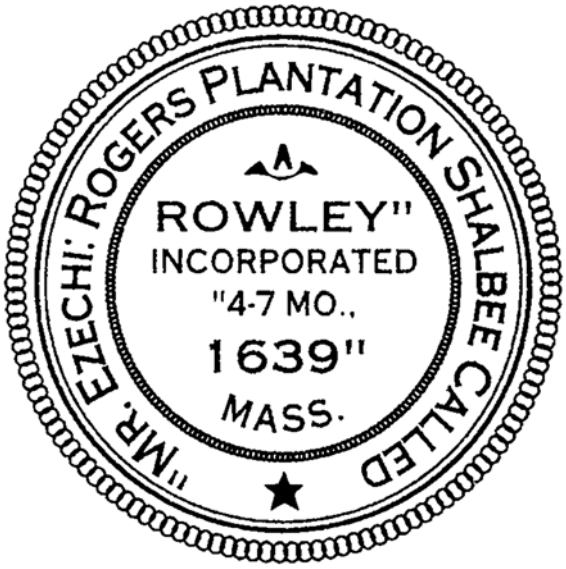
Town of Rowley, Massachusetts

ENERGY REDUCTION PLAN

In fulfillment of the

MASSACHUSETTS GREEN COMMUNITIES GRANT PROGRAM
CRITERIA 3



Prepared by

Town of Rowley, Massachusetts

With support from

Merrimack Valley Planning Commission

December 23, 2020

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I. Purpose and Acknowledgements

The Town of Rowley has completed and adopted this Energy Reduction Plan ("ERP") for submission to the Massachusetts Department of Energy Resources in fulfillment of Criteria 3 of the requirements for Green Community designation.

We attach, as Appendix A, a letter from the Town of Rowley's Board of Selectmen verifying the Town's adoption of this Energy Reduction Plan, as well a letter confirming the School Department's endorsement of the Rowley Energy Reduction Plan.

Preparation of this Plan has been a collaboration of Town Departments and the Merrimack Valley Planning Commission. Plan development participants include:

- Debbie Eagan, Town Administrator
- Natalie Lovett, Assitant Town Administrator
- Amy Lydon, Assistant Town Administrator
- Matt Brown, General Manager, Rowley Municipal Light Plant (RMLP)
- Eric Grover, Office Manager, RMLP
- Jennifer Hughes, Environmental Program Manager, Merrimack Valley Planning Commission
- Neal Duffy, Northeast Regional Coordinator, Green Communities
- Lori Timmerman, Municipal Energy Efficiency Representative, National Grid
- Erik Larson, Guardian Energy Management Solutions, LLC.
- Scott Gromko, Firefly E.E.S.

II. Executive Summary

About the Town of Rowley

The Town of Rowley is located approximately 32 miles north of Boston on Massachusetts' historic "North Shore". The Town encompasses 19 square miles and is characterized by gently rolling uplands and expansive salt marsh. It is bordered to the north by the Town of Newbury, to the west by Georgetown, to the southwest by Boxford, to the south by Ipswich, and to the east by Plum Island Sound and the Atlantic Ocean. According to the 2019 ACS Data, the year-round resident population is 6,400.

ROWLEY SNAPSHOT

$114,306
MEDIAN HOUSEHOLD INCOME

43.0
MEDIAN AGE

2,250
NO. OF HOUSING UNITS

354
NO. OF BUSINESS ESTABLISHMENTS

2,761
JOBS IN ROWLEY

SOURCE: 2014-2018 ACS & MVPC DATA PORTAL

Rowley's estimated population per the 2019 American Community Survey (ACS) is 6,473 people – a growth of almost 11 percent from 2010. The population of Massachusetts (state) increased by 5.3 percent and Essex County (county) by about 6.2 percent between 2010 and 2019.

The predominant land uses in Rowley are: *forest* – 5,401 acres (42.25%); *salt marsh/wetlands* – 2,515 acres (19.7%); *residential development* – 1,213 acres (9.5%); and *agriculture* – 700 acres (5.5%). Commercial and industrial uses combined comprise 214 acres, or less than 2% of the total area. Rowley's most conspicuous and visually stunning landscape feature is its vast salt marshes. Part of the 25,000-acre, multi-community Great Marsh ACEC (Area of Critical Environmental Concern), the Rowley salt marshes protect broad upland areas in town from the full brunt of high-energy coastal winds and waves. Interlaced with myriad tidal creeks, these ecologically rich salt wetlands are home to diverse plant and animal species, including commercially valuable soft-shell clams. They also provide outstanding recreational opportunities for bird watchers, kayakers, and other outdoor enthusiasts.[1]

[1] Merrimack Valley Multi Hazard Mitigation Plan Update, Merrimack Valley Planning Commission., April 2016.

Summary of Municipal Energy Uses

Town Buildings

The Town of Rowley occupies and/or maintains ten buildings for which it is responsible for energy use and cost, including two administration buildings, an elementary school and a police and fire station complex. Energy use for all ten buildings is tracked in MassEnergyInsight, however the Cemetery Office/Shed (120 s.f.) has minimal energy use, is not heated, and was not considered as part of the town's energy reduction plan. Rowley is a municipal light plant community, and most of the public and private properties in towns are served by the Rowley Municipal Light Department. Performance energy audits were conducted through the National Grid project expeditor program (Guardian Energy Management Solutions) on the Town Hall, Town Hall Annex, Pine Grove Elementary School, Water Treatment Plant (considered part of water service), Municipal Light Plant and Library. Separate audits were conducted by a different energy services company (Firefly Energy Efficiency Services, Inc.) on buildings heated with propane or oil including the Highway Garage, Town Hall and Water Department Office. Total energy use in buildings during FY2018, selected as Rowley's baseline year, was 17,744 MMBtus, primarily attributable to consumption of electricity through the Rowley Municipal Light Department and natural gas service through National Grid. Building energy consumption represents 62.7% of the Town's total energy use.

Total square footage of Rowley municipal-owned buildings (in FY2018) is 304,764 sq. ft. as shown below in Table 1A.

TABLE 1A: MUNICIPAL BUILDING INVENTORY 2018

BUILDING NAME	ADDRESS	SQUARE FOOTAGE	HEATING SOURCE
Town Hall	139 Main Street	6,390	Oil
Town Hall Annex	39 Central Street	7,388	Natural gas
Rowley Public Library	141 Main Street	14,006	Natural gas
Water Department Office	401 Central Street	6,168	Propane
Highway Garage	40 Independent Street	6,000	Electric (oil disc.)
Police Station	477 Haverhill Street	4,810	Natural gas
Fire Station	473 Haverhill Street	4,710	Natural gas
RMLP Office	47 Summer Street	7,510	Electric
Pine Grove School	191 Main Street	90,855	Natural Gas
Cemetery Shed	133 Main Street	~120	-

In FY2019, a new fire station went online (8,390 s.f.) replacing a smaller leased building (4,710 s.f.). The new fire station was sited immediately adjacent to the existing police station (4,810 s.f) which was also renovated and enlarged (7,659 s.f.). Construction at the Police Station began in January of 2018. Energy usage was assumed by the contractor and the Police Department occupied the existing building and temporary office trailers (previously part of the building energy use) were removed. As such, energy usage at the Police Station for FY2018 was not representative of regular use. To create a fair representation of baseline usage during the construction months, which spanned both FY2018 into early FY2019, FY2017 data was used.

The Pine Grove School was also renovated beginning in April of 2018, with construction completed in October 2019. It accounts for more than half (62%) of FY2018 building energy use followed by the Town Hall Annex (5.5%) and the Library (5.2%).

Vehicles

In FY2018, the Town of Rowley had a combined total of 41 vehicles and equipment used by Police, Fire, Light, Water, Highway, Cemetery, Health, Animal Control and the Council on Aging. Thirty-three (33) vehicles are considered exempt from Green Community rating requirements because of emergency use function or weight class exceeding 8,500 pounds. The eight (8) non-

exempt vehicles identified are used by the Water, Light, and Health Departments as well as for Animal Control and the Council on Aging. Vehicles account for just over 19% of Town energy use during the FY2018 baseline year, calculated at 3,447 MMBtus. Vehicles and municipal equipment used 2,436 gallons of unleaded gasoline and 1,011 gallons of diesel fuel.

Water and Electric

Rowley provides public water to most of its businesses and households. The Rowley Water Department supplies drinking water to the Town through infrastructure that includes the water treatment plant and pump stations. Rowley's water supply source is from three groundwater wells on town-owned parcels within the Parker River Basin (Haverhill Street, Boxford Road and Pingree Farm). A small chemical storage building (195 s.f.) is part of the Water Department Pumps complex. The treatment plant and well pump stations account for close to 14% of the Town's energy use in the baseline year.

Rowley is a Municipal Light Plant community which provides electricity to Rowley residents and businesses. The Rowley Municipal Lighting Plant (RMLP) offices are are heated with electricity and have backup power from a natural gas powered generator. The RMLP accounts for approximately 5% of building energy use in FY2018.

Streetlights and Traffic Signals

Rowley has approximately 560 street lights and is in the process of converting to LED. Street lighting accounted for approximately 4% of the Town's energy use in FY2018.

The streetlights in Rowley are owned by the Town with power supplied by the Municipal Light Department.

Open Space & Recreation

Open space operations serviced by electricity include Town Common lighting, the Eiras Park Concession Stand and two irrigation wells at Eiras Park and Veterans Field. These account for less than 1% of the Town's energy use in FY2018.

Table 1: Summary of Rowley's Municipal Energy Users

Buildings	**Number**	**Ownership**
Electric Heat	2	Muni
Natural Gas Heat	5	Muni
Propane Heat	1	Muni
Oil Heat	1	Muni
No Heat	1	Muni
Water and Sewer		
Drinking Water Wells	3	Muni
Drinking Water Treatment Plant	1	Muni
Water Pumping Stations	2	Muni
Vehicles		
Non-Exempt	7	Muni
Exempt	34	Muni
Open Space/Recreation	3	Muni
Streetlights	564+/-	Muni

Summary of Energy Use Baseline and Plans for Reductions

Rowley has selected FY2018 as its baseline year and is now using MEI to track energy performance. Total energy use in FY2018 was 17,908 MMBtus. Goal of the Town's Energy Reduction Plan is to reduce municipal energy usage by 20% or 3,582 MMBTUs over five years.

Building energy use reductions:

The Town identifies highest potential for reductions in energy use at Town and School buildings as a result of energy improvements that have been identified by the National Grid project expeditor Guardian and additional savings identified by Firefly in energy assessments conducted in the late summer and fall of 2020.

Based on audit findings to date and assuming their recommendations can be financed, we anticipate that energy use in buildings will decline by at least 20% during the period covered by this plan, compared to the FY2018 baseline.

Other planned energy reductions:

- For ***Vehicles***, Rowley expects an improvement in fuel efficiency through replacement of older vehicles with new, more fuel efficient models, better fleet maintenance, and other operational adjustments. The town will consider policies to reduce vehicle fuel use in the coming years but is not relying on these measures to meet its energy reduction goals.

- For ***Streetlights***, conversion of streetlights by the Rowley Municipal Lighting Plant to LED is in progress with over 360 fixtures completed in FY2019 and another 196 in FY2020. A final seven fixtures will be completed in the coming year. The remainder of the streetlights in Rowley are fairly new and of a decorative style that will be replaced as the fixtures fail. The conversion to LED is expected to result in a 17% reduction in electricity consumption for this end use and 1% of total municipal electricity savings.

In total, anticipated energy reductions under Rowley's proposed 5-year plan, ending in FY2023, should result in greater than 20% reduction from the FY2018 baseline.

Table 2 below summarizes Rowley's plans for energy reduction.

Table 2: Rowley Energy Use Baseline and Plans for Reduction

BASELINE: FY 2018	MMBtu Used in Baseline Year	% of Total MMBtu Baseline Energy Consumption	Projected Planned MMBtu Savings	Savings as % of Total MMBtu Baseline Energy Consumption
Buildings	11,282	63%	5,007	27.9%
Vehicles	3,447	19.2%	-	-
Streetlights/Traffic Signals	703	3.9%	120	0.7%
Water	2,459	13.8%	-	-
Open Space	16	<0.1%	-	-
Total	**17,907***	**100%**	**5,127**	**28.6%**

Total Energy Savings for Rowley under the proposed Energy Reduction Plan is estimated at **5,127 MMBTUs.**

*MEI lists FY2018 MMBTUs as 17,908 which must include some rounding as whole numbers shown add up to 17,907.

III. Energy Use Baseline Inventory

Inventory Tool Used

The Town of Rowley is using MassEnergyInsight (MEI) as its inventory tool. MEI set-ups of all Town buildings and other accounts have been completed with assistance from the Rowley Municipal Light Department and Town Administrator's Office staff. National Grid gas usage is automatically accounted for in the system. MVPC, as administrative agent for the Town, is working with the Rowley Light Department and Town Administrator's office to set up systematic updates for electricity accounts and delivered fuel accounts of heating oil, propane and vehicle gasoline and diesel.

Baseline Year

As noted earlier, Rowley will use FY2018 as its baseline year per the Criteria 3 program guidance.

Municipal Energy Consumption for the Baseline Year

Tables 3a and 3b below, derived from MassEnergyInsight, show the Town of Rowley's energy use during FY2018 (the baseline year) in native units and MMBtus.

Table 3a: Rowley Energy Use Baseline FY2018 (Native Units)

ERP Guidance Table 3a - Municipal Energy Consumption for 2018 (Native Fuel Units)

		2018					
		Electric (kWh)	Gas (therms)	Oil (gallons)	Gasoline (gallons)	Diesel (gallons)	Propane (gallons)
Building	Town Hall	36,534		3,286			
	Town Hall Annex	21,629	5,498				
	Library	92,240	2,747				
	Water Department Office	31,797					2,622
	Highway Garage	28,336	3,996				
	Police Station	120,993	909				
	Cemetery Shed/Office	54					
	RMLP Offices	157,360	327				
	Pine Grove School	316,852	59,237				
	Old Fire Station	55,659	3,760				
	Total	**861,454**	**76,474**	**3,286**			**2,622**
Open Space	Town Common	146					
	Eiras Park Concession	188					
	Eiras Park Irrigation Well	1,869					
	Veterans Field Irrigation Well	2,598					
	Total	**4,801**					
Street/Traffic Lights	Street Lights	206,104					
	Total	**206,104**					
Vehicle	Gas				19,648		
	Diesel					7,273	
	Total				**19,648**	**7,273**	
Water/Sewer	Water Treatment Plant	355,360	5,750				840
	Water Department Haverhill S..	51,216	1,091				
	Water Dept Boxford Street Pu..	34,346					2,133
	Total	**440,922**	**6,841**				**2,973**
Grand Total		**1,513,281**	**83,315**	**3,286**	**19,648**	**7,273**	**5,595**

Table 3b: Rowley Energy Use Baseline FY2018 (MMBTUs)

ERP Guidance Table 3b - Municipal Energy Consumption for 2018 (MMBTU)

Please make sure that any data submitted to DOER contains complete Data!

		2018						
		Diesel	Electric	Gas	Gasoline	Oil	Propane	Total
Building	Town Hall		125			457		581
	Town Hall Annex		74	550				624
	Library		315	275				589
	Water Department Office		108				239	347
	Highway Garage		97	400				496
	Police Station		413	91				504
	Cemetery Shed/Office		0					0
	RMLP Offices		537	33				570
	Pine Grove School		1,081	5,924				7,005
	Old Fire Station		190	376				566
	Total		2,939	7,647		457	239	11,282
Open Space	Town Common		0					0
	Eiras Park Concession		1					1
	Eiras Park Irrigation Well		6					6
	Veterans Field Irrigation Well (..		9					9
	Total		16					16
Street/Traffic Lights	Street Lights		703					703
	Total		703					703
Vehicle	Gas				2,436			2,436
	Diesel	1,011						1,011
	Total	1,011			2,436			3,447
Water/Sewer	Water Treatment Plant		1,212	575			76	1,864
	Water Department Haverhill S..		175	109				284
	Water Dept Boxford Street Pu..		117				194	311
	Total		1,504	684			271	2,459
Grand Total		1,011	5,163	8,332	2,436	457	509	17,908

IV. Energy Reduction Plan for Rowley

Narrative Summary

Rowley selected FY2018 as the Plan's baseline year to capture savings the town has recently achieved due to recent investments in the renovation of the Pine Grove School (PGS). Baseline year energy use of the Town is 17,908 MMBtus. The energy use total includes several municipal buildings in addition to the elementary school. The Town's goal through this Energy Reduction Plan is to reduce the Town's energy consumption over five years by 20%, or 3,582 MMBtus.

In the fall of 2020, the Town participated in National Grid's project expeditor program. Guardian Energy Management Solutions completed lighting and mechanical system audits for several town facilities including Town Hall, Town Hall Annex, Pine Grove School, Municipal Light Plant, Water Treatment Plant and Library. Earlier in the year, Firefly Energy Efficiency Services, Inc. completed ASHRAE Level II audits of Rowley's oil/propane heated buildings including the Highway Department Offices and Garage, Water Department Offices and Town Hall. The audits are attached as Appendix C of this plan. Table 4 of this Energy Reduction Plan includes a detailed summary of Energy Conservation Measures (ECMs) identified by Guardian and Firefly, as well as additional ECMs planned, including conversion of streetlights to LED fixtures.

In addition, Rowley included energy efficiency improvements made during the FY2019 renovation of the Pine Grove School. This renovation did not result in any footprint changes to the building. These efficiency measures included improvements to the building's envelope, lighting and HVAC systems and are outlined in the Section 179D Report included in Appendix E. The measures are also included in Table 4.

Efficiency measures included in the Pine Grove ES renovation resulted in an increase in electricity use, due primarily to the installation of a cooling/dehumidification system, but achieved a 64% reduction in gas use over the FY2018 baseline (FY2018 5,924 MMBtu/FY2020 2,112 MMBtu) and a 17.6% reduction in overall baseline energy use (3,147 MMBtu). Further measures to reduce energy use at the Pine Grove School were identified by Guardian and include HVAC scheduling adjustments and additional building envelope sealing/weatherization measures (949 MMBtu).

Other building energy efficiency measures are projected to produce greater reductions in energy use. Rowley is focused on efficiency improvements identified at Town Hall which combined would produce an added 1.9% reduction (334 MMBtu) as compared with the FY2018 baseline. Weatherization measures as well as light and fuel conversions identified by the audits could be financed through the Green Communities Program.

Measures proposed at the Highway Department Offices and Garage, Water Department Offices (see below), Town Hall Annex, Library and Municipal Lighting Plant would achieve an additional 599 MMBtu (3.3%) in energy use reduction from FY2018 baseline usage.

The recent energy audits did not include the newly renovated and expanded police station and newly constructed fire station, as both contained energy efficiency measures. These included a conversion from natural gas to air source heat pumps (heating and cooling), high efficiency natural gas fired water heaters, LED lighting fixtures, Energy Star rated appliances, and weatherization measures at both facilities (see appendix E for architecht's description).

While the Water Treatment Plant accounts for 10.4% of FY2018 energy use, the Guardian audit states that due to recent upgrades at the facility, "all systems are high performance and well maintained." Similarly, in FY2019, the Water Department Offices (part of building energy use) installed 5 LED 150 watt 277 volt bypass bulbs in 3 Hubbell outside wall pack light fixtures and replaced electrical eyes. The Office also installed air source heat pumps to replace propane (see Water Department memo in Appendix C). In addition to these recent upgrades, Firefly identified additional energy efficiency measures which are expected to reduce building energy use further by 48MMBtu (included in 3.3% reduction above).

Overview of Goals for Years 1 – 2 [FY2019– FY2020]

Over the first two years of Rowley's proposed ERP, energy savings are gained from renovation of the largest energy user in the town's building portfolio, the Pine Grove School. Savings are also gained through the conversion of over 300 streetlights to LED. Specific measures include:

- Installation of efficient HVAC system: Packaged VAV Rooftop Units with Furnace and Radiant Heating
- 96.2% Efficient Boilers and 80% Efficient Furnaces
- Sealed insulated glass units: Light diffusing insulated glazing; between-lite space filled with argon
- Complete LED retrofit of 362 Streetlights

Overview of Goals for Years 3 – 5 [FY2021 – FY2023]

Years 3, 4, and 5 of Rowley's ERP will focus on implementation of recommended ECMs at the Rowley Town Hall: Ideally this would include a fuel conversion from oil to air source heat pumps but additional research will be required concerning physical changes acceptable to the historic Town Hall structure. Although not required, the town may wish to further study the overall savings to be achieved through this conversion.

- Complete weatherization measures recommended by Firefly at Town Hall.
- Complete LED Lighting Conversion (interior and exterior) at Town Hall.
- Complete LED streetlight conversion (7 fixtures).
- Begin the process of improving vehicle fleet management with an eye toward reducing fuel use, including better tracking and analysis of fuel consumption, reinforcement of energy reduction objectives with vehicle users, and replacing end-of-life vehicles with more energy efficient models.
- Continuing to implement lighting upgrade measures identified by Guardian and Firefly across the Town's building portfolio including at the Town Hall Annex, MLP Office and Water Department Office, using Green Community grant funds and other state/federal grants to supplement local funding and any available incentives.
- Undertake weatherization projects as identified by Guardian and Firefly across the Town's building portfolio, using Green Community grant funds and other state/federal grants to supplement local funding and any available incentives. Measures with the largest energy savings are found at the Pine Grove School and Highway Garage Offices.

Areas of Least Efficiency / Greatest Waste

Buildings

The Town has made significant investments in energy savings through recent building renovations and new construction. Envisioned in this 5-year Energy Reduction Plan are next-generation investments to build on the Town's initial program of energy savings. Opportunities to install efficient air source heat pumps exist at Town Hall and the MLP Offices. Air source heat pumps were originally considered at the Highway Office Garage, but limited heating and cooling needs at this facility make this consideration less practicable and the measure was not included in Table 4. The town may still wish to pursue this project outside of the Green Communities program.

Street Lighting

The Town's streetlights have used older HPS technology. In FY2019, the initial year of this plan, the Town completed conversion of 362 Streetlights to LED, a project that resulted in both energy and maintenance cost savings. An additional 196 streetlights, were completed in FY2020 and seven (7) additional fixtures will be updated in FY2021.

Vehicles

The age of Rowley's fleet coupled with the high percentage of exempt vehicles results in higher energy consumption for this category. Currently gasoline and diesel fuel usage is 19.2% of of the FY2018 baseline energy use.

Through the procurement of more fuel efficient vehicles and consideration of anti-idling policies and procedures Rowley expects to see reductions to what is still a significant portion of the Town's overall energy consumption.

Getting to a 20% Energy Use Reduction within 5 Years

Buildings

Guardian and Firefly completed energy efficiency audits of Town facilities in 2020. Both firms identified lighting, mechanical and weatherization measures projected to reduce the Town's energy usage by 7.1% or 1,275 MMBtus. These reductions are in addition to those seen for the renovated Pine Grove School of 3,147 MMBtus (17.6%) and those additional School measures identified by Guardian of 949 MMBtu (5.3%). In total, the plan incorporates building energy saving measures totaling just under a 28% reduction in the Town's overall baseline energy usage.

Street and Traffic Lights

As noted above, Rowley plans to convert all traditional streetlights to LED by the end of FY2021, reducing electricity consumption of this energy end use by 17% and overall energy use by a little less than 1%.

Vehicles

Rowley believes that it can put the strategies and policies in place over the next five years that will lead to vehicle fuel savings. Naturally, the cycle for replacing all vehicles across Rowley's fleet is longer than the timeline of the energy reduction plan, but the Town can begin to demonstrate that putting more efficient vehicles on the road will not adversely affect the ability of Town departments to meet their service objectives for Town residents. Similarly, Rowley will take steps to institutionalize operations and maintenance policies that focus on energy efficiency.

The Town does not have a central fueling depot. Private vendors are used in fueling on-road vehicles used by departments. Usage is tracked through credit card billings.

The Town will review programs and policies promoting more efficient vehicle use to determine if they will result in energy savings. The possible program includes:

- A preventative maintenance schedule that better tracks repairs and preventative maintenance activities and closely monitors tire air pressures, reducing gasoline fuel usage
- Enacting an anti-idling policy to reduce pollution and unnecessary fuel consumption
- Making best efforts to match any and all equipment and vehicles purchased to the operations they are intended to perform and, further, training and reminding staff to schedule and deploy the most appropriate vehicles to perform the functions for which they are used

Program Management Plan for Implementation, Monitoring, Oversight

Implementation

Rowley's Board of Selectmen, action by and through the Town Administrator and Assistant Town Administrators, will have ultimate responsibility for implementing this Energy Reduction Plan, with oversight and leadership for specific elements assigned to individual personnel. Day-to-day energy management responsibility will reside with the respective department head associated with each municipal and school department building.

Future building energy upgrades will be coordinated with the Town Administrator's Office and will be managed by the respective department head responsible for the building.

For vehicle-related energy use reductions, responsibility will also reside with the respective department heads.

Monitoring

Rowley will use MassEnergyInsight (MEI) to track ongoing energy use and report on actual changes in energy use. Merrimack Valley Planning Commission is available to assist the Town in energy use monitoring and preparing Green Community Program annual reports through DOER funding.

The Town Administrator's Office staff will be responsible for supporting building owners and operators (i.e., the respective Town departments) to ensure that energy reduction strategies that are instituted under the plan continue to deliver savings. This will include:

- Checking in with building users regularly to identify building comfort or performance issues that could be indicators of equipment issues;

- Frequent confirmation of proper temperature settings and scheduling on programmable thermostats and other building management systems;
- Preventative maintenance of building systems and timely replacement of worn components (e.g. for steam traps, filters, boilers);
- Issuing work orders for necessary repairs.

Further, the Town will work to involve maintenance personnel in energy reduction efforts as they represent the first line of defense against energy waste.

Oversight

The Board of Selectmen, or their designee, will track progress toward goals and the status of project implementation. Rowley is a member community of the Merrimack Valley Planning Commission which provides assistance in monitoring and preparation of annual progress reports under the Energy Reduction Plan. These reports will be disseminated to stakeholders and filed with the Department of Energy Resources' Green Communities program.

Summary of Energy Audits or Other Sources for Projected Energy Savings

Strategies for energy reduction in buildings have been identified by Guardian Energy Management Solutions and Firefly E.E.S. Inc. in energy audits completed in the fall of 2020. The latest versions of the audits are included in this plan as Appendix C.

Appendix B provides additional calculations and assumptions associated with streetlight savings.

Energy Conservation Measures

The attached Table 4 (Attachment A) summarizes specific improvements, by technology or end use that the Town plans to implement during our five-year Energy Reduction Plan.

Long-Term Energy Reduction Goals – Beyond 5 years

Municipal and School Buildings

As the Town renovates, adds to, and replaces facilities in the context of its long-term capital improvement plans for buildings, which includes the PGS, they intend to reduce the energy required per square foot of building area to carry on government and school functions. Rowley's adoption of the stretch code will ensure that this efficiency improvement occurs as part of all major building construction.

Vehicles

The Town has adopted a Fuel Efficient Vehicle Use Policy in fulfillment of Green Community Criteria 4. The Town anticipates that all future vehicle purchases will be more efficient than the existing fleet. The Town will make both vehicle energy efficiency and life cycle cost key criteria for selecting new vehicles. The Town will ensure that new vehicles are well matched to the purposes for which they are intended so that operating efficiency is not sacrificed. Further, the Town will continue to encourage all vehicle users to operate their vehicles to minimize energy use to the greatest extent practical. And finally, the Town will work to enhance tracking systems for vehicle fueling and scheduled maintenance.

Street and Traffic Lighting

All traditional street lighting is proposed to be converted to LED by FY2021. Rowley has an additional 44 decorative fixtures which are expensive to replace and are relatively new. These fixtures will be updated over time as they fail. The Town will ensure that any new lights that are added use best available technology.

Perpetuating Energy Efficiency

The Town plans to integrate energy efficiency and additional reduction strategies where practical into future construction, purchasing, planning, and policy making. Older structures will be renovated or give way to newer ones over time, and the plan is to make energy efficiency and renewable energy development a part of future buildings to the full extent practical. Further, as noted above, the Town will make every effort to raise consciousness of Town personnel and building users regarding the energy implications of their choices and activities.

V. Onsite Renewable Energy Projects and Renewable Energy

Currently Rowley has not implemented solar at any of its facilities. Firefly did include in its ECMs, a recommendation for roof mounted solar panels at the Town Hall, Highway Garage and Water Department Offices.

Attachment A

Table 4: Proposed ERP Activities with Energy Reductions

[See accompanying electronic file of Table 4]

Appendix A

Authorizations and Endorsements of Rowley's Energy Reduction Plan

[Being provided as separate PDFs]

Town of Rowley

Massachusetts 01969

BOARD OF SELECTMEN
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debbie@townofrowley.org

December 21, 2020

Massachusetts Department of Energy Resources
C/O MassDEP Northeast Regional Office
Attn: Neal Duffy – Regional Coordinator, Green Communities
205B Lowell Street
Wilmington, MA 01887

To Whom It May Concern:

Please be advised that on December 21, 2020, the Rowley Board of Selectmen met at a duly noticed and regularly scheduled meeting and voted to adopt the Energy Reduction Plan for Criterion 3 of the Green Communities Application for Designation. The Board of Selectmen was given copies of the plan for review prior to the meeting. The Board of Selectmen voted unanimously to adopt the plan and the minutes of that meeting include the vote.

Sincerely,

Cliff Pierce
Chairman, Rowley Board of Selectmen

TRITON REGIONAL SCHOOL DISTRICT

Respect, Integrity, and Excellence for All

Brian L. Forget
Superintendent of Schools

Kyle M. Warne
School Business Administrator

Kimberly Croteau
Assistant Superintendent

David Magee
Administrator of Special Education

December 15, 2020

Mr. Neal Duffy, Regional Coordinator, Green Communities
Massachusetts Department of Energy Resources
C/O MassDEP Northeast Regional Office
205B Lowell Street, Wilmington, MA 01887

Dear Mr. Duffy,

Please be advised that the Triton Regional School District adopts the Energy Reduction Plan as it pertains to the Pine Grove Elementary School and as part of the Town of Rowley's application for Green Communities Designation.

If there are any questions I can answer about this effort, please don't hesitate to reach out to me directly.

Sincerely,

Brian Forget
Superintendent of Schools

Cc: Kyle M. Warne, *School Business Administrator*
Rowley Board of Selectmen
Debra Egan, *Rowley Town Administrator*

Appendix B

Streetlight Conversion to LED

Rowley has seen a 32,988 in annual kWh savings from conversion of 558 of its streetlights to more efficent LED lamps. This represents a projected 16% reduction in streetlight energy use since FY2018 from the conversion of existing high pressure sodium streetlights to LED technology. Rowley's streetlights at the baseline year of this plan were large watt HPS lamps. Our savings calculation are from the Rowley Municipal Light Dept. and, netted out against the baseline year, for a total energy reduction of 113 MMBtus for this energy end use. Rowley intends to complete the upgrade of seven final streetlights to LED over the next year for an additional savings of 7 MMBtu or 1% of streetlight energy use. These calculations rely on calculations provided by the RMLP and included in this appendix.

Streetlight Lighting Calculations

[see accompanying electronic spreadsheet]

Streetlight Tracking Table

[see attached pdf table]

Street Light Wattage Calculation for Town Streetlights

*Calendar Year 2017 used for Fiscal Year 2018	Number of Fixtures	Wattage	Total for the Year	Total KWh for Year/Fixture
70 Watt HPS	357	33,915	135,660,000	135,660
150 Watt HPS	1	150	600,000	600
175 Watt MH	1	175	700,000	700
250 Watt HPS	4	1,188	4,752,000	4,752
400 Watt HPS/M/MH	5	2,325	9,300,000	9,300
13 Watt LED	4	52	208,000	208
35 Watt LED	4	140	560,000	560
37 Watt LED	13	481	1,924,000	1,924
38 Watt LED	48	1,824	7,296,000	7,296
39 Watt LED	17	663	2,652,000	2,652
40 Watt LED	5	200	800,000	800
44 Watt LED	47	2,068	8,272,000	8,272
50 Watt LED	19	950	3,800,000	3,800
53 Watt LED	5	265	1,060,000	1,060
135 Watt LED	8	1,080	4,320,000	4,320
150 Watt LED	9	1,809	7,236,000	7,236
201 Watt LED	4	600	2,400,000	2,400
213 Watt LED	12	2,556	10,224,000	10,224
1000 Watt Metal Halide	1	1,085	4,340,000	4,340
Total KWH for Street Light Bill to Town	**564**	**51,526**	**206,104,000**	**206,104** KWH

Street Light Wattage Calculation for Town Streetlights

*Calendar Year 2018 used for Fiscal Year 2019	Number of Fixtures	Wattage	Total for the Year	Total KWh for Year/Fixture
70 Watt HPS	342	32,490	129,960,000	129,960
150 Watt HPS	0	0	0	0
175 Watt MH	1	215	860,000	860
250 Watt HPS	6	1,782	7,128,000	7,128
400 Watt HPS/M/MH	7	3,255	13,020,000	13,020
13 Watt LED	4	52	208,000	208
26 Watt LED	1	26	104,000	104
35 Watt LED	5	175	700,000	700
37 Watt LED	16	592	2,368,000	2,368
38 Watt LED	103	3,914	15,656,000	15,656
39 Watt LED	16	624	2,496,000	2,496
44 Watt LED	49	2,156	8,624,000	8,624
47 Watt LED	5	235	940,000	940
50 Watt LED	19	950	3,800,000	3,800
53 Watt LED	5	265	1,060,000	1,060
135 Watt LED	8	1,080	4,320,000	4,320
150 Watt LED	9	1,809	7,236,000	7,236
201 Watt LED	4	600	2,400,000	2,400
213 Watt LED	13	2,769	11,076,000	11,076
1000 Watt Metal Halide	0	0	0	0
Total KWH for Street Light Bill to Town	**613**	**52,989**	**211,956,000**	**211,956** KWH

Total LED Fixtures 257

Street Light Wattage Calculation for Town Streetlights

*Calendar Year 2019 used for Fiscal Year 2020	**Number of Fixtures**	**Wattage**	**Total for the Year**	**Total KWh for Year/Fixture**
70 Watt HPS	228	21,660	86,640,000	86,640
150 Watt HPS	0	0	0	0
175 Watt MH	0	215	860,000	860
250 Watt HPS	3	891	3,564,000	3,564
400 Watt HPS/M/MH	3	1,395	5,580,000	5,580
13 Watt LED	4	52	208,000	208
26 Watt LED	2	52	208,000	208
35 Watt LED	3	105	420,000	420
37 Watt LED	111	4,107	16,428,000	16,428
38 Watt LED	117	4,446	17,784,000	17,784
39 Watt LED	16	624	2,496,000	2,496
44 Watt LED	46	2,024	8,096,000	8,096
47 Watt LED	5	235	940,000	940
50 Watt LED	19	950	3,800,000	3,800
53 Watt LED	5	265	1,060,000	1,060
135 Watt LED	8	1,080	4,320,000	4,320
150 Watt LED	9	1,809	7,236,000	7,236
201 Watt LED	4	600	2,400,000	2,400
213 Watt LED	13	2,769	11,076,000	11,076
1000 Watt Metal Halide	0	0	0	0
Total KWH for Street Light Bill to Town	**596**	**43,279**	**173,116,000**	**173,116** KWH

Total LED Fixtures 362

Street Name	Pole #	Wattage	Bulb Type	Head Type	Turned		70HPS	150w hps	250 w hps	400w hps	35LED	37LED type 2	37LED type 4	38LED	39LED	47LED	44LED	53LED	135LED	150LED	201LED	213LED	70HPSurd	70HPSurd	26LEDurd	35LEDurd	50LEDurd
Wilkes Drive	SL-1-URD	70	HPS	Glass/REF	12/1/05																		1				
Town Accepted	SL-2-URD	70	HPS	Glass/REF	12/1/05	BO20,Shakespeare																	1				
5/18/2009	SL-3-URD	26	LED	Flat w/REF	11/14/18	AEL Valiant																			1		
	SL-4-URD	70	HPS	Glass/REF	12/1/05	3" Tenon top																	1				
	SL-5-URD	26	LED	Flat w/REF	12/1/05	AEL Valiant																			1		
	SL-6-URD	26	LED	Flat w/REF	11/12/19	AEL Valiant																			1		
	SL-7-URD	70	HPS	Glass/REF	12/1/05	UTR70SH22244P Type 2																	1				
Wilson Pond	SL-1	37-2(35)	LED	FCO	9/18/19	AEL / Autobahn						1															
Road	SL-2	37-2(35)	LED	FCO	9/18/19	AEL / Autobahn						1															
U-94																											
Street Lights & Municipal Lights totals																											
						1/15/2020	70HPS	150w hps	250 w hps	400w hps	35LED	37LED type 2	37LED type 4	38LED	39LED	47LED	44LED	53LED	135LED	150LED	201LED	213LED	70HPSurd	70HPSurd	26LEDurd	35LEDurd	50LEDurd
			wattage	watt per fix		Totals																	Traditionare	Box type			
HPS Fixtures	44		4,085	95	43	Total 70 W HPS	0																40	3			
muni	4		0	175	0	Total 150 W HPS		0																			
	48		297	297	1	Total 250 W HPS			1																		
			0	465	0	Total 400 W HPS				0																	
			190	95	2	Total muni 70 w HPS																					
			594	297	2	Total muni 250 W HPS																					
			0	465	0	Total muni 400 W HPS																					
			0																								
400 w Mercury	1		465	465	1	Total muni 400 W Merc																					
			0																								
			105	35	3	Total 35 W LED Leotek					3																
			10,434	37	282	Total 37 W(35) LED AEL Type 2						282															
			407	37	11	Total 37 W LED AEL Type 4							11														
			4,484	38	118	Total 38 W LED E-Lite								118													
			624	39	16	Total 39 W LED AEL AutoB									16												
			235	47	5	Total 47 W LED Lumec										5											
			2,024	44	46	Total 44 W LED Roadway											46										
			265	53	5	Total 53 W LED Cooper												5									
			1,080	135	8	Total 135 W LED Leotek													8								
			1,350	150	9	Total 150 W LED Roadway														9							
			804	201	4	Total 201 W LED Road way															4						
			852	213	4	Total 213 W LED AEL																4					
			286	26	11	Total 26W LED URD AEL Va																			11		
LED Fixtures	543		70	35	2	Total 35W LED URD AEL																				2	
muni Total LED	19		950	50	19	50w LED urd on the common																					19
Total LED fixtures	562		44	44	1	Total muni 44 W LED Roadway																					
			1,917	213	9	Total muni 213 W LED AEL																					
			52	13	4	Total muni 13 W LED common																					
			185	37	5	Total muni 37-4 W LED AEL																					
			350	175	2	Total muni175 W LED Flood																					
Metal Halide	2		215	215	1	Total muni 175 w MH																					
			465	465	1	Total muni 400 w MH																					
Total Fixtures	613		0	1085	0	Total muni1000 w MH																					
2-Muni OFF in place=609			32,829	Watt's																							
333.33 average hours per month			131,316,000	WH's																							
X 12 months = 4000 hours per year			131,316	KWH'S																							
						Orange in 70 cell means																					
% LED of total						Private Area Lights																					
		Municipal Lights only below																									
Street Name	**Pole #**	**Wattage**	**BulbType**	**Head Type**	**Turned ON**		70 W hps	213LED	175 MH	250 Whps	400 Whps 400 merc	37LED type 2	37LED type 4	175LED	39LED	1000 MH	44WLED	400MH	13WLED								
Central St	L-2-8	37-4	LED	FCO EW	12/12/16	Annex							1														
Central St	L-2-9	213	LED	FCO EW	6/16/16	Annex		1																			
Central St	L-2-9-S	213	LED	FCO EW	6/16/16	Annex		1																			
Pleasant St	L-32-17	70	HPS	SM/Flood		For Flag	1																				
Haverhill St-OFF	L-5-77-S	70	HPS	SM/Flood		For Flag at little league-OFF	1																				
	L-5-87-1	44	LED	FCO EU	4/16/14	Rec Dept/Eiras Field											1										
	L-5-87-3	250	HPS	SM/Flood	1/22/98	Rec Dept/Eiras Field				1																	
	L-5-87-3	400	Merc	SM/Flood	1/22/98	Rec Dept/Eiras Field					1																

		Municipal Lights only below																									
Independent St	L-21-9.5	213	LED	FCO EW	12/19/16	Highway		1																			
	L-21-10	213	LED	FCO EW	12/15/16	Highway		1																			
Main St	L-1-31	175	LED	Flood	3/2/20	Town Hall Flag								1													
Main St	L-1-SL-14-1	13W	LED	Flood	9/25/15	civil war monument (3K)													1								
	L-1-SL-14-2	13W	LED	Flood	9/25/15	civil war monument (3K)													1								
	L-1-SL-14-3	13W	LED	Flood	9/25/15	civil war monument (3K)													1								
	L-1-SL-14-4	13W	LED	Flood	9/25/15	civil war monument (3K)													1								
Main St	L-1-31-1	213	LED	FCO EW	3/7/14	Town Hall		1																			
	L-1-31-4	250	HPS	Flood		Town Hall				1																	
Main St	L-1-44-1-1-N	213	LED	FCO EW	10/24/13	Rec. Dept. Basketball		1																			
	L-1-44-1-1	213	LED	FCO EW	10/24/13	Court. "ON Switch"		1																			
shut off @ photo eye 3/28/12	L-1-44-1-2	400	MH mongo	FCO	1/9/12	ICE Rink "ON Switch"-OFF												1									
Powerhouse Rd	L-59-5	37-4	LED	FCO	7/30/15	sub-station							1														
Powerhouse Rd	L-59-10	37-4	LED	FCO	9/1/17	sub-station							1														
Powerhouse Rd	L-59-117-3	37-4	LED	FCO	7/30/15	sub-station							1														
School St	L-38-2	37-4	LED	FCO	6/16/16	Town Annex							1														
Summer St	L-41-4	175	LED	Flood		For Flag counted as 175 MH								1													
	L-41-11	213	LED	FCO EW		Light Dept Office		1																			
Warehouse Ln	L-43-20	213	LED	FCO EW	8/10/18	Town Landing		1																			
	30 total Muni																										

Appendix C – Energy Audits

Town of Rowley Energy Reduction Project Summary – Guardian Energy Management Solutions (November 2020)

Final Rowley Town Hall ASHRAE Level II Energy Audit – Firefly Energy Efficiency Services, Inc. (including Rowley Town Hall Oil Therms conversion chart)

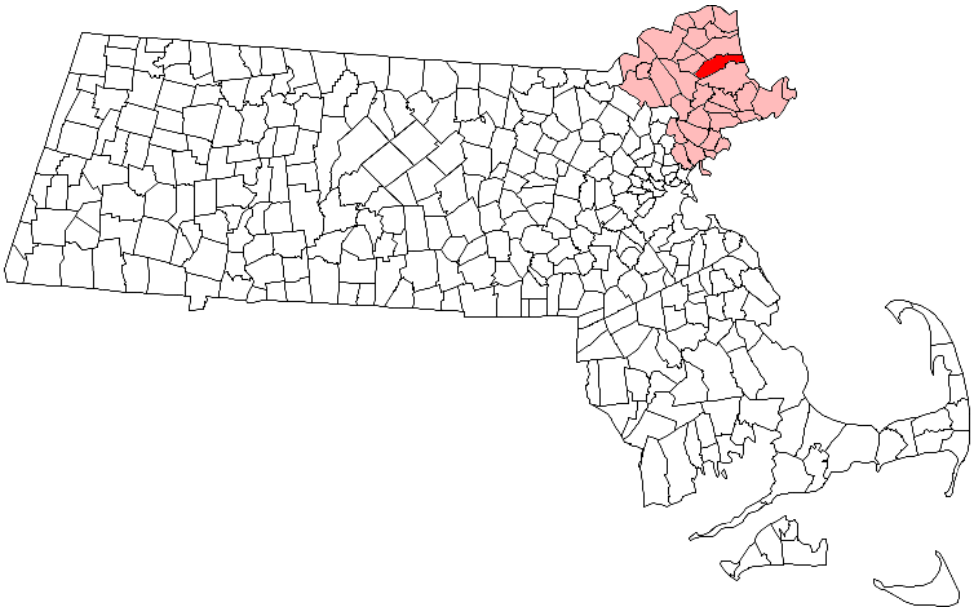
Final Town of Rowley Highway Garage Offices ASHRAE Level II Energy Audit – Firefly Energy Efficiency Services, Inc.

Rowley Water Department ASHRAE Level II Energy Audit – Firefly Energy Efficiency Services, Inc.

Water Department Offices Memo

Town of Rowley
Energy Reduction Project Summary

November 2020



Prepared for:

Town of Rowley

139 Main St
Rowley, Massachusetts 01969

Guardian Energy Management Solutions™
420 Northboro Rd. Central
Marlborough, MA 01752

Stop Wasting Energy. Start Saving Money.™

Contents

Introduction

Guardian Energy Management Solutions is pleased to provide the following Energy Reduction Plan for the Town of Rowley to help support Rowley'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 Rowley will be selecting specific projects for future implementation. Guardian will continue to support the Town of Rowley by assessing energy efficiency opportunities that may arise over the course of time, and will ensure the town is able to take full advantage of the utility incentive program available from National Grid for its Electric accounts and any gas related accounts. Guardian is an approved project expeditor for National Grid's energy efficiency retrofit program and will assist Rowley 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 2020, the utilities offer incentives as follows:

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

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

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

Finally, certain utility companies may offer the option for 'On Bill Repayment' (OBR) for Electric Projects. If this option is available for your project, the town may choose to pay the balance due after incentive amounts are deducted using this OBR option. All OBR requests must be submitted by Guardian and approved by your local utility in advance. If approved, the final amount due is split into either 12 or 24 equal monthly payments with no interest. The monthly charge is then listed on the building's 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 study represents our best effort to develop projected costs and estimated savings for the ECMs mentioned in this report. All costs are turn-key, however any unforeseen work or required asbestos abatement is not included in the pricing unless noted. Energy usage estimates are based on fiscal year 2018 weather data and have not been scaled with respect to heating or cooling degree days which vary annually. Weather variations will affect the overall energy usage.

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

Report Summary

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

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

Baseline Energy Usage Overview

Annual Town Energy Usage Breakdown								
Building Name	**Building Address**	**Rowley MLP Elec Account #**	**National Grid Natural Gas Account #**	**Bldg. Sq. Ft.**	**FY2018 Electric Usage [kWh]**	**FY2018 NG Usage [Therms]**	**FY2018 Oil Usage [gal]**	**Baseline MMBtu FY2018**
Town Hall	139 Main St	-	-	6,390	38,087	0	2,323	453
Town Hall Annex	39 Central St.	96100	04081615060	7,388	22,028	5,002	0	575
Pine Grove ES	191 Main St	115210	04081616180	90,855	511,840	21,108	0	3,857
WTP	64 Pingree Farm	126070	04081210130	9,086	317,040	3,046	0	1,386
MLP Office	47 Summer St	-	0481614510	7,510	164,000	121	0	572
Library	141 Main St	110220	04081614060	14,006	92,640	2,447	0	561
				Totals	**1,145,635**	**31,724**	**2,323**	**7,404**

Energy Savings Summary

Annual Savings Data										
			Electric Savings		NG Savings		Oil Savings			
			$0.20	[$/kWh]	$1.20	[$/therm]	$3.00	[$/gal]		
Building	**ECM**	**ECM Description**	**[kWh]**	**[$]**	**[therms]**	**[$]**	**[gal]**	**[$]**	**MMBtus Saved**	**Total Cost Savings [$]**
Town Hall	**1**	LED Lighting	11,000	$2,200	0	$0	0	$0	38	$2,200
	2	Building Envelope	1,696	$339	906	$1,087	0	$0	96	$1,426
Town Hall Annex	**1**	LED Lighting	13,000	$2,600	0	$0	0	$0	44	$2,600
Pine Grove ES	**1**	HVAC Scheduling	2,579	$516	4,555	$5,466	0	$0	464	$5,982
	2	Building Envelope	8,087	$1,617	4,567	$5,480	0	$0	484	$7,098
MLP Office	**1**	LED Lighting	13,000	$2,600	0	$0	0	$0	44	$2,600
	2	ASHP Install	33,614	$6,723	0	$0	0	$0	115	$6,723
	3	DHW Replacement	1,115	$223	0	$0	0	$0	4	$223
Library	**1**	RTU Replacement – Phase 1	4,632	$926	122	$147	0	$0	28	$1,073
	2	RTU Replacement – Phase 2	3,242	$648	98	$117	0	$0	21	$766
Totals			**91,965**	**$18,393**	**9,342**	**$11,211**	**739**	**$2,217**	**1,351**	**$31,821**

*Note: The energy savings listed are for individual, standalone measures. Combining measures in a building may affect the overall savings numbers through interactive effects.

