The New Hampshire Municipal Energy Assistance Program

Decision Grade Audit Report

Hollis Police Department
9 Silver Lake Road Hollis, New Hampshire 03049

Prepared for:

Town of Hollis, NH

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The following report was generated as part of the 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 Hollis 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. We are grateful for the time provided to us by many of the Town of Hollis staff members, without which this report would not be as thorough as it is.

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Introduction:

MEAP partners are pleased to provide this Decision-Grade Audit Report for the Town of Hollis and the Police Station (hereinafter “the building”). This report discusses the findings and subsequent recommendations for energy efficiency improvements at the building. Included within this report are details regarding the walk-through and exploration conducted in the facility and examples that illustrate recommended building alterations and improvements that can reduce energy costs 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 participating in several State level funding opportunities for municipal energy projects. These funds distributed under the aegis of the ARRA (American Recovery and Reinvestment Act) are targeted specifically to towns and cities.

Prior to the audit process beginning, each selected municipality must carry out the MEAP energy inventory process. The inventory process is required in order to receive an energy audit. This report relied on those initial findings to help determine the most appropriate building to conduct an energy audit for, with the intent of maximizing the potential energy savings.

The Audit

The first stage of any audit process is understanding the nature of the system and the objectives of the audit. The use of the building and the Town’s goals and objectives are the foundation of a solid audit. In most cases, these objectives combine environmental and economic goals. In the case of public buildings and facilities, comfort and safety are also primary concerns that help guide our analysis and recommendations.

A decision grade audit involves an inventory of heating systems, quantification of energy usage (electrical and heating fuel), and the process of coordinating this information with the goals and objectives of the Town into a decision tool. Under MEAP we look to provide recommendations that will, if carried out, help the Town achieve at least a 30% reduction in energy consumption. The level of detail provided herein is meant to create the basis upon which investment grade audits and decisions can be made. The decision grade audit is meant to filter options and expectations so that the Town can understand the fundamental building system, how changes to the system can result in economic and environmental benefits and how those changes can interact with other policy and philosophical objectives.

The following information will describe the characteristics witnessed during the walk-through and those areas of the building complex where improvements may be made. The objective of these recommendations is to create a series of options the Town can further explore.
On November 4th, 2009 Tobias Marquette of SDES Group, accompanied by Jeff Babel, toured four of the lowest performing buildings in the Town of Hollis. These were the Social library, the Fire Station, the Police Station, and the Town Hall.
After much consideration, and the discovery of sufficient opportunity, it was decided to audit the Police Station. The Police Station is one of the newest constructed municipal buildings in Hollis, and the single largest source of energy use and cost.

Though approximately 36% smaller than the largest municipal building (Town Hall), 28% of all municipal building energy use takes place at the Police Station. This equates to 30% of the total municipal energy expenses for buildings, and 31% of GHG emissions produced by operations in municipal buildings. The Police Station has the highest Source Energy Intensity, and the second highest Site Energy Intensity. Both are well above the national average for this type of building.[1] Two site visits were conducted for the collection of building data, the first on November 19th, and the second on November 24th.

Building Description:

The original structure was built in 1989, and later renovated and added to in 2006 by North Branch Construction, Inc. This is a two story, slab-on-grade Cape style structure. There is 9,918 ft^2 of occupied space. 7,918 ft^2 in the main part of the building with a 2,000 ft^2 attached garage.

Exterior Walls:

Much of the wall area is 2x6 wood frame, 16" on center with 5 ½ inches of fiberglass insulation. Typical amounts of thermal bridging are occurring at top/bottom plates, headers, studs and corners. These weak points in the thermal boundary usually add up to about 25% of the wall area, allow for air infiltration, and have an R-value of less than 10.

