Warwick Criterion 3 Appendices

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Table 4
Energy Conservation Measures Data

Measure		Status							Financial Data						Reference Data	
Category/Building	**Energy Conservation Measure**	**Status (Completed with month/year or planned Qtr/year)**	**Projected Annual Electricity Savings (kWh)**	**Projected Annual Natural Gas Savings (therms)**	**Projected Annual Oil Savings (gallons)**	**Projected Annual Propane Savings (gallons)**	**Projected Annual Gasoline Savings (gallons)**	**Projected Annual Diesel Savings (gallons)**	**Projected Annual Cost Savings ($)**	**Total Installed Cost ($)**	**Green Community Grant ($)**	**Utility Incentives ($)**	**Other Grants ($)**	**Net Town Cost ($)**	**Funding Source(s) for Other Grants and Net Town**	**Source for Projected Savings**
Town Hall	*weatherization*	Planned Q4 FY15	2,421		379				$788	$21,277	$21,277					*Guardian ERP*
Town Hall	*air-source heat pumps*	planned Q1 FY16	-5,639		590				$1,164	$36,400	$20,000			$16,400	*capital stabilization*	*Guardian ERP*
Town Hall	*wireless T-stats*	planned Q3 FY15	316		49				$788	$2,912	$2,912					*Guardian ERP*
Town Hall	*more interior storms*	planned Q3 FY15			50				$315	$1,000				$1,000	*operating appropriation*	R Value of two layer interior storms - Peter Talmage P.E., Interior Storm Plans – library example
Library	*weatherization*	Planned Q4 FY15	614		333				$374	$28,774	$28,744					*Guardian ERP*
Library	*wireless T-stat*	[planned] Q3 FY15	67		36				$144	$1,456	$1,456					*Guardian ERP*
Library	*Interior storms*	Planned Q3 FY15			86				$316	$800				$800	*operating appropriation*	R Value of two layer interior storms - Peter Talmage P.E., Interior Storm Plans – library example
Fire Station	*install interior storms*	Planned Q3 FY15			74				$272	$600				$600	*operating appropriation*	R Value of two layer interior storms - Peter Talmage P.E., Interior Storm Plans – library example
Fire Station	*wireless T-stat*	Planned Q4 FY15	55		34				$132	$1,456	$1,456					*Guardian ERP*
Fire Station	*change security light*	Planned Q4 FY15	750						$188	$554				$554	*operating appropriation*	*Steve Kurkoski Electric, MA Commercial – National Grid Electric rates table*
Highway Truck Garage (small)	*weatherization*	Planned Q4 FY15	181		57				$131	$3,772	$3,772					*Guardian ERP*
Highway Truck Garage (small)	*wireless T-stat*	planned Q3 FY14	88		28				$114	$1,456	$1,456					*Guardian ERP*
Highway Truck Garage (small)	*93%AFUE propane furnace*	planned Q4 FY16			550	-696			$825	$29,120				$29,120	*capital stabilization*	*Guardian ERP*
Highway Truck Garage (small)	*change security light*	Planned Q4 FY15	1,500						$375	$554				$554	*operating appropriation*	*Steve Kurkoski Electric, MA Commercial – National Grid Electric rates table*
Highway Equipment Garage	*wireless T-stat*	Planned Q3 FY15	132		79				$308	$1,456	$1,456					*Guardian ERP*
Highway Equipment Garage	*install R23 SIP on walls*	Planned Q4 FY15			1,236				$3,798	$20,000	$0			$20,000	*capital stabilization*	*Peter Talmage, P.E., Highway Equipment Garage Heat Loss Calculations (2 files)*
Highway Equipment Garage	*attic weatherization*	Planned Q4 FY15	283		168				$332	$4,819	$4,819					*Guardian ERP*
Highway Equipment Garage	*change to infrared heater*	Planned Q4 FY16			506	-518			$1,030	$46,592	$10,000			$36,592	*capital stabilization*	*Guardian ERP*
Police Station	*air-source heat pump*	Planned Q4 FY15	5,961						$1,192	$23,296	$22,700	$596				*Guardian ERP*
Police Station	*weatherization*	Planned Q4 FY15	3,925						$234	$13,494	$13,269	$225				*Guardian ERP*
Police Station	*wireless T-stat*	Planned Q3 FY15	468						$75	$1,456	$1,356	$82				*Guardian ERP*
Police Station	*Interior storms*	Planned Q3 FY15	609						$152	$800				$800	*operating appropriation*	R Value of two layer interior storms - Peter Talmage P.E., Interior Storm Plans – library example
Tranfer Station	*insulate equipment*	Planned Q2 FY15	389						$97	$250				$250	*operating appropriation*	*local contractor*
BUILDINGS SUBTOTAL			**12,120**	**0**	**4,255**	**-1,214**	**0**	**0**	**$13,144**	**$242,294**	**$134,673**	**$903**	**$0**	**$106,670**		
Blinking school lights	*none*		0													
STREET AND TRAFFIC LIGHTS SUBTOTAL			**0**	**0**	**0**	**0**	**0**	**0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**		
Cemetary	*none*		0													
Broadband Cell Tower	*none*		0													
Broadband Wheeler Por	*none*		0													
OPEN SPACE SUBTOTAL		**planned FY15**	**0**	**0**	**0**	**0**	**0**	**0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**		
Police Dept	*Replace Tahoe with Crown Victoria*	*planned Q2 FY15*					107	0								*Police chief*
Fire Dept	*use Tahoe instead of Fire trk for medical calls*	*planned Q2 FY15*					-46	120								*Fire Chief*
VEHICLES SUBTOTAL			**0**	**0**	**0**	**0**	**61**	**120**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**		
TOTAL Projected Savings			**12,120**	**0**	**4,255**	**-1,214**	**61**	**120**	**$13,144**	**$242,294**	**$134,673**	**$903**	**$0**	**$106,670**		Fire Chief
TOTAL MMBtu SAVINGS		**547**	**41**	**0**	**591**	**-110**	**8**	**17**								

Interior Storms (Winsert) Calculations

A single pane window has an R value resulting from the two air films on the surfaces. The outside film has and R value of .17 and the inside has and R value of .68 giving a total R value of .85. Adding another glazing traps air between the two layers. This trapped air has and R value of 1 for a thickness of 1/2" to 4 inches. This gives and R value of 1.85 for double layer windows. Adding more layers simply adds more trapped air spaces, each with an R value of 1. So, adding a winsert to a single glazed window raised the R value from .82 to 2.85. Adding it to a thermopane window raises the R value from 1.85 to 3.85. Heat loss is calculated by this formula: Heat loss in Btu per hour = window area times temp difference inside to outside divided by R value. Substituting degree days for temp difference and multiplying by 24 hours per day gives you the loss over the whole year.

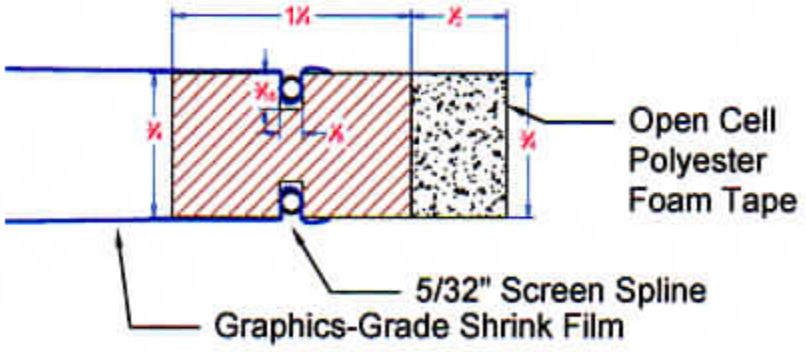
Peter Talmage, P.E.

Evaluation of existing winserts:

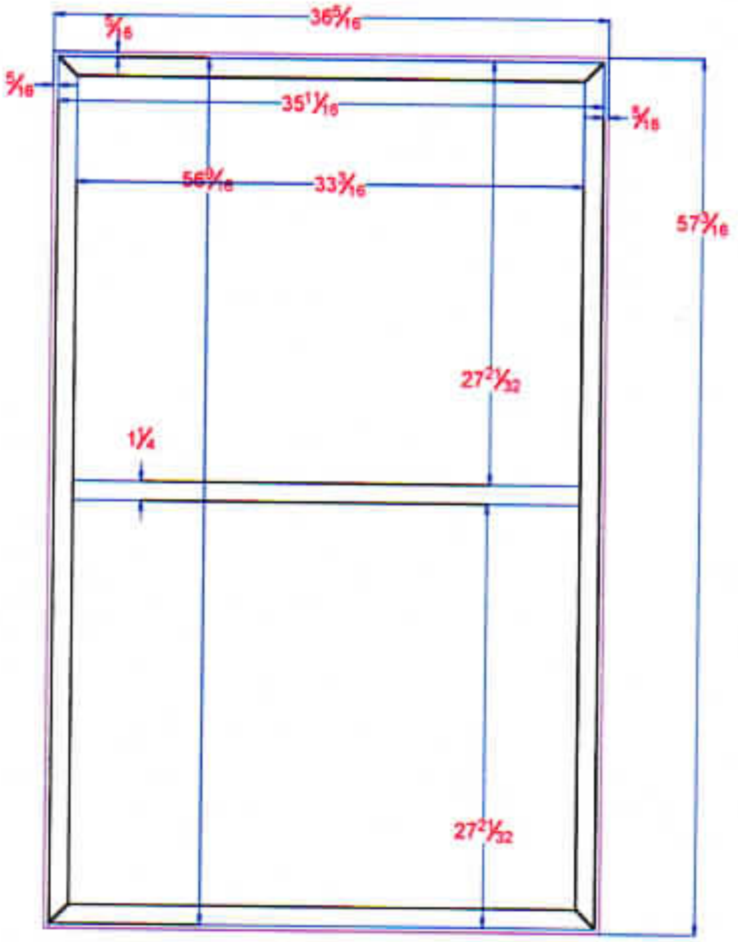
Winserts in my town hall office work so well that when we removed the almost 120 year old sash which was original to the building to restore them, with wincerts installed and exterior combination storms I didn't notice the sash was missing. My office is considerably more comfortable with winserts and the old single pipe steam heating system cycles much less frequently." David Young, Town Coordinator since 2007

Sample Calculation:

- Library window area targeted for winserts is 272 sq. ft. X 5229 (degree days in FY13) X 24 (hrs/day) divided by 1.85 (Rvalue of single pane window with storm) = 18.451303 MMBtu/yr loss from windows. 272 sq. ft. X 5229 X 24 divided by 3.85 (Rvalue of adding a winsert) = 8.866211 MMBtu/yr loss. The difference is 9.585092 MMBtu saved. Dividing this by .139 (conversion to #2 oil) = 68.957 gal oil saved. Dividing this by .8 (furnace efficiency) = 86.19 gallon actually saved as stated in Table 4 line 10 column F.



Section Through Winsert Frame



3/4" x 35 5/8" x 56 9/16
Need (3)

Jack Cadwell	Client: Warwick Library	
Cadwell Joinery	Item: Winserts	SCALE: 1"=12"
122 Hastings Pond Rd.	REV: February 4, 2013	DATE: January 29, 2014
Warwick, MA 01378	Approved By:	PAGE: 1
978-544-6452 jack@jackcadwell.com		

Lighting Calculations

Highway Dept. security light change-out: 400W to two 50W wall-packs = 75% reduction. This light currently uses 1975kWh/yr. Changing it to two 50W lights saves 1481kWh/yr. if the lights were on the same amount of time, more if the Highway Dept. wanted to activate the motion sensor features. Need to change Table 4 line 17 col D from 1500 to 1481 kWh.

Fire Dept. security light change-out: 250W to a 50W wall-pack = 80% reduction. This light currently uses 988kWh/yr. Changing it to a 50W light saves 790kWh/yr. if the light were on the same amount of time, more if the Fire Dept. wanted to activate the motion sensor feature. Need to change Table 4 line 13, col. D from 750 to 790kWh.

