Facility Audit Report

Hollis Town Hall

FINAL

May 2012

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A. EXECUTIVE SUMMARY

Program Introduction

The Town of Hollis requested investment grade audits for seven (7) municipal buildings and five (5) school buildings located within the Town. Funding was provided by the United States Department of Energy (DOE) through the New Hampshire Office of Energy and Planning (NHOEP) Energy Efficiency Conservation Block Grant (EECBG) program.

Figure 1: Hollis Town Hall

Phase one of the evaluation process involves site assessment planning including evaluating utility bills, benchmarking, reviewing available building and mechanical plans and coordinating site reviews with facility managers. Phase two involves a comprehensive and holistic facility evaluation to gather relevant information and data. Analyzing the collected data and developing recommendations for energy efficiency measures is completed in Phase three. This information is presented to the Town within this report.

The objective of the building evaluation completed at the Hollis Town Hall (Figure 1) is to identify measures that reduce the net energy consumption thereby reducing operating costs and the consumption of non-renewable fossil fuel energies. In addition to energy conservation, the evaluations and recommendations presented herein consider occupant comfort and holistic building performance consistent with its intended use and function. The information obtained as part of this evaluation has been used to develop recommended Energy Efficiency Measures (EEMs). These EEMs provide the basis for future building improvements and modifying the manner in which the building systems are operated.

Procedure

Facility audits or evaluations identify all appropriate EEMs and a financial analysis that considers implementation costs, operating costs, and attainable savings. The objective is to identify the predicted energy savings, the amount the measure will cost, and the estimated payback period for each EEM. The evaluation also identifies any changes to operations and maintenance procedures that will reduce energy consumption. A comprehensive field survey of the facility is completed to evaluate the following:

- *Building Characteristics*
- *Building Use and Function*
- *Envelope Systems*
- *Heating and Cooling Systems*
- *Ventilation Systems*
- *Electrical and Lighting Systems*
- *Domestic Hot Water Systems*
- *Plug Loads*

Following completion of the field evaluation, the data and information are reviewed to develop proposed recommendations for the facility. All information, data, and recommendations are then compiled into a comprehensive report. The final report is then distributed to the municipality or school to assist with implementation and budgeting of the proposed EEMs. The information provided in the reports will assist the owner with determining the best value EEMs for their facilities. The reports also identify potential financial resources available to help fund the EEMs.

On December 29th 2011, AEC personnel completed site surveys at the Town Hall to obtain the information necessary to complete an assessment of overall building performance. All building systems that impact energy consumption were evaluated including the building envelope, heating and cooling, ventilation, electrical, plumbing, and mechanical. Secondary observations are also reported herein and include building code compliance, life safety, structural systems, and roofing systems. This evaluation also considers whole building performance that measures how well the integrated building systems in the Town Hall function as a composite system.

AEC completed a desktop review of the data provided by the town including historical energy consumption data. The field review included an evaluation of all building systems and data collection including an infra-red thermal imaging survey, indoor air quality measurements, lighting density measurements, and metering of lighting fixtures and HVAC equipment. The Town Hall building was modeled using a building energy modeling computer program (eQUEST®) and calibrated to historical energy data. A series of energy efficiency measures (EEMs) were then simulated in the 3-D building model to measure their effect on energy consumption. Capital investment costs for each EEM were developed, and based upon the predicted cost savings associated with the energy efficiency measure, the payback term is calculated. A savings to investment ratio (SIR) for each EEM is then calculated based on the cost of implementation, the predicted energy cost savings, and the predicted service life of the measure/equipment. Other noted recommendations relate to indoor air quality, occupant comfort, code compliance, accessibility, and life safety.

Summary of Findings

The following significant findings are presented for the Hollis Town Hall building:

1. The Hollis Town Hall remains as one of few examples of historically significant municipal facilities that have endured in their current function and condition in modern rural New England.
2. The building does not comply with current building code and accessibility standards for commercial office spaces.
3. Maintenance, repair, and modernization of building systems has been deferred.
4. Occupant comfort is below industry standards for a commercial office space.
5. The building uses substantially less energy than expected when compared to other office buildings based on energy use per square foot per year. This is due to the fact the entire facility, with the exception of the basement, is labeled as office space in use 40 hours a week while in actuality only a portion of the space is utilized full time.

Notable Observations

The following notable observations were made during the desktop data review and/or the building evaluation. Notable observations may be related to data that is outside the normal or expected range, irregularities in building use or function, or problematic systems.

- Most of the original building envelope has not been modernized (c. 1886). Exterior walls lack insulation and windows and doors allow significant air leakage resulting nuisance drafts. Plastic film is placed over the windows to reduce drafts and some units have storm windows. Hung quilts are used to reduce cold air infiltration from the second floor stairwells.

- The dated heating supply and distribution systems are inefficient. Boiler efficiencies are significantly lower than modern boiler units and the distribution system does not provide uniform heat throughout the occupied spaces of the building.
- Makeup combustion air for the boiler room is provided by a ducted power vent (fan) ducted to the exterior and interlocked to the boiler operation. The unit should be inspected to verify that it has a fire detection systems actuated damper.
- There are no central cooling systems installed in the building. Cooling is provided by several window air conditioning units. Many occupants indicated that the offices are uncomfortably warm in the summer.
- All hydronic and domestic hot water piping is uninsulated contributing to heating of semi-conditioned spaces and loss of thermal energy such as in the basement. While this aids in providing necessary heat to these spaces, it is not an efficient source of heating. Insulating hot water pipes and providing a designated heat source would be much more efficient.
- Piping is not labeled creating more difficulties when identifying a problem.
- There are no mechanical exchange air ventilation systems in the building.
- A structural investigation and associated improvements were completed in 2011. Structural improvements included re-supporting the first floor, fortifying the clock tower framing, and fortifying the roof framing. The roof was also replaced as part of the project. Steel tension rods in the tower were found to be loose and require tightening to the appropriate tension.
- Electrical code compliance issues were noted throughout the building including exposed abandoned wiring, unsupported wiring, and unprotected wiring. Knob and tube wiring was observed to be in service in the clock tower.
- The basement and second floor of the building are not used by the public because they do not comply with accessibility standards.
- The southern chimney was observed to be in poor condition. Mortar is deteriorating and bricks are loose or missing.

Summary of Recommendations

Following is a summary table identifying the proposed recommendations, EEM investment costs, predicted annual energy cost savings, simple payback period and savings to investment ratio. Part G provides a more detailed explanation of these recommendations.

The energy cost savings and resulting payback are based upon each independent measure implemented for the building in its current condition and function. The savings to investment ratio (SIR) is the accumulated annual cost savings (as determined by the expected service life of the material or equipment associated with the EEM) divided by the cost of investment. A SIR equal to 1.0 indicates that the EEM has a “break-even” or net-zero cost. The higher the SIR value, the more favorable the return on investment is. There are interdependencies among measures that will affect the net composite energy savings. Interdependent measures are parametrically related therefore the net energy savings from two dependent measures do not equal the resulting savings determined by the addition of the two measures considered independent of each other. Investment costs are provided for budgetary planning only. They are estimated based on current industry pricing. A detailed cost estimate should be developed prior to appropriating capital funds for the more costly measures. Budgetary cost estimates for the Tier II and more costly Tier III measures are presented in Appendix J.

Table 1: Energy Efficiency Measures Summary Table

EEM No.	EEM Description	Capital Cost	Annual Cost Savings	Payback (yrs.)	S.I.R.
T1-1	Replace incandescent lamps with CFL lamps (10).	$60	$35	NA	NA
T1-2	Air-seal and insulate all abandoned chimneys and vents including the abandoned chimney flue in basement, the fireplace chimney in the finance office, and the blocked off basement window on the north side.	$350	$160	2.1	9.1
T1-3	Install time clock on copier.	$60	$100	0.6	8.3
T1-4	Install 2" of polyisocyanurate rigid insulation on the bell tower door and install weather-stripping.	$150	$30	10.8	4.0
T1-5	Complete air-sealing on all entry door jambs, partings, headers, thresholds, and moldings (interior and exterior).	$1,100	$600	1.8	3.8
T1-6	Install occupancy sensors in new addition lavatory to control lighting and exhaust fans.	$350	$50	7	1.7
T2-1	Replace the main DHW tank unit with an electric tankless unit.	$1,500	$210	7.1	2.5
T2-2	Replace the 5-gallon tank heater with an electric demand hot water heater for kitchen and lavatory.	$950	$132	7.2	2.1
T2-3	Insulate all hydronic hot water piping in the building.	$2,700	$250	5.0	1.9
T3-1	Air-seal all floor penetrations and install additional six (6) inches of blown cellulose insulation in attic.	$12,846	$1,681	7.6	3.9
T3-2	Insulate second floor walls of original building: limited demolition of original plaster wall sections and injection holes, fill/inject larger cavities with blown-in dense-packed cellulose insulation, inject small cavities (including wall corners, plates, and window and door frames) with open-cell polyurethane foam, patch and finish walls. Assume 8" deep wall cavity. Apply polyurethane caulking to air-seal all wall penetrations and gaps. Provide real-time verification of cavity insulation using IR camera and camera scope.	$35,989	$4,046	8.9	3.4
T3-3	Add 4" of blown-in cellulose insulation to the addition ceiling (plaster ceiling) and seal and insulate the hatch.	$6,268	$690	9.1	3.3
T3-4	Insulate first floor walls of original building: demolition of newer framed walls and limited demolition of original plaster wall sections, fill/inject larger cavities with blown-in dense-packed cellulose insulation, inject small cavities (including wall corners, plates, and window and door frames) with open-cell polyurethane foam, patch walls/install gypsum board and finish walls. Assume 8" deep wall cavity. Apply polyurethane caulking to air-seal all wall penetrations and gaps. Provide real-time verification of cavity insulation using IR camera and camera scope.	$28,083	$2,794	10.1	3.0
T3-5	Install 2 staggered layers of 1" FF rigid polyisocyanurate insulation (R-14) on interior of basement walls and tape-seal seams.	$6,445	$410	15.7	1.9
T3-6	Install a vapor/moisture barrier (4-mil polyethylene sheeting) and place 6" of blown-in cellulose insulation in the addition crawlspace.	$10,666	$580	18.4	1.6
T3-7	Replace two (2) boiler units with high-efficiency oil fired units. Replace existing heating registers with modern control valves and fin tube heating units. Install larger high efficiency pumps. Improve zone control and install new programmable thermostats.	$63,243	$2,520	25.1	1.0
T3-8	Restore the original historic windows (21) with coil spring pulleys, insulate weight boxes with spray foam, seal top portion of double-hung units, and install high-efficiency interior storm window units.	$47,570	$867	54.9	0.5
T3-9	Replace existing original windows with new fiberglass frame triple-pane high efficiency historically correct custom windows (21).	$76,956	$912	84.4	0.4
T3-10	Replace the existing hydronic heating system and window air-conditioning units with a high-efficiency inverter driven electric air-source heat pump system (VRF). Add interlocked ERV ventilation system. *(see narrative section)*	$310,270	$2,028	153.0	0.2

The following table summarizes the renewable energy technologies that were considered for the Hollis Police Department. Scores are determined based upon the feasibility of the technology for the facility. A more focused feasibility study should be completed prior to considering any renewable energy system(s).

Table 2: Renewable Energy Technology Feasibility Scoring Results

Renewable Energy Technology	Grade
Solar DHW	78%
Geothermal Heating/Cooling	74%
Biomass Heating	72%
Roof Photovoltaic	69%
Ground Photovoltaic	68%
Wind Turbine Generator	64%
Solar Thermal	59%
Combined Heat & Power	58%

Insulation resistance values (R-values) were determined based on given information, time of construction and visual observations. The industry standard *International Energy Conservation Code (IECC), 2009* for Commercial Buildings in Climate Zone 5 required values are provided along with the installed values in Table 3. The IECC values are for new construction only, however provide a guide as to how this facilities insulation compares with new construction.

Table 3: Facility Insulation Summary

	Insulation Values		
Space	Required (IECC, 2009)	Recommended	Installed
Basement Floor	NA	10	1.0
Addition Floor	NA	10	3.9
First Floor Wall	13.0 +3.8 ci	13.0 +3.8 ci	13.7
Second Floor Wall	13.0 +3.8 ci	13.0 +3.8 ci	4.0
Original Building Roof	38	38	18.1
Addition Building Roof	38	38	22.2

Master Planning Considerations

The Hollis Town Hall has continuously functioned as a municipal facility providing all Town administrative services and office space for Town employees since it was constructed in 1886. While the architecturally defining elements of the building have been substantially preserved, repairs and replacement of most building systems have been deferred and the building is general need of modernization. The building structure is compromised, energy performance of the building is poor, indoor air quality and occupant comfort are below modern standards, and the second floor assembly space cannot be used for its intended function due to life safety and accessibility code compliance issues. None of the existing building systems comply with current building code standards including structural, mechanical, electrical, plumbing, energy, and life safety.


Figure 2: Hollis Town Hall (c. 2010)

Structural framing of the building was recently improved and much of the roof was replaced. Other structural systems that require evaluation and repair include the original stone foundation wall. Groundwater permeates deteriorated mortar joints in the stone wall resulting in elevated humidity levels in the basement.

The original windows provide substantial air leakage and thermal transfer through frames and glazing resulting in nuisance drafts which substantially varies the temperature and increases heating and cooling loads. This leads to great discomfort from the occupants and increased energy use. The cedar shake shingles cladding on the upper sections of the building exterior appear to be in relatively good condition however some shingles do need to be replaced and the shingles require re-painting. Other exterior features that require repair include wood moldings and the architecturally significant brick chimneys where deteriorated mortar and displaced bricks have weakened the structures.

Some insulation has been added to the attic floor of the original building but it does not comply with current energy code standards and much of the insulation has been disturbed resulting in a poor thermal barrier. Little insulation exists in the first floor walls and no insulation was observed in the second floor walls. The existing heating system is dated and inefficient: 1) the oil-fired hot water boilers are inefficient and emit high concentrations of ozone depleting gases; 2) capacity of the distribution system appears inadequate; and, 3) control and zoning of heating is limited resulting unbalanced heating and low occupant comfort. Cooling of the building is provided by numerous inefficient window air-conditioning units which do not provide adequate cooling capacity for the office spaces. There are no mechanical exchange air ventilation systems in the building and air is currently exchanged by passive leakage through the building envelope.

While the first floor appears to provide adequate space for the current Town functions, layout and configuration is not optimal. Interior elements have been neglected and require repair and re-finishing including walls and ceilings, moldings, windows, doors, hardware, stairs and handrails, and flooring.

Considering the condition of the Town Hall building systems, a major renovation is prudent. This approach would yield the most cost practical investment based on the economy of scale, reduced maintenance costs, and reduced energy costs. A major renovation would improve the Town Hall facility by correcting the deficiencies that constrain its current use and function and reduce indoor air quality and occupant comfort.

B. PROCEDURES & METHODOLOGY

Standards and Protocol

The American Society for Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) has developed the most widely accepted process for completing energy audits at commercial facilities. ASHRAE document RP-669, SP-56, *Procedures for Commercial Building Energy Audits* defines several levels of audits. The appropriate level of audit for a particular facility depends on the availability of existing data and information, owner objectives, and owner budget. Levels range from simple benchmarking to a comprehensive review of all building systems. The most comprehensive audit is a Level III audit which was performed at the Town Hall. Level III audits are commonly referred to as "Investment Grade Audits".

Basic elements of a Level III Investment Grade Audit include the following:

- A review of existing facility data including energy usage.
- Benchmarking the facilities energy usage relative to similar use facilities.
- An on-site inspection and survey of all facility systems.
- On-site measurements and data collection.
- Informal interviews with owners, facility managers, and occupants.
- Energy use analysis and development of efficiency measures.
- Developing a simple payback cost estimate for each recommended measure.
- Development of a comprehensive report that clearly presents all findings and provides recommended energy conservation measures and the associated costs.

In addition to the ASHRAE standard for commercial audits, there are industry and code-based standards that must be considered when analyzing building systems and evaluating energy conservation measures. All recommendations must be consistent with the intent of these standards. For example, the US Environmental Protection Agency (EPA) has established a recommended carbon dioxide (CO_2) threshold concentration of 1,000 parts per million (ppm) to promote a healthy indoor air environment. ASHRAE defines recommended temperatures, relative humidity levels, minimum ventilation rates, and energy standards. The Illuminating Engineering Society of North America (IESNA) prescribes recommended lighting densities based on the designated space use. The International Code Council (ICC) is the adopted standard for all building and energy codes (2009) in the state of New Hampshire. New Hampshire has also adopted ASHRAE Standards 62.1 and 90.1.

Table 4: Relevant Industry Codes and Standards

Standard	Description
28 CFR Part 36	ADA Standards for Accessible Design
ANSI/ASHRAE Standard 55	Thermal Environmental Conditions for Occupancy
ANSI/ASHRAE Standard 62.1	Ventilation for Acceptable Indoor Air Quality
ANSI/ASHRAE/IESNA Standard 90.1	Energy Standards for Buildings Except Low-Rise Residential Buildings
ICC 2009	International Building Code (IBC)
ICC 2009	International Existing Building Code (IEBC)
ICC 2009	International Energy Conservation Code (IECC)
ICC 2009	International Mechanical Code (IMC)
ICC 2009	International Fuel Gas Code (IFGC)
IESNA Lighting Handbook	Reference and Application
NFPA 70	National Electrical Code (NEC)

While the primary objective of an energy audit is identify energy conservation measures, such measures cannot adversely affect occupant comfort and indoor air quality. For example, if a building ventilation system is inadequate then it would be recommended that additional ventilation capacity be added. The electrical power required to operate the added ventilation equipment would increase energy consumption. Typically, the net energy usage incorporating the sum of the recommended conservation measures would still be less than the current usage even with the added ventilation equipment.

It is noted that although there is a prescriptive approach to commercial building audits, that every building is unique in many ways. Buildings should be evaluated consistent with the characteristics that define its need and appropriate function. This includes the following:

- *Use*: Current building use and occupant needs.
- *Systems*: Building systems characteristics and integration.
- *Control*: The effectiveness in which the existing building systems controls are utilized.

Desktop Data Review

Ideally, the building owner provides all available information to the engineering firm prior to initiating the facility site review. Information such as utility bills, building plans, repair records, planned improvements, and occupant concerns will help the building engineer identify potential issues before initiating the site review. The Building Engineer can then focus the site review toward problematic and energy intensive building systems.

Facility Site Review

Following the desktop data review, the Engineer initiates the facility site review. This review includes all major building systems including the envelope, electrical, mechanical, heating, cooling, and ventilation. The Engineer not only determines the performance and operating characteristics of all building systems, they also evaluate how the users operate the systems and how they perceive building performance. Photographs of representative systems, major equipment, and any identified issues are obtained to help document existing conditions. Field notes are maintained by the Engineer to further document building and user characteristics.

Data Measurements

In addition to collecting equipment information, several data measurements are obtained as part of the facility site review. This data is necessary to identify potential building issues and to collect the information needed to develop an accurate energy analysis. Measurements include:

- Infra-red thermal imaging survey of the building envelope.
- Indoor air quality (IAQ) measurements (temperature, relative humidity, and CO_2).
- Lighting metering to determine energy use and operating schedules.
- Lighting output density.
- Metering of energy intensive electrical equipment (e.g., motors, compressors, heaters) to determine energy use and operating schedules.
- Metering of energy intensive plug-loads to determine energy use and operating schedules.

Data Gap Review

Once the facility site review and data measurements are substantially complete, the Engineer begins reviewing and processing all of the collected data. Any data gaps discovered during this process are addressed prior to completing the audit report.

Energy Modeling and Conservation Measures

To identify the best value ECMs and ensure that the calculated energy and cost savings are relatively accurate, a DOE approved energy modeling software program is utilized. A three-dimensional model of the building is created using the simulation program. This includes all characteristic envelope systems, heating, ventilation, air-conditioning and refrigeration (HVACR) systems, domestic hot water systems, and mechanical systems. The geographic position and orientation of the building is input and regional climatic data is imported from the program database.

