



BALES ENERGY ASSOCIATES

ENERGY STUDY For the Petersham Police Department



Date: February 21, 2014

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

Completed By:

**Bales Energy Associates
50 Miles Street
Greenfield, MA 01301
bart.bales@balesenergy.com
413-863-5020**

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Introduction

Bales Energy Associates (BEA), 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 Police 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 identified 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.

Building envelope improvements, both adding insulation and air sealing, and space conditioning temperature controls were the focus of the study at the Petersham Police 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 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													
												Propane	
												\$1.95	
												\$/Gallon	
ECM #	Energy Conservation Measures	Cost (\$)	Incremental Cost (\$)	Available Utility Rebates (\$)	Total Cost after Rebate (\$)	Incremental Cost after Rebate (\$)	Propane Savings (Gallons/yr)	Annual Savings (\$/yr)	Total Payback (yrs)	Incremental Payback (yrs)	Total Payback after Rebates (yrs)	Incremental Rebates (yrs)	Life Years
ECM 1	Temperature & Schedule Modifications	\$2,040		\$0	\$2,040	\$0	157	\$306	6.7	0.0	6.7	0.0	30+
ECM 2	Insulate & Air-Seal the Attic	\$3,415	-	\$0	\$3,415	-	122	\$237	14.4	-	14.4	-	30+
Totals		\$5,455	\$0	\$0	\$5,455	\$0	\$279	\$544	10.0	0.0	10.0	0.0	

Existing Conditions

Facility Description

The building is a slab-on-grade, single story structure and is in use 7 days a week (slightly reduced hours on Sunday). The original structure was renovated in 2010. That renovation included a remodel of the existing building and the addition of approximately 1,000 ft², of which there was a 400 ft² attached garage off the back.

The Petersham Police Department is a single story structure. It is a low-occupancy building used as office space for department staff and has a single bay garage located in the rear of the building.

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 older, front section of the building has mostly stone exterior over a concrete wall and a drywall interior surface, with the exception of the front wall section that is wood-framed with clapboard siding. The construction of the addition off the back is 2" x 6" wood framed structure insulated with fiberglass insulation in the stud bays, has a drywall interior and a vinyl siding exterior. It has a typical asphalt shingled roof over a wood truss cavity with fiberglass insulation over the flat ceilings. The front section has approximately 6" of fiberglass yielding a resistance value around R19 while the addition is insulated to R-30. The windows are relatively efficient, insulated, dual pane, operable units.

Below is a picture showing the two exterior wall construction types.



Recommendation: Air Seal Attic & Increase Attic Insulation Levels

Bales Energy Associates recommends adding sufficient blown cellulose insulation on top of the existing fiberglass insulation to raise the assembly R-value to approximately R60.

System costs and energy and dollar savings are reported in the appendices of this report.

Heating, Ventilation & Air Conditioning Systems

Furnace

The occupied facility, i.e. not including the garage, is served by relatively new a propane-fired furnace. The unit is an energy efficient Rheem condensing furnace. The original propane fired furnace was removed during the construction and re-installed in the garage to provide heat to that space.

The design heat load for the entire building is approximately 36,000 Btu/hr.

Heating & Cooling Distribution System

The heating and cooling distribution system consists of supply and return ducting to/from the conditioned space. There system is divided into two main zones with air flow to each zone being regulated by dedicated, inline variable air volume (VAV) boxes with internal motorized dampers.

It was noted during the site visit that the ductwork located in the mechanical room is not insulated. However, the majority of the ducted distribution lies outside the thermal envelope, i.e. above the ceiling insulation, in the unconditioned truss space and is insulated.

Cooling System

There is a cooling system at the police station which consists of an outdoor condensing unit that feeds the refrigerant cooling coil installed just downstream in the supply ductwork immediately after the Rheem's constant volume fan unit.