Vehicle Calculations

Estimated annual miles = 600. Diesel Fire Trk. @ 5mpg = 120 gal diesel X .139 = 16.68 MMBtu. 1999 Chevy Tahoe 4WD gas @ 13mpg = 46 gal gas X .124 = 5.72 MMBtu.16.68 minus 5.72 = 10.96MMBtu saved.

Highway Equipment Garage - Install R23 Structural Insulated Panel (SIP) Calculations

1,844 gallons oil	calculated oil usage with existing walls' heat loss (see following pages)
- 608 gallons oil	calculated oil usage with R24.7 SIP walls (see following pages)
1,236 gallons oil	projected oil savings from wall insulation

Highway Equipment Garage - AAnnual Heat Loss Calculation for Existing Walls

Annual Heat Loss Calculator

Peter Talmage P.E.   ptalmage@yahoo.com Version 3/8/11

Use this calculator at your own risk !!

The green boxes are for entered data.   The yellow boxes will be calculated.

In the "House Element" column are the various parts of the home such as wall, floors, ceilings, windows, doors, etc.

In the "Area" column are the net area of each element (subtact window and door areas from wall areas)

In the "U value" column enter the U value of each element (U = 1/R)

Monthly mean air temperature can be found here:

http://cdo.ncdc.noaa.gov/cgi-bin/climatenormals/climatenormals.pl?directive=prod_select2&prodtype=CLIM81&subrnum=

Degree day information is available at: www.weatherdatadepot.com/#
Select the "Yearly Comparison Report" option
Enter your location and the balance point or base temperature. The monthly degree day data for the "Base Year" you select will be shown on the left. For the most accurate information you should average the data for the last five years.

A house will be built on a slab on grade or on a full or partial basement.

Unheated slab on grade or basement floor temperature is the room temperature.
If the slab or floor is heated use the average of the room temp and heating water temp.

Soil conductivity values:
For dry sandy soil use .5
For average soil conditions use .8
For wet soils use 1.2

Assumptions:

Interior temperature °F	55	
Degree Days @ above temp	4349	
Basement floor temperature °F		
Slab on grade temperature °F	55	
Mean outdoor temp °F (Oct thru April)	32	
Soil conductivity Btu/h•ft•°F	0.5	
Foundation or slab average width in ft	44	
Foundation wall depth below grade in ft	1	NOTE: If slab on grade enter "1" here
Insulation added to basement wall, R value	0	

Insulation below slab or base floor, R value	0
Insulation on edge of slab on grade, R value	0
Exposed perimeter of slab on grade in ft	174
Number of days in the heating season	212
Conditioned living area in ft^2	1880

House Element	Area	U value	Annual heat loss, Btu	% of total
Basement walls above grade net	0		0	0.0%
Basement windows	0		0	0.0%
Basement walls below grade to floor	0	0.452	0	0.0%
Basement floor	0	0.026	0	0.0%
Slab on grade	1880		14,790,001	6.7%
walls R1.7	2584	0.59	159,127,475	71.9%
doors R12	472	0.083	4,089,034	1.8%
windows R2	36	0.5	1,878,768	0.8%
ceiling R58	1880	0.017	3,335,857	1.5%
			0	0.0%
			0	0.0%
			0	0.0%
			0	0.0%
			0	0.0%
			0	0.0%
			0	0.0%
			0	0.0%
			0	0.0%
			0	0.0%
Loss to outside			**183,221,135** Btu	**82.77%**

Ventilation air

Accurate infiltration numbers require a blower door test. In lieu test numbers use an ACH_n value of .5 for older houses and .3 for new construction. For the basement ACH_n use .2 for tight new construction with minimal windows. For older basements with concrete walls use .5, for cement block walls use .7 and for stone foundations use 1.

Assumptions:

ACH_n (infiltration)	0.6
ACH forced ventilation HRV	
HRV efficiency (as a decimal)	
House volume ft^3	33,840
Basement volume ft^3	
Basement ACH_n	

Loss from infiltration	**38,146,505**	**17.23%**
Loss from forced ventilation	**0**	**0.00%**

ANNUAL HEAT LOSS	**221,367,641**	**Btu**
HEATING ENERGY INTENSITY	**117,749**	**Btu/ft^2/yr**

Potential Instrisic Heat Gains

Number of occupants		
Occupancy hrs/day	8	
Electrical consumption per day in kWh		
Daily intrinsic load		Btu
Heating season intrinsic load heat gain	**0**	**Btu**
POTENTIAL TOTAL NET ANNUAL HEATING LOAD	**221,367,641**	**Btu**
Solar Heat Gain (Windows)		**Btu**
POTENTIAL TOTAL NET ANNUAL HEATING LOAD	**221,367,641**	**Btu**
Average Oil to heat house Standard combustion - 87% efficiency	**1844**	**Gallons**
Average Propane to heat house Sealed combustion, condesning boiler - 92% efficiency	**2615**	**Gallons**
Average Electricity to heat house Het pump, Average COP 2.5	**25952**	**kWh**

Annual Heat Loss Calculator

Peter Talmage P.E. ptalmage@yahoo.com Version 3/8/11

Use this calculator at your own risk !!

The green boxes are for entered data. The yellow boxes will be calculated.

In the "House Element" column are the various parts of the home such as wall, floors, ceilings, windows, doors, etc.

In the "Area" column are the net area of each element (subtact window and door areas from wall areas)

In the "U value" column enter the U value of each element (U = 1/R)

Monthly mean air temperature can be found here:

http://cdo.ncdc.noaa.gov/cgi-bin/climatenormals/climatenormals.pl?directive=prod_select2&prodtype=CLIM81&subrnum=

Degree day information is available at: www.weatherdatadepot.com/#
Select the "Yearly Comparison Report" option
Enter your location and the balance point or base temperature. The monthly degree day data for the "Base Year" you select will be shown on the left. For the most accurate information you should average the data for the last five years.

A house will be built on a slab on grade or on a full or partial basement.

Unheated slab on grade or basement floor temperature is the room temperature.
If the slab or floor is heated use the average of the room temp and heating water temp.

Soil conductivity values:
For dry sandy soil use .5
For average soil conditions use .8
For wet soils use 1.2

Assumptions:

Interior temperature °F	55	
Degree Days @ above temp	4349	
Basement floor temperature °F		
Slab on grade temperature °F	55	
Mean outdoor temp °F (Oct thru April)	32	
Soil conductivity Btu/h•ft•°F	0.5	
Foundation or slab average width in ft	44	
Foundation wall depth below grade in ft	1	NOTE: If slab on grade enter "1" here
Insulation added to basement wall, R value	0	

Insulation below slab or base floor, R value	0
Insulation on edge of slab on grade, R value	0
Exposed perimeter of slab on grade in ft	174
Number of days in the heating season	212
Conditioned living area in ft^2	1880

House Element	Area	U value	Annual heat loss, Btu	% of total
Basement walls above grade net	0		0	0.0%
Basement windows	0		0	0.0%
Basement walls below grade to floor	0	0.452	0	0.0%
Basement floor	0	0.026	0	0.0%
Slab on grade	1880		14,790,001	20.3%
walls R24.7	2584	0.04	10,788,303	14.8%
doors R12	472	0.083	4,089,034	5.6%
windows R2	36	0.5	1,878,768	2.6%
ceiling R58	1880	0.017	3,335,857	4.6%
			0	0.0%
			0	0.0%
			0	0.0%
			0	0.0%
			0	0.0%
			0	0.0%
			0	0.0%
			0	0.0%
			0	0.0%
			0	0.0%
Loss to outside			**34,881,964** **Btu**	**47.76%**

Ventilation air

Accurate infiltration numbers require a blower door test. In lieu test numbers use an ACH_n value of .5 for older houses and .3 for new construction. For the basement ACH_n use .2 for tight new construction with minimal windows. For older basements with concrete walls use .5, for cement block walls use .7 and for stone foundations use 1.

Assumptions:

ACH_n (infiltration)	0.6
ACH forced ventilation HRV	
HRV efficiency (as a decimal)	
House volume ft^3	33,840
Basement volume ft^3	
Basement ACH_n	

Loss from infiltration	**38,146,505**	**52.24%**
Loss from forced ventilation	**0**	**0.00%**

ANNUAL HEAT LOSS	**73,028,469**	**Btu**
HEATING ENERGY INTENSITY	**38,845**	**Btu/ft^2/yr**

Potential Instrisic Heat Gains

Number of occupants		
Occupancy hrs/day	8	
Electrical consumption per day in kWh		
Daily intrinsic load		Btu
Heating season intrinsic load heat gain	**0**	**Btu**
POTENTIAL TOTAL NET ANNUAL HEATING LOAD	**73,028,469**	**Btu**
Solar Heat Gain (Windows)		**Btu**
POTENTIAL TOTAL NET ANNUAL HEATING LOAD	**73,028,469**	**Btu**
Average Oil to heat house Standard combustion - 87% efficiency	**608**	**Gallons**
Average Propane to heat house Sealed combustion, condesning boiler - 92% efficiency	**863**	**Gallons**
Average Electricity to heat house Het pump, Average COP 2.5	**8561**	**kWh**

Library Weatherization - blower door results and air sealing remediation calculations (not used in ERP Table 4 but provided as reference)

Blower door test performed 4/18/2014
5250 CFM @ 50 Pascals

Bldg sq ft = 2400 X avg. 10 ft ceilings = 24,000 Cu Ft

24,000 Cu Ft X .35 air changes per hour (ACH) ÷ 60 minutes/hour = 140 cu ft air/min

140 X 19 (end factor for libraries) = 2660 CFM, Building Air flow Standard or BAS.

2660 CFM X 30% BAS = 796 CFM
2660 CFM – 796 CFM = 1862 CFM, Building Tightness Limit or BTL

There is plenty of opportunity here to reduce energy use with air sealing techniques before mechanical ventilation is needed because the actual air flow of 5250 CFM exceeds the building tightness limit of 1862 CFM. Combined with additional insulation, 10 – 20% reductions are often realized in these types of buildings.

Explanation of calculations and factors:

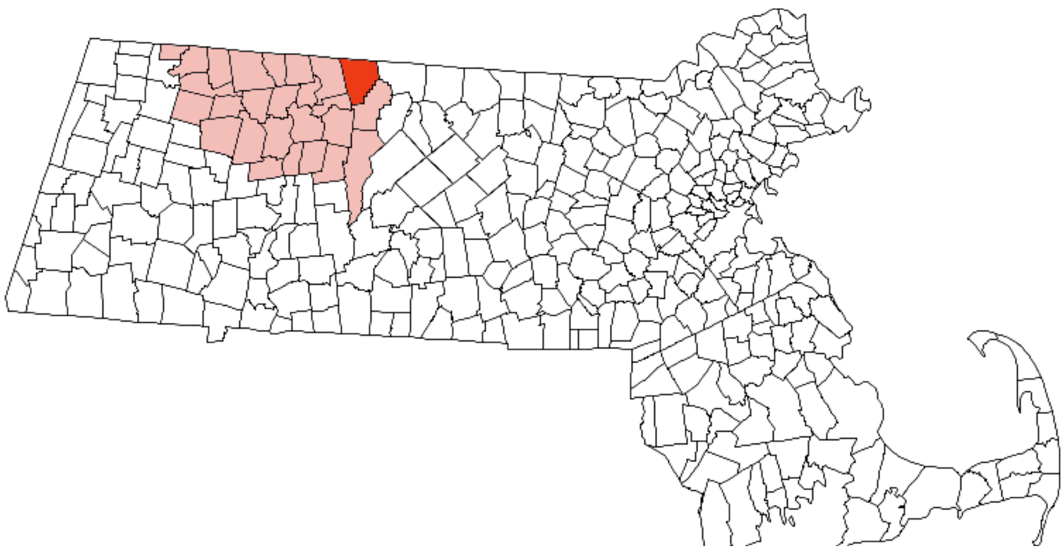
BAS: The 30% is the difference between the building airflow standard (BAS) and the building tightnessit (BTL). for a particular structure.
The building airflow standard number is the result of the blower door test for a particular structure. This number is the limit under which additional ventilation is recommended for a given structure. The building tightness limit is 30% below this number at which limit some form of mechanical ventilation would be required.
We monitor these numbers at the start and at the end of the job so that we know how tight our structure is before we start doing any air sealing or shell tightening work.

