ENE SYSTEMS

REDUCING THE OPERATING AND ENERGY COSTS OF YOUR FACILITY

TOWN OF SALISBURY ENERGY AUDIT REPORT
TOWN HALL, LIBRARY, DPW BUILDING

PREPARED FOR:
TOWN OF SALISBURY
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DATE: JANUARY 23, 2020

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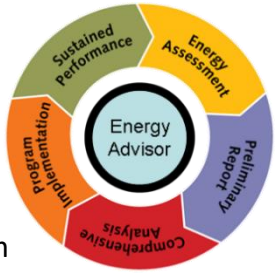
Executive Summary



The ENE Energy Advisor Group is a division of ENE Systems, Inc. The Energy Advisor group develops and implements comprehensive energy services projects for ENE Systems customers. We are a Lead National Grid Project Expediter (PEX) and an Eversource Preferred Partner which allows us to maximize the use of the *Mass Saves* Energy Efficiency Program for our customers.

On January 10th, 2020, Paul Murphy and Steve Tarantino of ENE Systems met with Lisa Pearson, Town Planning Director, to discuss the Town Buildings' existing conditions, problem areas, and energy consumption. Subsequent to the meeting, an ASHRAE Level 1 Audit was performed at the Town Hall, DPW Building, and Library to identify energy savings opportunities available to Town. On January 22, 2020, Chris Roy performed a more detailed weatherization scoping.

The audit findings have been summarized in the following report. The matrix below identified cost estimates for work that can be done immediately (Blue) and work that needs to be done but requires more comprehensive engineering and design (Green). The Town needs to spend the balance of the Green Communities Grant by February 2, 2020.

Energy Conservation Measure Number	ECM Description	Extended Price for Week of 1/27/20 Projects	Budgetary Estimate Future Projects	Electrical Savings (kWh)	Natural Gas Savings (Therm)	Energy Savings ($)	Potential Rebates [2]
Town Hall							
ECM 1	Weatherization - Weather-stripping Exterior Doors (2S+2D)	$2,090		0	364	200.0	$0
ECM 2	Weatherization - Attic Hatch	$320		417	136	150.0	$0
ECM 3	Weatherization - Sidewall Dense Pack Cellulose		TBD	TBD	TBD	TBD	$0
ECM 4	Weatherization - 1rst Floor Window Replacement		TBD	TBD	TBD	TBD	$0
ECM 5	Lighting - Interior LED		TBD	TBD	TBD	TBD	
	Building Total	**$2,410**	**$0**	**417**	**500**	**$ 350**	**$0**
DPW Building							
ECM 1	Weatherization - Weather-stripping Exterior Doors (3S)	$943		0	545	300.0	$0
ECM 2	Weatherization - Garage Overhead Door (4OV) 12x12	$4,660		0	727	400.0	$0
ECM 3	Weatherization - Garage Overhead Door (2OV) 16x14	$2,580		0	364	200.0	$0
ECM 4	Weatherization - Garage Overhead Door (1OV) 8x8	$1,340		0	182	100.0	$0
ECM 5	Weatherization - Roof Wall Closed Cell		$15,829	0	545	300.0	$0
ECM 6	Weatherizartion - Relocate Office Access Door		TBD	0	0	0.0	$0
ECM 7	Lighting Upgrade - Garage, Office, Ext		$19,563	6,628	0	1,193.0	$1,000
ECM 8	Mechanical - Boiler Upgrade to HE Condensing		$80,000	0	773	425.0	$3,000
	Building Total	**$9,523**	**$115,391**	**6,628**	**3,136**	**$ 2,918**	**$4,000**
Library							
ECM 1	Weatherization - Building Envelop Issues[1]		$55,086	TBD	TBD	TBD	$0
ECM 2	Mechanical - Resolve Heating Controls Issues		TBD	TBD	TBD	TBD	$0
	Building Total	**$0**	**$55,086**	**0**	**0**	**0**	**$0**

Note 1: The Library is a new construction buildiong most likely under warranty. Roof manufacturer andArchitect would need to be involved in approvingthis solution. Energy Savings Calculations would need to be completed to estimate energy savings. Savings expected to be significant.

	3 Building Total	**$11,933**	**$170,477**	**7,044**	**3,636**	**$ 3,268**	**$4,000**

Note 2: National Grid Incentives for 2020 have not been released. ENE will establish the incentives and complete the applications for Salisbury on approval of the different projects. Thermal savings incentives for Commercial Weatherization have been difficult to get approved in past years. New Program year 2020 may change that.

Building Summaries

Town Hall

General:

The Town Hall is a 9,000 sq. ft. two story wood frame building and is registered as a historic landmark. The building consists of offices, conference rooms, and public assembly space. The second story has been recently renovated including new lighting fixtures, windows, elevator, and three Air Handling Units (AHU) that provide AC and heat to the second floor. The building also has a full height basement where the boilers are located.

HVAC:

The first floor is served by perimeter radiator heat supplied by a 345 MBH Peerless natural gas fired steam boiler of newer vintage. The steam heat is supplemented by a gas fired furnace located on the second floor. The first floor spaces utilize portable or window mounted AC units in the summer to provide cooling. The second floor is served by the three new AHUs which have hot water coils and DX cooling. The second floor is supplemented with perimeter heating supplied by a standard efficiency 366 MBH Weil-McLain natural gas fired hot water boiler. Both boilers are equipped with outdoor air reset controls devices. A one (1) HP pump circulates water through the second floor space. Programmable thermostats control the building's HVAC equipment.

Domestic Hot Water

An electric hot water heater of relatively new age serves the building's domestic water needs.

Lighting:

The lighting consists of 28W high efficiency lamps and ballasts as well as compact fluorescent and incandescent screw ins. Each space has a wall or ceiling mounted occupancy sensor lighting control.

Building Envelope:

The first floor windows are single pane and in poor condition. The second floor windows were renovated recently but are single pane. There were also instances of improperly closing windows on the second floor. The attic is insulated but the walls are not.