Other areas are block wall with ½ inch sheathing on 2x4 pressure treated furring stock with 1 ½ inches of polyisocyanurate insulation between the furring boards. As seen in Figure 1 below, there is quite a lot of rapid heat-loss occurring from these walls. Unfortunately, there is no easy

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[1] All energy expense data referenced in this report was retrieved from the 2008 Hollis Inventory Report which was produce by the Hollis Energy Committee.
Site Energy Intensity—amount of energy expended per ft^2 on site to heat, cool, and electrify the area. This measurement fluctuates directly with actions such as how much lighting is being use and how the thermostats are set.
Source Energy Intensity—amount of energy expended per ft^2 based on the type of fuel and the efficiency of that fuel type.

way to reduce this loss. One way would be to remove the siding and fasten an additional 1 ½ - 2 inches of rigid insulation to the exterior before residing. If carefully removed, the existing siding could be reused if the corner trim pieces were replaced with wider stock. This rigid foam could be buried along-side the building, reducing the amount of heat-loss from the foundation and slab. An exterior finish would have to be applied to the exposed area and maintained. This would be a costly project, especially if it was considered to super-insulate the walls of the entire building. Though a cost benefit analysis would reveal a return on such an investment, the town would have to be considering energy savings over the life of the building, not necessarily the next 10 years.

Figure 1

Ceilings:

The ceiling insulation in this building is by far the largest problem. There are few sections of the ceiling above the second floor where there is a clearly defined building envelope.
A building envelope, also called a thermal boundary, consists of two basic items, an air-barrier and insulation. The air-barrier and insulation must be at the same location, that is, in contact with each other in order for the two to be effective.

On the east and west side of the second floor are two mechanical rooms, with three air-handlers in one, and two in the other. There is fiberglass insulation, but as seen in Figure 2, the poly air barrier is falling down in many places, and not sealed at any point. Basically, it may as well not be there at all.

Figure 2

Figure 3 shows 2 inches of foil-faced rigid insulation coming from the base of this sloped ceiling. This would be a very effective air-barrier and add a good amount of continuous R-value. It is highly encouraged to continue this effort, bringing the insulation board to the peak and across the gable wall, filling any gaps with spray foam, or, just sealing with foil tape where seams are too tight to fill.

Figure 3

This would dramatically reduce the amount of heat-loss from the equipment in the winter, and reduce the amount of heat gain in the warmer months when this same equipment is responsible for delivering cool, dry air to the building.

The cathedral ceilings above the workout room are certainly performing the best. There is 2 inches of rigid board insulation tacked to the truss system, strapping fasted to each truss, then 5/8" drywall finish. Though this serves as a good air-barrier, and has continuous R-value, it is still only an R-13 at best. One can see the glow of heat on Figure 4.

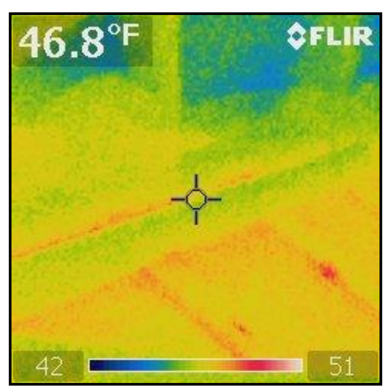

Figure 4

Where the two ceilings meet at the peak, the insulation board was not mitered, and creates a weak line across the highest point in the room as seen in Figure 5. Weak areas were also found at the edge of the dormers, and various penetrations.

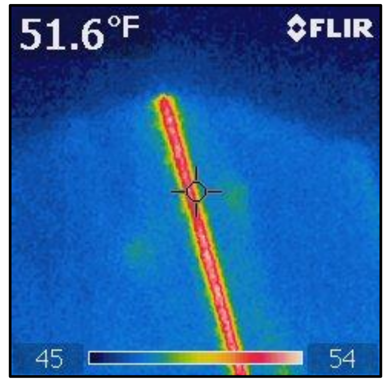

Figure 5

Figure 6 illustrates how the majority of the ceilings are insulated. There is about a 2 foot space above the suspended ceiling. A poly air-barrier has been fastened to the bottom of the truss system. No seams have been sealed. The fiberglass insulation above has little effect in this situation. This does not constitute a thermal boundary, and a tremendous amount of heat-loss is occurring.

