Energy Efficiency Opportunities

For

Town Facilities

Washington, New Hampshire

Preliminary Assessment

August 29, 2011

Prepared by:

Peregrine Energy Group, Inc.

Boston, Massachusetts

Provided by:

New Hampshire's Office of Energy and Planning

Energy Technical Assistance & Planning
For New Hampshire Communities
Funded by the ARRA Energy Efficiency Conservation Block Grant

1.0 Introduction and Executive Summary

Peregrine Energy Group, Inc. ("Peregrine") has prepared this preliminary energy efficiency and renewable energy investment assessment for the facilities we visited on Tuesday, August 16, 2011 in Washington, NH. We've prepared this report on behalf of the New Hampshire Office of Energy and Planning's Energy Technical Assistance & Planning for New Hampshire Communities program ("ETAP"). Funding for this project comes from the American Recovery and Reinvestment Act Energy Efficiency and Conservation Block Grant program of the U.S. Department of Energy. Peregrine gratefully acknowledges the assistance that Al Krygeris, Selectman, Mellisa Cole, Chair library trustees, Brenda Gilliland, Assistant Director, Jo Ellen Wright, Librarian Director, and Ed Thayer, Road Agent provided with coordinating our site visits, collecting utility data documentation, and answering questions for our initial assessment.

The primary goal for this report is to identify cost-effective energy efficiency and renewable energy investments that Washington should consider as part of its long-term energy management plan. The report includes Peregrine's recommendations for energy cost reduction projects that Washington may want to pursue and also a summary of building energy use and cost information we were able to collect.

Findings and Recommendations

In order to generate our list of recommendations, Peregrine's site visit and staff interviews focused on:

- Observations of existing facility conditions
- Current operating practices and facility uses
- Short term and long term facility plans
- Potential building and mechanical equipment energy efficiency upgrades
- Potential renewable energy upgrades

After our site visit, Peregrine reviewed utility bill information for each facility to corroborate our site visit observations and ground our recommendations against actual energy consumption.

Drawing on our site visit observations and discussions with Town staff, Peregrine has identified several energy saving opportunities in facilities we visited. Many of our recommendations focus on opportunities to improve energy management practices in day to day operations that the Town can implement within existing town budgets, using existing staff resources.

More capital intensive energy efficiency recommendations that Peregrine identified include:

- Air Leakage reduction and additional insulation in the Camp Morgan Lodge
- Basement insulation, moisture control measures, and duct insulation in the Library
- Energy efficient lighting in the Lodge and Fire Station

Table 1. Energy Reduction Program Potential Results[1]

Facility	Approximate Installed Cost ($)	Utility Incentive Available[1]	Potential Utility Savings			Annual Cost Avoidance ($)	Simple Payback Yr
			Other Benefits	Electric kWh/yr	Oil/ Propane Gallons/ yr		
Camp Morgan Lodge	8,583	-	A	1,076	268	901	10
Fire Station/ Rescue	864	-	-	162	-	30	10+
Library	1,100	-	A	362	47	161	7
Total	$10,547	$0	A	1,601	315	$1,091	10
Notes				*Current Utility Budget:*		*$15,863*	*/yr*
(1) Subject to Utility Incentive Policy and Screening Analysis				*Percent Reduction:*		*7%*	
(2) A - Better Comfort; B - Improved Reliability; C - Reduced Maintenance; D - Enhanced Appearance							

Summarizing our Major Findings and Recommendations:

- **Heating is the primary source for energy consumption in the buildings that we assessed**
- **Insulation and air sealing are the most important priorities to reduce building energy use**
- **Lighting in the Lodge and Fire Station is inefficient; however, full replacement is difficult to justify because the hours of operation are low**

Suggested Next Steps

Within the context of the ETAP program, Peregrine can provide phone support to the Town to help plan and execute these recommendations. All projects indentified in this report will require further development and analysis to obtain firm pricing and confirm savings projections.

Immediate next steps include:

- Select which measures the Town would like to proceed with and establish an implementation schedule.
- Authorize further engineering activity, if necessary, to develop detailed specifications and/or generate more accurate savings projections.
- Develop request for proposal documents and/or select preferred controls, insulation and air sealing vendors.
- Secure quotes for projects and select controls, insulation, equipment, and air sealing contractors.

[1] This table does not include renewable energy cost and savings

2.0 Utility Cost and Consumption

Energy Cost

The total energy cost for the buildings Peregrine visited is about $15,863. The cost per square foot varies from a high of $2.10 at the Fire Station down to $1.46 at the Camp Morgan Lodge.

Table 2. Annual utility cost and energy cost intensity

Facility	Square Feet	Electric Cost ($)	Oil Cost ($)	Propane Cost ($)	Total Cost ($)	Cost ($) per Square Foot
Camp Morgan Lodge	4,250	2,012	3,256	939	6,207	1.46
Fire Station/ Rescue	3,072	1,883	-	4,557	6,441	2.10
Library	1,960	1,293	-	1,923	3,216	1.64
Total	9,282	$5,188	$3,256	$7,419	$15,863	$1.71

Energy Use

Total energy use for the buildings Peregrine visited is about 26,249 kWh for electricity 1,342 gallons for oil and 3,509 gallons for propane. The total energy intensity units are expressed in site[2] kBtu[3] per square foot. Tables 7-9 in Section 8.0 of this report shows how the energy use intensity of these buildings compares to similar buildings that Peregrine has assessed as part of the NH ETAP program.

