The New Hampshire Municipal Energy Assistance Program

Decision Grade Audit Report

Weare Safety Complex
144 North Stark Hwy, Weare, NH 03281

Prepared for:

Town of Weare, NH

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Sustainable Energy Resource Group

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This project is made possible with support from the New Hampshire Regional Greenhouse Gas Initiative

3/7/2011

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 Weare 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 Weare.

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Introduction:

MEAP partners are pleased to provide this Decision-Grade Audit Report for the Town of Weare and the Public 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. 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.

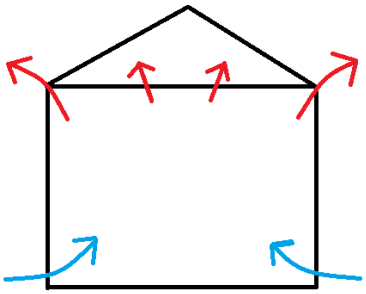
This DGA involves a quantification of energy usage (electrical and heating fuel), a description of existing heating/cooling and distribution systems, thermal barrier inefficiencies, potential electric savings through lighting/appliances upgrades and behavior change, occupancy health and safety concerns,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

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.

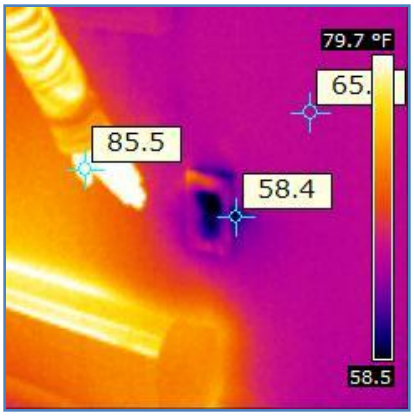
Heat moves through and leaves a building by three different means: *convection, conduction, and radiation*. One way to think of **convective** heat loss is by air movement into and out of a structure. One of the forces causing this to happen is the "stack effect".



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.

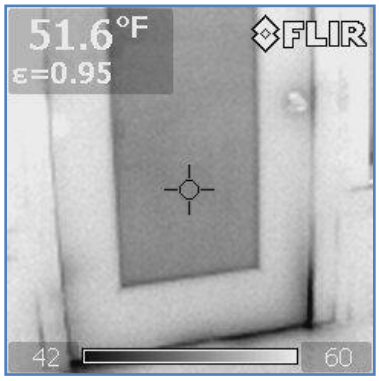
Conduction is the foremost way in which heat travels through a solid building material. R-value is one way to describe a given materials resistance to transfer heat. Materials with a high R-value, such as foams, cellulose, or fiberglass batts are used for insulation. At any location in the building envelope 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 single story building that houses the Weare Fire Department and the Police Department. Constructed in 2003, this building was well designed, not only for functionality, but for energy efficiency as well.

We would like to note that the Town of Weare has a generally energy efficient set of buildings, at least relative to many other MEAP towns. As it pertains to heating costs, the worst performing building of any notable size in Weare is the Safety Complex. This building needs around 36,000 BTU's per ft² per year to heat the building, while a typical MEAP "worst performing" town building would need at least twice that many delivered BTU's for heat and hot water.

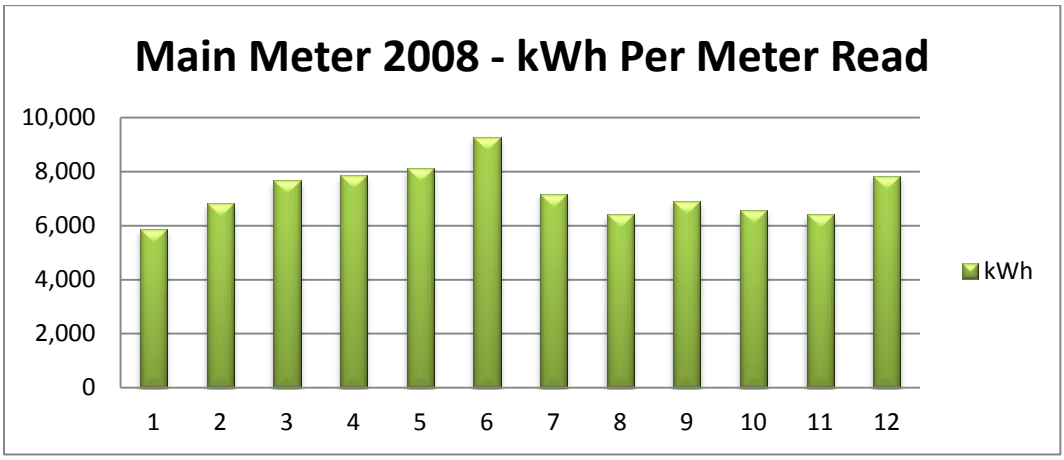
Regardless of how efficient any structure is, there is most always still opportunity for energy saving projects. In this report, we have highlighted some project options that will help usher this building into the next generation of energy prices and environmental challenges.

Energy Data Collection:

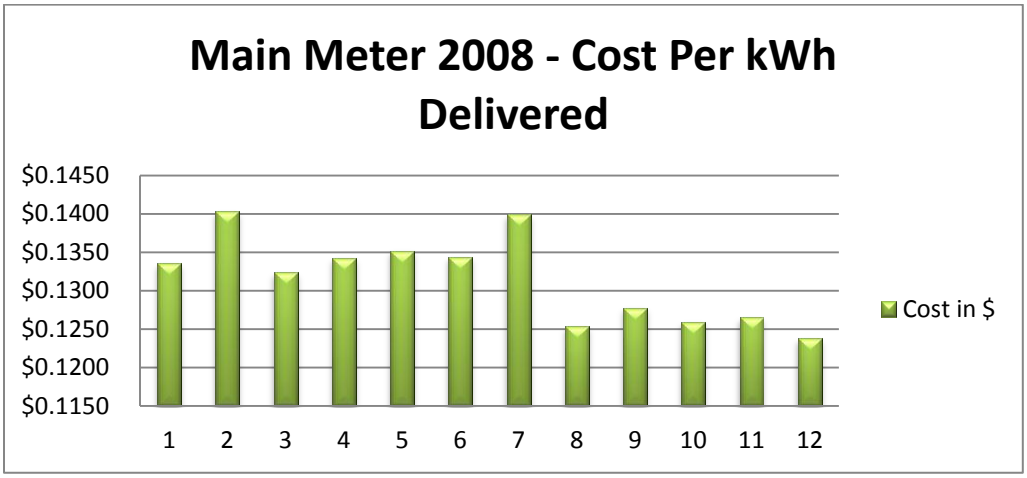
Electric -Main Meter			
PSNH			
Date	**KWH**	**Total $/mo**	**Cost Per kWh**
12/1/2008	5,839	$780.00	$0.1336
11/1/2008	6,820	$957.00	$0.1403
10/1/2008	7,660	$1,014.00	$0.1324
9/1/2008	7,860	$1,055.00	$0.1342
8/1/2008	8,100	$1,095.00	$0.1352
7/1/2008	9,280	$1,247.00	$0.1344
6/1/2008	7,160	$1,002.00	$0.1399
5/1/2008	6,420	$805.00	$0.1254
4/1/2008	6,880	$879.00	$0.1278
3/1/2008	6,560	$826.00	$0.1259
2/1/2008	6,420	$812.00	$0.1265
1/1/2008	7,820	$968.00	$0.1238

Table 1

Total kWh This Year +	**86819**
Total Paid For Year=	**$11,440.00**
Ave Cost Per kWh =	**$0.1316**



Graph 1



Graph 2

Heat Source 1			
LP Gas			
Date	**Fuel Units**	**$**	**Cost Per Unit**
12/1/2008	448	$673.20	$1.503
9/1/2008	960	$2,120.00	$2.208
3/1/2008	789	$1,663.00	$2.108
2/1/2008	410	$872.20	$2.127
1/1/2008	1,027	$2,284.00	$2.224
	Total Units Used =		**3634**
	Total Paid For Year =		**$ 7,612.40**
	Ave Cost Per Gal =		**$ 2.09**
NH Average By Date -	Click Here		$3.549 $ Per Unit
	Cost at this price per gallon =		**$12,897.07**

Table 2

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:

This building sits on a concrete slab, which we believe to be uninsulated, though this would have to be confirmed by the builder. We performed our site visit on a warm day and were unable to get a sense of this with an infrared (IR) camera.

