The Town of Marshfield Energy Reduction Plan

Prepared by the Metropolitan Area Planning Council with support from the Town of Marshfield

In fulfillment of the
Massachusetts Green Communities Grant Program
Criterion 3

December 2016

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I. Purpose and Acknowledgements

A. Letters from Both General Government and School District Verifying Adoption of the ERP

Rocco J. Longo
Town Administrator

Town of Marshfield

Board of Selectmen
870 Moraine Street
Marshfield, Massachusetts 02050
Tel: 781-834-5563 Fax: 781-834-5527

November 15, 2016

Massachusetts Department of Energy Resources
Green Communities Division
100 Cambridge Street, Suite 1040
Boston, MA 02114

Re: Energy Reduction Policy

To Whom it May Concern:

At a public meeting of the Marshfield Board of Selectmen held on November 14, 2016, the Board voted unanimously to adopt the attached Energy Reduction Policy.

Sincerely,

Rocco J. Longo
Town Administrator

Marshfield Public Schools

76 South River Street – Marshfield, MA 02050 ■ (781)834-5000 ■ FAX (781)834-5070

Jeffrey W. Granatino
Superintendent

Ellen M. Martin, Ed. D.
Asst. Superintendent

Thomas J. Miller
Asst. Supt. Business & Finance

Susan D. Dupuis, Ed. D.
Asst. Supt. Special Education / Pupil Personnel

November 15, 2016

Massachusetts Department of Energy Resources
Green Communities Division
100 Cambridge Street, Suite 1020
Boston, MA 02114

The Marshfield School Committee met on November 15, 2016. As part of that School Committee Meeting Agenda at that public meeting, reviewed and considered the Energy Reduction Plan being proposed by the Town of Marshfield as part of our Green Community Application.

The Marshfield School Committee endorsed and adopted this Energy Reduction Plan at the November 15, 2015 meeting and has authorized me to submit the plan as part of the Marshfield's Green Community Application.

We look forward to working with the Department of Energy Resources as we move forward with energy reduction plan implementation and other Green Community activities.

Sincerely,

Jeffrey W. Granatino,
Superintendent of Schools

JWG:rcd

Marshfield Public School District is an Equal Opportunity/Affirmative Action employer. Marshfield Public School District does not discriminate on the basis of race, color, religion, national origin, gender, gender identity, sexual orientation, disability, homelessness, or age in programs, activities, or employment.

B. List of Contributors:

The collaborative efforts of the offices of Town Manager Rocco Longo and Facilities Director Brian Adams and of the MA Department of Energy Resource's Green Communities Regional Coordinator Seth Pickering were vital to produce this plan.

Much of the information in this plan was derived from energy audits performed by Guardian Energy, led by William Harrow, and Horizon Energy Services, led by Mike Sciaraffa and Bruce Schaffer. Additional technical assistance was provided by the Metropolitan Area Planning Council (MAPC), the author of this plan.

II. Executive Summary

A. Narrative Summary of the Town

The Town of Marshfield is a Plymouth County community situated around 30 miles south of Boston along the Atlantic Ocean. Marshfield was first settled in 1632, and was officially incorporated in 1640. With an area of 31.7 square miles, Marshfield has a population of 25,132 according to the 2010 Census. The Town is governed by a Selectmen-Manager plan with an open Town meeting. Marshfield's school district is made up of a High School, Middle School, and five Elementary Schools.

B. Summary of Municipal Energy Uses

- Total Number of Municipal Buildings – 26

  Three buildings are responsible for over 50% of the energy use of all buildings: Marshfield High School, Furnace Brook Middle School and Martinson Elementary School.

  Marshfield High School is Leadership in Energy & Environmental Design (LEED) Gold Certified.

- Total Number of Municipal Vehicles: - 120

  29 of these vehicles are subject to Marshfield's Fuel Efficient Vehicle Policy, and the current average miles per gallon for these is 18.3 mpg, with the highest 32 mpg and the lowest 13 mpg.

- Total Number of Street Lights and Traffic Lights: 829 streetlights and accounts for 4 traffic lights.

  The most common streetlight is a 50w High Pressure Sodium.

- Water and Sewer: 2 drinking water pumping stations, 1 waste water pumping station, and 2 waste water treatment plants.

  The waste water treatment plant on 200 Driebeek Rd, which serves non-school buildings, consumes over 57% the energy use for the water and sewer sector.

Table 1: Municipal Energy Use Summary	
	Number
Buildings	26
Oil Heat	-
Natural Gas Heat	20
Propane Heat	-
Biomass Heat	-
Other Heat Type	-
Electric or No heat	6
Vehicles	
Gasoline or Diesel	120
Hybrid	-
Electric	-
Street Lights	829*
Traffic Lights	4
Water and Sewer	
Drinking Water Treatment Plant	0
Drinking Water Pumping Station	2
Wastewater Treatment Plant	2
Wastewater Pumping Station	1

*National Grid owns streetlights

C. Summary of Energy Use Baseline and Plans for Reduction

This Energy Reduction Plan commits Marshfield to reduce energy use in municipal facilities by at least 20% compared to Fiscal Year 2015 over five years. In the baseline year, the town used 100,030 MMBTUs of energy[1]. The weather-normalized usage, however, is 96,143 MMBTUs[2]. Weather normalization adjusts the usage data to remove the influence of unusually hot or cold weather, which allows for better "apples-to-apples" comparison of the data between years. All data in this ERP is non-weather normalized unless indicated otherwise.

Marshfield's 20% energy reduction goal will be measured against the non-weather normalized baseline of 100,030 MMBTUs. This means the town must reduce usage by at least 20,006 MMBTUs.

As shown in **Figure 1**, buildings made up over half (57%) of the usage by facility type (i.e. building, street/traffic light, vehicles and water/sewer). As shown in **Figure 2**, the School Department made up half (50%) of the usage by department (i.e. school, public works, safety, and miscellaneous).

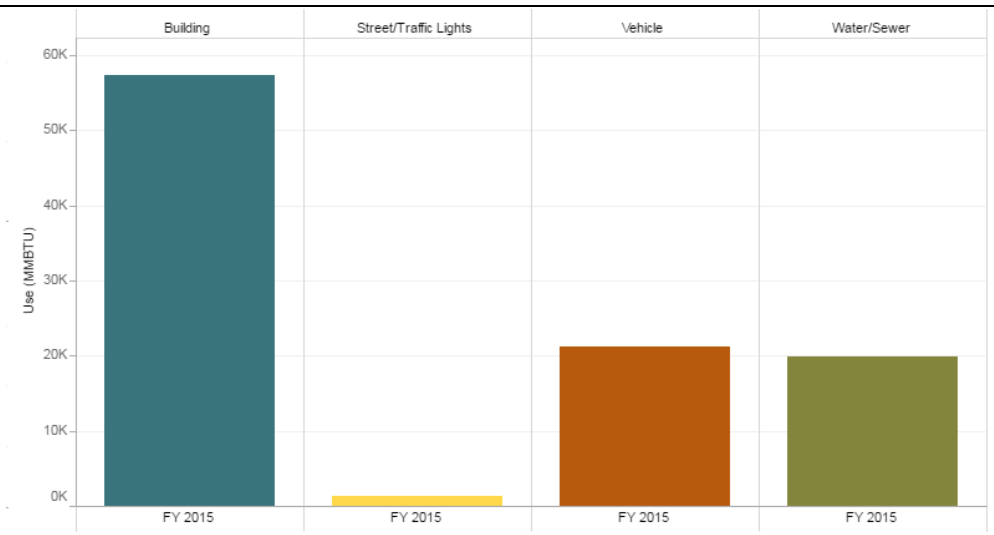


Figure 1. Municipal Energy Use Baseline Dashboard from MEI (FY 2015) by Facility Category.

[1] From Mass Energy Insight, *Energy Reduction Plan Guidance Table 3 (MMBTU)* tab, for FY 2015
[2] From Mass Energy Insight, *Baseline - Weather Normalized* tab, for FY 2015

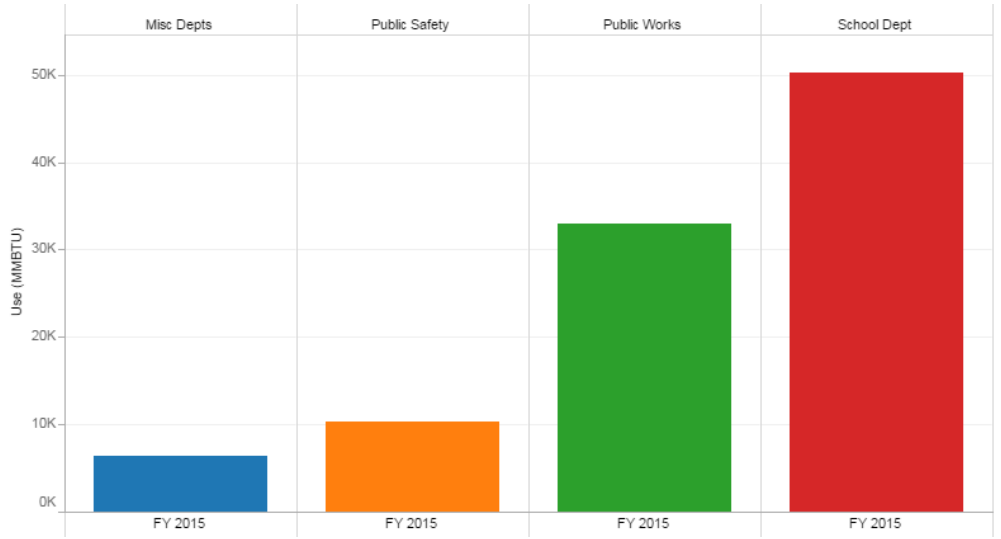


Figure 2. Municipal Energy Use Baseline Dashboard from MEI (FY 2015) by Department Category.

Marshfield has identified energy savings measures in each facility category to reduce energy use 20% based on the total **non-weather normalized** usage, as illustrated in **Table 2a**.

Table 2a: Summary of Municipal Energy Use& Reductions

Facility Category	MMBTU Used in Baseline Year	% of Total MMBTU Baseline Energy Consumption	Projected Planned MMBTU Savings	Savings as % of Total MMBTU Baseline Energy Consumption
Non-Weather Normalized				
Buildings	57,426	57%	15,158	15.2%
Vehicles	21,289	21%	3,066	3.1%
Street/Traffic Lights	1,374	1%	498	0.5%
Water/Sewer/Pumping	19,941	20%	1,350	1.4%
Total Non-Weather Normalized	**100,030**	**100%**	**20,073**	**20.1%**
Weather Normalized	**96,143**	**100%**	_*	_*

***Savings are not weather normalized and can only be compared against other data that is not weather normalized.**

III. Energy Use Baseline Inventory

A. Identification of the Inventory Tool Used – The Town of Marshfield used the Department of Energy Resources' (DOER) MassEnergyInsight (MEI) web-based energy inventory and analysis tool. Energy use is measured in British thermal units (MMBTUs), which allow all fuel types (e.g. electricity, natural gas, diesel, etc.) to be converted to a common unit.

B. Identification of the Baseline Year – Fiscal Year (FY) 2015 will serve as the baseline year. FY 2015 ran from July 1, 2014 to June 30, 2015. This will give the Town until June 30, 2020 (FY 2016 – FY 2020) to reach its 20% energy reduction goal.

C. Municipal Energy Consumption for the Baseline Year (FY 2015) – In the baseline year, the town used 100,030 MMBTUs of energy. The weather-normalized usage, however, is 96,143 MMTBUs. Weather normalization adjusts the usage data to remove the influence of unusually hot or cold weather, which allows for better "apples-to-apples" comparison of the data between years.

As shown in Figure 3, weather normalized energy use from electricity and natural gas is roughly equal and together they account for over three-quarters (75%) of weather normalized energy use.

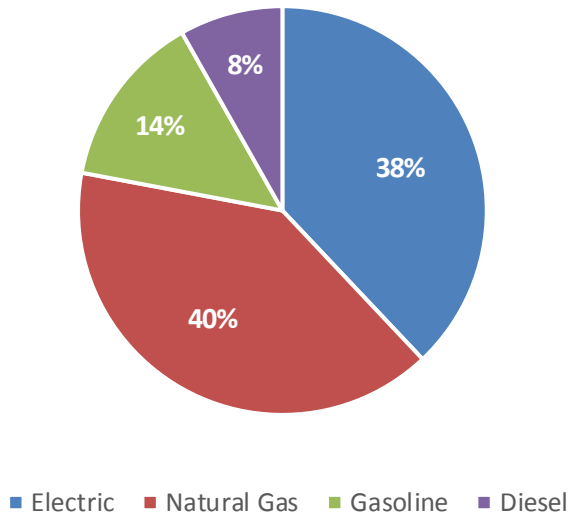


Figure 3. Energy Usage in FY2015 By Fuel Type (Propane (0.1%) is not shown).
***Data is Weather Normalized.**

Table 2b shows that the top 10 largest energy users in town account for roughly 69% of all usage. More than half of these users are schools. The waste water treatment facility and water pumps are also included in the top 10, as are police and highway vehicles.

Table 2b. Top 10 Energy Consuming Facilities in Marshfield

Facility	MMBTUs	Percent of FY2015 Baseline
Marshfield High School	12,994	13%
Furnace Brook Middle School	11,471	11%
Wastewater Treatment Facility	11,397	11%
Martinson School	6,740	7%
Water Pumps	6,655	7%
South River School	4,747	5%
Police Vehicles	4,043	4%
Eames Way School	4,015	4%
Gov Edward Winslow School	3,454	3%
Highway Vehicles	3,384	3%
Total FY 2015 Usage for Top 10	**68,900**	**69%**
Total FY 2015 Usage Baseline	**100,030**	**100%**

Energy Use Intensity is a measure of the energy used per square foot, with lower EUIs indicating more efficient buildings. Buildings with a higher EUI generally have more opportunities for cost-effective energy efficiency upgrades.

The median EUI of all buildings in Marshfield is 72.8 kBTU per square foot. As shown in **Figure 4**, the largest user in town, Marshfield High School, has a EUI of 48.5. This is very low for this type of building and reflects the fact that Marshfield High School is LEED Gold certified. LEED (Leadership in Energy & Environmental Design) is a building certification for highly energy efficient buildings.

The Governor Edward Winslow School, the 9th largest user in town, has a similarly low EUI of 52.8. The remaining 4 buildings in the top 10 largest users – Furnace Brook Middle School (#2), Martinson School (#4), South River School (#6) and Eames Way School (#8), all have an EUI either at or above the median. While Marshfield would not expect to see much savings from the High School or Governor Winslow School, these other four large users should be able to provide some savings.

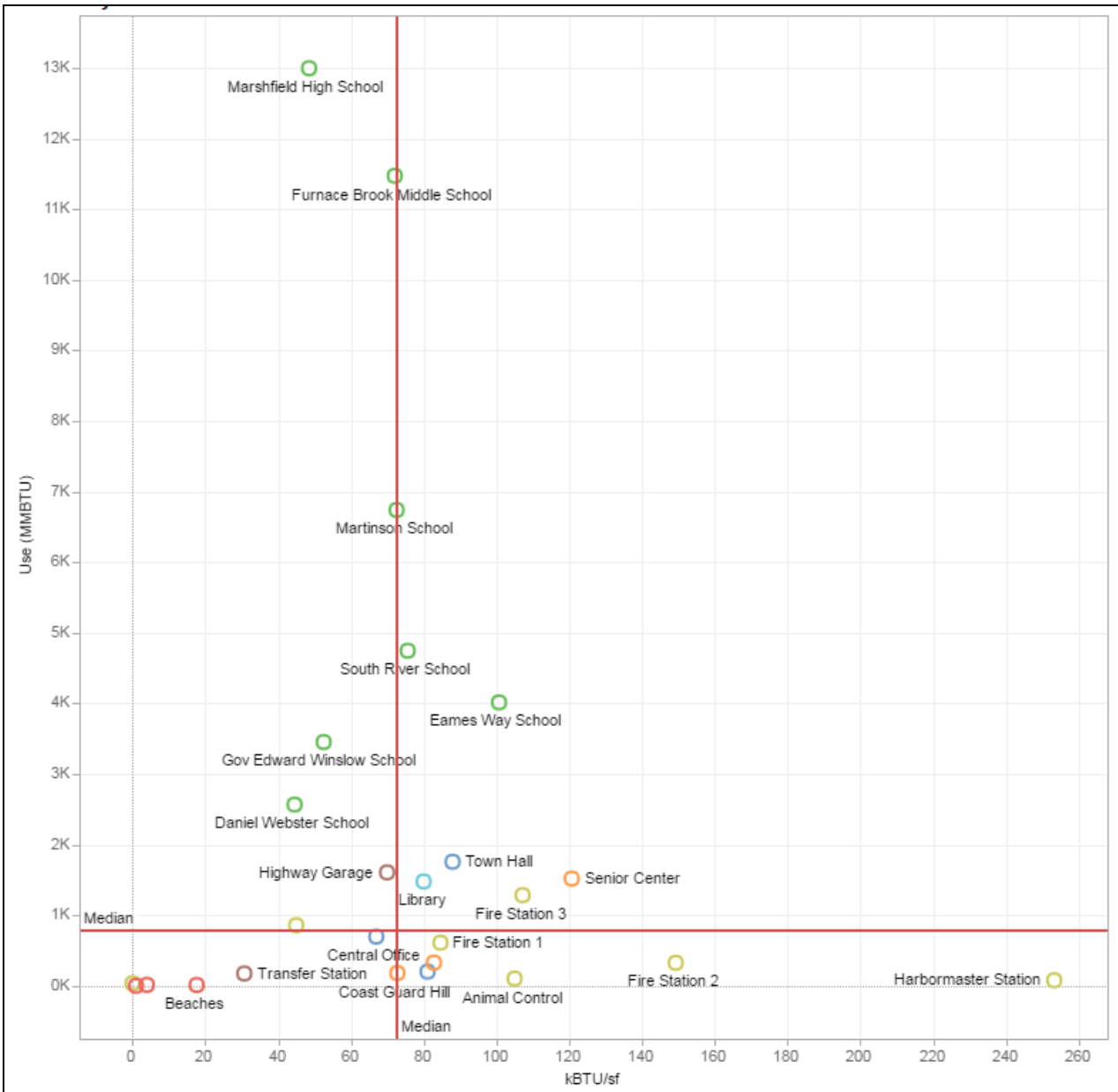


Figure 4. Energy Use Intensity (kBTU/sf) and Total Energy Use (MMBTU) for Buildings.

Points further to the right have a higher energy use per square foot (i.e. less energy efficient). Points higher up use more total energy. Marshfield High School, for example, uses the most energy of any building but has a relatively low usage per square foot.
Red lines show the medians for the town's buildings.

Appendix A presents **Table 3a and 3b** showing energy use for each municipal facility in native units and MMBTUs in the Baseline year. Note that Appendix A

shows **non-weather normalized** data, because MEI only provides weather-normalized data for total town usage and fuel type.

D. **Energy Reduction Goal -** Marshfield's 20% energy reduction goal will be measured against the non-weather normalized baseline of 100,030 MMTBUs. Marshfield will need to reduce its non-weather normalized energy consumption by at least 20,006 MMBTUs.

IV. Energy Reduction Plan

A. Narrative Summary

As shown in Table 4, the town has identified energy savings measures to reduce **non-weather normalized** usage from FY2015 by 20,073 MMBTUs or 20.1%.

Table 2c. Summary of Identified Savings by Facility

	Projected Planned MMBTU Savings	MMBTU Used by Facility in Baseline Year	Top 10 Energy User*
Buildings			
Marshfield High School	404	12,994	#1
Furnace Brook Middle School	4,802	11,471	#2
Martinson School	2,906	6,740	#4
South River School	1,387	1,387	#6
Eames Way School	535	4,015	#8
Winslow School	621	3,454	#9
Webster School	93	2,569	
Police Station	228	860	
Town Hall	164	1,759	
Library	502	1,480	
Senior Center	1,210	1,520	
South River Fire Station (Fire Station 3)	339	1,286	
Main Street Fire Station (Fire Station 2)	55	328	
Massasoit Fire Station (Fire Station 1)	104	613	
Harbor Master Station	19	81	
DPW Garage	646	1,608	
Transfer Station	162	177	
Animal Shelter	3	105	
Recreation (Beaches)	7	14	
Child Care Center	8	16	
Building Operator Certification	966	-	
Buildings Sub-Total	**15,158**	**52,477**	
Vehicles			
Police Vehicles	846	4,043	#7
All Vehicles	2,220	17,272	#10*
Vehicle Sub-Total	**3,066**	**21,315**	
Street/Traffic Lights			
Streetlights	**498**	**1,374**	

Table 2c. Continued - Summary of Identified Savings by Facility			
Water/Sewer/Pumping			
Waste Water Treatment Facility	1,008	11,397	#3
Lift Stations	63	1,099	
Well Stations	280	6,655	#5
Water/Sewer/Pumping Sub-Total	**1,350**	**19,151**	
Total	**20,073**	**-**	
Savings as Percent FY2015 Baseline	**20.1%**		
*The #10 user is Highway Vehicles, which have no specific energy efficiency measures, but would be part of the general vehicle efficiency measures.			

1. Overview of Goals for Years 1-3:

- Perform retrofits of Furnace Brook Middle School, Martinson Elementary School, and South River Elementary School which include:
    - Energy Management System installation
    - Summer boilers
    - Steam trap repair
    - Weatherization
    - Window A/C control
    - Refrigeration control
    - LED lighting and lighting controls across all municipal buildings to prevent unnecessary energy use.
- Eames Way School, Webster School, Winslow School, Police Department, Town Hall and Main Library – LED retrofit for interior lights.
- Arrange for new audits of Fire Stations, DPW Garage, Eames Way and Webster Schools, Town Hall, Senior Center, and Library for all measures identified in the 2012 Trane audit (see Table 4 and Appendix B-2) and/or not completed or recommended by the 2016 Guardian audit (see Table 4 and Appendix B-1).
- Pilot behavior-based energy savings programs in High School, Middle School and larger elementary schools, such as Martinson, South River, Eames Way and Governor Edward Winslow Schools.

    - Programs should include initial documentation of appropriate set points and a quarterly documentation that those set points are being followed.
- Achieve Building Operator Certification for Facilities Manager and additional staffer.
- Retrofit all streetlights with LED technology.
- Explore opportunity to retrofit highway department trucks with hybrid conversion technology.
- Adopt a city-wide "No Idling" policy for all municipal vehicles.
- Incorporate a switch to 100% synthetic oil for all municipal vehicles' oil replacement.
- Closely monitor vehicle tire air pressure to maintain vehicle fuel efficiency.
- Explore the possibility of using an education program to reduce the amount of oil dumped into drains and therefore treated by the waste water treatment plant. This could reduce hot water usage at the plant.

2. Overview of Goal for Years 4-5:

- Build on pilot behavior-based energy reduction programs to create a permanent program in schools
- Water and Sewer – Retrofit the steam traps, boiler controls and lighting at the water treatment facility; Replace thermostats at the lift and well stations, install a variable frequency drive on lift pump at Plymouth Avenue and upgrade to premium efficiency motors at well stations.
- Retrofit police cruisers with anti-idling technology
- Explore opportunity to retrofit senior transport vans with hybrid conversion technology

3. Energy Efficiency Identification Measures:

- As noted previously, the town should schedule new audits for any of the buildings with measures identified in the Trane audit (see Table 4)

- The town should continue to utilize MEI to review data and identify if year over year trends are occurring as expected. Unexpected increases or the failure of some categories to decrease despite known interventions/retrofits should prompt further inquiry.

- Use MEI's building "Buildings to Target" tab to identify underperforming and/or wasteful buildings based on Energy Use Intensity (see Figure 4 above).

- Conduct research and talk with experts such as energy auditors, DOER, MAPC, Massachusetts Clean Energy Center and others to find out if new technologies have come to market that could provide new savings in existing facilities.

  MAPC recommends exploring Massachusetts Clean Energy Center's Commercially Ready Technology's list. See http://www.masscec.com/.

B. Path to 20% Energy Use Reduction by the end of Fiscal Year 2020

1. Program Management Plan for Implementation, Monitoring, and Oversight

- The Town Manager's office, in collaboration with the School Department, will be responsible both for oversight of the Energy Reduction Plan and for implementation of energy conservation measures within the Town. The Town Manager's office, in coordination with the Facility Manger, will be responsible for the annual reporting requirements to DOER to maintain designation and eligibility for annual competitive grant funding.

- Hiring a full- or part-time energy manager has been shown to be an effective way to ensure projects get planned and executed, annual reporting occurs, the town secures Green Communities and other grant funding, and the town stays on track to meet its 20% energy reduction

goal. The town should evaluate hiring an energy manager, which could be shared with a nearby town to reduce costs.

- The Facility Manager, working with the Town Manager, should agree to set point and setback schedules for at least the top three largest energy users in town: Marshfield High School, Furnace Brook Middle School and Martinson Elementary School (which together comprise over 50% of the town's energy use). The desired set points and schedules may differ by season, and should be documented in writing. The Town Manager and Facilities Manager should then agree to a schedule for updates, at which the Facilities Manager will provide written confirmation that the buildings are operating with the agreed upon set points and set-backs. **This process is intended to minimize the chance that set points and setbacks get overridden or forgotten. In some communities, this type of set point change has gone unnoticed for months, causing excessive spikes in energy use.**

  The set point reporting could be included as part of a behavior-based energy reduction program, recommend for Marshfield's schools.

- The Facility Manager, or other designee of the Town Manager, should provide an annual update to the Board of Selectmen by the end of January following the submission of the Annual Report to DOER. The presentation should include:
  - The trend for town-wide **weather-normalized** energy usage
    - Should show the baseline, current year and any years in between
  - The trend for energy usage in at least the top three energy using buildings - Marshfield High School, Furnace Brook Middle School and Martinson Elementary School – which together comprise over 50% of the town's energy use
    - Should show the baseline, current year and any years in between

- A summary of the major efficiency measures implemented over the past year
- An explanation or hypothesis the cause of the trends town-wide and in at least each of the top 3 buildings
- Update on Green Communities competitive grant applications

2. Summary of Energy Audit(s) or Other Sources for Projected Energy Savings

- Building audits were provided by Guardian Energy in 2016 and provide 10.3% energy savings. Additional building audits were performed by Trane in 2012 as part of an Investment Grade Audit, and provide another 3.2% savings. The Guardian Energy Audit is included in Appendix B-1. The Trane Energy Audit is provided in Appendix B-2.

  MAPC developed estimates for energy savings through behavior-based energy programs in schools, based on published research from the report Powering Down from the US Green Building Council's Center for Green Schools and may be found in Appendix F.

- A streetlight analysis was performed by Guardian Energy in 2016 and predicts that the Town can reduce its streetlight electricity consumption by 498 MMBTUs. This will bring the baseline energy consumption down by a further 0.5%. The streetlight analysis is included in Appendix C.

- Vehicle measures targeting police, highway and overall vehicle usage will provide another 3.1%. MAPC developed estimates using available data for:
  - Anti-Idling Technology for Police Department cruisers
  - Hybrid-electric retrofits for some Highway Department vehicles
  - Tire pressure, synthetic oil and anti-idling policies for all vehicles

  Vehicle measures are available in Appendix D

- Water and Sewer measures were provided through an audit by Horizon Energy Services. It identifies 1.4% energy savings. The audit is available in Appendix E.

  Horizon's audit identified that the Waste Water Treatment Plant could reduce the amount of hot water it uses, however, the operators indicated that the current amount of hot water is needed because of the higher than normal level of oils that are in the water. MAPC suggests that the town could perform outreach and education to reduce the dumping of oils. If successful, it could allow the town to reduce the amount of hot water needed, and therefore the energy use associated with it.

3. Energy Conservation Measures

Table 4 lists recommended energy conservation measures. References for each measure is included in the table and these references are included as appendices to the Energy Reduction Plan. Projected annual MMBTU savings for each category (buildings, vehicles, street and traffic lights, water and sewer, and open space) are subtotaled to arrive at a municipal grand total.

Table 4: Estimated Energy Savings in Marshfield Municipal Facilities.

Table 4: Energy Conservation Measures for Marshfield

Table 4. Energy Conservation Measures

Measure		Status	Energy Data					Financial Data						Reference	
			Projected Annual Energy Savings												
Category/Building	Energy Conservation Measure	Status (Completed with month/year or Planned Quarter/Year) - All Calendar Year	Electricity Savings (kWh)	Natural Gas Savings (Therms)	Gasoline Savings (gallons)	Diesel Savings (Gallons)	Propane Savings (Gallons)	Projected Annual Cost Savings ($)	Estimated Total Project Cost ($)	Green Communities Grant* ($)	Estimated Utility Incentives ($)	Estimated Cost After Utility Incentives ($)	Estimated Payback After Incentives (years)	Funding Source*	Source for Energy Savings
Furnace Brook Middle School	DCV - EMS - OS/S	Planned Q3 2017	88,834	16,726				$ 31,724	$ 99,540		$ 30,051	$69,489	2.2		2016 Guardian Energy Audit
Furnace Brook Middle School	Summer Boiler	Planned Q3 2017	0	3,596				$ 3,956	$ 62,618		$ 4,000	$58,618	14.8		2016 Guardian Energy Audit
Furnace Brook Middle School	Steam Trap Repair	Planned Q3 2017	0	3,677				$ 4,045	$ 44,117		$ 5,000	$39,117	9.7		2016 Guardian Energy Audit
Furnace Brook Middle School	Incentive App - Boilers	Planned Q3 2017	2,169	12,004				$ 13,530	$ 500		$ 12,000	$500	0.0		2016 Guardian Energy Audit
Furnace Brook Middle School	Weatherization	Planned Q3 2017	1,387	873				$ 1,168	$ 12,180		$ 1,656	$10,524	9.0		2016 Guardian Energy Audit
Furnace Brook Middle School	Refrigeration Control	Planned Q3 2017	8,079	0				$ 1,212	$ 8,208		$ 2,020	$6,188	5.1		2016 Guardian Energy Audit
Furnace Brook Middle School	Lighting	Planned Q3 2017	184,497	0				$ 35,545	$ 484,007		$ 46,124	$437,883	12.3		2016 Guardian Energy Audit
Martinson Elementary School	DCV - EMS - OS/S	Planned Q3 2017	20,415	15,882				$ 20,532	$ 392,543		$ 48,000	$344,543	16.8		2016 Guardian Energy Audit
Martinson Elementary School	Steam Trap Repair	Planned Q3 2017	0	5,351				$ 5,886	$ 29,557		$ 5,000	$24,557	4.2		2016 Guardian Energy Audit
Martinson Elementary School	Window AC Control	Planned Q3 2017	3,857	0				$ 579	$ 7,751		$ 771	$6,980	12.1		2016 Guardian Energy Audit
Martinson Elementary School	Weatherization	Planned Q3 2017	1,029	648				$ 867	$ 10,529		$ 1,229	$9,300	10.7		2016 Guardian Energy Audit
Martinson Elementary School	Refrigeration Control	Planned Q3 2017	8,079	0				$ 1,212	$ 8,208		$ 2,020	$6,188	5.1		2016 Guardian Energy Audit
Martinson Elementary School	Lighting	Planned Q3 2017	156,574	0				$ 28,697	$ 309,384		$ 39,144	$270,240	9.4		2016 Guardian Energy Audit
South River Elementary School	EMS - EF VFDs, OS/S	Planned Q3 2017	7,107	3,758				$ 5,200	$ 77,906		$ 9,000	$68,906	13.3		2016 Guardian Energy Audit
South River Elementary School	Steam Trap Survey	Planned Q3 2017	0	4,018				$ 4,420	$ 44,117		$ 5,000	$39,117	8.9		2016 Guardian Energy Audit
South River Elementary School	De-Strat Fans - Gym	Planned Q3 2017	-1,136	502				$ 382	$ 18,281		$ 703	$17,578	46.0		2016 Guardian Energy Audit
South River Elementary School	Kitchen Ventilation	Planned Q3 2017	1,768	601				$ 926	$ 33,319		$ 600	$32,719	35.3		2016 Guardian Energy Audit
South River Elementary School	Harmonic Analysis	Planned Q3 2017	35,453	0				$ 5,318	$ 12,004		$ 7,091	$4,913	0.9		2016 Guardian Energy Audit
South River Elementary School	Lighting	Planned Q3 2017	91,696	0				$ 18,676	$ 290,952		$ 22,924	$268,028	14.4		2016 Guardian Energy Audit
Eames Way School	De-Strats - Café	Planned Q3 2017	-568	681				$ 664	$ 19,675		$ 953	$18,722	28.2		2016 Guardian Energy Audit
Eames Way School	De-Strats - Gym	Planned Q3 2017	-568	473				$ 435	$ 19,675		$ 662	$19,013	43.7		2016 Guardian Energy Audit
Eames Way School	Lighting	Planned Q3 2018	56,611					$ 10,190	$ 154,216		$ 14,153	$140,063	13.7		2016 Guardian Energy Audit
Webster School	De-Strats - Gym	Planned Q3 2018	-568	520				$ 487	$ 15,112		$ 728	$14,384	29.5		2017 Guardian Energy Audit
Winslow School	Lighting	Planned Q3 2018	88,830	0				$ 16,608	$ 190,945		$ 22,208	$168,737	10.2		2018 Guardian Energy Audit
Winslow School	Lighting	Planned Q3 2018	85,297	0				$ 15,918	$ 181,555		$ 21,324	$160,231	10.1		2019 Guardian Energy Audit
Senior Center	Boiler Upgrade	Planned Q3 2018	3,579	2,699				$ 3,506	$ 77,076		$ 4,000	$73,076	20.8		2020 Guardian Energy Audit
Senior Center	Refrigeration Control	Planned Q3 2018	4,605	0				$ 691	$ 7,058		$ 1,151	$5,907	8.5		2016 Guardian Energy Audit
Senior Center	Lighting	Planned Q3 2018	44,873	0				$ 8,462	$ 100,779		$ 11,218	$89,561	10.6		2016 Guardian Energy Audit
Library	Lighting	Planned Q3 2018	25,904	0				$ 4,775	$ 52,813		$ 6,476	$46,337	9.7		2016 Guardian Energy Audit
Police Station	Lighting	Planned Q3 2018	66,724	0				$ 11,239	$ 73,216		$ 16,681	$56,535	5.0		2016 Guardian Energy Audit
Town Hall	Lighting	Planned Q3 2018	41,361	0				$ 8,972	$ 165,411		$ 10,340	$155,071	17.3		2016 Guardian Energy Audit

