Comprehensive Energy Management Plan
Town of Avon, Connecticut

Prepared by the Avon Clean Energy Commission (ACEC)

October 2012

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EXECUTIVE SUMMARY

The Avon Clean Energy Commission (ACEC) has developed this energy plan for the Town of Avon ("Town") to guide the Town and Board of Education ("BOE") in making decisions that affect the community's energy future. Funding for this effort has come from the State of Connecticut through the ARRA Energy Efficiency and Conservation Block Grant (EECBG) program.

The ACEC was established by the Avon Town Council in December 2008 as part of the 20% by 2010 campaign to investigate opportunities for implementing energy efficiency in all aspects of Avon's public works, research and facilitate the use of clean renewable energy within the Town, and educate Avon residents about the clean energy options available to them.

The ACEC is recommending energy goals for Avon that are pro-active and challenge the status quo. Our progress toward achieving these goals should be measurable, measured, and reported.

The ACEC recommends that the following energy goals guide municipal and school operations:

- Reduce Town and BOE energy used in operations by 15% of total Btu/SF by 2015, against a 2008 baseline. Specifically,
  - Improve the energy efficiency of Town and BOE buildings by reducing energy used per square foot
  - Increase the measured fuel efficiency of the Town's vehicle fleet
  - Reduce the number and wattage of street lights and other outside lighting, where possible, and establish a program to convert this lighting to more efficient technologies
- Reduce the Town's "carbon footprint" by 20% by 2020, through an integrated strategy of efficiency improvement and substituting clean alternatives for fossil fuels and fossil fuel generated electricity

To achieve these goals, the Town should institutionalize a set of policies and practices that supports achieving these goals and should direct managers and employees, who are responsible for buildings and equipment, at all levels, to make achieving these goals a priority.

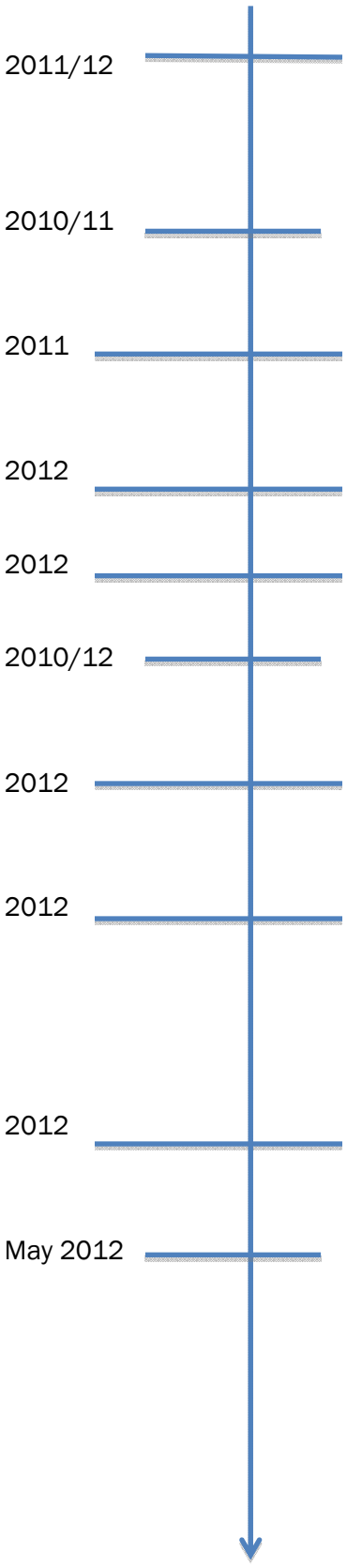
Beyond municipal and school operations, the ACEC suggests the following additional goals be pursued by the Town to facilitate increased energy efficiency and use of renewable technology town-wide:

- Increase local participation in utility and state sponsored programs that help improve energy efficiency and reduce greenhouse gas emissions associated with fossil fuel use
- Explore the feasibility of tightening up building codes for new construction and major renovations to require higher energy efficiency standards
- Encourage the use of renewable energy technology and the adoption of sustainable practices, such as recycling, by Town residents
- Support the use and expansion of mass transit and non-motorized transportation in Town by residents

This Plan describes Avon's current energy situation and strategies to achieve the goals presented.

ACEC Timeline of Activities

Date	Activity	Comments
December 2008	ACEC formed with meetings scheduled once a month	Initial commitment to 20% by 2010 state campaign
2009/10	ACEC member attends Library expansion Building Committee meetings	Helps support use of geothermal HVAC and other sustainable building practices
Spring 2010	ARRA Formula Grant awarded for Energy Improvements	$75,000 Federal Stimulus Grant is awarded to Avon
Fall 2010	Goal set to get solar panels for middle school	Receive one kilowatt of solar PV panels from CT Clean Energy Fund for every 3 residents who purchase "Green Power"
September 2010	ACEC booth at Avon Day	Goal is to spread the word about free panels for AMS. Turnout/results disappointing
2010	New block grant award of $250,000 approved for 5 towns	Avon uses its share of grant for initial energy use evaluation by Peregrine
2010/11	ACEC member serves on joint Hydro Dam Committee with Canton	Hydro project receives grant monies for feasibility studies
Winter 2010/11	Organize and support energy saving contest in schools	All schools take part; 30% overall savings achieved at Thompson Brook School, (winner)
2011	ACEC booth at Avon Day	Announcement of new Energy Plan is on display
2011	ACEC uses Peregrine to help draft comprehensive energy initiative	Drafting and review spanned approx. 9 months
2011/12	Peregrine completes analysis of building energy use	Consultant reports Avon has implemented many energy use reductions already; ahead of curve!



2011/12	All Avon schools initiate energy "behavior modification" process. A shared benefits consultant is hired to administer the program.	Active efforts at all schools. "The Energy Guy". Program is well received by students and faculty.
2010/11	Earlier $75,000 grant is used to purchase energy savings assets	Highway garage doors and school lighting replaced
2011	Plaque awarded to Thompson Brook School for energy savings initiatives	Award presented during school assembly at start of school year
2012	ARRA "Quick Spend" Energy Grant applied for by Town	$36,545 awarded to install high efficiency LED fixtures
2012	ACEC and Peregrine work to complete Energy Plan	Target date for completion set as May, 2012
2010/12	Members of ACEC attend various state/regional meetings on energy goals & processes.	40+ towns in CT have active committees involved in energy initiatives
2012	ACEC member does preliminary solar PV assessment for roof of Middle School	ACEC urges BOE to consider issuing RFP for solar PV systems for schools
2012	Town Council and BOE approve continued participation in 30% by 2015 campaign	Purchase of Renewable Energy Certificates (RECs) enables town to "count" those equivalent kilowatts of energy as offsetting fossil fuel derived energy in Avon facilities.
2012	ACEC members participate in Regional Municipal Energy Workshop	55 regional participants for one-full day of strategy and information sharing
May 2012	ACEC members attend CL&P CT Clean Communities meeting	Event sponsored by CL&P

INTRODUCTION

WHY IS THE ACEC PROPOSING AN ENERGY PLAN FOR THE TOWN?

In December 2008, the Town Council of the Town of Avon, by resolution as part of 20/2010, created the Avon Clean Energy Commission (ACEC) to:

- ***Investigate appropriate and cost effective opportunities for implementing energy efficiency measures in all aspects of Avon's public works***, including operational changes, changes in maintenance or capital improvements, and forward those recommendations for change to the appropriate municipal governing bodies;
- ***Research and facilitate the use of clean renewable energy within the Town of Avon***, which is most appropriate and cost-effective for its given function;
- ***Educate Avon residents about the clean energy options*** available to them through their current or alternative energy providers;
- ***Leverage ... Federal and State incentives and grants as they relate to energy efficiency programs and clean energy usage***; and
- ***Take advantage of unique opportunities and resources within Avon for providing clean renewable energy*** to help fulfill local energy needs.

Further, Town Council resolved that ***"The Commission shall establish goals and objectives and provide periodic reports to the Town Council from time to time on their efforts and achievements."***

ARE OTHER COMMUNITIES ADOPTING ENERGY PLANS?

Increasingly, at the local level, communities across Connecticut, New England, and the entire country are creating plans and establishing policies to guide energy decision making and related investments. Questions and concerns about our energy future are not new. Since the 1970's, the nation has engaged in discussion about what energy sources will be available for our future use, where they will come from, who should pay for their deployment, and what are the implications of choices we make.

This surge of interest in local energy action is likely attributable to the convergence of a number of factors:

- ✓ Increased attention to the relationship between climate change and greenhouse gas production from burning fossil fuels
- ✓ Widespread recognition of our need to reduce the Nation's dependence on foreign sources of energy, and, in particular, oil
- ✓ Rising costs of energy and the impact on local budgets
- ✓ Emergence of state policies and programs to increase energy efficiency and clean energy use
- ✓ Advances in cleaner energy technologies that are making them increasingly cost effective
- ✓ Availability of newer technologies to control and reduce the energy needed to provide us with the benefits we desire
- ✓ Opportunities to create new "green" jobs and a "green" economy

What is the Significance of Adopting an Energy Plan?

The Town of Avon should address its energy use comprehensively and coherently. The Avon Clean Energy Commission has developed this energy plan for the Town to guide Town officials and the Board of Education in making decisions that affect the community's energy future.

The ACEC views this Plan as the first phase in an ongoing formal energy management process that should expand to encourage and support the use of clean energy resources and adoption of sustainable practices across our community. The ACEC recommends that the Town's Energy Plan be a living document that is periodically updated to reflect new opportunities and goals that emerge, changes in perspectives, and accomplishments to date.

The ACEC hopes that this energy plan will:

- Establish a shared understanding of the Town's current energy use in municipal and school operations: what energy sources are used, where they are used, how they are used, how much is used, and how this use compares with other communities in Connecticut
- Create a baseline against which the Town can measure the effects of energy-related decisions it is making in municipal and school operations
- Suggest specific strategies available to Town of Avon decision makers to reduce energy consumption near-term and long-term, and in doing so, reduce our contribution to greenhouse gas emissions
- Identify immediate opportunities for reducing energy use while creating other benefits (e.g., budget savings, improved building comfort and better building control, increased equipment reliability, lowered maintenance and repair expense)
- Encourage the Town to commit to a series of actions to realize the benefits from these opportunities

What Principles and Best Practices are Available for Guiding Our Town's Energy Planning?

The ACEC suggests that the following principles and practices guide the Town's efforts.

- **Lead by Example.** One reason for the Town of Avon to better manage its energy use is to lead by example. If the Town expects its citizens to consume energy wisely, to make decisions that minimize waste, to use clean energy sources, and to adopt a lifestyle that conserves resources, the Town should do the same. A comprehensive energy plan should address all municipal and school energy consumption, as well as related waste reductions and resource use.
- **Measure Our Progress.** Establish quantifiable goals and measure progress, recognizing that without a system for measurement, the Town cannot effectively manage its energy use. To that end, the Town should identify and utilize a unified energy information system that tracks and benchmarks energy use and expense month to month, year to year, building to building, vehicle to vehicle, etc. using a set of locally significant metrics.
- **Communicate the Town's Successes to the Community at Large.** Consistent with the ACEC's vision of leading by example, the Town should tout its successes and their societal benefits and encourage

the community to emulate and exceed the Town's accomplishments, by reducing wasteful practices and substituting clean energy for fossil fuels wherever practical.

- **Collaborate with Other Connecticut Communities.** The Town of Avon is already collaborating with its immediate neighbors on energy matters, resulting in a state grant for energy planning shared among five area towns. These collaborations should continue. At a larger scale, many Connecticut municipalities with clean energy groups, like the ACEC, have been meeting to share their information on their clean energy efforts including plans, programs, and results. The ACEC should be an active participant in such discussions. Information gleaned from these exchanges can help the Town's energy program development and implementation. Additional regional programs may result, and economies of scale for purchasing may present themselves.

- **Increase Efficiency and Reduce Use Wherever Practical.** The Town should pursue and implement all practical and cost-effective actions to reduce energy use in buildings, for street lighting, for process use such as pumping, and in vehicles. A budget dollar not spent for energy is available to create some other community benefit.

- **Consider Life Cycle Costs in Future Building Design and Construction and Equipment Acquisition.** Decision making regarding major renovations, new construction, and purchase of equipment should always consider the energy requirements associated with alternatives. Wherever and whenever possible, Town decision makers should attempt to minimize the total lifetime energy consumption and other operating costs associated with an improvement made or an asset acquired.

- **Encourage and Support the Use of Renewable Energy Sources.** While the Town of Avon is not rich in indigenous conventional or renewable energy resources (e.g., natural gas, hydro, wind, biomass), solar electric and solar thermal systems can make a contribution to the local energy mix. The Town should identify ways to incorporate these technologies into its buildings to demonstrate their effectiveness and should put in place policies and programs that encourage investment in these technologies by community members.

WHAT IS THE SCOPE OF THE ENERGY PLAN?

This proposed plan focuses on matters within the Town's sphere of influence; specifically, municipal and school operations. Energy is a key input to all Town operations, in buildings, for transportation and fleet management, and in our provision of services to residents (e.g. wastewater management, street lighting, buildings and grounds maintenance).

There is a range of management decisions that Town government and the Board of Education officials make affecting where and how the Town uses energy, in what quantity, and how much it costs. For example:

- Who can use municipal and school buildings and when?
- At what temperatures are buildings operated at different times of the day and year?
- What energy source does the Town use for different purposes?
- Where does the Town purchase energy and at what price?
- How much of the energy that the Town uses is or could be generated locally?

- What energy-related criteria are used in purchasing decisions for new equipment for the municipal or school operations?
- What are the Town's energy performance requirements for new construction?
- How and when does the Town replace old and energy inefficient equipment?

Beyond the Town's own operations, there are other local energy consumption patterns and requirements that Town decision makers influence through policies, codes, and standards, including:

- Buildings standards (or lack thereof) that influence how efficiently residents use energy to heat and cool their homes
- Permitting, inspection, and property tax policies that encourage or support the use of alternative energy resources
- Creation of physical infrastructure and land use policies, such as innovative zoning, bike paths, community gardens, tree planting programs, etc. that enable resident lifestyles that reduce energy resources consumed and the carbon footprint associated with local activities

WHAT ARE THE RECOMMENDED GOALS FOR THE ENERGY PLAN?

Recommended Energy Goals for Municipal and School Operations

The ACEC recommends that Town officials formally adopt the following performance goals for energy management in Town operations and, further, direct all employees to consider the energy implications of their decisions and actions in light of these goals.

- Establish a system to track and benchmark all Town energy use against quantifiable goals.
- Reduce energy use in all Town operations by 15% by 2015. Specifically,
  - Improve the energy efficiency of municipal and school buildings
  - Increase the measured fuel efficiency of the Town's vehicle fleet
  - Reduce the number and wattage of street lights and other outside lighting where possible and establish a program to convert this lighting to more efficient technologies
- Reduce the Town's "carbon footprint" by 20% by 2020, through an integrated strategy of efficiency improvement and substituting clean alternatives for fossil fuels and fossil fuel generated electricity.

Avon's "carbon footprint" is the sum of all emissions of CO2 (carbon dioxide) induced by Town activities in a given time frame, usually one year.

Suggested Energy Goals Affecting the Community as a Whole

The Town's energy goals should be pro-active and challenge the status quo. Beyond municipal and school operations, the ACEC suggests the following goals be pursued by the Town to facilitate increased energy efficiency and the use of renewable technology by residents and businesses:

- Educate the community about energy use reduction strategies and energy supply options and the benefits and costs associated with them
- Encourage community members to establish their own personal energy plans
- Increase local participation in utility and state sponsored programs that help improve energy efficiency and reduce greenhouse gas emissions associated with fossil fuel use
- Explore the feasibility of tightening up building codes for new construction and major renovations to require higher energy efficiency standards
- Encourage the use of renewable energy technology and the adoption of sustainable practices, such as recycling, by town residents
- Support the use and expansion of mass transit and non-motorized transportation in town by residents

HOW CAN THE TOWN ATTAIN ITS ENERGY GOALS?