After the building is accurately modeled, the program simulates building performance and provides the estimated energy use for electric and heating fuel(s). The Engineer then compares the energy data to actual building data. The cause for any significant differences is determined and the building is re-simulated until the model closely matches the actual data. AEC utilizes eQUEST© for all building simulations and energy modeling.

With the base model complete, the Engineer then implements various energy reducing measures and simulates the performance of the building with the new measure. The resulting energy consumption is then compared to the baseline model and predicted energy savings are analyzed.

Cost Estimating and Payback

The cost for implementing each evaluated ECM is then estimated by the Engineer. This provides a net estimated energy savings per dollar invested. Simple payback calculations determine the number of years required for the capital investment cost to equal the present day cost savings realized from energy reductions. The savings to investment ratio (SIR) is the accumulated annual cost savings (as determined by the expected service life of the material or equipment associated with the EEM) divided by the cost of investment. A SIR equal to 1.0 indicates that the EEM has a “break-even” or net-zero cost. The higher the SIR value, the more favorable the return on investment is.

C. FACILITY INFORMATION / EXISTING CONDITIONS

Setting

The Hollis Town Hall is located in Hollis, NH within a light commercial and residential setting (Figure 3). The building and facilities are located on a land parcel owned by the Town of Hollis and is within the Hollis Historic District. The Town Hall is located at 7 Monument Square in the center of town. Cleasby Lane defines the northern boundary of the parcel and a residence bounds the parcel to the south. Parking is provided to employees in the rear of the building (eastern) and visitor parking is provided via on street spaces. To the west is the intersection of Monument Square and Depot Street. The gross area of the building is 15,606 square feet.

Figure 3: Aerial Photograph of Hollis Town Hall (2010)

History

According to archive records and information found on site the building was constructed in 1886 by Town's people for use as the Town Hall. In 1902 the clock and bell system, manufactured by George M. Stevens of Boston (manufactured in Baltimore), were purchased and installed in the tower. In 1950, a three-bay single story structure was added to the south side of the building to function as the Town fire house because the Always Ready Engine House was not capable of housing the larger fire apparatus. In 1978 the fire department constructed a new facility (at current location) and the entire building was renovated for its current function as a Town meeting space.


Figure 4: Hollis Town Hall (c. 1905)

The Hollis Town Hall is registered on the National Historic Register of Places. Constructed in 1886 as a Town Hall facility, it has continuously functioned as a municipal facility providing all Town administrative services and office space for Town employees. The continuance of function and preservation of a Town Hall facility with such architecturally significant elements is a rarity in New England today. The architecture, craftsmanship, and finishes represent the foresight and commitment by the Town's people to develop a functional Town Hall facility that has endured for centuries. Few examples of this unique facility remain in modern rural New England.

While the architecturally defining elements of the building have been substantially preserved, repairs and replacement of most building systems have been deferred and are in need modernization. The building structure is compromised, energy performance of the building is poor, indoor air quality and occupant comfort are below modern standards, and the second floor assembly space cannot be used for its intended function due to life safety and accessibility issues. None of the existing building systems comply with current building code standards including structural, mechanical, electrical, plumbing, energy, and life safety.

Use, Function & Occupancy Schedule

The building is a two-story structure with the single-story with a full basement, clock tower, and a community room addition. The first floor of the building contains six (6) rooms used for offices, an employee kitchen, and lavatories. The main lobby provides access to the second floor via two sets of stairs. The second floor contains a large gathering hall with stage and a private meeting room. The second floor gathering hall presently does not function as a public space due to accessibility constraints. The basement contains two (2) lavatories that remain functional but are seldom used. Other basement spaces include a mechanical room, storage areas, and maintenance office space. The building operational hours are typical of an office building and the meeting room is frequently used for evening and weekend meetings and events.

Anecdotal Information

Anecdotal information includes all relevant information collected during the desktop review, as part of occupant interviews, or general observations noted during the site evaluation. Generally, anecdotal information corresponds to issues or concerns that may not be apparent during the building evaluation. It includes complaints about seasonal occupant comfort, maintenance issues, systems or equipment performance issues, recent improvements or changes in use, and previous reports prepared by others. Anecdotal information obtained during the Town Hall evaluation includes the following:

- The building is registered on the National Register of Historical Places. Several unsuccessful attempts have been made to obtain grant monies to fund restoration of the building.
- Nuisance drafts in the winter season are controlled by hanging blankets in two (2) of the four (4) stairwells and covering the interior of the windows with plastic film.
- A structural investigation and associated improvements were completed in 2011. Structural improvements included re-supporting the first floor, fortifying the clock tower framing, and fortifying the roof framing. The roof was also replaced as part of the project.
- In warmer months, nine (9) window air conditioning (A/C) units provide cooling for the normally occupied office spaces.
- The response time for hot water from the kitchen faucet is very long.

Utility Data

Utility data for the Hollis Town Hall was provided by the Town. Table 2 summarizes the total energy consumption for the year including electric and oil usage. Energy consumption and cost for electricity per pay period is shown in Table 3 and Figure 5. The regional electric utility supplier is Public Service Company of New Hampshire (PSNH) and heating fuel oil (No. 2) is provided by a local supplier.

Table 5: Annual Energy Consumption (2010-2011)

Energy	Period	Consumption	Units	Cost
Electric	January 2010 – December 2010	30,618	Kilowatt hours	$5,066
No. 2 Fuel Oil	January 2010 – December 2010	4,506	Gallons	$10,259
			Total Annual Energy Cost (2010):	$15,325
Electric	January 2011 – December 2011	28,671	Kilowatt hours	$4,861
No. 2 Fuel Oil	January 2011 – December 2011	4,799	Gallons	$12,815
			Total Annual Energy Cost (2011):	$17,676

The monthly electrical usage (Figure 3) reveals that the use peaks during the winter months indicating a significant amount of energy is consumed by the heating system and has a second peak in the summer months indicating energy consumed by the multiple window A/C units. Over the twelve (12) month period of 2010, August was the peak demand month, consuming 3,330 kWh of electricity. Over the twelve month period of 2011, January was the peak demand month, consuming 3,222 kWh of electricity. Trending of electricity indicates there is a spike in the middle of the heating months and a spike in the middle of the cooling months. This is expected based on the building characteristics and use.

Table 6: Monthly Electric Consumption (2010 - 2011)

Month	Year	Electric Consumption (kWh)	Electric Cost
Jan	2010	3,033	$514
Feb	2010	3,267	$507
Marc	2010	2,421	$399
April	2010	2,376	$394
May	2010	2,205	$352
June	2010	2,106	$278
July	2010	2,466	$437
Aug	2010	3,330	$567
Sept	2010	2,502	$456
Oct	2010	2,232	$375
Nov	2010	2,205	$361
Dec	2010	2,475	$426
Totals:	*2011*	*30,618*	*$5,066*
Jan	2011	3,222	$529
Feb	2011	3,078	$495
Mar	2011	2,556	$423
April	2011	2,412	$385
May	2011	1,764	$291
June	2011	1,926	$372
July	2011	2,808	$477
Aug	2011	2,817	$500
Sep	2011	2,205	$372
Oct	2011	2,043	$368
Nov	2011	1,780	$293
Dec	2011	2,060	$356
Totals:	*2011*	*28,671*	*$4,861*
Totals:	*'10 - '11*	*59,289*	*$9,927*

Annual electric usage for the Hollis Town Hall based on the most recent data provided by Town (January 2010 through December 2011) is averaged at 29, 645 kWh at an average cost of $4,964. Based on the building size and function, this usage is lower than similar use office buildings. This is mostly attributable to the absence of mechanical ventilation equipment and energy conservation practices by the occupants. This also due to the entire building, with the exception of the basement, being listed as an office building in use 40 hours a week when in actuality only a portion of the facility is used full time.

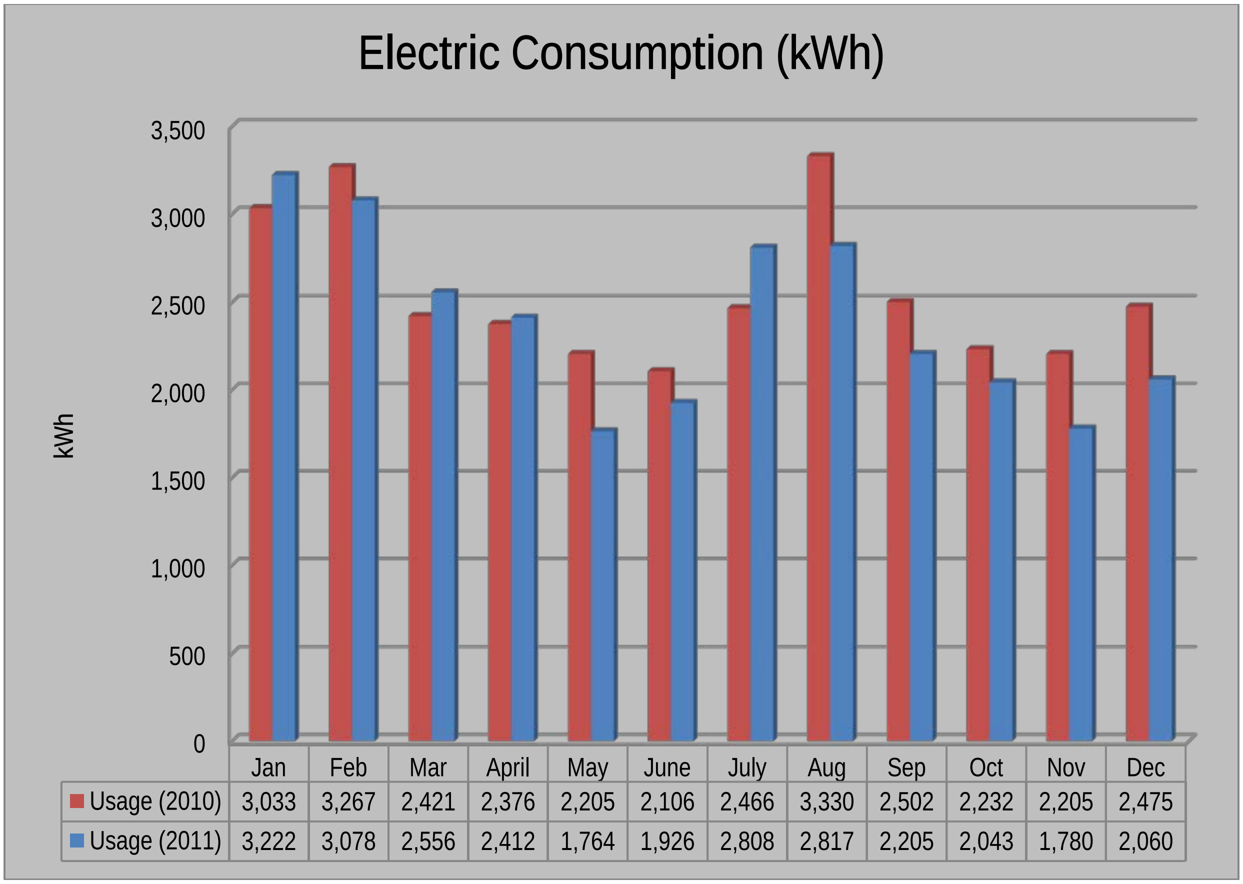


Figure 5: Electric Consumption (2010 - 2011)

To provide the most accurate recommendations for energy conservation, the energy consumption based on end use was determined. Table 4 presents the estimated electrical usage for categories including lighting, plug loads, and mechanical equipment. Mechanical equipment includes all hard-wired, permanently installed equipment including ventilation, exhaust, heating, cooling, pumps, etc. These values were determined using observations from the field audit and typical energy consumption data for appliances observed throughout the building. A more detailed accounting of all electrical equipment by end-use is presented in Part C of this Report.

Table 7: Categorized Electrical Consumption (2011)

Equipment Type	Annual Consumption (kWh/yr)	% of Total Consumption	Annual Cost
Plug Loads	9,652	34%	$1,636
Mechanical Equipment	9,582	34%	$1,625
Lighting Fixtures	9,183	32%	$1,557
Totals	28,417	100%	$4,818

Electrical consumption is nearly equivalent for all three categories. Plug loads are predicted to consume 9,652 kWh/yr. Major plug load equipment includes the nine (9) window A/C units accounting for 1,800 kWh/yr (19% plug load) and 1,256 kWh/yr (13% plug load) is attributed to the kitchen refrigerator. Mechanical loads are predicted to consume 34% of the electricity at the Town Hall as well at 9,582 kWh/yr. At 9,183 kWh/year, light fixtures account for 32% of the electrical demand in the building. Figure 6 illustrates the cost of each of the three categories.

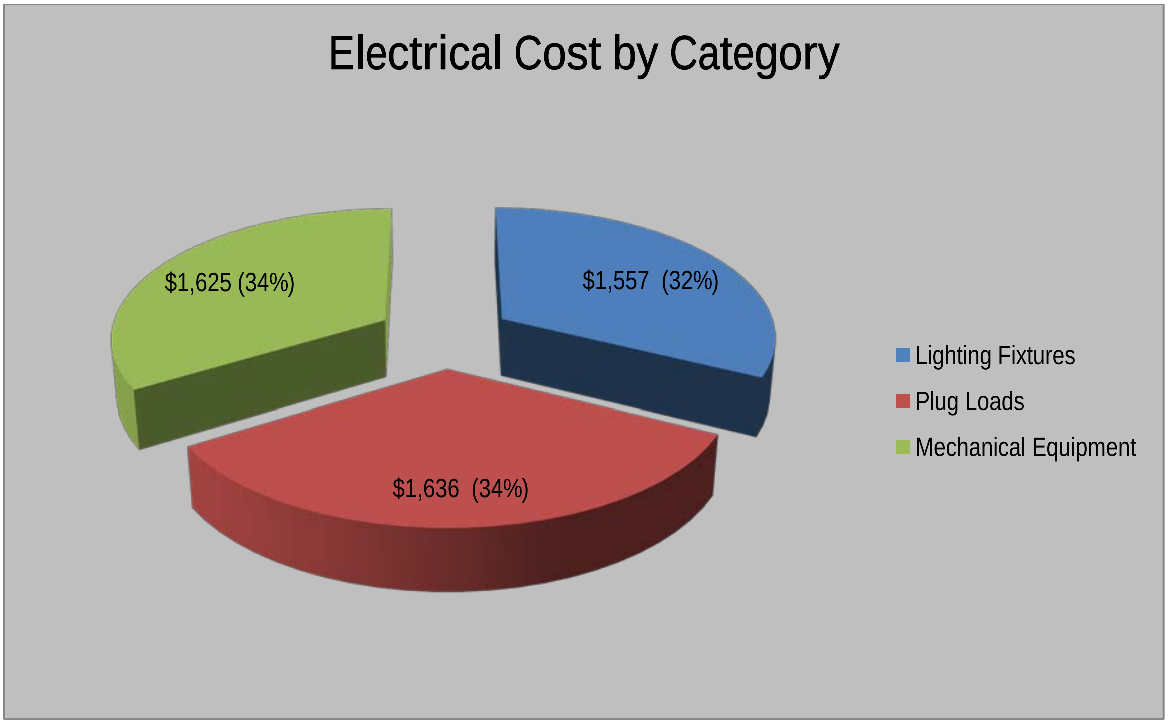


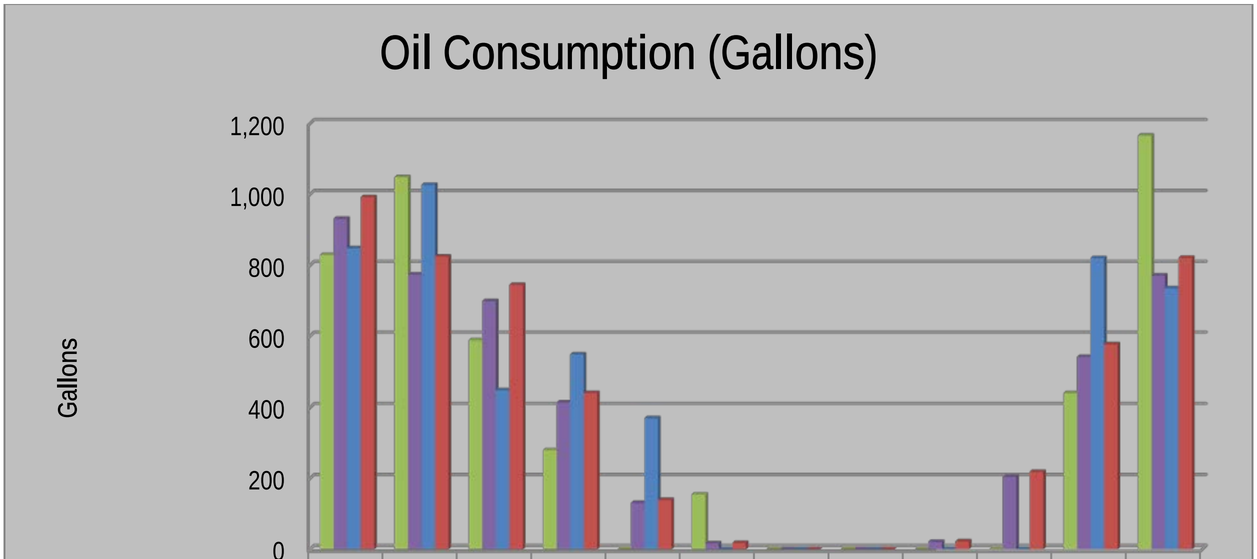
Figure 6: Hollis Town Hall Electrical Cost by Category (2011)

Plug loads account for the most usage with an annual cost of $1,636 (2011). This usage is higher than expected because of the building characteristics and use and can be reduce with simple improvements. Consumption for mechanical systems is lower than the expected range (40%-50%). This is explained by the absence of mechanical ventilation equipment which normally accounts for a substantial amount of electric consumption. Lighting fixtures consume a moderate amount of electricity which can be reduced with simple measures.

Table 8: Monthly Heating Fuel Consumption (2010 - 2011)

Month	Year	Oil Purchased (Gallons)	Cost of Purchase	Est. Oil Consumed (Gallons)	Est. Cost of Consumption
Jan	2010	829	$1,820	931	$2,121
Feb	2010	1,048	$2,301	774	$1,762
Marc	2010	588	$1,291	699	$1,591
April	2010	279	$613	414	$943
May	2010	0	$0	131	$297
June	2010	155	$361	17	$38
July	2010	0	$0	0	$0
Aug	2010	0	$0	0	$0
Sept	2010	0	$0	21	$48
Oct	2010	0	$0	205	$467
Nov	2010	441	$1,062	543	$1,237
Dec	2010	1,166	$2,811	771	$1,755
Totals:	*2010*	*4,506*	*$10,259*	*4,506*	*$10,259*
Jan	2011	848	$2,045	992	$2,392
Feb	2011	1027	$2,476	824	$1,988
Marc	2011	449	$1,082	744	$1,794
April	2011	550	$1,326	441	$1,064
May	2011	370	$892	139	$336
June	2011	0	$0	18	$43
July	2011	0	$0	0	$0
Aug	2011	0	$0	0	$0
Sept	2011	0	$0	22	$54
Oct	2011	0	$0	218	$651
Nov	2011	820	$2,632	579	$1,857
Dec	2011	735	$2,361	821	$2,637
Totals:	*2011*	*4,799*	*$12,815*	*4,799*	*$12,815*
Totals:	*10 - '11*	*9,305*	*$23,074*	*9,305*	*$23,074*

Heating fuel for space heating and domestic hot water heating at the Hollis Town Hall is provided by a local supplier (Table 5, Figure 7). The building consumed a total of 4,506 gallons of fuel oil in 2010 and 4,799 gallons of fuel oil in 2011, for an average annual usage of 4,653 gallons. The average annual heating fuel cost for the Hollis Town Hall is $11,537 (2010 - 2011).



