To: Canton Board of Selectmen
From: Canton Energy Committee
Date: September 18, 2013
RE: Report on Alternative Energy Options
Report Number: EC-0001

I. Executive Summary

In this report, the Canton Energy Committee provides information to the Board of Selectmen on the following energy-related topics:

- Measuring the Town's Energy Usage
- Energy Efficiency
- Renewable Energy
- Funding Sources
- Energy Performance Contracting

The first three topics are presented in the order in which the Town should take action on them. The reasons for this are simple. The Town must first establish a baseline for its energy usage so it knows where to focus its efforts. Then, energy efficiency measures, which are often comparatively inexpensive and can even be free, should be implemented to reduce the Town's energy consumption. Finally, the Town can use clean, renewable energy systems to offset some of its traditional energy generation sources. The final two topics, Funding Sources and Energy Performance Contracting, are complementary to all of the other three areas and should be investigated in parallel with the others. The following sections contain further details on all of these areas.

II. Introduction

In September of 2012, Thomas Sevigny, from the Board of Selectmen, attended the Energy Committee's meeting and spoke to the members about investigating alternative energy sources for the Town's buildings. He noted in particular that with new roofs possible in the near future, solar options should be considered. On behalf of the Board, he requested a report from the Committee on the best course of action. The Energy Committee appreciates the Board's patience in receiving this report.

The Town faces an inescapable economic imperative—for the foreseeable future, all energy from every source will become much more expensive. Combined with ever-increasing pressure on municipal budgets and it becomes clear that the Town must find ways to spend less on its energy. Cheaper is not always better, however, because while traditional generation from coal-burning sources is very inexpensive, it comes at a significant environmental and public health cost. The answer, as with most things, lies somewhere in the middle.

How we deal with energy now and in our future will be our legacy as a Town. This report describes a variety of options whereby the Town could significantly reduce its energy consumption—and therefore its energy budget—for little to no upfront capital cost, be involved

in the generation of clean, renewable energy, and discover a new revenue stream through that energy generation.

The following initiatives have been selected by the Energy Committee for investigation and possible action.

III. Metering, Data, Metrics

The first step in a comprehensive analysis of alternative energy options for the Town must be the development of baseline energy usage and user behavior for each major Town building. The Town cannot manage what it cannot measure.

Categories for measurement include:

- Electrical usage (kilowatt hours (kWh) / square-foot (sf))
- Peak demand (kilowatts (kW) / sf)
- Heating energy (kBtu / sf)
- Cooling energy (kBtu / sf)
- Total energy (kBtu / sf)
- Energy cost ($ / sf)

These metrics can be benchmarked against regional standards for a given building type and the data can be trended over time to provide a fuller picture of energy consumption.

Key Steps of Benchmarking

- Determine the level of benchmarking (for example: equipment, facility, organization)
- Develop metrics
- Conduct comparisons
- Track performances over time

Benchmarking can be done in a variety of ways:

- Past Performance: uses a comparison of current versus historical performance.
- Industry Average: is based on established performance metrics such as a peer group.
- Best in Class: benchmarks against best in the industry and not the average.
- Best Practices: uses a qualitative comparison against certain established practices considered the best in the industry.

Current Status

As far as the Energy Committee is aware, most energy benchmarking in Canton has been done by the Board of Education while little action by the Town has occurred to date. The Energy Committee believes that starting immediately the Town should undergo a strategy to create benchmarks for all municipal buildings. More importantly, the Town and Board of Education need to share benchmarks and plans for energy-related initiatives. Annual goals for improved efficiencies should be coordinated between the groups. A goal of a minimum of a ten percent reduction in energy use from an established baseline should be created. This benchmarking data could be easily entered into the federal government's building benchmarking tool through its Energy Star program, called Portfolio Manager. This database could create and maintain a

centralized tracking system for the use and costs of electricity, fuel oil, and natural gas for both the Town's and the Board of Education's buildings and equipment. More information on the Portfolio Manager program can be found at: https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/use-portfolio-manager.