DPW Building

General:

The DPW Building is a one story slab on grade building built in 1978 consisting of both Concrete Masonry Unit (CMU) and wood framing construction. The building is approximately 5,000 sq.ft. and is made up of office space, break room, storage, and maintenance bay. In addition to utility electric service, the building also employs the use of a standby natural gas fired generator.

HVAC:

The building is served by two Utica gas fired hot water boilers each 211 MBH that operate in lead/lag, are standard efficiency, and approximately 42 years old. The boilers are in a mechanical room with a vented door for combustion air intake. The flue exits through the chimney. The boiler supply water temperature is reset via an outdoor air control system. There is no heating source in the mechanical room other than the boiler and piping. Most of the hot water piping insulation is deteriorated and needs to be replaced. Baseboard radiation serves the offices and unit heaters serve the maintenance bay. Some areas of the building are also served by electric heat sources. The offices utilize window AC units in the summer for cooling. Programmable thermostats control the building's heating system.

Domestic Hot Water

An electric hot water heater of relatively new age serves the building's domestic water needs and is in the Men's Room closet.

Lighting:

The DPW Building existing interior lighting consists of 28W T8 lamps with energy efficient ballasts housed in strip, wrap, or troffer fixtures as well as compact fluorescent screw-in lamps. The exterior lighting is made up of two (2) 250W Metal Halide and two (2) 500W Metal Halide flood fixtures. The interior lamps and ballasts were replaced in 2014 as part of a previous energy efficiency upgrade project. The exterior fixtures were not included in the project. The fixtures themselves are original to the building construction, 1978, and are in moderate condition.

Building Envelope:

The building's double pane windows are in poor condition and need replacement. There is significant heat loss occurring through the three maintenance bay garage doors. This is because there is only a single door entrance at the front of the building. The parking lot is located on the side of the building near the garage bay doors and the occupants use these doors to enter and exit the building.

Library

General:
The Library is a two story, slab on grade, 17,000 sq. ft. building built in 2016 and is USGBC LEED Gold Certified. The building comprises of office space, conference rooms, study areas, and book shelf space.

HVAC:
Fresh air is delivered to the different spaces via an Energy Recovery Ventilator (ERV). The building utilizes two different types of heating/cooling systems. The primary source is the Mitsubishi heat pump system. The heat pump system has a central control system that modulates the individual ceiling evaporator cassettes and three outdoor condensing units to maintain the space heating or cooling temperature set point as determined by the local thermostats. The Mitsubishi controls are also integrated with the ERV unit and some spaces are equipped with CO2 sensors for demand control ventilation. The secondary source of heating is a hydronic system served by two (2) Lochinvar Knight natural gas fired boilers. Two (2), one (1) HP pumps circulate hot water through the building. The boilers serve perimeter baseboard heat and are controlled by their own local Johnson Controls Thermostat. The design intent for the hydronic system to operate only if the heat pump system cannot meet the building's heating load, however the owner has expressed concerns about simultaneous heating and cooling and maintaining occupant comfort.

Lighting:
The lighting fixtures are LED, however, the fixture manufacturer has since gone out of business and the owner is unable to purchase parts for repair.

Building Envelope:
The ceilings and walls are insulated with faced batt R-38 insulation. However, the owner has expressed trouble with sprinkler pipes freezing above ceiling and occupant comfort complains.