	Jan	Feb	Marc	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Oil Purchased (2010)	829	1,048	588	279	0	155	0	0	0	0	441	1,166
Oil Consumed (2010)	931	774	699	414	131	17	0	0	21	205	543	771
Oil Purchased (2011)	848	1027	449	550	370	0	0	0	0	0	820	735
Oil Consumed (2011)	992	824	744	441	139	18	0	0	22	218	579	821

Figure 7: Fuel Oil Consumption (2010 - 2011)

Considering the building systems including the envelope integrity (insulation and air leakage), mechanical equipment, and use of the facility, the heating fuel usage is expectedly high. This is mostly attributable to a poorly insulated envelope and the two (2) low efficiency boiler units. The boilers have relatively low combustion efficiencies, measured at 80% and 82.5% in 2011 (based on service records). Modern conventional commercial oil-fired boilers can operate at combustion efficiencies up to 90% and smaller condensing units can achieve 94% efficiency. With improved jacket insulation and boiler design, modern boilers have a much higher thermal efficiency than the existing units.

Other explanations for the high usage include heating setpoints that are higher than recommended and poor heating distribution throughout the building. For example, ten (10) of the thirteen (13) representative locations recorded temperatures exceeding 70°F and the average recorded temperature was 69.8°F. The recommended heating setpoints are between 67°F and 69°F. Setpoints were not representative of measured temperatures, such as in the Town Administrators office where the thermostat was set to 70°F but the measured temperature was 66°F.

D. FACILITY SYSTEMS

Building Envelope

The following sections present the building envelope systems and insulation values for each assembly. Assembly values are compared to the *International Energy Conservation Code (IECC), 2009* for commercial buildings located in Climate Zone 5. The IECC code is used as a standard of comparison only and existing buildings are not required to comply with the code unless it undergoes a substantial renovation. New construction and major renovations are required to comply with current energy codes. A set of building design plans were not available at the time of the audit, therefore the construction methods are based on observations and construction methods consistent with era (c. 1886) and fire house construction and renovations (c. 1950 and 1978).

Floor Systems

The exposed concrete floor in the basement is four (4) inches in thickness. The floor system has an installed assembly insulation resistance (R) value of 1.0 (Table 6). In the addition space, the pavement of the fire department bays exists below the raised floor. A timber framed floor was built up, creating a new floor in the addition and a crawl space between this floor and the pavement. There is no insulation between the paved ground and floor; only within the wall (Figure 8). Insulation R-values are shown in Table 6. Although the IECC does not specify an insulation requirement for unheated slab on grade floors in Climate Zone 5, a minimum value of R-10 is generally recommended.

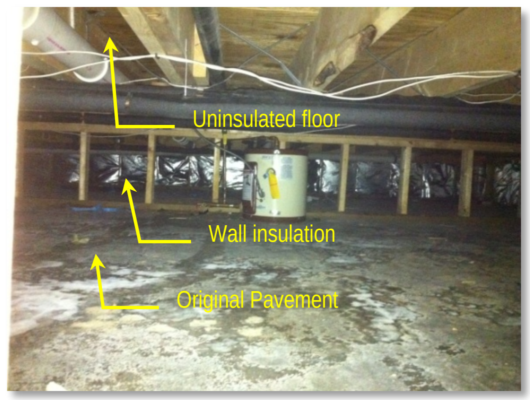


Figure 8: Firehouse Addition Crawlspace

Table 9: Floor Insulation Values

Main Building Basement Floor Area				
Material	Thickness (in.)	R-value	Integrity Factor	Installed R-value
Concrete slab	4.0	0.3	1.0	0.3
Interior air film	NA	0.7	NA	0.7
Installed Assembly				1.0
2009 IECC Requirement:				NR
Best Practice Recommendation				10.0
Addition Floor Area				
Material	Thickness (in.)	R-value	Integrity Factor	Installed R-value
Exterior air film	NA	0.3	1.0	0.3
Plywood decking	5/8	1.0	0.9	0.9
Commercial carpeting	1/4	2.0	1.0	2.0
Interior air film	NA	0.7	NA	0.7
Installed Assembly				3.9
2010 IECC Requirement:				NR
Best Practice Recommendation				10.0

Wall Systems

The main building is a two-story timber framed building with a full basement. Below grade foundation walls are original and constructed of stone presumably quarried from the site. Ground water was observed to be infiltrating the basement. Above grade basement walls are constructed of red masonry brick. No insulation exists below grade. On the exterior, a granite stone band wraps around the bottom of the north, west and south walls of the building where the foundation is below grade. On the east side of the building, where the foundation is exposed, brick is continuous to the ground. The wall system along the first floor is comprised of a brick exterior, air space, timber planking, and six inch columns. As part of the 1978 renovation of the firehouse, a 2 inch by 4 inch framed timber wall covered with gypsum board was constructed to finish the interior space. It is assumed that during this renovation batt insulation was added between the bays. The second floor walls were observed to be insulated. The exterior is clad in cedar shakes and the interior is finished stamped tin.

The single-story southern addition is above an unconditioned crawl space. The foundation walls are cast-in-place concrete and the concrete extends above grade around the south, east and north sides of the building. Along the west (road) side of the building the wall is finished in brick. The wall system above the foundation appears to be constructed the same as the single story in the main building, with a brick exterior, air space, planking, 2-inch by 4-inch timber studs and a gypsum interior finish. Inspection of the walls with the infra-red camera revealed thermal bridging at timber studs. None of the wall systems comply with current energy code standards (IECC 2009).

Table 10: Wall Assembly Insulation Values

Wall 1 (First Floor and Addition Walls)				
Material	Thickness (in.)	R-value	Integrity Factor	Installed R-value
Exterior Air Film	NA	0.2	NA	0.2
Brick	4.0	0.4	0.9	0.4
Air Gap	1.0	1.0	NA	1.0
Wood Planking	0.75	0.9	1.0	0.9
FG Batt Insulation	4.0	12.6	0.8	10.0
Gypsum Board	0.5	0.5	1.0	0.5
Interior Air Film	NA	0.7	NA	0.7
			Installed Assembly:	13.7
			2009 IECC Requirement:	13+3.8ci
			Code Compliant?	NO
Wall 2 (Second Floor Walls)				
Material	Thickness (in.)	R-value	Integrity Factor	Installed R-value
Exterior Air Film	NA	0.2	NA	0.2
Wooden Shakes	NA	0.8	0.9	0.7
Wood Planking	0.75	0.9	1.0	0.8
Air Gap	6.0	1.0	NA	1.0
Tin Paneling	NA	0.6	1.0	0.6
Interior Air Film	NA	0.7	NA	0.7
			Installed Assembly:	4.0
			2009 IECC Requirement:	13+3.8ci
			Code Compliant?	NO

Figure 9: Attic Insulation, Reinforced Beam, Exposed Wiring

Ceiling Systems

Ceilings throughout the first floor of the building are suspended acoustical tile (SAT) systems. The above ceiling space is used for routing of, piping, conduit, and electrical cable. The high ceiling in the second floor of the building in the main hall area is covered in tin panels and is insulated with blown-in fiberglass. Much of the insulation has been disturbed presumably during the recent structural and roof renovations resulting in compromises to the thermal barrier and allowing thermal energy to escape to unconditioned space.

Roofing Systems

The roofing system on the Town Hall consists of asphalt shingles, plywood sheathing and wood paneling. There is no insulation in the roof rafters (cold roof). The roof was replaced in 2011 as part of the renovation project. The floor of the attic space is insulated with blown-in fiberglass insulation and partially covered with plywood for worker access (Figure 9). Insulation in the addition consists of blown-in cellulose on the original plaster ceiling located above the suspended acoustical ceiling.

Table 11: Ceiling Insulation Values

Ceiling Insulation Value (original building)				
Material	Thickness (in.)	R-value	Integrity Factor	Installed R-value
Exterior Air Film	NA	0.2	NA	0.2
Blown-in Fiberglass	8.0	24.0	0.7	16.8
Tin Paneling	NA	0.6	1.0	0.6
Interior Air Film	NA	0.7	NA	0.7
			Installed Assembly:	18.1
			2009 IECC Requirement:	38.0
			Code Compliant?	NO
Ceiling Insulation Value (firehouse addition)				
Material	Thickness (in.)	R-value	Integrity Factor	Installed R-value
Exterior Air Film	NA	0.2	NA	0.2
Blown-in Fiberglass	8.0	24.0	0.8	19.2
Plaster Ceiling	5/8	0.6	0.9	0.5
Air Gap	6	1.0	NA	1.0
Suspended Acoustical Tiles	NA	0.6	1.0	0.6
Interior Air Film	NA	0.7	NA	0.7
			Installed Assembly:	22.2
			2009 IECC Requirement:	38.0
			Code Compliant?	NO

Fenestration Systems

Fenestration systems on the Town Hall building include operable windows, fixed window units, and one glazed entry door. Window units in the building are original wood framed units with single-pane glass. Consistent with IECC requirements, fenestration performance is measured by the U-factor, the solar heat gain coefficient (SHGC), and air leakage as determined by the unit manufacturer. Some windows are equipped with storm windows. Those without storm windows are covered with plastic film in the winter months to reduce drafts. No manufacturer information was available for the windows or doors therefore compliance with IECC standards for commercial buildings located in Climate Zone 5 cannot be established.

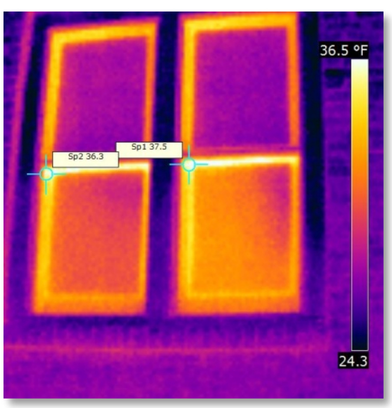


Figure 10: Exterior of Window

As expected, the original glazed units perform poorly based on visual inspection and survey with the infra-red thermal camera. Thermal transfer and air leakage occurs at the seals of operable windows and the interface between the window and the wall opening which is highly typical of older units and even occurs in newer units. Recommendations include exterior and interior inspection and re-caulking of window jambs, headers, and sills as needed. If the operable double-hung and sliding window units have adjustable jambs, they should be inspected and adjusted as necessary to maintain a complete air seal.

Doors

The door units in Hollis Town Hall include solid wooden units with and one hollow metal framed unit with top glazing. Units include solid double wooden doors (two sets of front entry doors to the main building, one set to the front of the addition) and single solid wooden doors (two sets at rear entrance of the main building). The single glazed door unit is located at the rear entrance of the addition. The metal framed unit is uninsulated providing high thermal transfer. Based on visual observations and thermal imaging, the seals on door jambs, partings, and thresholds are incomplete allowing substantial air leakage. Daylight can be seen through most door thresholds and double-door partings.

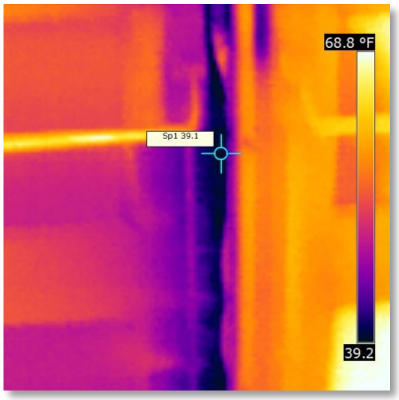


Figure 11: Air Leakage at Entry Door

Air Sealing

Based on the thermal imaging survey and visual observations, significant air leakage occurs through windows and entry doors. Although this is typical even for a modern building, simple measures can significantly reduce air leakage. Recommended measures for windows include: 1) adjusting jamb seals on operating windows; 2) adding weather-stripping; 3) caulking interior frames and moldings; and, 4) locking/clasping windows to maintain a complete seal.

Air sealing of all door units can be improved with commercial weather-stripping. All door and window units should be regularly inspected (every 2 to 3 years) to ensure proper operation, identify faulty seals, and to identify any deteriorated caulking requiring replacement.

Other air sealing recommendations include inspecting all exhaust and ventilation ducts to determine if they have a positive pressure actuated damper. Dampers are recommended on all exterior ducting to prevent passive air leakage.

Thermal Imaging Survey

The thermal imaging survey was completed on the morning of December 29th, 2011 and January 3rd, 2012. Outdoor ambient temperature was approximately 28°F during both surveys. The survey was conducted using a FLIR© B-CAM infra-red (IR) camera. The building exterior and interior envelope and major mechanical and electrical equipment were surveyed with the IR camera. IR camera surveys not only identify heat transfer through building envelopes, they also identify trapped moisture, electrical system overloading, heat loss through ducting and piping, high energy lighting fixtures, and energy intensive plug load equipment. Appendix B presents the survey report.

The IR surveys revealed the following notable observations:

- The thermal integrity of the envelope (walls and roof) is poor. Timber studs are visible in various rooms in the first floor indicating thermal bridging. A missing piece of tin in the stairway wall provides significant air leakage. Various cracks and breaches in the perimeter walls allow for transfer between indoor and outdoor air.
- Poorly sealed windows and doors provide a significant amount of thermal transfer and air leakage.
- Significant thermal transfer occurs through the door units.
- Uninsulated hot water pipes result in poor distribution of heating in

Figure 12: Uninsulated Hot Water Pipes in Basement

conditioned and semi-conditioned spaces (Figure 12).

- A passive air vent in the granite watermark around the building foundation allows thermal transfer between the conditioned basement and exterior.
- Electronic equipment including photocopiers and computers/monitors operate at high temperatures and increase heat loading of the building (summertime).

Electrical Systems

Supply & Distribution

Single phase grid electricity is supplied to the main panel in the north side of the basement. A sub-distribution panel is located in the second floor stairwell as well as in the meeting room between the old building and the major meeting room of the addition. Knob and tube wiring was found to be in operation in the clock tower which is considered to be a fire hazard and code violation due to being exposed. Wiring in the main building protected by conduit was found hanging out of the wall and junction boxes in various locations, exposing the wiring (Figure 13). It was noted that a hydronic water pipe is located above the main electrical panel (code infraction). It is highly recommended that a licensed electrical contractor inspect the building for electrical hazards.

Figure 13: Exposed Electrical Wiring

Lighting Systems

As presented in Table 9, there are a variety of lighting fixtures and lamp types in the Town Hall. Lighting fixtures in the building consist mainly of recessed mounted high performance T8 fluorescent fixtures and some surface mounted compact fluorescent lighting (CFL) fixtures. CFL's are also the source of exterior lighting. Incandescent lamped fixtures account for the second highest in total watts and third highest in quantity.

Table 12: Lighting Fixture Schedule

Fixture Lamp Type	Location(s)	Control	No. Lamps	Watts	Qty.	Total Watts
T8	Throughout	Switch	1-2	28, 32	89	4,576
CFL	Throughout	Switch	1	17, 40	29	535
Incandescent	Stairs, Bell Tower, 2nd fl. Meeting, Basement	Switch	1	60, 100	17	1,300
LED	Exit Signs	Always On	1	5	16	80
Spotlights	Stage Room and Balcony	Switch	1	32	6	192
Circle T9	Basement and Stairs	Switch	1	32	1	32
				Totals:	158	6,715

Table 10 presents the energy consumption by lighting fixture type. The high performance T8 fluorescent fixtures are the main source of lighting and account for 65% of all lighting energy consumption annually. Incandescent fixtures in the north and south stairs as well as on the stage can consume a moderate amount of electricity at 13%. It is recommended these be replaced with CFL's. The CFL fixtures, which are nearly double (29) the amount of incandescent fixtures (17), account for only 10% of lighting, including exterior lights which run frequently. LEDs in exit signs account for 8% of consumption. The stage lights are assumed to be infrequently used and account for 4% of total consumption. The one T9 fixture in the basement is infrequently used, and at a low wattage, consumes less than 1% of total electricity. Lighting fixtures account for 32% of the total electrical consumption of the building at 9,183 kilowatt-hours per year.

Table 13: Lighting Fixture Energy Consumption

Fixture Lamp Type	Location(s)	Est. Usage (KWH/yr)	% of Total
T8	Throughout	6,006	65%
Inc.	Stairs, Bell Tower, 2nd fl. Meeting, Basement	1,154	13%
CFL	Throughout	908	10%
LED	Exit Signs	699	8%
Stage	Stage Room and Balcony	399	4%
Circle T9	Basement and Stairs	17	<1%
	Totals:	9,183	100%

Lighting density measurements in Town Hall were obtained to establish if building illumination is consistent with the *Illuminating Engineer Society of North America* (IESNA) standards for the prescribed use. These measurements were obtained during normal operating conditions on December 29th, 2011 between the hours of 1400 and 1511. Table 11 presents the lighting density measurements obtained in units of foot-candles (FCs).

The T8 lamp fixtures are relatively efficient units. While replacement of the fixtures would not provide a reasonable payback on investment, adding controls to reduce the frequency of operation is recommended, especially in common spaces such as corridors. Motion controllers would turn the lights on when motion is detected and then turn them off when there is no longer someone in the area.

IESNA Standards

Lighting densities in common areas and meeting rooms exceed IESNA standards. Methods to reduce lighting densities include reducing the quantity of fixtures, replacing them with lower-wattage fixtures, and installing lower wattage bulbs in the existing fixtures. Other methods to reduce lighting density include replacing overhead lighting with task lighting, adding multiple control zones, adding daylight controls and adding dimming controls. Newer technology fixtures provide higher lighting density per watt than the existing older fixtures and provide improved lighting quality. The lighting density data is included in Appendix C.

Lighting densities in office spaces are adequate. Office spaces with particularly high densities included the Assessor's Office and the Selectmen's Office. Many offices do receive ample amount of natural light which may attribute to the higher densities. The main first floor hallway was particularly bright, as was the bathroom in the addition. A dimming switch in the hallway may be a good option to keep densities low most the time with the option to make it brighter for residents with a difficult time seeing.

Table 14: Illumination Densities

Location	Lighting Density (FC)	Recommended Density (FC) (1)
Stage and balcony	17	50
2nd floor meeting room	145	30
West entrance vestibule	11	10
1st fl EW hall	47	10
Bldg. Inspector/Zoning/Main	36	30
Planning Board Office	23	30
Finance Office	29	30
Assessor Office	50	30
Selectmen Office	42	30
Adminstrators Office	37	30
Kitchen	25	30
Community room	18	30
Men's Lavatory	28	5

(1) Based upon IESNA standards and AEC recommendations.

Plug Loads

Plug loads for the Town Hall were determined based on equipment nameplate information. The operating time for each item is based on observations, occupant loading, schedule, and typical operating time for the equipment. Plug loads are categorized as appliances, electronics and office equipment. Appendix F presents an inventory of all plug load equipment.

Based on this analysis, the total annual plug load is 9,652 kWh/yr. This accounts for the marginally highest total consumption between plug loads, lighting fixtures and mechanical equipment, accounting for 34% of consumption. Appliances account for the most plug load consumption at 64%. The nine (9) window AC units are predicted to consume 1,800 kWh/yr (19% all plug load) while the refrigerator with a bottom freezer is estimated to account for 13% of all plug load consumption. Replacing the AC units and refrigerator with respective ENERGY STAR ® models would help save some of this usage.

Table 15: Plug Load Energy Consumption

Category	Location(s)	Est. Usage (kWh/year)	% of Total
Appliances	Throughout	6,161	64%
Office Equipment, Computers, Electronics	Throughout	3,491	36%
	Subtotals	9,652	100%

Motors

Electrical motors are limited to a domestic water pressure booster and two (2) hydronic circulation pumps.

Emergency Power Systems

There is a dated O'Keefe & Merritt Co. emergency generator which was originally built for the U.S. Army (Figure 14). This generator was built for use in WWII and is rated at 10 kW at unity power factor and 12.5 kVa at 80% power factor. It will provide either 120 or 240 volt at 60 Hertz. The generator is located in the basement of the building. The exhaust ducting may not comply with code requirements.