Approach for Forward Progress

1. Develop a baseline for current energy usage in all Town buildings. This may be completed independently or as part of energy performance contracting (see Section VII).
2. Enter building data for all town buildings into Energy Star's Portfolio Manager by December 1, 2013.
3. Adopt a methodology for calculating life-cycle energy costs. This methodology can aid in prioritizing energy-related projects.
4. Create a joint committee between the Town and Board of Education to oversee and coordinate energy saving initiatives.

IV. Energy Efficiency

The cheapest unit of energy is the one not used. Energy efficiency measures run the gamut from simple and inexpensive (e.g., turning off lights when leaving an empty room; occupancy sensors for lights) to complex and expensive (e.g., building automation systems; advanced HVAC systems), but implementing even the simplest measures can significantly reduce a facility's electrical demand. Energy efficiency measures should be the first steps taken after determining a baseline of energy usage because many of them are relatively inexpensive and they have a fast return on investment. Also, because energy efficiency reduces a facility's load and renewable energy systems are sized based on that load, energy efficiency can reduce the cost of renewable energy systems because the now more-efficient facility would require a comparatively smaller and less expensive renewable energy system.

Current Status

Some energy efficiency improvements have been completed in the Town but have been addressed on a project-by-project basis. The Board of Education and school administrators have developed a preliminary plan for addressing energy usage in the school buildings and have started implementing some changes. The Energy Committee has reviewed options for implementing efficiency programs in other Town buildings. Specific actions have not yet been taken.

Approach for Forward Progress

1. Establish an energy efficiency sub-committee comprised of Board of Education and Energy Committee members. Many efficiency programs benefit from economies of scale. Considering the school buildings along with the town buildings allows for a "bigger" project with greater potential for savings. This could be the same joint committee as proposed in Section III.
2. Based on the review of all Town buildings as outlined in Section III, establish a building-by-building efficiency upgrade plan. If feasible, this could be part of performance contracting. Set cost/payback levels and timeframe for completion. Prioritize projects regarding payback,

capital expenditure, health of occupants, etc. The upgrade plan should be reviewed and updated yearly.
3. Review feasibility of adopting a Town policy on energy efficiency levels for new Town buildings (i.e., LEED building standards).
4. Perform a review of street lighting. Develop a plan for replacing street lamps over time with energy efficient lighting (i.e. LEDs).
5. Develop a culture of conservation. Our schools have a head start here and the Town can take what they have accomplished and build on it for all Town residents. Review options for building energy monitors so any Town resident can see energy usage; this encourages accountability in our public buildings for all of us who use them.

V. Renewable Energy

Renewable energy is the ultimate solution to society's long-term problems of energy resource availability and environmental problems associated with the use of fossil fuels. Due to the relatively low present cost of fossil fuels, however, most forms of renewable energy are more expensive at this point in time than fossil fuel alternatives. This is likely to change at some point in the not-too-distant future, due to the depletion of fossil fuel resources, reduced cost for renewable energy technologies, and taxes that may be imposed for carbon emissions. In general, energy conservation represents a better investment than renewable energy, and, with some exceptions, only after making significant strides in user behavior and energy efficiency does it make sense to invest in renewable energy systems. By their nature, renewable energy systems do not save energy; they simply make it cleaner than do traditional generation sources, but they do displace the use of fossil fuels. Renewable energy systems also provide a visible demonstration of environmental stewardship which can result in a positive image for the Town.

