler. For example, on the coldest days of a NH winter, the temperature of the water sent to baseboard radiators will most often not need to be greater than 180°F. If the outdoor temperature is only 50°F, the boiler may only have to send 160°F water to the baseboard. Many types can also stage multiple boilers and help reduce short cycling. Outdoor Resets, in conjunction with an indirect hot water heater will also reduce stand-by losses. Installing one of these units is an affordable solution and can reduce fuel usage by 10%-20% on a yearly basis.

Potable water is also provided by these boilers and is stored in the tanks seen to the right.
One alternative to heating potable water with the oil boiler would be to install a solar domestic hot water system. The south facing roof of the garage (directly above the boiler room) could be an ideal location for evacuated tube or flat panels. With the radiant tubes in the garage floor, there is also the possibility that solar thermal panels could contribute towards heating that space as well.

Electrical:

The spike in electric usage during the summer months is likely associated with the keeping the building cool. Check the Seasonal Energy Efficiency Rating (SEER) of the outdoor condensing units. The efficiency of condensing units is always increasing. It is possible that if these units were installed in 2006, they may only have a SEER of 10. Though today's condensing units can reach SEER 16 or more, even going from a SEER 10 to 14 will create an efficiency of 30% or more. Only invest in the most efficient models available.

LED lighting has come a long way in the past several years, and the use of this very efficient light source is becoming more and more popular. Whether for high bay lighting, task lighting, and even flood and parking lot lighting, the LED market is ever expanding to meet all lighting needs. One of the largest deterrents for most potential LED buyers is the high initial cost. However, the reduced electric demand, lower maintenance costs, and much longer lamp life provide maximized long term savings over the life of the equipment.

Modern electronic equipment often 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.

Installing a photovoltaic solar system on site, either to meet the needs, or supplement the costs of electricity is always recommended. Options for funding such a project are given in the next section of this report.

Health, Safety and Comfort:

The only potential safety issue we noticed during our brief visit to this building was found in the boiler room. In the below photo to the right is a combustion supply air duct. It was mentioned to us that the window in the boiler room (photo to the left) needs to remain open to ensure enough combustion air. Coming up with a permanent solution to this will eliminate to potential of human error.

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 8. 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.

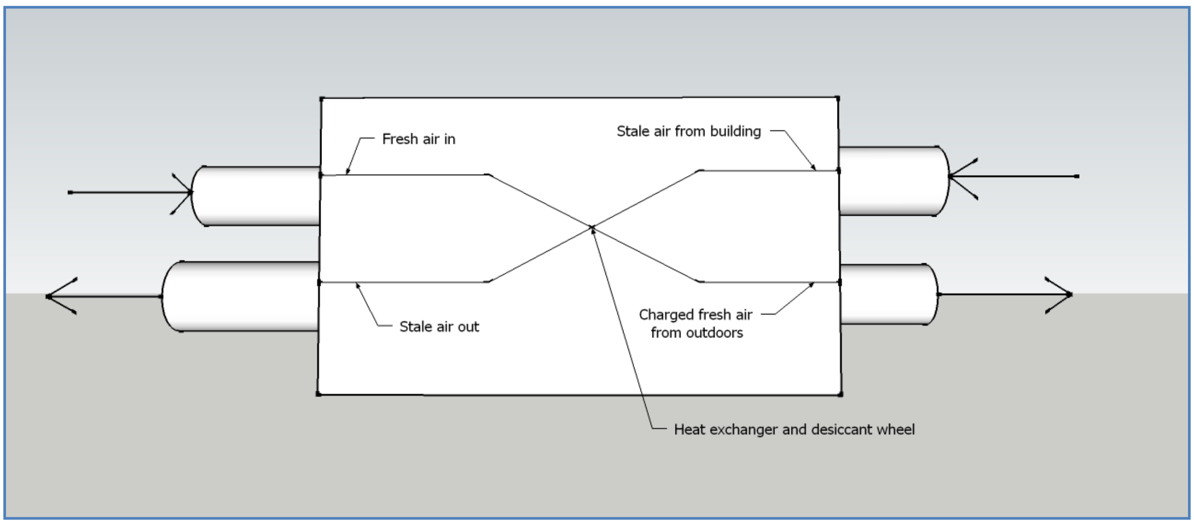


Figure 8

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 perimeter of the garage foundation. This should be done with 2 inch extruded polystyrene foam board, which should extend below grade 2 feet. 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:

- Determine of the framed wall cavities of the garage walls can be filled with cellulose insulation and fill them if so.

