The New Hampshire Municipal Energy Assistance Program

Investment Grade Audit Report

Tuftonboro Town House
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Tuftonboro, NH 03816

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Town of Tuftonboro, NH

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Clean Air Cool Planet

Sustainable Energy Resource Group
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2/09/2011

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 Tuftonboro 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 Tuftonboro.

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Introduction:

MEAP partners are pleased to provide this Investment-Grade Audit Report for the Town of Tuftonboro and the Townhouse (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 and occupancy health risks. 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 an Investment Grade Audit (IGA) combines the first and second steps 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 IGA serves to aid in "deciding," or sorting through potential projects and further examines actual cost and expected savings.

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 IGA 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.

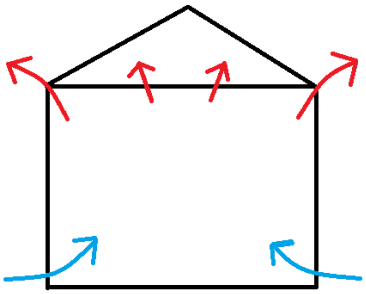
This IGA involves a quantification of energy usage (electrical and heating fuel), a description of existing heating/cooling and distribution systems, thermal barrier inefficiencies, potential electric savings through lighting/appliances upgrades and behavior change, occupancy health and safety concerns, 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 include information on estimates for the cost of implementation and will include estimated energy savings. These details will be needed to participate in 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.

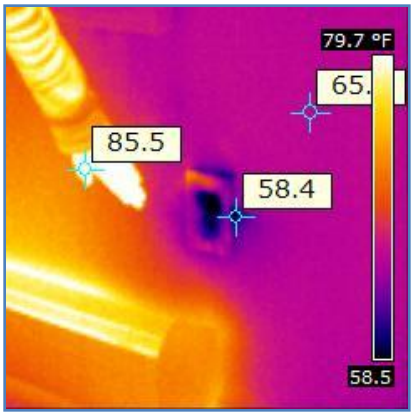
Heat moves through and leaves a building by three different means: *convection, conduction, and radiation*. One way to think of **convective** heat loss is by air movement into and out of a structure. One of the forces causing this to happen is the "stack effect".



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.

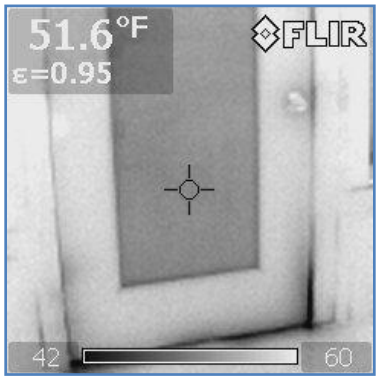
Conduction is the foremost way in which heat travels through a solid building material. R-value is one way to describe a given materials resistance to transfer heat. Materials with a high R-value, such as foams, cellulose, or fiberglass batts are used for insulation. At any location in the building envelope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

The Town House an approximately 1930 square foot structure used for a variety of functions such as, selectman, club, Scout and other meetings. It is also where town elections are held. The original structure was built in 1806 with a more recent addition added to the back of the building that includes a small kitchen, (2) bathrooms, closets and a basement for heating and domestic hot water systems. The original structure's siding is narrowly spaced clapboard; the interior walls are finished with solid pine paneling. The addition's siding is vinyl with interior drywall. Except for a several areas near grade the siding is in good condition. The roof is also in good condition.

Figure 1

Figure 4
Figure 2

Figure 3

Figure 5

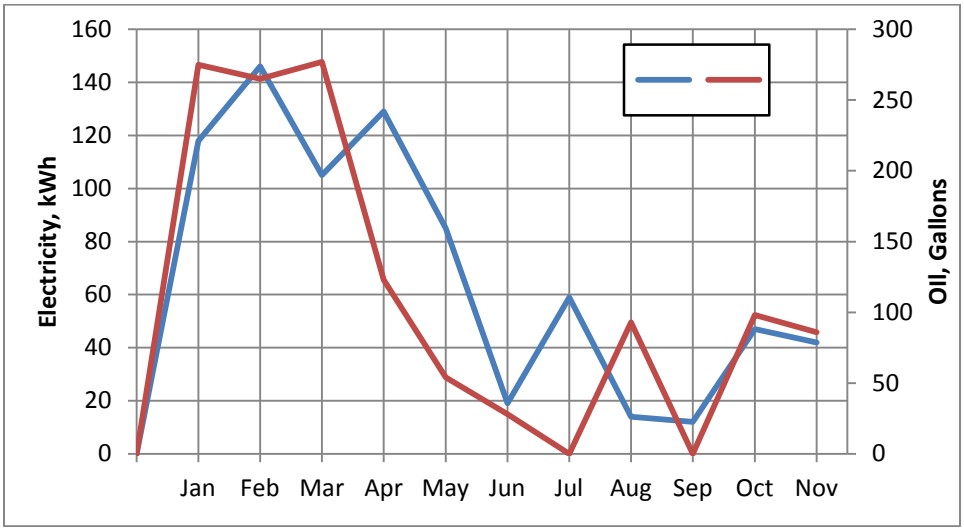
Figure 6

Figure 7

Energy Data Collection:

Meter: Electric			
Building: Tuftonboro, NH Town House			
Fuel Type: Electricity, Grid Purchase (kWh (1000 Watt-hours))			
Space(s): Entire Facility			
Start Date	**End Date**	**Energy Use**	**Cost - US Dollar**
12/1/2009	12/31/2009	77	$33.13
11/1/2009	11/30/2009	42	$27.49
10/1/2009	10/31/2009	47	$27.79
9/1/2009	9/30/2009	12	$21.91
8/1/2009	8/31/2009	14	$22.23
7/1/2009	7/31/2009	59	$29.43
6/1/2009	6/30/2009	19	$23.04
5/1/2009	5/31/2009	85	$33.57
4/1/2009	4/30/2009	129	$40.57
3/1/2009	3/31/2009	105	$38.43
2/1/2009	2/28/2009	146	$45.62
1/1/2009	1/31/2009	118	$39.37
2009 Total		**853**	**$ 382.58**

Meter: Heating Oil			
Building: Tuftonboro, NH Town House			
Fuel Type: Fuel Oil, No. 2 (Gallons)			
Space(s): Entire Facility			
12/1/2009	12/31/2009	107	$234.38
11/1/2009	11/30/2009	86	$190.12
10/1/2009	10/31/2009	98	$221.76
9/1/2009	9/30/2009	0	$0.00
8/1/2009	8/31/2009	93	$209.09
7/1/2009	7/31/2009	0	$0.00
6/1/2009	6/30/2009	28	$49.00
5/1/2009	5/31/2009	54	$214.83
4/1/2009	4/30/2009	123	$484.54
3/1/2009	3/31/2009	277	$1,092.29
2/1/2009	2/28/2009	265	$1,046.09
1/1/2009	1/31/2009	275	$1,085.97
2009 Total		**1406**	**$ 4,828.07**



Blower Door Test:

A blower door test is used to measure the amount of air infiltration into the building. Air infiltration is often one of the greatest sources of energy lose, especially in older buildings. The blower door test uses a powerful fan to depressurize the structure (though is some cases the direction of the fan can be reversed and the structure pressurized). All operable openings are closed then outside air is drawn into the building's envelope through gaps around windows and doors, siding, wall sheathing, porous materials such as fiberglass and some types of cellulose insulation. This "exaggerated" but instrumented condition provides data needed to estimate actual air infiltration under normal conditions and also makes it easier to identify actual locations of where air is entering the building.

Figure 8

Figure 9

The blower door test measured 5375 Cubic Feet per Minute (CFM) of air flow at 50Pa of negative pressure. This converts to an estimate of 363 CFM under natural conditions. Using this number and the conditioned volume of the building there are approximately 1.3 air changes per hour. This means that the all of the air is replaced by air infiltration more than once per hour. This level of air exchanges is about 3 ½ times higher than required by ASHRAE 62.89 ventilation standards, and represents are large source of energy loss.

The following images indicate a number of the most noticeable air infiltration locations.

Figure 10

Figure 11

Figure 12

Figure 13

Figure 14

Foundations, Floors, crawl spaces, and/or Basements:

The original structure is built upon a stone foundation with crawl space beneath. The addition uses a standard poured foundation with a small but full height basement. Although there was once access to the crawl space beneath the original structure it is now no longer accessible, preventing inspection of this space. The foundation appears to be in good condition however from what we can tell, it is completely uninsulated and is a source of significant heat loss. (Fig 18)

Figure 16

Figure 15

Figure 18

Figure 17

Recommendations

1. Crawl Space
    a. Create access to the crawl space and inspect structural and general conditions. Take action as necessary.
    b. Apply an 8 to 10 mil thick plastic vapor barrier to the ground and up the walls of the foundation approx 6”. All seams should be sealed including around support posts and other obstacles

   c. Apply 2” of spray polyurethane foam to walls and rim joists, overlapping onto the plastic sheeting.
   d. Install a ventilation fan between the crawlspace and the conditioned space above. (required by code).
2. Boiler Room Basement
   a. Insulate the walls using a rigid foam product such In-So-Fast Engineered Insulated Panels which are bonded to the concrete.
   b. Apply 2” spray foam to the rim joists, covering the sill plate and stopping at the top edge of the rigid foam wall panels.
   c. Cover exposed wall and spray foam insulation with at least ½” thick drywall. (Required by code). In-So-Fast Panels allow for drywall to be screw directly to embedded plastic structure speeding installation and reducing material cost.

Exterior Walls:

The exterior walls of the original structure are constructed of painted wood clapboard. The addition uses vinyl siding. In general the siding is good condition however there are several places where rot has set in and should be addressed. (Figs 19 & 21) The walls of the addition are insulated however, after using a borescope, no insulation was found in the original structure. Naturally an absence of insulation provides an easy path for heat to escape.

Recommendations

1. Insulate exterior walls of the original structure with blown-insulation. This is typically done by removing several pieces of clapboard, drilling a series of injection holes and blowing in insulation until the wall cavity is filled then replacing the clapboard.
2. Repair rotten areas and consider improving drainage and installing gutters where needed to reduce ground level moisture levels.