There are several forms of renewable energy that may be applicable to reduce the Town's dependence on fossil fuels. Renewable energy systems are often costly to implement and need to be applied in the most efficient manner possible to maximize benefits and minimize costs. The main forms of renewable energy systems available are:

1. Solar energy
    i. Solar electric systems (photovoltaic or "PV")
    ii. Solar thermal systems
2. Wind energy
3. Geothermal energy
4. Biomass energy
5. Hydropower

Each of these renewable energy sources are briefly described, with possible approaches in the Town, as follows:

Solar Electric Systems

Though many types of larger-scale systems are available to convert solar energy to electricity, the application in Canton would be limited to the use of photovoltaic (PV) panels that directly

convert solar energy into electricity. Photovoltaic panels create direct current (DC) electricity, which is then converted to alternating current (AC) for use in buildings through specialized solar inverters. The output AC electricity can then be generated in parallel with utility power, eliminating the need for batteries or specialized electrical equipment. PV system costs have dropped dramatically in recent years, but without incentives still represent a relatively long payback investment; fifteen to twenty years is the norm. With State and Federal incentives that are in place, however, PV systems can represent a very attractive investment. Because municipalities cannot take advantage of the Federal tax incentives, currently at thirty percent, the use of private third-party developers is usually the best approach for municipalities to implement PV systems.

Solar Thermal Systems

Solar thermal systems use solar energy to produce useful thermal energy in the form of hot water or warm air. Solar thermal systems have substantially higher conversion efficiencies than PV systems, but thermal energy has less value than electricity, is difficult to store, and may only be needed during cold weather. As such, solar thermal applications are typically limited to relatively low-temperature loads which exist year-round, such as domestic hot water and pool heating. The Town does not own or operate many facilities with these types of thermal loads, but possible applications would be domestic hot water for the high school/middle school or wastewater treatment plant. Solar heating of the Mills Pond pool might also be considered to extend the season; solar pool heating systems for outdoor pools are relatively inexpensive.

Wind Energy Systems

Wind energy systems produce electricity through the use of a wind turbine which drives an electric generator. Wind energy can be one of the most cost-effective forms of renewable energy, but its economic performance is highly dependent on the local wind resource, which varies significantly by area. Area-specific wind resource mapping is available, and generally in New England sufficient wind resources to make wind energy cost-effective exist only in coastal and mountain-top areas. Canton does have some hills that might produce marginally favorable economics for wind energy, but land acquisition and permitting would represent major challenges. At the present time, wind energy is at best questionably feasible for Canton and far less viable than other renewable energy forms.

Geothermal Energy

Geothermal energy systems utilize energy stored in the earth to produce useful thermal or electrical energy. True geothermal systems use high-temperature stored energy directly for heating or to produce electricity, as in Iceland, the western United States, or Central America. In New England, however, no such resources for direct geothermal energy utilization exist, so geothermal applications are limited to the use of ground-source heat pumps (GSHP).

GSHP systems use earth coupling to increase the efficiency of mechanical refrigeration systems. A mechanical refrigeration is used to extract heat from (heating mode), or reject heat to (cooling mode), underground closed loop “wells” to provide heating and cooling for buildings. While

such systems exhibit high efficiency, they are not true renewable energy systems, as they do not produce energy; they only use electricity more efficiently to heat and cool buildings. They can be quite expensive to install due to the cost of the ground coupling systems (typically wells), making for lengthy payback periods, particularly in retrofit applications. Their best applications are buildings where thermal fuel source cost is high (i.e. no natural gas availability), electrical cost is relatively low, and the building has relatively balanced heating and cooling loads. As no such facilities are owned or controlled by the Town and no true geothermal resources exist in Canton, economically viable geothermal energy applications in Canton are limited to private residences.

Biomass Energy/Biofuels

Biomass energy involves the use of any biological matter to produce useful energy in the form of thermal or electrical energy. This can take a wide variety of forms (far too many for review here), but in Canton applications would be limited to direct biomass combustion for heating or the use of liquid biofuels (biodiesel or ethanol) as vehicle fuels.