The ACEC encourages the Town Council to endorse a program of short-term and longer-term strategies and actions to achieve the energy goals outlined in this Plan. To that end, the Commission asks Town decision makers to formally adopt these goals and establish policies and encourage practices that support achieving them.

The ultimate effectiveness of the Town's plan will rest on the plan's faithful adoption and execution by the entire management structure, from maintenance departments to facility managers to teachers and school administrators and to department heads and Town boards.

Pursue immediate implementation of shorter payback efficiency improvement projects

Implement all strategies that are no cost, low cost, and moderate cost as soon as possible to achieve the 15% energy reduction goal in Town operations by 2015. Projects should include all potential improvements with simple paybacks that meet an established guideline, perhaps 5 years or less.

- This effort should include a close examination of operations and maintenance practices for each and all municipal and BOE buildings, as well as how and when building spaces are conditioned.
- The Town should seek to make any already planned, near-term capital improvements as energy efficient as possible.
- All construction projects should, when appropriate, identify and incorporate energy efficiency enhancement opportunities (for example, if a roof is being replaced, use this as an opportunity to increase roof insulation, if practical and cost effective).

As a long-term strategy, consider life cycle costing and strive for increased efficiency in all infrastructure replacement and renewal projects

Long-term energy strategies should focus on larger capital improvement projects, including new building construction and replacing equipment that is at the end of its useful life. It should also consider where and how renewable and clean energy technologies can be embraced and used.

- The Town and Board of Education should look at adopting energy saving technology innovations as they become mainstream and cost effective.
- "Life cycle cost" should become a standard criteria in Town planning, design, and purchasing, ensuring that any new equipment purchased and any major building renovations and new construction weigh the relative operating efficiency of alternatives being considered and include the highest level of energy efficiency possible.
- Town projects should consider renewable, clean energy sources to offset fossil fuel use substantially or to demonstrate the efficacy of clean energy sources and technologies.

HOW WILL THE TOWN KNOW IF IT'S ENERGY PLAN IS WORKING?

The Town should establish quantifiable goals for energy reduction

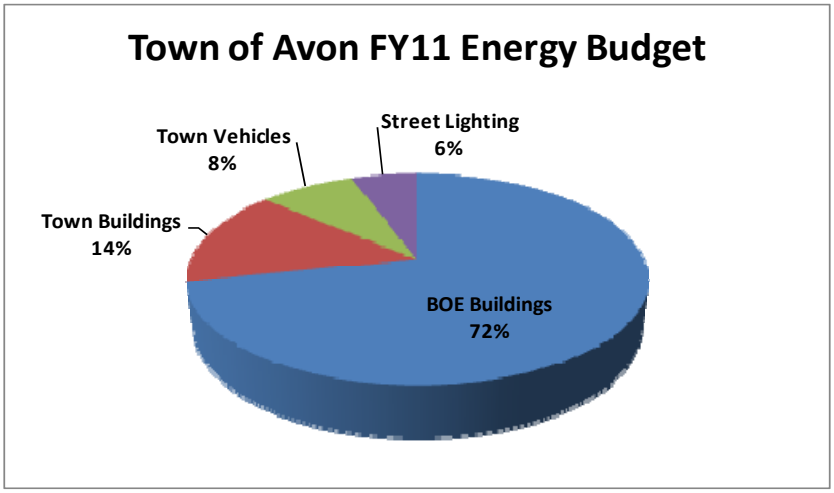
As was stated earlier in the guiding principles section, the Town should establish quantifiable energy management goals for each department (e.g., schools, public works, public safety) and each area of energy use (buildings, lighting, transportation) that reflect the pursuit for savings and reasonable continuous improvement. Perhaps one set of goals will reflect immediate opportunities for behavior changes in operations, while another set of goals focus on lower-cost improvements for savings, and yet another set focuses on longer-term investment in new equipment and systems.

The Town should measure progress toward meeting goals

The Town can't manage what is not measured. And, without a establishing a formal measurement system that accounts for weather and other variables, the Town cannot effectively gauge its progress. To that end, the Town should create, acquire, or utilize a unified energy information system that tracks and benchmarks energy use and expense month to month, year to year, building to building, vehicle to vehicle, etc. using a set of locally significant metrics. What is needed here is the ability to measure building performance against itself. There are commercially available energy information systems or services that can be acquired to track and communicate the Town's progress towards meeting its goals. The EPA also offers a free program called Portfolio Manager, which should be examined.

THE TOWN OF AVON'S ENERGY BUDGET

In FY 11, the Town of Avon's annual energy bill, for buildings operated by the Town and Board of Education, for vehicles operated by all Town departments, for street lighting, and for other major uses (e.g. water pumping), totaled around $1,950,000.



Most of the energy used in Town operations is in buildings. In FY 11, total energy use in municipal and Board of Education buildings cost the Town of Avon $1,684,300. BOE buildings (five schools and the BOE Annex), totaling 596,600 square feet in floor area, account for 86% of energy used in buildings or $1,399,300. The remaining $285,000 in building energy expense was attributable to the many small Town buildings totaling 94,900 square feet. Vehicle fuel (for Public Works and Public Safety vehicles) and street lighting cost the Town $155,818 and $110,000 respectively. A last, small energy user is the sewer pump stations, which account for less than 1% of electricity use and around $10,000 in expense.

Energy Cost and Energy Use

Energy cost is a function of how much energy the Town requires to do the work it needs to do (e.g., heat and cool buildings, light classrooms, power fire engines, etc.) and the price the Town chooses or is required to pay for each unit of energy purchased or gathered for some purpose. The price the Town pays per unit of electricity, natural gas, oil, etc. is generally outside of local control, though the Town does purchase these conventional fuels competitively in Connecticut. The Town has much more control over how much energy is used and which energy source is used, when options are available, to provide benefits desired (such as light, comfort, ventilation, and hot water).

The Town presently pays for most energy as it is used (e.g. natural gas and electricity from utility companies). Some sources (e.g. heating oil or transportation fuel) are paid for when purchased. Other sources, like the geothermal heating and cooling system at the Library, are paid for ahead of time and on an ongoing basis. At the Library, there was the cost to dig the wells to access water as well as the initial cost of specialized equipment needed to gather and transfer heat to and from water and the ongoing cost for electricity required to pump the water into and around the Library.

Benchmarking Energy Use in Town and School Buildings

The simplest way to compare the intensiveness of energy use for individual buildings is to look at the amount of energy they use per square feet of floor area. Comparing energy used (e.g., total kilowatt hours, hundreds of cubic feet of natural gas, gallons of oil) is best accomplished by converting these native units to British thermal units (Btus) using standard formulas. This conversion allows different types of energy used in buildings for different purposes to be added together and compared.

The tables below show an EUI ("Energy Use Index") score for each building using a kBtu/SF (thousand British thermal units per square foot of area) for each building. Again, this score represents the Btu equivalent of combined annual electricity, natural gas and/or oil use, divided by building square footage, divided by 1,000.

The US Environmental Protection Agency's ENERGYSTAR program reports that EUI values for buildings can range from 30 kBtu/SF to 340 kBtu/SF. An efficient commercial office building in the Northeast should perform at around 80 kBtu/SF. EUI scores are a useful metric to compare the relative efficiency of energy use in different buildings against each other and against larger pools of buildings.

That said, an accurate understanding of performance differences between buildings and opportunities for reductions in individual buildings requires knowledge of when and how a building is used, what types of systems are installed, levels of occupancy, and other factors.

British Thermal Unit **(Btu) is a scientific term for the amount of heat energy needed to raise the temperature of one pound of water by one degree F.**

A building's *Energy Use Index* (EUI) measures the Btu equivalent of combined annual electricity, natural gas and/or oil use, divided by building square footage, divided by 1,000, and is expressed in kBtu per SF or thousand British thermal units per square foot.

The following tables compare energy intensiveness of Town municipal buildings and of Board of Education buildings in FY 11. The Library was not included in this analysis because of the ongoing renovations.

Table 1. 2011 Avon Board of Education Facility Utility Summary

Facility	Sq. Ft.	Electricity kWh	Gas ccf	Oil gal	EUI[1] kBtu/SF
Avon High School	221,000	2,234,879	105,710	-	82
Avon Middle School	109,500	903,120	26,900	-	53
Central Office	11,000	95,120	-	5,500	100
Pine Grove School	85,100	709,248	36,580	-	71
Roaring Brook School	75,000	582,144	33,701	-	71
Thompson Brook School	95,000	854,457	37,231	-	70
Total	***596,600***	***5,378,968***	***240,122***	***5,500***	72

[1]**Energy Use Index (EUI)**

The EUI metric shows variations between the schools, with the High School having the highest score among the schools. Higher relative scores are not, in and of themselves, indicators of less efficient operation. For example, the extended operating hours of the High School and its use on weekends could account for its relatively high energy use per square foot. Conversely, a lower score does not mean that a school building is not worth considering for efficiency improvement. Overall, this information, in combination with what the ACEC has learned from on-site building assessments the Town commissioned, indicates a variety of opportunities for energy reduction and cost savings.

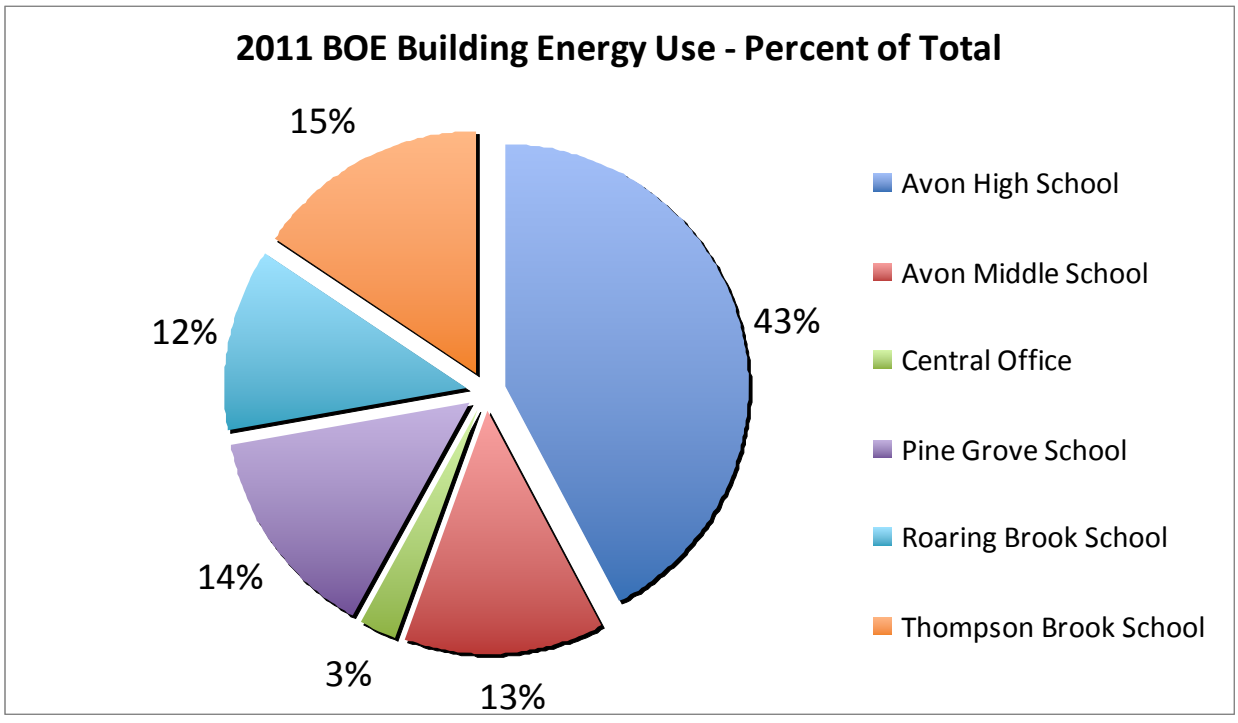


Table 2. FY 11 Avon Municipal Building Utility Summary

Facility	Sq. Ft.	Electricity kWh	Gas ccf	Oil gal	EUI[1] kBtu/SF
Animal Shelter	800	6,993	1,295	-	192
Building 1, 2	9,900	63,760	2,740	-	50
Building 5, 6, 7	17,200	122,040	3,121	-	42
Building 3, 4 (Police)	9,600	295,439	9,745	-	207
Building 8 (Gym)	1,700	44,291	293	-	106
Company 1	10,100	73,960	5,036	-	75
Company 2	5,000	18,512	-	1,762	62
Company 3	5,400	36,438	3,922	-	96
Company 4	3,700	32,619	-	1,272	78
Countryside Park	2,800	6,428	-	713	43
Public Works Facility	18,700	91,898	6,545	-	52
Recycling Center	1,600	22,655	-	432	86
Senior Center	8,400	84,640	4,097	-	83
Total	***94,900***	***899,673***	***36,794***	***4,179***	77

[1]**Energy Use Index (EUI)**

For Town buildings, the EUIs reveal that there are significant variations in energy use between what are otherwise similar buildings from a construction perspective, as in the mill complex buildings that are now used for Town offices. The Police Department's energy use is particularly high compared to other Town offices. It is also very high compared to other Police Departments (though, in general, high energy intensiveness for police stations is expected, given the extended hours of operation for Police business). The Gym (Building 8) is another more energy intensive building, perhaps due to hours of use or comfort space conditioning requirements. The four Fire Companies also vary in their energy intensiveness despite the similarities in function at all of them. These differences could be attributable to hours of operation, to building construction and systems, to temperature settings and space conditioning, or a combination of these factors. Again, this information, in combination with what the ACEC has learned from on-site building assessments, indicates there are opportunities for energy use reduction.

Why Choose FY 08 as the Baseline Year for Energy Reduction?

The Energy Plan sets a goal of 15% reduction in energy use in Avon's municipal and Board of Education operations by FY 15, compared to a FY 08 baseline (July 1, 2007 to June 30, 2008). The focus for action is on reducing energy consumed, measured in kilowatt hours (kWh) for electricity, hundreds of cubic feet (ccf) for natural gas, and gallons for heating oil and transportation fuel.

The ACEC chose FY 08 as the Baseline year (i.e. the year used to compare current use against) to recognize the Town's accomplishments to date in reducing energy use. In FY 08, the Town initiated a concerted effort for all Town buildings to take advantage of programs and services being offered to customers of Connecticut Light and Power to help increase energy efficiency. Lighting retrofits were installed widely across the portfolio using utility incentives, resulting in significant energy savings. Choosing FY 08 as the baseline gives credit to Town officials and building managers for the successes

they have achieved. It also acknowledges that some of the most cost effective savings opportunities have already been mined.

Building Energy Use FY 08 to FY 11

Tables 3 and 4 show (next page) energy consumption in municipal buildings and school buildings by fuel, for electricity, natural gas, and heating oil, over the three most recent complete fiscal years against the FY 08 baseline year, using native units of energy.

Overall, Board of Education buildings, which represent 86% of the floor area of buildings town-wide, have had much greater success in reducing energy use during this period. Better savings performance by schools during this period could be attributed to a number of factors. These include:

- More centralized management of BOE buildings
- Fewer and larger BOE buildings to manage
- More sophisticated HVAC systems and automated controls in these larger school buildings
- Greater investment in more energy efficient technology

That said, it is reasonable to expect that all Town buildings show the energy reductions that the ACEC has established as a goal for the Town to achieve.