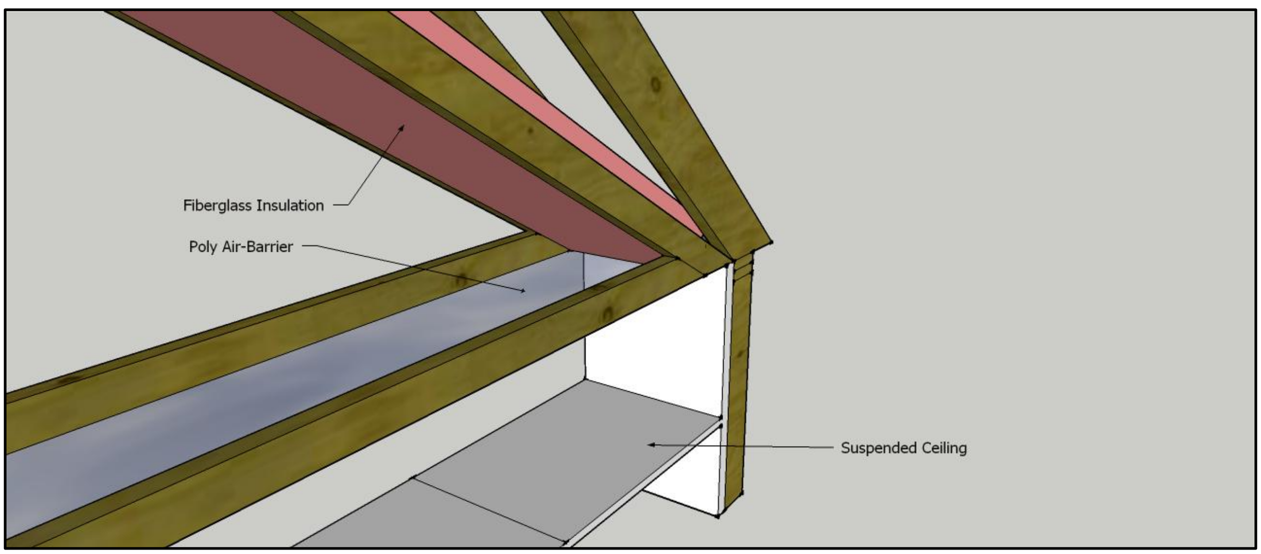

Figure 6

Not only does fiberglass insulation not serve as an air-barrier, in addition, there are large gaps found throughout as illustrated in Figure 7. During the field inspection, whole pieces of insulation were found displaced, leaving virtually nothing in the way of the heat trying to escape.