Biomass for direct combustion to produce thermal energy is used fairly extensively throughout northern New England, primarily in the form of wood chips or wood pellets as an alternate fuel source to oil or gas. With the present low cost of gas and higher cost of biomass boiler systems, applications that produce desirable economics are typically limited to those where natural gas is not available. Presently, wood chips are about one-third the cost of oil, and wood pellets are about half the cost of oil on a per unit energy basis. Wood pellets are about the same cost as natural gas. Because of material handling and operational issues, wood chip applications are limited to larger-scale facilities. As most of the Town's buildings now have natural gas availability, the only possible application which could produce desirable economics would be the use of a wood pellet boiler system at Cherry Brook School (which is presently heated by oil boilers). Because the boilers are not that old and are in good condition, it would not be cost-effective to proceed with a biomass conversion at this time, but this should be considered when boiler replacement is warranted in roughly fifteen years.

Hydropower

Hydropower uses the potential energy associated with water flowing to a lower elevation to drive a turbine, which in turn drives an electric generator to produce electricity. Like wind power, its application is very resource-dependent. Unlike wind power, however, Canton is fortunate to have a substantial hydropower resource in the form of a river with significant change in elevation and existing dams. Hydropower can be quite cost-effective, but its application can be very difficult due to regulatory issues. Based on an extensive pre-feasibility study conducted recently, the application of hydropower generating facilities to the upper and possibly the lower Collinsville dams appear to be feasible and economically attractive.

Significant effort has taken place to date by Town staff and the Energy Committee toward the development of hydropower systems at the upper and lower Collinsville dams. A pre-feasibility study was completed in 2011 by the engineering firm GZA, financed by a $50,000 grant from the Connecticut Clean Energy Fund (now the Clean Energy Finance and Investment Authority or

CEFIA). This study showed favorable economics for the development of the hydropower systems, particularly at the upper dam. The economic performance could improve substantially depending on the status of legislation regarding virtual net metering and renewable energy credits (RECs). The project is presently on hold, awaiting the approval of legislation to transfer to the Town of Canton an existing FERC license originally issued to a private developer and then pulled due to lack of progress. Substantial work to move the project forward could be taking place while the legislation is under review, however, but the project has no funding available at the present time.

Current Status

The Town presently supplies its energy almost entirely through traditional fossil-fuel-based energy sources – natural gas, oil, and electricity from the grid. Electricity from the grid in New England is roughly sixty percent natural gas, twenty percent nuclear, and twenty percent mix of other sources – oil, coal, hydro, etc. The only renewable energy system presently operated by the Town is a three-kW solar PV system located at the wastewater treatment plant, providing a small percentage of the electricity used at the plant.

The Town has recently completed a successful program to promote the application of residential solar PV systems. The Energy Committee and the Town partnered with People's Action for Clean Energy (PACE) to successfully execute the "Solarize Canton" program. "Solarize Canton" involved a public relations campaign and attractive pricing from a selected solar contractor to stimulate the development of residential solar systems in Town. This program resulted in the addition of thirty-five new solar PV systems in Canton with a combined capacity of 236 kW, increasing residential PV capacity in Canton by roughly a factor of four. This program did not address any Town-owned facilities, however.

Approach for Forward Progress

There are two particular areas where the potential for significant development of renewable energy resources in the Town of Canton exists:

- Hydropower for the upper and possibly the lower Collinsville dams.
- Large-scale solar PV systems on the roofs of major Town buildings (e.g., the Middle/High School, Canton Intermediate School, Cherry Brook School, and the Library).

As noted previously, the hydropower project has seen substantial progress to date, but is presently stagnated due to lack of funding. The Energy Committee recommends that the hydropower project receive initial funding from the Town or another source for further project development, with the ultimate goal of partnering with a third-party energy developer for project implementation.