Figure 1 is not an image of this building but of a building of almost the exact size and construction type and has the same type of heating system. In cold conditions, this is what the foundation would look like when viewed through an IR camera if insulation was not present. This image helps to illustrate how much of a building's heat loss can occur from around the perimeter of an uninsulated foundation or slab. Note how the foundation glows orange from heat loss in comparison to the insulated exterior wall.

Figure 3 also helps describe this heat loss process. As the slab of the building is heated, much of the heat moves downward to the colder earth below. As the edge of the slab is exposed to the coldest conditions, the heat is continuously drawn towards the edges where is eventually lost to ambient conditions. This is usually why, for example, bulbs planted around the immediate perimeter of many buildings will begin sprouting much earlier than bulbs planted elsewhere in the landscape.

If a lack of insulation could be confirmed, insulating around this foundation could save up to 10% or more on heating costs, and would increase occupancy comfort. It would, however, take a sizable initial investment, and it may take some time before such an investment could be recouped through energy savings. Given that this building will likely be owned and operated by the Town for the next 50 years or more, we would still recommend insulating the slab; however, this project would be placed relatively low on a prioritized list of recommendations.

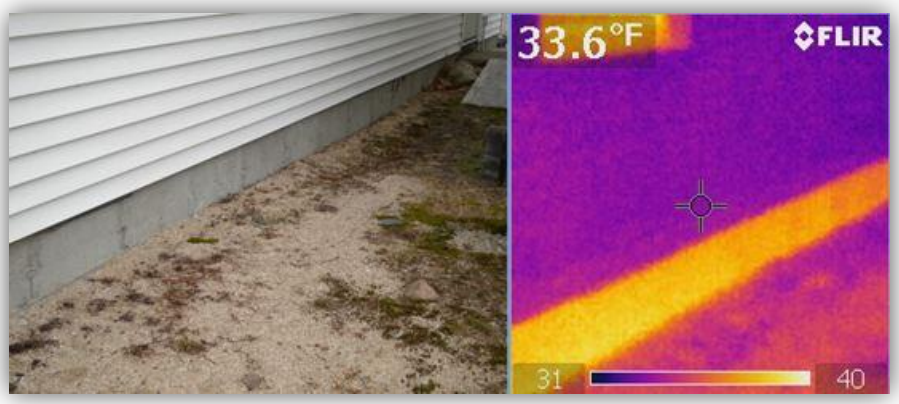


Figure 1

The basic process of insulating the slab would require digging a 4-foot deep trench alongside the building and then applying 2 inches of extruded polystyrene foam board insulation with a durable exterior finish. This is an effective way in which to slow the heat loss from around the perimeter of the slab, though somewhat controversial. In cases where this insulation method has been used and not done well, pests, such as ants, have found their way into the foam board and made nests. Therefore, it is very important to create a strong barrier between the foam and any potential infestation. A thick cement type finish, or coated sheet metal, could be an ideal solution to this potential problem.

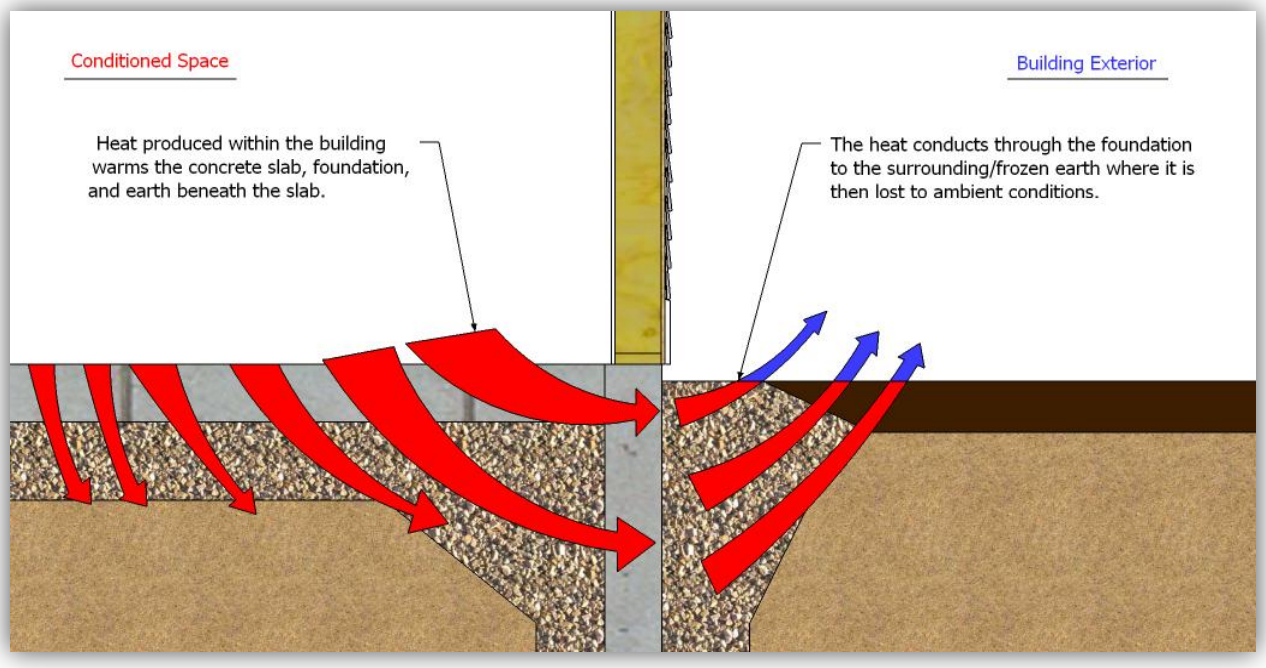


Figure 3

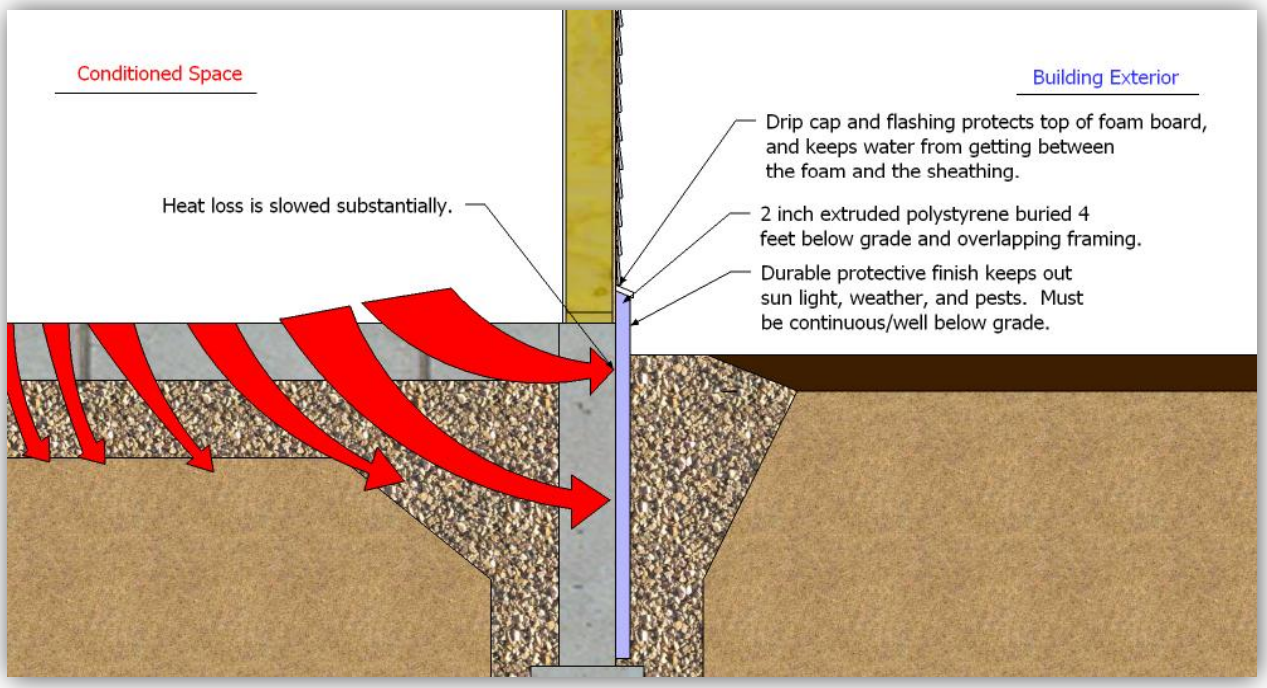


Figure 2

Exterior Walls:

It is safe to guess that most of the exterior walls of this building were constructed with 2x6 inch wood studs; however, this is in part a police station, therefore, some of the exterior walls could have been constructed with cement blocks and/or concrete.