Table 3 Annual utility consumption and energy use intensity

Facility	Square Feet	Electric kWh	Oil Gallons	Propane Gallons	Total kBTU	Site kBtu per Square Foot
Camp Morgan Lodge	4,250	8,668	1,342	424	256,133	60
Fire Station/ Rescue	3,072	10,333	-	2,155	231,803	75
Library	1,960	7,248	-	930	109,553	56
Total	9,282	26,249	1,342	3,509	597,489	64

[2] Site energy = All non-electric fuel consumption in the building plus electric energy measured at the meter.
[3] kBtu = 1,000 British Thermal Units. 1 kilowatt hour of electricity = 3,413 Btus, 1 gallon of #2 oil = 140,000 Btus, 1 gallon of Propane = 100,000 Btus.

3.0 Camp Morgan Lodge

Washington's Camp Morgan Lodge (1970 renovation) is located on the site of a former YMCA camp that the Town purchased. The facility includes about 4,250 square feet and is used for public and private functions.

Figure 1. Camp Morgan Lodge

Building Envelope

The building envelope consists of a full basement with an uninsulated concrete foundation, wood frame walls with sheetrock interior finish, fiberglass batt insulation, and vinyl siding, and a wood roof assembly with asphalt shingles and fiberglass batt insulation installed above the sheetrock ceiling. Windows are vinyl double-hung with thermopane glass. Half of the basement is finished and half of the basement is unfinished. Peregrine characterizes the basement as unheated space in our recommendations.

Mechanical Systems

The mechanical systems in Camp Morgan Lodge include an oil-fired hot air furnace with a metal ductwork hot air distribution system and a propane-fired domestic hot water storage tank. The furnace was installed in 1988 and the hot water storage tank was installed more recently. There is no air conditioning or central ventilation system. Two "round" thermostats control the room temperature and turn the heating system on and off. One thermostat is located upstairs and one thermostat is located downstairs. The Lodge has a commercial-grade kitchen with associated commercial grade kitchen appliances[4] and exhaust ventilation.

[4] The commercial gas range has gas pilot lights that run continuously. Peregrine recommends installing a gas shut off valve near the stove (local code permitting) to turn off the pilot lights when the kitchen is not in use.

Figure 2. Oil-fired furnace

Figure 3. Commercial kitchen

Lighting and Other Electric Loads

Lighting is primarily T12 fluorescent lighting. Other electric loads include the furnace blower motor, water pressure pump that serves the Lodge and the Elementary School next door, and miscellaneous plug loads.

Figure 4. Main room lighting

Recommendations

Table 4.Summary of energy reduction opportunities for Camp Morgan Lodge

	Description	Approximate Installed Cost ($)	Utility Incentive Available[1]	Other Benefits[2]	Potential Utility Savings Electric kWh/yr	Potential Utility Savings Oil Gallons/ yr	Annual Cost Avoidance ($)	Simple Payback Yr
1	Air seal attic and basement	$2,000		A		134	326	6
2	Install energy efficienct lighting	$2,983	$0		676		157	10+
3	Install new refrigerator	$600			400		93	7
4	Seal and insulate ductwork	$500				67	163	3
5	Insulate basement walls	$2,500				67	163	10+
	Estimated Program	*$8,583*	*$0*	*A*	*1,076*	*268*	*$901*	*9.5*

Notes
(1) Subject to Utility Incentive Policy and Screening Analysis
(2) A - Better Comfort; B - Improved Reliability; C - Reduced Maintenance; D - Enhanced Appearance

Current Utility Budget: *$6,207 /yr*
Percent Reduction: *15%*

1. Air seal attic and basement

Peregrine's site inspection identified several potential sources for air leakage in the attic and the basement. A concern in the attic is six grilles that are open directly from the main room on the first floor to the attic. Hopefully this is just a temporary condition and the vents are sealed tightly and covered with insulation in the winter. A less glaring but important concern in the basement were the large garage doors that lead into the unfinished space. The doors are quite loose. An option that we discussed onsite was to create the equivalent of a "mud room" inside the basement to act as an air lock for the doors. Another option is to close off the doors in the winter and insulate and seal them air tight each fall.

Figure 5. Open vent in the ceiling

Figure 6. Basement service door

Peregrine's cost estimate for this measure assumes a professional air sealing contractor with two trained staff to identify and seal air leaks in the attic and basement. Constructing the air lock chamber in the basement would be a capital improvement and is not included in our cost estimate.

<u>Next Step</u>: Prepare a Request for Proposals for air sealing work in the Lodge.

2. Install energy efficient lighting

More efficient lighting is available than the existing T12 lighting. The hours of operation for the facility, however, are very low (400 hours per year or less) which makes full scale replacement less cost effective. In addition, the low hours of operation are below Public Service of New Hampshire's (PSNH) criteria of 1,000 hours per year of operation to qualify for the utility company's energy efficient lighting incentive programs for lighting.[5]

At some point, Washington will need to upgrade the existing lighting. According to recent reports, "as of July 1, 2010 magnetic ballasts most commonly used for the operation of T12 lamps will no longer be produced for commercial and industrial applications. Also, many T12 lamps will be phased out of production starting July 2012."[6] When the T12 fluorescent lights burn out and/or the ballasts fail, Washington will need to install more efficient lighting. Peregrine recommends replacing 4' T12 light bulbs with 4' T8 light bulbs and high efficiency electronic ballasts and replacing 8' T12 light fixtures with dual 4'T8 light fixtures[7].

<u>Next Step</u>: No next steps are necessary at this point.

3. Install new refrigerator

The Lodge has two refrigerators, a large commercial refrigerator that is turned off except for large events and a smaller residential grade refrigerator that is left on. Washington should record the energy used by the residential grade refrigerator with a Kill-a-watt meter for a week and replace it with a new Energy Star rated refrigerator if the energy use is 3 kWh per week or the equivalent of about 1,000 kWh per year.