Table 3. Energy Use by Energy Type in Board of Education Buildings FY 08 to FY 11[1]

Electricity

Facility	FY 08		FY 09		FY 10		FY 11	
Avon High School	**2,251,648**	**100%**	**1,984,000**	**88%**	**2,436,000**	**108%**	**2,234,879**	**99%**
Avon Middle School	**1,003,776**	**100%**	**1,119,000**	**111%**	**848,000**	**84%**	**903,120**	**90%**
BOE Annex	**101,920**	**100%**	**93,400**	**92%**	**91,000**	**89%**	**95,120**	**93%**
Pine Grove School	**814,080**	**100%**	**949,000**	**117%**	**735,000**	**90%**	**709,248**	**87%**
Roaring Brook School	**639,744**	**100%**	**726,000**	**113%**	**636,000**	**99%**	**582,144**	**91%**
Thompson Brook School	**1,325,184**	**100%**	**1,376,000**	**104%**	**1,097,000**	**83%**	**854,457**	**64%**
Total	*6,136,352*	100%	*6,247,400*	*102%*	*5,843,000*	95%	*5,378,968*	88%

Natural Gas

Facility	FY 08		FY 09		FY 10		FY 11	
Avon High School	**96,764**	**100%**	**195,667**	**202%**	**118,000**	**122%**	**105,710**	**109%**
Avon Middle School	**52,408**	**100%**	**84,614**	**161%**	**50,000**	**95%**	**26,900**	**51%**
BOE Annex	**-**	**100%**			**-**		**-**	
Pine Grove School	**46,492**	**100%**	**53,398**	**115%**	**43,000**	**92%**	**36,580**	**79%**
Roaring Brook School	**36,234**	**100%**	**66,166**	**183%**	**34,000**	**94%**	**33,701**	**93%**
Thompson Brook School	**30,239**	**100%**	**42,802**	**142%**	**49,000**	**162%**	**37,231**	**123%**
Total	*262,137*	100%	*442,647*	*169%*	*294,000*	112%	*240,122*	92%

Oil

Facility	FY 08		FY 09		FY 10		FY 11	
Avon High School	**-**	**100%**	**5,228**		**-**		**-**	
Avon Middle School	**-**	**100%**			**-**		**-**	
BOE Annex	**5,000**	**100%**	**5,300**		**5,000**	**100%**	**5,500**	**110%**
Pine Grove School	**-**	**100%**			**-**		**-**	
Roaring Brook School	**-**	**100%**			**-**		**-**	
Thompson Brook School		**100%**	**5,000**		**-**		**-**	
Total	*5,000*	100%	*15,528*		*5,000*	100%	*5,500*	110%

Board of Education Buildings

- Electricity. After rising slightly in FY 09, aggregate electricity use in schools has declined steadily to the point where, in total in FY 11, it was 88% of the baseline year. The high school, which is the largest single electricity user in the portfolio, has not achieved the same level of reductions as other school buildings, but some of this can be attributed to increased floor area due to expansion. There is also the possibility that re-commissioning of controls and HVAC systems are warranted to review and refine scheduling and set-points.
- Natural Gas. Natural Gas use in the high school spiked significantly in FY 09, again perhaps due to construction activity. This use has declined since then, though it remained higher than the baseline year for FY 11. Overall, natural gas use in schools is declining, though we believe that further reductions are possible and likely through a well structured re-commissioning program.
- Fuel Oil. The BOE Annex is heated with oil and use remains steady year to year. Changes to building operations and replacement systems could reduce this use and should be considered

[1] Note that there is no degree day normalization for this Table or the following table describing municipal building energy use.

Table 4. Energy Use by Energy Type in Municipal Buildings FY 08 to FY 11

Electricity

Facility	FY 08		FY 09		FY 10		FY 11	
Animal Shelter	**5,229**	**100%**	**4,752**	**91%**	**6,000**	**115%**	**6,993**	**134%**
Building 1, 2	**81,200**	**100%**	**72,560**	**89%**	**71,000**	**87%**	**63,760**	**79%**
Building 5, 6, 7	**92,120**	**100%**	**13,279**	**14%**	**137,000**	**149%**	**122,040**	**132%**
Building 3, 4 (Police)	**262,723**	**100%**	**271,112**	**103%**	**287,000**	**109%**	**295,439**	**112%**
Building 8 (Gym)	**45,745**	**100%**	**39,084**	**85%**	**38,000**	**83%**	**44,291**	**97%**
Company 1	**79,520**	**100%**	**72,280**	**91%**	**75,000**	**94%**	**73,960**	**93%**
Company 2	**19,091**	**100%**	**17,314**	**91%**	**18,000**	**94%**	**18,512**	**97%**
Company 3	**37,704**	**100%**	**37,671**	**100%**	**35,000**	**93%**	**36,438**	**97%**
Company 4	**17,161**	**100%**	**20,403**	**119%**	**20,000**	**117%**	**32,619**	**190%**
Countryside Park	**4,826**	**100%**	**4,660**	**97%**	**5,000**	**104%**	**6,428**	**133%**
Public Works Facility	**80,946**	**100%**	**83,720**	**103%**	**80,000**	**99%**	**91,898**	**114%**
Recycling Center	**22,524**	**100%**	**20,899**	**93%**	**23,000**	**102%**	**22,655**	**101%**
Senior Center	**71,720**	**100%**	**68,959**	**96%**	**76,000**	**106%**	**84,640**	**118%**
Avon Free Public Library	**200,640**	**100%**	**189,280**	**94%**	**193,280**	**96%**	**174,712**	**87%**
Total	*1,021,149*	*100%*	*915,973*	*90%*	*1,064,280*	*104%*	*1,074,385*	*105%*

Natural Gas

Facility	FY 08		FY 09		FY 10		FY 11	
Animal Shelter	**1,115**	**100%**	**1,133**	**102%**	**1,300**	**117%**	**1,295**	**116%**
Building 1, 2	**2,458**	**100%**	**3,101**	**126%**	**2,900**	**118%**	**2,740**	**111%**
Building 5, 6, 7			**3,284**	**100%**	**2,400**	**73%**	**3,121**	**95%**
Building 3, 4 (Police)	**9,757**	**100%**	**11,794**	**121%**	**8,300**	**85%**	**9,745**	**100%**
Building 8 (Gym)	**726**	**100%**	**734**	**101%**	**500**	**69%**	**293**	**40%**
Company 1	**5,491**	**100%**	**5,737**	**104%**	**5,600**	**102%**	**5,036**	**92%**
Company 2	**-**	**100%**	**-**		**-**		**-**	
Company 3	**3,613**	**100%**	**3,761**	**104%**	**3,300**	**91%**	**3,922**	**109%**
Company 4	**-**	**100%**	**-**		**-**		**-**	
Countryside Park	**-**	**100%**	**-**		**-**		**-**	
Public Works Facility	**12,970**	**100%**	**8,168**	**63%**	**7,000**	**54%**	**6,545**	**50%**
Recycling Center	**-**	**100%**	**-**		**-**		**-**	
Senior Center	**4,053**	**100%**	**4,424**	**109%**	**3,800**	**94%**	**4,097**	**101%**
Avon Free Public Library	**24**		**9,689**	**100%**	**9,098**	**94%**	**7,472**	**77%**
Total	*40,207*		*51,825*		*44,198*		*44,266*	

Oil

Facility	FY 08		FY 09		FY 10		FY 11	
Animal Shelter	**-**		**-**		**-**		**-**	
Building 1, 2	**-**		**-**		**-**		**-**	
Building 5, 6, 7	**-**		**-**		**-**		**-**	
Building 3, 4 (Police)	**-**		**-**		**-**		**-**	
Building 8 (Gym)	**-**		**-**		**-**		**-**	
Company 1	**-**		**-**		**-**		**-**	
Company 2	**1,586**	**100%**	**1,389**	**88%**	**1,800**	**113%**	**1,762**	**111%**
Company 3	**-**		**-**		**-**		**-**	
Company 4	**1,916**	**100%**	**1,742**	**91%**	**1,300**	**68%**	**1,272**	**66%**
Countryside Park	**937**	**100%**	**685**	**73%**	**700**	**75%**	**713**	**76%**
Public Works Facility	**-**		**-**		**-**		**-**	
Recycling Center	**239**	**100%**	**331**	**138%**	**400**	**167%**	**432**	**181%**
Senior Center	**-**		**-**		**-**		**-**	
Avon Free Public Library	**5,668**		**1,182**					
Total	*10,346*		*5,329*		*4,200*		*4,179*	

Municipal Buildings

- Electricity. High level analysis of this energy use shows that, despite participation in utility lighting programs, the municipal buildings' total electricity use in FY 11 remained nearly the same or has increased, with the exception of the Library, compared to FY 08.
- Natural Gas. The change in total natural gas consumption is difficult to calculate because the Library, which has duel fuel capability, used oil instead of natural gas in the baseline year FY 08 and then used natural gas in FY 09 to FY 11 (and this will change again in FY 12 when the geothermal heating comes on line). But, a number of buildings reduced their gas use, most notably, the Public Works facility, which replaced its older overhead doors with new insulated doors and reduced gas consumption by 50%. The Police Gym also is using much less natural gas.
- Fuel Oil. Oil use is limited in municipal buildings. It is showing a downward trend, even discounting the decision of the Library to use natural gas exclusively in recent years. Fire Company 4 and Countryside Park both lowered their oil use.

Vehicles

Town vehicles include the full range of vehicles employed by the Public Works department for road maintenance and repair, snow removal and road treatment, and other Town property maintenance activity. They also include Public Safety vehicles for the Fire and Police Departments. Further, they include vehicles supplied to Town officials for carrying out their official responsibilities. They do not include school buses, which are provided by a contractor to the Board of Education.

Town vehicles use both diesel and gasoline fuel. Gasoline and diesel fuel are purchased in bulk by the Town and are distributed using key card controlled access to ensure that Town fuel is only used for Town business. This key card system also facilitates tracking and analysis of fuel use for the entire fleet and for individual vehicles. In FY 11, vehicles consumed a total of 24,578 gallons of diesel fuel at a cost of $51,860 (at an average price of $2.11 per gallon) and consumed 42,773 gallons of gasoline costing $103,958 at an average price of $2.43 per gallon.

The following table shows gasoline and diesel use by Town vehicles from FY 08 to FY 11, annual miles traveled by the fleet, and total miles traveled per combined gallons of gasoline and diesel fuel.

Table 5. Energy Use by Town Vehicle Fleet FY 08 to FY 11

	Annual Miles Traveled	Gasoline (Gallons)	Diesel (Gallons)	Total Miles Traveled per Gallon	% Change vs FY 08
FY 08	497,814	54,149	24,243	6.35	0
FY 09	498,833	52,537	24,112	6.50	2.4
FY 10	470,561	46,590	22,021	6.86	8.0
FY 11	515,228	42,736	24,551	7.66	20.6

DPW analysis of fuel use determined that the average miles traveled per gallon of fuel used by all vehicles have increased from 6.35 MPG (FY 08) to 7.66 MPG (FY 11). These statistics show a continuous increase in efficiency (miles traveled per gallon) from FY 08 of over 20%. This analysis blends the consumption of cars and light trucks with the much lower and harder to affect fuel efficiencies of heavy equipment such as fire apparatus, snow removal vehicles, and construction equipment. It does not take into account weather as a factor, including number of snow storms and plowing miles.

Street Lighting

The Town has 772 street lights, all owned by Connecticut Light and Power. Street lights are all high pressure sodium fixtures, with predominantly 84 and 118 watt lamps. Avon is billed a fixed monthly amount per street light that covers the electricity consumed, retiring the cost of the light and pole, and ongoing maintenance for the equipment, including lamp replacements. Actual energy consumption data is not provided. The annual cost to the Town for street lighting is around $110,000. A street light inventory provided by Connecticut Light and Power is attached to this document.

BTU Content of Common Energy Units (1 million Btu equals 1 MMBtu)

- 1 kilowatt hour of electricity = 0.003412 MMBtu
- 1 therm = 0.1 MMBtu
- 1 ccf (100 cu. ft.) of natural gas = 0.1028 MMBtu
- 1 gallon of heating oil = 0.139 MMBtu
- 1 gallon of propane = 0.091 MMBtu
- 1 cord of wood = 20 MMBtu
- 1 gallon of gasoline = 0.125 MMBtu
- 1 gallon of diesel fuel = 0.139 MMBtu

Comparing Total Town Energy Use from FY 08 to FY 11

Our Energy Plan sets a goal of 15% reduction in energy use by FY 15 in the Town's municipal and school operations (including buildings, vehicles, and street lighting), compared to a FY 08 baseline.

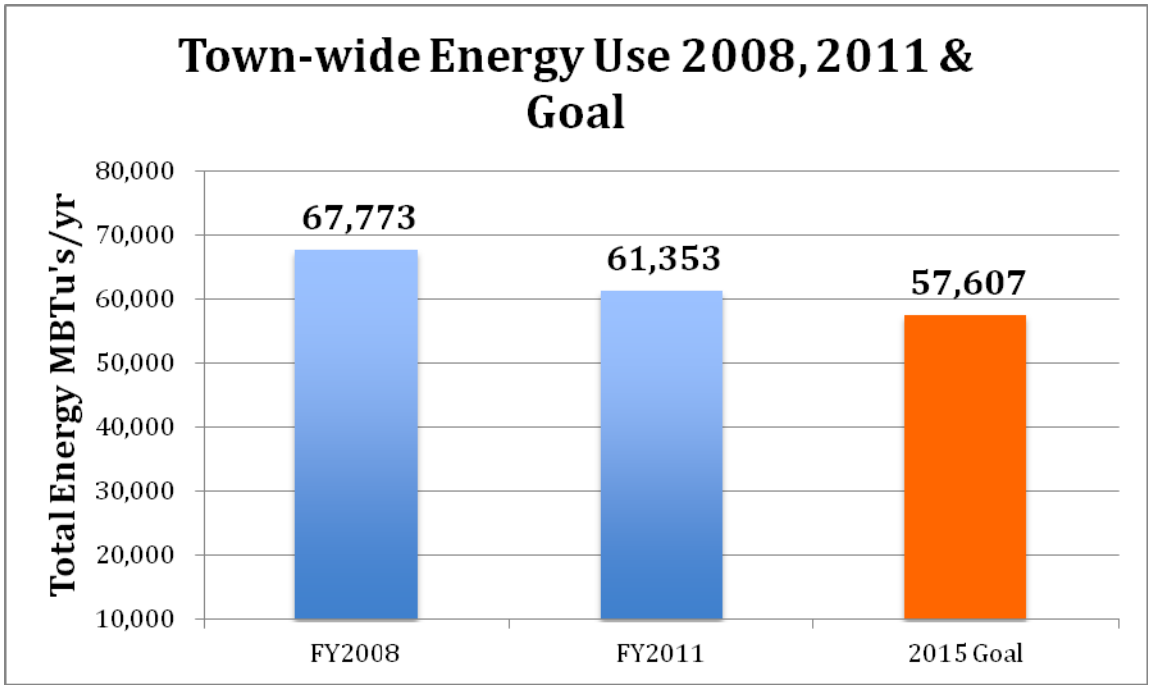
As noted earlier, the easiest way to compare energy use across fuel types and by different energy users or uses is to convert the energy used from its native units (again, kilowatt hours of electricity, hundreds of cubic feet of natural gas, and gallons of oil, gasoline, diesel, or propane) into British thermal units or Btus, which reflect the energy value that each of these native units represents.

If a building is converted from one energy source to another (for example, the Library being changed from heating with oil and gas and cooling with electricity to using groundwater heat pumps for both), we can compare the energy used in Btus to determine how great the change in energy use actually is.