Ceilings and Attic:

- Ensure that there is continuous R-value from the tops of the garage walls to the roof insulation.
- Examine the cost vs. long term savings of making the administrative wing roof a “cold roof” with the use of closed-cell spray foam insulation.

Doors and Windows:

- Check all the doors and window every several years to ensure that they are providing a proper air seal when closed.
- Make good use of shades in the summer months to reduce cooling costs.

Mechanical:

- Ensure that the most advance control systems are in place with the current HVAC system.
- There are many options for reducing heating costs with full system replacements, including wood pellet systems, solar integration, and CHP, etc. These options and more can be discussed during the presentation of this report.
- Consult with a ventilation specialist about incorporating ERV technology for building ventilation.

Electrical:

- Find out what the SEER of the outdoor condensing units is. If the units have a SEER rating of 13 or less, replace them with units that have a SEER rating of 16 or greater.
- Where ever possible, install LED lighting. The focus for this should start with outdoor lights that are left on all night throughout the year.

Health and Safety:

- Ensure that an adequate amount of combustion air is being supplied to the boilers.

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:

NH utilities may provide technical and financial assistance for various types of efficiency measures that can be carried out at the Town's municipal facilities. 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 National Grid Customers:

- Call - 1.800.843.3636
- Visit - https://www.powerofaction.com/newhampshirecigasnaturalgasheating/

For Unitil electric and/or gas Customers:

- For natural gas customers – 866.933.3820
- For electric customers – 800.582.7276
- Visit - http://www.unitil.com/energy-efficiency/commercial-industrial-programs-rebates-assistance

For PSNH Customers - contact the PSNH representative for your region:

- Seacoast/Northern Region, Kathleen Lewis, 603.436.7708 ext. 5628 lewiskx@nu.com
- Southern Region, Elizabeth Larocca, 603.634.2380 larocel@nu.com
- Western/Central Region, Sue Blothenburg, 603.357.7309 ext. 5115 blothse@nu.com
- Visit - http://www.psnh.com/SaveEnergyMoney/For-Business/Municipal-Smart-Start-Program.aspx

For NH Electric Coop Customers:

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

For PSNH Customers - contact the PSNH representative for your region:

- Seacoast/Northern Region, Kathleen Lewis, 603.436.7708 ext. 5628 lewiskx@nu.com
- Southern Region, Elizabeth Larocca, 603.634.2380 larocel@nu.com
- Western/Central Region, Sue Blothenburg, 603.357.7309 ext. 5115 blothse@nu.com
- Visit - http://www.psnh.com/SaveEnergyMoney/For-Business/Municipal-Smart-Start-Program.aspx

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.