How do you apply a building tightness limit to the actual energy use to calculate a potential energy savings? Using ASHRAE standards 62–1989, the blower door test determines whether air leakage is adequate for ventilation or whether mechanical ventilation is necessary. An energy assessment auditor would calculate an MVR converted to CFM 50 and compares this number to the homes measured blower door test results. The MVR for single-family homes depends on the climate, number of occupants, building height, etc. (these are the words of Mark Tajima, the energy engineer from Energia).

Green Communities
Energy Reduction Plan

Town of Warwick, MA

October 2014



Prepared for:

Town of Warwick
12 Athol Rd
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Janis Kurkoski, Warwick Energy Committee

Prepared by:

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Stop Wasting Energy. Start Saving Money.™

GUARDIAN
ENERGY MANAGEMENT SOLUTIONS™

Table of Contents

Introduction

Guardian Energy Management Solutions is pleased to provide the following Energy Reduction Plan for the Town of Warwick to help support Warwick's initiatives under the MA DOER's Green Community Program. Guardian specializes in working with municipalities that are positioned to identify and implement energy efficiency solutions, and has worked with dozens of cities and towns in Massachusetts to help drive down energy usage while reducing operational costs.

This report was designed under the assumption that Warwick will be selecting specific projects for implementation over the course of time. Guardian will continue to support the Town of Warwick by assessing energy efficiency opportunities that may arise over the course of time, and will ensure the town is able to take full advantage of the utility incentive program available from National Grid for its Electric accounts and NStar for any gas related accounts. Guardian is an approved vendor under both utility programs and will assist Warwick in defining projects, developing financials on projects, submitting utility incentive applications and implementing projects that are chosen by the town.

Utility incentives offer an important means of project funding and are designed to help buy down the total cost of a project should that project qualify. In some instances the utility will not support a project for incentive funding, and we will note this in our report. For calendar year 2014, the utilities offer incentives as follows:

- Prescriptive incentives for standard prescriptive measures are predefined by the MassSave energy efficiency program for customers that qualify. These incentives are typically available for projects categorized as lighting retrofits, energy management systems, variable frequency drives, etc. A list of these incentives are located on the MassSave web site, located here: http://www.masssave.com/business/incentive-programs/energy-efficiency-retrofits

- Custom measures must screen the cost benefit ratio calculator and if accepted, can receive between $.10 - $.40 per kWh saved or up to $1.25/therm for gas measures. Custom measures require detailed energy savings documentation and can take longer for the utility to review. However, they can provide greater incentive levels.

Guardian compares each of the available and qualifying incentive programs and applies for the most rewarding incentive total for the customer that is available to help buy down the project cost. We include all documentation and application forms to ensure the incentive application process is streamlined. Your utility company can provide Guardian with the incentive payment directly, which in turn, reduces the final cost burden to the town.

Finally, certain utility companies may offer the option for 'On Bill Repayment' (OBR) for Electric Projects. If this option is available for your project, the town may choose to pay the balance due after incentive amounts are deducted using this OBR option. All OBR requests must be submitted by Guardian and approved by your local utility in advance. If approved, the final amount due is split into either 12 or 24 equal monthly payments with no interest. The monthly charge is then listed on the buildings electric utility bill as part of its monthly utility amount due. The OBR option allows your town to consider self-funding additional projects through energy savings rather than waiting for savings to accumulate over the course of 1-2 years. This may be an excellent option should you wish to implement projects at a faster pace and expand your available grant funding to additional projects. Please note that the utility companies can change or modify their incentive programs at any time. We suggest submitting utility incentive applications for projects chosen as quickly as possible to reserve approved incentive funding amounts.

Please contact us directly with any questions or if we can be of any assistance as you review each project and consider the funding opportunities.

Contacts:

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Energy Management Specialist	Director, Energy Management Solutions	Energy Engineer
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781-629-0106	774-285-1294	978-406-5234

Notices & Disclaimers

This report is based upon information gathered during site assessments for each building/facility on the date of the assessment. The ECMs (Energy Conservation Measures) are calculated from information gathered on this date, potential vendors, building occupants and others involved in the assessment process. Any energy report is based upon individual opinion and is not a guarantee for energy savings. Pricing and information should be used as a guide when developing a project list for the Green Communities Grant however final pricing is subject to change. This energy reduction study represents our best effort to develop projected costs and estimated savings for the ECMs mentioned in this report. All costs are turn-key, however any unforeseen work or required asbestos abatement is not included in the pricing unless noted. Energy usage estimates are based on fiscal year 2013 weather data and have not been scaled with respect to heating or cooling degree days which vary annually. Weather variations will affect the overall energy usage.

All material included in this package is intended for use by Town Officials and committee members involved in Energy Conservation and/or the Green Communities Act. This material contains sensitive, proprietary information that cannot be duplicated for, or shared with, any vendors involved in energy efficiency consulting, retrofits or construction related to the improvements contained within this report without written consent by Guardian Energy Management Solutions.

Report Summary

Guardian Energy Management Solutions (GEMS) was requested to assess and document each building in this report through an ASHRAE Level 2 building audit for the Town of Warwick. The cost, savings, utility consumption and return on investment for each building audited for Energy Conservation Measures (ECMs) is shown below.

Guardian's focus was based upon several site visits, inspections, staff interviews and data collected through the course of our ASHRAE Level 2 study process. After reviewing the age, size, condition and energy usage for each building, our efforts revolved around energy conservation measures for measures that can help the Town of Warwick meet its energy reduction goals. The baseline energy usage summary is below.

Baseline Energy Usage Overview

Town of Warwick Energy Usage Breakdown					
Location	**Sq. Ft.**	**FY2013 Annual kWh Usage**	**FY2013 Annual Gallons Oil Usage**	**FY2013 Baseline Year Total MMBtu**	**FY2013 Baseline MMBtu/sq.ft./yr**
Town Hall	5,888	18,480	989	201	0.03
Library	2,400	2,884	728	111	0.05
DPW Large (Hwy)	1,880	5,727	1,570	238	0.13
DPW Small (TS)	1,350	3,818	550	89	0.07
Police Station	1,260	12,187	0	42	0.03
Fire Station	1,830	3,704	673	106	0.06
Transfer Station	n/a	1,947	0	7	n/a
Total	**14,608**	**48,782**	**4,510**	**793**	**0.05**

Energy Savings Summary

The energy savings estimates for the weatherization measures were based off of comparison buildings. These are buildings of similar size, located in a similar climate region that had similar weatherization upgrade measures installed by the same contractor listed in our report. In order to perform heat loss differential calculations for various assemblies and then aggregate them we would use detailed information regarding each assembly (wall, attic, floor) including existing cavity size, existing insulation type and amount versus spec, fenestration type and area, baseline utility info and heating/cooling set points. In addition, a baseline air infiltration/exfiltration measurement (blower door testing) would need to be done along with an estimate for the expected contribution of this to heat loss and prospective change based on the spec. At the current time, we do not have enough information to provide differential heat-loss-based energy savings calculations therefore we are relying on the reported energy savings of the comparison buildings. Data pulled from these buildings showed a 10-30% reduction in seasonal energy usage for attic-only retrofits, and up to 50% reduction for buildings where attics, walls, and infiltration was addressed.

Energy Savings Data

Location	ECM	ECM Description	Est. Annual kWh Saved	Est. Annual gal fuel oil Saved	Est. Annual gal propane Saved	Est. Annual MMBtu Saved	% Savings from Baseline MMBtu
Town Hall	ECM 1	High Efficiency Heat Pumps	-5639	590	0	63	31%
	ECM 2	Wireless T-Stats	316	49	0	8	4%
	ECM 3	Weatherization Upgrades	2421	379	0	61	30%
Library	ECM 1	Wireless T-Stat	67	36	0	5	5%
	ECM 2	Weatherization Upgrades	614	333	0	48	44%
Hwy Garage	ECM 1	Infrared Heating	0	1570	-1588	73	31%
	ECM 2	Wireless T-Stat	132	79	0	11	5%
	ECM 3	Weatherization Upgrades	283	168	0	24	10%
Trk Garage	ECM 1	Proposed 93% AFUE Propane Unit Heaters	0	550	-696	13	14%
	ECM 2	Wireless T-Stat	88	28	0	4	5%
	ECM 3	Weatherization Upgrades	181	57	0	9	10%
Police Station	ECM 1	Proposed High Efficiency Heat Pump	5961	0	0	20	49%
	ECM 2	Weatherization Upgrades	3925	0	0	13	32%
	ECM 3	Wireless T-Stat	468	0	0	2	4%
Fire Station	ECM 1	Wireless T-Stat	55	34	0	5	5%
		TOTAL	8872	3873	-2284	359	45%

Financial Savings Summary

Financial Analysis								
Location	ECM	ECM Description	Final Project Cost	Final Est. Incentive	Final Cost to Town	Annual Savings	Payback in years	Simple Rate of Return
Town Hall	ECM 1	High Efficiency Heat Pumps	$36,400	$0	$36,400	$1,164	31.3	3.2%
	ECM 2	Wireless T-Stats	$2,912	$0	$2,912	$231	12.6	7.9%
	ECM 3	Weatherization Upgrades	$21,277	$0	$21,277	$1,770	12.0	8.3%
Library	ECM 1	Wireless T-Stat	$1,456	$0	$1,456	$144	10.1	9.9%
	ECM 2	Weatherization Upgrades	$28,774	$0	$28,774	$1,315	21.9	4.6%
Hwy Garage	ECM 1	Infrared Heating	$46,592	$0	$46,592	$3,030	15.4	6.5%
	ECM 2	Wireless T-Stat	$1,456	$0	$1,456	$308	4.7	21.2%
	ECM 3	Weatherization Upgrades	$4,819	$0	$4,819	$658	7.3	13.7%
Trk Garage	ECM 1	Proposed 93% AFUE Propane Unit Heaters	$29,120	$0	$29,120	$825	35.3	2.8%
	ECM 2	Wireless T-Stat	$1,456	$0	$1,456	$114	12.8	7.8%
	ECM 3	Weatherization Upgrades	$3,772	$0	$3,772	$236	16.0	6.3%
Police Station	ECM 1	Proposed High Efficiency Heat Pump	$23,296	$596	$22,700	$1,192	19.0	5.3%
	ECM 2	Weatherization Upgrades	$13,494	$225	$13,269	$628	21.1	4.7%
	ECM 3	Wireless T-Stat	$1,456	$82	$1,374	$75	18.3	5.5%
Fire Station	ECM 1	Wireless T-Stat	$1,456	$0	$1,456	$132	11.0	9.1%
		TOTAL	$217,736	$903	$216,833	$11,822	18.3	5.5%

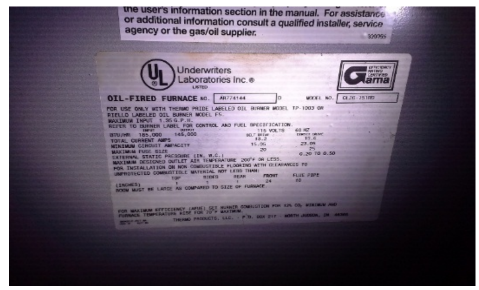
Warwick Town Hall

The Warwick Town Hall is a two-story building with a full basement. The building has a full stage complete with lighting. The upper and lower meeting halls are heated by forced air from an oil-fired furnace. The front office area of the building is heated by an oil-fired steam boiler with cast iron radiators.