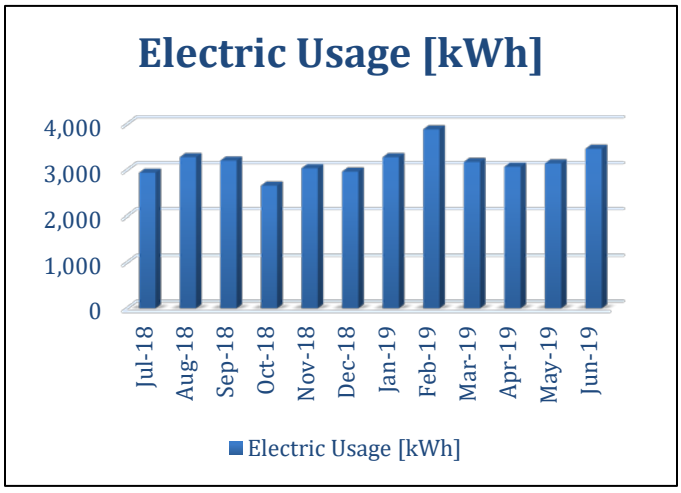
Financial Savings Summary

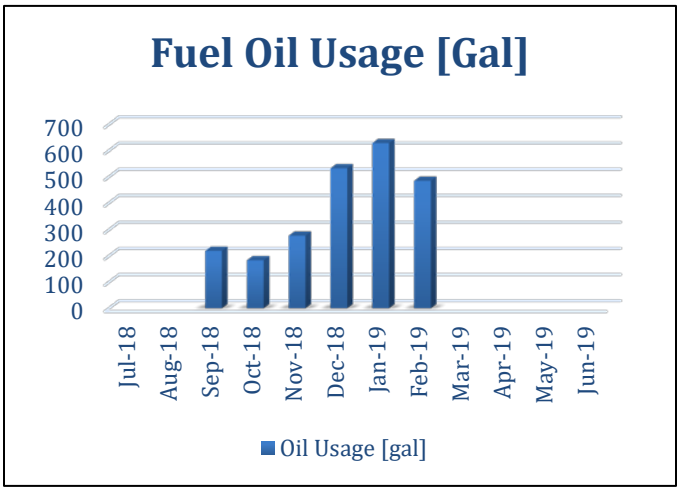
Financial Analysis								
Building	**ECM**	**ECM Description**	**Project Cost [$]**	**Incentive [$]**	**Final Cost [$]**	**Total Cost Savings [$]**	**Simple Rate of Return**	**Payback [years]**
Town Hall	**1**	LED Lighting	$36,000	$0	**$36,000**	**$2,200**	6.1%	16.4
	2	Building Envelope	$11,117	$0	**$11,117**	**$1,426**	12.8%	7.8
Town Hall Annex	**1**	LED Lighting	$42,000	$0	**$42,000**	**$2,600**	6.2%	16.2
Pine Grove ES	**1**	HVAC Scheduling	$4,328	$0	**$4,328**	**$5,982**	138.2%	0.7
	2	Building Envelope	$60,166	$0	**$60,166**	**$7,098**	11.8%	8.5
MLP Office	**1**	LED Lighting	$42,000	$0	**$42,000**	**$2,600**	6.2%	16.2
	2	ASHP Install	$45,832	$0	**$45,832**	**$6,723**	14.7%	6.8
	3	DHW Replacement	$11,000	$0	**$11,000**	**$223**	2.0%	49.3
Library	**1**	RTU Replacement – Phase 1	$83,193	$1	**$83,192**	**$1,073**	1.3%	77.5
	2	RTU Replacement – Phase 2	$71,887	$0	**$71,887**	**$766**	1.1%	93.9
Totals			**$407,523**	**$1**	**$407,522**	**$31,821**	**8%**	**12.8**

Town Hall

The Rowley Town Hall is a 6,390 sq. ft. 2-story building with full basement built in 1904. It is heated by a 725 MBH HB Smith NG steam boiler primarily serving radiators. Air source heat pumps have been added to the building for cooling. The insulation levels in the building are typical for a building of its age, and the only significant heat leakage is through the foundation/wall joint and through the doors. The building is primarily lit with incandescent fixtures and is open Monday through Thursday from 9am to 4pm, and 9am to Noon on Fridays.

Town Hall Usage Profile 2018-2019							
Billing Period	Electricity			Fuel Oil			Total
	Energy (kWh)	Cost ($)	Unit Cost ($/kWh)	Usage (gal)	Cost ($)	Unit Cost ($/gal)	Monthly Cost ($)
Jul-18	2,939	$588	$0.20	0	$0	$3.00	**$588**
Aug-18	3,278	$656	$0.20	0	$0	$3.00	**$656**
Sep-18	3,204	$641	$0.20	219	$657	$3.00	**$1,298**
Oct-18	2,658	$532	$0.20	183	$549	$3.00	**$1,081**
Nov-18	3,037	$607	$0.20	277	$831	$3.00	**$1,438**
Dec-18	2,964	$593	$0.20	532	$1,596	$3.00	**$2,189**
Jan-19	3,277	$655	$0.20	628	$1,884	$3.00	**$2,539**
Feb-19	3,884	$777	$0.20	484	$1,452	$3.00	**$2,229**
Mar-19	3,174	$635	$0.20	0	$0	$3.00	**$635**
Apr-19	3,069	$614	$0.20	0	$0	$3.00	**$614**
May-19	3,142	$628	$0.20	0	$0	$3.00	**$628**
Jun-19	3,461	$692	$0.20	0	$0	$3.00	**$692**
Totals	38,087	$7,617	$0.20	2,323	$6,969	$3.00	$14,586





Recommended Energy Conservation Measures (ECMs)

ECM-1: LED Lighting Upgrades

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 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 and can facilitate the process of applying for available incentives.

Basis of Savings

This ECM conserves energy through replacing the existing light fixtures with fixtures that require less energy to produce similar results.

ECM-2: Building Envelope

Findings

Air leakage is defined as, “the uncontrolled migration of conditioned air through the building envelope”. Caused by pressure differences due to wind, chimney (or stack) effect and mechanical systems it has been shown to represent the single largest source of heat loss or gain through the building envelopes of nearly all types of buildings.

Recommendations

Measure	Qty
Exterior door to be weather stripped and sealed	4
Foundation/Wall Joint sealing with 2-part foam	230 ft.

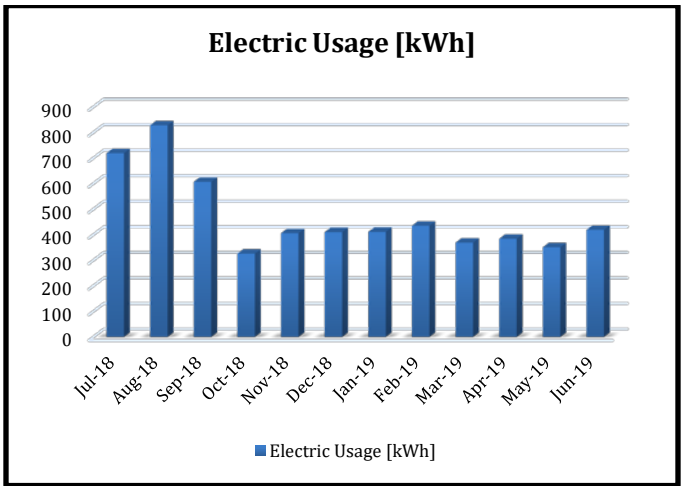
Basis of Savings

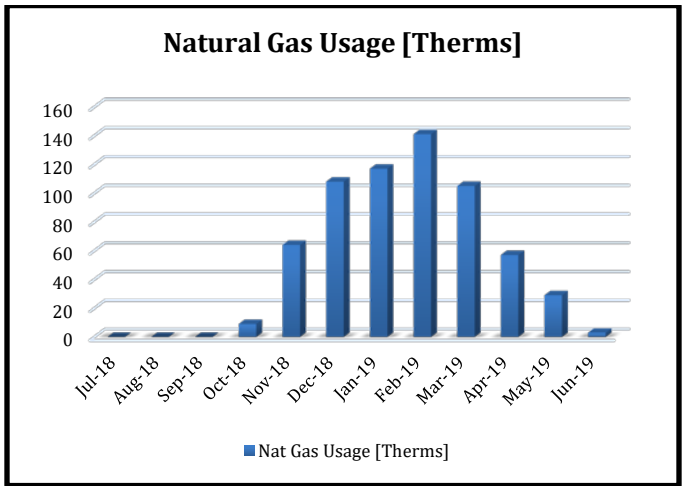
Natural gas and electrical savings will result from the reduction of uncontrolled loss of conditioned air out of the building.

Town Hall Annex

The Rowley Town Hall Annex is a 7,388 sq. ft. 2-story building built in 1904. It is heated by a Burnham V905A 8087 MBH output NG steam boiler installed in 2011 primarily serving radiators. Cooling for the building is through window cooling units. The insulation levels in the building are typical for a building of its age. The building is primarily lit with incandescent fixtures and is open Monday through Thursday from 9am to 4pm, and 9am to Noon on Fridays.

Town Hall Annex Usage Profile 2018-2019							
Billing Period	Electricity			Natural Gas			Total
	Energy (kWh)	Cost ($)	Unit Cost ($/kWh)	Usage (therm)	Cost ($)	Unit Cost ($/therm)	Monthly Cost ($)
Jul-18	1,934	$387	$0.20	0	$0	$1.20	$387
Aug-18	2,641	$528	$0.20	5	$6	$1.20	$534
Sep-18	2,472	$494	$0.20	0	$0	$1.20	$494
Oct-18	1,688	$338	$0.20	105	$126	$1.20	$464
Nov-18	1,798	$360	$0.20	619	$743	$1.20	$1,102
Dec-18	1,658	$332	$0.20	955	$1,146	$1.20	$1,478
Jan-19	1,595	$319	$0.20	1,021	$1,225	$1.20	$1,544
Feb-19	1,961	$392	$0.20	962	$1,154	$1.20	$1,547
Mar-19	1,487	$297	$0.20	695	$834	$1.20	$1,131
Apr-19	1,600	$320	$0.20	583	$700	$1.20	$1,020
May-19	1,594	$319	$0.20	51	$61	$1.20	$380
Jun-19	1,600	$320	$0.20	6	$7	$1.20	$327
Totals	**22,028**	**$4,406**	$0.20	**5,002**	**$6,002**	$1.20	$10,408





Recommended Energy Conservation Measures (ECMs)

ECM-1: LED Lighting Upgrades

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 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 and can facilitate the process of applying for available incentives.

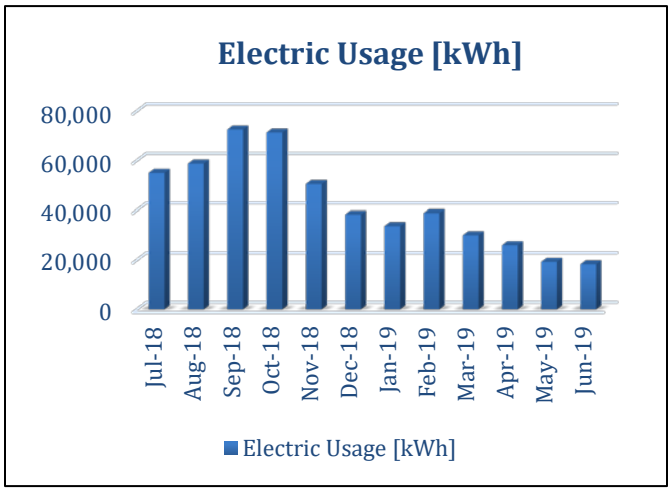
Basis of Savings

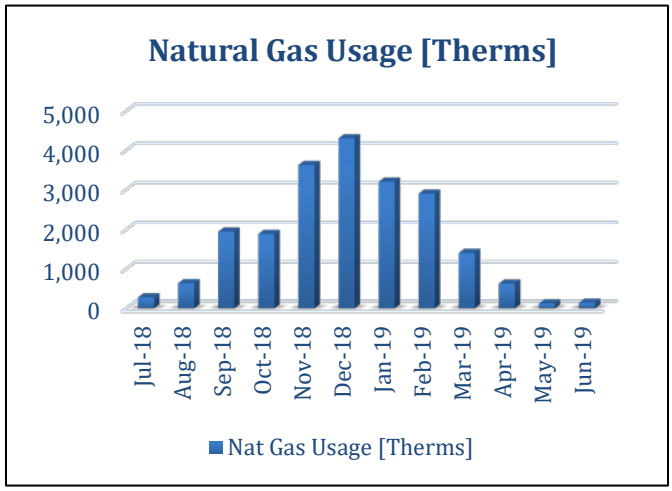
This ECM conserves energy through replacing the existing light fixtures with fixtures that require less energy to produce similar results.

Pine Grove Elementary

Pine Grove Elementary School is a 90,855 sq. ft. building last renovated in 2018. It is heated by (2) 2.0 MMBTU Aerco BMK 2000 NG sealed combustion condensing boilers, supported by (2) 5-HP secondary pumps operated by VFDs. The DHW is a Lochinvar Shield SNA501-125 500-gal NG fired DHW heater. The building is centrally cooled and has updated LED lighting. Though the new portion of the building is well insulated, heat loss was observed in several areas in the older section. There is a Facilities Explorer Niagara EMS system. Lighting has been upgraded to LED throughout the facility. Normal school hours are from 8:25am to 3:00pm with frequent activities after hours, and the school takes the traditional Summer holiday.

Pine Grove Elementary Usage Profile 2018-2019							
Billing Period	Electricity			Natural Gas			Total
	Energy (kWh)	Cost ($)	Unit Cost ($/kWh)	Usage (therm)	Cost ($)	Unit Cost ($/therm)	Monthly Cost ($)
Jul-18	54,960	$10,992	$0.20	278	$334	$1.20	$11,326
Aug-18	58,720	$11,744	$0.20	638	$766	$1.20	$12,510
Sep-18	72,480	$14,496	$0.20	1,951	$2,341	$1.20	$16,837
Oct-18	71,280	$14,256	$0.20	1,891	$2,269	$1.20	$16,525
Nov-18	50,480	$10,096	$0.20	3,630	$4,356	$1.20	$14,452
Dec-18	38,240	$7,648	$0.20	4,307	$5,168	$1.20	$12,816
Jan-19	33,600	$6,720	$0.20	3,204	$3,845	$1.20	$10,565
Feb-19	38,800	$7,760	$0.20	2,903	$3,484	$1.20	$11,244
Mar-19	29,920	$5,984	$0.20	1,410	$1,692	$1.20	$7,676
Apr-19	25,920	$5,184	$0.20	628	$754	$1.20	$5,938
May-19	19,200	$3,840	$0.20	124	$149	$1.20	$3,989
Jun-19	18,240	$3,648	$0.20	144	$173	$1.20	$3,821
Totals	**511,840**	**$102,368**	$0.20	**21,108**	**$25,330**	$1.20	$127,698





Recommended Energy Conservation Measures (ECMs)

ECM-1: Building Scheduling Adjustments

Findings

We audited the building in July. While there was a skeleton administration crew occupying the building, classes were not in session, no students were present, and the large majority of the school was unoccupied. The entire school was fully air conditioned during the walkthrough, and the systems supporting the classrooms all appeared to be in operation.

Recommendations

We recommend a thorough analysis of all HVAC schedules in the EMS system. We will identify opportunities to relax temperature and ventilation settings during unoccupied hours.

Basis of Savings

Natural gas and electrical savings will result from optimization of HVAC operations schedules.

ECM-2: Building Envelope

Findings

Air leakage is defined as, “the uncontrolled migration of conditioned air through the building envelope”. Caused by pressure differences due to wind, chimney (or stack) effect and mechanical systems it has been shown to represent the single largest source of heat loss or gain through the building envelopes of nearly all types of buildings.

Recommendations

Measure	Qty
Exterior door to be weather stripped and sealed	30
Roof/Level change sealing with 2-part foam	260 ft.
Roof/Wall joint sealing with 2-part foam	1,755 ft
Skylights sealed with 2 lines of caulk	5

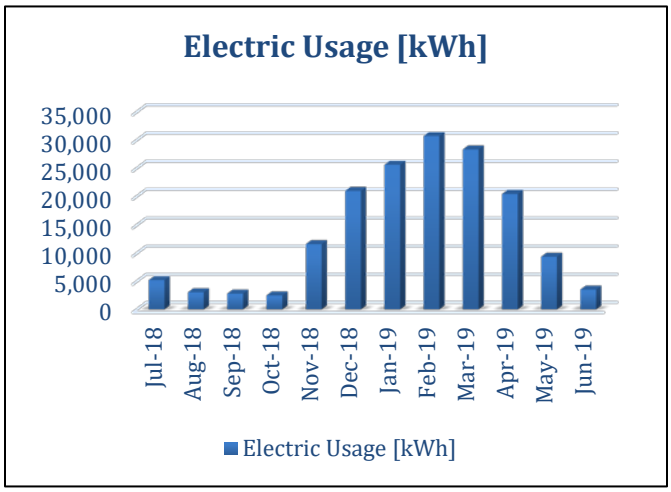
Basis of Savings

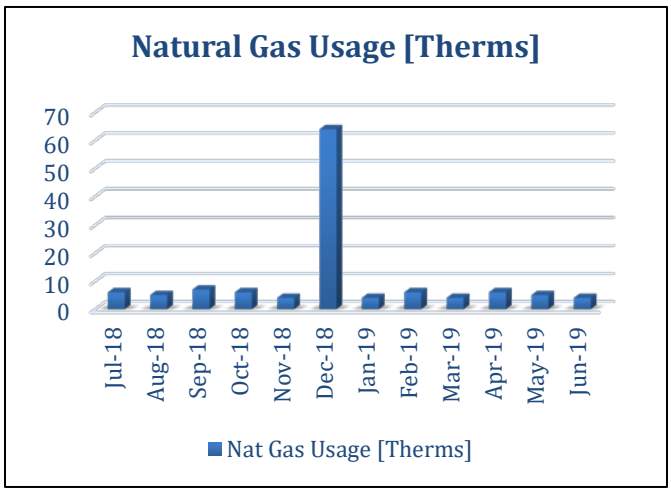
Natural gas and electrical savings will result from the reduction of uncontrolled loss of conditioned air out of the building.

Municipal Light Plant

The Rowley Municipal Light Plant is a 7,510 sq. ft. building comprised of office space and (5) 14' garage bays. The building is heated with electric baseboard and electric unit heaters. The office space is cooled with a 4-ton condenser and air handler, and also includes an electrically heated sidewalk to mitigate snowfall. The insulation levels in the building are typical for a building of its age. The building is primarily lit with incandescent fixtures and is open Monday through Friday from 8am to 4:30pm.

Municipal Light Plant Usage Profile 2018-2019							
Billing Period	Electricity			Natural Gas			Total
	Energy (kWh)	Cost ($)	Unit Cost ($/kWh)	Usage (therm)	Cost ($)	Unit Cost ($/therm)	Monthly Cost ($)
Jul-18	5,200	$1,040	$0.20	6	$7	$1.20	**$1,047**
Aug-18	3,040	$608	$0.20	5	$6	$1.20	**$614**
Sep-18	2,800	$560	$0.20	7	$8	$1.20	**$568**
Oct-18	2,480	$496	$0.20	6	$7	$1.20	**$503**
Nov-18	11,600	$2,320	$0.20	4	$5	$1.20	**$2,325**
Dec-18	20,960	$4,192	$0.20	64	$77	$1.20	**$4,269**
Jan-19	25,600	$5,120	$0.20	4	$5	$1.20	**$5,125**
Feb-19	30,720	$6,144	$0.20	6	$7	$1.20	**$6,151**
Mar-19	28,320	$5,664	$0.20	4	$5	$1.20	**$5,669**
Apr-19	20,400	$4,080	$0.20	6	$7	$1.20	**$4,087**
May-19	9,360	$1,872	$0.20	5	$6	$1.20	**$1,878**
Jun-19	3,520	$704	$0.20	4	$5	$1.20	**$709**
Totals	**164,000**	**$32,800**	**$0.20**	**121**	**$145**	**$1.20**	$32,945





Recommended Energy Conservation Measures (ECMs)

ECM-1: LED Lighting Upgrades

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 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 and can facilitate the process of applying for available incentives.

Basis of Savings

This ECM conserves energy through replacing the existing light fixtures with fixtures that require less energy to produce similar results.

ECM-2: Air Source Heat Pumps

Findings

The office space is currently heated using electric baseboard and electric unit heaters. These are outdated and inefficient by today's standards. It is cooled using a 15-year-old 4-ton condenser that uses R-22 (Freon) as the coolant. Not only is this inefficiency by today's standards, R-22 is also being phased out, replaced with safer alternatives.

Recommendations

We recommend that the baseboard, unit heaters and condensing unit in the office spaces be demolished and removed and replaced with an air source heat pump (ASHP) system. This will include placing a 4-ton condenser on the exterior of the building feeding ¾-ton evaporator in (3) office spaces, and a 1-1/2-ton evaporator in the dispatch office.

Basis of Savings

Electrical savings will result from the greater efficiency heating and cooling from the ASHP system.

ECM-3: Heat Pump DHW

Findings

The domestic hot water (DHW) in the building is served by a 10-year-old 40-gal 4.5 kW electric DHW heater. This is inefficient by today's standards

Recommendations

We recommend the installation of a 40-gal heat pump DHW heater. These heaters use heat pump technology to heat the water and consume approximately 1/3 of the energy required of a standard electric DHW heater.

Basis of Savings

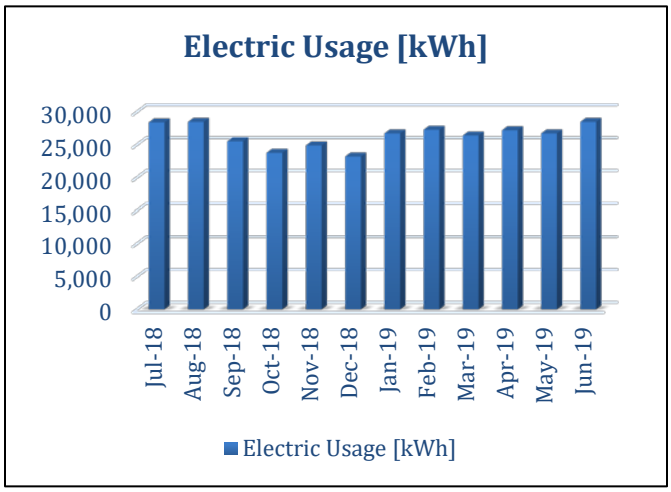
Electrical savings will result from the implementation of a more efficient water heating source.

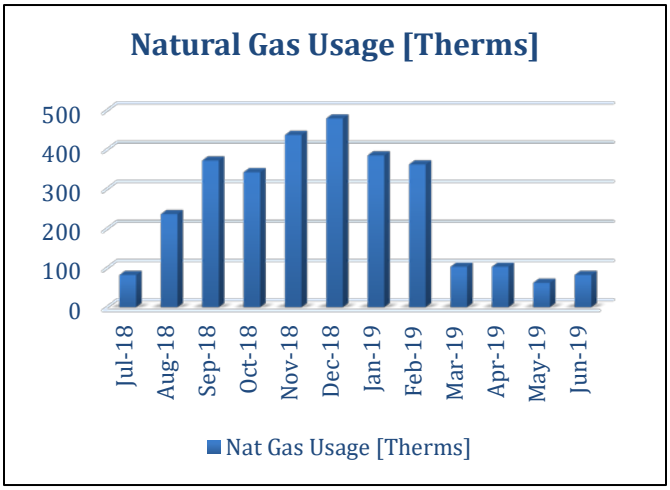
Water Treatment Plant

The Rowley Water Treatment Plant is a 9,086 sq. ft. 1-story building built in 2013. It is heated using (2) 80 MBH natural gas HTP boilers with an in-floor radiant heating system supported by Grundfos variable speed pumps. The DHW is supplied by (2) AO Smith BTHG-150 100-gal 150 BTU NG fired DHW heaters. Air conditioning is provided by a Panasonic U-72ME2U9 heat pump. All process loads in the facility that can be operated by VFD are programmed to do so.

We do not have any recommendations for ECMs at this facility. While it is one of the largest energy consuming facilities in the portfolio, all systems are high performance and well maintained.

Rowley WTP Usage Profile 2018-2019							
Billing Period	Electricity			Natural Gas			Total
	Energy (kWh)	Cost ($)	Unit Cost ($/kWh)	Usage (therm)	Cost ($)	Unit Cost ($/therm)	Monthly Cost ($)
Jul-18	28,400	$5,680	$0.20	82	$98	$1.20	**$5,778**
Aug-18	28,480	$5,696	$0.20	237	$284	$1.20	**$5,980**
Sep-18	25,520	$5,104	$0.20	372	$446	$1.20	**$5,550**
Oct-18	23,760	$4,752	$0.20	342	$410	$1.20	**$5,162**
Nov-18	24,880	$4,976	$0.20	437	$524	$1.20	**$5,500**
Dec-18	23,200	$4,640	$0.20	479	$575	$1.20	**$5,215**
Jan-19	26,720	$5,344	$0.20	385	$462	$1.20	**$5,806**
Feb-19	27,280	$5,456	$0.20	362	$434	$1.20	**$5,890**
Mar-19	26,400	$5,280	$0.20	103	$124	$1.20	**$5,404**
Apr-19	27,200	$5,440	$0.20	103	$124	$1.20	**$5,564**
May-19	26,720	$5,344	$0.20	62	$74	$1.20	**$5,418**
Jun-19	28,480	$5,696	$0.20	82	$98	$1.20	**$5,794**
Totals	**317,040**	**$63,408**	$0.20	**3,046**	**$3,655**	**$1,20**	**$67,063**

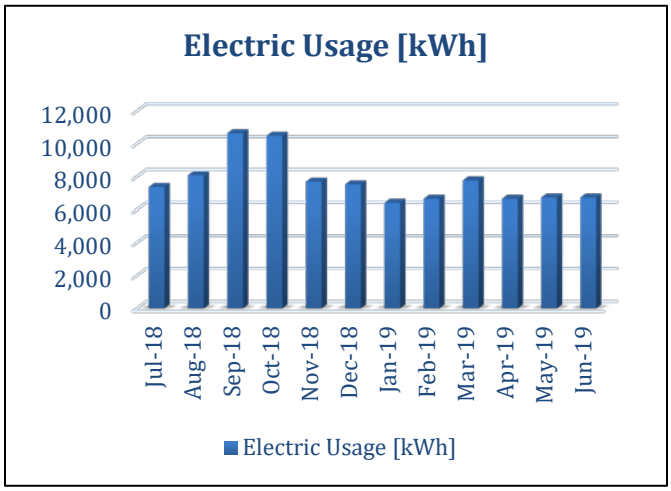


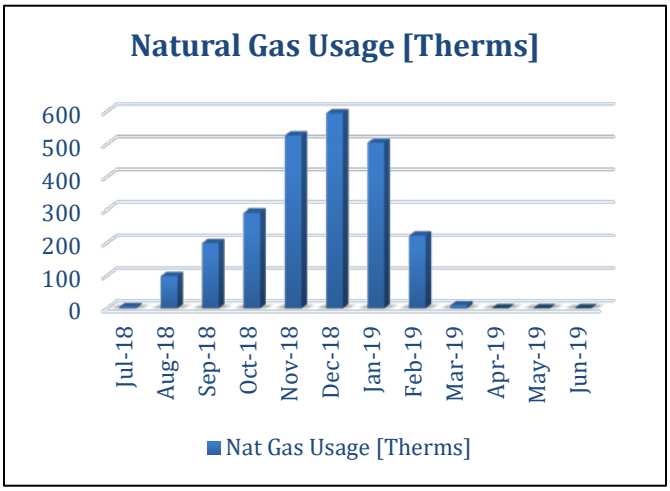


Library

The Rowley Library is a 14,006 sq. ft. 1-story building primarily heated and cooled using a ducted forced air system supported by (4) primary rooftop units (RTUs). The insulation levels in the building are very good, and the building is lit by LED lighting throughout. The Library is open Monday through Thursday from 10am to 6pm, and 10am to 2pm Fridays and Saturdays.

Rowley Library Usage Profile 2018-2019							
Billing Period	Electricity			Natural Gas			Total
	Energy (kWh)	Cost ($)	Unit Cost ($/kWh)	Usage (therm)	Cost ($)	Unit Cost ($/therm)	Monthly Cost ($)
Jul-18	7,360	$1,472	$0.20	4	$5	$1.20	$1,477
Aug-18	8,080	$1,616	$0.20	98	$118	$1.20	$1,734
Sep-18	10,640	$2,128	$0.20	199	$239	$1.20	$2,367
Oct-18	10,480	$2,096	$0.20	291	$349	$1.20	$2,445
Nov-18	7,680	$1,536	$0.20	526	$631	$1.20	$2,167
Dec-18	7,520	$1,504	$0.20	594	$713	$1.20	$2,217
Jan-19	6,400	$1,280	$0.20	504	$605	$1.20	$1,885
Feb-19	6,640	$1,328	$0.20	222	$266	$1.20	$1,594
Mar-19	7,760	$1,552	$0.20	9	$11	$1.20	$1,563
Apr-19	6,640	$1,328	$0.20	0	$0	$1.20	$1,328
May-19	6,720	$1,344	$0.20	0	$0	$1.20	$1,344
Jun-19	6,720	$1,344	$0.20	0	$0	$1.20	$1,344
Totals	**92,640**	**$18,528**	$0.20	**2,447**	**$2,936**	$1.20	$21,464





Recommended Energy Conservation Measures (ECMs)

ECM-1: Rooftop Unit Replacement – Phase 1

Findings

The RTUs at the Rowley Library are 17 years old, are nearing the end of their useful life, and use R-22 (Freon) as their coolant. This includes (1) 7.5-ton, (2) 10-ton, and (1) 20-ton unit, all manufactured by Lennox.

Recommendations

We recommend that the first phase involve replacing the 20-ton unit, and the 7.5-ton unit with high efficiency units of similar size.

Basis of Savings

Natural gas and electrical savings will result from the replacement of the RTUs with newer, more efficient models.

ECM-2: Rooftop Unit Replacement – Phase 2

Findings

The RTUs at the Rowley Library are 17 years old, are nearing the end of their useful life, and use R-22 (Freon) as their coolant. This includes (1) 7.5-ton, (2) 10-ton, and (1) 20-ton unit, all manufactured by Lennox.

Recommendations

We recommend the second phase involve replacing the (2) 10-ton units with high efficiency units of similar size.

Basis of Savings

Natural gas and electrical savings will result from the replacement of the RTUs with newer, more efficient models.

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 and ASHRAE Level 2 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 Ever source.

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.

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

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.

Prepared by:
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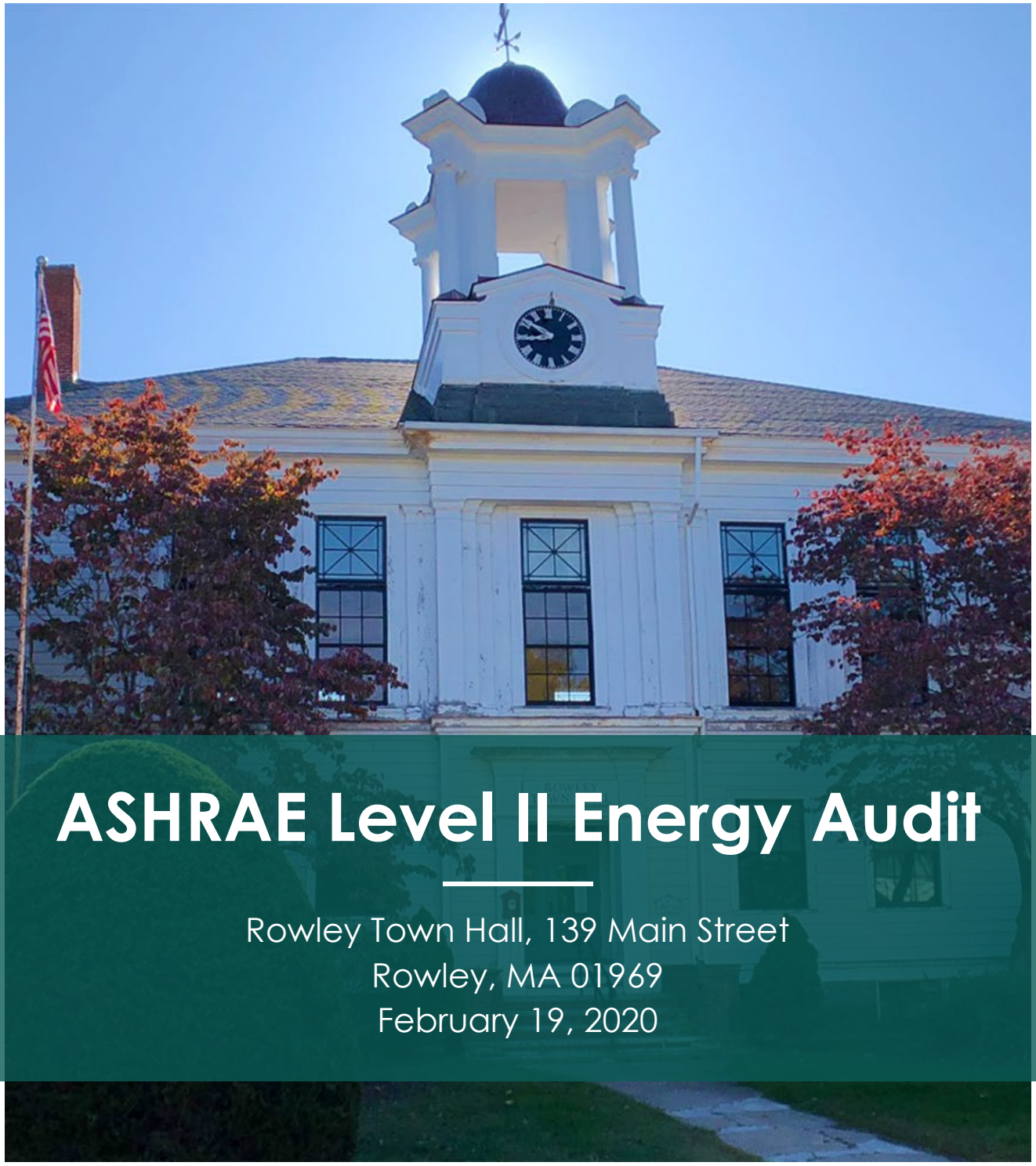


ASHRAE Level II Energy Audit

Rowley Town Hall, 139 Main Street
Rowley, MA 01969
February 19, 2020

Table of Contents

1. Executive Summary

The Town of Rowley contracted with Firefly Energy Efficiency Services, Inc (Firefly EES) to conduct an energy audit of the subject property, Rowley Town Hall, located at 139 Main Street, Rowley, Massachusetts 01969. The audit consisted of a building evaluation aimed at 1) assessing the overall energy usage of the building and its on-site systems, 2) identifying potential energy areas of improvement in these systems, and 3) where applicable, proposing "clean energy" alternatives to the current systems where future energy savings could be realized. Included as part of the audit was a review of the building's construction features, its historical energy costs, discussions with the local utilities concerning the property's energy usage, and discussions with the prime energy equipment suppliers/manufactures for the purpose of determining more efficient alternatives.

This audit meets the Level II requirements established by ASHRAE. As a result, this report includes the following: an historical analysis of all building utility consumption (electricity, heating oil, and town water); specific efficiency improvement recommendations for each of the primary building systems (HVAC equipment, weatherization, lighting, plug loads, and domestic water heating); and a detailed financial analysis of each recommendation, which includes the Savings to Investment Ratio (SIR) based on life cycle costs and using contractor-provided pricing for full installation. This comprehensive approach uses structured techniques to provide a valuable framework for substantial and measurable utilities savings.

Key Audit Findings:

- In FY 2018, the Town Hall spent $14,016.23 on all utilities.
- Eleven (11) separate Energy Efficiency Measures (EEMs) identified.
- Annualized savings for of all EEMs totals $5,195, a 37% reduction at current energy prices.

Recommendations:

- Phase 1
    - Replace interior and exterior lighting with LED technology
    - Insulate basement and attic
    - Install ductless high efficiency heat and cooling system
- Phase 2
    - Insulate building walls
- Phase 3
    - Replace access doors and insulate front entry vestibule
    - Consider installing photovoltaic renewable energy source on south facing roof

This audit demonstrates the potential for Town Hall to serve as a model of sustainable building operations and resource conservation to the town. To that end, the Audit Team hopes this report proves to be a useful decision-making tool in considering sustainable building operation strategies. We believe that with continued collaboration, Town Hall can make significant progress towards the goal of ensuring a sustainable, healthy, and energy-efficient building.

Rowley Town Hall Energy Efficiency Measures						
EEM #	EEM Title	Reason for Evaluation	Approx. Annual Savings	Net Costs	SIR	Simple Payback Years
1	Replace Interior Lighting with LED alternative	Inefficient lighting	$748	$4,861	3.08	6.50
2	Replace Exterior Lighting with LED alternative	Inefficient lighting	$1,323	$510	51.90	0.39
3	Install Programable Thermostats	Inefficient HVAC equipment	$124	$300	8.28	2.42
4	Install insulated door and wall insulation to separate boiler room from basement	Inefficient weatherization	$198	$3,680	1.08	18.55
5	Replace Basement Door with insulated, weather stripped door	Inefficient weatherization	$83	$1,750	0.95	20.99
6	Air seal attic 1" closed cell foam and install 2 layers of (Cross Batt) R25 fiberglass insulation	Inefficient weatherization	$1,058	$12,995	1.63	12.28
7	Install Heat Pump System for Heating and Cooling the Building**	Inefficient HVAC Equipment	-$630	$43,589	-3.22	NA
8	Spray rim of floor frame (R20) and foundation walls (R15) with closed cell foam, encapsulate with thermal barrier paint	Inefficient weatherization	$1,125	$13,168	1.17	11.70
9	Install dense pack cellulose in exterior wall cavities	Inefficient weatherization	$981	$25,300	0.78	25.80
10	Strip bookcases on office side of vestibule and insulate with rigid foam board	Inefficient weatherization	$161	$2,875	1.12	17.84
11	Replace access doors with insulated, weather stripped doors, install storm panel on all single glazed windows	Inefficient weatherization	$117	$3,450	0.68	29.41
		Total	**$5,195**	**$114,748**	**0.91**	**12.70**

SIR = Savings to investment ratio. Equals useful estimated savings multiplied by product life divided by project costs. Ex. ($748 x 20 years)/$4,861 = 3.08.

The SIR for a project must have a savings-to-investment ration of at least 1 to pay for itself.
Simple Payment = Net Costs/annual savings

** Installing a high efficiency heat pump and cooling system is estimated to increase electricity costs as a result of adding cooling to second floor. Savings reflects reduction in oil use to offset increased electricity use. Oil system would be retained and used on a limited basis as a back up system.

2. Background

Rowley Town Hall (Town Hall) houses the administrative offices and meeting hall for the Town of Rowley. Built in 1904, the building is owned and operated by the Town of Rowley. Town Hall has a total of four departments (4) and houses a meeting hall on the second floor. The building has two (2) floors above grade and an unoccupied basement level encompassing a total of 6,390 square feet of space.

2.1. Space Types

The main level/first floor at Town Hall is used as office and conference space for the Town of Rowley. The second floor is used as a town meeting hall and has a small office space. The basement level provides storage space, mechanical equipment, and information technology equipment. The basement is not used as office space.

2.2. Occupancy & Use Schedules

The office space and common areas at Town Hall are typical occupied during varying work hours by the staff of the building. Payback calculations for conservation projects included twelve (12) full-time occupants and a visitor average of twenty (20) people per day. These occupancy patterns are leveraged in the energy conservation strategies included in this report. The chart below represents the typical occupancy by space type.

Town Hall Occupancy Schedules							
Space Type	**Mon**	**Tues**	**Wed**	**Thurs**	**Friday**	**Sat**	**Sun**
Selectman Offices	8am - 8pm	8am - 4:30pm	8am - 4:30pm	8am - 4:30pm	8am - 12pm	Closed	
Town Clerk Offices	9am - 8pm	8am - 12pm	8am - 4:30pm	8am - 12pm	8am - 12pm	Closed	
Assessor Offices	8:30am - 8 pm	8:30am - 4:30pm	8:30am - 4:30pm	8:30am - 4:30pm	Closed	Closed	
Treasurer Offices	8am - 8pm	8am - 4:30pm	8am - 4:30pm	8am - 4:30pm	8am - 12pm	Closed	
Meeting Hall	By appt	By appt	By appt	By appt	By appt	By appt	

2.3. Recent Building System Upgrades & Existing Conditions

In recent years, the Town Hall building systems have benefited from a variety of efficiency improvements. To save water, the restroom toilet has been replaced with a low flow product. A

majority of the windows in the building have been replaced with insulated glass with effective weather stripping. The oil-fired heating system has annual cleaning and frequent replacement of worn parts. The building mechanical equipment is older but as a result of maintenance efforts is still in good working order. The following describes the existing primary building systems.

Heating

Town Hall heating is served by two oil burning units. One unit is an oil boiler, steam system. This system is roughly 20 years old and requires continuous maintenance. The maintenance is performed by Olson Heating and Cooling. The heat is served by five thermostats that call for heat to the different town departments. There are two (2) programable thermostats and three manual thermostats. The thermostat in the common area hallway is protect by a locked case to prevent public access. The temperature is set at 68 degrees during working hours and 60 degrees during nonworking hours. Honeywell actuators allow or prevent steam to the requested area based on the thermostat temperature settings. These actuators are nearing the end of useful life and can be replaced after failure; however, it can be a challenging project leading to the replacement of additional piping. As the steam used to heat the radiators cools, the condensate is fed back into the oil boiler by a pump. Due to the age of the system, the pump becomes stressed by sediment and as a result is cleaned every year. The pump was replaced in 2019.

The second oil fired system is a forced hot air system. This system is roughly four years old and performs well. It serves the second-floor meeting hall by a programable thermostat. The meeting room is not often in use, so this system maintains heat at 60 degrees.

Cooling

Each office on the first floor has air conditioning to cool the space. The Selectman's office is cooled by a mini split system. The rest of the offices have window box air conditioners. The mini-split system is an efficient option for climate control. The unit performs well, however, proper installation includes installing the condensing unit where there are no obstructions near the unit and mounted or placed on a solid stand above snow levels and debris (leaves) to allow for proper air flow. The condensing units for the town hall are located on the ground, below snow levels and where debris can pile up. These units show signs of premature wear in the form of rust around the base. If possible, the condensing unit should also be installed in an area that is shielded from the sun. These steps greatly improve efficiency. Records show there have been maintenance charges for freeze ups which can be caused by air flow issues around the condensing unit.

Town Hall Condensing Unit

Properly Installed Condensing Unit

Ventilation

The bathroom on the first floor is equipped with an exhaust fan that vents through the side of the building. This fan is controlled with the wall mounted switch located near the bathroom door. The windows throughout the building are operable without screens and can be used to provide outside air to the office and meeting hall spaces when the climate allows for natural ventilation.

Building Automation Controls

Town Hall has limited building automation controls. There are two programmable thermostats, one on the first floor and one on the second, and motion sensors for lighting on the second floor of the building.

Lighting

The lighting at the facility is comprised primarily of fluorescent lamps in common and office areas and metal halide (MH) lamps in the parking lot and on the exterior of the town hall building.

The lighting on the first floor of the building is mostly provided by T8 and T12 linear fluorescent overhead prismatic lens, wrap fixtures. This equipment uses two (2) 32-watt linear (T8) or two (2) 40-watt four foot (T12), fluorescent lamps with magnetic ballasts. The first floor also has A19, 25-watt compact fluorescent lamps (CFL) in closets and storage areas. The bathroom has two (2) drum fixtures each with two (2) horizontal, four pin, 13-watt, CFL lamps. All lighting throughout the first floor of the building is manually controlled by wall mounted switches.

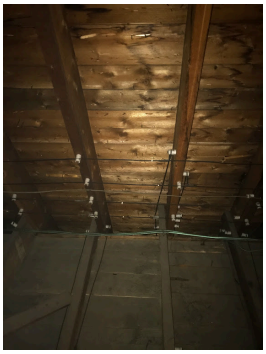
The second floor lighting has decorative fixtures on the walls of the stairwells and hanging from the ceiling. These hold multiple 60-watt, G9, halogen lamps. These lights are controlled by a sensor mounted on the ceiling. In addition to decorative fixtures on the walls, the meeting room has ten (10) inch recessed cans with 175- watt MH lamps. This area is manually controlled by wall mounted switches. Prior to insulation installation in the attic these lights must be replaced since the existing ten (10) inch recessed cans are not designed/equipped to be covered with insulation. There is a small office that has four-foot, linear fluorescent, prismatic lens, wrap fixtures controlled by wall mounted switches. The stage behind the meeting room has A19, 60-watt lamps, while a small balcony area has decorative drum fixtures with three (3), A19, lamps.

The basement has a combination of A19, 25-watt CFL lamps and four-foot fluorescent strip fixtures that have T12 lamps. See Appendix A for pictures and Appendix B for additional information from lighting audit.

Plumbing

The toilet fixture at Town Hall is a low flow 1.28 gallon per flush toilet that was installed in 2018. The bathroom sink is fitted with efficient 0.5 gallon per minute (gpm) faucet aerators.

Electrical


Knob and tube wiring

The electrical supply is 120/240 volt single phase three-wire service. The building has a single utility meter. There is knob and tube wiring in the attic. Knob-and-tube wiring is a method of electrical wiring for North American buildings used from about 1880 to the 1930s. The system is considered obsolete and can be a safety hazard. Basic testing, using a tic tester, did not find electrical load to this wiring; however, it is recommended that a master electrician test this wiring to confirm it is not charged then remove to prevent accidental future use.

Building Envelope

Interior: The main access points (north side and west side) to the building have double entry, wood panel doors that are one and three quarter inch (1 ¾). The wood sashes fit poorly and do not make a tight seal. The emergency exit at the east side of the building is fiberglass, insulated, with tight seals. All of these doors have a single glazed transom window over the top of the doors. Most of the operable windows in the building have been replaced with insulated glass. There is one window on the second floor at the rear of the building, above the elevator entrance that was not replaced. In addition, the second floor has decorative transom windows above the main windows that are single glazed. The building exterior walls are assumed to have the following composition: aluminum siding, vapor barrier, wood studs, and drywall. The Treasurer's and Assessor's offices have walls abutting the front door vestibule. These walls appear to be approximately one (1) inch thick with no insulation. Thermal imaging shows significant thermal conductivity to the exterior. Pictures are provided in Appendix A

Basement: The basement has no insulation in the ceiling /1st level subfloor and there is no insulation at the perimeter of the floor frame. The basement includes a room that houses the oil fired boiler (1st floor heating) and furnace (2nd floor heating). This room has a louvered grill in place of a transom window to provide outside combustion air to the boiler. There is a rear door (south side) that provides direct access to the outside. This door has a significant gap between the threshold and bottom door seal revealing day light. There are chases/conduits for piping and wiring to connect equipment, such as oil fill spickets and condensing units placed outside. The conduits also show areas of day light allowing outside air into the basement of the building. These open areas are significant gaps in the thermal envelope. Pictures are provided in Appendix A.

Attic: The Attic has no insulation in the ceiling frames and no insulation in the roof frame cavities. The ceiling has numerous penetrations primarily from recessed lighting in the meeting room on the second floor.