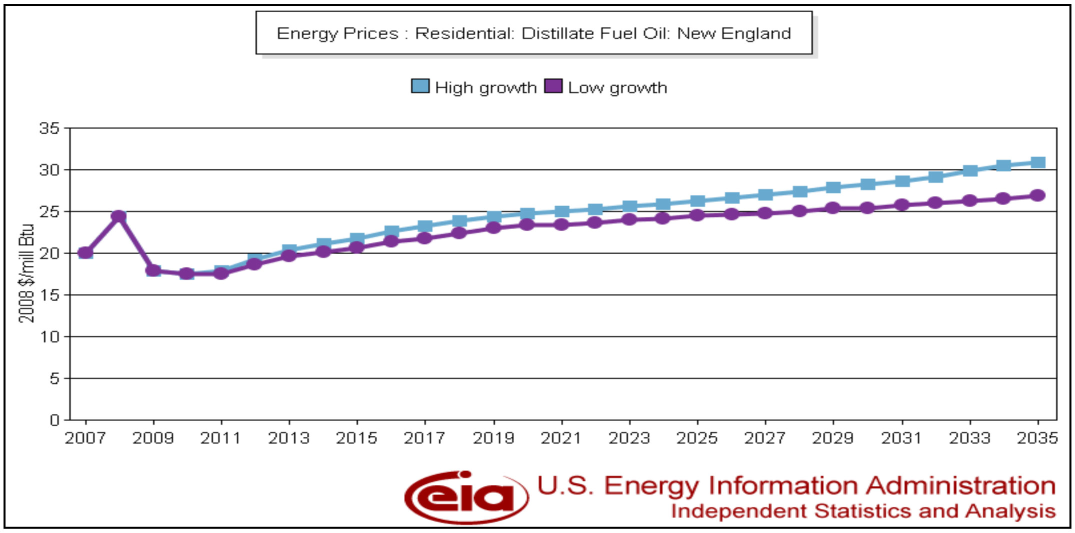
For more information on the history of energy prices and how energy cost projections are calculated, please visit: http://www.eia.doe.gov/analysis/

Price Summary

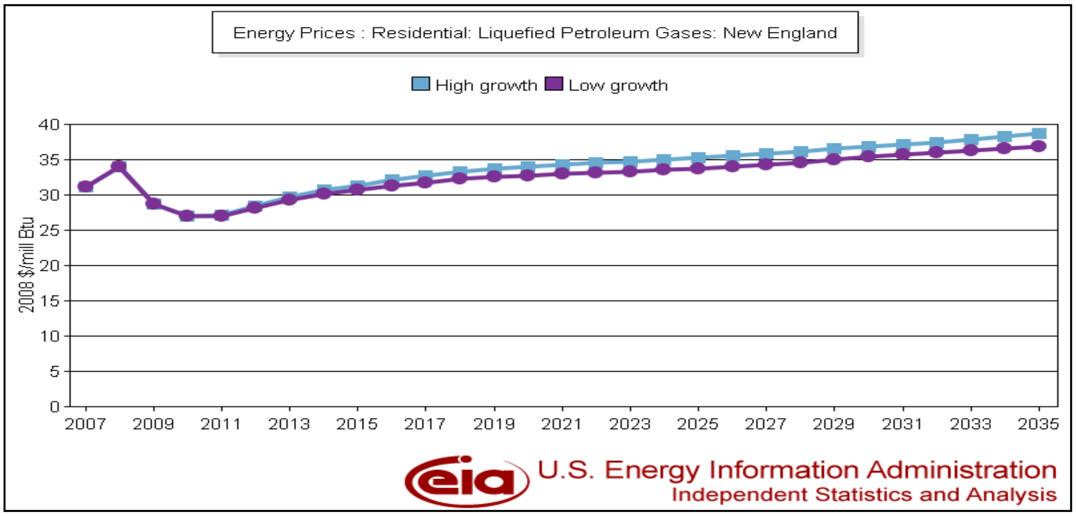
	Year				Percent Change		
	2009	2010	2011	2012	09-10	10-11	11-12
WTI Crude[a] ($/barrel)	61.65	79.40	*93.26*	*97.50*	28.8	*17.5*	*4.5*
Gasoline[b] ($/gal)	2.35	2.78	*3.15*	*3.30*	18.4	*13.4*	*4.8*
Diesel[c] ($/gal)	2.46	2.99	*3.43*	*3.51*	21.5	*14.7*	*2.4*
Heating Oil[d] ($/gal)	2.52	2.97	*3.41*	*3.55*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