Table 4: Energy Conservation Measures for Marshfield

Measure		Status	Energy Data					Financial Data						Reference	
Category/Building	Energy Conservation Measure	Status (Completed with month/year or Planned Quarter/Year) - All Calendar Year	Projected Annual Energy Savings					Projected Annual Cost Savings ($)	Estimated Total Project Cost ($)	Green Communities Grant* ($)	Estimated Utility Incentives ($)	Estimated Cost After Utility Incentives ($)	Estimated Payback After Incentives (years)	Funding Source*	Source for Energy Savings
			Electricity Savings (kWh)	Natural Gas Savings (Therms)	Gasoline Savings (gallons)	Diesel Savings (Gallons)	Propane Savings (Gallons)								
Eames Way	LED Parking Lot Light	Planned Q3 2018	16,126	-				$ 2,419	TBD		TBD	TBD	TBD		**2012 Trane Energy Audit
Eames Way	Walk in Cooler Freezer Controls	Planned Q3 2018	4,597	-				$ 690	TBD		TBD	TBD	TBD		**2012 Trane Energy Audit
Eames Way	Building Envelpoe Improvement	Planned Q3 2018	0	1,227				$ 1,227	TBD		TBD	TBD	TBD		**2012 Trane Energy Audit
Webster School	Walk in Cooler Freezer Controls	Planned Q3 2018	3,202	-				$ 480	TBD		TBD	TBD	TBD		**2012 Trane Energy Audit
Webster School	Building Envelpoe Improvement	Planned Q3 2018	518	301				$ 379	TBD		TBD	TBD	TBD		**2012 Trane Energy Audit
Town Hall	Building Envelpoe Improvement	Planned Q3 2018	363	214				$ 268	TBD		TBD	TBD	TBD		**2012 Trane Energy Audit
Senior Center	Condensing Boiler	Planned Q1 2019	192	1,556				$ 1,585	TBD		TBD	TBD	TBD		**2012 Trane Energy Audit
Senior Center	VFD on HW Pumps	Planned Q1 2019	4,906	-				$ 736	TBD		TBD	TBD	TBD		**2012 Trane Energy Audit
Senior Center	EMS with new HVAC Units	Planned Q1 2019	41,090	4,460				$ 10,624	TBD		TBD	TBD	TBD		**2012 Trane Energy Audit
Library	New EMS System	Planned Q1 2019	11,418	3,596				$ 5,309	TBD		TBD	TBD	TBD		**2012 Trane Energy Audit
Library	Building Envelpoe Improvement	Planned Q1 2019	120	147				$ 165	TBD		TBD	TBD	TBD		**2012 Trane Energy Audit
South River Fire Station (Fire Station 3)	Boiler and DHW Heater Replacement	Planned Q1 2019	0	1,566				$ 1,566	TBD		TBD	TBD	TBD		**2012 Trane Energy Audit
South River Fire Station (Fire Station 3)	VFD on HW Pumps	Planned Q1 2019	2,531	-				$ 380	TBD		TBD	TBD	TBD		**2012 Trane Energy Audit
South River Fire Station (Fire Station 3)	EMS Upgrade	Planned Q1 2019	18,463	-				$ 2,769	TBD		TBD	TBD	TBD		**2012 Trane Energy Audit
South River Fire Station (Fire Station 3)	Lighting Retrofit	Planned Q1 2019	18,482	-				$ 2,772	TBD		TBD	TBD	TBD		**2012 Trane Energy Audit
South River Fire Station (Fire Station 3)	Building Envelpoe Improvement	Planned Q1 2019	0	473				$ 473	TBD		TBD	TBD	TBD		**2012 Trane Energy Audit
DPW Garage	Overhead doors	Planned Q1 2019	5,189	2,102				$ 2,880	TBD		TBD	TBD	TBD		**2012 Trane Energy Audit
DPW Garage	New Air Regulation Unit	Planned Q1 2019	-1,541	3,141				$ 2,910	TBD		TBD	TBD	TBD		**2012 Trane Energy Audit
DPW Garage	Heat Pump system for Office	Planned Q1 2019	705	-				$ 106	TBD		TBD	TBD	TBD		**2012 Trane Energy Audit
DPW Garage	Lighting Retrofit	Planned Q1 2019	8,494	-				$ 1,274	TBD		TBD	TBD	TBD		**2012 Trane Energy Audit
DPW Garage	Building Envelpoe Improvement	Planned Q1 2019	0	776				$ 776	TBD		TBD	TBD	TBD		**2012 Trane Energy Audit
Harbor Master	New Heat Pump	Planned Q1 2019	4,751	-				$ 713	TBD		TBD	TBD	TBD		**2012 Trane Energy Audit
Harbor Master	Lighting Retrofit	Planned Q1 2019	798	-				$ 120	TBD		TBD	TBD	TBD		**2012 Trane Energy Audit
Massasoit Fire Station (Fire Station 1)	Overhead door replacement	Planned Q1 2019	82	480				$ 492	TBD		TBD	TBD	TBD		**2012 Trane Energy Audit
Massasoit Fire Station (Fire Station 1)	Boiler Plant Replacement	Planned Q1 2019	816	487				$ 609	TBD		TBD	TBD	TBD		**2012 Trane Energy Audit
Massasoit Fire Station (Fire Station 1)	Lighting Retrofit	Planned Q1 2019	1,293	-				$ 194	TBD		TBD	TBD	TBD		**2012 Trane Energy Audit
Transfer Station	Heat Pump system for Offices at Maintenance Bldg	Planned Q1 2019	9,885	(124)				$ 1,359	TBD		TBD	TBD	TBD		**2012 Trane Energy Audit

Table 4: Energy Conservation Measures for Marshfield

Measure		Status	Energy Data					Financial Data						Reference	
Category/Building	Energy Conservation Measure	Status (Completed with month/year or Planned Quarter/Year) - All Calendar Year	Projected Annual Energy Savings					Projected Annual Cost Savings ($)	Estimated Total Project Cost ($)	Green Communities Grant* ($)	Estimated Utility Incentives ($)	Estimated Cost After Utility Incentives ($)	Estimated Payback After Incentives (years)	Funding Source*	Source for Energy Savings
			Electricity Savings (kWh)	Natural Gas Savings (Therms)	Gasoline Savings (gallons)	Diesel Savings (Gallons)	Propane Savings (Gallons)								
Transfer Station	Over head doors at Maint Building	Planned Q1 2019	-7	630				$ 629	TBD		TBD	TBD	TBD		**2012 Trane Energy Audit
Transfer Station	Lighting Retrofit	Planned Q1 2019	7,958	505				$ 1,699	TBD		TBD	TBD	TBD		**2012 Trane Energy Audit
Main Street Fire Station (Fire Station 2)	Boiler Replacement	Planned Q1 2019	0	515				$ 515	TBD		TBD	TBD	TBD		**2012 Trane Energy Audit
Main Street Fire Station (Fire Station 2)	Lighting Retrofit	Planned Q1 2019	978	-				$ 147	TBD		TBD	TBD	TBD		**2012 Trane Energy Audit
Animal Shelter	Lighting Retrofit	Planned Q1 2019	778	-				$ 117	TBD		TBD	TBD	TBD		**2012 Trane Energy Audit
Recreation Center	Lighting Retrofit	Planned Q1 2019	2,167	-				$ 325	TBD		TBD	TBD	TBD		**2012 Trane Energy Audit
Child Care Center	Lighting Retrofit	Planned Q1 2019	2,318	-				$ 348	TBD		TBD	TBD	TBD		**2012 Trane Energy Audit
Marshfield High School	Behavior-based energy efficienty program	Planned Q3 2018	118,288					$ 17,743	$5,000		0	$5,000	0.3		MAPC and Powering Down report.
Furnace Brook Middle School	Behavior-based energy efficienty program	Planned Q3 2018	41,545					$ 6,232	$5,000		0	$5,000	0.8		MAPC and Powering Down report
Martinson Elementary School	Behavior-based energy efficienty program	Planned Q3 2018	20,340					$ 3,051	$5,000		0	$5,000	1.6		MAPC and Powering Down report
South River Elementary School	Behavior-based energy efficienty program	Planned Q3 2018	11,401					$ 1,710	$5,000		0	$5,000	2.9		MAPC and Powering Down report
Eames Way School	Behavior-based energy efficienty program	Planned Q3 2018	10,683					$ 1,602	$5,000		0	$5,000	3.1		MAPC and Powering Down report
Gov Edward Winslow School	Behavior-based energy efficienty program	Planned Q3 2018	7,957					$ 1,194	$5,000		0	$5,000	4.2		MAPC and Powering Down report
Town-Wide	Building Operator Certification	Planned Q4 2017	201,000	2,800				$ 16,615	$1,695		0	$1,695	0.1		http://www.theboc.info/wp-content/uploads/2015/09/BOC-Energy-Savings-FAQ-2015.pdf
Buildings Subtotal	**MMBTU Saved:**	**15,158**	**1,603,774**	**96,861**	**-**	**-**	**-**	**$ 184,974**	**$ 3,008,252**	**$ -**	**$ 352,227**	**$ 1,753,123**	**9.48**		
Street Lights	LED Retrofit	Planned Q4 2017	145,928					$21,889	$400,000		$36,482	$363,518	**16.6**		2016 Guardian Energy Audit
Street Lights Subtotal	**MMBTU Saved:**	**498**	**145,928**	**-**	**-**	**-**	**-**	**$ 21,889**	**$ 400,000**	**$ -**	**$ 36,482**	**$ 363,518**	**16.61**		
Police Vehicles	Install Anti-Idling technology in cruisers	Planned Q4 2017			6,825			$10,266	$6,750		$0	$6,750	**0.7**		MAPC calculation based on Havis IdleRight (http://idleright.havis.com/fuel-mgmt.html) and Town Police Chief
Vehicle Maintenance	Switch to 100% synthetic oil	Planned Q3 2017			2,168	1,129		$5,228	$0		$0	$0	**0.0**		The savings estimate accounts for any additional costs incurred by switching to costlier synthetic oil. Source: http://www.fueleconomy.gov/feg/pdfs/OwnerRelatedFuelEconomyImprovements.pdf
Vehicle Policy	Town-wide "No Idling" policy for gasoline municipal vehicles	Planned Q3 2017			7,601			$11,401	$0		$0	$0	**0.0**		http://www.fueleconomy.gov/feg/pdfs/OwnerRelatedFuelEconomyImprovements.pdf
Vehicle Maintenance	Tire air pressure maintenance toolkit	Planned Q3 2017			4,336	2,258		$10,456	$0		$0	$0	**0.0**		http://www.fueleconomy.gov/feg/pdfs/OwnerRelatedFuelEconomyImprovements.pdf
Vehicle Subtotal	**MMBTU Saved:**	**3,066**	**-**	**-**	**20,930**	**3,387**	**-**	**$ 37,351**	**$ 6,750**	**$ -**	**$ -**	**$ 6,750**	**0.18**		

Table 4: Energy Conservation Measures for Marshfield

Measure		Status	Energy Data					Financial Data						Reference	
			Projected Annual Energy Savings												
Category/Building	Energy Conservation Measure	Status (Completed with month/year or Planned Quarter/Year) - All Calendar Year	Electricity Savings (kWh)	Natural Gas Savings (Therms)	Gasoline Savings (gallons)	Diesel Savings (Gallons)	Propane Savings (Gallons)	Projected Annual Cost Savings ($)	Estimated Total Project Cost ($)	Green Communities Grant* ($)	Estimated Utility Incentives ($)	Estimated Cost After Utility Incentives ($)	Estimated Payback After Incentives (years)	Funding Source*	Source for Energy Savings
Waste Water Treatment Plant	Savings on the 200 and 400 gallon hot water tanks through behavioral education	Planned Q2 2018		3,233				$ 3,233	$ -		$ -	$ -	0.0		MAPC using Horizong Data
Waste Water Treatment Facility	Steam Traps	Planned Q2 2019	-	3,213			-	$ 3,213	$14,726		$1,500	$13,226	4.1		Horizon Energy Audit
Waste Water Treatment Facility	Boiler Controls	Planned Q2 2019	-	1,662			-	$ 1,662	$18,642		$550	$18,092	10.9		Horizon Energy Audit
Waste Water Treatment Facility	LED Lighting Upgrade	Planned Q2 2019	57,656					$ 8,648	$99,995		$14,414	$85,581	9.9		Horizon Energy Audit
Lift Stations	Thermostats	Planned Q2 2019	9,273	-			-	$ 1,391	$8,961		$2,318	$6,643	4.8		Horizon Energy Audit
Well Stations	Thermostats	Planned Q2 2019	16,174	-			809	$ 4,246	$17,081		$4,043	$13,038	3.1		Horizon Energy Audit
Plymouth Avenue Lift Station	Lift Pump VFD's	Planned Q2 2019	9,187	-			-	$ 1,378	$30,632		$15,187	$15,445	11.2		Horizon Energy Audit
Well Stations	Premium Efficiency Motor Upgrades	Planned Q2 2019	44,296	-			-	$ 6,644	$51,441		$11,074	$40,367	6.1		Horizon Energy Audit
Water & Sewer Subtotal		1,350	136,586	8,108	-	-	809	$ 30,415	$ 241,478	$ -	$ 49,086	$ 192,392	6.33		
Total			1,886,288	104,969	20,930	3,387	809								
	Total MMBTU Saved	20,073	6,436	10,497	2,595	471	74								

the 'Green Communities Grant' column and 'Funding Source' columns are for reference only and will be filled in based on the designation and future competiti

**Due to timing, the town could not get updated audits for these buildings. The original Trane audit identified savings but not cost and incenvties. The town plans to get an audit of these buildings withing the first three years.

C. Summary of Long-Term Energy Reduction Goals – Beyond 5 Years

1. Municipal Buildings (including schools)

To better strategize for the long-term maintenance and management of municipal buildings, Marshfield will work with internal schools and Town staff as well as outside consultants, when necessary, to assess and document the condition of major municipal buildings. In addition to exposing continuing opportunities for energy use reductions, this effort will provide the Town with a clear, long-term asset management strategy for the effective budgeting and maintenance of buildings.

2. Vehicles (including schools)

The Fuel-Efficient Vehicle policy will have become engrained within municipal purchasing practices after 5 years, and the Town will seek to explore even more efficient policies and tracking systems to enable more efficiency.

3. Street and Traffic Lighting

As the Town expects to have all streetlights retrofitted with LED bulbs within the 5 year period, the Town will next look to include wireless controls that can dim to drive further savings.

4. Perpetuating Energy Efficiency

An annual municipal audit by Town and Schools staff can tap into the knowledge of the employees who use and maintain the building every day. It can empower building staff to develop a detailed repair and management schedule and collect data on problems and inefficiencies that may be missed by traditional third party audits. Web-based application systems such as See Click Fix can be considered to create additional real-time opportunities for efficiencies in operation and maintenance.

The Town of Marshfield will grow its capacity to retrofit and build more efficient facilities, purchase more efficient vehicles, and illuminate the Town through more efficient lighting throughout the 5-year period. These practices will become more engrained in the culture of the Town and will provide opportunities to instill the ethos into additional policies and programs for more dedicated long-term funding streams and strategies.

V. Appendix A.: Municipal Energy Consumption for FY 2015 – MMBTUs and Native Units

Table 3a. Baseline in MMBTUs:

		2015					
		Diesel	Electric	Gas	Gasoline	Propane	Total
Building	Marshfield High School		8,072	4,922			**12,994**
	South River School		729	4,018			**4,747**
	Eames Way School		543	3,472			**4,015**
	Fire Station 2		61	267			**328**
	Daniel Webster School		622	1,947			**2,569**
	Fire Station 1		114	500			**613**
	Fire Station 3		449	837			**1,286**
	Martinson School		1,388	5,351			**6,740**
	Gov Edward Winslow School		778	2,677			**3,454**
	Furnace Brook Middle School		2,835	8,636			**11,471**
	Central Office		570	129			**699**
	Facilities Office		64	140			**203**
	Hancock Paint		3				**3**
	Town Hall		761	998			**1,759**
	Childcare		16				**16**
	Transfer Station		177			129	**306**
	Coast Guard Hill		50	134			**183**
	Boys & Girls Club		53	278			**331**
	Beaches		14				**14**
	Highway Garage		73	1,536			**1,608**
	Senior Center		454	1,066			**1,520**
	Harbormaster Station		81				**81**
	Library		583	897			**1,480**
	Animal Control		32	73			**105**
	Police Radio Tower		39				**39**
	Police Station		496	364			**860**
	Total		**19,057**	**38,240**		**129**	**57,426**
Street/Traffic Lights	School Traffic Signals		2				**2**
	School Security Lights		140				**140**
	Transfer Station Lights		34				**34**
	Clay Pit Rd Flood Light		6				**6**
	Street Lighting		996				**996**
	Park Lights		106				**106**
	Town Pier Rd Lights		36				**36**
	Veterans Park		54				**54**
	Total		**1,374**				**1,374**

Table 3a. MMBTUs (Continued)

Vehicle	Fire Vehicles	2,467			388		**2,856**
	Admin Vehicles	0			1,068		**1,068**
	Cemetery Vehicles	311			1,239		**1,550**
	Highway Vehicles	2,079			1,305		**3,384**
	Transfer Station Vehicles	1,812			157		**1,969**
	Wastewater Vehicles	300			652		**952**
	School Vehicles	1			2,454		**2,455**
	Water Vehicles	851			2,162		**3,013**
	Police Vehicles	26			4,017		**4,043**
	Total	**7,847**			**13,442**		**21,289**
Water/Sewer	Wastewater Pump/Lift Stations		998	102			**1,099**
	Wastewater Treatment Facility		8,164	3,233			**11,397**
	School Wastewater Treatment		282	440			**722**
	Cemetery Pumps		67				**67**
	Water Pumps		6,655				**6,655**
	Total		**16,166**	**3,775**			**19,941**
Grand Total		**7,847**	**36,597**	**42,014**	**13,442**	**129**	**100,030**

Table 3b. Baseline in Native Units

		2015				
		Electric (kWh)	Gas (therms)	Gasoline (gallons)	Diesel (gallons)	Propane (gallons)
Building	Marshfield High School	2,365,908	49,215			
	South River School	213,600	40,179			
	Eames Way School	159,200	34,721			
	Fire Station 2	17,948	2,671			
	Daniel Webster School	182,320	19,466			
	Fire Station 1	33,361	4,996			
	Fire Station 3	131,534	8,372			
	Martinson School	406,880	53,514			
	Gov Edward Winslow School	228,000	26,765			
	Furnace Brook Middle School	830,960	86,359			
	Central Office	167,120	1,287			
	Facilities Office	18,714	1,396			
	Hancock Paint	840				
	Town Hall	223,087	9,975			
	Childcare	4,586				
	Transfer Station	51,826				1,421
	Coast Guard Hill	14,517	1,338			
	Boys & Girls Club	15,478	2,784			
	Beaches	4,125				
	Highway Garage	21,260	15,358			
	Senior Center	133,171	10,661			
	Harbormaster Station	23,753				
	Library	170,745	8,970			
	Animal Control	9,487	726			
	Police Radio Tower	11,472				
	Police Station	145,280	3,643			
	Total	**5,585,172**	**382,396**			**1,421**
Street/Traffic Lights	School Traffic Signals	454				
	School Security Lights	41,159				
	Transfer Station Lights	10,014				
	Clay Pit Rd Flood Light	1,856				
	Street Lighting	291,857				
	Park Lights	31,068				
	Town Pier Rd Lights	10,568				
	Veterans Park	15,810				
	Total	**402,786**				

Table 3b. Native Units (Continued)

Vehicle	Fire Vehicles			3,130	17,751	
	Admin Vehicles			8,614	0	
	Cemetery Vehicles			9,991	2,236	
	Highway Vehicles			10,523	14,955	
	Transfer Station Vehicles			1,264	13,036	
	Wastewater Vehicles			5,261	2,158	
	School Vehicles			19,788	9	
	Water Vehicles			17,433	6,124	
	Police Vehicles			32,397	187	
	Total			**108,401**	**56,456**	
Water/Sewer	Wastewater Pump/Lift Stations	292,356	1,018			
	Wastewater Treatment Facility	2,392,700	32,330			
	School Wastewater Treatment	82,757	4,397			
	Cemetery Pumps	19,714				
	Water Pumps	1,950,595				
	Total	**4,738,122**	**37,745**			
Grand Total		**10,726,080**	**420,141**	**108,401**	**56,456**	**1,421**

VII. Appendix B-1: Building Energy Audits – Guardian Energy

nter Data into Y

Guardian Enegy Audit Report Summary - 12-9-2016

Town Energy Usage Breakdown					
Building Name	Building Address	Bldg. Sq. Ft.	FY2015 Annual Electric Usage [kWh]	FY2015 Annual NG Usage [Therms]	Baseline MMBtu FY2015
Furnace Brook Middle School	500 Furnace Street	159,220	830,960	86,359	11,471
Marshfield High School	167 Forest Street	268,000	2,363,540	49,215	12,986
Martinson Elementary School	275 Forest Street	92,900	406,880	53,514	6,740
South River Elementary	59 Hatch Street	62,790	213,600	40,179	4,747
Eames Way School	165 Eames Way	40,020	159,200	34,721	4,015
Daniel Webster School	1456 Ocean Street	58,805	182,320	19,466	2,569
Edward Winslow School	60 Regis Road	65,790	228,000	26,765	3,454

ellow Fields Or

Savings Data										
			Electric Rate			NG Rate				
			$0.15	[$/kWh]		$1.10	[$/therm]			
Building	**ECM**	**ECM Description**	**Annual Electric Savings [kWh]**	**Annual Electric Savings [$]**	**Annual Maintenance Savings [$]**	**Annual NG Savings [therms]**	**Annual NG Savings [$]**	**Annual MMBtus Saved**	**% MMBTU Savings**	**Total Annual Cost Savings [$]**
Furnace Brook Middle School	1	DCV - EMS - OS/S	88,834	$13,325	$0	16,726	$18,399	1,976	17.2%	$31,724
	2	Summer Boiler	0	$0	$0	3,596	$3,956	360	3.1%	$3,956
	3	Steam Trap Repair	0	$0	$0	3,677	$4,045	368	3.2%	$4,045
	4	Incentive App - Boilers On	2,169	$325	$0	12,004	$13,204	1,208	10.5%	$13,530
	5	Weatherization	1,387	$208	$0	873	$960	92	0.8%	$1,168
	6	Refrigeration Control	8,079	$1,212	$0	0	$0	28	0.2%	$1,212
	7	Lighting	184,497	$27,675	$7,870	0	$0	630	5.5%	$35,545
Martinson Elementary School	1	DCV - EMS - OS/S	20,415	$3,062	$0	15,882	$17,470	1,658	24.6%	$20,532
	2	Steam Trap Repair	0	$0	$0	5,351	$5,886	535	7.9%	$5,886
	3	Window AC Control	3,857	$579	$0	0	$0	13	0.2%	$579
	4	Weatherization	1,029	$154	$0	648	$713	68	1.0%	$867
	5	Refrigeration Control	8,079	$1,212	$0	0	$0	28	0.4%	$1,212
	6	Lighting	156,574	$23,486	$5,211	0	$0	534	7.9%	$28,697
South River Elementary	1	EMS - EF VFDs, OS/S	7,107	$1,066	$0	3,758	$4,134	400	8.4%	$5,200
	2	Steam Trap Survey	0	$0	$0	4,018	$4,420	402	8.5%	$4,420
	3	De-Strat Fans - Gym	-1,136	-$170	$0	502	$552	46	1.0%	$382
	4	Kitchen Ventilation	1,768	$265	$0	601	$661	66	1.4%	$926
	5	Harmonic Analysis	35,453	$5,318	$0	0	$0	121	2.5%	$5,318
	6	Lighting	91,696	$13,754	$4,922	0	$0	313	6.6%	$18,676
Eames Way School	1	De-Strats - Café	-568	-$85	$0	681	$749	66	1.6%	$664
	2	De-Strats - Gym	-568	-$85	$0	473	$520	45	1.1%	$435
	3	Lighting	56,611	$8,492	$2,638	0	$0	193	4.8%	$11,130
Daniel Webster School	1	De-Strats - Gym	-568	-$85	$0	520	$572	50	1.9%	$487
	2	Lighting	88,830	$13,325	$3,283	0	$0	303	11.8%	$16,608
Edward Winslow School	1	Lighting	85,297	$12,795	$3,123	0	$0	291	8.4%	$15,918
Council on Aging	1	Boiler Upgrade	3,579	$537	$0	2,699	$2,969	282	18.6%	$3,506
	2	Refrigeration Control	4,605	$691	$0	0	$0	16	1.0%	$691
	3	Lighting	44,873	$6,731	$1,731	0	$0	153	10.1%	$8,462
Library	1	Lighting	25,904	$3,886	$889	0	$0	88	6.2%	$4,775
Police	1	Lighting	66,724	$10,009	$1,230	0	$0	228	26.5%	$11,239
Town Hall	1	Lighting	41,361	$6,204	$2,768	0	$0	141	8.1%	$8,972
Street Lighting	1	Lighting	145,928	$21,889	$0	0	$0	498	50.0%	$21,889
Totals			**1,171,816**	**$175,772**	**$33,665**	**72,009**	**$79,210**	**11,199**	**21.3%**	**$288,647**

% MMBTU Reduction for all Muni Bldgs	**19.5%**

Financial Analysis									
Building	**ECM**	**ECM Description**	**Final Project Cost [$]**	**Est. Electric Incentive [$]**	**Est. Nat Gas Incentive [$]**	**Total Incentive [$]**	**Final Cost to Town [GC Grant]**	**Simple Rate of Return**	**Payback [years]**
Furnace Brook Middle School	**1**	DCV - EMS - OS/S	$99,540	$13,325	$16,726	$30,051	**$69,489**	45.7%	2.2
	2	Summer Boiler	$62,618	$0	$4,000	$4,000	**$58,618**	6.7%	14.8
	3	Steam Trap Repair	$44,117	$0	$5,000	$5,000	**$39,117**	10.3%	9.7
	4	Incentive App - Boile	$500	$0	$12,000	$12,000	**$500**	2706.0%	0.0
	5	Weatherization	$12,180	$347	$1,309	$1,656	**$10,524**	11.1%	9.0
	6	Refrigeration Contro	$8,208	$2,020	$0	$2,020	**$6,188**	19.6%	5.1
	7	Lighting	$484,007	$46,124	$0	$46,124	**$437,883**	8.1%	12.3
Martinson Elementary School	**1**	DCV - EMS - OS/S	$392,543	$38,400	$9,600	$48,000	**$344,543**	6.0%	16.8
	2	Steam Trap Repair	$29,557	$0	$5,000	$5,000	**$24,557**	24.0%	4.2
	3	Window AC Control	$7,751	$771	$0	$771	**$6,980**	8.3%	12.1
	4	Weatherization	$10,529	$257	$972	$1,229	**$9,300**	9.3%	10.7
	5	Refrigeration Contro	$8,208	$2,020	$0	$2,020	**$6,188**	19.6%	5.1
	6	Lighting	$309,384	$39,144	$0	$39,144	**$270,240**	10.6%	9.4
South River Elementary	**1**	EMS - EF VFDs, OS/S	$77,906	$9,000	$0	$9,000	**$68,906**	7.5%	13.3
	2	Steam Trap Survey	$44,117	$5,000	$0	$5,000	**$39,117**	11.3%	8.9
	3	De-Strat Fans - Gym	$18,281	$0	$703	$703	**$17,578**	2.2%	46.0
	4	Kitchen Ventilation	$33,319	$600	$0	$600	**$32,719**	2.8%	35.3
	5	Harmonic Analysis	$12,004	$7,091	$0	$7,091	**$4,913**	108.2%	0.9
	6	Lighting	$290,952	$22,924	$0	$22,924	**$268,028**	7.0%	14.4
Eames Way School	**1**	De-Strats - Café	$19,675	$0	$953	$953	**$18,722**	3.5%	28.2
	2	De-Strats - Gym	$19,675	$0	$662	$662	**$19,013**	2.3%	43.7
	3	Lighting	$154,216	$14,153		$14,153	**$140,063**	7.9%	12.6
Daniel Webster School	**1**	De-Strats - Gym	$15,112	$0	$728	$728	**$14,384**	3.4%	29.5
	2	Lighting	$190,945	$22,208	$0	$22,208	**$168,737**	9.8%	10.2
Edward Winslow School	**1**	Lighting	$181,555	$21,324	$0	$21,324	**$160,231**	9.9%	10.1
Council on Aging	**1**	Boiler Upgrade	$77,076	$0	$4,000	$4,000	**$73,076**	4.8%	20.8
	2	Refrigeration Contro	$7,058	$1,151	$0	$1,151	**$5,907**	11.7%	8.6
	3	Lighting	$100,779	$11,218	$0	$11,218	**$89,561**	9.4%	10.6
Library	**1**	Lighting	$52,813	$6,476	$0	$6,476	**$46,337**	10.3%	9.7
Police	**1**	Lighting	$73,216	$16,681	$0	$16,681	**$56,535**	19.9%	5.0
Town Hall	**1**	Lighting	$165,411	$10,340	$0	$10,340	**$155,071**	5.8%	17.3
Street Lighting	**1**	Lighting	$400,000	$36,482	$0	$36,482	**$363,518**	6.0%	16.6
Totals			**$3,403,252**	**$327,056**	**$61,654**	**$388,710**	**$3,026,542**	**10%**	**10.5**

December 9, 2016

Town of Marshfield
870 Moraine Street
Marshfield, MA 02050

Re: Marshfield Eames Way School Lighting

Dear Rocco,

We are pleased to provide you with the following proposal for consideration. In reviewing the opportunity to improve the energy efficiency and reduce operational costs for the building listed below, we are proposing the attached measures for your consideration.

Guardian is projecting utility incentives based upon previous projects and current incentive amounts available through your utility company's incentive program. We will submit utility incentive applications on your behalf, and the utility company will issue a final letter of commitment so that you can proceed with this project. A summary of our recommended project from a financial perspective is listed below:

Project	Annual kWh Usage	Project Cost	Incentive	Grant Request	kWh Saved	Therms Saved	Energy Cost Savings
Eames Way School Lighting	159,200	$154,216	$14,153	**$140,064**	56,611	N/A	$10,190

The total Green Community request for these projects should be **$140,064.**

If you have any questions, or if you would like to discuss specifics, please contact me directly at **(617) 935-9550**. Thank you again for the opportunity to provide this proposal to you. We will look forward to working with you on this project.

Sincerely,

William Harrow
Energy Efficiency Specialist

Email: williamh@guardian-energy.com
Direct: (617) 935-9550

Energy Efficiency Project Order Form

GUARDIAN
ENERGY MANAGEMENT SOLUTIONS

Date: December 9, 2016

Customer:

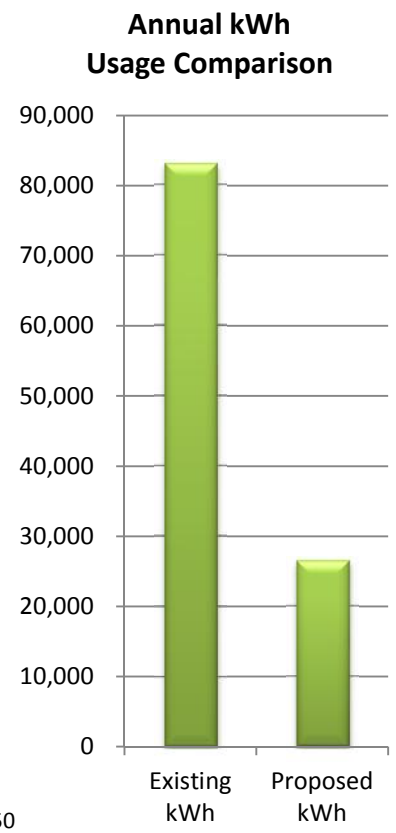
Town of Marshfield
870 Moraine Street
Marshfield, MA 02050

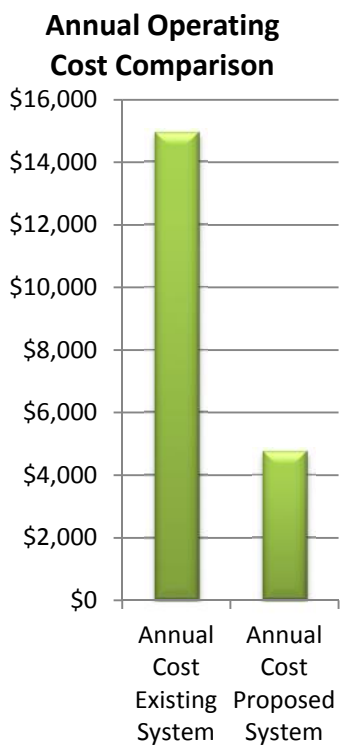
Project Type: Lighting
Project Location: Eames Way School

Project Pricing & Utility Incentives	
Project Cost	$154,216
(minus) Est. Utility Incentive	-$14,153
Final Cost	**$140,064**

ROI Estimates	
Return on Investment Rate	7%
Payback Timeframe (years)	13.75
Ten Year Payback Scenario	-$38,164
Annual Cost Existing System	$14,941
Annual Cost Proposed System	$4,751
Est. Annual Cost Savings	$10,190
Average Monthly Savings	$849
MMBTU Saved	193.2
Tons of CO2 Saved	43.0

Annual Estimated Electrical Savings	
Existing kWh	83,006
Proposed kWh	26,395
Saved kWh	**56,611**
Annual Electric Savings	$10,190
Annual Maintenance Savings	$2,638
Total Annual Savings	**$12,828**





Energy Efficiency Specialist: Billy Harrow, (617) 935-9550

Payment Terms: Guardian will submit an invoice for 50% of the Final Project Cost due upon receipt of the signed Project Agreement. The remaining 50% will be invoiced upon project completion. All invoices are payable with **Net30** payment terms unless otherwise noted. Late fees of 1.5% monthly are assessed after Net30 days.

Sales Tax Exemption: Guardian has assumed that you are exempt from paying state sales tax on the goods provided under this sale. To ensure sales tax is not charged to the amount above, please submit your **Tax Exemption Certificate** and a signed copy of the **ST-5C form** with your signed order form. If both forms are not received, the State of Massachusetts will require that Guardian add sales tax to the total project cost shown above

Incentives: If approved incentives are available for this project, your local utility company will submit the incentives for payment to Guardian to help buy down the total cost of this project as shown above. Any changes to the incentive will change the Final Amount Due.

Lighting Installation Plan and Schedule

This is a 'shovel ready' project and Guardian estimates that this project will take 6-7 weeks to implement upon order receipt. The following process defines a typical installation schedule:

Weeks 1-2

- Design Review and Walk Through
- Order material.
- Permits are secured for installation to proceed.

Weeks 3-4

- Dumpsters and storage containers delivered to site (if necessary)
- Materials delivered onsite

Weeks 5-7

- Lights are installed
- If necessary, System Commissioning Agent will commission system to ensure system is fully functional.
- System is tested and any final changes are made.
- If necessary, system training with staff.
- Final walk through with customer to ensure installation meets their satisfaction.

Note: All permits are included in this installation. This project is subject to a basic permitting process.

Guardian will apply the following resources to complete this project:

- Licensed electricians with foreman (installation)
- Project Manager (project oversight, planning and scheduling)
- System Commissioning Agent if necessary (programming, training, and commissioning)

Project Terms & Conditions

Project: Marshfield Eames Way School
Energy Efficiency Specialist: Billy Harrow, (617) 935-9550

This project involves a lighting retrofit that is designed to reduce the overall operational cost for the building owner, while improving the lighting for building occupants. The following Terms & Conditions apply to this project.

- We are proposing a turn-key energy efficiency project with fixed project costs. Guardian will provide all labor (licensed trades people paid at Prevailing Wage Rates), material, equipment, etc.
- Guardian will pay for and obtain any required permits (if applicable).
- Any existing equipment recycling and/or disposal will be handled & paid for by Guardian.
- Guardian assumes that all work can be completed during normal working hours (8am-6pm), Monday through Friday.
- Guardian is not responsible for the repair or alteration of equipment above and beyond the scope of work stated. Should Guardian identify any existing code violations, maintenance related issues to existing equipment or hazardous material (i.e. asbestos, faulty wiring, existing code violations, etc.) during the installation phase, we will alert the customer immediately and it will be the customer's responsibility to rectify the issue. Please keep in mind that we are proposing a basic energy efficiency retrofit project and are not responsible for existing conditions that were unknown to Guardian that may incur additional costs.
- Guardian will provide a Certificate of Insurance prior to the start of any work.
- Guardian will be responsible for the design, engineering and project management of this project.
- Customer will provide Guardian with tax exempt forms (if applicable).
- All pricing is valid for 30 days. Equipment costs may increase or decrease based on market trends. We are happy to present an update proposal should you not make a decision in the 30 day period. This proposal will expire 30 calendar days from 12/9/2016.

Proposal Acceptance

By signing below, you are agreeing to contract with Guardian Energy Management Solutions on this project. Any changes to the utility incentive may change the final amount due.