Figure 14: Backup Generator

Plumbing Systems

Domestic Water Supply

Domestic water supply for the Town Hall is provided by the Rocky Pond Pump House near the Hollis Upper Elementary School (HUES). The south branch of the pump house distribution system makes its way from the pump house on Rocky Pond Road into the Hollis Brookline Middle School along Main Street and just west of the Town Hall. Passing through the Hollis-Brookline Middle School, the water flows east through the historic Farley Building, through the historic Always Ready Engine House and into a vault at the northwest corner of Monument Square. The main line leaves this vault and enters another which is on the east side of Depot Street and directly south of the Town Hall, from which a service connection provides water to the Town Hall. The main leaves this vault and travels along Depot Road, terminating at the Lawrence Barn. Based on this mapping, the water travels approximately one mile from the Pump House to the Town Hall. Water demand for the building is expected to be limited and includes lavatory facilities (toilets and sinks).

Domestic Water Pump Systems

Figure 15: Water Booster Pump

The Rocky Pond Pump House has two (2) pumps for the entire system which are 5 horsepower and 7 horsepower pumps. Electric for these pumps is supplied through the Hollis Upper Elementary School's electrical meter. A domestic water booster pump is located in the basement (Figure 15) to increase water pressure. Water demand for the building is limited to lavatories.

Domestic Water Treatment Systems

Water is treated at the Rocky Pond Pump House for pH balance and corrosion inhibition. There are no water treatment systems in the Town Hall.

Domestic Hot Water Systems

Domestic hot water is provided by two (2) electric hot water heaters. A 47-gallon tank is located in the basement of the main building and supplies heated water to the kitchen, staff lavatories and basement bathrooms. A small 5-gallon unit is located in the crawl space and supplies water to the two bathrooms and sink in the single-story addition (Figure 16).

Figure 16: Main DHW Tank

Hydronic Systems

Space conditioning is provided by hot water baseboards, cabinet heaters and steam radiators connected to a hydronic loop. Water is circulated by two (2) ¾ horsepower circulation pumps located in the boiler room in the basement. Hydronic piping is uninsulated. This results in a loss of heat to semi-conditioned areas and insulating all hot water pipes would result in a more efficient heating system. The system does not contain glycol to prevent freezing of the system. Pumps and piping were observed to be in poor condition.

Figure 17: DHW Tank in Addition Crawlspace

Mechanical Systems

Heating Systems

Heat is provided to the building by two (2) oil-fired boilers in the basement boiler room (Figure 18). The larger Burnham® boiler services the main Town Hall space and was installed in 1995. The smaller Utica® boiler services the single-story addition and was installed in 2000. The boilers have relatively low combustion efficiencies, measured at 80% and 82% in 2011, respectively. Modern conventional commercial oil-fired boilers can achieve combustion efficiencies up to 90% and smaller condensing units can achieve up to 94% efficiency. With improved jacket insulation and boiler design, modern boilers have a much higher thermal efficiency than the existing units.

Table 16: Heating Supply Systems

Heating Unit	Unit Description	Area(s) Served	Output (MBH)	Age (yrs.)	Combustion Efficiency (2011)	Control Type
Boiler No. 1	Utica Boilers	New building	231	12	80%	Thermostat
Boiler No. 2	Burnham	Old building	562	17	82%	Thermostat

Cooling Systems

Cooling is provided to the building by nine (9) window air conditioning units which are installed in the summertime. Window units are an inefficient means to cool a building and they consume a substantial amount of energy. Based on accounts by occupants and as expected, the window units do not provide adequate cooling capacity for the office spaces.

Pumps

There are two (2) ¾ HP water circulation pumps located in the boiler room to circulate heated water through the hydronic loop. The pumps are relatively small considering the building configuration and estimated pipe loop length. One (1) domestic water booster located in the basement to supply pressurized water to lavatory and kitchen facilities. When the pumps are replaced it is recommended than NEMA premium rated motors are installed.

Figure 18: Hydronic Boiler Units

Controls Systems

Heating systems in the building are controlled by several thermostats including a programmable unit, a manual slide unit, and clock faced thermostats. It is recommended that the scheduling feature of the programmable thermostats are used and updated and that non-programmable units are replaced with programmable units.

Refrigeration

No commercial refrigeration systems are installed in the Town Hall.

Mechanical Equipment Energy Consumption

The electrical energy consumption for mechanical equipment was determined according to nameplate information and building function and occupancy schedules. Table 14 presents a summary of the mechanical equipment and annual energy usage. Appendix E presents the detailed inventory and the associated energy consumption for each piece of mechanical equipment. Total mechanical consumption per year is estimated to be 9,582 kWh per year compared to 9,562 kWh for plug loads and 9,183 kWh for lighting.

Table 17: Mechanical Equipment Energy Consumption

Equipment Type	Qty.	Item Manufacturer(s)	Consumption (kWh/yr)	% of Total
DHW Heaters	2	Bradford White®	4,550	47%
Boiler Blowers	2	NA	3,120	33%
Circulation Pumps	2	Beckett®, Carlin®	1,600	17%
Booster Pumps	1	Gould®	312	3%
		Totals:	9,582	100%

Ventilation Systems

Exhaust Ventilation Systems

Exhaust fan units provide several functions including humidity control, odor control, venting of VOC containing materials (e.g., cleaning solvents), chemical gas venting in laboratories, and venting of cooking fumes. Operation frequency and schedules for the fans units should be consistent with the use type and intensity of the vented space. For example, lavatories may be demand ventilated (interlocked with light switch) or they may operate continuously at a low rate during occupied periods. Spaces equipped with exhaust fans are commonly over-ventilated resulting in increased energy consumption. All exhaust controls and rates should be consistent with ASHRAE Standard 62.1. Fan ducting should have pressure actuated dampers to restrict air flow and heat loss when the units are not operating.

Exhaust ventilation systems in the Town Hall are limited to lavatory exhaust fans in the new addition lavatories. These are interconnected with the lights to only operate when the bathrooms are occupied. Passive ventilation appears to adequately support necessary building ventilation.

Exchange Air Ventilation Systems

There are no exchange air ventilation systems installed at the Town Hall.

Energy Recovery Ventilation Systems

There are no energy recovery ventilation systems installed at the Town Hall.

Indoor Air Quality

Indoor air quality (IAQ) is established based upon temperature (°F), relative humidity (%), and carbon dioxide (CO_2); measured in parts per million (ppm). This data provides the best representation of building ventilation performance and occupant comfort. They are also indicative of conditions that are detrimental to building systems including moisture intrusion and the potential for fungi growth (mold and mildew) and related damage of building materials.

Recommended temperatures vary based on the season, occupant activity, and relative humidity levels. Generally, recommended setpoint heating temperatures in northern New England range between 67°F and 69°F and recommended cooling setpoint temperatures range between 73°F and 76°F. Relative humidity (RH) levels fluctuate consistent with seasonal atmospheric conditions. A range between 30% and 65% is recommended (ASHRAE). While there are no known adverse health effects related to elevated CO_2 concentrations, it can cause acute illness including headaches, drowsiness, lethargy, and nausea. For this reason, the U.S. Environmental Protection Agency (EPA) has established a recommended threshold concentration of 1,000 ppm.

The IAQ in the Town Hall was measured on December 29th, 2011 between the hours of 1400 and 1511. The building was normally occupied when the measurements were obtained. Thirteen (13) IAQ measurements were obtained at representative locations throughout the building. Appendix C presents all of the measurements. Results of the IAQ measurements are summarized as follows:

- Temperatures in the building ranged from 61.8°F in the community room (addition), to 77.1°F in the second floor meeting room. The average recorded temperature was 69.8°F.
- Relative humidity levels varied substantially throughout the building from 4% in the second floor meeting room to 26% in the men's room in the community room. The average relative humidity was 15%.
- CO_2 concentrations ranged from 333 ppm in the west entrance vestibule to 631 ppm in the Selectmen's office with an average of 511 ppm. No levels exceeded the EPA recommended threshold of 1,000 ppm.

Table 18: Summary of IAQ Data

IAQ Metric	Low	High	Avg.	Range of Variance	Recommended
Temperature (°F)	61.8	77.1	69.8	15.3	67 – 69
Relative Humidity (%)	3.9	26.4	14.9	22.5	30 – 65
Carbon Dioxide (ppm)	333	631	551	298	<1.000

Temperatures varied widely through the building. It was noted that setpoint temperatures did not represent actual temperature, for example the recorded temperature in the Town Administrators office was 70°F while the measured temperature was 66°F. Ten (10) of the thirteen (13) representative locations revealed temperatures above the recommended setpoint of 69°F during heating periods. Relative humidity also varied widely throughout the building. CO_2 concentrations were consistently low even with the absence of ventilation systems. This indicates that a substantial amount of air is being ventilated through passive leaks throughout the building. The west vestibule for example had a CO_2 concentration (333 ppm) close to the ambient outdoor concentration (315 ppm).

Figure 19 presents the data trending for the three IAQ parameters.

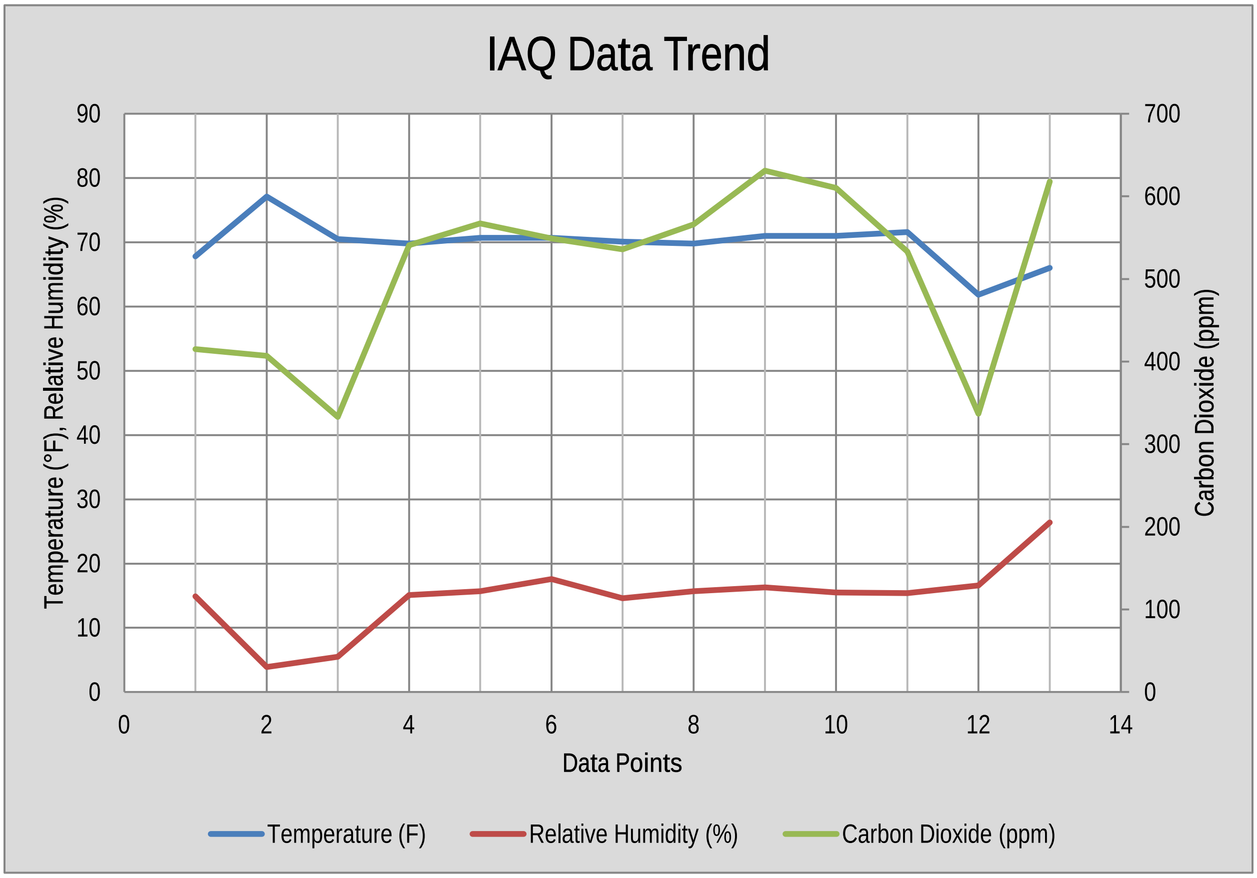


Figure 19: Indoor Air Quality Data Trends

Secondary Observations

Observations noted herein are not directly related to the objective of the energy audit. Investigation of these items is beyond the defined scope of services and these observations are not intended to be inclusive of all building issues and code infractions. They are provided as anecdotal information for the Town's consideration and may warrant further investigation.

Structural Systems

Figure 21: Seepage through Basement Wall

It is noted that a comprehensive structural evaluation of the Town Hall is beyond the intent and scope of this evaluation. The issues presented herein are secondary observations noted during the course of the energy systems assessment.

Figure 20: Reinforced Support Beam

A structural engineering investigation and associated improvements were completed in June 2011. New support beams in the basement were installed for frame support, the support column extending through the balcony in the second floor meeting hall was reinforced, (Figure 20) and the clock tower was reinforced with steel-tension rods and gusset plates. Two hybrid steel and laminated channel-beams were also installed in the attic space above the second floor gathering hall to support the roof extending the length of the building.

Groundwater seepage through the original stone foundation walls in the basement is evident on the east wall (Figure 21). Although no apparent structural issues were noted, the wall should be evaluated to assess condition and to mitigate the seepage.

The main chimney of the Town Hall is in poor condition. Mortar has deteriorated and bricks have fallen away. Recommendations include dismantling the chimney and re-constructing it.

Roofing Systems

As part of the structural renovation project, the roof of the original building and clock tower was fully replaced with new plywood, copper flashing, shingles and gutters.

Building Code

Knob and tube wiring is connected and operable in the clock tower (Figure 22). Unlike modern wiring, there is no safety grounding conductor and wires can be spliced together without a junction box which could result in a spark of electricity causing an electrical fire. Knob and tube wiring also lacks the capacity for electrical demands for uses today. Other issues include insulation on the wiring is susceptible to drying and cracking and rodent damage. Knob and tube wiring cannot be in contact with insulation per code requirements due to the fire hazard. AEC recommends that all knob and tube wiring be replaced with in accordance with current code standards.

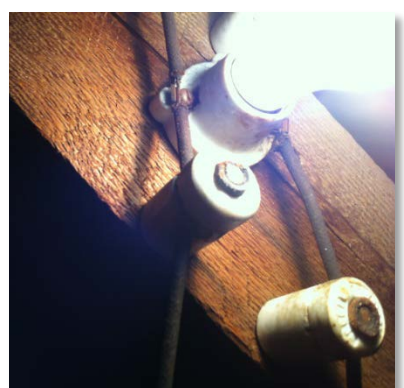


Figure 22: Knob and Tube Wiring in Clock Tower

There are no exchange air ventilation systems in the Town Hall building. Current code standards (IMC and ASHRAE 62.1) require mechanical ventilation of commercial office spaces. Any major building renovation or addition would require compliance with current standards. Air exchange is currently provided by passive air leakage through the building envelope. As the envelope is improved with air sealing and insulation, ventilation becomes a more significant concern.

Portions sections in the basement are supported with rubber bungee cords. Pipe hangers are required by code. Current code also requires that all hydronic piping be insulated and labeled.

Life Safety Code

Fire detection and notification systems are presumed to comply with code requirements. Current code requires all assembly areas without a level (at-grade) emergency egress to have an automatic fire suppression system. Therefore the second floor hall is required to have an automatic fire suppression system if it is utilized as an assembly space. Currently this space does not appear to be utilized.

The fire door between the mechanical room and the basement is unable to completely close/seal. Some sections of the plaster ceiling in the boiler room have spalled away and do not provide sufficient fire rating.

Blankets are hung in the first floor stairwells to prevent nuisance drafts from the cooler second floor space. This presents a egress safety issue and poses a fire hazard.

The boilers are exhausted through the original brick chimney which is in poor condition due to deteriorated mortar and brick. The chimney may not comply with code standards and may pose a fire hazard. Recommendations include inspecting the chimney with a remote camera scope. Repair options include lining the chimney with a metal stack.

ADA Accessibility

The first floor of the building, including the addition, appears to comply with current ADA code. Accessibility to the second floor does not comply with ADA standards.

Hazardous Building Materials

Lead paint is a potentially hazardous material and is presumed to be located throughout the building. Asbestos containing materials (ACM) was commonly used in many building materials including window glazing, boiler refractory, pipe insulation, and plaster. A hazardous materials assessment should be completed prior to any major renovation project.

E. BUILDING ENERGY MODELING

Source Data

Required source data input for the eQUEST© model includes geographical location, building use type(s), occupancy schedules, building dimensions, envelope systems, fenestration systems, lighting systems, and all mechanical systems (heating, cooling, ventilation domestic hot water). The building characteristics and systems data was obtained during the building site review. Energy usage was provided by the Town for grid electricity and heating oil.

Model Calibration

The quality of the output data is a function of the accuracy of the input data. While eQUEST© is a sophisticated computer simulation program, like any program there are limitations resulting from unusual building characteristics and operating variables that cannot be discretely defined in the program. To ensure that the model simulates the building operation with high accuracy, an iterative model calibration process is completed where actual building energy usage data is checked against the model output values. This process is repeated until the deviation between the energy usage derived from the baseline building simulation and the actual energy consumption is within an acceptable range.

Summary of Model Results

The Hollis Town Hall was modeled using eQUEST© computer simulation program. Developing an accurate baseline model of the building presented certain challenges including accounting for the high electrical usage and the high heating fuel usage. Once the baseline calibration was completed, several major Energy Efficiency Measures (EEMs) were simulated within the model including:

- Insulating the entire building up to current code.
- Replacing the hot water heater with a demand tankless unit.
- Insulating the basement walls.
- Insulating the hydronic piping.

The resulting energy savings and costs for these measures are presented in Section G (Recommendations) and the model output is provided in Appendix I. Tables 16 and 17 present a summary of the model predicted annual energy usage by category for electrical and heating fuel. The actual electrical consumption of 28,671 kWh/yr is slightly lower than the model prediction of 28,860 kWh/yr.

Table 19: Model Predicted Baseline Electrical Usage

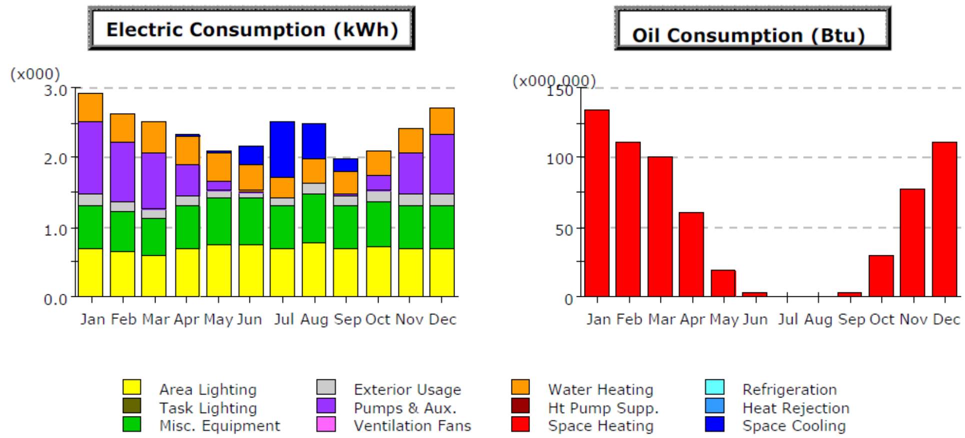
Electric Category	Annual Usage (kWh x 1,000)
Space Cooling	1.84
Hot Water	4.51
Pumps & Aux.	4.99
Exterior Lighting	1.59
Misc. Equipment	7.59
Area Lights	8.33
Total Predicted:	**28.86**
Total Actual:	**28.67**

Actual heating fuel consumption (665.5 MBtu) is slightly higher than the model predicted value (648.7 MBtu) based on available data through December 2011. This variation is within the expected range of deviation.