Significant opportunities exist for the installation of large-scale solar PV systems on Town facilities. The economic viability of such installations is dependent upon available funding from State and Federal sources. The availability of this funding has historically been somewhat inconsistent. Because much of the funding is in the form of tax credits, which municipalities cannot take advantage of, municipal PV projects are typically carried out through an RFP

process to select a solar developer. The selected developer would design, permit, own, and operate the system for a period of time, typically ten to twenty years, during which time electricity would be sold to the Town at a rate lower than those available through Connecticut Light & Power. At the end of the period, ownership of the system would be transferred to the Town and the Town would receive the full benefit of the electricity produced. Under the right conditions, this represents a "win-win" approach, where the Town bears no cost and receives the benefit of low-cost renewably generated energy.

The Energy Committee recommends that the Town monitor the status of the State and Federal funding programs and be prepared to issue an RFP for a solar developer to undertake such a project when proper funding conditions exist. Other smaller-scale renewable energy projects should be investigated also, such as solar domestic hot water systems for the high school/middle school or wastewater treatment plant.

VI. Funding Sources

The Energy Committee has investigated various sources of funding available and is aware of additional sources to be explored.

Funding for Energy Efficiency:

Performance contracting is a form of financing for energy efficiency. An energy service company (ESCO) would evaluate the Town's usage of energy and where efficiencies can be achieved. The ESCO would implement energy efficiency upgrades at its own cost with minimal or zero upfront capital expenditure by the Town. The ESCO would guarantee a particular level of energy savings over historical energy bills and the Town would repay the ESCO's financing by sharing a portion of those savings with the ESCO. For more detailed information, see Section VII.

Utilities:
Financing is available through the Connecticut Energy Efficiency Fund (CEEF). Incentives are available to the Town to cover part of the cost. The remaining cost can be covered by zero-interest on-bill financing. There is zero upfront capital expenditure by the Town. Eligible technologies include high-efficiency electric or natural gas equipment, high-efficiency air conditioning and heat pump systems, and lighting.

CEFIA:
The Clean Energy Finance and Investment Authority (CEFIA) is the state's quasi-public agency in charge of, among other things, the Clean Energy Fund, formerly known as the CCEF. CEFIA has moved away from the historic focus of the CCEF of giving out grants and incentives to a new model of providing low-cost financing and attracting private capital. CEFIA's emphasis is still on renewable energy, and the only energy efficiency program it has is known as Commercial Property-Assessed Clean Energy or C-PACE. Municipalities are eligible to participate in C-PACE provided that the municipality adopts a resolution joining the C-PACE program (which then authorizes any commercial or industrial customer in the municipality to also participate) and obtains a tax ID number. Canton has joined C-PACE. Through 100% financing provided by

CEFIA's lending partners, a municipality can make a wide variety of building energy upgrades for zero upfront capital expenditure. The financing is then paid back via a property tax assessment.

Typical eligible energy efficiency measures include high-efficiency lighting, heating ventilation air conditioning (HVAC) upgrades and controls, high-efficiency chillers, boilers, furnaces and water heating systems, building enclosure/envelope improvements, and building automation (energy management) systems.

Funding for Renewable Energy:

CEFIA:
The C-PACE program mentioned previously can be used to fund renewable energy projects. Renewable energy systems are eligible if they meet the threshold C-PACE requirements of an energy savings-to-investment ratio greater than one over the lifetime of the assessment term and the system is permanently affixed to the building or property.

ZREC/LREC Auction:
Projects such as solar photovoltaic (PV), fuel cells, or small wind are eligible to bid into the ZREC/LREC auction. If selected, then the project owner receives a long-term contract with Connecticut Light & Power for the purchase and sale of RECs from the project. These are fifteen-year contracts at a fixed rate, resulting in a steady post-construction revenue stream. Note that this is not for construction/installation funding, meaning someone will have to pay for the project upfront.

Approach for Forward Progress
1. Capital Improvement Plan (bonding): The Energy Committee recommends that the Town utilize the capital projects budget process for energy efficiency and renewable energy upgrades as these projects will reduce operating costs and volatility of future Town budgets.
2. The Town should create a separate capital project category for energy-related investments in the Capital Improvement Plan.