_____	_____
Printed Name	Title
_____	_____
Signature	Date

Please return this signed document via fax to Billy Harrow at (508) 597-1335, or email a scanned copy to: williamh@guardian-energy.com

Scope of Work Detail

GUARDIAN
ENERGY MANAGEMENT SOLUTIONS

EXISTING LIGHTING SYSTEM						PROPOSED LIGHTING SYSTEM					
Measure #	Location	Qty.	Existing Fixture Description	Existing Wattage	Existing Hours	Proposed Qty.	Proposed Fixture Description	Fixture Type and Wattage	Add Occupancy Sensor?	Proposed Hours	Total kWh Reduction
1	Front Drive	4	Shoe Box, Sq Pole	295	4,380	4	LED Shoe Box-AR1310M	85 WATT LED	Step Dim	3,066	4,126
2	Door 30	1	Wall Pack, Sm Forward Throw	95	4,380	1	Led Wall Pack-LWP-MN	10 WATT LED	None	4,380	372
3	Wall Near Parking Lot	1	Wall Pack, Forward Throw PC	120	4,380	1	LED Wall Pack-LWP-FT	24 WATT LED	None	4,380	420
4	Left Lot	3	Shoe Box, Sq Pole	295	4,380	3	LED Shoe Box-AR1310M	85 WATT LED	Step Dim	3,066	3,094
5	Gym Door	1	Wall Pack, Sm Forward Throw	95	4,380	1	Led Wall Pack-LWP-MN	10 WATT LED	None	4,380	372
6	Back Drive	1	Shoe Box, Sq Pole	295	4,380	1	LED Shoe Box-AR1310M	85 WATT LED	Step Dim	3,066	1,031
7	Door 4	1	Wall Pack, Sm Forward Throw	95	4,380	1	Led Wall Pack-LWP-MN	10 WATT LED	None	4,380	372
8	Door 6	1	Wall Pack, Sm Forward Throw	95	4,380	1	Led Wall Pack-LWP-MN	10 WATT LED	None	4,380	372
9	Door 11	1	Wall Pack, Sm Forward Throw	95	4,380	1	Led Wall Pack-LWP-MN	10 WATT LED	None	4,380	372
10	Door 11	1	Wall Pack, Forward Throw PC	120	4,380	1	LED Wall Pack-LWP-FT	24 WATT LED	None	4,380	420
11	Back Lot	4	Shoe Box, Sq Pole	295	4,380	4	LED Shoe Box-AR1310M	85 WATT LED	Step Dim	3,066	4,126
12	Door 13+20	2	Wall Pack, Forward Throw PC	120	4,380	2	LED Wall Pack-LWP-FT	24 WATT LED	None	4,380	841
13	Middle Door in Courtyard	1	Wall Pack, Forward Throw PC	120	4,380	1	LED Wall Pack-LWP-FT	24 WATT LED	None	4,380	420
14	Door 21	1	Wall Pack, Sm Forward Throw	95	4,380	1	Led Wall Pack-LWP-MN	10 WATT LED	None	4,380	372
15	Door 21	1	Wall Pack, Forward Throw PC	120	4,380	1	LED Wall Pack-LWP-FT	24 WATT LED	None	4,380	420
16	Door 23	1	Wall Pack, Forward Throw PC	120	4,380	1	LED Wall Pack-LWP-FT	24 WATT LED	None	4,380	420
17	Door 26	1	Wall Pack, Forward Throw PC	120	4,380	1	LED Wall Pack-LWP-FT	24 WATT LED	None	4,380	420

18	Near 26	1	Wall Pack, Forward Throw PC	120	4,380	1	LED Wall Pack-LWP-FT	24 WATT LED	None	4,380	420
19	Door 29	1	Wall Pack, Sm Forward Throw	95	4,380	1	Led Wall Pack-LWP-MN	10 WATT LED	None	4,380	372
20	8	12	4' Wrap	60	1,780	12	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,353	795
21	9	12	4' Wrap	60	1,780	12	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,353	795
22	6	12	4' Wrap	60	1,780	12	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,353	795
23	7	12	4' Wrap	60	1,780	12	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,353	795
24	4	12	4' Wrap	60	1,780	12	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,353	795
25	5	12	4' Wrap	60	1,780	12	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,353	795
26	Boys	3	4' Wrap	60	2,480	3	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,885	277
27	Staff Bathroom	1	2' Wrap	37	2,480	1	LED Retrofit-Lin	18 WATT LED	Occ Sensor	1,885	58
28	Data Closet	1	4' Wrap	60	400	1	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	304	15
29	Girls	3	4' Wrap	60	2,480	3	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,885	277
30	2	12	4' Wrap	60	1,780	12	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,353	795
31	3	12	4' Wrap	60	1,780	12	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,353	795
32	1	9	4' Wrap	60	1,780	9	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,353	596
33	Gym	12	High Bay-Surface Mount	177	3,300	12	LED High Bay w/ Adaptive Technology-4MS	88 WATT LED	Occ Sensor	2,508	4,361
34	Phys Ed Office	1	4' Wrap	60	1,780	1	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,353	66
35	Boys	2	4' Vapor Tight	60	2,480	2	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,885	185
36	Gym Entrance	1	4' Wrap	60	3,300	1	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	2,508	123
37	Girls	2	4' Vapor Tight	60	2,480	2	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,885	185
38	32	1	4' Wrap	60	1,780	1	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,353	66
39	10	4	4' Wrap	60	1,780	4	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,353	265
40	Clinic	6	4' Wrap	60	2,410	6	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,832	538

41	Clinic Bath	1	2' Wrap	37	2,410	1	LED Retrofit-Lin	18 WATT LED	Occ Sensor	1,832	56
42	11	4	4' Wrap	60	1,780	4	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,353	265
43	30	2	4' Wrap	60	1,780	2	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,353	132
44	12	2	4' Wrap	60	1,780	2	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,353	132
45	12 Kitchenette	1	2x4 Prismatic Lens	88	1,780	1	LED 2x4 Vola- w/ Adaptive Technology	35 WATT LED	Occ Sensor	1,353	109
46	Restroom	1	2x4 Prismatic Lens	60	2,480	1	LED 2x4 Vola- w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,885	92
47	Office	3	4' Wrap	60	2,410	3	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,832	269
48	Assistant Prin	1	4' Wrap	60	2,410	1	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,832	90
49	Office Bath	1	2' Wrap	37	2,480	1	LED Retrofit-Lin	18 WATT LED	Occ Sensor	1,885	58
50	Principal	2	4' Wrap	60	2,410	2	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,832	179
51	Display	1	4' Strip	30	8,760	1	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	6,658	63
52	25	4	4' Wrap	60	1,780	4	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,353	265
53	22	10	4' Wrap	60	1,780	10	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,353	662
54	28	1	8' Strip	112	1,780	1	4' LED Wrap w/ Adaptive Technology	45 WATT LED	Occ Sensor	1,353	138
55	26	11	4' Wrap	60	1,780	11	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,353	728
56	27	4	4' Wrap	60	1,780	4	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,353	265
57	Men	1	4' Wrap	60	2,480	1	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,885	92
58	Women	2	4' Wrap	60	2,480	2	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,885	185
59	General Storage	1	4' Wrap	60	400	1	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	304	15
60	Caf	8	High Bay-Chain	234	1,780	8	LED High Bay w/ Adaptive Technology-4MS	88 WATT LED	Occ Sensor	1,353	2,380
61	Stage	4	High Bay-Chain	234	1,480	4	LED High Bay w/ Adaptive Technology-4MS	88 WATT LED	Occ Sensor	1,125	989
62	Kitchen	12	2x4 Prismatic Lens	112	1,780	12	LED 2x4 Vola- w/ Adaptive Technology	35 WATT LED	Occ Sensor	1,353	1,824
63	Kitchen Office	1	4' Wrap	60	1,480	1	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,125	55

64	Ms Low	1	4' Wrap	60	2,410	1	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,832	90
65	15	12	4' Wrap	60	1,780	12	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,353	795
66	Girls	3	4' Wrap	60	2,480	3	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,885	277
67	14	12	4' Wrap	60	1,780	12	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,353	795
68	Bathroom	1	2' Wrap	37	2,480	1	LED Retrofit-Lin	18 WATT LED	Occ Sensor	1,885	58
69	Boys	3	4' Wrap	60	2,780	3	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	2,113	310
70	17	12	4' Wrap	60	1,780	12	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,353	795
71	16	12	4' Wrap	60	1,780	12	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,353	795
72	19	12	4' Wrap	60	1,780	12	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,353	795
73	18	12	4' Wrap	60	1,780	12	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,353	795
74	21	12	4' Wrap	60	1,780	12	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,353	795
75	20	12	4' Wrap	60	1,780	12	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,353	795
76	Hallway	41	2x4 Prismatic Lens	60	3,616	41	LED 2x4 Vola- w/ Adaptive Technology	30 WATT LED	Occ Sensor	2,748	5,515
77	Hallway	21	2x4 Prismatic Lens w Emerg Ball	60	3,616	21	LED 2x4 Vola- w/ Adaptive Technology	30 WATT LED	Occ Sensor	2,748	2,825
Totals		**414**				**414**					**56,611**

Invoicing Details

Please provide the invoicing details for this project below.

Bill to: _____

Address: _____

City, State & Zip: _____

Invoicing Contact: _____

Phone: _____ Email: _____

Purchase Order # (If applicable): _____

Are you Tax Exempt? If so, Please remember to include your Tax Exempt Certificate and ST-5C with this order form.

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 Eversource.

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.

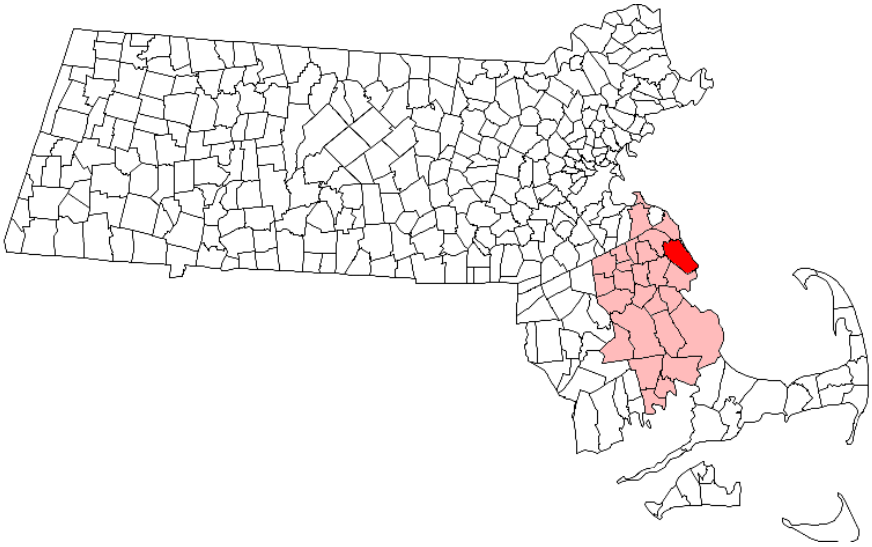
Massachusett's Accelerated Energy Program (AEP)
Guardian is an approved vendor under the Massachusetts Accelerated Energy Program and provides energy audits and implementation services for energy efficiency projects under DCAM (Division of Capital Asset Management) for a variety of state owned and/or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

Guardian Energy Management Solutions™
420 Northboro Road Central, Marlborough, MA 01752 www.guardian-energy.com

Stop Wasting Energy. Start Saving Money.™

Town of Marshfield
Energy Reduction Project Summary

November 2016



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Introduction

Guardian Energy Management Solutions is pleased to provide the following Energy Reduction Project Summary for the Town of Marshfield to help support Marshfield'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 Marshfield will be selecting specific projects for implementation over the course of time. Guardian will continue to support the Town of Marshfield 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 Eversource for its Electric accounts and Columbia Gas for any gas related accounts. Guardian is an approved project expeditor for National Grid's energy efficiency retrofit program and will assist Marshfield 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 2016, 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 $1.40/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.

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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 project summary 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 2015 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.

Weatherization Assumptions & Exclusions

- *Door and Window Replacement Projects – this Report does not include recommendations to replace doors or windows; a separate glazing or general contractor should be utilized to investigate door and window replacement projects in more detail.*
- *Electrical Hazards – testing and/ or repair of hazardous electrical components (knob and tube wiring, open junction boxes, etc) that are encountered are excluded from the B|E Retrofit scope of work and pricing. Others are responsible for testing and/ or repair of electrical hazards.*
- *Hazardous Materials – testing, remediation and/ or removal of any potentially hazardous material that is encountered is excluded from the Guardian scope of work and pricing. Others are responsible for testing, remediation and/ or removal of potentially hazardous material.*
- *Unit Ventilators – weatherization work related to unit ventilators is not included in this Report. Air leakage around unit ventilators are often associated with occupant comfort complaints for drafts and to maintenance issues related to frozen pipes. The infiltration at unit ventilators is also a savings opportunity. Guardian has developed a system that reduces unwanted air infiltration at unit ventilators and directs outside air properly to the fan coil unit (See the Factsheet – Unit Ventilator Air Sealing included with the other Factsheets). If there are specific locations where unit ventilators are problematic, an inspection of the unit vents could be scheduled with a Guardian installation team and project manager. In order to inspect the performance of unit ventilators related to controlling air infiltration the intake grate must be removed from the outside. Note that the caulk around any unit vents installed before 1977 may need to undergo an environmental test for PCBs and/or asbestos prior to work.*

Report Summary

Guardian Energy Management Solutions (GEMS) was requested to assess and document each building in this report through a walk-through building audit for the Town of Marshfield. 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 energy audit 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 Marshfield meet its energy reduction goals. The baseline energy usage summary is below.

Baseline Energy Usage Overview

Town Energy Usage Breakdown							
Building Name	**Building Address**	**Bldg. Sq. Ft.**	**FY2015 Annual Electric Usage [kWh]**	**FY2015 Annual NG Usage [Therms]**	**FY2015 Annual Oil Usage [gal]**	**FY2015 Annual Propane Usage [gal]**	**Baseline MMBtu FY2015**
Furnace Brook Middle School	500 Furnace Street	159,220	830,960	86,359	0	0	11,471
Marshfield High School	167 Forest Street	268,000	2,363,540	49,215	0	0	12,986
Martinson Elementary School	275 Forest Street	92,900	406,880	53,514	0	0	6,740
South River Elementary	59 Hatch Street	62,790	213,600	40,179	0	0	4,747
Eames Way School	165 Eames Way	40,020	159,200	34,721	0	0	4,015
Daniel Webster School	1456 Ocean Street	58,805	182,320	19,466	0	0	2,569
Edward Winslow School	60 Regis Road	65,790	228,000	26,765	0	0	3,454
Council on Aging	230 Webster Street	n/a	131,360	10,661	0	0	1,514
Library	15 Library Plaza	n/a	153,760	8,970	0	0	1,422
Police	1639 Ocean Street	n/a	145,280	3,643	0	0	860
Town Hall	870 Moraine Street	n/a	220,480	9,973	0	0	1,750
Street Lighting	n/a	n/a	291,857	0	0	0	996
		Totals	**5,327,237**	**343,466**	**0**	**0**	**52,523**

Energy Savings Summary

Savings Data										
			Electric Rate			NG Rate				
			$0.15	[$/kWh]		$1.10	[$/therm]			
Building	**ECM**	**ECM Description**	**Annual Electric Savings [kWh]**	**Annual Electric Savings [$]**	**Annual Maintenance Savings [$]**	**Annual NG Savings [therms]**	**Annual NG Savings [$]**	**Annual MMBtus Saved**	**% MMBTU Savings**	**Total Annual Cost Savings [$]**
Furnace Brook Middle School	1	DCV - EMS - OS/S	88,834	$13,325		16,726	$18,399	1,976	17.2%	$31,724
	2	Summer Boiler	0	$0		3,596	$3,956	360	3.1%	$3,956
	3	Steam Trap Repair	0	$0		3,677	$4,045	368	3.2%	$4,045
	4	Incentive App - Boilers Only	2,169	$325		12,004	$13,204	1,208	10.5%	$13,530
	5	Weatherization	1,387	$208		873	$960	92	0.8%	$1,168
	6	Refrigeration Control	8,079	$1,212		0	$0	28	0.2%	$1,212
	7	Lighting	184,497	$27,675	$7,870	0	$0	630	5.5%	$35,545
Martinson Elementary School	1	DCV - EMS - OS/S	20,415	$3,062		15,882	$17,470	1,658	24.6%	$20,532
	2	Steam Trap Repair	0	$0		5,351	$5,886	535	7.9%	$5,886
	3	Window AC Control	3,857	$579		0	$0	13	0.2%	$579
	4	Weatherization	1,029	$154		648	$713	68	1.0%	$867
	5	Refrigeration Control	8,079	$1,212		0	$0	28	0.4%	$1,212
	6	Lighting	156,574	$23,486	$5,211	0	$0	534	7.9%	$28,697
South River Elementary	1	EMS - EF VFDs, OS/S	7,107	$1,066		3,758	$4,134	400	8.4%	$5,200
	2	Steam Trap Survey	0	$0		4,018	$4,420	402	8.5%	$4,420
	3	De-Strat Fans - Gym	-1,136	-$170		502	$552	46	1.0%	$382
	4	Kitchen Ventilation	1,768	$265		601	$661	66	1.4%	$926
	5	Harmonic Analysis	35,453	$5,318		0	$0	121	2.5%	$5,318
	6	Lighting	91,696	$13,754	$4,922	0	$0	313	6.6%	$18,676
Eames Way School	1	De-Strats - Café	-568	-$85	$0	681	$749	66	1.6%	$664
	2	De-Strats - Gym	-568	-$85	$0	473	$520	45	1.1%	$435
Daniel Webster School	1	De-Strats - Gym	-568	-$85	$0	520	$572	50	1.9%	$487
	2	Lighting	88,830	$13,325	$3,283	0	$0	303	11.8%	$16,608
Edward Winslow School	1	Lighting	85,297	$12,795	$3,123	0	$0	291	8.4%	$15,918
Council on Aging	1	Boiler Upgrade	3,579	$537	$0	2,699	$2,969	282	18.6%	$3,506
	2	Refrigeration Control	4,605	$691	$0	0	$0	16	1.0%	$691
	3	Lighting	44,873	$6,731	$1,731	0	$0	153	10.1%	$8,462
Library	1	Lighting	25,904	$3,886	$889	0	$0	88	6.2%	$4,775
Police	1	Lighting	66,724	$10,009	$1,230	0	$0	228	26.5%	$11,239
Town Hall	1	Lighting	41,361	$6,204	$2,768	0	$0	141	8.1%	$8,972
Street Lighting	1	Lighting	145,928	$21,889	$0	0	$0	498	50.0%	$21,889
Totals			**1,115,205**	**$167,281**	**$31,027**	**72,009**	**$79,210**	**11,006**	**21.0%**	**$277,518**

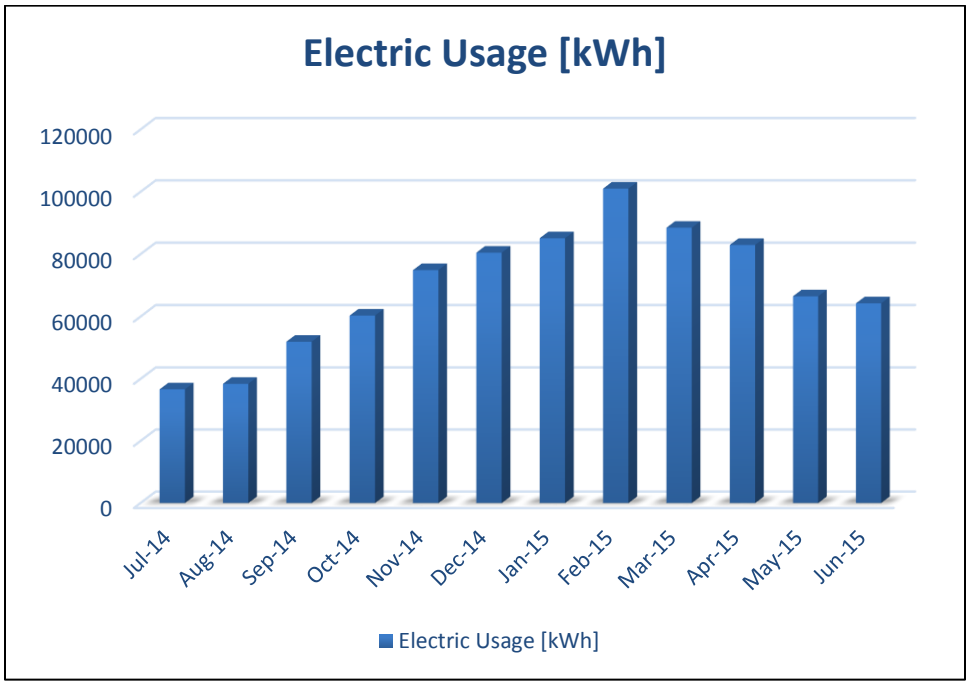
% MMBTU Reduction for all Muni Bldgs	**19.2%**

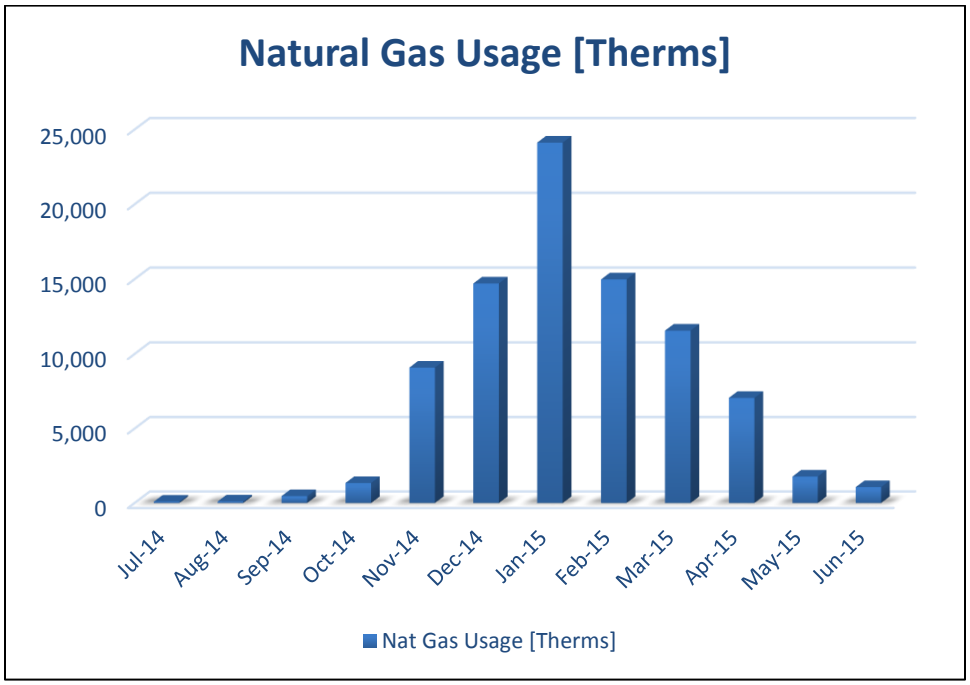
Financial Savings Summary

Financial Analysis									
Building	**ECM**	**ECM Description**	**Final Project Cost [$]**	**Est. Electric Incentive [$]**	**Est. Nat Gas Incentive [$]**	**Total Incentive [$]**	**Final Cost to Town [GC Grant]**	**Simple Rate of Return**	**Payback [years]**
Furnace Brook Middle School	**1**	DCV - EMS - OS/S	$99,540	$13,325	$16,726	$30,051	**$69,489**	45.7%	2.2
	2	Summer Boiler	$62,618	$0	$4,000	$4,000	**$58,618**	6.7%	14.8
	3	Steam Trap Repair	$44,117	$0	$5,000	$5,000	**$39,117**	10.3%	9.7
	4	Incentive App - Boilers Only	$500	$0	$12,000	$12,000	**$500**	2706.0%	0.0
	5	Weatherization	$12,180	$347	$1,309	$1,656	**$10,524**	11.1%	9.0
	6	Refrigeration Control	$8,208	$2,020	$0	$2,020	**$6,188**	19.6%	5.1
	7	Lighting	$484,007	$46,124	$0	$46,124	**$437,883**	8.1%	12.3
Martinson Elementary School	**1**	DCV - EMS - OS/S	$392,543	$38,400	$9,600	$48,000	**$344,543**	6.0%	16.8
	2	Steam Trap Repair	$29,557	$0	$5,000	$5,000	**$24,557**	24.0%	4.2
	3	Window AC Control	$7,751	$771	$0	$771	**$6,980**	8.3%	12.1
	4	Weatherization	$10,529	$257	$972	$1,229	**$9,300**	9.3%	10.7
	5	Refrigeration Control	$8,208	$2,020	$0	$2,020	**$6,188**	19.6%	5.1
	6	Lighting	$309,384	$39,144	$0	$39,144	**$270,240**	10.6%	9.4
South River Elementary	**1**	EMS - EF VFDs, OS/S	$77,906	$9,000	$0	$9,000	**$68,906**	7.5%	13.3
	2	Steam Trap Survey	$44,117	$5,000	$0	$5,000	**$39,117**	11.3%	8.9
	3	De-Strat Fans - Gym	$18,281	$0	$703	$703	**$17,578**	2.2%	46.0
	4	Kitchen Ventilation	$33,319	$600	$0	$600	**$32,719**	2.8%	35.3
	5	Harmonic Analysis	$12,004	$7,091	$0	$7,091	**$4,913**	108.2%	0.9
	6	Lighting	$290,952	$22,924	$0	$22,924	**$268,028**	7.0%	14.4
Eames Way School	**1**	De-Strats - Café	$19,675	$0	$953	$953	**$18,722**	3.5%	28.2
	2	De-Strats - Gym	$19,675	$0	$662	$662	**$19,013**	2.3%	43.7
Daniel Webster School	**1**	De-Strats - Gym	$15,112	$0	$728	$728	**$14,384**	3.4%	29.5
	2	Lighting	$190,945	$22,208	$0	$22,208	**$168,737**	9.8%	10.2
Edward Winslow School	**1**	Lighting	$181,555	$21,324	$0	$21,324	**$160,231**	9.9%	10.1
Council on Aging	**1**	Boiler Upgrade	$77,076	$0	$4,000	$4,000	**$73,076**	4.8%	20.8
	2	Refrigeration Control	$7,058	$1,151	$0	$1,151	**$5,907**	11.7%	8.6
	3	Lighting	$100,779	$11,218	$0	$11,218	**$89,561**	9.4%	10.6
Library	**1**	Lighting	$52,813	$6,476	$0	$6,476	**$46,337**	10.3%	9.7
Police	**1**	Lighting	$73,216	$16,681	$0	$16,681	**$56,535**	19.9%	5.0
Town Hall	**1**	Lighting	$165,411	$10,340	$0	$10,340	**$155,071**	5.8%	17.3
Street Lighting	**1**	Lighting	$400,000	$36,482	$0	$36,482	**$363,518**	6.0%	16.6
Totals			**$3,249,036**	**$312,903**	**$61,654**	**$374,557**	**$2,886,479**	**10%**	**10.4**

Furnace Brook Middle School

The Furnace Brook Middle School is a two-story brick building with a full basement and a flat roof top. The building is currently heated by (3) natural gas-fired boilers and cooled by window AC units. The school has plans to replace the (3) boilers in December of 2016. The domestic hot water is served by (2) PVI water heaters, (1) of which is currently out-of-commission. Energy conservation measures for the Furnace Brook Middle School identified by Guardian Energy include an energy management system upgrade, switching the PVI DHW heaters to an indirect water heater, retro-commissioning of the HW Plant, lighting and lighting controls upgrades, and refrigeration controls.





Recommended Energy Conservation Measures (ECM's)

ECM 1: Demand Control Ventilation (DCV) and EMS Upgrades

Current System: The existing air handling systems are constant-volume single-zone systems that provide adequate circulation for peak design conditions. Throughout the heating and cooling seasons, these systems are providing significant CFM of outdoor air which has to be conditioned (heated/cooled) before it enters the space. This heated and treated air is then almost immediately exhausted back outside. During the times of day when certain spaces are not at full occupancy, this constant ventilation is not required to meet the heating/cooling demand load or the minimum fresh air requirements. There is a potential opportunity to reduce the ventilation when these rooms are not at full occupancy. This would therefore reduce the amount of air being heated and treated every day throughout the heating and cooling seasons and would reduce overall energy consumption throughout the year. CO2 sensors would be utilized in these spaces to alert the system as to when greater levels of ventilation are required due to fluctuations in occupancy to comply with fresh air requirements.

Recommendations: Guardian recommends installing DCV in the following spaces:

Proposed DCV Locations					
			Airflow, CFM		
Unit Tag	Service	Current System Control	Total	OA	Supply HP
AHU-1	Gymnasium	Const	8000	4000	5
AHU-2	Gymnasium	Const	8000	4000	5
RTU-1	Auditorium	Const	16000	8000	20
RTU-2	Cafeteria	Const	16800	6800	20
RTU-4	Media Center	Const	6000	2000	7.5

EMS Optimum Start:

An EMS is a building-wide energy management system (EMS) that allows for a variety of energy saving opportunities including occupancy sensor driven ventilation, night-time setback scheduling, and optimum start. The start-up time for a building is the time it takes to heat the building up from its' cooler nighttime un-occupied set-point to the higher and more comfortable daytime occupied set-point. This is typically done in the early morning hours before the building is open. The time it takes to warm the building up can vary due to outdoor conditions. By activating an optimum start, the building will begin to automatically heat itself up at the "right" time every day. This will cut down on the overall start-up time and will reduce the overall heating fuel usage.

ECM 2: Summer Boiler

Existing:

- The existing Domestic Hot Water (DHW) is served by (2) PVI DHW Heaters. One (1) of these is currently failed.

Recommendations:

- Guardian recommends the installation of a gas fired summer boiler with (2) indirect water heaters. This will be supplemented with a connection to the winter boilers and a control valve to provide a potable hot water source in case of summer boiler failure or for use during the winter. This will not only reduce stand-by losses, but it will reduce maintenance and repair costs as well.

ECM 3: Steam Trap Repair

According to the US D.O.E. in steam systems that have not been maintained for 3 to 5 years, between 15% - 30% of the installed steam traps may have failed—thus allowing live steam to escape into the condensate return system. In systems with a regularly scheduled maintenance program, leaking traps should account for less than 5% of the trap population.

ECM 4: Incentive Applications – Boiler Replacement

The Furnace Brook Middle School has plans to replace their boilers sometime in December of 2016. Guardian Energy Management Solutions works closely with local utility companies throughout New England. We combine energy conservation solutions with available utility incentive funding to reduce project costs for our clients. Guardian is an approved vendor with National Grid and Eversource and can help facilitate the incentive application process by providing energy savings calculations and assistance with document preparation.

ECM 5: Weatherization Upgrades

Findings: Furnace Brook Middle School

- Roof-Wall Intersection Air Sealing – the roof-wall intersection is regularly an area that allows unwanted air leakage through the building shell. Exterior flashing and finish details at this area are not constructed to stop air leakage (exterior flashings are for water control, not air control); unsealed exterior flashing details combine with interior gaps in the framing between the roof and wall assembly to allow infiltration/ exfiltration.
- Overhang Air Sealing – overhangs are roofs, floor systems or areas above entryways that extend beyond the plane of the exterior wall system. These areas of construction are often misunderstood by builders and the cavity that extends beyond the plane of the exterior wall system is often incorrectly "connected" to the interior heated spaces of the building. Overhangs that are not properly sealed at the plane of the surface that should separate the conditioned space from the outdoors lead to excessive air leakage and heat loss at these vulnerable areas in the building envelope.

Recommendations:

- Roof-Wall Intersection Air Sealing
- Overhang Air Sealing

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

Roof-Wall Intersection Air Sealing – gaps at the interior of the roof-wall intersection combine with the unsealed exterior flashing and finish details to allow unwanted infiltration/ exfiltration (Furnace Brook MS).

Overhang Air Sealing – the yellow arrow shows a pathway between the outdoor overhang and the conditioned space; the

Overhang Air Sealing – the overhang extends beyond the conditioned space; air bypasses in the exterior finishes

bypasses in the exterior soffit combine with the gaps at the plane of the wall system to allow unwanted air leakage and heat loss (Furnace Brook MS).

Overhang Air Sealing – there is no air barrier in place to separate the conditioned space from the outdoor overhang at the plane of the exterior wall below (shown by the yellow arrow). As a result, there is excessive air leakage and heat loss at this area in the building (Furnace Brook MS).

including recessed lights and gaps at the perimeter of the outdoor ceiling surface are direct pathways for infiltration/ exfiltration (Furnace Brook MS).

ECM 6: Refrigeration Controls

The Frigitek is an energy saving device designed for walk-in or industrial refrigerators and freezers. The purpose of a refrigeration compressor and related equipment is to pump heat out of a box. Often, more than 30% of that heat is generated by the evaporator fan motors. Frigitek reduces this heat load approximately 75-80% by lowering the voltage to the evaporator fan motors when the box is not being actively cooled. The result is a significant saving in operation costs. The dramatic energy saving produced by the Frigitek have been confirmed by more than ten years of extensive laboratory and field testing and satisfied customers.

ECM 7: Lighting and Lighting Controls Upgrade

Findings

Inefficient lighting equipment and lighting controls or lack thereof can be a significant source of unnecessary energy waste. Only 5-10% of the energy used by an incandescent light bulb is actually converted into light. The remaining 90-95% of the energy used is released into the space as waste heat. This can add to the cooling load during summer. Newer more efficient lighting technology is currently available at affordable costs. In addition utility sponsored incentives are available to help buy down the initial cost of lighting upgrades.

Recommendations

Guardian recommends implementing the lighting upgrade measures listed below and can facilitate the process of applying for available incentives from National Grid.