Figure 19

Figure 20

Figure 21

Figure 22

Ceilings and Attic:

The attic area is an interesting space. It is loaded with mechanical and other artifacts going back decades! Access is gained via a ladder and removable panel. The most obvious occupant is a no longer operable forced hot air system (Figs 24 & 25). Although there are fiberglass batts throughout, the space is greatly under-insulated. (Fig 27 & 30) Many gaps are plainly visible between the insulation and joists. (Fig 31) Arguably the most significant energy issue is air leakage from the conditioned space below. The ceiling being constructed of individual boards allows for hundreds of places for warm air to leak into the attic space. (Figs 26 & 28)

Figure 23

The kitchen and bathroom ceilings show signs of water damage coming the attic space. (Fig 32) The addition attic space is also inadequately insulated, including the access door itself. A number of the Styrofoam Cora-Vents used in the winter to keep warm air from condensing on the cold underside of the roof sheathing are crushed or blocked by insulation. (Fig 29)

Figure 24

Figure 25

Figure 26

Figure 28

Figure 27

Figure 29

Figure 30

Figure 31

Figure 32

Recommendations

1. Remove unused forced hot air system and ductwork from attic.
2. Remove all fiberglass batt insulation from original structure attic and set aside.
3. In original attic space, apply 1" thick air-sealing layer of polyurethane spray foam (R6 per inch) to top surface of ceiling wood paneling.
4. Apply minimum of 18" of loose fill fiberglass or cellulose (R3 per inch) insulation, reusing and substituting fiberglass batts as possible.
5. Determine source of water damage in kitchen and bathroom ceilings and respond accordingly.
6. In kitchen and bathroom attic reposition insulation, extend Cor-A-Vents and add additional insulation.
7. Construct or install attic access doors suitable for highly insulated areas.

Doors and Windows:

Most of the windows in the original structure are poorly sealed sash units with aluminum triple storm windows. These windows allow for significant air leakage and have a low R value compared to replacement windows. The kitchen, bathroom, one of the meeting room and basement windows are double paned units and appear to be in good working condition. The two doors on the first floor are also in good condition. The basement door beneath the bulkhead door is in need of replacement.

Figure 33

Figure 34

Figure 35

Figure 36

Figure 37

Figure 38

Recommendations

1. Replace all triple track storm and single pane sash windows found in original structure with double or triple pane low-e argon filled units.
2. Replace the basement door with an insulated unit, preferably fiberglass frame for higher R value and corrosion resistance.

Mechanical:

For many years and up through the energy audit site visit, an oil–fired boiler supplied hot water to baseboard radiators for general space heating. (Fig 39) Through a federal grant, the fossil fuel unit has since been replaced with a wood pellet boiler as shown below in Fig 42. It is interesting to note the extremely long radiators runs though out the building, suggesting very high heat loads or in other words, high heat loss. (Fig 40)

The thermostat is a standard, manually-set device. (Fig 41) Although users are requested to turn down the set point when the building is unoccupied this does not always occur.

Figure 39

Figure 40

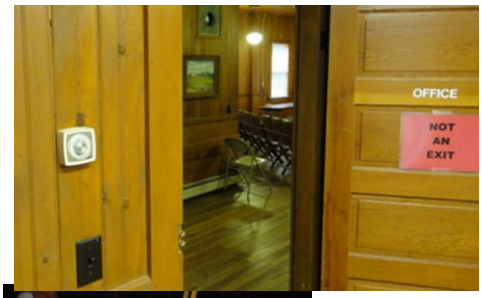


Figure 41

Figure 42

Figure 43

Reco

mmendations:

1. Replace thermostats with setback / programmable devices to reduce energy use during unoccupied hours.

Electrical & Lighting:

The electrical panel is small by today's standards but appears to be adequate for the loads. (Fig 43) Lighting in the main room is provided by high efficiency CFLs that appear to be working well. (Fig 44) Side rooms however use older styles of 4 foot tubes, some of which are not functioning. (Fig 45) Water is supplied from a submersible well pump. Pump controls and pressure tank are shown below. (Fig 46)

Figure 44

Figure 45

Figure 46

Recommendations

1. Replace 4 foot long tube-style florescent lights with energy efficient T8 or T8 Super fixtures.

Health, Safety and Comfort:

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. (Fig 47) 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.

Currently, air filtration in the Town House is so high there is no need for mechanical ventilation as plenty of fresh air is coming in on its own. After air sealing, this condition may change

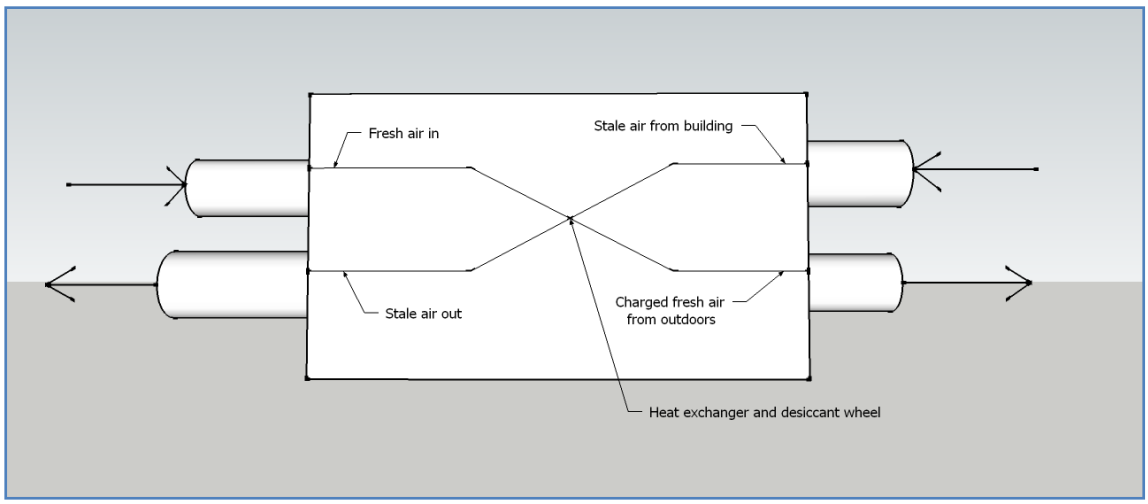


Figure 47

Recommendations

1. After air sealing, another blower door test should be conducted to not only verify the success of the air sealing efforts but to also determine if mechanical ventilation is required. If it is, install an HRV and suitable duct work to provide fresh air and to remove odors. The number of air changes per hour (ACH) and can be controlled by a timer, occupancy, or CO2 sensor or all of the above.