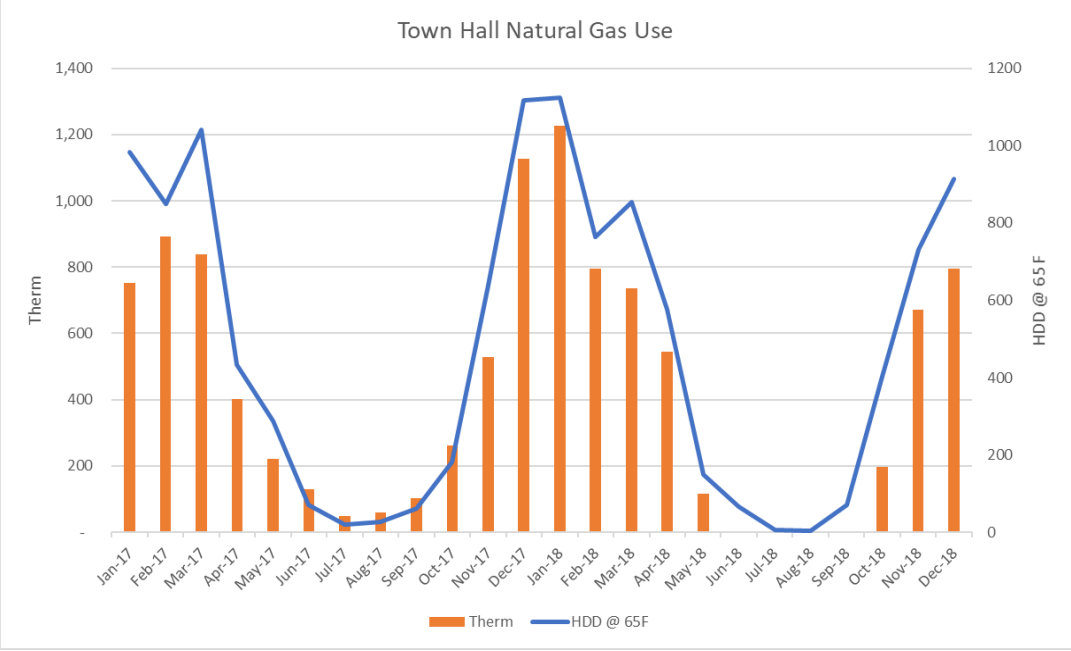
Utility Data

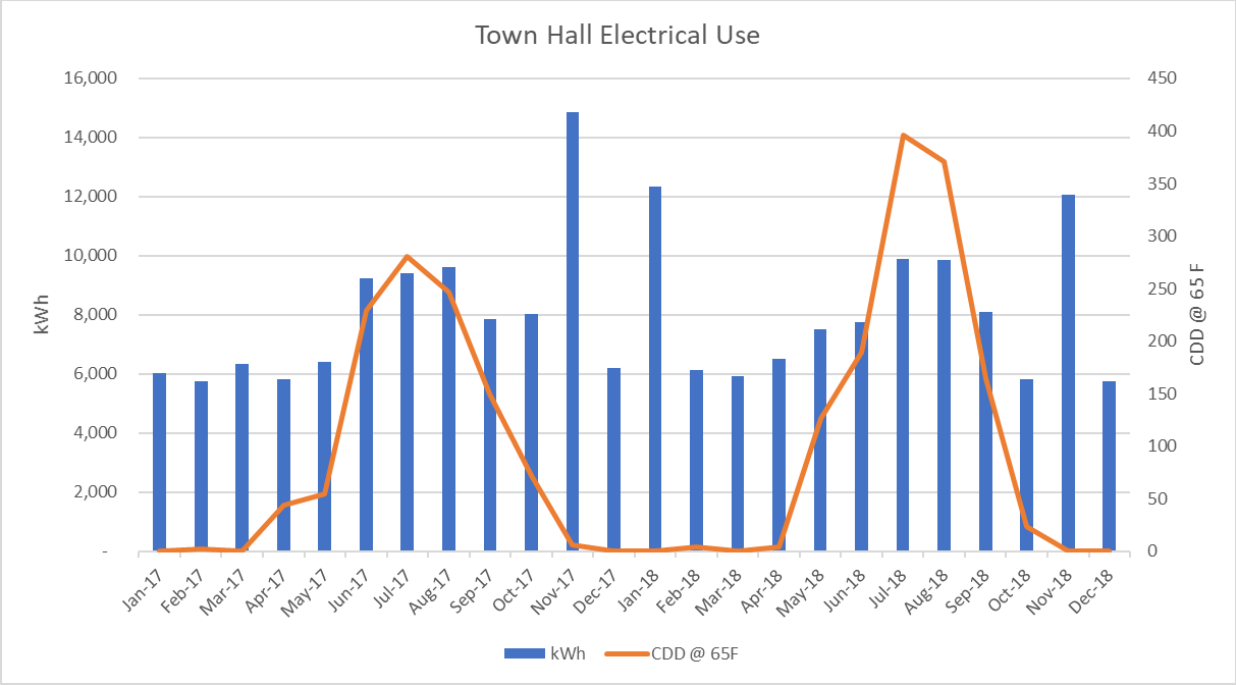
The Town buildings all utilize National Grid Electric and Gas service. ENE Systems has analyzed the 2017 & 2018 utility data for each of the three buildings. This analysis gives a better understanding of how efficiently each building is presently operating and will also serve as a baseline to compare future energy conservation measure effectiveness against.

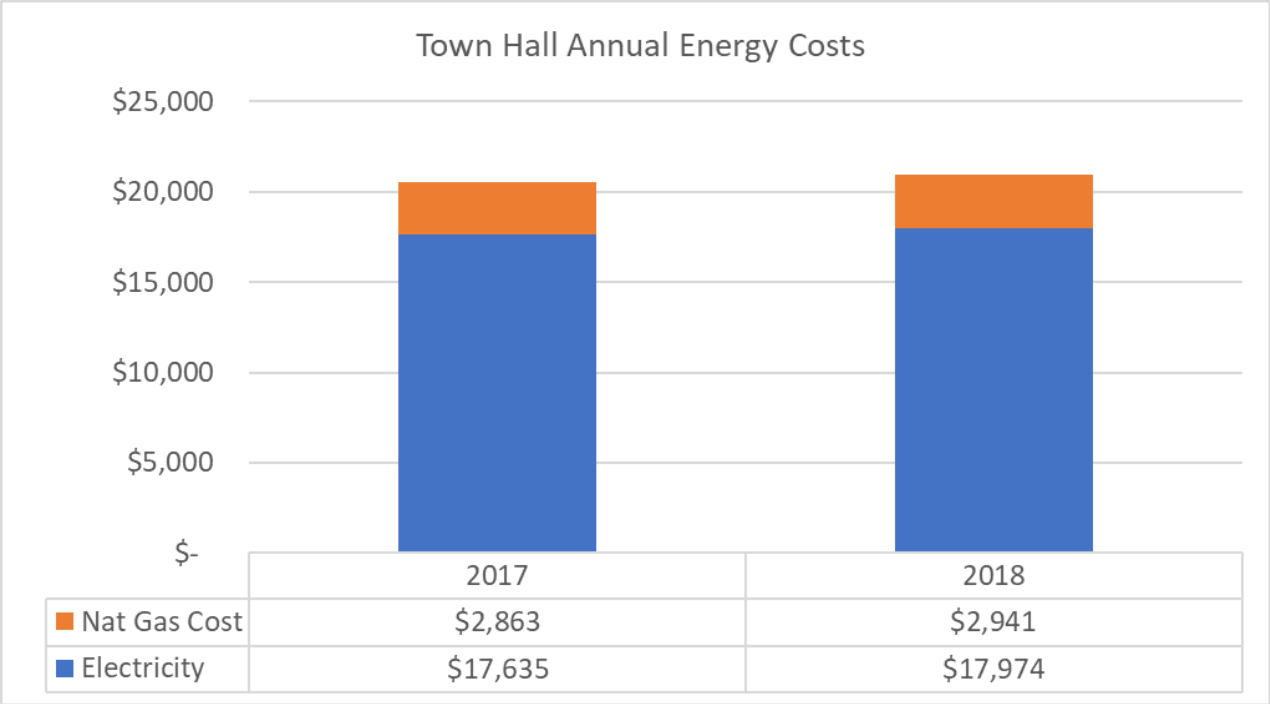
Town Hall

The Town Hall's Energy Use Intensity (EUI) over the past two years has been 96 and 94 kBtu/sq. ft. respectively. The Energy Use Intensity provides a reference metric to compare energy use to similar building types. The U.S Energy Star reference for an office building is 52.9 kbtu/sq.ft. The Town Hall consumes 80% more energy than the average office building meaning there are opportunities for energy savings to be realized. The natural gas usage tracks closely with heating degree days, hours of the year requiring a building to be heated, and there are no significant outlying data points. This matches expectations as the building's only natural gas use is for building heating. The electricity usage tracks with cooling degree days, hours of the year requiring a building to be cooled. There are a few spikes in electricity use during the winter months that require further investigation. The building's average total energy cost is $20,706 with 86% of the cost coming from electricity consumption. Decreasing electricity consumption should be prioritized first when considering the application of energy conservation measures.