EXISTING LIGHTING SYSTEM				
Measure #	Location	Qty.	Existing Fixture Description	Lamp/ Ballast Type
1	Main Entrance Canopy	12	Canopy	70W METAL HALIDE
2	Door 2	6	Canopy	70W METAL HALIDE
3	Door 4	1	Canopy	70W METAL HALIDE
4	Door 5	2	Canopy	70W METAL HALIDE
5	Door 6	1	Canopy	70W METAL HALIDE
6	Door 7	1	Canopy	70W METAL HALIDE
7	Door 8	1	Canopy	70W METAL HALIDE
8	Door 9	1	Canopy	70W METAL HALIDE
9	Door 10	1	Canopy	70W METAL HALIDE
10	North Wall	2	Flood, Fixed Mount	400W METAL HALIDE
11	Door 11	1	Canopy	70W METAL HALIDE
12	West Wall	2	Flood, Fixed Mount	400W METAL HALIDE
13	North Gym Wall	2	Flood, Fixed Mount	400W METAL HALIDE
14	Gym Entrance Door 18	10	Canopy	70W METAL HALIDE
15	Door 19	1	Canopy	70W METAL HALIDE
16	Right Lot	9	Shoe Box, Sq. Pole	400W METAL HALIDE
17	Gym Lot	2	Shoe Box, Sq. Pole	400W METAL HALIDE
18	Gym Lot	1	Utility Light	150W METAL HALIDE
19	Front Drive	2	Shoe Box, Sq. Pole	400W METAL HALIDE
20	Left Lot	13	Shoe Box, Sq. Pole	400W METAL HALIDE
21	Main Entrance	3	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
22	Main Lobby	7	8" Recessed Cans-Hard Ceiling	2/26W COMPACT HW ELIG
23	Main Lobby	32	8" Recessed Cans-Drop Ceiling	2/26W COMPACT HW ELIG
24	Main Office	16	2x4 Prismatic Lens Bi-Lev Switch	2L4' 30W T8EE/ELEE
25	Main Office	2	2x2 Prismatic Lens Bi-Lev Switch	2L4' 30W T8EE/ELEE
26	Mr. Millis	2	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
27	Mrs. Kemmett	3	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
28	Copy	2	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
29	101	9	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
30	101	1	2x2 Prismatic Lens Bi-Lev Switch	2L4' 30W T8EE/ELEE
31	103	8	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
32	105	8	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
33	107	11	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
34	109	7	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
35	109	1	2x2 Prismatic Lens Bi-Lev Switch	2L4' 30W T8EE/ELEE
36	111	8	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
37	Conf Room	4	2x2 Prismatic Lens Bi-Lev Switch	2L4' 30W T8EE/ELEE
38	113	8	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
39	115	12	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
40	117	8	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
41	Conf Room	4	2x2 Prismatic Lens Bi-Lev Switch	2L4' 30W T8EE/ELEE
42	119	8	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
43	121	7	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
44	121	1	2x2 Prismatic Lens Bi-Lev Switch	2L4' 30W T8EE/ELEE
45	123	11	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
46	123	1	2x2 Prismatic Lens Bi-Lev Switch	2L4' 30W T8EE/ELEE
47	125	8	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
48	127	8	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
49	129	9	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
50	129	1	2x2 Prismatic Lens Bi-Lev Switch	2L4' 30W T8EE/ELEE

51	5	10	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
52	Science Resources	4	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
53	7	10	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
54	9	8	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
55	11	8	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
56	Gym	40	High Bay	4L4' T8/ELIG HIGH LMN
57	Girls Locker	16	Vapor Tight	2L4' 30W T8EE/ELEE
58	Girls Locker	5	1x4 Wide Wrap	2L4' 30W T8EE/ELEE
59	Girls Locker Office	3	2x4 Prismatic Lens Bi-Lev Switch	2L4' 30W T8EE/ELEE
60	Boys Locker	2	2x4 Prismatic Lens Bi-Lev Switch	2L4' 30W T8EE/ELEE
61	Boys Locker	18	Vapor Tight	2L4' 30W T8EE/ELEE
62	Boys Locker	5	1x4 Wide Wrap	2L4' 30W T8EE/ELEE
63	Boys Locker	4	2x4 Prismatic Lens Bi-Lev Switch	2L4' 30W T8EE/ELEE
64	Boys Room	3	2x4 Prismatic Lens Bi-Lev Switch	2L4' 30W T8EE/ELEE
65	Girls Room	3	2x4 Prismatic Lens Bi-Lev Switch	2L4' 30W T8EE/ELEE
66	Custodian	1	2x4 Prismatic Lens Bi-Lev Switch	2L4' 30W T8EE/ELEE
67	13	11	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
68	15	8	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
69	17	8	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
70	21	8	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
71	23	6	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
72	Tech Ed	9	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
73	27	8	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
74	Boiler Room	9	4' Strip	2L4' 30W T8EE/ELEE
75	Custodian Office Storage	6	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
76	Custodian Office	2	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
77	Storage Off Kitchen	2	2x4 Prismatic Lens	3L4' 30W T8EE/ELEE
78	Kitchen Bathroom	1	2x4 Prismatic Lens	3L4' 30W T8EE/ELEE
79	Kitchen	20	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
80	Kitchen Storage	1	2x4 Prismatic Lens	3L4' 30W T8EE/ELEE
81	Laundry	1	2x4 Prismatic Lens	3L4' 30W T8EE/ELEE
82	Mrs. Landry	6	2x4 Prismatic Lens	3L4' 30W T8EE/ELEE
83	Mrs. Landry	2	10" Recessed Can	2/26W COMPACT HW ELIG
84	Dietitian	1	2x4 Prismatic Lens	3L4' 30W T8EE/ELEE
85	Storage Room	1	2x4 Prismatic Lens	3L4' 30W T8EE/ELEE
86	Cafeteria	32	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
87	Cafeteria	46	10" Recessed Can	2/26W COMPACT HW ELIG
88	Choral	12	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
89	Practice Room 1	1	2x4 Prismatic Lens	3L4' 30W T8EE/ELEE
90	Practice Room 2	1	2x4 Prismatic Lens	3L4' 30W T8EE/ELEE
91	Practice Room 3	1	2x4 Prismatic Lens	3L4' 30W T8EE/ELEE
92	Band Room	12	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
93	Band Room	2	8' Strip	4L4' 30W T8EE/ELEE
94	Band Room	1	4' Strip	2L4' 30W T8EE/ELEE
95	Band Office	2	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
96	Band Office Bathroom	1	2x2 Prismatic Lens	2L4' 30W T8EE/ELEE
97	Drum Room	2	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
98	Audio Visual Storage	4	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
99	317	2	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
100	Library Computer Area	25	1x4 Parabolic Lens	2L4' 30W T8EE/ELEE
101	Main Library Area	21	2x4 Parabolic Lens	2L4' 30W T8EE/ELEE
102	Head End Room	2	2x4 Prismatic Lens	3L4' 30W T8EE/ELEE
103	Grade 8 Computer Lab	10	2x4 Parabolic Lens	2L4' 30W T8EE/ELEE
104	MS Cullen/MS Delucca	2	2x4 Parabolic Lens	2L4' 30W T8EE/ELEE
105	Work Room	2	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
106	Library Entrance	5	2x4 Parabolic Lens	2L4' 30W T8EE/ELEE

107	Conf Room	4	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
108	Principal Conf Room	2	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
109	Principal	2	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
110	Electric Room 3	1	4' Strip	2L4' 30W T8EE/ELEE
111	Electric Room 4	1	4' Strip	2L4' 30W T8EE/ELEE
112	Boys	3	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
113	Storage Room2	2	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
114	Girls	2	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
115	Boys	2	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
116	Technology	1	4' Strip	2L4' 30W T8EE/ELEE
117	100	6	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
118	100	3	2x2 Prismatic Lens Bi-Lev Switch	2L4' 30W T8EE/ELEE
119	Grade 7 Comp Lab	8	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
120	Grade 7 Comp Lab	4	2x2 Prismatic Lens Bi-Lev Switch	2L4' 30W T8EE/ELEE
121	Teachers Room	6	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
122	Storage Room	1	4' Strip	2L4' 30W T8EE/ELEE
123	Women's Room	2	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
124	Girls Room	2	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
125	Storage	2	2x4 Prismatic Lens	3L4' 30W T8EE/ELEE
126	Boys	3	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
127	102	7	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
128	131	8	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
129	3	10	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
130	1A	3	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
131	1	8	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
132	2	8	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
133	4	8	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
134	6	8	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
135	8	8	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
136	10	8	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
137	12	8	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
138	Women's	1	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
139	Men's	1	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
140	Storage	1	4' Strip	2L4' 30W T8EE/ELEE
141	14A	3	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
142	14	8	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
143	16	6	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
144	16A	3	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
145	Boys	2	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
146	Girls	2	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
147	Storage	2	4' Strip	2L4' 30W T8EE/ELEE
148	18	6	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
149	20	11	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
150	22	12	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
151	24	8	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
152	Women's	1	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
153	Men's	1	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
154	Boys	3	2x4 Prismatic Lens	3L4' 30W T8EE/ELEE
155	Girls	3	2x4 Prismatic Lens	3L4' 30W T8EE/ELEE
156	Guidance Conf	3	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
157	#5	2	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
158	#3	1	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
159	#4	1	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
160	Open Guidance	6	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
161	#2	1	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
162	#1	1	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE

163	Health	4	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
164	Storage	1	2x4 Prismatic Lens	3L4' 30W T8EE/ELEE
165	Bathrooms	2	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
166	Gym Storage 1	2	4' Strip	2L4' 30W T8EE/ELEE
167	Gym Storage 2	3	4' Strip	2L4' 30W T8EE/ELEE
168	201	9	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
169	201	1	2x2 Prismatic Lens Bi-Lev Switch	2L4' 30W T8EE/ELEE
170	203	7	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
171	203	1	2x2 Prismatic Lens Bi-Lev Switch	2L4' 30W T8EE/ELEE
172	205	8	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
173	207	11	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
174	207	1	2x2 Prismatic Lens Bi-Lev Switch	2L4' 30W T8EE/ELEE
175	209	7	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
176	209	1	2x2 Prismatic Lens Bi-Lev Switch	2L4' 30W T8EE/ELEE
177	211	8	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
178	212	4	2x2 Prismatic Lens Bi-Lev Switch	2L4' 30W T8EE/ELEE
179	213	8	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
180	215	12	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
181	217	8	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
182	218	4	2x2 Prismatic Lens Bi-Lev Switch	2L4' 30W T8EE/ELEE
183	219	8	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
184	221	7	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
185	221	1	2x2 Prismatic Lens Bi-Lev Switch	2L4' 30W T8EE/ELEE
186	223	11	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
187	223	1	2x2 Prismatic Lens Bi-Lev Switch	2L4' 30W T8EE/ELEE
188	225	8	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
189	227	8	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
190	229	9	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
191	229	1	2x2 Prismatic Lens Bi-Lev Switch	2L4' 30W T8EE/ELEE
192	202	7	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
193	Storage	1	4' Strip	2L4' 30W T8EE/ELEE
194	Boys	3	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
195	Storage	2	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
196	Girls	2	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
197	Women	2	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
198	Storage	1	4' Strip	2L4' 30W T8EE/ELEE
199	216	6	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
200	Computer Lab	8	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
201	Computer Lab	4	2x2 Prismatic Lens Bi-Lev Switch	2L4' 30W T8EE/ELEE
202	220	6	2x4 Prismatic Lens Bi-Lev Switch	3L4' 30W T8EE/ELEE
203	220	3	2x2 Prismatic Lens Bi-Lev Switch	2L4' 30W T8EE/ELEE
204	Book Room	1	4' Strip	2L4' 30W T8EE/ELEE
205	Men’s	2	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
206	Girls	2	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
207	Storage Room	2	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
208	Boys	3	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
209	Electrical Room #5	1	4' Strip	2L4' 30W T8EE/ELEE
210	Electrical Room #6	1	4' Strip	2L4' 30W T8EE/ELEE
211	Storage	1	4' Strip	2L4' 30W T8EE/ELEE
212	2nd Floor Hallway	49	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
213	2nd Floor Hallway	8	1x4 Parabolic Lens	2L4' 30W T8EE/ELEE
214	Stairwell #1	4	4' Wrap	2L4' 30W T8EE/ELEE
215	Stairwell #2	3	4' Wrap	2L4' 30W T8EE/ELEE
216	7th Hallway	57	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
217	7th Hallway	4	1x4 Parabolic Lens	2L4' 30W T8EE/ELEE
218	7th Hallway	8	8" Recessed Can	2/26W COMPACT HW ELIG

219	Door 19	2	8" Recessed Can	2/26W COMPACT HW ELIG
220	8th Hallway	1	2x2 Prismatic Lens	2L4' 30W T8EE/ELEE
221	8th Hallway	42	2x4 Prismatic Lens	1L4' 30W T8EE/ELEE
222	8th Hallway	2	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
223	Gym Hallway	3	2x4 Prismatic Lens	1L4' 30W T8EE/ELEE
224	Gym Hallway	8	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
225	Cafe Hallway	4	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
226	Cafe Hallway	40	2x4 Prismatic Lens	1L4' 30W T8EE/ELEE
227	Custodian Hallway	6	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
228	Bathroom Hallways	2	2x2 Prismatic Lens	2L4' 30W T8EE/ELEE
229	Hall to Courtyard	2	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
Totals		**1444**		

PROPOSED LIGHTING SYSTEM				
Proposed Qty.	Proposed Fixture Description	Lamp/ Ballast Type	Add Occupancy Sensor?	Total kWh Reduction
12	LED Canopy- LUM LC SM	22 WATT LED	None	3,837
6	LED Canopy- LUM LC SM	22 WATT LED	None	1,918
1	LED Canopy- LUM LC SM	22 WATT LED	None	320
2	LED Canopy- LUM LC SM	22 WATT LED	None	639
1	LED Canopy- LUM LC SM	22 WATT LED	None	320
1	LED Canopy- LUM LC SM	22 WATT LED	None	320
1	LED Canopy- LUM LC SM	22 WATT LED	None	320
1	LED Canopy- LUM LC SM	22 WATT LED	None	320
1	LED Canopy- LUM LC SM	22 WATT LED	None	320
2	Led Flood- LUM LF LG w/ Bracket	125 WATT LED	None	2,891
1	LED Canopy- LUM LC SM	22 WATT LED	None	320
2	Led Flood- LUM LF LG w/ Bracket	125 WATT LED	None	2,891
2	Led Flood- LUM LF LG w/ Bracket	125 WATT LED	None	2,891
10	LED Canopy- LUM LC SM	22 WATT LED	None	3,197
1	LED Canopy- LUM LC SM	22 WATT LED	None	320
9	LED Shoebox-AR13	129 WATT LED	Step Dim	14,376
2	LED Shoebox-AR13	129 WATT LED	Step Dim	3,195
1	LED Utility Light	50 WATT LED	None	613
2	LED Shoebox-AR13	129 WATT LED	Step Dim	3,195
13	LED Shoebox-AR13	129 WATT LED	Step Dim	20,766
3	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	317
7	LED Retrofit-GC CDL	27 WATT LED	None	683
32	LED Retrofit-GC CDL	27 WATT LED	None	3,124
16	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,689
2	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	266
2	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	392
3	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	588
2	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	392
9	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	868
1	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	66
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	772
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	772
11	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,061
7	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	675
1	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	66
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	772

4	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	262
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	772
12	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,158
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	772
4	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	262
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	772
7	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	675
1	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	66
11	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,061
1	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	66
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	772
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	772
9	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	868
1	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	66
10	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	965
4	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	386
10	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	965
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	772
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	772
40	LED High Bay- 4MS	88 WATT LED	Occ Sensor	7,442
16	WT2-30W	30 WATT LED	None	1,007
5	LED Strip - FZA 22W	22 WATT LED	None	429
3	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	156
2	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	167
18	WT2-30W	30 WATT LED	None	1,133
5	LED Strip - FZA 22W	22 WATT LED	None	429
4	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	334
3	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	217
3	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	217
1	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	105
11	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,061
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	772
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	772
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	772
6	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	579
9	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	868
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	772
9	LED Strip - FZA 22W	22 WATT LED	None	108
6	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	70
2	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	210
2	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	43
1	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	134
20	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,145
1	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	106
1	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	106
6	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	579
2	LED Retrofit-GC CDL	23 WATT LED	None	110
1	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	96
1	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	106
32	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	3,399
46	LED Retrofit-GC CDL	23 WATT LED	None	2,795
12	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,158
1	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	96
1	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	96
1	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	96
12	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,158

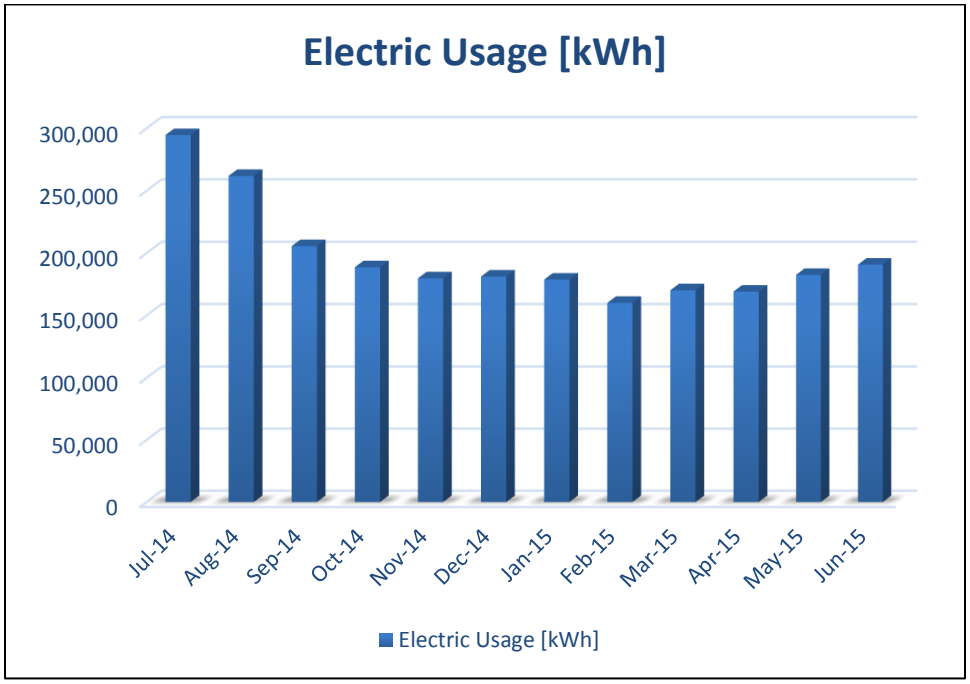
2	LED 8' Strip-FZ8	32 WATT LED	None	246
1	LED Strip - FZA 22W	22 WATT LED	None	53
2	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	104
1	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	91
2	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	104
4	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	208
2	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	193
25	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,299
21	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,091
2	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	43
10	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	520
2	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	104
2	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	193
5	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	260
4	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	208
2	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	310
2	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	310
1	LED Strip - FZA 22W	22 WATT LED	None	12
1	LED Strip - FZA 22W	22 WATT LED	None	12
3	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	217
2	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	23
2	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	145
2	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	145
1	LED Strip - FZA 22W	22 WATT LED	None	53
6	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	579
3	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	197
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	772
4	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	262
6	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	579
1	LED Strip - FZA 22W	22 WATT LED	None	12
2	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	145
2	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	145
2	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	43
3	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	217
7	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	675
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	772
10	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	965
3	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	289
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	772
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	772
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	772
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	772
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	772
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	772
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	772
1	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	72
1	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	72
1	LED Strip - FZA 22W	22 WATT LED	None	12
3	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	289
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	772
6	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	579
3	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	289
2	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	145
2	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	145
2	LED Strip - FZA 22W	22 WATT LED	None	24
6	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	579

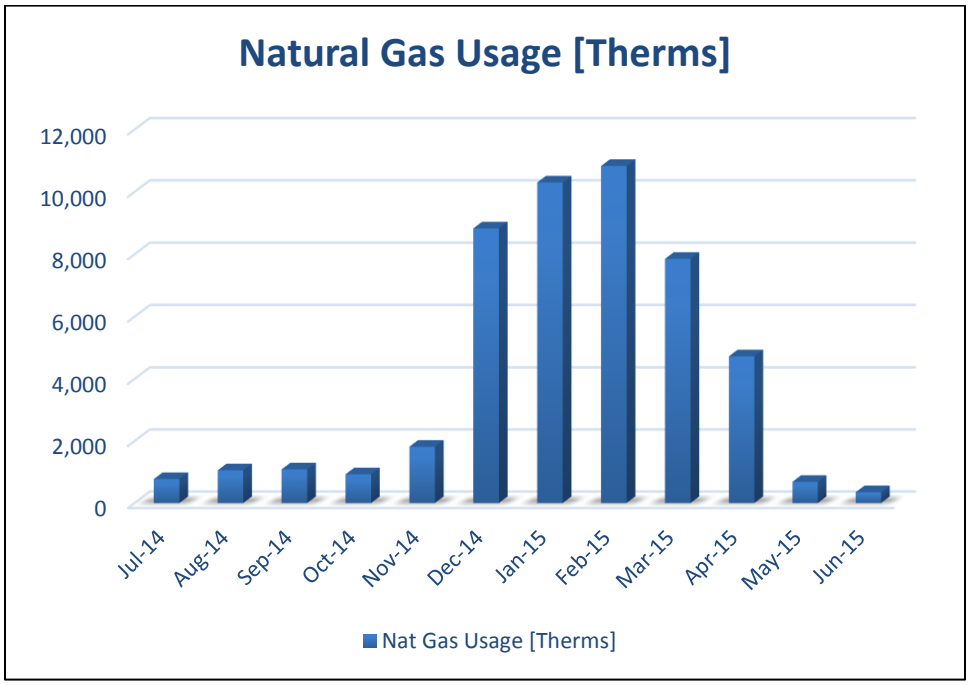
11	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,061
12	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,158
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	772
1	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	72
1	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	72
3	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	403
3	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	403
3	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	465
2	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	193
1	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	96
1	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	96
6	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	579
1	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	96
1	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	96
4	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	208
1	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	22
2	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	145
2	LED Strip - FZA 22W	22 WATT LED	None	24
3	LED Strip - FZA 22W	22 WATT LED	None	36
9	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	868
1	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	66
7	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	675
1	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	66
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	772
11	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,061
1	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	66
7	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	675
1	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	66
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	772
4	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	262
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	772
12	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,158
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	772
4	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	262
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	772
7	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	675
1	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	66
11	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,061
1	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	66
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	772
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	772
9	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	868
1	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	66
7	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	675
1	LED Strip - FZA 22W	22 WATT LED	None	12
3	LED 2x4 w/ Adaptive Tech	24 WATT LED	Occ Sensor	251
2	LED 2x4 w/ Adaptive Tech	24 WATT LED	Occ Sensor	27
2	LED 2x4 w/ Adaptive Tech	24 WATT LED	Occ Sensor	167
2	LED 2x4 w/ Adaptive Tech	24 WATT LED	Occ Sensor	167
1	LED Strip - FZA 22W	22 WATT LED	None	12
6	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	579
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	772
4	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	262
6	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	579
3	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	197
1	LED Strip - FZA 22W	22 WATT LED	None	12

2	LED 2x4 w/ Adaptive Tech	24 WATT LED	Occ Sensor	167
2	LED 2x4 w/ Adaptive Tech	24 WATT LED	Occ Sensor	167
2	LED 2x4 w/ Adaptive Tech	24 WATT LED	Occ Sensor	27
3	LED 2x4 w/ Adaptive Tech	24 WATT LED	Occ Sensor	251
1	LED Strip - FZA 22W	22 WATT LED	None	12
1	LED Strip - FZA 22W	22 WATT LED	None	12
1	LED Strip - FZA 22W	22 WATT LED	None	12
49	LED 2x4 w/ Adaptive Tech	24 WATT LED	Occ Sensor	5,982
8	LED 2x4 w/ Adaptive Tech	24 WATT LED	Occ Sensor	977
4	LED Strip - FZA 22W	22 WATT LED	None	1,051
3	LED Strip - FZA 22W	22 WATT LED	None	788
57	LED 2x4 w/ Adaptive Tech	24 WATT LED	Occ Sensor	6,958
4	LED 2x4 w/ Adaptive Tech	24 WATT LED	Occ Sensor	488
8	LED Retrofit-GC CDL	27 WATT LED	None	781
2	LED Retrofit-GC CDL	27 WATT LED	None	195
1	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	133
42	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	486
2	LED 2x4 w/ Adaptive Tech	24 WATT LED	Occ Sensor	244
3	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	35
8	LED 2x4 w/ Adaptive Tech	24 WATT LED	Occ Sensor	977
4	LED 2x4 w/ Adaptive Tech	24 WATT LED	Occ Sensor	488
40	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	463
6	LED 2x4 w/ Adaptive Tech	24 WATT LED	Occ Sensor	732
2	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	266
2	LED 2x4 w/ Adaptive Tech	24 WATT LED	Occ Sensor	244
				184,497

Marshfield High School

The Marshfield High School is a two-story brick building with a full basement and a flat roof top. The High School is LEED Silver certified. The building is currently heated with natural gas and cooled with a central air system. There are currently no energy conservation measures for the Marshfield High School identified by Guardian Energy.



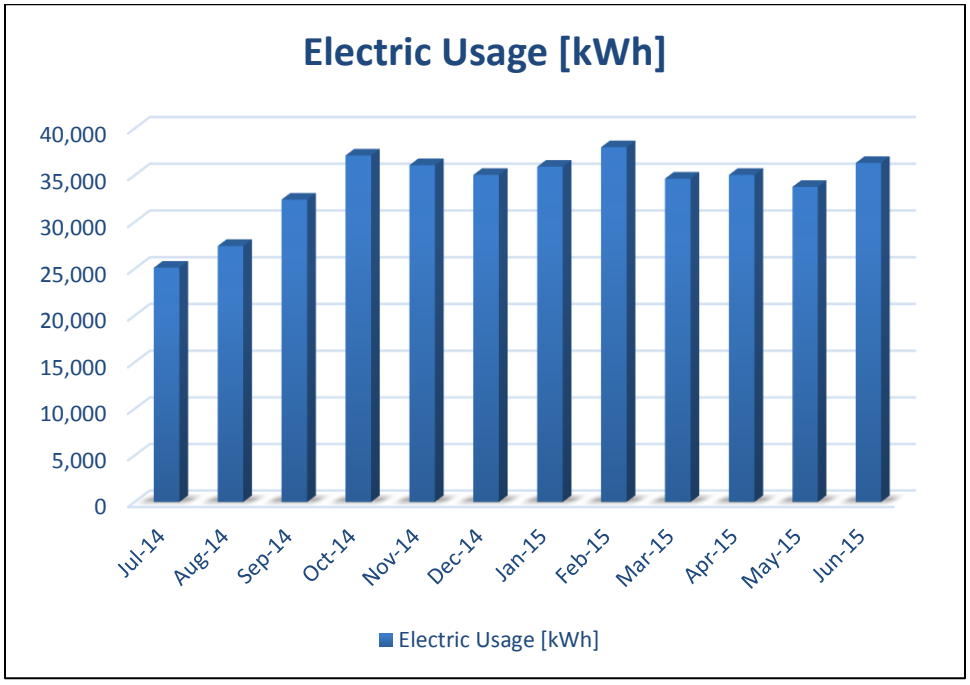


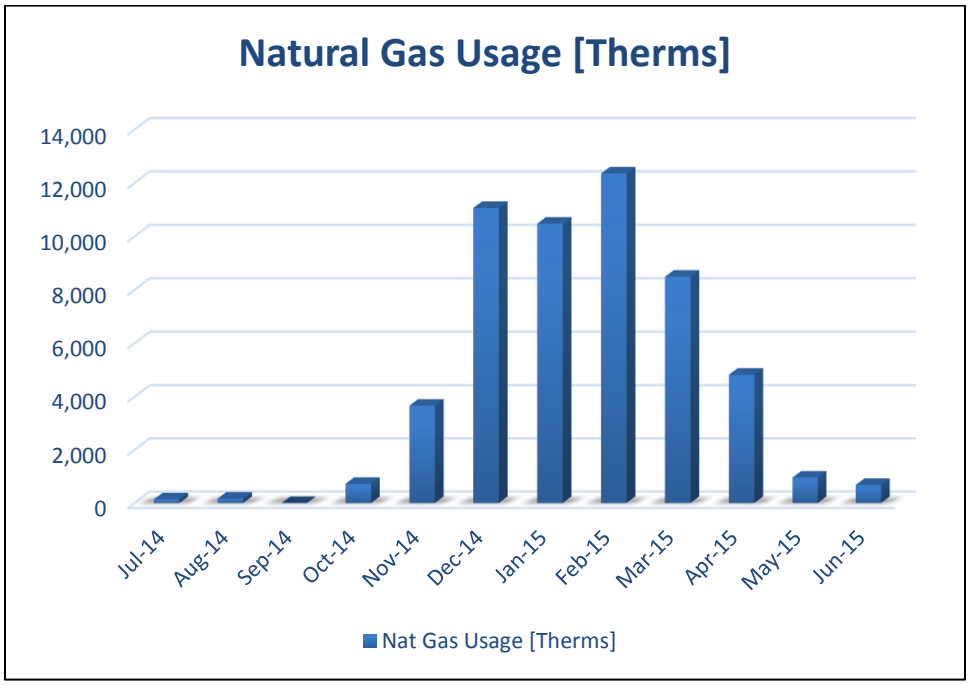
Recommended Energy Conservation Measures (ECM's)

There were no energy conservation measures identified for the Marshfield High School by Guardian Energy at this time.

Martinson Elementary School

The Martinson Elementary School is a single-story brick building with a flat roof. The building is currently heated by natural gas and cooled with window AC units. The building is controlled by an antiquated Barber-Coleman system which runs on a Windows 98 platform. The classrooms are heated by unit ventilators that are 18 years old. There may an opportunity to control the OA on these Univents. Energy conservation measures identified for the Martinson Elementary School by Guardian Energy include an energy management system (EMS) upgrade with demand control ventilation and optimal start/stop sequencing, a steam trap survey, lighting and lighting controls upgrades, weatherization, and refrigeration controls.





Recommended Energy Conservation Measures (ECM's)

ECM 1: Demand Control Ventilation (DCV) and EMS Upgrades

Current System: The existing air handling systems are constant-volume single-zone systems that provide adequate circulation for peak design conditions. Throughout the heating and cooling seasons, these systems are providing significant CFM of outdoor air which has to be conditioned (heated/cooled) before it enters the space. This heated and treated air is then almost immediately exhausted back outside. During the times of day when certain spaces are not at full occupancy, this constant ventilation is not required to meet the heating/cooling demand load or the minimum fresh air requirements. There is a potential opportunity to reduce the ventilation when these rooms are not at full occupancy. This would therefore reduce the amount of air being heated and treated every day throughout the heating and cooling seasons and would reduce overall energy consumption throughout the year. CO2 sensors would be utilized in these spaces to alert the system as to when greater levels of ventilation are required due to fluctuations in occupancy to comply with fresh air requirements.

Recommendations: Guardian recommends installing DCV in the following spaces:

Proposed DCV Locations					
			Airflow, CFM		
Tag #	Service	Current System Control	Total	OA	Supply HP
HV-1	Gym	Const	4500	2250	2
HV-2	Gym	Const	4500	2250	2
HV-3	Art Classroom	Const	2500	1225	1
HV-4	Music Classroom	Const	2500	1225	1

HV-5	Auditorium	Const	6000	6000	3
HV-6	Kitchen	Const	3600	3600	1.5

Proposed DCV Locations										
	# Units						Airflow, CFM			
Tag #	A - East	B - South	C - North	D - West	Totals	Current System Control	Total	OA	# Fans	Fan HP Total
UV-1	1	5		2	8	Const	750	350	3	1/8
UV-2	1	8	1	14	24	Const	1000	500	4	1/8
UV-3	1	6		2	9	Const	1250	500	5	1/8
UVH-1	1	1	2	2	6	Const	750	300	3	1/2
UVH-2			2		2	Const	1000	500	4	1/2
UVH-3	2				2	Const	1500	400	6	1/2
UVH-4			2		2	Const	1000	250	4	1/2
UVH-5		1			1	Const	1000	400	4	1/2
UVH-6		1			1	Const	750	300	3	1/2

EMS Upgrades

An EMS is a building-wide energy management system (EMS) that allows for a variety of energy saving opportunities including occupancy sensor driven ventilation, night-time setback scheduling, and outdoor air reset. According to several studies, EMS systems are able to reduce energy, operations and maintenance, and repair costs by 10% or more. An EMS consists of a software system connected to various sensors and actuators which control the heating, cooling, and ventilation throughout a building. An EMS may be part of a larger system that also covers occupant comfort, safety and security. When properly programmed and commissioned an EMS is a modern tool for controlling and reducing energy consumption throughout the year.

EMS Optimum Start:

An EMS is a building-wide energy management system (EMS) that allows for a variety of energy saving opportunities including occupancy sensor driven ventilation, night-time setback scheduling, and optimum start. The start-up time for a building is the time it takes to heat the building up from its' cooler nighttime un-occupied set-point to the higher and more comfortable daytime occupied set-point. This is typically done in the early morning hours before the building is open. The time it takes to warm the building up can vary due to outdoor conditions. By activating an optimum start, the building will begin to automatically heat itself up at the "right" time every day. This will cut down on the overall start-up time and will reduce the overall heating fuel usage.

ECM 2: Steam Trap Repair

According to the US D.O.E. in steam systems that have not been maintained for 3 to 5 years, between 15% - 30% of the installed steam traps may have failed—thus allowing live steam to escape into the condensate return system. In systems with a regularly scheduled maintenance program, leaking traps should account for less than 5% of the trap population.

ECM 3: Window AC Control

The existing window-ACs are not controlled by the BAS. The system relies on the occupants to turn off the ACs at the end of each day. If we were to tie an outlet into the BAS, the BAS could turn off the ACs by default during the un-occupied schedule by cutting power to the outlets. This would result in electric savings throughout the summer.

ECM 4: Weatherization Upgrades

Findings: Martinson Elementary School

- Roof-Wall Intersection Air Sealing – the roof-wall intersection is regularly an area that allows unwanted air leakage through the building shell. Exterior flashing and finish details at this area are not constructed to stop air leakage (exterior flashings are for water control, not air control); unsealed exterior flashing details combine with interior gaps in the framing between the roof and wall assembly to allow infiltration/ exfiltration.
- Overhang Air Sealing – overhangs are roofs, floor systems or areas above entryways that extend beyond the plane of the exterior wall system. These areas of construction are often misunderstood by builders and the cavity that extends beyond the plane of the exterior wall system is often incorrectly "connected" to the interior heated spaces of the building. Overhangs that are not properly sealed at the plane of the surface that should separate the conditioned space from the outdoors lead to excessive air leakage and heat loss at these vulnerable areas in the building envelope.
- Door Weather Stripping – deteriorated weather stripping materials, ineffective weather stripping installation and daylight showing at the perimeter of door systems create direct pathways for unwanted infiltration/ exfiltration.

Recommendations

- Roof-Wall Intersection Air Sealing
- Overhang Air Sealing
- Door Weather Stripping

Roof-Wall Intersection Air Sealing – gaps at the roof and unsealed gaps around framing components create pathways for unwanted infiltration/ exfiltration (Martinson ES).

Door Weather Stripping – the gasket material has deteriorated. There is no compression seal at the perimeter of the door and as a result the door is allowing infiltration/ exfiltration (Martinson ES).

Door Weather Stripping – clear daylight around the door shows a direct pathway for unwanted air leakage (Martinson ES).

ECM 5: Refrigeration Controls

The Frigitek is an energy saving device designed for walk-in or industrial refrigerators and freezers. The purpose of a refrigeration compressor and related equipment is to pump heat out of a box. Often, more than 30% of that heat is generated by the evaporator fan motors. Frigitek reduces this heat load approximately 75-80% by lowering the voltage to the evaporator fan motors when the box is not being actively cooled. The result is a significant saving in operation costs. The dramatic energy saving produced by the Frigitek have been confirmed by more than ten years of extensive laboratory and field testing and satisfied customers.

ECM 6: Lighting and Lighting Controls Upgrade

Findings

Inefficient lighting equipment and lighting controls or lack thereof can be a significant source of unnecessary energy waste. Only 5-10% of the energy used by an incandescent light bulb is actually converted into light. The remaining 90-95% of the energy used is released into the space as waste heat. This can add to the cooling load during summer. Newer more efficient lighting technology is currently available at affordable costs. In addition utility sponsored incentives are available to help buy down the initial cost of lighting upgrades.

Recommendations

Guardian recommends implementing the lighting upgrade measures listed below and can facilitate the process of applying for available incentives from National Grid.