Expected Energy Savings:

Wright Soft energy modeling software was used to determine the expected energy savings after implementation of energy-use reduction measures. It is estimated that if the energy reduction measures recommended in this report are implemented, there would be an annual savings of approximate 30 to 35%. Since the wood pellet boiler was recently installed we do not have numbers for the annual cost of pellets and therefore will look at predicted changes in oil usage and expected savings. The total 2009 fuel oil cost was $4828. Looking at the month to month bills, it is estimated that approximately $600 went towards domestic hot water during the non-heating months. DHW usage is very small as it is only needed for the kitchen and bathroom sinks however in the non-space heating months, without an indirect DHW loop and tank, the boiler must heat up a large thermal mass in order to create even a small quantity of hot water. If the oil boiler was still in operation this would translate to estimate annual savings of $1270 to $1480.

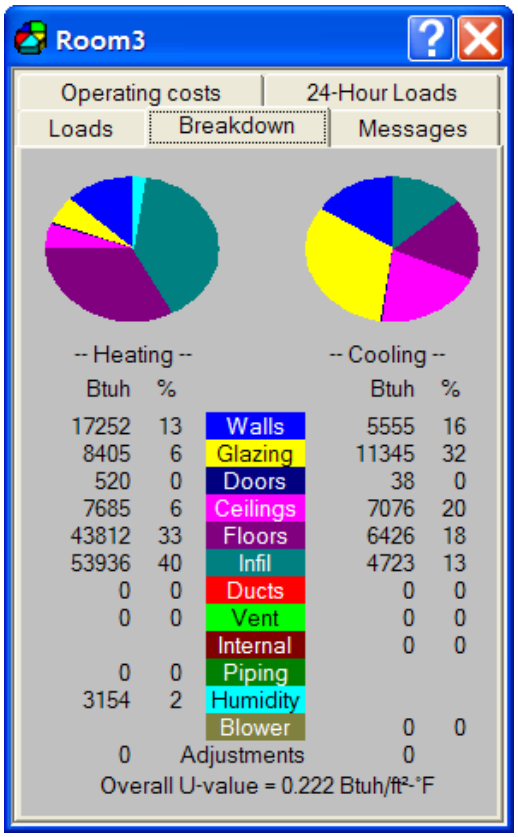


Figure 48 Before Energy Improvements in Meeting Room

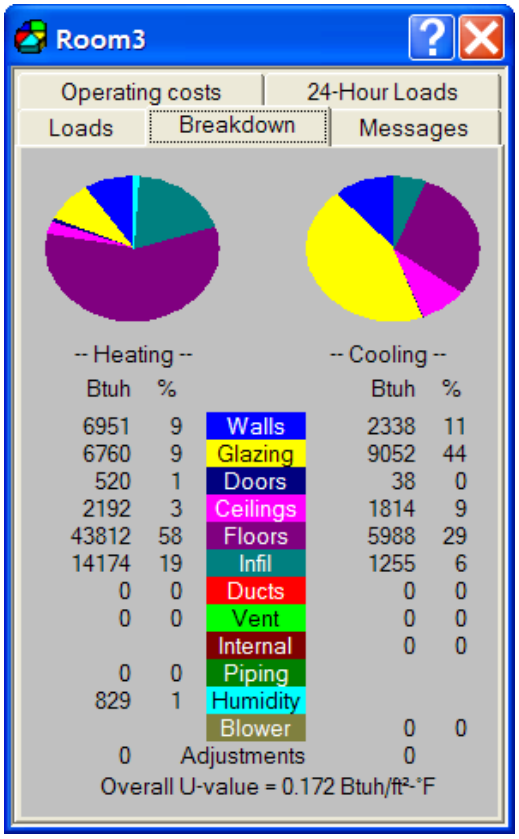


Figure 49 After Energy Improvements in Meeting Room

The cost of the energy savings measures are as follows:

Description	Cost	Comments
(10) Window Replacements	$2,950	Quality Insulation, Merideth, NH Quote # 542810
Insulation & Air Sealing (Walls, Crawl Space an Attics)	$ 9,255	Quality Insulation, Merideth, NH Quote # 542698
Removal of unused forced hot air system & debris in attic	$ 800	Estimate
Create crawlspace access	$ 700	Estimate
Total	$ 13,705	

Again, working with expected 2009 oil savings, the simple payback period for the recommended space heating related energy savings measures is between 9.3 and 10.8 years at current energy prices. Naturally, any increase in fuel prices shortens the payback period.

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

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/

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.