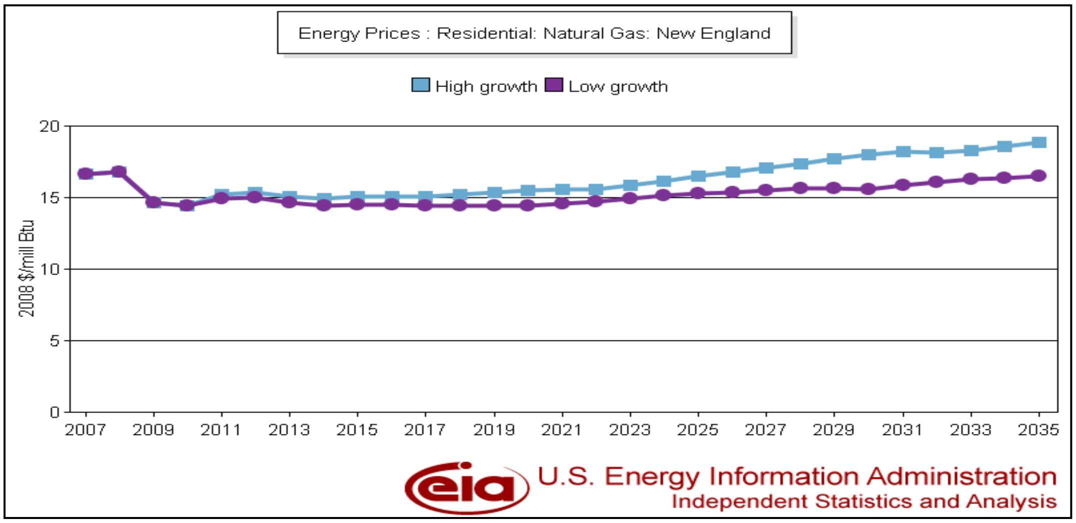
Table 1 – Retrieved from US EIA website



Graph 1 - Retrieved from US EIA website



Graph 2 - Retrieved from US EIA website



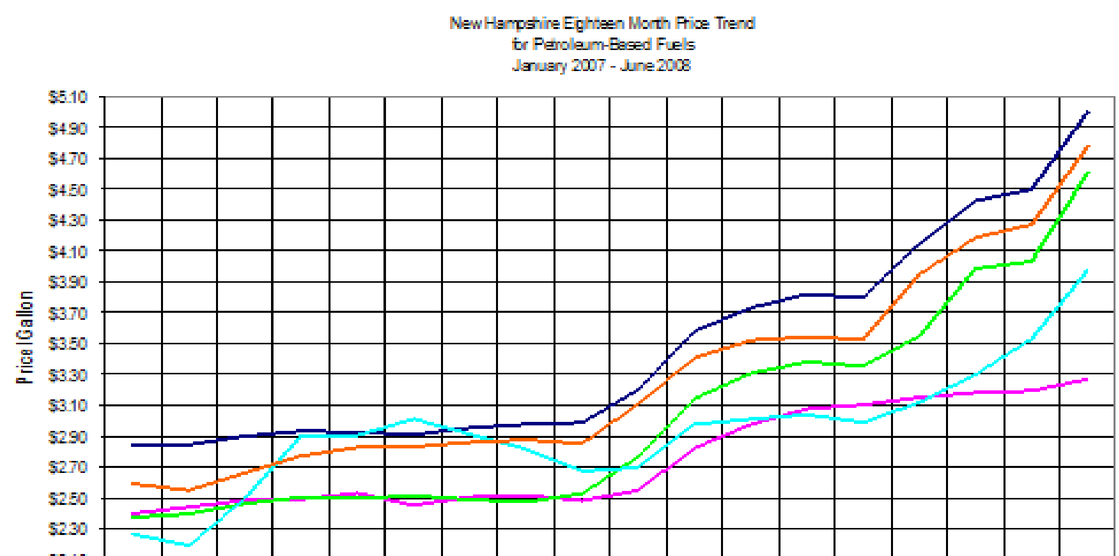
Graph 3 - Retrieved from US EIA website

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.