EXISTING LIGHTING SYSTEM					
Measure #	Location	Qty.	Existing Fixture Description	Existing Wattage	Existing Run Hours
1	Staff Lot	4	Shoe Box, Sq. Pole	455	4380
2	Back Drive Near Field	4	Shoe Box, Sq. Pole	455	4380

3	Back Drive Near Field	4	Flood, Slip Fit	1075	4380
4	Back Drive Near Playground	3	Shoe Box, Sq. Pole	455	4380
5	Visitor Parking	2	Shoe Box, Sq. Pole	455	4380
6	Front Drive Loop	4	Shoe Box, Sq. Pole	455	4380
7	Main Drive	4	Shoe Box, Sq. Pole	455	4380
8	Door 8	1	Canopy	95	4380
9	Door 9	1	Canopy	95	4380
10	Corner Near Door	2	Flood, Fixed Mount	455	4380
11	Door 1	6	Canopy	95	4380
12	Bus Lot Wall	2	Flood, Fixed Mount	455	4380
13	Doors Near Field	2	Wall Pack	95	4380
14	Back Wall of Gym	7	Wall Pack	120	4380
15	Back Wall of Gym	2	Flood, Fixed Mount	455	4380
16	Back Wall of Cafe	2	Flood, Fixed Mount	455	4380
17	Loading Dock at Dumpster	2	Wall Pack	120	4380
18	Door 5	1	Canopy	120	4380
19	Door 5 Near Elect Room	2	Wall Pack	95	4380
20	Door 6	8	Canopy	120	4380
21	Wall Near Garden	1	Wall Pack	95	4380
22	Door 7	1	Canopy	120	4380
23	Wall Near Woods	1	Wall Pack	95	4380
24	Washing	2	Flood, Fixed Mount	455	4380
25	Kitchen	20	2x4 Prismatic Lens	77	1780
26	Conference Rm B	4	2x4 Prismatic Lens, Dual Switch	77	1780
27	Hall to Kitchen Toilet	1	4' Wrap	52	3616
28	Kitchen Toilet	1	2x2 Prismatic Lens	52	2480
29	Kitchen Storage	2	4' Wrap	52	400
30	Cafe	18	4' Wrap	52	1780
31	Class 33 Music	8	2x4 Prismatic Lens	77	1780
32	Girls Dressing	10	4' Wrap	52	2480
33	Women's	1	2x2 Prismatic Lens	52	2480
34	Switch Gear	8	4' Strip	52	400
35	Auditorium Stage	11	4' Strip	52	1780
36	Men	1	2x2 Prismatic Lens	52	2480
37	Girls Room	2	2x4 Prismatic Lens	52	2480
38	Boys Room	2	2x4 Prismatic Lens	52	2480
39	Conf Room A	3	2x4 Prismatic Lens	77	1780
40	Cafe Hallway	13	2x4 Prismatic Lens	77	3616
41	Cafe Hallway	4	2x2 Prismatic Lens	52	3616
42	Auditorium Storage	4	4' Strip	52	400
43	Door B Lobby	12	2x2 Prismatic Lens	52	3616
44	Main Office	9	2x4 Prismatic Lens	77	2410
45	Admin Office	2	2x4 Prismatic Lens	77	2410
46	Faculty Dining	7	2x4 Prismatic Lens	77	1780
47	Principal	4	2x4 Prismatic Lens	77	2410
48	Principal	1	2x2 Prismatic Lens	52	2410
49	Nurse	6	2x4 Prismatic Lens	77	1780
50	Nurse Toilet	1	2x4 Prismatic Lens	77	2480
51	Nurse Storage	1	2x4 Prismatic Lens	77	400
52	Nurse Beds	2	2x2 Prismatic Lens	52	1780
53	Psych Meeting Room	2	2x4 Prismatic Lens	77	1780
54	Psych Bathroom	1	2x2 Prismatic Lens	52	2480
55	Psych Entrance Hall	1	2x4 Prismatic Lens	77	3616
56	Psych Office	1	2x4 Prismatic Lens	77	1780
57	Sensory Reading Room	1	2x4 Prismatic Lens	77	1780
58	Sensory Reading Room	1	2x2 Prismatic Lens	52	1780

59	Room 9	10	2x4 Prismatic Lens	77	1780
60	Room 8	8	2x4 Prismatic Lens	77	1780
61	Room 10	8	2x4 Prismatic Lens	77	1780
62	Room 11	10	2x4 Prismatic Lens	77	1780
63	Room 12	10	2x4 Prismatic Lens	77	1780
64	Staff Supply	3	2x4 Prismatic Lens	77	400
65	Staff	4	2x4 Prismatic Lens	77	1780
66	Door Outside Tel Data	1	2x2 Prismatic Lens	52	1780
67	Room 13	10	2x4 Prismatic Lens	77	1780
68	Room 14	6	2x4 Prismatic Lens	77	1780
69	Room 15	6	2x4 Prismatic Lens	77	1780
70	Room 16	10	2x4 Prismatic Lens	77	1780
71	Room 17	10	2x4 Prismatic Lens	77	1780
72	Girls	3	2x4 Prismatic Lens	52	2480
73	Women's	1	2x2 Prismatic Lens	52	2480
74	Men's	1	2x2 Prismatic Lens	52	2480
75	Custodian Storage	2	2x4 Prismatic Lens, Hanging	52	400
76	Room 18	10	2x4 Prismatic Lens	77	1780
77	Boys Room	1	2x4 Prismatic Lens	52	2480
78	Custodian	1	2x2 Prismatic Lens, Hanging	52	1780
79	Room 19	10	2x4 Prismatic Lens	77	1780
80	Room 20	10	2x4 Prismatic Lens	77	1780
81	Room 21	10	2x4 Prismatic Lens	77	1780
82	EC Coordinator	2	2x4 Prismatic Lens	77	1780
83	EC Offices	4	2x4 Prismatic Lens	77	1780
84	Reading	6	2x4 Prismatic Lens	77	1780
85	Book Room	4	4' Strip	52	1780
86	Library	18	2x4 Prismatic Lens	77	1780
87	Library Office	2	2x4 Prismatic Lens	77	1780
88	Library Office	2	2x4 Prismatic Lens	77	1780
89	Library Copy	4	2x4 Prismatic Lens	77	1780
90	Head End Room	4	2x4 Prismatic Lens, Hanging	77	400
91	Mechanical Room	12	4' Strip	52	400
92	General Storage	4	2x4 Prismatic Lens, Hanging	77	400
93	Girls	3	2x4 Prismatic Lens	52	2480
94	Speech	2	2x4 Prismatic Lens	77	1780
95	Room 22	10	2x4 Prismatic Lens	77	1780
96	Room 23	10	2x4 Prismatic Lens	77	1780
97	Room 24	8	2x4 Parabolic Lens	77	1780
98	Work Room	4	2x4 Prismatic Lens	77	1780
99	Room 25	10	2x4 Prismatic Lens	77	1780
100	Room 26	10	2x4 Prismatic Lens	77	1780
101	Girls	2	2x4 Prismatic Lens	52	2480
102	Women's	1	2x2 Prismatic Lens	52	2480
103	Men's	1	2x2 Prismatic Lens	52	2410
104	Room 10	10	2x4 Prismatic Lens	77	1780
105	Occ Therapy	4	2x4 Prismatic Lens	77	1780
106	Boys Room	2	2x4 Prismatic Lens	52	2480
107	Room 28	10	2x4 Prismatic Lens	77	1780
108	Room 29	8	2x4 Prismatic Lens	77	1780
109	Data Closet	1	2x4 Prismatic Lens	77	400
110	Custodian	2	2x4 Prismatic Lens	77	1780
111	Room 30	8	2x4 Prismatic Lens	77	1780
112	Room 31	8	2x4 Prismatic Lens	77	1780
113	Room 32	8	2x4 Prismatic Lens	77	1780
114	Bathrooms B/T 1+2	3	2x2 Prismatic Lens	52	2480

115	Room 1	15	2x4 Prismatic Lens	77	1780
116	Room 2	15	2x4 Prismatic Lens	77	1780
117	Room 3	15	2x4 Prismatic Lens	77	1780
118	Room 4	15	2x4 Prismatic Lens	77	1780
119	Bathrooms B/T 3+4	3	2x2 Prismatic Lens	52	2480
120	Men's	1	2x4 Prismatic Lens	52	2410
121	Room 6	7	2x4 Prismatic Lens	77	1780
122	Motor Room	4	2x4 Prismatic Lens	77	1780
123	Women's	1	2x4 Prismatic Lens	52	2480
124	Custodian Storage	2	2x4 Prismatic Lens	52	400
125	Tele Data	1	2x4 Prismatic Lens, Hanging	52	400
126	Computer Lab	8	2x4 Parabolic Lens	77	1780
127	Room 5	8	2x4 Prismatic Lens	77	1780
128	Art	14	2x4 Prismatic Lens	77	1780
129	Elec Room	1	4' Vapor Tight	52	400
130	Music/IT LAB	12	2x4 Parabolic Lens	77	1780
131	Storage Rooms	4	4' Vapor Tight	52	400
132	Boys Room	2	2x4 Prismatic Lens	52	2480
133	Girls Room	2	2x4 Prismatic Lens	52	2480
134	Gym	35	High Bay	156	3616
135	Gym Storage	3	4' Strip	70	400
136	Main Hallway	27	2x4 Prismatic Lens	52	3616
137	Main Hallway	11	2x2 Prismatic Lens	52	3616
138	Courtyard Hallway	26	2x4 Prismatic Lens	52	3616
139	Door 1 Lobby	7	2x2 Prismatic Lens	52	3616
140	Gym Hallway	24	2x4 Prismatic Lens	52	3616
141	PT Hallway	8	2x4 Prismatic Lens	52	3616
142	Custodian Hall Bathroom	1	4' Strip	52	2480
143	Custodian Electrical Room	1	4' Vapor Tight	52	400
144	Custodian Hall Storage	2	4' Vapor Tight	52	3616
145	Emergency Electrical Room	1	4' Vapor Tight	52	3616
146	Custodial Office	4	4' Vapor Tight	52	3616
147	Library Courtyard Hall	32	2x4 Prismatic Lens	52	3616
148	Library Courtyard Hall	11	2x2 Prismatic Lens	52	3616

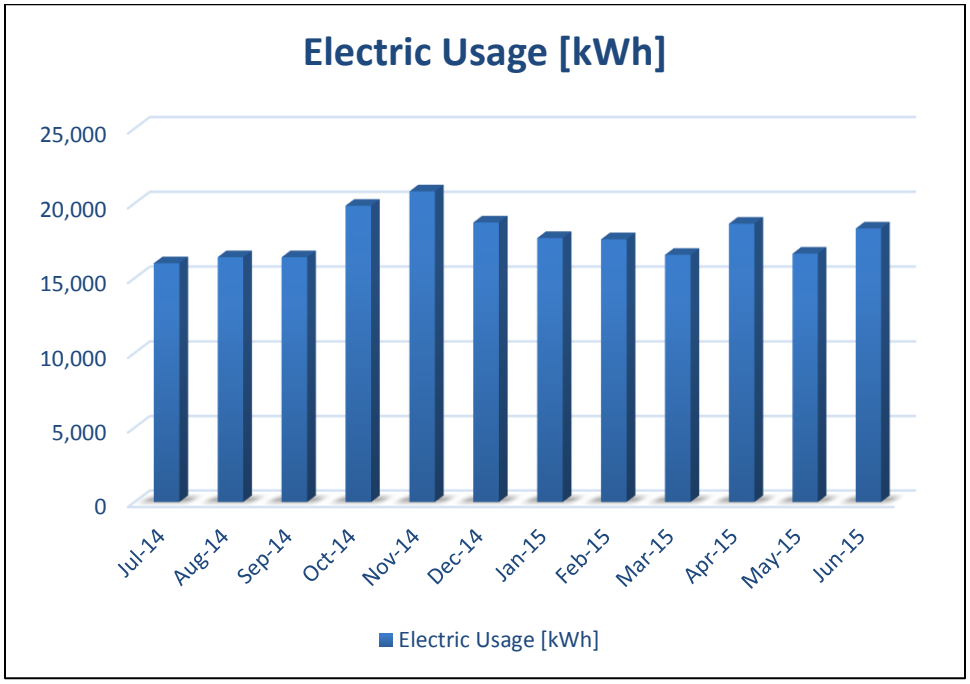
PROPOSED LIGHTING SYSTEM					
Proposed Qty.	Proposed Fixture Description	Type and Wattage	Add Occupancy Sensor?	Proposed Hours	Total kWh Reduction
4	LED Shoebox-AR13	129 WATT LED	Step Dim	3,066	6,390
4	LED Shoebox-AR13	129 WATT LED	Step Dim	3,066	6,390
4	LED Flood-LUM LFS-LFL 280	279 WATT LED	None	4,380	13,946
3	LED Shoebox-AR13	129 WATT LED	Step Dim	3,066	4,792
2	LED Shoebox-AR13	129 WATT LED	Step Dim	3,066	3,195
4	LED Shoebox-AR13	129 WATT LED	Step Dim	3,066	6,390
4	LED Shoebox-AR13	129 WATT LED	Step Dim	3,066	6,390
1	LED Canopy- LUM LC SM	22 WATT LED	None	4,380	320
1	LED Canopy- LUM LC SM	22 WATT LED	None	4,380	320
2	Led Flood- LUM LF LG w/ Bracket	125 WATT LED	None	4,380	2,891
6	LED Canopy- LUM LC SM	22 WATT LED	None	4,380	1,918
2	Led Flood- LUM LF LG w/ Bracket	125 WATT LED	None	4,380	2,891
2	LED Wall Pack-LUM LWP FT-25	24 WATT LED	None	4,380	622
7	LED Wall Pack-LUM LWP FT-25	24 WATT LED	None	4,380	2,943
2	Led Flood- LUM LF LG w/ Bracket	125 WATT LED	None	4,380	2,891
2	Led Flood- LUM LF LG w/ Bracket	125 WATT LED	None	4,380	2,891
2	LED Wall Pack-LUM LWP FT-25	24 WATT LED	None	4,380	841
1	LED Canopy- LUM LC SM	22 WATT LED	None	4,380	429
2	LED Wall Pack-LUM LWP FT-25	24 WATT LED	None	4,380	622
8	LED Canopy- LUM LC SM	22 WATT LED	None	4,380	3,434
1	LED Wall Pack-LUM LWP FT-25	24 WATT LED	None	4,380	311
1	LED Canopy- LUM LC SM	22 WATT LED	None	4,380	429
1	LED Wall Pack-LUM LWP FT-25	24 WATT LED	None	4,380	311
2	Led Flood- LUM LF LG w/ Bracket	125 WATT LED	None	4,380	2,891
20	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	1,930
4	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	386
1	LED Strip - FZA 22W	22 WATT LED	None	3,616	108
1	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	1,885	91
2	LED Strip - FZA 22W	22 WATT LED	None	400	24
18	LED Strip - FZA 22W	22 WATT LED	None	1,780	961
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	772
10	LED Strip - FZA 22W	22 WATT LED	None	2,480	744
1	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	1,885	91
8	LED Strip - FZA 22W	22 WATT LED	None	400	96
11	LED Strip - FZA 22W	22 WATT LED	None	1,780	587
1	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	1,885	91
2	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,885	145
2	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,885	145
3	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	289
13	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	2,748	2,548
4	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	2,748	532
4	LED Strip - FZA 22W	22 WATT LED	None	400	48
12	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	2,748	1,597
9	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,832	1,176
2	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,832	261
7	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	675
4	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,832	522
1	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	1,832	89
6	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	579
1	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,885	134

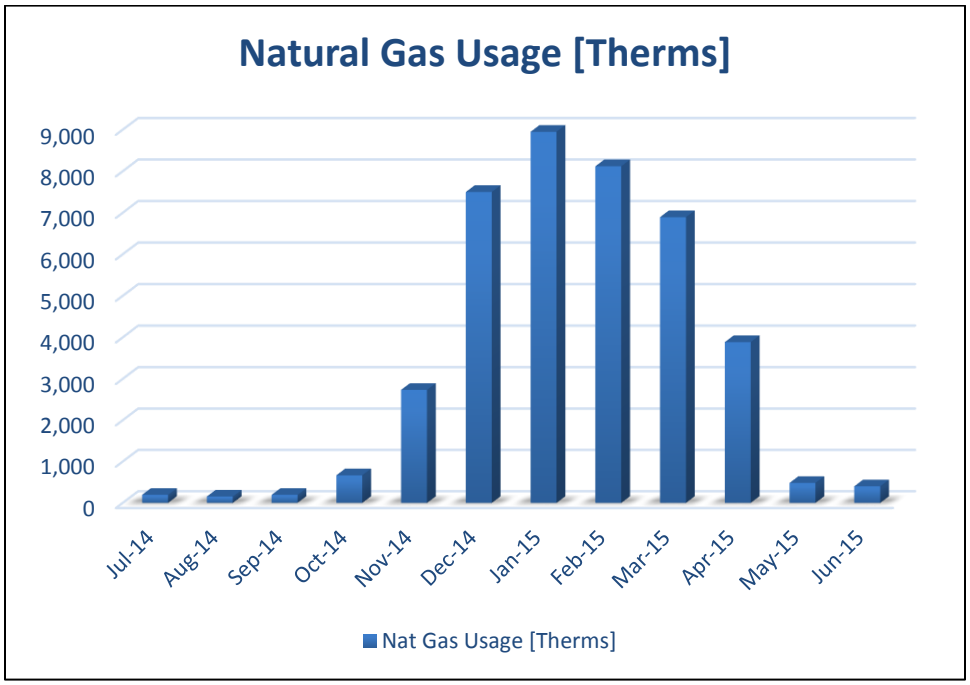
1	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	304	22
2	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	1,353	131
2	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	193
1	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	1,885	91
1	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	2,748	196
1	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	96
1	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	96
1	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	1,353	66
10	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	965
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	772
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	772
10	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	965
10	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	965
3	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	304	65
4	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	386
1	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	1,353	66
10	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	965
6	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	579
6	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	579
10	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	965
10	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	965
3	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,885	217
1	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	1,885	91
1	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	1,885	91
2	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	304	23
10	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	965
1	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,885	72
1	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	1,353	66
10	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	965
10	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	965
10	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	965
2	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	193
4	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	386
6	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	579
4	LED Strip - FZA 22W	22 WATT LED	None	1,780	214
18	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	1,737
2	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	193
2	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	193
4	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	386
4	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	304	87
12	LED Strip - FZA 22W	22 WATT LED	None	400	144
4	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	304	87
3	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,885	217
2	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	193
10	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	965
10	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	965
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	772
4	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	386
10	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	965
10	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	965
2	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,885	145
1	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	1,885	91
1	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	1,832	89
10	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	965
4	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	386
2	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,885	145

10	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	965
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	772
1	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	304	22
2	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	193
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	772
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	772
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	772
3	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	1,885	274
15	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	1,447
15	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	1,447
15	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	1,447
15	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	1,447
3	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	1,885	274
1	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,832	70
7	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	675
4	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	386
1	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,885	72
2	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	304	23
1	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	304	12
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	772
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	772
14	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	1,351
1	WT2-30W	30 WATT LED	None	400	9
12	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,353	1,158
4	WT2-30W	30 WATT LED	None	400	35
2	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,885	145
2	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	1,885	145
35	LED High Bay- 4MS	88 WATT LED	None	3,616	8,606
3	LED Strip - FZA 22W	22 WATT LED	None	400	58
27	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	2,748	2,851
11	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	2,748	1,464
26	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	2,748	2,745
7	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	2,748	931
24	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	2,748	2,534
8	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	2,748	845
1	LED Strip - FZA 22W	22 WATT LED	None	2,480	74
1	WT2-30W	30 WATT LED	None	400	9
2	WT2-30W	30 WATT LED	None	3,616	159
1	WT2-30W	30 WATT LED	None	3,616	80
4	WT2-30W	30 WATT LED	None	3,616	318
32	LED 2x4 w/ Adaptive Tech	30 WATT LED	Occ Sensor	2,748	3,379
11	LED 2x2 w/ Adaptive Tech	20 WATT LED	Occ Sensor	2,748	1,464

South River Elementary School

The South River Elementary School is a single-story brick building with a full basement and sloped roof built in 1950 with an add-on in 1954. The building runs on a Trane system with Trane units. The building is currently heated by natural gas and cooled by windows AC units. Energy conservation measures identified for the South River Elementary School by Guardian Energy include an energy management system (EMS) upgrade with demand control ventilation and optimal start/stop sequencing, a steam trap survey, de-stratification fans for the gymnasium, OA damper control for the kitchen ventilation, harmonic analysis on drives and motors, lighting and lighting controls upgrades, and a condensing DHW heater.





Recommended Energy Conservation Measures (ECM's)

ECM 1: EMS – Exhaust Fan Optimization/Control and Optimal Start/Stop Sequencing

Current System: The existing air handling units are equipped with CO2 sensors and programmed with demand controlled ventilation sequencing to gear down the air supply when the spaces are not at full-occupancy. However, the exhaust fans that serve the same spaces are not tied into the demand control. This means that the supply is being geared down but the exhaust is not being geared down. This causes the spaces to become de-pressurized which ends up pulling in un-wanted and un-treated outside air. The HVAC system must then work harder to bring the space back to the desired temperature. This is in-effect preventing the school from realizing the savings associated with demand control ventilation. In addition, EF-2 in the original building serving the administration offices is currently running 24/7.

Recommendations: Guardian recommends installing VFDs on the following exhaust fans (EFs) to gear down the exhaust and reduce unwanted OA infiltration:

Exhaust Fan Info			
bldg.	Fan Tag	HP	Notes
1954 bldg.	EF-1	1/3	
	EF-2	1	
	EF-3	1 1/2	
	EF-4	1/3	
	EF-5	1	
	EF-6	1	
original bldg. (1950)	EF-1	1/4	
	EF-2	1/2	Admin

	EF-3		
	EF-4		

EMS Optimum Start/Stop:

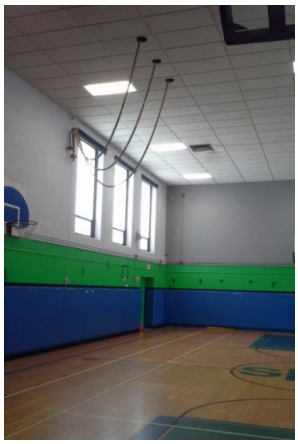
An EMS is a building-wide energy management system (EMS) that allows for a variety of energy saving opportunities including occupancy sensor driven ventilation, night-time setback scheduling, and optimum start. The start-up time for a building is the time it takes to heat the building up from its' cooler nighttime un-occupied set-point to the higher and more comfortable daytime occupied set-point. This is typically done in the early morning hours before the building is open. The time it takes to warm the building up can vary due to outdoor conditions. By activating an optimum start, the building will begin to automatically heat itself up at the "right" time every day. This will cut down on the overall start-up time and will reduce the overall heating fuel usage.

ECM 2: Steam Trap Repair

According to the US D.O.E. in steam systems that have not been maintained for 3 to 5 years, between 15% - 30% of the installed steam traps may have failed—thus allowing live steam to escape into the condensate return system. In systems with a regularly scheduled maintenance program, leaking traps should account for less than 5% of the trap population.

ECM 3: De-Stratification Fans for Gymnasium

Heat rises. In spaces with high ceilings, rising heat causes stratification meaning layers within the air. The hottest layers of air rise to the top instead of where you want the heat to be which is down on ground near the occupants and the thermostats. When all your heat keeps rising to the ceiling, your heating system must work harder throughout the winter to supply enough heat to reach the ground level. De-Stratification fans move the heat back down to ground level increasing occupant comfort and reducing energy usage.



ECM 4: Kitchen Ventilation Control

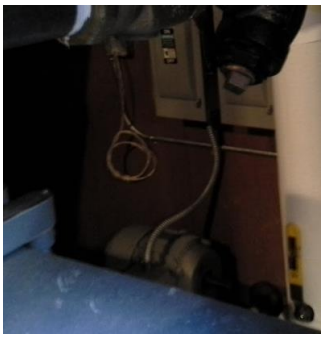
Current System: The existing air handling system is a constant-volume single-zone systems that provides adequate circulation for peak design conditions. Throughout the heating and cooling seasons, this system provides significant CFM of outdoor air which has to be conditioned (heated/cooled) before it enters the space. This heated and treated air is then almost immediately exhausted back outside. During the times of day when the kitchen is not occupied, this constant ventilation is not required to meet the heating/cooling demand load or the minimum fresh air requirements. There is a potential opportunity to reduce the ventilation during unoccupied times. The Kitchen ventilation system should be retrofitted with a new fan/motor and VFD to allow for Occupied operation, low-occupation, and unoccupied.

Recommendations: Guardian recommends installing kitchen ventilation control in the following spaces:

Proposed Kitchen Ventilation Control Locations					
			Airflow, CFM		
TAG	Service	Current System Control	Total	OA	Supply HP
AHU	Kitchen	Const	n/a	n/a	1.5

ECM 5: Harmonic Analysis for Motors & Drives

- There is a 7-1/2-Hp motor running continuously in the Attic. The customer was told that this was needed due to a phase imbalance problem. It is very likely that this phase imbalance can be eliminates through a detailed harmonic analysis on the building and the motor turned off.



ECM 6: Lighting and Lighting Controls Upgrade

Findings

Inefficient lighting equipment and lighting controls or lack thereof can be a significant source of unnecessary energy waste. Only 5-10% of the energy used by an incandescent light bulb is actually converted into light. The remaining 90-95% of the energy used is released into the space as waste heat. This can add to the cooling load during summer. Newer more efficient lighting technology is currently available at affordable costs. In addition utility sponsored incentives are available to help buy down the initial cost of lighting upgrades.

Recommendations

Guardian recommends implementing the lighting upgrade measures listed below and can facilitate the process of applying for available incentives from National Grid.

EXISTING LIGHTING SYSTEM				
Measure #	Location	Qty.	Existing Fixture Description	Lamp/ Ballast Type
1	Poles	22	Shoe Box	250W METAL HALIDE
2	Walls	8	Wall Pack	250W METAL HALIDE
3	Classroom 101	24	4' Wrap	2L4' 30W T8EE/ELEE
4	Classroom 102	24	4' Wrap	2L4' 30W T8EE/ELEE
5	Classroom 103	24	4' Wrap	2L4' 30W T8EE/ELEE
6	Classroom 104	24	4' Wrap	2L4' 30W T8EE/ELEE
7	Classroom 105	24	4' Wrap	2L4' 30W T8EE/ELEE
8	Classroom 106	24	4' Wrap	2L4' 30W T8EE/ELEE
9	Classroom 107	24	4' Wrap	2L4' 30W T8EE/ELEE
10	Classroom 108	24	4' Wrap	2L4' 30W T8EE/ELEE
11	Classroom 109	24	4' Wrap	2L4' 30W T8EE/ELEE

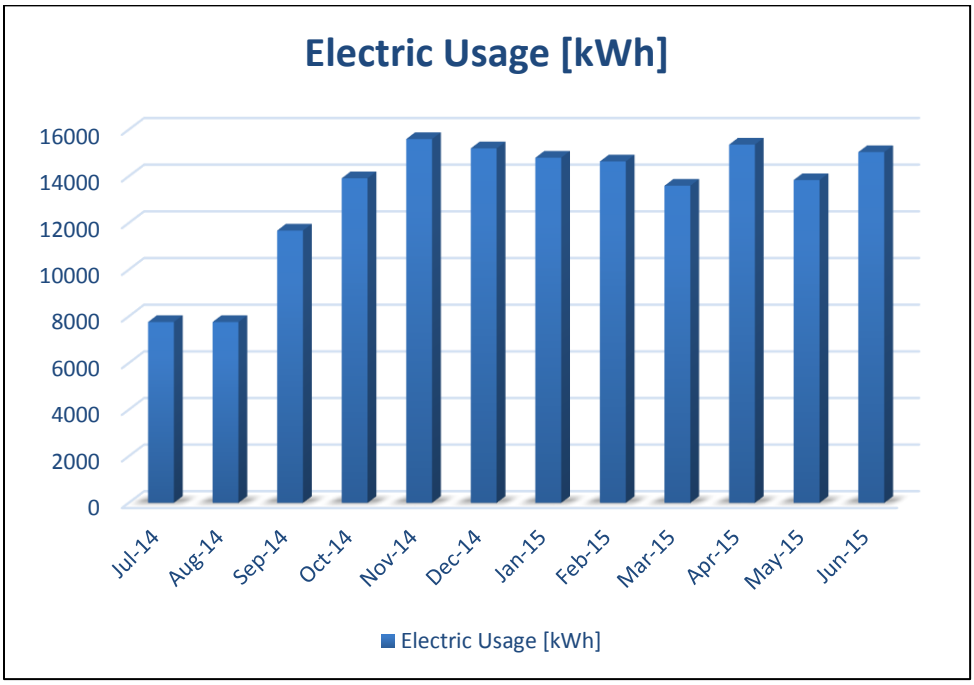
12	Classroom 110	24	4' Wrap	2L4' 30W T8EE/ELEE
13	Classroom 111	24	4' Wrap	2L4' 30W T8EE/ELEE
14	Classroom 112	24	4' Wrap	2L4' 30W T8EE/ELEE
15	Classroom 113	24	4' Wrap	2L4' 30W T8EE/ELEE
16	Classroom 114	24	4' Wrap	2L4' 30W T8EE/ELEE
17	Classroom 115	24	4' Wrap	2L4' 30W T8EE/ELEE
18	Classroom 116	24	4' Wrap	2L4' 30W T8EE/ELEE
19	Classroom 117	24	4' Wrap	2L4' 30W T8EE/ELEE
20	Classroom 201	24	4' Wrap	2L4' 30W T8EE/ELEE
21	Classroom 202	24	4' Wrap	2L4' 30W T8EE/ELEE
22	Classroom 203	24	4' Wrap	2L4' 30W T8EE/ELEE
23	Classroom 204	24	4' Wrap	2L4' 30W T8EE/ELEE
24	Classroom 205	24	4' Wrap	2L4' 30W T8EE/ELEE
25	Classroom 206	24	4' Wrap	2L4' 30W T8EE/ELEE
26	Classroom 207	24	4' Wrap	2L4' 30W T8EE/ELEE
27	Classroom 208	24	4' Wrap	2L4' 30W T8EE/ELEE
28	Classroom 209	24	4' Wrap	2L4' 30W T8EE/ELEE
29	Classroom 210	24	4' Wrap	2L4' 30W T8EE/ELEE
30	Classroom 211	24	4' Wrap	2L4' 30W T8EE/ELEE
31	Classroom 212	24	4' Wrap	2L4' 30W T8EE/ELEE
32	Classroom 213	24	4' Wrap	2L4' 30W T8EE/ELEE
33	Classroom 214	24	4' Wrap	2L4' 30W T8EE/ELEE
34	Classroom 215	24	4' Wrap	2L4' 30W T8EE/ELEE
35	Classroom 216	24	4' Wrap	2L4' 30W T8EE/ELEE
36	Classroom 217	24	4' Wrap	2L4' 30W T8EE/ELEE
37	1st Hallway	26	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
38	2nd Hallway	32	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
39	Cafe	24	4' Wrap	2L4' 30W T8EE/ELEE
40	Gym	24	2x4	4L4' 54W T5HO/ELIG
41	1st Girls	3	2x4 Prismatic Lens	3L4' 30W T8EE/ELEE
42	1st Boys	3	2x4 Prismatic Lens	3L4' 30W T8EE/ELEE
43	2nd Girls	3	2x4 Prismatic Lens	3L4' 30W T8EE/ELEE
44	2nd Boys	3	2x4 Prismatic Lens	3L4' 30W T8EE/ELEE
45	Offices	24	2x4 Prismatic Lens	2L4' 30W T8EE/ELEE
46	Library	28	4' Wrap	2L4' 30W T8EE/ELEE
Totals		**1016**		

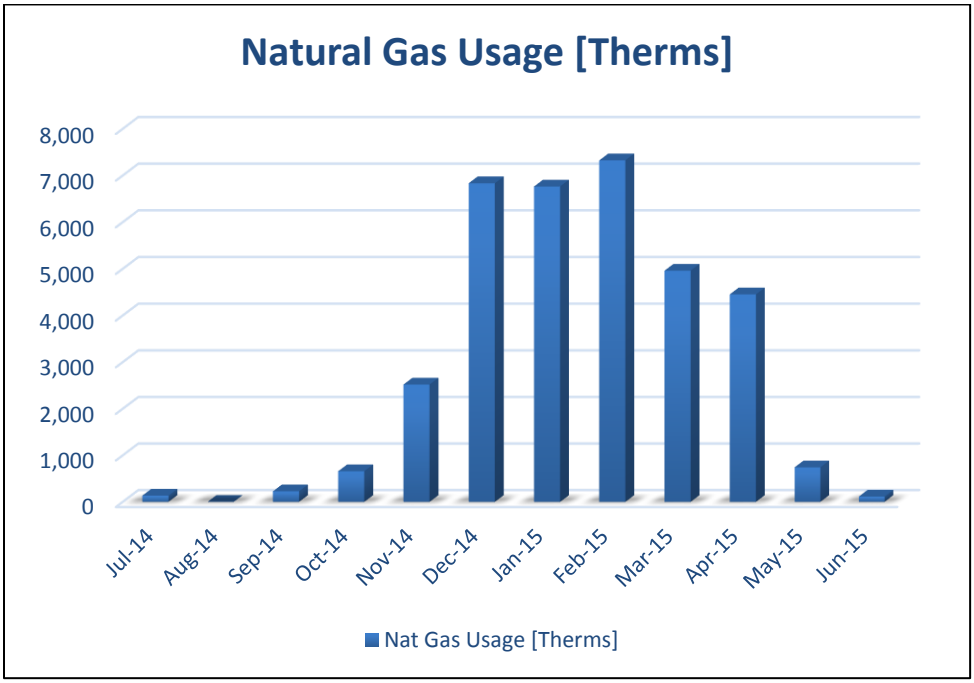
PROPOSED LIGHTING SYSTEM				
Proposed Qty.	Proposed Fixture Description	Lamp/ Ballast Type	Add Occupancy Sensor?	Total kWh Reduction
22	LED Shoebox LEO AR13	65 WATT LED	None	22,163
8	LED Wall Pack	60 WATT LED	None	8,234
24	4' LED Wrap	26 WATT LED	None	1,111
24	4' LED Wrap	26 WATT LED	None	1,111
24	4' LED Wrap	26 WATT LED	None	1,111
24	4' LED Wrap	26 WATT LED	None	1,111
24	4' LED Wrap	26 WATT LED	None	1,111
24	4' LED Wrap	26 WATT LED	None	1,111
24	4' LED Wrap	26 WATT LED	None	1,111
24	4' LED Wrap	26 WATT LED	None	1,111
24	4' LED Wrap	26 WATT LED	None	1,111
24	4' LED Wrap	26 WATT LED	None	1,111

24	4' LED Wrap	26 WATT LED	None	1,111
24	4' LED Wrap	26 WATT LED	None	1,111
24	4' LED Wrap	26 WATT LED	None	1,111
24	4' LED Wrap	26 WATT LED	None	1,111
24	4' LED Wrap	26 WATT LED	None	1,111
24	4' LED Wrap	26 WATT LED	None	1,111
24	4' LED Wrap	26 WATT LED	None	1,111
24	4' LED Wrap	26 WATT LED	None	1,111
24	4' LED Wrap	26 WATT LED	None	1,111
24	4' LED Wrap	26 WATT LED	None	1,111
24	4' LED Wrap	26 WATT LED	None	1,111
24	4' LED Wrap	26 WATT LED	None	1,111
24	4' LED Wrap	26 WATT LED	None	1,111
24	4' LED Wrap	26 WATT LED	None	1,111
24	4' LED Wrap	26 WATT LED	None	1,111
24	4' LED Wrap	26 WATT LED	None	1,111
24	4' LED Wrap	26 WATT LED	None	1,111
24	4' LED Wrap	26 WATT LED	None	1,111
24	4' LED Wrap	26 WATT LED	None	1,111
24	4' LED Wrap	26 WATT LED	None	1,111
24	4' LED Wrap	26 WATT LED	None	1,111
24	4' LED Wrap	26 WATT LED	None	1,111
24	4' LED Wrap	26 WATT LED	None	1,111
26	LED 2x4 w/ Adaptive	30 WATT LED	Step Dim	2,914
32	LED 2x4 w/ Adaptive	30 WATT LED	Step Dim	3,587
24	4' LED Wrap	26 WATT LED	None	924
24	LED Retrofit-Lin	120 WATT LED	Occ Sensor	11,310
3	LED 2x4 w/ Adaptive	30 WATT LED	Step Dim	417
3	LED 2x4 w/ Adaptive	30 WATT LED	Step Dim	417
3	LED 2x4 w/ Adaptive	30 WATT LED	Step Dim	417
3	LED 2x4 w/ Adaptive	30 WATT LED	Step Dim	417
24	LED 2x4 w/ Adaptive	30 WATT LED	Step Dim	1,793
28	4' LED Wrap	26 WATT LED	None	1,340
				91,696

Eames Way Elementary School

The Eames Way Elementary School is a 40,020 sq. ft. facility that serves 382 students in grades K-5. The building is currently heated by natural gas. Energy conservation measures identified for the Eames Way Elementary School by Guardian Energy include de-stratification fans.