Stack Effect: Heat rises. In conditioned buildings the effect is warm air rises and looks to escape at the highest levels. This movement creates positive pressure at the tops of buildings and negative pressure to draw in cooler air at the lower levels of buildings. Somewhere in the middle of buildings

there is a neutral pressure point. When trying to moderate buildings for heating and cooling it becomes important to create an effective thermal barrier at the top to have the greatest impact on combating the stack effect. Due to the inefficient weatherization equipment, Rowley Town Hall is an example of a building that battles stack effect.

Domestic Hot Water

Domestic hot water (DHW) is supplied by one (1) A.O Smith® 6-gallon free-standing electric water heater. DHW in the tanks is maintained at 125°F and used for the bathroom sink faucet.

2.4. Renewable Energy Assessment

As part of the auditing process the team examined the possibility of adding renewable energy technologies at Town Hall including: solar photovoltaic (PV), solar hot water, small scale wind, and cogeneration systems. This analysis is meant to provide general information regarding existing conditions at Town Hall and is not meant to serve as a guarantee regarding the feasibility of installing any of these systems.

Solar PV: Town Hall has a pitched roof that could be used to install solar panels. The roof will allow for panels to be oriented to the southern direction to maximize the exposure to the sun. There are no surrounding buildings or trees that would create shading effect. The estimated payback for this system is 12 years.

Solar Hot Water: The roof at Town Hall would make it a possible candidate for a solar hot water installation, however the need and use of water at the building is very low. This creates a long payback for this system.

Small Scale Wind: Due to the urban location of Town Hall small scale wind turbines would likely not be feasible due to inconsistent wind flows and moderate population density. The wind turbines generate a fair amount of noise which may be disruptive to the people in the area and at the Rowley Town Public Library. Additionally, the flickering shading effect caused by the spinning blades may also be a disturbance to people in the area.

Cogeneration: Town Hall does not have opportunities for cogeneration at the building due to its relatively small heat load.

2.5. Energy Use Index & Benchmarks

The chart below summarizes the current, as well as the historical energy use indexes (EUI) and utility costs of Town Hall.

Since city water is not considered an energy use, it is not included in the calculation of the EUI and is not included in the total energy cost per square foot calculation.

ENERGY STAR Rating

Town Hall's office space is recognized by the Environmental Protection Agency (EPA) ENERGY STAR Portfolio Manager Program and thus eligible for an ENERGY STAR rating. A minimum rating of 75 is necessary to receive ENERGY STAR certification. The current ENERGY STAR rating for TOWN HALL is 41, indicating the building is performing in the 41st percentile of buildings of comparable size and in similar climates. By implementing the recommendations in this report, it is possible to achieve certification with an even greater ENERGY STAR rating.

Metrics Summary			
Metric	**Sep 2017 (Energy Baseline)**	**Dec 2019 (Other)**	**Change**
ENERGY STAR Score (1-100)	47	41	-6.00 (-12.80%)
Source EUI (kBtu/ft^2)	108.7	115.8	7.10 (6.50%)
Site EUI (kBtu/ft^2)	77.2	86.9	9.70 (12.60%)
Energy Cost ($)	10,731.39	14,584.52	3853.13 (35.90%)
Total GHG Emissions Intensity (kgCO2e/ft^2)	5.7	6.4	0.70 (12.30%)
Water Use (All Water Sources) (kgal)	15.7	11.9	-3.80 (-24.20%)
Total Waste (Disposed and Diverted (Tons)	Not Available	Not Available	N/A

Since the baseline year of 2017, total energy use for Town Hall increased by 12.6% and energy cost by 36%.

3. General Information

3.1. Audit Team

Firefly Energy Efficiency Services, Inc. (Firefly EES) collaborated with Ms. Natalie Lovell, Assistant Town Administrator to collect the necessary data for this audit.

3.2. Audit Process

Prior to starting field visits, the Audit Team collected historical energy data for Town Hall. Firefly EES visited Town Hall on a few occasions in early 2020 and collected detailed information on the mechanical, lighting, and plumbing systems as well as occupancy, building use patterns, and equipment operating schedules. In the late Winter, the COVID 19 pandemic caused a delay in

the audit process. As a result, data was collected was collected in the Summer of 2020. Additionally, Olson Heating and Cooling provided valuable information regarding equipment maintenance. Ultimately, each recommendation was fully priced and energy savings and payback estimates calculated.

3.3. Financial Analysis – Methodologies & Assumptions

All financial analyses included in this report were derived using available resources from the ASHREA guidance, EPA, Green Communities program and information provided on the equipment. These resources were used to perform an analysis of each recommendation. Using initial project cost, annual savings, life of the equipment, and the equipment's replacement cost, a variety of useful financial, energy savings, and greenhouse gas reduction metrics were generated.

Energy use values were calculated by collecting the total annual use for oil and electricity. These values were provided by the electricity and oil utility companies. Annual electricity use was provided by Rowley Municipal Electric. Equipment energy use was calculated into kilowatt per hour (kWh), by reviewing the equipment label. Hourly use was estimated against the buildings occupancy schedule and multiplied by the kWh per hour. The value for the equipment was then subtracted from the annual use to determine the usage percentage for that equipment. Costs were calculated by multiplying equipment use to average annual utility rate. Oil use data was provided by Donald F. Knowles, Inc. Average annual price per gallon was used for oil and kWh for electricity.

The savings calculations were estimated based on a phased approach to installation.
Phase 1 energy efficiency measures (EEM) were based on FY 2018 energy data. Phase 2 ECM savings were based on FY 2018 energy use that was prorated to include the savings from adopting the Phase 1 ECMs. Phase 3 EEMs included savings from adopting Phase 1 and Phase 2 savings estimates. Savings estimates generated from the removal of electric personal space heaters (Qty 9) were not included. Even though once the ECMs have been installed the use of this equipment will not be needed, the conservative approach considers the difficulty in modifying employee behaviors.

The following table reflects the approximate portion of fixed costs for each utility.

Fixed Costs of Utilities Supplied through Town of Rowley Town Hall (FY 2018 Rates)				
	Propane	Oil	Electricity	Water
Unit Rate	NA	$2.30 per gallon	$0.183 per kWh	$20.31 per 1000 gallons
Estimated Infrastructure Percentage	NA	51%	48%	1%

4. Energy Efficiency Measures

4.1. Energy Efficiency Measures Summary

EEM Collective, Rowley Town Hall													
EEM	Project Phase	Measure Type	Energy Efficiency Measure	Electricity	Oil	GHG Reduction	Total Annual Savings	Total Costs**	Utility Rebate	Net Costs	Cost / MTCDE	Payback (years)	SIR
				kWh	Therms	MTCDE							
1	1	Lighting	Replace Interior Lighting with LED alternative	4,155	0	2.36	$748	$6,251	$1,390	$4,861	$2,060.34	6.50	3.08
2	1	Lighting	Replace Exterior Lighting with LED alternative	7,352	0	4.18	$1,323	$990	$480	$510	$122.17	0.39	51.90
3	1	HVAC Equipment	Install Programable Thermostats	0	75	0.58	$124	$700	$400	$300	$514.75	2.42	8.28
4	1	Weatherization	Install insulated door and wall insulation to separate boiler room from basement	208	97	1.34	$198	$3,680	$0	$3,680	$4,212.49	18.55	1.08
5	1	Weatherization	Replace Basement Door with insulated, weather stripped door	208	28	0.51	$83	$1,750	$0	$1,750	$5,240.13	20.99	0.95
6	1	Weatherization	Air seal attic 1" closed cell foam and install 2 layers of (Cross Batt) R25 fiberglass insulation	692	564	6.52	$1,058	$12.995	$0	$12,995	$2,721.61	12.28	1.63
7	1	HVAC Equipment	Install Heat Pump System	-35,553	3,612	18.06	-$630	$43,589	$0	$43,589	$5,536.59	NA	-3.22
8	1	Weatherization	Spray rim of floor frame (R20) and foundation walls (R15) closed cell foam, encapsulate with thermal barrier paint	692	604	5.85	$1,125	$13,168	$0	$13,168	$2,491.96	11.70	1.71
9	2	Weatherization	Install dense pack cellulose in exterior wall cavities	1,038	479	7.76	$981	$25,300	$0	$25,300	$6,564.50	25.80	0.78
10	3	Weatherization	Strip bookcases on office side of vestibule and insulate with rigid foam board	230	72	1.51	$161	$2,875	$0	$2,875	$2,060.34	17.84	1.12
11	3	Weatherization	Replace access doors with insulated, weather stripped doors, install storm panel on all single glazed windows	208	48	1.09	$117	$3,450	$0	$3,450	$ 6,955.65	29.41	0.68

** Prevailing wage not used in calculation

4.2. Energy Efficiency Measures

Note: Savings calculations reflect savings from individual measures only and do not assume that other recommendations have been implemented. Calculations and assumptions used are solely based on the existing equipment and usage schedules.

EEM 1 *(Phase 1 - implemented as part of electricity reduction)*

Replace Interior Lighting with LED alternative									
Budgetary Cost	Annual Utility Savings				GHG MTCODE	Annual Savings	Available Incentives	Payback with Incentives	Payback without Incentives
	Electricity	Oil	Natural Gas	Water					
$	kWh	Therms	Therms	CCF	Metric Tons	$	$	Years	Years
$6,251	4,155	NA	NA	NA	2.36	$748	$1,390	6.50	8.35

Existing Condition: *Inefficient Lighting*
Lighting in most of the basement, offices, conference areas, common areas and second floor office space is provided with 4 foot prismatic wrap fixtures fitted with T8 and T12 fluorescent lamps. The second-floor meeting hall has ten (10) inch recessed cans with 175W Metal Halide lamps. These lights generate a high level of heat and will need to be replaced prior to insulating the attic.

Recommendation: Complete as a phase 1 project by replacing the existing T8 and T12 lamps with a 20-watt LED by Remphos® Barkit J LED or similar alternative to reduce electric consumption. The new lamps and drivers will be a direct replacement for the existing lamps and ballasts and can accompany existing sensors. The replacement LEDs also have a rated lifespan of 100,000 hours versus 2,000 for the existing fluorescent lamps, which will help reduce maintenance costs associated with replacing burn outs. Replace 175W with LED 26W cans.

Implementation: Estimate includes the cost to professionally install the 20W LED Barkit J® products. In order to estimate the electric savings assumptions for daily usage were made based on space type. Incentives are available for each of these fixture/lamps installed through the mass save program and these incentives are included in the price calculations. Further information regarding assumptions and the calculations made for this EEM can be found in Appendix C.

EEM 2 *(Phase 1 - implemented as part of electricity reduction)*

Replace Exterior Lighting with LED alternative									
Budgetary Cost	Annual Utility Savings				GHG MTCODE	Annual Savings	Available Incentives	Payback with Incentives	Payback without Incentives
	Electricity	Oil	Natural Gas	Water					
$	kWh	Therms	Therms	CCF	Metric Tons	$	$	Years	Years
$990	7,352	0	0	NA	4.18	$1,323	$480	0.39	0.75

Existing Condition: *Inefficient Lighting*
Lighting for the exterior of the building is provided by Metal Halide fixtures. LED fixtures with photocells (illuminate at dusk and shut down at dawn) provide better lighting output at greatly reduced wattages. In addition, LED products are instant on where existing MH takes 20-30 minutes to reach full illumination.

Recommendation: Complete as a phase 1 project by replacing the lamps in the existing exterior fixtures with LED fixtures, lamps and add photocells. The photocells will remove the need for a time clock and revision to account for day light savings. The products have a 100,000-hour useful life with the reduced wattage and maintenance costs.

Implementation: Estimate includes the cost to install new fixtures. Yearly savings runtime estimates were dusk to dawn operation. Incentives are available for each of these fixture/lamps installed through the mass save program and these incentives are included in the price calculations. Further information regarding assumptions and calculations are included in Appendix C.

EEM 3 *(Phase 1 - implemented as part of HVAC Control)*

Install Programable Thermostats									
Budgetary Cost	Annual Utility Savings				GHG MTCODE	Annual Savings	Available Incentives	Payback with Incentives	Payback without Incentives
	Electricity	Oil	Natural Gas	Water					
$	kWh	Therms	Therms	CCF	Metric Tons	$	$	Years	Years
$700	0	75	NA	NA	0.58	$124	$400	2.42	5.74

Existing Condition: *Inefficient HVAC equipment*
The oil-fired boiler requires thermostats to provide steam to areas requesting heat. Many of the thermostats are manual operation and the some of the programable are old.

Recommendation: Complete as a phase 1 project by replacing the thermostats with programable thermostats. This will prevent the departments from forgetting to turn the heat down during non-working hours.

Implementation: Estimate includes the cost to purchase and install thermostats. Further information regarding assumptions and calculations are included in Appendix C.

EEM 4 *(Phase 1 - implemented as part of weatherization)*

Install insulated door and wall insulation to separate boiler room from basement									
Budgetary Cost	Annual Utility Savings				GHG MTCODE	Annual Savings	Available Incentives	Payback with Incentives	Payback without Incentives
	Electricity	Oil	Natural Gas	Water					
$	kWh	Therms	Therms	CCF	Metric Tons	$	$	Years	Years
$3,680	208	97	NA	NA	0.87	$198	$0	NA	18.55

Existing Condition: *Inefficient Building Envelope*
The oil-fired boiler requires ventilation for combustion. This is provided by a louvered window near the unit. This allows outside air into the basement.

Recommendation: Complete as a phase 1 project by replacing the existing doors with an insulated door and insulate the walls to prevent outside air from entering the entire basement. This outside air rises to the office spaces.

Implementation: Estimate includes the cost to install the insulated door and insulate the walls of the equipment room. Savings estimates were made for a reduction in heating the building. Further information regarding assumptions and calculations are included in Appendix C.

EEM 5 *(Phase 1 - implemented as part of weatherization)*

Replace Basement Door with insulated, weather stripped door									
Budgetary Cost	Annual Utility Savings				GHG MTCODE	Annual Savings	Available Incentives	Payback with Incentives	Payback without Incentives
	Electricity	Oil	Natural Gas	Water					
$	kWh	Therms	Therms	CCF	Metric Tons	$	$	Years	Years
$1,750	208	28	NA	NA	0.34	$83	$0	NA	20.99

Existing Condition: *Inefficient Building Envelope*
The basement access door to the parking lot at the rear of the building has a large gap under the bottom of the door. This gap allows outside air into the basement.

Recommendation: Complete as a phase 1 project by replacing the door with insulated, weather stripped door.

Implementation: Estimate includes the cost to install the insulated door. Estimated savings were calculated into a reduction in heating the building. Further information regarding assumptions and calculations are included in Appendix C.

EEM 6 *(Phase 1 - implemented as part of weatherization)*

Air seal attic 1" closed cell foam and install 2 layers of (Cross Batt) R25 fiberglass insulation									
Budgetary Cost	Annual Utility Savings				GHG MTCODE	Annual Savings	Available Incentives	Payback with Incentives	Payback without Incentives
	Electricity	Oil	Natural Gas	Water					
$	kWh	Therms	Therms	CCF	Metric Tons	$	$	Years	Years
$12,995	692	564	NA	NA	4.77	$1,058	$0	NA	12.18

Existing Condition: *Inefficient Building Envelope*
Attic has no insulation in the ceiling frame cavities, and no insulation in the roof frame cavities. In addition, there are numerous penetrations from chases and recessed lighting in the floor of the attic.

Recommendation: Install as part of phase 1 project. Spray attic floor with R15 closed cell foam, cover with R25 fiberglass insulation.

Implementation: The installation includes the cost to spray/air seal attic with R15 closed cell foam and install 2 layers of R25 fiberglass insulation. A catwalk would need to be installed to allow for walking in the attic to reach equipment such as the clock and Verizon network. Further information regarding assumptions and calculations are included in Appendix C.

EEM 7 *(implemented as part of HVAC System)*

Install Heat Pump System									
Budgetary Cost	Annual Utility Savings				GHG MTCODE	Annual Savings	Available Incentives	Payback with Incentives	Payback without Incentives
	Electricity	Oil	Natural Gas	Water					
$	kWh	Therms	Therms	CCF	Metric Tons	$	$	Years	Years
$43,589	-35,553	3,612	NA	NA	7.87	-$630	$0	NA	NA

Existing Condition: *Inefficient HVAC*

The oil-fired boiler is nearing the end of useful life.

Recommendation: Complete as part of phase 1 by installing energy efficient, variable speed, ductless, heat pump and cooling system for climate control in first floor spaces, second floor meeting hall and office space. The oil system would be kept as a back up system.

Implementation: Estimate includes the cost to purchase and heat pump and cooling system. This system would be the primary unit used to condition the space (heat and cool) and the oil system would be used as a backup system for heating. As a result, the electricity consumption for the building would increase as a result of cooling the second floor which currently does not have air conditioning. Further information regarding assumptions and calculations are included in Appendix C.

EEM 8 *(Phase 1 - implemented as part of weatherization)*

Spray rim of floor frame (R20) and foundation walls (R15) closed cell foam, encapsulate with thermal barrier paint									
Budgetary Cost	Annual Utility Savings				GHG MTCODE	Annual Savings	Available Incentives	Payback with Incentives	Payback without Incentives
	Electricity	Oil	Natural Gas	Water					
$	kWh	Therms	Therms	CCF	Metric Tons	$	$	Years	Years
$13,168	692	604	NA	NA	5.28	$1,125	$0	NA	11.70

Existing Condition: *Inefficient Building Envelope*
Within the basement there is no insulation at the perimeter of the first-floor frame. Chases for plumbing, electrical and HVAC ducts between the basement and upper floors are not sealed allowing outside air to enter the basement.

Recommendation: Complete as part of phase 1, by spraying foundation walls with R15 closed cell foam, encapsulate with thermal barrier paint (code requirement).

Implementation: The installation includes the cost to spray foundation walls with R15 closed cell foam and paint walls to meet code requirements. Appendix C.

EEM 9 *(Phase 2 - implemented as part of weatherization)*

Install dense pack cellulose in exterior wall cavities									
Budgetary Cost	Annual Utility Savings				GHG MTCODE	Annual Savings	Available Incentives	Payback with Incentives	Payback without Incentives
	Electricity	Oil	Natural Gas	Water					
$	kWh	Therms	Therms	CCF	Metric Tons	$	$	Years	Years
$25,300	1,038	479	NA	NA	3.85	$981	$0	NA	25.80

Existing Condition: *Inefficient Building Envelope*

The walls of the building have limited insulating value. This is a result of the age in which the building was constructed.

Recommendation: Complete as part of phase 2 project. Spray dense pack foam into the building walls.

Implementation: The installation includes the cost to spray dense pack foam into the walls of the building. Access by removing sections of aluminum siding as required. Replace siding after insulating. Further information regarding assumptions and calculations are included in Appendix C.

EEM 10 *(Phase 3 - implemented as part of the weatherization)*

Strip bookcases on office side of vestibule and insulate with rigid foam board									
Budgetary Cost	Annual Utility Savings				GHG MTCODE	Annual Savings	Available Incentives	Payback with Incentives	Payback without Incentives
	Electricity	Oil	Natural Gas	Water					
$	kWh	Therms	Therms	CCF	Metric Tons	$	$	Years	Years
$2,875	230	72	NA	NA	0.68	$161	$0	NA	17.84

Existing Condition: *Inefficient Building Envelope*

Employees in the Assessor and Treasure's departments shared that the workspace near the bookcases along the front door vestibule wall is very cold in the winter. Subsequent thermal imaging showed significant heat loss.

Recommendation: Complete as a phase 3 project. Strip bookcase shelves on office sides of front entry vestibule, install rigid 1" minimum foil faced foam insulation. Cover with wood panel or plaster board.

Implementation: The estimate includes the cost to strip the bookcase and install rigid 1" foil faced foam insulation. Estimated savings included revised energy baseline energy use, assuming phase 1 and phase 2 projects are completed. Further information regarding assumptions and calculations are included in Appendix C.

EEM 11 *(Phase 3 - implemented as part of the weatherization)*

Replace access doors with insulated, weather stripped doors, install storm panel on all single glazed windows									
Budgetary Cost	Annual Utility Savings				GHG MTCODE	Annual Savings	Available Incentives	Payback with Incentives	Payback without Incentives
	Electricity	Oil	Natural Gas	Water					
$	kWh	Therms	Therms	CCF	Metric Tons	$	$	Years	Years
$3,450	208	48	NA	NA	0.49	$117	$0	NA	29.41

Existing Condition: *Inefficient Building Envelope*

Entry doors are double 1 ¾" wood panel doors. These doors would typically have an R-value of around 1.75. Most of these doors also have single glazed transom windows over the top of the doors which would have an R-value of 1. Thermal imaging showed significant leakage through these entry openings. Doors do not have effective weather stripping.

Recommendation: Complete as phase 3 project. Replace access doors with insulated, weather stripped doors and install storm panels on all single glazed transom lights over doors and windows.

Implementation: The estimate includes the cost to furnish and install doors and windows. Estimated savings included revised energy baseline energy use, assuming phase 1 and phase 2 projects are completed. Further information regarding assumptions and calculations are included in Further information regarding assumptions and calculations are included in Appendix C.

5. Utility Analysis

5.1. Utility Rate Schedules

Utility Rates: 2017-2019				
Utility	**Unit**	**2017 Rate**	**2018 Rate**	**2019 Rate**
Electricity	kWh	$0.17	$0.17	$0.18
Oil	Gallons	$1.97	$2.30	$2.26
Water	Gallons	$0.02	$0.02	$0.02

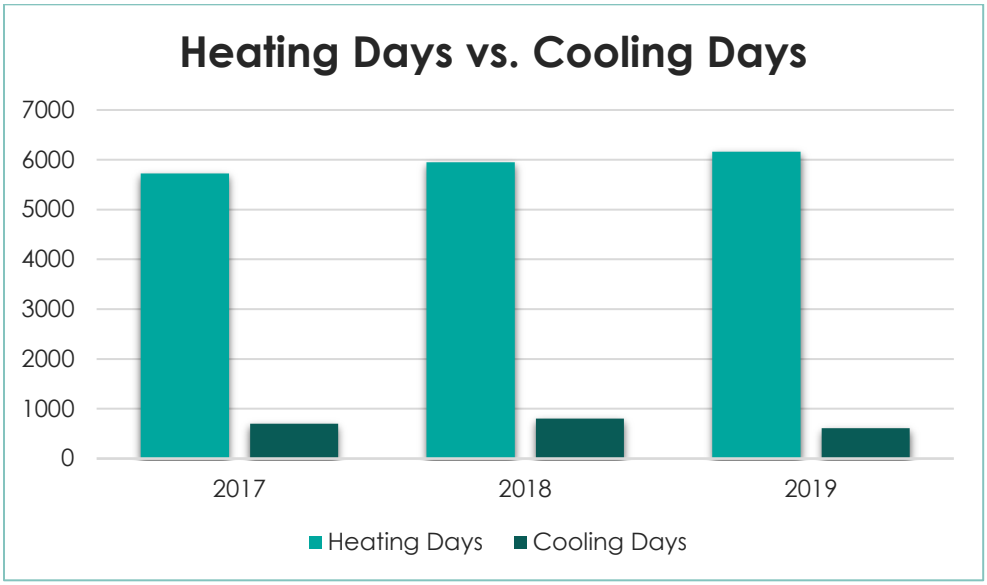
5.2. CO_2 Equivalents for Utilities

The table below lists the metric ton of carbon dioxide equivalents (MTCDE) for each utility consumed by Town Hall. The conversion factors were calculated by the Greenhouse Gas Inventory through the Environmental Protection Agency. These factors were used to estimate the greenhouse gas reductions for each energy conservation recommendation at Town Hall.

Carbon Dioxide Equivalents by Utility Type	
Oil (MTCDE/therm)	**Electricity** (MTCDE/kWh)
0.005318	0.000390

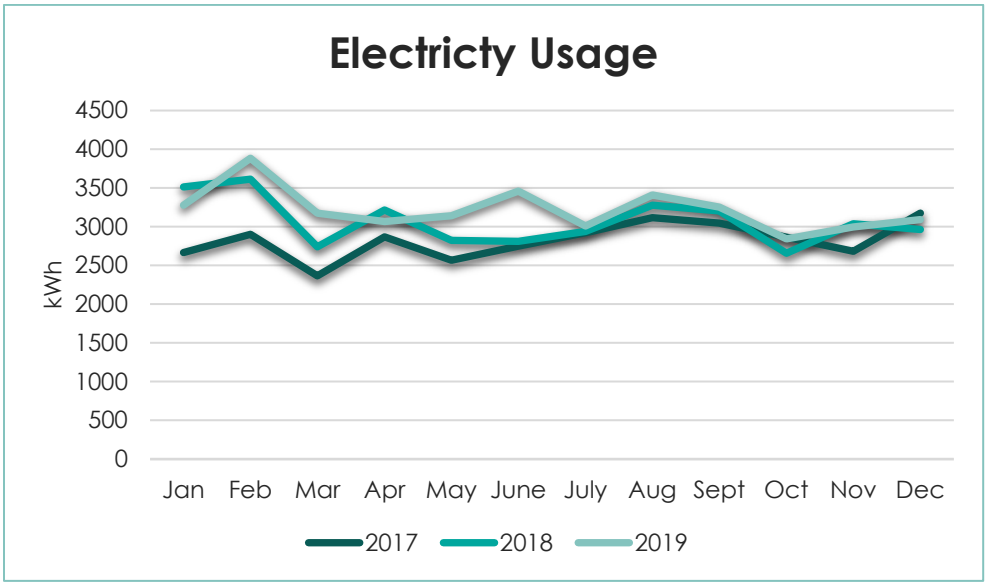
5.3. Annual Degree Days 2017 – 2019

This graph provides the number of heating and cooling degree-days for Rowley, Massachusetts for the past three (3) years. A heating degree-day (HDD) is the number of degrees that a day's average outside air temperature is below 65°F and a building's interior is typically heated. A cooling degree-day (CDD) is the number of degrees that a day's average outside air temperature is above 65°F and air conditioning is typically used to cool a building's interior spaces. This data is useful to determine increases in energy uses based on weather conditions. For example, an increase in HDD will typically increase oil/heating costs, where the increase in CDD will typically increase cooling cost.



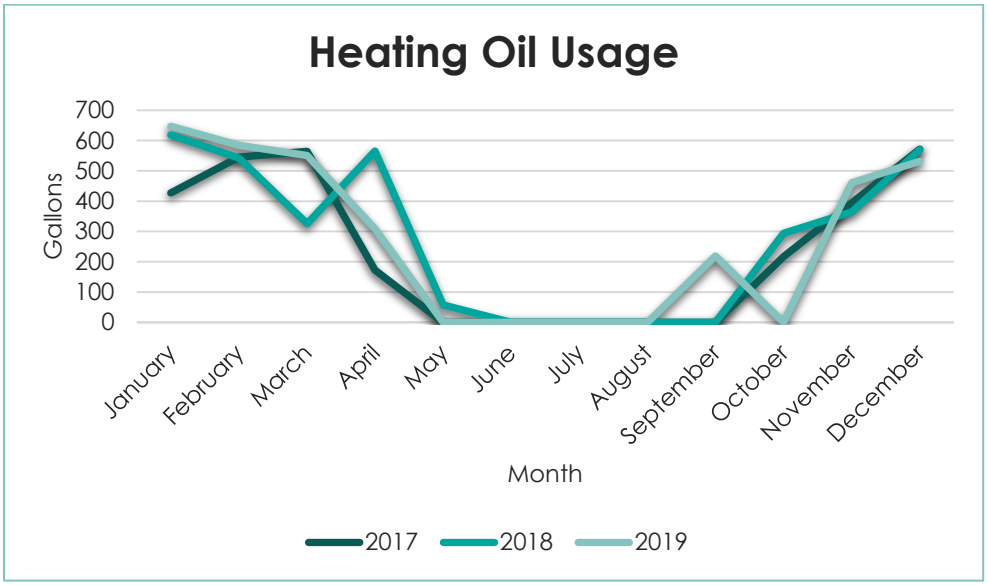
5.4. Utility Performance Summary by Fiscal Year

Examining the historical utility data of the building is a requirement of an ASHRAE Level II audit. The table below shows the electricity use for Town Hall from 2017 through 2019. The graph below visually represents the trend in energy consumption over these years.



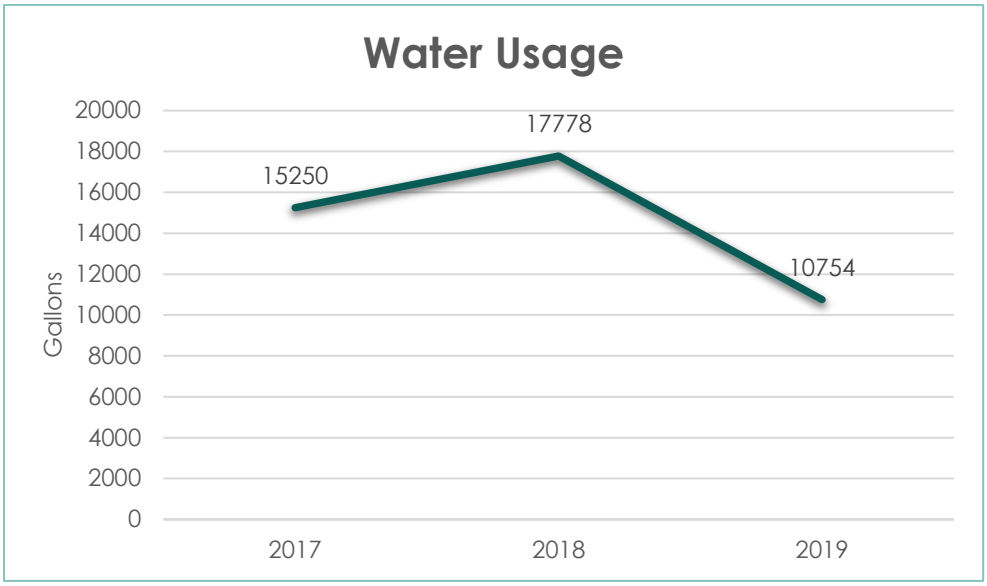
Electricity use at Town Hall has increased 13% between 2017 and 2019 with the most noticeable spike occurring in the months of January and February. February is a short month but also typically

one of the coldest. This increase in energy use most likely a result of increased HDD and corresponding electric space heater use.



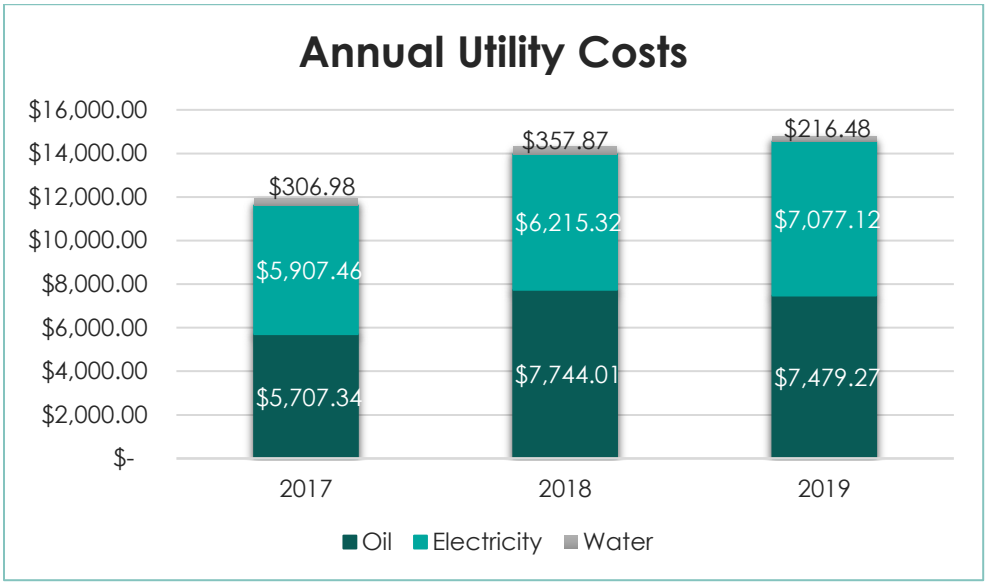
The table above shows the heating oil use for Town Hall from 2017 through 2019. Heating oil use trends are as one would expect. It is in heavy need during the colder months and not needed in the warm months. Overall heating oil use has increased by 14% since 2017. This is most likely a result of HDD increases over 2018 and 2019.

Water usage had been increasing until a low flow toilet was installed in 2018. This has cut the water demand by 29%. The table below shows water use from 2017 through 2019.

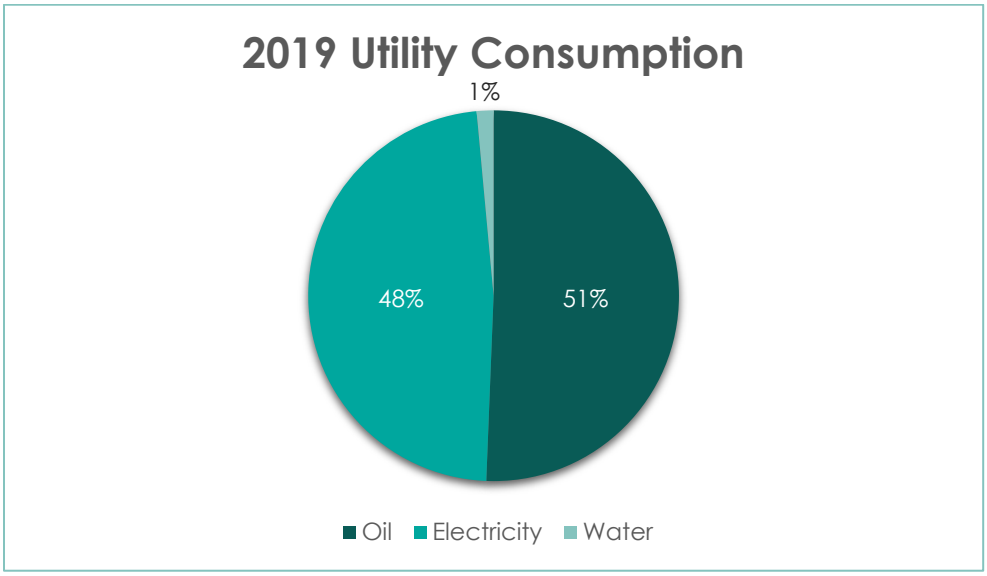


5.5. Utility Component Breakdown

In fiscal year (FY) 2018, Town Hall spent a total of $14,016.23 on all utilities including electricity, oil, and city water. The chart below proportionally illustrates the cost breakdown by utility category. 48% of the total utility cost was comprised of electricity while 51% of the total cost was oil. City water accounted for 1% of all utility cost. The table below shows the annual utility costs.

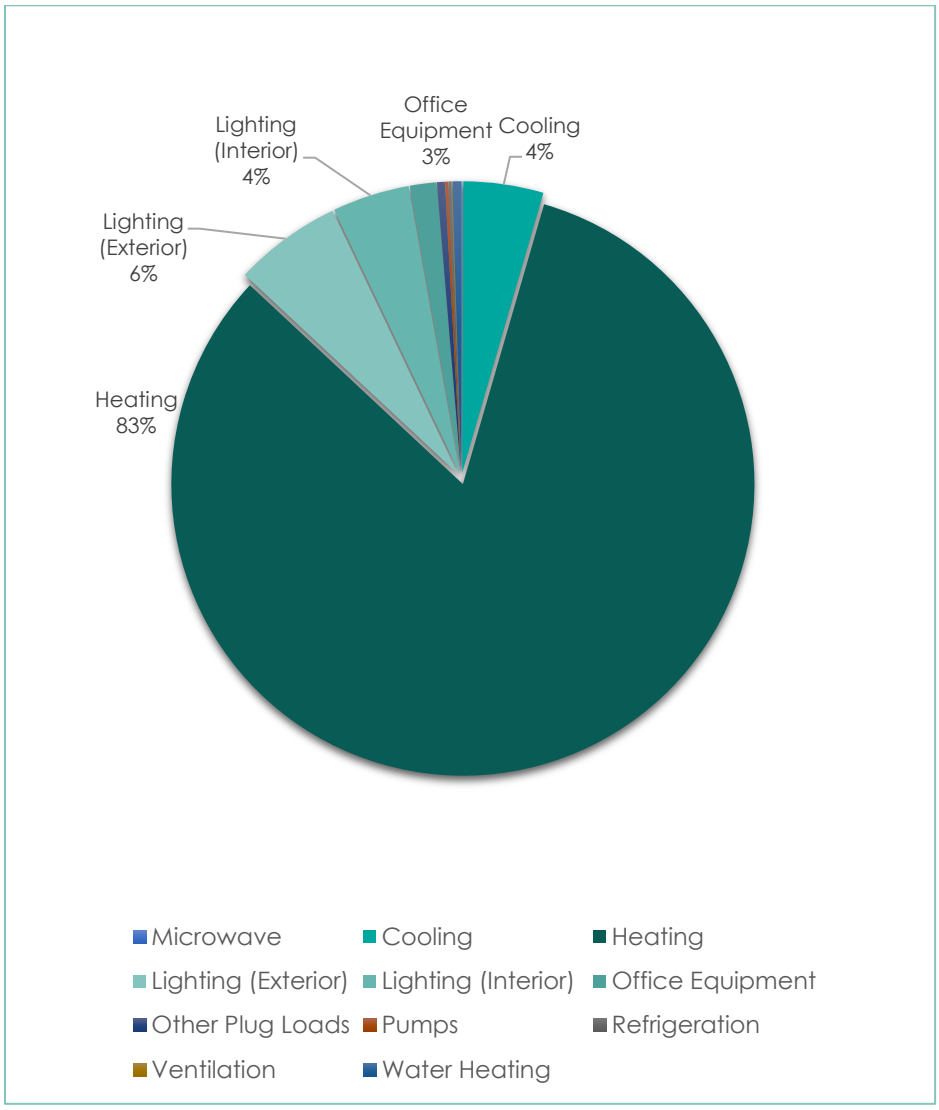


5.6. End Use Component Energy Usage Breakdown



The table above provides energy consumption end use breakdowns for Town Hall based on 2019 data. Since there are no sub meters to continuously measure electrical loads within Town Hall, the Team used some assumptions in order to estimate and then extrapolate annual distribution loads. The lighting load is based on a count of all the lighting fixtures and estimates of yearly runtime per fixture. The space cooling load is based on the ratings of the window air-conditioning units and the split system unit. The space heating consumption is equal to the oil and electrical space heating consumption at the building. The domestic hot water consumption is a result of the electric hot water heater at the building.

Town water was not included in this analysis since it is strictly a utility cost and is not considered a component of energy consumption by the building.



The total energy consumption is calculated by converting gallons of oil and kilowatt hours of electricity in British Thermal Units then multiplied by a "kilo" or 1,000 (kBtus). One kBtu is the amount of energy needed to raise the temperate of one pound of water by one degree Fahrenheit.

In 2019, Town Hall's total energy consumption was 587,824 kBtus of energy including electricity, and oil. The chart below proportionally illustrates energy use breakdown by utility category. Oil represents 78% of the total energy consumption while electricity represents 22%.

Heating consumes the most energy and comprises 83% of Town Hall's annual energy consumption in KBtu. This value includes the use of electric space heaters. The use of the heating equipment amounts to 65% of the building's annual energy cost. Interior and exterior lighting accounts for 10% of the annual energy consumption and comprises 20% of the annual energy cost. Cooling the office spaces equals 4% of the annual energy consumption and 9% of the annual budget. Office equipment (computers, microwave, refrigerator and water heater) accounts for 3% of the annual energy consumption and 6% of the annual budget.

Annual Energy Consumption by End Use Components 2019						
End Use	Electricity	Oil	Total	% of Total Use	Total Cost ($)	% of Total Cost
	kWh	Therms	kBtu			
Space Heating	10,213	4,559	490,749	83%	$9,286	65%
Lights	16,587		56,597	10%	$2,986	20%
Space Cooling	7,179		24,496	4%	$1,292	9%
Office Equipment*	3,838		13,096	3%	$872	5%
Domestic Hot Water	793		2,706	<1%	$146	1%
Total	**38,633**	**4,559**	**587,824**	**100%**	**$14,492**	**100%**
*Includes: Plug loads, refrigerator, fan motors, condensate pumps, and miscellaneous equipment.						

5.7. Energy Use & Cost Indices by Fiscal Year

Calculating historical energy usage on a square footage basis is a requirement of an ASHRAE Level II audit. The EUI information can be helpful in comparing energy intensity in buildings of similar space types in similar geographical locations on a per square footage basis. Additionally, the cost index can be helpful in comparing one buildings operation cost to that of similar buildings.

The table below displays the energy performance data in consumption and cost per square foot. The annual utility cost indices for Town Hall, in dollars per square foot, show the energy costs are increasing annually.

Energy Use and Cost Indices by Year		
Year	**Metric**	**Utility Data**
2019	Energy Utilization Index (kBtu/ft²/year)	93.14
	Energy Cost Index ($/ft2/year)	$2.31
	Utility Cost Index (Including City Water) ($/ft²/year)	$2.34
2018	Energy Utilization Index (kBtu/ft²/year)	85.4
	Energy Cost Index ($/ft2/year)	$2.21
	Utility Cost Index (Including City Water) ($/ft²/year)	$2.27
2017	Energy Utilization Index (kBtu/ft²/year)	80.0
	Energy Cost Index ($/ft2/year)	$1.84
	Utility Cost Index (Including City Water) ($/ft²/year)	$1.89

5.8. Electrical Demand

Review of electrical demand data is a requirement of an ASHRAE Level II audit. The table below illustrates the maximum electrical demand as well as demand per square foot. Demand charges are fees applied to the electric bills of commercial and industrial customers based upon the highest amount of power drawn during any (typically 15-minute) interval during the billing period.

Demand has been increasing over the past three years. The maximum demand for 2019 was slightly higher than previous years possibly due to occupant behavioral changes and increased building usage. The highest reading occurred in August 2017, February 2018, and 2019. The high reading in August is from electric cooling equipment and February increases a result of electric space heaters.

Electrical Demand 2017 through 2019		
Year	**Metric**	**Electrical Data**
2019	Maximum Demand (kW)	23.28
	Maximum Demand (watts/ft2)	3.7
2018	Maximum Demand (kW)	19.36
	Maximum Demand (watts/ft2)	3.1
2017	Maximum Demand (kW)	18.64
	Maximum Demand (watts/ft2)	3.0

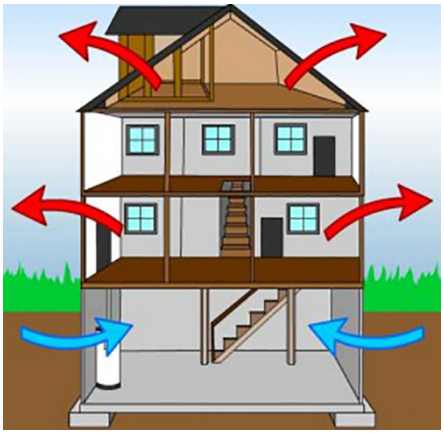
6. Phased Approach To Energy Savings

This section is an effort to help the Town of Rowley plan the adoption energy efficiency equipment and installation process. Securing funding through town budgets and grants can take extended periods of time for planning. As a result, by viewing the EEMs in a phased approach, the Town of Rowley can better predict the steps needed to execute the project installations.

6.1. Phased 1: Lighting, Weatherization and Heat Pump System

The Town of Rowley can harness a considerable savings by changing the interior and exterior lighting at Town Hall. This will reduce the wattage required to illuminate the facility common areas, office space and improve security around the building. LED lighting uses less wattage, provides increased lumens and does not require the maintenance that legacy lighting requires. It saves money in utility costs and in maintenance costs. Interior LED lighting also runs cooler and reduces the load on the air conditioning equipment.

The Town Hall should also focus on sealing the building envelope. This building provides a classic example of the stack effect, as there are open areas in the basement allowing outside air into the building and no insulation in the exterior walls or attic. In conditioned buildings the stack effect is warm air rises and looks to escape at the highest levels. This movement creates positive pressure at the tops of buildings and negative pressure to draw in cooler air at the lower levels of buildings. Somewhere in the middle of buildings there is a neutral pressure point. When trying to moderate buildings for heating and cooling it becomes important to create an effective thermal barrier at the top to have the greatest impact on combating the stack effect.



Stack Effect

A good way to understand the effective use of insulation is to think of the building as one would think of a boat. If a boat were taking on water and mechanical equipment, such as a pump system was used to remove the water, you would want to fix the leaks before spending money to increase the water removal equipment. Sizing heating and cooling equipment in a building is no different. Focusing on the areas of loss allow the mechanical equipment to be properly sized, which will save in equipment and installation costs, and reduce the load on the energy system required to power the pump. This also has a great effect on reducing the facilities carbon footprint.

After the attic and the basement for the building is properly insulated the Town of Rowley should install a variable refrigerant flow ductless (VRF) heat pump. There are different options for this system, but they all provide air conditioning in the form of heating and cooling for the building.

Town Hall would be a good fit for a multi-zone, ductless, ceiling suspended, mini-split system. This system would effectively heat the space even during minus 13 (thirteen) degrees Fahrenheit and cool the space on the hottest summer days. A system for Town Hall would cost approximately $43,500, (equipment and the installation). This energy efficient system would be the primary heat and cooling source for the building. The oil system would remain as a back up system used during electricity outages and for days where the temperature drops below -13 degrees Fahrenheit.

Solar Array with mini-split system

Based on the remaining useful life of the existing oil boiler, steam generating system, this would be a preferred alternative for replacement. To replace the existing oil burner, it would cost roughly $20,000. This a result of the labor required to disassemble the existing oil boiler system prior to removal.

6.2. Phase 2: Insulate Building Walls

The building walls for Town Hall should be insulated with a spray technology to fill in the areas between the inside wall and outside wall. This will help to seal the building envelope and create a neutral pressure point in the building where the offices and meeting rooms are located.

6.3. Replace access doors, solar array on roof

The remaining ECMs needed to seal the building envelope is the replacement of the north and west access doors should. While the front access doors are under construction the vestibule walls should be insulated.

The Town Hall has an ideal roof setting to install solar panels. The back of the building is south facing and has no shading from trees or nearby buildings. It captures the most sunlight allowed. In addition, it is thirty to forty (30 – 40) feet above ground surface resulting in low visibility of the solar panels. This could be important if the Rowley Town Hall is located in a historic district. A 15 kW direct current (DC) system would produce approximately 18,000 kWh and cost around $42,000. This would account for roughly half of the 2019 electricity needs for Town Hall. The simple return on investment (ROI) is estimated to be around 12 years with a life expectancy of 30 years.