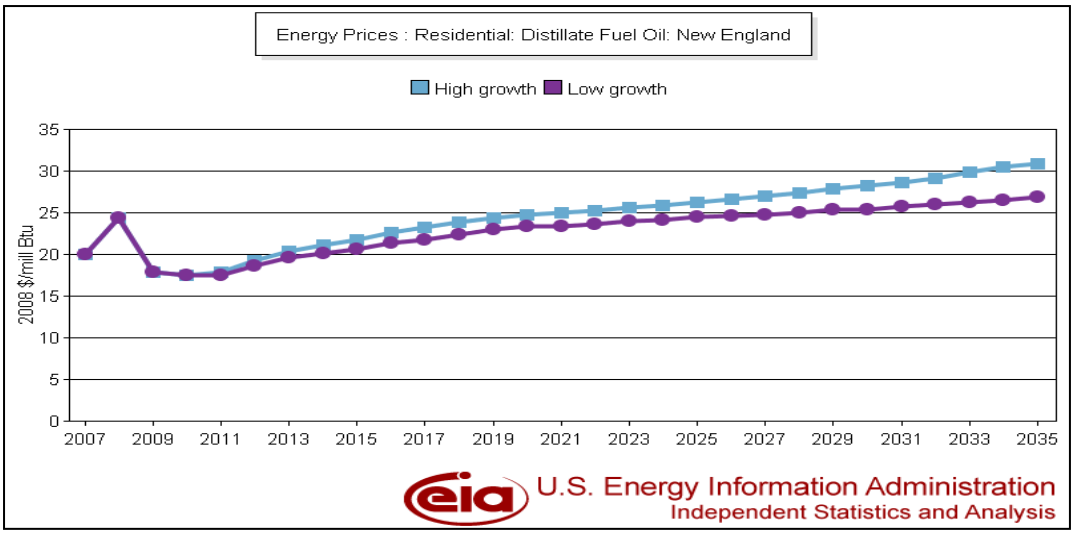
For more information on the history of energy prices and how energy cost projections are calculated, please visit: http://www.eia.doe.gov/analysis/

Price Summary

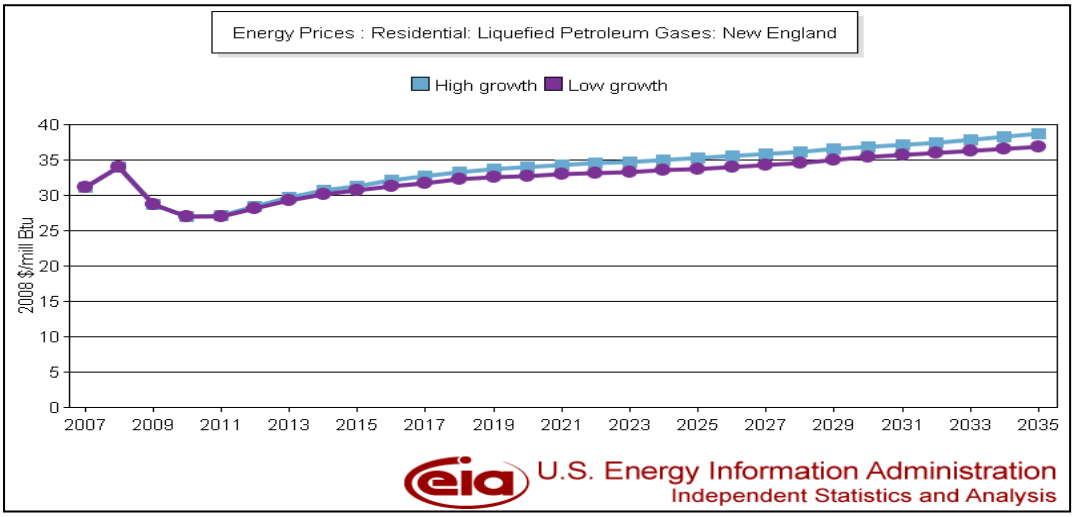
	Year				Percent Change		
	2009	2010	2011	2012	09-10	10-11	11-12
WTI Crude[a] ($/barrel)	61.65	79.40	93.26	97.50	28.8	17.5	4.5
Gasoline[b] ($/gal)	2.35	2.78	3.15	3.30	18.4	13.4	4.8
Diesel[c] ($/gal)	2.46	2.99	3.43	3.51	21.5	14.7	2.4
Heating Oil[d] ($/gal)	2.52	2.97	3.41	3.55	17.5	14.8	4.3
Natural Gas[d]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