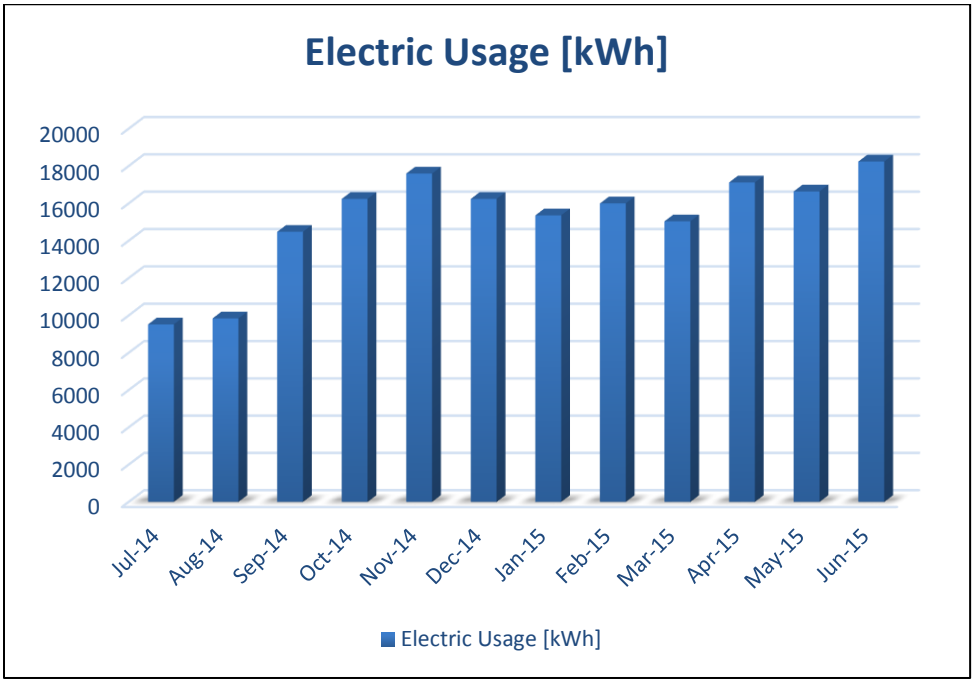
Recommended Energy Conservation Measures (ECM's)

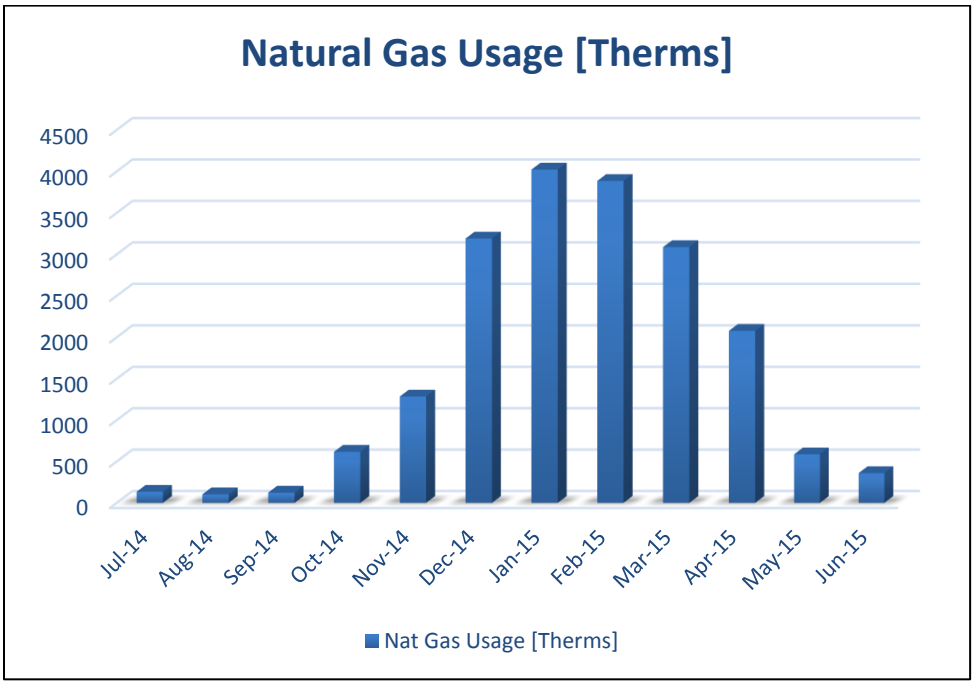
ECM 1: De-Stratification Fans

Heat rises. In spaces with high ceilings, rising heat causes stratification meaning layers within the air. The hottest layers of air rise to the top instead of where you want the heat to be which is down on ground near the occupants and the thermostats. When all your heat keeps rising to the ceiling, your heating system must work harder throughout the winter to supply enough heat to reach the ground level. De-Stratification fans move the heat back down to ground level increasing occupant comfort and reducing energy usage.

Daniel Webster Elementary School

The Daniel Webster School is a 58,805 sq. ft. facility that serves 471 students in grades PK-5. The building is currently heated by natural gas. Energy conservation measures identified for the Daniel Webster School by Guardian Energy include de-stratification fans and lighting upgrades.





Recommended Energy Conservation Measures (ECM's)

ECM 1: De-Stratification Fans

Heat rises. In spaces with high ceilings, rising heat causes stratification meaning layers within the air. The hottest layers of air rise to the top instead of where you want the heat to be which is down on ground near the occupants and the thermostats. When all your heat keeps rising to the ceiling, your heating system must work harder throughout the winter to supply enough heat to reach the ground level. De-Stratification fans move the heat back down to ground level increasing occupant comfort and reducing energy usage.

ECM 2: Lighting and Lighting Controls Upgrade

Findings

Inefficient lighting equipment and lighting controls or lack thereof can be a significant source of unnecessary energy waste. Only 5-10% of the energy used by an incandescent light bulb is actually converted into light. The remaining 90-95% of the energy used is released into the space as waste heat. This can add to the cooling load during summer. Newer more efficient lighting technology is currently available at affordable costs. In addition utility sponsored incentives are available to help buy down the initial cost of lighting upgrades.

Recommendations

Guardian recommends implementing the lighting upgrade measures listed below and can facilitate the process of applying for available incentives from National Grid.

EXISTING LIGHTING SYSTEM					
Measure #	Location	Qty.	Existing Fixture Description	Existing Wattage	Existing Hours

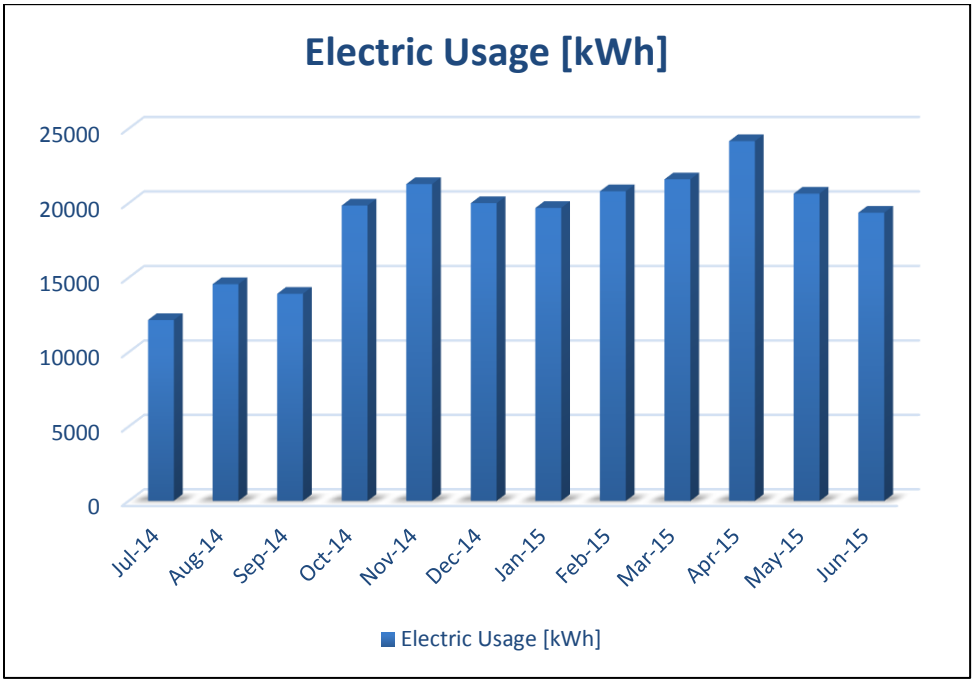
1	Front Drive + Lot	8	Shoe Box, Sq. Pole	295	4,380
2	Front Entrance	9	Lensed Recessed	120	4,380
3	Door 2	1	Lensed Recessed	120	4,380
4	Wing Wall near Baseball	1	Wall Pack, Forward Throw PC	190	4,380
5	Door 3	1	Wall Pack, Sm Forward Throw	95	4,380
6	Door 3	1	Flood, Bracket	295	4,380
7	Wing Wall near Woods	1	Wall Pack, Forward Throw PC	190	4,380
8	Wing Wall near Woods	1	Wall Pack, Forward Throw PC	295	4,380
9	Near Loading Dock	3	Wall Pack, Forward Throw PC	190	4,380
10	Loading Dock	4	Canopy	120	4,380
11	Back Lot	3	Shoe Box, Sq. Pole	295	4,380
12	Wall Near Playground	2	Wall Pack, Sm Forward Throw	95	4,380
13	Wall Near Playground	1	Flood, Bracket	295	4,380
14	Room 101	12	2x4 Prismatic Lens-Surface Mount	112	1,780
15	Room 102	12	2x4 Prismatic Lens-Surface Mount	112	1,780
16	Room 103	12	2x4 Prismatic Lens-Surface Mount	112	1,780
17	Room 104	12	2x4 Prismatic Lens-Surface Mount	112	1,780
18	Room 105	12	2x4 Prismatic Lens-Surface Mount	112	1,780
19	Room 106	12	2x4 Prismatic Lens-Surface Mount	112	1,780
20	Room 107	12	2x4 Prismatic Lens-Surface Mount	112	1,780
21	Room 108	12	2x4 Prismatic Lens-Surface Mount	112	1,780
22	Room 109	12	2x4 Prismatic Lens-Surface Mount	112	1,780
23	Room 110	12	2x4 Prismatic Lens-Surface Mount	112	1,780
24	Room 111	12	2x4 Prismatic Lens-Surface Mount	112	1,780
25	Room 112	12	2x4 Prismatic Lens-Surface Mount	112	1,780
26	Reading Room	4	2x4 Prismatic Lens	88	1,780
27	Reading Room	4	2x2 Prismatic Lens	60	1,780
28	Primary Activity Room	8	2x4 Prismatic Lens	88	3,300
29	Cafe	20	2x4 Prismatic Lens	88	1,780
30	Gym	20	High Bay	117	1,780
31	Library	12	2x4 Prismatic Lens-Surface Mount	112	1,780
32	Kitchen	22	4' Vapor Tight	60	1,780
33	Admin + Nurse	14	2x4 Prismatic Lens-Surface Mount	112	1,780
34	Room 125	14	2x4 Prismatic Lens-Surface Mount	112	1,780
35	Room 113	12	2x4 Prismatic Lens-Surface Mount	112	1,780
36	Room 114	13	2x4 Prismatic Lens-Surface Mount	112	1,780
37	Room 115	14	2x4 Prismatic Lens-Surface Mount	112	1,780
38	Room 116	15	2x4 Prismatic Lens-Surface Mount	112	1,780
39	Room 117	16	2x4 Prismatic Lens-Surface Mount	112	1,780
40	Room 118	17	2x4 Prismatic Lens-Surface Mount	112	1,780
41	Room 119	18	2x4 Prismatic Lens-Surface Mount	112	1,780
42	Room 120	19	2x4 Prismatic Lens-Surface Mount	112	1,780
43	Room 121	20	2x4 Prismatic Lens-Surface Mount	112	1,780
44	Room 122	21	2x4 Prismatic Lens-Surface Mount	112	1,780
45	Room 123	22	2x4 Prismatic Lens-Surface Mount	112	1,780
46	Room 124	23	2x4 Prismatic Lens-Surface Mount	112	1,780
Totals		**508**			

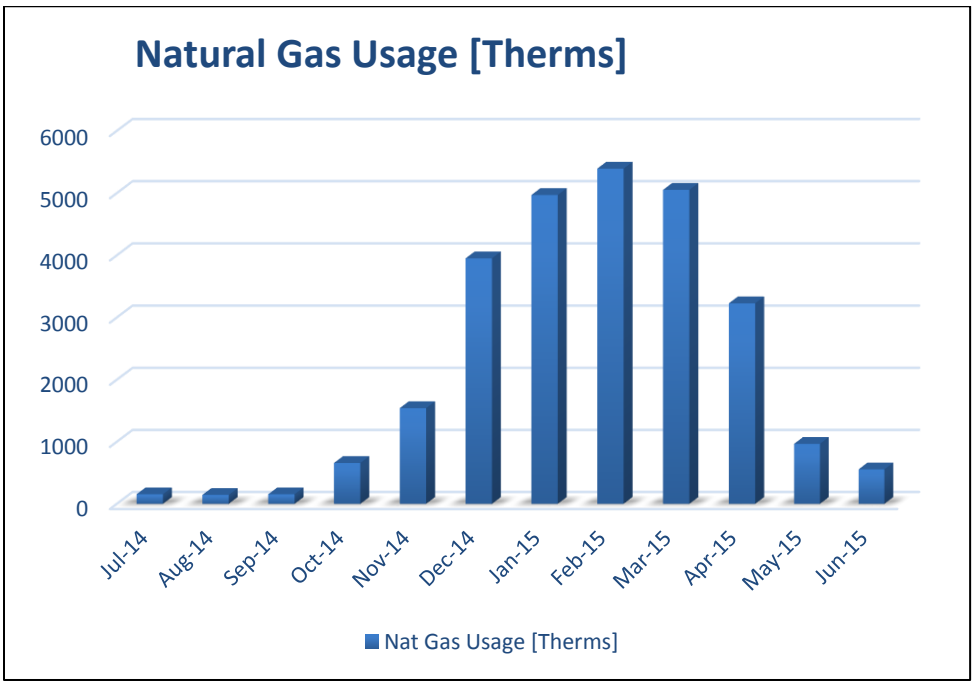
PROPOSED LIGHTING SYSTEM					
Proposed Qty.	Proposed Fixture Description	Fixture Type and Wattage	Add Occupancy Sensor?	Proposed Hours	Total kWh Reduction
8	LED Shoe Box-AR1310M	85 WATT LED	Step Dim	3,066	8,252
9	LED Can Retrofit-CDL45	45 WATT LED	None	4,380	2,957

1	LED Can Retrofit-CDL45	45 WATT LED	None	4,380	329
1	LED Wall Pack-LWP-FT	55 WATT LED	None	4,380	591
1	Led Wall Pack-LWP-MN	10 WATT LED	None	4,380	372
1	LED Flood, Bracket Mount	60 WATT LED	None	4,380	1,029
1	LED Wall Pack-LWP-FT	55 WATT LED	None	4,380	591
1	LED Wall Pack-LWP-FT	80 WATT LED	None	4,380	942
3	LED Wall Pack-LWP-FT	55 WATT LED	None	4,380	1,774
4	Led Canopy-Lum	22 WATT LED	None	4,380	1,717
3	LED Shoe Box-AR1310M	85 WATT LED	Step Dim	3,066	3,094
2	Led Wall Pack-LWP-MN	10 WATT LED	None	4,380	745
1	LED Flood, Bracket Mount	60 WATT LED	None	4,380	1,029
12	LED 2x4 Vola- w/ Adaptive Technology (surf mnt)	42 WATT LED	Occ Sensor	1,353	1,711
12	LED 2x4 Vola- w/ Adaptive Technology (surf mnt)	42 WATT LED	Occ Sensor	1,353	1,711
12	LED 2x4 Vola- w/ Adaptive Technology (surf mnt)	42 WATT LED	Occ Sensor	1,353	1,711
12	LED 2x4 Vola- w/ Adaptive Technology (surf mnt)	42 WATT LED	Occ Sensor	1,353	1,711
12	LED 2x4 Vola- w/ Adaptive Technology (surf mnt)	42 WATT LED	Occ Sensor	1,353	1,711
12	LED 2x4 Vola- w/ Adaptive Technology (surf mnt)	42 WATT LED	Occ Sensor	1,353	1,711
12	LED 2x4 Vola- w/ Adaptive Technology (surf mnt)	42 WATT LED	Occ Sensor	1,353	1,711
12	LED 2x4 Vola- w/ Adaptive Technology (surf mnt)	42 WATT LED	Occ Sensor	1,353	1,711
12	LED 2x4 Vola- w/ Adaptive Technology (surf mnt)	42 WATT LED	Occ Sensor	1,353	1,711
12	LED 2x4 Vola- w/ Adaptive Technology (surf mnt)	42 WATT LED	Occ Sensor	1,353	1,711
12	LED 2x4 Vola- w/ Adaptive Technology (surf mnt)	42 WATT LED	Occ Sensor	1,353	1,711
12	LED 2x4 Vola- w/ Adaptive Technology (surf mnt)	42 WATT LED	Occ Sensor	1,353	1,711
4	LED 2x4 Vola- w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,353	464
4	LED 2x2 Vola- w/ Adaptive Technology	22 WATT LED	Occ Sensor	1,353	308
8	LED 2x4 Vola- w/ Adaptive Technology	30 WATT LED	Occ Sensor	2,508	1,721
20	LED 2x4 Vola- w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,353	2,321
20	LED High Bay w/ Adaptive Technology-2MS	44 WATT LED	Occ Sensor	1,353	2,975
12	LED 2x4 Vola- w/ Adaptive Technology (surf mnt)	42 WATT LED	Occ Sensor	1,353	1,711
22	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,353	1,457
14	LED 2x4 Vola- w/ Adaptive Technology (surf mnt)	42 WATT LED	Occ Sensor	1,353	1,996
14	LED 2x4 Vola- w/ Adaptive Technology (surf mnt)	42 WATT LED	Occ Sensor	1,353	1,996
12	LED 2x4 Vola- w/ Adaptive Technology (surf mnt)	42 WATT LED	Occ Sensor	1,353	1,711
13	LED 2x4 Vola- w/ Adaptive Technology (surf mnt)	42 WATT LED	Occ Sensor	1,353	1,853
14	LED 2x4 Vola- w/ Adaptive Technology (surf mnt)	42 WATT LED	Occ Sensor	1,353	1,996
15	LED 2x4 Vola- w/ Adaptive Technology (surf mnt)	42 WATT LED	Occ Sensor	1,353	2,138
16	LED 2x4 Vola- w/ Adaptive Technology (surf mnt)	42 WATT LED	Occ Sensor	1,353	2,281
17	LED 2x4 Vola- w/ Adaptive Technology (surf mnt)	42 WATT LED	Occ Sensor	1,353	2,423
18	LED 2x4 Vola- w/ Adaptive Technology (surf mnt)	42 WATT LED	Occ Sensor	1,353	2,566
19	LED 2x4 Vola- w/ Adaptive Technology (surf mnt)	42 WATT LED	Occ Sensor	1,353	2,708
20	LED 2x4 Vola- w/ Adaptive Technology (surf mnt)	42 WATT LED	Occ Sensor	1,353	2,851
21	LED 2x4 Vola- w/ Adaptive Technology (surf mnt)	42 WATT LED	Occ Sensor	1,353	2,993
22	LED 2x4 Vola- w/ Adaptive Technology (surf mnt)	42 WATT LED	Occ Sensor	1,353	3,136
23	LED 2x4 Vola- w/ Adaptive Technology (surf mnt)	42 WATT LED	Occ Sensor	1,353	3,278
508					**88,830**

Edward Winslow Elementary School

The Edward Winslow Elementary School is a 65,790 sq. ft. facility that serves 480 students in grades PK-5. The building is currently heated by natural gas. Energy conservation measures identified for the Edward Winslow Elementary School by Guardian Energy include lighting upgrades.





Recommended Energy Conservation Measures (ECM's)

ECM 1: Lighting and Lighting Controls Upgrade

Findings

Inefficient lighting equipment and lighting controls or lack thereof can be a significant source of unnecessary energy waste. Only 5-10% of the energy used by an incandescent light bulb is actually converted into light. The remaining 90-95% of the energy used is released into the space as waste heat. This can add to the cooling load during summer. Newer more efficient lighting technology is currently available at affordable costs. In addition utility sponsored incentives are available to help buy down the initial cost of lighting upgrades.

Recommendations

Guardian recommends implementing the lighting upgrade measures listed below and can facilitate the process of applying for available incentives from National Grid.

EXISTING LIGHTING SYSTEM					
Measure #	Location	Qty.	Existing Fixture Description	Existing Wattage	Existing Hours
1	Front Drive	3	Shoe Box, Sq. Pole	295	4,380
2	Front Wall	1	Wall Pack, Forward Throw PC	120	4,380
3	Entrance Canopy	6	10" Recessed Can	120	4,380
4	Sign Light	1	Flood, Knuckle Mount	120	4,380
5	Side Lot	4	Shoe Box, Sq. Pole	295	4,380
6	Right Side	8	Wall Pack, Forward Throw PC	120	4,380
7	Back Wall	7	Wall Pack, Forward Throw PC	120	4,380
8	Door 11	2	10" Recessed Can	120	4,380
9	Door 8	2	10" Recessed Can	120	4,380
10	Basketball Side	9	Wall Pack, Forward Throw PC	120	4,380
11	Door 6	2	10" Recessed Can	120	4,380
12	Playroom 511	24	High Bay	117	3,300
13	Room 301	12	4' Wide Wrap-end to end	112	1,780
14	Room 302	12	4' Wide Wrap-end to end	112	1,780
15	Room 303	12	4' Wide Wrap-end to end	112	1,780
16	Room 304	12	4' Wide Wrap-end to end	112	1,780
17	Room 305	12	4' Wide Wrap-end to end	112	1,780
18	Room 306	12	4' Wide Wrap-end to end	112	1,780
19	Room 307	12	4' Wide Wrap-end to end	112	1,780
20	Room 308	12	4' Wide Wrap-end to end	112	1,780
21	Room 309	4	4' Wide Wrap-end to end	112	1,780
22	Work 300	4	4' Wide Wrap-end to end	112	1,780
23	Room 200	4	4' Wide Wrap-end to end	112	1,780
24	Room 209	4	4' Wide Wrap-end to end	112	1,780
25	Room 201	12	4' Wide Wrap-end to end	112	1,780
26	Room 202	12	4' Wide Wrap-end to end	112	1,780
27	Room 203	12	4' Wide Wrap-end to end	112	1,780
28	Room 204	12	4' Wide Wrap-end to end	112	1,780
29	Room 205	12	4' Wide Wrap-end to end	112	1,780
30	Room 206	12	4' Wide Wrap-end to end	112	1,780
31	Room 207	12	4' Wide Wrap-end to end	112	1,780

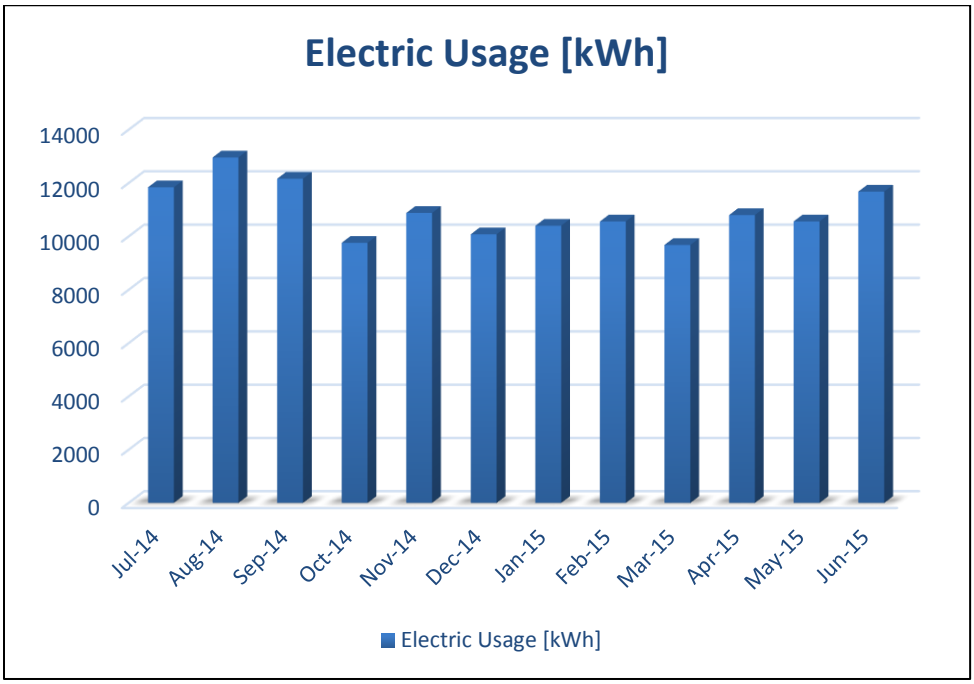
32	Room 208	12	4' Wide Wrap-end to end	112	1,780
33	Cafe	24	High Bay	117	1,780
34	Kitchen	16	4' Vapor Tight	60	1,780
35	Admin Offices	10	4' Wide Wrap-end to end	112	2,410
36	Library	16	4' Wide Wrap-end to end	112	1,780
37	Room 400	6	4' Wide Wrap-end to end	112	1,780
38	Room 401	12	4' Wide Wrap-end to end	112	1,780
39	Room 402	12	4' Wide Wrap-end to end	112	1,780
40	Room 403	12	4' Wide Wrap-end to end	112	1,780
41	Room 404	12	4' Wide Wrap-end to end	112	1,780
42	Room 405	12	4' Wide Wrap-end to end	112	1,780
43	Room 406	12	4' Wide Wrap-end to end	112	1,780
44	Room 407	12	4' Wide Wrap-end to end	112	1,780
45	Room 408	12	4' Wide Wrap-end to end	112	1,780
46	Room 409	16	4' Wide Wrap-end to end	112	1,780
47	Room 410	16	4' Wide Wrap-end to end	112	1,780
Totals		**477**			

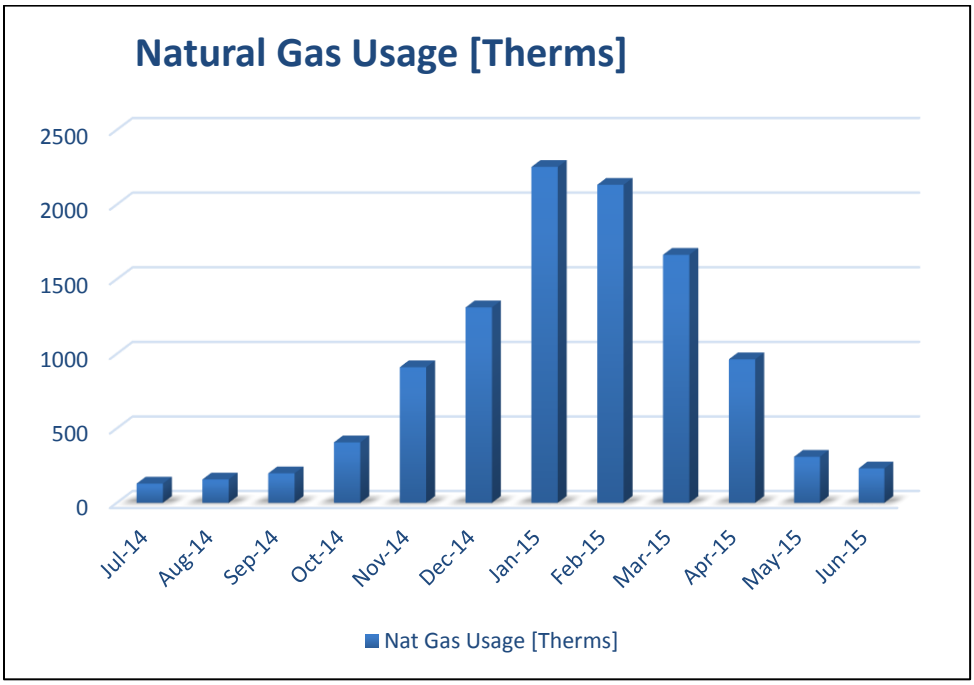
PROPOSED LIGHTING SYSTEM					
Proposed Qty.	Proposed Fixture Description	Fixture Type and Wattage	Add Occupancy Sensor?	Proposed Hours	Total kWh Reduction
3	LED Shoe Box-AR1310M	85 WATT LED	Step Dim	3,066	3,094
1	LED Wall Pack-LWP-FT	24 WATT LED	None	4,380	420
6	LED Can Retrofit-CDL45	45 WATT LED	None	4,380	1,971
1	LED Flood-LF-MD-25	24 WATT LED	None	4,380	420
4	LED Shoe Box-AR1310M	85 WATT LED	Step Dim	3,066	4,126
8	LED Wall Pack-LWP-FT	24 WATT LED	None	4,380	3,364
7	LED Wall Pack-LWP-FT	24 WATT LED	None	4,380	2,943
2	LED Can Retrofit-CDL45	45 WATT LED	None	4,380	657
2	LED Can Retrofit-CDL45	45 WATT LED	None	4,380	657
9	LED Wall Pack-LWP-FT	24 WATT LED	None	4,380	3,784
2	LED Can Retrofit-CDL45	45 WATT LED	None	4,380	657
24	LED High Bay w/ Adaptive Technology-2MS	44 WATT LED	Occ Sensor	2,508	6,618
12	4' LED Wrap w/ Adaptive Technology	44 WATT LED	Occ Sensor	1,353	1,678
12	4' LED Wrap w/ Adaptive Technology	44 WATT LED	Occ Sensor	1,353	1,678
12	4' LED Wrap w/ Adaptive Technology	44 WATT LED	Occ Sensor	1,353	1,678
12	4' LED Wrap w/ Adaptive Technology	44 WATT LED	Occ Sensor	1,353	1,678
12	4' LED Wrap w/ Adaptive Technology	44 WATT LED	Occ Sensor	1,353	1,678
12	4' LED Wrap w/ Adaptive Technology	44 WATT LED	Occ Sensor	1,353	1,678
12	4' LED Wrap w/ Adaptive Technology	44 WATT LED	Occ Sensor	1,353	1,678
12	4' LED Wrap w/ Adaptive Technology	44 WATT LED	Occ Sensor	1,353	1,678
4	4' LED Wrap w/ Adaptive Technology	44 WATT LED	Occ Sensor	1,353	559
4	4' LED Wrap w/ Adaptive Technology	44 WATT LED	Occ Sensor	1,353	559
4	4' LED Wrap w/ Adaptive Technology	44 WATT LED	Occ Sensor	1,353	559
4	4' LED Wrap w/ Adaptive Technology	44 WATT LED	Occ Sensor	1,353	559
12	4' LED Wrap w/ Adaptive Technology	44 WATT LED	Occ Sensor	1,353	1,678
12	4' LED Wrap w/ Adaptive Technology	44 WATT LED	Occ Sensor	1,353	1,678
12	4' LED Wrap w/ Adaptive Technology	44 WATT LED	Occ Sensor	1,353	1,678
12	4' LED Wrap w/ Adaptive Technology	44 WATT LED	Occ Sensor	1,353	1,678
12	4' LED Wrap w/ Adaptive Technology	44 WATT LED	Occ Sensor	1,353	1,678
12	4' LED Wrap w/ Adaptive Technology	44 WATT LED	Occ Sensor	1,353	1,678
12	4' LED Wrap w/ Adaptive Technology	44 WATT LED	Occ Sensor	1,353	1,678
12	4' LED Wrap w/ Adaptive Technology	44 WATT LED	Occ Sensor	1,353	1,678

24	LED High Bay w/ Adaptive Technology-2MS	44 WATT LED	Occ Sensor	1,353	3,570
16	4' LED Wrap w/ Adaptive Technology	30 WATT LED	Occ Sensor	1,353	1,059
10	4' LED Wrap w/ Adaptive Technology	44 WATT LED	Occ Sensor	1,832	1,893
16	4' LED Wrap w/ Adaptive Technology	44 WATT LED	Occ Sensor	1,353	2,237
6	4' LED Wrap w/ Adaptive Technology	44 WATT LED	Occ Sensor	1,353	839
12	4' LED Wrap w/ Adaptive Technology	44 WATT LED	Occ Sensor	1,353	1,678
12	4' LED Wrap w/ Adaptive Technology	44 WATT LED	Occ Sensor	1,353	1,678
12	4' LED Wrap w/ Adaptive Technology	44 WATT LED	Occ Sensor	1,353	1,678
12	4' LED Wrap w/ Adaptive Technology	44 WATT LED	Occ Sensor	1,353	1,678
12	4' LED Wrap w/ Adaptive Technology	44 WATT LED	Occ Sensor	1,353	1,678
12	4' LED Wrap w/ Adaptive Technology	44 WATT LED	Occ Sensor	1,353	1,678
12	4' LED Wrap w/ Adaptive Technology	44 WATT LED	Occ Sensor	1,353	1,678
12	4' LED Wrap w/ Adaptive Technology	44 WATT LED	Occ Sensor	1,353	1,678
16	4' LED Wrap w/ Adaptive Technology	44 WATT LED	Occ Sensor	1,353	2,237
16	4' LED Wrap w/ Adaptive Technology	44 WATT LED	Occ Sensor	1,353	2,237
477					**85,297**

Council on Aging

The Marshfield Council on Aging is open Mon - Fri from 8:30 am – 5:00pm. The building is currently heated by natural gas-fired boilers. Energy conservation measures identified for the Marshfield Council on Aging by Guardian Energy include replacing the standing pilots on the boilers with spark ignition to improve overall burner efficiency, refrigeration controls, and lighting upgrades.





Recommended Energy Conservation Measures (ECM's)

ECM 1: Boiler Replacement - Standing Pilots to Electronic Ignition

Standing pilot ignition systems use a pilot light that is lit 24/7 to ignite the main burners. Standing pilot ignition systems are not as efficient as an electronic gas ignition system. It uses gas even during off cycles of the main burner. The standing pilot ignition system also adds heat to the system even in the summer. This causes the air conditioning system to have to work harder and the overall system to suffer slightly when it comes to efficiency.

ECM 2: Refrigeration Controls

The Frigitek is an energy saving device designed for walk-in or industrial refrigerators and freezers. The purpose of a refrigeration compressor and related equipment is to pump heat out of a box. Often, more than 30% of that heat is generated by the evaporator fan motors. Frigitek reduces this heat load approximately 75-80% by lowering the voltage to the evaporator fan motors when the box is not being actively cooled. The result is a significant saving in operation costs. The dramatic energy saving produced by the Frigitek have been confirmed by more than ten years of extensive laboratory and field testing and satisfied customers.

ECM 3: Lighting and Lighting Controls Upgrade

Findings

Inefficient lighting equipment and lighting controls or lack thereof can be a significant source of unnecessary energy waste. Only 5-10% of the energy used by an incandescent light bulb is actually converted into light. The remaining 90-95% of the energy used is released into the space as waste heat. This can add to the cooling load during summer. Newer more efficient lighting technology is currently available at affordable costs. In addition utility sponsored incentives are available to help buy down the initial cost of lighting upgrades.

Recommendations

Guardian recommends implementing the lighting upgrade measures listed below and can facilitate the process of applying for available incentives from National Grid.