<u>Next Step</u>: Purchase a Kill-a-Watt meter[8] and measure the energy use of the refrigerator.

4. Seal and insulate ductwork

The basement has an extensive network of metal ductwork that supplies hot air to the basement and the main floor. Washington should maximize the amount of heat delivered to the main floor in the winter and seal and insulate the basement ductwork. There are several resources online that describe duct sealing and insulation options. [9] Peregrine's cost estimate is for material only. This is a good DIY measure that would me much less cost effective if it was installed professionally.

<u>Next Step</u>: Confirm material costs and identify volunteers who might help seal and insulate the ductwork.

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[5] URL: http://www.psnh.com/SaveEnergyMoney/PDFs/RetroLightingApplication.aspx
[6] As summarized at http://greensavingsco.com/network/2010/05/t12-lighting-phase-out/
[7] Source for dual 4' T8 light fixtures: http://www.homedepot.com/Lighting-Fans-Indoor-Lighting-Industrial-Shop-Lighting-Strip-Fluorescents/h_d1/N-5yc1vZbvm3Z1z10p31/R-202193133/h_d2/ProductDisplay?langId=-1&storeId=10051&catalogId=10053
[8] URL: http://www.p3international.com/products/special/P4400/P4400-CE.html
[9] URL: http://www.insulation.com/insulation/DIY_duct_insulation.html

Figure 7. Basement ductwork

5. Insulate basement walls

Once the heating system ductwork is sealed and insulated, the basement temperature will probably drop. Air sealing measures will reduce heat loss in the basement caused by air infiltration; however, the basement has a large exposed concrete wall service that should be insulated. Peregrine recommends gluing 2" rigid insulation directly to the exterior wall in the finished and unfinished basement sections. This is another good DIY project for town staff or volunteers that would be much less cost effective if it was installed professionally. The two major details to consider with this measure are the fire rating of the installed insulation and potential frost heaves caused by less heat thawing the ground next to the foundation. Building Science Corporation (BSC) has several excellent foundation insulation details on their corporate website[10].

<u>Next Step</u>: Review the foundation design details on BSC's website, confirm material costs, and identify volunteers who might help insulate the foundation walls.

Additional discussion

The Lodge heating system is about 25 years old and, though it is still functioning, the Town should expect to replace it before too long. If the heat exchanger fails, the furnace will need to be replaced right away. If the oil burner or the blower motor fails, the furnace can be repaired and replaced later. Peregrine recommends that Washington should anticipate a furnace replacement and review furnace replacement options now instead of later.

The Library and the Fire Station both provide good examples of recent high efficiency propane furnace installations in Town. The one component missing in those two furnaces is a high efficiency variable speed blower motor. Furnace blower motors are quite large and standard furnace motors are only 10% to 15% efficient and use about the same amount of energy at low speed as they use at high speed. The Lodge has long periods of low temperature setback and could benefit from a furnace that has an energy efficient low fan speed.

[10] URL: http://www.buildingscience.com/resources/cond-crawlspaces

4.0 Fire Station

Washington's Fire Station (1970) is the larger of two Fire Department facilities in Washington. The facility includes about 3,072 square feet and houses the Town's fire apparatus.

Figure 8. Fire Station

Building Envelope

The building envelope consists of an uninsulated slab-on-grade foundation, wood frame walls with sheetrock interior finish, fiberglass batt insulation, and aluminum siding, and a wood roof assembly with asphalt shingles, fiberglass batt insulation installed above the ceiling, and sheetrock interior finish. Windows are single-pane wood frame with aluminum storm windows.

Mechanical Systems

The mechanical systems in the Fire Station include a propane-fired high efficiency condensing gas furnace and an electric domestic hot water storage tank. The building does not have a ventilation system or air conditioning. Heating system operation and supply temperature control includes a single "round" thermostat located in the garage bay set at 55 Deg F.

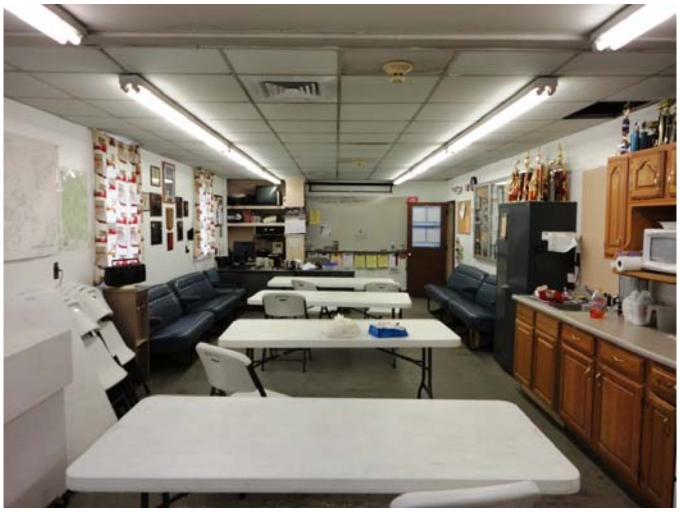
Figure 9. High efficiency furnace

Figure 10. Thermostat

Lighting and Other Electric Loads

Lighting is primarily 8' T12 fluorescent lighting. Other electric loads include an air compressor, commercial grade laundry equipment, office equipment, radio charging stations and communication equipment, fire apparatus charging equipment, kitchen appliances, and other plug loads.

Figure 11. Eight foot T12 fluorescent lighting



Recommendations

Peregrine did not identify any significant energy efficiency investment opportunities in the Fire Station that would pay for themselves in10 years or less. The building is constructed well with reasonable levels of insulation, has a high efficiency heating system. In addition, Fire Department staff keeps the temperature at a reasonable level in the winter and has an appropriate level of electric equipment hard-wired or plugged into the electrical distribution system.