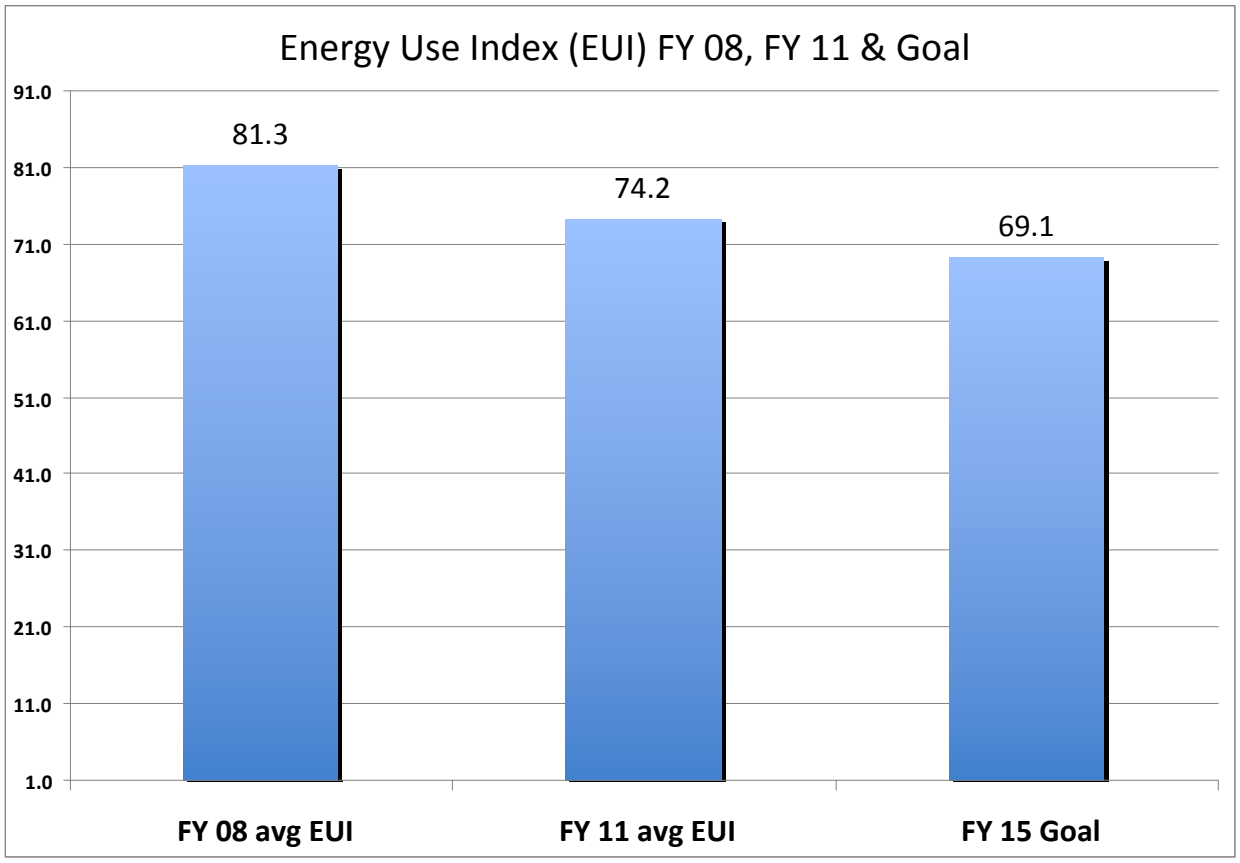
Table 6. Change in Combined Building and Vehicle Energy Use FY 08 to FY 11 (in MMBtus)

	FY 08 (in MMBTus)	FY 11 (in MMBtus)	Change (in Percent)
Municipal Buildings			
Electricity	3,484.16	3,665.80	
Natural gas	4,133.28	4,550.54	
Oil	1,438.09	580	
Total	**9,055.53**	**8,797.23**	**(2.85%)**
School Buildings			
Electricity	20,937.23	18,353.04	
Natural gas	26,947.68	24,684.54	
Oil	695.00	764.50	
Total	**48,579.92**	**43,802.08**	**(9.84%)**
Vehicles	**10,138.41**	**87,54.59**	**(13.65%)**
TOTAL	**67,773.76**	**61,353.90**	**(9.47%)**

On an MMBtu basis, as shown in the table above, aggregate energy use in municipal buildings, in school buildings, and for vehicles all have dropped since the FY 08 baseline year. The combined change is from 67,773.76 MMBtus to 61,353.90 MMBtus, for a total reduction of almost 9.5 percent.



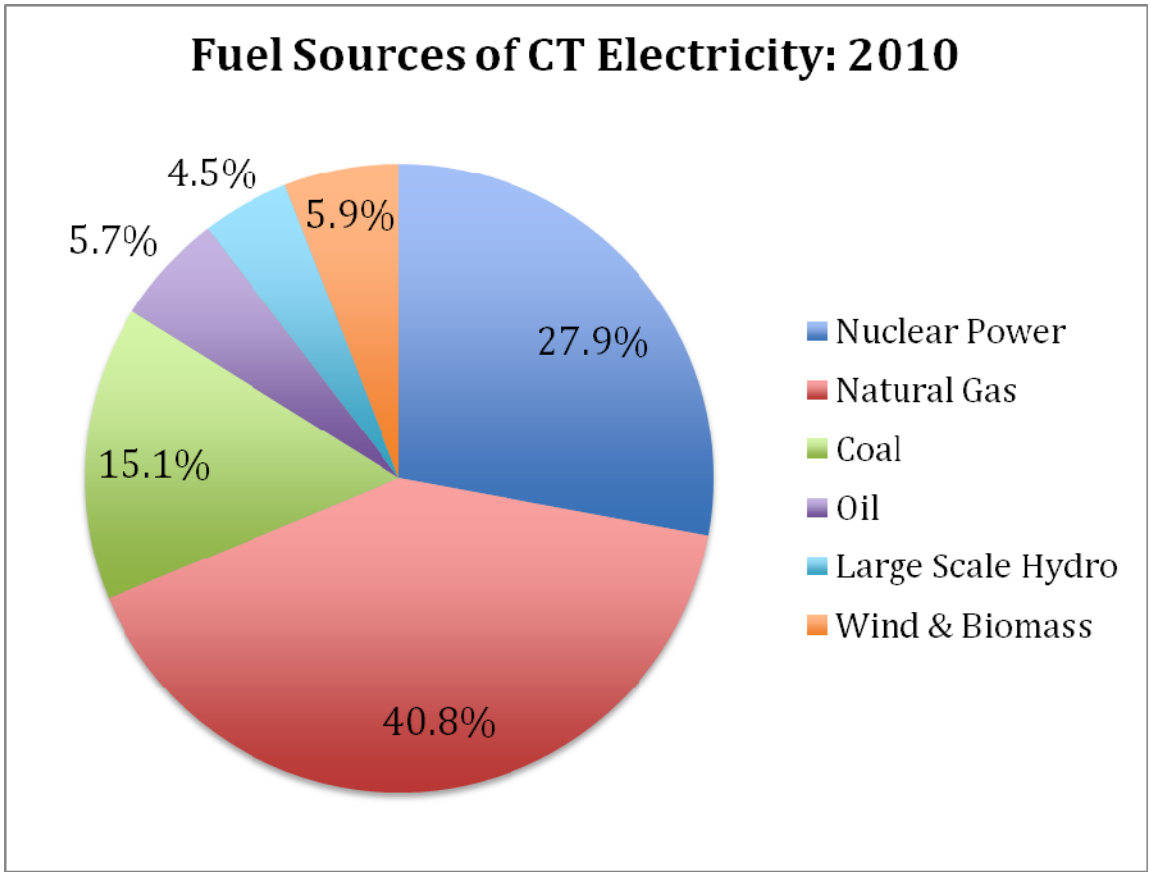
The ACEC recognized that energy use in buildings is a major opportunity for efficiency improvements and for the use of renewable energy sources. To accurately capture changes / improvements, the Commission chose to separate out building energy use and use the EUI metric as a measure of performance. This way, if more buildings are built (additional schools), or existing buildings are expanded (the town library), the overall energy increase, would be normalized by the increase in floor space of the buildings (Btu's per square feet). The chart below shows the reductions in EUI achieved against the FY 08 baseline for ALL Town buildings.



Benchmarking Carbon Produced by Town Operations 2008 - 2011

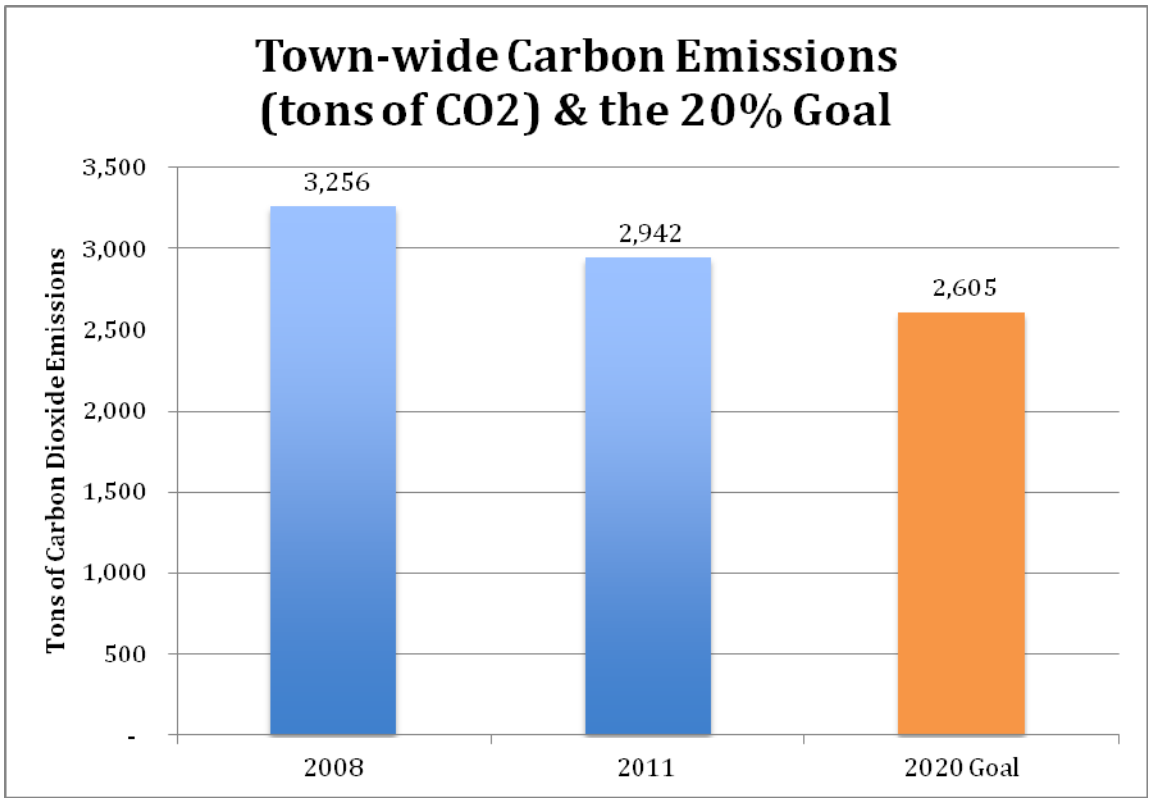
In the same way that native units of energy can be converted to British thermal units, these same native units of energy can be represented in terms of tons of carbon dioxide produced through their use or their generation (in the case of electricity). Tons of carbon produced by directly burning fossil fuels or other carbon-containing fuel (e.g., biomass in a wood stove) to release their thermal content are calculated using simple formulas that equate a unit of fuel (e.g. a gallon of fuel oil) to some quantity of carbon dioxide released into the atmosphere.

For electricity, it is important to know how that electricity was generated since the carbon emissions will vary greatly from dirty carbon sources like coal or #6 oil to cleaner sources such as natural gas to carbon-free sources such as solar photovoltaic systems or nuclear power stations. Since electricity is a commodity (similar to oil), the fuels (oil, natural gas, nuclear, etc.) that are used to create the kilowatts determine its price. When one resource is less expensive, more of the electricity will be generated by using that cheaper fuel. This can change significantly over a multi-year study, such as this plan. As of the writing of this report the, ISO New England power mix consisted of the sources in the chart below.



Currently, over 40% of the electricity is generated using natural gas. "Zero carbon" sources in this mix make-up 38.4% (nuclear, hydro, wind & biomass.) "High-carbon" sources of fuel contribute about 20.8% of the total mix. On average these sources produce 0.88 pounds of carbon dioxide per kWh delivered to the Town.

The Town of Avon is considering participation in the "20 by 2020 Challenge," which is a 20% reduction in greenhouse gas emissions by the year 2020. The chart below shows progress to date in meeting that potential goal. In the three years since 2008, there has been a 10% reduction in carbon emissions from all Town buildings[2]. The installation of renewable energy projects (solar photovoltaic, wind, small-scale hydro, biomass, etc.) and continued energy efficiency efforts could easily allow the Town to meet this target.



[2] The ACEC has chosen to follow the internationally accepted GHG reporting protocols of the World Resources Institute (WRI). This standard classifies GHG emissions into three categories, Scope 1(fuels burned on-site –oil & gas), Scope 2 (electricity used on-site from an off-site generator (utility company)), and Scope 3 (all other uses - fleet vehicles, suppliers of goods, commuting of employees, etc.). Currently, most companies and municipalities, which report their GHG emissions publicly, report Scopes 1 & 2, and defer Scope 3 calculations as they are the most variable and subject to error. For these reasons, the chart above shows ONLY Scope 1 & 2 emissions.

ACTION PLAN: TOWN-WIDE ENERGY EDUCATION

Energy education is necessary to ensure that the Town has community support for the plan's goals. The energy plan's success requires educating not only Town staff and building users about how their behaviors and choices will reduce energy use and about the potential for using clean energy sources, but also informing and educating residents and taxpayers about proposed investments in efficiency and clean energy.

Outreach and education will help the community participate in and support development and implementation of energy reduction and clean energy strategies. Further, as residents learn about energy conservation and declining fossil fuel use by the Town, this knowledge will also encourage informed decision making in their own energy choices.

The Avon Clean Energy Commission was charged by the Town Council to "research and facilitate the use of clean renewable energy within the Town of Avon, which is most appropriate and cost-effective for its given function" and to "educate Avon residents about the clean energy options available to them through their current or alternative energy providers".

To that end, the ACEC hopes to take the lead in identifying and communicating information to the Avon community-at-large about:

- Alternative Energy. Where can clean renewable energy be used cost effectively, instead of conventional energy sources, to satisfy energy needs?
- Energy Efficiency and Home / Business Economics. How can households and businesses increase the efficiency of using all forms of energy in operations (e.g., lighting, heating, cooling, hot water use, electronic devices, transportation) through no-cost behavior adjustments, low-cost improvements, building renovations, and investments in newer, more efficient equipment?
- Available Technical and Financial Resources. How can Avon businesses and residents connect with resources and programs provided by utilities, the state, and the federal government to encourage and support both increased energy efficiency and the use of renewable energy?

Efforts to Date

In addition to efforts discussed under the following section, "Action Plan: Achieve a 15% Energy Use Reduction in Buildings," the ACEC has sponsored an information table at Avon Day for the past two years. Public education focused on residential energy conservation measures and on signing up residents as clean energy users through the state Connecticut Clean Energy Option program.

ACEC also sponsored a School Energy Competition among Avon schools to promote adoption of behaviors to reduce energy consumption, decrease the school's carbon footprint, and save taxpayer money. The Avon schools competed in the contest between February 22, 2010 and April 23, 2010, to see which school could achieve the largest percent reduction in energy consumption (both kWh of electricity and cubic feet of natural gas) compared with the same time period in 2009.

The ACEC has also been working with Avon High School Green Energy Club, and has two Club members serving as liaisons between the ACEC and the High School and participating in monthly ACEC meetings as non-voting representatives.

Additional Opportunities for Community Education and Outreach

There are a variety of additional educational initiatives that the ACEC would like to pursue to promote Town-wide energy conservation and clean energy use. These include:

- Establish a list of energy and sustainability-related seminar topics of interest to community members. Potential topics include, but are not limited to: Town and family carbon footprints; community gardening; home and business energy and water conservation strategies; utility programs for home and business energy efficiency; using solar energy for heating and power; incorporating passive solar design in new construction; encouraging non-motorized transportation alternatives; Is wind power right for you?; tax incentives for clean energy investment; utility bills, energy supply, and alternative suppliers; expanding clean energy technology use in Avon: understanding the effects of Town regulations and policies.
- Identify energy topic experts in Avon that can be tapped for local seminars and group interaction.
- Identify additional resources (perhaps in nearby towns, through advocacy groups, from state government or utilities) that are able and willing to share such information for free or inexpensively.
- Create a speakers list that can be used by local organizations.
- Partner with local organizations or institutions to put on programs for residents or businesses (e.g. community and student information sessions or charettes).
- Arrange for tours of renewable installations in Avon or nearby, perhaps in collaboration with other local energy commissions. Examples include: Talcott Mountain Science Center, Zahren wind installation, solar house tours, Avon Old Farms School, Reflexite, new Library geothermal system, among others.
- Establish a Town website for posting energy information, links to resources, and a calendar of events

ACTION PLAN: ACHIEVE A 15% ENERGY USE REDUCTION IN BUILDINGS

Buildings are the Town's largest users of energy and, therefore, the biggest opportunity for savings. The ACEC calls on Avon to reduce energy used in buildings for municipal and school operations by 15% by FY 15, against a FY 08 baseline.