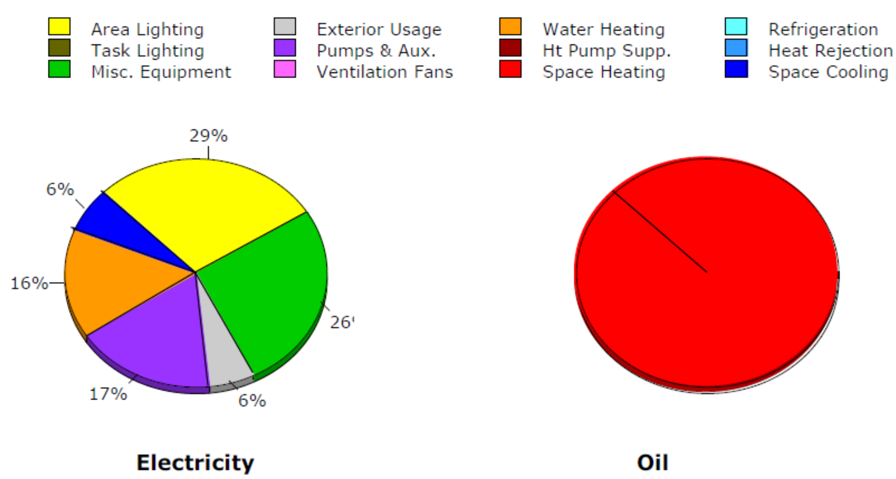
Table 20: Model Predicted Heating Fuel Usage

Electric Category	Annual Usage (MBtu)
Space Heating	648.7
Total Predicted:	648.7
Total Actual:	665.5

The energy modeling results are depicted graphically by a monthly bar graph (Figure 16) which breaks down the energy consumption for electricity and gas consumption separately by category. For example, "Area Lighting" is relatively consistent throughout the year while "Space Cooling" and "Pumps & Aux." consumes a variable amount of electricity depending on the time of year.



Annual energy consumption by category is also graphed using eQUEST® (Figure 17). This information is depicted in a pie graph and helps determine the largest overall use categories. For the Town Hall the "Area Lighting" category is determined to use the most electrical energy (29%) while "Space Heating" consumes all of the oil. A final comparison between the baseline and modeled energy efficiency measures is also provided in the appendices in bar graph format to illustrate changes in energy use with each measure. This provides an indication of where the EEM savings occur and any possible increased energy use from the new measure. That information is then used to formulate whether the EEM is economically sound for the particular application.



F. FACILITY BENCHMARKING

ENERGY STAR for Commercial Buildings

The Town Hall was benchmarked using the EPA's ENERGY STAR® Portfolio Manager for Commercial Buildings. This benchmarking program accounts for building characteristics, regional climatic data, and user function. It then ranks a building within its defined category amongst all other buildings entered in the program to date. The defining metric is the building Energy Use Intensity (EUI). If a building scores at or above the 75^{th} percentile within its category then it becomes eligible for ENERGY STAR® certification pending an on-site validation review by a licensed Professional Engineer. Currently the program does not have categories for every commercial building type but they can still be entered into the program and checked against similar buildings to determine where the building ranks compared to the current national average. The average energy intensity for every building type category is constantly changing and theoretically is it reducing as more efficient buildings are constructed and existing buildings implement energy efficiency measures. Therefore, buildings that currently meet the eligibility requirements may not be eligible next year when they apply for annual re-certification.

The Hollis Town Hall is defined as an "Office" use building and cannot be certified in the Commercial Building ENERGY STAR® program do to its use category. Utility data for electric and heating fuel for the preceding twelve (12) months was input into the benchmarking program. Table 18 presents the annual energy use (through December 2011) and Table 19 presents a summary of the Statement of Energy Performance (SEP) benchmarking results. The SEP is presented in Appendix G.

Table 21: Annual Energy Consumption

Energy	Site Usage (kBtu)
Electric – Grid	97,825
Fuel Oil	665,465
Total Energy:	763,290

Table 22: SEP Benchmarking Summary

Location	Site EUI (kBtu/ft^2/yr)	Source EUI (kBtu/ft^2/yr)
Hollis Town Hall	49	64
National Median (Office)	68	164
% Difference:		-61%
Portfolio Manager Score:		NA

Compared to the office buildings that have entered data into Portfolio Manager to date, the Town Hall energy use is considerably lower than the national average. The source EUI for the Town Hall is 64 kBtu/ft^2/yr while the national average is 164 kBtu/ft^2/yr, meaning the Town Hall uses 61% less energy than the average office building. This comparatively low usage is most attributable to the absence of mechanical ventilation equipment.

G. RECOMMENDATIONS

Energy Conservation Measures

Based on the observations and measurements of the Town Hall, several energy conservation measures (EEMs) are proposed for consideration (Tables 20 to 22). These recommendations are grouped into three tiers based on the cost and effort required to implement the EEM. EEMs are ranked within each tier based on the capital cost for implementation versus the net estimated energy cost savings.

Tier I EEMs are measures that can be quickly implemented with little effort for no or little cost. They include routine maintenance items that can often be completed by facility maintenance personnel and changes in occupant behavior or building operation. Tier II items generally require contracted tradesmen to complete but can generally be implemented at low cost and within operating building maintenance budgets. EEMs that require large capital expenditure and budgetary planning (one year or greater) are categorized as Tier III measures.

Simple payback is calculated for the proposed EEMs. The cost to implement the measure is estimated based on current industry labor and equipment costs and the annual cost savings represents the reduced costs for energy savings. The net energy and cost savings for smaller EEMs is based on the estimated reduction of the associated energy consumption as defined in the model and equipment inventory. Using these costs, the payback period is then calculated as the number of years at which the capital cost of implementation equals the accumulated energy cost savings. Other qualitative considerations that do not influence the Simple Payback Method calculation but should be considered by the owner during the decision-making process include:

- Occupant comfort.
- Relative operation and maintenance requirements.
- Remaining useful life of equipment and systems to be replaced.

Energy cost savings are based on the average electric utility charge over the past year at the Town Hall of $0.165 per kWh (PSNH) and a heating fuel cost of $3.96 per gallon. (NHOEP March 1, 2012)

Tier I Energy Efficiency Measures

Tier I EEMs are measures that can be quickly implemented with little effort for zero or little cost (Table 20). They include routine maintenance items that can often be completed by facility maintenance personnel, and changes to occupant behavior or building operation. Six (6) Tier I EEMs are recommended.

Table 23: Tier I Energy Efficiency Measures

EEM No.	EEM Description	Investment	Annual Cost Savings	Payback (yrs.)	SIR
T1-1	Replace incandescent lamps with CFL lamps (10).	$60	$35	NA	NA
T1-2	Air-seal and insulate all abandoned chimneys and vents including the abandoned chimney flue in basement, the fireplace chimney in the finance office, and the blocked off basement window on the north side.	$350	$160	2.1	9.1
T1-3	Install time clock on copier.	$60	$100	0.6	8.3
T1-4	Install 2” of polyisocyanurate rigid insulation on the bell tower door and install weather-stripping.	$150	$30	10.8	4.0
T1-5	Complete air-sealing on all entry door jambs, partings, headers, thresholds, and moldings (interior and exterior).	$1,100	$600	1.8	3.8
T1-6	Install occupancy sensors in new addition lavatory to control lighting and exhaust fans.	$350	$50	7	1.7

Recommended Tier I EEMs include CFL lamps, typical air-sealing measures, and adding time and occupancy controls to energy intensive office equipment, lighting, and exhaust fans. The incandescent lamps were all replaced as part of the lighting upgrade project but were changed back after not providing sufficient light densities. It is therefore recommended higher watt CFL bulbs be installed. A 13-watt CFL offers the same output as a 60-watt incandescent, while a 30-watt CFL has the potential to offer the same output as a 150-watt incandescent and still use half the energy as a typical 60-watt incandescent with an average lifespan over 5-times longer.

Tier II Energy Efficiency Measures

Tier II items generally require contracted tradesmen to complete but can be implemented at low cost and within operating building maintenance budgets. Three (3) Tier II EEMs are recommended at this time as presented in Table 21.

Table 24: Tier II Energy Efficiency Measures

EEM No.	EEM Description	Investment	Annual Cost Savings	Payback (yrs.)	SIR
T2-1	Replace the main DHW tank unit with an electric tankless unit.	$1,500	$210	7.1	2.5
T2-2	Replace the 5-gallon tank heater with an electric demand hot water heater for kitchen and lavatory.	$950	$132	7.2	2.1
T2-3	Insulate all hydronic hot water piping in the building.	$2,700	$250	5.0	1.9

The two domestic hot water (DHW) tank units are inefficient units. Considering the limited demand for hot water in the Town Hall, replacing the tank units with electric tankless units would yield energy savings. The existing tanks are estimated to be about 10 years old and based on the size and use of the equipment will likely require replacement in the next 5 years. If the existing hydronic piping is expected to remain in service for the foreseeable future, then adding insulation would provide modest energy savings and would improve system distribution. This measure should also consider the condition of the piping as it may require replacement in the near future. The associated drawback is the energy lost to the space is used to condition it and therefore if pipes are insulated a new heat source will need to be installed. This is still the more efficient approach as for example in summer months the pipes are used for DHW and energy is lost when the space does not need to be heated and excess air-conditioning is then needed.

Tier III Energy Efficiency Measures

EEMs that require large capital expenditure and budgetary planning (one year or greater) are categorized as Tier III measures. Nine (9) Tier III EEMs are provided in Table 22 for the Town Hall. The costs assume a phased approach including a comprehensive engineering evaluation, developing a list of corrective actions that reduce energy consumption and improve occupant comfort, and implementation of the corrective actions.

Tier III EEMs for the Town Hall include insulating floors, walls, and attic spaces in the original building and the firehouse addition. Properly insulating the first and second floor walls in the original building will require substantial renovation work including limited demolition of walls. An evaluation of the stone foundation wall and mitigation of groundwater seepage should be completed prior to installing rigid insulation panels on the basement wall interior. The proposed hybrid approach consists of dense-packed blown-in cellulose insulation in larger accessible cavities and injected open-cell polyurethane foam insulation in smaller and less accessible cavities. Caulking will be used to air-seal all wall penetrations and gaps. This approach will limit the disturbance of the original plaster walls, moldings, and paneling while significantly improving the integrity of the envelope.

Two options are provided for windows including rehabilitation of the original units and total replacement of the original units with custom high-efficiency units. Window restoration and replacement measures typically do not yield significant energy savings relative to the investment. The predicted SIR for these measures is affirms this point due to the associated costs based on their age such as lead paint removal and retaining historical significance. Other considerations for windows include the condition of the existing windows, occupant comfort, and aesthetics. Improvements of the insulation and windows should also consider impacts to historically significant elements.

Table 25: Tier III Energy Efficiency Measures

EEM No.	EEM Description	Investment (1)	Annual Cost Savings	Payback (yrs.)	SIR
T3-1	Air-seal all floor penetrations and install additional six (6) inches of blown cellulose insulation in attic.	$12,846	$1,681	7.6	3.9
T3-2	Insulate second floor walls of original building: limited demolition of original plaster wall sections and injection holes, fill/inject larger cavities with blown-in dense-packed cellulose insulation, inject small cavities (including wall corners, plates, and window and door frames) with open-cell polyurethane foam, patch and finish walls. Assume 8" deep wall cavity. Apply polyurethane caulking to air-seal all wall penetrations and gaps. Provide real-time verification of cavity insulation using IR camera and camera scope.	$35,989	$4,046	8.9	3.4
T3-3	Add 4" of blown-in cellulose insulation to the addition ceiling (plaster ceiling) and seal and insulate the hatch.	$6,268	$690	9.1	3.3
T3-4	Insulate first floor walls of original building: demolition of newer framed walls and limited demolition of original plaster wall sections, fill/inject larger cavities with blown-in dense-packed cellulose insulation, inject small cavities (including wall corners, plates, and window and door frames) with open-cell polyurethane foam, patch walls/install gypsum board and finish walls. Assume 8" deep wall cavity. Apply polyurethane caulking to air-seal all wall penetrations and gaps. Provide real-time verification of cavity insulation using IR camera and camera scope.	$28,083	$2,794	10.1	3.0
T3-5	Install 2 staggered layers of 1" FF rigid polyisocyanurate insulation (R-14) on interior of basement walls and tape-seal seams.	$6,445	$410	15.7	1.9
T3-6	Install a vapor/moisture barrier (4-mil polyethylene sheeting) and place 6" of blown-in cellulose insulation in the addition crawlspace.	$10,666	$580	18.4	1.6
T3-7	Replace two (2) boiler units with high-efficiency oil fired units. Replace existing heating registers with modern control valves and fin tube heating units. Install larger high efficiency pumps. Improve zone control and install new programmable thermostats.	$63,243	$2,520	25.1	1.0
T3-8	Restore the original historic windows (21) with coil spring pulleys, insulate weight boxes with spray foam, seal top portion of double-hung units, and install high-efficiency interior storm window units.	$47,570	$867	54.9	0.5
T3-9	Replace existing original windows with new fiberglass frame triple-pane high efficiency historically correct custom windows (21).	$76,956	$912	84.4	0.4
T3-10	Replace the existing hydronic heating system and window air-conditioning units with a high-efficiency inverter driven electric air-source heat pump system (VRF). Add interlocked ERV ventilation system. *(see narrative section)*	$310,270	$2,028	153.0	0.2

(1) Tier III EEM investment costs include fees for design & engineering, construction management, and a 15% cost contingency.

EEMs for heating systems in the Town Hall include two options: 1) replacing the hydronic boiler units with higher efficiency oil-fired units, replacing distribution equipment, and adding zone control; and, 2) whole replacement of the hydronic heating system with a high-efficiency air-source heat pump system with an interlocked energy recovery ventilation (ERV) system. While the payback and SIR for the electric heat pump system are not economically favorable, it provides additional benefits including mechanical exhausts ventilation via ERV units, cooling for the entire building, and improved control and occupant comfort.

Because the Town Hall building is in need of significant repair and modernization, implementing multiple EEMs as part of a major renovation and improvements project would yield lower total cost investment. T3-10 (installing air-source heat pump system) savings for example only account for system to system savings and would yield a much higher savings if insulation was also added.

The energy cost savings and resulting payback are based upon each independent measure implemented for the building in its current condition and function. There are interdependencies among measures that will affect the net realized energy savings. For example, replacing lighting fixtures with lower energy units reduces heat load to the building thereby requiring more heating fuel to compensate for the loss in heat from the inefficient light fixtures. Also, many of the larger capital Tier III EEM projects may include some of the smaller dependent Tier I and II EEMs.

Capital costs are provided for budgetary planning only. They are estimated based on current industry pricing for materials and labor. A detailed cost estimate should be developed prior to appropriating capital funds for the more costly measures.

EEMs Considered but not Recommended

The following measures were identified as part of the building evaluation but are not recommended as best-value EEMs. Considerations include the cost feasibility and payback term and occupant comfort concerns.

1. A lighting retrofit project was recently completed (2011) and replacing the modern fixtures with higher efficiency units is not cost practical at this time.

O&M Considerations

O&M and considerations are provided for existing systems and for proposed EEMs. They are intended to provide best-value practices for the building manager and to identify any O&M requirements for the proposed EEMs.

1. Storm windows are installed on some windows. Where there are no storm windows, plastic film is placed over windows in the wintertime and blankets are used in the east stairways leading to the second floor for draft control.
2. Window AC units are taken out of windows during non-cooling periods.

Indoor Air Quality Measures

Based upon the measured indoor air quality in the Hollis Town Hall, no area exceeds the EPA CO_2 recommended threshold of 1,000 ppm. CO_2 concentrations ranged between 333 in west entrance vestibule to 631 in the selectmen's office, with a building average of 511 ppm. Currently there are no mechanical exchange air ventilation systems in the building. Although the addition of ventilation equipment will increase energy consumption, it is a best-practice recommendation and will be required by code if the building undergoes a major renovation or addition. As the integrity of the Town Hall envelope is improved, ventilation will become a greater concern as passive air ventilation is reduced.

Renewable Energy Considerations

While renewable energy systems generally require a higher capital investment, they provide a significant reduction in the consumption of non-renewable fossil fuel energies. Other obvious benefits include a reduction in ozone depleting gas emissions (as measured by CO_2 equivalency), otherwise referred to as the "carbon footprint". Renewable energy systems also reduce the reliance upon fossil fuels derived from foreign nations and mitigate pricing fluctuations in a volatile and unpredictable market.

Evaluating the practicality of a renewable energy system for a specific facility should consider several facility specific variables including:

- Geographical location.
- Building orientation.
- Adjacent and abutting land features.
- Site footprint and open space.
- Building systems configuration and condition.
- Local zoning or permitting restrictions.
- Currently available financial resources (grants, utility provider rebates, tax incentives).

Table 23 provides a summary description of the more common and proven renewable energy technologies. The Table also provides a preliminary feasibility assessment for implementing each technology at the Town Hall. Additionally, each renewable energy technology is scored and graded based on technology and facility specific characteristics. Appendix H presents the criteria used to develop the score and grade for each renewable energy technology. A more rigorous engineering evaluation should be completed if the Town Hall is considering implementing any renewable energy system.

Table 26: Renewable Energy Considerations

Renewable Energy System	System Description & Site Feasibility
Solar Domestic Hot Water	System Description: Solar domestic hot water (DHW) systems include a solar energy collector system which transfers the thermal energy to domestic water thereby heating the water. These are typically used in conjunction with an existing conventional DHW system as a supplemental water heating source. Because of the high capital cost, solar DHW systems are only feasible for facilities that have a relatively high demand for DHW.
Score: 78%	*Site Feasibility:* *Based on the low demand for domestic hot water, a solar hot-water system may be a practical consideration for the building. The capital cost could be offset with substantial utility rebates and incentives. The system could provide primary DHW during summer months when demand is low. In colder months, it would provide secondary heating.*
Geothermal Heating & Cooling	System Description: Geothermal heating systems utilize solar energy residing in the upper crust of the earth. Cooling is provided by transferring heat from the building to the ground. There are a variety of heating/cooling transfer systems but the most common consists of a deep well and piping loop network. All systems include a compressor and pumps which require electrical energy. Geothermal systems are a proven and accepted technology in the New England region. Site constraints and building HVAC characteristics define the practicality.
Score: 74%	*Site Feasibility:* *Considering the existing hydronic heating equipment is compatible with a ground-source water heat pump system, it is a practical technology for the building. However the wells and piping network would have to be installed in the Town common located across the road which would increase the associated infrastructure costs. Payback for this system is expected to be relatively high.*
Biomass Heating Systems	System Description: Biomass heating systems include wood chip fueled furnaces and wood pellet fueled furnaces. For several reasons, wood chip systems are generally practical only in large scale applications. Wood pellet systems can be practical in any size. Wood chip systems are maintenance intensive based on the market availability and procurement of woodchip feedstock and variability of woodchip characteristics (specie, size, moisture content, bark content, Btu value) which affect the operating efficiency of the furnace and heating output. They require a constant feed via a hopper and conveyor system and feed rates must vary according to feedstock Btu value and heating demand. For these reasons they typically require full-time maintenance and are practical only in large scale applications. Wood pellet systems are much less maintenance intensive and feedstock availability and consistency is less of an issue. Both systems reduce the dependency on fossil-fuels and feedstock can be harvested locally.
Score: 72%	*Site Feasibility:* *A conventional pellet boiler unit is a practical heating system for the building however this requires additional effort for procurement of pellets, storing pellets, periodic filling the pellet hopper during the heating season, and emptying the ash. However, there are new systems with automated feed and ash removal systems that would be a practical application at the Town Hall. Based on the spatial constraints of the building and site, biomass may not be a practical consideration.*
Roof-Mounted Solar Photovoltaic Systems	System Description: Photovoltaic (PV) systems are composed of solar energy collector panels that are electrically connected to DC/AC inverter(s). The inverter(s) then distributes the AC current to the building electrical distribution system. Surplus energy is sent into the utility grid via net metering and reimbursed by the utility at a discounted rate. The capital investment cost for PV systems is high but the technology is becoming increasingly more efficient thereby lowering initial costs.
Score: 69%	*Site Feasibility:* *Based on the limited area of the southern facing roof, a small roof-mounted system (5kW-10kW) could be installed on the building. The main building with the new roof does not appear to have enough south facing space therefore it would have to be put on the single-story structure which receives less light. This would require a design and permitting process with the local utility for a grid-tie connection. Current utility incentives and renewable energy grants would help offset the capital cost for the system. A structural evaluation of the roof framing system would be required to ensure that it could accommodate the increased loading. The existing electrical systems may require upgrade especially if the PV system is interconnected to the grid.*