Appendices

A. Project Pictures

Entry door with transom window – thermal image

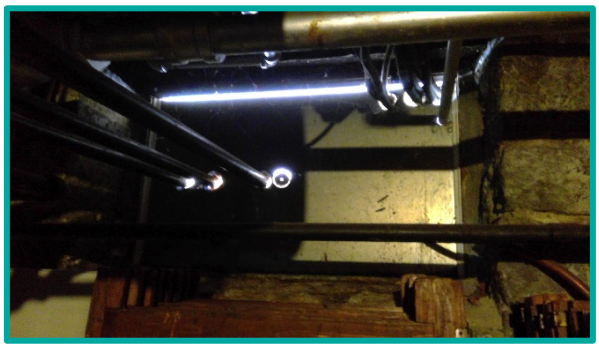
Front Vestibule – thermal image

Town Hall exterior – thermal image

No Attic Insulation

Attic Void

Basement louvered window



Basement Conduit and chases

Outside conduit and chases

Basement door

No insulation in basement ceiling

Second floor window transoms

Second floor single pane window

Four Foot Wrap Fixture

Second Floor Meeting Hall

Exterior Area Flood

Parking Lot Fixture

Recessed Can – 2nd floor meeting hall

B. Lighting Audit Data

Customer Info	Town of Rowley
Company Name	Rowley Town Hall
Address	139 Main Street
City	Rowley
State	MA
Zip	01969

Contact name	Natalie Lovett
Phone	
Email	
Account #, if known	

Vendor Info	
Company Name	Firefly EES, Inc
Address	18 Hart Road
City	Lynnfield
State	MA
Zip	01940

Contact Name	Scott Gromko
Phone	
Email	

Rowley Municipal	
kWh Rate	$0.18
Sensor Tech Hours Reduction	
0.68	

Existing						Proposed					Savings and Incentives							
Location	Qty	Desc. (# and type of lamps, type of fixture)	Watts (if known)	Ann. Hrs. Use	Qty	Desc. (# and type of lamps, type of fixture)	Watts	Control Type to be added (if any)	Ann. Hrs. Use	Ann. kWh Savings	Ann. $ Savings	Existng kWh	Rebate Each	Total Rebate	Unit Cost	Estimated Labor Unit Cost	Estimated Material Cost	Estimated Labor Cost**
Exterior - Parking Lot	3	Pole Light	205	4368	3	Corn Cobb	50		4368	2,031.12	$365.60	2686.32	$60.00	$180.00	$50.00	$35.00	$150.00	$105.00
Exterior - Building	3	Area Flood	205	4368	3	Area Flood	50		4368	2,031.12	$365.60	2686.32	$50.00	$150.00	$75.00	$50.00	$225.00	$150.00
Exterior - Building	1	Canopy	205	4368	1	Area Flood	50		4368	677.04	$121.87	895.44	$50.00	$50.00	$75.00	$35.00	$75.00	$35.00
Exterior Front	2	Area Flood	205	4368	2	Area Flood	50		4368	1,354.08	$243.73	1790.88	$50.00	$100.00	$75.00	$50.00	$150.00	$100.00
Main Hallway	9	4 ft wrap - T12	80	2210	9	LED BarKit	20		2210	1,193.40	$214.81	1591.2	$0.00	$0.00	$25.00	$30.00	$225.00	$270.00
Bathroom	2	Drum - cfl	30	1800	2	LED A19	8		1800	79.20	$14.26	108	$0.00	$0.00	$8.00	$5.00	$16.00	$10.00
Town Clerk	4	4 ft wrap - T8	52	2002	4	LED BarKit	20		2002	256.26	$46.13	416.416	$15.00	$60.00	$25.00	$30.00	$100.00	$120.00
Treasurer Collector	4	4 ft wrap - T8	52	2210	4	LED BarKit	20		2210	282.88	$50.92	459.68	$15.00	$60.00	$25.00	$30.00	$100.00	$120.00
Treasurer Collector Office	4	4 ft wrap - T8	52	2210	4	LED BarKit	20		2210	282.88	$50.92	459.68	$15.00	$60.00	$25.00	$30.00	$100.00	$120.00
Assessors	9	4ft wrap - T8	52	1846	9	LED BarKit	20		1846	531.65	$95.70	863.928	$15.00	$135.00	$25.00	$30.00	$225.00	$270.00
Principal Assessor	1	2x4 - T8	52	1846	1	2x4 Retrofit Kit	25	Fixture	1384.5	61.38	$11.05	95.992	$85.00	$85.00	$125.00	$35.00	$125.00	$35.00
Selectman Office Entrance	4	2x4 - T8	52	1846	4	2x4 Retrofit Kit	25	Fixture	1384.5	245.52	$44.19	383.968	$85.00	$340.00	$125.00	$ 35.00	$500.00	$140.00
Selectman Office	2	2x4 - T8	52	1846	2	2x4 Retrofit Kit	25	Fixture	1384.5	122.76	$22.10	191.984	$85.00	$170.00	$125.00	$35.00	$250.00	$70.00
Amy Lydon Office	1	Drum - cfl	30	1846	1	LIVC Drum	14	Fixture	1846	29.54	$5.32	55.38	$0.00	$0.00	$50.00	$30.00	$50.00	$30.00
Storage Hall	1	Keyless Socket	25	500	1	LED A19	8		500	8.50	$1.53	12.5	$3.00	$3.00	$8.00	$5.00	$8.00	$5.00
Exit Hallway	3	Keyless Socket	25	500	3	LED A19	8		500	25.50	$4.59	37.5	$3.00	$9.00	$8.00	$5.00	$24.00	$15.00

Mail Room	1	2x4 - T8	52	500	1	LED BarKit	20		500	16.00	$2.88	26	$15.00	$15.00	$25.00	$30.00	$25.00	$30.00
Stairs to Second Floor	2	Decorative Wall	60	500	2	No Change	60		500	-	$0.00	60	$0.00	$0.00			$-	$ -
Second Floor Entry	1	Decorative Hanging	60	500	1	No Change	60		500	-	$0.00	30	$0.00	$0.00			$-	$ -
Second floor Meeting room	4	Decorative Hanging	60	500	4	No Change	60		500	-	$0.00	120	$0.00	$0.00			$-	$ -
Second floor Meeting room	1	Second floor Meeting room	60	500	1	No Change	60		500	-	$0.00	30	$0.00	$0.00			$-	$ -
Second floor Meeting room	4	Decorative Wall	60	500	4	No Change	60		500	-	$0.00	120	$0.00	$0.00			$-	$-
Second floor Meeting room	16	10" Recessed Can	205	500	16	10" Replacement	26		500	1,432.00	$257.76	1640	$15.00	$240.00	$100.00	$50.00	$1,600.00	$800.00
Second Floor Office	1	4 ft wrap	52	2000	1	LED BarKit	20		2000	64.00	$11.52	104	$0.00	$0.00	$25.00	$30.00	$25.00	$30.00
Balcony Stairs to third flr	1	Decorative Hanging	60	100	1	No Change	60		100	-	$0.00	6	$0.00	$0.00			$ -	$ -
Balcony - third flr	3	Decorative Drum	60	100	3	LED A19	8		100	15.60	$2.81	18	$3.00	$9.00	$8.00	$5.00	$24.00	$15.00
Back Stars to Balcony	1	Decorative Drum	60	100	1	LED A19	8		100	5.20	$0.94	6	$3.00	$3.00	$8.00	$5.00	$8.00	$5.00
Electric Panel Room	1	Keyless Socket	60	100	1	LED A19	8		100	5.20	$0.94	6	$3.00	$3.00	$8.00	$5.00	$8.00	$5.00
Second floor Elevator	1	4ft wrap - T12	34	100	1	LED Barkit	10		100	2.40	$0.43	3.4	$15.00	$15.00	$25.00	$30.00	$25.00	$30.00
Second floor stage	1	Decorative Hanging	60	100	1	No Change	60		100	-	$0.00	6	$0.00	$0.00			$-	$-
Second floor stage	1	Keyless Socket	60	100	1	No Change	60		100	-	$0.00	6	$0.00	$0.00			$-	$-
Basement	11	Keyless Socket	25	100	11	LED A19	8		100	18.70	$3.37	27.5	$3.00	$33.00	$8.00	$5.00	$88.00	$55.00
Basement	3	4 ft wrap	52	100	3	LED BarKit	20		100	9.60	$1.73	15.6	$15.00	$45.00	$25.00	$30.00	$75.00	$90.00
Basement - network room	4	4 ft wrap - T8	52	100	4	LED BarKit	20		100	12.80	$2.30	20.8	$15.00	$60.00	$25.00	$30.00	$100.00	$120.00
Basement	2	2x4 - T8	52	100	2	LED BarKit	20		100	6.40	$1.15	10.4	$15.00	$30.00	$25.00	$30.00	$50.00	$60.00
Basement	1	4 ft strip	52	100	1	LED Barkit	10		100	4.20	$0.76	5.2	$15.00	$15.00	$25.00	$30.00	$25.00	$30.00
Basement	1	Water Heater	1650	500	1		1650		500	-	$0.00	825	$0.00	$0.00			$-	$-
1st Floor	1	Split System								-	$0.00	0	$0.00	$0.00			$-	$-
										10,804.92	$1,944.88	15821.088			Total	$1,870.00	$4,376.00	$2,865.00
															Exterior	$480.00	**Total**	**$7,241.00**
															Interior	$1,390.00	Exterior	$990.00
																	Interior	$6,251.00

**** does not assume prevailing wage rates**

C. EEM Assumptions & Calculations

Energy Use Assumptions

Utility	Phase 1 Baseline (FY 2018)	Phase 2 (FY 2018 minus Phase 1 savings)	Phase 2 (FY 2018 minus Phase 1 and Phase 2 savings)
Oil	3,286 gallons	2,362 Gallons	2,310 Gallons
Electricity	36,549 kWh	22,897 kWh	22,668 kWh

Personal space heater electricity not included in savings for an added level of conservatism:
Equipment = 6.3 amps x 208V = 1310.4 watts
1310.4 watts / 1000 = 1.31 kWh
1.31 kWh x 8 hours = 10.48 kWh per day
10.48 kWh per day x 5 days = 52.42 kWh per week
52.42 kWh x 4.33 weeks = 226.96 kWh per month
226.96 x 5 months = 1,134.8 kWh (adjusted annual use)
9 space heaters X 1,134.8 = 10,213.25 kWh
The electric space heaters are not included in savings calculations. Included for future calculations.

EEM 1 – Replace Interior Lighting with LED alternative

First Floor Legacy Lighting Assumptions		
Location	**Est. Annual Hours**	**Est. Annual kWh**
Town Hall Hallway	2210	1591
Town Clerk Department	1800	416
Treasurer Department	2210	460
Assessors Department	1846	864
Assessor's Office	1846	96
Selectman Department	1846	384
Selectman Office	1846	192
Selectman Support Office	1846	55
Bathroom	1800	108
Storage Areas	500	76
Total		4187
Days per year	261	

First Floor LED Lighting Assumptions			
Location	**Est. Annual Hours**	**Est. Annual kWh Savings**	**Est. Savings**
Town Hall Hallway	2210	1193	$244
Town Clerk Department	1800	256	$46

Treasurer Department	2210	566	$102
Assessors Department	1846	531	$96
Assessor's Office *	1385	61	$11
Selectman Department *	1385	246	$44
Selectman Office *	1385	123	$22
Selectman Support Office	1846	30	$5
Bathroom	1800	79	$14
Storage Areas	500	50	$9
Total		3135	$593
Rowley Municipal kWh rate	$0.18		

***LED fixture with sensor reduces existing hours by 32%**

Second Floor Legacy Lighting Assumptions		
Location	**Est. Annual Hours**	**Est. Annual kWh**
Decorative Wall and Hanging Stairs	500	300
Meeting Hall	500	1640
Accounting Dept	2000	104
Balcony Stairs	100	6
Balcony	100	24
Balcony/Stage Decorative Hanging	100	12
Keyless Sockets	100	35
Elevator	100	3
Total		2124

Second Floor LED Lighting Assumptions			
Location	**Est. Annual Hours**	**Est. Annual kWh Savings**	**Est. Savings**
Decorative Wall and Hanging Stairs**	500	0	$0
Meeting Hall	500	1432	$258
Accounting Dept	2000	64	$12
Back Balcony Stairs	100	6	$1
Balcony	100	16	$3
Balcony/Stage Decorative Hanging**	100	0	$0
Keyless Sockets	100	24	$4
Elevator	100	2	$0.50
Total		1544	$278.50

Rowley Municipal kWh rate	$0.18		

**** LED Replacement not available**

Basement Legacy Lighting Assumptions		
Location	**Est. Annual Hours**	**Est. Annual kWh**
Keyless Sockets	100	28
Strip Fixtures	100	52
Total		80

Basement LED Lighting Assumptions			
Location	**Est. Annual Hours**	**Est. Annual kWh Savings**	**Est. Savings**
Keyless Socket	100	13	$3
Strip Fixtures	100	33	$6
Total		66	$9
Rowley Municipal kWh rate	$0.18		

Equation	
((Qty*Existing Watts)*Annual Hours))/1000	Annual kWh

AC Savings based on LED running cooler than traditional lighting:

- Step 1: Calculate Total Annual Inside Lighting Energy Savings = 3,453 kWh
- Step 2: Calculate Percentage of year the cooling operates (4.6 months) = 38%
- Step 3: Calculate Energy Savings (kWh) from reduced HVAC load (33%) = 437 kWh
- Step 4: Calculate dollar savings from reduced HVAC load = $78.62

kWh Rate: $0.18

EEM 2 – Replace Exterior Lighting with LED Replacements

Exterior Legacy Lighting Assumptions		
Location	**Est. Annual Hours**	**Est. Annual kWh**
Parking Lot – Pole Lights	4368	2686
Building Area Flood	4368	4477
Building Canopy	4368	895
Total		

Equation	
((Qty*Existing Watts)*Annual Hours))/1000	Annual kWh

Basement LED Lighting Assumptions			
Location	Est. Annual Hours	Est. Annual kWh Savings	Est. Savings
Parking Lot – Pole Lights	4368	2031	$366
Building - Area Flood	4368	3385	$610
Building Canopy	4368	677	$122
Total		66	$1098
Rowley Municipal kWh rate	$0.18		

Equation	
((Qty*Existing Watts)*Annual Hours))/1000 – (Qty*LED Watts)*Annual Hours))/1000	Electricity Savings

EEM 3 –Install programable thermostats

FY 2018 Oil Purchased = 3286 gallons: Assume 1 day per month thermostat not turned down = 109.63 gallons per year. Conservative factor of 0.5 to adjust for heat being on and set at 63 degrees during nonworking hours = Gallons saved by programable thermostats = 54 gallons
54 gallons X 1.38907 therms per gallon = 75 therms

EEM 4 – Install insulated door & wall insulation to separate boiler room from basement

Oil Heat reduction:
70 gallons of oil = 2% of 2019 total gallons of 3,286
1 gallon [U.S.] of distillate no. 2 fuel oil to therm [U.S.] = 1.38907 therm [U.S.]
97 therms

Air conditioning Annual: Panasonic Split System:
1.8 ton/21600 kWh = 2.16 kW
2.16 kW x 10 hours = 21.6 kWh.
21.6 kWh x 5 days per week = 108 kWh
4.33 avg days per week x 108 kWh = 467.64 kWh per month
5 months x 519 kWh = 2,338.2 kWh (adjusted annual use)

Air conditioning reduction: Window Units and Panasonic Split System:
9.2 Amps X 115V = 1,058 watts
1058 watts / 1000 = 1.058 kwh
1.058 kWh x 10 hours = 10.58 kWh per day
10.58 X 5 = 52.9 kwh per week
52.9 kWh X 4.33 weeks = 229.057 kWh p/month
229.057 x 5 months = 1,145.28 per year
4 Window AC x 1,145.2 = 4,581.14 kWh (adjusted annual use)
Total AC kWh use = 4,581.14 kWh (window units) + 2,338.2 kWh (split system) = 6,919.34 kWh
6,919.34 X 3% reduction = 207.58 kWh

EEM 5 – Replace Basement Door with insulated, weather stripped door

Oil Heat Reduction:
20 gallons of oil = 1% of 2019 total gallons of 3,286
1 gallon [U.S.] of distillate no. 2 fuel oil to therm [U.S.] = 1.38907 therm [U.S.]
20 gallons * 1.38907 = 28 therms

Air conditioning reduction: See EEM 4 for Annual Use Calculations
Window Units and Panasonic Split System:
Total AC kWh use = 4,581.14 kWh (window units) + 2,338.2 kWh (split system) = 6,919.34
6,919.34 X 3% reduction = 207.58 kWh

EEM 6 – Air Seal Attic 1" closed cell foam and install 2 layers of (Cross Batt) R25 Fiberglass Insulation

Oil Heat Reduction:
406 gallons of oil = 13% of 2019 total gallons of 3,286
1 gallon [U.S.] of distillate no. 2 fuel oil to therm [U.S.] = 1.38907 therm [U.S.]
406 gallons * 1.38907 = 564 therms

Air conditioning reduction: See EEM 4 for annual use calculation
Total AC kWh use = 4,581.14 kWh (window units) + 2,338.2 kWh (split system) = 6,919.34
6,919.34 X 10% reduction = 691.93 kWh

EEM 7 – Install VRV Heating and Cooling System

Oil Heat Reduction:
2,600 gallons of oil = 79% of 2019 total gallons of 3,286
1 gallon [U.S.] of distillate no. 2 fuel oil to therm [U.S.] = 1.38907 therm [U.S.]
2600 gallons * 1.38907 = 3,612 therms

Air conditioning reduction: See EEM 4 for annual use calculations
Total AC kWh use = 4,581.14 kWh (window units) + 2,338.2 kWh (split system) = 6,919.34
6,919.34 X 100% reduction = 6919.34 kWh

VRV estimated kWh for heating:
2600 gallons of oil saved. It is estimated the backup oil heat system will be used in combination with VRV during the coldest days (below minus 13 Fahrenheit). A total of 433 gallons of oil would be purchased annually. This will help to prevent settling of the oil in the storage tank.

Increase in electricity use = 33,694 kWh to heat plus 8,759 kWh to cool the work space on 1st and 2nd floor. The VRV operates more efficiently to heat and cool the space and would remove the estimated 6,919 kWh from the existing air conditioning use. This would result in a total kWh increase of 35,553 kWh * $0.183 = $6,506.20.

$5,876 (oil savings) - $6,506.20 (electricity increase) = $630.20 annual increase.

EEM 8 – Spray rim of floor frame (R20) and foundation walls (R15) closed cell foam, encapsulate with thermal barrier paint

Oil Heat Reduction:
435 gallons of oil = 14% of 2019 total gallons of 3,286
1 gallon [U.S.] of distillate no. 2 fuel oil to therm [U.S.] = 1.38907 therm [U.S.]
435 gallons * 1.38907 = 604 therms

Air conditioning reduction: See EEM 4 for annual use calculation

Total AC kWh use = 4,581.14 kWh (window units) + 2,338.2 kWh (split system) = 6,919.34
6,919.34 X 10% reduction = 691.93 kWh

EEM 9 – Spray Foam Exterior Building Walls

Oil Heat Reduction:
345 gallons of oil = 15% of FY 2018 after Phase 1 savings is estimated to be total gallons of 2,362
1 gallon [U.S.] of distillate no. 2 fuel oil to therm [U.S.] = 1.38907 therm [U.S.]
504 gallons * 1.38907 = 700 therms

Air conditioning reduction: See EEM 4 for annual use calculation
Total AC kWh use = 4,581.14 kWh (window units) + 2,338.2 kWh (split system) = 6,919.34
6,919.34 X 15% reduction = 1,037.90 kWh

EEM 10 –Strip bookcases on office side of vestibule and insulate with rigid foam board

Oil Heat Reduction:
52 gallons of oil = 2% of FY 2018 after Phase 1 and Phase 2 savings (2, 310 total gallons)
1 gallon [U.S.] of distillate no. 2 fuel oil to therm [U.S.] = 1.38907 therm [U.S.]
52 gallons * 1.38907 = 48 therms

Air conditioning reduction: Window Units Only:
9.2 Amps X 115V = 1,058 watts
1058 watts / 1000 = 1.058 kwh
1.058 kWh x 10 hours = 10.58 kWh per day
10.58 X 5 = 52.9 kwh per week
52.9 kWh X 4.33 weeks = 229.057 kWh p/month
229.057 x 5 months = 1,145.28 per year
2 Window AC x 1,145.2 =2,290.56 kWh (adjusted annual use)
2,290.56 X 10% reduction =229.06 kWh

ECR 11 – Replace access doors with insulated, weather stripped doors, install storm panel on all single glazed windows

Space Heater Reduction: See EEM 4 for annual use calculation.
Replace access doors, storm windows = 1,134.8 (annual single space heater kWh) *0.05 (5%) * 9 = 510.66 kWh

Oil Heat Reduction:
35 gallons of oil = 2% of FY 2018 after Phase 1 and Phase 2 savings = 2, 310 total gallons
1 gallon [U.S.] of distillate no. 2 fuel oil to therm [U.S.] = 1.38907 therm [U.S.]
74 gallons * 1.38907 = 103 therms

Air conditioning reduction: See EEM 4 for annual use calculation
Total AC kWh use = 4,581.14 kWh (window units) + 2,338.2 kWh (split system) = 6,919.34
6,919.34 X 3% reduction = 207.58 kWh

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ASHRAE Level II Energy Audit

Rowley Highway Garage Offices, 40 Independent Street
Rowley, MA 01969
December 2, 2020

Table of Contents

1. Executive Summary

The Town of Rowley contracted with Firefly Energy Efficiency Services, Inc (Firefly EES) to conduct an energy audit of the subject property, Rowley Highway Garage Offices, located at 40 Independent Street, Rowley, Massachusetts 01969. The audit consisted of a building evaluation aimed at 1) assessing the overall energy usage of the building and its on-site systems, 2) identifying potential energy areas of improvement in these systems, and 3) where applicable, proposing "clean energy" alternatives to the current systems where future energy savings could be realized. Included as part of the audit was a review of the building's construction features, its historical energy costs, discussions with the local utilities concerning the property's energy usage, and discussions with the prime energy equipment suppliers/manufactures for the purpose of determining more efficient alternatives.

This audit meets the Level II requirements established by ASHRAE. As a result, this report includes the following: a historical analysis of all building utility consumption (electricity, natural gas, and city water); specific efficiency improvement recommendations for each of the primary building systems (HVAC equipment, weatherization, lighting, plug loads, and domestic water heating); and a detailed financial analysis of each recommendation, which includes the Savings to Investment Ratio (SIR) based on life cycle costs and using contractor-provided pricing for full installation. This comprehensive approach uses structured techniques to provide a valuable framework for substantial and measurable utilities savings.

Key Audit Findings:

- In 2019, the Highway Garage spent $10,136.68 on all utilities
- Nine (9) separate Energy Efficiency Measures (EEMs) identified
- Annualized savings for of all EEMs totals $5,053.00 (50% reduction at current energy prices)

Recommendations:

- Replacing interior lighting with LED technology and motion sensors
- Install storm windows, replace access door and garage door weather stripping
- Insulate hot water tank, building walls and attic
- Install heat pump and cooling equipment
- Consider installing photovoltaic renewable energy source on south facing roof

This audit demonstrates the potential for the Highway Garage Offices to serve as a model of sustainable building operations and resource conservation to the town. To that end, the Audit Team hopes this report proves to be a useful decision-making tool in considering sustainable building operation strategies. We believe that with continued collaboration, the Highway Garage Offices can make significant progress toward the goal of ensuring a sustainable, healthy, and energy-efficient building.

Rowley Highway Maintenance Energy Efficiency Measures						
EEM #	EEM Title	Reason for Evaluation	Approx. Annual Savings	Net Costs	SIR	Simple Payback Years
1	Install Water Heater Thermal Blanket	Inefficient Insulation	$60	$120	10.02	2.00
2	Replace Interior Lighting with LED alternative	Inefficient lighting	$1,528	$4,569	6.69	2.99
3	Install Programable Thermostats	Inefficient HVAC Equipment	$286	$100	57.21	0.35
4	Install Storm Windows over existing windows	Inefficient weatherization	$381	$2,925	2.61	7.67
5	Replace Access Door	Inefficient weatherization	$165	$1,750	1.89	10.58
6	Replace Weather Stripping on Garage Doors	Inefficient weatherization	$351	$1,250	3.56	3.50
7	Install 2" closed cell foam on Masonry Walls (R15) and encapsulate with thermal barrier paint	Inefficient weatherization	$1,082	$21,456	1.01	19.83
8	Air seal attic 1" closed cell foam, tape and mud joints in ceiling, Install R19 fiberglass in ceiling and cross batt with R30 (R19 Total)	Inefficient weatherization	$1,169	$37,988	0.62	32.50
9	Install Heat Pump System for Heating and Cooling office and break areas	Inefficient HVAC Equipment	$31	$9,560	0.06	306.32
		Total	**$5,053**	**$84,524**	**1.20**	**48.23**

SIR = Savings multiplied by useful product life divided by project costs. Ex. ($60 x 20 years)/$120 = 10.00. The SIR for a project must have a savings-to-investment ration of at least 1 to pay for itself.

Simple Payment = Net Costs/annual savings

2. Background

Rowley Highway Garage Offices (Highway Garage Offices) has one office, a breakroom, bathroom, and lounge (common area) which is approximately 500 square feet and separated from the garage which serves as storage and repair space for vehicles and equipment necessary to maintain Town of Rowley roadways. Built in 1960, the building is owned and operated by the Town of Rowley. The Highway Garage Offices has a total of four garage doors that allow inside storage for trucks and equipment. The building has one (1) floor above grade and an unoccupied mezzanine level for file storage. The mezzanine is located above the common area. The entire building offers approximately 6,200 square feet of space.

2.1. Space Types

The main level/first floor at the Highway Garage Offices has one office, a bathroom, a lounge, and breakroom (common areas). There is a mezzanine area above the common area used for file storage. This area is not used as office space. The remaining area of the building is used for vehicle and maintenance equipment storage. There is no basement level.

2.2. Occupancy & Use Schedules

The office space and common areas at the Highway Garage Offices are rarely occupied during work hours by the staff of the building. The manager is periodically in the office, while the crew is out maintaining roadways. Payback calculations for efficiency projects included seven (7) full-time employees. There are periods during the winter months, mostly during snowstorms, when the crew will work long shifts on snow removal duties. In addition, the Town of Rowley periodically holds town events, such as household hazardous wastes collections at the Highway Garage Offices. These occupancy patterns are leveraged in the energy conservation strategies included in this report. The chart below represents the typical occupancy by space type.

Highway Garage Offices Occupancy Schedules							
Space Type	**Mon**	**Tues**	**Wed**	**Thurs**	**Friday**	**Sat**	**Sun**
Highway Maintenance	7am - 3pm	7am - 3pm	7am - 3pm	7am - 3pm	7am - 3pm	Closed	

2.3. Recent Building System Upgrades & Existing Conditions

There have been a few upgrades at the Highway Garage Offices. A review shows newer windows for the office, a newer electric water heater and a low flow toilet.

Heating

The Highway Garage Offices heating is served by natural gas heaters and electric base boards. The natural gas system replaced the forced hot air oil burner system for the garage bays roughly 10 years ago. The electric baseboard heating system serves the common area.

Cooling

The office is cooled by a window unit air conditioner. The remaining Highway Garage Office facility does not have cooling equipment.

Ventilation

The windows in the office and bathroom are operable. The office windows have screens. The garage bays have large garage doors that can be used to provide outside air and natural ventilation. The windows in the rear of the garage building do not have screens and are operable to allow for ventilation.

Building Automation Controls

The Highway Garage Offices does not have building automation controls other than the natural gas generator that will automatically power the facility during electrical power loss.

Lighting

The lighting at the facility is comprised primarily of fluorescent lamps in the garage area and common area. There is one cobra head light on the salt shack in the maintenance yard that has been converted to LED.

The building lighting is primarily provided by T5, T8, T12 linear fluorescent technology. The common area, and mezzanine lighting consists of either two (2) 32-watt linear (T8) or two (2) 40-watt four foot (T12), fluorescent lamps with magnetic ballasts. The lounge has A19, 60-watt lamps in decorative drum fixtures. The bathroom has A19, LED lamps. All lighting in the building is manually controlled by wall mounted switches. See Appendix A for pictures and Appendix B for additional information from the lighting audit.

Plumbing

The toilet fixture at Highway Garage Offices is a low flow 1.28 gallon per flush toilet. The bathroom sink is fitted with efficient 0.5 gallon per minute (gpm) faucet aerators. There is a sink in the garage area and hose spickets for washing down equipment.

Electrical

The electrical supply is 120/240 volt single phase three-wire service. The building has a single utility meter. There is a generator that runs on natural gas to offer power to the building during outages.

Building Envelope

The main access points to the building are a single entry, glass panel door that measures thirty-six inches (36) wide by eighty three (83) inches tall and four (4) garage doors. The metal sash fits poorly around the single-entry door and does not make a tight seal. The garage doors to allow for inside storage of maintenance vehicles and equipment. Two (2) of the garage doors measure

fourteen (14) feet tall, fourteen (14) feet wide and two (2) inches thick and two (2) garage doors a slightly smaller measuring twelve (12) feet tall by twelve (12) feet wide and two (2) inches thick. On the first garage door (nearest Independent Street) there are two (2) rollers off the track which present a safety issue. The last garage door has a broken window with sign material used to cover the opening.

A majority of the windows in the building are found in the garage area and measure forty-nine (49) inches wide by sixty-five (65) inches tall. These appear to be original (1960) and allow natural light into space. They are single glazed, frosted glass. The small office has double pane windows that measure forty-one (41) inches by forty-five (45) inches tall. The bathroom has one window measuring forty (40) inches by seventeen (17) inches. The building exterior walls are cinder block for approximately fifteen (15) feet above ground surface then asphalt shingles to a pitched roof on the front and back of the building. The sides of the building are also fifteen feet (15) of cinder block then wood frame with siding in a triangular pattern creating a peak height of twenty-six (26) feet. The attic space has no insulation in the ceiling frames and no insulation in the roof frame cavities. The ceiling has numerous penetrations from equipment such as lighting and unused duct work. Pictures are provided in Appendix A.

Domestic Hot Water

Domestic hot water (DHW) is supplied by one (1) State Select® 40-gallon free-standing electric water heater. DHW in the tanks is maintained at 125°F and used for the bathroom sink faucet, kitchen sink and maintenance sink in one of the garage bays.

2.4. Renewable Energy Assessment

As part of the auditing process the team examined the possibility of adding renewable energy technologies at the Highway Garage Offices which includes: solar photovoltaic (PV), solar hot water, small scale wind, and cogeneration systems. This analysis is meant to provide general information regarding existing conditions at Highway Garage Offices and is not meant to serve as a guarantee regarding the feasibility of installing any of these systems.

Solar PV: Highway Garage Offices has a pitched roof that could be used to install solar panels. The roof will allow for panels to be oriented to the southern direction to maximize the exposure to the sun. There are no surrounding buildings or trees that would create shading effects. The estimated payback for this system is 12 years.

Solar Hot Water: The roof at the Highway Garage Offices would make it a possible candidate for a solar hot water installation, however the need and use of hot water at the building is very low. This creates a long payback for this system.

Small Scale Wind: Due to the urban location of Highway Garage Offices small scale wind turbines would likely not be feasible due to inconsistent wind flows and moderate population density. The wind turbines generate noise which may be disruptive to the people in the area. Additionally, the flickering shading effect caused by the spinning blades may also be a disturbance to people in the area.

Cogeneration: Highway Garage Offices does not have opportunities for cogeneration at the building due to its relatively small heat load.

2.5. Energy Use Index & Benchmarks

The chart below summarizes the current, as well as the historical energy use indexes (EUI) and utility costs of Highway Garage Offices. Since city water is not considered an energy use, it is not included in the calculation of the EUI and is not included in the total energy cost per square foot calculation.

ENERGY STAR Rating

The Highway Garage Offices' office space is recognized by the Environmental Protection Agency (EPA) ENERGY STAR Portfolio Manager Program. According to EPA guidance the facility is classified as a Transportation Terminal/Station is not eligible for an ENERGY STAR rating.

Metrics Summary			
Metric	**Dec 2017 (Energy Baseline)**	**Dec 2019 (Other)**	**Change**
ENERGY STAR Score (1-100)	Not Available	Not Available	NA
Source EUI (kBtu/ft^2)	118.5	114.5	-4.00 (-3.40%)
Site EUI (kBtu/ft^2)	87.7	83.5	-4.20 (-4.80%)
Energy Cost ($)	$10,273.73	$10,082.16	-191.57 (-1.90%)
Total GHG Emissions Intensity (kgCO2e/ft^2)	4.9	4.7	-0.20 (-4.10%)
Water Use (All Water Sources) (kgal)	6.7	0.1	-6.60 (-98.50%)
Total Waste (Disposed and Diverted (Tons)	Not Available	Not Available	N/A

Since the baseline year of 2017, total energy use for Highway Garage Offices has decreased by 3.40% and energy cost by 1.20%.

3. General Information

3.1. Audit Team

Firefly Energy Efficiency Services, Inc. (Firefly EES) collaborated with Ms. Natalie Lovell, Assistant Town Administrator and Mr. Pat Snow, Highway Maintenance Manager to collect the necessary data for this audit.

3.2. Audit Process

Prior to starting field visits, the Audit Team collected historical energy data for the Highway Garage Offices. Firefly EES visited Highway Garage Offices on a few occasions in early 2020 and collected detailed information on the mechanical, lighting, and plumbing systems as well as occupancy, building use patterns, and equipment operating schedules. In the late Winter, the COVID 19 pandemic caused a delay in the audit process. As a result, data was collected in the Summer and Fall of 2020. Ultimately, each recommendation was fully priced and energy savings and payback estimates calculated.

3.3. Financial Analysis – Methodologies & Assumptions

The financial analyses included in this report were derived using available resources from the ASHREA guidance, EPA, the Massachusetts Green Communities program and information provided on the equipment. These resources were used to perform an analysis of each recommendation. Using the estimates for project cost, annual savings, life of the equipment, and the equipment's replacement cost, a variety of useful financial, energy savings, and greenhouse gas reduction metrics were generated.

Energy use values were calculated by collecting the total annual use for natural gas and electricity. These values were collected from the utility providers.

Annual electricity use was provided by Rowley Municipal Electric. Equipment energy use was calculated into kWh per hour by reviewing the equipment label. Hourly use was estimated against the buildings occupancy schedule and multiplied by the kWh use per hour. The value for the equipment was then subtracted from the annual use to determine the usage percentage for that equipment.

Costs were calculated by multiplying equipment use by the average annual utility rate. Average annual price per centum cubic feet (CCF) was used for natural gas, kWh for electricity and gallons for water.

The following table reflects the approximate portion of fixed costs for each utility.

Fixed Costs of Utilities Supplied through Town of Rowley Highway Garage Offices (2019 Rates)				
	Oil	Natural Gas	Electricity	Water
Unit Rate	NA	$1.29 per CCF	$0.183 per kWh	$20.31 per 1000 gallons
Estimated Infrastructure Percentage	NA	45%	53%	2%

4. Energy Efficiency Measures

4.1. Energy Efficiency Measures Summary

EEM Collective, Rowley Highway Garage Offices													
EEM	Measure Type	Energy Conservation Recommendation	Electricity	Natural Gas	Water	GHG Reduction	Total Annual Savings	Total Costs	Utility Rebate	Net Costs	Cost / MTCDE	Payback (years)	SIR
			kWh	Therms	Gal	MTCDE							
1	Install Water Heater Thermal Blanket	Install Water Heater Thermal Blanket	334	0	0	0.02	$60	$120	$0	$120	$6,316	2.00	10.02
2	Lighting	Replace Interior Lighting with LED alternative	8,486	0	0	4.82	$1,528	$9,075	$4,506	$4,569	$948	2.99	6.69
3	HVAC Equipment	Install Programable Thermostats	104	217	0	1.21	$286	$400	$300	$100	$82	0.35	57.21
4	Weatherization	Install Storm Windows on Garage Windows	40	303	0	1.64	$381	$2,925	$0	$2,925	$1,784	7.67	2.61
5	Weatherization	Replace Access Door	28	130	0	0.71	$165	$1,750	$0	$1,750	$2,465	10.58	1.89
6	Weatherization	Repair Garage Doors	167	260	0	1.48	$351	$1,250	$0	$1,250	$844	3.50	3.56
7	Weatherization	Install 2" closed cell foam on Masonry Walls (R15) and encapsulate with thermal barrier paint	664	780	0	4.43	$1,082	$21,456	$0	$21,456	$4,843	19.83	1.01
8	Weatherization	Air seal attic 1" closed cell foam, tape and mud joints in ceiling, Install R19 fiberglass in ceiling and cross batt with R30 (R19 Total)	553	866	0	4.76	$1,169	$37,988	$0	$37,988	$7,981	32.50	0.62
9	HVAC Equipment	Install Heat Pump System for Heating and Cooling office and break areas	957	0	0	0.54	$31	$9,560	$0	$9,560	$17,704	306.32	0.06

4.2. Energy Efficiency Measures

Note: Savings calculations reflect savings from individual measures only and do not assume that other recommendations have been implemented. Calculations and assumptions used are solely based on the existing equipment and usage schedules.

Low Cost (EEM 1 – EEM 3)

EEM 1 *(implemented as part of electricity reduction)*

Install Water Heater Jacket									
Budgetary Cost	Annual Utility Savings				GHG MTCODE	Annual Savings	Available Incentives	Payback with Incentives	Payback without Incentives
	Electricity	Oil	Natural Gas	Water					
$	kWh	Therms	Therms	CCF	Metric Tons	$	$	Years	Years
$120	334	NA	NA	NA	0.02	$60	$0	NA	2.00

Existing Condition: *Inefficient Lighting*
The water heater is stored on the mezzanine above the office and break area. The water heater does not have the added insulation layer around the holding tank.

Recommendation:
The water heater should be wrapped in a water heater blanket. There are products designed for easy installation around water heaters to reduce heat transfer from the heated water tank by outside air.

Implementation:
Estimate includes the cost to install the water heater blanket. Further information regarding assumptions and the calculations made for this EEM can be found in Appendix C.

EEM 2 *(implemented as part of electricity reduction)*

Replace Interior Lighting with LED alternative									
Budgetary Cost	Annual Utility Savings				GHG MTCODE	Annual Savings	Available Incentives	Payback with Incentives	Payback without Incentives
	Electricity	Oil	Natural Gas	Water					
$	kWh	Therms	Therms	CCF	Metric Tons	$	$	Years	Years
$9,075	8,486	NA	NA	NA	4.82	$1,528	$4,506	2.99	5.94

Existing Condition: *Inefficient Lighting*
Lighting in office space and breakroom is provided by four (4) foot prismatic wrap fixtures fitted with T8 and T12 fluorescent lamps. The maintenance bays in the garage have twenty-one (21) high bay fixtures with four (4) T5 fluorescent lamps.

Recommendation: Replace the existing T8 and T12 lamps with a 20-watt LED by Remphos® Barkit J LED or similar alternative to reduce electric consumption. The new lamps and drivers will be a direct replacement for the existing lamps and ballasts and can accompany motion sensors. The replacement LEDs also have a rated lifespan of 100,000 hours versus 2,000 for the existing fluorescent lamps, which will help reduce maintenance costs associated with replacing burn outs. By replace the T5 fixtures in the garage with 100-watt LED high bay fixtures with motion sensors the fixture sensors will shut the lights off during periods of inactivity.

Implementation: Estimate includes the cost to professionally install 20W LED Barkit J® products and LED High bays with motion sensors. The electric savings assumptions for daily usage were made based on space type and incentives available for each fixture/lamps installed. Further information regarding assumptions and the calculations made for this EEM can be found in Appendix B and C.

EEM 3 *(implemented as part of HVAC Control)*

Install Programable Thermostats									
Budgetary Cost	Annual Utility Savings				GHG MTCODE	Annual Savings	Available Incentives	Payback with Incentives	Payback without Incentives
	Electricity	Oil	Natural Gas	Water					
$	kWh	Therms	Therms	CCF	Metric Tons	$	$	Years	Years
$400	104	NA	217	NA	1.21	$286	$300	0.35	1.40

Existing Condition: *Inefficient HVAC equipment*
The gas fired heating units and electric baseboards require thermostats to maintain heat to comfort employees and prevent pipes from freezing in the facility. The existing thermostats are manual operation.

Recommendation: Replace the thermostats with programable thermostats. Programmable thermostats allow pre-set scheduling for heating use to mimic building occupancy times. This will prevent employees from forgetting to turn the heat down during non-working hours.

Implementation: Estimate includes the cost to purchase and install thermostats. Further information regarding assumptions and calculations are included in Appendix C.

Weatherization (EEM 4-8)

EEM 4 *(implemented as part of weatherization)*

Install Storm Windows									
Budgetary Cost	Annual Utility Savings				GHG MTCODE	Annual Savings	Available Incentives	Payback with Incentives	Payback without Incentives
	Electricity	Oil	Natural Gas	Water					
$	kWh	Therms	Therms	CCF	Metric Tons	$	$	Years	Years
$2,925	40	NA	303	NA	1.64	$381	$0	NA	7.67

Existing Condition: *Inefficient Building Envelope*
The nine (9) windows along the back of the building are single pane windows installed during construction of the building in 1960.

Recommendation: Install storm windows to decrease the heat transfer from the outside space to the garage bays.

Implementation: Estimate includes the cost to install storm windows in the building. Savings estimates were made for a reduction in heating the garage bays and common area. The installation of storm windows could prevent the use of these windows for ventilation; however, these windows appear to not be used for this purpose. Further information regarding assumptions and calculations are included in Appendix C.

EEM 5 *(implemented as part of weatherization)*

Replace Access Door									
Budgetary Cost	Annual Utility Savings				GHG MTCODE	Annual Savings	Available Incentives	Payback with Incentives	Payback without Incentives
	Electricity	Oil	Natural Gas	Water					
$	kWh	Therms	Therms	CCF	Metric Tons	$	$	Years	Years
$1,750	28	NA	130	NA	0.71	$165	$0	NA	10.58

Existing Condition: *Inefficient Building Envelope*
The main access door is a single pane, glass door with worn weather stripping.

Recommendation: Replace the door with insulated, weather stripped door.

Implementation: Estimate includes the cost to install the insulated door. Estimated savings were calculated into a reduction in heating the garage bays and common area. Further information regarding assumptions and calculations are included in Appendix C.

EEM 6 *(implemented as part of weatherization)*

Replace Weather Stripping on Garage Doors									
Budgetary Cost	Annual Utility Savings				GHG MTCODE	Annual Savings	Available Incentives	Payback with Incentives	Payback without Incentives
	Electricity	Oil	Natural Gas	Water					
$	kWh	Therms	Therms	CCF	Metric Tons	$	$	Years	Years
$1,250	167	NA	260	NA	1.48	$351	$0	NA	3.50

Existing Condition: *Inefficient Building Envelope*
The four (4) garage doors have beat up rubber seals at the bottom of the doors. The exterior seal attached to the building along the vertical edge of the door are peeling away. There are visible gaps in most of the seals.

Recommendation: Install new rubber seals along the bottom of the garage doors and weather stripping along the building frame of the garage door. The rubber stripping should be sized correctly (up to six inches) to close the gap between the floor and base of the door. Prior to installing the rubber seals and weather stripping the garage door should be adjusted to correct misalignment.

Implementation: The installation includes the cost to align garage doors, replace rubber stripping, and replace weather stripping. Further information regarding assumptions and calculations are included in Appendix C.

EEM 7 *(implemented as part of the weatherization)*

Install 2 inch Foam on Masonry Walls and cover with Thermal Barrier									
Budgetary Cost	Annual Utility Savings				GHG MTCODE	Annual Savings	Available Incentives	Payback with Incentives	Payback without Incentives
	Electricity	Oil	Natural Gas	Water					
$	kWh	Therms	Therms	CCF	Metric Tons	$	$	Years	Years
$21,456	664	NA	780	NA	4.43	$1,082	$0	NA	19.83

Existing Condition: *Inefficient Building Envelope*

Concrete block walls are the main building material for the building perimeter. Concrete blocks provide an air barrier but have minimal insulation value.

Recommendation: Install two (2) inch closed cell foam (R15) on masonry walls. To meet code requirements, encapsulate the foam with thermal barrier paint.

Implementation: The estimate includes the cost install two (2) inch foil faced foam insulation and paint with thermal barrier. Further information regarding assumptions and calculations are included in Appendix C.

EEM 8 *(implemented as part of the weatherization)*

Air Seal Ceiling, Tape and Mud Ceiling Joints, Install fiberglass (R19) insulation in ceiling and cross batt (R30)									
Budgetary Cost	Annual Utility Savings				GHG MTCODE	Annual Savings	Available Incentives	Payback with Incentives	Payback without Incentives
	Electricity	Oil	Natural Gas	Water					
$	kWh	Therms	Therms	CCF	Metric Tons	$	$	Years	Years
$37,988	553	NA	866	NA	4.76	$1,169	$0	NA	32.50

Existing Condition: *Inefficient Building Envelope*
Above the ceiling there is spotty fiberglass insulation. There is no air sealing and the sheet rock ceiling joints which were finished without tape and joint compound.

Recommendation: Reduce heat loss through the ceiling by properly air sealing and installing insulation. The existing insulation should be removed so the ceiling can be air sealed. The joints in the sheet rock should be taped and joint compounded. The ceiling joists insulated with R19 fiberglass and the cross batts with R30 fiberglass.

Implementation: The estimate includes the cost to furnish, install air sealing and insulation materials. Additional information regarding assumptions and calculations are included in Appendix C.

EEM 9 *(implemented as part of HVAC System)*

Install Heat Pump System									
Budgetary Cost	Annual Utility Savings				GHG MTCODE	Annual Savings	Available Incentives	Payback with Incentives	Payback without Incentives
	Electricity	Oil	Natural Gas	Water					
$	kWh	Therms	Therms	CCF	Metric Tons	$	$	Years	Years
$	957	NA	0	NA	0.54	$31	$0	NA	306

Existing Condition: *Inefficient HVAC*
The office is heated by electric baseboard and cooled by a window unit air conditioning unit. The breakroom, bathroom and the lounge are heated by electric baseboard heating and do not have cooling.

Recommendation: Install energy efficient, mini-split variable speed, heat pump and cooling system for climate control in the office space, the breakroom, bathroom and the lounge.

Implementation: Estimate includes the cost to purchase heat pump and cooling system. This system would be the primary unit used to condition the space (heat and cool) and the baseboard system would be used as a backup system for heating. The electricity consumption for the building would decrease slightly even when adding cooling to areas that currently do not have air conditioning. Further information regarding assumptions and calculations are included in Appendix C.

5. Utility Analysis

5.1. Utility Rate Schedules

Utility Rates: 2017-2019				
Utility	**Unit**	**2017 Rate**	**2018 Rate**	**2019 Rate**
Electricity	kWh	$0.17	$0.17	$0.18
Natural Gas	CCF	$1.97	$2.30	$2.26
Water	Gallons	$0.02	$0.02	$0.02

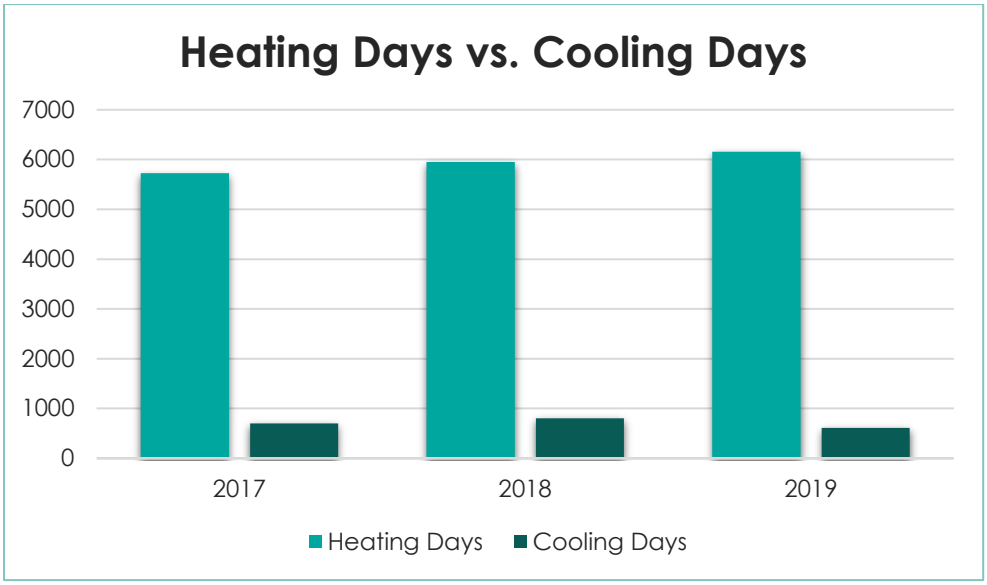
5.2. CO_2 Equivalents for Utilities

The table below lists the metric ton of carbon dioxide equivalents (MTCDE) for each utility consumed by Highway Garage Offices. The conversion factors were calculated by the Greenhouse Gas Inventory through the Environmental Protection Agency. These factors were used to estimate the greenhouse gas reductions for each energy conservation recommendation at Highway Garage Offices.