Table 5. Summary of energy reduction opportunities for the Fire Station

	Description	Approximate Installed Cost ($)	Utility Incentive Available[1]	Other Benefits[2]	Potential Utility Savings Electric kWh/yr	Potential Utility Savings Propane Gallons/ yr	Annual Cost Avoidance ($)	Simple Payback Yr
1	Install energy efficient lighting	$864	$0		162		$30	10+
	Estimated Program	***$864***	***$0***		***162***	-	***$30***	***29.3***

Notes
(1) Subject to Utility Incentive Policy and Screening Analysis
(2) A - Better Comfort; B - Improved Reliability; C - Reduced Maintenance; D - Enhanced Appearance

Current Utility Budget: ***$6,441 /yr***
Percent Reduction: ***0%***

1. Install energy efficient lighting

Similar to Camp Morgan, the Fire Station has inefficient T12 fluorescent lighting, but the operating hours are short. Please refer to Peregrine's comments regarding energy efficient lighting upgrades at the Lodge. Washington should replace the existing 8' T12 fluorescent lighting fixtures with dual 4' T8 light fixtures when the T12 light bulbs and ballasts fail.

<u>Next Step</u>: No next step required other than to anticipate future T8 fixture installations. This is a measure that can be installed by qualified Fire Department or other Town staff.

5.0 Library

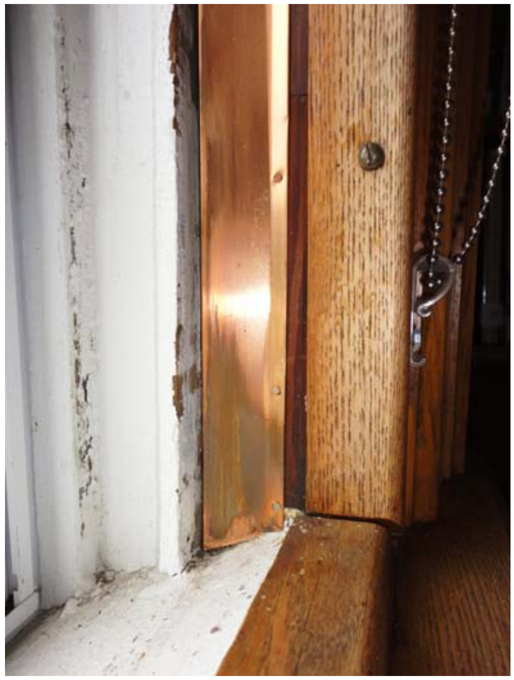
Washington's Shedd Free Library (1881) was designed by the eminent Boston architect S. S. Woodcock. The library includes the original building and a new addition constructed in 1980. The facility includes about 1,960 square feet and provides full library services and houses the Town's historical archives in the basement.

Figure 12. Library

Building Envelope

The building envelope consists of a stone foundation in the old section and a concrete foundation in the new section, walls are structural brick with plaster and lathe and no insulation in the old section and veneer brick with wood frame, fiberglass batt insulation, and sheetrock in the new section. The wood frame roof assembly has a slate roof on the original building and an asphalt roof on the new addition with fiberglass batt insulation installed above the ceiling of both sections of the Library. Windows are wood frame with single pane glass and exterior triple-track storm windows. The Library's contractor did an excellent job installing spring copper weatherstripping on the original wood windows.

Figure 13. Window weatherstripping



Mechanical Systems

The mechanical systems in the Library include a propane-fired high efficiency condensing furnace and metal distribution system ductwork, small window air conditioners for cooling, and a small electric storage tank for domestic hot water. Room temperature control includes a single programmable thermostat located in the audio books section.

Lighting and Other Electric Loads

Lighting is primarily energy efficient fluorescent, both tube and compact fluorescent light bulbs. Other electric loads include two dehumidifiers, one for each side of the basement, a water pressure booster pump, computers available for public use, standard office equipment, and other minor plug loads.

Recommendations

Table 6. Summary of energy reduction opportunities for the Library

	Description	Approximate Installed Cost ($)	Utility Incentive Available[1]	Other Benefits[2]	Potential Utility Savings Electric kWh/yr	Potential Utility Savings Propane Gallons/ yr	Annual Cost Avoidance ($)	Simple Payback Yr
1	Reduce basement moisture	$500		A	362	-	$65	8
2	Seal and insulate ductwork	$600		A		47	$96	6
	Estimated Program	***$1,100***	***$0***	***A***	***362***	***47***	***$161***	***6.8***

Notes
(1) Subject to Utility Incentive Policy and Screening Analysis
(2) A - Better Comfort; B - Improved Reliability; C - Reduced Maintenance; D - Enhanced Appearance

Current Utility Budget: ***$3,216 /yr***
Percent Reduction: ***5%***

1. Reduce the amount of dehumidification

Water infiltration into the basement appears to have been a significant issue at one point. The original stone foundation of the old building has been waterproofed and a french drain installed to direct water to a sump pump. In addition, the Library has installed two dehumidifiers in the basement. Library staff has measured the energy consumption of at least one of the dehumidifiers in the basement and confirmed that it does not use much energy.

Peregrine recommends that the Library could use even less energy for dehumidification with a combination of water drainage and insulation upgrades. In the "dungeon", both the dehumidifier and the condensing furnace generate water. The dehumidifier has a drain hose that runs to the sump pit. The furnace condensate drain empties into the french drain. Peregrine recommends installing a vinyl hose from the furnace condensate drain pipe to the sump pit to reduce the amount of water that the dehumidifier needs to extract from the basement.