Regardless of potential variations in the exterior wall type, making energy efficient improvements to any of the exterior walls would likely involve the same strategy. One method for improving the performance of this portion of the building envelope would be to remove all of the exterior siding and trim and add ridged foam board to the exterior before refinishing the exterior. This is a strategy that has been employed for decades and has been proven to dramatically reduce heating and cooling needs. One great benefit of taking this approach is the ability to combine improvements to the exterior walls and the foundation into one project.

Improving the thermal performance of the exterior walls would be quite costly, and it could take a substantial amount of time to recoup an investment of this type through energy savings. This may be a project for this building that will have to wait until the price on energy is high enough to warrant such measures. That said, we would still recommend achieving a "super-insulated" building envelope.

Ceilings and Attic:

There are suspended ceilings throughout the office space in this building and tall finished sheetrock ceilings in the sally port of the Police Station and the garage of the Fire Station. Above the suspended ceilings, there is drywall that has a 1st coat of sheetrock tape and joint compound. Above the sheetrock, we found a polyethylene vapor barrier, metal strapping, and an average of about 10 inches of loose fill fiberglass insulation. The roof framing is a wood truss roof system, which has an asphalt shingle covering. There are round gable vents present and a mesh type ridge vent.

Figure 4

During our inspection of the building, we did find that penetrations from the conditioned space to the attic space (wires, piping, and so forth) were not adequately sealed (see Figure 4). Though they are not as numerous as those found in some older buildings, we would still recommend sealing them in order to stop all air flow from the conditioned space to the attic.

There is a small mechanical room located in the attic space that houses the five furnaces which provide conditioned air (hot and cold) to the office portion of the building. This is a wood framed room with a sheetrock interior finish that has been insulated with fiberglass insulation (see figure 5). This insulation, both on the sides and the top, is very loosely fitted and is not providing optimum protection from the cold conditions of the attic in the winter months nor protection from extreme heat experience during the cooling season.

Figure 5

Figure 6 shows a foam proper vent fastened to the underside of the roof sheathing. Also visible in this photo are pieces of pink fiberglass batt insulation that has been placed along the tops of the exterior walls. The purpose of this insulation is to try and seal between the top plate of the exterior walls and the proper vent as well as to serve as a dam for the white loose-fill insulation also seen in this photo. Fiberglass insulation does very little to impede air flow and is usually very ineffective for this purpose. This is why the edges of a ceiling are most often the weakest areas in regards to heat loss.

Figure 6

Figure 7 shows a photo and an IR image of a building of the same construction type during winter months. The cold areas appear as purple, with the coldest of these almost black in color. The orange in this IR image represents wall and ceiling cavities that have been insulated. This is the same building from Figure 1 and represents a relatively safe assumption of how the edges of the ceilings in this building might appear during the heating months. Figure 8 serves to illustrate how this occurs.

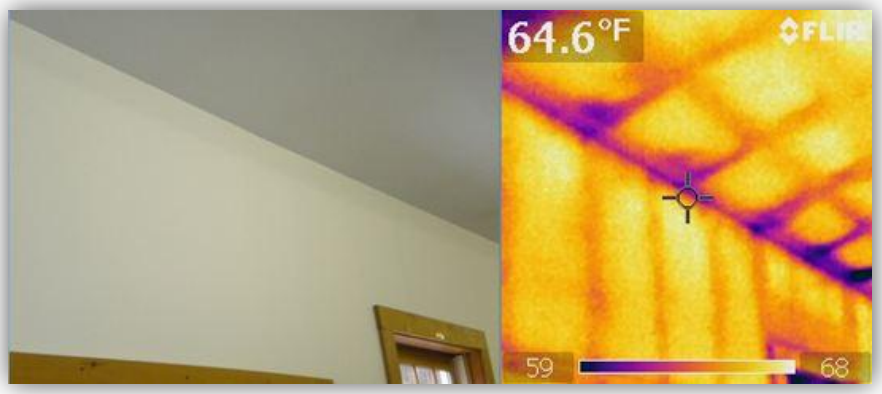


Figure 7

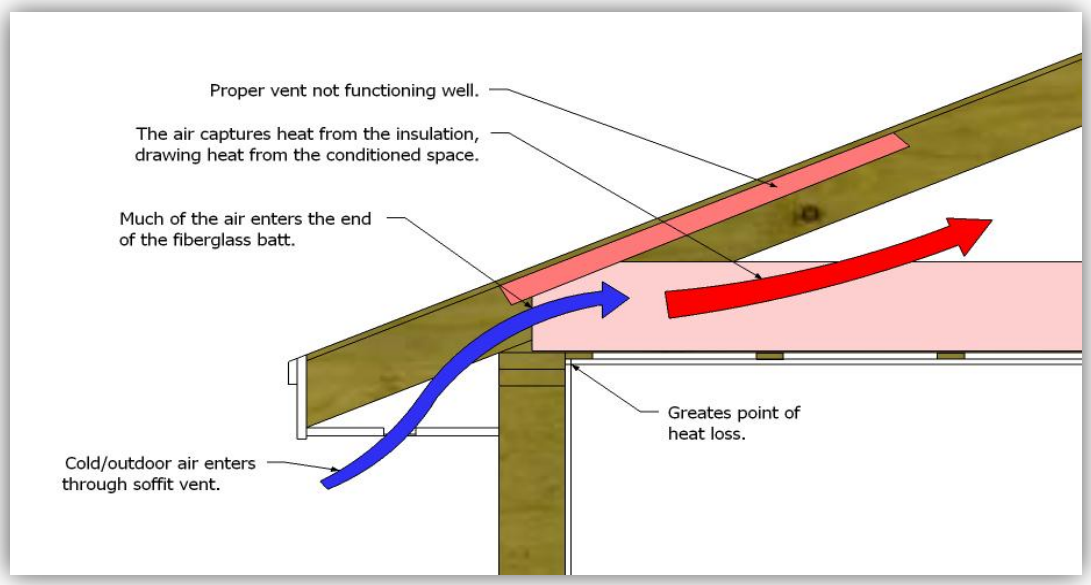


Figure 8

Figure 9 illustrates a more effective solution to these weak points in the thermal boundary. Note the pieces of ridged foam between the rafters. In this case, the pieces of ridged foam would need to be sealed in place using spray foam insulation. This is a method that can be difficult to employ in older historic buildings with eve trim that cannot be disturbed. In the case, there is vinyl soffit vent material that could be temporarily removed in order to work from the exterior of the building. Doing this would be a much easier approach than working in the confines of the attic space. Furthermore, this could potentially allow for ridged foam to be brought from the proper vent down to the exterior of the top plates, thereby reducing some of the thermal bridging of the exterior walls.

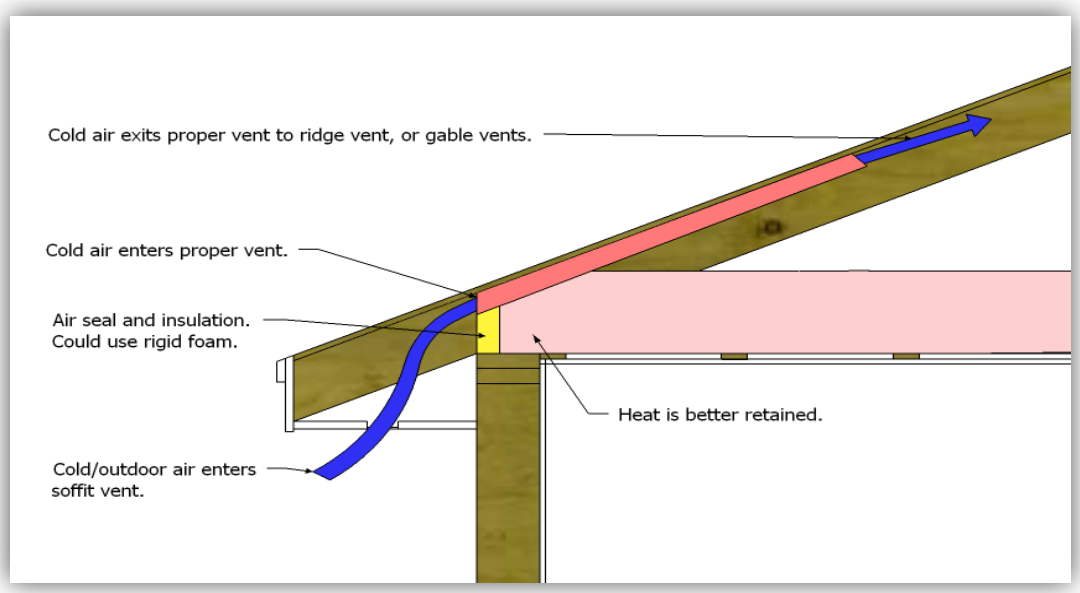


Figure 9

Having addressed the penetrations into the attic from the condition space and the eves of the building, it would then be beneficial to increase the level of insulation in the attic. This would likely be done best by adding loose fill cellulose insulation on top of the existing fiberglass. This would require adding a section of proper vent to the existing vents, extending it further towards the peak of the roof.