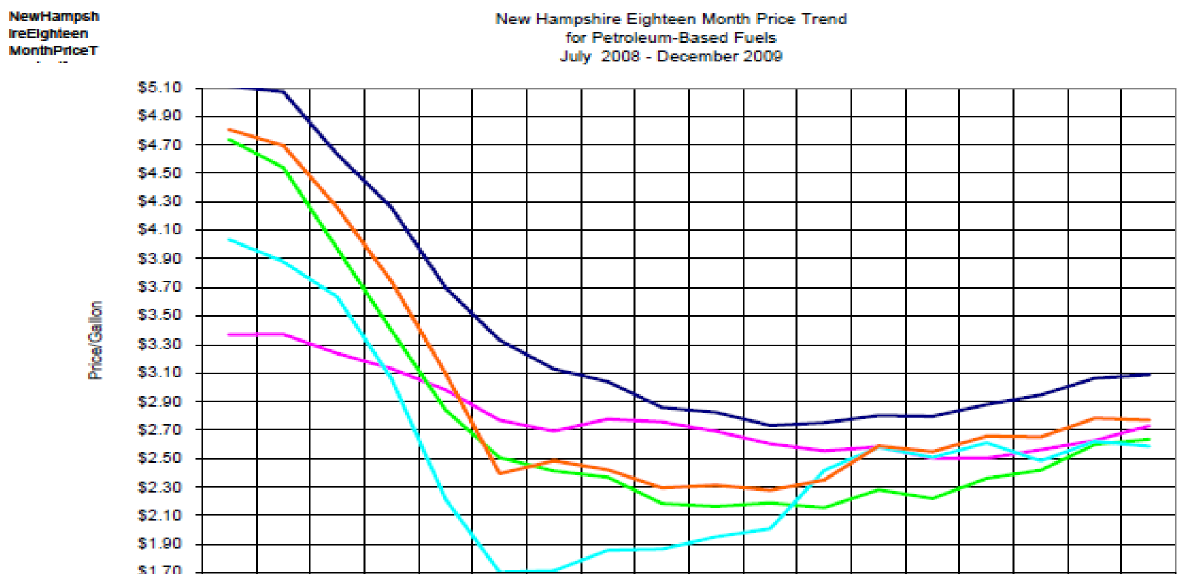
Insulation and other building envelope projects are investments that are permanent, require little or no active maintenance, and will stand with the building during its lifetime. These investments secure baseline improvements that in turn provide a foundation for other investments. Lowering the amount 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	$3.103	$3.150	$3.181	$3.194	$3.270
#2 Heating Oil	$2.376	$2.396	$2.464	$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	$2.266	$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

Prices surveyed all Mondays Dec '06 - Mar '07; two Mondays, Apr 07; first Mondays, May -Sept each year; and on all Mondays, October '07-April '08. - NH Office of Energy and Planning