Carbon Dioxide Equivalents by Utility Type	
Natural Gas (MTCDE/therm)	**Electricity** (MTCDE/kWh)
0.005318	0.000390

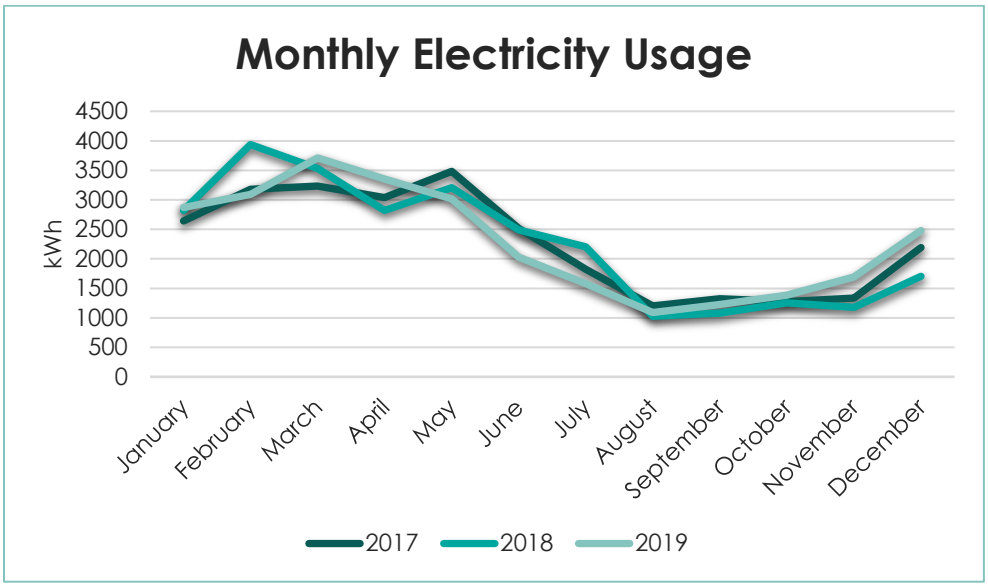
5.3. Annual Degree Days 2017 – 2019

This graph provides the number of heating and cooling degree-days for Rowley, Massachusetts for the past three (3) years. A heating degree-day (HDD) is the number of degrees that a day's average outside air temperature is below 65°F and a building's interior is typically heated. A cooling degree-day (CDD) is the number of degrees that a day's average outside air temperature is above 65°F and air conditioning is typically used to cool a building's interior spaces. This data is useful to determine increases in energy uses based on weather conditions. For example, an increase in HDD will typically increase heating costs, where the increase in CDD will typically increase cooling cost.

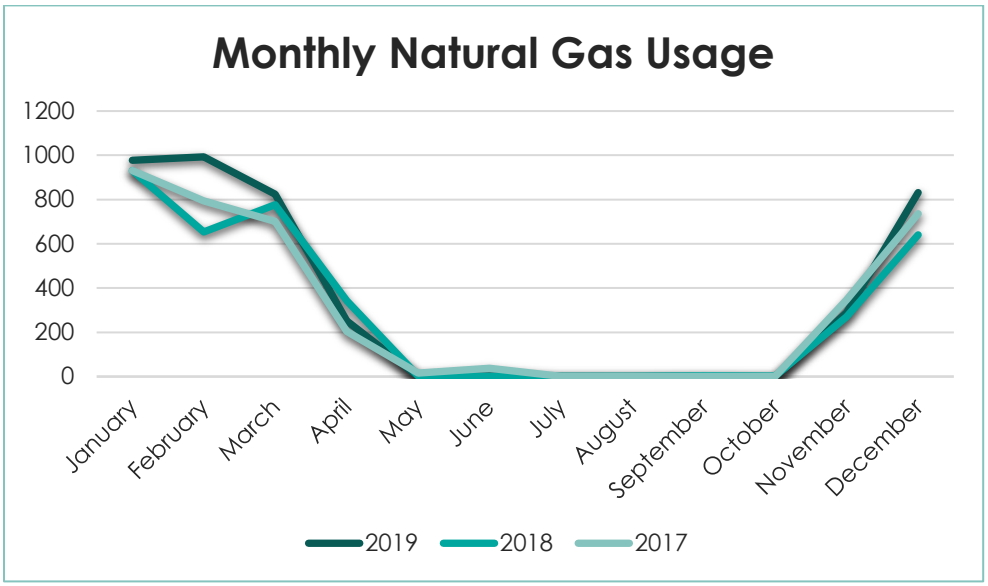


5.4. Utility Performance Summary by Fiscal Year

Examining the historical utility data of the building is a requirement of an ASHRAE Level II audit. The table below shows the electricity use for Highway Garage Offices from 2017 through 2019. The graph below visually represents the trend in energy consumption over these years.

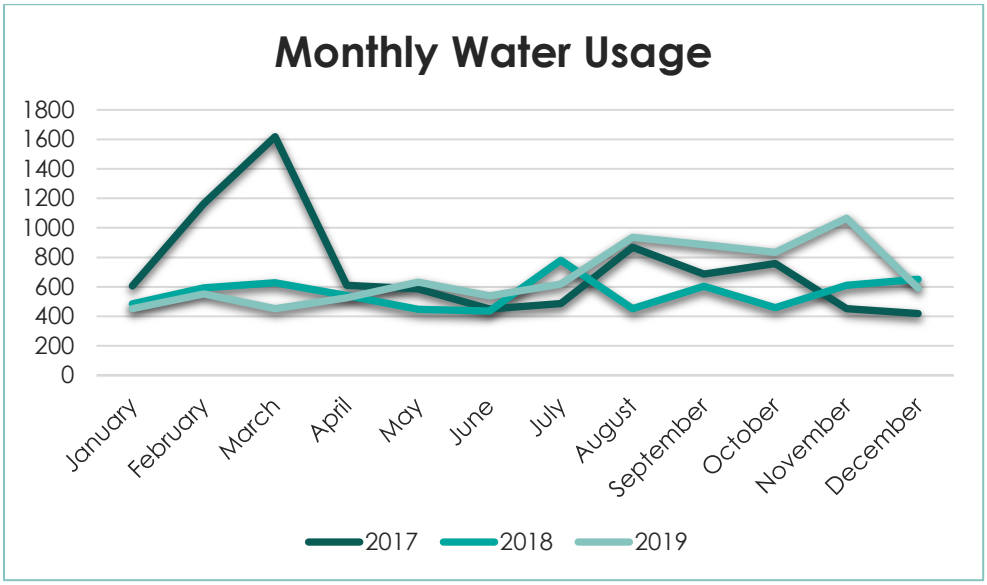


Electricity use at Highway Garage Offices has increased 17% between 2017 and 2019.



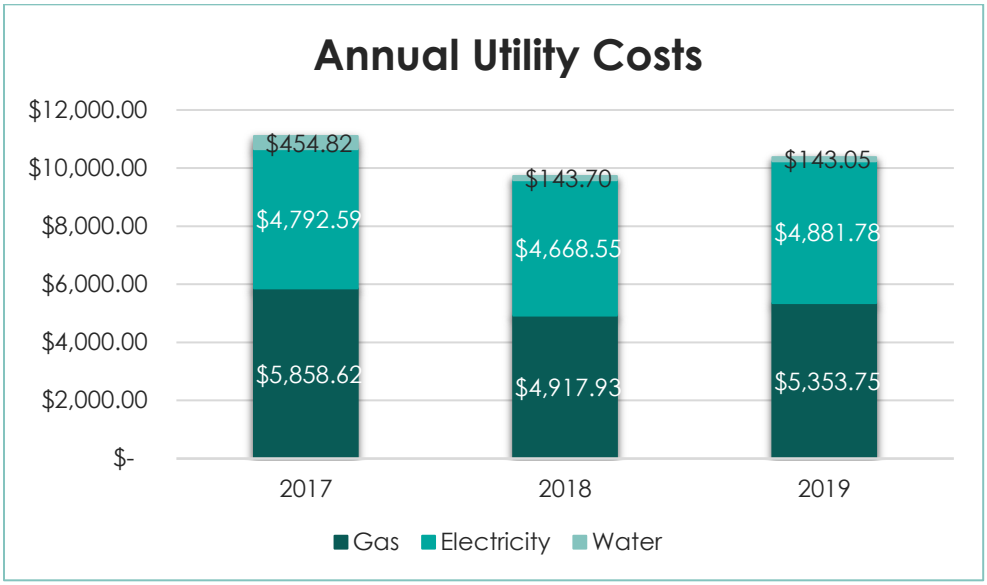
The table above shows the natural gas use for Highway Garage Offices from 2017 through 2019. Natural Gas use trends are as one would expect. It is in heavy need during the colder months and not needed in the warm months. Overall natural gas use has increased by 29% since 2017.

Water usage had been increasing until a low flow toilet was installed in early 2017. In the Winter months after snow events the monthly water use increases from washing ice melt from snow removal equipment. Since 2017 water use has decreased by 7%. The table below shows water use from 2017 through 2019.

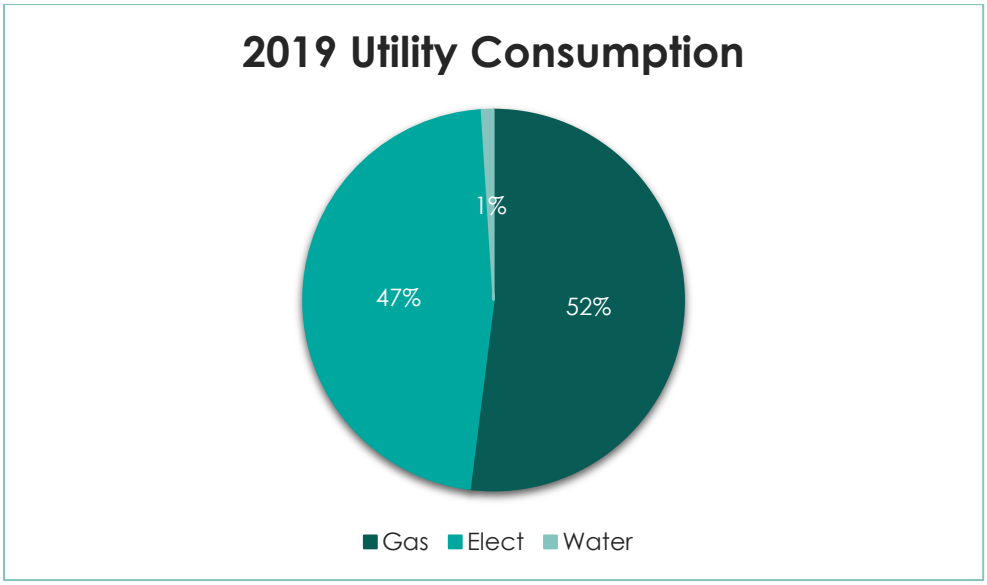


5.5. Utility Component Breakdown

In 2019, Highway Garage Offices spent a total of $10,279.73 on all utilities including electricity, natural gas, and city water. The chart below proportionally illustrates the cost breakdown by utility category. 47% of the total utility cost was comprised of electricity while 52% of the total cost was natural gas. City water accounted for 1% of all utility cost. The table below shows the annual utility costs.

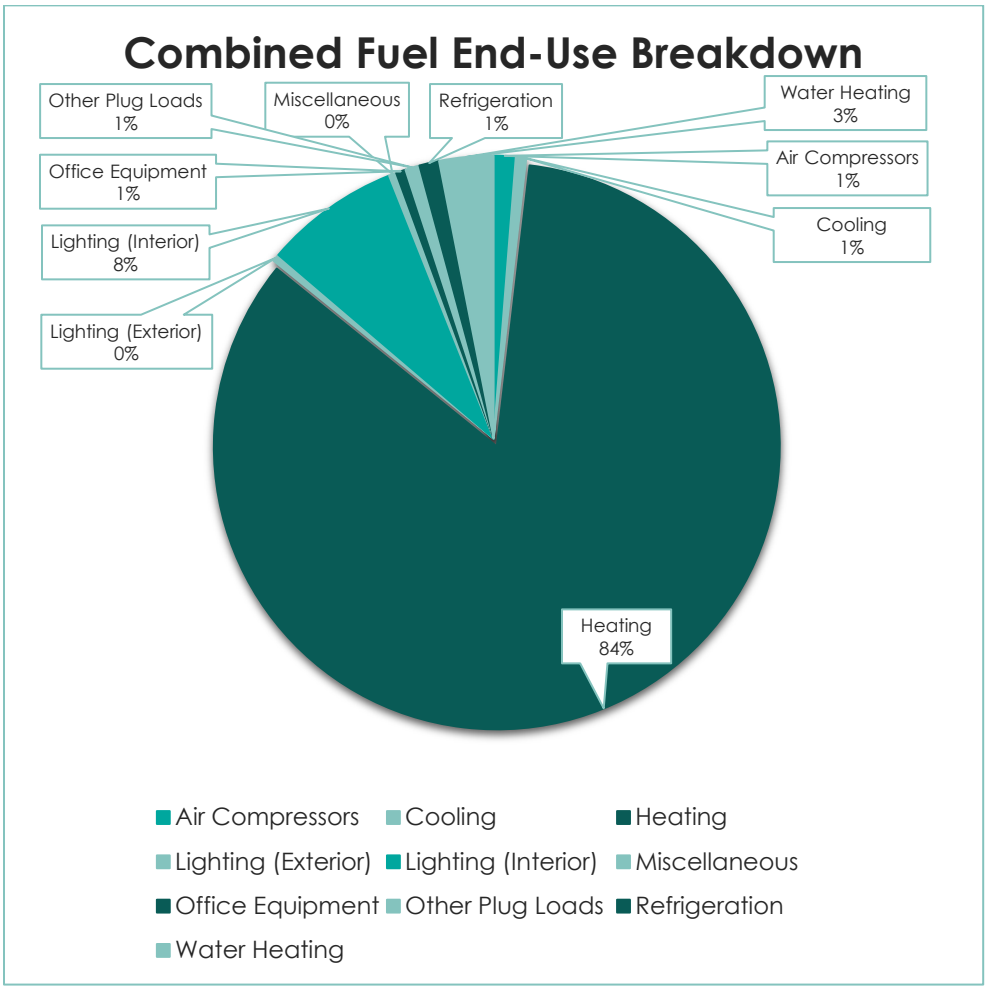


5.6. End Use Component Energy Usage Breakdown



The table above provides energy consumption end use breakdowns for the Highway Garage Offices based on 2019 data. Since there are no sub meters to continuously measure electrical loads within the Highway Garage Offices, the Team used some assumptions to estimate and then extrapolate annual distribution loads. The lighting load is based on a count of all the lighting fixtures and estimates of yearly runtime per fixture. The space cooling load is based on the ratings of the window air-conditioning unit. The space heating consumption is equal to the natural gas heaters and electrical baseboard heating consumption at the building. The domestic hot water consumption is a result of the electric hot water heater at the building.

Town water was not included in this analysis since it is strictly a utility cost and is not considered a component of energy consumption by the building.



The total energy consumption is calculated by converting gallons of oil and kilowatt hours of electricity in British Thermal Units then multiplied by a "kilo" or 1,000 (kBtus). One kBtu is the amount of energy needed to raise the temperate of one pound of water by one (1) degree Fahrenheit.

In 2019, Highway Garage Offices' total energy consumption was 527,157 kBtus of energy including electricity, and natural gas. The chart below proportionally illustrates energy use breakdown by utility category. Natural gas represents 52% of the total energy consumption while electricity represents 47%.

Heating consumes the most energy and comprises 84% of Highway Garage Offices' annual energy consumption in KBtu. This value includes the use of electric baseboard heaters and the natural gas heaters in the garage. The use of the heating equipment amounts to 46% of the

building's annual energy cost. Interior and exterior lighting accounts for 12% of the annual energy consumption and comprises 25% of the annual energy cost. Cooling the office spaces equals 1% of the annual energy consumption and 2% of the annual budget. Office equipment (computers, microwave, refrigerator) accounts for approximately 3% of the annual energy consumption and 10% of the annual budget.

Annual Energy Consumption by End Use Components 2019						
End Use	Electricity	Natural Gas	Total	% of Total Use	Total Cost ($)	% of Total Cost
	kWh	Therms	kBtu			
Air Compressor	1,938	0	6,613	1%	$360	4%
Cooling	916	0	3,126	<1%	$190	3%
Heating	2,771	4,332	442,655	83%	$4,630	46%
Lighting (Exterior)	659	0	2,249	<1%	$130	1%
Lighting (Interior)	11,949	0	40,772	12%	$2,219	24%
Miscellaneous	657	0	2,242	<1%	$130	1%
Office Equipment	858	0	2,928	<1%	$160	3%
Other Plug Loads	1,265	0	4,316	1%	$240	3%
Refrigeration	1,750	0	5,971	1%	$320	4%
Domestic Hot Water	4,773	0	16,286	3%	$875	11%
Total	**27,543**	**4,337**	**527,181**	**100%**	**$9,254**	**100%**

5.7. Energy Use & Cost Indices by Fiscal Year

Calculating historical energy usage on a square footage basis is a requirement of an ASHRAE Level II audit. The EUI information can be helpful in comparing energy intensity in buildings of similar space types in similar geographical locations on a per square footage basis. Additionally, the cost index can be helpful in comparing one buildings operation cost to that of similar buildings.

The table below displays the energy performance data in consumption and cost per square foot. The annual utility cost indices for the Highway Garage Offices, in dollars per square foot, show the energy costs are increasing slightly annually.

Energy Use and Cost Indices by Year		
Year	**Metric**	**Utility Data**
2019	Energy Utilization Index (kBtu/ft²/year)	114.5
	Energy Cost Index ($/ft2/year)	$1.65
	Utility Cost Index (Including City Water) ($/ft²/year)	$1.67
2018	Energy Utilization Index (kBtu/ft²/year)	277.1
	Energy Cost Index ($/ft2/year)	$1.55
	Utility Cost Index (Including City Water) ($/ft²/year)	$1.57
2017	Energy Utilization Index (kBtu/ft²/year)	118.5
	Energy Cost Index ($/ft2/year)	$1,72
	Utility Cost Index (Including City Water) ($/ft²/year)	$1.79

5.8. Electrical Demand

Review of electrical demand data is a requirement of an ASHRAE Level II audit. The table below illustrates the maximum electrical demand as well as demand per square foot. Demand charges are fees applied to the electric bills of commercial and industrial customers based upon the highest amount of power drawn during any (typically 15-minute) interval during the billing period.

Demand has been increasing over the past three years. The maximum demand for 2019 was consistent with previous years. The highest reading occurred in April 2017, February 2018, and February 2019, as a result of the electric baseboard heating use during these months.

Electrical Demand 2017 through 2019		
Year	**Metric**	**Electrical Data**
2019	Maximum Demand (kW)	13.22
	Maximum Demand (watts/ft2)	0.0021
2018	Maximum Demand (kW)	13.46
	Maximum Demand (watts/ft2)	0.0021
2017	Maximum Demand (kW)	12.37
	Maximum Demand (watts/ft2)	0.0020

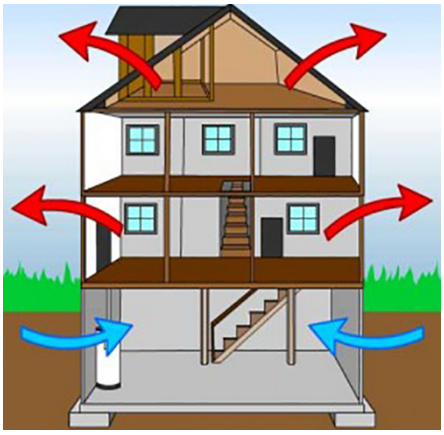
6. Phased Energy Savings Approach

This section is an effort to help the Town of Rowley plan the adoption energy efficiency equipment and the installation process. Securing funding through town budgets and grants can take extended periods of time for planning. As a result, by viewing the next steps as a phased approach, the Town of Rowley can better predict the steps needed to execute the project installations.

6.1. Phased 1: Lighting and Weatherization

The Town of Rowley can harness a considerable savings by changing the interior lighting at the Highway Garage Offices. This will reduce the wattage required to illuminate the office, break room, lounge and the garage area. LED lighting uses less wattage, provides more lumens (light) and does not require the maintenance that legacy lighting requires. It saves money in utility costs and in maintenance costs. Interior LED lighting also operate at cooler temperatures which reduce the load on the air conditioning equipment. The garage area would benefit considerably from LED high bay fixtures with fixture sensors. The sensors would provide the automated feature of shutting the lighting off during periods of inactivity. Currently, if an employee forgets to turn the lighting off, the lights remain on.

The Highway Garage Offices should also focus on sealing the building envelope. This building provides an example of the stack effect, as there are areas of poor air seals along the perimeter of the building and little to no insulation around the exterior walls and attic. The ceiling in the garage area is unfinished with gaps to the attic and penetrations for equipment. In conditioned buildings the stack effect is warm air rises and looks to escape at the highest levels. This movement creates positive pressure at the tops of buildings and negative pressure to draw in cooler air at the lowest levels of buildings. When trying to moderate buildings for heating and cooling it becomes important to create effective thermal barrier at the top to have the greatest impact on combating the stack effect.



Stack Effect

A good way to understand the effective use of insulation is to think of the building as one would view a boat. If a boat were taking on water and mechanical equipment, such as a pump system is used to remove the water, you want to fix the leaks before spending money to increase the water removal equipment. Sizing heating and cooling equipment in a building is no different. Focusing on the areas of loss allow future mechanical equipment to be properly sized, which will

save in equipment and installation costs, and reduce the load required to operate the system. This also has a great effect on reducing the facilities carbon footprint.

6.2. Phase 2: Heat Pump

After the building envelope is properly insulated the Town of Rowley should consider installing a variable refrigerant flow (VRF) heat pump to heat and cool the office, breakroom, bathroom and the lounge. There are different options for this system, but they all condition the space in the form of heating and cooling. Highway Garage Offices would be a good fit for a mini-split system. This system would effectively heat the space even during minus 13 (thirteen) degrees Fahrenheit and cool the space on the hottest summer days. A system for Highway Garage Offices would cost approximately $10,000 (equipment and the installation).

6.3. Renewable Energy – Solar Array on Roof

Highway Garage Offices also has an ideal roof setting to install solar panels. The front of the building is south facing and has no shading from trees or nearby buildings. It captures the most sunlight allowed.

A 20kW direct current (DC) system, that would generate roughly 24,000kWh at a cost of approximately $56,000. This would account for all of the 2019 electricity needs for Highway Maintenance. The simple return on investment (ROI) is estimated to be around 11 years with a life expectancy of 30 years.

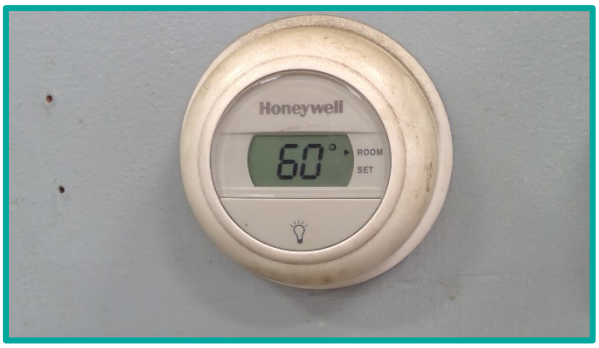
Solar Array with mini-split system

Appendices

A. Project Pictures

Office Manual Thermostat

Water Heater



Garage Manual Thermostat

Ceiling Joints Not Sealed

Attic – No Insulation

Attic – No Insulation

Garage Door Missing Window

14x 14 foot Garage Door – Rubber Seal Worn

Garage Door – Weather Stripping Peeling

T5 Lights – Garage Lights

T5 Fixture/unfinished ceiling

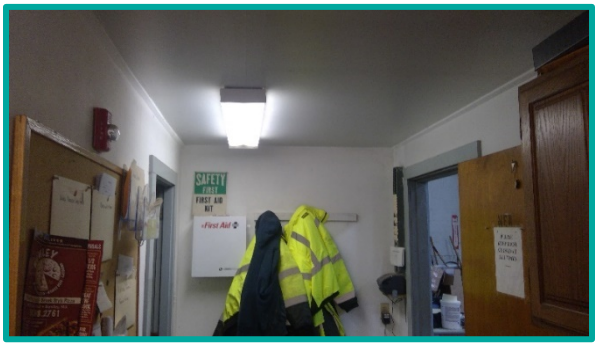
Office Lighting

Unfinished/Pipe in Ceiling

Garage Windows

12 x 12 foot Garage Door – Rubber Seal Worn

Office Window



Four Foot Wrap Fixture

Main Access Door

B. Lighting Audit Data

Customer Info	Town of Rowley
Company Name	Highway Department
Address	40 Independent St
City	Rowley
State	MA
Zip	01969

Contact name	
Phone	
Email	
Account #, if known	

Vendor Info	
Company Name	Firefly EES, Inc
Address	18 Hart Road
City	Lynnfield
State	MA
Zip	01940

Contact Name	
Phone	
Email	

Existing						Proposed				Savings and Incentives					Financials			
Item ID (match to cut sheet)	**Location**	**Qty**	**Desc. (# and type of lamps, type of fixture)**	**Watts (if known)**	**Ann. Hrs. Use**	**Qty**	**Desc. (# and type of lamps, type of fixture)**	**Watts**	**Control Type to be added (if any)**	**Ann. Hrs. Use**	**Ann. kWh Savings**	**Ann. $ Savings**	**Existing kWh**	**Rebate Each**	**Total Rebate**	**Product Cost**	**Labor**	**Subtotal**	**Total After Rebate**
	Main Garage	21	4L4' 54W T5HO/ELIG	234	2350	21	Highbay Linmore	100	Fixture	1598	8,192.10	$1,474.58	11547.9	$200.00	$4,200.00	$5208	$2835	$8,043.00	$3,843.00
	Managers Office	2	2L4 T8/ELIG LOW PWR	52	2000	2	LED BARKIT J	20	Wall	1360	153.60	$27.65	208	$30.00	$60.00	$100.00	$100.00	$200.00	$140.00
	Bathroom	1	A19 - LED	8	500	1	No Change	8		500	-	$0.00	4	$0.00	$0.00	$-	$-	$-	$-
	Breakroom	2	2L4 T8/ELIG LOW PWR	52	500	2	LED BARKIT J	20		500	32.00	$5.76	52	$30.00	$60.00	$100.00	$100.00	$200.00	$140.00
	Lounge Room	2	A19 75 W	75	500	2	A19 LED	8		500	67.00	$12.06	75	$3.00	$6.00	$10.00	$10.00	$30.00	$24.00
	Tool Room	2	2L4 T8/ELIG LOW PWR	52	200	2	LED BARKIT J	20		200	12.80	$2.30	20.8	$30.00	$60.00	$100.00	$100.00	$200.00	$140.00
	Mower Storage	1	2L8' EE/STD - T12	138	100	1	LED BARKIT J	20		100	11.80	$2.12	13.8	$30.00	$30.00	$50.00	$50.00	$100.00	$70.00
	Mezzanine	3	2L4' STD/STD - T12	94	100	3	LED BARKIT J	40		100	16.20	$2.92	28.2	$30.00	$90.00	$150.00	$150.00	$300.00	$210.00
											-	$0.00		$0.00	$0.00			$-	$-
											8,485.50	1,527.39	11949.7		4,506			$9,073.00	$4,567.00

C. EEM Assumptions & Calculations

EEM 1 – Install Water Heater Jacket

kWh Water heater use = 4773
kWh rate = $0.18
Assume 25% reduction in heat loss
Assume 7% annual reduction in energy cost = 334.11kWh
334.11 kWh x $0.18 = $60.14 annually
Insulating your water tank, can reduce standby heat losses by 25%–45% and save you approximately 7%–16% in water heating costs.

EEM 2 – Replace Interior Lighting with LED Replacements

Interior Legacy Lighting Assumptions		
Location	**Est. Annual Hours**	**Est. Annual kWh**
Maintenance Garage Bays	2,350	11,548
Manager Office	2,000	208
Breakroom	500	52
Lounge Room	500	75
Tool Room	200	21
Mower Storage	100	14
Mezzanine	100	28
Total		12,346

Equation	
((Qty*Existing Watts)*Annual Hours))/1000	Annual kWh

Basement LED Lighting Assumptions			
Location	**Est. Annual Hours**	**Est. Annual kWh Savings**	**Est. Savings**
Maintenance Garage Bays	1,598	8,192	$1,475
Manager Office	1,360	154	$28
Breakroom	500	32	$6
Lounge Room	500	67	$12
Tool Room	200	13	$2

Mower Storage	100	12	$2
Mezzanine	100	16	$3
Total		8,486	$1,528
Rowley Municipal kWh rate	$0.18		

Equation	
((Qty*Existing Watts)*Annual Hours))/1000 – (Qty*LED Watts)*Annual Hours))/1000	Electricity Savings

***LED fixture with sensor reduces existing hours by 32%**

EEM 3 –Install Programmable Thermostats

Installing a programmable thermostat can save them anywhere from 10 to 30% on the space heating and cooling portion of their energy bills. Conservative factor of 0.5 to adjust for heat being on and set at 55 degrees during nonworking hours. 5% of CCF of Annual Natural Gas 4177 purchased is estimated to be saved = 217 CCF

Baseboard Heat Electricity reduction: 5% reduction in baseboard heating use. Baseboards are estimated to account for 2,778 kWh annually = 104 kWh.

Cooling Electricity Reduction: Cooling is not estimated to be reduced.

EEM 4 – Install Storm Windows on Garage Back Windows

Natural gas reduction:
Low-e exterior or interior storm windows can save between 12%–33% on heating and cooling costs. Estimating half of low end based on garage door use. 7% of CCF of 2019 Annual Natural Gas CCF (4177 purchased) is estimated to be saved by storm windows = 292 CCF

Baseboard Heat Electricity reduction: 1% reduction in baseboard heating use. Baseboards are estimated to account for 2,778 kWh annually = 40 kWh.

Cooling Electricity Reduction: Cooling is not estimated to be reduced.

EEM 5 – Replace Access door with insulated, weather stripped door

Garage Bay Natural Gas Heat Reduction: 3% reduction in CCF of 2019 Annual Natural Gas CCF (4177 purchased) is estimated to be saved by insulated, weather striped door = 125 CCF

Baseboard Heat Electricity reduction: 3% reduction in baseboard heating use. Baseboards are estimated to account for 2,778 kWh annually = 83 kWh.

Cooling Electricity Reduction: Cooling is not estimated to be reduced.

EEM 6 – Replace weather stripping around garage doors

Garage Bay Natural Gas Heat Reduction: 6% reduction in CCF in 2019 Annual Natural Gas CCF (4177 purchased) is estimated to be saved by repairing the weather stripping around the garage doors = 155 CCF.

Baseboard Heat Electricity reduction: 6% reduction in baseboard heating use. Baseboards are estimated to account for 2,078 kWh annually = 167 kWh.

Cooling Electricity Reduction: Cooling is not estimated to be reduced.

ECR 7 – Install 2 inch closed cell foam Insulation on inside masonry walls and cover with thermal barrier paint

Natural gas reduction:
18% reduction in CCF in 2019 Annual Natural Gas CCF (4177 purchased) is estimated to be saved by insulating the masonry walls of the building = 750 CCF

Baseboard Heat Electricity reduction: 18% reduction in baseboard heating use. Baseboards are estimated to account for 2,778 kWh annually. Insulating the masonry walls is estimated to save 500 kWh.

Cooling Electricity Reduction: Cooling is estimated to account for 916 annual kWh. This measure is estimated reduced by 18% = 164 kWh.

EEM 8 – Air Seal Ceiling, Tape and Mud Ceiling Joints, Install fiberglass (R19) insulation in ceiling and cross batt (R30)

Natural gas reduction:
20% reduction in CCF in 2019 Annual Natural Gas CCF (4177 purchased) is estimated to be saved = 835 CCF

Baseboard Heat Electricity reduction: 15% reduction in baseboard heating use. Baseboards are estimated to account for 2,778 kWh annually. Insulating the masonry walls is estimated to save 416 kWh.

Cooling Electricity Reduction: Cooling is estimated to account for 916 annual kWh. This measure is estimated reduced by 15% = 137 kWh.

EEM 9 – Install VRV Heating and Cooling System

Natural gas reduction:
This system will be unaffected by the VRV heating and cooling system.

Baseboard Heat Electricity reduction: 100% reduction in baseboard heating use. The VRV heating and cooling system will save 2,078 kWh annually.

Cooling Electricity Reduction: Cooling is estimated to account for 916 annual kWh. This measure is estimated reduced by 100% since that system will no longer be needed = 916 kWh.

VRV estimated kWh for heating and cooling:

	Heating	Cooling
kwh/hour	2.5	2.5
Hours/day	8	4
Days/week	5	5
Weeks/month	4.33	4.33
Months	4	4
	1732	866
Total Use	2598	

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ASHRAE Level II Energy Audit

Rowley Water Department, 401 Central Street
Rowley, MA 01969
December 14, 2020

Table of Contents

1. Executive Summary

The Town of Rowley contracted with Firefly Energy Efficiency Services, Inc (Firefly EES) to conduct an energy audit of the subject property, Rowley Water Department Offices, located at 40 Independent Street, Rowley, Massachusetts 01969. The audit consisted of a building evaluation aimed at 1) assessing the overall energy usage of the building and its on-site systems, 2) identifying potential energy areas of improvement in these systems, and 3) where applicable, proposing "clean energy" alternatives to the current systems where future energy savings could be realized. Included as part of the audit was a review of the building's construction features, its historical energy costs, discussions with the local utilities concerning the property's energy usage, and discussions with the prime energy equipment suppliers/manufactures for the purpose of determining more efficient alternatives.

This audit meets the Level II requirements established by ASHRAE. As a result, this report includes the following: a historical analysis of all building utility consumption (electricity, propane gas, and city water); specific efficiency improvement recommendations for each of the primary building systems (HVAC equipment, weatherization, lighting, plug loads, and domestic water heating); and a detailed financial analysis of each recommendation, which includes the Savings to Investment Ratio (SIR) based on life cycle costs and using contractor-provided pricing for full installation. This comprehensive approach uses structured techniques to provide a valuable framework for substantial and measurable utilities savings.

Key Audit Findings:

- In 2019, the Water Department spent $11,411.67 on all utilities
- Seven (7) separate Energy Efficiency Measures (EEMs) identified
- Annualized savings for of all EEMs totals $2,027 (18% reduction at current energy prices)

Recommendations:

- Replace remaining interior legacy lighting with LED technology and motion sensors
- Replace remaining exterior legacy lighting with LED technology
- Install motion sensors for lighting previously converted to LED technology
- Insulate hot water tank
- Replace windows along front of building (south facing)
- Air seal and update insulation in attic space

This audit demonstrates the potential for the Water Department Offices to serve as a model of sustainable building operations and resource conservation to the town. To that end, the Audit Team hopes this report proves to be a useful decision-making tool in considering sustainable building operation strategies. We believe that with continued collaboration, the Water

Department Offices can make significant progress toward the goal of ensuring a sustainable, healthy, and energy-efficient building.

Rowley Highway Maintenance Energy Efficiency Measures						
EEM #	EEM Title	Reason for Evaluation	Approx. Annual Savings	Net Costs	SIR	Simple Payback Years
1	Install Programable Thermostats	Conservation	$371	$0	NA	0
2	Install Motion Sensors for existing LED Lighting	Electricity reduction	$89	$875	2.04	9.82
3	Install Water Heater Thermal Blanket	Electricity reduction	$111	$120	18.54	1.08
4	Install LED Lighting	Electricity reduction	$702	$1,668	8.42	2.38
5	Install Exterior Lighting	Electricity reduction	$248	$660	7.50	2.67
6	Replace Front Windows	Weatherization	$114	$4,650	0.49	40.96
7	Insulated stair cover, air seal attic, additional insulation	Weatherization	$392	$10,226	0.77	26.11
		Total	**$2,027**	**$19,759**	**2.05**	**9.75**

SIR = Savings multiplied by useful product life divided by project costs. Ex. ($60 x 20 years)/$120 = 10.00. The SIR for a project must have a savings-to-investment ration of at least 1 to pay for itself.

Simple Payment = Net Costs/annual savings

2. Background

Built in in 1975 and constructed with masonry block walls with a wooden truss roof the building was originally used as retail outlet and until purchased by the Town of Rowley. The Rowley Water Department Offices (Water Department Offices) offers approximately 6,168 square feet for office space, a conference room, file storage and garage space for truck and equipment storage.

2.1. Space Types

The first floor at Water Department Offices has an open office area, a conference room, and kitchenette (administrative area). The midsection of the building is used as a single bay garage which includes a bathroom for the administrative personnel. The rear of the building includes a (3) bay garage, an office, a locker and break area and a bathroom (crew area). The second floor above the crew area is used as a file storage room for maps and other water department related documents. Both garage spaces are used for vehicle and equipment storage. There is no basement level.

2.2. Occupancy & Use Schedules

The administrative area is occupied during business hours and the crew area is sporadically occupied during work hours. The office manager is on-site during business hours and the water department manager is periodically in the office, while not assisting the crew with maintaining the water system. Payback calculations for conservation projects include five full-time employees and two part-time employees. There are periods during the year, when the crew may work long shifts for water main breaks or other immediate maintenance needs. The chart below represents the typical occupancy by space type.

Water Department Offices Occupancy Schedules							
Space Type	**Mon**	**Tues**	**Wed**	**Thurs**	**Friday**	**Sat**	**Sun**
Maintenance Crew	7am - 3pm	7am - 3pm	7am - 3pm	7am - 3pm	7am - 3pm	Closed	
Administrative Personnel	7:30am-3:30pm	7:30am-3:30pm	7:30am-3:30pm	7:30am-3:30pm	7:30am-3:30pm	Closed	

2.3. Recent Building System Upgrades & Existing Conditions

There have been efficiency upgrades at the Water Department Offices. A review shows a newer electric water heater, water saving toilets, interior LED lighting, along with a mini-split heating and cooling system for the administrative area.

Heating

The Water Department Office heating is served by propane gas heaters, electric base boards and a mini-split heating system. The propane gas system provides forced hot air to the garage bays. The electric baseboard heating system serves the crew area and the mini-split heat pump system serves the administrative area.

Cooling

The administrative area is cooled by the mini-split cooling system. The remaining Water Department Office facility does not have cooling equipment.

Ventilation

The windows in the administration area and conference room are large picture windows which do not allow for ventilation. The garage bays have large garage doors that can be used to provide outside air and natural ventilation. The windows in the rear of the garage building are

approximately ten (10) feet above ground surface and are not operable to allow for ventilation. These provide daylight to the garage area. The windows in the crew area are operable and allow for ventilation.

Building Automation Controls

The Water Department Offices has programable thermostats as building automation controls.

Lighting

The lighting in the administrative office areas and single bay garage of the facility is comprised LED fixtures. The lighting in the rear garage area consists of T5 fluorescent fixtures and T8 fluorescent fixtures in the crew area and file storage room. All lighting in the building is manually controlled by wall mounted switches. The exterior lighting around the front and sides of the building consist of LED recessed lighting and area floods, which are controlled by time clocks. The outside storage area behind the building has metal halide wall packs also controlled by time clocks. One of the wall packs is peeling off the building and should be remounted or replaced with an LED area flood light.

See Appendix A for pictures and Appendix B for additional information from the lighting audit.

Plumbing

The toilet fixtures at Water Department Offices are low flow 1.28 gallon per flush toilet. The bathroom sinks are fitted with efficient 0.5 gallon per minute (gpm) faucet aerators. There is a sink in the garage area and hose spickets for washing down equipment. The outside areas have irrigation; however, due to drought conditions it has not been used since 2017.

Electrical

The electrical supply is 120/240 volt single phase three-wire service. The building has a single utility meter. The building does not have a backup generator.

Building Envelope

The main access point to the building for the public and the administrative personnel is a double entry, glass panel door. There are two (2) additional access doors for use by the crew. The doors are well maintained and not make tight seals. The garage doors to allow for inside storage of

maintenance vehicles and equipment. Three (3) of the garage doors measure fourteen (14) feet tall, fourteen (14) feet wide and two (2) inches thick and one (1) garage doors a slightly smaller measuring twelve (12) feet tall by twelve (12) feet wide and two (2) inches thick.

The front offices have a wood truss roof system with insulation in the ceiling. This ceiling is insulated with fiberglass insulation with open areas lacking insulation. The existing fiberglass insulation is R13. Current code would be R38 minimum for a commercial building. No air sealing exists around wire and light penetrations. The rear offices also have the wood truss roof system above the ceiling, accessed by a pull- down stairway. This stairway has no insulated cover. The ceiling has blown in fiberglass installed to a depth of 14" (R42). There is no air sealing around penetrations. Pictures are provided in Appendix A.

Domestic Hot Water

Domestic hot water (DHW) is supplied by one (1) Bradford White® 40-gallon free-standing electric water heater. DHW in the tanks is maintained at 125°F and used for the bathroom sink faucet, kitchen sink and maintenance sink in one of the garage bays.

2.4. Renewable Energy Assessment

As part of the auditing process the team examined the possibility of adding renewable energy technologies at the Water Department Offices which include: solar photovoltaic (PV), solar hot water, small scale wind, and cogeneration systems. This analysis is meant to provide general information regarding existing conditions at Water Department Offices and is not meant to serve as a guarantee regarding the feasibility of installing any of these systems.

Solar PV: Water Department Offices has a pitched roof that could be used to install solar panels. The roof will allow for panels to be oriented to the southern direction to maximize the exposure to the sun. There are no surrounding buildings and limited trees that would create shading effects. The estimated payback for this system is approximately 17 years.

Solar Hot Water: The roof at the Water Department Offices would make it a possible candidate for a solar hot water installation, however the need and use of hot water at the building is very low. This creates a long payback for this system.

Small Scale Wind: Due to the urban location of Water Department Offices small scale wind turbines would likely not be feasible due to inconsistent wind flows and moderate population density. The wind turbines generate noise which may be disruptive to the people in the area.

Cogeneration: Water Department Offices does not have opportunities for cogeneration at the building due to its relatively small heat load.

2.5. Energy Use Index & Benchmarks

The chart below summarizes the current, as well as the historical energy use indexes (EUI) and utility costs for the Water Department Offices. Since city water is not considered an energy use, it is not included in the calculation of the EUI and is not included in the total energy cost per square foot calculation.

ENERGY STAR Rating

The Highway Garage Offices' office space is recognized by the Environmental Protection Agency (EPA) ENERGY STAR Portfolio Manager Program. According to EPA guidance the facility is classified as a Transportation Terminal/Station is not eligible for an ENERGY STAR rating.

Metrics Summary			
Metric	**Dec 2016 (Energy Baseline)**	**Dec 2019 (Other)**	**Change**
ENERGY STAR Score (1-100)	Not Available	Not Available	NA
Source EUI (kBtu/ft^2)	85.9	88.2	2.30 (2.70%)
Site EUI (kBtu/ft^2)	54.5	57.5	3.00 (5.50%)
Energy Cost ($)	$10,360.43	$11,200.85	840.42 (8.10%)
Total GHG Emissions Intensity (kgCO2e/ft^2)	4.9	4.7	0.20 (5.60%)
Water Use (All Water Sources) (kgal)	24.0	8.5	-15.50 (-64.60%)
Total Waste (Disposed and Diverted (Tons)	Not Available	Not Available	N/A

3. General Information

3.1. Audit Team

Firefly Energy Efficiency Services, Inc. (Firefly EES) collaborated with Ms. Natalie Lovett, Assistant Town Administrator, Ms. Katherine Bento, Office Manager and Mr. Robert Gray, Water Department Manager to collect the necessary data for this audit.

3.2. Audit Process

Prior to starting field visits, the Audit Team collected historical energy data for Water Department Offices. Firefly EES visited Water Department Offices on a few occasions in early 2020 and collected detailed information on the mechanical, lighting, and plumbing systems as well as occupancy, building use patterns, and equipment operating schedules. In the late Winter, the COVID 19 pandemic caused a delay in the audit process. As a result, data was collected in the Summer and Fall of 2020. Ultimately, each recommendation was fully priced and energy savings and payback estimates calculated.

3.3. Financial Analysis – Methodologies & Assumptions

The financial analyses included in this report were derived using available resources from the ASHREA guidance, EPA, the Massachusetts Green Communities program and information provided on the equipment. These resources were used to perform an analysis of each recommendation. Using the estimates for project cost, annual savings, life of the equipment, and the equipment's replacement cost, a variety of useful financial, energy savings, and greenhouse gas reduction metrics were generated.

Energy use values were calculated by collecting the total annual use for propane gas and electricity. These values were collected from the utility providers.

Annual electricity use was provided by Rowley Municipal Electric. Equipment energy use was calculated into kWh per hour, by reviewing the equipment label. Hourly use was estimated against the buildings occupancy schedule and multiplied by the kWh use per hour. The value for the equipment was then subtracted from the annual use to determine the usage percentage for that equipment. Annual propane gas use was provided by Holden Oil.

Costs were calculated by multiplying equipment use by the average annual utility rate. 2019 average annual price per gallon (gal) was used for propane gas and water, while kWh was used for electricity.

The following table reflects the approximate portion of fixed costs for each utility.

Fixed Costs of Utilities Supplied through Town of Rowley Water Department Offices (2019 Rates)				
	Oil	Propane Gas	Electricity	Water
Unit Rate	NA	$2.10 per gallon	$0.183 per kWh	$20.31 per 1000 gallons
Estimated Infrastructure Percentage	NA	45%	53%	2%

4. Energy Efficiency Measures

4.1. Energy Efficiency Measures Summary

EEM Collective, Rowley Water Department Offices													
ECR	Measure Type	Energy Conservation Recommendation	Electricity	Propane Gas	Water	GHG Reduction	Total Annual Savings	Total Costs	Utility Rebate	Net Costs	Cost / MTCDE	Payback (years)	SIR
			kWh	Gallons	Gal	MTCDE							
1	Conservation	Install Programable Thermostats	334	132	0	0.74	$371	$0	$0	$0	$0	0	NA
2	Electricity reduction	Install Motion Sensors for existing LED Lighting	495	0	0	0.28	$89	$875	$0	$875	$3,125	9.82	2.04
3	Electricity reduction	Install Water Heater Thermal Blanket	618	0	0	0.35	$111	$120	$0	$120	$342	1.08	18.54
4	Electricity reduction	Install Interior LED Lighting	3,900	0	0	2.22	$702	$2,988	$1,320	$1,668	$751	2.38	8.42
5	Electricity reduction	Install Exterior LED Lighting	1,375	0	0	0.78	$248	$900	$240	$660	$846	2.67	7.50
6	Weatherization	Replace Front Windows	167	0	0	0.36	$114	$4,650	$0	$4,650	$12,917	40.96	0.49
7	Weatherization	Insulated stair cover, air seal attic, additional insulation	945	105	0	1.13	$392	$10,226	$0	$10,226	$4,843	26.11	0.77

4.2. Energy Efficiency Measures

Note: Savings calculations reflect savings from individual measures only and do not assume that other recommendations have been implemented. Calculations and assumptions used are solely based on the existing equipment and usage schedules.

Zero Cost (EEM 1)

EEM 1 *(implemented as part of HVAC Control)*

Set Programable Thermostats									
Budgetary Cost	Annual Utility Savings				GHG MTCODE	Annual Savings	Available Incentives	Payback with Incentives	Payback without Incentives
	Electricity	Oil	Propane Gas	Water					
$	kWh	Therms	Gallons	CCF	Metric Tons	$	$	Years	Years
$0	334	NA	132	NA	0.74	$371	$0	NA	0

Existing Condition: *Inefficient Lighting*
The propane gas fired heating units, mini-split system, and electric baseboards require thermostats to maintain heat (and cooling for the split system) to comfort employees and prevent pipes from freezing in the facility.

Recommendation: The facility has programmable thermostats that should be set for working hours and non-working hours. Programmable thermostats allow pre-set scheduling for heating use to mimic building occupancy times. This will prevent employees from forgetting to turn the heat or cool down during non-working hours.

Implementation:
The implementation requires reviewing the instruction manual and setting the thermostats for working and non-working hours. Further information regarding assumptions and calculations are included in Appendix C.

Low Cost (EEM 2-5)

EEM 2 *(implemented as part of electricity reduction)*

Install Ceiling Sensors in the Administrative Office area									
Budgetary Cost	Annual Utility Savings				GHG MTCODE	Annual Savings	Available Incentives	Payback with Incentives	Payback without Incentives
	Electricity	Oil	Propane Gas	Water					
$	kWh	Therms	Gallons	CCF	Metric Tons	$	$	Years	Years
$875	495	NA	NA	NA	0.28	$89	$0	NA	9.82

Existing Condition: *Inefficient Building Controls*
The LED Fixtures in the administrative area and the first garage bay do not have motion sensors.

Recommendation: Install ceiling sensors in the administrative areas (open office, conference room, and breakroom) and the first garage bay. The sensors will keep the lighting on during periods of activity and shut the lights off during periods of inactivity. This will prevent employees from forgetting to turn the lights off during non-working hours or when leaving for short runs.