Figure 14. Condensate drain

In addition, the Library should consider installing a waterproof membrane similar to one that the Town of Orford installed in the basement of its Town Hall and also can cover the sump pit. In the archive room, the Library can install rigid insulation on the smooth concrete walls similar to what we have recommended for basement insulation at the Camp Morgan Lodge building. This measure would probably not be cost effective if it was installed professionally. Our cost estimate is for insulation and waterproofing material and may run higher depending on the cost of the rigid insulation. The work is straightforward and a good task for volunteers or Friends of the Library to help with.

<u>Next Step</u>: Confirm material costs and identify volunteers who might help install these measures.

2. Seal and insulate the hot air ductwork

Similar to the Lodge building at Camp Morgan, the Library has heating system ductwork in the basement that should be sealed and insulated. Air leakage and heat from the ductwork probably has a side benefit of heating the air and reducing the amount of dehumidification required, however, this will be less important after the basement moisture is reduced with the measures recommended above.

Figure 15. Air leaks in uninsulated ductwork

<u>Next Step</u>: Confirm material costs and identify volunteers who might help install the duct sealing and insulation.

6.0 Town Hall

Peregrine received a copy of the Town Hall energy audit that SDES Group prepared in January, 2010. Peregrine can review the audit and provide additional assistance under the NH ETAP program if requested.

7.0 Town Garage

Washington's Road Agent, Ed Thayer, asked Peregrine for our professional opinion regarding a potential wood-fired outdoor boiler installation for the DPW building. Peregrine researched this option for Orford recently, and we were able to visit and assess a wood-fired outdoor boiler the day after our visit to Washington that Dalton, NH has installed at its Town Garage.

Washington's DPW staff mentioned that they are interested in technology and believe they can collect adequate supplies of wood to feed the boiler. Washington should be aware that, in response to the rapid growth of outdoor boiler installations and complaints of poor air quality caused by the boilers, NH has adopted an EPA-developed voluntary emissions standard program.[11] Few boilers now meet the "white tag" emissions requirements that took effect in April 2010. Peregrine conservatively estimates that the installed cost for a 250 kBtu/ hr boiler for Washington's Town Garage is about $20,000. This includes $12,000 - $15,000 (list price) for the boiler and $5,000 for underground interconnections and piping.

Dalton installed its wood-fired boiler three years ago and paid $8,000 for the boiler and $3,000 for the installation. As the pictures below show, the boiler in Dalton was installed in a shed, with piping run underground and tied directly into the existing boiler. DPW staff hasn't filled the oil tank in three years. The piping layout Dalton selected allows the existing oil-fired boiler to turn on if the wood-fired boiler can't keep up with the building's heating requirements.

Figure 16. Dalton, NH wood-fired boiler

[11] URL: http://des.nh.gov/organization/commissioner/pip/factsheets/ard/documents/ard-40.pdf

Figure 17. Dalton, NH underground piping connection to boiler

Figure 18. Dalton, NH oil-fired boiler back up for wood boiler

8.0 Building Performance

The chart below provides an opportunity for Washington to compare the performance of its buildings against comparable buildings that Peregrine has assessed as part of the NH ETAP program. The score is based on total energy use per square foot (1,000 Btus per Square Foot or kBtu/ SF). The higher the energy use per square foot the more inefficient the building is. In addition to total use, the chart includes the energy use per square foot for each major utility.

As the chart shows, energy use intensities in Washington's facilities are comparable to other Towns'.

Table 7. Building performance use per square foot for Community Centers and Fire Stations

Building	SF	Building Type	Total Site kBtu/ SF	Elec Site kBtu/ sf	Oil Site kBtu/ SF	Propane Site kBtu/ SF	Natural Gas Site kBtu/ SF	Waste Oil Site kBtu/ SF
Stevens Hall	5,724	Community Center	86	4	81	1		
Community Center	5,326	Community Center	80	19		61		
Community Center	1,496	Community Center	78	14	64			
Community Center/ Library	12,000	Community Center	66	23	43			
Camp Morgan Lodge	4,250	Community Center	60	7	44	9		
Grapvine Community Center	3,536	Community Center	53		53			
Community Center	200,600	Community Center	50	17			33	
Community House	12,220	Community Center	43	5	39			
Recreation	4,800	Community Center	16	6		10		
Uptown Fire Station	5,988	Fire Station	150					
Fire Station	3,236	Fire Station	131	9	122			
Mirror Lake Fire Station	2,402	Fire Station	111	21	91			
East Fire Station	725	Fire Station	110	6		104		
Fire Station	5,125	Fire Station	98					
Company 1	1,189	Fire Station	95	7		88		
Fire Station	2,080	Fire Station	88	7	81			
ES Fire Station	2,438	Fire Station	77	10	67			
Fire Station - Contoocook	5,543	Fire Station	77	17	60			
Fire Station	6,800	Fire Station	77	20	57			
Fire/ Police Station	6,688	Fire Station	76	22	44	10		
Fire Station/ Rescue	3,072	Fire Station	75	11		64		
Company 2	1,201	Fire Station	70	7	64			
Fire Station	7,000	Fire Station	69					
Fire Station	3,000	Fire Station	68	3	65			
Volunteer Fire Station	6,579	Fire Station	63		53	10		
Public Safety	13,000	Fire Station	58	21	37			
Fire Station	13,783	Fire Station	54	10	45			
Fire Station	9,300	Fire Station	54					
Public Safety Building	4,848	Fire Station	51	13		37		
Fire Station - Central	6,442	Fire Station	50	10		40		
Ridge Fire House	3,488	Fire Station	50	0	50			
Fire Station	6,960	Fire Station	49	11	38			
Fire Station	4,958	Fire Station	49	10		39		
Fire Station	5,878	Fire Station	46	12		34		
Ws Fire Station	3,960	Fire Station	45	11	34			
Fire Station	4,260	Fire Station	43	13	30			
Fire Department	8,740	Fire Station	42	17		25		
Company 3	2,500	Fire Station	42	7	36			
Public Safety	19,716	Fire Station	41	13	28	1		
Narrows Fire House	3,136	Fire Station	38	11		27		
Fire Station	4,000	Fire Station	34	5	29			
Fire Station	9,000	Fire Station	33	3	30			
Union Fire Station	3,264	Fire Station	28	5	23			
East Fire Station	4,608	Fire Station	23	1	22			