Often we see, as is the case in this building, that the loose fill insulation has been compressed or pushed aside where electricians, HVAC technicians, or building maintenance personnel have needed to access areas of the attic space, rendering their consequent trails as weak points in the thermal boundary. Creating a "cat-walk" for anyone needing to access the various sections of the attic would be a great way to help protect the investment of added insulation. This could be a simple addition to the structure using wood cleats and ¾ inch plywood fastened to the truss systems above the insulation level.

An important component when considering making improvements to the attic space is taking measures to improve the insulated value of the furnace room. This too could be done in a variety of different methods at varying costs and effectiveness. At first glance, it may seem that the logical process is to better insulate from the exterior of this room. Although this may in the end be the best option for the walls, the ceiling poses a great problem owing to the limited amount of space to work in above the room.

Another major factor that needs to be addressed at the same time as the furnace room ceiling is the inefficiency of the supply air trunks. These sections of ductwork exit the ceiling of this room before turning 90° downward toward the conditioned areas of the building. This is a substantial weak point in an otherwise fairly efficient distribution system. Though there is some insulation on the sides and tops of these trunks, it seems inadequate and disproportionate given this crucial location.

Heat lost from supply trunks in an attic during the heating months, results in heating equipment needing to run for longer periods of time in order to meet thermostat set points. The same is true during the cooling months. The temperature of the attic, especially the roof, becomes extremely hot in the summer, thereby increasing the temperature of the supply air before it enters the conditioned space. Including this ductwork in the insulation strategy of the furnace room would likely add little to the overall cost, while adding great benefit.

Adding additional insulation (R-value) to the ceilings would certainly reduce the cost of heating and cooling the building over the long term. Estimates for these savings could be determined by energy modeling the heating and cooling loads of the building under current conditions vs. suggested improvements.

Increasing the amount of ventilation in the attic is something that would be quite beneficial. As with most other measures, there are several ways to do this with varying cost and effectiveness. After the air sealing and increased insulation measures previously discussed have been carried out, the largest benefit may be realized by reducing the temperatures in the attic during the cooling months. There are a variety of solar powered attic vent fans, which come equipped with

a small solar panel and are capable of moving relatively large amounts of air. Depending on the type of ventilation needs, these units can also be controlled by a thermostat.

Doors and Windows:

Given that this is a newer building, the doors and the windows are relatively efficient units; therefore, we would not recommend their replacement. However, we would recommend making good use of shades and blinds in order to help control heat loss in the heating months and heat gain during the cooling months.

Mechanical:

This building is heated with three different types of heating systems—all three burn Liquid Propane (LP) gas as a fuel source. There are five condensing furnaces which heat all the office areas, meeting, and break room. There is a suspended space heating furnace in the sally port of the police station, and there are several infrared heaters suspended from the garage bay ceilings of the fire department. The potable water is produced with a 98 gallon, LP fired, open combustion, automatic storage, hot water heater.

The infrared heaters (see Figure 10) are relatively efficient units and a good heat source for a space of this type. The basics of how infrared heating works is by heating objects in the room, not the air. The very hot temperatures produced in the tubes are reflected to the space below heating the personnel, trucks and other equipment, the concrete slab, etc.

Figure 10

Figure 11 shows three of the five furnaces that heat the office portion of the building. Each are rated at 92% combustion efficiency and have a cooling coil in each supply air plenum (coming out of the top of the furnace). The PVC piping attached to the top of each unit is the combustion supply air and exhaust pipes. All five of the furnaces have these two sections of PVC piping that lead to five concentric vents terminated through the roof.

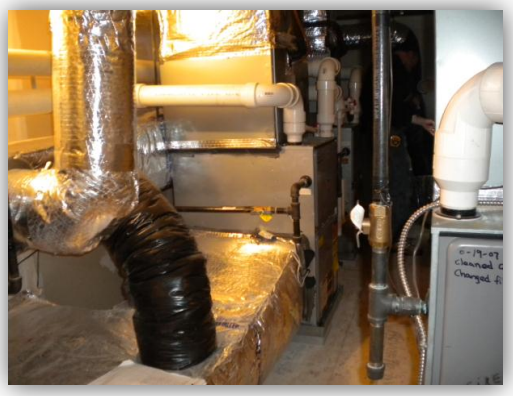


Figure 11

Though there are more efficient furnaces available on today's market, the five furnaces are relatively efficient units; therefore, we would not recommend their replacement at this time. The best furnaces with a rated combustion efficiency of around 96% would still only represent a 4% savings. This, coupled with the cost of having to replace five individual furnaces, would represent a project that would not likely have any return on the investment. If properly maintained, these units will last quite some time before they need to be replaced. When it does come time to replace any of these furnaces, whether because of early equipment failure or age, only the most efficient furnace models should be considered.

The space heater in the picture to the right does have a pilot flame. Making sure the gas to this unit is turn off during non-heating months will reduce unnecessary gas consumption.

Figure 12

Figure 5 shows several of the "line sets" running across the collar ties where they then enter the mechanical room through the ceiling. These line sets are the transportation system for refrigerant to and from the five outdoor condensing units located in the rear of the building seen in Figure 12.

These are relatively efficient units; therefore, we would not recommend replacing them at this time. Should any of these units fail and need to be replaced—purchase and install units with the highest Seasonal Energy Efficiency Rating (SEER) available.
Be sure to have the condensing units serviced regularly. The better they operate, the more energy will be conserved. One important component to servicing this system is making sure the air filters are changed regularly. Keeping clean filters protects the equipment and reduces heating and cooling cost. It is difficult to get into the furnace room; therefore, we suggest devising a strategy to increase the ease of access.

These units have been factory charged with R-22 refrigerant and are possibly still being serviced with it. This refrigerant is a greenhouse gas and leaks of R-22 from air conditioning systems contribute to ozone depletion. R-22 is being phased out of production and usage in the U.S. by the EPA in cooperation with Montreal Protocol. Unfortunately, it is not uncommon to hear about air conditioning systems that use R-22 and need to be charged regularly due to the loss of line pressure caused from refrigerant leaks. Sometimes these leaks are difficult to find, and it seems easier to keep charging the lines. Take time to speak with the service technician and confirm the type of refrigerant being used. If R-22 is being used, make sure they know not to ignore hard to find leaks and to replace line sets if need be.

On the day of our building inspection, the mechanical room was one of the coolest rooms in the building. This was in part owing to the amount of conditioned air that is leaking from the air handlers. Figure 13 shows a condensate drain coming from the drip pan of a cooling coil. This metalized tape was put in place to reduce air leakage, but a fair amount of cool air was still coming from around this and other areas on each unit. There are panels on this equipment that need to be removed from time to time for cleaning/servicing or making repairs. It would, however, be a good idea to ask the service technician to seal the units as much as possible for energy conservation.

Figure 13

Seen in Figure 14 is a section of black, flexible duct running from a larger section of ductwork into the return plenum (attached to the bottom of the furnace). Each furnace is connected the same way to the main trunk, which is connected to a supply air hood terminated through the roof. This is how the building receives fresh air, which is typical for a building of this type. As the blowers in the furnaces cycle air through, negative pressure in the return plenum builds, pulling in outside air. How this affects energy efficiency is as follows: In the winter, fresh air coming into the return plenum is cold, reducing the temperature of the return air before it is heated and supplied back to the building. In the summer, hot/humid air is introduced to the system, which then needs to be dried and cooled before being supplied to the building. A more energy efficient way in which to provide fresh air to the building would be to install an Energy Recovery Ventilation system (ERV).

