Windham Town Office Energy Assessment Report

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2. Project Description

The Town office is a complex of three buildings joined together. Originally built in 1910 as a school, it represented about 40% of the present size, and was an 8,008 square foot wood framed two story building resting on a concrete and masonry foundation. According to records the school was expanded in 1931 by adding a gym, increasing the size of the building by 6000 square feet. The gym is a wood framed structure resting on a slab on grade foundation. In 1963 the annex was added increasing the size by another 6,500 square feet. The annex is also wood framed structure and rests on a slab on grade foundation. The total square footage of the building is approximately 20,503 square feet. The Annex was renovated in 2005 to provide office space and the school was renovated in 2007 to provide office space. The gym currently serves as the community center. There have been other miscellaneous renovations over the years.

The upper level is offices, work rooms, book storage, computer facilities and reading space. The facade of the building is vinyl siding over wood clapboard at the old school and annex, at the community center it is wood clapboards with wood trim. The roof of the old school is asphalt shingle on a hip roof and the annex and community center have flat EPDM roofs. The roofs at the old school and annex are due for replacement this year. Many of the windows have been replaced with newer vinyl thermo-pane double hung windows and the entrances have been replaced at the old school and annex. The interior has been renovated, is painted drywall with wood trim, the floors are mostly carpet with some floor tiles and acoustical tile ceilings.

The front entrance of the building faces a south easterly direction. The building presently serves as the town Offices and Community Center for the town.

3. Executive Summary

3.1 Introduction:

This report details the recommendations and findings of the audit report conducted for the Windham Town Office and Community Center, located at 8 School Street in Windham, Maine. The site visit was conducted on August 9 & 10, by John Monaghan, who met with Ben Smith, the Assistant Town Planner and David Dickson, the Public Works Supervisor.

Windham Town Office Energy Assessment Report

This assessment recommends twenty two (22) Energy Conservation Measures (ECMs) addressing the electric and natural gas usage; increasing comfort and cost savings. Details of the findings and recommendations are contained in the assessment.

The priorities are to improve the building envelope, improve the lighting, adjust the heating system controls and add a timer to hot water tank and replace the Office Area tank with an on demand system. A number of the ECM's are recommended for when equipment or components have to be replaced or upgraded and are marked by an * in the table. This is often the best time to make an energy saving improvement for a reasonable incremental cost that can be paid back over an acceptable period of time. The table looks at simple payback and the savings to investment ratio. Simple pay back is the cost of the improvement divided by the projected annual savings and it tells you how many years it will take to recoup your investment. Savings to Investment Ratio (SIR) is the projected annual savings times the useful life of the improvement, divided by the cost of the improvement which it tells you how many times the investment will pay for itself over the life of the investment. The SIR should be greater than 1 and the higher the number than 1 the better the investment. The table does not include the maintenance savings or the improvement in thermal comfort for the ECM's.

3.2 Identified Energy Conservation Measures:

1. Building Envelope Improvements

a. **Provide general air sealing and repairs to insulation throughout the building**
b. **Apply 2" of spray foam insulation at the band and rim joist**
c. **Install 4" of rigid insulation when re-roofing the Annex**
d. **Relocate the thermal boundary to the ceiling/ attic plane in the Office section of the building, install a GWB ceiling and blow in 12" of cellulose**
e. **Install 2" of rigid insulation at the Office building above ground foundation wall**
f. **Install 2" of rigid insulation when re-roofing the Community Center Roof**
g. **Install 1" of rigid insulation at the outer face of the Community Center walls that have not received vinyl siding when they are re--sided**
h. **Install 1" of rigid insulation at the gym floor of the Community Center when the flooring is replaced**

2. Energy Efficient Lighting

a. **Re-ballast & re-lamp the existing T12 fixtures to T8's**
b. **Reduce lighting levels by removing fixtures or replacing 32 watt lamps with 28 watt lamps where indicated**
c. **Install occupancy sensors where indicted**
d. **Install a switch for bi level lighting**
e. **Replace HPS exterior fixtures with LED fixtures**

3. Heating and Air Conditioning System

a. **Increase setback of thermostats**
b. **Install scroll compressors in AHU's when replacement is needed**
c. **Install economizers on AHU's when replacement is needed**
d. **When replacement AHU is needed replace with higher SEER or EER rated units that meet Energy Star or Efficiency Maine standards**
e. **Replace the window air conditioner with a mini split unit that has a high SEER rating for the CCTV room**
f. **Investigate the air leakage on the duct system and have it sealed properly**

4. Domestic Hot water

a. **Add a seven day timer to the Annex hot water heater**
b. **Replace the electric hot water heater that serves the Office Area and Community Center with a high efficiency on demand natural gas fired unit**

5. Miscellaneous Items

a. **Install Energy Misers on the vending machines**

Windham Town Office Energy Assessment Report

Windham Town Office Building Proposed Energy Conservation Measures

Energy Conservation Measure	Annual Cost Savings in Dollars	Annual Electric Savings in kWh	Annual Natural Gas Savings in Therms	Annual CO2 Emissions Savings in tons	Cost of Work	Simple Payback in Years	Savings to Investment Ratio
Bldg Envelope							
Annex							
Air seal & repairs	$ 185	269	101	1	$ 1,200	6.5	4.63
4" Insulation@roof *	$ 731	278	462	3	$ 13,532	18.5	1.35
2" Foam insulation@band joist	$ 106	2	70	0.5	$ 1,218	11.5	2.61
Subtotal	**$ 1,022**	**549**	**633**	**4.38**	**$ 15,950**	**15.6**	2.86
Office Area							
Air seal & repairs	455	19	300	2	300	0.7	45.50
GWB Ceiling & 12' Cellulose	1274	584	797	5	22000	17.3	1.74
2" Foam Insulation @ Rim Joist	341	198	210	1	1960	5.7	4.35
& 2" Rigid insulation @ found							
Subtotal	**$ 1,615**	**782**	**1,007**	**$ 7**	**$ 23,960**	**14.8**	2.03
Community Center							
2" Insulation@roof *	516	209	325	2	5875	11.4	2.20
Air seal & repairs	481	206	302	2	2400	5.0	6.01
1" Rigid insulation @ Walls *	341	21	224	2	2250	6.6	4.55
1" Rigid insulation @ SOG *	148	9	97	1	3120	21.1	1.42
Subtotal	**$ 1,486**	**445**	**948**	**6**	**$ 13,645**	**9.2**	3.54
Bldg Envelope Subtotal	**$ 4,123**	**1,776**	**2,588**	**18**	**$ 53,555**	**13.0**	**2.81**
Lighting							
Annex							
Reduce lamp watts, reduce fixtures, add controls & switches	$306	2,549		1	$2,217	7.2	2.07
Office Area							
Change to T8's,reduce lamp watts, reduce fixtures, & add controls	$846	7051		2	$4,005	4.7	3.17
Community Center							
Change to T8's,reduce lamp watts & add controls	$348	2897		1	$1,613	4.6	3.24
Exterior							
Install LED fixtures & relamp w/LED	$671	5589		1	$3,115	4.6	3.23
Lighting Subtotal	**$1,152**	**9,600**		**4**	**$6,222**	**5.4**	2.78

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Windham Town Office Building Proposed Energy Conservation Measures

Energy Conservation Measure	Annual Cost Savings in Dollars	Annual Electric Savings in kWh	Annual Natural Gas Savings in Therms	Annual CO2 Emissions Savings in tons	Cost of Work	Simple Payback in Years	Savings to Investment Ratio
Heating System							
Annex							
Increase Set back T stat	83	1	**55**	**0.4**	1	0.0	1245.00
Scroll Compressor Replacement*	137	1,139		**0.3**	600	4.4	3.43
Add Economizer	191	1,595		**0.4**	1000	5.2	2.87
AHU with Higher SEER/EER*	205	1,709		**0.4**	2000	9.8	1.54
Subtotal	$616	4,444	55	1	$3,601	5.8	313.21
Office Area							
Increase Set back T stat	91	1.45	**60.4**	**0.4**	1	0.0	1365.00
Scroll Compressor Replacement*	167	1388		**0.3**	600	3.6	4.18
Add Economizer	467	3888		**1**	1000	2.1	7.01
AHU with Higher SEER/EER*	500	4165		**1**	2000	4.0	3.75
Install Mini Split @CCTV	**252**	2097		**0.5**	2200	8.7	1.72
Subtotal	$1,477	11,539	60	3	$5,801	3.9	276.33
Community Center							
Increase Set back T stat	153	2.43	**54**	**0.4**	**1**	0.0	2295.00
Scroll Compressor Replacement*	93	774		**0.2**	450	4.8	3.10
Add Economizer	260	2168		**0.5**	1000	3.8	3.90
AHU with Higher SEER/EER*	288	2323		**0.5**	2000	6.9	2.16
Subtotal	$794	5,267	54	2	$3,451	4.3	576.04
Heating & AC Subtotal	$2,887	21,251	169	6	$12,853	4.5	388.53
Domestic Hot Water							
Add Seven Day Timer	**258**	**2,152**		**0.5**	**$290**	**1.1**	8.90
Replace NGas On Demand Syst'm	347	2,895		**0.7**	$1,140	3.3	4.57
Domestic Hot Water Subtotal	$ 605	5,047		1	$1,430	2.4	6.73
Misc. Items							
Energy Miser for Vending Machines	247	2,059		**0.5**	$340	1.4	7.26
ECM Totals	$ 9,014	39,733	2,757	29	$ 74,400	8.3	82