Table 8. Building performance use per square foot for

Building	SF	Building Type	Total Site kBtu/ SF	Elec Site kBtu/ sf	Oil Site kBtu/ SF	Propane Site kBtu/ SF	Natural Gas Site kBtu/ SF	Waste Oil Site kBtu/ SF
Town Garage	1,600	Garage	206	20		186		
Farm Machinery	1,200	Garage	158					
Highway Garage	4,320	Garage	126	10	5			
Highway Garage	2,592	Garage	123	3				121
DPW Garage	2,800	Garage	108	15	21	24		49
DPW Garage	3,375	Garage	107	18		89		
Town Garage	1,920	Garage	106	10		15		81
DPW Garage	32,450	Garage	101	12	89			
Town Garage	7,200	Garage	99	18	81			
Highway Garage	2,180	Garage	95	14	81			
DPW Highway Barn	5,108	Garage	95	12	83			
Highway Complex	3,200	Garage	83	20		64		
Highway Garage	3,556	Garage	80	5				
New Highway Garage	6,400	Garage	73	8	66			
Highway Garage	6,000	Garage	73	10				63
Armory	6,000	Garage	70					
Highway	3,170	Garage	64	5	59			
DPW Garage	9,507	Garage	64	10				
DPW Garage	6,448	Garage	61	14	47			
Highway Barn	6,000	Garage	60	17		43		
Highway Garage	3,329	Garage	53	5	41	7		
Highway Garage	4,000	Garage	46		35	11		
Highway Garage	5,000	Garage	52	6	45			
Highway Garage	11,148	Garage	25	5	15	5		
DPW	7,000	Garage	11					
Old Highway Garage	2,100	Garage	3	3				
Library	13,243	Library	161					
Library	1,200	Library	150					
Tuttle Library	3,936	Library	120		120			
Library	1,012	Library	109	15	94			
Library	16,500	Library	87					
Library	9,984	Library	86	27	59			
Library	4,480	Library	82		41	42		
Library	4,604	Library	75	14	62			
Library	19,100	Library	74	28	46			
Social Library	2,500	Library	60	2	58			
Library	10,823	Library	60	5	55			
Library	1,960	Library	56	13		43		
Smyth Library	1,320	Library	53	6	47			
Library	2,120	Library	52	20	31			
Library	3,762	Library	50	26	24			
Library	8,338	Library	42	10	30	2		
Library	6,276	Library	40		38	2		
Chesley Library	2,584	Library	38	0	38			
Library	2,051	Library	38	8		30		
Library	5,232	Library	36	19	18			

Table 9. Building performance use per square foot for Town Hall, Police Station, and Elementary School

Building	SF	Building Type	Total Site kBtu/ SF	Elec Site kBtu/ sf	Oil Site kBtu/ SF	Propane Site kBtu/ SF	Natural Gas Site kBtu/ SF	Waste Oil Site kBtu/ SF
Administration	17,500	Office	183					
General Building	4,231	Office	130	61	68			
Town Hall	3,749	Office	128	44	85			
Town Hall	2,210	Office	115	16	100			
City Hall/Fire	30,300	Office	114	38	47		30	
Bates Building	2,060	Office	106	22	84			
GBW Building	13,774	Office	103	43	60			
Town Hall	4,800	Office	102	30	71			
Town Hall	14,000	Office	101	17	84			
Town Hall	8,707	Office	95	8	87			
Town Hall	4,211	Office	90	26	56	9		
Registry of Deeds	28,000	Office	86					
Town Hall	3,718	Office	82	14	69			
Town Hall	15,360	Office	73					
Administration	12,000	Office	72					
City Hall	15,872	Office	71	15	56			
Municipal Building	6,000	Office	69					
Town Offices	5,366	Office	67	20	47			
Town Hall	2,924	Office	66	14	51			
City Hall	15,750	Office	65					
Town Office	5,616	Office	63	8		55		
Town Hall	7,563	Office	63	17	45	1		
Town Hall	33,907	Office	62	16	32	14		
City Hall	15,300	Office	61					
Town Hall	7,316	Office	60	18	43			
Town Hall	5,915	Office	56	5		51		
Town Hall	8,436	Office	55	9	38	4		5
Town Offices	1,944	Office	54	14		40		
Town Hall Annex	3,584	Office	54	25	29			
Town Hall	14,400	Office	50	3	48			
Town Hall	9,500	Office	48					
Town Hall	13,476	Office	48	12	36			
Town Office Main Building	12,384	Office	27	4	23			
Town Offices	4,811	Office	33	19		14		
Academy Hall	3,626	Office	32	3		29		
Town Hall	7,183	Office	29	9	19			
Town Office Food Shelf	5,880	Office	16	9	7			
Police	14,200	Police	154					
Police	16,660	Police	152					
Police	3,480	Police	99	30	69			
Police	11,318	Police	95					
Police Station	1,794	Police	91	13		79		
Police Station	1,718	Police	90	44	46			
Police and Recreation	16,714	Police	75	27	47			
Police Station	8,800	Police	-					
Brown Elementary	14,835	Elementary School	212	23	189			
Elementary School	13,240	Elementary School	100	31		69		
Elementary School	7,700	Elementary School	69	23	45			
Elementary School	27,300	Elementary School	67	14	53			

9.0 Light Levels

Measured and Target Light Levels

Following are light levels measured by Peregrine and Town staff during the site assessment. The table includes target light levels for the Town's consideration[12].