Ground-Mounted Solar Photovoltaic Systems	System Description: A ground-mounted PV system is composed of the same solar collector panels used for a roof-mount system. The collectors are mounted on a frame support system on the ground verses a roof structure. This is advantageous when roof framing cannot accommodate the increased load of the collector panel and the ease of installation and access for maintenance and repair.
Score: 68%	*Site Feasibility:* *Based on the limited southern facing land area, only a small sized PV system (5-10 kW) could possibly be sited but closer determination would need to be made. This would require a design and permitting process with the local utility for a grid-tie connection. Current utility incentives and renewable energy grants would help offset the capital cost for the system.*
Wind Turbine Generator	System Description: Wind turbine generators (WTGs) simply convert wind energy into electrical energy via a turbine unit. WTGs may be pole mounted or rooftop mounted however system efficiency improves with increased elevation. Due to cost and site related constraints, WTG technology in New England is only practical for select sites. Constraints include local geographical and manmade features that alter wind direction, turbulence, or velocity. Other technology constraints include local variability of wind patterns and velocity. Additionally, WTGs require permitting (local, state, FAA) and local zoning that may restrict systems due to height limitations, and/or, visual detraction of the local landscape. Presently, WTG technology is not widely used in New England based on the relatively high capital cost compared to the energy savings.
Score: 64%	*Site Feasibility:* *Considering the small and obstructed (trees and buildings) parcel and the relatively low mean wind speeds in the region, a WTG unit may not be a practical consideration.*
Solar Thermal Systems	System Description: Similar to a roof-mounted solar PV system, solar thermal systems are most commonly installed on rooftops. These systems utilize solar energy for heating of outdoor air. The most common application is for pre-heating of outdoor air used for air exchanges systems in buildings. This reduces the heating fuel required to maintain setpoint temperatures in interior spaces.
Score: 59%	*Site Feasibility:* *Considering the lack of heating and ventilation equipment, solar thermal is not a viable option without proper mechanical equipment. Solar thermal should be re-evaluated if new air exchange equipment is installed.*
Combined Heat & Power (CHP)	System Description: Combined heat and power (CHP) systems are reliant on non-renewable energies. Systems are composed of a fossil-fuel powered combustion engine and electrical generator. Electrical current is distributed to the building distribution system to reduce reliance on grid supplied electricity. Byproduct thermal energy derived from the combustion engine is recovered and used to heat the building (this is generally considered to be renewable energy). Another benefit of CHP systems is that they provide electrical energy during power outages in buildings that do not have emergency power backup. Larger CHP units require a substantially large fuel supply and if natural gas is not available then a LPG tank must be sited.
Score: 58%	*Site Feasibility:* *Considering the relatively small electric and heating demand for the Town Hall, a CHP may not be cost practical. There is no natural gas within the Town and costs associated with the infrastructure development for a large propane tank would be high. CHP systems also require intensive maintenance and have a low expected service life.*

H. ENERGY EFFICIENCY INCENTIVE AND FUNDING OPPORTUNITIES

The State of New Hampshire along with the utility companies offer multiple programs designed to improve the energy efficiency of municipal and school buildings through financial incentives and technical support. Some of the currently available programs are presented herein however building managers are encouraged to explore all funding and incentive opportunities as some programs end and new programs are developed. For a current listing of advertised programs and initiatives, visit www.dsireusa.org.

New Hampshire Public Utilities Commission

New Hampshire Pay for Performance

This program addresses the energy efficiency improvement needs of the commercial and industrial sector. The Program is implemented through a network of qualified Program Partners. Incentives will be paid out on the following three payment schedule: Incentive # 1: Is based on the area of conditioned space in square feet. Incentive #2: Per kWh saved and Per MMBTU saved based on projected savings and paid at construction completion. Incentive #3: Per kWh saved and Per MMBTU saved based on actual energy savings performance one year post construction. Total performance incentives (#2 and #3) will be capped at $300,000 or 50% of project cost on a per project basis. For more information visit http://nhp4p.com.

New Hampshire Public Utilities Commission's Renewable Energy Rebates

The Sustainable Energy Division provides an incentive program for solar electric (photovoltaic or PV) arrays and solar thermal systems for domestic hot water, space and process heat, with a capacity of 100 kW or equivalent thermal output or less. The rebate for PV systems as follows: $1.00 per Watt, capped at 25% of the costs of the system or $50,000, whichever is less. For solar hot water (SHW) systems, the base rebate is $0.07 per rated or modeled kBtu/year, capped at 25% of the cost of the facility or $50,000, whichever is less, as a one-time incentive payment. http://www.puc.state.nh.us/Sustainable%20Energy/RenewableEnergyRebates-CI.html.

New Hampshire Community Development Finance Authority

New Hampshire Community Development Finance Authority Revolving Loan Fund

The Enterprise Energy Fund is a low-interest loan and grant program available to businesses and nonprofit organizations to help finance energy improvements and renewable energy projects in their buildings. The loans will range from $10,000 to $500,000. Larger amounts will be considered on a case by case basis. The program is available to finance improvements to the overall energy efficiency performance of buildings owned by businesses and nonprofits, thereby lowering their overall energy costs and the associated carbon emissions. More information about the program can be found on their website www.nhcdfa.org. These activities may include:

- Improvements to the building's envelope, including air sealing and insulation in the walls, attics and foundations;
- Improvements to HVAC equipment and air exchange;
- Installation of renewable energy systems;
- Improvements to lighting, equipment, and other electrical systems; and
- Conduction of comprehensive, fuel-blind energy audits.

Public Service of New Hampshire (PSNH)

Commercial (Electric) Energy Efficiency Incentive Programs

This program targets any commercial/industrial member building a new facility, undergoing a major renovation, or replacing failed (end-of-life) equipment. The program offers prescriptive and custom rebates for lighting and lighting controls, motors, VFDs, HVAC systems, chillers and custom projects. http://www.psnh.com/SaveEnergyMoney/For-Business/Energy-Saving-Programsand-Incentives.aspx

SmartSTART

The SmartSTART (Savings Through Affordable Retrofit Technologies) advantage is simple – pay nothing out of pocket to have energy efficiency products and services installed in your building. The Smart Start program is limited to PSNH's municipal customers only and includes schools. The program is available on a first-come, first served basis to projects which have been pre-qualified by PSNH. The cost of the improvements is fronted by PSNH which is then repaid over time by the municipality or school using the savings generated by the products themselves. This program is for lighting and lighting controls, air sealing, insulation and other verifiable energy savings measures which have sufficient kilowatt-hour savings. For more information on this program visit: http://www.psnh.com/SaveEnergyMoney/For-BusinesslMunicipal-Smart-Start-Program.aspx

Clean Air - Cool Planet

Community Energy Efficiency

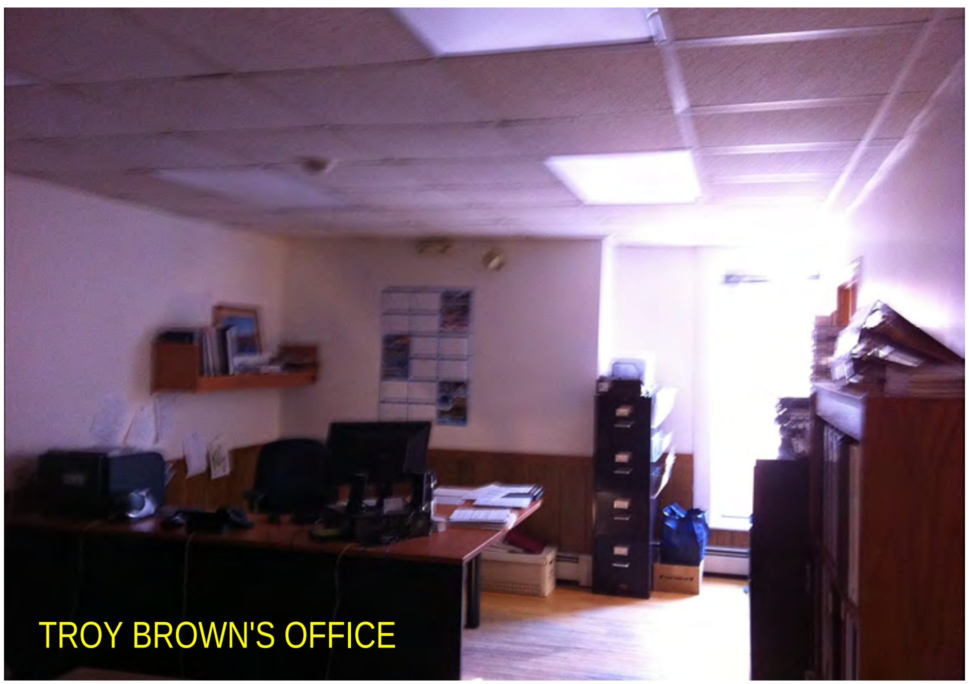
CA-CP works with communities throughout the Northeast to find solutions to climate change and build constituencies for effective climate policies and actions. Much of their work focuses on successful models for energy efficiency and renewable energy planning. They advise and partner with citizens, educators, faith groups, small businesses, municipal governments, and other local leaders. They explore cost-effective opportunities that exist for communities to reduce their emissions as well as their vulnerability to climate impacts. One such example is CA-CP's partnership with the University of NH, NH Sustainable Energy Association and UNH Cooperative Extension to create www.myenergypian.net . A groundbreaking suite of web and outreach tools for individual action used by households, schools and community groups around the northeast. http://www.cleanair-coolplanet.orglfor_communities/index.php .

APPENDIX A

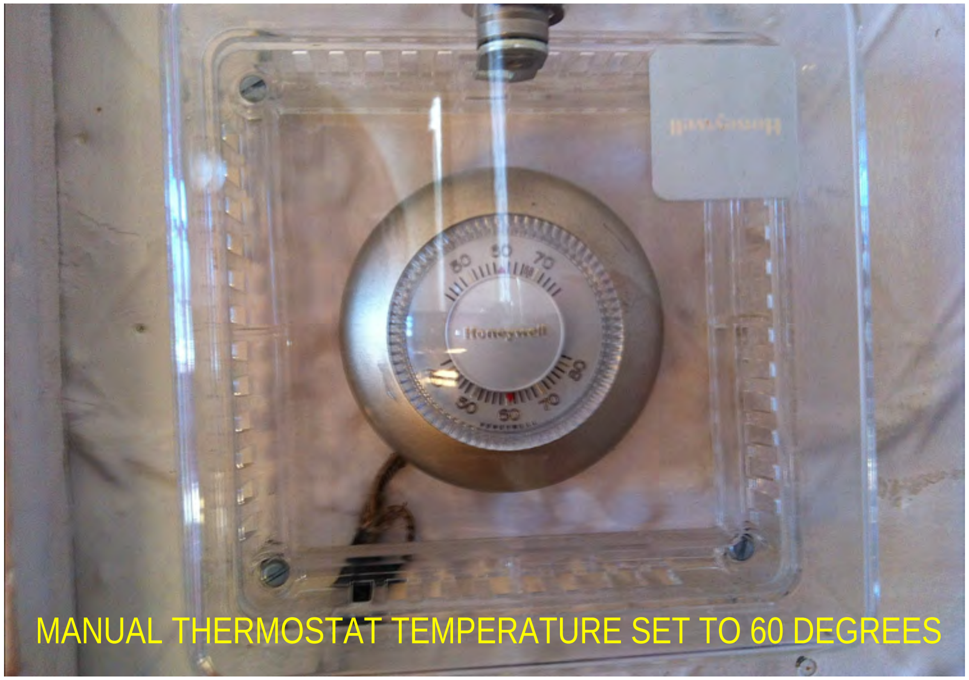
Photographs

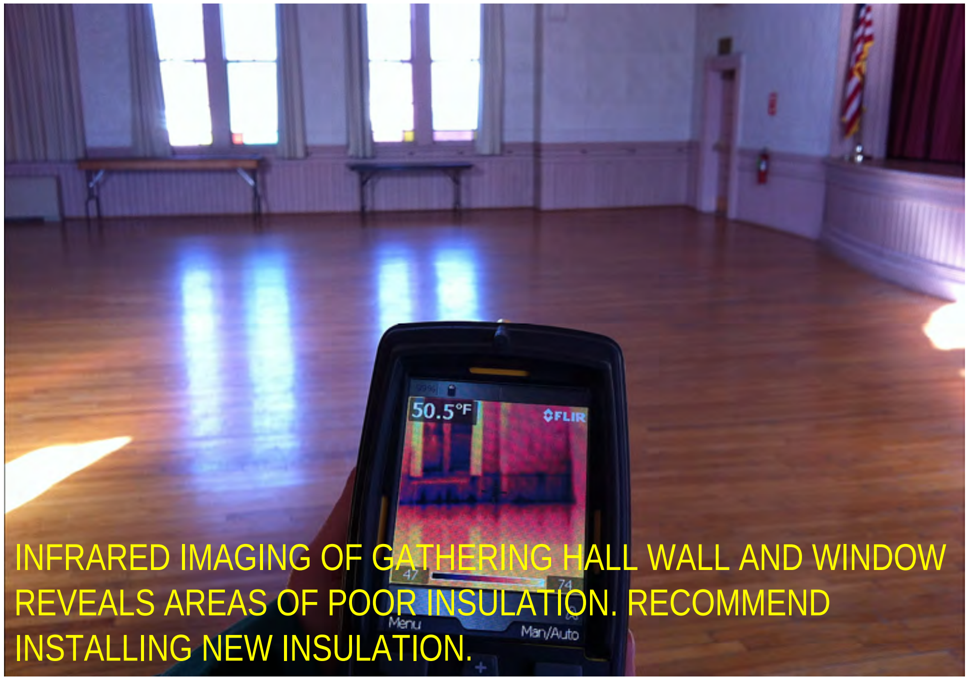
REAR EAST EXITS LEADING TO PARKING LOT


SECOND FLOOR MAIN GATHERING HALL


TROY BROWN'S OFFICE


BUILDING PLANS OFFICE


MANUAL THERMOSTAT TEMPERATURE SET TO 60 DEGREES



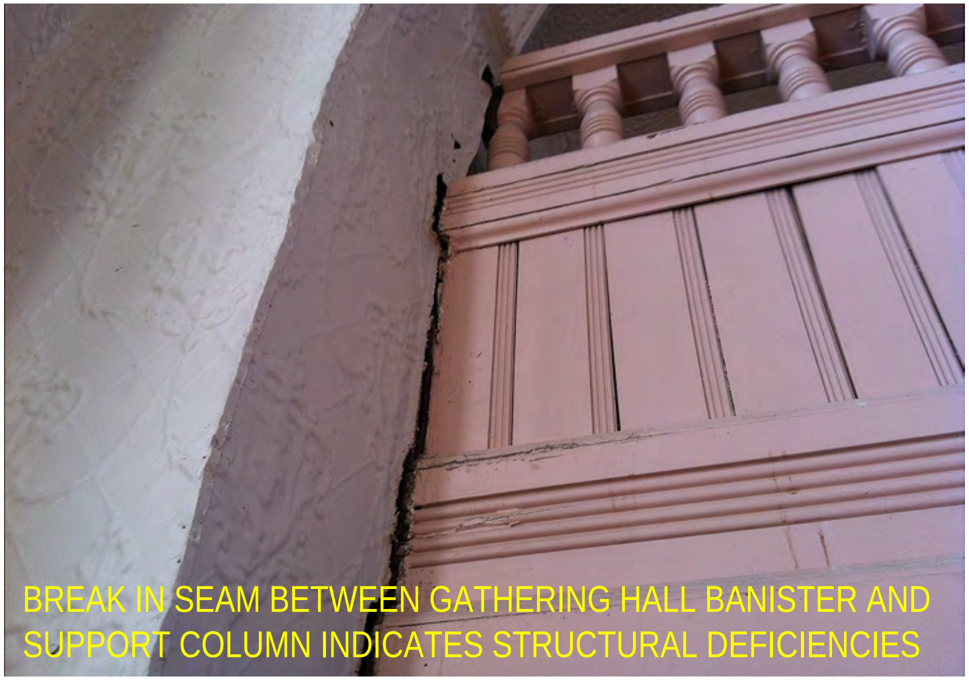
INFRARED IMAGING OF GATHERING HALL WALL AND WINDOW REVEALS AREAS OF POOR INSULATION. RECOMMEND INSTALLING NEW INSULATION.


STAGE LIGHTING IN MAIN GATHERING HALL


WINDOW SILL PAINT CHIPPING IN GATHERING HALL


SECOND FLOOR SMALL MEETING ROOM ALONG THE WEST SIDE OF THE BUILDING


POOR SEAL AROUND WINDOW ALLOWS THERMAL TRANSFER


BREAK IN SEAM BETWEEN GATHERING HALL BANISTER AND SUPPORT COLUMN INDICATES STRUCTURAL DEFICIENCIES


OPENING IN WALL ALLOWS THERMAL TRANSFER


ELECTRICAL WIRING HANGING
OUT OF WALL


SUPPORT COLUMN PENETRATION WITH NO SEALING


POOR SEAL BETWEEN SUPPORT COLUMN
AND FLOORING

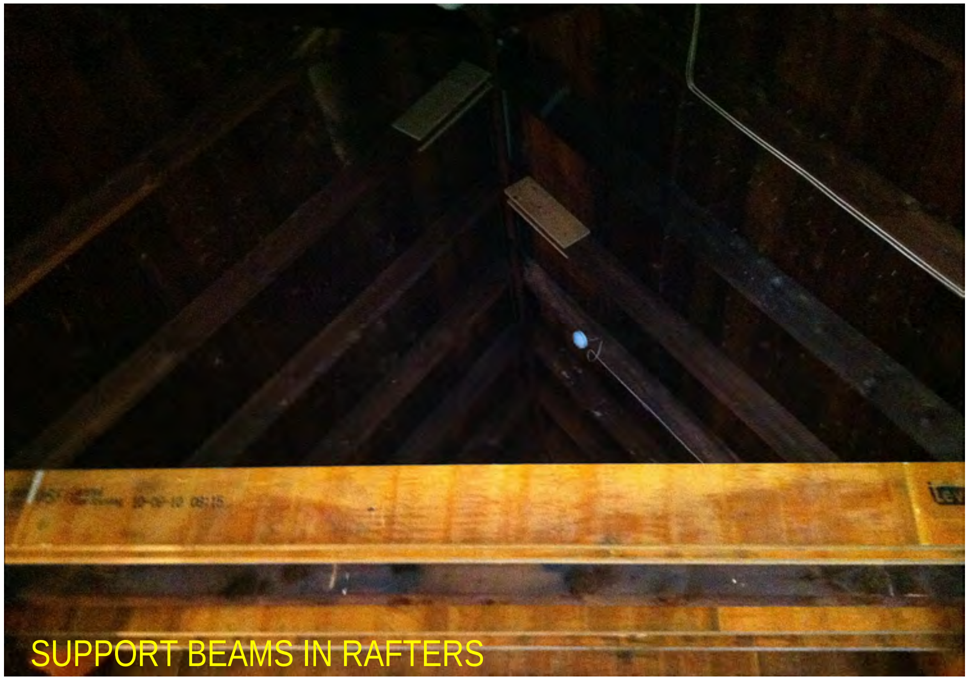

ELECTRICAL WIRING HANGING OUT OF WALL

SUPPORT BRACING IN CLOCK TOWER

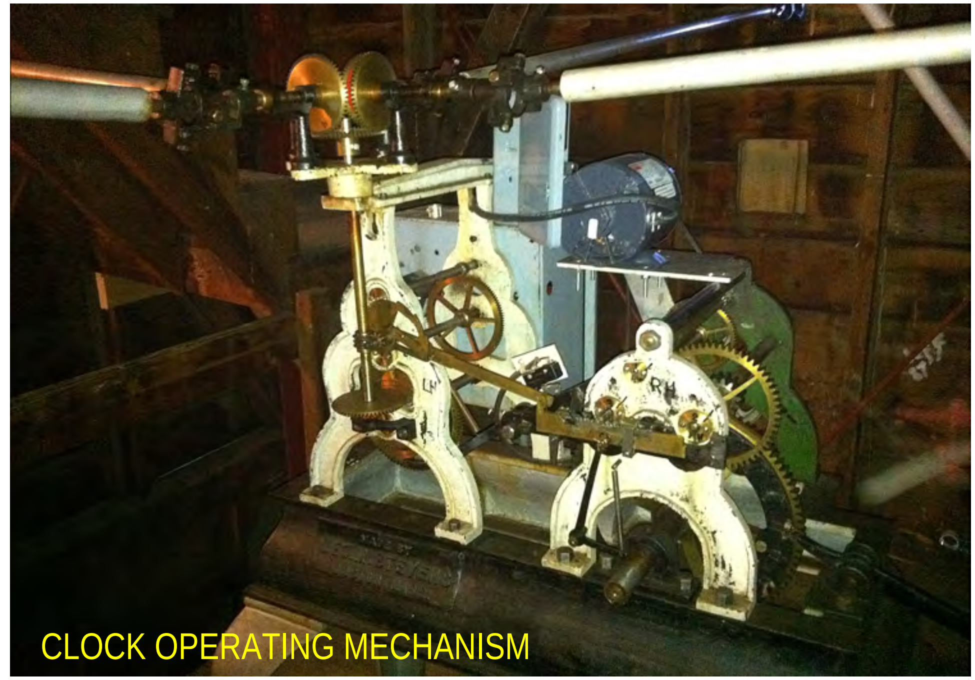
SUPPORT BEAMS IN RAFTERS ABOVE GATHERING HALL