Town Hall Annual Totals									
Year	HDD @ 65F	EUI	Electric Use (kWh)	Electric Cost	$/kWh	Nat Gas Use (therm)	Nat Gas Cost	$/therm	Total Energy Cost
2017	5712	96	95,581	$ 17,635	$ 0.18	5,368	$ 2,863	$ 0.53	$ 20,498
2018	5666	94	97,696	$ 17,974	$ 0.18	5,083	$ 2,941	$ 0.58	$ 20,915



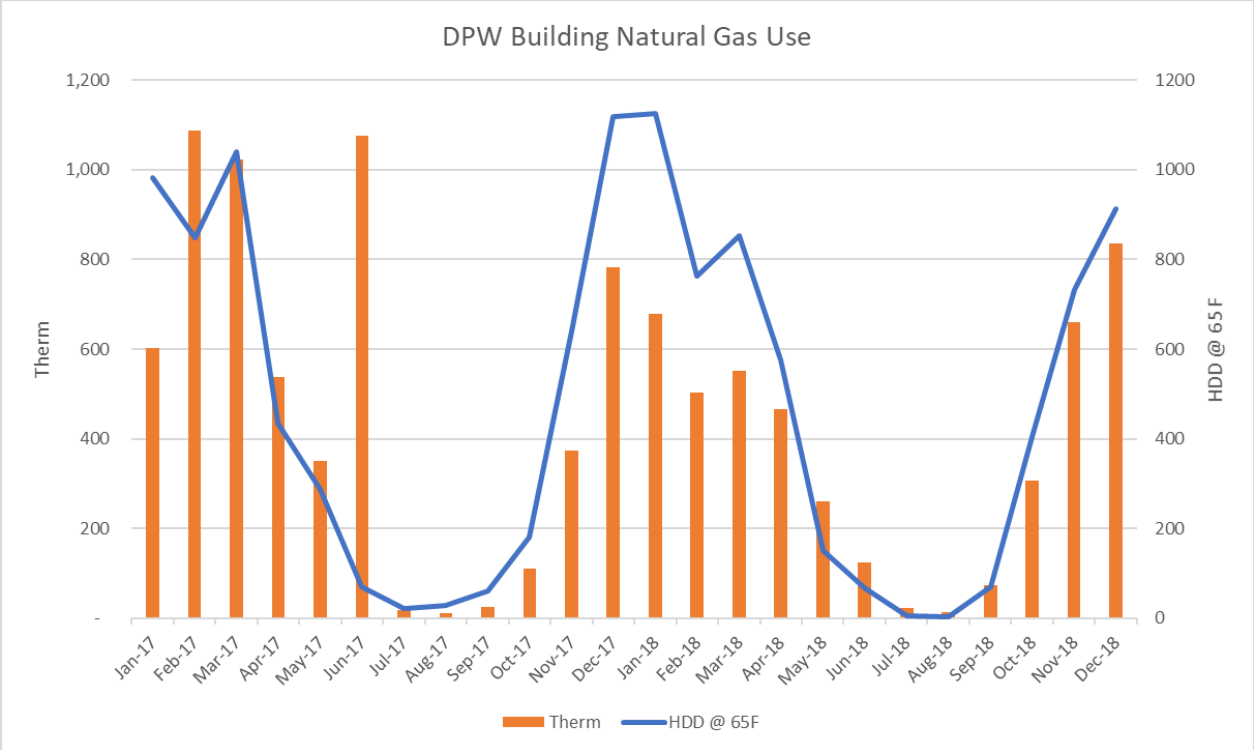

Town Hall Electrical Use
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
-
kWh
450
400
350
300
250
200
150
100
50
0
CDD @ 65 F
Jan-17
Feb-17
Mar-17
Apr-17
May-17
Jun-17
Jul-17
Aug-17
Sep-17
Oct-17
Nov-17
Dec-17
Jan-18
Feb-18
Mar-18
Apr-18
May-18
Jun-18
Jul-18
Aug-18
Sep-18
Oct-18
Nov-18
Dec-18
kWh
CDD @ 65F