VII. Energy Performance Contracting

The Energy Committee strongly recommends that the Town investigates Performance Contracting. Performance Contracting is a method for municipalities to procure all the services required from one source to design and execute an energy-efficiency project for targeted Town-owned facilities. The performance contract would include all the necessary expertise including the evaluation of existing systems relative to energy use, recommendations for improvements including evaluation of expected energy savings, design services, construction management services, construction, commissioning, monitoring of energy savings, and financing for the project. This one-stop shopping approach provides all the services and expertise required to complete the project and stabilize energy costs and budgeting. This approach also provides the Town with an opportunity to complete capital improvement projects with little or no cash outlay.

Opportunities for Savings:

Performance contracting provides an opportunity to engage with a team of professional energy experts to investigate the condition and efficiency of existing facilities in a comprehensive manner designed to determine the most effective way to invest funds to deliver the maximum benefit. Typical energy saving measures include lighting, HVAC systems, energy management systems, motors, building envelope improvements, and water-saving measures.

Reduction in Energy Expenses:
Performance Contracting allows for a reduction in overall energy expenses and applies the savings from the energy budget toward the purchase of energy-efficient equipment. This savings allows for the funding required for the financing of these improvements outside of the capital budget process through dollars made available within the operating budget. Project financing is normally arranged by the selected contractor through a reputable third-party such a GE Capital or Citibank under an operating lease or tax-exempt lease purchase agreement. After the lease of the energy-efficient equipment is satisfied and the purchase of the installed equipment is completed, the Town would continue to benefit from these energy savings. Savings realized as part of the contract are guaranteed, both by contract and by statute, and the contractor bears the risk of interest rate and utility cost changes through the life of the lease agreement.

Benefits of Maintenance:
There are also other benefits in the overall maintenance of these energy systems which are reduced, emergency repairs are reduced, and the Town contributes to stimulation of a clean energy economy in Connecticut.

Current Status
Several municipalities have already moved forward with performance contracting including East Hartford, Branford, Bristol, and Farmington. There are many ways that the procurement process can be advanced if the Town decided to participate in the program. Below is a brief description of several methods that can be used to solicit these services:

a. CT Energy Savings Performance Contracting (ESPC) Program – A procurement process administered by the State of Connecticut that provides a list of qualified vendors to provide this service along with master contract documents that can be utilized by the Town. The Town can "piggyback" on the procurement process developed by the State to contract with a vendor from the list of pre-qualified contractors.

b. Energy Performance Engineering Services – Procure an independent engineering consultant to perform a Preliminary Energy Assessment, prepare and issue an RFP to solicit a Performance Contractor, and assist in the selection of the contractor. The consultant would also prepare plans and specifications for all improvements and also monitor the resultant energy savings for a period of three years after installation. All payments to the consultant would be paid by the Performance Contractor selected by the Town.