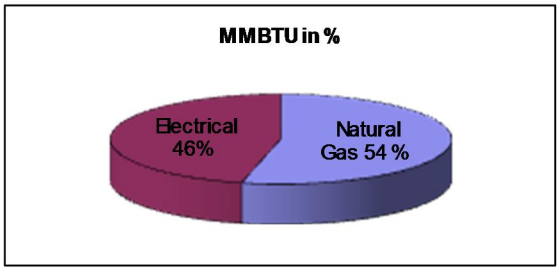
Note: A 5% to 10% contingency should be carried for the cost of work

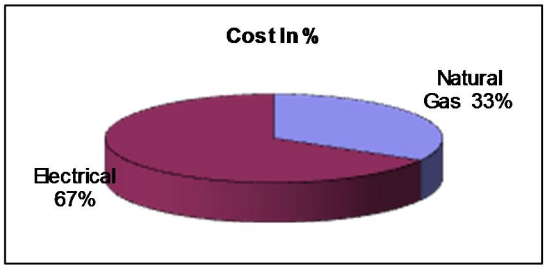
*** Only includes cost of the energy up grade**

4. Energy Usage

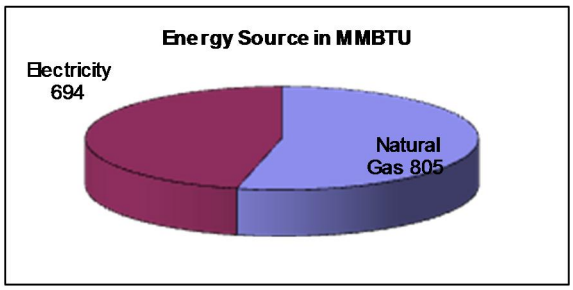
The energy usage of the building is from two sources: electricity for lighting, domestic hot water, air conditioning and power; and natural gas for heat.

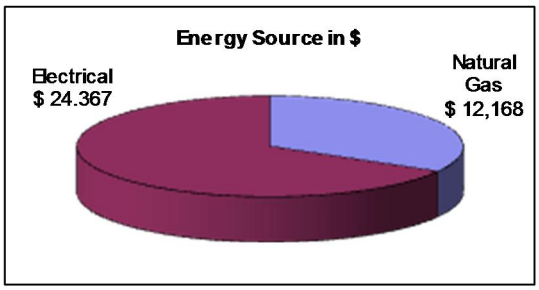
The first series of pie charts show the energy usage in percent for both BTU's, the common energy measurement unit and as the cost of energy.





The second series of pie charts shows the energy usage in millions of BTU's (MMBtu) and the cost in dollars.





As shown in the pie charts, electrical accounts for the greater portion of the energy usage in cost, $ 24,010 or 67 % in dollars and natural gas is the greater in energy units, 804 MMBTU or 54 % of the BTU's.

4.1 Historic Energy Consumption

1. Electrical

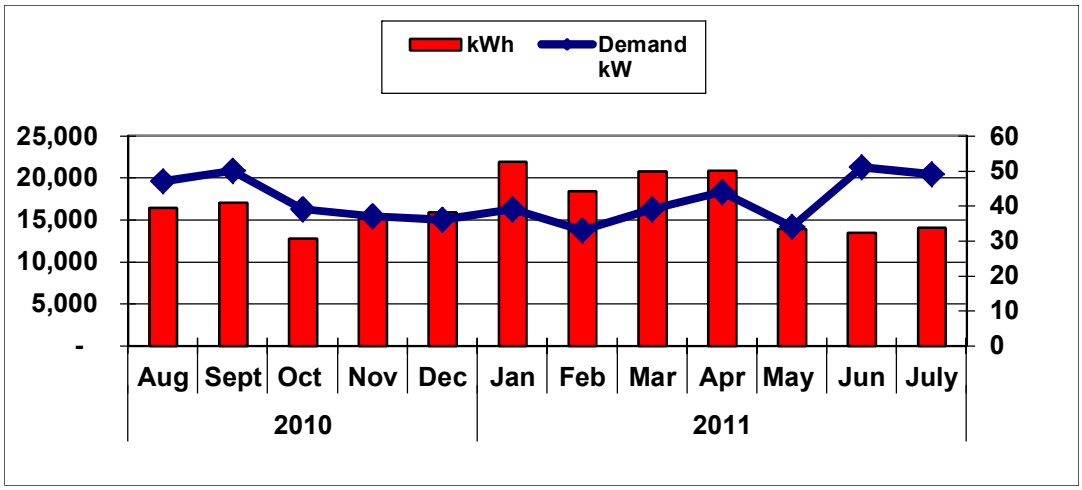
Usage is shown in the table and graph below for the year 2010/2011 and represents both meters. The baseline average monthly consumption is 13,010 kWh/month based on June and October.

The monthly usage increased beginning in July reflecting the use of air conditioning and did return to the expected usage in October. This followed the cooling season for the area.

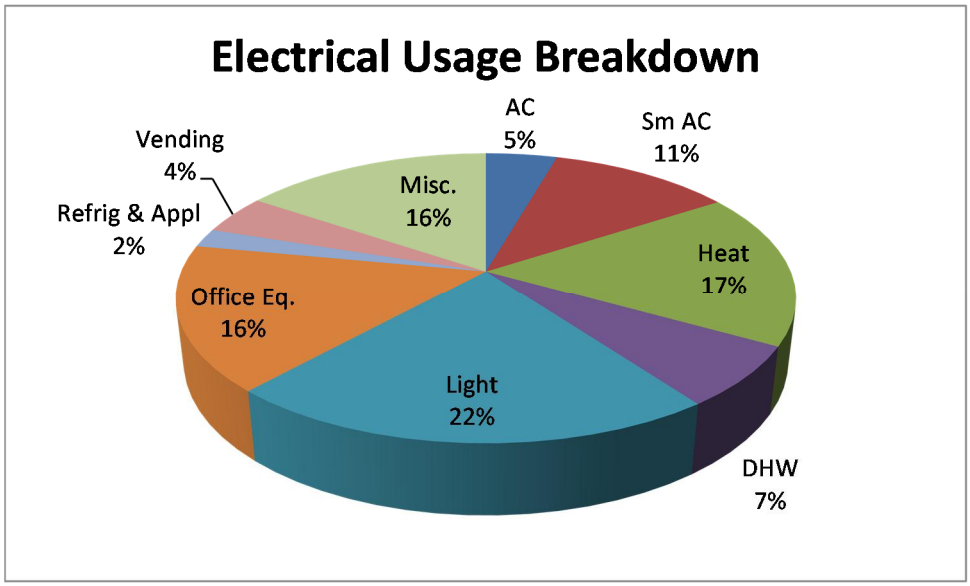
Electrical use per square foot averaged 9.77 kWh as compared to the New England average of 10.8 kWh which is 91% of the average for commercial buildings in New England. This is less than the New England average and higher than other municipal buildings that have been assessed in Maine. Based on 7 other town office buildings the average kWh/SF is 5.75.

The table and graph below show the 2010/2011 electrical usage for both meters for the Town Office Building.

Windham Town Office Both Meters					
Electricity Usage-2010/2011					
		kWh	Cost (incl demand)	Demand kW	Demand Charge
2010	Aug	16,399	1968	47	393
	Sept	17,032	1820	50	409
	Oct	12,755	1514	39	274
	Nov	15,123	1933	37	355
	Dec	15,896	1887	36	353
2011	Jan	21,889	2522	39	303
	Feb	18,407	2219	33	352
	Mar	20,745	2705	39	328
	Apr	20,798	2267	44	296
	May	13,928	1929	34	352
	Jun	13,464	1564	51	404
	July	14,031	1684	49	383
	Total	200,467	$ 24,010	498	$4,202
12 Mo	Avg	16,706	$2,001	42	$350
Avg	$/kW		$0.12		



Below is a table showing the estimated breakdown of electrical usage, light, heat, air conditioning and office equipment are the major users of electricity. These sources of use should be reviewed for energy improvement measures with this in mind.

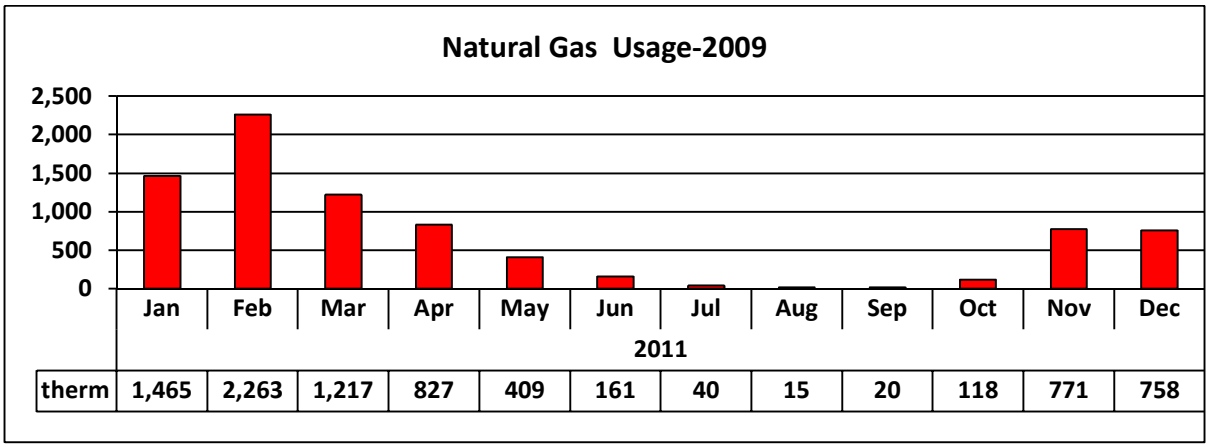


2. Natural Gas

The natural gas usage for the year 2009, beginning in January 2009 and ending in December of 2009 is shown below in the table and graph. The natural gas usage mostly coincides with the colder winter weather.