Recommended Energy Conservation Measures (ECM's)

ECM 1: High Efficiency Ductless Heat Pumps

The existing heating system is comprised of a forced hot air oil-fired furnace serving the upper and lower meeting halls connected by ducting in the basement. The furnace at best would have a rating of 80% efficiency.



If we split the two areas up and install zone valves for the current oil-fired furnace, it would eliminate the need to heat both areas at the same time resulting in fuel savings. Another no cost measure could be to reduce the weekly hours of operation for certain zones. The Warwick Energy Committee is currently discussing this possibility.

The front office area of the building is heated with an oil-fired steam boiler with cast iron radiators. The most attractive solution would be to install ductless high efficiency heat pumps in the front office areas.

Current HVAC System Usage Summary Town Hall				
Baseline		**Annual gal oil Usage**	**Annual MMBtu Usage**	**Total Annual Cost [$]**
	Current Oil-Fired Furnace	399	55	$1,455
	Current Oil-Fired Boiler	590	82	$2,067

Proposed HVAC Upgrade Town Hall Energy Savings						
ECM	**ECM Description**	**Annual gal oil Usage**	**Annual kWh Usage**	**Annual MMBtu Usage**	**Annual MMBtu Savings**	**% Reduced MMBtu**
ECM 1	**High Efficiency Heat Pumps - Front Offices**	0	5639	19	63	31%

Proposed HVAC Upgrade Town Hall Financial Savings						
ECM	ECM Description	Total Annual Cost [$]	Annual Savings [$]	Install Cost [$]	Payback Years	ROI
ECM 1	High Efficiency Heat Pumps - Front Offices	$902	$1,164	$36,400	31.3	3.2%

ECM 2: Wireless T-Stats

Wireless programmable thermostats have been shown to reduce seasonal energy consumption by up to 20%. However after interviewing the staff responsible for operations and maintenance, they were found to already have excellent energy efficient practices in place. Energy savings can therefore be expected to be around 5% of the seasonal energy consumption. Guardian recommends replacing the current thermostats with wireless programmable thermostats.

Current Seasonal Heating and Cooling Usage Summary Town Hall					
Baseline		Seasonal kWh usage	Annual gal oil Usage	Annual MMBtu Usage	Total Annual Cost [$]
	Current Heating and Cooling Usage	6320	989	159	$4,621

Proposed Seasonal Heating and Cooling Town Hall Energy Savings						
ECM	ECM Description	Seasonal kWh usage	Annual gal oil Usage	Annual MMBtu Usage	Annual MMBtu Savings	% Reduced MMBtu
ECM 1	Wireless T-stat	6004	940	151	8	4%

Proposed Seasonal Heating and Cooling Town Hall Financial Savings						
ECM	ECM Description	Total Annual Cost [$]	Annual Savings [$]	Install Cost [$]	Payback Years	ROI
ECM 1	Wireless T-stat	$4,390	$231	$2,912	12.6	7.9%

ECM 3: Weatherization Upgrades

Findings:

A walk-through inspection was done on the Warwick Town Hall to identify potential areas for weatherization improvements. The chart below details the recommended weatherization upgrades.

Location	Measure	Depth	R-Value	# / SF
Basement Wall	Closed Cell Spray Foam 4”-2”	3	21	164
Walls	Cellulose Densepack	4	14	4,690
Attic	Flash & Firecaulk Chimneys	0	N/A	3
Attic	Air Sealing	6	22	20
Attic Floor	Cellulose Open Blow	6	22	700
Attic Floor	Cellulose Densepack	10	N/A	30
Attic	Damming with Fiberglass	0	N/A	140
Attic	Thermax over Elevator Shaft	2	14	320
Attic Hatch	Thermax over Polyiso AIP	4	28	1

Notes:

- We did not specify anything for sash weight pockets as the cost/benefit never works out
- Cellulose in attic is 6" (R22) on top of existing to achieve R60
- CCSF on basement wall is 4" tapering to 2" (an average of 3") and includes an application of Intumescent Thermal Barrier Paint
- Town will need to move storage items out of way

Current Seasonal Heating and Cooling Usage Summary Town Hall					
Baseline		Seasonal kWh usage	Annual gal oil Usage	Annual MMBtu Usage	Total Annual Cost [$]
	Current Heating and Cooling Usage	6320	989	159	$4,621

Proposed Seasonal Heating and Cooling Town Hall Energy Savings						
ECM	ECM Description	Seasonal kWh usage	Annual gal oil Usage	Annual MMBtu Usage	Annual MMBtu Savings	% Reduced MMBtu
ECM 1	Weatherization Upgrade	3899	610	98	61	30%

Proposed Seasonal Heating and Cooling Town Hall Financial Savings						
ECM	ECM Description	Total Annual Cost [$]	Annual Savings [$]	Install Cost [$]	Payback Years	ROI
ECM 1	Weatherization Upgrade	$2,851	$1,770	$21,277	12.0	8.3%

Warwick Library

The Warwick Library is single floor building with a root cellar basement and a full attic. Energy conservation measures identified for the Warwick Free Public Library include weatherization upgrades and programmable thermostats.

Existing HVAC System

Findings: The Library is currently heated by a 0.9 gph oil-fired furnace at 80% efficiency.

Recommended Energy Conservation Measures (ECM's)

ECM 1: Wireless T-Stat

Wireless programmable thermostats have been shown to reduce seasonal energy consumption by up to 20%. However after interviewing the staff responsible for operations and maintenance, they were found to already have excellent energy efficient practices in place. Energy savings can therefore be expected to be around 5% of the seasonal energy consumption. Guardian recommends replacing the current thermostat with a wireless programmable thermostat.

Current Seasonal Heating and Cooling Usage Summary Library					
Baseline		**Seasonal kWh usage**	**Annual gal oil Usage**	**Annual MMBtu Usage**	**Total Annual Cost [$]**
	Current Heating and Cooling Usage	1,340	728	106	$2,872

Proposed Seasonal Heating and Cooling Library Energy Savings						
ECM	**ECM Description**	**Seasonal kWh usage**	**Annual gal oil Usage**	**Annual MMBtu Usage**	**Annual MMBtu Savings**	**% Reduced MMBtu**
ECM 1	**Wireless T-stat**	1273	692	100	5	5%

Proposed Seasonal Heating and Cooling Library Financial Savings						
ECM	**ECM Description**	**Total Annual Cost [$]**	**Annual Savings [$]**	**Install Cost [$]**	**Payback Years**	**ROI**
ECM 1	**Wireless T-stat**	$2,728	$144	$1,456	10.1	9.9%

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ECM 2: Weatherization Upgrades

Findings:

A walk-through inspection was done on the Warwick Town Library to identify potential areas for weatherization improvements. The chart below details the recommended weatherization upgrades.

Location	Measure	Depth	R-Value	# / SF
OLD SECTION				
Walls	Cellulose Densepack	4	14	2,220
Room Floor	Cellulose Densepack	8	28	220
Attic Stairwell Walls	Cellulose Densepack	4	22	304
Attic Stair Treads	Cellulose Densepack	8	28	57
Attic Door	Thermax Board	2	N/A	1
Attic Door	Weatherstrip	0	N/A	1
Attic	Thermax Board	2	14	320
Attic Hatch	Thermax Board	4	28	1
Attic	Access	0	N/A	2
Attic Floor	Cellulose Open Blow	10	37	1,344
				1
NEW SECTION				1
Walls	Cellulose Densepack	4	14	1,152
Attic Floor	Reinforced Strapping	0	#N/A	480
Attic Slope	Propavents To Soffit	0	N/A	50
Attic Floor	Cellulose Open Blow	13	48	940
Attic Gable	Vent 18x24 Primed & Painted	0	#N/A	1
				1
BASEMENT				1
Basement Stairwell	Cellulose Densepack	4	14	20
Basement Floor	6mm Plastic	0	N/A	2,748
Basement Wall	Closed Cell Spray Foam 4”-2”	3	21	928

Notes:

- There were many plaster ceiling cracks in closets,
- CCSF on basement wall is 4" tapering to 2" (an average of 3") and includes an application of Intumescent Thermal Barrier Paint
- Town will move storage items out of way

Current Seasonal Heating and Cooling Usage Summary Library					
Baseline		Seasonal kWh usage	Annual gal oil Usage	Annual MMBtu Usage	Total Annual Cost [$]
	Current Heating and Cooling Usage	1,340	728	106	$2,872

ECM	ECM Description	Seasonal kWh usage	Annual gal oil Usage	Annual MMBtu Usage	Annual MMBtu Savings	% Reduced MMBtu
Proposed Seasonal Heating and Cooling Library Energy Savings						
ECM 1	**Weatherization Upgrade**	726	395	57	48	44%

ECM	ECM Description	Total Annual Cost [$]	Annual Savings [$]	Install Cost [$]	Payback Years	ROI
Proposed Seasonal Heating and Cooling Library Financial Savings						
ECM 1	**Weatherization Upgrade**	$1,556	$1,315	$28,774	21.9	4.6%

Warwick DPW (Highway Equipment Garage)

The Warwick DPW Highway Equipment Garage is single-story garage style building. Energy conservation measures identified for the Warwick DPW Highway Equipment Garage include conversion from an oil-fired unit heater to propane infrared heating, weatherization upgrades, and programmable thermostats.

Recommended Energy Conservation Measures (ECM's)

ECM 1: Propane-Fired Infrared Heating

Findings:

The building is currently heated with one oil-fired unit heater most likely rated at 400 MBH input with probably an 80% efficiency for an output of 320 MBH. If we replace this unit heater with propane-fired infrared heaters, we could downsize the heating system by at least 25% and the cost of propane would result in significant financial savings in addition to the large potential for energy savings.

Current HVAC System Usage Summary DPW Highway Equipment Garage						
Baseline		Annual kWh Usage	Annual gal oil Usage	Annual gal Propane Usage	Annual MMBtu Usage	Total Annual Cost [$]
	Current Oil Fired Furnaces	0	1,570	0	218	$5,731

Proposed HVAC Upgrade DPW Highway Equipment Garage Energy Savings							
ECM	**ECM Description**	**Annual kWh Usage**	**Annual gal oil Usage**	**Annual gal Propane Usage**	**Annual MMBtu Usage**	**Annual MMBtu Savings**	**% Reduced MMBtu**
ECM 1	**Proposed 90% AFUE Propane Infrared Heaters**	0	0	1588	145	73	31%

Proposed HVAC Upgrade DPW Highway Equipment Garage Financial Savings						
ECM	**ECM Description**	**Total Annual Cost [$]**	**Annual Savings [$]**	**Install Cost [$]**	**Payback Years**	**ROI**
ECM 1	**Proposed 90% AFUE Propane Infrared Heaters**	$2,700	$3,030	$46,592	15.4	6.5%

ECM 2: Wireless T-Stat

Wireless programmable thermostats have been shown to reduce seasonal energy consumption by up to 20%. However after interviewing the staff responsible for operations and maintenance, they were found to already have excellent energy efficient practices in place. Energy savings can therefore be expected to be around 5% of the seasonal energy consumption. Guardian recommends replacing the current thermostat with a wireless programmable thermostat.

Current Seasonal Heating and Cooling Usage Summary Highway Equipment Garage					
Baseline		Seasonal kWh usage	Annual gal oil Usage	Annual MMBtu Usage	Total Annual Cost [$]
	Current Heating and Cooling Usage	2,641	1570	227	$6,153

Proposed Seasonal Heating and Cooling Highway Equipment Energy Savings						
ECM	ECM Description	Seasonal kWh usage	Annual gal oil Usage	Annual MMBtu Usage	Annual MMBtu Savings	% Reduced MMBtu
ECM 1	Wireless T-stat	2509	1492	216	11	5%

Proposed Seasonal Heating and Cooling Highway Equipment Garage Financial Savings						
ECM	ECM Description	Total Annual Cost [$]	Annual Savings [$]	Install Cost [$]	Payback Years	ROI
ECM 1	Wireless T-stat	$5,845	$308	$1,456	4.7	21.1%

ECM 3: Weatherization Upgrades

Findings:

A walk-through inspection was done on the Warwick Highway Garage to identify potential areas for weatherization improvements. The chart below details the recommended weatherization upgrades.