Table 10. Light levels measured during our site visit and proposed targets

Building	Room	Measured Light Level	Target Light Level
Camp Morgan	Kitchen	9-92	30-70 FC
Camp Morgan	Main room	30-80	30 FC
Camp Morgan	Downstairs	8-50	30 FC
Fire Station	Apparatus bay	5-35	15-30 FC
Fire Station	Training room	50-60	30 FC
Library	Archives room	50-100	35-50 FC
Library	Main reading room	50-150	35-50 FC
Library	Entrance	5-30	30 FC
Library	Check out	7-35	75 FC

In addition, following are sample light levels for several types of buildings and tasks we see in municipal building portfolios.

Table 11. Sample light level recommendations for municipal facilities

Office private w/o task light level	50 FC
Office open w task light level	35 FC
Office computer work	30 FC
Hallway light level	20 FC
Library reading light level	50 FC
Library stack light level	35 FC
Library circulation light level	75 FC
Garage parking light level	15-30 FC
Garage body work light level	80 FC
Gymnasium General	30 FC
Gymnasium Matches	50 FC

[12] The target light levels come from a number of different sources that are available online. The primary source for light level standards in the United States is the Illuminating Engineering Society of North America (IESNA) Lighting Handbook.

Suggested Strategies for Reducing Energy Use and Increasing Energy Efficiency in Local Operations

Prepared by

Energy Technical Assistance & Planning
For New Hampshire Communities
Funded by the ARRA Energy Efficiency Conservation Block Grant

Introduction

Whether you represent a City, Town, or County that is trying to reduce its energy use and expenses, adhering to the simple principles and processes described here will greatly increase the likelihood of both near term and long term success. Sections 2-4 give you specific steps you should take to move the process forward in your community. Section 5 outlines the broad steps for putting together a comprehensive Energy Management Plan.

Getting Organized for Energy Efficiency

The goal of the ETAP program is to assist communities take action to reduce their energy usage. Like any other project you might undertake at work or at home, knowing where you are and where you hope to get to and agreeing on the roles and responsibilities of the members of your team will make your efforts more fruitful.

Decide who is in charge: Designate an Energy Lead

Your community should have a single person responsible for monitoring energy use, tracking your progress in increasing energy efficiency, and measuring progress against goals. Ideally this should be an individual who has both the responsibility and the authority to affect policy and move your goals forward. This will help guarantee that energy efficiency initiatives stay on track and are an integral part of all policy and decision making.

Establish an Energy Committee and Share Information about Energy Use and Cost

A successful energy cost reduction strategy requires the involvement and commitment of elected officials, local government managers and departments, building users, and maintenance staff. Bringing them together to confirm policies, goals, and strategies, to determine resources needed, to establish timelines and responsibilities, and to measure and communicate progress is critical to your success.

You can't manage what you don't measure: Monitor Monthly Energy Use

Track energy use and cost for each building both month to month and year to year. Using the Inventory Tool offered by ETAP is an easy way to get an overview of this use and cost and to measure your progress toward reaching the energy efficiency goals you set.

Inform town employees that energy reduction is a priority and solicit suggestions

Town employees often have good ideas for how to reduce energy use. But no one ever asks them for their opinion. Get employees involved in energy efficiency discussions and ask for their ideas on how improvements can be made in your programs and policies.

Finding Resources to Implement Energy Projects

While many energy use reduction opportunities are low cost or even no cost, others will require the investment of funds for major capital projects.

Look for and secure utility rebates and incentives

New Hampshire's utility companies often offer incentives to encourage their customers to adopt and install energy efficiency technologies. Even when you purchase electricity or natural gas from a competitive supplier, you still qualify for incentives offered by the distribution company that delivers your supply to you. Before proceeding with any upgrades or renovations, contact your utility to see what is being offered and how you can qualify. If you've taken advantage of lighting upgrade programs in the past, you may qualify for additional incentives to upgrade lighting again with more efficient fixtures.

Plan for the inevitable replacement of older equipment: Include funding in CIP or in reserve funds for energy systems replacement when equipment is 50% of useful life

It is a typical for a municipality or county to use a piece of equipment, vehicle, or building energy system until it fails and needs to be replaced. But the time to think about improving the energy efficiency of equipment is not that January day when the heating system in the Town Building stops functioning. Bring in contractors to review the condition of your system and research what alternatives might be available. You might find out that it will pay to replace a system sooner with new efficient equipment and avoid the costly repairs that aging systems can require. Consider putting funds away yearly beginning when equipment gets to its half-life to minimize the budget impacts of its replacement.

Engage citizens in energy efficiency planning and policy making

Where there may not be needed expertise within the town, city or county government to address energy efficiency issues, there may be concerned or interest citizens willing to help and lend their expertise. If your town does not have a Local Energy Committee, reach out to interested citizens to form one. This not only will help you optimize how local government uses energy, but will give you a conduit to citizens when you need to secure their support for capital projects and procurements.

