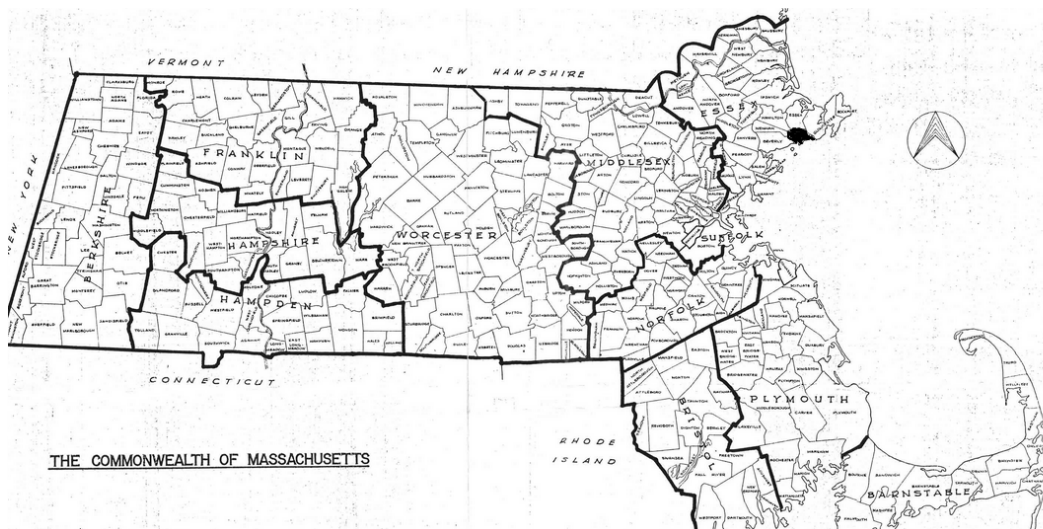


Green Communities

Energy Reduction Plan

Town of Manchester by the Sea, MA

June 2014



Prepared for:

Town of Manchester by the Sea

10 Central Street

National Grid, MA 01944

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Stop Wasting Energy. Start Saving Money.™



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Introduction

Guardian Energy Management Solutions is pleased to provide the following Energy Reduction Plan for the Town of Manchester by the Sea (Manchester) to help support Manchester'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 Manchester will be selecting specific projects for implementation over the course of time. Guardian will continue to support the Town of Manchester 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 gas related accounts. Guardian is a National Grid Lead Project Expediter and will assist Manchester 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:

National Grid Electric

- Prescriptive incentives for standard prescriptive measures are predefined by National Grid.
- Custom measures must screen the cost benefit ratio calculator and if accepted, can receive between \$.10 - \$.40 per kWh saved.

National Grid Gas

- National Grid's Municipal program requires that all gas related measures must screen the cost benefit ratio calculator and if accepted, can receive up to \$1.50/therm saved.

As a Lead Project Expediter under the National Grid program, 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. National Grid can provide Guardian with the incentive payment which in turn, reduces the final cost to the town.

Finally, National Grid offers an 'On Bill Repayment' (OBR) option for Electric Projects. 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 National Grid. If approved, the final amount due is split into 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.

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Notices & Disclaimers

This report is based upon information gathered during site assessments for each building/facility on the days the audits were conducted. The ECMs (Energy Conservation Measures) are calculated from information gathered on this date including available energy usage data, Guardian staff, potential vendors, building occupants, and other individuals that were involved in the audit 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. This 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 such as code violations, or required asbestos abatement (or other hazardous materials) is not included in the pricing unless noted.

*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 Manchester. 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 Manchester meet its energy reduction goals. The baseline energy usage summary is below.

Baseline Energy Usage Overview

Location	Building Sq.Ft.	kWh Usage 2013	2013 Elec Cost	Gallons Oil/ Propane Usage 2013	2013 Oil/ Propane Cost	Gas Therms Usage	Gas Therms Cost	Total 2013 Energy Costs	MMBTU Usage Total	Energy Intensity Cost per Sq.Ft.	Energy Intensity MMBTU per sq.ft.
WasteWater Treatment Plant	7,500	550,800	\$ 76,885	419	\$1,880			\$78,765	1,937	\$10.50	0.26
Fire Station	12,750	36,320	\$ 5,633	4,431	\$15,635			\$21,268	749	\$2.04	0.07
Town Hall / Police Station	15,600	192,387	\$ 25,230	10	\$43			\$25,273	657	\$1.62	0.04
Library	4,103	34,202	\$ 5,518	1,833	\$6,476			\$11,994	375	\$2.92	0.09
DPW Garage	5,200	28,690	\$ 4,266	386	\$1,421	7345	\$8,080	\$13,766	887	\$2.65	0.17
	45,153	842,399	\$117,532	7,079	\$25,455			\$151,066	3,870	\$3.53	0.09

Energy Conservation Measure Project & Savings Overview

Location	Project	Project Cost	Est. Incentive	Final Amount	Grant Request	Electric Saved (kWh)	Gas Saved (therms)	Oil/ Propane Saved (gal)	MMBTU Saved	Energy Cost Savings	Page #
Town Hall / Police Station	Interior Lighting	\$24,273	\$4,154	\$20,119	\$20,119	16,614	0	0	56.6	\$2,193	9
Fire Station	Oil to Gas conversion	\$57,000	\$4,000	\$53,000	\$53,000	0	-4,789	4,431	145.9	\$10,241	13
Fire Station	Insulating curtain	\$9,800	\$0	\$9,800	\$9,800	0	-5,860	4,431	38.8	\$426	14
DPW Garage	Building Envelope	\$8,160	\$630	\$7,530	\$7,530	0	423	0	42.3	\$465	17
DPW Garage	High Bay lighting	\$16,344	\$1,324	\$15,020	\$15,020	5,264	0	0	17.9	\$811	18
DPW Garage	Infrared heaters	\$43,920	\$3,000	\$40,920	\$40,920	0	2,000	0	200	\$2,200	19
DPW Garage	Heat Pump Office	\$11,000	\$0	\$11,000	\$11,000	0		0	0.0	\$0	19
Waste Water Treatment Plant	75 HP VFD's	\$36,500	\$10,000	\$26,500	\$26,500	58,302	0	0	198.8	\$8,139	21
Manchester Library	Oil to Gas, Outdoor air, T-stat	\$61,000	\$4,000	\$57,000	\$57,000	0	-1,750	1,833	83.5	\$4,491	24
Manchester Library	Ductless splits	\$50,000	\$1,400	\$48,600	\$48,600	5,000	0	0	17.0	\$810	24
		\$317,997	\$28,508	\$289,489	\$289,489	85,180	-9,976	10,695	800.8	\$29,776	

Location	Project	Final Cost	Savings	ROI %	Payback (years)
Town Hall / Police Station	Interior Lighting	\$20,119	\$2,193	10.9%	9.2
Fire Station	Oil to Gas conversion	\$53,000	\$10,241	19.3%	5.2
Fire Station	Insulating curtain	\$9,800	\$426	4.4%	23.0
DPW Garage	Building Envelope	\$7,530	\$465	6.2%	16.2
DPW Garage	High Bay lighting	\$15,020	\$811	5.4%	18.5
DPW Garage	Infrared heaters	\$40,920	\$2,200	5.4%	18.6
DPW Garage	Heat Pump Office	\$11,000	\$0	0.0%	0.0
Waste Water Treatment Plant	75 HP VFD's	\$26,500	\$8,139	30.7%	3.3
Manchester Library	Oil to Gas, Outdoor air, T-stat	\$57,000	\$4,491	7.9%	12.7
Manchester Library	Ductless splits	\$48,600	\$810	1.7%	60.0
		\$289,489	\$29,776	10.3%	9.7

Manchester Town Hall / Police Station

10 Central Street,

The building that hosts the Manchester by the Sea Town Hall & Police Station was built in 1969. The building is approximately 15,600 sq. ft. and is occupied 45-55 hours per week (Police wing 24/7). It is in decent condition for a building it's age and function. The lighting was upgraded 5 to 7 years ago by National Grid on an incentive program. Heating is provided by electric radiation that was part of the original design of the building. The single pane windows and wood doors are original. Air conditioning is provided by window units that are replaced periodically. Domestic hot water needs are minimal (bath rooms and showers for the police). More detail follows.