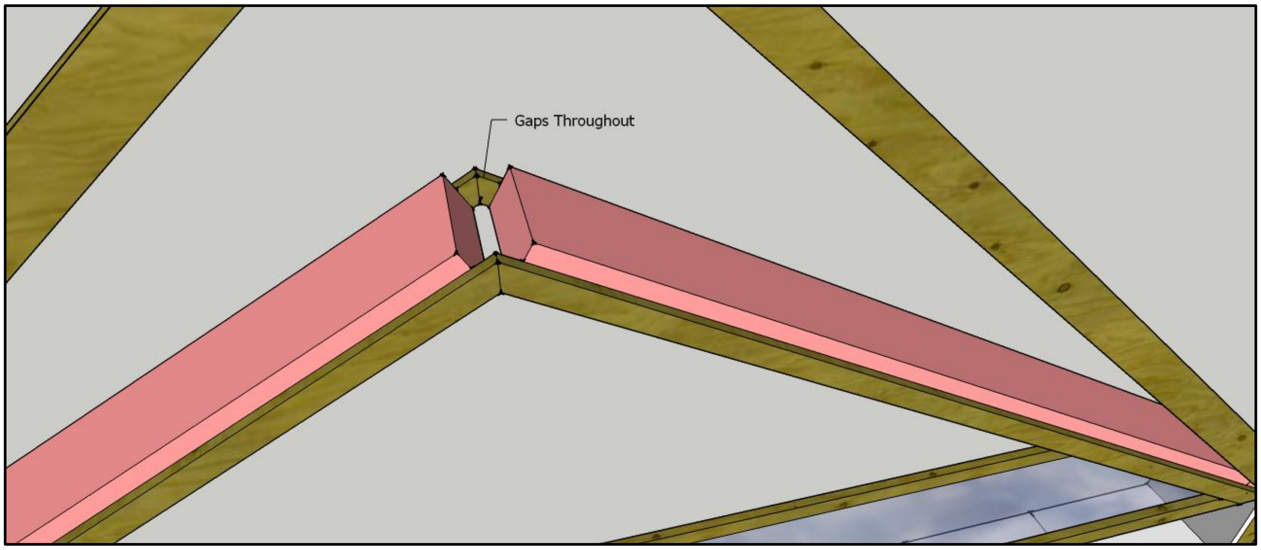

Figure 7

In one circumstance, as seen in Figure 8, a ceiling tile was removed to not only reveal about a 20 ft^2 gap in the air barrier, but also a light above the air barrier was discovered, and has probably been on since the building was renovated. We were able to remove the bulb.


Figure 8

Recommendation:

A new strategy for insulating the second floor ceilings needs to be developed. This should be done with cooperation from an insulation contractor, a BPI certified Building Analyst Professional, and with consideration from the staff at the police department. With a clearly defined and effective thermal boundary, it should be possible to increase building envelope efficiency by around 10 - 15%. This would likely leave the return on investment (ROI) for this corrective work to fall within 10 years.

Mechanical:

Overview:

- The police station is heated with, for the most part, a hydro-air system.
- A single boiler heats hot water, delivers it to 8 air-handling units located in various places on the second floor, and to baseboard radiators in two offices on the second floor.
- The boiler is a Burnham, model # P-209A-WPV. This is an open combustion boiler burning liquid propane gas (LP gas) rated at 266,000 BTU input, and is likely running at (at best) 80-82% efficiency. This is the original boiler for the building, making it about 20 years old.
- Both sections of garage are heated with Sterling LP gas fired space heaters suspended from the ceiling.
- There are two air-to-air heat exchangers. One heats and cools the last room adjacent to the garage. The other controls the climate a computer server room.
- There are six compressor/condenser units (CCU) supplying the main air-handlers.
- Each air-handler imports fresh air from the exterior into the return plenum. There are mechanical dampers on the fresh air feed ducts, however it is uncertain which, if any, are functioning correctly.
- The domestic hot water (DHW) is supplied by a separate LP fired, 40 gallon hot water heater.

General notes:

The baseboard radiators on the second floor appear to be controlled by thermostats on the radiators themselves. As far as we could tell, these have never been turned down. It is all together possible that the air conditioning (AC) is fighting with the baseboard during the summer months.

It was also brought to our attention that the boiler runs frequently during the summer. Given that the DHW is a separate system, this could mean that there has been a call for heat from somewhere in the building, unless the boiler itself is set up to maintain its own temperature. Further investigation into the functions of the heating system would reveal this. In either case, maintaining boiler temperature during non-heating months is a costly function.

All the air-handling units import fresh air from the exterior into the return plenums. This is a very common way of providing fresh air in a commercial setting. However, it is hardly the most efficient. During the winter months, cold air is introduced to the return side of the distribution system before it is conditioned (heated) and sent back to the occupied space, forcing the heating system to work harder to maintain output temperature. During the summer months, the opposite is true. Warm, humid air is introduced to the return side. This means a greater cost to maintain not only temperature, but introduces additional costs to remove the moisture from the air. Much of the cost of cooling comes from removing moisture from the air.