Establishing Policies that Encourage Energy Efficiency

Use building renovations as an opportunity to improve energy efficiency

Every building upgrade should be viewed as a chance to improve how the building operates, including how it uses energy. Consider adding insulation when wall are being opened. Be sure that new doors or windows are purchased with efficiency in mind.

Consider life cycle energy costs when purchasing any new equipment

When purchasing any new system that uses energy to operate (such as boilers, ventilation, air conditioning units, street lights, or vehicles) don't only consider the "first cost" or sticker price of the equipment or system, but compare and consider the "total cost" of different equipment, including it operation and maintenance over its expected life. It may be that the least expensive system will have a far greater impact on annual operating budgets than a more expensive, but energy efficiency alternative. This should be a standard principal in budgeting for any item with uses energy.

Creating an Energy Management Plan

The goal of the ETAP program is to not only to help communities identify specific actions it can take to reduce energy waste, but also to support ongoing energy management and planning to make buildings, systems and processes more energy efficient.

There are general principles and methods that are pertinent to any community to move them along the path towards energy efficiency. These are set forth in *New Hampshire Handbook on Energy Efficiency & Climate Change, Volume II* (2009), developed by the NH Carbon Coalition, Clean Air-Cool Planet, and Sustainable Development & Energy Systems (SDES) along with the Local Energy Committee Working Group of the NH Energy Efficiency and Sustainable Energy (ESSE) Board. These documents lay out an energy efficiency planning "roadmap" that municipalities can follow to understand their energy usage, plan for increased energy efficiency and work with their community to educate and implement effective energy efficiency solutions.

The aspects of this Roadmap are illustrated in Figure 1 briefly described in the following sections. You may already be following some or all of these steps in your community, if so congratulations! If not these steps are a strong foundation to use for thinking and acting on energy efficiency objectives.

Figure 1 Energy Efficiency Roadmap

Energy Baseline and Benchmarking

An inventory process can help establish a baseline of energy data describing the current performance of each building, as well as other areas needing attention, such as transportation and street lighting. For buildings, this involves collecting and organizing energy use information over a number of years to be able to look at annual, monthly, and seasonal patterns of energy consumption. The ETAP program provides assistance in collecting, maintaining and utilizing this information. If you have not taken advantage of this free ETAP service, contact your Regional Planning Commission for more information.

Establishing Priorities

Reviewing the baseline and benchmarking information can help a community target its energy efficiency initiative. One approach to setting priorities is to focus on buildings that are larger energy users or that have the higher energy use per square foot of floor area. Another approach focuses on buildings that are older or are known to have older systems or systems that have required frequent or costly repairs or have a record of occupant comfort complaints. We recommend a combination of approaches that looks at each building individually, recognizes that different types of building uses result in different energy profiles, and that high energy use can reflect envelope and equipment inefficiencies, poor maintenance practices, conscious choices by building occupants, opportunities for behavior modification, or the inherent energy requirements of the use to which a building is put.

Buildings Assessments/Audits

Once buildings are identified as being the high priority targets, a building assessment by a qualified specialist should be arranged to determine what steps could be taken to reduce energy use without conflicting with the business for which a building is used.

For buildings with systems which perform like residential buildings (such as former homes converted to office space), there are standards from the Building Performance Institute (BPI) for conducting audits. Commercial buildings have different systems and The American Society of Heating Air Conditioning and Refrigeration Engineers (ASHRAE) has developed standard energy audit levels for these types of buildings. For all such assessments, regardless of building type, the cost will vary with the level of detail and type of information sought. This can range from relatively inexpensive high level "scoping audits" which identify opportunities with ranges of costs and savings to help screen investment alternatives to extensive and expensive "investment grade audits" which provide exact costs and savings estimates and identify replacement equipment to be installed with design requirements.

Prioritizing and Implementing Recommendations

Building assessments will usually generate a range of recommendations that include relatively quick and easy changes or improvements as well as capital intensive projects. Some measures will have relatively quick paybacks on investment, while others will have long paybacks and may be best implemented as part of long term equipment replacement process.

Regardless, it is important to review all the recommendations and understand the implications of acting now or later on each one in terms of cost and savings; and further, to develop a formal plan, with responsibilities assigned and actions identified for proceeding with each recommendation of interest.

In many cases, the limiting factor in proceeding will be securing funding. While it is tempting to look for grant sources and wait until grant money is secured for projects, it may make more sense to commit and invest local funds now to gain efficiencies and savings as well as the peace of mind and greater comfort that new systems will create. If a significant energy cost savings can be documented, consider finding the funding for the work through loans programs such as the Municipal Energy Reduction Fund offered by the Community Development Finance Authority, or bonding. If the audits include lighting, HVAC or motor and drive upgrades, utilities may offer incentives that help pay for improvements.

Measurement/Assessment

Continue to monitor energy usage and savings achieved. If you've spent hard-won taxpayers dollars on these energy saving measures, you want to document how this work made a difference, and if not, determine why expected benefits are not being realized.

Reprioritize and Continue Improvements

Very seldom will one round of energy efficiency upgrades cover all the work that could be done to maximize energy savings. Establish the next set of priorities and begin the process of implementing these changes as well.

References

- New Hampshire Handbook on Energy Efficiency & Climate Change, Volume II (2009), developed by the NH Carbon Coalition, Clean Air-Cool Planet, and Sustainable Development & Energy Systems (SDES) along with the Local Energy Committee Working Group of the NH Energy Efficiency and Sustainable Energy (ESSE) Board. Copies of this document can found at http://www.nhenergy.org
- Information on building audits can be found at http://www.bpi.org and http://www.ashrae.org/
- Information on the Municipal Energy Reduction Fund can be found at http://www.nhcdfa.org/web/erp/merf/merf_overview.html .