Lighting Systems

- Interior lighting - Numerous two lamp fixtures were observed that are candidates to be retrofitted with single lamp fixtures with reflectors to elevate light levels. Most rooms have more than adequate light that is augmented by light from windows. Hallway lighting on the 1st and 2nd floors is inadequate. Please see the lighting upgrade proposal for recommendations.
- Lighting Control- Occupancy sensors are not used and should be considered where applicable. 2 x 2 fluorescent fixtures should be replaced with 2 x 2 LED's controlled by wireless occupancy sensors. Please see the lighting upgrade proposal for recommendations.
- Exterior Lighting – There are a few existing exterior fixtures are metal halide and high pressure sodium technology and should be upgraded to high efficiency LED technology.

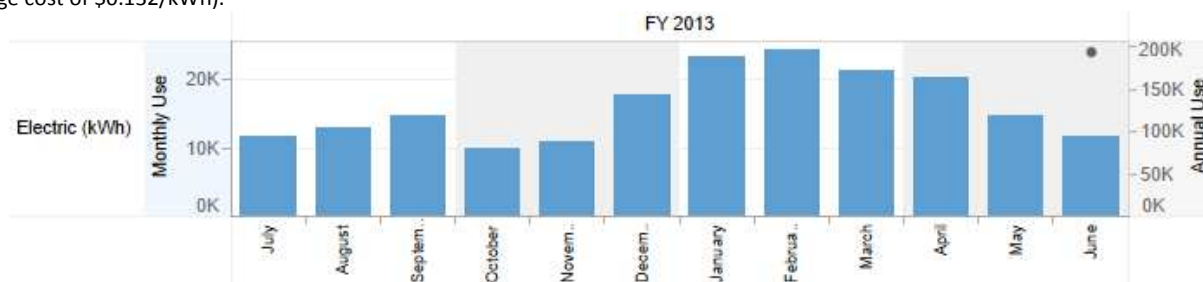
Heating & Cooling System

- The heating system is electric with individual wall units in each of the office spaces controlled by an associated thermostat. The system is original with the building.
- Cooling is provided by portable wall and window units that have varying SEER ratings that were the most energy efficient at the time of purchase. Units are serviceable and in good working condition.

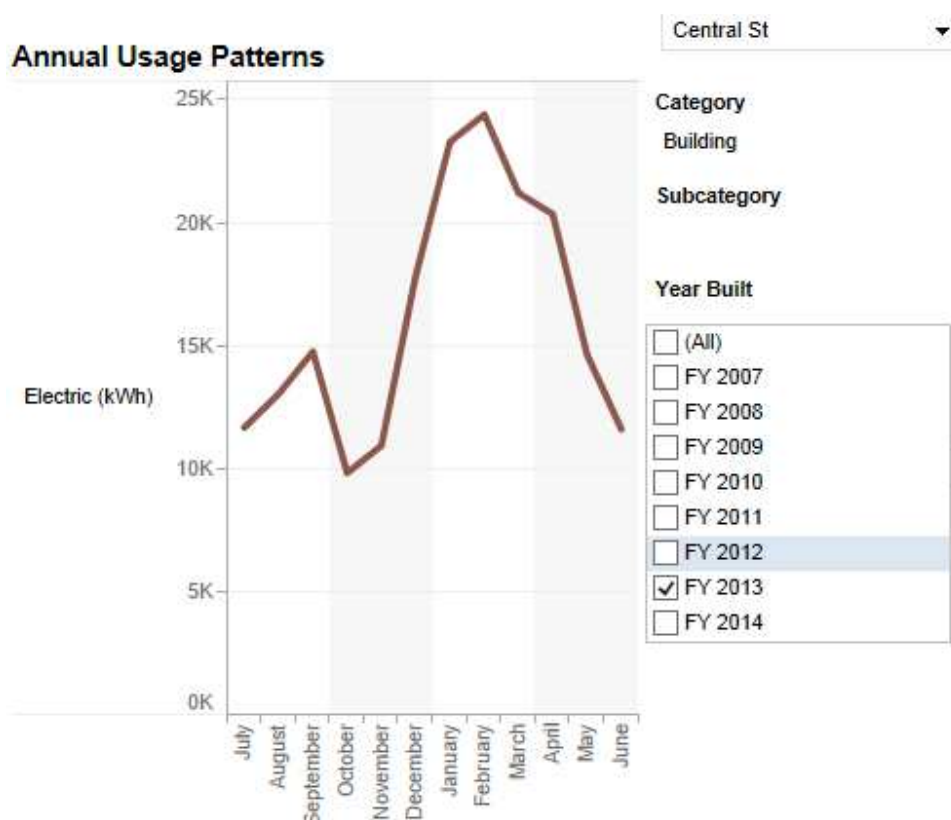
National Grid Electric Account: 8866669005

Energy Usage Profile FYE 2013

Usage obtained from MassEnergyInsight shows that the town hall / police station usage in FYE2013 consists solely of electricity (191,120 kwh with an average cost of \$0.132/kWh).



Usage Patterns: The pattern of energy usage is dependent upon the delivery and reporting of energy consumption. The graph below shows that electricity usage reaches its peak during the heating season. This is to be expected as resistive electric heat is very inefficient. Electricity consumption is lowest during the spring and fall in between the cooling and heating season.



Manchester by the Sea Town Hall Police Station recommendations

For the short term the only recommendation is to upgrade the interior lighting in the building for two reasons. First, as it currently is today interior lighting accounts for approximately one sixth the electric consumption in the building. The proposed retrofit will reduce consumption by approximately 50% or one twelfth current consumption leaving just over 90% to be addressed. The bulk of the electric demand is divided between the critical command and control electronics in the police station and the building's HVAC system. Guardian cannot assess the police equipment, but a few words about the HVAC system and the building weatherization are in order.

Weatherization

The building's windows are single pane and the doors are wood. As such they are a major source of thermal losses. With existing windows and doors a replacement HVAC system needs to be oversized by 50% to account for the excess thermal losses.

HVAC

The options to address the HVAC system are limited due to the nature of the building. That is the unavailability of natural gas and the absence of any duct work. Fortunately, there is a viable option that will provide major savings. That is a ductless split heat pump.