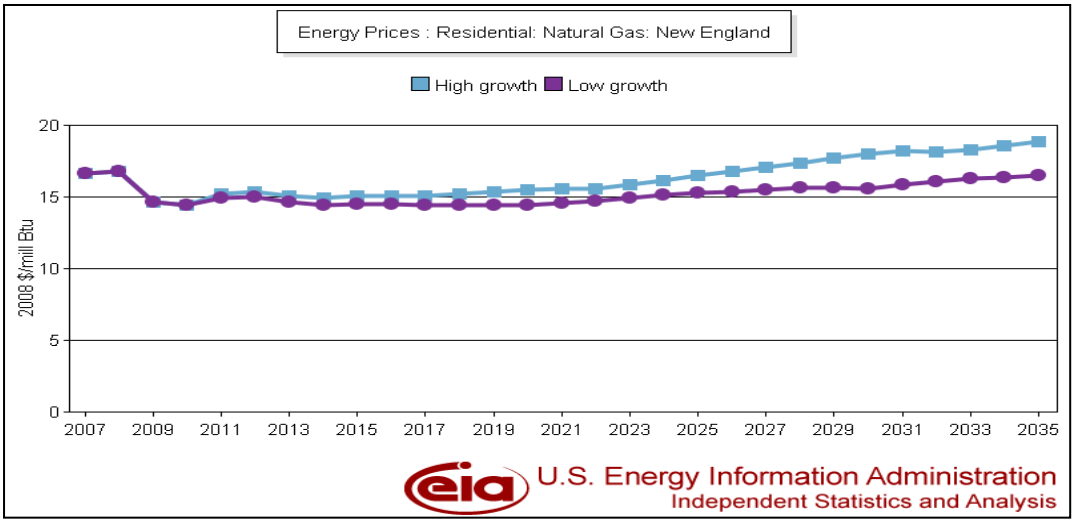
Table 1 – Retrieved from US EIA website



Graph 1 - Retrieved from US EIA website



Graph 2 - Retrieved from US EIA website



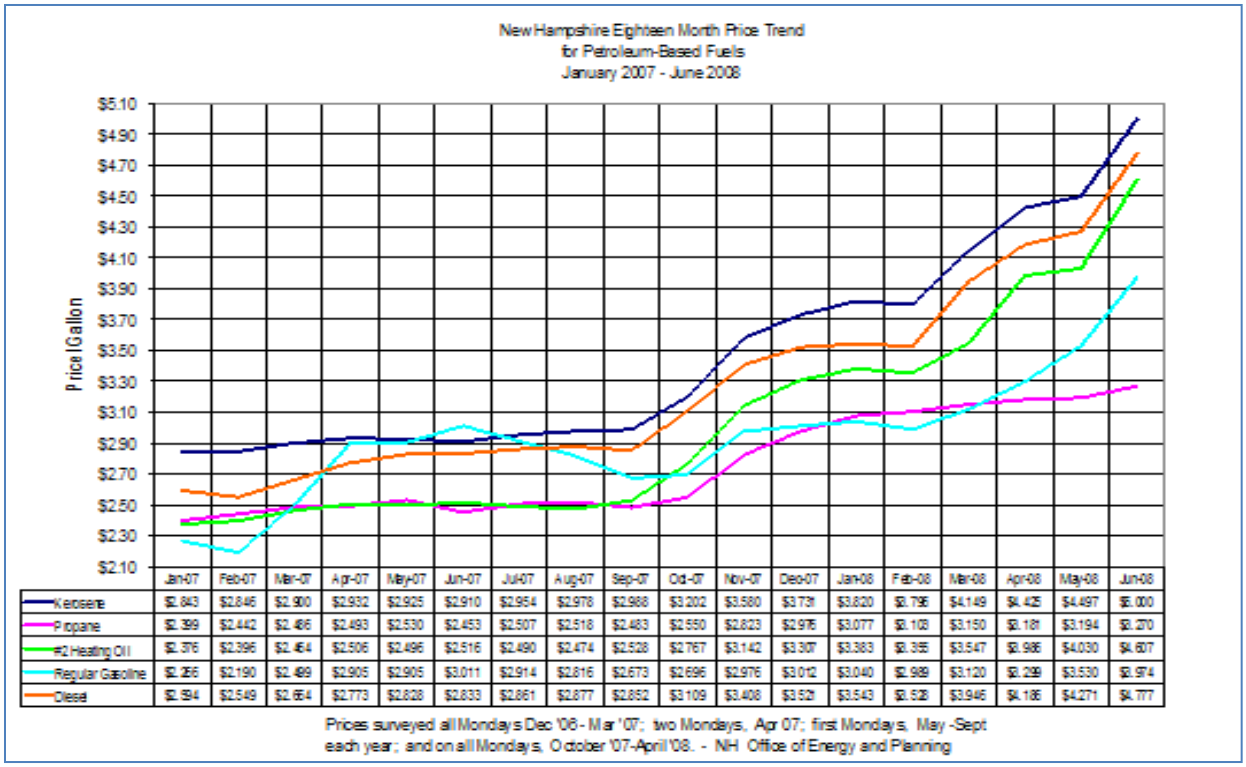
Graph 3 - Retrieved from US EIA website

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.