Efforts to Date

The following initiatives have been undertaken to date by the Town and Board of Education since FY 08, the baseline year, to reduce energy use and improve the performance of energy conversion equipment (i.e. equipment and systems that transform energy into beneficial uses: heating, cooling, hot water, light, etc.)

Capital Projects Implemented

There have been numerous equipment and system investments in both Town and BOE facilities. Lighting upgrades and lighting controls have been installed in most municipal and school buildings through the Connecticut Light and Power incentive program.

- In municipal buildings during this period, Avon upgraded lighting (and controls) at the Town Hall Campus, Library, Public Works, Senior Center, Landfill, DPW Salt Shed, and Fire Company One on Darling Drive.
- In school facilities district-wide, BOE replaced 9,904 32w bulbs with 25w long life high efficiency bulbs in all school classrooms, re-lamped exterior/parking lot lighting with lower wattage bulb and re-ballasted fixtures, and installed LED lighting for exterior/parking lot fixtures at all schools

Other improvements in facilities have included:

- Avon Middle School: high efficiency gas boilers (2010), white insulated EPDM roof (2009), high efficiency roof-top units (2009), high efficiency indirect fired water heaters (2007);
- Roaring Brook School: high efficiency gas boilers (2008), high efficiency indirect fired water heaters (2008), white insulated EPDM roof (2007);
- Avon High School: high efficiency roof-top units in addition/renovation (2007) and white insulated EPDM roof (2007)
- Public Works Garage: corroded garage bay doors were replace with insulated doors, funded in part with ARRA EECBG funds.

Operations and Maintenance Changes

More recently, on June 1, 2011, Avon Public Schools enlisted the services of Energy Education, Inc. to provide a methodology to reduce energy costs throughout the district. They provided Energy Guidelines to follow to obtain our goals. Peter Gaski, BOE Director of Facilities, was selected as the Energy Specialist to implement, enforce and oversee the Plan. All personnel in the District were made aware of the new Energy Guidelines, which outline the responsibilities of teachers, custodians, HVAC techs, administrators and the Energy Specialist with regard to the Energy Plan. Heating and cooling set points are provided as well as equipment run times. Everyone is expected to shut off unnecessary lighting and electronic equipment on a daily basis. During weekends and extended school breaks the buildings are essentially shut down, except for essential equipment. The Energy Specialist makes daily after hours and weekend rounds to ensure that the guidelines are being followed and to look for additional opportunities for savings.

Results

While the overall reduction resulting from Town efforts to date to improve the energy efficiency of buildings and equipment has been quite significant (i.e. almost 9.5% without weather normalization), results are more mixed in terms of total reductions in energy use in individual buildings and for different energy sources.

As noted earlier, significant savings are evident in electricity use across much of the BOE portfolio through FY 11, and natural gas use is trending downward (even though the High School was expanded significantly in FY 09); however, oil use in the BOE Annex is largely unchanged.

In municipal buildings, electricity use is mostly unchanged compared to FY 08 and natural gas use is, in many cases, somewhat higher than in the baseline year (with the notable exception of the Library, the Police Gym, and Public Works, which have all realized significant reductions). Heating oil use in Town Buildings has increased in Fire Station Company 2 and the Recycling Center, but dropped very significantly at Fire Station Company 4 and Countryside Park. One possible explanation for these results is that, despite the physical improvements made, buildings are not being operated with enough attention to efficiency as should be possible given systems in place.

Additional Opportunities for Energy Reduction

In 2010, Town of Avon secured a State grant to hire Peregrine Energy Group, Inc. ("Peregrine") as its energy consultant to undertake an assessment of all Town and Board of Education buildings. Reports from the building assessments completed by Peregrine are summarized in Appendix A to this document.

Peregrine toured Avon's municipal and school buildings in winter 2011. Accompanied school and the municipal facilities staff, Peregrine visited all Board of Education buildings (Avon High School, Avon Middle School, Pine Grove, Roaring Brook, Thompson Brook, and the BOE Annex) , as well as the Town Hall Campus (Buildings 1, 2, 5, 6, 7 at the former munitions factory), the Police Department and Gym (Buildings 3, 4, 8), the four fire companies, Public Works, the Landfill, the Senior Center, and the Animal Control building. The Library was not included in these site visits because of the ongoing construction.

Peregrine's objective in touring the buildings was to explore building performance issues with knowledgeable staff, observe current operations and building automation systems, and inventory the existing energy-related infrastructure and equipment. Based on their observations and analysis, they suggested potential improvements and projects for the Town to better manage energy use and cost. These projects would also, in many cases, result in other tangible benefits (i.e. increased occupant comfort, improved teaching environment, better reliability, and reduced maintenance expense).

Board of Education Buildings

With respect to energy use in operations, Peregrine found that the Town's school buildings are overall better than average compared to other school systems they work with. School buildings demonstrate consistent attention to ongoing management and maintenance of these assets.

From Peregrine's report:

> ***"The Town [of Avon's Board of Education] has demonstrated a clear commitment to upgrading building systems as they get older and adopting new technology as it becomes available. We have every reason to believe that the Town will choose to continue these practices as older building systems reach the end of their normal service lives."***

That said, Peregrine identified a number of additional projects and improvements that could yield significant additional energy reductions. Appendix A includes a table summarizing additional energy conservation measures (ECMs) that Peregrine suggested for BOE consideration, as well as a matrix organized by building that shows which of the ECMs is recommended for which of the buildings.

Recommended ECMs fall into six, named technology categories (operations and maintenance (O&M), lighting, retro-commissioning ("Cxing"), controls, mechanical, and envelope) and a "miscellaneous" group. Aggregate annual cost savings projected for these ECMs in the BOE building portfolio are estimated at about $139,000, equal to approximately 10% of the FY 11 annual utility expense. Additional benefits Peregrine anticipates that would accrue to Avon Public Schools from implementation include reduced operations and maintenance liabilities, replacement of end of life equipment, and comfort improvements. They estimated a total implementation cost for this energy reduction program of approximately $2,790,000.

The BOE building with the greatest savings opportunity was the High School with $53,900 in potential savings, to almost 40% of the savings identified in the BOE portfolio. The BOE building with the greatest potential percentage savings was the BOE Annex, at 24%, for a cost avoidance of $7,000.

Municipal Buildings

The total annual energy expense in FY 11 for municipal buildings, which total 94,900 square feet in area, is approximately $285,000, for electricity, natural gas, and oil. As was the case with BOE buildings, Peregrine found municipal buildings to be in good condition and to show consistent attention to ongoing asset management and maintenance. And as was the case with the schools, municipal buildings are overall in better than average condition compared to other municipalities Peregrine works with.

Peregrine evaluated the Town Hall Campus (Buildings 1, 2, 5, 6, 7 at the former munitions factory), the Police Department and Gym (Buildings 3, 4, 8), the four fire companies, Public Works, the Landfill, the Senior Center, and the Town's Animal Control building. Their report did not address the Library, undergoing major renovations and a large increase in floor area, with the existing HVAC and heating system to be removed and a new geothermal system to be operational later in 2012.

With respect to the Library and other future major renovations across the portfolio, Peregrine suggests, in the context of ongoing energy planning, continuous improvement, and Avon's goal to substitute clean energy sources for fossil fuel wherever possible, that the completed, fully commissioned Library geothermal system be monitored closely for performance and potential applicability elsewhere.

Appendix A also includes a table summarizing the energy conservation measures that Peregrine recommends for municipal buildings, as well as a matrix organized by municipal building that shows which ECMs are recommended for which buildings. For municipal buildings, recommended ECMs fall

into five named technology categories (operations and maintenance (O&M), lighting, controls, mechanical, and envelope) and a "miscellaneous" group. Aggregate annual savings projected for these ECMs in the municipal building portfolio are approximately $17,000, equal to approximately 6% of the current annual utility expense. Additional benefits that would accrue to Avon from implementation include reduced operations and maintenance liabilities, replacement of end of life equipment, and comfort improvements. The estimated implementation cost for this program is about $180,000.

Savings identified for each of the individual buildings were modest, generally in the range of 5% to 10% of energy expense. This was attributed by Peregrine to prior actions taken to date and the care that operators are taking in operating practices. Also, the smaller size and lesser complexity of these buildings and their systems mean that there is less waste that can be readily addressed through equipment and systems adjustments.

Short and Long-Term Building Improvement Strategies

The Town should pursue a combined program of short-term and longer-term strategies and actions in school and Town buildings to achieve the 15% energy reduction goal outlined in this plan. To that end, Town decision makers should formally institutionalize a set of policies and practices that support achieving this goal. The ultimate effectiveness of Avon's plan will rest on its faithful adoption and execution by the entire management structure, from maintenance departments to facility managers to teachers and school administrators and to department heads and Town boards.

Immediate or Short Term strategies should focus on operations and maintenance practices, with an eye towards achieving the 15% energy reduction goal against the FY 08 baseline. This should include a close examination of how each and all of the Town and BOE buildings are used and how and when building spaces are conditioned. These strategies should also include ensuring that any near term capital improvements that are already planned for implementation are as efficient as possible and, where appropriate, incorporate efficiency enhancement opportunities they create (for example, if a roof is being replaced, try to use this as an opportunity to increase roof insulation, if practical and warranted). Finally, short term strategies should include efficiency investments with simple paybacks that meet an established guideline, perhaps 5 years.

Specific projects recommended by Peregrine for immediate action include:

- Operations and maintenance improvements (e.g., thermostat management, central vacuum system replacement in schools, door and window weather-stripping, duct work and pipe insulation)

> ***Operations*** **strategies focus on ensuring that building users have sufficient heat, cooling, and hot water available to them to optimize comfort, and that energy is not expended without creating measurable benefits.**

- Lighting technology upgrades (e.g., replacing any remaining incandescent and halogen lamps, exterior HID light replacement, occupancy sensors and photocell controls, replacing metal halide gymnasium lights)
- Retro-commissioning of controls and HVAC systems and air-side HVAC testing and balancing

Longer-Term strategies should focus on capital improvement projects for all municipal and BOE buildings, including replacing equipment that is at the end of its useful life, adopting major technology innovations as they become mainstream and cost effective (such as LED lighting), augmenting or enhancing building controls systems, and ensuring that future major building renovation plans and any new construction that the Town embarks on includes the highest level of efficiency possible into building envelopes and takes note of relative efficiency of alternative systems being considered for purchase. These longer term energy reduction strategies should address if and how clean energy sources such as solar hot water systems can be used to offset fossil fuel use. These are all good opportunities that will reduce energy use and cost and also improve occupancy comfort and improve equipment reliability.

Retro-commissioning **is the process of reviewing and comparing current equipment operating parameters to optimal settings and correcting them.**

Specific "longer-term" capital improvement projects recommended by Peregrine include:

- Enhancing or expanding control of building systems (e.g., add Hot Water Reset Control in many Town Buildings, refrigeration motor and controls upgrades in schools, add kitchen hood ventilation controls in schools, interlock dishwasher exhaust fan with dishwasher in schools, expand and update school controls systems)
- Upgrade mechanical systems in individual schools and municipal buildings (e.g. installing chilled water isolation valves, replacing rooftop units, replacing boiler plants, shutting down chillers in winter and replacing them with local ductless split units (Police Building)
- Improving building envelope to reduce heating and cooling requirements (e.g., air sealing to reduce air flow through buildings, installing insulation,

Maintenance **strategies focus on preventative care of equipment to ensure it functions with optimal efficiency, including the replacement of worn components that reduce equipment effectiveness.**

These and other projects are described in more detail in Appendix A.

Guidelines for Future Construction and Equipment Acquisition

Beyond the energy conservation measures described thus far, achieving the 15% reduction goal and maintaining the results will require that future energy consumption be a criterion in all future building construction and equipment acquisition. While energy reduction is likely not the primary driver in

future business decisions, it is important to the achievement of the Town's energy management goals that the question "How is this going to affect our current energy use?" be considered by all decision makers at all organizational levels involved in purchasing and ongoing building operations.

Life cycle analysis is the term of art that is used to describe an approach to design and purchasing that looks at the total cost of equipment acquisition for that equipment's life. Contrast this with a first cost approach to equipment purchasing that only looks at initial out-of-pocket expense. We recommend that life cycle analysis be a standard procedure in all purchasing decisions.

***Life Cycle Analysis* focuses on comparing "first cost" (i.e. purchase price) and other "lifetime costs" (e.g., energy use, repair, and maintenance) for new equipment or new construction being considered.**

ACTION PLAN: REDUCE NON-BUILDING ENERGY USE

Vehicles and street lighting are the other major energy users of the Town of Avon. Strategies should be put in place and opportunities identified for reducing the energy required for both, including adopting alternative operations and maintenance practices, life cycle costing in purchasing decisions, and replacement of aging and failed equipment with new models using more energy efficient technologies

Town Vehicle Fleet

As noted above, the Town vehicle fleet includes automobiles, light trucks, and special purpose vehicles used for highway and property maintenance and public safety purposes. The ACEC recommends that the Town try to increase the measured fuel efficiency of the Town's vehicle fleet by 15% by 2015, and that they continue to implement programs and make purchases to increase the work completed for every gallon of fuel consumed.

Progress to Date

We commend the Department of Public Works for already implementing a range of procedures and programs to improve vehicle performance and to track and control the use of transportation fuel that the Town is purchasing:

- In an effort to monitor and control fuel usage, the Town of Avon installed a Fuel Management System approximately five years ago to monitor fuel utilization. This system prevents fuel from being dispensed into anything but the vehicle that it is activated for by using an electronic ring on the vehicle and the gas pump nozzle. Once the connection is broken, the pump shuts off, preventing dispensing into additional unauthorized vehicles or gas cans.
- The same system also monitors the engines computer and alerts the DPW if there is an engine malfunction that could result in the use of additional fuel usage because of poor performance.
- In addition to the Fuel Management System, the DPW has a Fleet Management System to track repairs and preventative maintenance costs. This system uses mileage reports from the Fuel

Management System and alerts the Machinery and Equipment staff when preventative maintenance services are due based on a predetermined mileage and time schedule by class of vehicle.

- Part of the preventative maintenance schedule is to closely monitor tire air pressures. Poorly filled tires contribute to excessive fuel consumption and poor tire life cycles.
- Four years ago, the DPW switched from a conventional motor, transmission and hydraulic oil to 100% synthetic oil products. They anticipate that this change is reducing fuel consumption by 2%, consistent with national studies. In addition, by using these oil products, they have also reduced the number of oil changes they perform annually, with a commensurate reduction in associated oil expense, labor, and disposal of the waste product. This oil is also expected to reduce wear over the life cycle of the unit.
- Waste oil that is collected is burned through a waste oil heating system, which heats the Machinery and Equipment shop as well as the maintenance building at the Landfill, offsetting the need for other heating fuel purchases.
- The Department of Public Works also instituted a no idle policy that its employees follow in an effort to reduce pollution and unnecessary fuel consumption.
- Finally, any and all new equipment and vehicle purchases are being matched to the operation vehicles are intended to do. This means not purchasing undersized or underpowered units that will not hold up to the demands and needs of the operations or not buying an oversized or over powered unit that will not be an efficient unit. To that end, the DPW focuses on developing individual equipment specifications that secure a vehicle or equipment that performs the operations it is intended to do as efficiently as possible, with the best prolonged life cycle.