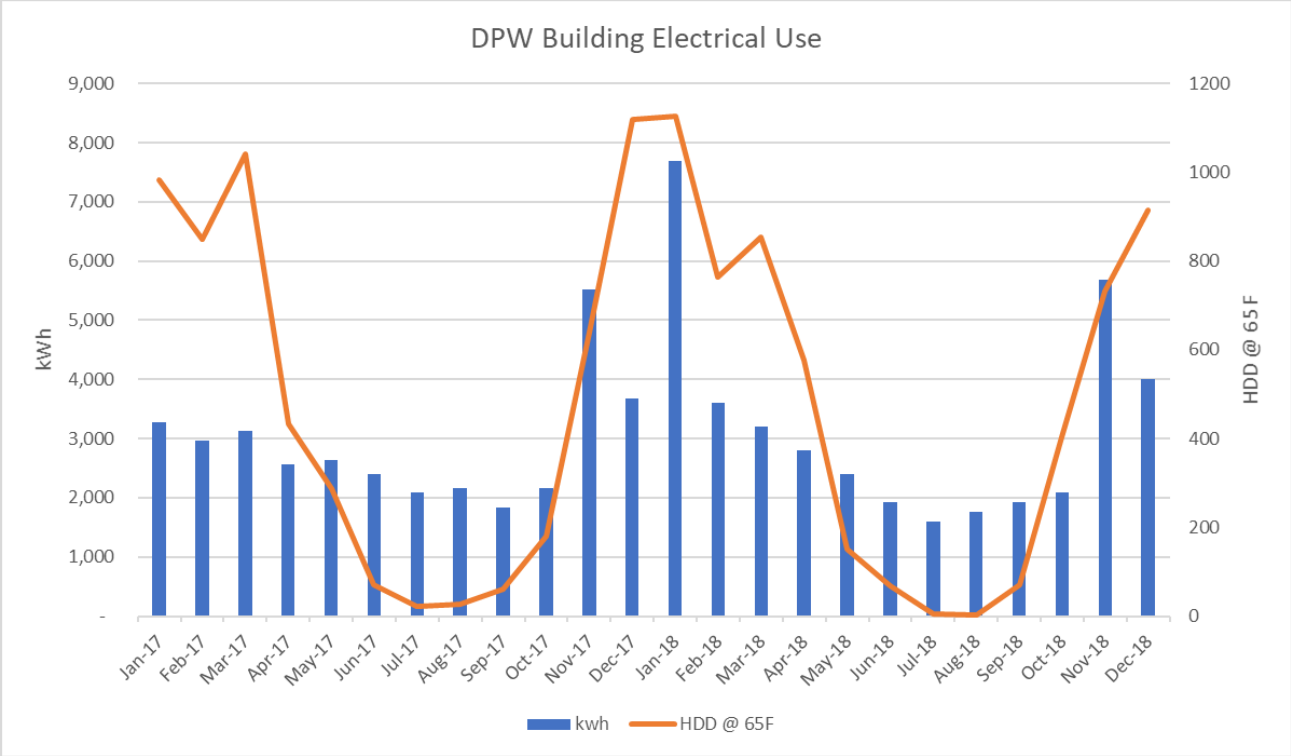

Town Hall Annual Energy Costs
$25,000
$20,000
$15,000
$10,000
$5,000
$-
2017
2018
Nat Gas Cost
$2,863
$2,941
Electricity
$17,635
$17,974

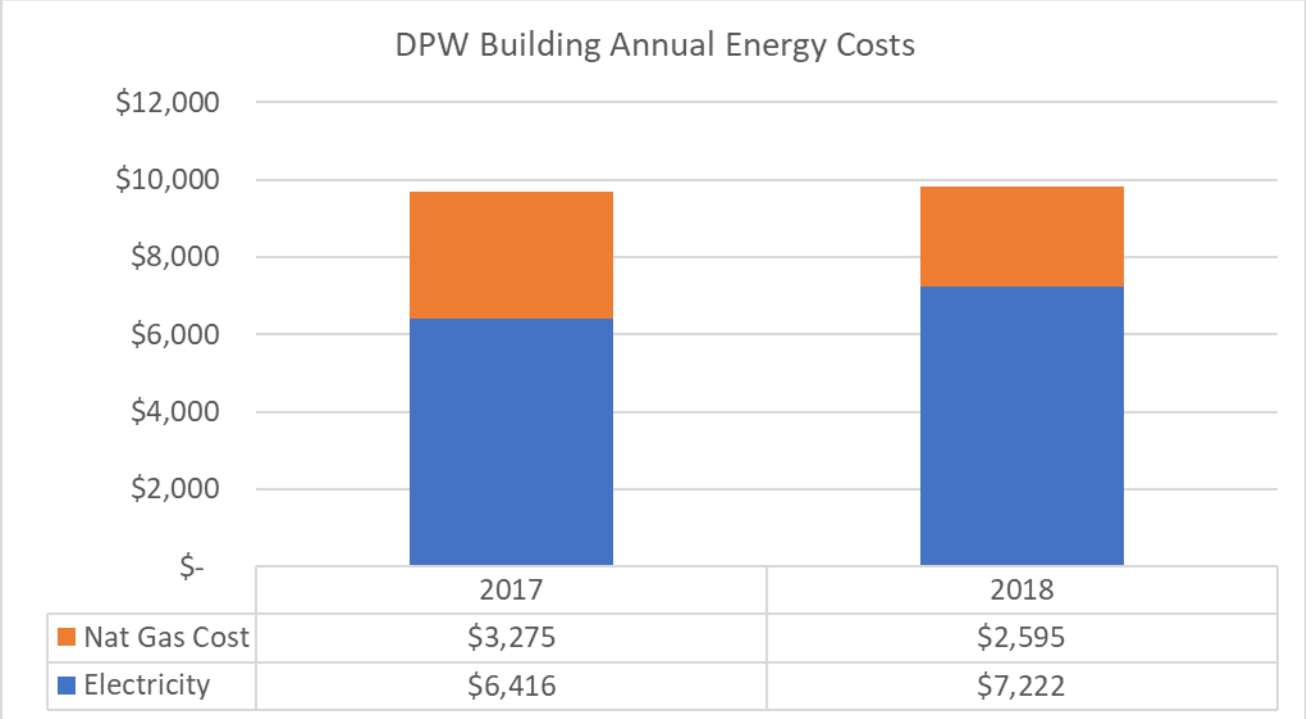
DPW Building

The DPW Building's Energy Use Intensity (EUI) over the past two years has been 143 and 116 kBtu/sq. ft. respectively. The Energy Use Intensity provides a reference metric to compare energy use to similar building types. The U.S Energy Star reference for a vehicle repair service is 47.9 kbtu/sq.ft. The Salisbury DPW Building consumes 170% more energy than the average vehicle repair service center meaning there are significant opportunities for energy savings to be realized. The natural gas usage tracks closely with heating degree days, hours of the year requiring a building to be heated. There is one outlier point in June of 2017 that may be a result of using the natural gas fired generator, further investigation is necessary. The electricity usage also tracks closely with heating degree days. This is expected as there some sources of electric heat in the building. The building's average total energy cost is $9,754 with 66% of the cost coming from electricity consumption.