It was brought to our attention that there are times when the garage bay doors are left open for periods of time during the winter months. As small as these periods may be, it comes at a great cost over the long term. Because the garage is heated with hot air, as soon as the doors are open, most of the heat will exit right away. If the doors are open, the effort from the space heater to maintain temperature is futile. Devising a control system that would keep the heaters from firing when the doors are open would save a great deal of energy over the long term.

Recommendations:

1. Replace boiler – The current boiler functions in a very simple way. It is either on, or it is off. A new high efficiency modulating/condensing boiler (95-96% efficient) would deduct about 15% off the cost to heat the main building (this does not consider the LP burned in the garage or the DHW heater). A modulating boiler has the ability to ramp-down its BTU output. This boiler would have an "outdoor reset," a control device that senses the outdoor temperature and tells the boiler when to modulate down or up in output. This boiler would have the capability of running at as low as 25% of its full capacity during the shoulder (warmer) months.

2. Replace the current DHW heater with a foam insulated indirect hot water tank. If there is a call for potable water, it would be drawn from the storage tank, while the new high efficiency boiler maintains its temperature. Again, the boiler would ramp down its capable output and run at a more efficient capacity.

3. Discontinue importing unconditioned exterior fresh air by incorporating energy recovery ventilation systems (ERV) into at least the three main air-handling units. These 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 ERV. 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. This allows for the transfer of moisture. In the winter months, 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 9.

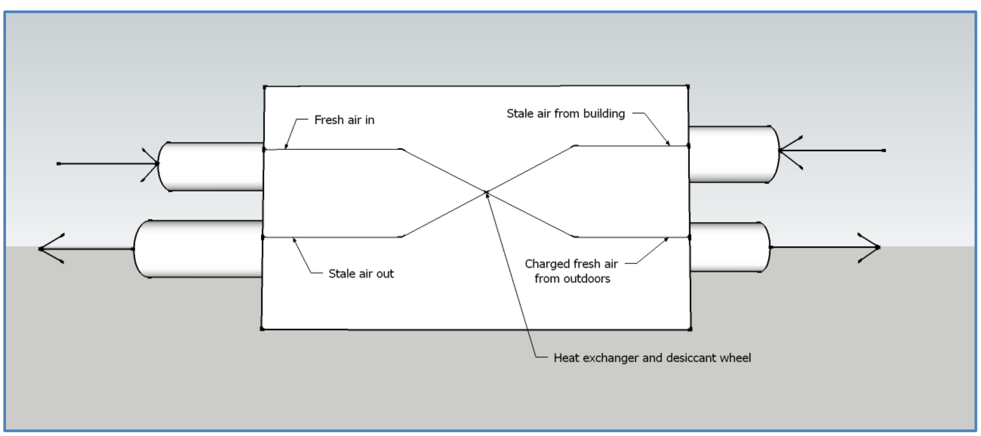

Figure 9

4. Shut down the boiler when the heating season is over in the spring until heat is need again in the fall.

5. There is an inline exhaust fan attached to the return plenum in the east mechanical room which runs continuously, drawing air from the evidence room and in the containment cells. This fan could be wired to a switch and turned off when not needed. Not only is this fan high powered and using a lot of electricity, but is constantly exhausting conditioned air to the outdoors.

6. All duct work should be seal and insulated, even if it is within the thermal boundary. Duct work was found in the un-insulated areas of the attic. Any ducts or flex ducts that must be run outside of the thermal boundary should be insulated to a minimum of R-8. A higher R-value, however, is encouraged.

7. Investigate the feasibility of installing a micro combined heat and power system (CHP). A micro CHP system is a small system (usually in the form of an engine at the scale that this building is) that generates both heat and electricity on site for consumption in the building. Heat is removed from the engine and exhaust and used to heat hot water for thermal use in the building. This system may not provide all the heat and electricity the building needs, but rather can work with a back-up boiler that would fire when the CHP could not handle the complete load. Given the amount of electricity used at the police station, this could be an effective option for reducing winter time electric bills which average over $1000.00 per month.