The natural gas usage on a square foot basis is 39,336 BTU/SF as opposed to 44,480 BTU/SF, or 88% of the average for commercial buildings in New England.

Windham Town Offices			
Natural Gas Usage-2009			
		therm	cost
2009	Jan	1,465	2,212
	Feb	2,263	3,417
	Mar	1,217	1,838
	Apr	827	1,249
	May	409	618
	Jun	161	244
	Jul	40	60
	Aug	15	22
	Sep	20	30
	Oct	118	178
	Nov	771	1,165
	Dec	758	1,144
	Total	8,065	$12,178
Month	Average	529	$798
$/gal	Average		$1.51



The heating season for 2009 was about 13% warmer than the average heating season for the greater Portland area based on Heating Degree days which adjust the Btu's to 44,449 Btu's/SF or 99% of the average . The fact that the building operates on a 4 day 10 hour day also helps with the heating fuel consumption.

4. Building Envelope

As stated the building, originally built in 1910, was expanded and renovated over the years to its present size of 20,500 SF.

The older school section of the building is two stories with walls that are 2x4 balloon framing with 4" of batt insulation at the walls and 6" of batt insulation in the wood framed sloped roof. The doors and windows have been replaced during the last renovation. The doors are single pane store front units and the windows are thermo pane double hung vinyl windows. The roof is asphalt shingles and is scheduled to be replaced this fall, when replaced a 3/8" layer of plywood should be installed over the decking. The building rests on a full foundation with the lower portion being concrete and the upper masonry with no signs of insulation.

The gym, now called the community center is a high bay structure that has 2x4 balloon framing with 4" of batt insulation at the walls and a flat roof with R12 rigid insulation under the EPDM roofing. The windows have been replaced with double hung thermo pane vinyl windows and the doors with metal insulated units. The community center rests on a slab on grade that has no signs of insulation. Two sides of the community center have been sided with vinyl siding.

The annex is a single story wood framed structure with 2x4 framed walls and a flat roof. The walls have 4" of batt insulation and the roof has 6" of batt insulation. The building rests on a slab on graded foundation and there were no signs of insulation at the foundation. The roof is scheduled to be replaced and the insulation improved. The doors and windows have been replaced during the latest renovation with the exception of the doors on the south west side of the Annex.

An infrared scan of the newer windows revealed some air infiltration at the windows themselves but more infiltration at the perimeter. The perimeter infiltration is likely due to poor air sealing between the window frame and the rough opening. At the windows, the perimeters and joints between the trim and window to sash edge should be caulked to

reduce air infiltration. It is recommended that this be done at the offices and locations where occupants sit next to the windows for extended periods of time.

A visual inspection and infrared scan of the doors revealed considerable air infiltration at the side doors to the community center. It is time consuming and costly, but doors such as these require considerable maintenance and adjustment to keep them tight. Replacing them with more efficient doors should be considered as part of an ongoing maintenance program. The perimeter joints should be caulked, doors adjusted and the weather stripping replaced with commercial grade material.

As mentioned earlier, the town office facility is really three buildings joined together, with different ages, construction and somewhat different operating characteristics. Each section will be looked at separately from a building envelope perspective.

The annex is scheduled to receive a new roof with 4" of rigid insulation that will increase the R value to an estimated R 40 and decease the heat loss through the roof by 35% and the cooling load by 5%. In addition, it is recommended that the band joist be sprayed with 2" of closed cell foam and that general air sealing take place throughout the building. It is estimated this will reduce the heat loss through this section of the building by 10% and the cooling load by 5%. Note most of the cooling load does not come through the walls and roof via conduction but from solar heat gain and air infiltration. In addition the building is in a predominately cooling environment.

The Office section of the building presents the greatest opportunity for improvement but is also the most costly to implement. The upper thermal boundary is the sloped roof and it is poorly insulated and appears not to be properly vented. Access to the area was limited however based on discussions, the areas viewed are representative of the space. The attic area, for purpose of heat loss and gain, is connected to the upper floor of the building, the suspended ceiling does little to act as an air or thermal barrier and represents a considerable volume of space to heat and cool. Another question is whether the roof acts as a hot/non-vented or cold/vented roof. The roof appears to be a warm/semi vent warm roof but performs very poorly. Roofs cannot be in between and provide adequate thermal protection and prevent condensation issues. Based on tests of similar buildings of this type the air changes per hour (ACH) is estimated to be between .8 and 1, classifying it as a loose building. The primary concerns in developing an improvement strategy are moisture issues, ice dams, volume of the space being heated or cooled, air infiltration and heat loss and heat gain.

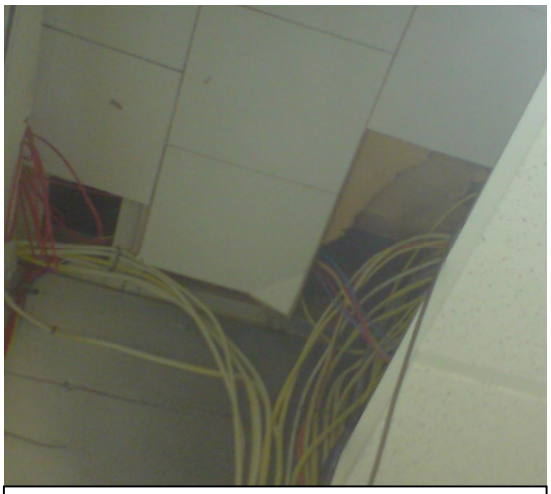
At one time the ceiling was at a higher level and the recommendation would be to re-establish this as the thermal and pressure boundary rather than the slope section of the roof. This approach reduces the volume of heated and cooled space, is easier to air seal, ventilate, establish an air and thermal barrier and improve the insulation level. In addition, there is also concern about the weight that would be added to the sloped roof to improve it as the thermal boundary. This measure will include installing a fire taped layer of drywall at the upper ceiling area, eliminating all possible penetrations, air sealing penetrations, installing air dams at the wall eave intersection, installing soffit and roof vents, six to eight feet of sloped vent and blowing in 12" (settled) of cellulose insulation. Also, the upper wall insulation should be repaired, missing insulation be installed, air sealing applied and a complete air/ vapor barrier at the wall be provided. This is estimated to reduce the heat loss and air exfiltration through the roof by 50% and cooling by 7%.

The exposed foundation also presents another opportunity to improve the building envelope by air sealing, installing 2" of closed cell foam at the foundation rim joist and applying a layer of 2" EXP rigid insulation with a protective coating over the outside face of the foundation. It is estimated that this will save 40% of the heat loss through the foundation. There are unused openings in the wall that should be in-filled and the bulk head should be replaced or eliminated as it is a source of water leakage into the basement.

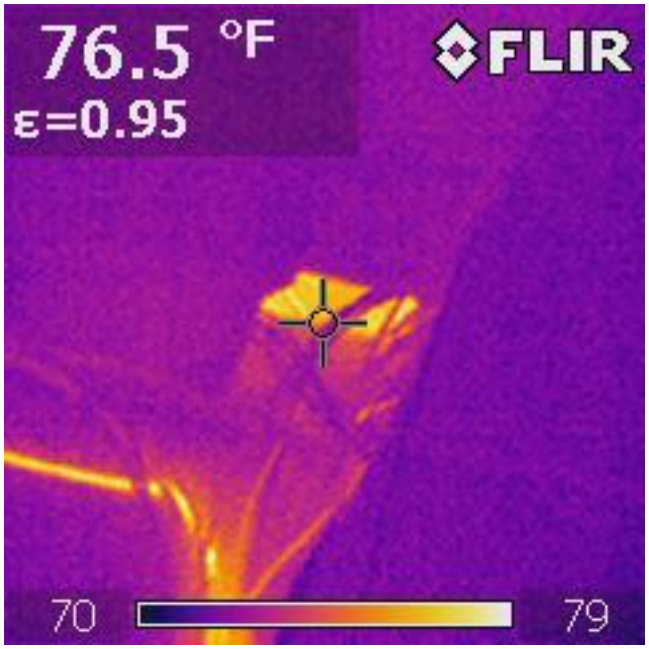
The community center shows poorly insulated walls at exposed locations that should be repaired as well as general air sealing. The back and side wall of the building still have the original wood clapboards and will need replacement at some point, when the time comes they should be removed, an air/ vapor barrier installed, 1" of rigid polyisocyanurate insulation installed increasing the R value to R 17 and then resided. This will reduce the heat loss by 30% through the walls. When the roof is in need of replacement it is recommended that an additional 2" of insulation be added to it, increasing the R value to R- 32.This will reduce the heat loss thr0ugh the roof by 50%. If the gym floor is replaced this will present an opportunity to install a layer of 1 or 2" insulation over the floor and along the edges to provide a thermal break and improve the floors insulating value. This is estimated to reduce the heat loss through the floor and slab perimeter by 40%. A vapor barrier should also be installed over the floor reducing the moisture migrating through the concrete floor. Cooling savings were not considered because of the varied schedule and low use of the space during the summer months.