INSIDE CLOCK TOWER

GUSSET PLATE USED TO BRACE SUPPORT BEAMS AT INTERSECTION



SUPPORT BEAMS IN RAFTERS



CLOCK OPERATING MECHANISM

ATTIC / RAFTER SPACE ABOVE GATHERING HALL

INSULATION MISSING IN SPOTS ALLOWING THERMAL TRANFER

BREAKER BOX FOR CLOCK

CLOCK BELL IN TOP OF TOWER (C. 1902)

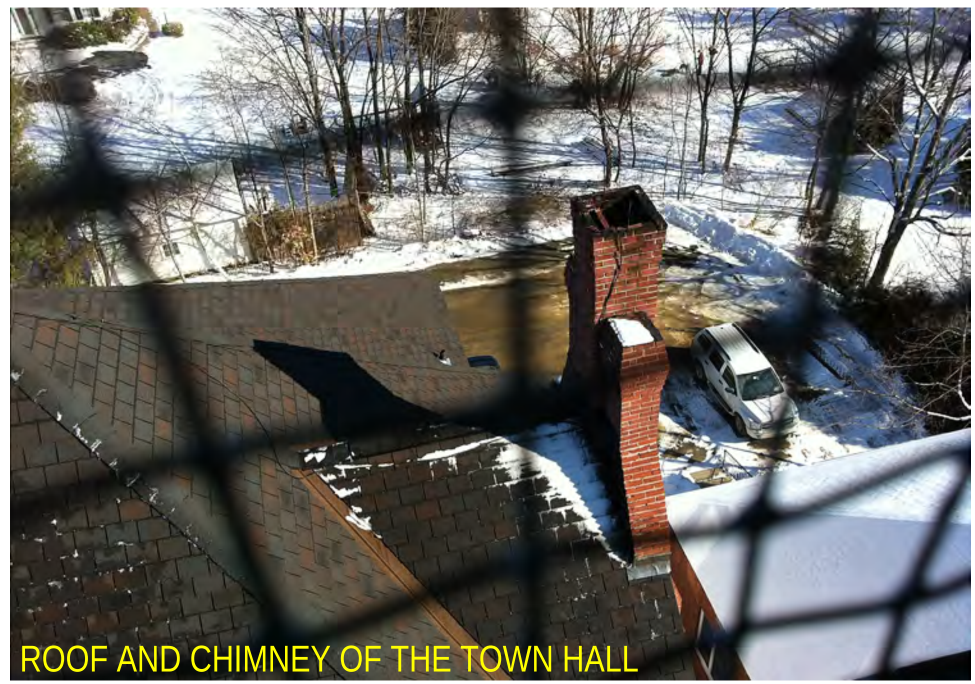
CLOCK MECHANISM MANUFACTURER (C. 1902)


SUPPORT CABLE IN CLOCK TOWER

ROOF OF THE TOWN HALL

BATHROOMS IN THE BASEMENET

CLOCK BELL



ROOF AND CHIMNEY OF THE TOWN HALL

ANTIQUE SAFE IN THE BASEMENT

DETERIORATING ORIGINAL FOUNDATION. RECOMMEND ADDING INSULATION.

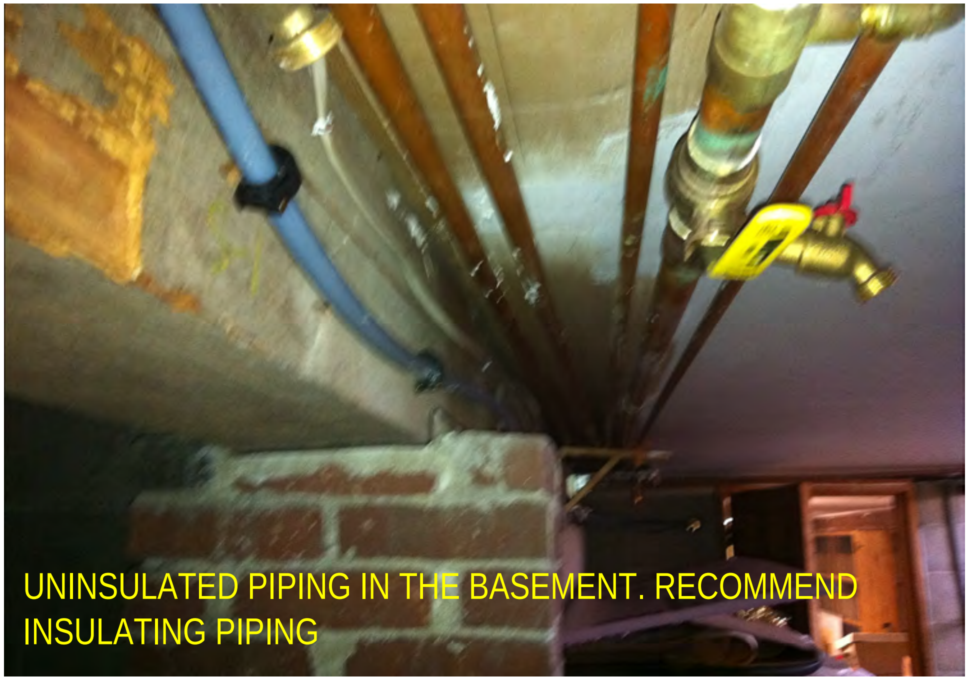
VENT IN THE BASEMENT BATHROOM

BASEMENT CEILING WITH NONCONTINUOUS INSULATION


BASEMENT STORAGE SPACE


ELECTRICAL PANELS IN THE BASEMENT

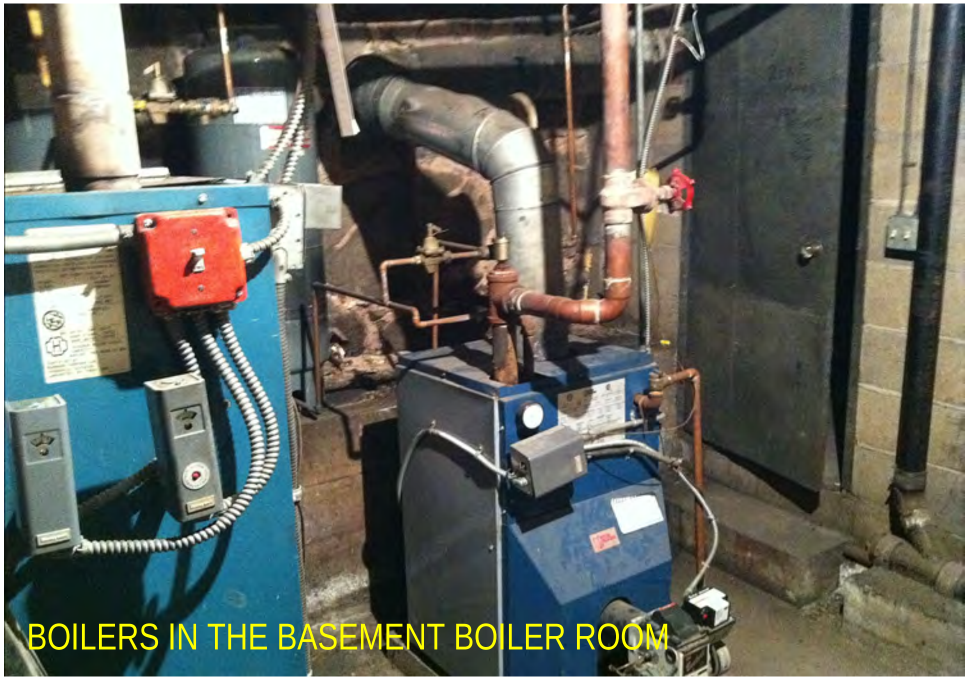

BASEMENT WINDOW


UNINSULATED PIPING IN THE BASEMENT. RECOMMEND INSULATING PIPING


BOILER IN THE BASEMENT BOILER ROOM


BOILER MAKE-UP AIR

OLD GENERATOR IN THE BASEMENT


BOILERS IN THE BASEMENT BOILER ROOM

DOOR LEADING TO SPACE UNDERNEATH BASEMENT STAIRS

WATER LEAKING THROUGH ORIGINAL FOUNDATION.
RECOMMEND SEALING AND INSULATING WALLS.

BASEMENT HALLWAY LEADING TO BOILER ROOM

POOR SEALING IN ORIGINAL FOUNDATION

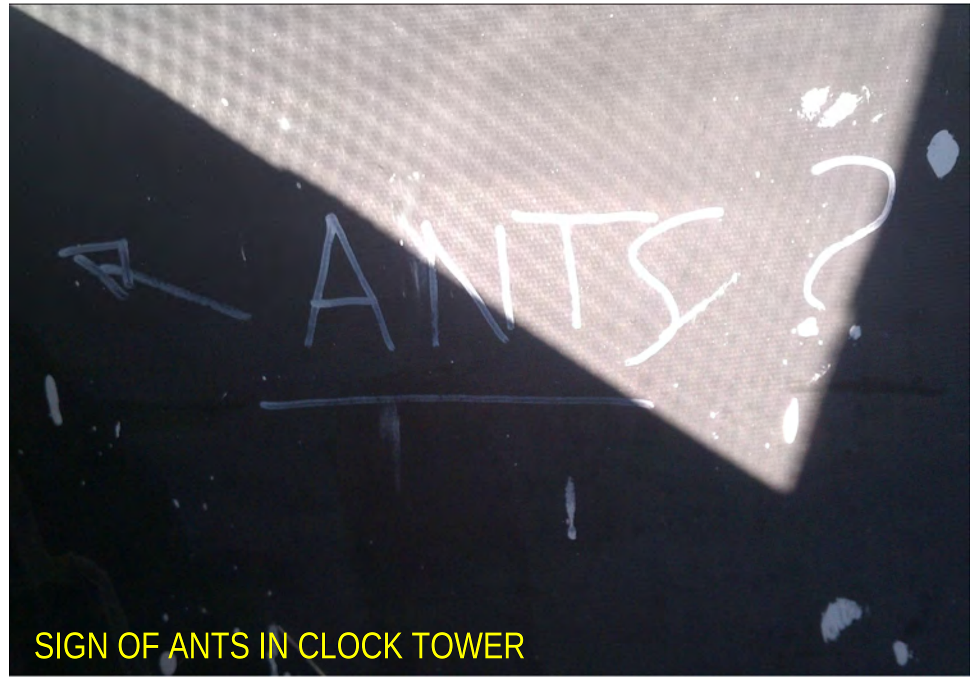

LARGE MEETING ROOM IN NEW ADDITION


LARGE MEETING ROOM IN NEW ADDITION


WINDOW WITHIN NEW
ADDITION TO TOWN HALL

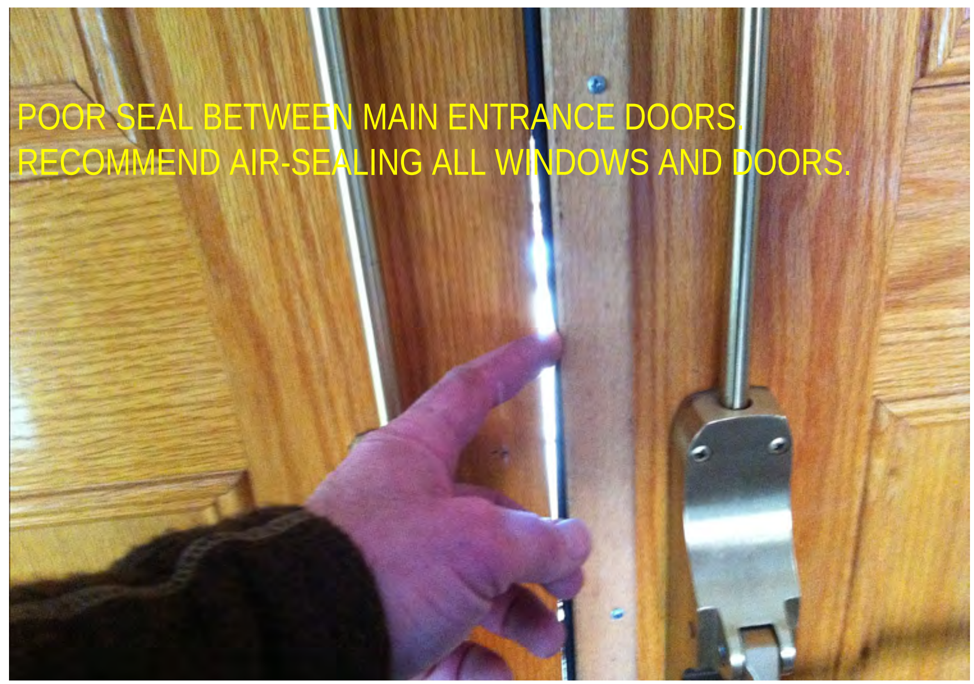

LARGE MEETING ROOM IN NEW ADDITION

MANUAL THERMOSTAT OUTSIDE WOMENS BATHROOM IN NEW



SIGN OF ANTS IN CLOCK TOWER


BATHROOM IN NEW ADDITION


POOR SEAL BETWEEN MAIN ENTRANCE DOORS.
RECOMMEND AIR-SEALING ALL WINDOWS AND DOORS.

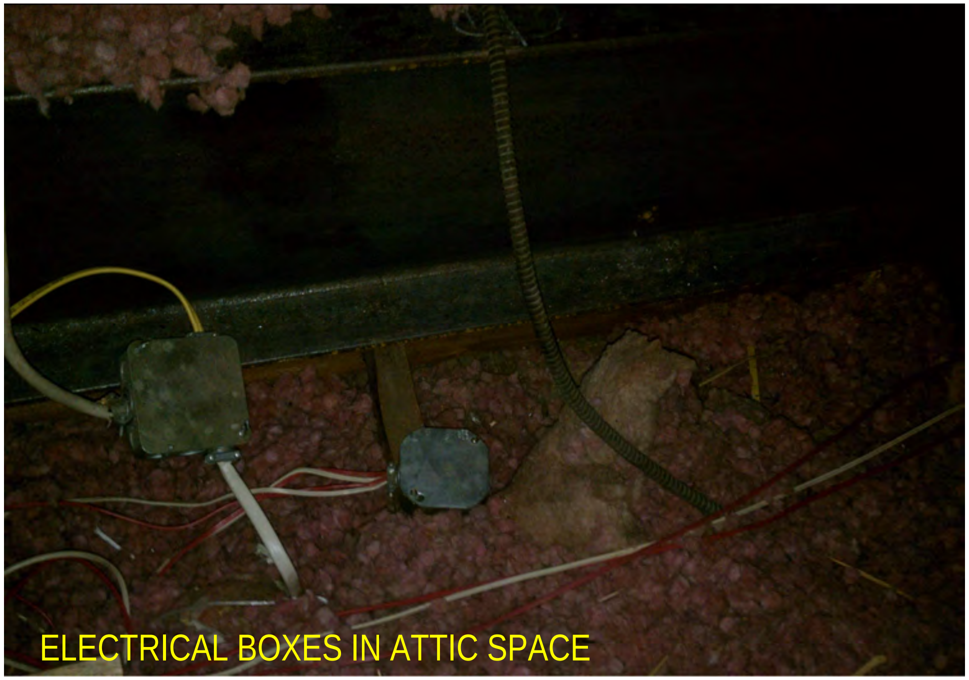
ROOF AND CHIMNEY OF TOWN HALL. RECOMMEND SEALING ALL ABANDONED CHIMNEYS TO REDUCE THERMAL ENERGY LOSS.

CLOCK TOWER ELECTRONIC TIME SWITCH BOX

CLOCK TOWER SPACE

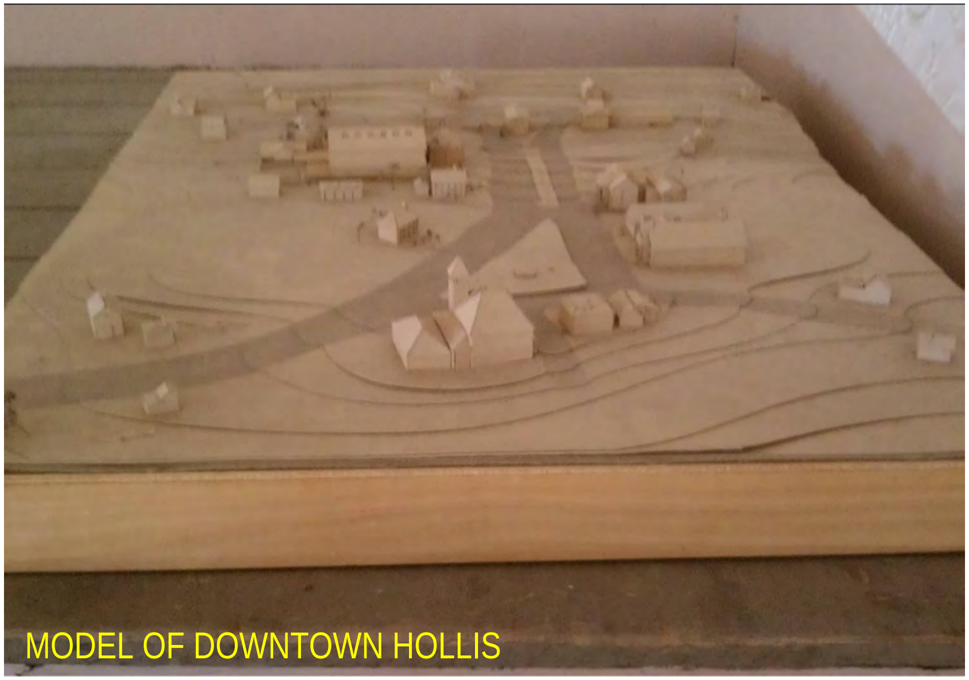
SMOKE DETECTOR IN ATTIC SPACE ABOVE GATHERING HALL

ELECTRICAL OUTLET IN THE CLOCK TOWER WITH NOTE TO USE FOR TEMPORARY ATTIC LIGHTS ONLY.


ELECTRICAL BOXES IN ATTIC SPACE


SMOKE DETECTOR IN CLOCK TOWER


ELECTRICAL BOX IN ATTIC SPACE AND EXPOSED WIRES.



MODEL OF DOWNTOWN HOLLIS

LIGHT FIXTURE ABOVE GATHERING HALL BALCONY

ATTIC SPACE WITH BLOWN INSULATION. RECOMMEND RE-INSULATING SPACE.

