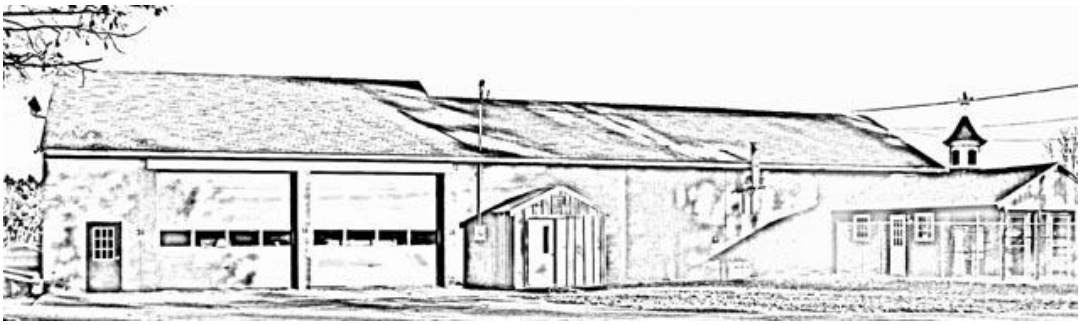
BALES ENERGY ASSOCIATES

ENERGY STUDY
for the
Petersham Highway Department



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Energy Analysis of Measures
Through the
Massachusetts Clean Energy Center
Green Communities Program

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Introduction

Bales Energy Associates, an energy efficiency engineering firm, was contracted to provide an energy study for selected town-owned buildings in Petersham, Massachusetts. The study was funded through grant funds provided by Green Communities Program of the Massachusetts Clean Energy Center. The building evaluated in this report is the Highway Department.

Bart Bales, PE, MSME, senior engineer at BEA, visited the site, reviewed energy usage & billing information, examined relevant equipment and systems, and developed energy analyses and recommendations with regard to each building's energy related systems.

Given the nature of the funding process for the Green Communities Program, a preliminary site visit identified specific measures for inclusion in the current report. Other potential measures indentified in the course of this study have been noted and may be considered for evaluation for future Green Communities grant applications.

Executive Summary

Energy Conservation Opportunities Evaluated

During the proposal and contracting process, specific energy conservation measures needing evaluation were identified at each facility. ASHRAE Level 2 calculations were completed for all measures evaluated.

Heating and enclosure system improvements were the focus of the study at the Petersham Highway Department.

Key conclusions are the following:

1. **Controls Systems Recommendation**
   - **Install microprocessor-based programmable thermostats to provide temperature setback for areas. Equip with wifi capability to allow systems to be scheduled locally and remotely using "smart' phones and tablet and laptop computers.**

2. **Enclosure Improvements** can substantially reduce the building's heat loss characteristics. Recommendations include:
   - **Increase attic insulation levels.** Add sufficient cellulose insulation to increase the ceiling assembly R-value to R60. Air seal bypasses and penetrations in the attic.

The costs, savings, and economic payback for these energy conservation measures are presented in the following Executive Summary Chart. The values shown in the Executive Summary Chart represent the savings with measures taken in the order of economic feasibility shown. The calculations supporting each measure are included in the appendices.

Executive Summary Chart

Executive Summary Chart					Oil $3.22				
Petersham Highway Barn									
ECM #	Energy Conservation Measures	Cost	Available Utility Rebates ($)	Total Cost after Rebate ($)	Oil Savings (Gallons/yr)	Annual Savings ($/yr)	Total Payback (yrs)	Total Payback Payback after Rebates (yrs)	Life Years
ECM 1	"Smart" Programmable Thermostat w/ Wifi	$1,270	$0	$1,270	132	$426	3.0	3.0	20+
ECM 2	Insulate & Air Seal the Attic	$3,306	$0	$3,306	109	$350	9.4	9.4	30+
	Totals	**$4,576**	**$0**	**$4,576**	**241**	**$776**	**5.9**	**5.9**	

Existing Conditions

Facility Description

The Highway Department facility's main function is to serve as an office space, maintenance garage and vehicle/equipment storage space for the town's highway department. It is a single story, concrete block structure that comprises two large garage areas. One is used as the main maintenance garage and the other is mainly for truck storage. The maintenance section is heated by a #2 fuel oil furnace where as the adjacent truck storage area utilizes a waste oil furnace for its heating. There is a modest office space, approximately 9' x 25', located in the northwest corner.

Utility Energy Use

Utility data for a multi-year period was collected. Data for the reference year used, June 2012 - July 2013, is tabulated and reported in the appendices.

Building Enclosure

The building has a low sloped roof over a ceiling insulated with approximately 6" of fiberglass and cellulose insulation. Exterior walls are concrete block structure with no insulation and are not finished on either side. There are minimal windows and six overhead garage bay doors. The overhead doors on the truck storage side have been replaced with insulated doors and the two on the maintenance side are older, lower efficiency doors and though they have insulation on them it is pieces being held in place by a fabric/mesh layer. This setup results in gaps between the pieces of insulation and thus less effective thermal barrier.

Below is a picture taken of the interior of the main maintenance bay heated with the oil furnace.

Recommendation: <u>Increase Attic Insulation</u>

Bales Energy Associates recommends adding 9 inches of cellulose on top of the existing cellulose insulation to raise the assembly R-value to approximately R60. Prior to the installation of the added insulation, air seal the attic ceiling to reduce air infiltration from the conditioned space into the attic.