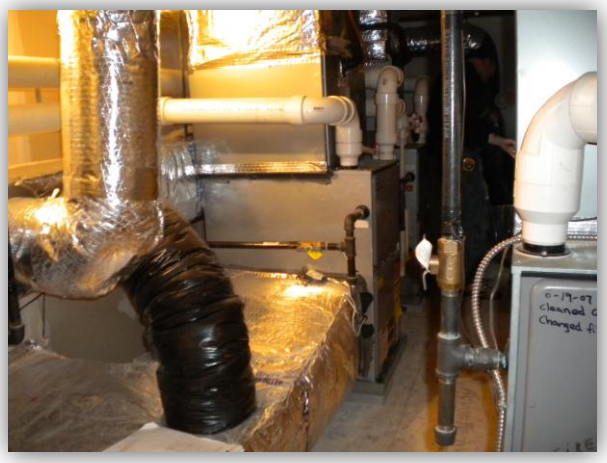


Figure 14

If energy recovery ventilation is to replace the current fresh air system, it may be most appropriate to install several smaller units instead of one larger commercial unit. This has much to do with the building size, potential space issues, and the design of the current HVAC system. We recommend consulting with a ventilation specialist to fully examine the variety of factors. Some of these factors are as follows: what strategy would produce the greatest energy reductions, the cost of installing a given system vs. energy savings (ROI), and the estimated cost for servicing a given system. These units do have washable filters, which need to be cleaned periodically. Cleaning the filters is a simple process and could likely be done by building staff. More about this is discussed in the "Health, Safety, and Comfort" section of this report.

While going through the construction plans for this building, we found drawings showing that a "hydro air" system was being considered during the design phase. How a system of this type differs from the "forced air" system currently installed is as follows: instead of heating the air directly with furnaces, a hydro air system would have a central boiler, which would send hot water to heating coils located in five separate air handlers (in place of the furnaces). Reverting back to the hydro air plan would allow for the integration of a range of alternative and renewable energy systems, which could ultimately reduce heating and cooling costs as well as minimize the greenhouse gas emissions associated with building operations. Two great options that would become available in this case would be a wood pellet boiler or a combined heat and power system (CHP also known as Cogeneration). If this option of replacing the furnaces with air handlers was to be seriously considered, a careful "cost benefit" and "life cycle" analysis would have to be performed in order to make a fully educated decision.

Electrical:

There is room for reducing the electrical expenditures of this facility which could involve a variety of projects. The first line of defense always centers around behavioral change. Most modern electronics will still draw a small amount of electricity when powered down. Making use of power strips, and cutting power to electronics will serve to reduce this unintended energy consumption.

All of the previously mentioned improvements to the building envelope will have positive effects on the cooling load in regards to external gains. It is also important to remember that internal heat gains (lighting, electronics, appliances, personnel, etc.) are a major component to the amount of electricity needed to keep the building cool and comfortable. Many of these internal gains can be reduced by the same behavioral changes previously mentioned. During the cooling months, if lights are shut off in rooms that are not in use, the cost to light the fixture is eliminated, and the heat from the fixture (adding to the cooling load) is also eliminated. This is same for computers, printers, paper shredders, and so forth.

Health, Safety and Comfort:

This new facility seems to be safe and healthy work environment. The image to the right shows the only obvious safety concerns noticed during our inspection of the facility. What is seen here is a gasoline powered piece of equipment sitting directly next to an open combustion appliance (LP fired hot water heater. This closet should be clear of any other sources of flammable fumes, and it should tested to ensure that the hot water heater has enough combustion air under worse case conditions.

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 15. 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.

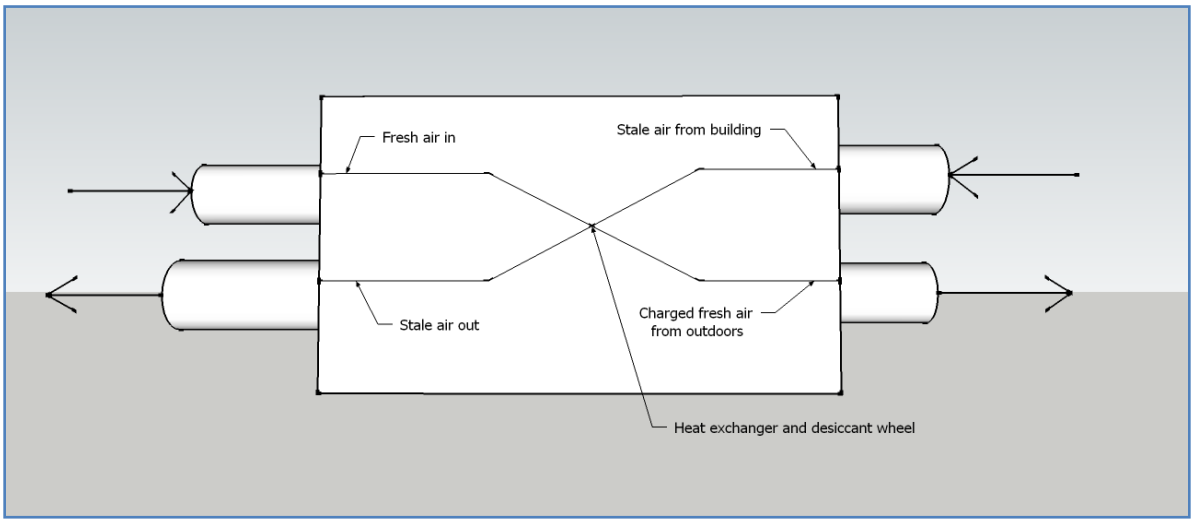


Figure 15

Recommendations:

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

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

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

Foundation:

- Confirm with the builder and/or architect whether or not the concrete slabs of the building were insulated. Insulate the perimeter of the slabs/foundations if this has not been done.

Exterior Walls:

- Investigate the long term cost benefit of super-insulating the exterior walls of this building. The best way of doing this may be to apply 2-4 inches of rigid foam board to the exterior. This will likely be a project with a relatively long payback period, but this building also likely has a 50 year plan, and could be under Town ownership and operation even beyond this.

Ceilings and Attic:

- Air seal any penetrations from the 1st floor to the attic space.
- Air seal between the top plate of the exterior walls and the proper vents. Add and additional length of proper vent to the existing.
- Build raised catwalks in the attic from the furnace room to any areas that may need to be accessed for regular service.
- Blow an additional 12 inches or more of loose-fill cellulose insulation on top of the existing loose-fill fiberglass.
- Remove the fiberglass batt insulation from the sides and top of the furnace room. Apply a minimum of 4 inches of closed-cell spray foam to the walls and ceiling. Make sure that all components of the wooden frame are covered with a minimum of 1 inch of foam. Covering the lengths of ductwork running outside of this room may also be appropriate.

Doors and Windows:

- If the exterior walls of this building are someday super-insulated, it may also then be beneficial to install higher efficiency doors and windows. Otherwise, make sure that the current doors and windows offer a good air seal when closed.
- Continue to make good use of window shades, both for insulation purposes in the winter, and to help reduce cooling loads in the summer.
- Maintain appropriate procedures for the opening and closing of garage doors in order to minimize this aspect of the buildings energy loads.

Mechanical:

- Devise a way to make the furnace room easier to access. It is currently quite difficult, which may inhibit how often the equipment can reasonably be serviced.
- Make sure that all of the furnace cabinets and related ductwork are as well sealed as possible.
- Change the air filters in furnaces according to manufacturer recommendations, or more often if needed. Doing so will help to ensure that this equipment is operating as efficiently as possible, as well as prolong its useful life.
- Make sure that the gas lines are checked once a year for leaks and that even the smallest leaks are addressed.
- Consult with a ventilation specialist about incorporating either heat or energy recovery ventilators to replace the current method of fresh air supply. Be sure to inquire about the possibility of using smaller residentially sized units associated with each of the five furnaces. Regardless of type and size, expanding the size of the furnace room to house a new ventilation system would be beneficial.
- Whether keeping the existing ventilation system, or incorporating a more sophisticated system, consider moving the fresh air supply hood further away from the 5 concentric furnace vents. The distance was measured, and seemed to be just far enough away to comply with manufacturer specs and building codes. Moving the two further apart, much greater than the minimum allowed, would offer more assurance that combustion gases are not re-entering the supply end of the forced-air system.
- Shut off the gas supply to the space heater in the sally port during non-heating months.
- Find out if R-22 coolant is still being used in the cooling systems line sets. Make sure that the service technician reports any leaks, and that they are properly addressed.
- If any of the furnaces or outdoor condensing units need to be replaced, only purchase the highest efficiency equipment available. The greater initial investment will ensure the maximization of energy savings potential over the life of the equipment.
- Replace the current potable hot water system with a solar powered system. As the price of LP gas continues to make a steady rise, taking advantage of this natural resource and technology will without doubt produce measurable savings.
- If a major heating system replacement is considered in the future, make sure that a combined heat and power system (CHP or cogeneration) is considered for system integration. Given the type of facility, electric costs will always be a major factor going forward.