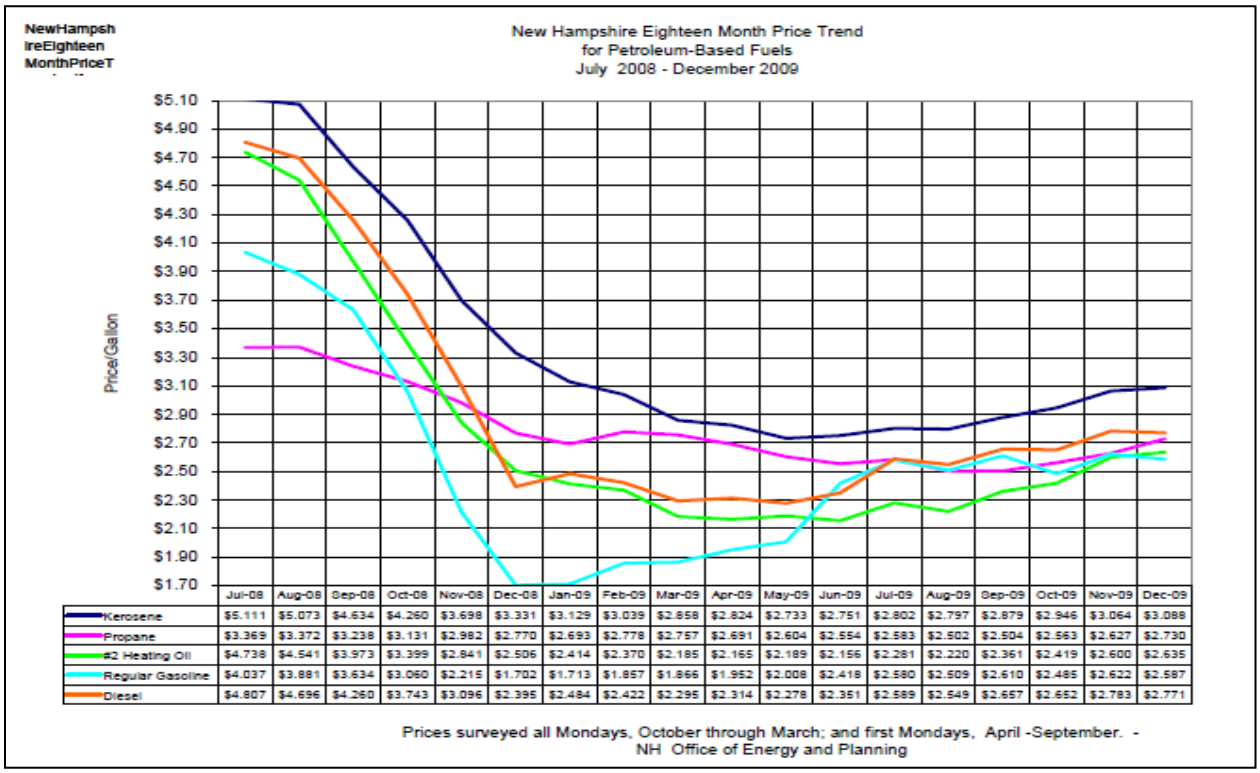
Projects such as air-sealing and insulating can be thought of as a different species of project and investment when compared to items like heat systems, appliances, and alternative energy systems. In the case of the latter, these types of energy investments have a shelf life. A boiler and a PV system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



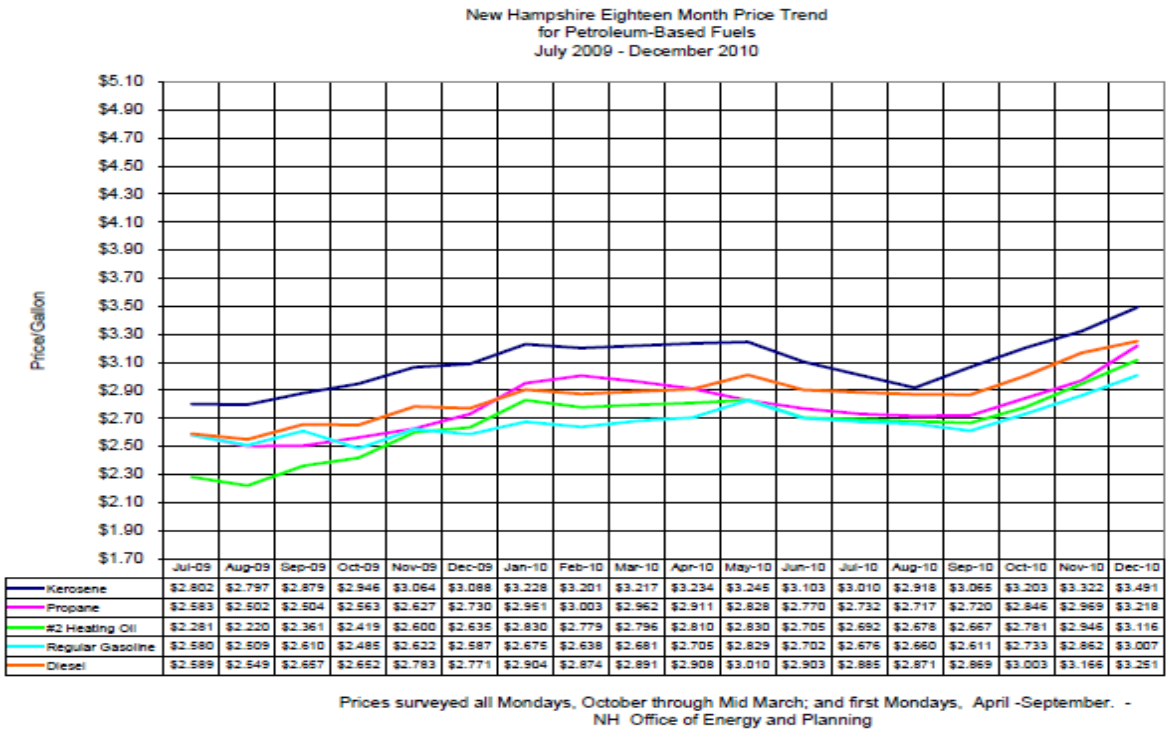
	Jan-07	Feb-07	Mar-07	Apr-07	May-07	Jun-07	Jul-07	Aug-07	Sep-07	Oct-07	Nov-07	Dec-07	Jan-08	Feb-08	Mar-08	Apr-08	May-08	Jun-08
Kerosene	$2.843	$2.846	$2.900	$2.932	$2.925	$2.910	$2.954	$2.978	$2.988	$3.202	$3.580	$3.731	$3.820	$3.795	$4.149	$4.425	$4.497	$5.000
Propane	$2.399	$2.442	$2.486	$2.493	$2.530	$2.453	$2.507	$2.518	$2.483	$2.550	$2.823	$2.975	$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	$2.654	$2.773	$2.828	$2.833	$2.861	$2.877	$2.852	$3.109	$3.408	$3.521	$3.543	$3.528	$3.946	$4.186	$4.271	$4.777