Additional Opportunities to Increase Operating Efficiencies

If the Town wants to be more aggressive in its reduction of energy used by vehicles, it can, as other Connecticut cities and towns are doing, elect to replace conventionally powered vehicles with “hybrid” vehicles, where this change does not compromise functionality. The around town energy mileage of hybrid vehicles are almost twice the performance of conventionally powered vehicles.

If the Town does not choose to take this tack, vehicle operating efficiencies will still steadily increase as new model years with higher mileage efficiencies replace older vehicles. But actual use of fuel in vehicles is driven by a number of variables that, outside of these “sticker efficiencies” and total consumption by individual vehicles, is a function of business requirements of the individual enterprise they are used for.

Efforts to date by the Department of Public Works to track and control the use of transportation fuel should continue. Policies and procedures that are in place governing preventative maintenance, equipment idling, and day to day management of tire pressures, for example, should also be continued to positively affect fuel use as Town vehicles do the daily work that needs to be done.

Street Lighting

The Town’s street lights are owned by Connecticut Light & Power. This creates a significant limitation on what the Town can do to reduce energy use and reduce the associated carbon footprint for lighting.

Of course, one way to reduce the energy use attributed to street lighting is to reduce the number of lights. While the Town can target individual lights for removal, there is usually considerable push back around general public safety concerns or concerns by individual residents that see a particular light as important to their peace of mind and safety. Nevertheless, a detailed inventory of each light's location and the functions it serves (e.g. lighting an intersection, lighting a turn, lighting a business location, illuminating a residential neighborhood) could form the basis for decision making about lighting changes, including light removal or reduction in light levels (i.e. through lower wattage).

Another related option is to reduce the operating hours of certain lights. CL&P has a program that permits a town to elect to limit hours of operation after midnight, in exchange for conversion to an alternative rate. While reductions in burn hours from this program will help reduce the Town's carbon footprint, the dollar savings are limited under this alternative tariff because the ongoing (and unchanged) cost for street light maintenance is a big portion of the total tariff, compared to the charge and savings for the electricity no longer used. To date, the Town has been reluctant to make a change that could raise concerns about local road safety while creating limited budget relief.

Finally, replacing lights with newer technologies that use less energy to provide comparable illumination is an alternative worth pursuing. Traffic signals owned by the Town are the best candidates with light emitting diode (LED) technology being a big saver on a lamp by lamp basis. For street lighting, replacement is limited by CL&P's ownership and the lack of a utility interest, incentive, or mandate to retrofit these lights to more efficient technologies.

Progress to Date

The Town has made progress on its own to convert outside lighting it owns to the more efficient LED technology at its school parking lots and on the Town Hall Campus. They believe that the new technology works and is cost effective.

The Town has also looked at reduced operating hours and elimination of street lights in select locations, but has not, to date, found the benefits of these strategies compelling, compared to the costs.

Additional Opportunities

Future opportunities for energy reductions in street lighting will require a comprehensive review of options and alternatives, and should address the following:

- Economics of purchase of street lights from CL&P as an alternative to continuing the ongoing arrangement. The Town of West Hartford completed purchase of their lights a number of years ago and realized significant savings. Unfortunately, the Town has many fewer lights than West Hartford, and the economics of taking over maintenance is not attractive. This could be an opportunity for collaboration among multiple towns.
- Consider conversion of traffic signals to LED, if they have not been converted already. LED are now widely in use for this application. Green and Red lights have the fastest paybacks since they are on most often in the traffic signal cycle, but converting the Yellow lights at the same time probably makes economic sense.

- Continue discussions with CL&P about opportunities to reduce wattages of high pressure sodium lamps being used by CL&P at the time of burnout replacement or town-wide replacement.
- Confirm the accuracy of the list of street lights for which the Town is being billed and consider if any should be or could be eliminated or replaced with an energy saving alternative.

ACTION PLAN: REDUCE THE TOWN'S CARBON FOOTPRINT BY 20%

The ACEC has suggested that Avon adopt a goal of lowering the Town's carbon footprint by 20% by the year 2020 through an integrated program of energy conservation, energy efficiency improvement, transitioning to non-carbon dioxide generating energy supply, and substituting clean alternatives to fossil fuels and fossil fuel generated electricity, whenever practical and economically feasible to meet our remaining energy needs.

The final option is to continue to purchase competitively priced REC's from inside or outside the State of Connecticut.

As Avon considers its energy future and continues to plan for it, it is likely that renewable energy resources will be among the sources of energy that are considered for inclusion in the overall mix. While many of these renewable sources are best suited for large installations where there are economies of scale, and most depend on site specific availability of a resource (such as strong and frequent winds, continuous access to sunlight, or abundant waste wood or forest resources), others will work at the scale of individual buildings (e.g. solar hot water or solar electric, geothermal heating or cooling, or wood heating).

The Town of Avon currently purchases certified renewable energy certificates equal to 15% of the Town's electricity consumption (and gets another 9% of "green" energy from its electricity supplier, for a total of 24%) as part of its commitment to the 30% by 2015 Clean Energy Communities program sponsored by the Connecticut Clean Energy Finance and Investment Authority (CEFIA). These certificates are certified to be from qualifying renewable energy installations, predominantly wind farms, generally located in the United States mid-west.

Renewable Energy Sources:

Most renewable energy comes either directly or indirectly from the sun.

Solar **energy can be used directly for heating and lighting buildings, for generating electricity, and for hot water heating.**

Wind **is driven by the sun's heat and the energy it contains is captured with wind turbines to create electricity.**

Geothermal **energy, the energy held in the ground, is best captured by using ground water or the earth's temperature below frost line for heating and cooling using heat exchangers**

Hydropower **is generated by tapping the energy in moving water and using it to turn a water wheel or turbine to create electricity.**

By FY 15, the Town of Avon hopes to have achieved its 15% energy use reduction goal. It is the Commission's belief that the 30% Clean Energy by 2015 goal should be achieved through a combination of strategies that includes the Town's own clean energy projects (solar PV, solar hot water, wind, hydro or bio-mass, or additional geothermal). The total clean energy goal is 14,700 MBtu/yr in 2015; 42% of this could be met through Solar Photovoltaic panels having a total capacity of 743 kW. Another portion could be met by converting the existing oil-fired heating units to run on bio-diesel (either 100% or some blend).

Another option is to identify clean energy projects within the Sate of Connecticut and purchase their REC's directly in order to keep the clean energy "in-state."

Progress to Date

- A geothermal heating and cooling system has been installed at the Avon Free Public Library, replacing the conventional boiler and chiller units. The Town hopes that this system can be a model for future replacement of fossil fuel with a renewable resource. Now complete, the energy use for the Library needs to be tracked and compared on a Btu per square foot basis with its energy prior to the renovation/expansion. This analysis will assist in reaching our carbon footprint reduction goals.
- As noted above, Avon joined the State of Connecticut's 20% by 2010 initiative and recently also signed up for the 30% by 2015 campaign. Under the successful 20% by 2010 effort, Avon purchased enough renewable energy certificates ("RECs") to green 10% of the total Town and BOE electricity purchases. These certificates were purchased in the REC market from certified projects. The remainder of the 20% was achieved through the State's own requirements that utilities secure 10% of the electricity they supply from Class 1 renewable generators. Going forward, to achieve the 30% by 2015 goal, the Town will continue to purchase an increasing number of RECs annually through 2015, equal to 14.5% of electricity used. Again, the remainder of the 30% will be made up by utility purchase requirements.
- ACEC has encouraged residents to sign up for clean energy on their CL&P bills. Choosing clean energy helps the Town qualify for solar arrays through the Connecticut Clean Energy Fund (1KwH for every 100 residents to sign up)

Additional Opportunities

In February of 2012, an ACEC member conducted a solar feasibility analysis of the Avon Middle School, the results of which show a significant potential to generate electricity through solar photovoltaic panels. Specifically, the report shows:

> "The existing buildings are suitable for solar PV panels due to their beneficial southern exposure, flat roofs, and minimal shading from adjacent topography, trees or buildings. The roof surface is newer, in good condition, and of a material that would contribute to solar panels staying cool in the heat of the summer. Depending upon solar panel layout on the roof, it would be possible to create 139.4 kW of power capacity, possibly more with precise calculation.

Under normal solar exposures this translates to 147,920 kWh of electricity and $16,780 / year in costs at current utility rates."

Reductions in grid-purchased electricity could offset up to 16% of the school's electricity use, with a reduction of 65 tons of GHG emissions.

PLAN IMPLEMENTATION: TECHNICAL AND FINANCIAL RESOURCES Funding Sources for Energy-related Capital Projects

There are a variety of sources that Avon can draw on to fund projects that reduce energy use and the Town's carbon footprint.

Local Funding Sources for Energy Reduction and Renewable Energy

Purchasing Policies

The most obvious way to secure local funding for Town and school energy reduction projects is to build energy reduction into all future purchasing and building renovations decisions so, as buildings and equipment need to be replaced, new systems and equipment will perform more efficiently. The incremental cost of adding efficiency to ongoing purchasing is very small and easy to sell as part of a larger capital expenditure. Life cycle analysis can be used to justify these decisions. Renewable technology can also be included in projects.

Capital Improvement Plan

Avon's capital improvement plan is the most obvious source of funds for targeted energy projects. Where energy conversion equipment is at the end of its designed service life, replacement equipment with higher performance standards can be included in the CIP and funded through Town appropriation.

Reinvesting Savings

When significant savings result from energy improvements, these savings can be banked and reapplied to additional investments in energy efficiency. One strategy for doing this is to level fund the year-to-year utility budget at an amount equal to some portion of these energy savings and put the funds into a separate investment account that can be drawn for approved energy reduction projects.

Performance Contracting

A more formalized approach to *Reinvesting Savings* occurs in performance contracting, an approach to funding energy improvements and capital upgrades where energy savings in level funded utility budgets are used to cover the debt service for a bundle of projects implemented by the Town through an energy services company. Given the relatively high level of investment in efficiency that Avon has been willing to make through its CIP over the years, there may be limited opportunity for a larger scale paid-from-savings approach.

Power Purchase Agreements

While not a capital project funding mechanism per se, power purchase agreements ("PPAs") are being increasingly used by public and private entities to secure renewable energy, and most typically solar-generated electricity, though PPAs are also executed for wind and landfill gas projects. The Town would execute a PPA with a private company that would purchase, install, own, maintain, and operate a renewable energy project at a Town facility. The Town would agree to purchase the power produced by the project at an agreed upon price over some number of years. The owner would get the tax benefits associated with the project. There are sometimes early buyout or term extension provisions in these contracts.

Outside Funding Sources

Utility Company Incentives

State Grants

Federal Grants

Additional Funding Sources for ACEC Initiatives

Communities Program "Bright Ideas" Grants of approximately $5,000 each will be available for task forces/energy commissions that are part of the Clean Energy Communities Program. Grants are earned via a points system for sign-ups in your town for energy efficiency programs.

Deadline: Ongoing

Contact: Bob Wall <Bob.Wall@ctcleanenergy.com>, 860.257.2354

Communities Program "Community Innovation Grants" of $250-$2000 are for task forces/energy commissions that are part of the Clean Energy Communities Program to use/distribute in their community.

Deadline: rolling

Contact: Bob Wall <Bob.Wall@ctcleanenergy.com>, 860.257.2354
http://www.ctcleanenergy.com/YourCommunity/CommunityInnovationGrants/tabid/99/Default.aspx

New England Grassroots Environment Fund offers small grants ($500-$2,500) for "community groups in Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island and Vermont that are working at the grassroots level and have 1) significant volunteer involvement, 2) no more than two full-time paid staff, 3) budgets of less than $100,000/year, and 4) Ad Hoc, Incorporated or Non-Profit status"

Deadlines: SEED grants: rolling deadline; GROW grants: Thursday March 15, 2012

Contact: Ginny Callan <callan@grassrootsfund.org>, (802) 223-462
http://grassrootsfund.org/grants/small_grants/

Clean Air Cool Planet "Community Catalyst" Grants ($250 to $2,500) are for "projects that will promote environmental sustainability, improve environmental stewardship, and/or decrease consumption of energy and fossil fuels on a local level." A variety of groups can apply -- see the website for stipulations.

Deadline: rolling

Contact: Amanda Sayut, Development Officer <asayut@cleanair-coolplanet.org>, 203.966.5427
http://www.cleanair-coolplanet.org/smallgrants/

Other Potential Funding Opportunities for Consideration by ACEC

Many regions and towns have community foundations that offer a variety of grants to grassroots/community groups. For more information:

- A List of Community Foundations in Connecticut: http://www.tgci.com/funding/cfs.asp?statename=Connecticut&statecode=CT
- Connecticut Community Foundation - Grants Overview:

  http://www.conncf.org/grants-overview

PLAN IMPLEMENTATION: NEXT STEPS FOR AVON

ACEC recommends the Council's consideration and adoption of the following next steps:

General Policy & Statewide Effort Coordination

1. Continue to pursue the 30% Clean Energy by 2015 policy
2. Endorse and participate in the initiatives of the Connecticut Clean Communities
3. Support the effort to form an Assoc. of Clean Energy Task Forces throughout the state
4. Support the efforts of the CT Clean Energy Investment and Finance Authority

Short-term & Specific Actions

1. Review and implement the energy saving steps identified in the Peregrine Energy Use Report. Consider financing alternatives
2. Consider an RFP for solar PV leasing (i.e. 3rd party financing) for the Avon Middle School and possibly other school facilities
3. Achieve the already adopted goal of reducing energy use in all Town operations by 15% by 2015 measured on an energy use / square foot basis, against the 2008 baseline. Specifically,
   - Improve the energy efficiency of municipal and school buildings
   - Increase the measured fuel efficiency of the Town's vehicle fleet
   - Reduce the number and wattage of street lights and other outside lighting where possible and establish a program to convert this lighting to more efficient technologies
4. Encourage Ensign Bickford to explore green/energy efficient building practices for the proposed new town Center development
5. Consider other forms of renewable or more efficient energy for town and BOE facilities and fleet operations, including anti-idling enforcement for vehicles
6. Continue and expand the "behavior modification" practices being implemented by the BOE. Adopt a similar program for other Town of Avon facilities

Continuing Activities

1. Continue to Set Goals: Adopt and commit to attaining quantifiable goals for reducing Town and BOE energy use and carbon footprint. Goals should be an established percentage by unit measure, including as applicable, per square foot, per gallon or pounds of carbon dioxide emissions.
2. Measure Progress: Identify and utilize a unified energy information system to track and benchmark the energy use, on monthly and annual basis, of each Town and BOE building and vehicle.
3. Continue to educate the public on the benefits energy conservation and reduction of carbon emissions from fossil fuels. Plan/conduct future town wide meetings on energy use

4. Encourage expanded education in our schools of the benefits of energy conservation and the threats to national security and the environment that ignoring these issues raise
5. Actively publicize all work the town and BOE is doing with regard to all aspects of this energy plan
6. Review and identify capital improvement projects for all Town and BOE building including replacement of equipment at the end of its useful life, adopting major technology innovations as they become cost effective, such as LED lighting and augmenting building control systems.

Long-term Activities

1. Research and evaluate all incentives, financing and other Federal and State programs for energy savings, carbon reductions and alternate sources of renewable energy
2. Review building codes and consider feasibility of higher standards for energy conservation throughout Avon
3. New Construction and Equipment Acquisitions: Explore Request for Proposals and other Procurement policies and procedures that ensure that future energy consumption be a criterion for new Town and BOE building construction and equipment purchases. Evaluate Life Cycle Analysis (the comparison of purchase cost and other lifetime costs such as energy use, repair and maintenance) as an approach for bidding and accepting proposals. Life cycle cost could become standard criteria for Town and BOE planning, designing and purchasing of new equipment or construction projects.
4. Reduce the Town's "carbon footprint" by 20% by 2020, through an integrated strategy of efficiency improvement and substituting clean alternatives for fossil fuels and fossil fuel generated electricity.

APPENDIX A

SHORT AND LONG TERM STRATEGIES FOR ADDITIONAL ENERGY REDUCTIONS IN BUILDINGS

The ACEC recommends that Avon pursue a combined program of short-term and longer-term strategies and actions to achieve the 15% energy reduction goal outlined in this plan. The following specific recommendations for action were generated by Peregrine Energy Group based on site visits to Town and Board of Education buildings in winter and spring 2011. They are described in additional detail in Peregrine's reports.