EXISTING LIGHTING SYSTEM					
Measure #	Location	Qty.	Existing Fixture Description	Existing Wattage	Existing Hours
1	Main Lot	9	Shoebox, Green, Sq. Pole	295	4,380
2	Drive	3	Shoebox, Green, Sq. Pole	295	4,380
3	Flag Light	2	Spot Flood, Knuckle Mnt	120	4,380
4	Front Lot	1	Shoebox, Green, Sq. Pole	295	4,380
5	Street Side Canopy	3	10" Recessed Can	54	4,380
6	Back Wall	4	Wall Pack	150	4,380
7	Drive Side Canopy	6	10" Recessed Can	54	4,380
8	Main Entrance Doors	2	10" Recessed Can	54	4,380
9	Entrance Vestibule	3	10" Recessed Can	54	4,380
10	Electric Room	1	4' Vapor Tight	60	400
11	Multi-Purpose	20	2x2 Parabolic Lens	60	2,250
12	Back Entrance Vest	4	10" Recessed Can	54	2,250
13	Kitchen	9	2x4 Prismatic Lens	112	2,250
14	Nutrition Office	1	2x4 Prismatic Lens	112	2,250
15	Pantry	2	2x4 Prismatic Lens	112	2,250
16	Bathroom	2	2x2 Parabolic Lens	60	2,250
17	Emma's Closet	3	2x4 Prismatic Lens	112	2,250
18	Dining	10	14" Recessed	100	2,250
19	Dining	15	2x2 Parabolic Lens	60	2,250
20	Computer Lab	12	2x2 Parabolic Lens	60	2,250
21	Arts and Crafts	12	2x2 Parabolic Lens	60	2,250
22	Function 3	10	14" Recessed	100	2,250
23	Function 3	15	2x2 Parabolic Lens	60	2,250
24	Men's	3	2x2 Prismatic Lens	60	2,250
25	Men's	2	4' Vapor Tight	60	2,250
26	Women's	3	2x2 Prismatic Lens	60	2,250
27	Women's	4	4' Vapor Tight	60	2,250
28	Exercise Room	13	2x2 Parabolic Lens	60	2,250
29	Health Room	4	2x2 Parabolic Lens	60	2,250
30	Supplies	2	2x2 Parabolic Lens	60	400
31	Conference Room	6	2x2 Parabolic Lens	60	2,250
32	Media	9	2x2 Parabolic Lens	60	2,250
33	Restroom	2	2x2 Parabolic Lens	60	2,250
34	Meeting 1&2	8	2x2 Parabolic Lens	60	2,250
35	Admin Area Back Office	4	2x2 Parabolic Lens	60	2,250
36	Admin Area Middle Office	4	2x2 Parabolic Lens	60	2,250
37	Admin Area 1st Office	4	2x2 Parabolic Lens	60	2,250
38	Left Side Office	4	2x2 Parabolic Lens	60	2,250

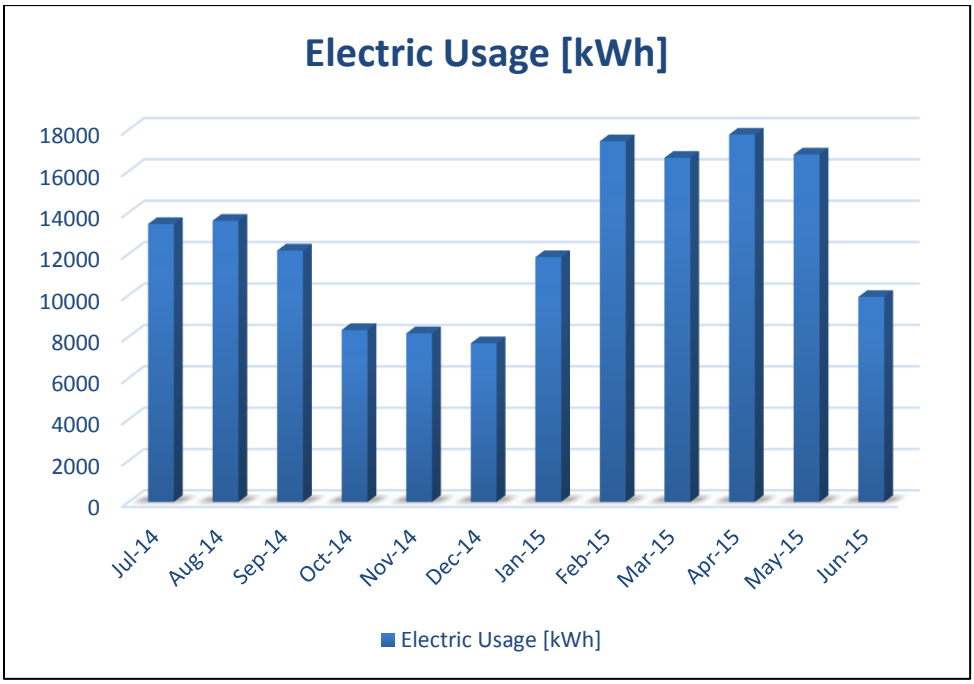
39	Administrator	2	2x2 Parabolic Lens	60	2,250
40	Pool Area	14	8" Recessed Can	54	2,250
41	Front Hall to Gift Shop	40	8" Recessed Can	54	2,250
42	Hall from Gift to Back	36	8" Recessed Can	54	2,250
43	Hall	11	Sconce	30	2,250
44	Hall Closet	1	8" Recessed Can	54	400
45	Attic	14	4' Strip	60	1,000
Totals		**339**			

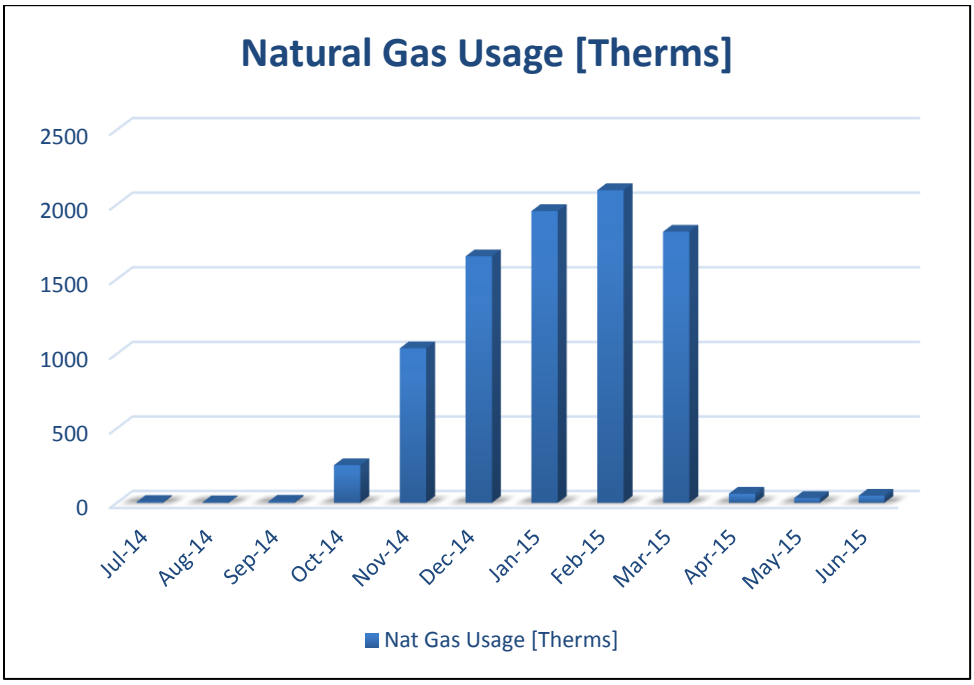
PROPOSED LIGHTING SYSTEM					
Proposed Qty.	Proposed Fixture Description	Fixture Type and Wattage	Add Occupancy Sensor?	Proposed Hours	Total kWh Reduction
9	LED Shoe Box-AR1310M	85 WATT LED	Step Dim	3,066	9,283
3	LED Shoe Box-AR1310M	85 WATT LED	Step Dim	3,066	3,094
2	LED Flood, Knuckle w/PC	24 WATT LED	None	4,380	841
1	LED Shoe Box-AR1310M	85 WATT LED	Step Dim	3,066	1,031
3	LED Retrofit-Great-CDL	24 WATT LED	None	4,380	394
4	LED Wall Pack-LWP-FT	55 WATT LED	None	4,380	1,664
6	LED Retrofit-Great-CDL	24 WATT LED	None	4,380	788
2	LED Retrofit-Great-CDL	24 WATT LED	None	4,380	263
3	LED Retrofit-Great-CDL	24 WATT LED	None	4,380	394
1	4' LED Strip w/Adaptive Technology	30 WATT LED	Step Dim	280	16
20	LED 2x2 w/Adaptive Technology	22 WATT LED	Step Dim	1,575	2,007
4	LED Retrofit-Great-CDL	24 WATT LED	None	2,250	270
9	LED 2x4 w/Adaptive Technology	35 WATT LED	Step Dim	1,575	1,772
1	LED 2x4 w/Adaptive Technology	35 WATT LED	Step Dim	1,575	197
2	LED 2x4 w/Adaptive Technology	35 WATT LED	Step Dim	1,575	394
2	LED 2x2 w/Adaptive Technology	22 WATT LED	Step Dim	1,575	201
3	LED 2x4 w/Adaptive Technology	35 WATT LED	Step Dim	1,575	591
10	LED Retrofit-Great-CDL	45 WATT LED	None	2,250	1,238
15	LED 2x2 w/Adaptive Technology	22 WATT LED	Step Dim	1,575	1,505
12	LED 2x2 w/Adaptive Technology	22 WATT LED	Step Dim	1,575	1,204
12	LED 2x2 w/Adaptive Technology	22 WATT LED	Step Dim	1,575	1,204
10	LED Retrofit-Great-CDL	45 WATT LED	None	2,250	1,238
15	LED 2x2 w/Adaptive Technology	22 WATT LED	Step Dim	1,575	1,505
3	LED 2x2 w/Adaptive Technology	22 WATT LED	Step Dim	1,575	301
2	4' LED Strip w/Adaptive Technology	30 WATT LED	Step Dim	1,575	176
3	LED 2x2 w/Adaptive Technology	22 WATT LED	Step Dim	1,575	301
4	4' LED Strip w/Adaptive Technology	30 WATT LED	Step Dim	1,575	351
13	LED 2x2 w/Adaptive Technology	22 WATT LED	Step Dim	1,575	1,305
4	LED 2x2 w/Adaptive Technology	22 WATT LED	Step Dim	1,575	401
2	LED 2x2 w/Adaptive Technology	22 WATT LED	Step Dim	280	36
6	LED 2x2 w/Adaptive Technology	22 WATT LED	Step Dim	1,575	602
9	LED 2x2 w/Adaptive Technology	22 WATT LED	Step Dim	1,575	903
2	LED 2x2 w/Adaptive Technology	22 WATT LED	Step Dim	1,575	201
8	LED 2x2 w/Adaptive Technology	22 WATT LED	Step Dim	1,575	803
4	LED 2x2 w/Adaptive Technology	22 WATT LED	Step Dim	1,575	401
4	LED 2x2 w/Adaptive Technology	22 WATT LED	Step Dim	1,575	401
4	LED 2x2 w/Adaptive Technology	22 WATT LED	Step Dim	1,575	401
4	LED 2x2 w/Adaptive Technology	22 WATT LED	Step Dim	1,575	401
2	LED 2x2 w/Adaptive Technology	22 WATT LED	Step Dim	1,575	201
14	LED Retrofit-Great-CDL	27 WATT LED	None	2,250	851
40	LED Retrofit-Great-CDL	27 WATT LED	None	2,250	2,430

36	LED Retrofit-Great-CDL	27 WATT LED	None	2,250	2,187
11	LED Retrofit-Rem-LEDSR	7 WATT LED	None	2,250	569
1	LED Retrofit-Great-CDL	27 WATT LED	None	400	11
14	4' LED Strip w/Adaptive Technology	30 WATT LED	Step Dim	700	546
339					**44,873**

Library

The Marshfield Library is open Mon-Sat 9am – 8pm. The newly-constructed building heated by natural gas. Energy conservation measures identified for the Marshfield Library by Guardian Energy include lighting upgrades.





Recommended Energy Conservation Measures (ECM's)

ECM 1: Lighting and Lighting Controls Upgrade

Findings

Inefficient lighting equipment and lighting controls or lack thereof can be a significant source of unnecessary energy waste. Only 5-10% of the energy used by an incandescent light bulb is actually converted into light. The remaining 90-95% of the energy used is released into the space as waste heat. This can add to the cooling load during summer. Newer more efficient lighting technology is currently available at affordable costs. In addition utility sponsored incentives are available to help buy down the initial cost of lighting upgrades.

Recommendations

Guardian recommends implementing the lighting upgrade measures listed below and can facilitate the process of applying for available incentives from National Grid.

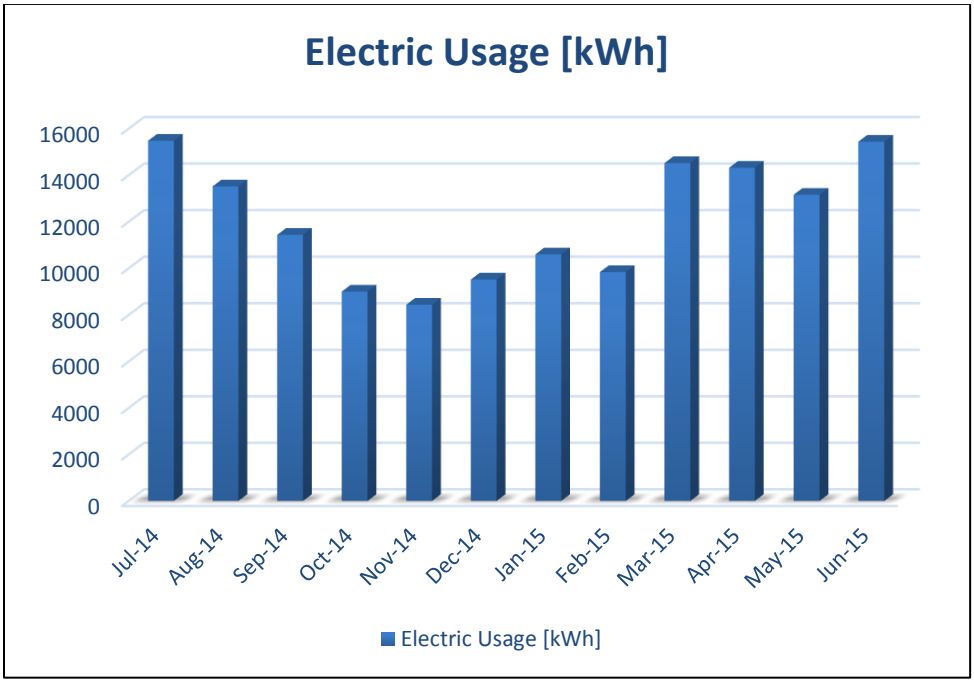
EXISTING LIGHTING SYSTEM					
Measure #	Location	Qty.	Existing Fixture Description	Existing Wattage	Existing Hours
1	Cove Lighting	30	4' Strip	30	3,250
2	Cove Lighting	2	3' Strip	24	3,250
3	Main Section	12	Pendant	120	3,250
4	Tall Stacks	54	4' Wrap	30	3,250
5	DVD's	5	2x4 Parabolic Lens	88	3,250
6	Children's DVD's	2	2x4 Parabolic Lens	88	3,250
7	Center Area	10	2x4 Parabolic Lens	88	3,250
8	Quiet Study	4	2x4 Prismatic Lens	60	3,250
9	Desk Area	9	2x4 Parabolic Lens	88	3,250
10	Program Room	4	Pendant	120	3,250
11	Program Kitchen	2	4' Wrap	30	3,250
12	Audi Visual Room	3	4' Wrap	60	3,250
13	Children's Room	15	2x4 Prismatic Lens	60	3,250
14	Children's Cove	8	3' Strip	24	3,250
15	Directors Office	2	2x2 Parabolic Lens	37	3,250
16	Admin Assistant	2	2x4 Parabolic Lens	88	3,250
17	Back Area	7	4' Wrap	60	3,250
18	Back Area	3	2x4 Prismatic Lens	60	3,250
19	Back Area Office	2	4' Wrap	60	3,250
20	Break Room	4	4' Wrap	60	3,250
21	Break Room	2	4' Wrap	30	3,250
22	Break Room Bathroom	1	4' Wrap	60	3,250
23	Men's	1	4' Wrap	60	3,250
24	Men's	1	2x2 Prismatic Lens	37	3,250
25	Women's	1	4' Wrap	60	3,250
26	Women's	1	2x2 Prismatic Lens	37	3,250
27	Book Storage	8	4' Wrap	60	3,250
28	Upstairs Storage	6	8' Industrial	123	800

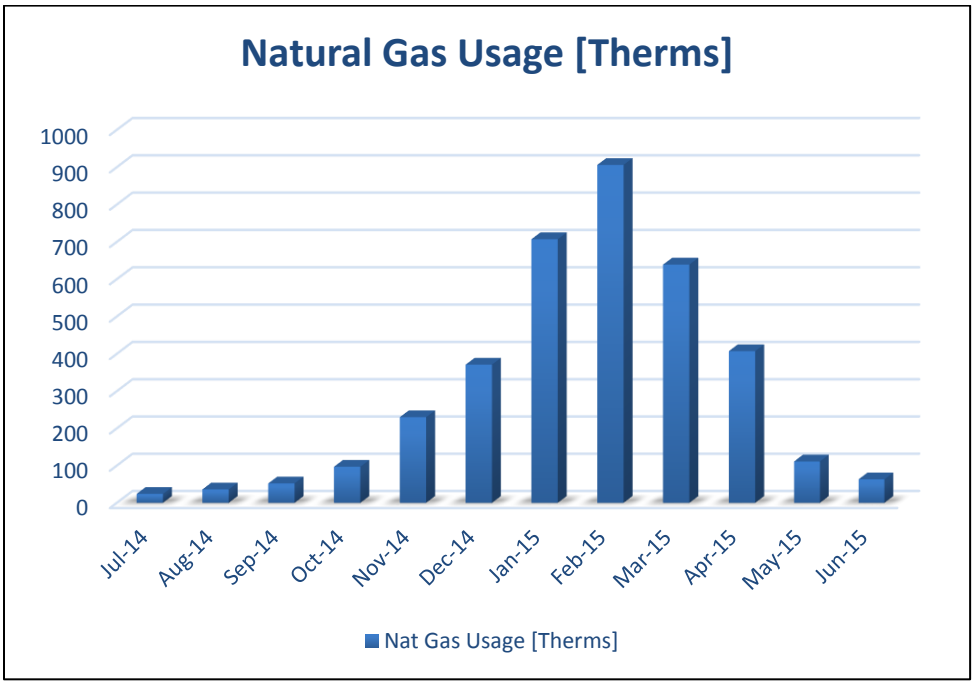
29	Ground Mount	1	Flood, Knuckle Mount	190	4,380
30	Flag Light	1	Flood, Knuckle Mount	190	4,380
31	Back Staff Lot	3	Wall Pack, FT	190	4,380
Totals		**206**			

PROPOSED LIGHTING SYSTEM					
Proposed Qty.	Proposed Fixture Description	Fixture Type and Wattage	Add Occupancy Sensor?	Proposed Hours	Total kWh Reduction
30	LED Retrofit-Lin	18 WATT LED	None	3,250	1,170
2	LED Retrofit-Lin	9 WATT LED	None	3,250	98
12	LED Retrofit-Rem	30 WATT LED	None	3,250	3,510
54	LED Retrofit-Lin	15 WATT LED	None	3,250	2,633
5	LED 2x4 w/Adaptive Technology	30 WATT LED	Step Dim	2,275	1,089
2	LED 2x4 w/Adaptive Technology	30 WATT LED	Step Dim	2,275	436
10	LED 2x4 w/Adaptive Technology	30 WATT LED	Step Dim	2,275	2,178
4	LED 2x4 w/Adaptive Technology	30 WATT LED	Step Dim	2,275	507
9	LED 2x4 w/Adaptive Technology	30 WATT LED	Step Dim	2,275	1,960
4	LED Retrofit-Rem	30 WATT LED	None	3,250	1,170
2	LED Retrofit-Lin	15 WATT LED	None	3,250	98
3	LED 4' Wrap w/Adaptive Technology	22 WATT LED	Step Dim	2,275	435
15	LED 2x4 w/Adaptive Technology	30 WATT LED	Step Dim	2,275	1,901
8	LED Retrofit-Lin	9 WATT LED	None	3,250	390
2	LED 2x2 w/Adaptive Technology	16 WATT LED	Step Dim	2,275	168
2	LED 2x4 w/Adaptive Technology	30 WATT LED	Step Dim	2,275	436
7	LED 4' Wrap w/Adaptive Technology	22 WATT LED	Step Dim	2,275	1,015
3	LED 2x4 w/Adaptive Technology	30 WATT LED	Step Dim	2,275	380
2	LED 4' Wrap w/Adaptive Technology	22 WATT LED	Step Dim	2,275	290
4	LED 4' Wrap w/Adaptive Technology	22 WATT LED	Step Dim	2,275	580
2	LED Retrofit-Lin	15 WATT LED	None	3,250	98
1	LED 4' Wrap w/Adaptive Technology	22 WATT LED	Step Dim	2,275	145
1	LED 4' Wrap w/Adaptive Technology	22 WATT LED	Step Dim	2,275	145
1	LED 2x2 w/Adaptive Technology	16 WATT LED	Step Dim	2,275	84
1	LED 4' Wrap w/Adaptive Technology	22 WATT LED	Step Dim	2,275	145
1	LED 2x2 w/Adaptive Technology	16 WATT LED	Step Dim	2,275	84
8	LED 4' Wrap w/Adaptive Technology	22 WATT LED	Step Dim	2,275	1,160
6	8' LED Wrap w/Adaptive Technology	44 WATT LED	Step Dim	560	443
1	LED Flood, Knuckle w/PC	24 WATT LED	None	4,380	727
1	LED Flood, Knuckle w/PC	24 WATT LED	None	4,380	727
3	LED Wall Pack-FT-PC-LUM	60 WATT LED	None	4,380	1,708
206					**25,904**

Police Station

The Marshfield Police Station is a two-story brick building with sloped roof. The building is currently heated by natural gas. Energy conservation measures identified for the Marshfield Police Station by Guardian Energy include lighting upgrades.





Recommended Energy Conservation Measures (ECM's)

ECM 1: Lighting and Lighting Controls Upgrade

Findings

Inefficient lighting equipment and lighting controls or lack thereof can be a significant source of unnecessary energy waste. Only 5-10% of the energy used by an incandescent light bulb is actually converted into light. The remaining 90-95% of the energy used is released into the space as waste heat. This can add to the cooling load during summer. Newer more efficient lighting technology is currently available at affordable costs. In addition utility sponsored incentives are available to help buy down the initial cost of lighting upgrades.

Recommendations

Guardian recommends implementing the lighting upgrade measures listed below and can facilitate the process of applying for available incentives from National Grid.

EXISTING LIGHTING SYSTEM					
Measure #	Location	Qty.	Existing Fixture Description	Existing Wattage	Existing Hours
1	Front Lot	2	Shoebox, Sq. Pole	455	4,380
2	Front Lot	3	Flood, Knuckle Mount	190	4,380
3	Back Lot	2	Flood, Slip Fitter	295	4,380
4	Back Lot	2	Flood, Slip Fitter	455	4,380
5	Back Lot	2	Flood, Slip Fitter	460	4,380
6	By Generator	1	Flood, Slip Fitter	460	4,380
7	Prosecution	10	4' Wrap	60	4,380

8	Data Closet	2	4' Wrap	60	800
9	Oscars	6	4' Wrap	60	4,380
10	Detectives	8	4' Wrap	60	4,380
11	Forensics	3	4' Wrap	60	4,380
12	214	2	4' Wrap	60	3,000
13	212	2	4' Wrap	60	3,000
14	Hall	3	4' Wrap	60	8,760
15	Women's	3	4' Wrap	60	8,760
16	201	2	3' Strip	38	3,000
17	Pool Room	2	Screw In Lamp	28	800
18	Kitchen	4	4' Wrap	60	3,000
19	Hall	2	1x4 Egg Crate Surf Mount	60	8,760
20	Hall	3	Exit Sign	11	8,760
21	Hall Near Women's	1	4' Wrap	60	8,760
22	Hall Near Women's	2	Exit Sign	11	8,760
23	Men	2	4' Wrap	60	8,760
24	Men	2	3' Strip	38	8,760
25	Men	21	4' Strip	30	8,760
26	227	2	4' Wrap	60	3,000
27	226	4	4' Wrap	60	3,000
28	Quigley	3	4' Wrap	60	3,000
29	Hall and Stairs	3	4' Wrap	60	8,760
30	Integration	2	4' Wrap	60	8,760
31	Photo ID	9	4' Wrap	60	8,760
32	132	2	4' Wrap	60	3,000
33	137	1	3' Strip	38	3,000
34	Keys	1	3' Strip	24	3,000
35	Records	8	4' Wrap	60	3,000
36	Front Command	11	4' Wrap	60	8,760
37	Hall Behind Command	4	4' Wrap	60	8,760
38	Cell Area	3	1x4 Prismatic Lens, Surf Mount	60	8,760
39	Idling	2	4' Wrap	60	8,760
40	Cells	4	4' Wrap	60	8,760
41	Back Cells	6	4' Wrap	60	8,760
42	Sally Port	4	1x4 Prismatic Lens, Surf Mount	60	8,760
43	911 Room	1	4' Wrap	60	3,000
44	Back Stairs Hall	3	4' Wrap	60	8,760
45	Back Stairs Hall	1	Exit Sign	11	8,760
46	Gym	6	8' Strip	112	8,760
47	Women's	1	4' Wrap	30	8,760
48	Men	1	4' Wrap	30	8,760
49	Captain Hall	2	4' Wrap	60	3,000
50	Captain Hall	1	Exit Sign	11	3,000
51	Basement Hall	2	Exit Sign	11	8,760
52	Basement Hall	2	3' Strip	38	8,760
53	Basement Hall	2	3' Strip	24	8,760
54	Captain	4	4' Wrap	60	3,000
55	Conference Room	4	4' Wrap	60	3,000
56	Chief	4	4' Wrap	60	3,000
57	Chief Assistant	4	4' Wrap	60	3,000
58	Back Hall + Stairs	4	4' Wrap	60	8,760
59	Entrance Lobby	4	1x4 Parabolic Lens, Surf Mount	60	8,760
60	Entrance Lobby	1	Exit Sign	11	8,760
61	Men's @ Lobby	1	4' Wrap	60	8,760
62	Women's @ Lobby	1	4' Wrap	60	8,760
63	EOC Office	3	4' Wrap	60	2,000

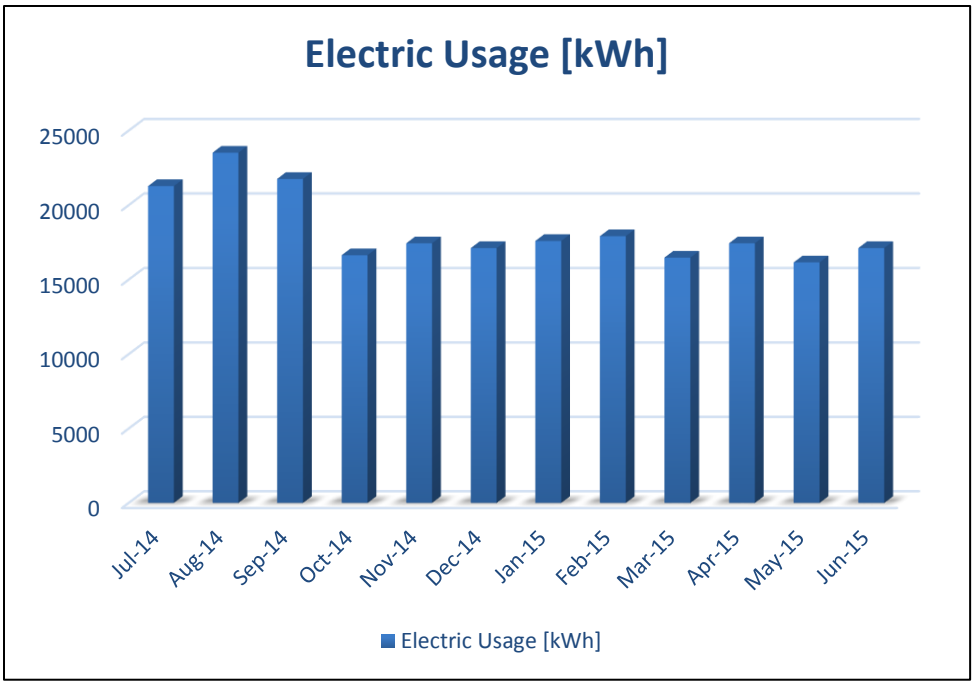
64	EOC Command	9	4' Wide Wrap	112	2,000
65	EOC Kitchen	1	4' Wrap	60	2,000
66	EOC Kitchen	1	Drum	40	2,000
67	EOC Dig	2	4' Wide Wrap	60	2,000
68	EOC Lobby	2	4' Wrap	60	2,000
Totals		**228**			

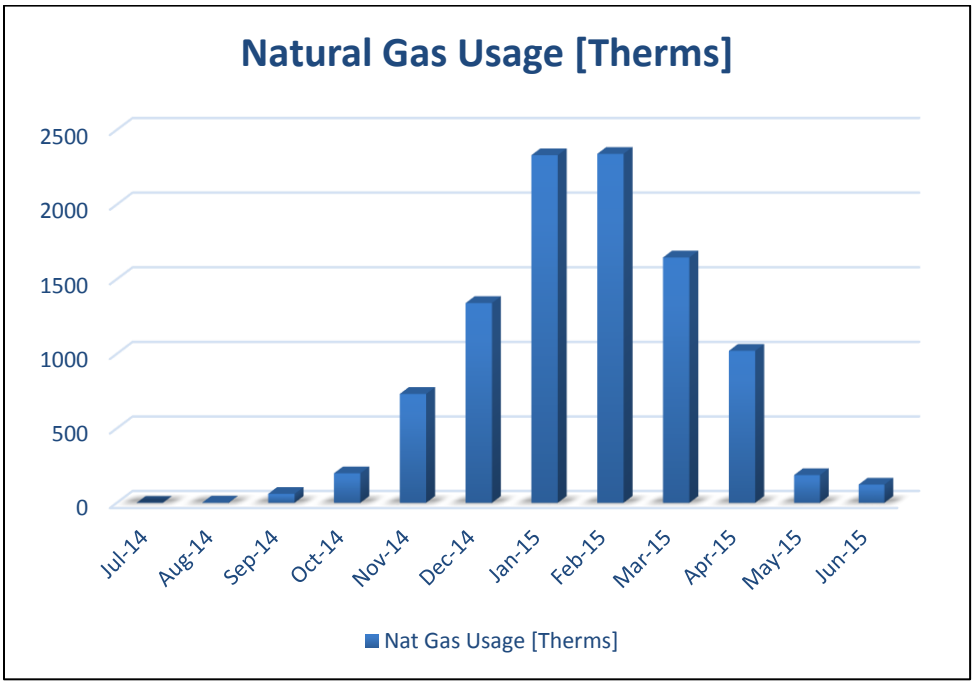
PROPOSED LIGHTING SYSTEM					
Proposed Qty.	Proposed Fixture Description	Fixture Type and Wattage	Add Occupancy Sensor?	Proposed Hours	Total kWh Reduction
2	LED Shoebox w/Adaptive Technology-Leo	129 WATT LED	Step Dim	3,066	3,195
3	LED Flood, Knuckle w/PC	24 WATT LED	None	374	2,470
2	LED Flood, Slip Fitter-LUM	60 WATT LED	None	4,380	2,059
2	LED Flood, Slip Fitter-LUM	125 WATT LED	None	4,380	2,891
2	LED Flood, Slip Fitter-LUM	125 WATT LED	None	4,380	2,935
1	LED Flood, Slip Fitter-LUM	125 WATT LED	None	4,380	1,467
10	4' LED Wrap w/Adaptive Technology-FZ	22 WATT LED	Step Dim	3,066	1,953
2	4' LED Wrap w/Adaptive Technology-FZ	22 WATT LED	Step Dim	560	71
6	4' LED Wrap w/Adaptive Technology-FZ	22 WATT LED	Step Dim	3,066	1,172
8	4' LED Wrap w/Adaptive Technology-FZ	22 WATT LED	Step Dim	3,066	1,563
3	4' LED Wrap w/Adaptive Technology-FZ	22 WATT LED	Step Dim	3,066	586
2	4' LED Wrap w/Adaptive Technology-FZ	22 WATT LED	Step Dim	2,100	268
2	4' LED Wrap w/Adaptive Technology-FZ	22 WATT LED	Step Dim	2,100	268
3	4' LED Wrap w/Adaptive Technology-FZ	22 WATT LED	Step Dim	6,132	1,172
3	4' LED Wrap w/Adaptive Technology-FZ	22 WATT LED	Step Dim	6,132	1,172
2	LED Retrofit-Lin	15 WATT LED	None	3,000	138
2	LED Screw In Lamp	11 WATT LED	None	800	27
4	4' LED Wrap w/Adaptive Technology-FZ	22 WATT LED	Step Dim	2,100	535
2	1x4 LED w/Adaptive Technology-VOL-Surf Mnt	22 WATT LED	Step Dim	6,132	781
3	LED Exit Sign	2.0 WATT LED	None	8,760	237
1	4' LED Wrap w/Adaptive Technology-FZ	22 WATT LED	Step Dim	6,132	391
2	LED Exit Sign	2.0 WATT LED	None	8,760	158
2	4' LED Wrap w/Adaptive Technology-FZ	22 WATT LED	Step Dim	6,132	781
2	LED Retrofit-Lin	15 WATT LED	None	8,760	403
21	4' LED Wrap w/Adaptive Technology-FZ	16 WATT LED	Step Dim	6,132	3,458
2	4' LED Wrap w/Adaptive Technology-FZ	22 WATT LED	Step Dim	2,100	268
4	4' LED Wrap w/Adaptive Technology-FZ	22 WATT LED	Step Dim	2,100	535
3	4' LED Wrap w/Adaptive Technology-FZ	22 WATT LED	Step Dim	2,100	401
3	4' LED Wrap w/Adaptive Technology-FZ	22 WATT LED	Step Dim	6,132	1,172
2	4' LED Wrap w/Adaptive Technology-FZ	22 WATT LED	Step Dim	6,132	781
9	4' LED Wrap w/Adaptive Technology-FZ	22 WATT LED	Step Dim	6,132	3,516
2	4' LED Wrap w/Adaptive Technology-FZ	22 WATT LED	Step Dim	2,100	268
1	LED Retrofit-Lin	15 WATT LED	None	3,000	69
1	LED Retrofit-Lin	15 WATT LED	None	3,000	27
8	4' LED Wrap w/Adaptive Technology-FZ	22 WATT LED	Step Dim	2,100	1,070
11	4' LED Wrap w/Adaptive Technology-FZ	22 WATT LED	Step Dim	6,132	4,298
4	4' LED Wrap w/Adaptive Technology-FZ	22 WATT LED	Step Dim	6,132	1,563
3	1x4 LED w/Adaptive Technology-VOL-Surf Mnt	22 WATT LED	Step Dim	6,132	1,172
2	4' LED Wrap w/Adaptive Technology-FZ	22 WATT LED	Step Dim	6,132	781
4	4' LED Wrap w/Adaptive Technology-FZ	22 WATT LED	Step Dim	6,132	1,563
6	4' LED Wrap w/Adaptive Technology-FZ	22 WATT LED	Step Dim	6,132	2,344

4	1x4 LED w/Adaptive Technology-VOL-Surf Mnt	22 WATT LED	Step Dim	6,132	1,563
1	4' LED Wrap w/Adaptive Technology-FZ	22 WATT LED	Step Dim	2,100	134
3	4' LED Wrap w/Adaptive Technology-FZ	22 WATT LED	Step Dim	6,132	1,172
1	LED Exit Sign	2.0 WATT LED	None	8,760	79
6	4' LED Wrap w/Adaptive Technology-FZ	44 WATT LED	Step Dim	6,132	4,268
1	4' LED Wrap w/Adaptive Technology-FZ	16 WATT LED	Step Dim	6,132	165
1	4' LED Wrap w/Adaptive Technology-FZ	16 WATT LED	Step Dim	6,132	165
2	4' LED Wrap w/Adaptive Technology-FZ	22 WATT LED	Step Dim	2,100	268
1	LED Exit Sign	2.0 WATT LED	None	3,000	27
2	LED Exit Sign	2.0 WATT LED	None	8,760	158
2	LED Retrofit-Lin	15 WATT LED	None	8,760	403
2	LED Retrofit-Lin	15 WATT LED	None	8,760	158
4	4' LED Wrap w/Adaptive Technology-FZ	22 WATT LED	Step Dim	2,100	535
4	4' LED Wrap w/Adaptive Technology-FZ	22 WATT LED	Step Dim	2,100	535
4	4' LED Wrap w/Adaptive Technology-FZ	22 WATT LED	Step Dim	2,100	535
4	4' LED Wrap w/Adaptive Technology-FZ	22 WATT LED	Step Dim	2,100	535
4	4' LED Wrap w/Adaptive Technology-FZ	22 WATT LED	Step Dim	6,132	1,563
4	1x4 LED w/Adaptive Technology-VOL-Surf Mnt	22 WATT LED	Step Dim	6,132	1,563
1	LED Exit Sign	2.0 WATT LED	None	8,760	79
1	4' LED Wrap w/Adaptive Technology-FZ	22 WATT LED	Step Dim	6,132	391
1	4' LED Wrap w/Adaptive Technology-FZ	22 WATT LED	Step Dim	6,132	391
3	4' LED Wrap w/Adaptive Technology-FZ	22 WATT LED	Step Dim	1,400	268
9	LED Wrap w/Adaptive Technology-FWS	55 WATT LED	Step Dim	1,400	1,323
1	4' LED Wrap w/Adaptive Technology-FZ	22 WATT LED	Step Dim	1,400	89
1	LED Drum	17 WATT LED	None	2,000	46
2	LED Wrap w/Adaptive Technology-FWS	30 WATT LED	Step Dim	1,400	156
2	4' LED Wrap w/Adaptive Technology-FZ	22 WATT LED	Step Dim	1,400	178
228					**66,724**

Town Hall

The Marshfield Town Hall is open Mon-Fri from 8:30 am – 4:00 pm. The building is currently heated by natural gas. Energy conservation measures identified for the Marshfield Town Hall by Guardian Energy include lighting upgrades.