Location	Measure	Depth	R-Value	# / SF
Attic	Air Sealing Foam	0	N/A	12
Attic Floor	Cellulose Open Blow	8	30	1880
Permitting Allowance		0	N/A	1

Current Seasonal Heating and Cooling Usage Summary Highway Equipment Garage					
Baseline		Seasonal kWh usage	Annual gal oil Usage	Annual MMBtu Usage	Total Annual Cost [$]
	Current Heating and Cooling Usage	2,641	1570	227	$6,153

Proposed Seasonal Heating and Cooling Highway Equipment Garage Energy Savings						
ECM	ECM Description	Seasonal kWh usage	Annual gal oil Usage	Annual MMBtu Usage	Annual MMBtu Savings	% Reduced MMBtu
ECM 1	Weatherization Upgrade	2358	1402	203	24	10%

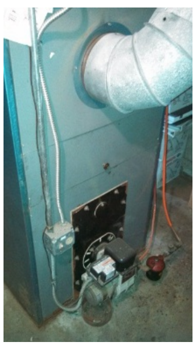
Proposed Seasonal Heating and Cooling Highway Equipment Garage Financial Savings						
ECM	ECM Description	Total Annual Cost [$]	Annual Savings [$]	Install Cost [$]	Payback Years	ROI
ECM 1	Weatherization Upgrade	$5,495	$658	$4,819	7.3	13.7%

Warwick DPW Truck Garage

The Warwick DPW Truck Garage is single-story garage style building. Energy conservation measures identified for the Warwick DPW Trk Garage include conversion from an oil-fired unit heater to propane unit heaters, weatherization upgrades, and programmable thermostats.

Recommended Energy Conservation Measures (ECM's)

ECM 1: Propane Unit Heaters



Findings: The small office area and three OHD's to the right as you face the building, are presently heated by an oil-fired furnace that was originally rated at 1.75GPH but now has a 1.2 GPH nozzle. It is ducted to the 3 bays as well as the office area. It most likely is operating below 80% efficiency. At 1.2 GPH the input would have been 166,800 BTUH and at 80% the output would be 133,440 BTUH.

If we remove the furnace and install two propane fired condensing unit heaters and install a small high efficiency heat pump for the office area, the heat pump would nearly rival the unit heaters in performance and save an estimated 13%. This would provide the added benefit of high efficiency air conditioning for the office. There would also be savings since the oil heater maintenance would no longer be necessary.

Current HVAC System Usage Summary DPW Truck Garage						
Baseline		Annual kWh Usage	Annual gal oil Usage	Annual gal Propane Usage	Annual MMBtu Usage	Total Annual Cost [$]
	Current Oil Fired Furnace	0	550	0	76	$2,008

Proposed HVAC Upgrade DPW Truck Garage Energy Savings							
ECM	ECM Description	Annual kWh Usage	Annual gal oil Usage	Annual gal Propane Usage	Annual MMBtu Usage	Annual MMBtu Savings	% Reduced MMBtu
ECM 1	Proposed 93% AFUE Propane Unit Heaters	0	0	696	64	13	14%

Proposed HVAC Upgrade DPW Truck Garage Financial Savings						
ECM	ECM Description	Total Annual Cost [$]	Annual Savings [$]	Install Cost [$]	Payback Years	ROI
ECM 1	Proposed 93% AFUE Propane Unit Heaters	$1,182	$825	$29,120	35.3	2.8%

ECM 2: Wireless T-Stat

Wireless programmable thermostats have been shown to reduce seasonal energy consumption by up to 20%. However after interviewing the staff responsible for operations and maintenance, they were found to already have excellent energy efficient practices in place. Energy savings can therefore be expected to be around 5% of the seasonal energy consumption. Guardian recommends replacing the current thermostat with a wireless programmable thermostat.

Current Seasonal Heating and Cooling Usage Summary DPW Garage - Truck Garage					
Baseline		Annual kWh Usage	Annual gal oil Usage	Annual MMBtu Usage	Total Annual Cost [$]
	Current Heating and Cooling Usage	1,760	550	82	$2,289

Proposed Seasonal Heating and Cooling DPW Truck Garage Energy Savings						
ECM	**ECM Description**	**Annual kWh Usage**	**Annual gal oil Usage**	**Annual MMBtu Usage**	**Annual MMBtu Savings**	**% Reduced MMBtu**
ECM 1	**Wireless T-stat**	1672	523	78	4	5%

Proposed Seasonal Heating and Cooling DPW Truck Garage Financial Savings						
ECM	**ECM Description**	**Total Annual Cost [$]**	**Annual Savings [$]**	**Install Cost [$]**	**Payback Years**	**ROI**
ECM 1	**Wireless T-stat**	$2,175	$114	$1,456	12.7	7.9%

ECM 3: Weatherization Upgrades

Findings:

A walk-through inspection was done on the Warwick Trk Garage to identify potential areas for weatherization improvements. The chart below details the recommended weatherization upgrades.

Location	Measure	Depth	R-Value	# / SF
Misc Wall	Air Sealing Caulking	0	N/A	5
Attic	Air Sealing Foam	0	N/A	8
Attic Floor	Cellulose Open Blow	8	30	1350
Permitting Allowance		0	N/A	1

Current Seasonal Heating and Cooling Usage Summary DPW Truck Garage					
Baseline		Annual kWh Usage	Annual gal oil Usage	Annual MMBtu Usage	Total Annual Cost [$]
	Current Heating and Cooling Usage	1,760	550	82	$2,289

Proposed Seasonal Heating and Cooling DPW Truck Garage Energy Savings						
ECM	**ECM Description**	**Annual kWh Usage**	**Annual gal oil Usage**	**Annual MMBtu Usage**	**Annual MMBtu Savings**	**% Reduced MMBtu**
ECM 1	**Weatherization Upgrade**	1579	493	74	8	10%

Proposed Seasonal Heating and Cooling DPW Truck Garage Financial Savings						
ECM	ECM Description	Total Annual Cost [$]	Annual Savings [$]	Install Cost [$]	Payback Years	ROI
ECM 1	Weatherization Upgrade	$2,053	$236	$3,772	16.0	6.3%

Warwick Police Station

The Warwick Police Station is a trailer style building mounted 2 ft. above the ground. A small crawl space runs in between the metal support beams at the base however there is not enough room to install further insulation beneath. The building is currently heated with electrical resistance strip heaters.

Recommended Energy Conservation Measures (ECM's)

ECM 1: Ductless Heat Pumps

Findings:

The Warwick Police Station is currently heated by electrical strip heaters. The analysis of the electrical utility data shows that the police station used an estimated 9,367 kWh's of electricity last year for heating and cooling purposes. It is recommended to decommission the electrical strip heaters and install high efficiency ductless heat pumps.

Current HVAC System Usage Summary Police Station						
Baseline		Annual kWh Usage	Annual gal oil Usage	Annual gal Propane Usage	Annual MMBtu Usage	Total Annual Cost [$]
	Current Electrical Resistance Strip Heaters	9367	0	0	32	$1,873

Proposed HVAC Upgrade Police Station Energy Savings							
ECM	ECM Description	Annual kWh Usage	Annual gal oil Usage	Annual gal Propane Usage	Annual MMBtu Usage	Annual MMBtu Savings	% Reduced MMBtu
ECM 1	Proposed High Efficiency Heat Pump	3406	0	0	12	20	49%

Proposed HVAC Upgrade Police Station Financial Savings						
ECM	ECM Description	Total Annual Cost [$]	Annual Savings [$]	Install Cost [$]	Payback Years	ROI
ECM 1	Proposed High Efficiency Heat Pump	$681	$1,192	$23,296	19.5	5.1%

ECM 2: Weatherization Upgrades

Findings:

A walk-through inspection was done on the Warwick Police Station to identify potential areas for weatherization improvements. The chart below details the recommended weatherization upgrades

Location	Measure	Depth	R-Value	# / SF
Crawl Ceiling	Thermax Board	2	14	1,107
Walls	Cellulose Densepack	4	14	1,224
Attic	Air Sealing	0	N/A	8
Attic Hatch	Rigid Damming	0	22	1
Attic Hatch	Thermax Board	8	56	1
Attic Hatch	Weatherstrip	0	N/A	1
Attic Slope	Propavents To Soffit	0	N/A	62
Attic Floor	Cellulose Open Blow	10	37	1,107
Misc Door	Weatherstrip	0	#N/A	2
				1

Notes:

- Exterior wall cavities (vinyl) are assumed to be empty or deficient

Current Seasonal Heating and Cooling Usage Summary Police Station					
Baseline		Annual kWh Usage	Annual gal oil Usage	Annual MMBtu Usage	Total Annual Cost [$]
	Current Heating and Cooling Usage	9,367	0	32	$1,499

Proposed Seasonal Heating and Cooling Police Station Energy Savings						
ECM	ECM Description	Annual kWh Usage	Annual gal oil Usage	Annual MMBtu Usage	Annual MMBtu Savings	% Reduced MMBtu
ECM 1	Weatherization Upgrade	5442	0	19	13	32%

Proposed Seasonal Heating and Cooling Police Station Financial Savings						
ECM	ECM Description	Total Annual Cost [$]	Annual Savings [$]	Install Cost [$]	Payback Years	ROI
ECM 1	Weatherization Upgrade	$871	$628	$13,494	21.5	4.7%

ECM 3: Wireless T-Stat

Wireless programmable thermostats have been shown to reduce seasonal energy consumption by up to 20%. However after interviewing the staff responsible for operations and maintenance, they were found to already have excellent energy efficient practices in place. Energy savings can therefore be expected to be around 5% of the seasonal energy consumption. Guardian recommends replacing the current thermostats with a wireless programmable thermostat.

Current Seasonal Heating and Cooling Usage Summary Police Station					
Baseline		Annual kWh Usage	Annual gal oil Usage	Annual MMBtu Usage	Total Annual Cost [$]
	Current Heating and Cooling Usage	9,367	0	32	$1,499

Proposed Seasonal Heating and Cooling Police Station Energy Savings						
ECM	**ECM Description**	**Annual kWh Usage**	**Annual gal oil Usage**	**Annual MMBtu Usage**	**Annual MMBtu Savings**	**% Reduced MMBtu**
ECM 1	**Wireless T-stat**	8899	0	30	2	4%

Proposed Seasonal Heating and Cooling Police Station Financial Savings						
ECM	**ECM Description**	**Total Annual Cost [$]**	**Annual Savings [$]**	**Install Cost [$]**	**Payback Years**	**ROI**
ECM 1	**Wireless T-stat**	$1,424	$75	$1,456	19.4	5.1%

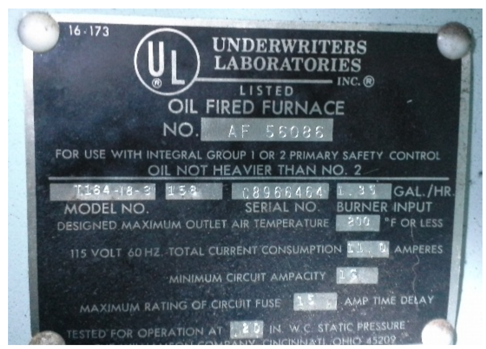
Warwick Fire Station

The Warwick Fire Station is a two-story barn style building. The building is currently heated by forced air from an oil-fired furnace. Energy conservation measures have been recommended below however savings have been based on the current operational schedule. If the building is transitioned to being used for a different purpose, the energy usage will likely change as well.

Current HVAC System

Findings:

The Fire station is currently heated by a 1.35 gph oil-fired furnace with estimated 80% efficiency. We could replace the oil-fired furnace with a 96% AFUE propane-fired furnace. This measure offers significant energy and financial savings.