The purpose of including the following photos is to offer a visual representation of the present condition of the building envelope so the reader may have a better understanding of the situation and why the recommendations are being made.

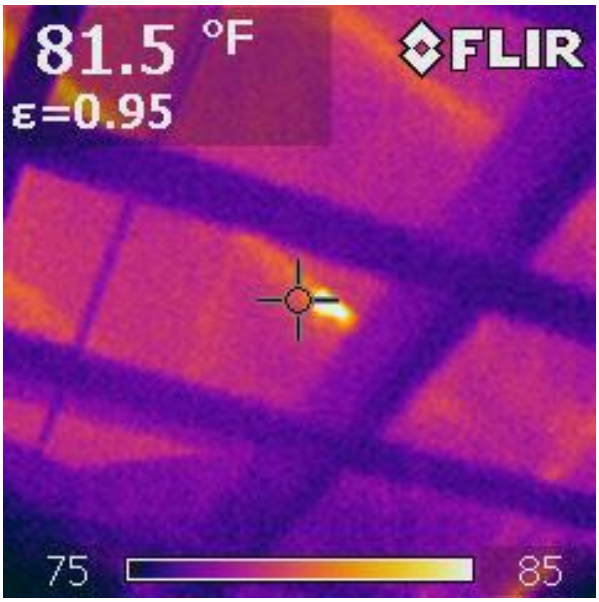
View of ceiling cavity above Annex conference room showing top of vapor barrier just below band joist above old tiles that should be spray foamed



View of cable penetration at utility closet in Annex showing heat gain and air infiltration path, penetrations should be sealed

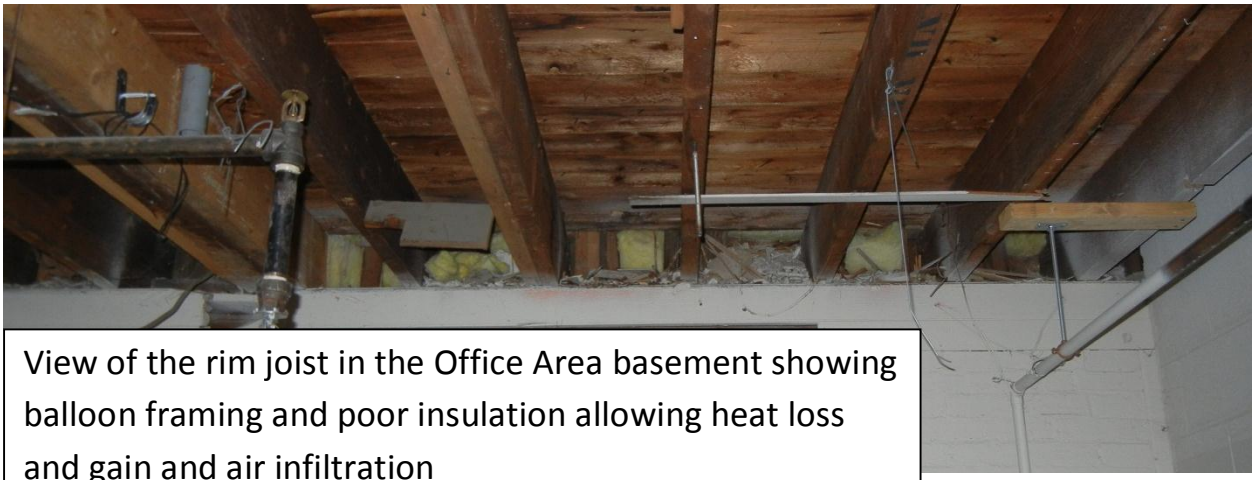


View of attic above second floor showing loose insulation, heat gain through void and missing insulation at wall all which contribute to heat loss & ice damns

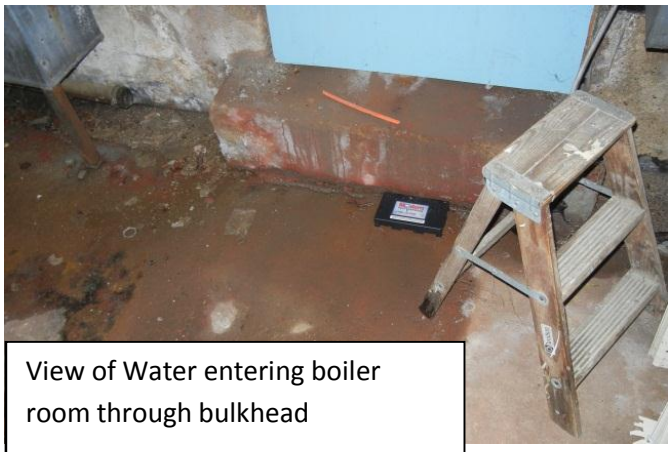


View of back of Office section showing some soffit and roof vents, deterioration of the eave facia and mold growth. This area likely has ice dams in the winter due to high heat loss & air infiltration. Correcting the attic issues will greatly improve the situation.

View of missing insulation & gap at window in mezzanine at Community Center



View of the rim joist in the Office Area basement showing balloon framing and poor insulation allowing heat loss and gain and air infiltration



View of Water entering boiler room through bulkhead

6. Lighting

The predominant lighting fixtures are linear fluorescent 700 series T8's and some T12's. There are also some interior incandescent and exterior high pressure sodium fixtures. The primary measures are to re-lamp and re-ballast the existing T12 fixtures with high performance800 series T8's, reducing the wattage of some of the T8's where high foot candles exist and replacing the exterior HPS fixtures with LED fixtures. At some locations reducing the number of fixtures is recommended due to higher than recommended foot candles. In addition adding sensors in rooms to turn off lights when not occupied is recommended, where sensors are added the ballasts should be programmed start. In the public rest rooms sensors are recommended because lights are often left on which was confirmed during the audit, this is a hidden cost of lighting. At the Annex lobby 3 of the 7 fixtures are recommended to be placed on a photo sensor so they will only come on during cloudy days and at night.

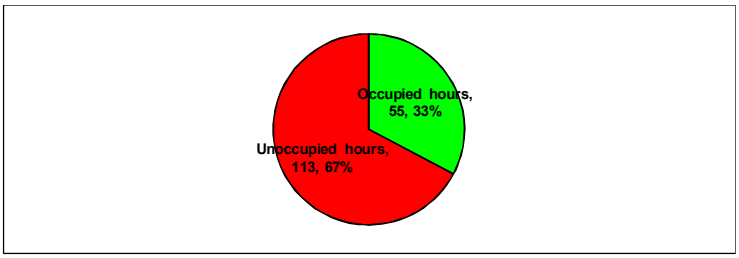
These recommendations should result in better lighting control, more comfortable lighting and save lighting expense. Many of the recommended improvements have the potential for Efficiency Maine incentives, lamps, fixtures and controls should meet the incentive standards.

The lighting accounts for about 22% of the electrical usage, which is below the 30% national average.

The table below provides an approximate potential for energy savings opportunities to reduce electrical lighting consumption throughout the facility by upgrading some of your lighting.