Electrical:

- The first line of defense against electric costs is always behavior change. Making sure that lights and electronics are not drawing power when they are not needed can have a

large impact on electric costs over a year's time. Remember that in the summer months this will also reduce the electric cost to cool the facility.

- Only purchase the most efficient Energy Star rated electronics when buying new, or replacing old, equipment.
- Investigate the cost benefit of replacing the security lighting of this facility with LED options. This includes all of the parking lot lights, and those lining the police exit road. Given that these lights are likely on every night for the entire year, installing the most efficient light sources available will have the greatest benefit. As more tested LED options for interior lighting become available, investing in this will not only lead to greater reduced lighting costs, but also reduced cooling costs.
- Installing a photovoltaic solar system on site, either to meet the needs, or supplement the costs of electricity is always recommended. Options for funded such a project are given in the next section of this report.

Health and Safety:

- Remove any sources of flammable gases from the hot water heater closet.
- Always put occupant health and safety first, even before energy efficiency.

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:

Many 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 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

From PSNH's Program website:
PSNH's municipal customers have the opportunity to install energy saving measures with no upfront costs - through our Smart Start Program. Payment for services and products are made over time with the savings obtained from lower energy costs.

Here's how it works:

PSNH applies rebates for all eligible retrofit measures.
PSNH finances the remaining costs associated with the purchase and installation of approved measures.

A Smart Start Purchase and Installation Charge, calculated to be less than the monthly savings, is added to your monthly electric bill until all costs are repaid.
The new energy efficient, environmentally friendly equipment you install through this program pays for itself over time.

For NH Electric Coop Customers:
Contact Member Solutions at 1.800.698.2007
Visit - www.nhec.com/energy_efficiency_programs.php

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

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

We can provide a free energy audit and report of recommended energy efficiency improvements
We pay 50% of the cost of the installation of energy efficient equipment and you can finance the remaining 50% interest free for up to 24 months.
Cost-cutting, energy efficient equipment available through this program include:
Lighting Upgrades
Energy Efficient Time Clocks
Photo Cells For Outdoor Lighting
Occupancy Sensors
Programmable Thermostats
Walk-in Cooler Measures

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

Third-Party Financing Options:

The most important part to understanding the potential in third-party is the ability to address up front capital costs and access tax benefits. Additional benefits are potential operations and maintenance savings where the implementation is owned by a third-party. In the three-party model, new businesses create an income stream and take over the insurance, performance

assurance, and maintenance of the renewable energy system. New jobs and local investment follow. The business secures stable and long-term funding enabling expansion to other facilities for similar projects.