Figure 50 - Retrieved from NH OEP website



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

Graph 4 – Retrieved from NH OEP website



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

Graph 5 – Retrieved from NH OEP website

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 51 – Retrieved from NH OEP website

Conclusion:

As a result of this audit, the Town has several options available to increase the efficiency of the Town House. We highly encourage that the Town pursue these recommendations described in this report and to utilize the further assistance provided under this program to help develop plans for implementation including identification of contractors who will provide the services needed to carry out the recommendations.

Appendix

1. Quality Insulation, Merideth, NH Quote # 542810

MASCO Contractor Services

Quality Insulation of Meredith
Lic #: NONE ON FILE
1 Pease Road Meredith, NH 03253-5506
Tel: (603) 279-3371, Fax: (603) 279-3321

WORK AGREEMENT

TO: CHRIS DUNDORF	**RE:** SDES GROUP LLC/WINDOWS	
Address: 2 WASHINGTON STREET SUITE #206 DOVER, NH 03820	**Job Address:** 247 MIDDLE ROAD, TUFTONBORO, NH 03816	
Attn:	**Date:** 02/07/2011	**Expiration Date:** 05/08/2011
Tel: (603) 617-3767	**Estimator:** Delafontaine, Scott	
Fax:		

Bid Summary

Quote #	Plan	Trade	Total
542810	**Version** 1 **Of** 1	SIDING	$2,950.00

Prices Good For Work Performed Through: May 08, 2011
Bid Date: February 07, 2011

Total Bid: $2,950.00

Subject to the terms and conditions stated in this document, Contractor is willing to furnish to you all material and labor required for the Scope of Work described below:

Scope of Work (the "Work") to be performed:

Plan#: ***Trade***: SIDING

(10) HARVEY VINYL SINGLE HUNG LOW-E ARGON FILLED, NO DIVIDER LIGHTS, DOUBLE PAIN WINDOWS & REMOVAL OF OLD WINDOWS

Base Price: **$2,950.00** **Additional Information:**

2. Quality Insulation, Merideth, NH Quote # 542689

MASCO Contractor Services	**Quality Insulation of Meredith** **Lic #: NONE ON FILE** 1 Pease Road Meredith, NH 03253-5506 Tel: (603) 279-3371, Fax: (603) 279-3321 **WORK AGREEMENT**	
TO: CHRIS DUNDORF	**RE:** SDES GROUP LLC/INSULATION	
Address: 2 WASHINGTON STREET SUITE #206 DOVER, NH 03820	**Job Address:** 247 MIDDLE ROAD, TUFTONBORO, NH 03816	
Attn :	**Date:** 02/07/2011	**Expiration Date:** 05/08/2011
Tel: (603) 617-3767	**Estimator:** Delafontaine, Scott	**Quote #:**542689 **Version** 1 **Of** 1
Fax:		

Subject to the terms and conditions stated in this document, Contractor is willing to furnish to you all material and labor required for the Scope of Work described below:

Scope of Work (the "Work") to be performed:

Draft stop, fire block, fire stop (UBC 708.2.1 et seq., formerly 2516(f), or locally adopted equivalent), and fire rated caulking are not included within Contractor's Work unless specifically listed below.

CELLULOSE NOTICE. If cellulose is to be applied with a wet spray application, you must allow adequate time for it to cure and dry before installing drywall or other materials. The adequate time required varies depending upon climate, altitude and weather. Do not install vapor barriers, vapor retards, dry wall, or other interior finish until the material has dried to less than 20% moisture content. Time to cure will vary based on climate and weather. Be sure to schedule your trades accordingly.

Building codes may require a thermal barrier or ignition barrier be applied to the spray applied foam insulation. A thermal barrier or ignition barrier is not included within the scope of this agreement of work unless specifically listed below.

Plan#: ***Trade***: INSULATION

CEILING AREA FLAT	R-30 FIBERGLASS BLOW INSULATION R-6.7 = 1 NOMINAL INCH CLOSED CELL FOAM R-60 FIBERGLASS BLOW INSULATION	KITCHEN CEILING SPRAY FOAM ATTIC FLAT CLG BLOWN FIBERGLASS R-60 22"
DRILL & BLOW EXTERIOR WALL	R-13 FIBERGLASS BLOW INSULATION	DRILL + BLOW EXTERIOR WALLS
BASEMENT EXTERIOR WALLS	R-13.4 = 2 NOMINAL INCHES CLOSED CELL FOAM	CRAWL SPACE WALL 3' WALL 2" FOAM
BAND JOIST, BOX SILL, RIM JOIST	R-13.4 = 2 NOMINAL INCHES CLOSED CELL FOAM	

Additional Information: PRICE INCLUDES INSOFAST ON BOILER ROOM WALLS, AIRSEAL VISABLE PENATRATIONS IN THE WALL, INSTALL 8MIL PLASTIC ON CRAWL FLOOR + TAPE SEAMS, BUILD ATTIC HATCH, REMOVE EXISTING FIBERGLASS INSUALTION IN ATTIC FLAT.

Base Price: **$9,255.00**