Based on 168 hours in a week

Occupied hours	Unoccupied hours
55	113



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Lighting Table													
1	Location	Fixture type	# of units	Watts per Unit	Max Total kW	Hrs/ Day	# of Days	Annual Operating Hours	Annual Total kWh	Annual kWh Cost	Potential Annual Savings	Annual kWh Saved	Potential Reduced kW
	Annex									$0.12			
Existing	Lobby	2L 1x4 T8	7	53	0.371	11	250	2750	1,020	$122			
Retrofit	Add Photo Sensor, use28 W lamps	2L 1x4 T8	7	48	0.336	6	250	1500	504	$60	$62	516	0.035
Existing	Women's Rm	2L 1x4 T8	1	53	0.053	6	250	1500	80	$10			
Retrofit	Add Vac Sensor, use 28 W lamps	2L 1x4 T8	1	48	0.048	2	250	500	24	$3	$7	56	0.005
Existing	Men's Rm	2L 1x4 T8	1	53	0.053	6	250	1500	80	$10			
Retrofit	Add Vac Sensor	2L 1x4 T8	1	48	0.048	2	250	500	24	$3	$7	56	0.005
Existing	HC Ramp	2L 1x4 T8	6	53	0.318	11	250	2750	875	$105			
Retrofit	Use 28 W lamps	2L 1x4 T8	6	48	0.288	11	250	2750	792	$95	$10	83	0.03
Existing	Kitchen/ Break	2L 1x4 T8	4	53	0.212	6	250	1500	318	$38			
Retrofit		2L 1x4 T8	4	53	0.212	6	250	1500	318	$38	$0	0	0
Existing	Stg/Utility Rm	4L 2x4 T8	1	106	0.106	3	250	750	80	$10			
Retrofit	Elim 2 lamps	2L 1x2 T8	1	53	0.053	3	250	750	40	$5	$5	40	0.053
Existing	Conf. Rm 1	2L 1x4 T8	6	53	0.318	6	250	1500	477	$57			
Retrofit	Use 28 W lamps	2L 1x4 T8	6	48	0.288	6	250	1500	432	$52	$5	45	0.03
Existing	HR Office	2L 1x4 T8	4	53	0.212	11	200	2200	466	$56			
Retrofit	Use 28 W lamps	2L 1x4 T8	4	48	0.192	11	200	2200	422	$51	$5	44	0.02
Existing	File Rm	2L 1x4 T8	4	53	0.212	11	200	2200	466	$56			
Retrofit	Use 28 W lamps Delete 1 Fixt	2L 1x4 T8	3	48	0.144	11	200	2200	317	$38	$18	150	0.068
Existing	Twn Mgr Waiting	2L 1x4 T8	12	53	0.636	11	250	2750	1,749	$210			
Retrofit	Use 28 W lamps	2L 1x4 T8	12	48	0.576	11	250	2750	1,584	$190	$20	165	0.06
Existing	Finance Off	2L 1x4 T8	2	53	0.106	11	200	2200	233	$28			
Retrofit		2L 1x4 T8	2	53	0.106	11	200	2200	233	$28	$0	0	0
Existing	Asst Twn Mgr Off	2L 1x4 T8	2	53	0.106	11	250	2750	292	$35			
Retrofit		2L 1x4 T8	2	53	0.106	11	250	2750	292	$35	$0	0	0
Existing	Twn Mgr Off	2L 1x4 T8	12	53	0.636	11	225	2475	1,574	$189			
Retrofit	Add Sw	2L 1x4 T8	4	48	0.192	11	225	2475	475	$57			
Retrofit	Use 28 W lamps	2L 1x4 T8	4	48	0.192	4	225	900	173	$21	$111	926.1	0.252
Existing	Clerks Lobby	2L 1x4 T8	12	53	0.636	11	200	2200	1,399	$168			
Retrofit	Use 28 W lamps	2L 1x4 T8	12	48	0.576	11	200	2200	1,267	$152	$16	132	0.06
Existing	Clerks Lobby	2L 1x4 T8	26	53	1.378	11	200	2200	3,032	$364			
Retrofit	Use 28 W lamps	2L 1x4 T8	26	48	1.248	11	200	2200	2,746	$329	$34	286	0.13
Existing	Clerks Office	2L 1x4 T8	2	53	0.106	11	200	2200	233	$28			
Retrofit	Use 28 W lamps	2L 1x4 T8	2	48	0.096	11	200	2200	211	$25	$3	22	0.01
Existing	Registers Office	2L 1x4 T8	2	53	0.106	11	200	2200	233	$28			
Retrofit	Use 28 W lamps	2L 1x4 T8	2	48	0.096	11	200	2200	211	$25	$3	22	0.01
Existing	Stg/Copy	2L 1x4 T8	2	53	0.106	4	200	800	85	$10			
Retrofit	Use 28 W lamps	2L 1x4 T8	2	48	0.096	4	200	800	77	$9	$1	8	0.01
Existing	Exit Lights	2L	3	4	0.012	24	365	8760	105	$13			
Retrofit	Exit Lights	2L	3	4	0.012	24	365	8760	105	$13	$0	0	0
Red indicates estimate									Annual Total kWh	Annual kWh Cost	Potential Annual Savings	Annual kWh Saved	Potential Reduced kW
			72							$0.12			
Estimated Annual Lighting Usage and Cost									12,796	$1,536			
Table 1 Estimated Annual Lighting Savings											$306	2,549	1

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2	Location	Fixture type	# of units	Watts per Unit	Max Total kW	Hrs/ Day	# of Days	Annual Operating Hours	Annual Total kWh	Annual kWh Cost	Potential Annual Savings	Annual kWh Saved	Potential Reduced kW
	Office Basement									$0.12			
Existing	Lwr Landing	2L 1x4 T12	1	80	0.08	3	50	150	12	$1			
Retrofit		2L 1x4 T8	1	53	0.053	3	50	150	8	$1	$0.5	4	0.027
Existing	Hall	2L 1x4 T12	4	80	0.32	3	50	150	48	$6			
Retrofit	Vac Sensor	2L 1x4 T8	4	53	0.212	3	50	150	32	$4	$2	16	0.108
Existing	Vault	2L 1x4 T12	2	80	0.16	2	50	100	16	$2			
Retrofit		2L 1x4 T8	2	53	0.106	2	50	100	11	$1	$1	5	0.054
Existing	Shop	2L 1x4 T12	3	80	0.24	3	50	150	36	$4			
Retrofit		2L 1x4 T8	3	53	0.159	3	50	150	24	$3	$1	12	0.081
Existing	Storage #1	2L 1x4 T12	2	80	0.16	2	50	100	16	$2			
Retrofit		2L 1x4 T8	2	53	0.106	2	50	100	11	$1	$1	5	0.054
Existing	Cont'd	2L 1x4 T12	1	80	0.08	24	365	8760	701	$84			
Retrofit		2L 1x4 T8	2	53	0.106	2	50	100	11	$1	$83	690	0
Existing	Storage #2	2L 1x4 T12	2	80	0.16	2	50	100	16	$2			
Retrofit		2L 1x4 T8	2	53	0.106	2	50	100	11	$1	$1	5	0.054
	First Flr		15										
Existing	Hall	2L 1x4 T12	7	80	0.56	11	250	2750	1,540	$185			
Retrofit	Use 28 W lamps	2L 1x4 T8	7	48	0.336	11	250	2750	924	$111	$74	616	0.224
Existing	IT	2L 1x4 T12	4	80	0.32	8	200	1600	512	$61			
Retrofit	Elim Fixt,Use 28 W lamps	2L 1x4 T8	3	48	0.144	8	200	1600	230	$28	$34	282	0.176
Existing	Conf Rm	2L 2x2 U T12	8	80	0.64	4	250	1000	640	$77			
Retrofit	Elim 2 Fixt	2L 2x2 U T18	6	53	0.318	4	250	1000	318	$38	$39	322	0.322
Existing	Park & Rec Recep Area	2L 1x4 T8	13	53	0.689	11	200	2200	1,516	$182			
Retrofit	Use 28 W lamps	2L 1x4 T8	13	48	0.624	11	200	2200	1,373	$165	$17	143	0.065
Existing	Park & Rec Office	2L 1x4 T12	4	80	0.32	11	200	2200	704	$84			
Retrofit		2L 1x2 T8	3	53	0.159	11	200	2200	350	$42	$43	354	0.161
Existing	Copy	2L 2x2 U T12	2	80	0.16	11	200	2200	352	$42			
Retrofit	Add sensor & use 28 W lamps	2L 2x2 U T18	2	48	0.096	11	200	2200	211	$25	$17	141	0.064
Existing	CTV Rm	2L 1x2 T8	6	53	0.318	5	175	875	278	$33			
Retrofit	Use 28 W lamps	2L 1x2 T8	5	48	0.24	5	175	875	210	$25	$8	68	0.078
Existing	Council Chamber	2L 1x4 T8	20	53	1.06	5	175	875	928	$111			
Retrofit		2L 1x4 T8	20	53	1.06	5	175	875	928	$111	$0	0	0
Existing	SW Stair	2L 1x4 T8	3	53	0.159	11	250	2750	437	$52			
Retrofit	Use 28 W lamps	2L 1x4 T8	3	48	0.144	11	250	2750	396	$48	$5	41	0.015
Red indicates estimate									Annual Total kWh	Annual kWh Cost	Potential Annual Savings	Annual kWh Saved	Potential Reduced kW
			31							$0.12			
Estimated Annual Lighting Usage and Cost									7,752	$ 930			
Table 2a Estimated Annual Lighting Savings											$ 325	2,706	1