Recommended Energy Conservation Measures (ECM's)

ECM 1: Wireless T-Stat

Wireless programmable thermostats have been shown to reduce seasonal energy consumption by up to 20%. However after interviewing the staff responsible for operations and maintenance, they were found to already have excellent energy efficient practices in place. Energy savings can therefore be expected to be around 5% of the seasonal energy consumption. Guardian recommends replacing the current thermostat with a wireless programmable thermostat.

Current Seasonal Heating and Cooling Usage Summary Fire Station					
Baseline		Annual kWh Usage	Annual gal oil Usage	Annual MMBtu Usage	Total Annual Cost [$]
	Current Heating and Cooling Usage	1,096	673	97	$2,632

Proposed Seasonal Heating and Cooling Fire Station Energy Savings						
ECM	**ECM Description**	**Annual kWh Usage**	**Annual gal oil Usage**	**Annual MMBtu Usage**	**Annual MMBtu Savings**	**% Reduced MMBtu**
ECM 1	**Wireless T-stat**	1041	639	92	5	5%

Proposed Seasonal Heating and Cooling Fire Station Financial Savings						
ECM	**ECM Description**	**Total Annual Cost [$]**	**Annual Savings [$]**	**Install Cost [$]**	**Payback Years**	**ROI**
ECM 1	**Wireless T-stat**	$2,500	$132	$1,456	11.1	9.0%

GUARDIAN
ENERGY MANAGEMENT SOLUTIONS™

About Guardian Energy Management Solutions

Guardian Energy Management Solutions is a Massachusetts based company that provides comprehensive energy efficiency solutions for non-residential buildings throughout New England. Guardian offers a turn-key solution for the analysis, design, engineering and implementation of energy conservation measures.

Our energy reduction solutions include:

- ASHRAE Level 1, ASHRAE Level 2 and ASHRAE Level 3 Energy Audits.
- Energy Data Logging Services and Solutions.
- Energy Metering & Sub Metering to Track and Report Energy Usage.
- Lighting Retrofits for Indoor Lighting and Outdoor Lighting.
- LED Streetlight Retrofit Solutions.
- Energy Conservation Solutions for a wide variety of HVAC (Heating, Ventilation and Air Conditioning) Equipment.
- Steam Trap Studies and Replacement Services.
- Energy Management Systems and Building Automation Software.
- Building Envelope & Weatherization Solutions.
- Low E (Emissivity) Ceiling Installations.
- Installation of Energy Efficient Motors.
- Variable Frequency Drives/Variable Speed Drives.
- Freezer and Refrigeration Controls.
- Utility Incentive Funding Services.

Utility Incentives
Guardian Energy Management Solutions works closely with local utility companies throughout New England to identify and implement energy reduction solutions. Guardian's process is designed to save energy while driving down energy costs. We combine energy conservation solutions with available utility incentive funding to reduce project costs for our clients. By offering a wide variety of energy reduction solutions, Guardian ensures that all of your bases are covered when it comes to developing cost reduction strategies. Guardian is an approved vendor with National Grid and NStar.

Guardian's Green Community Roadmap Program
Guardian also partners with communities that are working to become or have been designated a Massachusetts Green Community through the Massachusetts Department of Energy Resources (DOER). A key element under this program is to design a roadmap to identify energy reduction solutions and save energy across all municipal buildings - with a commitment in energy reduction by 20% over a 5 year period. Guardian provides comprehensive energy efficiency solutions to help Massachusetts cities and towns design, develop and implement energy conservation solutions to help meet these goals.

Massachusett's Accelerated Energy Program (AEP)
Guardian is an approved vendor under the Massachusetts Accelerated Energy Program and provides energy audits and implementation services for energy efficiency projects under DCAM (Division of Capital Asset Management) for a variety of state owned and/or operated facilities. Guardian supports the State of Massachusetts goals to reduce energy usage at state facilities over the next several years.

Our Qualifications Include:

- National Grid Project Expediter & NStar Municipal Vendor
- DCAM Certified, Electrical Services (MA)
- DCAM Accelerated Energy Program Vendor
- Experience working with the Massachusetts Green Communities Act
- Guardian is licensed to perform work in MA, NH, RI, VT and ME
- Registered Small Veteran Owned Business
- Federal Contractor registered with the Department of Defense
- Master Electricians, Journeyman Electricians, Controls Electricians, Field Technicians and Project Managers on staff.
- Key partnerships with firms that specialize in energy reduction solutions.

Energy Audit

Town of Warwick

Town Hall
12 Athol Road
Warwick, MA 01378

Massachusetts Department of Energy Resources Energy Audit Program

July 20, 2009

Prepared by: **Bowman Engineering, Inc.**
PO Box 410
Greenfield, MA 01302
(413) 303-0238

Preparer: Bernie Jwaszewski
Reviewer: Thomas Bowman, P.E.

Executive Summary

The Town Hall was evaluated based on data gathered during site walkthroughs, a review of the utility bills, and discussions with administration officials, staff, and occupants.

There are 2 energy conservation measures (ECMs) that have been identified through the audit process. The specific ECMs that are recommended are summarized in the following table, along with the estimated costs and savings.

Energy Conservation Measures Summary

ECM #	Description	Cost	Building Annual Usage				Usage Savings				Annual Cost Savings				Payback (years)
			Electrical		Fuel Oil	Total	Electrical		Fuel Oil	Total	Electrical		Fuel Oil	Total	
			kWh	Avg. kW	MMBtu	MMBtu	kWh	kW	MMBtu	MMBtu	Dollars				
1	Wall cavity insulation	$9,048	20,880	no data	401	472	0	0.00	112	112	$0	$0	$1,777	$1,777	5.1
2	Elevator ventalation control to reduce building heat exhaust	$9,757	20,880	no data	401	472	0	0.00	58	58	$0	$0	$924	$924	10.6
Total		**$18,805**	**20,880**	no data	**401**	**472**	**0**	0.00	**170**	**170**	**$0**	$0	**$2,701**	**$2,701**	**7.0**

The Commonwealth of Massachusetts is dedicated to promoting clean energy as an alternative to traditional sources of energy. As such, the DOER and other agencies have developed a number of programs to promote the use of clean energy sources by potentially providing technical assistance and/or financial incentives based on project feasibility. The following table lists the specific projects that might be appropriate for various clean energy technologies.

Clean Energy Opportunities
Description: Consideration should be given to heating the Town Hall with biomass and possibly creating a biomass district heating system that connects the Town Hall and the Library.
Action Item: Bowman Engineering, Inc. to prepare a feasibility study.

Table of Contents

Introduction

Through the Energy Audit Program (EAP) offered by the Commonwealth of Massachusetts, Department of Energy Resources (DOER), technical assistance is provided for all buildings owned and operated by cities, towns, regional school districts and wastewater districts to identify capital improvements to reduce energy costs. The technical assistance provided by DOER includes an initial benchmarking of buildings and structures included in the application. Based on the results of the benchmarking, a detailed energy audit may be performed as well as a variety of feasibility studies to evaluate the potential to incorporate renewable energy sources. This comprehensive assistance provides communities with the knowledge needed to reduce energy consumption and associated financial resources.

The purpose of this audit report is to provide the program participant with a list of energy conservation projects, their costs and estimated energy savings. This information may be used to support a future application to DOER's Energy Conservation Improvement Program (ECIP), support performance contracting or justify a municipal bond funded improvement program. ECIP is a state funded grant program that provides funds for energy conserving capital improvements.

The approach taken in this audit included a thorough walk-through of the building(s) and associated systems and equipment, including both process systems and building systems. The major areas covered in the audit included the building envelope, process systems, electrical systems, HVAC systems, lighting systems and operational and maintenance procedures. A major element of the audit also included an initial interview and ongoing consultation with operational and maintenance personnel, as well as building occupants. This approach is critical to the quality of the audit process, since the input of building personnel is invaluable to the effort to obtain accurate information required for the audit.

The recommendations within this report are based on a minimum of one year of submitted usage data, a site review and preliminary evaluation. The energy savings and energy production figures are projected estimates based on conceptual project upgrades, information gathered at the site, and from the historical utility information provided. The actual savings may vary from these estimates due to a variety of factors. The figures used for the cost of recommended upgrades are 'opinions of probable cost' and are intended to be used for feasibility purposes only. The recommended measures should proceed to detailed design and further re-evaluation followed by competitive bidding per the Massachusetts Procurement Guidelines. The resulting responses to the bid should be used for budget approval purposes. For more information see:

Office of the Inspector General, Municipal, County, District, and Local Authority Procurement of Supplies, Services, and Real Property, Publication No. CR-1520-170-200-09/06-IGO.

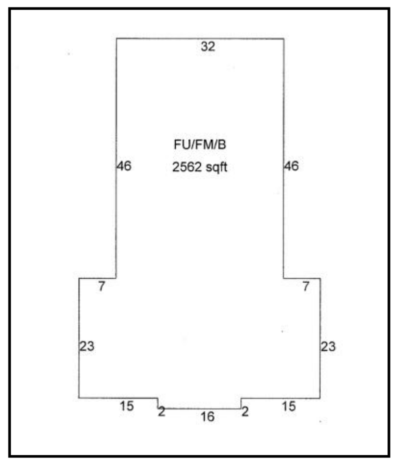
Facility Description

The Town Hall is located at 12 Athol Road, Warwick Massachusetts and was built in 1893. The building has a brick foundation, wood framing, and a clapboard / shingle exterior. The interior walls are plaster on lath. The building has a full kitchen in the dining room area but is lightly used.

The published occupied floor area is 5,888 square feet.

Insulation details provided by the Town's Energy Committee and/or by audit inspection are:

- First floor elevation, dining room, has insulated walls, 4-inch fiberglass
- All other walls are not insulated. The Energy committee has inspected the walls and found them empty with a 5.5-inch cavity. This detail was confirmed during the audit inspection.
- The attic area is accessible, and has 6-inches of fiberglass insulation over the main hall, and 12-inches over the office areas. No vapor barriers installed and the insulation is poorly fitted.



Windows are double hung and appear original to the building but are fitted with exterior storm glazing

The pitched asphalt shingle roof is 22 years old with 3-brick chimneys; 2 in-service, 1 retired. The elevator shaft ventilation duct has a gooseneck outlet and no isolation damper.

Steam heat is used in the front of the building; 2-floors of offices and the occupied area of the basement (toilets). The boiler is an oil fired Smith Mills 20, rated at 309,100 BTU / 412,000 BTU = 75% efficiency.