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

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

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

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

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

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

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

Energy Price Stability –

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

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

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

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

Price Summary

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

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

Table 3 - Retrieved from US EIA website

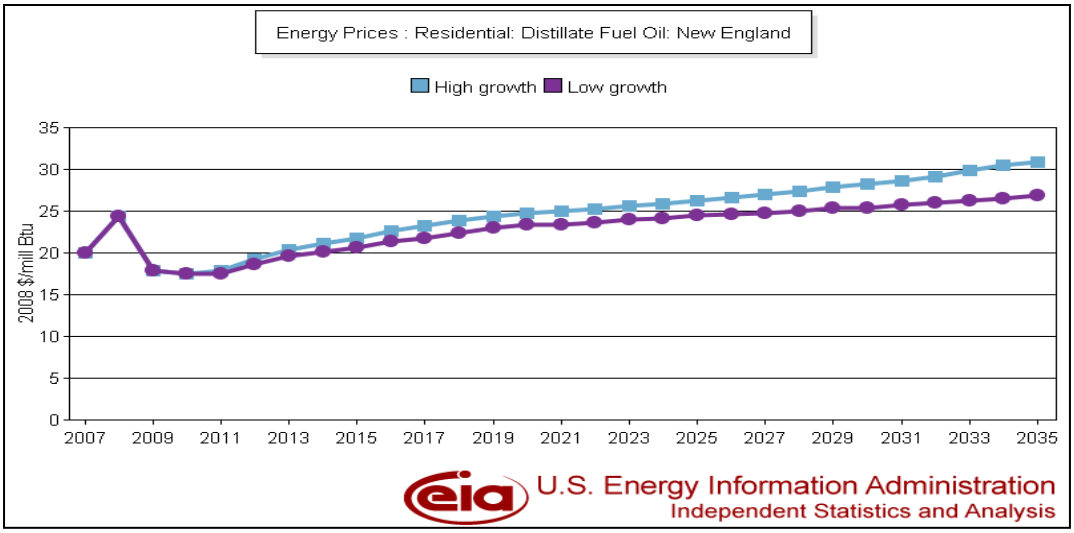


Table 4 - Retrieved from US EIA website

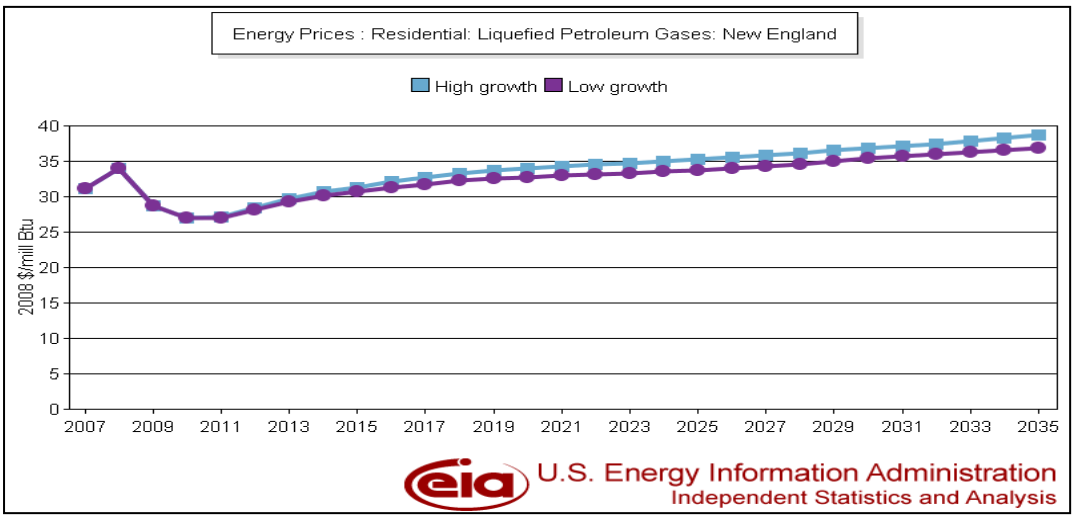


Table 5 - Retrieved from US EIA website

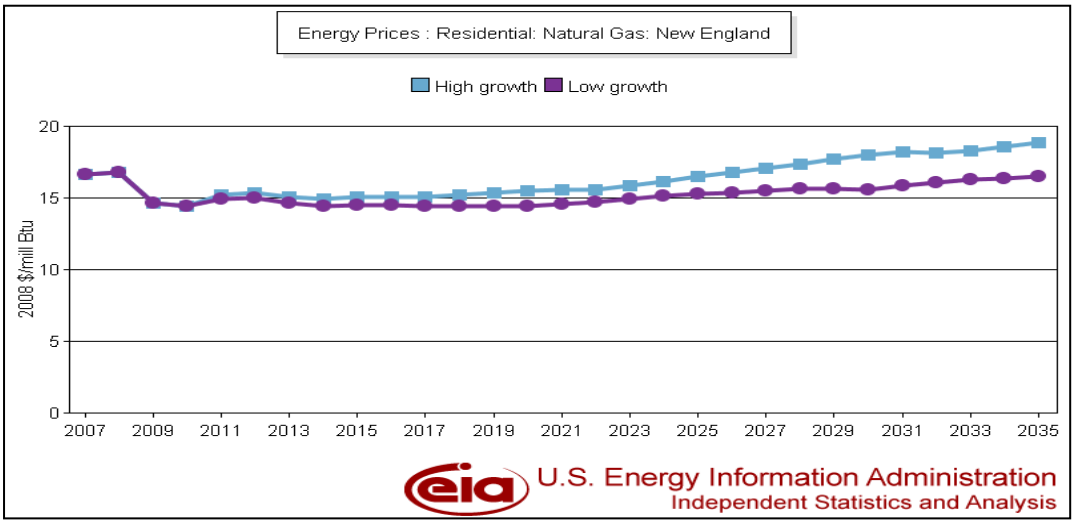


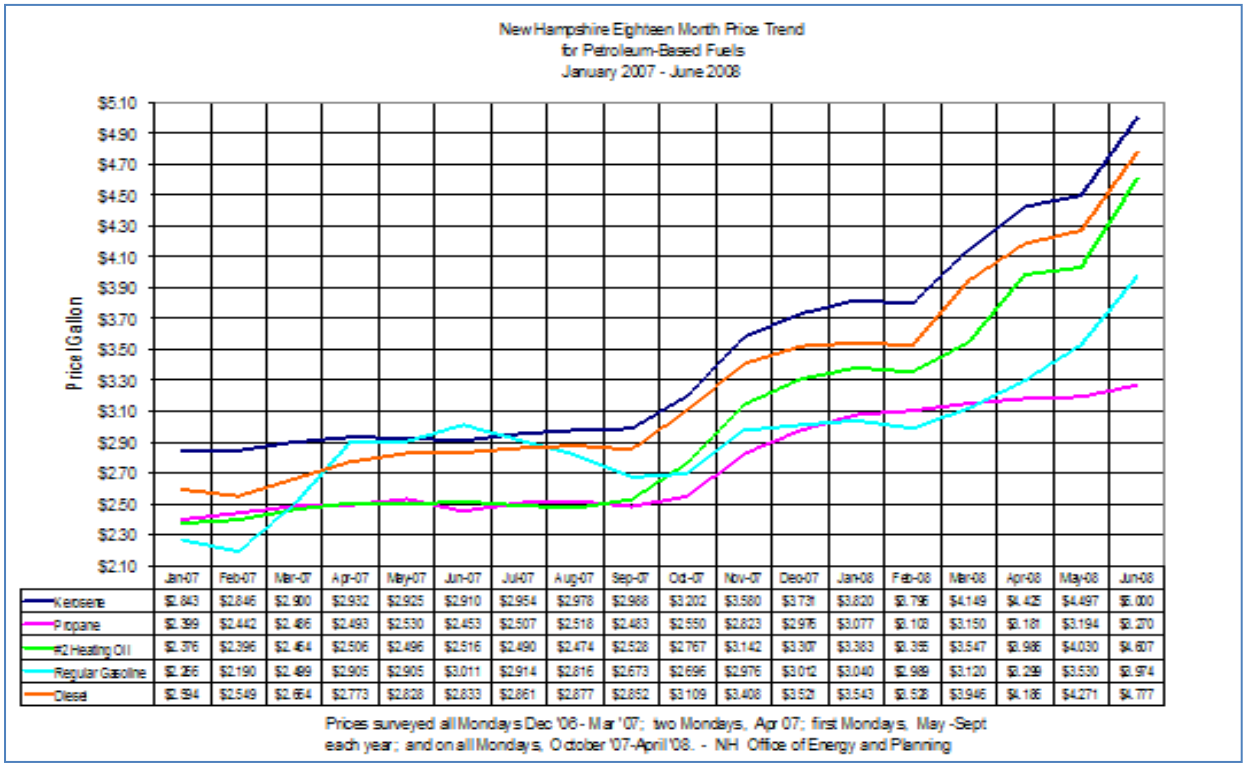
Table 6 - Retrieved from US EIA website

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.

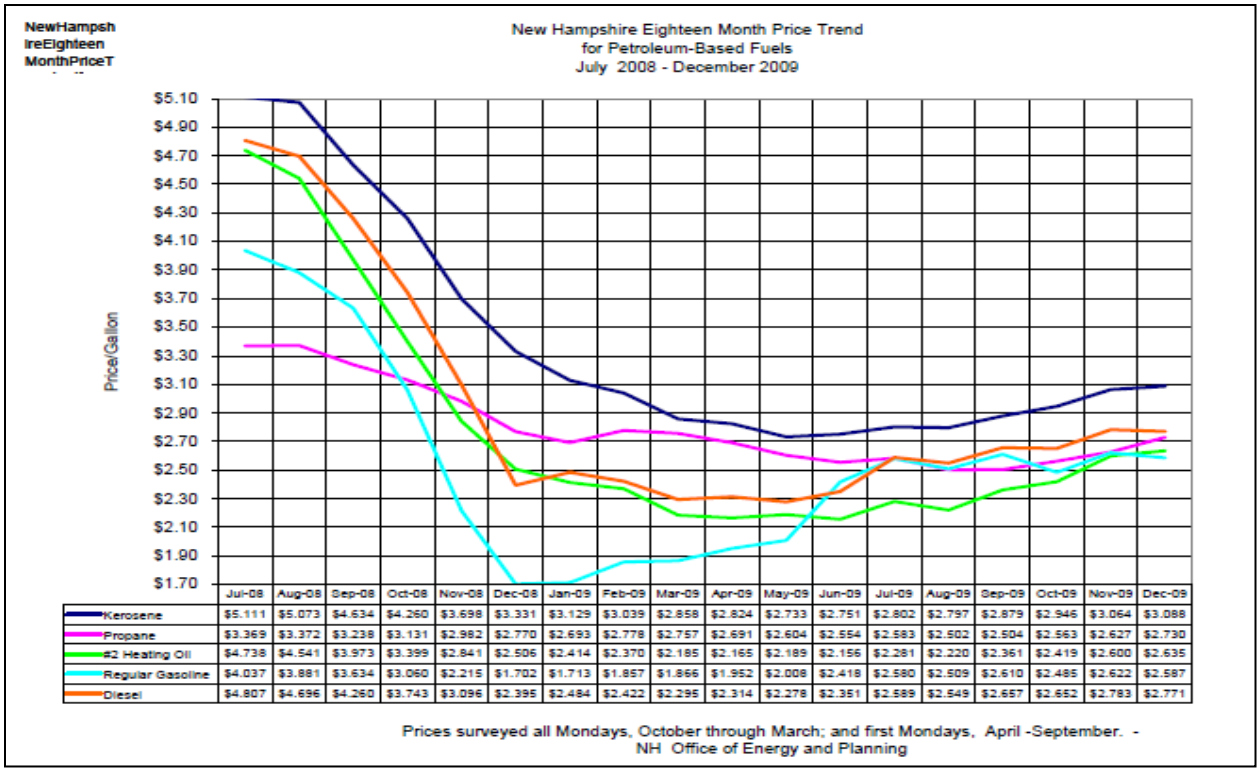
Projects such as air-sealing and insulating can be thought of as a different species of project and investment when compared to items like heat systems, appliances, and alternative energy systems. In the case of the latter, these types of energy investments have a shelf life. A boiler and a PV system 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.