The main elements of this system are as follows. An electric heat pump that is located outside the building. The electric heat pump refrigerant and heating line would be connected to a distribution box located in the building. In turn distribution box would have individual lines going to the head or room unit. Each room unit has a fan and line for heating or cooling dependent upon what is demanded by the room's thermostat which would be supplied as part of the system.

Recommendation

Accordingly the town should secure budgetary pricing for replacement energy efficient windows/doors and ductless split heat pumps systems as described above that assumes the up to date energy efficient windows and doors. With budgetary costs (likely to exceed \$200,000) and estimated energy savings the town can make informed decisions about upgrading the building's HVAC with a strong long term solution that is appropriate for the building with its inherent limitations. Given the amount involved the town needs to consider if the project should be financed out of its own capital budget or potentially with Green Community Competitive Grant or a combination thereof and if it should be completed all at once or in phases.

ECM1: Interior Lighting Upgrade

Guardian performed an interior lighting audit at the Manchester Elementary School and identified a total of 203 fixtures that can be retrofit to a more energy efficient solution. The existing fixtures include 2 x 2 ceiling mount and 1 x 4 ceiling mount 2' and 4' fluorescents. Guardian is recommending a combination of LED's and fluorescent reflector retrofit kits that reduce the number of lamps.

Our audit details are listed below for this project:

EXISTING LIGHTING SYSTEM							
Measure #	Location	Qty.	Existing Fixture Description	Lamp/ Ballast Type	Existing Lamp/ Ballast Wattage	Annual Operating Hours	EXISTING Total kWh
1	Basement Elevator Area	2	2 x 2 prismatic, flush ceiling mount	2L4' T8/ELIG	60	2,190	263
2	Clerk's office	6	2 x 2 prismatic, flush ceiling mount	2L4' T8/ELIG	60	2,190	788
3	Break Room, Hall	3	2 x 2 prismatic, flush ceiling mount	2L4' T8/ELIG	60	2,190	394
4	Police Bathroom, locker area	1	2 x 2 prismatic, flush ceiling mount	2L4' T8/ELIG	60	2,190	131
5	Basement Foyer	3	2 x 2 prismatic, flush ceiling mount	2L2' 17W T8/ELIG	37	2,190	243
6	Basement Exit	1	2 x 2 prismatic, flush ceiling mount	2L2' 17W T8/ELIG	37	4,380	162
7	1st floor Hall	5	2 x 2 prismatic, flush ceiling mount	2L2' 17W T8/ELIG	37	4,380	810
8	2nd floor Hall	7	2 x 2 prismatic, flush ceiling mount	2L2' 17W T8/ELIG	37	4,380	1,134
9	Stairway 1	1	2 x 2 prismatic, flush ceiling mount	2L2' 17W T8/ELIG	37	4,380	162
10	Main Stairway	3	2 x 2 prismatic, flush ceiling mount	2L2' 17W T8/ELIG	37	4,380	486
11	Council on Aging	3	1 x 4 prismatic, flush ceiling mount	2L4' T8/ELIG LOW POWER	52	2,190	342
12	Town Accountant	6	1 x 4 prismatic, flush ceiling mount	2L4' T8/ELIG LOW POWER	52	2,190	683
13	Treasurer Collector	8	1 x 4 prismatic, flush ceiling mount	2L4' T8/ELIG LOW POWER	52	2,190	911
14	Treasurer Collector, Closet	2	1 x 4 prismatic, flush ceiling mount	2L4' T8/ELIG LOW POWER	52	2,190	228
15	Admin Office	4	1 x 4 prismatic, flush ceiling mount	2L4' T8/ELIG LOW POWER	52	2,190	456
16	Assessor's Office Foyer	9	1 x 4 prismatic, flush ceiling mount	2L4' T8/ELIG LOW POWER	52	2,190	1,025
17	Assessor's Office	4	1 x 4 prismatic, flush ceiling mount	2L4' T8/ELIG LOW POWER	52	2,190	456
18	Assessor's office Closet	2	1 x 4 prismatic, flush ceiling mount	2L4' T8/ELIG LOW POWER	52	2,190	228
19	Break Room	4	1 x 4 prismatic, flush ceiling mount	2L4' T8/ELIG LOW POWER	52	2,190	456
20	Selectman Meeting Room	15	1 x 4 prismatic, flush ceiling mount	2L4' T8/ELIG LOW POWER	52	4,380	3,416
21	Water & Sewer	9	1 x 4 prismatic, flush ceiling mount	2L4' T8/ELIG LOW POWER	52	2,190	1,025
22	Park's & Recreation	6	1 x 4 prismatic, flush ceiling mount	2L4' T8/ELIG LOW POWER	52	2,190	683
23	Pam's Office	2	1 x 4 prismatic, flush ceiling mount	2L4' T8/ELIG LOW POWER	52	2,190	228
24	Ellen's Office	6	1 x 4 prismatic, flush ceiling mount	2L4' T8/ELIG LOW POWER	52	2,190	683
25	Conservation Commission	6	1 x 4 prismatic, flush ceiling mount	2L4' T8/ELIG LOW POWER	52	2,190	683
26	Closet	1	1 x 4 prismatic, flush ceiling mount	2L4' T8/ELIG LOW POWER	52	1,000	52
27	Town Admin's Admin	5	1 x 4 prismatic, flush ceiling mount	2L4' T8/ELIG LOW POWER	52	2,190	569

28	Town Administrator	4	1 x 4 prismatic, flush ceiling mount	2L4' T8/ELIG LOW POWER	52	2,190	456
29	Police Entrance	2	1 x 4 prismatic, flush ceiling mount	2L4' T8/ELIG LOW POWER	52	8,760	911
30	Police main foyer	2	1 x 4 prismatic, flush ceiling mount	2L4' T8/ELIG LOW POWER	52	8,760	911
31	Control/Squad room	12	1 x 4 prismatic, flush ceiling mount	2L4' T8/ELIG LOW POWER	52	8,760	5,466
32	Chief of Police	4	1 x 4 prismatic, flush ceiling mount	2L4' T8/ELIG LOW POWER	52	4,380	911
33	Closet	2	1 x 4 prismatic, flush ceiling mount	2L4' T8/ELIG LOW POWER	52	1,000	104
34	Sgt's Det. Office	4	1 x 4 prismatic, flush ceiling mount	2L4' T8/ELIG LOW POWER	52	2,190	456
35	Booking area	2	1 x 4 prismatic, flush ceiling mount	2L4' T8/ELIG LOW POWER	52	2,190	228
36	Police Bathroom, locker area	3	1 x 4 prismatic, flush ceiling mount	2L4' T8/ELIG LOW POWER	52	4,380	683
37	Council on Aging	3	1 x 4 prismatic, flush ceiling mount	2L4' EE/ELIG	60	2,190	394
38	Harbormaster	2	ind strip, aircraft cable suspend	2L4' T8/ELIG LOW POWER	52	2,190	228
39	Harbormaster	1	desktop lamp	60W INC	60	2,190	131
40	Safe	2	2L industrial strip, ceiling mount	2L4' T8/ELIG LOW POWER	52	2,190	228
41	Stairway 1	1	2L industrial strip, ceiling mount	2L4' T8/ELIG LOW POWER	52	4,380	228
42	Stairway 1	4	1 Lamp Industrial Strip	1L4' T8/ELIG LOW POWER	26	4,380	456
43	Police Basement Hall	4	4' 2lamp pris wraps	2L4' T8/ELIG LOW POWER	52	2,190	456
44	Main Holding area	3	4' 2lamp pris wraps	2L4' T8/ELIG LOW POWER	52	2,190	342
45	Police Mechanical Area	3	4' 2lamp pris wraps	2L4' T8/ELIG LOW POWER	52	1,000	156
46	Locker Room	9	4' 2lamp pris wraps	2L4' T8/ELIG LOW POWER	52	4,380	2,050
47	Garage	12	Heavy Wet duty 2lamp strips	2L4' T8/ELIG LOW POWER	52	2,190	1,367