Recommended Energy Conservation Measures (ECM's)

ECM 1: Lighting and Lighting Controls Upgrade

Findings

Inefficient lighting equipment and lighting controls or lack thereof can be a significant source of unnecessary energy waste. Only 5-10% of the energy used by an incandescent light bulb is actually converted into light. The remaining 90-95% of the energy used is released into the space as waste heat. This can add to the cooling load during summer. Newer more efficient lighting technology is currently available at affordable costs. In addition utility sponsored incentives are available to help buy down the initial cost of lighting upgrades.

Recommendations

Guardian recommends implementing the lighting upgrade measures listed below and can facilitate the process of applying for available incentives from National Grid.

EXISTING LIGHTING SYSTEM					
Measure #	Location	Qty.	Existing Fixture Description	Existing Wattage	Existing Hours
1	Front Wall	4	Flood, Bracket Mount	295	4,380
2	Soffit	12	12" Recessed Can	190	4,380
3	Entrance Vestibule	2	Wallwash	24	2,225
4	Collectors	70	2x2 Prismatic Lens	37	2,225
5	Collectors Office	6	2x2 Prismatic Lens	37	2,225
6	Safe Room	2	8' Strip	60	2,225
7	Accountant	15	2x2 Prismatic Lens	37	2,225
8	IT	9	2x2 Prismatic Lens	37	2,225
9	Back Vestibule	2	Wallwash	24	2,225

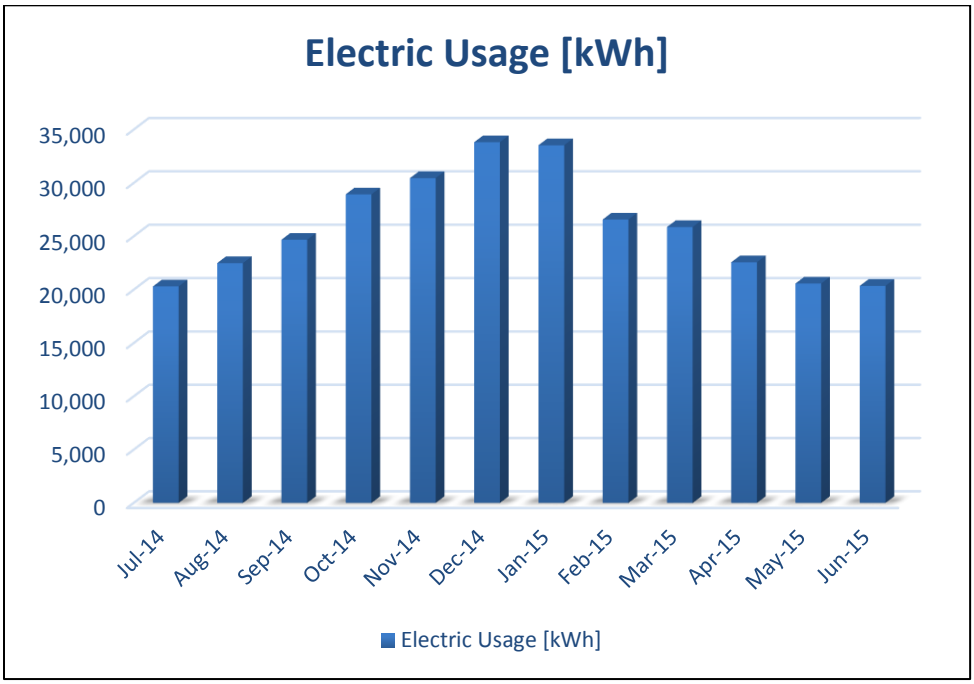
10	Health	24	2x2 Prismatic Lens	37	2,225
11	Assessor's 108	12	2x2 Prismatic Lens	37	2,225
12	109	2	2x2 Prismatic Lens	37	2,225
13	Assessor's	30	2x2 Prismatic Lens	37	2,225
14	Assessor's Vault	1	8' Strip	60	2,225
15	111 Building Dept.	22	2x2 Prismatic Lens	37	2,225
16	Benefits	7	2x2 Prismatic Lens	37	2,225
17	Men's	2	2x2 Prismatic Lens	37	2,225
18	Men's	1	Wallwash	24	2,225
19	Women's	2	2x2 Prismatic Lens	37	2,225
20	Women's	1	Wallwash	24	2,225
21	Mail Room	2	2x4 Prismatic Lens	72	2,225
22	Mail Room	1	2x2 Prismatic Lens	37	2,225
23	Payroll	3	2x2 Prismatic Lens	37	2,225
24	Front stairs	6	2x2 Prismatic Lens	37	2,225
25	Selectmen's Office	12	2x2 Prismatic Lens	37	2,225
26	Selectmen's Hearing Room	24	2x2 Prismatic Lens	37	2,225
27	201 Town Administrator	13	2x2 Prismatic Lens	37	2,225
28	202 Copy Room	6	2x2 Prismatic Lens	37	2,225
29	202 Reynolds	9	2x2 Prismatic Lens	37	2,225
30	202 Conference	6	2x2 Prismatic Lens	37	2,225
31	202 Bowen	6	2x2 Prismatic Lens	37	2,225
32	202 Plan Room	4	8' Industrial	94	2,225
33	202	71	2x2 Prismatic Lens	37	2,225
34	202 Plotter Room	2	2x2 Prismatic Lens	37	2,225
35	202 Men's	2	2x2 Prismatic Lens	37	2,225
36	202 End Office	2	2x2 Prismatic Lens	37	2,225
37	205	8	2x2 Prismatic Lens	37	2,225
38	Back Stairs	6	2x2 Parabolic Lens	37	2,225
39	Copy Area	2	2x2 Prismatic Lens	37	2,225
40	206	8	2x2 Prismatic Lens	37	2,225
41	Planning	15	2x2 Prismatic Lens	37	2,225
42	207	10	2x2 Prismatic Lens	37	2,225
43	Rest Room	1	2x2 Prismatic Lens	37	2,225
44	Rest Room Hall	1	2x2 Prismatic Lens	37	2,225
45	Women's	2	2x2 Prismatic Lens	37	2,225
46	Hearing 2	24	2x2 Prismatic Lens	37	2,225
47	Hearing 3	18	2x2 Prismatic Lens	37	2,225
48	1st Hallway	23	2x2 Prismatic Lens	37	2,225
49	2nd Hallway	18	2x2 Prismatic Lens	37	2,225
Totals		**531**			

PROPOSED LIGHTING SYSTEM					
Proposed Qty.	Proposed Fixture Description	Fixture Type and Wattage	Add Occupancy Sensor?	Proposed Hours	Total kWh Reduction
4	Led Flood-LUM	63 WATT LED	None	4,380	4,065
12	LED Retrofit-GT21	50 WATT LED	None	4,380	7,358
2	LED Retrofit-Lin	15 WATT LED	None	2,225	40
70	LED 2x2 w/ Adaptive Technology-Vola	16 WATT LED	Step Dim	1,558	4,018
6	LED 2x2 w/ Adaptive Technology-Vola	16 WATT LED	Step Dim	1,558	344
2	LED 8' Strip w/Adaptive Technology-FZ	32 WATT LED	Step Dim	1,558	167
15	LED 2x2 w/ Adaptive Technology-Vola	16 WATT LED	Step Dim	1,558	861

9	LED 2x2 w/ Adaptive Technology-Vola	16 WATT LED	Step Dim	1,558	517
2	LED Retrofit-Lin	15 WATT LED	None	2,225	40
24	LED 2x2 w/ Adaptive Technology-Vola	16 WATT LED	Step Dim	1,558	1,378
12	LED 2x2 w/ Adaptive Technology-Vola	16 WATT LED	Step Dim	1,558	689
2	LED 2x2 w/ Adaptive Technology-Vola	16 WATT LED	Step Dim	1,558	115
30	LED 2x2 w/ Adaptive Technology-Vola	16 WATT LED	Step Dim	1,558	1,722
1	LED 8' Strip w/Adaptive Technology-FZ	32 WATT LED	Step Dim	1,558	84
22	LED 2x2 w/ Adaptive Technology-Vola	16 WATT LED	Step Dim	1,558	1,263
7	LED 2x2 w/ Adaptive Technology-Vola	16 WATT LED	Step Dim	1,558	402
2	LED 2x2 w/ Adaptive Technology-Vola	16 WATT LED	Step Dim	1,558	115
1	LED Retrofit-Lin	15 WATT LED	None	2,225	20
2	LED 2x2 w/ Adaptive Technology-Vola	16 WATT LED	Step Dim	1,558	115
1	LED Retrofit-Lin	15 WATT LED	None	2,225	20
2	LED 2x4 w/ Adaptive Technology-Vola	30 WATT LED	Step Dim	1,558	227
1	LED 2x2 w/ Adaptive Technology-Vola	16 WATT LED	Step Dim	1,558	57
3	LED 2x2 w/ Adaptive Technology-Vola	16 WATT LED	Step Dim	1,558	172
6	LED 2x2 w/ Adaptive Technology-Vola	16 WATT LED	Step Dim	1,558	344
12	LED 2x2 w/ Adaptive Technology-Vola	16 WATT LED	Step Dim	1,558	689
24	LED 2x2 w/ Adaptive Technology-Vola	16 WATT LED	Step Dim	1,558	1,378
13	LED 2x2 w/ Adaptive Technology-Vola	16 WATT LED	Step Dim	1,558	746
6	LED 2x2 w/ Adaptive Technology-Vola	16 WATT LED	Step Dim	1,558	344
9	LED 2x2 w/ Adaptive Technology-Vola	16 WATT LED	Step Dim	1,558	517
6	LED 2x2 w/ Adaptive Technology-Vola	16 WATT LED	Step Dim	1,558	344
6	LED 2x2 w/ Adaptive Technology-Vola	16 WATT LED	Step Dim	1,558	344
4	LED 8' Strip w/Adaptive Technology-FZ	32 WATT LED	Step Dim	1,558	637
71	LED 2x2 w/ Adaptive Technology-Vola	16 WATT LED	Step Dim	1,558	4,076
2	LED 2x2 w/ Adaptive Technology-Vola	16 WATT LED	Step Dim	1,558	115
2	LED 2x2 w/ Adaptive Technology-Vola	16 WATT LED	Step Dim	1,558	115
2	LED 2x2 w/ Adaptive Technology-Vola	16 WATT LED	Step Dim	1,558	115
8	LED 2x2 w/ Adaptive Technology-Vola	16 WATT LED	Step Dim	1,558	459
6	LED 2x2 w/ Adaptive Technology-Vola	16 WATT LED	Step Dim	1,558	344
2	LED 2x2 w/ Adaptive Technology-Vola	16 WATT LED	Step Dim	1,558	115
8	LED 2x2 w/ Adaptive Technology-Vola	16 WATT LED	Step Dim	1,558	459
15	LED 2x2 w/ Adaptive Technology-Vola	16 WATT LED	Step Dim	1,558	861
10	LED 2x2 w/ Adaptive Technology-Vola	16 WATT LED	Step Dim	1,558	574
1	LED 2x2 w/ Adaptive Technology-Vola	16 WATT LED	Step Dim	1,558	57
1	LED 2x2 w/ Adaptive Technology-Vola	16 WATT LED	Step Dim	1,558	57
2	LED 2x2 w/ Adaptive Technology-Vola	16 WATT LED	Step Dim	1,558	115
24	LED 2x2 w/ Adaptive Technology-Vola	16 WATT LED	Step Dim	1,558	1,378
18	LED 2x2 w/ Adaptive Technology-Vola	16 WATT LED	Step Dim	1,558	1,033
23	LED 2x2 w/ Adaptive Technology-Vola	16 WATT LED	Step Dim	1,558	1,320
18	LED 2x2 w/ Adaptive Technology-Vola	16 WATT LED	Step Dim	1,558	1,033
531					**41,361**

Street Lighting

Monthly Profile of Street Lighting Electricity Usage



Recommended Energy Conservation Measures (ECM's)

ECM 1: Lighting and Lighting Controls Upgrade

In reviewing the opportunity change your street lighting to LED lights, there is a significant reduction in kWh usage that could be gained in the conversion. It is estimated that a conservative estimate of the kWh reduction for the conversion to LED is a 50% reduction.

Guardian is projecting utility incentives based upon previous projects and current incentive amounts available through your utility company's incentive program.

Estimated Project Numbers for Street Lighting LED Conversion

Project	Annual kWh Usage	Estimated Project Cost	Incentive	kWh Saved	Therms Saved	Energy Cost Savings
Street Lighting	291,857	$400,000	$36,482	145,928	N/A	$21,889

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 Eversource.

Guardian's Green Community Roadmap Program
Guardian also partners with communities that are working to become or have been designated a Massachusetts Green Community. 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 & Eversource Municipal Vendor
- 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.

IX. Appendix B-2: Trane Audit (p. 62 – 67 of 111)

4 ENERGY CONSERVATION MEASURES & FACILITY IMPROVEMENT MEASURES

The following table outlines the energy conservation measures for the school buildings.

Building ECM	Guaranteed Savings	% Total Util. Cost	Guaranteed kWh Saved	kW Saved	Therms Saved	Water Gallons
High School						
VFD for HW Pumps	$12,053	2.9%	87,124	131	-	
New AHUs and Uvs with new EMS	$31,122	7.6%	20,149	(4)	20,714	
Multizone to VAV Conversion	$17,581	4.3%	111,117	89	2,016	
New Windows	$23,794	5.8%	13,459	1	15,997	
Building Envelope Improvement	$5,966	3.0%	-	-	4,323	
Automatic Control valve for Boilers	$1,656	1.0%			1,200	
Dust Collector System	$1,100	0.7%	6,839		-	
Lighting Retrofit	$26,450	35.2%	189,869	71	(2,971)	
Kitchen Hood Controls	$2,263	1.4%	1,195		1,500	
Destratification Fan	$1,751	1.1%	(4,049)		1,655	
Efficient Motors	$839		5,213			
New Burner Motor Controller	$2,792		-		2,023	
Walk in Cooler and Freezer Controls	$1,415	1.9%	8,794			
Total Savings	**$104,988**	25.6%	417,456	288	28,438	

Building ECM	Guaranteed Savings	% Total Util. Cost	Guaranteed kWh Saved	kW Saved	Therms Saved	Water Gallons
Middle School						
New Condensing Boiler	$5,227	2.6%	-	-	4,430	
VFD on HW Pumps	$6,652	3.3%	42,616	143	-	
New EMS System	$12,793	6.4%	9,919	107	9,230	
Building Envelope Improvement	$1,669	0.8%	-	-	1,210	
Solar Track Lighting	$4,290	5.7%	26,665	-	-	
Lighting Retrofit	$9,285	12.3%	65,330		(889)	
Kitchen Hood Controls	$2,752	1.7%	5,648		1,336	
Walk in Cooler and Freezer Controls		0.0%	1,987			
Total Savings	$42,669	21.3%	152,165	250	15,316	

Building ECM	Guaranteed Savings	% Total Util. Cost	Guaranteed kWh Saved	kW Saved	Therms Saved	Water Gallons
Martinson						
New Boilers	$14,931	9.2%	8,204	16	10,243	
EMS Upgrade	$14,701	9.1%	2,067	52	10,583	
Kitchen Hood Controls	$1,292	0.8%	978		822	
Building Envelope Improvement	$4,764	2.4%	-	-	3,453	
Lighting Retrofit	$4,186	5.6%	29,456	-	(401)	

Walk in Cooler and Freezer Controls	$660	0.9%	4,100	-	-	
Water Cooled Condenser for Walk in Refrigerator	$1,434	0.9%	(817)	-	-	262,080
Total Savings	$41,968	26.0%	43,988	68	24,699	262,080

Building ECM	Guaranteed Savings	% Total Util. Cost	Guaranteed kWh Saved	kW Saved	Therms Saved	Water Gallons
DWES						
Boiler Replacement	$9,098	12.1%	4,598	13	6,272	
VFD on HW Pumps	$2,291	3.0%	15,359	29	-	
EMS Upgrade and New HVAC	$10,466	13.9%	12,944	58	6,258	
Window Replacement	$4,750	6.3%	2,800	4	3,243	
Building Envelope Improvement	$482	0.6%	518	1	301	
Lighting Retrofit	$3,745	5.0%	26,350	-	(359)	
Walk in Cooler and Freezer Controls	$515	0.7%	3,202	-	-	
Kitchen Hood Controls	$1,608	1.0%	652		1,089	
Efficient Motors for HW Pumps	$514	0.7%	3,195	-	-	
Water Cooled Condenser for Walk in Refrigerator	$1,434	1.9%	(817)			262,080
Total Savings	$34,903	46.4%	68,802	106	16,804	262,080

Building ECM	Guaranteed Savings	% Total Util. Cost	Guaranteed kWh Saved	kW Saved	Therms Saved	Water Gallons
Eames Way						
New Windows	$14,682	19.7%	2,427	4	10,703	
Boiler Replacement	$6,244	8.4%	-	-	4,666	
New EMS and Unit Ventilators	$9,590	12.8%	28,118	(2)	4,238	
LED Parking Lot Light	$2,500	3.3%	16,126	51	-	
Lighting Retrofit	$770	1.0%	5,416	-	(74)	
Walk In Cooler Freezer Controls	$740	1.0%	4,597	-	-	
Building Envelope Improvement	$1,693	0.8%	-	-	1,227	
Kitchen Hood Controls	$1,492	0.9%	968		968	
Total Savings	$37,711	50.5%	57,652	52	21,729	

Building ECM	Guaranteed Savings	% Total Util. Cost	Guaranteed kWh Saved	kW Saved	Therms Saved	Water Gallons
South River Elem						
New Boiler	$17,784	15.4%	-	-	13,290	
New EMS and HVAC Equipment	$16,032	13.9%	8,794	13	11,016	
Building Envelope Improvement	$1,145	1.0%	263	-	828	
Lighting Retrofit	$4,587	6.1%	32,274	-	(439)	
Walk In Cooler and Freezer Control	$886	1.2%	5,505	-	-	
Kitchen Hood Controls	$2,700	1.7%	434		1,906	
Total Savings	$43,134	37.5%	47,271	13	26,601	

Building	Guaranteed	% Total	Guaranteed kWh	kW	Therms	Water

ECM	Savings	Util. Cost	Saved	Saved	Saved	Gallons
All Buildings						
Computer Network Controller	$18,970		117,900	-	-	
Total Savings	$18,970		117,900	-	-	

Building ECM	Guaranteed Savings	% Total Util. Cost	Guaranteed kWh Saved	kW Saved	Therms Saved	Water Gallons
Governor Winslow						
Water Cooled Condenser for Walk in Refrigerator	$1,434	1.6%	(817)	-	-	262,080
Total Savings	$1,434	1.6%	(817)	-	-	
Grand Total / Avg.	**$325,778**	**29.0%**	**904,416**	**776**	**133,588**	

The following table outlines the energy conservation measures for the town buildings.

Building ECM	Guaranteed Savings	% Total Util. Cost	Guaranteed kWh Saved	kW Saved	Therms Saved
Town Hall					
Boiler Replacement	$5,577	10.5%	3,285	(39)	3,846
VAV Conversion	$11,094	20.9%	48,872	(51)	3,266
Building Envelope Improvement	$356	0.7%	363	2	214
Lighting Retrofit	$1,855	3.5%	11,526	-	
Total Savings	**$18,881**	35.6%	64,046	(88)	7,326

Building ECM	Guaranteed Savings	% Total Util. Cost	Guaranteed kWh Saved	kW Saved	Therms Saved
Senior Center					
New Condensing Boiler	$2,175	6.1%	192	0	1,556
VFD on HW Pumps	$721	2.0%	4,908	7	-
New EMS System with New HVAC Units	$12,710	35.8%	41,090	167	4,460
Lighting Retrofit	$1,357	3.8%	8,431	-	
Kitchen Hood Controls	$0	0.0%	-	-	-
Walk In Cooler and Freezer Controls	$0	0.0%	-	-	-
Building Envelope Improvements	$14	0.0%	-	-	11
Total Savings	**$16,962**	47.7%	54,621	174	6,027

Building ECM	Guaranteed Savings	% Total Util. Cost	Guaranteed kWh Saved	kW Saved	Therms Saved
Library					
New EMS System	$6,427	14.7%	11,418	(27)	3,596
Building Envelope Improvement	$230	0.5%	120	2	147
Lighting Retrofit	$3,518	9.9%	21,866	-	
Total Savings	**$10,176**	23.2%	33,404	(25)	3,743

Building ECM	Guaranteed Savings	% Total Util. Cost	Guaranteed kWh Saved	kW Saved	Therms Saved
South River Fire Station					
Boiler and DHW heater Replacement	$2,161	6.1%	-	-	1,566
VFD on HW Pumps	$388	1.1%	2,531	7	-
EMS Upgrade	$2,634	7.4%	18,463	11	(0)
Over Head Doors	$0	0.0%	-	-	-
Lighting Retrofit	$2,974	8.4%	18,482	-	
Building Envelope Improvements	$652	1.8%	-	-	473
Total Savings	**$8,157**	23.0%	39,477	18	1,566

Building ECM	Guaranteed Savings	% Total Util. Cost	Guaranteed kWh Saved	kW Saved	Therms Saved
DPW Garage					
Over Head Doors	$3,767	10.6%	5,189	29	2,102
New Air Rotation Unit	$4,089	11.5%	(1,541)	(6)	3,141
Heat Pump system for Office	$155	0.4%	705	12	(0)
Lighting Retrofit	$1,367	3.8%	8,494	-	
Building Envelope Improvements	$1,071	3.0%	-	-	776
Total Savings	**$9,378**	26.4%	12,848	35	5,243

Building ECM	Guaranteed Savings	% Total Util. Cost	Guaranteed kWh Saved	kW Saved	Therms Saved
Harbor Master					
New Heat Pump	$821	31.0%	4,751	18	-
Lighting retrofit	$128	0.4%	798	-	
Total Savings	**$950**	35.8%	5,549	18	-

Building ECM	Guaranteed Savings	% Total Util. Cost	Guaranteed kWh Saved	kW Saved	Therms Saved
Massasoit Fire Station					
Overhead Door Replacement	$689	9.7%	82	0	489
Boiler Plant Replacement	$814	11.5%	816	1	487
Lighting Retrofit	$208	0.6%	1,293	-	
Total Savings	**$1,710**	24.1%	2,191	1	976

Building ECM	Guaranteed Savings	% Total Util. Cost	Guaranteed kWh Saved	kW Saved	Therms Saved
Transfer Station					
Heat Pump for Offices at Maint Bldg	$1,441	13.7%	9,889	15	(124)
Over Head Doors at Maint Bldg	$868		(7)	(0)	630
Lighting Retrofit for all buildings	$1,280	12.1%	7,958	-	
Total Savings	**$3,589**	34.0%	17,840	15	505

Building ECM	Guaranteed Savings	% Total Util. Cost	Guaranteed kWh Saved	kW Saved	Therms Saved
Main Street Fire Station					
Boiler Replacement	$711				515
Lighting Retrofit	$157	0.4%	978	-	
Building Envelope Improvements	$169		0	0	123
Total Savings	**$1,038**	25.2%	978	-	638

Building	Guaranteed	% Total	Guaranteed kWh	kW	Therms

ECM	Savings	Util. Cost	Saved	Saved	Saved
WWTP					
Lighting Retrofit	$1,280		7,958	-	-
Building Envelope Improvements	$508		0	0	368.2
Total Savings	**$1,789**		7,958	-	368
Building ECM	**Guaranteed Savings**	**% Total Util. Cost**	**Guaranteed kWh Saved**	**kW Saved**	**Therms Saved**
Police Station					
Building Envelope Improvements	$407		0	0	295
Total Savings	**$407**	3.9%	-	-	295
Building ECM	**Guaranteed Savings**	**% Total Util. Cost**	**Guaranteed kWh Saved**	**kW Saved**	**Therms Saved**
Animal Shelter					
Lighting Retrofit	$125	0.4%	778	-	
Total Savings	**$125**	1.2%	778	-	-
Building ECM	**Guaranteed Savings**	**% Total Util. Cost**	**Guaranteed kWh Saved**	**kW Saved**	**Therms Saved**
Recreation Center					
Lighting Retrofit	$349	1.0%	2,167	-	-
Building Envelope Improvements	$169		0	0	123
Total Savings	**$518**	4.9%	2,167	-	123
Building ECM	**Guaranteed Savings**	**% Total Util. Cost**	**Guaranteed kWh Saved**	**kW Saved**	**Therms Saved**
Child Care Center					
Lighting Retrofit	$373	1.0%	2,318	-	
Total Savings	**$373**	3.5%	2,318	-	-
Grand Total / Avg.	**$ 74,053**	**28%**	**239,691**	**148**	**26,686**

XI. Appendix C: Guardian Streetlight Audit

November 21, 2016

Town of Marshfield
870 Moraine Street
Marshfield, MA 02050

Re: Marshfield Street Lighting Estimated Savings

Dear Rocco,

In reviewing the opportunity change your street lighting to LED lights, there is a significant reduction in kWh usage that could be gained in the conversion. It is estimated that a conservative estimate of the kWh reduction for the conversion to LED is a 50% reduction.

Guardian is projecting utility incentives based upon previous projects and current incentive amounts available through your utility company's incentive program.

Estimated Project Numbers for Street Lighting LED Conversion

Project	Annual kWh Usage	Estimated Project Cost	Incentive	kWh Saved	Therms Saved	Energy Cost Savings
Street Lighting	291,857	$400,000	$36,482	145,928	N/A	$21,889

William Harrow
Energy Efficiency Specialist

Email: williamh@guardian-energy.com
Direct: (617) 935-9550

XIII. Appendix D: Vehicle Calculations

Anti-Idling Technology in Police Cruisers

MAPC used the Havis IdleRight system to scope out this Energy Conservation Measure. The system is an example of one of many anti-idling technologies available to the Town. This particularly system monitors battery conditions and can turn the engine on and off when needed to minimize gasoline use while preserving battery life.

Item	Unit	Data Source
# of Cruisers	15	Police Chief
FY15 gasoline usage in gallons	4017	Town/MEI
Hours per shift idling	2	Police Chief
Shifts per day	3	
Hours per day idling	6	Calculation
Days per week on duty	7	Police Chief
Gallons saved per hour of idling	0.625	Havis IdleRight (http://idleright.havis.com/fuel-mgmt.html)
Gallons saved per vehicle per year	1365	Calculation
# Cruisers per shift	5	Police Chief
Total gallons saved per year	6825	Calculation
MMBTUs saved per year	**846.3**	Calculation
Conservative $/gallon of gas	$ 1.50	Approx. 70% of current gas prices (http://www.massachusettsgasprices.com)
Annual cost savings	**$ 10,237.50**	Calculation
Cost per Vehicle	$450	Source: Ashurnham and Truro ERPs
Total Cost for all Cruisers	$6,750	Calculation
Payback (Years)	0.66	Calculation

Additional Calculations	
Gallons saved per hour*	0.625
% energy saved over vehicle baseline	27.6%
% energy saved over total baseline	11.7%

*Source: http://idleright.havis.com/fuel-mgmt.html

A typical vehicle that idles for 6 hours at an emergency or construction scene uses as much as 4 gallons of gas. That same vehicle, equipped with the Havis IdleRight system, uses less than one-quarter of a gallon of gas.

Policies that Affect Fleet Gas and Diesel Usage

Anti-Idling Policy**		
Non-Police FY 2015 Gas Usage (Gallons)	76,008	
Percent Savings	10%	Idling vehicles contribute significantly to air pollution and waste fuel, increasing fleet management costs. Municipalities across the commonwealth and the nation have seen significant cost and greenhouse gas emission reductions since implementing Town-wide "no idling" policies for municipal vehicles.*
Gallons Gasoline Saved per Year	7,601	
MMBTUs Saved per Year	**1,057**	
Closely Monitor Tire Air Pressure and Use Fuel Efficient Tires		
All FY 2015 Gasoline Usage (Gallons)	108,403	
All FY 2015 Diesel Usage (Gallons)	56,453	
Percent Savings	4%	Maintaining appropriate air pressure in vehicle tires can decrease that vehicles fuel consumption by as much as 4%.*
Gallons Gasoline Saved per Year	4,336	
Gallons Diesel Saved per Year	2,258	
MMBTUs Saved per Year	**852**	
Use 100% Synthetic Oil		
All FY 2015 Gasoline Usage (Gallons)	108,403	
All FY 2015 Diesel Usage (Gallons)	56,453	
Percent Savings	2%	The use of 100% synthetic oils reduces fuel consumption, the number of annual oil change and labor costs.*
Gallons Gasoline Saved per Year	2,168	
Gallons Diesel Saved per Year	1,129	
MMBTUs Saved per Year	**426**	
Total MMBTUs	**2,334**	
*http://www.fueleconomy.gov/feg/pdfs/OwnerRelatedFuelEconomyImprovements.pdf		
**Applies to all gasoline using cars other than Police, because of separate anti-idling measures.		

XIV. Appendix E: Water & Sewer Audits – Horizon Energy

Location: Town Of Marshfield, MA

Primary Contact:
Phone:

Eversource Electrical Incentives	$ 0.25	**kWh Rate:**	$ 0.15
Eversource Gas Incentives	$ 1.50	**Therm Rate:**	$ 1.00
		Propane Rate:	$ 2.25

No.	Measure Location	Measure Description	Total Cost	Electric Rebate	Gas Rebate	Net Cost	KWH Saved	Gas Therms Saved	Gallons Propane Saved	Estimated Savings $	Simple Payback
1	Waste Water Treatment Facility	Steam Traps (Based on 30 Traps)	$ 14,725.61	$ -	$ 1,500.00	$ 13,225.61	-	3,213	-	$3,213	4.12
2	Waste Water Treatment Facility	Boiler Controls	$ 18,642.62	$ -	$ 550.00	$ 18,092.62	-	1,662	-	$1,662	10.89
3	Waste Water Treatment Facility	LED Lighting Upgrade	$ 99,995.78	$ 14,414.00	$ -	$ 85,581.78	57,656	-	-	$8,648	9.90
4	Lift Stations	Thermostats	$ 8,961.59	$ 2,318.25	$ -	$ 6,643.34	9,273	-	-	$1,391	4.78
5	Well Stations	Thermostats	$ 17,081.71	$ 4,043.50	$ -	$ 13,038.21	16,174	-	809	$4,246	3.07
6	Plymouth Avenue Lift Staion	Lift Pump VFDs	$ 30,632.77	$ 15,187.50	$ -	$ 15,445.27	9,187	-	-	$1,378	11.21
7	Well Stations	Premium Efficency Motor Upgrades	$ 51,441.46	$ 11,074.00	$ -	$ 40,367.46	44,296	-	-	$6,644	6.08
		TOTALS	**$ 241,481.54**	**$ 47,037.25**	**$ 2,050.00**	**$ 192,394.29**	**136,586**	**4,875**	**809**	**$ 27,183**	7.08

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Engineering Manager
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XV. Appendix F: Behavior-Based Energy Savings

School Behavior-Based Savings Program

A School Behavior-Based Energy Use Reduction Program will allow Marshfield communities to not only better understand the inefficiencies in their school building operations, but will also help them implement programs that will work synergistically with their existing investments in energy infrastructure in school buildings. Further, this program can support or expand school curriculum by using "buildings as a teaching tool" for students.

While behavior-based energy reduction strategies have been difficult to measure or evaluate in the past, this is no longer the case. The Acton-Boxborough School District has been recognized by both DOER and the U.S. Department of Education as a national leader in implementing behavior-based energy programs that result in significant and measured energy savings. Moreover, schools with established behavior-based energy programs have reduced their energy use by 20 to 37% as a direct result to the behavior-based initiatives.

More information can be found in the Powering Down report the US Green Building Council's Center for Green Schools at http://centerforgreenschools.org/sites/default/files/resource-files/Behavior-based-Efficiency.pdf.

In 2016, four MAPC communities (Hamilton, Wenham, Salem and Swampscott), hired a consultant to oversee the implementation of a behavior-based energy reduction program in one school in each school district. The programs used a faculty lead to work with students that developed programs to ensure everyday energy savings – such as lights being turned off – as well as larger weekly savings, such as powering down all applicable electronics by end of day Friday. The programs also connected students to the facilities staff. In this way, students became an extension of the facilities staff to help monitor issues and check up on set points, etc.

Hiring a consultant is not necessary, but is highly recommended for the first year of implementation. Based on MAPC's program with the four schools, MAPC would recommend budgeting about $15,000 to $20,000 for a consultant. Also, each school would want to set aside about $500 to $1000 per year to pay for materials the students may need to implement their behavioral awareness programs.

For Marshfield, MAPC assumed a conservative 5% savings per year for electricity in six schools.

School	MMBTU Electricity FY 2015	Reduction from Program	MMBTU Saved Electricity (Annual)	kWh Saved Electricity (Annual)	Cost Savings Electricity (Annual)
Marshfield High	8,072	5%	403.6	118,288	$ 17,743.26
Furnace Brook	2,835	5%	141.8	41,545	$ 6,231.68
Martinson School	1,388	5%	69.4	20,340	$ 3,051.00
South River School	778	5%	38.9	11,401	$ 1,710.14
Eames Way School	729	5%	36.5	10,683	$ 1,602.43
Gov Edward Winslow School	543	5%	27.2	7,957	$ 1,193.58
Total	**14,345**		**717.3**	**210,214**	**$ 31,532.09**

Building Operator Certification

The Building Operator Certification suggests that based on evaluated programs, the certification will have an average savings of:

- 100,500 kWh per year
- 1,400 therms per year

This translates to **428 MMBTUs** per year.

Source: http://www.theboc.info/wp-content/uploads/2015/09/BOC-Energy-Savings-FAQ-2015.pdf

XVI. Appendix G: MMBTU Conversion Chart – DOER

MMBTU Conversion Chart[3]

Fuel Energy Content of Common Fossil Fuels per DOE/EIA

BTU Content of Common Energy Units – (1 million BTU equals 1 MMBTU)

- 1 kilowatt hour of electricity = 0.003412 MMBTU
- 1 therm = 0.1 MMBTU
- 1 ccf (100 cubic foot) of natural gas = 0.1028 MMBTU (based on U.S. consumption, 2007)
- 1 gallon of heating oil = 0.139 MMBTU
- 1 gallon of propane = 0.091 MMBTU
- 1 cord of wood = 20 MMBTU
- 1 gallon of gasoline = 0.124 MMBTU (based on U.S. consumption, 2007)
- 1 gallon of E100 ethanol = 0.084 MMBTU
- 1 gallon of E85 ethanol = 0.095 MMBTU
- 1 gallon of diesel fuel = 0.139 MMBTU
- 1 gallon of B100 biodiesel = 0.129 MMBTU
- 1 gallon of B20 biodiesel = 0.136 MMBTU[4]
- 1 gallon of B10 biodiesel = 0.137 MMBTU[7]
- 1 gallon of B5 biodiesel = 0.138 MMBTU[7]
- 1 barrel of residual fuel oil = 6.287 MMBTU

[3] If a conversion factor for a fuel you use is not provided, please contact DOER.

[4] Calculated Values from those of diesel and B100 biodiesel