Immediate Action Recommended:

Projects recommended for immediate action include Operations and Maintenance improvements, lighting upgrades, retro-commissioning of controls and HVAC systems, and air-side HVAC testing and balancing.

Operations and Maintenance Projects

Operations projects will often mean a rethinking of the way work is done or how buildings are used. Maintenance projects will include a variety of measures including regular, preventative maintenance of all equipment, ensuring that set points and schedules for operations continue to be relevant to current building use, and regularly checking that wearing items, like door weather stripping, are doing their jobs. The following projects identified by Peregrine are representative of the types of O&M projects that the Town and BOE should consider.

- **Thermostat Management (Town Buildings)**

  All of Avon's town buildings have local thermostats to control building zone space temperatures. There are no central building automation systems to provide management and oversight of this function. Buildings have a mix of conventional and programmable thermostats that building staff actively adjust to maintain a reasonable degree of comfort and economy.

  In some areas with very limited occupancy (such as fire station apparatus rooms), it may be possible to operate with more aggressive thermostat settings to conserve energy. Whenever it is practical, thermostats should be turned down at night in the heating season when staff leaves for the day.

  Each programmable thermostat needs periodic monitoring to ensure that all units are operating on the correct time and day of week and that programmed set-points are appropriate.

  ACTION PLAN: Institute an awareness program so that staff at each building are clear on what set-points are recommended and what the costs are for keeping higher set-points or systems active during unoccupied periods. There should be further discussion to flush out obstacles for changing set-points such as complaints that the building will be too cold to work effectively. There are likely solutions or compromises to most of these issues that will result in energy reduction without sacrificing comfort.

- **Replace Central Vacuum System with Portable Vacuums (High School, Middle School, Pine Grove, Thompson Brook)**

  Several of the public schools in Avon have central vacuum cleaning systems. The systems consist of a single vacuum pump with cyclone separator located in a mechanical room and vacuum piping from the pump throughout the school to sealed classroom outlets. Normally cleaning staff turn on the vacuum pump after school lets out and vacuum rooms by plugging in a hose with attachment. Once the entire cleaning staff has completed vacuuming, the system is shut down for the night. Typically the pumps are on for three to five or more hours a day. It is considerably more energy efficient to discontinue using the central system and revert to conventional portable vacuum cleaners (upright or backpack units). Having four or five of these units in operation to vacuum one of the schools will consume about half the power as the central system. Motor run times on the portable units will be much less than the central system which runs during breaks, setup time, etc.

  ACTION PLAN: Have further discussion with janitorial staff and other school operating staff to weigh the pros and cons of switching to portable vacuum cleaners. Assuming there is a decision to purchase portable vacuum cleaners, test a few models and select a standard unit that provides the best combination of performance and ease of maintenance.

- **Change Food Storage Policy in Snack Area (High School)**

  Candy bars and other temperature sensitive food products are stored in high school's cafeteria serving area. There are several refrigerated cases in this area that generate heat. School staff cannot cut off the rooftop unit that serves this area during unoccupied periods because the area gets warm enough to damage the food products. We recommend a change of policy to relocate the food products to a cooler at night. Operating staff can then program the rooftop unit to shutdown during unoccupied periods to save energy.

  ACTION PLAN: Have further discussion with kitchen and school operating staff to reach a consensus on a new policy that will allow the area HVAC system to be shutdown.

- **Upgrade Door and Window Weather Stripping (Many BOE and Town buildings)**

  At most of the BOE and Town facilities, exterior doors aren't closing properly and/or don't have weather stripping or sweeps to seal the door sill. There are significant exposed gaps to the weather. During the winter heating season, these gaps cause uncomfortable drafts and tax adjacent heating devices. This also applies to overhead doors in the Fire Stations. In other Town buildings there are opportunities to add better weather seals on some of the windows and assure proper window closure in the heating season.

  ACTION: We suggest developing a comprehensive program that inventories and gives attention to all exterior doors and windows to make sure they provide a reasonable seal to the elements.

- **Repair Ductwork and Pipe Insulation (High School, BOE Central Office)**

  Exterior ductwork near some of the rooftop units at the High School has damaged insulation. It is important to maintain a weather seal on outside ductwork with exterior insulation because water will permeate into the insulation and destroy insulation properties. It is also very likely that the

moisture will cause corrosion of ductwork and/or enter into the building. Peregrine recommended immediate attention to damaged exterior ductwork insulation. Rooftop systems with known damaged ductwork insulation includes: RTU-11, RTU-13, and HRU-2.

Steam pipes at the Central Office aren't insulated in the mechanical room. If the Town plans to retain the steam system, insulation is recommended to reduce losses to the space as well as make the area safer and more comfortable to work in.

ACTION: Assess all rooftop ductwork and Central Office steam piping to determine final scope of work.

Implement Additional Lighting Improvements

We include lighting among the short term strategies that Avon should pursue because the payback of lighting improvements is usually relatively short, and lighting projects are often supported by incentives offered by Connecticut Light and Power (CL&P). Currently, CL&P also offers on-bill financing at zero interest that allows the Town to pay off the balance of qualified lighting improvements with no upfront out-of pocket cash expense. The Town has already made use of these programs to replace many lights with more efficient alternatives.

- **Replace Any Remaining Incandescent & Halogen Lighting (Town Buildings)**

  Almost all prior energy intensive incandescent and halogen lighting systems in Avon's municipal building have been replaced with more energy efficient compact fluorescent or other technologies. Remaining older lighting systems that should be updated are:

  - Animal Control building: There are incandescent fixtures in kennel area and outdoors. We recommend replacement of these lamps with screw-in CFLs.
  - Fire Company No. 1: There are incandescent lamps in the apparatus bay area that should be replaced with screw-in CFLs.
  - Recycling Center: There is an incandescent track system in the back room. We are not clear if this system is required anymore. It should be removed or the lamps changed to CFLs.
  - Senior Center: There are some PAR18 halogen lamps illuminating artwork in the hallway. We recommend changing this system to LED. There are also some incandescent lamps in the computer / library room. Assuming these lamps remain for dimming purposes, we recommend installing appropriate replacement LED lamps.

  ACTION PLAN: Confirm quantity and wattage of existing lamps. Identify a qualified lighting contractor who will look at the existing lights and propose a fixed price CFL/LED solution. The lighting contractor's proposal normally includes energy savings and projected value of CL&P rebates. It is also customary for the lighting contractor to handle the paperwork associated with obtaining CL&P rebates. It may be possible for the Town to purchase replacement CFL and/or LED lamps and install with its own staff at a lower cost. This may be necessary unless the project is combined with a larger scope lighting project.

- **Update Exterior HID Lighting (Town Buildings)**

  There are two HID exterior lights at the Recycling Center that operate daily. These fixtures can be replaced with much more efficient LED technology. The new fixtures should be equipped with photocell controls to automatically turn on/off.

  ACTION PLAN: Confirm quantity and wattage of existing lamps. As above, select a qualified lighting contractor who will look at the existing lights and propose a fixed price exterior light solution. The lighting contractor's proposal normally includes energy savings and projected value of CL&P rebates. It is also customary for the lighting contractor to handle the paperwork associated with obtaining CL&P rebates. It also may be possible for the Town to purchase replacement fixtures and install with its own staff at a lower cost.

- **Add Occupancy Sensors in Select Areas (Town Buildings)**

  Most of Avon's Town buildings do not have lighting motion sensors that automatically turn lights on/off based on occupancy. Suitable locations to install sensors include offices, conference rooms, restrooms, work bays, storage areas, hallways, and mechanical and electrical rooms. We recommend further review of building lighting systems and occupancy patterns to select suitable locations for new sensors. It will not make sense to install sensors where daily use requires lights to be on continuously and/or staff regularly turns lights off when they aren't needed.

  Peregrine recommends lighting occupancy sensors in the following buildings:

  - DPW: Offices, bathrooms, grounds bay
  - Senior Center: Function rooms, bathrooms
  - Town Hall Building 1 and 2: Offices, meeting rooms and bathrooms
  - Police Station Building 3 and 4: Offices, hallways, meeting rooms and bathrooms

  ACTION PLAN: Conduct a more detailed review of the buildings to decide which areas are suitable for occupancy sensors and develop a bill of materials for installation. Use a CL&P qualified lighting contractor who will provide this service at no cost and will subsequently generate a fixed price proposal for an engineered solution that may include other enhancements such as minor lighting updates, light level adjustments, etc. The lighting contractor's proposal normally includes energy savings and CL&P rebate projection, plus their scope of work would include all paperwork to apply for the CL&P rebates.

- **Add Photocell Controls for Exterior Lights (Town Buildings)**

  The Animal Control building has a few outside lights that don't appear to be controlled. Fix any existing controls that may not be operating properly, or add a photocell controller that automatically turns the lights on/off based on ambient light level.

  ACTION PLAN: Pursue lighting control using in-house staff or obtain services of lighting specialist. For contracted services, we recommend combining animal shelter exterior lighting controls with lighting project scope at other Town buildings.

- **Replace Incandescent & Halogen Lighting (High School, Roaring Brook, Thompson Brook, Central Office)**

  As was the case in Town Buildings, almost all more energy intensive incandescent and halogen lighting in Avon's schools has been replaced with more energy efficient compact fluorescent or other technologies. Additional untapped opportunities for savings that Peregrine identified include:

  - Specialty incandescent fixtures in the High School Media Center that can be replaced with CFL or LED. Also, the auditorium house lights over the seating area are likely 120 watt incandescent that could be replace with dimmable with LED lamps if possible, or with new drop in LED replacement fixtures.
  - Incandescent lamps in Roaring Brook School's kitchen hood could be replaced with CFL.
  - At Thompson Brook, the Halogen wall wash lighting system illuminating art work in the main hallway can be replaced with LED technology.
  - The incandescent track lighting in the main entrance of the Central Office should be updated to LED, or removed from service if it is not needed.

  ACTION PLAN: Confirm quantity and wattage of existing lamps. As above, select a CL&P qualified lighting contractor who will look at the existing lights and propose a fixed price CFL/LED solution.

- **Replace Gym Lights with T5s (High School, Thompson Brook)**

  The BOE updated all the older school gymnasiums with new T5 fluorescent sport fixtures. Thompson Brook, a newer school, retains its original metal halide gym fixtures. Similarly the High School's new gymnasium has metal halide fixtures. It is likely that these fixtures are higher efficiency pulse start. T5 fluorescent lighting is preferred because it is more slightly more efficient and doesn't require a warm-up period and therefore can be turned on/off during the course of the day to save energy. We recommend considering replacement of the existing fixtures with new T5 fixtures with integral occupancy sensors.

  ACTION PLAN: As above, confirm quantity and wattage of existing lamps. Engage a qualified lighting contractor who will look at the existing lights and propose a fixed price T5 solution.

- **Add Occupancy Sensors in Select Areas (All Schools)**

  Avon's schools have few lighting motion sensors that automatically turn lights on/off based on occupancy. Suitable locations to install sensors include offices, conference rooms, restrooms, library stacks, classrooms, gyms, hallways, and mechanical and electrical rooms.

  Teachers are reported to turn off lights in their classrooms when they leave. This is a great example of how a cost reduction strategy is well integrated into behaviors throughout organizations. There is no need to install motion sensors in classrooms as long as lights are doused when they aren't needed. The gyms with new T5 fluorescent lights already have built in motion sensors.

  ACTION PLAN: Conduct more detailed review of the schools to decide which areas are suitable for occupancy sensors and develop a bill of materials for installation. As above, secure a qualified

lighting contractor who will at no cost generate a fixed price proposal for an engineered solution that may include other enhancements such as minor lighting updates, light level adjustments, etc.

- **Add Photocell Controls for Skylight Areas (High School, Thompson Brook)**

  The High School and Thompson Brook both have a series of sky lights in their main entrance hallways. Fluorescent up-lighting fixtures that remain on during the day are built into the perimeter of the skylights. Since there is sufficient ambient light coming from the skylights, these lights do not need to be on during the day. Adding photocell control to "daylight" the lighting fixtures near the skylights (i.e. determine if there is sufficient ambient light) will automatically cut the electrical lights when appropriate. Depending on the existing wiring configuration, this could be a very simple project, or it could involve substantial rewiring.

  ACTION PLAN: Conduct more detailed review of the lighting system and wiring in the hallway of the High School and Thompson Brook to determine how to add day-lighting controls. Use a qualified lighting contractor to generate a fixed price proposal for an engineered solution that would include completing all paperwork to secure CL&P rebates.

Retro-commissioning of Building Controls / Systems

Controls includes a variety of building automation strategies to schedule and coordinate equipment operations and establish set points (based on a variety of conditions such as outside temperature, inside temperature, light levels, carbon dioxide levels, and humidity) at which equipment will cycle up or cycle down or turn on and off. ***Retro-commissioning*** (RCxing) is a systematic review of an existing building's control and mechanical systems. The purpose is to assure that the design intent is being met and/or that operations are consistent with current use. The goal is to achieve the best performance from existing system as possible.

Many common RCxing-related operating deficiencies can be traced to original design and construction issues and how thoroughly systems were setup during commissioning. A second controls-related building efficiency problem is related to changed conditions in the building and whether the schedule and settings continue to accurately reflect how and when the building is used. The third occurrence that can justify retro-commissioning is adjustments or overrides to operating systems and settings made by building personnel to address a short-term need (e.g. a special night meeting, a comfort complaint, manual control of air handlers) which are left in place and nullify the original design settings.

ACTION PLAN: Retro-commissioning is normally provided by a third party commissioning specialist in two or more phases. The first phase is "discovery" where the building is reviewed fairly quickly, but in enough detail to develop a comprehensive RCxing plan, including target systems to be addressed and establishing testing and data collection procedures. The next phase involves detailed testing, data collection and diagnostic services which results in a list of specific recommendations to make improvements. Many changes can be implemented on the fly with the owner's approval. Other recommendations may require the paid services of a controls programmer or contractor to replace defective components. The Town and Board of Education should engage a qualified contractor to complete a retro-commissioning study on systems and their controls to optimize operations and confirm proper system settings and scheduling.

Test and Balance Services on Air-Side HVAC

Both the High School and Middle School had extensive mechanical updates in 2007. These projects were completed with limited test and balancing (TAB) services, but without formal commissioning. The BOE reported that some of the new systems are not operating with correct air balance, and Peregrine recommends building retro-commissioning in both of these schools (see previous section). It would advantageous to include TAB services on systems that are suspected of having significant balance issues as part of this process. Ideally, all deficiencies can be worked out by the TAB contractor through system adjustments with resulting improved variable air volume turndown and thereby better operating efficiency. However, there can be design or other issues that prevent achievement of proper air flow without expensive system modifications. Sometimes, adjustments lead to more energy use. Having systems operating closer to design air flows is always preferable and should result in better system control.

ACTION: Develop appropriate requirements for TAB services to meet the needs of the schools. It may make sense to wait for recommendations from the RCxing engineer(s) to assure that TAB work is being focused where it is most needed.

Longer-Term

The longer-term strategies briefly described below are among other opportunities covered in more depth in Peregrine's reports of Findings and Recommendations for Town and BOE Buildings. These are all good opportunities that will reduce energy use and cost and also improve occupancy comfort and improve equipment reliability.

Enhance or Expand Control of Building Systems

Controls enhancements identified include, but are not limited to:

- **Add Hot Water Reset Control (many Town Buildings)**

  Many of the Town buildings (Fire Company No. 2, Fire Company No. 3, Fire Company No. 4, Senior Center, Police Building 3, and Police Building 4) have small hot water boiler plants that have limited controls. Most of these plants operate with a fixed hot-water distribution temperature (probably 170 to 180^{o}F). Peregrine recommends expanding the boiler controls to include a hot water temperature reset that lowers the distributed hot water temperature when ambient (i.e. outside) temperatures get warmer. Having hot water supplied to the building at lower temperature in milder weather reduces heating expense because there is less distribution system loss. There is also much less overheating when controls malfunction. .