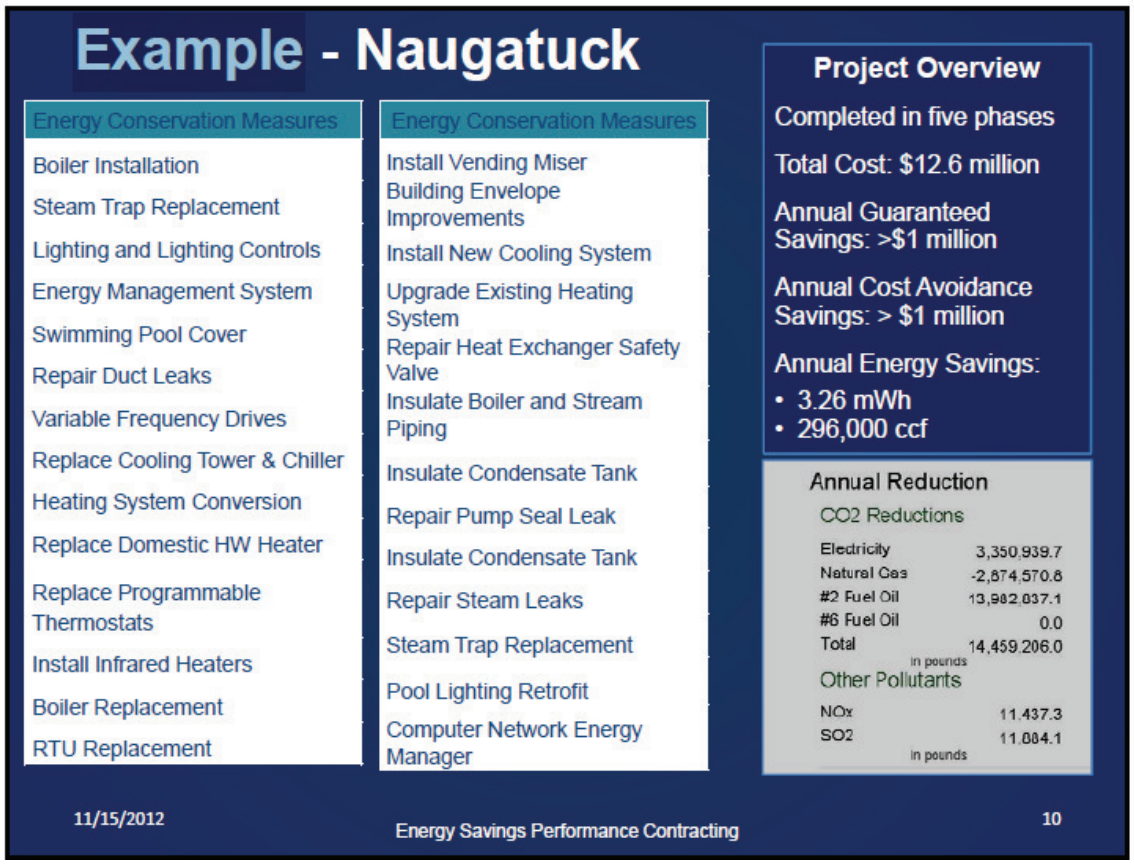
c. Connecticut Conference of Municipalities (CCM) Energy Savings Performance Contracting - A single pre-selected Performance Contractor is under contract with CCM to provide services to member municipalities. CCM staff assists with contract negotiations and also is involved through the construction phase of the project.

d. Independent Procurement by the Town – A typical procurement process through issuance of an RFP for a Performance Contractor and an independent consultant to assist and monitor energy performance.

Approach for Forward Progress

These various forms of procurement for performance contracting services need further consideration by the Energy Committee as applied to the Town's facilities and the Board of Education's facilities. Below is a brief case study of performance contracting completed in Naugatuck that was very effective in lowering energy costs and providing for more energy-efficient equipment replacement as part of the project. Naugatuck implement over $12 million in energy improvements to town buildings and schools, all paid for by lower energy bills achieved through the project.

Naugatuck participated in the CCM performance contracting program. Naugatuck's verified energy savings as a result of the project for 2010 was $888,539. This exceeded the guaranteed saving as part of the contract of $565,448. The graphic below provides additional information on the project.



VIII. Conclusion

Re-engineering how the Town purchases, budgets for, and uses energy requires a long-term commitment and investment of time and resources. Success will not be achieved overnight. That being said, the time to act is now. Every day that passes is another lost opportunity. The Energy Committee proposes a stepped approach with many small victories that can cumulatively move the Town toward its goals.

The Energy Committee has reviewed all of the current options and has decided that the following items should be its priorities in the immediate future:

1) Furtherance of the hydropower project
2) Benchmarking / baselining the Town's energy consumption
3) Investigation of an Energy Manager position, whether part-time or full-time, possibly shared with another town
4) Implementation of energy efficiency measures in Town buildings

The Energy Committee looks forward to continued discussion and collaboration with the Board of Selectmen and the Town as a whole on these vitally important issues.