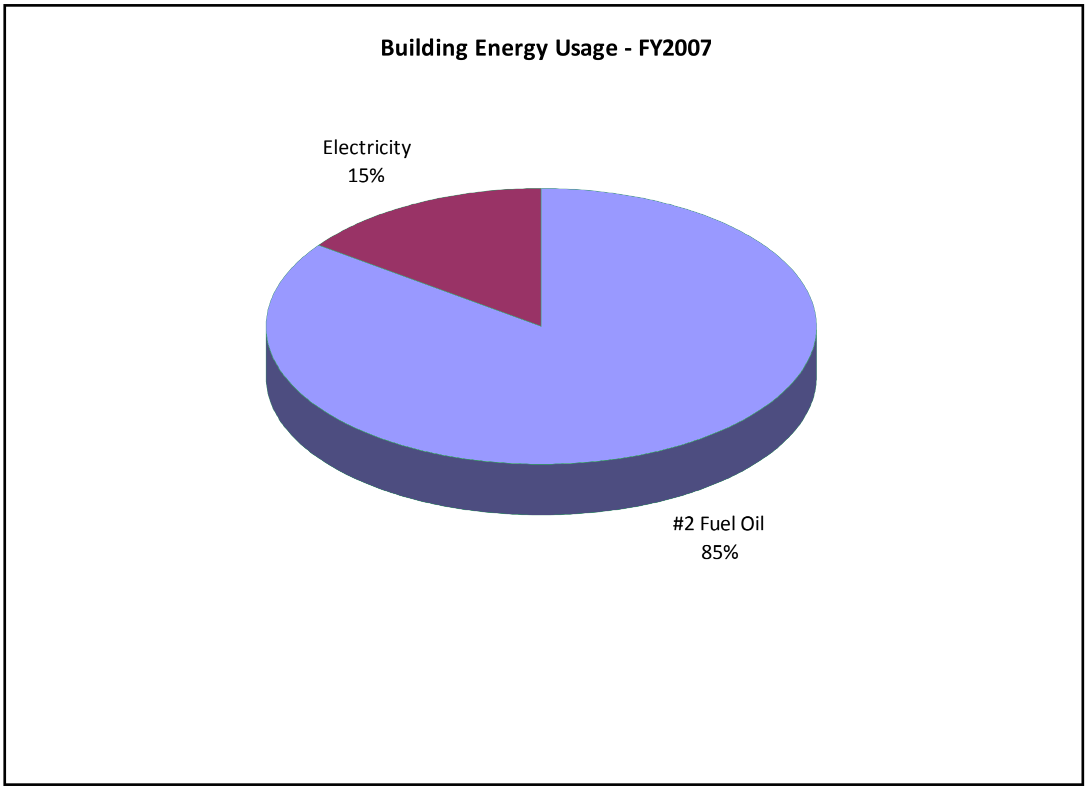
A forced hot air system is used for the first floor dinning room and the Main hall. A Thermo Pride oil fired hot air furnace is in the unoccupied area of the basement; a Model OL20-151RD with a published performance of 151,000 Btu/hr output at the bonnet and a seasonal efficiency (Annual Fuel Utilization Efficiency [AFUE%]) of 81.8%.

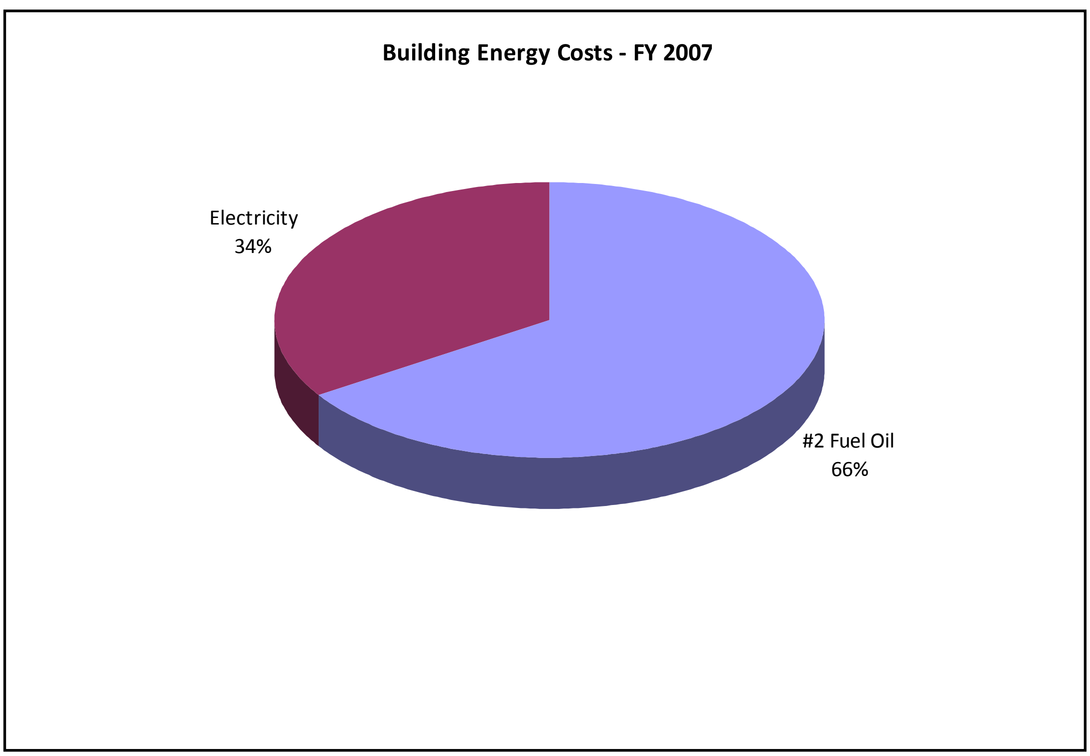
The building has two hot water heaters; 1-80 gallon electric heater located in the unoccupied basement for kitchen use, manually controlled on/off as needed and 1-30 gallon electric heater located in the steam boiler room for general domestic hot water use.

Benchmarking/Energy Usage Analysis

The Town Hall uses electricity for lighting and oil for heat. The energy usage breakdown for the fiscal year 2007 is provided in the following table in the form of purchased units, MMBtu, and costs. This same information is provided in graphical form on the following page. This information indicates that the majority of energy consumption is used for heating but heating and electricity expenses are comparable due to the higher cost of electricity per unit of delivered energy.

Town Hall Usage - 2007			
	#2 Fuel oil	**Electricity**	**Total**
Purchase Units	2,885 gal	20,880 kWh	
MMBtu	401	71	472
Facility Energy Costs	$7,025	$3,663	$10,688


Building Energy Usage - FY2007
Electricity
15%
#2 Fuel Oil
85%


Building Energy Costs - FY 2007
Electricity
34%
#2 Fuel Oil
66%

Energy Performance Summary

The Energy Performance Summary for the Town Hall is provided below. The total energy index is a measure of energy intensity, or annual energy usage per square foot of building area. Similarly, the energy cost index is a measure of annual energy costs per square foot of building area. The average electrical load factor is a measure of the consistency of electrical demand.

Energy Performance Summary				
	Gross Floor Area (ft^2)	**Total Energy Index (kBtu/ft^2-yr)**	**Energy Cost Index ($/$ft^2$-yr)**	**Average Electrical Load Factor**
Town Hall	5,888	80.21	$1.82	No data

Energy Conservation Measures

The Energy Conservation Measures (ECMs) in this section are recommended based on available information at the time of the audit. Equipment specifications and associated costs are provided for budgetary planning purposes only. Detailed equipment sizing, code compliance, and system design should be performed prior to final equipment and materials selection and procurement.

ECM 1 – Wall Cavity Insulation

Description

The building's outside walls are of "balloon" construction and have interior finishing of plaster on lath. Balloon construction is a system of framing a wooden building where all vertical structural elements of the exterior bearing walls consist of single studs which extend the full height of the frame, from the top of the sole-plate to the roof plate; all floor joists are fastened by nails to studs. No drawings were available but access from inside the attic area confirms that there is no insulation between the inside finished wall and the outside wall sheathing.

It is estimated that this wall system has an average R-value of 4.22 based on a component list in ASHRAE Cooling and Heating Load Calculation Manual GRP 158. An R-value indicates a material resistance to heat flow. The higher the R-value, the greater the insulating effectiveness.

It is recommended that supplemental insulation be added to accessible cavities between the interiors finished walls and outside wall sheathing. A material example is pour-in cellulose, rated at R3.8 per inch.

It is estimated that the building has 5,382 ft^2 of wall surface. Subtracting the window area of 588 ft^2 in the uninsulated walls, the economic evaluation was done using 4,794 ft^2.

Operation

The addition of passive insulation, having no operable elements does not require any change in building operation.

Initial Cost Estimate

Note: The following cost figures are provided for budgetary purposes only. Equipment and labor costs might differ based on final system design:

A spreadsheet evaluation was done using RS Means cost data for cellulose fiber insulation, R3.8 per inch, poured in. The total installed cost to insulate 4,794 Ft^2 (5.5-inch wall cavity requires 2,196 ft^3 of cellulose) is $9,048.

Item	Cost
Materials & Installation Labor	$9,048
Total	**$9,048**

Annual Savings Estimate and Payback

A spreadsheet evaluation incorporating the energy savings by adding supplemental insulation, thereby increasing the wall thermal performance from R4.22 to R19.68 (R4.22 + composite equal to R15.46), calculates an overall savings of $1,777/year. This saving is based on the 75% efficiency rating of the oil-fired steam boiler.

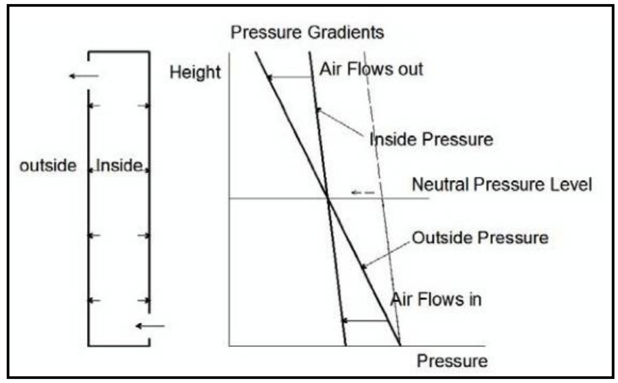
This pay back is conservative because it does not include the expected energy savings by any reduction of unconditioned infiltration air.

Simple payback is $9,048 / $1,777 = 5.1 years

ECM 2 – ELEVATOR VENTILATION CONTROL TO REDUCE BUILDING HEAT EXHAUST

Description

Airflow caused by temperature difference is termed buoyancy-driven ventilation. Because indoor air is heated, its density is lower than that of the outdoor air, thus the indoor air pressure is lower than the outdoor air pressure. This means that outdoor air will enter the building. When a balance is established, outdoor air will keep entering the building at the lower level, while the warmed indoor air will keep leaving the building at the higher level.



Infiltration through stairwells and elevator shafts due to stack effect can significantly add to both heating and/or cooling loads in buildings. It is recommended that an isolation damper be added at the top of the elevator shaft vent to decrease this airflow.

Performance Verification

The Massachusetts Building and Elevator codes[1] require that a ventilation isolation damper be electrically controlled to respond to multiple functions; (1) when the fire protection system signals the car to move to a "fire recall" floor, the ventilation isolation damper shall open, and (2) anytime there is a loss of electric power the isolation damper shall open. There is also a third requirement depending on elevator construction; if the machinery room is on top of the elevator shaft, the isolation damper shall open on a high heat signal. The recommendation presented is limited to the "potential" energy savings of adding an isolation damper and that an expert in elevator systems should perform the design, installation and initial operational testing. Furthermore, the modification needs to be reviewed by the insurance underwriter.

Operation

The operation of an automatic damper would have to be verified during start-up to confirm that it responds to the installed elevator life-safety control system. After proof testing there is no controls adjustment/monitoring required by the occupants.

Initial Cost Estimate

Note: The following cost figures are provided for budgetary purposes only. Equipment and labor costs might differ based on final system design:

[1] Mr. Jean Piermttei 617-590-9371 MA elevator inspector

Item	Cost
Engineering, Materials & Installation Labor	$6,720
GC mark-up/general conditions/O&P	$3,037
Total	**$9,757**

Annual Savings Estimate and Payback

Buoyancy-driven ventilation[2]

$CFM = (10)(A)\,[H\,(t_i - t_o)]^{1/2}$

Where;

- Q (cfm): Calculated Airflow
- A (ft^2): Orifice Area;
  1. exhaust duct thru the roof is 14.5 x 31-inches = 3.12 ft^2
  2. standard door in the sub-basement; 6'-8" x 3' = 232" around x 0.25" door/frame gap = 58in^2, or 0.4 ft^2.
- H (ft): height = (23+15+10) = 48-feet
  1. building height from the first floor is ~23-feet,
  2. elevator shaft starts in a sub-basement, ~15-feet below the first floor,
  3. top of the exhaust duct w/o the gooseneck louver is at the peak of the roof, ~10-feet up from the roof edge.
- t_i (^oF) = average inside temperature
- t_o (^oF)= average outside temperature

A spreadsheet bin analysis was done using the above equation to determine the amount of energy exhausted through the elevator shaft top vent. The buoyancy-driven ventilation equation requires an orifice area number equal to the smallest opening in the elevator shaft, ether inlet(s) or exhaust. The gap between the maintenance door and its frame in the sub-basement is used as the smaller opening. The door perimeter equates to an opening of 0.4ft^2. A value of 1.2ft^2, three times the opening, is used in the calculation to represent the opening/closing of the elevator car doors.