PROPOSED RETROFIT									
Measure #	Location	Proposed Qty.	Proposed Fixture Description	Lamp/ Ballast Type	Add Occupancy Sensor?	Proposed Lamp/ Ballast Wattage	Proposed Annual Operating Hours	NEW Total kWh	Total kWh Reduction
1	Basement Elevator Area	2	2 x 2 mirra retrofit kit	2L2' 17W T8EE/ELEE	0	29	2,190	127	136
2	Clerk's office	6	2 x 2 mirra retrofit kit	2L2' 17W T8EE/ELEE	0	29	2,190	381	407
3	Break Room, Hall	3	2 x 2 LED panel	22 WATT LED	0	22	2,190	145	250
4	Police Bathroom, locker area	1	2 x 2 mirra retrofit kit	2L2' 17W T8EE/ELEE	0	29	2,190	64	68
5	Basement Foyer	3	2 x 2 mirra retrofit kit	2L2' 17W T8EE/ELEE	0	29	2,190	191	53
6	Basement Exit	1	2 x 2 mirra retrofit kit	2L2' 17W T8EE/ELEE	0	29	4,380	127	35
7	1st floor Hall	7	2 x 2 LED panel	22 WATT LED	0	22	4,380	675	136
8	2nd floor Hall	7	2 x 2 LED panel	22 WATT LED	0	22	4,380	675	460
9	Stairway 1	1	2 x 2 mirra retrofit kit	2L2' 17W T8EE/ELEE	0	29	4,380	127	35
10	Main Stairway	3	2 x 2 mirra retrofit kit	2L2' 17W T8EE/ELEE	0	29	4,380	381	105
11	Council on Aging	3	1 x 4 mirra retrofit kit	1L4' 28W T8EE/ELEE	0	24	2,190	158	184
12	Town Accountant	6	1 x 4 mirra retrofit kit	1L4' 28W T8EE/ELEE	0	24	2,190	315	368
13	Treasurer Collector	8	1 x 4 mirra retrofit kit	1L4' 28W T8EE/ELEE	0	24	2,190	420	491
14	Treasurer Collector, Closet	2	1 x 4 mirra retrofit kit	1L4' 28W T8EE/ELEE	Yes	24	1,445	69	158
15	Admin Office	4	1 x 4 mirra retrofit kit	1L4' 28W T8EE/ELEE	Yes	24	1,445	139	317
16	Assesor's Office Foyer	9	1 x 4 mirra retrofit kit	1L4' 28W T8EE/ELEE	0	24	2,190	473	552
17	Assesor's Office	4	1 x 4 mirra retrofit kit	1L4' 28W T8EE/ELEE	yes	24	1,445	139	317
18	Assesor's office Closet	2	1 x 4 mirra retrofit kit	1L4' 28W T8EE/ELEE	yes	24	1,445	69	158
19	Break Room	4	1 x 4 mirra retrofit kit	1L4' 28W T8EE/ELEE	yes	24	1,445	139	317
20	Selectman Meeting Room	15	1 x 4 mirra retrofit kit	1L4' 28W T8EE/ELEE	Yes	24	2,891	1,041	2,376
21	Water & Sewer	9	1 x 4 mirra retrofit kit	1L4' 28W T8EE/ELEE	Yes	24	1,445	312	713

22	Park's & Recreation	6	1 x 4 mirra retrofit kit	1L4' 28W T8EE/ELEE	0	24	2,190	315	368
23	Pam's Office	2	1 x 4 mirra retrofit kit	1L4' 28W T8EE/ELEE	Yes	24	1,445	69	158
24	Ellen's Office	6	1 x 4 mirra retrofit kit	1L4' 28W T8EE/ELEE	0	24	2,190	315	368
25	Conservation Commission	6	1 x 4 mirra retrofit kit	1L4' 28W T8EE/ELEE	0	24	2,190	315	368
26	Closet	1	1 x 4 mirra retrofit kit	1L4' 28W T8EE/ELEE	0	24	1,000	24	28
27	Town Admin's Admin	5	1 x 4 mirra retrofit kit	1L4' 28W T8EE/ELEE	0	24	2,190	263	307
28	Town Administrator	4	1 x 4 mirra retrofit kit	1L4' 28W T8EE/ELEE	0	24	2,190	210	245
29	Police Entrance	2	1 x 4 mirra retrofit kit	1L4' 28W T8EE/ELEE	0	24	8,760	420	491
30	Police main foyer	2	1 x 4 mirra retrofit kit	1L4' 28W T8EE/ELEE	0	24	8,760	420	491
31	Control/Squad room	12	1 x 4 mirra retrofit kit	1L4' 28W T8EE/ELEE	0	24	8,760	2,523	2,943
32	Chief of Police	4	1 x 4 mirra retrofit kit	1L4' 28W T8EE/ELEE	0	24	4,380	420	491
33	Closet	2	1 x 4 mirra retrofit kit	1L4' 28W T8EE/ELEE	0	24	1,000	48	56
34	Sgt's Det. Office	4	1 x 4 mirra retrofit kit	1L4' 28W T8EE/ELEE	0	24	2,190	210	245
35	Booking area	2	1 x 4 mirra retrofit kit	1L4' 28W T8EE/ELEE	Yes	24	1,445	69	158
36	Police Bathroom, locker area	3	1 x 4 mirra retrofit kit	1L4' 28W T8EE/ELEE	0	24	4,380	315	368
37	Council on Aging	3	1 x 4 mirra retrofit kit	1L4' 28W T8EE/ELEE	0	24	2,190	158	237
38	Harbormaster	2	relamp reballast	2L4' 25W T8EE/ELEE LOW PWR	0	37	2,190	162	66
39	Harbormaster	1	CREE LED bulb	10 WATT LED	0	10	2,190	22	110
40	Safe	2	No Retro	0	0	52	2,190	0	0
41	Stairway 1	1	No Retro	0	0	52	4,380	0	0
42	Stairway 1	4	relamp reballast	1L4' 25W T8EE/ELEE LOW PWR	0	19	4,380	0	123
43	Police Basement Hall	4	No Retro	0	0	52	2,190	0	0
44	Main Holding area	3	No Retro	0	0	52	2,190	0	0
45	Police Mechanical Area	3	relamp reballast	2L4' 25W T8EE/ELEE LOW PWR	0	37	1,000	0	45
46	Locker Room	9	relamp reballast	2L4' 25W T8EE/ELEE LOW PWR	0	37	4,380	0	591
47	Garage	12	relamp reballast	2L4' 25W T8EE/ELEE LOW PWR	Yes	37	1,445	0	725

Annual Estimated Electrical Savings	
Existing kWh	32,858
Proposed kWh	16,244
Saved kWh	16,614
Annual Electric Savings	\$2,492
Annual Maintenance Savings	\$500
Total Annual Savings	\$2,992

Manchester Fire Station

12 School Street

This facility acts as Manchester's central fire and emergency response building that houses trucks, equipment and personnel. The building operates 24/7/365 and can be staffed by up to 8 fire/rescue workers at any given time. The building is approximately 10,407 Sq Ft in area.