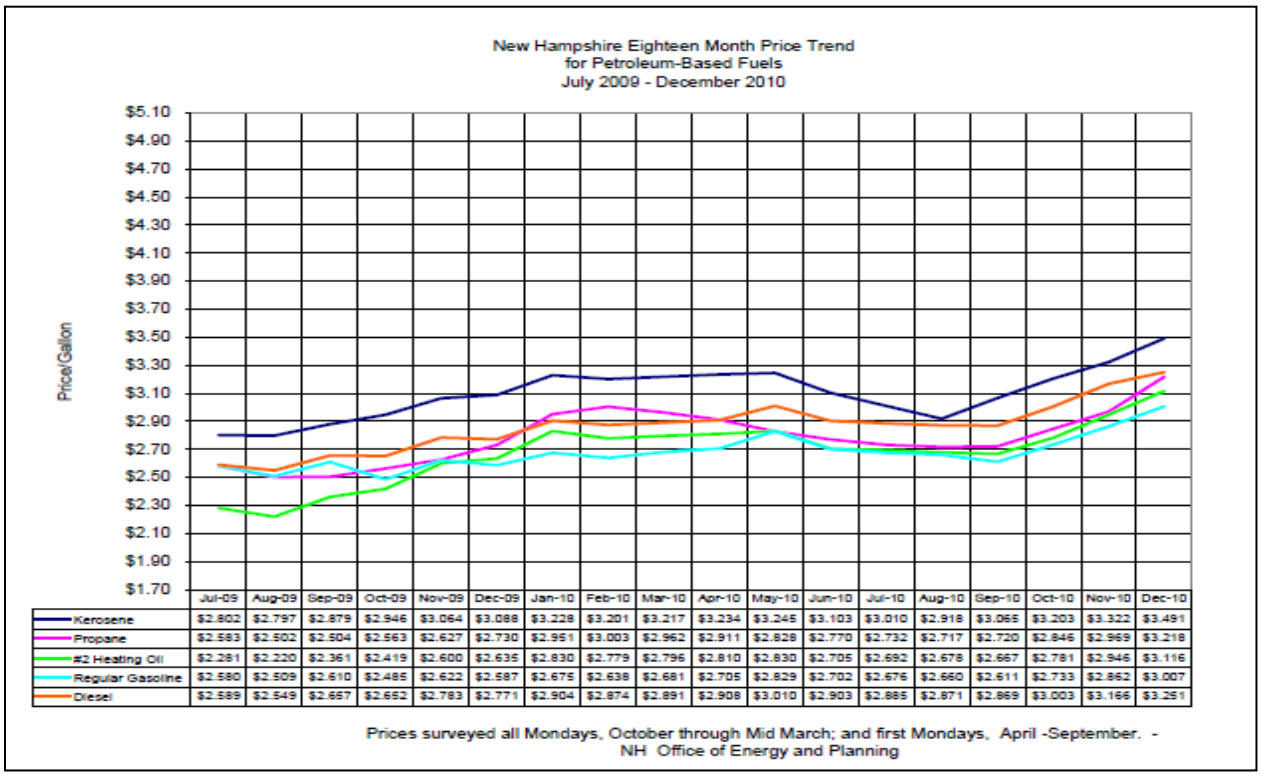
	Jan-07	Feb-07	Mar-07	Apr-07	May-07	Jun-07	Jul-07	Aug-07	Sep-07	Oct-07	Nov-07	Dec-07	Jan-08	Feb-08	Mar-08	Apr-08	May-08	Jun-08
Kerosene	$2.843	$2.846	$2.900	$2.932	$2.925	$2.910	$2.954	$2.978	$2.988	$3.202	$3.580	$3.731	$3.820	$3.796	$4.149	$4.425	$4.497	$5.000
Propane	$2.399	$2.442	$2.486	$2.493	$2.530	$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	$2.256	$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	$2.654	$2.773	$2.828	$2.833	$2.861	$2.877	$2.852	$3.109	$3.408	$3.521	$3.543	$3.523	$3.946	$4.186	$4.271	$4.777

Table 7 - 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

Table 8 - 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

Table 9 - 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 2010

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 16 – 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.

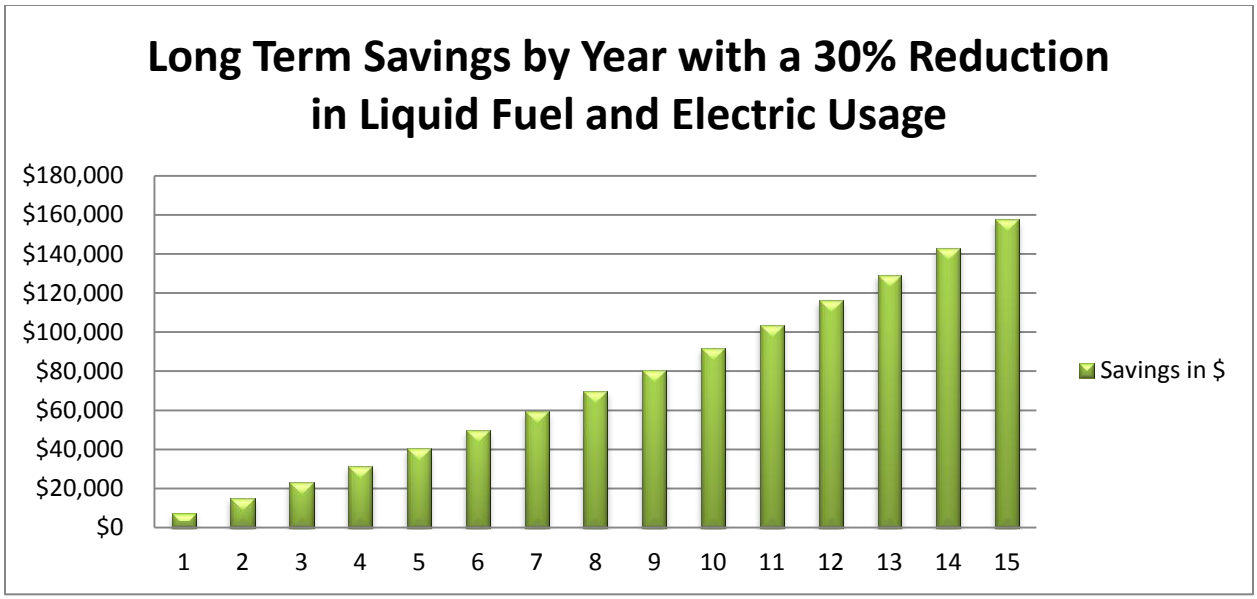
Current Fuel Usage				
Year	Energy Cost By Year	Yearly Increase	Total Accumulated Cost by Year	
		Escalation Rate	5.00%	
Year 1	$12,897.07	$ 644.85		$12,897
Year 2	$13,542	$ 677.10		$26,439
Year 3	$14,219	$ 710.95		$40,658
Year 4	$14,930	$ 746.50		$55,588
Year 5	$15,676	$ 783.82		$71,264
Year 6	$16,460	$ 823.01		$87,725
Year 7	$17,283	$ 864.17		$105,008
Year 8	$18,147	$ 907.37		$123,155
Year 9	$19,055	$ 952.74		$142,210
Year 10	$20,008	$ 1,000.38		$162,218
Year 11	$21,008	$ 1,050.40		$183,226
Year 12	$22,058	$ 1,102.92		$205,284
Year 13	$23,161	$ 1,158.06		$228,446
Year 14	$24,319	$ 1,215.97		$252,765
Year 15	$25,535	$ 1,276.77		**$278,300**

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	$11,440.00	$ 572.00		$11,440
Year 2	$12,012	$ 600.60		$23,452
Year 3	$12,613	$ 630.63		$36,065
Year 4	$13,243	$ 662.16		$49,308
Year 5	$13,905	$ 695.27		$63,213
Year 6	$14,601	$ 730.03		$77,814
Year 7	$15,331	$ 766.53		$93,145
Year 8	$16,097	$ 804.86		$109,242
Year 9	$16,902	$ 845.10		$126,144
Year 10	$17,747	$ 887.36		$143,891
Year 11	$18,635	$ 931.73		$162,526
Year 12	$19,566	$ 978.31		$182,092
Year 13	$20,545	$ 1,027.23		$202,637
Year 14	$21,572	$ 1,078.59		$224,208
Year 15	$22,650	$ 1,132.52		**$246,859**

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 - LP Gas 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	$7,301	$ 365.06		$7,301
Year 2	$7,666	$ 383.31		$14,967
Year 3	$8,049	$ 402.47		$23,017
Year 4	$8,452	$ 422.60		$31,469
Year 5	$8,875	$ 443.73		$40,343
Year 6	$9,318	$ 465.91		$49,662
Year 7	$9,784	$ 489.21		$59,446
Year 8	$10,273	$ 513.67		$69,719
Year 9	$10,787	$ 539.35		$80,506
Year 10	$11,326	$ 566.32		$91,833
Year 11	$11,893	$ 594.64		$103,725
Year 12	$12,487	$ 624.37		$116,213
Year 13	$13,112	$ 655.59		$129,325
Year 14	$13,767	$ 688.37		$143,092
Year 15	$14,456	$ 722.79		**$157,548**



As one 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 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.