[2] Buffalo Forge, Fan Engineering 8th edition, page 20-17

The evaluation calculates an energy loss of approximately 58 MMBtu/year, equating to a fuel cost of $924/year.

This estimate is considered conservative because it does not include the wind influenced component of unconditioned ventilation airflow, which can be substantial.

Simple Payback is $9,757 / $924 = 10.6 years

Operations/Maintenance Measures

Operation and Maintenance

The quality of the maintenance and operation of the facility's energy systems has a direct effect on its energy efficiency. Energy efficiency needs to be a consideration when implementing facility modifications, equipment replacements, and general corrective actions. The following is recommended to be incorporated into the facility's preventative maintenance procedures.

Building Envelope

- Caulking and weather stripping is functional and effective.
- Holes are patched in the building envelope.
- Cracked windowpanes are repaired.
- Automatic door closing mechanisms are functional.
- Interior vestibule doors are closed.

Heating and Cooling

- The burners are clean and fuel/air ratios are optimized.
- Heat exchange surfaces of boilers are clean and free of scale.
- Boilers are staged so that only those demanded are in operation.
- Thermostats settings are reduced in unoccupied areas and set points are seasonally adjusted.
- Control valves and dampers are fully functional.
- Equipment is inspected for worn or damaged parts.
- Radiators, hot air registers, and return air ductwork are clean and unobstructed.
- Uni-vent controls and mechanism are functioning correctly.
- Heating is uniform throughout the designated areas.

Domestic Hot Water

- Domestic hot water heater temperature is set to the minimum temperature required.
- All hot water piping is insulated and not leaking.
- Tank-type water heaters are flushed as required.

Lighting

- Energy efficient replacement lamps are in stock.
- Lighting fixture reflective surfaces and translucent covers are clean.
- Walls are clean and bright.
- Timers and/or photocells are operating correctly on exterior lighting.

Misc.

- Refrigerator and freezer doors close and seal correctly.
- Kitchen exhaust fans are only used when needed.
- Office/computer equipment is either in the "sleep" or off mode when not used.
- All other recommended equipment specific preventive maintenance actions are conducted,
- Usage demands on the building/ equipment have not changed significantly since the original building commissioning or the most recent retro commissioning.

In addition, equipment replacement selection should be performed assuring that;

- All equipment replacements are not over/undersized for the particular application,
- All equipment replacements should be with energy conserving and/or high efficiency devices.

Other Considerations

1. The unoccupied area of the basement is used as by the Town for the long-term storage of paper records. They use a 700-watt dehumidifier in the summer and heat from the uninsulated duct in the winter to control the storage environment. An alternative to using uninsulated ductwork to provide winter heat for document storage would be to insulate the ductwork system and add outlet dampers for warm airflow as desired. It is also recommended that mastic be applied to the warm air ductwork joints before insulation to seal the ductwork.

2. The existing attic insulation is serviceable but should be repositioned for better thermal performance. Consideration should also be given to installing vapor barrier material under the insulation.

3. Add insulation to the exposed steam pipe in the boiler room area.

4. Insulate the DHW piping from the 30-gallon electric heater.

Clean Energy Opportunities

The Commonwealth of Massachusetts is dedicated to promoting clean energy as an alternative to traditional sources of energy. As such, the DOER and other agencies have developed a number of programs to promote the use of clean energy sources by potentially providing technical assistance and/or financial incentives based on project feasibility. A brief discussion of the various programs is provided below, along with specific projects that may be appropriate for the respective technologies.

Solar Energy

Through the Commonwealth Solar Program[3], rebates are offered to encourage the installation of solar photovoltaic (PV) power by homeowners, businesses and municipalities. The rebate program is designed to help defray the costs that are associated with the installation of eligible systems from 20% - 60%. Rebate applications have been available since January 23, 2008. Incentives are greater for projects on public buildings and those that incorporate products manufactured in Massachusetts. The rebates are available for systems that will be directly owned by the applicant, as well as those financed through a third-party ownership model that takes advantage of federal and state tax credits. A total of $68 million is available over the next four years. The following table provides the initial rebate levels:

Non-Residential Rebates for Incremental Capacity ($/Watt)				
Incremental Capacity	**First: 1 to 25 kW**	**Next: > 25 to 100 kW**	**Next: > 100 kW to 200 kW**	**Next: > 200 kW to 500 kW**
Base Incentive	$3.25	$2.50	$2.00	$1.50
PLUS: Additions to Base Incentives				
Massachusetts Manufactured System	$0.25	$0.25	$0.25	$0.25
Public Building	$0.50	$0.50	$0.25	$0.25

Third-Party PV Financing Resources

MTC and DOER encourage applicants to explore various options for financing their PV project. One such option is known as Third-Party Financing. With Third-Party Financing, the PV system is owned and operated by an entity that is separate from the building owner or the PV installer. The Third-Party Financing entity has sufficient financial capital to pay for the entire installation and to maintain and operate the system over its lifetime. In return, the building owner, or "host" site, signs a long-term contract agreeing to purchase all the power produced by the PV system.

Third-Party Financing is a way to install a large PV array with little or no up-front capital expense from the building owner or "host" site. This type of financing may be most applicable to entities such as non-profits or public buildings. The Third-Party PV Owner can utilize the substantial tax incentives available for PV projects, along with rebates and other incentives, plus the sale of the electricity from the PV array to finance the PV project.

[3] Web site: www.commonwealthsolar.org

Wind and Hydroelectric

The Massachusetts Technology Collaborative[4] (MTC) is a quasi-public agency and is the state's development agency for renewable energy. MTC offers a number of programs, including those that provide funding for wind and hydroelectric projects. The two primary programs are the Small Renewables Initiative (SRI) and the Large Onsite Renewables Initiative (LORI). The SRI provides rebates for the installation of wind and small hydroelectric projects that are up to 10 kW. Annual funding is approximately $3.6 million and is provided on a "first come – first served" basis.

The LORI awards grants for feasibility studies and design and construction projects for projects that are greater than 10 kW. Feasibility grants are capped at $40,000 with an applicant cost share of 15%. Design grants are capped at the lesser of $125,000 or 75% of actual cost and construction grants are capped at the lesser of $275,000 or 75% of actual costs.

Wood Pellet Fueled Heating

On a periodic basis, the DOER accepts grant applications for wood pellet fueled heating systems[5], which burn pellets made from renewable sources of energy such as compacted sawdust, wood chips, bark and agricultural crop waste. Funding is available to cities, towns, regional school districts, as well as water and wastewater districts. A maximum of $50,000 per project is available for installation; however, applicants may propose greater grant requests, which will be considered based on the merits of the project and available funding. A total of $525,000 is available for this program. The grantee is responsible for repaying 30% of the funds granted within one year of the completed installation.

[4] Web site: www.masstech.org
[5] http://www.mass.gov/Eoca/docs/doer/pub_info/doer_pellet_guidebook.pdf

Clean Energy Projects for the Town Hall

Based on the walkthrough that was performed as part of this audit, the Town Hall has one *Clean Energy* opportunity that could be pursued further. If a decision is made to move forward on this or any other such project, then the granting authority should be contacted for the respective program, as previously described. The typical process requires the submittal of an initial application. Once a preliminary approval is obtained, a more detailed technical assessment is performed to determine the specific costs and potential payback of the project. Often, the granting authority will provide some level of funding to support this phase of the project. If there are any questions or further guidance required, please contact Mr. Scott Durkee at DOER: (617) 626-7356.

Clean Energy Opportunities
Description: Consideration should be given to heating the Town Hall with biomass and possibly creating a biomass district heating system that connects the Town Hall and the Library. **Action Item:** Bowman Engineering, Inc. to prepare a feasibility study.

Note: No structural analysis was performed as part of this initial analysis. A full structural analysis must be performed on all the affected structural members for the specific solar equipment considered before the project is to proceed to construction. It is recommended that this be done prior to the detailed design phase for this project. The complete procedure for this analysis is detailed in Chapter 34 of the MA Building Code (Note: the 'pending' 7th edition of the 'basic' code has a more detailed procedure than the current 6th edition for this evaluation.

Appendices

Appendix I: ELEVATOR SHAFT ISOLATION DAMPER & HOOD QUOTE

Appendix I

ELEVATOR SHAFT ISOLATION DAMPER & HOOD QUOTE

Buckley Associates, Inc.
15 Progress Circle
Newington, CT 06111
(850) 606-0556
Fax (800) 560-3636

QUOTATION

** Customer List **

Page 1 of 1

Quote Number **077628**
Bid Date 06/23/2009
Salesperson DAN CARAFENO

Project **WARWICK TOWN HALL**
Location
Plan Date
Engineer No Assigned Engineer
Addendum

Qty	Product	Description	Price
SHEET METAL PRODUCTS			
1	CONTROL DAMPER	GREENHECK MODEL VCD-18 LIGHT DUTY LOW LEAKAGE CONTROL DAMPER, SIZE 15" x 31" WITH 120 V ACTUATOR	$495
1	GRAVITY HOOD	GREENHECK MODEL WRH WITH GALV BIRD SCREEN, ALUMINUM HOUSING, 0.5 HOOD INSULATION, SIZE 15" WIDE x 31" LONG x 12.25 HIGH	$925

Sheet Metal Notes

Unless specifically noted, all registers, grilles, and diffusers are quoted with standard white finish. All diffusers that have t-bar lay-in panels are quoted for standard 15/16 inch ceiling grid.

Terms & Conditions

** This quote is based on a customer list. Buckley Associates will not be responsible for compliance with plans or specifications **

The above quotation is based on standard factory lead times and a one time release unless specifically noted. Any changes or cancellations made to orders after release may be subject to additional fees. The above quotation is valid for 30 days from the date of the quote. Prices do not include local sales tax. All standard terms and conditions of Buckley Associates or the manufacturer responsible for the billing applies. (Copy provided upon request)

QUOTATION TOTAL $ 1,420

My Portfolio: Thomas Bowman	Town of Warwick - Benchmarking (Rev. 1)									
4-Jun-09										
Total Buildings: 6										
Facility Name	**Baseline Rating (1-100)**	**Performance Indicator** Green: 75-100 Yellow: 51-74 Red: 0-50 Blue: TBD	**Baseline Site Energy Intensity (kBtu/Sq. Ft.)**	**National Average Site EUI (kBtu/Sq. Ft.)**	**Baseline Total Site Energy Use (kBtu)**	**Baseline Site Electric Use (kWh)**	**Baseline Site Non-Electric Use (kBtu)**	**Building Type**	**Total Floor Space (Sq. Ft.)**	**Recommended Audit Type**
town hall	N/A	Red	94.4	104	555,923	23,644	475,225	Other	5,888	Detailed
police station	N/A	Yellow	23.6	78	29,718	8,710	-9	Fire Station/Police Station	1,260	Detailed
fire station	N/A	Yellow	55.1	78	100,861	2,844	91,156	Fire Station/Police Station	1,830	Detailed
Highway Dept	N/A	Yellow	174.6	77	563,878	9,417	531,738	Service (Vehicle Repair/Service, Postal Service)	3,230	Walkthrough
library	N/A	Green	54.2	104	130,061	3,428	118,362	Library	2,400	No Audit
Warwick Community School	38	Blue	99.5	98.4	1,990,745	167,178	1,420,166	K-12 School	20,000	ESCO
Group Total					**3,371,186**	**215,221**	**2,636,637**		**34,608**	

Town of Warwick Clean Energy Study	
Biomass District Heating for Town Hall and Library	District Heating - Small
Wind Turbine at Mt. Grace State Forest	Wind
Biomass Shop Heater for Highway Garage	Biomass - Small
Biomass Appliance for Fire Station (to be covered in conservation report)	Biomass - Appliance
Biomass Appliance for Police Station (to be covered in conservation report)	Biomass - Appliance