The Fire Department utilizes oil for space heating and gas for domestic hot water. The garage must maintain temperatures above freezing during winter months to preserve medical supplies/equipment. The Fire house is presently heated with 2-Weil McLain A/B-WGO-9 Series 3 oil-fired boilers rated at 2.55 GPH or 355 MBH input and a net output of 257 MBH which is about 73% efficient.

The lighting system is a combination T8 linear fluorescents and flood lighting. Occupancy sensing or lighting control is not employed. However lights are turned off in unoccupied spaces. Due to the very low hours of usage a lighting retrofit will deliver a very little energy savings for the cost.

The firehouse has several issues driving excessive thermal losses and occupant discomfort. The 1st issue is the windows throughout the building are extremely leaky. The firemen install an interior storm system during the winter to deal with comfort issues, but the interior panel system makes the windows hard to see out of and unable to be opened. The windows are single pane, so they have a poor insulation value and allow excessive heat loss.

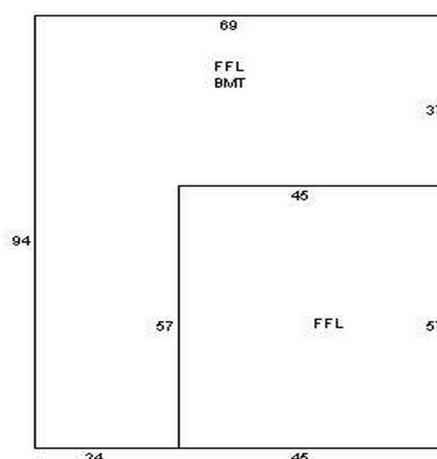
The 2nd issue is there is excessive heat loss through the roof at the garage and the lower level roofs of the office and living spaces.

Finally two different environments exist in the fire station with the garage and the office/ living spaces being poorly isolated. This condition leads to excessive heat loss from the office/ living spaces into the garage and very uncomfortable spaces.

National Grid Electric Account: 7618974009

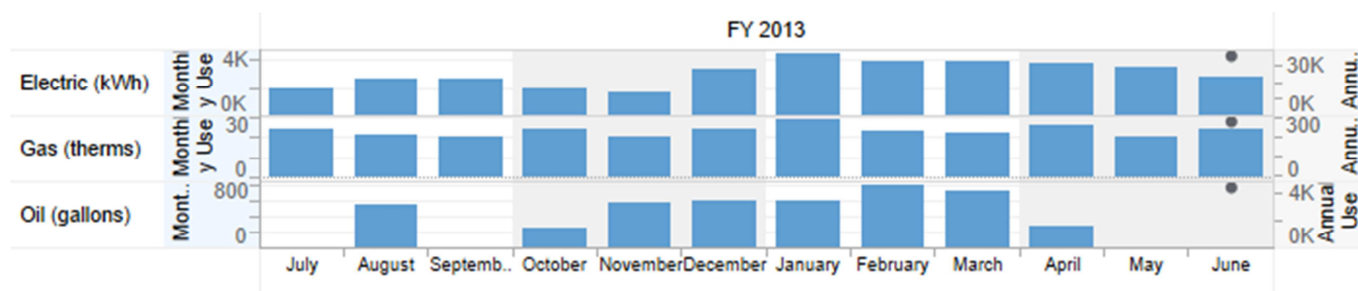
National Grid Gas Account: 4192013480

Scott Oil Account: 869

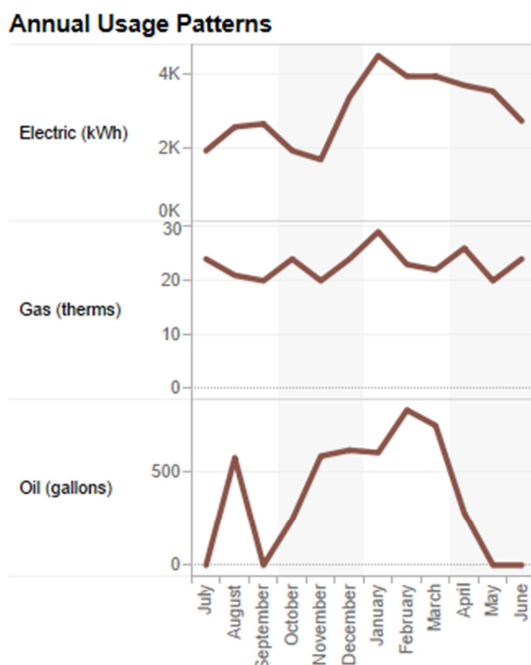


Energy Usage Profile FYE 2013

Usage obtained from Mass Energy Insight shows that the Fire house's usage in FYE2013 consists of electricity (36,320 kWh with an average cost of \$0.155/kWh) and heating oil (4,431 gallons with an average cost of \$3.53/gallon). Gas was used for Domestic Hot water 277 therms at a rate of \$1.86 per therm.



Usage Patterns: The pattern of energy usage is dependent upon the delivery and reporting of energy consumption. The graph below shows that electricity usage peaks in January and reaches an overall low point in the fall months. Oil usage peaks during January/February/March as expected, as the heating season and required temperature settings are typically at full load during this time for year.



Manchester Fire Station Energy Conservation Recommendations

ECM1: Boilers Upgrade

This ECM includes the removal of the two existing Weil McClain boiler operating at 73% efficiency, and installation of a new Weil McClain high efficiency gas fired boilers that operates at 93% efficiency with outdoor reset controls. By upgrading to a high efficiency boiler, the Town Hall will realize energy savings and a reduction in repairs. It is highly recommended that the boiler be cleaned and serviced annually and maintained by a professional HVAC service provider.

The following Scope of work is included:

1. Removal and disposal of the existing boilers.
2. Procurement of the new gas fired boilers.
3. Rigging and installation of the new boilers.
4. Piping and electrical work to tie the new boilers into the existing system.
 - a. Since the large louver for the existing boilers combustion air would not be needed, it will be capped and used for the new PVC venting
5. Insulation of boiler room piping.
6. Start-up and testing of the boiler.



Existing Boilers

ECM2: Install R-Value Flexible Curtain between Apparatus garage and living space

This ECM puts a thermal barrier between the Apparatus bay and the living area. By separating the spaces occupant comfort will be improved as the thermostats in the living space will have the opportunity to reach their temperature set point. Currently they don't due to the excessive air infiltration in the apparatus bay.



Flexible Curtain Example

Other Recommendations

Additional Notes: The Fire Station apparatus bay lacks the insulation needed to reduce the loss of heat that is produced by the existing heating equipment. This is a **flaw** in the construction of the building that presents a potentially large construction project to correct the issue. Moreover the windows are very leaky and in need of replacement. Due to the extremely high cost (in excess of \$100K) to address the envelope and windows. we have not included a final price. With an extremely low payback and limited energy savings, the project should be considered a capital improvement to the building itself. It is not a simple building envelope or weatherization retrofit project. From a building envelope perspective the garage and living spaces are all one space as the garage is open to the living area.