Implementation: The installation includes the cost to purchase and install ceiling sensors. Further information regarding assumptions and calculations are included in Appendix C.

EEM 3 *(implemented as part of electricity reduction)*

Install Water Heater Jacket									
Budgetary Cost	Annual Utility Savings				GHG MTCODE	Annual Savings	Available Incentives	Payback with Incentives	Payback without Incentives
	Electricity	Oil	Propane Gas	Water					
$	kWh	Therms	Gallons	CCF	Metric Tons	$	$	Years	Years
$120	618	NA	NA	NA	0.35	$111	$0	NA	1.08

Existing Condition: *Inefficient insulation*
The water heater is stored in the first bay garage. The water heater does not have the added insulation layer around the holding tank.

Recommendation: Wrap the heater in a water heater blanket. There are products designed for easy installation around water heaters to reduce heat transfer from the heated water tank by outside air. These blankets offer up to 25% energy use reductions.

Implementation: Estimate includes the cost to install the water heater blanket. Further information regarding assumptions and the calculations made for this EEM can be found in Appendix C.

EEM 4 *(implemented as part of electricity reduction)*

Replace Interior Lighting with LED alternative									
Budgetary Cost	Annual Utility Savings				GHG MTCODE	Annual Savings	Available Incentives	Payback with Incentives	Payback without Incentives
	Electricity	Oil	Propane Gas	Water					
$	kWh	Therms	Gallons	CCF	Metric Tons	$	$	Years	Years
$2,988	3,900	NA	NA	NA	2.22	$702	$1,320	2.38	4.26

Existing Condition: *Inefficient Lighting*
The lighting in the crew area and file storage is provided by prismatic wrap fixtures fitted with T8 fluorescent lamps. Lighting in the rear garage bay has high bay fixtures with six (6) T5 fluorescent lamps.

Recommendation: Retrofit the existing T8 fluorescent fixtures with 20-watt LED by Remphos® Barkit J LED or similar alternative to reduce electric consumption. The new lamps and drivers will be a direct replacement for the existing lamps and ballasts and can accompany motion sensors. Replace the T5 fixtures in the rear garage with 100-watt LED high bay fixtures with motion sensors the fixture sensors will shut the lights off during periods of inactivity. The replacement LEDs have a rated lifespan of 100,000 hours versus 2,000 for the existing fluorescent lamps, which will help reduce maintenance costs associated with replacing burn outs.

Implementation: Estimate includes the cost to professionally install 20W LED Barkit J® products and LED High bays with motion sensors. The electric savings assumptions for daily usage were made based on space type and incentives available for each fixture/lamps installed. Further information regarding assumptions and the calculations made for this EEM can be found in Appendix B and C.

EEM 5 *(implemented as part of electricity reduction)*

Replace Exterior Lighting with LED alternative									
Budgetary Cost	Annual Utility Savings				GHG MTCODE	Annual Savings	Available Incentives	Payback with Incentives	Payback without Incentives
	Electricity	Oil	Propane Gas	Water					
$	kWh	Therms	Therms	CCF	Metric Tons	$	$	Years	Years
$900	1,375	NA	NA	NA	0.78	$248	$240	2.67	3.64

Existing Condition: *Inefficient Lighting*
Lighting for the rear exterior of the building is provided by wall pack legacy fixtures.

Recommendation: Replace the legacy wall pack fixtures with LED area flood fixtures with photocells. Area Flood LED fixtures with photocells (illuminate at dusk and shut down at dawn) provide better lighting output for the storage area at greatly reduced wattages. In addition, LED products are instant on where metal halide takes 20-30 minutes to reach full illumination. The photocells will remove the need for a time clock and revision to account for day light savings. The products have a 100,000-hour useful life with the reduced wattage and maintenance costs.

Implementation: Estimate includes the cost to install new fixtures. Yearly savings runtime estimates were dusk to dawn operation. Further information regarding assumptions and calculations are included in Appendix C.

Weatherization (EEM 6-7)

EEM 6 *(implemented as part of weatherization)*

Replace Front Windows									
Budgetary Cost	Annual Utility Savings				GHG MTCODE	Annual Savings	Available Incentives	Payback with Incentives	Payback without Incentives
	Electricity	Oil	Propane Gas	Water					
$	kWh	Therms	Gallons	CCF	Metric Tons	$	$	Years	Years
$4,650	167	NA	0	NA	1.13	$114	$0	NA	40.96

Existing Condition: *Inefficient Building Envelope*
The front of the building is south facing with large single glazed picture windows. These windows allow intense sunlight (heat) into the administrative area.

Recommendation: Replace the picture windows with double hung or casing windows with screens.

Implementation: Estimate includes the cost to install the windows. The energy efficient windows will reduce the greenhouse effect and the screens will allow for ventilation and comfort during seasonal periods where outdoor air provides comfortable setting. Estimated savings were calculated into a reduction in heating and cooling for the administrative area. Further information regarding assumptions and calculations are included in Appendix C.

EEM 7 *(implemented as part of weatherization)*

Air Seal, Install additional 6 inch cellulose insulation, Install (R30)									
Budgetary Cost	Annual Utility Savings				GHG MTCODE	Annual Savings	Available Incentives	Payback with Incentives	Payback without Incentives
	Electricity	Oil	Propane Gas	Water					
$	kWh	Therms	Gallons	CCF	Metric Tons	$	$	Years	Years
$10,226	945	NA	105	NA	1.13	$392	$0	NA	26.11

Existing Condition: *Inefficient Building Envelope*
This ceiling above the administrative area is insulated with fiberglass insulation with open areas lacking insulation. There is no attic stair cover. The existing fiberglass insulation is R13. Current code would be R38 minimum for a commercial building. No air sealing exists around wire and light penetrations.

Recommendation: Reduce heating and cooling loss through the ceiling by properly air sealing and installing attic cover over the stairs (access point) and add insulation. Install additional 6 inches of cellulose insulation along with R13 fiberglass insulation. Add (2) two inches of rigid insulation on attic knee wall.

Implementation: The estimate includes the cost to furnish, install air sealing and insulation materials. Additional information regarding assumptions and calculations are included in Appendix C.

5. Utility Analysis

5.1. Utility Rate Schedules

Utility Rates: 2017-2019				
Utility	**Unit**	**2017 Rate**	**2018 Rate**	**2019 Rate**
Electricity	kWh	$0.17	$0.17	$0.18
Natural Gas	CCF	$1.97	$2.30	$2.26
Water	Gallons	$0.02	$0.02	$0.02

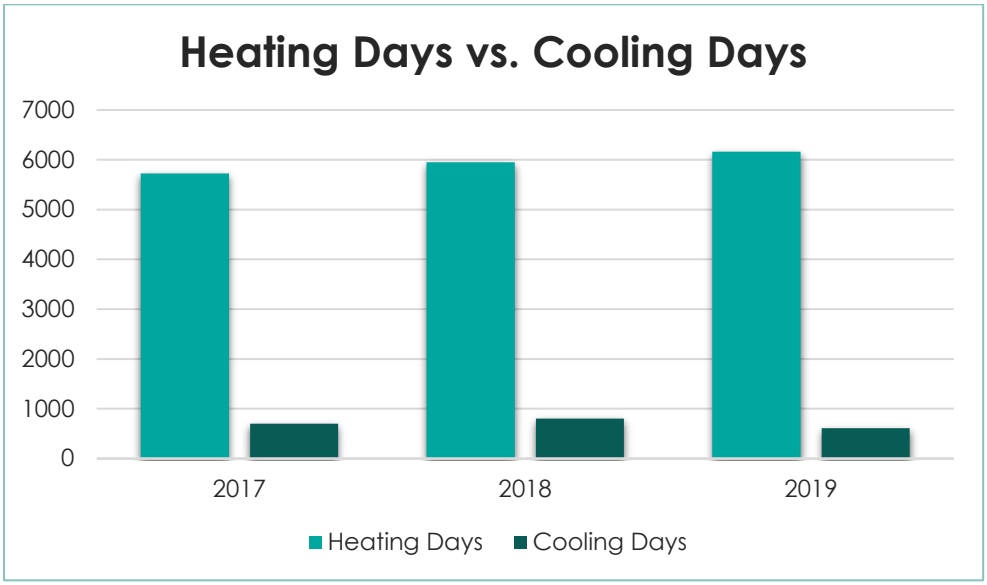
5.2. CO_2 Equivalents for Utilities

The table below lists the metric ton of carbon dioxide equivalents (MTCDE) for each utility consumed by Water Department Offices. The conversion factors were calculated by the Greenhouse Gas Inventory through the Environmental Protection Agency. These factors were used to estimate the greenhouse gas reductions for each energy conservation recommendation at Water Department Offices.

Carbon Dioxide Equivalents by Utility Type	
Propane Gas (MTCDE/therm)	**Electricity** (MTCDE/kWh)
0.005318	0.000390

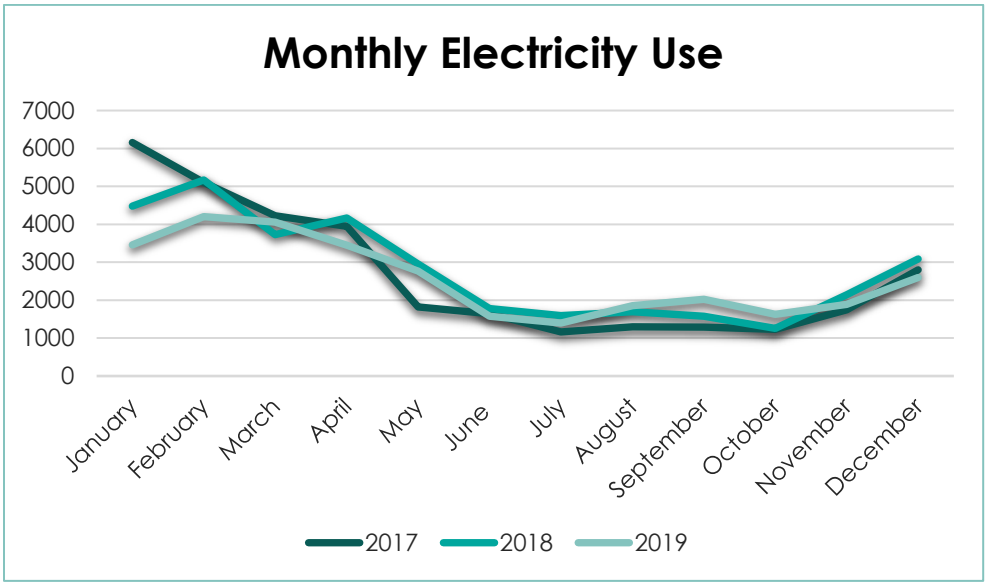
5.3. Annual Degree Days 2017 – 2019

This graph provides the number of heating and cooling degree-days for Rowley, Massachusetts for the past three (3) years. A heating degree-day (HDD) is the number of degrees that a day's average outside air temperature is below 65°F and a building's interior is typically heated. A cooling degree-day (CDD) is the number of degrees that a day's average outside air temperature is above 65°F and air conditioning is typically used to cool a building's interior spaces. This data is useful to determine increases in energy uses based on weather conditions. For example, an increase in HDD will typically increase heating costs, where the increase in CDD will typically increase cooling cost.

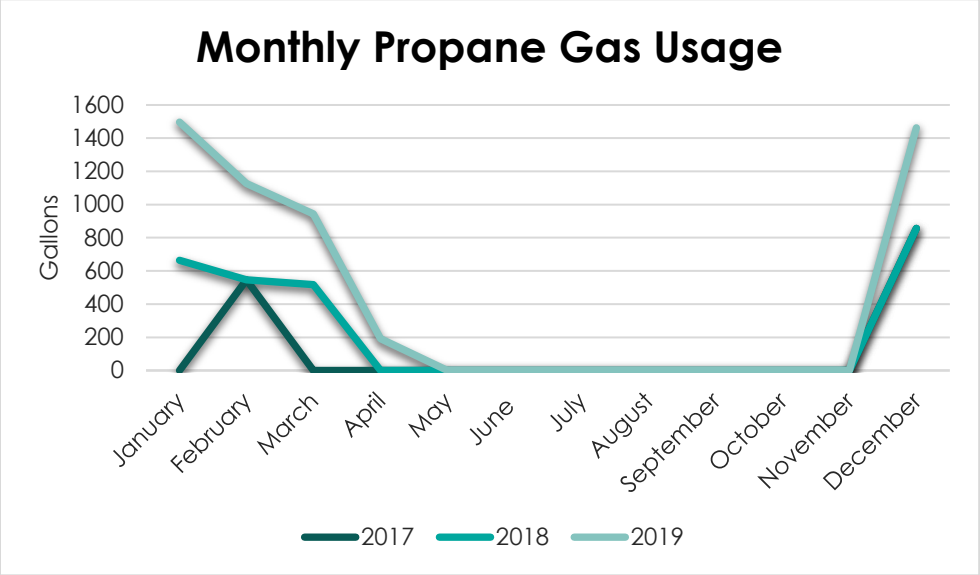


5.4. Utility Performance Summary by Fiscal Year

Examining the historical utility data of the building is a requirement of an ASHRAE Level II audit. The table below shows the electricity use for Water Department Offices from 2017 through 2019. The graph below visually represents the trend in energy consumption over these years.

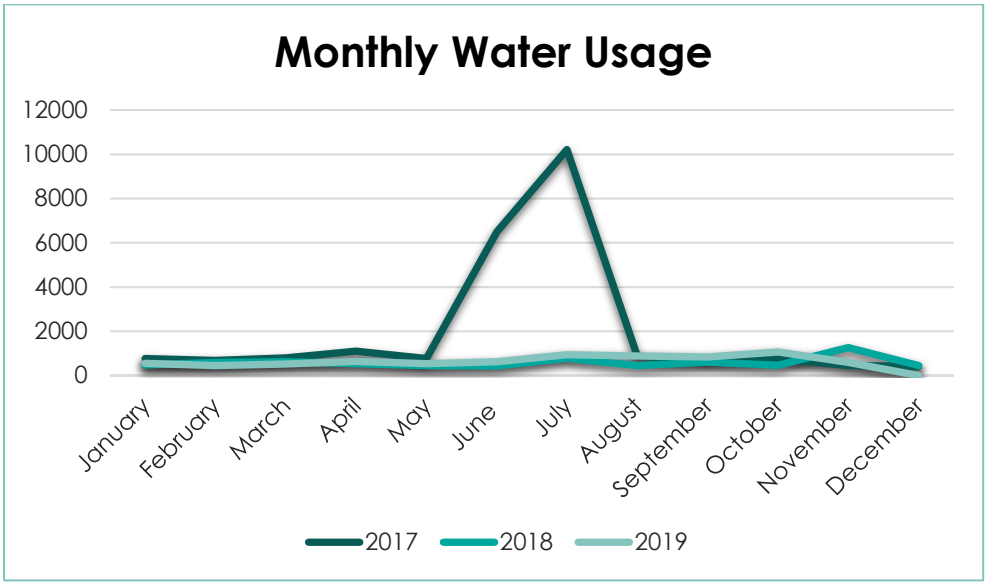


Electricity use at Water Department Offices has decreased by 5% between 2017 and 2019.



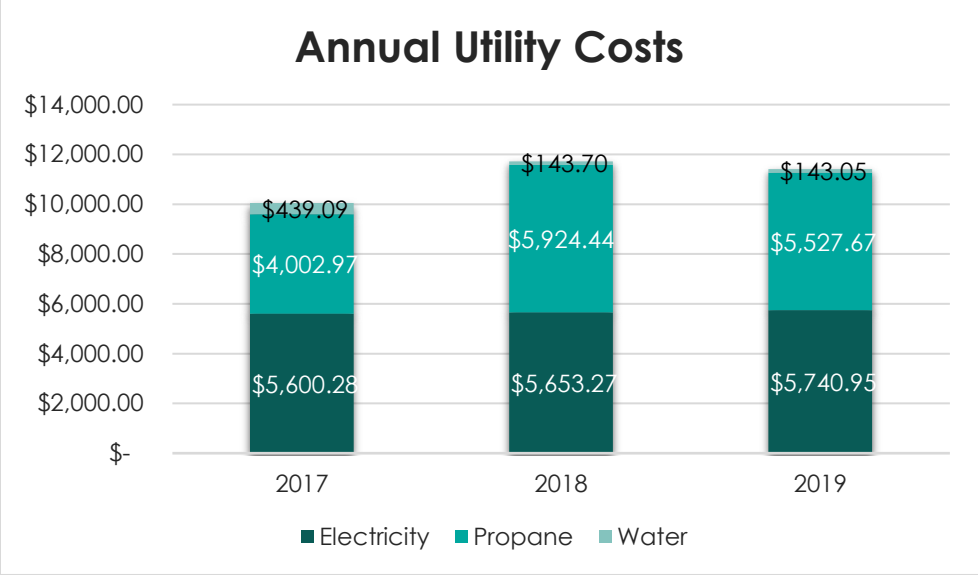
The table above shows the natural gas use for Water Department Offices from 2017 through 2019. Natural Gas use trends are as one would expect. It is in heavy need during the colder months and not needed in the warm months. Overall natural gas use has increased by 29% since 2017.

Water usage had spiked during the summer months of 2017. This is a result of irrigating outdoor plants around the building. Since 2017 outdoor watering has stopped due to summer droughts resulting in outdoor watering restrictions. The table below shows water use from 2017 through 2019.

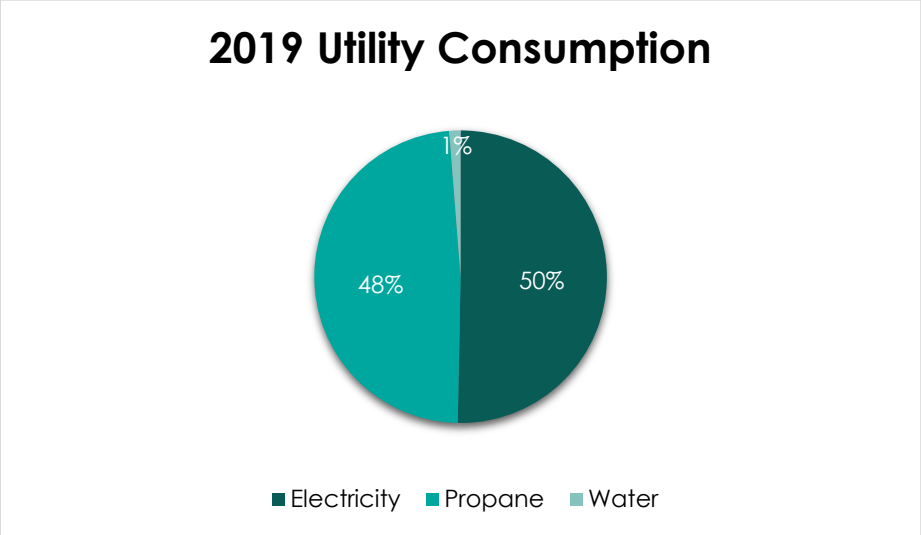


5.5. Utility Component Breakdown

In 2019, Water Department Offices spent a total of $11,411.67 on all utilities including electricity, propane gas, and city water. The chart below proportionally illustrates the cost breakdown by utility category. 50.3% of the total utility cost was comprised of electricity while 48.4% of the total cost was propane gas. City water accounted for 1.2% of all utility cost. The table below shows the annual utility costs.

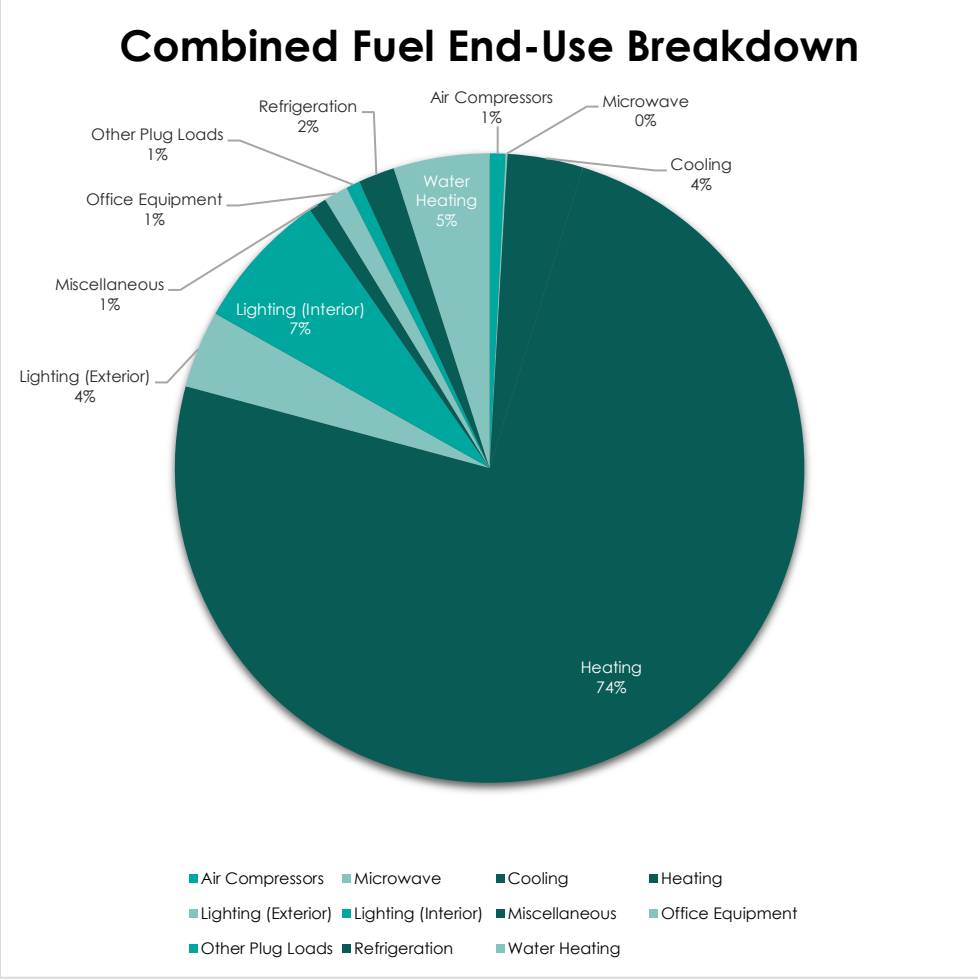


5.6. End Use Component Energy Usage Breakdown



The pie chart below provides energy consumption end use breakdowns for the Water Department Offices based on 2019 data. Since there are no sub meters to continuously measure electrical loads within the Water Department Offices, the Team used some assumptions to estimate and then extrapolate annual distribution loads. The lighting load is based on a count of all the lighting fixtures and estimates of yearly runtime per fixture. The space cooling load is based on the ratings of the window air-conditioning unit. The space heating consumption is equal to the natural gas heaters and electrical baseboard heating consumption at the building. The domestic hot water consumption is a result of the electric hot water heater at the building.

Town water was not included in this analysis since it is strictly a utility cost and is not considered a component of energy consumption by the building.



The total energy consumption is calculated by converting gallons of oil and kilowatt hours of electricity in British Thermal Units then multiplied by a "kilo" or 1,000 (kBtus). One kBtu is the amount of energy needed to raise the temperate of one pound of water by one degree Fahrenheit.

In 2019, Water Department Offices' total energy consumption was 320,123 kBtus of energy including electricity, and propane gas. The chart below proportionally illustrates energy use breakdown by utility category. Propane gas represents 48% of the total energy consumption while electricity represents 50%.

Heating consumes the most energy and comprises 74% of Water Department Offices' annual energy consumption in KBtu. This value includes the use of electric baseboard heaters, mini-split system and the propane gas heaters. The use of the heating equipment amounts to 60% of the building's annual energy cost. Interior and exterior lighting accounts for 11% of the annual energy consumption and comprises 17% of the annual energy cost. Cooling the office spaces equals 4% of the annual energy consumption and 6% of the annual budget. Office equipment (computers, copier) accounts for approximately 1% of the annual energy consumption and 2% of the annual budget. The water heater is responsible for 5% of the energy use and 8% of the budget, while refrigeration accounts for 1% of energy use and 3% of the budget.

Annual Energy Consumption by End Use Components 2019						
End Use	Electricity	Natural Gas	Total	% of Total Use	Total Cost ($)	% of Total Cost
	kWh	Therms	kBtu			
Air Compressor	767	0	2,671	1%	$140.36	1%
Cooling	3,645	0	12,437	4%	$667.04	6%
Heating	7,011	2,142	238,123	74%	$6,810.68	60%
Lighting (Exterior)	3,734	0	12,741	4%	$683.32	6%
Lighting (Interior)	6,712	0	22,902	7%	$1,228.30	11%
Miscellaneous	657	0	2,242	<1%	$130	1%
Office Equipment	1,158	0	3,951	1%	$211.91	2%
Other Plug Loads	675	0	2,303	1%	$123.53	1%
Refrigeration	1,750	0	5,971	1%	$320.25	3%
Domestic Hot Water	4,622	0	15,771	5%	$845.83	8%
Total	**27,543**	**4,337**	**527,181**	**100%**	**$9,254**	**99%**

5.7. Energy Use & Cost Indices by Fiscal Year

Calculating historical energy usage on a square footage basis is a requirement of an ASHRAE Level II audit. The EUI information can be helpful in comparing energy intensity in buildings of similar space types in similar geographical locations on a per square footage basis. Additionally, the cost index can be helpful in comparing one buildings operation cost to that of similar buildings.

The table below displays the energy performance data in consumption and cost per square foot. The annual utility cost indices for the Water Department Offices, in dollars per square foot, show the energy costs are increasing slightly annually.

Energy Use and Cost Indices by Year		
Year	**Metric**	**Utility Data**
2019	Energy Utilization Index (kBtu/ft²/year)	114.5
	Energy Cost Index ($/ft2/year)	$1.65
	Utility Cost Index (Including City Water) ($/ft²/year)	$1.67
2018	Energy Utilization Index (kBtu/ft²/year)	277.1
	Energy Cost Index ($/ft2/year)	$1.55
	Utility Cost Index (Including City Water) ($/ft²/year)	$1.57
2017	Energy Utilization Index (kBtu/ft²/year)	118.5
	Energy Cost Index ($/ft2/year)	$1,72
	Utility Cost Index (Including City Water) ($/ft²/year)	$1.79

5.8. Electrical Demand

Review of electrical demand data is a requirement of an ASHRAE Level II audit. The table below illustrates the maximum electrical demand as well as demand per square foot. Demand charges are fees applied to the electric bills of commercial and industrial customers based upon the highest amount of power drawn during any (typically 15-minute) interval during the billing period.

Demand has been increasing over the past three years. The maximum demand for 2019 was consistent with previous years. The highest readings occurred in January 2017, February 2018, and March 2019, as a result of the electric heating use during these months.

Electrical Demand 2017 through 2019		
Year	**Metric**	**Electrical Data**
2019	Maximum Demand (kW)	14.4
	Maximum Demand (watts/ft2)	0.0023
2018	Maximum Demand (kW)	16.6
	Maximum Demand (watts/ft2)	0.0027
2017	Maximum Demand (kW)	19.2
	Maximum Demand (watts/ft2)	0.0031

6. Phased Energy Savings Approach

This section is an effort to help the Town of Rowley plan the adoption of energy efficiency equipment and the installation process. Securing funding through town budgets and grants can take extended periods of time for planning. As a result, by viewing the next steps as a phased approach, the Town of Rowley can better predict the steps needed to execute the project installations.

6.1. Phased 1: Set Programable Thermostats, Water Heater Blanket, and Update Remaining Lighting

The Town of Rowley can harness a considerable savings by changing the remaining lighting to LED technology at the Water Department Offices. This will reduce the wattage required to illuminate the rear building garage area, the crew area and the laydown area in the back of the facility. LED lighting uses less wattage, provides more lumens (light) and does not require the maintenance that legacy lighting requires. It saves money in utility costs and in maintenance costs. The garage area would benefit considerably from LED high bay fixtures with fixture sensors. The sensors would provide the automated feature of shutting the lighting off during periods of inactivity. Currently, if an employee forgets to turn the lighting off, the lights remain on. In addition, ceiling sensors added in the administrative office area, which has already been outfitted with LED lighting will also provide electricity savings when employees forget to turn the lights off. For the exterior of the building replacing existing wall packs to LED area floods will not only provide saving in utility and maintenance costs but will also project additional light for added security.

The Water Department Offices should set the programable thermostats to mimic work schedules. This will prevent employees from forgetting to turn the heating or cooling system down during non-working periods. We all rush out of the office at one time or another and if that happens on a Friday, the heating or cooling system will use energy unnecessarily over the weekend.

Lastly, the Water Department Offices can save energy by placing a water heater blanket around the electric water heater. The water heater is located in a garage bay. The water heater blanket will reduce heat transfer from the tank.

6.2. Phase 2: Update building envelope

The Water Department Office has existing insulation in the attic; however, there are areas that need to be air sealed and insulation can be upgraded to increase the R Value. Air sealing around conduits for wires for lighting and other equipment and installing stair covers will reduce heat and cooling loss.

The front windows to the building are single glazed, large picture windows. In the winter their low R value allows cold air to enter the space. In the summer the south facing windows allow intense sunlight in the space which increases temperature. New, energy efficient windows, with screens will reduce this effect while also allowing for outside ventilation during seasonable days.

6.3. Renewable Energy – Solar Array on Roof

Water Department Offices also has an ideal roof setting to install solar panels. The front of the building is south facing and has limited shading from trees and no shading from nearby buildings.

A 37.5 kW direct current (DC) system, that would generate roughly 33,000kWh at a cost of approximately $105,000. This would account for all of the 2019 electricity needs for Water Department Offices. The simple return on investment (ROI) is estimated to be around 17 years with a life expectancy of 30 years.

Appendices

A. Project Pictures

Office Programable Thermostat

Water Heater

Garage Programable Thermostat

Picture Windows in Administrative Area

Evidence of Wall Insulation

Attic – Insulation Void

Crew Area T8 Office Lighting

Rear Garage T5 High Bay Lighting

Exterior Legacy Wall Pack

Garage Propane Heater

Crew Area Baseboard Heater

Administrative Area Mini-Split System

B. Lighting Audit Data

Customer Info	Town of Rowley
Company Name	Water Depart. Offices
Address	401 Central St
City	Rowley
State	MA
Zip	01969

Contact name	
Phone	
Email	
Account #, if known	

Vendor Info	
Company Name	Firefly EES, Inc
Address	18 Hart Road
City	Lynnfield
State	MA
Zip	01940

Contact Name	
Phone	
Email	

Existing						Proposed				Savings and Incentives					Financials			
Item ID (match to cut sheet)	**Location**	**Qty**	**Desc. (# and type of lamps, type of fixture)**	**Watts (if known)**	**Ann. Hrs. Use**	**Qty**	**Desc. (# and type of lamps, type of fixture)**	**Watts**	**Control Type to be added (if any)**	**Ann. Hrs. Use**	**Ann. kWh Savings**	**Ann. $ Savings**	**Existing kWh**	**Rebate Each**	**Total Rebate**	**Product Cost**	**Labor**	**Subtotal**	**Total After Rebate**
	Rear Garage Bay	6	4L4' 54W T5HO/ELIG	303	2080	6	Highbay	100	Fixture	1414	3,421.60	$684.32	4,411.68	$190.00	$1,140.00	$1,488	$900	$2,388	$1,248
	Crew Area	6	2L4 T8/ELIG LOW PWR	52	2080	2	LED BARKIT J	20	Wall	1414	479.23	$95.85	91	$30.00	$180.00	$300	$300	$600	$420
	File Storage	4	2L4 T8/ELIG LOW PWR	52	500	4	LED BARKIT J	20	Wall	340	76.80	$15.36	104	$30.00	$120.00	$200	$200	$400	$280
	Exterior Rear	3	Wall Pack	205	4368	3	LED Area Flood	100	Photocell	4368	1,375.92	$275.18	2,686.32	$80.00	$240.00	$600	$300	$900	$660
	Front Garage Bay	11	LED Wrap	35	1500	11	LED Wrap	35	Ceiling	1020	184	36.96	577.5	$0	$0	$150	$100	$250	$250
	Conference Room	2	LED Wrap	35	1300	2	LED Wrap	35	Ceiling	884	29.12	$5.82	91	$0	$0	$75	$50	$125	$125
	Open Office Area	5	LED Wrap	2080	100	5	LED Wrap	35	Ceiling	1414	116.48	$23.30	364	$0	$0	$150	$100	$250	$250
	Hallway	2	LED Wrap	35	100	3	LED Wrap	35	Ceiling	100	46.59	$9.32	145.6	$0	$0	$75	$50	$125	$125
											-								
											6,336.66	$1,267.33	11949.7		$1,680.00	$3,113	$2050	$5163	$3,483

C. EEM Assumptions & Calculations

EEM 1 – Set Programmable Thermostats

Setting a programmable thermostat can save 10 to 30% on the space heating and cooling portion of energy bills. Conservative factor of 0.5 to adjust for heat being on and set at 55 degrees during nonworking hours. 2019 Annual Propane Gas was 2637 gallons, a 5% reduction in gallons purchased is estimated to be save 131.85 gallons

Baseboard Heat Electricity reduction:
Crew Area has four electric baseboard heaters.
1.0 kWh X 8 = 8 kWh per day
5 days X 8 kWh = 40 kWh per week
40 kWh per week X 4.33 = 173.2 kWh
173.2 kWh X 4 months = 692 kWh
692 kWh X 4 heaters = 2,771.2 kWh

5% reduction in baseboard heating use. Baseboards are estimated to account for 2,771.2 kWh annually = 138.56 kWh.

Administrative Heating reduction: The administrative area is estimated to use 4,239.8 kWh annually. A reduction of 5% is equal to 211.99 kWh.

Administrative Cooling Reduction: The cooling in the administrative office area is estimated 3,489 kWh annually. A reduction of 5% is equal to 174.45 kWh.

EEM 2 – Install Motion Sensors for Existing Interior LED Lighting

Existing LED Lighting Assumptions		
Location	**Est. Annual Hours**	**Est. Annual kWh**
Front Garage Bay	1,500	577.5
Conference Room	1,300	91
Open Office Area	2080	364
Hallway	2080	145.6
Total		1881.66

Equation	
((Qty*Existing Watts)*Annual Hours))/1000	Annual kWh

Sensor Assisted LED Lighting Assumptions			
Location	Est. Annual Hours	Est. Annual kWh Savings	Est. Savings
Front Garage Bay	1,020	185	$36.96
Conference Room	884	29	$5.82
Open Office Area	1414	116	$23.30
Hallway	1414	47	$9.32
Total		424	$84.72
Rowley Municipal kWh rate	$0.18		

Equation	
((Qty*Existing Watts)*Annual Hours))/1000 – (Qty*LED Watts)*Annual Hours))/1000	Electricity Savings

***LED sensor reduce existing hours by 32%**

EEM 3 –Install Water Heater Jacket

kWh Water heater use = 4622
kWh rate = $0.18
Assume 25% reduction in heat loss
Assume 7% annual reduction in energy cost = 323.54 kWh
323.54 kWh x $0.18 = $58.24 annually
Insulating your water tank, can reduce standby heat losses by 25%–45% and save you approximately 7%–16% in water heating costs.

EEM 4 – Install Interior LED Lighting with Sensor in Rear Garage and Crew Area

Interior Legacy Lighting Assumptions		
Location	Est. Annual Hours	Est. Annual kWh
Rear Building Garage Bays	2080	3,781.44
Crew Area	2080	648.96
File Storage	500	104
Total		4,534.4

Equation	
((Qty*Existing Watts)*Annual Hours))/1000	Annual kWh

Interior LED Lighting With Sensor Assumptions			
Location	**Est. Annual Hours**	**Est. Annual kWh Savings**	**Est. Savings**
Rear Building Garage Bays	1414	2,932.80	$586.56
Crew Area	1,414	479.23	$95.85
File Storage	340	76.80	$15.36
Total			$697.77
Rowley Municipal kWh rate	$0.18		

Equation	
((Qty*Existing Watts)*Annual Hours))/1000 – (Qty*LED Watts)*Annual Hours))/1000	Electricity Savings

EEM 5 –Install Exterior LED Lighting with Photocell

Exterior Legacy Lighting Assumptions		
Location	**Est. Annual Hours**	**Est. Annual kWh**
Rear Building Wallpacks	4368	2,686.32
Total		2,686.32

Equation	
((Qty*Existing Watts)*Annual Hours))/1000	Annual kWh

Exterior LED Lighting Assumptions			
Location	**Est. Annual Hours**	**Est. Annual kWh Savings**	**Est. Savings**
Replace with LED Area Floods for added security	4368	1,375.92	$275.18
Total		8,486	$1,528
Rowley Municipal kWh rate	$0.18		

Equation	
((Qty*Existing Watts)*Annual Hours))/1000 – (Qty*LED Watts)*Annual Hours))/1000	Electricity Savings

EEM 6 – Replace Front Picture Windows

Garage Bay Propane Gas Heat Reduction: Savings not estimated since front windows not near garage bays and separated by closed door and walls.

Split System Heat reduction: 5% reduction in heating use. Split System Heat is estimated to account for 4,239 kWh annually = 211.95 kWh.

Split System Cooling Electricity Reduction: 12% reduction in cooling estimated. The mini-split cooling system is estimated to use 3489 kWh annually. A 12% reduction represents 418.68 kWh savings.

ECR 7 – Install Stair Covers, Air Seal Attic additional insulation

Propane gas reduction:
4% reduction in gallons from 2019 purchase data. Annual propane gas (2637 purchased) is estimated to be saved by addressing improper insulation status = 105.48 gallons

Baseboard Heat Electricity reduction: 4% reduction in baseboard heating use. Baseboards are estimated to account for 2,771.2 kWh annually. Savings estimated to save 110.84 kWh.

Split System Heat reduction: 4% reduction in heating use. Split System Heat is estimated to account for 4,239 kWh annually = 211.95 kWh.

Split System Cooling Electricity Reduction: 9% reduction in cooling estimated. The annual estimated kWh for this cooling system is 3,489 which is estimated to be reduced by 314.01 kWh.

March 30, 2020

Rowley Water Dept. Energy Audit:

To: Scott Gromko

Dear Scott,

Per your request, the building maintenance records are below.

Please contact me if you need further information.

Thank you,
Kathy

October 18, 2018	John Cardillo Electric	Installed 5 LED 150 watt 277 volt by pass bulbs in 3 Hubbell outside wall pack light fixtures and replaced electrical eyes	$875.00
May 21, 2019	Dry Air Systems	Installed heat/ac for two office rooms, included refrigeration piping and electrical work.	$15,900

Appendix D

MMBTU Conversion Chart (MA Department of Energy Resources)

Fuel Energy Content of Common Fuels

BTU Content of Common Energy Unit – (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 diesel fuel = 0.139 MMBTU
- 1 barrel of residual fuel oil = 6.287 MMBTU

Appendix E

Supporting Documents:

- Section 179D Report – Pine Grove School
- Memo from architect RE: Energy Efficient Features of PD / FD Project

Section 179D Report

Presented to:

Dore & Whittier Architects
212 Battery Street
Burlington, VT 05401

Pine Grove Elementary School

214 E. Roosevelt St.
Phoenix, AZ 85004
877-666-5539
www.capitalreviewgroup.com

SECTION 179D INDEX

May 1, 2020

Dore & Whittier Architects
212 Battery Street
Burlington, VT 05401

RE: §179D – ENERGY TAX DEDUCTION TRANSFER AND ALLOCATION NOTICE

This Notice is to transfer and allocate the Energy Study Certification tax benefits from the Public Building Entity to the Primary Designer for the energy efficient assets designed for the subject property:
191 Main Street, Rowley, MA 01969 These benefits are transferred to the Primary Designer who is: Dore & Whittier Architects.

The Energy Policy Act of 2005 (EPAct2005), added §179D to the United States Code Title 26, Internal Revenue Code – and is administered through Internal Revenue Bulletin 2006-26 (Notice 2006-52), later clarified and amplified by Internal Revenue Bulletin 2008-14 (Notice 2008-40). Notice 2012-22 sets forth additional guidance relating to the deduction for energy efficient commercial buildings under §179D and is intended to be used with Notice 2006-52 and Notice 2008-40. §179D, the "Commercial Building Deduction" provides an immediate tax deduction for the cost of improvements to commercial property designed to save energy through envelope, HVAC and lighting system improvements. These tax deductions – per EPAct2005 and extended by the Emergency Economic Stabilization Act of 2008 - are available for systems "placed in service" from January 1, 2006 through December 31, 2014. House Amendment #2 to the Senate Amendment to H.R. 2029 or PROTECTING AMERICANS FROM TAX HIKES ACT OF 2015 retroactively extended §179D through 2016. The Bipartisan Budget Act of 2018 again retroactively extended the tax deductions through 2017. The effective date of §179D now is from January 1, 2006 through December 31, 2020.

§179D (d)(1) includes the provision for a partial allowance if a taxpayer replaces one of the systems identified under §179D(c)(1), subject to meeting the efficiency requirements for that system. Partially qualifying commercial building property is property that would be energy efficient commercial building property but for the failure to achieve the 50 per cent (50%) reduction in energy and power costs required under §179D (c)(1)(D).

Internal Revenue Bulletin 2008-14 (Notice 2008-40) allows the tax deduction under §179D relating to energy efficient commercial building property installed on or in property owned by a Federal, State, or local government or a political subdivision thereof, to be transferred and allocated to the person/entity primarily responsible for designing the property (the Primary Designer). If the allocation of a §179D deduction to the Primary Designer satisfies the requirement of this section, the deduction will be allowed only to that designer. The deduction will be allowed to the Primary Designer for the taxable year that includes the date on which the property was/is placed in service.

IRS REQUIRED INFORMATION: Pine Grove Elementary School

1. The address of the government-owned building on or in which the property is installed:
191 Main Street
Rowley, MA 01969

2. The cost of the property (assets): $38,992,086
3. The date the property (assets) was/were placed in service: 09/03/2019
4. The amount of the §179D deduction allocated to the Primary Designer: $157,892
5. Third party "Qualified Individual" providing Certification:

6. Third party "Qualified Individual" address and phone number:

7. Third party "Qualified Individual" calculations via IRS prescribed software: eQuest

"Under penalty of perjury, I declare that I have examined this allocation, including accompanying documents, and to the best of my knowledge and belief, the facts presented in support of this allocation are true, correct and complete".

Signature: _____ **Date:** _____

Acknowledged by the Authorized Representative of the Owner of the Public Entity:

NAME: Brian Forget
TITLE: Triton Superintendent of Schools
ADDRESS: 112 Elem Street
Byfield, MA 09122
PHONE: 978-465-2397

Agreed and accepted this_____day of _____, 20_____. Recipient of §179D Deduction:

CONTACT PERSON: Lee Dore
ADDRESS: Dore & Whittier
212 Battery Street
Burlington, VT 05401
PHONE: 978-499-2999

May 1, 2020

Dore & Whittier
212 Battery Street
Burlington, VT 05401

PROJECT: Pine Grove Elementary School

IRS Approved Software Used: eQuest

IRS qualified computer software was used to calculate energy and power consumption costs to certify that the required energy cost reductions were obtained. The DOE approved software used to calculate the energy and power consumption of this facility was e**Quest.**

The Performance Rating Method (PRM) has been used to compute the percentage reduction in the total annual energy and power costs with respect to combined usage of a building's heating, cooling, ventilation, hot water, envelope and interior lighting systems as compared to the minimum requirements of ASHRAE Standard 90.1-2001 through December 31, 2015 or ASHRAE Standard 90.1-2007 for projects completed January 1, 2016 through December 31, 2017. The Bipartisan Budget Act of 2018 again retroactively extended the tax deductions through 2017. The effective date of §179D now is from January 1, 2006 through December 31, 2020.

ENERGY TAX CERTIFICATE

This letter constitutes Capital Review Group's final results having performed services related to the engineering analysis, engineering calculations and necessary functions relative to an Energy Certification Study/Review per the Energy Policy Act of 2005.

The subject property qualified for a $1.80 per sq. ft. §179D deduction. The Envelope, Lighting and HVAC systems that have been incorporated into the building reduced the total annual energy and power costs by the necessary amount to a Reference Building (modeled) that meets the minimum requirements of ASHRAE Standard 90.1-2001 if the "date of service" was on or before December 31, 2015 or ASHRAE Standard 90.1-2007 if the "date of service" is January 1, 2016 through December 31, 2017.

Date of Service: 09/03/2019

The cost of the assets: $38,992,086

The square footage Certified: 87,696

Deduction: $157,892

The Energy Policy Act of 2005 (EPAct), added §179D to the United States Code Title 26, Internal Revenue Code – and administered through IRS Notice 2006-52. §179D, the "Commercial Building Deduction" provides an immediate tax deduction for the cost of energy-efficient improvements to commercial property designed to save energy through envelope, HVAC and lighting system improvements. The Emergency Economic Stabilization Act of 2008 (HR-1424), approved and signed on October 3, 2008, extends the benefits of the Energy Policy Act of 2005 through December 31, 2014. These tax deductions – per EPAct2005 and extended by the Emergency Economic Stabilization Act of 2008 - are available for systems "placed in service" from January 1, 2006 through December 31, 2014. House Amendment #2 to the Senate Amendment to H.R. 2029 or PROTECTING AMERICANS FROM TAX HIKES ACT OF 2015

retroactively extended §179D through 2016. The Bipartisan Budget Act of 2018 again retroactively extended the tax deductions through 2017. The effective date of §179D now is from January 1, 2006 through December 31, 2020.

§179D(d)(1) includes the provision for a partial allowance if a taxpayer replaces one of the systems identified under §179D(c)(1), subject to meeting the efficiency requirements for that system. Partially qualifying property commercial building property is property that would be energy efficient commercial building property but for the failure to achieve the 50 percent (50%) reduction in energy and power costs required under §179D (c)(1)(D).

IRB Notice 2008-14 allows the tax deduction under §179D that is installed on or in property owned by a Federal, State, or local government or a political subdivision thereof, to be transferred and allocated to the person/entity primarily responsible for designing the property (the designer). This Notice is amplified and explained in IRS Notice 2008-40. If the allocation of a §179D deduction to a designer satisfies the requirement of this section, the deduction will be allowed only to that designer. The deduction will be allowed to the designer for the taxable year that includes the date on which the property was/is placed in service.

Notice 2006-52 also provides for a public list of software programs that may be used in calculating energy and power consumption for purposes of §179D which are used by Capital Review Group. This notice sets forth additional guidelines relating to the deduction for energy efficient commercial buildings under §179D and is intended to be used with Notice 2006-52. Any reference in this notice to Standard 90.1-2001 should be treated as a reference to ANSI/ASHRAE/IESNA Standard 90.1- 2001 for projects through December 31, 2015. Any reference in this notice to Standard 90.1-2007 should be treated as a reference to ANSI/ASHRAE/IESNA Standard 90.1- 2007 for projects from January 1, 2016 through December 31, 2017. The cited Standards reflect the Energy Standard for Buildings Except Low-Rise Residential Buildings, developed for the American National Standards Institute by the American Society of Heating, Refrigerating, and Air Conditioning Engineers and the Illuminating Engineering Society of North America (as in effect on April 2, 2003, including addenda 90.1a-2003, 90.1b-2002, 90.1c-2002, 90.1d-2002, and 90.1k-2002 as in effect on that date).

Section 179D(a) allows a deduction to a taxpayer for part or all of the cost of energy efficient commercial building property that the taxpayer places in service after December 31, 2005, and before January 1, 2018.
Section 179D(d)(1) and §179D(f) allow a deduction to a taxpayer for part or all of the cost of certain partially qualifying commercial building property that the taxpayer places in service after December 31, 2005 and before January 1, 2018. Partially qualifying commercial building property is property that would be energy efficient commercial building property but for the inability to achieve the 50 percent (50%) reduction in energy and power costs required under §179D(c) (1) (D).

In accordance with the request for a Certificate relating to the deduction for energy efficient commercial buildings under §179D of the Internal Revenue Code for the proposed or newly installed: Envelope, Lighting and HVAC systems, Capital Review Group conducts this Certification process in accordance to Section 1331 of the Energy Policy Act of 2005 Pub. L. No. 109-58, 119 Sta. 594 (2005) enacted §179D of the Internal Revenue Code and all relevant IRS and Legislative rules, procedures and laws.