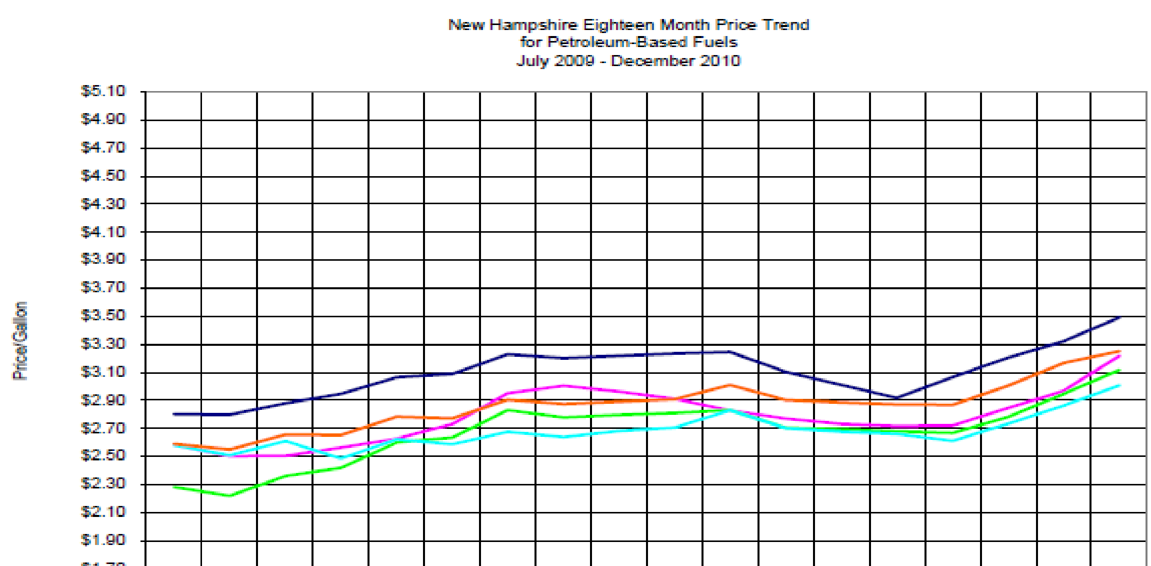
Figure 9 - Retrieved from NH OEP website



	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

Prices surveyed all Mondays, October through March; and first Mondays, April -September. - NH Office of Energy and Planning

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

Prices surveyed all Mondays, October through Mid March; and first Mondays, April -September. - NH Office of Energy and Planning

Graph 5 – Retrieved from NH OEP website

Potential for Savings:

The following tables and graph are provided to illustrate the potential savings for the Town if recommendations are carried out in the near future. The tables provide an assumed fuel escalation rate that is built into the savings model to show a fifteen year potential savings for the 30% reduced energy costs today as compared to the escalation of costs over fifteen years. (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 10 – 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.

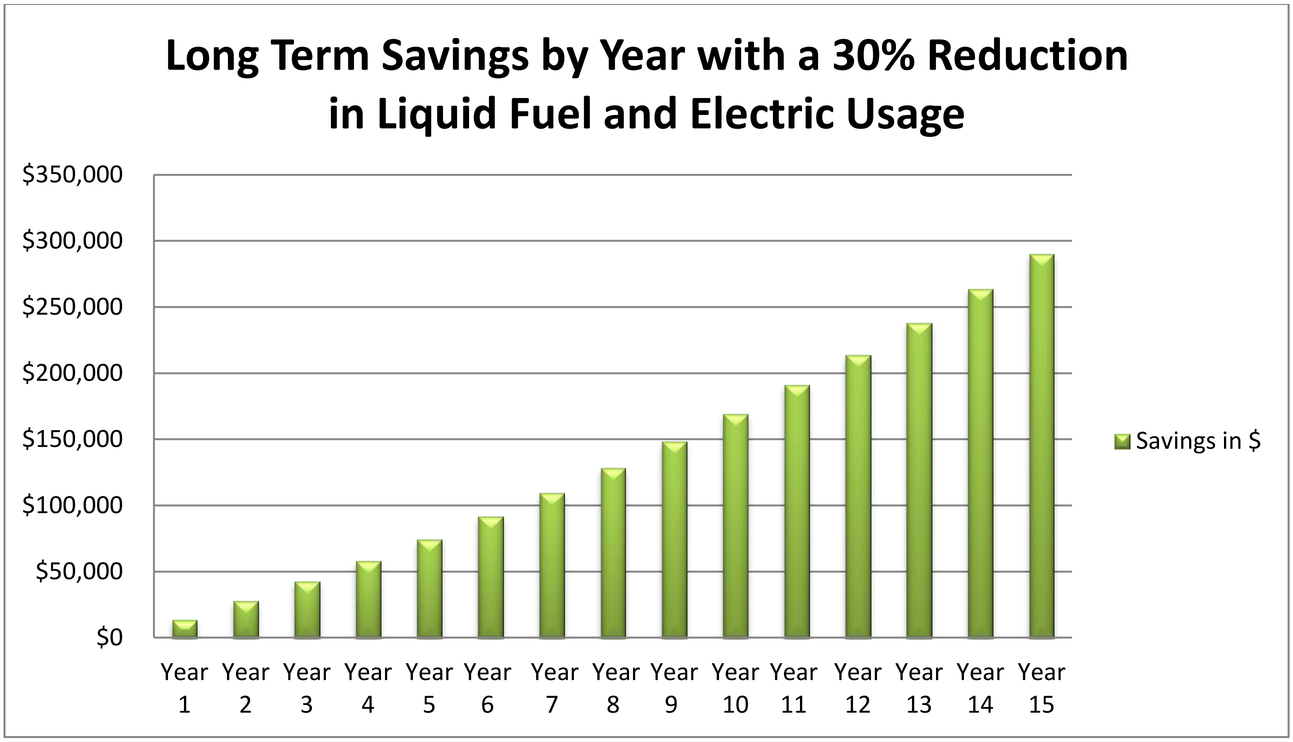
Current Fuel Usage				
Year	Energy Cost By Year	Yearly Increase		Total Accumulated Cost by Year
		Escalation Rate	5.00%	
Year 1	$24,663.49	$ 1,233.17		$24,663
Year 2	$25,897	$ 1,294.83		$50,560
Year 3	$27,191	$ 1,359.57		$77,752
Year 4	$28,551	$ 1,427.55		$106,303
Year 5	$29,979	$ 1,498.93		$136,281
Year 6	$31,478	$ 1,573.88		$167,759
Year 7	$33,051	$ 1,652.57		$200,810
Year 8	$34,704	$ 1,735.20		$235,514
Year 9	$36,439	$ 1,821.96		$271,954
Year 10	$38,261	$ 1,913.06		$310,215
Year 11	$40,174	$ 2,008.71		$350,389
Year 12	$42,183	$ 2,109.15		$392,572
Year 13	$44,292	$ 2,214.60		$436,864
Year 14	$46,507	$ 2,325.33		$483,371
Year 15	$48,832	$ 2,441.60		**$532,203**