We believe the most cost-effective way to address not having any insulation at the top of the building is to:

- Spray 3" of closed cell spray polyurethane foam between the framing that was just installed
- Install sheetrock over the foam, fastened into the framing that was installed
- Paint/ finish

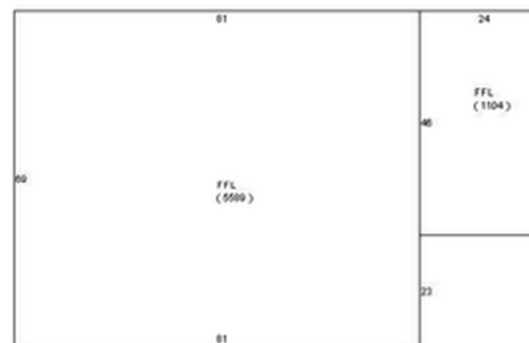
Manchester DPW

87 Pleasant St

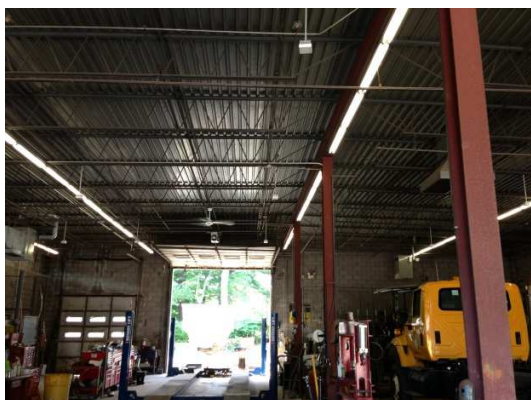
The Manchester DPW garage facility is located off of Pleasant Street. It was built around 1970 is approximately 5200 ft.² in size. The construction is cinderblock walls with a flat roof. It appears to be in fair condition. Inside is largely a garage space but there is a small office & kitchen area that is has conditioned air. The hours of operation are from 6:30 to 3:30 afternoon daily Monday through Friday and other times as needed during emergency events.

There are two principal issues with the garage area of the building. The roof-wall intersection is a major source of unwanted air leakage in the building. The exterior flashing and finishes at the roof-wall intersection are not air-tight. The large gaps at the framing components were once sealed with a foam material, but the material has completely deteriorated over time. This system is allowing significant infiltration/exfiltration. Secondly the overhead doors are in disrepair and are weak points in the building for air leakage and heat loss.

The facility is lit by approximately linear t8 fluorescent as depicted below. These units are continually on during operating hours.



DPW Floor Plan



linear 2 lamp T8 Strip

The DPW highway building is heated by three (3) conventional gas-fired unit heaters that are nominally rated at 80% efficiency and 200 MBH input each. One is ducted and used to heat the office area. There is also one in the addition (Modine Hot-Dawg) rated at 80% and 125 MBH input and 100 MBH output. Each are their own zone controlled by a non-programmable thermostat.



Unit Heater



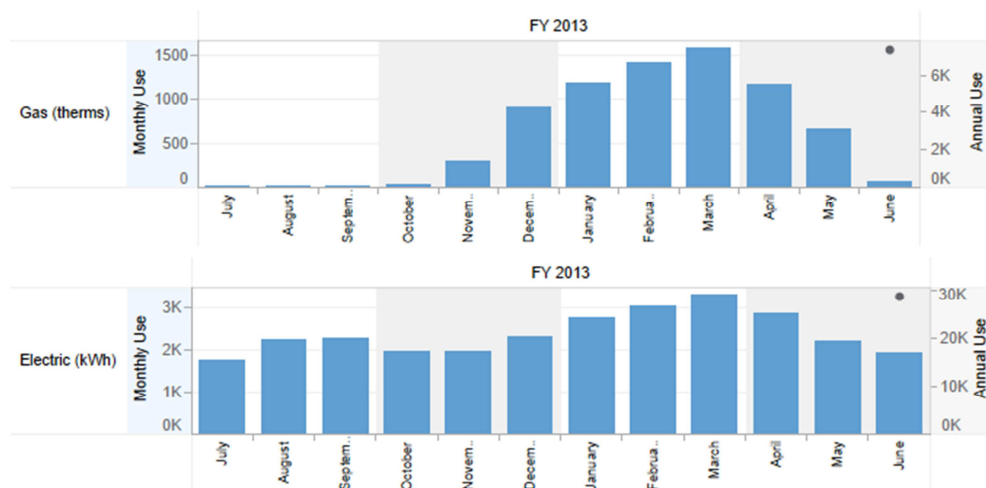
non programmable thermostat

National Grid Electric Account: 0161973002

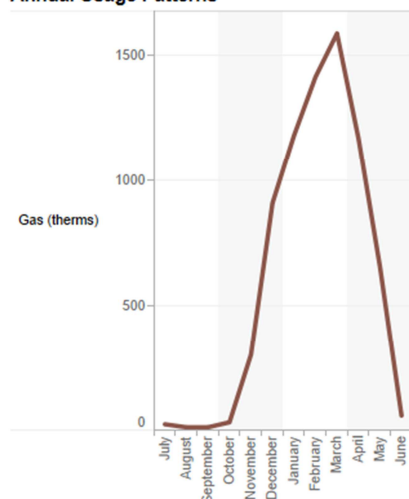
National Grid Gas Account: 4191413990

Energy Usage Profile FYE 2013

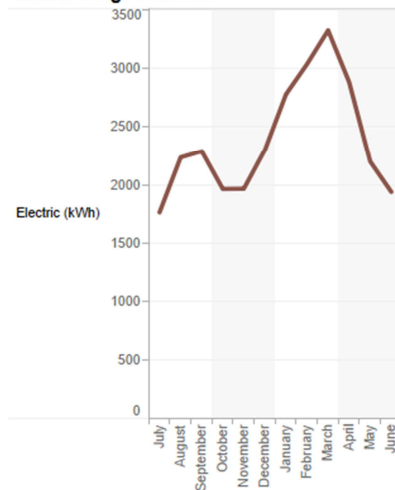
Usage obtained from Mass Energy Insight shows that the DPW's usage in FY2013 consists of electricity (27,612 kWh with an average cost of \$0.155/kWh) and 7,345 therms of Gas at an estimated cost of \$1.10 per therm. As expected, energy usage peaks during the heating season and troughs during the fall months.



Annual Usage Patterns



Annual Usage Patterns



ECM1 Building Envelope

The DPW Garage Bay roof-wall intersection is a major source of unwanted air leakage in the building. The exterior flashing and finishes at the roof-wall intersection are not air-tight. The large gaps at the framing components were once sealed with a foam material, but the material has completely deteriorated over time. This system is allowing significant infiltration / exfiltration.



Roof-Wall Intersection Air Sealing – the exterior flashing and finishes at the roof-wall intersection are not constructed to stop air leakage.



Roof-Wall Intersection Air Sealing – gaps between the roof deck and structure wall framing due to trusses at the roof-wall intersection are pathways for unwanted infiltration/exfiltration; the foam material has completely deteriorated and does not provide a tight seal.



Roof-Wall Intersection Air Sealing – gaps between the roof deck and structure wall framing due to trusses at the roof-wall intersection are pathways for unwanted infiltration/exfiltration; the foam material has completely deteriorated and does not provide a tight seal.