- **Refrigeration Motor and Controls Upgrade (Middle School, Pine Grove, Roaring Brook)**

  All of Avon's schools have commercial kitchens with walk-in cooler/freezer equipment. Each is equipped with one or two-fan evaporators. Almost all older evaporator fan motors are standard shaded pole technology, most of which run continuously. Several refrigeration vendors offer evaporator upgrades that include replacing motors with more efficient motors that are better suited for refrigeration service. Further, the update includes new refrigeration controls that cycle fan motors on/off when appropriate while monitoring space temperature. All schools should be

considered, however we believe that the Middle School, Pine Grove, and Roaring Brook are the best candidates.

- **Add Kitchen Hood Ventilation Controls (High School and possible others)**

  The High School kitchen has a central, dedicated make-up air unit and exhaust system. These systems operate at full flow whenever the kitchen is operational. Control is limited to a wall switch. Although staff turns the systems off in the afternoon when the kitchen closes, such automated kitchen hood control is recommended to reduce fan and thermal load during operating hours. Available kitchen hood control systems use temperature and smoke sensors to determine when hood activity is required, and it ramps up exhaust and make-up air fan speed using variable speed drives; when kitchen cooking activity is minimal, fans turn off or return to a low speed.

- **Interlock Dishwasher Exhaust Fan with Dishwasher (All schools)**

  Each kitchen has an individual hood to exhaust heat and moisture from conveyor-style commercial dishwashers. Each has a dedicated exhaust fan to this hood controlled by wall switch. By reconfiguring the exhaust fan's control so that it is interlocked with the dishwasher, when the dishwasher is on, the fan is automatically on. Reducing the run time of the fan is desirable because there will be less volume of make-up air (through infiltration) to the building to re-condition.

- **Expand and Update Controls Systems (Pine Grove, Roaring Brook, Middle School)**

  Both Pine Grove and Roaring Brook have a Trane Tracer Summit direct digital control (DDC) system that provides energy management of HVAC systems. Unlike the systems at the High School, Middle School and Thompson Brook, which are all current technology with more or less complete coverage of HVAC systems, these schools have earlier versions and less complete coverage.

  At Pine Grove, upgrading to Trane's latest Summit version will update communications from current dial-up to a web-based platform for much more convenient access and higher speed. It will also be advantageous to add the boiler plant to the system, including new burner and pump control-points, as well as hot water temperature monitoring points. As part of the project, consider implementing new programming for a deep, off-hour hot water temperature reset.

  Roaring Brook would get similar benefits from an upgrade to Summit. In addition, as part of the recommended HVAC update, Peregrine recommends converting remaining pneumatic systems controlling VAV boxes, reheat coils and perimeter convectors to DDC. The update will likely require replacement of hot water valves and VAV box components, or possibly outright replacement of VAV boxes. New electronic zone thermostats will be required as well as additional control panels and processing modules.

  The Middle School, although otherwise up to date and complete, still needs DDC control-points added to gym H&V unit, which is currently pneumatic. This will eliminate the need to maintain the compressed air system and associated pneumatic components in the building.

Upgrade Mechanical Systems

- **Install Chilled Water Isolation Valves (Thompson Brook)**

Thompson Brook has a pad-mounted, central chilled-water system that is located outside, adjacent to the mechanical room. The chiller's evaporator and parts of the chilled-water piping to the mechanical room are exposed to freezing temperatures. To ensure that water doesn't freeze in the piping system, operators have run the 25 hp chilled water-pump through the winter. A more practical solution is to install isolation valves just inside the mechanical room and to drain down the outdoor portion of the chilled-water system during cold weather. This will provide complete protection against freeze damage and eliminate the need to run the chilled-water pump in the winter.

- **Replace Rooftop Units (Roaring Brook)**

  The school is conditioned by twenty-two, DX rooftop units, some with gas-fired burners. Most of the rooftop equipment is eighteen or more years old and beyond its service life. Dampers, enclosures, coils, burners, compressors and/or electrical gear are generally in rough condition. In a few cases, rooftop units don't appear to be functional. Nine units are reported to be turned off for the winter, which may compromise indoor air quality. Zones served by AC-6 and AC-7 are difficult to heat, and fan-powered box reheat coils may not be adequately sized.

  Replacement units are required in the immediate to near future and the following features are recommended for inclusion: highest air conditioning EER rating available for new rooftop units; two-stage burners with stainless steel heat exchanger, if available; premium efficiency, inverter duty fan motors; variable speed fan control for variable air volume (VAV) applications. The installation should include Controllers using an open, external communication protocol and thorough testing and repair/replacement of problematic VAV boxes and reheat coils. BOE should require third party commissioning with thorough test and balancing (TAB) services.

- **Replace Boiler Plant (High School, BOE Central Office, Fire Company No. 4, Recycling Center)**

  All these buildings have boiler plant issues that are best addressed through system replacement. Specifics are provided in the Peregrine reports.

- **Shut Down Chiller in Winter and Add local Ductless Split Units (Police Building 3)**

  The building's central, chilled-water system serves small air handlers throughout the building, some of which are in areas that have high-heat loads (Dispatch and IT room). These air handlers require year-round cooling to maintain reasonably cool space temperature in these areas; the building's central, chilled-water system remains active year-round. By adding ductless split units in high load areas, the Town can shut down the main chiller plant and pumps for the non-cooling season.

Improve Building Envelope to Reduce Heating and Cooling Requirements

Building envelope enhancements identified in Town and School buildings include air sealing and the addition of insulation in walls and roofs.

- **Reduce Air Flows through Buildings by Air Sealing to Increase Tightness**

  Many of Avon's smaller buildings (BOE Annex, Animal Control building, Fire Company No.2, Fire company No. 3, Fire company No. 4, Landfill main building, Countryside Park, Police Building 8 (gym)

are good candidates for air sealing. The air sealing contractor sets up a blower door to test these smaller buildings for air leakage rates. While the blower door is running, the contractor systematically improves the tightness of the building using caulk, foam and other materials in leakage areas. Many of these buildings also need better door, window, and window A/C sealing products. Other typical locations where air can enter a building include plumbing or electrical wall penetrations, basement windows, older stacks or shafts, structural joints, and/or edges of attic space.

- **Install Insulation as Needed to Increase Thermal Performance**

  All buildings also should be evaluated for potential insulation improvements as part of the air sealing assessment process. Wall insulation is generally only practical in wood framed structures by blowing in material at strategic points from inside or outside drilled holes. Block construction requires building out into interior space or adding a new exterior treatment, both of which are very expensive. For attic spaces, it is usually easiest to access the space to determine what is in place now and whether adding more material will be worthwhile. For older buildings, where it is common to see chopped or blanket fiberglass insulation under floor boards ranging from 4 to 8 inches in thickness, insulating properties can usually be improved by replacement with 8 to 12 inches of chopped cellulose and by making sure that wall header and access points to the attic are well sealed. Fire Company 1, Fire Company 4, and Countryside Park are likely candidates for insulation improvements, though other buildings may benefit as well.

BOE Buildings: Recommended Energy Conservation Measures (ECMs)

ECM #	Description	Technology Group	Approximate Implementation Cost	Utility Incentive Available[1]	Potential Utility Savings					Annual Cost Avoidance	Reduces O&M Liability	Replaces End Of Life Equipment	Provides Visual and/or Comfort Improvement	Simple Payback Yr
					Demand kW	Electric kWh/yr	Gas Therm/yr	Oil Gal/yr	Water kGal					
1	Use portable vacuums vs central vacuum system	O&M	$9,000	$0	43	33,000	-	-	-	$5,600				1.6
2	Change food storage policy in snack area	O&M	$0	$0	-	2,000	300	-	-	$900				Immediate
3	Replace incandescent & halogen lighting	Lighting	$7,650	$1,500	2	9,500	-	-	-	$1,550				4.0
4	Replace gym lights with T5s	Lighting	$25,000	$1,800	4	17,000	-	-	-	$2,900				8.0
5	Add occupancy sensors in select areas	Lighting	$52,000	$7,000	3	45,000	-	-	-	$7,400				6.1
6	Add photocell controls for skylight areas	Lighting	$2,000	$0	-	4,000	-	-	-	$600				3.3
7	Retro-commission control and HVAC systems	Cxing	$160,000	$0	5	130,000	3,300	-	-	$27,700	X		X	5.8
8	Test and balance services on air-side HVAC	Cxing	$115,000	$0	10	60,000	800	-	-	$11,400	X		X	10.1
9	Walk-in refrigeration motor and controls update	Controls	$18,000	$0	3	24,000	-	-	-	$3,900				4.6
10	Add kitchen hood ventilation controls	Controls	$18,000	$500	-	4,000	1,400	-	-	$3,300				5.3
11	Interlock dishwasher exhaust fan with dishwasher	Controls	$7,000	$0	-	6,000	-	-	-	$1,100				6.4
12	Expand/update control system (basic)	Controls	$35,000	$0	-	5,000	1,000	-	-	$2,800	X	X	X	12.5
13	Expand/update control system (comprehensive)	Controls	$265,000	Custom	-	13,000	1,300	-	-	$4,700	X	X	X	56
14	Add VFDs to fan system	Controls	$45,000	$3,200	3	57,000	500	-	-	$10,400				4.0
15	Install CHW isolation valves	Mechanical	$5,000	$0	-	24,000	-	-	-	$4,000	X			1.3
16	Replace rooftop units	Mechanical	$1,300,000	Custom	20	80,000	-	-	-	$13,200	X	X	X	98
17	Replace boiler plant	Mechanical	$390,000	$0	-	(1,000)	(4,000)	3,500	-	$4,500	X		X	NA
18	Exterior door seal maintenance	Envelope	$43,000	$0	6	9,000	3,400	100	-	$8,300			X	5.2
19	Airseal building	Envelope	$15,000	$0	-	-	-	400	-	$1,400			X	10.7
20	Repair ductwork & pipe insulation	Envelope	$4,500	$0	-	-	-	50	-	$200	X			NA
21	Replace domestic fixtures with low flow	Misc	$276,000	$0	-	-	-	-	4,500	$23,100				11.9
Total Program			$2,792,150	$14,000	99	521,500	8,000	4,050	4,500	$138,950				20.0

Notes

(1) Subject to Utility Incentive Policy and Screening Analysis

Existing Utility Cost:	***$978,000 /yr***
Total Savings:	***$138,950 /yr***
Percent Cost Reduction:	***14%***

Source: Peregrine Energy Group, Inc. study of BOE facilities, 2011

BOE Building ECM Summary

Building	O&M		LIGHTING				CXING		CONTROLS						MECHANICAL			MISC			
	1. Use portable vacuums vs. central vacuum system	2. Change food storage policy in snack area	3. Replace incandescent & halogen lighting	4. Replace gym lights with T5s	5. Add occupancy sensors in select areas	6. Add photocell controls for skylight areas	7. Retro-commission control and HVAC systems	8. Test and balance services on air-side HVAC	9. Walk-in refrigeration motor and controls update	10. Add kitchen hood ventilation controls	11. Interlock dishwasher exhaust fan with dishwasher	12. Expand/update control system (basic)	13. Expand/update control system (comprehensive)	14. Add VFDs to fan system	15. Install CHW isolation valves	16. Replace rooftop units	17. Replace boiler plant	18. Exterior door seal maintenance	19. Airseal building	20. Repair ductwork & pipe insulation	21. Replace domestic fixtures with low flow
Avon High School	X	X	X	X	X	X	X	X		X	X			X			X	X		X	X
Avon Middle School	X				X		X	X	X		X		X	X				X			X
BOE Annex			X														X	X	X	X	X
Pine Grove	X				X		X		X		X	X						X			X
Roaring Brook			X		X				X		X	X	X			X		X			X
Thompson Brook	X		X	X	X	X					X				X						X

Municipal Buildings: Recommended Energy Conservation Measures (ECMs)

ECM #	Description	Technology Group	Approximate Implementation Cost	Utility Incentive Available[1]	Potential Utility Savings					Annual Cost Avoidance	Reduces O&M Liability	Replaces End Of Life Equipment	Provides Visual and/or Comfort Improvement	Simple Payback Yr
					Demand kW	Electric kWh/yr	Gas Therm/yr	Oil Gal/yr	Water kGal					
1	Thermostat Management	O&M	$0	$0	-	8,000	900	100	-	$3,300				-
2	Replace Incandscent / Halogen Lighting	Lighting	$1,175	$400	1	1,940	-	-	-	$370				2.1
3	Update Exterior HID Lighting	Lighting	$1,500	$200	-	1,000	-	-	-	$200				6.5
4	Install Occupancy Sensor Control	Lighting	$16,000	$3,500	5	13,000	-	-	-	$2,100				6.0
5	Add Photocell Control for Exterior Lights	Lighting	$250	$0	-	300	-	-	-	$50				5.0
6	Add Programmable Thermostats	Controls	$5,800	$0	1	7,500	1,300	100	-	$4,000				1.5
7	Add HW Reset Control	Controls	$21,000	$0	-	-	650	100	-	$1,500				14.0
8	Insulate Piping / Valves / Other	Mechanical	$3,500	$0	-	-	75	50	-	$350			X	10.0
9	Replace HVAC Unit	Mechanical	$10,000	$0	-	600	-	-	-	$100	X	X		100.0
10	Replace Boiler Plant	Mechanical	$55,000	$0	-	-	(1,600)	1,300	-	$100	X	X		550.0
11	Add Local DX Unit; Shutdown Chiller in Winter	Mechanical	$15,000	$0	-	15,000	-	-	-	$2,400	X			6.3
12	Door / Window Weatherization	Envelope	$3,500	$0	-	300	150	75	-	$500			X	7.0
13	Overhead Door Repair/ / Replacement	Envelope	$7,000	$0	-	-	-	100	-	$200			X	35.0
14	Airseal Building	Envelope	$0	$0	-	-	-	-	-	$0				NA
15	Attic / Wall Insulation	Envelope	$15,000	$0	-	-	-	100	-	$200				75.0
16	Seal Fireplace Shaft	Envelope	$0	$0	-	-	-	30	-	$80				Immediate
17	Domestic Fixture Upgrade	Misc	$25,000	$0	-	-	-	-	245	$1,400				17.9
Total Program			*$179,725*	*$4,100*	*7*	*47,640*	*1,475*	*1,955*	*245*	*$16,850*				*10.4*

Existing Utility Cost:	*$244,000*	*/yr*
Total Savings:	*$16,850*	*/yr*
Percent Cost Reduction:	*7%*	

Source: Peregrine Energy Group, Inc. review of Town facilities, 2011

Municipal Building ECM Summary

Building	O&M	LIGHTING				CTRLS		HVAC				ENVELOPE					Misc
	1. Thermostat Management	2. Replace Incandescent / Halogen Lighting	3. Update Exterior HID Lighting	4. Install Occupancy Sensor Control	5. Add Photocell Control for Exterior Lights	6. Add Programmable Thermostats	7. Add HW Reset Control	8. Insulate Piping / Valves / Other	9. Replace HVAC Unit	10. Replace Boiler Plant	11. Add Local DX Unit; Shutdown Chiller in Winter	12. Door / Window Weatherization	13. Overhead Door Repair/ / Replacement	14. Airseal Building	15. Attic / Wall Insulation	16. Seal Fireplace Shaft	17. Domestic Fixture Upgrade
Animal Control Building		X			X	X								?			
Building 1, 2 (Town Hall)	X			X				X	X			X					X
Building 5, 6, 7 (Town Hall)																	
Police Bldg 3, 4 (Police)	X			X		X	X				X						X
Police Bldg 8 (Gym)	X					X								?			X
Company 1	X	X													?		
Company 2							X	X				X	X	?		X	
Company 3	X						X	X				X		?			
Company 4	X						X	X		X				?	X		
Countryside Park												X		?	?	X	
Public Works Facility	X			X		X						X					X
Recycling Center	X	X	X			X				X			X	?			
Senior Center	X	X		X		X	X										X