Temperature & Ventilating Control System

The two zones are controlled by wall mounted thermostats for each zone. The plan documents indicated they are capable of automatic changeover from heating to cooling depending on the needs of the space. Connected to the return duct in the mechanical room is an outside air intake that introduces fresh air ventilation to the system through a louver in the exterior wall.

Recommendation: Utilize programmable thermostats to control temperatures and allow for automatic setback of unused areas during unoccupied hours.

System costs and energy and dollar savings are reported in the appendices of this report.

Domestic Hot Water System

A small Ruud electric hot water tank with a single 2,000 kW heating element serves the DHW demand at the Police Department.

It was observed that the 1/2" copper piping supplying the hot water to the building was not insulated and therefore represents energy losses that could be readily reduced. Bales Energy associates recommends that this piping be insulated.



APPENDICES

UTILITY INFORMATION

Billed Energy Use for Electricity & Fuel					
Jul 2012 - Jun 2013					
Building Name	Police Department				
Owner	Town of Petersham				
Account #					
	Electricity	Electricity	Propane	Propane	Energy \$
Month	KWH	Total \$	Gallons	\$	Totals
Jul	1,262	\$85			\$85
Aug	1,462	\$97			\$97
Sept	1,193	\$81	76.0	\$148	\$229
Oct	857	\$61			\$61
Nov	805	\$58	72.0	\$140	\$198
Dec	928	\$65	164.0	\$319	\$384
Jan	990	\$69	181.0	\$353	\$422
Feb	868	\$60	336.0	\$656	\$716
Mar	831	\$46	164.0	\$320	\$366
Apr	851	\$63			\$63
May	852	\$64	88.0	\$173	\$237
Jun (prev June data)	1,102	\$75			\$75
Annual (Units)	12,001	\$824	1,081.0	\$2,109	\$2,933
Heating Season (Units)	6,130	\$422	917.0	\$1,788	\$2,210
Annual (\$/Unit)		\$0.069		\$1.951	
Heating Season (\$/Unit)		\$0.069		\$1.950	
	Electricity MBtu		Propane MBtu	Energy Use Totals (Mbtu)	
Annual (Mbtu)	40,947		99,992.5	140,940	Energy \$
Heating Season (Mbtu)	20,916		84,822.5	105,738	Totals
				Totals (Mbtu/sf)	(\$/sf)
Annual (Mbtu/sf)	24.6		60.1	84.7	\$1.76
Heating Season (Mbtu/sf)	12.6		50.9	63.5	\$1.33
Building Name	Police Department		Heated Square Footage		1,665

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

CONTROLS SYSTEM MEASURE

Summary of Energy Savings					
ECM 1 Temperature Controls Modifications					
	</				

Temperature Controls Costs			
	t-stat	labor	Cost (\$)
1st thermostat	500	270	\$ 770
2nd thermostat	500	270	\$ 770
O.A. sensors	300	200	\$ 500
Totals	\$ 1,300	\$ 740	\$ 2,040
Costs provided by Sandri Energy Solutions, Greenfield, MA www.sandri.com ; 413-772-2121			

ENCLOSURE MEASURE INFORMATION

Summary of Energy Savings					
ECM 2Attic Insulation & Air Sealing					
	Baseline (after ECM 1)	After ECM 2	Savings	Reduction	
Net Building Demand (MMBtu/yr)	77.6	65.5	12.11	15.6%	
Existing Seasonal System Efficiency	91%	91%			
Fuel Energy Usage (MMBtu/yr)	85.5	72.1			
Energy Savings	% Reduction	Propane Use	Gallons Saved	\$/Unit	\$ Saved
	15.6%	780	122	\$1.95	\$237
Total Savings					\$237

Entire facility Ceiling		1,665 sq.ft.	
blown in cellulose insulation		13.5 "	
	Depth (in.)	R-value	Cost (\$)
Open Blow	9	33	\$ 2,414
O.B. to R60	4.5	17	\$ 441
Air Sealing	-	-	\$ 560
	Totals	50	\$ 3,415