Capital Review Group follows the IRS Guidelines relative to Partial Credits and the Interim Rule, Partial Credits and the Permanent Rule IRS Notice 2006 -52, Calculation methods – Notice 2006 52, and the Certification – Notice 2006, Notice 2008-40 (Amplification of Notice 2006-52), Notice 2012-22 – Modification of Notice 2008-40.

The following energy report identifies the components of the interior lighting system, heating, cooling, ventilation and envelope installed in the building, and the energy efficiency features of the building and its projected annual energy costs.

We are relying on the relevant provisions of the Internal Revenue Code, the regulations within and the judicial and administrative interpretations thereof, which are subject to change or modification by subsequent legislative, regulatory, administrative or judicial decisions. Any such change could also have an effect on the validity of our conclusions. Unless specifically requested we will not update our results for subsequent changes or modification to the law or the judicial and administrative interpretations thereof.

Capital Review Group certifies the following:

1. That it has no present or future contemplated interest in the property.
2. Neither our contractual agreement nor our compensation relative to this report is contingent upon the conclusions.
3. This report sets forth all assumptions and limiting conditions affecting the analysis, values and conclusions contained herein.
4. No person other than the undersigned or those acknowledged in this report developed the analysis, values or conclusions contained herein.

Sincerely,

Jordan Taylor

Jordan Taylor, CEO

Executive Summary

This report discusses the results of the full building annual energy simulation for Pine Grove Elementary School. The energy simulation demonstrates that the building satisfies the energy efficiency requirements of sections 179D(c)(1) and (d) of the Internal Revenue Code (IRC) and as built, is a qualifying property for Envelope, Lighting and HVAC systems. Based on the above guidelines and Construction Documents of the actual building, the Taxpayer's Building performs 50.20 % better in terms of regulated cost than the Reference Building.

Features	Taxpayer Building	Reference Building
Project Name	**Pine Grove Elementary School**	
Project Address	**191 Main Street, Rowley, Massachusetts, 01969**	
Climate Zone	**5**	
Building Area (Sq. Ft.)	**87,696**	
Number of hours heating loads not met	2	38
Number of hours cooling loads not met	50	0
Total Energy Cost (Excluding Process Load)	$ 68,330	$ 137,203
Percentage Energy Cost Saving	50.20 %	
Eligible Tax Deduction Regime along with specifications (USD/Sq. Ft.)	$ 1.8	
Total Tax Deduction (USD)	$ 157,892	

Introduction

Pine Grove School is a school building located at Rowley, Massachusetts. The total area of the building is 87,696 sq.ft.

Figure 1 Pine Grove School

This report includes the following information:

- The Methodology section describes the method and simulation tool used in the energy modeling and the energy savings calculation with associated guidelines and references.
- The Building Energy Efficiency Measures section describes energy-efficiency strategies that are incorporated in the Taxpayer's Building Model.
- The energy and power costs savings comparison between the Taxpayer's Building and the Reference Building are provided in the Summary of Results section. This section also concludes that the savings meet the requirement for a fully qualifying property for commercial building federal tax deductions.

Methodology

The eligibility for tax deductions for Pine Grove Elementary School is determined from the energy and power cost savings of the Taxpayer's Building Model as compared to those of a Reference Building model of equivalent area and use. Table 2 below provides descriptions of the Taxpayer's Building and Reference Building Model (see Appendix for details). Pine Grove School evaluated the energy performance of the energy models using eQUEST v.3.65 an advanced whole-building energy simulation tool based on the simulation software DOE 2.2. The energy and power cost savings are calculated from annual hourly energy simulations. The energy models followed the guidelines given in the technical report NREL/TP-5500-66774. According to this technical report, the energy models must be completed in accordance with the Building Performance Rating Method presented in ANSI/ASHRAE/IESNA Standard 90.1-2007 Appendix G, and the models must comply with the requirements of Standard 90.1-2007.

Table 1: Building and Model Description

Building/ Model	Description
Taxpayer's Building	Physical building used for the tax deduction
Reference Building Model	Computer simulation model that matches the Taxpayer's Building except that the interior lighting systems, HVAC, SHW, and building envelope comply with the minimum requirements of Standard 90.1-2007
Taxpayer's Building Model	Computer simulation model that is identical to the Reference Building model except for the systems that are qualifying for the tax deduction. The systems not qualifying for the tax deduction shall match the systems in the Reference Building.

The model geometries and general system configurations are based on the following sources:

- Architectural drawings and specifications
- Mechanical, electrical drawings and specifications
- Lighting design and control documentation submittals

Summary of Results

The savings calculation for the property shows that in comparison with the Reference Building, the Taxpayer's Building is 50.20 % more energy-efficient in terms of energy cost (Fig.1). This reduction translates to an annual regulated savings of $ 157,892. The savings meet the requirement for a fully qualifying property for Commercial Building Federal Tax Deductions.

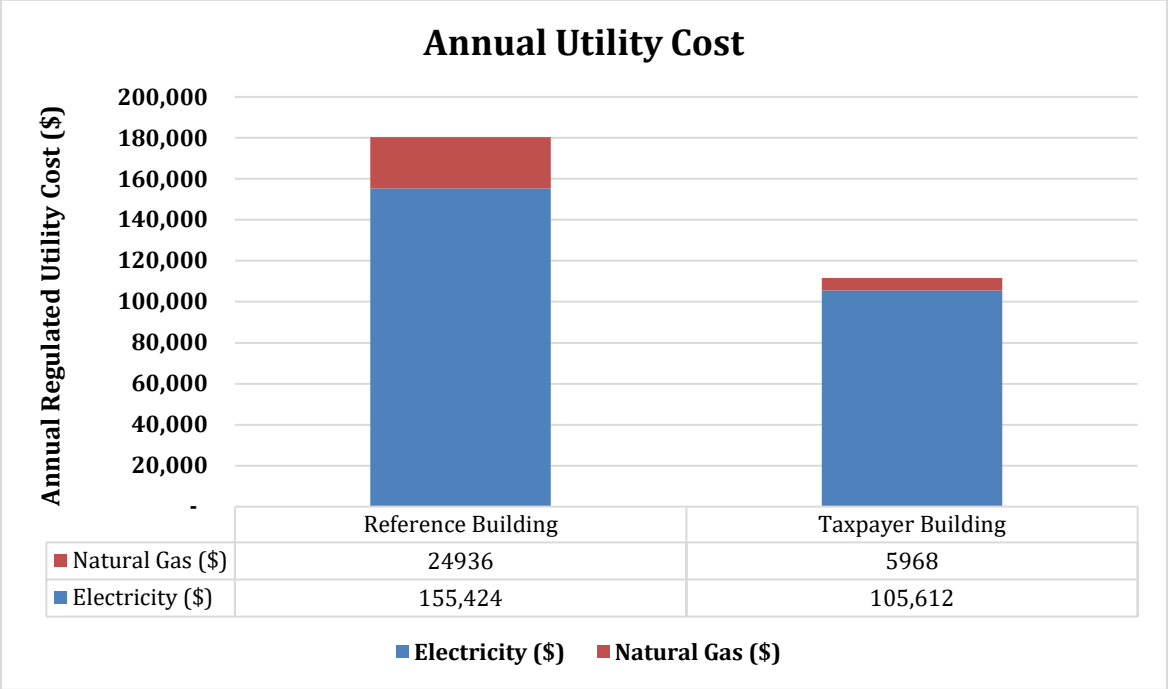


Figure 2: Annual utility comparison in the calculation for a fully qualifying property

According to the guidelines given in Section 3.1 of the technical report NREL/TP-550-40467 "Energy Savings Modeling and Inspection Guidelines for Commercial Building Federal Tax Deductions" published by NREL (2nd edition, May 2007), receptacle and process loads are included in the energy simulations, but the energy and power costs associated with these loads are not included in the energy and power costs savings comparison.

Appendices

General Modeling Parameters

- **Analysis Tool:** eQUEST v3.65 build 7173
- **Energy Code:** ASHRAE 90.1-2007 (minimum requirements of the Reference Building model) ASHRAE Standard 90.1-2007, Appendix G (modeling method follows the Energy Performance Rating Method)
- **Weather File:** BOSTONMA.BIN
- **Climate Zone**: 5
- **Number of Floors:** Basement + above 2 Level
- **Space Type(s):** School building
- **Principal Heating Source:** Hot Water and Gas Fired Furnace
- **Principal Cooling Source:** DX Cooling System

Table 2: Area Statement

Floors	Area (ft^2)
Below Grade Floor	2,071
Level 1	55,403
Level 2	30,222
Total Area	**87,696**

Summary of Building Modeling Parameters

Parameter		Taxpayer Building	Reference Building
Building/Space Classification		School Building	
Location		Rowley, Massachusetts	
Utility Rate Structure	**Natural gas**	1.256 Dollars/therm	
	Electricity	0.1608 Dollars/KWh	
Annual Weather Data		Boston, MA	
Form (area, shape, floors)		Area :– 87,696 Floors:- Basement + 2 Levels	
Envelope	**Wall**	4” Face Brick with 8” CMU and 3” Polystyrene Insulation	Steel Framed Wall, Table 5.5-5, ASHRAE 90.1 2007
	Roof	5” Rigid Insulation with Bitumen Layer and Metal Deck	Insulation Entirely Above Deck, Table 5.5-5, ASHRAE 90.1 2007
	Fenestration	Light diffusing insulted glazing filled with argon	Metal Framing Vertical Glazing, Table 5.5-5, ASHRAE 90.1 2007
Interior Lighting		LPD= 0.35 W/sq.ft.	From ASHRAE 90.1 2007 LPD= 1.2 W/sq.ft
HVAC Systems	**System no.**	-	From ASHRAE 90.1 2007 System 5. Packaged VAV with Reheat
	System type	Packaged VAV Rooftop Units with Furnace and Radiant Heating	Packaged rooftop VAV with reheat
	Fan control	VAV	VAV
	Cooling type	Direct Expansion	Direct Expansion
	Heating type	Combination of Hot-water fossil fuel boiler and gas fired furnaces	Hot-water fossil fuel boiler
Ventilation Requirements		Same as Reference Building	ASHRAE 62.1 2004 Table 6-1
Receptacle Loads		Same as Reference Building	From EP-Act Receptacle Load Summary
Schedules		Same as Reference Building	EPAct N2-5 Schedule

Building Shell Construction

Building Element	Taxpayer Building	Reference Building
Exterior Wall Construction (U-value)(Btu/h-sq.ft-F)	0.061	0.064
Roof Construction (U-value)(Btu/h-sq.ft-F)	0.029	0.048
Window-to-Wall Ratio	22.21%	22.21%
Fenestration U-value (Btu/h-sq.ft-F)	0.44	0.55
Fenestration SHGC	0.23	0.40

Building Occupancy, Lighting and Equipment Load

Building Element	Taxpayer Building	Reference Building
Building Average Interior Lighting Power Density (W/sf)	0.35	1.20
Building Average Equipment Power Density[1] (W/sf)	1.00	1.00
Maximum Building Occupancy for Energy Model	3931	3931

[1] Receptacle and process loads are included in the energy simulations, but the energy and power costs associated with these loads are not included in the savings calculation.

Building Occupancy, Lighting and Equipment Schedules

The table below lists occupancy, lighting and equipment schedules are from table N2-5 of EPAct. The same schedules are used for the Reference Building.

Hour		Occupancy			Lighting			Equipment		
From	To	WD	Sat	Sun	WD	Sat	Sun	WD	Sat	Sun
12:00 AM	1:00 AM	0%	0%	0%	5%	5%	5%	20%	20%	15%
1:00 AM	2:00 AM	0%	0%	0%	5%	5%	5%	20%	20%	15%
2:00 AM	3:00 AM	0%	0%	0%	5%	5%	5%	20%	20%	15%
3:00 AM	4:00 AM	0%	0%	0%	5%	5%	5%	20%	20%	15%
4:00 AM	5:00 AM	10%	0%	0%	20%	10%	10%	20%	20%	15%
5:00 AM	6:00 AM	5%	0%	0%	10%	5%	5%	20%	20%	15%
6:00 AM	7:00 AM	25%	5%	0%	40%	15%	10%	35%	20%	15%
7:00 AM	8:00 AM	65%	15%	5%	70%	25%	15%	60%	20%	20%
8:00 AM	9:00 AM	65%	15%	5%	80%	25%	15%	70%	25%	20%
9:00 AM	10:00 AM	65%	15%	5%	85%	25%	15%	70%	25%	20%
10:00 AM	11:00 AM	65%	15%	5%	85%	25%	15%	70%	25%	20%
11:00 AM	12:00 PM	65%	15%	5%	85%	25%	15%	70%	25%	20%
12:00 PM	1:00 PM	65%	15%	5%	85%	25%	15%	70%	25%	20%
1:00 PM	2:00 PM	65%	15%	5%	85%	25%	15%	70%	25%	20%
2:00 PM	3:00 PM	65%	15%	5%	85%	20%	15%	70%	20%	20%
3:00 PM	4:00 PM	65%	15%	5%	85%	20%	15%	70%	20%	20%
4:00 PM	5:00 PM	65%	15%	5%	85%	20%	15%	65%	20%	20%
5:00 PM	6:00 PM	40%	5%	5%	80%	15%	10%	45%	20%	15%
6:00 PM	7:00 PM	25%	5%	5%	35%	10%	10%	30%	20%	15%
7:00 PM	8:00 PM	10%	5%	5%	10%	10%	10%	20%	20%	15%
8:00 PM	9:00 PM	5%	0%	0%	10%	10%	5%	20%	20%	15%
9:00 PM	10:00 PM	5%	0%	0%	10%	10%	5%	20%	20%	15%
10:00 PM	11:00 PM	5%	0%	0%	10%	10%	5%	20%	20%	15%
11:00 PM	12:00 AM	0%	0%	0%	10%	10%	5%	20%	20%	15%

HVAC System

Building Element	Taxpayer Building	Reference Building
Mechanical Systems		
HVAC System Type	Packaged VAV Rooftop Units with Furnace and Radiant Heating	Packaged rooftop VAV with reheat
Air-Side System		
Cooling		
Cooling Source	DX Cooling	DX Cooling
Cooling Efficiency	All RTU's are having EER in the range of 11.1 – 12.7	9.5 EER
Heating		
Heat Source	Hot Water Boilers and Gas Fired Furnace	Hot Water Boilers
Heating Efficiency	96.2% Efficient Boilers and 80% Efficient Furnaces	80% Efficient

Mechanical Schedules

ROOFTOP UNITS -

UNIT NO.	MANUF. NO.	AREA SERVED	TOTAL C.F.M.	O.A. C.F.M.	MAX. COIL VEL. F.P.M.	NATURAL GAS HEATING DATA (NOTE #1)					DX COOLING							
						ENT. AIR °F	LVG. AIR °F	CFH INPUT	HEATING M.B.H.	MIN. EFF.	ENT. COND. D.B. °F	ENT. COND. W.B. °F	LVG. COND. D.B. °F	LVG. COND. W.B. °F	M.B.H. SENS.	M.B.H. TOTAL	NO. OF COMP.	HOT GAS LDB
RTU-1	RN	NORTH CLASSROOMS	2,700	2,700	500	45.3	98.8	195.0	156.0	80%	79.6	66.4	53.3	50.7	80.8	120.2	2	70.0
RTU-2	RN	EAST CLASSROOMS	5,590	5,590	500	46.4	85.4	270.0	218.7	80%	79.7	66.9	52.3	51.9	194.3	314.4	2	70.0
RTU-3	RN	EAST CLASSROOMS	5,175	5,175	500	46.4	85.4	270.0	218.7	80%	79.7	66.9	52.3	51.9	151.0	225.1	2	70.0
RTU-4	RN	SOUTH CLASSROOMS	5,075	5,075	500	44.6	84.6	270.0	218.7	80%	79.5	66.7	51.7	51.4	149.2	223.3	2	70.0
RTU-5	RN	SOUTH CLASSROOMS	5,000	5,000	500	45.2	85.8	270.0	218.7	80%	79.4	66.6	52.9	52.6	140.4	202.8	2	70.0
RTU-6	RN	GYMNASIUM	7,000	7,000	500	41.9	85.4	405.0	328.1	80%	80.6	67.3	51.9	51.7	212.4	317.1	2	70.0
RTU-7	RN	ADMINITRATION	2,500	2,500	500	45.1	102.9	195.0	156.0	80%	79.4	66.4	53.3	52.8	69.1	98.3	2	70.0
RTU-8	RN	CAFETERIA / PLATFORM	9,350	4,000	500	62.3	94.9	405.0	328.1	80%	76.5	63.6	50.9	50.4	255.8	341.7	2	70.0

ROOFTOP UNITS - PREPURCHASED UNDER ERP #1

DX COOLING						VAV CONTROL	SUPPLY AIR						RETURN AIR					
M.B.H. SENS.	M.B.H. TOTAL	NO. OF COMP.	HOT GAS REHEAT COIL LDB	EER / IEER @ ARI LWB	EER	IEER	VF DRIVE	E.S.P. IN.W.G.	H.P.	VOLT	PH.	R.P.M	WHEEL DIA.	E.S.P. IN.W.G.	H.P.	VOLT	PH.	R.P.M	WHEEL DIA.
80.8	120.2	2	70.0	58.3	12.2	14.9	YES	2.0"	3	460	3	1760	18.5"	2.0"	3	460	3	1760	18.5"
194.3	314.4	2	70.0	58.3	11.7	12.7	YES	2.0"	7.5	460	3	1760	24.5"	2.0"	5	460	3	1760	22"
151.0	225.1	2	70.0	58.9	12.0	14.4	YES	2.0"	7.5	460	3	1760	24.5"	2.0"	5	460	3	1760	22"
149.2	223.3	2	70.0	58.7	12.0	14.4	YES	2.0"	7.5	460	3	1760	24.5"	2.0"	5	460	3	1760	22"
140.4	202.8	2	70.0	59.3	12.2	14.1	YES	2.0"	7.5	460	3	1760	24.5"	2.0"	5	460	3	1760	22"
212.4	317.1	2	70.0	58.9	11.7	12.7	YES	2.0"	10	460	3	1614	22.0"	2.0"	7.5	460	3	1825	22"
69.1	98.3	2	70.0	59.3	12.7	15.5	YES	2.0"	3	460	3	1760	18.5"	2.0"	2	460	3	1760	18.5"
255.8	341.7	2	70.0	58.2	11.1	12.0	YES	2.0"	15	460	3	1760	27.4"	2.0"	3	460	3	1760	22"

MAKE UP AIR UNIT - PREPURCHASED UNDER ERP #1

UNIT NO.	MANUF. NO.	AREA SERVED	TOTAL CFM	O.A. CFM	E.D.B.	L.D.B.	OUTPUT MBH	GAS PRESS	INPUT CFH	MIN. EFF.	EXT. IN W.G.	COOLING TOTAL MBH	SENSIBLE MBH	E.A.T DB/WB	L.A.T DB/WB	EER @ AMRI	MOTOR QTY	MOTOR HP.	MOTOR V	MOTOR PH.	MOTOR MCA	MOTOR MOCP	RPM	UNIT WEIGHT (LBs)	REMARKS
MAU-1	RN	KITCHEN	4,500	4,500	5.0	93.8	432		540	80%	2.0"	299.9	172.9	88.0/73.0	51.0/50.8	11.2	1	7.5	460	3	58	70	1459	2,875	SEE NOTES

SELECTION BASED ON "AAON". PROVIDE MOTORIZED INLET DAMPER.
NOTE #1: PROVIDE VFD ON SUPPLY FAN MOTOR IN ACCORDANCE W/ DIVISION 260000 REQUIREMENTS.
NOTE #2: MINIMUM EFFICIENCY RATINGS PER ANSI Z21.47 TEST PROCEDURES.

DUCTLESS COOLING UNIT SYSTEMS

UNIT NO.	MANUF. NO.	EVAP. LOCATION	COND. PUMP	EVAPORATOR UNTS CFM	EVAPORATOR UNTS COOLING MBH	EVAPORATOR UNTS V	EVAPORATOR UNTS PH	EVAPORATOR UNTS MAX. FUSE	ASSOCIATED CONDENSER	CONDENSER UNITS TAG	CONDENSER UNITS MODEL	CONDENSER UNITS TONS	CONDENSER UNITS COOLING MBH	CONDENSER UNITS V	CONDENSER UNITS PH	CONDENSER UNITS MAX. FUSE	REMARKS
DCUe-1	PKA	1115 IDF	CP-1	320	12.0	208	1	15	DCUc-1	DCUc-1	PUY	1	12.0	208	1	15	
DCUe-2	PKA	1114 ELEC	CP-1	320	12.0	208	1	15	DCUc-2	DCUc-2	PUY	1	12.0	208	1	15	
DCUe-3	PKA	1339 MAIN ELECTRICAL	CP-1	320	12.0	208	1	15	DCUc-3	DCUc-3	PUY	1	12.0	208	1	15	
DCUe-4	PEAD	1204 MEDIA CENTER	CP-1	520	24.0	208	1	30	DCUc-4	DCUc-4	PUY	2	24.0	208	1	30	
DCUe-5	PEAD	1204 MEDIA CENTER	CP-1	520	24.0	208	1	30	DCUc-5	DCUc-5	PUY	2	24.0	208	1	30	
DCUe-6	PKA	1206 ELEC	CP-1	320	12.0	208	1	15	DCUc-6	DCUc-6	PUY	1	12.0	208	1	15	
DCUe-7	PKA	1305 ELEC	CP-1	320	12.0	208	1	15	DCUc-7	DCUc-7	PUY	1	12.0	208	1	15	
DCUe-8	PKA	2101 ELEC	CP-1	320	12.0	208	1	15	DCUc-8	DCUc-8	PUY	1	12.0	208	1	15	
DCUe-9	PKA	2327 IDF	CP-1	320	12.0	208	1	15	DCUc-9	DCUc-9	PUY	1	12.0	208	1	15	
DCUe-10	PKA	2305 ELEC	CP-1	320	12.0	208	1	15	DCUc-10	DCUc-10	PUY	1	12.0	208	1	15	
DCUe-11	PKA	0104 ELEV. MACH. RM	CP-1	320	12.0	208	1	15	DCUc-11	DCUc-11	PUY	1	12.0	208	1	15	
DCUe-12	PKA	2232 NETWORK IT HUB	CP-1	635	24.0	208	1	25	DCUc-12	DCUc-12	PUY	2	24.0	208	1	30	

SELECTION BASED ON "MITSUBISHI". PROVIDE WIRED T'STAT. LOW AMBIENT CONTROL AND INTERNAL MOUNTED CONDENSATE PUMP OF MODEL LISTED ABOVE. CFM BASED ON FANS SET AT MED SPEED. PROVIDE WITH AIR COOLED CONDENSING UNIT AS INDICATED ON THE DRAWINGS. ALL REFRIGERANT TUBING SHALL BE SIZED BY UNIT MANUFACTURER. PROVIDE ALL NECESSARY JOINT KITS, FITTINGS AND ACCESSORIES FOR A COMPLETE OPERATING SYSTEM PER MANUFACTURER'S RECOMMENDATIONS PROVIDE NECESSARY EQUIPMENT FOR BAS INTERFACE. CEILING MOUNTED EVAPORATORS SHALL HAVE INTERNAL CONDENSATE PUMPS. DCU CONTROLS SHALL BE BACNET COMPATIBLE; BMS SYSTEM INTEGRATION REQUIRED BY ATC CONTRACTOR.

UNIT HEATERS (HEATING HOT WATER)

UNIT NO.	MANUF. NO.	BUILDING LOCATION	CFM	MBH	GPM	WPD	MOTOR HP	MOTOR V	MOTOR PH.	REMARKS
UH-1	RH	102 CUSTODIAL WORKROOM	450	55.0	5.5	1.7	1/60	120	1	--
UH-2	RH	1334 BOILER ROOM	450	55.0	5.5	1.7	1/60	120	1	--
UH-3	RFRC	1123 VESTIBULE	450	55.0	5.5	1.7	1/60	120	1	--
UH-4	RFRC	1100 VESTIBULE	450	55.0	5.5	1.7	1/60	120	1	--
UH-5	RFRW	1101 LOBBY	450	55.0	5.5	1.7	1/60	120	1	--
UH-6	RFRC	1200A VESTIBULE	450	55.0	5.5	1.7	1/60	120	1	--
UH-7	RFRW	S1-1 STAIR 1	450	55.0	5.5	1.7	1/60	120	1	--
UH-8	RFRC	1101 LOBBY	450	55.0	5.5	1.7	1/60	120	1	--
UH-9	RH	1327 RECIEVING	450	55.0	5.5	1.7	1/60	120	1	--
UH-10	RFRW	S3-1 STAIR 3	450	55.0	5.5	1.7	1/60	120	1	--
UH-11	RFRC	S2-1 STAIR 2	450	55.0	5.5	1.7	1/60	120	1	--

SELECTION BASED ON "RITTLING", 160° EWT, 20° WTD.

HOT WATER BOILER - PREPURCHASED UNDER ERP #1

UNIT NO.	MANUF. NO.	OUTPUT	EWT	LWT	FLUE SIZE	INLET SIZE	GAS INPUT C.F.H.	GAS PRESSURE	GAS INLET SIZE	BURNER FAN		REMARKS
										V	PH.	
B-1	FBN	1,539	140	160	8"	8"	1,600	4"	1 1/2"	120	1	--
B-2	FBN	1,539	140	160	8"	8"	1,600	4"	1 1/2"	120	1	--

SELECTION BASED ON "LOCHINVAR"
96.2% THERMAL EFFICIENCY

WATER PUMPS

UNIT NO.	MANUF. NO.	BUILDING LOCATION	SERVICE	GPM	TDH FT.	MOTOR				REMARKS
						HP.	VOLT	PH.	RPM	
P-1	FI	BOILER RM	HHW PRIMARY	180	60	5.0	460	3	1160	VFD
P-2	FI	BOILER RM	HHW STAND-BY	180	60	5.0	460	3	1160	VFD

SELECTION BASED ON "BELL & GOSSETT"
PROVIDE SHAFT GROUNDING RINGS SIMILAR TO AEGIS FOR EACH PUMP
VFD BY DIVISION 260000 4

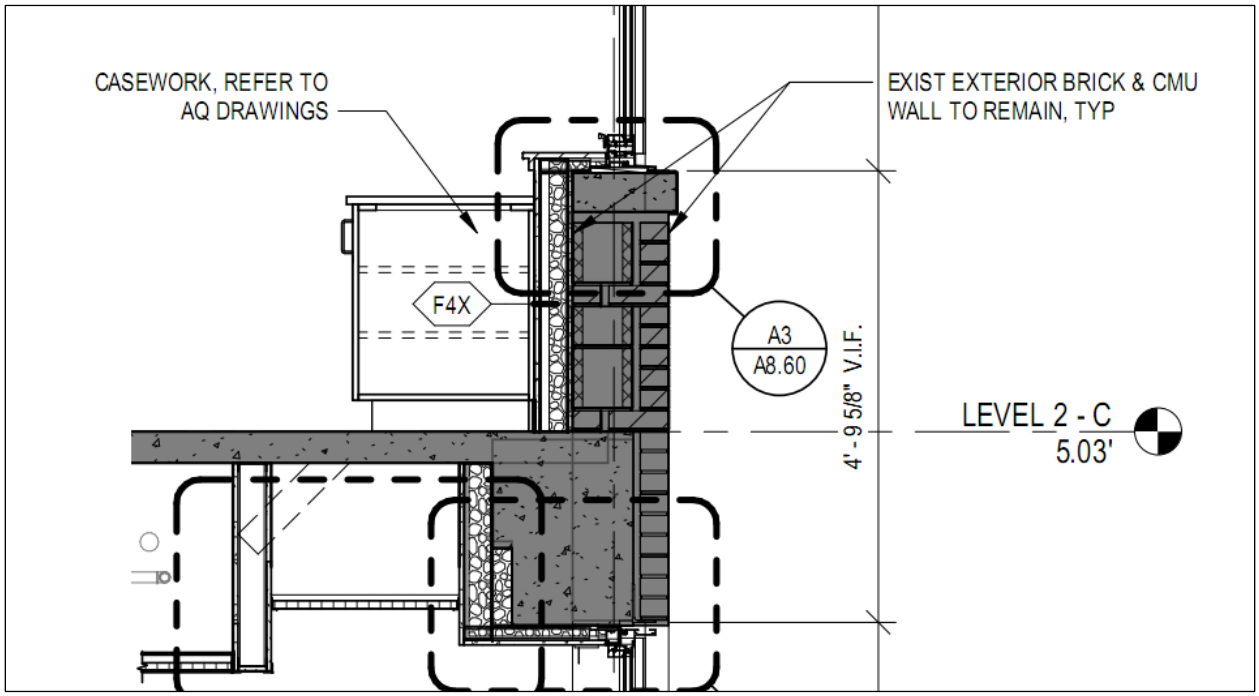
Lighting Schedules

LIGHTING FIXTURE SCHEDULE

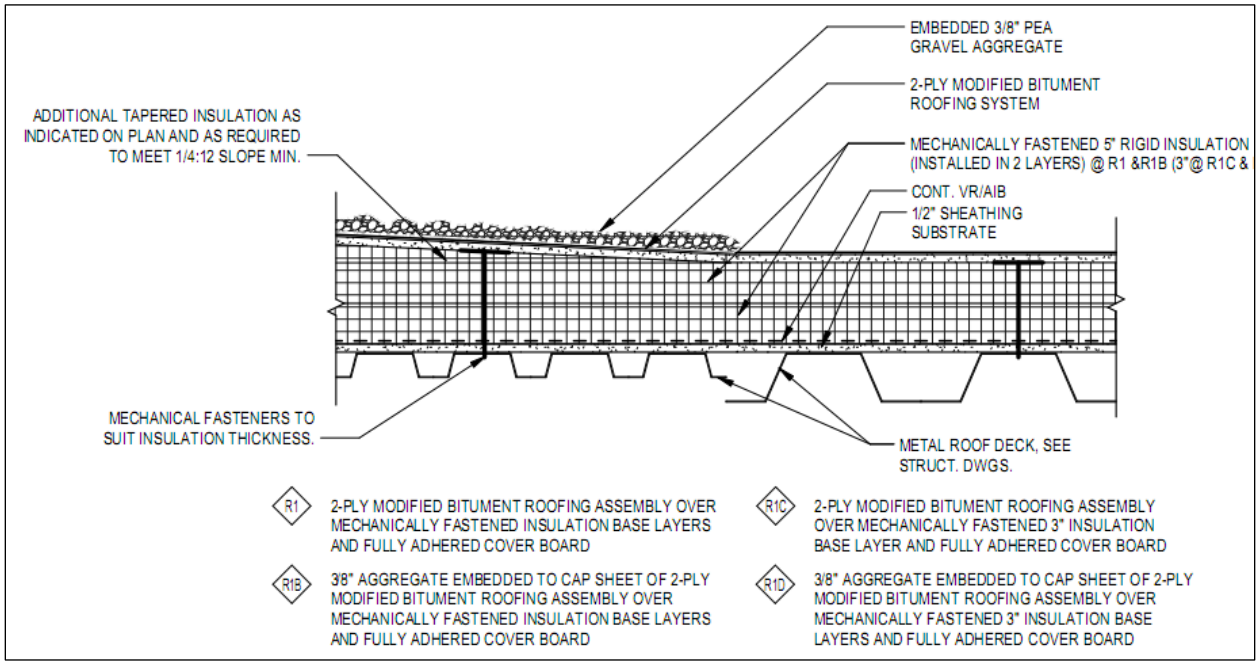
TYPE	MANUFACTURER	MODEL / SERIES	MTG.	VOLTAGE	LIGHT SOURCE			DESCRIPTION
					LUMENS	WATTAGE	TYPE	
J	SIMKAR	VAPLED-W-11-50-U1	W	UNIVERSAL	700	11	LED/3500K	LED JELLY JAR STYLE UTILITY FIXTURE WITH CLEAR HEAT TREATED GLASS GLOBE AND CAST ALUMINUM GLOBE GUARD.
CP1	ABSOLUX	PLAL-550/LAMP-CMTD-UNV	P	UNIVERSAL	550/LAMP	10.5/LAMP	LED/3500K	CHANDELIER LED PENDANT FIXTURE CAPABLE OF 0-10V DIMMING
DC	SIMKAR	CHLED-4-50-35-U1	S	UNIVERSAL	5000	36	LED/3500K	LINEAR DISPLAY CASE LIGHTING FIXTURE
L22	MOBERN	SKB22LED40DMVWH35	R	UNIVERSAL	5000	40	LED/3500K	2' X 2' LED SKYLIGHT RECESSED TROFFER FIXTURE CAPABLE OF 0-10V DIMMING
L44	MOBERN	SKB44LED80DMVWH35	R	UNIVERSAL	9400	80	LED/3500K	4' x 4' LED SKYLIGHT RECESSED TROFFER FIXTURE CAPABLE OF 0-10V DIMMING
LP1	G LIGHTING	GL2725-B-WH-1	P	UNIVERSAL	5141	56	LED/3500K	24" ROUND LED HIGH BAY PENDANT FIXTURE PROVIDE WITH 0-10V DIMMING DRIVER.
LP2	G LIGHTING	GL2738-V-WH-1	P	UNIVERSAL	7684	80	LED/3500K	36" ROUND LED HIGH BAY PENDANT FIXTURE PROVIDE WITH 0-10V DIMMING DRIVER.
LP3	G LIGHTING	GL2726-F-WH-1	P	UNIVERSAL	10197	112	LED/3500K	48" ROUND LED HIGH BAY PENDANT FIXTURE PROVIDE WITH 0-10V DIMMING DRIVER.
LPC1	TMS LIGHTING	JDO-18-19LED-CRD-35K-277-V-TBD-TBD-DIML-ACC-WAT	P	UNIVERSAL	1880	19	LED/3500K	LED PENDANT FIXTURE WITH WOOD ACCENT TRIM. PROVIDE WITH 0-10V DIMMING DRIVER.
LPG	MOBERN	FHBC48LED127DMV35K	P	UNIVERSAL	18000	127	LED/3500K	LINEAR LED HIGH BAY FIXTURE PROVIDE WITH 0-10V DIMMING DRIVER AND FROSTED PROTECTIVE LENS.
LR14	LAMAR	FPLN-14-40-35-D	R	UNIVERSAL	4475	40	LED/3500K	1' X 4' RECESSED LED LUMINAIRE CAPABLE OF 0-10V DIMMING
LR22	ZOOM	ZT-CA-2X2-AN-WA-WA-LED2200-35K-G-WH	R	UNIVERSAL	2200	20	LED/3500K	2' X 2' RECESSED LED LUMINAIRE CAPABLE OF 0-10V DIMMING
LR24	LAMAR	FPLN-24-42-35-D	R	UNIVERSAL	5434	42	LED/3500K	2' X 4' RECESSED LED LUMINAIRE CAPABLE OF 0-10V DIMMING
LR4	SIMKAR	ETY-14-P-20-35-U1	R	UNIVERSAL	2230	20	LED/3500K	1' X 4' RECESSED LED LUMINAIRE CAPABLE OF 0-10V DIMMING
LRK	KURTZON	FP-R-3-2X4-2/LEDR-835-UNV-GTD	R	UNIVERSAL	8160	68	LED/3500K	2'X4' FIXTURE SUITABLE FOR USE IN FOOD PREP AREA AND NSF CERTIFIED. FIXTURE ALSO TO BE CAPABLE OF 0-10V DIMMING.
LRW	NORA LIGHTING	NMR-T-1-3-L85-35-WW	R	UNIVERSAL	2122	32	LED/3500K	RECESSED MODULAR FIXTURE WITH THREE LED MODULES CAPABLE OF 0-10V DIMMING.
LS4	SIMKAR	LCH-4-FA-50-35-U1	S	UNIVERSAL	5000	36	LED/3500K	4' LED UTILITY STRIP FIXTURE PROVIDED WITH FROSTED ACRYLIC DIFFUSING LENS AND CHAIN MOUNTING HARDWARE.
LS8	SIMKAR	LCH-8-FA-90-35-U1	S	UNIVERSAL	9000	72	LED/3500K	8' LED UTILITY STRIP FIXTURE PROVIDED WITH FROSTED ACRYLIC DIFFUSING LENS AND CHAIN MOUNTING HARDWARE.
LWS2	LAMAR	44L-XX-F-M-FA-35-D	R	UNIVERSAL	861/FT	8/FT	LED/3500K	SLIM RECESSED LINEAR FIXTURE CAPABLE OF 0-10V DIMMING. LENGTHS AS SPECIFIED ON PLANS.
LWS4	DELVIRO ENERGY	DTLCR-10-35K-U-FR-TBD-DRT-3.18-N-N-RC	R	UNIVERSAL	1000/FT	10/FT	LED/3500K	SLIM RECESSED LINEAR FIXTURE CAPABLE OF 0-10V DIMMING. LENGTHS AS SPECIFIED ON PLANS.
PC1	COVENTRY	C12X6PLCR-1250-35K-D6-XX	P	UNIVERSAL	3700	28	LED/3500K	6" LED PENDANT CYLINDER PROVIDED WITH 0-10V DIMMING. CONFIRM FINISH OF FIXTURE WITH ARCHITECT.
RC1	PEACHTREE	4BLRD-12-35K-90-TBD-TBD-F-UNV	R	UNIVERSAL	1223	21.9	LED/3500K	4" LED RECESSED DOWNLIGHT FIXTURE CAPABLE OF 0-10V DIMMING.
RC2	PEACHTREE	8BLRD-18-35K-90-TBD-DSCR-F-UNV	R	UNIVERSAL	1789	24.9	LED/3500K	8" LED RECESSED DECORATIVE DOWNLIGHT FIXTURE CAPABLE OF 0-10V DIMMING.
RCK	PEACHTREE	6BLRD-20-35K-90-PP-LH-W-DSCR-F-UNV	R	UNIVERSAL	2099	24.9	LED/3500K	6" LED RECESSED ENCLOSED DOWNLIGHT FIXTURE CAPABLE OF 0-10V DIMMING.

Envelope Details

Wall Section:



Roof Section:



Glass Details:

F. Type IG-4 - Sealed Insulating Glass Units: Light diffusing insulated glazing; between-lite space filled with argon.

1. Manufacturers:
   a. Okalux; http://www.okaluxna.com/.
   b. Substitutions: The Awarding Authority has determined that the use of the product listed is in the best interest of the project and the public interest, and has voted to designate the listed products as proprietary bid products: See Section 01 60 00 - Product Requirements. Any other product submitted shall be considered a substitution.
2. Application(s): Facade glazing as indicated on Drawings.
3. Outboard Lite: Annealed float glass, 1/4 inch (6mm) thick, minimum.
   a. Tint: To be selected by Architect from manufacturer's full range.
4. Air Space: 12 mm PMMA acrylic UV stable capillary slab encased in fiber tissue. Capillaries are not to exceed 3 mm diameter to assure proper diffusion.
5. Inboard Lite: Annealed float glass, 1/4 inch (6 mm) thick, minimum
   a. Tint: To be selected by Architect from manufacturer's full range.
6. Total Thickness: 1 inch (25 mm)
7. Visible Light Transmittance (VLT): 32 percent.
8. SHGC: 0.23
9. U-Value: 0.44

BEPS Report of Taxpayer's Building

REPORT- BEPS Building Energy Performance — WEATHER FILE- Boston MA TMY2

	LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY													
MBTU	226.3	0.0	918.0	0.0	546.5	0.0	30.3	520.6	0.0	0.0	0.0	0.0	2241.6
FM1 NATURAL-GAS													
MBTU	0.0	0.0	0.0	341.5	0.0	0.0	0.0	0.0	0.0	0.0	133.7	0.0	475.2
MBTU	226.3	0.0	918.0	341.5	546.5	0.0	30.3	520.6	0.0	0.0	133.7	0.0	2716.8

TOTAL SITE ENERGY 2716.80 MBTU 31.0 KBTU/SQFT-YR GROSS-AREA 31.0 KBTU/SQFT-YR NET-AREA
TOTAL SOURCE ENERGY 7200.03 MBTU 82.1 KBTU/SQFT-YR GROSS-AREA 82.1 KBTU/SQFT-YR NET-AREA

PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE = 0.59
PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED = 0.00
HOURS ANY ZONE ABOVE COOLING THROTTLING RANGE = 50
HOURS ANY ZONE BELOW HEATING THROTTLING RANGE = 2

BEPU Report of Taxpayer's Building

REPORT- BEPU Building Utility Performance — WEATHER FILE- Boston MA TMY2

	LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY													
KWH	66294.	0.	268968.	0.	160116.	0.	8891.	152522.	0.	0.	0.	0.	656792.
FM1 NATURAL-GAS													
THERM	0.	0.	0.	3415.	0.	0.	0.	0.	0.	0.	1337.	0.	4752.

TOTAL ELECTRICITY 656792. KWH 7.489 KWH /SQFT-YR GROSS-AREA 7.489 KWH /SQFT-YR NET-AREA
TOTAL NATURAL-GAS 4752. THERM 0.054 THERM /SQFT-YR GROSS-AREA 0.054 THERM /SQFT-YR NET-AREA

PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE = 0.59
PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED = 0.00
HOURS ANY ZONE ABOVE COOLING THROTTLING RANGE = 50
HOURS ANY ZONE BELOW HEATING THROTTLING RANGE = 2

BEPS Report of Reference Building

REPORT- BEPS Building Energy Performance — WEATHER FILE- Boston MA TMY2

	LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY													
MBTU	1100.0	0.0	918.0	0.0	813.7	0.0	14.9	452.3	0.0	0.0	0.0	0.0	3298.9
FM1 NATURAL-GAS													
MBTU	0.0	0.0	0.0	1817.0	0.0	0.0	0.0	0.0	0.0	0.0	168.4	0.0	1985.3
MBTU	1100.0	0.0	918.0	1817.0	813.7	0.0	14.9	452.3	0.0	0.0	168.4	0.0	5284.2

TOTAL SITE ENERGY 5284.22 MBTU 60.3 KBTU/SQFT-YR GROSS-AREA 60.3 KBTU/SQFT-YR NET-AREA
TOTAL SOURCE ENERGY 11882.00 MBTU 135.5 KBTU/SQFT-YR GROSS-AREA 135.5 KBTU/SQFT-YR NET-AREA

PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE = 0.43
PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED = 0.00
HOURS ANY ZONE ABOVE COOLING THROTTLING RANGE = 0
HOURS ANY ZONE BELOW HEATING THROTTLING RANGE = 38

BEPU Report of Reference Building

REPORT- BEPU Building Utility Performance — WEATHER FILE- Boston MA TMY2

	LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY													
KWH	322277.	0.	268968.	0.	238415.	0.	4375.	132533.	0.	0.	0.	0.	966569.
FM1 NATURAL-GAS													
THERM	0.	0.	0.	18170.	0.	0.	0.	0.	0.	0.	1684.	0.	19853.

TOTAL ELECTRICITY 966569. KWH 11.022 KWH /SQFT-YR GROSS-AREA 11.022 KWH /SQFT-YR NET-AREA
TOTAL NATURAL-GAS 19853. THERM 0.226 THERM /SQFT-YR GROSS-AREA 0.226 THERM /SQFT-YR NET-AREA

PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE = 0.43
PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED = 0.00
HOURS ANY ZONE ABOVE COOLING THROTTLING RANGE = 0
HOURS ANY ZONE BELOW HEATING THROTTLING RANGE = 38

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CAPITAL REVIEW GROUP

Jordan I. Taylor is the Lead Advisor Consultant at Capital Review Group. Through his experience in identifying and implementing energy saving strategies for clients, Mr. Taylor provides keen expertise to Capital Review Group and the firm's Capital Discovery® process by helping clients fully realize the value of their capital assets. Additionally, Mr. Taylor provides detailed guidance on all tax-related elements of energy efficiency projects and his background in public accounting allows him to provide clients with the foundation for well executed tax strategies.

TRUE NORTH STUDIO

Director of Finance. True North Studio has developed more than $5 billion in over 200 projects across 3 continents to date with specialties including Real Estate, Sustainable Development, Residential, Lifestyle, Food & Beverage, Economic Development, Arts & Culture, Historic Preservation, Hotel, Culinary Arts, Retail & Office Space, Nightlife & Entertainment, Sustainability, and Development.

VESTBOARD

Founder. Combining personalized technology with expert tax advice. Mr. Taylor believes proper financial planning is essential to the success of individuals and business owners. Vestboard is devoted to stewardship through enhancing your financial future.

MANORSHARE

Jordan I. Taylor is Co-Founder of this boutique firm with a variety of specialties including property acquisition services and turnkey property management for short-term rentals (Airbnb) real estate investment, manage investment property in Phoenix, Seattle, Washington DC, Austin, Las Vegas, Los Angeles and Chicago.

CURRICULUM VITAE (CV)

Position Title and No	Assistant Manager
Name of Firm	Design2Occupancy Services LLP
Name of Expert	Swapnil Jain
Date of Birth	9th August 1994
Citizenship	Indian

Education:

College/University	Institution	Dates attended	Degree
Rajasthan Technical University, Kota	Poornima College of Engineering, Jaipur	2012-2016	B.Tech (Mechanical Engineering)

Professional Credentials:

Credential	Awarding Organisation
LEED® Green Associate	Green Business Certification Inc.
IGBC Accredited Professional	Indian Green Building Council

Awards:

- Second Runner up for net-zero building design competition for the project THE ZERO held by The Energy Simulation Academy, US
- Won State level IGL competition held by IGBC.

Employment Record Relevant to the Assignment:

Period	Employing Organization and Title/Position. Contact information for references	Country	Summary of activities performed relevant to the assignment
May 2016-Present February 2020-present	**Employing organization:** Design2Occupancy Services LLP **Position:** Assistant Manager Capital Review Group **Position** 179D Specialist	India	Key responsibilities included energy and sustainability consultancy for new and existing buildings. Team lead for energy simulation and green building facilitation projects. Energy Audit and commissioning of buildings.

Membership in Professional Associations	
Professional Associations	**Details of Responsibility**
FSAI (Fire & Security Association of India), Rajasthan Chapter	Core Working Committee Member
ASHRAE _ Rajasthan Chapter	Member

Language skills (Indicate only languages in which you can work):			
Language Skills	**Speaking**	**Reading**	**Writing**
English	Excellent	Excellent	Excellent
Hindi	Excellent	Excellent	Excellent

Project Experience:

Detailed Task Assigned/Deliverables	Work/Assignments that Best Illustrates Capability to Handle the Assigned Tasks
	Assignment Details: ASHRAE 90.1 App. G Energy Modeling **Location**: Global **Scope –** LEED, IGBC and other code compliance projects. **Specific Project Rating** : LEED v4 BD+C : NC , CI, CS IGBC New Building, Green factory etc.

Expert Contact Information:	Cell No.: +91 8233618802
	Email Id: swapnil@design2occupancy.com

Certification:
I, the undersigned, certify that to the best of my knowledge and belief, this CV correctly describes myself, my qualifications, and my experience, and I am available to undertake the assignment in case of an award. I understand that any misstatement or misrepresentation described herein may lead to my disqualification or dismissal by the Client, and/or sanctions by the Bank.

Swapnil Jain

E: swapnil@design2occupancy.com

M: +91-8233618802

Part III - Administrative, Procedural, and Miscellaneous
Amplification of Notice 2006-52
Deduction for Energy Efficient Commercial Buildings
Notice 2008-40

SECTION 1. PURPOSE

This notice clarifies and amplifies Notice 2006-52, 2006-1 C.B. 1175. Notice2006-52 provides a process that allows a taxpayer who owns a commercial building and installs property as part of the commercial building's interior lighting systems, heating, cooling, ventilation, and hot water systems, or building envelope to obtain a certification that the property satisfies the energy efficiency requirements of § 179D(c)(1) and (d) of the Internal Revenue Code. Notice 2006-52 also provides for a public list of software programs that may be used in calculating energy and power consumption for purposes of § 179D. This notice sets forth additional guidance relating to the deduction for energy efficient commercial buildings under § 179D and is intended to be used with Notice 2006-52. Any reference in this Notice to Standard 90.1-2001 should be treated as a reference to ANSI/ASHRAE/IESNA Standard 90.1-2001, Energy Standard for Buildings Except Low-Rise Residential Buildings, developed for the American National Standards Institute by the American Society of Heating, Refrigerating, and Air Conditioning Engineers and the lluminating Engineering Society of North America (as in effect on April 2, 2003, including addenda 90.1a-2003, 90.1b-2002, 90.1c-2002, 90.1d-2002, and 90.1k-2002 as in effect on that date).