2 Cont'd	Location	Fixture type	# of units	Watts per Unit	Max Total kW	Hrs/ Day	# of Days	Annual Operating Hours	Annual Total kWh	Annual kWh Cost	Potential Annual Savings	Annual kWh Saved	Potential Reduced kW
	2nd Flr									$0.12			
Existing	SW Stair	2L 2x2 U T12	3	53	0.159	11	200	1600	254	$31			
Retrofit	Use 28 W lamps	2L 2x2 U T8	3	48	0.144	11	200	1600	230	$28	$ 3	24	0.128
Existing	Plan'g Off #1	2L 1x4 T12	4	80	0.32	8	200	1600	512	$61			
Retrofit	Use 28 W lamps	2L 1x4 T8	4	48	0.192	8	200	1600	307	$37	$ 25	205	0.128
Existing	Plan'g Off #2	2L 1x4 T12	4	80	0.32	8	200	2200	704	$84			
Retrofit	Use 28 W lamps	2L 1x4 T8	4	48	0.192	8	200	2200	422	$51	$ 34	282	0.512
Existing	Code Area	2L 2x2 U T12	16	80	1.28	11	200	2200	2,816	$338			
Retrofit	Use 28 W lamps	2L 2x2 U T8	16	48	0.768	11	200	1400	1,075	$129	$ 209	1,741	0.215
Existing	Code Off #1	2L 1x4 T12	6	80	0.48	8	175	1400	672	$81			
Retrofit	Elim 1 fixt	2L 1x4 T8	5	53	0.265	8	175	800	212	$25	$ 55	460	0.215
Existing	Code Off #2	2L 1x4 T12	6	80	0.48	4	200	800	384	$46			
Retrofit	Elim 1 Fixt, add Vac Sensor	2L 1x4 T8	5	53	0.265	4	200	800	212	$25	$ 21	172	0.215
Existing	Eco Devlp't	2L 2x2 U T12	3	80	0.24	8	200	1600	384	$46			
Retrofit	Use 28 W lamps	2L 2x2 U T8	3	48	0.144	8	200	1600	230	$28	$ 18	154	0.096
Existing	Women's Rm	1L Inc	1	60	0.06	2	200	400	24	$3			
Retrofit		1L CFL	1	14	0.014	2	200	400	6	$1	$ 2	18	0.046
Existing	Men's Rm	1L Inc	1	60	0.06	2	200	400	24	$3			
Retrofit		1L CFL	1	14	0.014	2	200	400	6	$1	$ 2	18	0.046
Existing	Assess'g Area	2L 2x2 U T12	15	80	1.2	11	200	2200	2,640	$317			
Retrofit	Use 28 W lamps	2L 2x2 U T8	15	48	0.72	11	200	2200	1,584	$190	$ 127	1,056	0.48
Existing	Assessor Office	2L 1x4 T12	5	80	0.4	2	200	400	160	$19			
Retrofit	Elim Fixt	2L 1x4 T8	4	53	0.212	2	200	400	85	$10	$ 9	75	0.188
Existing	NW Stair	2L 2x2 U T12	7	60	0.42	2	200	400	168	$20			
Retrofit	Elim 2 Fixt & Use 28 W lamps	2L 2x2 U T8	5	14	0.07	2	200	400	28	$3	$ 17	140	0.35
Existing	Exit Lights	2L	4	4	0.016	24	365	8760	140	$17			
Retrofit	Exit Lights	2L	4	4	0.016	24	365	8760	140	$17	$0	0	0
Red indicates estimate			59						Annual Total kWh	Annual kWh Cost	Potential Annual Savings	Annual kWh Saved	Potential Reduced kW
										$0.12			
Estimated Annual Lighting Usage and Cost									8,883	$ 1,066			
Table 2b Estimated Annual Lighting Savings											$ 521	4,345	2.6

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3	Location	Fixture type	# of units	Watts per Unit	Max Total kW	Hrs/ Day	# of Days	Annual Operating Hours	Annual Total kWh	Annual kWh Cost	Potential Annual Savings	Annual kWh Saved	Potential Reduced kW
	Community Ctr									$0.12			
Existing	Lobby	2L 1x4 T12	6	80	0.48	11	250	2750	1,320	$158			
Retrofit	Elim Fixt,Use 28 W lamps	2L 1x4 T8	5	48	0.24	11	250	2750	660	$79	$79	660	0.24
Existing	Women's Rm	2L 1x4 T8	1	80	0.08	2	350	700	56	$7			
Retrofit	Add Vac Sensor,	2L 1x4 T8	1	48	0.048	2	350	700	34	$4	$3	22	0.032
Existing	Men's Rm	2L 1x4 T12	1	80	0.08	2	350	700	56	$7			
Retrofit	Add Vac Sensor,	2L 1x4 T8	1	48	0.048	2	350	700	34	$4	$3	22	0.032
Existing	Kitchen	4L 2x4 T8	3	160	0.48	4	350	1400	672	$81			
Retrofit	Use 28 w lamps	2L 1x2 T8	3	48	0.144	4	350	1400	202	$24	$56	470	0.336
Existing	Facilities Office	2L 1x4 T12	2	80	0.16	4	200	800	128	$15			
Retrofit	Use 28 w lamps	2L 1x4 T8	2	48	0.096	4	200	800	77	$9	$6	51	0.064
Existing	Stair	2L 1x4 T12	1	80	0.08	4	250	1000	80	$10			
Retrofit	Use 28 w lamps	2L 1x4 T8	1	48	0.048	4	250	1000	48	$6	$4	32	0.032
Existing	Mezzanine	2L 1x4 T12	4	80	0.32	4	250	1000	320	$38			
Retrofit	Use 28 w lamps	2L 1x4 T8	4	48	0.192	4	250	1000	192	$23	$15	128	0.128
Existing	Low Gym Ceiling	2L 1x4 T12	3	80	0.24	6	350	2100	504	$60			
Retrofit	Use 28 w lamps	2L 1x4 T8	3	48	0.144	6	350	2100	302	$36	$24	202	0.096
Existing	High Gym	4L 2x4 T5	6	254	1.524	6	350	2100	3,200	$384			
Retrofit		4L 2x4 T5	6	254	1.524	6	350	2100	3,200	$384	$0	0	0
Existing	Stage Stairs	2L 1x4 T12	2	80	0.16	5	75	375	60	$7			
Retrofit	Use 28 w lamps	2L 1x4 T8	2	48	0.096	5	75	375	36	$4	$3	24	0.064
Existing	Stage Storage	2L 1x4 T12	2	80	0.16	5	75	375	60	$7			
Retrofit	Use 28 w lamps	2L 1x4 T8	2	48	0.096	5	75	375	36	$4	$3	24	0.064
Existing	Exit Lights	2L	4	40	0.16	24	365	8760	1,402	$168			
Retrofit	Exit Lights	2L	4	4	0.016	24	365	8760	140	$17	$151	1,261	0.144
Red indicates estimate									Annual Total	Annual kWh	Potential Annual	Annual kWh	Potential Reduced
										$0.12			
Estimated Annual Lighting Usage and Cost									7,858	$ 943			
Table 3 Estimated Annual Lighting Savings											$ 348	2,897	1

4	Location	Fixture type	# of units	Watts per Unit	Max Total kW	Hrs./ Day	# of Days	Annual Operating Hours	Annual Total kWh	Annual kWh Cost	Potential Annual Savings	Annual kWh Saved	Potential Reduced kW
	Extra Lighting									$0.12			
	Annex												
Existing	Wall Pak	1L HPS	3	195	0.585	12	365	4380	2,562	$307			
Retrofit		1L LED	2	20	0.04	12	365	4380	175	$21			
Retrofit	Spot	1L LED	1	31	0.031	12	365	4380	136	$16	$270	2,251	0.514
Existing	Canopy Down	1L CFL Dwn	4	15	0.06	12	365	4380	263	$32			
Retrofit		1L CFL	4	15	0.06	12	365	4380	263	$32	$0	0	0
	Office & Com. Ctr												
Existing	Ent Canopy	1L HPS Dwn	1	195	0.195	12	365	4380	854	$102			
Retrofit		1L LED Dwn	1	22	0.022	12	365	4380	96	$12	$91	758	0.173
Existing	Wall Pak	1L HPS	3	195	0.585	12	365	4380	2,562	$307			
Retrofit		1L LED	3	30	0.09	12	365	4380	394	$47	$260	2,168	0.495
Existing	Door Lantern	1L Inc	3	75	0.225	4	365	1460	329	$39			
Retrofit		1L LED	3	9	0.027	4	365	1460	39	$5	$35	289	0.198
Red indicates estimate									Total kWh	kWh Cost	Annual Savings	kWh Saved	Potential Reduced kW
										$0.12			
Estimated Annual Lighting Usage and Cost									6,570	$788			
Table 3 Estimated Annual Lighting Savings											$ 656	5,466	1

This table is for informational purposes only. Always consult your lighting professional before specifying a new technology for your facility.

The estimated annual savings are based on a general walk through of the building and the reported operating hours.

Detailed energy savings should be determined by your electrician, supplier or manufacturer before a purchase is completed.

Your electrician, supplier or manufacturer must confirm that the proposed lighting meets the Efficiency Maine prescriptive cash incentives.

You can find Efficiency Maine incentives at www.efficiencymaine.com/pdfs/Prescriptive-Cash-Incentives.pdf.

7. Mechanical Systems

The mechanical systems are comprised of the heating, air conditioning, controls and domestic hot water systems.

7.1 Heating, Air Conditioning System & Controls:

The HVAC system provides heat and air conditioning using package Roof top Units. The system is a forced air constant volume system that provides heat via a gas fire furnace/ heat exchange and air conditioning via a DX coil located in the roof top unit.

View of three of the Air Handling Units on the Community Center Roof

There are six packaged roof top Air Handling Units for the Town office Building:

Two units serve the community center; one is a Carrier serving a single zone made up of the office, kitchen, rest room and mezzanine area. It is a single stage unit that provides 115,000 Btu's heat and 47,000 Btu's of cooling with a two stage blower and single stage heating and cooling. The steady state heating e efficiency is rated at 80% which provides a measure of part of the systems efficiency at a point in time. Seasonal heating efficiency is a more accurate measure of efficiency of the system that occurs during the season at various loads and reflects the partial load efficiency. The AC is rated at a SEER of 9.7, which nominally met the old minimum efficiency of SEER 10 when the system was installed. Today the minimum is SEER 13 for AC Units less than 65,000 BTU's. The second is a Unitary Products AHU, a division of York, serving a single zone made up of the gym and stage area. It has two stage capability that provides 180,000/106,000 Btu's heat and 90,000/45,000 Btu's of cooling. The steady

state heating efficiency is rated at 80% which provides a measure of the systems efficiency at a point in time. The AC is rated at an EER of 9, which nominally met the old minimum efficiency of EER 10.3, today the minimum is an of EER 11.2 for AC Units greater than 65,000 BTU's. Both units are controlled by programmable thermostats, one is located in the facilities office and other in the gym area. The system was installed in 2007 and the units are located on the roof of the community center.