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	$20,133.00	$ 1,006.65		$20,133
Year 2	$21,140	$ 1,056.98		$41,273
Year 3	$22,197	$ 1,109.83		$63,469
Year 4	$23,306	$ 1,165.32		$86,776
Year 5	$24,472	$ 1,223.59		$111,248
Year 6	$25,695	$ 1,284.77		$136,943
Year 7	$26,980	$ 1,349.01		$163,923
Year 8	$28,329	$ 1,416.46		$192,252
Year 9	$29,746	$ 1,487.28		$221,998
Year 10	$31,233	$ 1,561.64		$253,231
Year 11	$32,795	$ 1,639.73		$286,025
Year 12	$34,434	$ 1,721.71		$320,460
Year 13	$36,156	$ 1,807.80		$356,615
Year 14	$37,964	$ 1,898.19		$394,579
Year 15	$39,862	$ 1,993.10		**$434,441**

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 - Liquid Fuel and Electricity				
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	$13,439	$ 671.95		$13,439
Year 2	$14,111	$ 705.54		$27,550
Year 3	$14,816	$ 740.82		$42,366
Year 4	$15,557	$ 777.86		$57,924
Year 5	$16,335	$ 816.76		$74,259
Year 6	$17,152	$ 857.59		$91,411
Year 7	$18,009	$ 900.47		$109,420
Year 8	$18,910	$ 945.50		$128,330
Year 9	$19,855	$ 992.77		$148,185
Year 10	$20,848	$ 1,042.41		$169,034
Year 11	$21,891	$ 1,094.53		$190,924
Year 12	$22,985	$ 1,149.26		$213,909
Year 13	$24,134	$ 1,206.72		$238,044
Year 14	$25,341	$ 1,267.06		$263,385
Year 15	$26,608	$ 1,330.41		**$289,993**



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 within 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 Safety Complex. Achieving 30% savings in energy cost for this building is 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.