Heating, Ventilating & Air Conditioning Systems

Furnace

The main maintenance bay of the building is served by an oil-fired, non-condensing furnace. The unit is a Metromatic MFG Co. furnace (model: LB-140). It has an oil input rate of 1.25 GPH (approx. 173 MBH), a listed efficiency rating of 83%, and a measured efficiency of 82% and provides an output of 144 MBH.

The design heat load for the entire facility is approximately 171,000 Btu/hr and is broken out as follows:

- Maintenance bays, office & lav - being served by the Metromatic furnace is around 94,000 Btu/hr
- Truck Storage bays - utilizing the waste oil burner is around 76,000 Btu/hr

Furnace replacement was analyzed but, due, in part, to relatively low fuel usage, is not recommended at this time.

Heating Distribution System

The heating distribution system consists of hot air supply and return ducting.

Cooling System

There is currently no cooling equipment utilized at the Highway Department.

Temperature & Ventilation Control System

The existing thermostat controls are manually adjusted thermostats in each garage bay.

Recommendation: <u>Utilize a programmable"smart"wifi thermostat in the maintenance bay</u>

To allow for more effective scheduled temperature setback and building warm-up, Bales Energy recommends a programmable thermostat with wifi capability to control temperatures and allow for automatic setback of unused areas during unoccupied hours and to allow activation of unscheduled building warm-up remotely using "smart' phones and tablet and laptop computers.

Domestic Hot Water System

An 82 gallon electric hot water tank serves the DHW demand at the Highway Department. Water use is modest, mainly for hand washing and occasional limited use for washing of tools and equipment. No recommendation is made with regard to domestic hot water.

APPENDICES

UTILITY INFORMATION

Billed Energy Use for Electricity & Fuel					
Jul 2012 - Jun 2013					
Building Name	**Highway Department**				
Owner	**Town of Petersham, MA**				
Account #					
Month	Electricity KWH	Electricity Total $	Oil Gallons	Oil $	**Energy $ Totals**
Jul	354	$31			**$31**
Aug	456	$37			**$37**
Sept	430	$36			**$36**
Oct	532	$42			**$42**
Nov	704	$52	175.0	$566	**$618**
Dec	778	$56			**$56**
Jan	2,388	$159	207.0	$670	**$829**
Feb	2,314	$149	182.0	$589	**$738**
Mar	2,158	$130	204.0	$659	**$789**
Apr	2,017	$137	202.0	$639	**$776**
May	669	$52			**$52**
Jun (prev Jun data used)	***419***	***$35***			**$35**
Annual (Units)	13,219	$916	970.0	$3,123	**$4,039**
Heating Season (Units)	10,891	$725	970.0	$3,123	**$3,848**
Annual ($/Unit)		$0.069		$3.220	
Heating Season ($/Unit)		$0.067		$3.220	
	Electricity MBtu		**Oil MBtu**	**Energy Use Totals (Mbtu)**	
Annual (Mbtu)	45,103		134,539.0	179,642	**Energy $ Totals**
Heating Season (Mbtu)	37,160		134,539.0	171,699	
				Totals (Mbtu/sf)	**($/sf)**
Annual (Mbtu/sf)	26.8		80.1	**106.9**	**$2.40**
Heating Season (Mbtu/sf)	22.1		80.1	**102.2**	**$2.29**
Building Name	**Highway Department**		**Heated Square Footage**		**1,680**

***Note**: electricity costs provided to BEA during the audit may to be incomplete, i.e. they appear to include supply OR demand, FY'11 data provided indicated the more likely figure of $0.19/kWh*

ECM 1

"SMART" WIFI THERMOSTAT

MEASURE INFORMATION

Temperature Controls Costs			
	t-stat	labor	Cost ($)
1st thermostat	500	270	$ 770
O.A. sensor	300	200	$ 500
Totals	*$ 800*	*$ 470*	*$ 1,270*

Costs provided by Sandri Energy Solutions, Greenfield, MA
www.sandri.com; 413-772-2121

Summary of Energy Savings					
ECM 1	"Smart" Programmable Thermostat w/ Wifi				
	Use after Insulation	After Thermostat	Savings	Reduction	
Net Building Demand (MMBtu/yr)	92.5	79.9	12.60	13.6%	
Existing Seasonal System Efficiency	77%	77%			
Fuel Energy Usage (MMBtu/yr)	119.5	103.2			
Energy Savings	% Reduction	Current Oil Use	Gallons Saved	$/Unit	$ Saved
	13.6%	970	132	$3.22	$426
				Total Savings	$426

Cost	Savings	Payback (yr)
$1,270	$426	3.0

Note:
Cost estimates were developed by BEA based upon figures from Sandri Energy Services

ECM 2

ATTIC MEASURE INFORMATION

Main Maintenance Bay	1,680 sq.ft.		
in. of added cellulose insulation	12.2 "		
	Depth (in.)	**R-value**	**Cost ($)**
Open Blow	9	33	$ 2,436
O.B. to R60	3	12	$ 310
Air Sealing			$ 560
	Totals	***45***	***$ 3,306***

Summary of Energy Savings

ECM 2 **Attic Insulation & Air Sealing**

	Baseline	After ECM	Savings	Reduction	
Net Building Demand (MMBtu/yr)	104.1	92.5	11.68	11.2%	
Existing Seasonal System Efficiency	77%	77%			
Fuel Energy Usage (MMBtu/yr)	134.5	119.5			

Energy Savings	**% Reduction**	**Current Oil Use**	**Gallons Saved**	**$/Unit**	**$ Saved**
	11.2%	970	109	$3.22	$350
				Total Savings	**$350**

Cost	**Savings**	**Payback (yr)**
$3,306	**$350**	**9.4**

Note:

Cost estimates were developed by BEA based upon figures from Energia, LLC