SECTION 2. BACKGROUND

Section 1331 of the Energy Policy Act of 2005, Pub. L. No. 109-58, 119 Stat. 594 (2005), enacted § 179D of the Code, which provides a deduction with respect to energy efficient commercial buildings. Section 204 of the Tax Relief and Health Care Act of 2006, Pub. L. No. 109-432, 120 Stat. 2922 (2006), extends the § 179D deduction through December 31, 2008. Section 179D(a) allows a deduction to a taxpayer for part or all of the cost of energy efficient commercial building property that the taxpayer places in service after December 31, 2005, and before January 1, 2009. Sections 179D(d)(1) and 179D(f) allow a deduction to a taxpayer for part or all of the cost of certain partially qualifying commercial building property that the taxpayer places in service after December 31, 2005, and before January 1, 2009. Partially qualifying commercial building property is property that would be energy efficient commercial building property but for the failure to achieve the 50-percent reduction in energy and power costs required under §179D(c)(1)(D).

SECTION 3. SPECIAL RULE FOR GOVERNMENT-OWNED BUILDINGS

.01 In General. In the case of energy efficient commercial building property (or partially qualifying commercial building property for which a deduction is allowed under § 179D) that is installed on or in property owned by a Federal, State, or local government or a political subdivision thereof, the owner of the property may allocate the § 179D deduction to the person primarily responsible for designing the property (the designer). If the allocation of a § 179D deduction to a designer satisfies the requirements of this section, the deduction will be allowed only to that designer. The deduction will be allowed to the designer for the taxable year that includes the date on which the property is placed in service.

.02 Designer of Government-Owned Buildings. A designer is a person that creates the technical specifications for installation of energy efficient commercial building property (or partially qualifying commercial building property for which a deduction is allowed under § 179D). A designer may include, for example, an architect, engineer, contractor, environmental consultant or energy services provider who creates the technical specifications for a new building or an addition to an existing building that incorporates energy efficient commercial building property (or partially qualifying commercial building property for which a deduction is allowed under § 179D). A person that merely installs, repairs, or maintains the property is not a designer.

.03 Allocation of the Deduction. If more than one designer is responsible for creating the technical specifications for installation of energy efficient commercial building property (or partially qualifying commercial building property for which a deduction is allowed under § 179D) on or in a government-owned building, the owner of the building shall--

(1) determine which designer is primarily responsible and allocate the full deduction to that designer, or

(2) at the owner's discretion, allocate the deduction among several designers.

.04 Form of Allocation. An allocation of the § 179D deduction to the designer of a government-owned building must be in writing and will be treated as satisfying the requirements of this section with respect to energy efficient commercial building property (or partially qualifying commercial building property for which a deduction is allowed under § 179D) if the allocation contains all of the following:

(1) The name, address, and telephone number of an authorized representative of the owner of the government-owned building;

(2) The name, address, and telephone number of an authorized representative of the designer receiving the allocation of the § 179D deduction;

(3) The address of the government-owned building on or in which the property is installed;

(4) The cost of the property;

(5) The date the property is placed in service;

(6) The amount of the § 179D deduction allocated to the designer;

(7) The signatures of the authorized representatives of both the owner of the government-owned building and the designer or the designer's authorized representative; and

(8) A declaration, applicable to the allocation and any accompanying documents, signed by the authorized representative of the owner of the government owned building, in the following form:

"Under penalties of perjury, I declare that I have examined this allocation, including accompanying documents, and to the best of my knowledge and belief, the facts presented in support of this allocation are true, correct, and complete."

.05 Obligations of Designer. Before a designer may claim the § 179D deduction with respect to property installed on or in a government-owned building, the designer must obtain the written allocation described in section 3.04. A designer is not required to attach the allocation to the return on which the deduction is taken. However, §1.6001-1(a) of the Income Tax Regulations requires that taxpayers maintain such books and records as are sufficient to establish the entitlement to, and amount of, any deduction claimed by the taxpayer. Accordingly, a designer claiming a deduction under § 179D should retain the allocation as part of the taxpayer's records for purposes of §1.6001-1(a) of the Income Tax Regulations.

.06 Tax Consequences to Designer of Government-Owned Buildings. The maximum amount of the § 179D deduction to be allocated to the designer is the amount of the costs incurred by the owner of the government-owned building to place the energy efficient commercial building property in service. A partial deduction may be allocated and computed in accordance with the procedures set forth in sections 2 and 3 of Notice 2006-52. The designer does not include any amount in income on account of the § 179D deduction allocated to the designer. In addition, the designer is not required to reduce future deductions by an amount equal to the § 179D deduction allocated to the designer. Although reducing future deductions in this manner would provide equivalent treatment for designers that are allocated a § 179D deduction and building owners that are required to reduce the basis of their energy efficient commercial building property by the amount of the § 179D deduction they claim, § 179D does not provide for any reductions other than reductions to the basis of the energy efficient commercial building property.

.07 Tax Consequences to Owner of Public Building. The owner of the public building is not required to include any amount in income on account of the § 179D deduction allocated to the designer. The owner of the public building is, however, required to reduce the basis of the energy efficient commercial building property (or partially qualifying commercial building property) by the amount of the § 179D deduction allocated.

SECTION 4. LIST OF APPROVED SOFTWARE PROGRAMS

.01 In General. The Department of Energy creates and maintains a public list of software that may be used to calculate energy and power consumption and costs for purposes of providing a certification under section 4 of Notice 2006-52. This public list appears at http://www.eere.energy.gov/buildings/info/tax_incentives.html. Software will be included on the list if the software developer submits the following information to the Department of Energy:

(1) The name, address, and (if applicable) web site of the software developer;

(2) The name, email address, and telephone number of the person to contact for further information regarding the software;

(3) The name, version, or other identifier of the software as it will appear on the list;

(4) All test results, input files, output files, weather data, modeler reports and the executable version of the software with which the tests were conducted; and

(5) A declaration by the developer of the software made under penalties of perjury and containing all of the following information:

(a) A statement that the software has been tested according to the American National Standards Institute/American Society of Heating, Refrigerating and Air-Conditioning Engineers (ANSI/ASHRAE) Standard 140-2007 Standard Method of Test for the Evaluation of Building Energy Analysis Computer Programs.

(b) A statement that the software can model explicitly--

(i) 8,760 hours per year;

(ii) Calculation methodologies for the building components being modeled;

(iii) Hourly variations in occupancy, lighting power, miscellaneous equipment power, thermostat setpoints, and HVAC system operation, defined separately for each day of the week and holidays;

(iv) Thermal mass effects;

(v) Ten or more thermal zones;

(vi) Part-load performance curves for mechanical equipment;

(vii) Capacity and efficiency correction curves for mechanical heating and cooling equipment; and

(viii) Air-side and water-side economizers with integrated control.

(c) A statement that the software can explicitly model each of the following HVAC systems listed in Appendix G of Standard 90.1-2004:

(i) Packaged Terminal Air Conditioner (PTAC) (air source), single-zone package (through the wall), multi-zone hydronic loop, air-to-air DX coil cooling, central boiler, hot water coil.

(ii) Packaged Terminal Heat Pump (PTHP) (air source), single-zone package (through the wall), air-to-air DX coil heat/cool.

(iii) Packaged Single Zone Air Conditioner (PSZ-AC), single zone air, air-to-air DX coil cool, gas coil, constant-speed fan.

(iv) Packaged Single Zone Heat Pump (PSZ-HP), single zone air, air-to-air DX coil cool/heat, constant-speed fan.

(v) Packaged Variable-Air-Volume (PVAV) with reheat, mult izone air; multi-zone hydronic loop, air-to-air DX coil, VAV fan, boiler, hot water VAV terminal boxes.

(vi) Packaged Variable-Air-Volume with parallel fan powered boxes (PVAV with PFP boxes), multi-zone air, DX coil, VAV fan, fan-powered induction boxes, electric reheat.

(vii) Variable-Air-Volume (VAV) with reheat, multi-zone air, multi-zone hydronic loop, air-handling unit, chilled water coil, hot water coil, VAV fan, chiller, boiler, hot water VAV boxes.

(viii) Variable-Air-Volume with parallel fan powered boxes (VAV with PFP boxes), multi-zone air, air-handling unit, chilled water coil, hot water coil, VAV fan, chiller, fan-powered induction boxes, electric reheat.

(d) A statement that the software can--

(i) Either directly determine energy and power costs or produce hourly reports of energy use by energy source suitable for determining energy and power costs separately; and

(ii) Design load calculations to determine required HVAC equipment capacities and air and water flow rates.

(e) A statement describing which, if any, of the following the software can explicitly model:

(i) Natural ventilation.

(ii) Mixed mode (natural and mechanical) ventilation.

(iii) Earth tempering of outdoor air.

(iv) Displacement ventilation.

(v) Evaporative cooling.

(vi) Water use by occupants for cooking, cleaning or other domestic uses.

(vii) Water use by heating, cooling, or other equipment, or for on-site landscaping.

(viii) Automatic interior or exterior lighting controls (such as occupancy, photocells, or time clocks).

(viii) Daylighting (sidelighting, skylights, or tubular daylight devices).

(ix) Improved fan system efficiency through static pressure reset.

(x) Radiant heating or cooling (low or high temperature).
(xi) Multiple or variable speed control for fans, cooling equipment, or cooling towers.
(xii) On-site energy systems (such as combined heat and power systems, fuel cells, solar photovoltaic, solar thermal, or wind).

.02 Addresses. Submissions under this section must be addressed as follows:
Commercial Software List
Department of Energy
Office of Building Technologies, EE-2J
1000 Independence Ave., SW
Washington, DC 20585-0121
.03 Updated Lists. The software list at http://www.eere.energy.gov/buildings/info/tax_incentives.html will be updated as necessary to reflect submissions received under this section.
.04 Removal from Published List. The Department of Energy may, upon examination, determine that software is not sufficiently accurate to justify its use in calculating energy and power consumption and costs for purposes of providing a certification under section 4 of Notice 2006-52 and remove the software from the published list. The Department of Energy may undertake such an examination on its own initiative or in response to a public request supported by appropriate analysis of the software's deficiencies.
.05 Effect of Removal from Published List. Software may not be used to calculate energy and power consumption and costs for purposes of providing a certification with respect to property placed in service after the date on which the software is removed from the published list. The removal will not affect the validity of any certification with respect to property placed in service on or before the date on which the software is removed from the published list.
.06 Public Availability of Information. The Department of Energy may make all information provided under paragraph .01 of this section available for public review.
.07 Applicability. The procedures in this section supersede the procedures set forth in section 6 of Notice 2006-52 for periods after March 31, 2008. Any software that is included on the public list on March 31, 2008, will remain on the public list unless and until removed under the procedures set forth in this section.

SECTION 5. CERTIFICATION REQUIREMENTS FOR INTERIM LIGHTING RULE
.01 In General. Section 2.03(1)(b) of Notice 2006-52 provides an interim rule under which partially qualifying property is treated as energy efficient lighting property (the Interim Lighting Rule). Before a taxpayer may claim the § 179D deduction under the Interim Lighting Rule with respect to energy efficient lighting property installed on or in a commercial building, the taxpayer must obtain a certification with respect to the property. The certification must be provided by a qualified individual. Section 4 of Notice 2006-52 provides that the certification must include a statement that qualified computer software was used to calculate energy and power consumption and costs. That section also provides that the certification must include a statement that the building owner has received an explanation of projected annual energy costs. These requirements are appropriate only in the case of certifications that involve calculations of energy and power consumption and cost. The Interim Lighting Rule is satisfied by a reduction in lighting power density and such a reduction may be computed using a spreadsheet or other similar software. This computation does not require qualified computer software to model the entire building system or a determination of projected annual energy costs. Accordingly, the requirements of section 4 of Notice 2006-52 do not apply to certifications under the Interim Lighting Rule.
.02 Applicable Requirements. A taxpayer is not required to attach the certification to the return on which the deduction is taken. However, § 1.6001-1(a) of the Income Tax Regulations requires that taxpayers maintain such books and records as are sufficient to establish the entitlement to, and amount of, any deduction claimed by the taxpayer. Accordingly, a taxpayer claiming a deduction under § 179D should retain the certification as part of the taxpayer's records for purposes of § 1.6001-1(a) of the Income Tax Regulations. The qualified individual providing a certification under the interim rule must document a reduction in lighting power density in a thorough and consistent manner. A certification under the Interim Lighting Rule will be treated as satisfying the requirements of § 179D(c)(1) if the certification contains all of the following:
(1) The name, address, and telephone number of the qualified individual;
(2) The address of the building to which the certification applies;
(3) A statement by the qualified individual that the interior lighting systems that have been, or are planned to be, incorporated into the building—
(a) Achieve a reduction in lighting power density of at least 25 percent (50 percent in the case of a warehouse) of the minimum requirements in Table 9.3.1.1 or Table 9.3.1.2 (not including additional interior lighting power allowances) of Standard 90.1-2001;
(b) Have controls and circuiting that comply fully with the mandatory and prescriptive requirements of Standard 90.1-2001;
(c) Include provision for bi-level switching in all occupancies except hotel and motel guest rooms, store rooms, restrooms, public lobbies, and garages; and
(d) Meet the minimum requirements for calculated lighting levels as set forth in the IESNA Lighting Handbook, Performance and Application, Ninth Edition, 2000;
(4) A statement by the qualified individual that--
(a) Field inspections of the building were performed by a qualified individual after the energy efficient lighting property has been placed in service;
(b) The field inspections confirmed that the building has met, or will meet, the reduction in lighting power density required by the design plans and specifications; and
(c) The field inspections were performed in accordance with inspection and testing procedures that--
(i) Have been prescribed by the National Renewable Energy Laboratory (NREL) as Energy Savings Modeling and Inspection Guidelines for Commercial Building Federal Tax Deduction; and
(ii) Are in effect at the time the certification is given;
(5) A list identifying the components of the energy efficient lighting property installed on or in the building, the energy efficiency features of the building, and its projected lighting power density;

(6) A statement that the building owner has received an explanation of the energy efficiency features of the building and its projected lighting power density; (7) A declaration, applicable to the certification and any accompanying documents, signed by the qualified individual, in the following form:

> "Under penalties of perjury, I declare that I have examined this certification, including accompanying documents, and to the best of my knowledge and belief, the facts presented in support of this certification are true, correct, and complete."

SECTION 6. APPLICATION OF THE INTERIM LIGHTING RULE TO UNCONDITIONED GARAGE SPACE

For purposes of the Interim Lighting Rule, the definition of a Building within the Scope of Standard 90.1-2001 (found in Section 5.01 of Notice 2006-52) is expanded to include a structure that--

(1) Encloses space affording shelter to persons, animals, or property within exterior walls (or within exterior and party walls) and a roof;

(2) Is not a single-family house, a multi-family structure of three stories or fewer above grade, a manufactured house (mobile home), or a manufactured house (modular); and

(3) Is unconditioned attached or detached garage space as referenced by Tables 9.3.1.1 and 9.3.1.2 of Standard 90.1-2001.

SECTION 7. CHANGES RELATING TO PARTIALLY QUALIFYING PROPERTY

.01 Energy Savings Percentages. A taxpayer may apply section 2.05 of Notice 2006-52 by substituting "10" for "16⅔" in section 2.05(1)(a) of such notice. If a taxpayer makes this substitution, the taxpayer must apply sections 2.03 and 2.04 of Notice 2006- 52 by substituting "20" for "16⅔" in sections 2.03(1)(a) and 2.04(1) of such notice. If § 179D is extended beyond December 31, 2008, the Internal Revenue Service and the Treasury Department expect, in the absence of other changes to § 179D, that the substitute percentages set forth in this section will be the only percentages used in determining whether property placed in service after December 31, 2008, is partially qualifying property.

.02 Limitation on Deduction for Partially Qualifying Property.

(1) In General. If property installed on or in a building is treated as partially qualifying property under sections 2.03, 2.04, and 2.05 of Notice 2006-52, the deduction for the cost of such property shall not exceed the greatest of the following amounts:

(a) The sum of the deductions allowable under sections 2.03 and 2.04 of such notice;

(b) The sum of the deductions allowable under sections 2.04 and 2.05 of such notice; or

(c) The sum of the deductions allowable under sections 2.03 and 2.05 of such notice.

(2) Application to Multiple Taxpayers. If two or more taxpayers install property on or in the same building and the deduction for the cost of the property is subject to the limitation in section 7.02(1) of this notice, the aggregate amount of the § 179D deductions allowed to all such taxpayers with respect to the building shall not exceed the amount determined under section 7.02(1) of this notice.

SECTION 8. PAPERWORK REDUCTION ACT

The collections of information contained in this notice have been reviewed and approved by the Office of Management and Budget in accordance with the Paperwork Reduction Act (44 U.S.C. 3507) under control number 1545-2004. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless the collection of information displays a valid OMB control number.

The collections of information are in sections 4 and 6 of Notice 2006-52 and sections 4 and 5 of this notice. This information is required to be collected and retained in order to ensure that energy efficient commercial building property meets the requirements for the deduction under § 179D. This information will be used to determine whether commercial building property for which certifications are provided is property that qualifies for the deduction. The collection of information is required to obtain a benefit.

The likely respondents are two groups: qualified individuals providing a certification under § 179D (section 4 of Notice 2006-52 and section 5 of this notice) and software developers seeking to have software included on the public list created by the Department of Energy (section 6 of Notice 2006-52 and section 4 of this notice). For qualified individuals providing a certification under § 179D, the likely respondents are individuals. The likely number of certifications is 20,000. The estimated burden per certification ranges from 15 to 30 minutes with an estimated average burden of 22.5 minutes. The estimated total annual reporting burden is 7,500 hours.

For software developers seeking to have software included on the public list created by the Department of Energy, the likely respondents are individuals, corporations and partnerships. The estimated total annual reporting burden is 75 hours. The estimated annual burden per respondent varies from 1 to 2 hours, depending on individual circumstances, with an estimated average burden of 1½ hours to complete the submission required to have the software added to the public list. The estimated number of respondents is 50. The estimated frequency of responses is once. Books or records relating to a collection of information must be retained as long as their contents may become material in the administration of any Internal Revenue law. Generally, tax returns and tax return information are confidential, as required by 26 U.S.C. 6103.

SECTION 9. DRAFTING INFORMATION

The principal author of this notice is Jennifer C. Bernardini of the Office of Associate Chief Counsel (Passthroughs & Special Industries). For further information regarding this notice contact Jennifer C. Bernardini at (202) 622-3110 (not a toll-free call).

Part III - Administrative, Procedural, and Miscellaneous

Modification of Notice 2008-40; Deduction for Energy Efficient Commercial Buildings

Notice 2012-22

SECTION 1. PURPOSE

This notice modifies Notice 2006-52, 2006-1 C.B. 1175, and Notice 2008-40,

2008-1 C.B. 725, which clarified and amplified Notice 2006-52. This notice sets forth additional guidance relating to the deduction for energy efficient commercial buildings under § 179D and is intended to be used with Notice 2006-52 and Notice 2008-40.

On June 26, 2006, the Service published Notice 2006-52, which provides, among other things, the requirements for achieving a partial deduction under the permanent rule for (1) interior lighting systems, (2) heating, cooling, ventilation, and hot water systems, and (3) the building envelope. Specifically, Notice 2006-52 requires that for a partial deduction (other than a deduction under the interim lighting rule described below), the system must reduce the total annual energy and power costs with respect to the combined usage of the building's heating, cooling, ventilation, hot water, and interior lighting systems by at least a specified percentage as compared to a Reference Building that meets the minimum requirements of Standard 90.1-2001[1] (the energy savings percentages). The energy savings percentages prescribed in Notice 2006-52 were 16⅔ percent for each of the three systems. On April 7, 2008, the Service published Notice 2008-40, which provided alternative energy savings percentages that taxpayers could use to qualify for the partial deduction under the permanent rule. The energy savings percentages provided in Notice 2008-40 are 10 percent for the building envelope and 20 percent for interior lighting systems and heating, cooling, ventilation, and hot water systems.

This notice provides an additional set of energy savings percentages that taxpayers may use to qualify for a partial deduction under the permanent rule.

SECTION 2. BACKGROUND

Section 1331, Title XIII of the Energy Policy Act of 2005, Pub. L. No. 109-58, 119

Stat. 594 (Aug. 8, 2005), enacted § 179D of the Code, which provides a deduction with respect to energy efficient commercial buildings. As originally enacted, § 179D applied to property placed in service after January 1, 2006 and before January 1, 2008. Section 204, Div. A, Title II of the Tax Relief and Health Care Act of 2006, Pub. L. No. 109-432, 120 Stat. 2922 (Dec. 20, 2006), extended the § 179D deduction to apply to property placed in service before January 1, 2009. Section 303, Div. B, Title III of the Emergency Economic Stabilization Act of 2008, Pub. L. No. 110-343, 122 Stat. 3845

[1] Any reference in this notice to Standard 90.1-2001 should be treated as a reference to ANSI/ASHRAE/IESNA

Standard 90.1-2001, Energy Standard for Buildings Except Low-Rise Residential Buildings, developed for the American National Standards Institute by the American Society of Heating, Refrigerating, and Air Conditioning Engineers and the Illuminating Engineering Society of North America (as in effect on April 2, 2003, including addenda 90.1a-2003, 90.1b-2002, 90.1c-2002, 90.1d-2002, and 90.1k-2002 as in effect on that date).

(October 8, 2008), further extended the § 179D deduction to apply to property placed in service before January 1, 2014. Section 179D(a) allows a deduction to a taxpayer for part or all of the cost of energy efficient commercial building property that the taxpayer places in service. Section 179D(c)(1) defines "energy efficient commercial building property" as depreciable property that satisfies each of the following conditions: (1) the property is installed on or in any building that is located in the United States and is within the scope of Standard 90.1-2001; (2) the property is installed as part of the interior lighting systems; the heating, cooling, ventilation, and hot water systems; or the building envelope; and (3) it is certified that the interior lighting systems, heating, cooling, ventilation, and hot water systems, and the building envelope that have been incorporated into the building, or that the taxpayer plans to incorporate into the building subsequent to the installation of such property, will reduce the total annual energy and power costs with respect to the combined usage of the building's heating, cooling, ventilation, hot water, and interior lighting systems by 50 percent or more as compared to a Reference Building that meets the minimum requirements of Standard 90.1-2001.

Section 179D(b) provides that the maximum amount of the § 179D deduction shall not exceed the excess (if any) of (i) the product of $1.80 and the square footage of the building, over (ii) the aggregate amount of the § 179D deductions allowed with respect to the building for all prior taxable years.

In the event that the installation of energy efficient commercial building property does not achieve the 50-percent reduction in total annual energy and power costs required by § 179D(c)(1)(D), § 179D(d)(1) provides for a partial deduction, in an amount not to exceed the product of $0.60 and the square footage of the building, for each system that satisfies the requirements § 179D(d)(1) (the permanent rule). While the taxpayer may claim a partial § 179D deduction for each system, the taxpayer may not claim partial deductions that in total exceed the overall limitation of (i) the product of $1.80 and the square footage of the building, over (ii) the aggregate amount of the § 179D deductions allowed with respect to the building for all prior taxable years.

Section 179D(f) provides an interim lighting rule, which is an alternate method of calculating a partial deduction for interior lighting systems. This rule provides a partial deduction for part or all of the cost of certain energy efficient commercial building property installed as part of a lighting system that reduces the lighting power density of the building by more than 25 percent (50 percent in the case of a warehouse).

SECTION 3. CHANGES RELATING TO PARTIALLY QUALIFYING PROPERTY

Under the permanent rule, property that would be energy efficient commercial building property but for the failure to achieve the target 50-percent reduction in energy and power costs required under § 179D(c)(1)(D) is partially qualifying commercial building property if it is installed as part of a system that satisfies the applicable energy savings percentage.

.01 Energy Savings Percentages Provided in Notice 2006-52. Section 2.03(1)(a) of Notice 2006-52 provides that property installed as part of the interior lighting system is partially qualifying property under the permanent rule if the installation of such property will reduce the total annual energy and power costs with respect to the combined usage of the building's heating, cooling, ventilation, hot water, and interior lighting systems by 16⅔ percent or more as compared to a Reference Building that meets the minimum requirements of Standard 90.1-2001. Notice 2006-52 provides an identical rule for heating, cooling, ventilation and hot water systems in section 2.04(1), and for the building envelope in section 2.05(1). Thus, the applicable energy savings percentage under Notice 2006-52 is 16⅔ percent for each of the three systems.

.02 Energy Savings Percentages Provided in Notice 2008-40. Section 7.01 of Notice 2008-40 provides that when calculating a partial deduction for the building envelope, a taxpayer may apply section 2.05 of Notice 2006-52 by substituting "10" for "16⅔" in section 2.05(1) of such notice. However, a taxpayer that makes this substitution must apply sections 2.03 (relating to the partial deduction for interior lighting systems) and 2.04 (relating to the partial deduction for heating, cooling, ventilation, and hot water systems) of Notice 2006-52 by substituting "20" for "16⅔" in section 2.03(1)(a) and section 2.04(1) of such notice, respectively. Thus, the alternative energy savings percentages permitted under Notice 2008-40 are 20 percent for the interior lighting system and the heating, cooling, ventilation, and hot water systems, and 10 percent for the building envelope.

Section 7.01 of Notice 2008-40 also provides that if § 179D is extended beyond December 31, 2008, taxpayers should use these updated energy savings percentages to determine whether property placed in service after December 31, 2008, is partially qualifying property. Accordingly, the energy savings percentages provided in Notice 2006-52 (16⅔ for each system) may not be used to determine whether property placed in service after December 31, 2008, is partially qualifying property.

.03 Energy Savings Percentages Provided in Current Notice. Under this notice, when calculating a partial deduction for heating, cooling, ventilation, and hot water systems, a taxpayer may apply section 2.04 of Notice 2006-52 by substituting "15" for "16⅔" in section 2.04(1) of such notice. However, a taxpayer that makes this substitution must apply section 2.03 of Notice 2006-52 (relating to the partial deduction for interior lighting systems) by substituting "25" for "16⅔" in section 2.03(1)(a) of such notice, and must apply section 2.05 of Notice 2006-52 (relating to the partial deduction for the building envelope) by substituting "10" for "16⅔" in section 2.05(1) of such notice. Thus, the applicable energy savings percentages permitted under this notice are 25 percent for the interior lighting system, 15 percent for the heating, cooling, ventilation, and hot water systems, and 10 percent for the building envelope.

The energy savings percentages permitted under this notice are available for property placed in service on or after the effective date of this notice. If § 179D is extended beyond December 31, 2013, the Internal Revenue Service and the Treasury Department expect, in the absence of other changes to § 179D, that the substitute energy savings percentages set forth in this notice will be the only energy savings percentages used in determining whether property placed in service after December 31, 2013, is partially qualifying property. Until December 31, 2013, taxpayers may use either the energy savings percentages provided in section 7.01 of Notice 2008-40 or the substitute energy savings percentages provided under this notice.

Notwithstanding the foregoing provisions of this section 3.03 or any other provision of this notice, if a taxpayer claims or previously claimed a partial deduction with respect to a commercial building under Notice 2006-52 or Notice 2008-40 and the system for which the deduction is or was claimed does not satisfy the applicable energy savings percentage specified for such system in this section 3.03, the taxpayer may not claim a partial deduction for any other system in the same building using the energy savings percentages permitted under this section 3.03.

The following table summarizes the energy savings percentages permitted under

Notice 2006-52, Notice 2008-40 and this notice.

Summary of Energy Savings Percentages Provided by IRS Guidance			
	Energy Savings Percentages permitted under Notice 2006-52	Energy Savings Percentages permitted under Notice 2008-40	Energy Savings Percentages permitted under Notice 2012-22
Interior Lighting Systems	16⅔	20	25
Heating, Cooling, Ventilation, and Hot Water Systems	16⅔	20	15
Building Envelope	16⅔	10	10
Effective for property placed in service	January 1, 2018 – December 31, 2020	January 1, 2018 – December 31, 2020	Effective date of Notice 2018-22 – December 31, 2020; if § 179D is extended beyond December 31, 2020, also effective (except as otherwise provided in an amendment of § 179D or the guidance thereunder) during the period of the extension

.04 Limitation on Deduction for Partially Qualifying Property.

(1) In General. A taxpayer who owns, or is a lessee of, a commercial building and installs partially qualifying energy efficient commercial building property may claim a partial deduction for each system that meets the requirements provided in sections 2.03, 2.04 and 2.05 of Notice 2006-52 (as modified by Notice 2008-40 and this notice). However, because the deduction for each such system is limited to $0.60 per square foot, the sum of all partial § 179D deductions claimed cannot exceed the excess (if any) of (i) the product of $1.80 and the square footage of the building, over (ii) the aggregate amount of the § 179D deductions allowed with respect to the building for all prior taxable years.
(2) Application to Multiple Taxpayers. If two or more taxpayers install property on or in the same building and the deduction for the cost of the property is subject to the limitation in section 3.04(1) of this notice, the aggregate amount of the § 179D deductions allowed to all such taxpayers with respect to the building shall not exceed the amount determined under section 3.04(1) of this notice.

SECTION 4. EFFECT ON OTHER DOCUMENTS

This notice modifies Notice 2008-40, 2008-1 C.B. 725, which clarified and amplified Notice 2006-52, 2006-1 C.B. 1175.

SECTION 5. EFFECTIVE DATE

This notice is effective on the date that it is published in the Internal Revenue Bulletin.

SECTION 6. DRAFTING INFORMATION

The principal author of this notice is Jennifer C. Bernardini of the Office of Associate Chief Counsel (Passthroughs & Special Industries). For further information regarding this notice contact Ms. Bernardini on (202) 622-3110 (not a toll-free call).

TO: Debbie Eagan, Amy Lydon

Town of Rowley, MA

FROM: Neil Joyce / CMS

DATE: December 3, 2020

RE: Energy Efficient Features of PD / FD Project

The Following is a summary of energy efficient components that were incorporated into the Rowley Police Renovation / New Fire Station Project. Systems are typical to each building, unless noted otherwise:

06100 – Exterior Sheathing System - ZIP SYSTEM WALL SHEATHING AND WEATHER RESIUSTIVE BARRIER

A. Sheathing shall be equal to Zip System by Huber Engineered Woods and provide a weather resistive barrier and wall sheathing. The system shall include Oriented Strand Board sheathing with integral weather resistive barrier, joint tape, approved fasteners, self adhering flexible flashing and all accessories and components required for a complete assembly

1.Code Compliance

Comply with ICC –ESR1474 (ZIP Wall sheathing)
Comply with ICC –ESR2227 (ZIP Joint Tape)

Section 07400 – Insulation: Designed to meet the standards as noted below:

A. Batt Insulation: (at exterior walls and attics)

1. All batt insulation shall be unfaced fiberglass in thicknesses and locutions shown on the drawings. Provide 6 mil polyethylene vapor barrier at the interior side of all batt insulation.

2.R Values for batt insulation shall be as follows:

Thickness R Value

3 ½" 11
6 ¼" 19
9 ½" 30
12" 38

B. Rigid insulation shall be extruded polystyrene foam such as "Styrofoam SM" as manufactured by Dow Chemical or approved equal of the thickness' and in the locations shown on the Drawings. Rigid insulation shall provide a minimum R-5 per inch. Vanuatu Rigid insulation shall be closed cell extruded polystyrene with taped joints. Adhesive for bonding insulation at vertical surfaces shall be recommended by the insulation manufacturer with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation of substrates. Board insulation was included under all slabs on grade, and at the inside face of foundation walls.

C. Insulation in rated walls shall comply with ASTM C665, Type III, Class A, and ASTM

E136.

D. Air and Vapor Barrier
1) Air and vapor barrier (AVB) shall be self adhering, self sealing, and self healing rubberized asphalt integrally bonded to polyethylene film, nominal 40 mil thickness overall. It shall be provided at all exterior walls and where and AVB is indicted. Provide computable membrane joint tape recommended by the manufacturer. The AVB in exterior walls shall be non combustible.

Section 08400 – Aluminum Entrances: Designed to meet standards as noted below:

Air leakage performance standard shall comply with ASTM E283.

Section 08600 – Clad Wood Windows: Designed to meet standards as noted below:

Appearance and performance shall be equal to Pella "Architect Series", Sun Defense TM, Low-E IG with argon.

1) *Window shall not exceed a U factor of 0.32, an SGHC of 0.40, and have a VLT/SHGC ratio greater than 1.5*

Section 08800 – Glass and Glazing: Designed to meet standards as noted below:

Exterior Entrances and Metal Windows: 1" thick insulating glass consisting of 1/4" clear, tempered glass for exterior light, 1/2" air space, and 1/4" clear tempered glass for interior light, hermetically sealed.

Section 11000 – Appliances: provide Energy Star-rated Appliances, as noted:

1) Dishwasher: General Electric Profile PDT750SSFSS, built-in type.
2) Range: General Electric Profile PB930SFSS 30" slide in electric range.
3) Refrigerator: General Electric Profile PWE23KSDSS French door bottom freezer with automatic icemaker.
4) Microwave Oven Over the Range: General Electric Profile PVM9179SFSS with venting to the outside.
5) Microwave Oven: General Electric Profile, 1.1 cu ft, PEM31SFSS
6) Under Counter Refrigerator: General Electric ZIFS240PSS
7) Washer/Dryer, Stackable: General Electric 4.3 DOE cu ft capacity, front load washer, GFWN1600JWW; General Electric 7.5 cu ft capacity, front load dryer, GFDN160EJWW; General Electric washer/dryer stack bracket kit, GEFLSTACK

Section 15400 – Plumbing: Designed to meet standards as noted below:

A. Pipe Insulation: Insulation shall be in accordance with the following schedule:
Fiberglass pipe insulation with jackets, to the noted thicknesses:
Service Thickness - Cold water 1", Non Potable 1", Hot Water 1", Horizontal Roof Conductors 1-1/2"

B. Water Heater (s): shall be as manufactured by HTP, A.O. Smith, Rheem Ruud, Bradford White or approved equal. Water heater shall meet or exceed all applicable energy codes and shall have a working pressure of no less than 150 psi. Heater shall be design certified by A.G.A. for 180 deg. service. ***Heater Design shall be 94% thermal efficiency***. Heater shall be provided with an automatic gas/fuel shutoff device and safety shutoff in event pilot flame is extinguished; a gas pressure regulator set for the type of gas/fuel supplied; an approved draft diverter, an extruded anode rod rigidly supported for cathodic protection

C. Low Flow Plumbing Fixtures (toilets, water faucets, etc.)

Section 15600 – HVAC: Designed to meet standards as noted below:

Heat Pumps – Ductless, Multi-Zoned or Single Zoned as noted below:

MULTI–ZONE AIR COOLED CONDENSING UNIT SCHEDULE

ALTERNATE MANUFACTURERS
1. SANYO
2. LG
3. MITSUBISH

UNIT NUMBER	DESIGN CONDITIONS AMB. D.B.T. °F	INDOOR D.B.	INDOOR W.B.	COMPRESSOR NOM. TONS	COMPRESSOR TYPE	NOMINAL COOLING MBH	MBH HEATING @47°F	MBH HEATING @17°F	MBH HEATING @0°F	ELECTRIC DATA VOLTAGE VOLT	PH	Hz	BHP	MCA	SEER	EER	HSPF	BASED ON MANUF	MODEL	REMARKS
①	95	80	67	2.0	DC INVERTER	24,000	23.0	18.0	16.0	208	1	60	25A	18A	18	10	10	HAIER	2U24HS2VHB	1. FURNISH AND INSTALL ALL STANDARD FACTORY FEATURES, CONTROLS, INTERLOCKS, ZONE ADAPTORS AND SAFETY DEVICES AS REQUIRED FOR A COMPLETE FULLY OPERATIONAL SYSTEM 2. INSULATED REFRIGERANT PIPING BETWEEN OUTDOOR AIR COOLED CONDENSING UNIT AND ASSOCIATED AIR HANDLER 3. FURNISH AND INSTALL FACTORY MODEL YRE–17 WIRED CONTROLLER
②	95	80	67	3.0	DC INVERTER	36,000	34.5	26.0	24.0	208	1	60	30A	23A	18	9	10	HAIER	4U36HS2VHB	

MULTI–ZONE DX FAN COIL SCHEDULE

ALTERNATE MANUFACTURERS
1. SANYO
2. LG
3. MITSUBISH

UNIT NUMBER	NOMINAL TONS	ARRANGEMENT	CONTROL	WEIGHT LB's	EVAP FAN DATA CFM	EVAP FAN DATA SPEED	NOMINAL PERFORMANCE DATA REFRIG	MBH COOLING	MBH HEATING	ELECTRIC DATA V	P	Hz	MCA	MOCP	BASED ON MANUF	MODEL	REMARKS
Ⓐ	0.50	DUCTLESS WALL HUNG SPLIT	WIRED THERMOSTAT	26.8	295	MED	R410A	7,000	8000	208	1	60	----	15	HAIER	AW07LC2VH	1. FURNISH AND INSTALL ALL STANDARD FEATURES, CONTROLS, INTERLOCKS AND SAFETY DEVICES AS REQUIRED. 2. INDOOR UNITS RECEIVE LINE VOLTAGE POWER FROM A TERMINAL CONNECTION AT ITS ASSOCIATED OUTDOOR CONDENSING UNIT 3. CONCEALED DUCTED AND CASSETTE UNITS ARE FURNISHED WITH FACTORY BUILT–IN CONDENSATE PUMP AND FLOAT SWITCH 4. CONTRACTOR TO FURNISH AND INSTALL ASPEN WM WHITE MODEL ASPIRVUM UNIVOLT CONDENSATE PUMP, 2.0 GPHRR FEET HEXD, 42,800 MAXIMUM BTUH, VOLTAGE 115–1–10 0.19 AMPS, 19 WATTS
Ⓑ	0.75	DUCTLESS WALL HUNG SPLIT	WIRED THERMOSTAT	26.8	295	MED	R410A	8,000	10,000	208	1	60	----	15	HAIER	AW09LC2VH	
Ⓒ	1.00	DUCTLESS WALL HUNG SPLIT	WIRED THERMOSTAT	26.8	380	HIGH	R410A	12,000	13,000	208	1	60	----	15	HAIER	AW12LC2VH	
Ⓓ	0.75	CEILING CASSETTE	WIRED THERMOSTAT	37.5	365	HIGH	R410A	8,000	10,000	208	1	60	----	15	HAIER	AB09SC2VHA	
Ⓔ	1.00	CEILING CASSETTE	WIRED THERMOSTAT	40.8	365	HIGH	R410A	12,000	13,000	208	1	60	----	15	HAIER	AB12SC2VHA	
Ⓕ	1.50	CEILING CASSETTE	WIRED THERMOSTAT	35.3	530	HIGH	R410A	18,000	19,000	208	1	60	----	15	HAIER	AB18SC2VHA	
Ⓖ	1.50	DUCTED CONCEALED	WIRED THERMOSTAT	61.8	500	HIGH	R410A	18,000	19,000	208	1	60	----	15	HAIER	AD18SL2VHA	

SINGLE ZONE AIR COOLED CONDENSING UNIT SCHEDULE

ALTERNATE MANUFACTURERS
1. SANYO
2. LG
3. MITSUBISH

UNIT NUMBER	DESIGN CONDITIONS AMB. D.B.T. °F	INDOOR D.B.	INDOOR W.B.	COMPRESSOR NOM. TONS	COMPRESSOR TYPE	NOMINAL COOLING MBH	MBH HEATING @47°F	MBH HEATING @17°F	MBH HEATING @0°F	ELECTRIC DATA VOLTAGE VOLT	PH	Hz	BHP	MCA	SEER	EER	HSPF	BASED ON MANUF	MODEL	REMARKS
③	95	80	67	1.0	DC INVERTER	12,000	14.7	10.7	7.30	208	1	60	15A	15A	18	10.0	8.2	HAIER	1U12LC2VHA	1. FURNISH AND INSTALL ALL STANDARD FACTORY FEATURES, CONTROLS, INTERLOCKS, ZONE ADAPTORS AND SAFETY DEVICES AS REQUIRED FOR A COMPLETE FULLY OPERATIONAL SYSTEM 2. INSULATED REFRIGERANT PIPING BETWEEN OUTDOOR AIR COOLED CONDENSING UNIT AND ASSOCIATED AIR HANDLER 3. FURNISH AND INSTALL FACTORY MODEL YRE–17 WIRED CONTROLLER
④	95	80	67	1.5	DC INVERTER	18,000	20.3	14.3	8.5	208	1	60	20A	17A	18	11.0	8.0	HAIER	1U18LC2VHA	
⑤	95	80	67	1.5	DC INVERTER	18,000	20.3	14.3	8.5	208	1	60	20A	17A	18	9.0	8.0	HAIER	1U18LC2VHA	
⑥	95	80	67	2.0	DC INVERTER	24,000	27.3	21.0	16.9	208	1	60	25A	21A	17	11.0	11.0	HAIER	1U24LP2VHA	
⑦	95	80	67	2.0	DC INVERTER	24,000	27.1	20.0	16.5	208	1	60	25A	21A	17	11.5	10.0	HAIER	1U24LP2VHA	
⑧	95	80	67	3.0	DC INVERTER	36,000	37.8	29.8	23.1	208	1	60	30A	26A	17	10.0	10.5	HAIER	1U36LP2VHA	

SINGLE ZONE DX FAN COIL SCHEDULE

ALTERNATE MANUFACTURERS
1. SANYO
2. LG
3. MITSUBISH

UNIT NUMBER	NOMINAL TONS	ARRANGEMENT	CONTROL	WEIGHT LB's	EVAP FAN DATA CFM	EVAP FAN DATA SPEED	NOMINAL PERFORMANCE DATA REFRIG	MBH COOLING	MBH HEATING	ELECTRIC DATA V	P	Hz	MCA	MOCP	BASED ON MANUF	MODEL	REMARKS
Ⓗ	1.00	DUCTED CONCEALED	WIRED THERMOSTAT	36.8	353	HIGH	R410A	12.0	11.5	208	1	60	----	----	HAIER	AD12SL2VH	1. FURNISH AND INSTALL ALL STANDARD FEATURES, CONTROLS, INTERLOCKS AND SAFETY DEVICES AS REQUIRED. 2. INDOOR UNITS RECEIVE LINE VOLTAGE POWER FROM A TERMINAL CONNECTION AT ITS ASSOCIATED OUTDOOR CONDENSING UNIT 3. CONCEALED DUCTED AND CASSETTE UNITS ARE FURNISHED WITH FACTORY BUILT–IN CONDENSATE PUMP AND FLOAT SWITCH 4. CONTRACTOR TO FURNISH AND INSTALL ASPEN WM WHITE MODEL ASPIRVUM UNIVOLT CONDENSATE PUMP, 2.0 GPHRR FEET HEXD, 42,800 MAXIMUM BTUH, VOLTAGE 115–1–10 0.19 AMPS, 19 WATTS
Ⓘ	1.50	DUCTLESS WALL HUNG SPLIT	WIRED THERMOSTAT	28.7	530	HIGH	R410A	18.0	17.0	208	1	60	----	----	HAIER	AW18LC2VH	
Ⓙ	1.50	CEILING CASSETTE	WIRED THERMOSTAT	40.8	410	HIGH	R410A	18.0	16.0	208	1	60	----	----	HAIER	AB18SC2VHA	
Ⓚ	2.00	HIGH STATIC DUCTED CONCEALED	WIRED THERMOSTAT	68.8	670	HIGH	R410A	24.0	26.5	208	1	60	----	----	HAIER	AM24LP2VHA	
Ⓛ	2.00	CEILING CASSETTE	WIRED THERMOSTAT	68.3	670	HIGH	R410A	24.0	27.3	208	1	60	----	----	HAIER	AL24LP2VHA	
Ⓜ	3.00	HIGH STATIC DUCTED CONCEALED	WIRED THERMOSTAT	121.3	900	HIGH	R410A	36.0	37.5	208	1	60	----	----	HAIER	AM36LP2VHA	

Mechanical Piping Insulation:

Cover all supply air, return air and outside air intake ducts with 1 1/2" thick fiberglass duct insulation with a vapor seal of Flame Resistant Reinforced Foil Faced Kraft Paper. All duct insulation shall have a minimum density of 1 pound per cubic foot. Insulation shall be adhered to duct with Foster No. 81-13 or Minnesota Mining EC1329, or approved equal, adhesive applied in 6" wide strips, 12" on center. Butt all edges of all insulation and seal all joints of vapor seal insulation with tape of same material as vapor seal applied with adhesive specified above to provide a continuous vapor seal. On the bottom of ducts 24" and wider, stick clips shall be installed 10" to 14" on centers. Seal all holes for stick clips with tape and adhesive as specified above to provide a continuous vapor seal.

Insulate all refrigerant liquid and suction piping and air conditioning condensate piping with 1" thick rubber pipe insulation. Seal all joints vapor tight. Interior systems shall be provided with PVC jacketing. Exterior systems shall be provided with aluminum jacketing.

Automatic Temperature Controls:

The Mechanical Subcontractor shall provide all material and equipment necessary to install a complete and operational automatic temperature control package as required for all systems shown on the Drawings.

Section 16000 – Electric: Designed to meet standards as noted below:

Lighting System – Low Voltage LED Fixtures, as noted below:

LIGHTING FIXTURE SCHEDULE

TYPE	MANUFACTURER	CATALOGUE #	LAMPING			MOUNTING	REMARKS
			TYPE	WATTAGE	QUANTITY		
A	METALUX	22CZLD434UNVL835CD1U	LED	34		RECESSED	
AE	METALUX	22CZLD434UNVEL14WL835CD1U	LED	34		RECESSED	INTERNAL EMERGENCY
B	METALUX	24CZLD450UNVL835CD1U	LED	45		RECESSED	
BE	METALUX	24CZLD450UNVEL14WL835CD1U	LED	45		RECESSED	INTERNAL EMERGENCY
C	PORTFOLIO	LD6A20D010TEERM6A208356LMOLIHB26	LED	18		RECESSED	
CE	PORTFOLIO	LD6A20D010TEIEMBODERM6A20835 6LMOELIHB26	LED	18		RECESSED	INTERNAL EMERGENCY
D	METALUX	24GRLD448F1UNVL835CD1U	LED	48		RECESSED	
E	NONE						
F	OXYGEN	3-526-24	LED	23		WALL	VANITY LIGHT
G	NONE						
H	METALUX	22CZLD434UNVEL14WL835CD1U	LED	40		RECESSED	INTERNAL EMERGENCY
I	NONE						
J	NEWSTAR	STWL4TL235UNBBEL1SD3	LED	60		SURFACE	INTERNAL OCCUPANCY SENSOR/EMERG
K	METALUX	2SNLED23SLLWUNVL840CD1U	LED	20		SURFACE	INTERNAL EMERGENCY
L	ATLANTIC	LED6DLM1535KULEM6LEDPRCL	LED	13.8		RECESSED	WET LOCATION – EMERG. DRIVER
M	CSL	ECL32WT303	LED	10		SURFACE	UNDERCABINET LIGHT
N	CSL	ECL24WT303	LED	10		SURFACE	UNDER CABINET LIGHT
O	NONE						
P	METALUX	8VT2LD412DR100UNVTREMELL835CD1WLU	LED	74		SURFACE	INTERNAL EMERGENCY
Q	NEWSTAR	33MN2AL2401AAUNLN	LED	25		SURFACE	CELL CORRIDOR LIGHT
R	METALUX	8WSL80SRSUNVL840CD1U	LED	74		SURFACE	
S	NONE						
T	METALUX	4WSL40SRSUNVL840CD1U	LED	35		SURFACE	
U	MCGRAW EDISON	TTC3LEDE1MQCOLOR8030	LED	43		SURFACE	
EX	ISOLITE	RLPRUWHUNSD					EXIT SIGN
EX1	ISOLITE	EUNEMR1C					EXIT SIGN
EX2	NEWSTAR	620SFLEDUNRWEM	LED			WALL	EXIT SIGN – CELL AREA

Lighting Control System – Low Voltage Controller for Station Lighting Systems Occupancy Sensors – with Lighting Control System.