Guardian recommends air sealing at the roof wall intersection

Scope of Work

- Provide labor and materials to install a 4 inch – 6 inch wide and 2 inch deep bead of high-density spray polyurethane foam at the air leakage pathway.



DPW GARAGE - MANCHESTER BY THE SEA
WEATHERIZATION DATA FOR CALCULATIONS

Measure	Location	Crack Width	Length of Crack / Unit	Total Crack Length	Leakage Area	Savings (CFM)
Air Sealing Measures						
Roof-Wall Intersection Air Sealing Seal	Original Building Full Perimeter	1/8 In.	300 LF	300 LF	3.1 SF	243 CFM
Total Air Sealing Measures		---	---	---	3.1 SF	243 CFM

ECM2: High Bay lighting Lighting

The interior lighting in the garage is by t8 linear fluorescents. Light levels are adequate but could be improved. Guardian recommends the replacement of these lamps with 60 Watt LED high bays. LED's have over 50,000 hr design life and are effectively maintenance free.

EXISTING LIGHTING SYSTEM

Measure #	Location	Qty.	Existing Fixture Description	Lamp/ Ballast Type	Existing Lamp/ Ballast Wattage	Annual Operating Hours	EXISTING Total kWh
1	Row 1	17	2 Lamp industrial Strip	2L4' T8/ELIG	60	2,830	2,887
2	Row 2	17	2 Lamp industrial Strip	2L4' T8/ELIG	60	2,830	2,887
3	Row 3	17	2 Lamp industrial Strip	2L4' T8/ELIG	60	2,830	2,887
4	Row 4	7	2 Lamp industrial Strip	2L4' T8/ELIG	60	2,830	1,189

PROPOSED RETROFIT									
Measure #	Proposed Qty.	Proposed Fixture Description	Lamp/ Ballast Type	Add Occupancy Sensor?	Proposed Lamp/ Ballast Wattage	Proposed Annual Operating Hours	NEW Total kWh	Total kWh Reduction	Fixture Height
1	8	LED Low bay	60 WATT LED	No	60	2,830	1,358	1,528	15'-20'
2	8	LED Low bay	60 WATT LED	No	60	2,830	1,358	1,528	15'-20'
3	8	LED Low bay	60 WATT LED	No	60	2,830	1,358	1,528	15'-20'
4	3	LED Low bay	60 WATT LED	No	60	2,830	509	679	15'-20'

Scope of Work

- Install 4 sample LED's to optimize spacing and light levels.
- Remove and properly dispose of existing T8 linear fluorescents
- Install balance of LED's in proposed retrofit according to sample install

ECM3 Infrared Heaters

Heating by far is the greatest use of energy in the building. Guardian recommends the installation of infrared radiant heaters in the place of the unit heaters. Infrared heaters raise the ambient air temperature in a building by using radiant energy that is absorbed from the infrared heater and stored in surfaces exposed to the heater be they concrete floor or DPW equipment. Infrared heaters also provide additional warming and spot heating for people and objects that directly absorb their radiant energy. They are an excellent application for facility like DPW Garages that lose conditioned air when the garage doors open and close.

Scope of Work

- (4) Four New 80 MBH heaters as manufactured by Schwank to replace the (3) three 200 MBH unit heaters
- (1) 1 new 80 MBH heater as manufactured by Schwank to replace the Modine Hot Dawg
- Replace existing thermostats and replace with programmable T-stat for each infrared heater
- Gas piping and flue venting.
- Power wiring.
- Start-up.



Example of IR Heater

ECM4 Heat Pump for office

Assuming the install of IR heaters the heat source for the office is gone. Guardian recommends the installation of a small Mitsubishi heat pump rated for 9000 BTUH. It has a SEER rating of 26 and an HSPF of 10 which means over the heating season will deliver nearly 3KW for every KW used. At 5F it has a 100% heating output, at -4F it has an 86% heating output. Since the office is 14' X 16.6' 8'H and is in heated space, the variable speed unit will modulate according to space demands it most likely will only be running at half the rated output.

Manchester Wastewater Treatment plant

12 Church Street

National Grid Electric Account: 5363944026

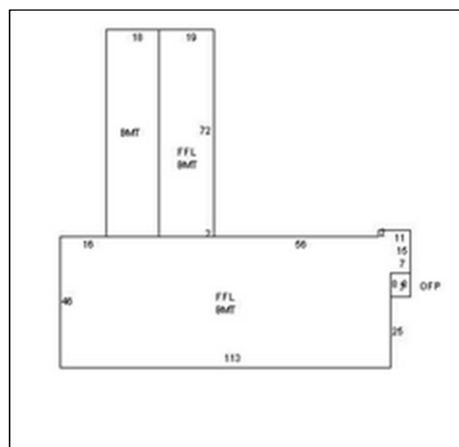
Heating Oil Account: 310156

The Manchester Waste Water Treatment Plant (WWTP) is located behind the Town Hall adjacent to the harbor. The WWTP underwent a major upgrading and expansion from 1997 through 1999. The plant appears to be well maintained and in good condition for a facility of its type and age. Most but not all of its process equipment employs premium efficiency motors controlled by variable speed drives

The two (2) 75 HP motors that discharge the plant's effluent into the Manchester Bay at system rating of 0.67 Million Gallons per day are controlled by tank level. When the effluent tank reaches a preset height one of the motors is started with a reduced voltage starter (soft starts) until the motor reaches full speed which drives the effluent pump unit one of the tank empty's to the pre-set level. The soft start prevents a voltage spike but provide little energy savings.

The WWTP's lighting has numerous fixtures throughout the facility which are good candidates for retrofit with reflector kits which reduce the number of lamps yet maintain light levels. However, pricing is not offered as it was observed that the low hours of operation as the lights are turned off in rooms that are unoccupied. Given the low occupancy of the building even more efficient fixtures offer little savings due low operating hours.

The facility is heated with a HB Smith gas fired cast iron boiler rated at 1645 MBH and is 70% efficient. Pricing was not developed for replacement as this will be a long payback item. However Guardian recommends that when it is time to upgrade or replace the boiler, consideration should be given to the transfer the exhaust air energy to the makeup air stream using an energy recovery system (plate type or runaround loop heat exchanger). This will allow the reduction in the size and cost of the replacement system.