DPW Building Annual Totals									
Year	HDD @ 65F	EUI	Electric Use (kWh)	Electric Cost	$/kWh	Nat Gas Use (therm)	Nat Gas Cost	$/therm	Total Energy Cost
2017	5712	143	34,400	$ 6,416	$ 0.19	5,998	$ 3,275	$ 0.55	$ 9,691
2018	5666	116	38,640	$ 7,222	$ 0.19	4,497	$ 2,595	$ 0.58	$ 9,817







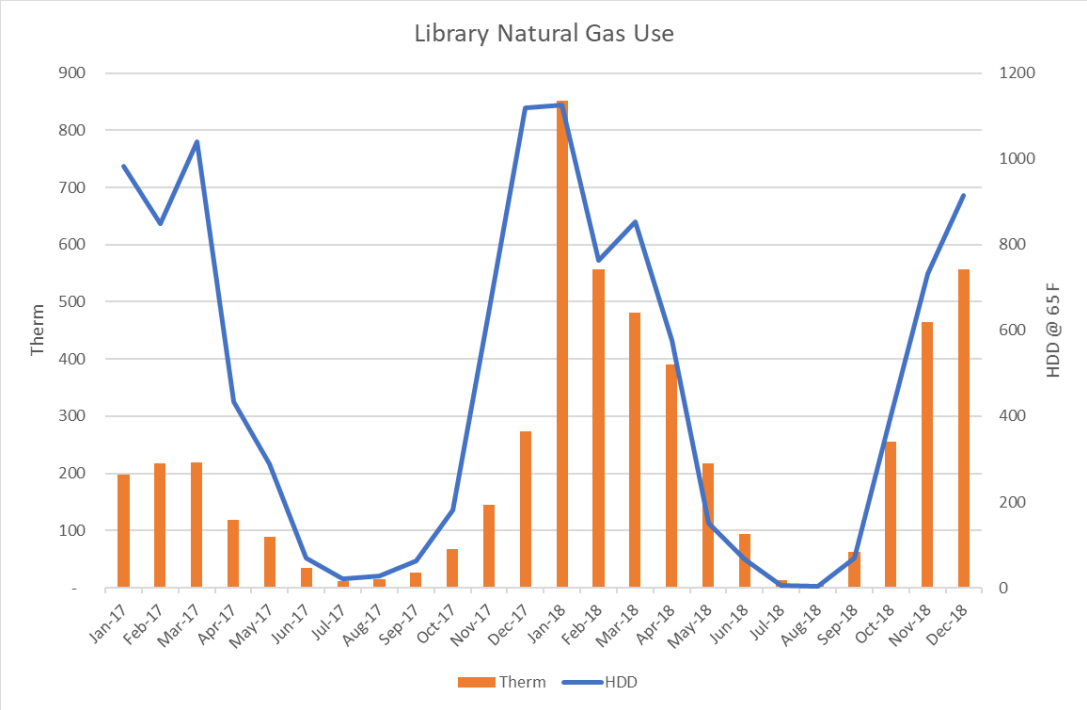
	2017	2018
Nat Gas Cost	$3,275	$2,595
Electricity	$6,416	$7,222

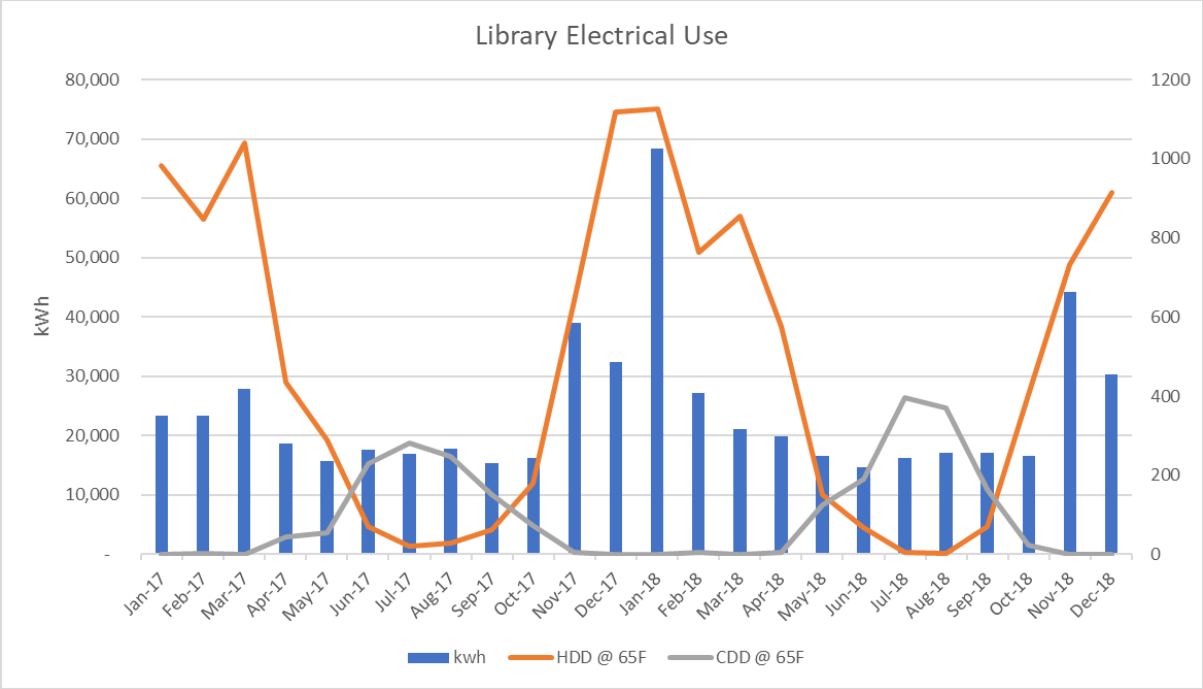
Library

The Library's Energy Use Intensity (EUI) over the past two years has been 61 and 85 kBtu/sq. ft. respectively. The Energy Use Intensity provides a reference metric to compare energy use to similar building types. The U.S Energy Star reference for a public library is 71.6 kbtu/sq.ft. The Salisbury Library consumes 2% more energy than the average public library. It should be noted however that the utility data has been increasingly steadily over time with the 2018 energy use being 40% greater than 2017 and appearing to be increasing further in 2019. This is most likely because the building has only been occupied since 2016 and the controls and equipment operation is drifting away from the design intent as occupants continue to use the building. It should also be expected that a USGBC LEED Gold certified building's energy consumption be well below the national average.

The natural gas usage tracks closely with heating degree days, hours of the year requiring a building to be heated. There are no significant outlying data points, however the consumption has been increasingly steadily over time. The electricity usage tracks with heating and cooling degree days, this is expected as the electric heat pump system provides both heating and cooling to the spaces. The building's average total energy cost is $52,684 with 96% of the cost coming from electricity consumption. Decreasing electricity consumption should be prioritized first when considering the application of energy conservation measures.