8. We also recommend investigating the option of installing a photovoltaic system. Police departments do typically have high electric costs due to the amount of equipment needed for their service to the public. Reducing the amount of energy needed from the grid would benefit the department greatly.

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 has been taken from the New Hampshire Handbook on Energy Efficiency and Climate Change – Volume II.

Life Cycle Costing –

The National Institute of Standards and Technology (NIST) Handbook 135, 1995 edition, defines Life Cycle Cost as “the total discounted dollar cost of owning, operating, maintaining, and disposing of a building or a building system” over a period of time. Life Cycle Cost Analysis is an economic evaluation technique that determines the total cost of owning and operating a facility over period of time.

Since municipal buildings are funded in their initial year through bonds and/or capital outlays, they generally fall victim to an inordinate focus on the bottom line cost of construction instead of the lifetime cost to operate the building. This is a critical misstep in particular with energy concerns for municipal buildings because they are placed in service for a significant period and are subject to extended energy pricing. A more efficient building could save the costs of initial investments several times over during its lifespan.

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.

"Green" Building Cost Myths –

A perception that all energy-efficient construction costs more than conventional construction persists. We have been unable to find valid research that supports this conclusion - especially where choices made about efficiency are evaluated in a realistic context considering the life cycle cost to operate the facility. To the contrary, we have found several sources, from government facility agencies, that show not only that in most cases costs are in fact lower but that any increased cost is almost immediately realized through lower operating expenses.

State Grant Program Under American Recovery and Reinvestment Act (ARRA)

A significant opportunity that the town should consider looking into that is coming up very shortly is opportunities to acquire funding through the New Hampshire Office of Energy and Planning (OEP) The following information can be found on the OEP's website at the following link - http://www.nh.gov/oep/recovery/news/122309.htm#sa1. The site discusses the announcement of available funding to municipalities under the Energy Efficiency and Conservation Block Grant program.

> The New Hampshire Office of Energy and Planning (OEP) announces the availability of $6.6 million through the Energy Efficiency and Conservation Block Grant (EECBG) program. This grant program will fund projects that reduce energy use and fossil fuel emissions, and improve energy efficiency. OEP is currently targeting the following timetable:

- **Grant Application Released: January 8, 2010**
- **Intent to Bid Letter Due: January 15, 2010**
- **Applications Due: February 15, 2010**
- **Grants Awarded: March 10, 2010**

In conjunction with the January 8, 2010 release of the EECBG Subgrant Application, OEP will also release a program guidance document and guidelines for the format of the "Intent to Bid" submission. EECBG will entail a competitive application process and funds will be awarded based on the value of the project and the benefit to the public. Selection criteria include, but are not limited to, projected energy savings, greenhouse gas emission reductions, and the ability to implement projects expeditiously. Eligible applicants are local governments and local government partnerships.

Eligible uses of this funding include projects such as: energy efficiency retrofits; energy audits; transportation efficiency measures; solid waste/wastewater treatment; energy distribution technologies; financial incentive programs; and renewable energy technologies for local government buildings. Each community will be eligible to receive funding up to 100% of the project cost with a limit of $400,000 per applicant.

For more information please contact Dari Sassan, (603) 271-1765, or visit the EECBG Web site.

Additionally, a terrific resource to 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.

Utility Programs:

Many utilities provide rebates for various types of efficiency measures that can be carried out at a municipal facility. PSNH offers the Municipal Smart Start Program. This program offers 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.

For more information please contact Elizabeth Larocca, (603) 634-2380, or visit http://www.psnh.com/Business/Efficiency/Paysave.asp

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 a 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.

Conclusion:

As a result of this audit the Town has several options available to increase the efficiency of the Police Department building. We highly encourage the that the Town pursue these recommendations described in this report and to utilize the further assistance provided under this program to identify contractors who will provide the services needed to carry out the recommendations. SDES Group will provide the Town an additional twenty-five hours of Community Energy Advocate service to assist with any needed service under this audit to continue to bring the recommendations outlined in the report to fruition. A further explanation of these additional services will be provided during the audit presentation.