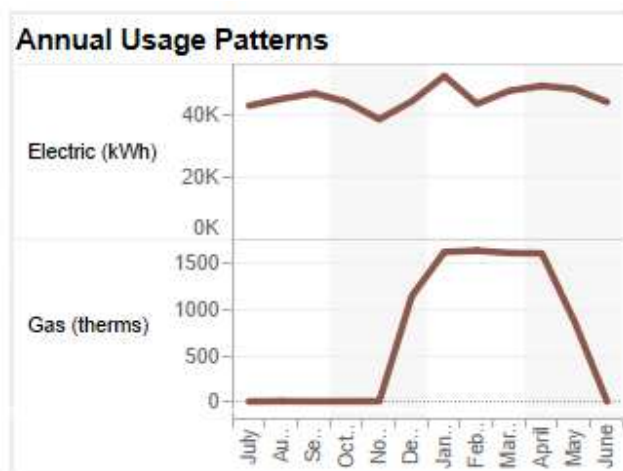
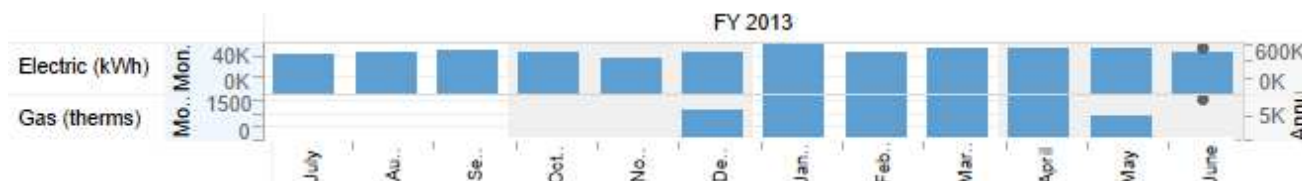


National Grid Electric Account: 0147453003

National Grid Gas Account: 4192021610

Energy Usage Profile FYE 2013

Usage obtained from Mass Energy Insight shows that the waste water treatment plant's usage in FYE2013 consists of electricity (550,800 kWh with an average cost of \$0.140/kWh) and 8,589 therms of Gas at an estimated cost of **\$1.10 per therm**. The bulk of electrical energy is associated with process of the facility. Gas use is during the heating system and is likely to be high due to need to condition fresh air.



ECM1 - Replace Soft Starts with VFD's

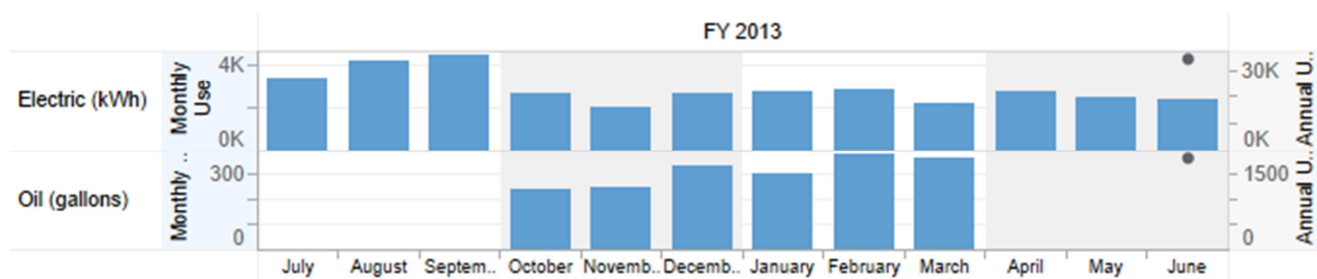
By installing VFDs to these pump motors, you are adding the opportunity to adjust the motor speed and torque by varying motor input frequency and voltage. Rather than running your motor at 100% at all times, the VFD will turn down the motor speed based upon the actual need. A VFD can also extend the lifespan for a motor by providing a "soft" start and stop. Circulating pumps are an ideal scenario to implement VFDs to gain energy savings.

Scope of Work

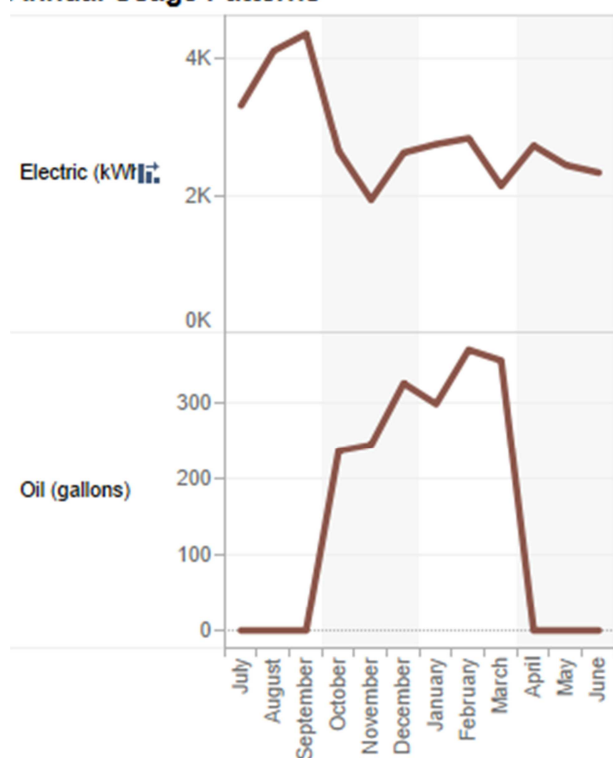
- Remove the outdated inefficient and deteriorated full voltage motor starters from the motor control center.
- Furnish and install two new 75 HP "Altivar – ATV" variable frequency drives (VFDs) in their place.
- Furnish and install ventilation fans in the MCC for cooling of the VFD's.
- Furnish and install interface want to existing SCADA system for speed control.
- Obtain electrical permit as necessary.
- Perform start up and testing.

Energy Usage Profile FYE 2013

Usage obtained from Mass Energy Insight shows that the library's usage in FYE2013 consists of electricity (34,202 kWh with an average cost of \$0.161/kWh) and 1,833 gallons of oil at an estimated cost of \$3.53 per gallon. Peak energy usage appears to coincide with cooling season (electric) and heating season (oil) as would be expected.



Annual Usage Patterns



ECM 1 – Oil to Gas Conversion of Boilers

Guardian recommends the town examine the cost of bringing gas service to the library. Gas service is available no more than several hundred feet away at the Fire Station and possibly closer. If the cost is not too high to bring service to the library than the installation of a new Weil McLain high efficiency gas fired boilers that operate at 93% efficiency with outdoor reset controls makes sense. By upgrading to a high efficiency boiler, the library will realize energy savings and a reduction in repairs. It is highly recommended that the boiler be cleaned and serviced annually and maintained by a professional HVAC service provider.

The following Scope of work is included:

1. Removal and disposal of the existing oil boilers.
2. Procurement of the new gas fired boilers.
3. Rigging and installation of the new boilers.
4. Piping and electrical work to tie the new boilers into the existing system.
5. Insulation of boiler room piping.
6. Installation of programmable thermostats
7. Startup & Commissioning

ECM 2 – Condenser and Ductless Split Upgrade

The existing condensers and ductless splits can be upgraded as they are no longer efficient as compared to units available today.

The following Scope of Work is included:

- Delivery of materials and labor for the purpose of upgrading the cooling portion of the first floor HVAC system by replacing the existing 5 Ton condenser and 2.5 ton evaporator coil and to include the following;
- Replace 1 American Standard Trane 5 Ton condenser rated 12 SEER with 5 Ton Trane unit rated at 16 SEER.
- Replace 1 Fujitsu condenser rated at 20500 BTU/hr and 10 SEER with Fujitsu condenser rated at 20,500 BTU/hr and 17.5 SEER.
- Replace 1 Fujitsu condenser rated at 17000 BTU/hr and 11 SEER with Fujitsu condenser rated at 17,000 BTU/hr and 19 SEER.
- Recovery of existing refrigerant and disposal.
- Flush lines, Leak check and evacuate existing refrigerant lines
- Installation of new refrigerant drier.
- Assess expansion device and modify to be compatible with air handler.
- Charge and start-up system.
- Includes all permits and inspections.
- Complete code compliance of all workmanship.
- One year warranty on workmanship and components.
- All labor is paid at MA Prevailing Wage Rate.

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.

Massachusetts'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.