Library Annual Totals									
Year	HDD @ 65F	EUI	Electric Use (kWh)	Electric Cost	$/kWh	Nat Gas Use (therm)	Nat Gas Cost	$/therm	Total Energy Cost
2017	5712	61	264,400	$ 47,340	$ 0.18	1414	$ 905	$ 0.64	$ 48,245
2018	5666	85	309,400	$ 54,828	$ 0.18	3949	$ 2,296	$ 0.58	$ 57,124




Library Electrical Use
kWh
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
-
1200
1000
800
600
400
200
0
Jan-17
Feb-17
Mar-17
Apr-17
May-17
Jun-17
Jul-17
Aug-17
Sep-17
Oct-17
Nov-17
Dec-17
Jan-18
Feb-18
Mar-18
Apr-18
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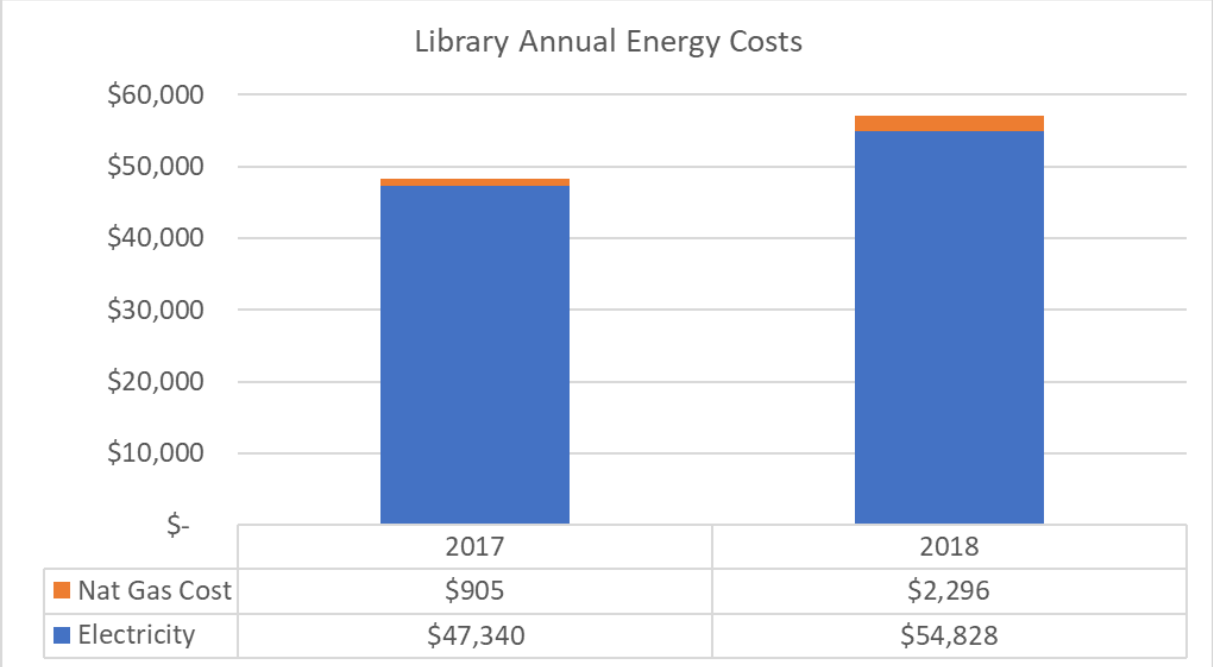
Sep-18
Oct-18
Nov-18
Dec-18
kwh
HDD @ 65F
CDD @ 65F


Library Annual Energy Costs
$60,000
$50,000
$40,000
$30,000
$20,000
$10,000
$-
2017
2018
Nat Gas Cost
$905
$2,296
Electricity
$47,340
$54,828

Findings & Possible Energy Conservation Measures

The findings and resulting possible Energy Conservation Measures (ECM) for each of the buildings has been summarized below. Further investigation and data collection will be needed in order to determine the utility rebate potential and economic viability of each ECM.

Town Hall

HVAC:

- The existing hot water boiler has an approximate efficiency of 81%. The existing boiler could be replaced with condensing boilers with an efficiency rating of 96%.

- Split System AC units could be installed on the first floor where window AC units are currently being used. Split Systems are approximately 25% more efficient than window AC units.

- The schedules on each of the programmable thermostats should be verified and adjusted as necessary so that the HVAC system operates only when the building is occupied.

Lighting:

- The existing 28W high efficiency lamps, compact fluorescent lamps, and incandescent lamps can be retrofitted with LED equivalents. Because the second floor lighting has recently been replaced and there are also many architectural lights, it would be more cost effective to utilize LED retrofit lamps, strip kits, and bulbs rather than installing new LED fixtures.

Building Envelope:

- Interviews with facilities staff indicated that the building's walls are not currently insulated. ENE Systems would recommend insulating the wood frame 2x4 wall system with blown in cellulose insulation. This will more than double the overall wall system R-value bringing the total to R-21. Increasing the walls' R-value slows the transfer of heat thus saving HVAC heating and cooling energy.

- Further investigation should be performed in the attic space to check the condition of the insulation. Most of a building's heat is lost through the roof.

- Several air gaps were observed in the windows. Air gaps allow unconditioned outside air to enter the building disrupting occupant comfort and increasing energy costs. ENE Systems recommends that all windows and doors are further inspected for air gaps and repaired accordingly.

Figure 1: Air Gap in Second Floor Window

- It was observed that the windows are all single pane. Double pane windows have approximately double the R-value of single pane windows. It is recommended that the first floor windows be either retrofitted or replaced with double pane windows. The second floor windows have been replaced recently but could be a candidate for retrofitting with double pane glass.

DPW Building

General:

- The building has a natural gas fired generator on site. Further investigation is necessary to determine if the generator can be used in a demand response program. In this program, the utility pays the user to operate the building on generator power rather than utility power during certain times of the year.