Two additional units serve the two story office section and each serving a single zone. The units are also Unitary Products, a division of York, and are the same type and size as the one for the gym/ stage area. Both units are controlled by programmable thermostats: one is located in the second floor hallway by the codes office and serves the second floor, the other in the first floor hallway and serves the first floor. The first floor also has averaging sensors located in the conference room and the council chambers office. These sensors average the temperature for the floor to control the heating and air conditioning in conjunction with the thermostat. The unit serving the second floor is located on the community center gym roof and the unit for the first floor is located on the entrance lobby roof between the Annex and office section. Both were installed in 2007.

The final two units serve the Annex and are located on the roof of the Annex. It is reported to be the same type and size as the other Unitary Products units. Each unit serves a single zone, one for the side of the building where the Town Clerk is located and the other for the side where the Town Manager is located. The thermostats are located in the Town clerks open office area and the waiting area of the Town Manager.

The use of programmable thermostats is a basic method of control and does allow some measure of efficiency. The thermostats are used to program the occupied mode during the work week and an unoccupied mode with a setback of 5 to 7 degrees after 10 pm and Friday through Sunday when most of the building is not occupied. Increasing the Friday to Monday set back 10 degrees and experimenting with 12 degrees is recommended. This change will likely result in increasing the warm up time on Monday morning. It is not recommended to increase the setback more than the amount that results in an additional hour of warm up time in the morning. This measure could result in saving an additional 2 to 3% in energy costs for cooling and heating by using the 1 degree set back equals 1 % in saving rule and prorating it over the setback time. Another measure is to ensure that when the units are in heating or cooling mode that the fan is set on Auto and not the On position. This causes the fan to cycle on and off as the system calls for heating or cooling. If the fan is in the On position it will run

constantly and possibly when the building is not occupied. These are both no cost measures that can be implemented to improve efficiency.

The HVAC system is relatively new and the AHU's do not warrant replacement. However, both the heating and cooling systems only met the minimum efficiency ratings when they were installed in 2005 and 2007 and have an expected useful life of 12 to 15 years. Upgrades to the AHU's are most cost effective when a component fails or approaches the end of its useful life. The two most likely items to need replacement are the compressor for the AC and the burner/ heat exchanger for the furnace. In the event the compressor fails, a scroll compressor is recommended and can save 10 to 20% in compressor electric costs. If the burner fails, a modulating burner is recommended if it is compatible with the present furnace. Since these are packaged units, replacing the entire unit with a current more efficient unit becomes more cost effective as they age and get closer to the end of their useful life. These units should be Energy Star, eligible for Efficiency Maine incentives, have Economizers and DDC controls. In 5 to 7 years when the replacement is likely, newer wireless controls should be available that will offer better control, efficiency and thermal comfort.

Consideration was given to recommend installing an economizer on the Annex and office area units. Economizers have been known to save significant amounts of energy by providing free cooling, with an estimated 20 to 40% savings being reasonable in this application. However, retrofitting a unit is two to three times as expensive as having the factory install it at the time of purchase and would result in a 10 + year payback as opposed to a 2 or 5 year payback.

It is estimated that the air conditioning accounts for 8,900 kWh per year, or $ 1,068 per year and 4% of the annual electric usage. In addition the heating system accounts for an estimated 29,688 kWh per year, or $ 3,565 per year and 15% of the annual electric usage.

The table below shows the heating and cooling capacities and energy densities of the six AHU's. They are on the conservative side, especially on the cooling end.

When replacing the units a thorough heat loss and gain calculations should be conducted to properly size the units, which will likely result in a smaller unit and lower first cost. In addition, if the building envelope is improved, this will also reduce the first cost of replacing the units. The first step should always be to improve the building envelope.

Windham Town Office Energy Assessment Report

Town Office AHU Capacity's, Cooling & Heating Densities

	Sq. Footage	Cooling Capacity	Heating Capacity	Cooling	Heating
Location	SF	BTU	BTU	SF/Ton	Btu/SF
Com Center	6,031	137,000	235,000	88.04	38.97
Office Area	8,008	180,000	360,000	88.98	44.96
Annex	6,494	180,000	360,000	72.16	55.44

Average cooling capacities for Municipal Buildings are 200 to 250 SF/ton, for offices 300 to 400 SF/ton. For heating 20 to 60 BTU/SF.

Note; These are order of magnitude comparisons and not actual heat load calcualtions.

Another concern is the leakage from the duct work, which typically ranges from 10 to 30%. Much of the duct work is in the attic or ceiling space and covered. There is a point of view that if the duct work leaks, but the leakage is with in the thermal envelope it is not that important. That is false, because the cool air is not being delivered to where you want it and creates uneven temerpatures. If the duct work is located in the upper part of the building envelope much of it escapes through the roof. Some of the duct work in the Community Center mezzanine was exposed and showed joints and connections that leak air. It is recommended that a duct leakage test be conducted to determine the magnitude of the leakage and seal the ducts properly if significant leakage is found.

View of duct work at mezzanine shows no duct mastic and poorly fitting joints

Below is a table showing the dollar reduction in fuel costs based up on a percentage improvement in fuel use, and based on the usage by the old system. Using some industry parameters, if the recommended improvements to the building envelope and the heating system are made, a savings of 15% to 30% could be realized.

Estimated Natural Gas Savings for Your Building Based on Cost Per Therm						
Therms of Natural Gas used in 2009	8,045					
Natural Gas cost per Therm	$1.51	$1.65	$1.75	$1.80	$1.90	$2.00
10 percent savings	$1,215	$1,327	$1,408	$1,448	$1,529	$1,609
15 percent savings	$1,822	$1,991	$2,112	$2,172	$2,293	$2,414
20 percent savings	$2,430	$2,655	$2,816	$2,896	$3,057	$3,218
25 percent savings	$3,037	$3,319	$3,520	$3,620	$3,821	$4,023
30 percent savings	$3,644	$3,982	$4,224	$4,344	$4,586	$4,827

Two auxiliary sources of air conditioning exist. One is for the server room and is a Fujitsu AOU36CLX 33,100 Btu mini split unit with a SEER 14. The option to have a standalone fresh air intake that would act like an economizer should be explored. The fresh air intake has the potential to cut the energy use of the unit by 40%. The second unit is an 8,000 Btu window air conditioner with an EER of 9.8 and an estimated SEER of 10.3 to 10.8. It is recommended that this be replaced with a Fujitsu Halcyon 9RL 9,000 Btu or similar unit. The unit has a SEER of 26 and can modulate the amount of AC from 3,600 to 12,000 Btu's. The proposed unit uses 45% less energy than the present unit does. Because the units operate much of the year they account for an estimated 11% of the electrical use.

7.2 Ventilation:

The building has one source of ventilation, which is provided by exhaust fans in the rest rooms. Outside air intakes were not present on the roof top units. As the building is tightened up, it may become necessary to provide outside air if the ACH to the building drops below .5 ACH. When the roof top units reach the end of their useful life and are replaced, outside air capabilities with economizers should be provided and can be linked to demand ventilation based on CO2 levels.

7.2 Domestic Hot Water:

Hot water is provided by two electric hot water heaters. One is a 30 gallon Proline located in the Annex break room assumed to have been installed in 2005 and the other is a 40 gallon Proline located in a storage space by the NW stairs that serves the office area and the Community Center.

Based upon the scheduled use of the Annex tank it is recommended that a seven day timer be added to reduce the electric demand. This will allow the hot water heater to be shut off at night, on the weekends and turned on early in the morning and during the day when needed.

The electric hot water tank for the Office/Community Center is recommended to be replaced with an on demand Natural Gas fired tankless hot water heater capable of providing 5 gpm.

In addition the first 8' of the supply and feed lines of both hot water tanks should be insulated.

Below are the tables showing the estimated hot water use for the building.

Annex Estimated Hot Water Peak Demand and Yearly Use						
Fixture	Units	Gals per minute	mins / day	gals / day	days / year	Gal Year
Restroom Sink	2	0.5	30	30	200	6000
Kitchen Sink	1	2	7	14	200	2800
Peak use in gallons per minute (all fixtures on simultaneously)						3
Estimated total gallons of hot water per year						8,800
Days per year hot water is used						200
Estimated gallons of hot water used per day						44
These are estimates based on the number of fixtures and estimated use.						

Office/Com Ctr. Estimated Hot Water Peak Demand and Yearly Use						
Fixture	Units	Gals per minute	mins / day	gals / day	days / year	Gal Year
Restroom Sink	4	0.5	25	50	200	10000
Kitchen Sink	1	2	10	20	100	2000
Peak use in gallons per minute (all fixtures on simultaneously)						4
Estimated total gallons of hot water per year						12,000
Days per year hot water is used						200
Estimated gallons of hot water used per day						60
These are estimates based on the number of fixtures and estimated use.						