HVAC:

- The two existing boilers are 42 years old and are approaching the end of their useful life. ENE Systems recommends that the existing 80% efficient boilers be replaced with a single condensing 96% efficient boiler. To implement this measure, the existing vented door will need to be replaced with a solid one, new flue and combustion air venting will need to be installed, and a unit heater will need to be installed in the mechanical room to prevent possible freezing issues.

Figure 2: Existing Hot Water Boilers

- It was observed that much of the hot water piping throughout the building is uninsulated. It is recommended that all hot water piping is insulated.

- Further investigation is necessary to determine if the electric heating can be replaced with a hot water system that is more cost efficient to operate. It is approximately 10x more expensive to operate an electric resistive system than a natural gas fired hot water system.

Lighting:

- ENE Systems has developed a separate proposal for an LED lighting upgrade project at the DPW building. This has been proposed because we believe it is the best option for the Town to cross the $10,000 spending threshold needed to qualify for the next phase of Green Communities Act funding.

Building Envelope:

- The existing double pane windows are in very poor condition with failed seals. These can be replaced with new double pane replacements.

Figure 3: Window with Broken Seal

- There is significant heat loss occurring through the three garage bay doors. This is because there is only a single door entrance at the front of the building. The parking lot is located on the side of the building near the garage bay doors and the occupants use these doors to enter and exit the building. ENE Systems proposes installing a secondary entrance on the parking lot side of the building. To implement this, the existing building hallway will need to be extended through the Men's Bathroom and the water heater in the bathroom closet will be relocated.

Figure 4: Proposes Secondary Door Location in Men's Bathroom, the Green Door is the Existing Closet.

Library

HVAC:

- The building currently utilizes two different sets of HVAC controls, one for the Mitsubishi Heat Pumps & ERV, and one for the Lochinvar Boilers. These two sets of controls do not communicate with one another which opens the possibility for system mismatch, simultaneous heating and cooling, excess energy consumption, and occupant discomfort. Interviews with the owner, site observations, and utility data analysis confirms that these systems are not operating in harmony. ENE Systems suggests that further investigation be performed to determine if these two separate controls systems can be merged into one. This will eliminate all afore-mentioned inefficiencies.

Figure 5: Controls Systems Present In Space; From Left to Right, CO2 Sensor for ERV, Thermostat for Boiler, Thermostat for Heat Pump.

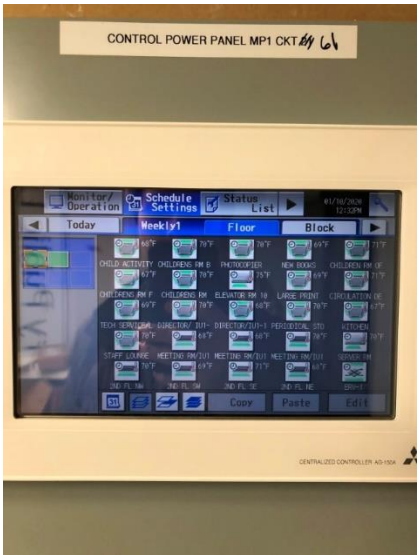


Figure 6: Mitsubishi Control System

- Fins were observed missing on the Archive Room baseboard radiators. This detracts from the effectiveness of the radiator making space temperature control more difficult. ENE Systems recommends spot checking all radiators and installing fins where missing.

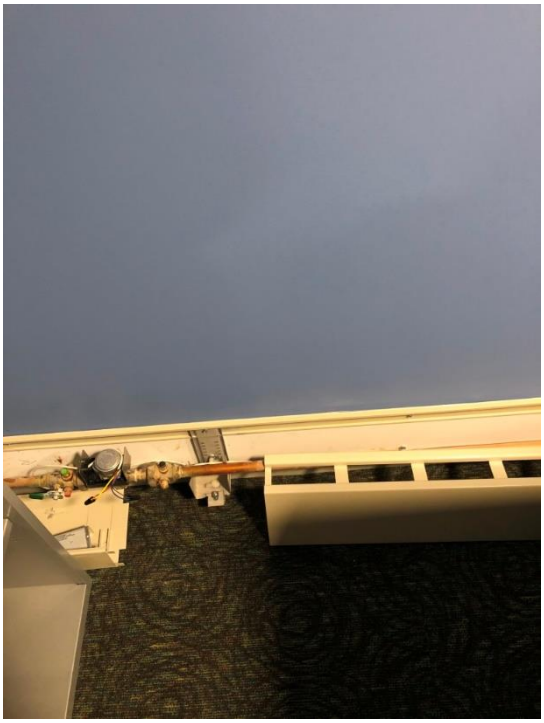


Figure 7: Missing Fins on Baseboard Radiator

- The owner described issues controlling the space temperature in Office 109. Investigation revealed that there is no thermostat located in the space. Further investigation is necessary to determine if and how the temperature in the space is controlled and resolve as necessary.

- The owner described issues with controlling the space temperature in the children's area bathroom. Investigation showed that there is no heat source present in the bathroom which has an exterior facing wall. ENE Systems recommends installing a heat source with thermostat control in the space.

Lighting:

- The building's lights are all LED, however, the fixture manufacturer has since gone out of business and the owner is unable to acquire replacement parts. Further investigation is necessary for ENE Systems to recommend a LED retrofit product that can replace the existing fixtures as needed.

Building Envelope:

- The owner has expressed problems with sprinkler pipes freezing above the ceiling. Investigation during the audit revealed several instances of faced batt insulation improperly installed, missing, or not installed in the correct location. This is creating gaps in an air barrier that must be continuous between the outside air and interior spaces where the piping is located. One instance was observed where piping was installed in an area that is open to soffit venting. Another instance was observed where the insulation was not attached to the floor in a crawlspace, allowing air to infiltrate underneath it. In addition to freezing pipes, these gaps in the air barrier reduce the overall energy efficiency of the building. ENE Systems recommends a thorough investigation of the entire building envelope be performed to identify all gaps in the air barrier. Subsequent repair of all air gaps will be performed thereafter.

Figure 8: Sprinkler Piping Located in Space Open to Soffit Venting

Figure 9: Insulation/Air Barrier Not Installed Continuously to Floor