The tables below show the estimated savings that can be realized by adding a 24 hour timer to the Annex tank and replacing the Office/Community Center. tank with a Natural Gas on demand system.

Annex Electric Water Heater-- Add a 7-day Timer												
	Location	Fixture type	# of units	Watts per unit	Max Total kW	Hrs/ Day	# of Days	Annual Operating Hours	Annual Total kWh	Annual kWh Cost @	Potential Annual Savings	Annual kWh Saved
										$0.12		
Existing	Utility Closet	30 Gal electric water heater	1	4500	4.5	2	365	730	3285	$493		
Retrofit		30 gallon electric tank with a 7 day timer	1	4500	4.5	1.75	305	533.75	2401.875	$288	$205	883
									Annual Total kWh	Annual kWh Cost	Potential Annual Savings	Annual kWh Saved
									3285	$493	$205	883
Estimated Carbon Dioxide (CO2) Savings Tons Per Year												0.7
Installing a timer will allow for the hot water heater to operate outside of normal business hours to help reduce electric demand.												
A 7- day timer turns the water on and off during the week. For a typical application with the normal water demand less than the tank's capacity, you can run the heater twice a day (early morning and late evening) for an hour outside of the business peak demand.												

Office/Community Ctr. Electric Hot Water Heater -- Replace with On-Demand Tankless NGas Water												
	Location	Fixture type	# of units	Watts or Therms fuel per hour	KW or Therms per day	Hrs/ Day	# of Days	Annual Operating hours	Yearly Total kWh's or therms	Annual Cost kWh - therms	Potential Annual Savings	Annual kWh Saved
									kWh	$0.12		
									Therm	$1.51		
Existing	Boiler Room	40 gallon electric hot water heater	1	4500	11.25	2.5	365	912.5	10266	$1,540		
Retrofit	Boiler Room	NGas tankless hot water heater	1	1	2.1	2.1	210	441	441	$666	$874	10,266
											Potential Annual Savings	Annual kWh Saved
Annual Estimated Savings											$874	10,266
Estimated Carbon Dioxide (CO2) Savings Tons Per Year												8.1
The estimated annual savings is based on the reported or average hours of operation for the device.												
You may need a indirect storage tank to meet peak load - for example, all sinks calling for hot water simultaneously. This should be determined by an engineer or your mechanical supplier.												
Confirm your peak hot water demand and ensure that your engineer, supplier or plumber provides the necessary calculations to demonstrate that equipment being proposed meets your peak hot water demand.												

The tables below show the estimated cost of the improvements and pay back adding a 24 hour timer to the Annex tank and replacing the Office/Community Center. tank with a Natural Gas on demand system. The payback for the timer is 1.4 years and the on demand system is 3.2 years.

Estimated cost to Install a 24 hour Timer			
Equipment/Labor	**Qty**	**cost each**	**Total**
24 hour Timer	1	$150	$150
Installation Labor Electrician	2	$70	$140
Estimated installed capital cost			**$290**
Eff Maine Incentives	1	$0	**$0**
Cost to Implement (capital cost-incentives)			**$290**
*Projected Yearly Energy Savings			**$205**
Simple Payback in Years			**1.4**

Estimated cost to Install Tankless NGas Heater			
Equipment/Labor	**Qty**	**cost each**	**Total**
Tankless water heater with controller	1	$1,800	$1,800
Piping	1	$400	$400
Installation Labor	8	$70	$560
Contingency	1	$70	$70
Estimated installed capital cost			**$2,830**
Eff Maine Incentives	1	$0	**$0**
Cost to Implement (capital cost-incentives)			**$2,830**
*Projected Yearly Energy Savings			**$874**
Simple Payback in Years			**3.2**
Tankless water heater is commercial grade rated at 200,000 Btu's and a a max temperature of 180°F.			

8. Electronic Equipment

Based on the computer, copier and count of other periphery equipment, it is estimated that the buildings office equipment uses about 24,600 kWh per year or 12% of the electrical usage. The office and computer area has 34 computers and monitors which can account for 50% to 60 % of the power used for office equipment. The settings and hours of use for the computers could not determined during the audit because of the different departments and varied use. However, listed below is some information regarding procedures for savings and some examples of the type of savings that can be realized by following the recommended procedures.

The DOE through Energy Star has a Computer Power Management program for businesses both large and small, which can be accessed through www.energystar.gov/powermangement.

By setting your equipment to the standby or hibernate mode it is reported, based on historical data, that $25 to $75 per station can be saved.

Most new office equipment is Energy Star compliant and has energy saving software installed. Consult your manual for activating this feature.

In addition Smart Strips can shut off your equipment when not being used. These strips can operate manually, by motion or timer and can be purchased on the internet. They also can provide surge protection

Simply shutting off the computer monitor when not in use saves the equivalent of turning off a 60 to 100 watt light bulb. "Screen Savers" require as much energy as leaving your monitor on. "Sleep" mode lowers energy consumption to about 25 watts or less. Establish an office policy to shut down all non-essential computers nightly (i.e., servers and computers that are not externally accessed after office hours). See table below for a typical desktop computer savings.

You can expect potential annual savings from $23-150 a year per computer by simply shutting the computer off at the end of the work day and programming the sleep mode during the work day. Examples below:

The first example is a computer left on 24/7. The retrofit illustrates potential savings by turning the computer off at the end of each work day of 8 hours and on the weekends.

	Location	Unit Type	Number of Units	Watts per Unit	Total kW	Hours/ day	Number of Days	Annual Operating Hours	Total kWh	Annual Cost @ $.15/kWh	Potential Annual Savings	Annual kWh Saved
Existing	Office	Computer on 24 hrs/day/7 days	1	150	0.15	24	365	8760	1314	$197		
Retrofit	Office	Computer on 8 hrs/day/5 days	1	150	0.15	8	260	2080	312	$47	$150	1002
										SAVINGS	$150	1002
The energy consumption is an estimate: computer towers at 75 watts and monitors at 75 watts based on average published energy usage.												
The assumption is that the screen saver is not selected and is on the same amount of time the computer is on.												
There were no actual energy measurements taken on any of the electronic equipment.												

The second example shows a computer left on for the duration of the work week but shut off for the weekend. The retrofit illustrates potential savings by turning the computer off at the end of each work day and on the weekends.

	Location	Unit Type	Number of Units	Watts per Unit	Total kW	Hours/ day	Number of Days	Annual Operating Hours	Total kWh	Annual Cost @ $.15/kWh	Potential Annual Savings	Annual kWh Saved
Existing	Office	Computer on 24 hrs/day/5 days	1	150	0.15	24	260	6240	936	$140		
Retrofit	Office	Computer on 8 hrs/day/5 days	1	150	0.15	8	260	2080	312	$47	$94	624
										SAVINGS	$94	624
The energy consumption is an estimate: computer towers at 75 watts and monitors at 75 watts based on average published energy usage.												
The assumption is that the screen saver is not selected and is on the same amount of time the computer is on.												
There were no actual energy measurements taken on any of the electronic equipment.												

The last example shows a computer on 8 hours a day for a 5 day work week versus a computer programmed for sleep mode with an average on-time of 4 hours a day for a typical 5 day work week.

	Location	Unit Type	Number of Units	Watts per Unit	Total kW	Hours/ day	Number of Days	Annual Operating Hours	Total kWh	Annual Cost @ $.15/kWh	Potential Annual Savings	Annual kWh Saved
Existing	Office	Computer on 8 hrs/day/5 days	1	150	0.15	8	260	2080	312	$47		
Retrofit	Office	Computer sleep mode on 4 hrs/day/5 days	1	150	0.15	4	260	1040	156	$23	$23	156
										SAVINGS	$23	156
The energy consumption is an estimate: computer towers at 75 watts and monitors at 75 watts based on average published energy usage.												
The assumption is that the screen saver is not selected and is on the same amount of time the computer is on.												
There were no actual energy measurements taken on any of the electronic equipment.												

As you can see, it is important to have an office policy regarding computers. Education is a key component in achieving savings with computers such as publishing the potential savings on the employee bulletin board. In a typical office, people attend meetings, take coffee and lunch breaks, etc. which are all opportunities for computer energy savings.

There are a number of measures that may be applicable to help you generate and sustain energy savings such as ensuring copy machines and other equipment are programmed for sleep modes. Therefore, standing by the copier waiting for the 30 second warm up period can result in energy savings. Ensuring the copier machine is off or programmed for sleep mode after hours and weekends will result in significant savings.

9. Miscellaneous Equipment

The community center has two vending machines one with refrigeration and the other without. The two machines use 2% of the electricity in the building. It is recommended to install vending misers on each machine. The savings that can potentially be realized are shown in the table below.

A typical vending machine consumes approximately $300 of electricity per year. By using a Vending Miser, http://www.vendingmiserstore.com, you can reduce electricity use of each cold drink vending machine by an average of 40%. Since the drink dispenser vending machine is a refrigerator, the heat exhausted from the condensing coil in the back of the vending machine can reach over 100ºF. This adds to the heat load of the building. Ensure the machine does not get placed next to a thermostat, ice machine, etc.

Vending Machines		
Snack Machine		
Estimated Annual Savings		$38.00
Miser Cost		$165.00
Simple Payback- yrs		4.3
Pepsi Machine		
Estimated Annual Savings		$209.00
Miser Cost		$175.00
Simple Payback-yrs		0.84