SUPPORT BEAM THROUGH GATHERING HALL BALCONY

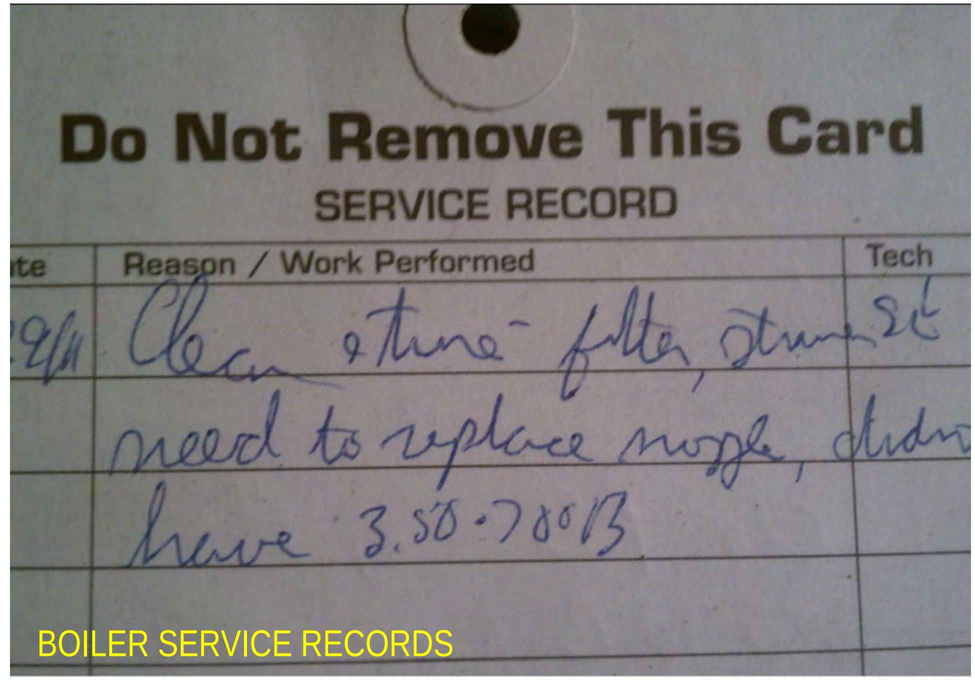
BOILER TAG INFORMATION

BOILER COMBUSTION


BASEMENT SPACE

UTICA BOILER NAME TAG

BOILER TAG INFORMATION

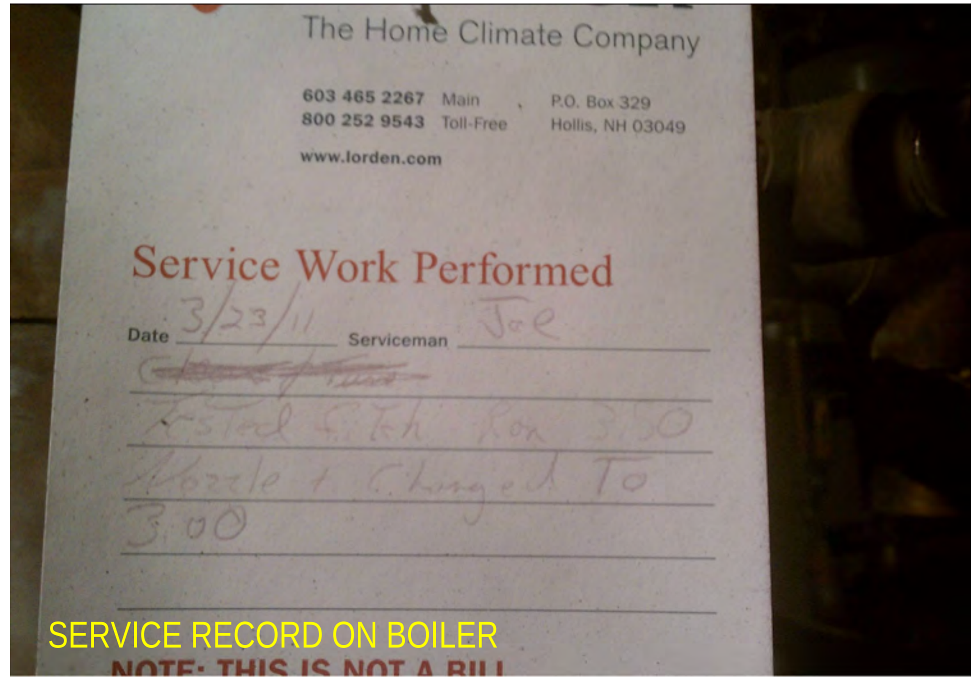


BOILER SERVICE RECORDS

BOILER OIL BURNER

BOILER SERVICE TAG

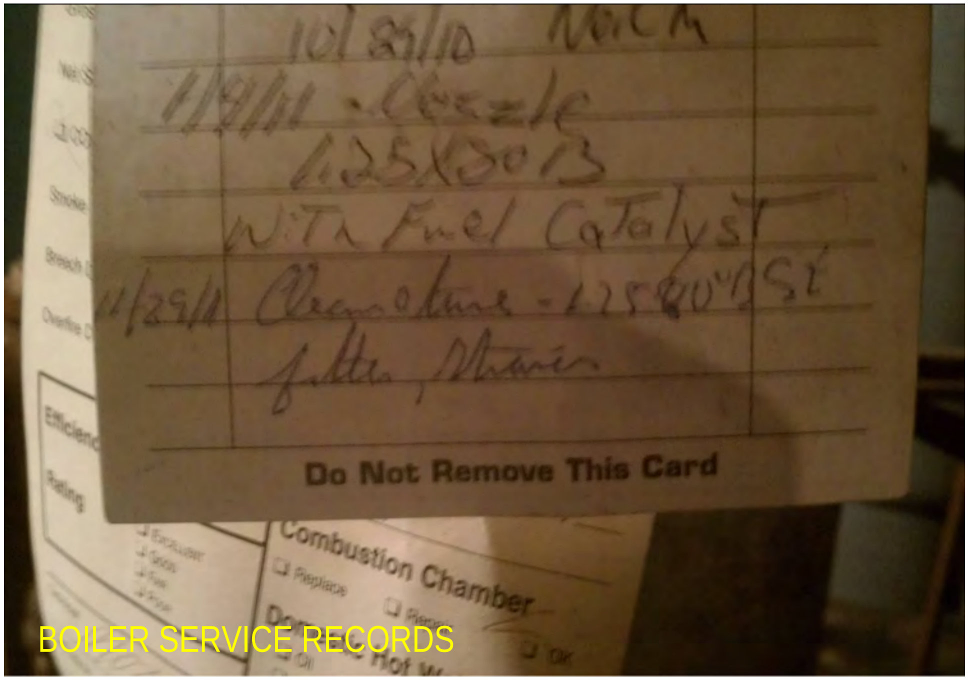
WATER EXPANSION TANK



SERVICE RECORD ON BOILER

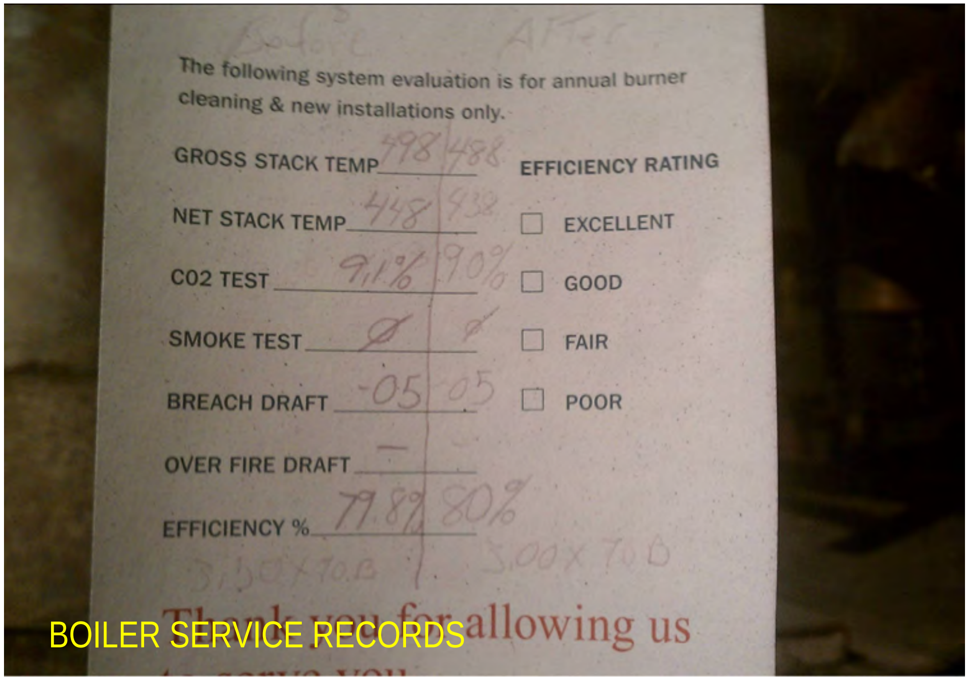
BOILER COMBUSTION


BOILER ROOM PIPES AND EXHAUST

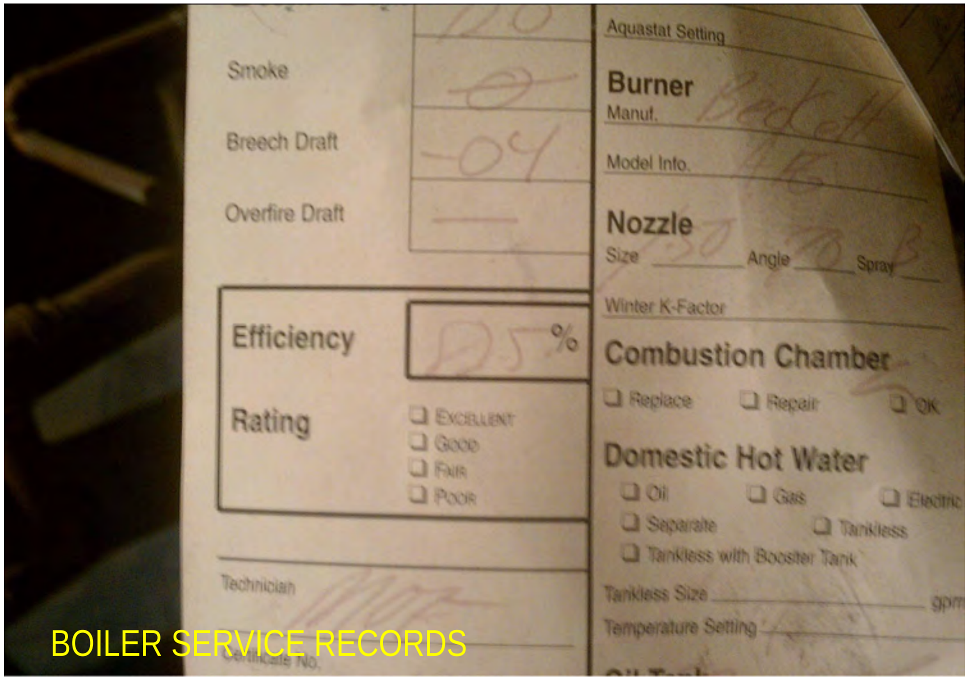


BOILER SERVICE RECORDS


MAKE-UP AIR FAN IN BOILER ROOM



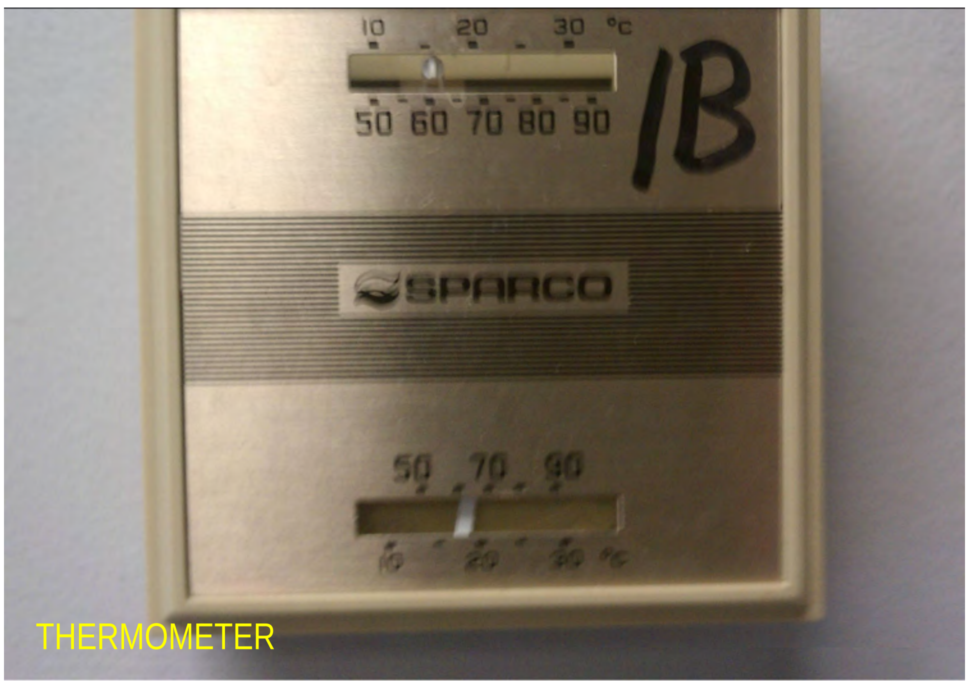
BOILER SERVICE RECORDS



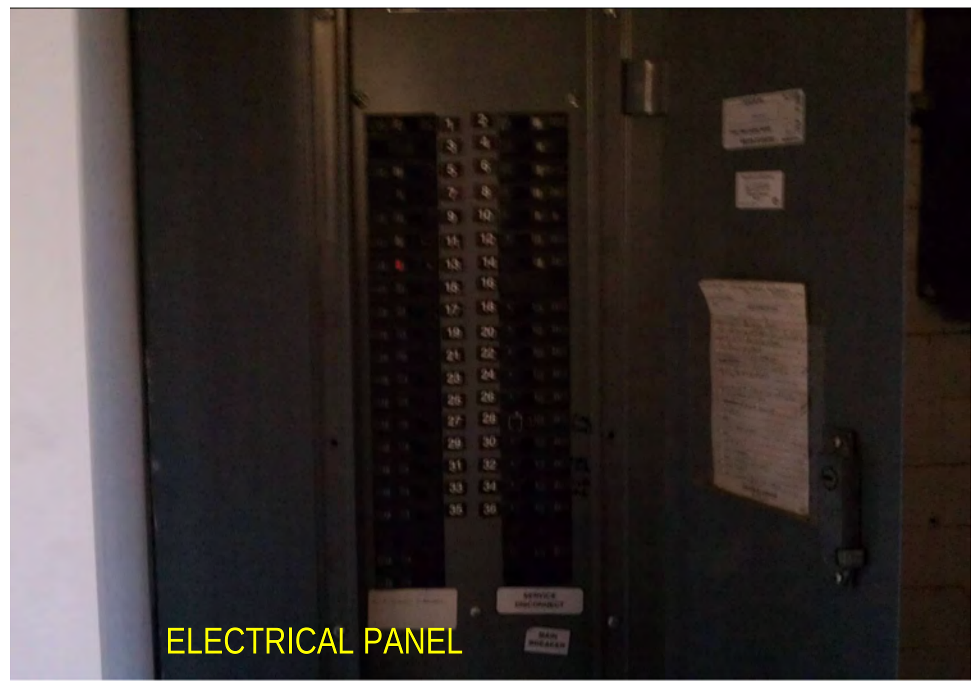
BOILER SERVICE RECORDS

PANEL IN BASEMENT

NORTH SIDE OF THE BUILDING



THERMOMETER



ELECTRICAL PANEL


NORTH SIDE OF THE BUILDING


NORTH SIDE WINDOWS

MAIN ENTRANCE ALONG THE NORTH SIDE OF THE BULIDING


WHEELCHAIR RAMP ALONG THE NORTH SIDE

NORTH SIDE OF THE BUILDING

CLOCK BELL

NORTH SIDE OF THE BUILDING

NORTH SIDE OF THE BUILDING


BELL TOWER PENETRATION


BELL TOWER ROOF ACCESS


CLOCK BELL TOWER


FIRE EXTINGUISHER IN BELL TOWER


METAL BRANCE INADEQUATELY SECURED


CLOCK MECHANISM


BELL TOWER SPACE


INADEQUATELY BRACED PIPE

POSSIBLE SIGN OF ANTS IN CLOCK TOWER

CLOCK TOWER WALL AND BRACE LEADING TO CLOCK

KNOB AND TUB WIRING IN CLOCK TOWER

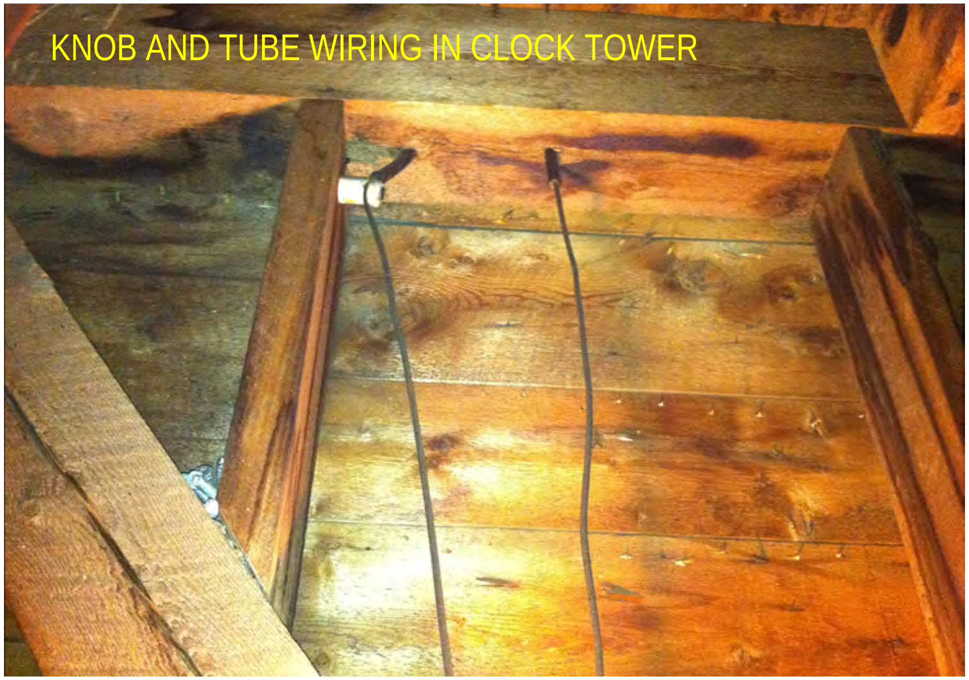
KNOB AND TUBE WIRING IN CLOCK TOWER


CLOCK TOWER STAIRS AND BRACING


CLOCK TOWER BRACING


GUSSET PLATE IN CLOCK TOWER


STEEL BEAM SUPPORT IN CLOCK TOWER



KNOB AND TUBE WIRING IN CLOCK TOWER

GUSSET PLATE IN CLOCK TOWER

SUPPORTS IN CLOCK TOWER

KNOB AND TUBE WIRING IN CLOCK TOWER


CLOCK TOWER SPACE


ATTIC SPACE ABOVE GATHERING HALL


METAL BRACING IN CLOCK TOWER


ATTIC SPACE ABOVE GATHERING HALL

CLOCK TOWER BRACING

ATTIC SPACE ABOVE GATHERING HALL

GUSSET PLATE IN CLOCK TOWER

KNOB AND TUBE WIRING IN CLOCK TOWER


WINDOW IN ATTIC SPACE


ROOF ABOVE ATTIC SPACE


EXPOSED WIRING THROUGH ATTIC INSULATION


DETERIORATING BRICK WALL IN ATTIC SPACE


RAFTERS IN ATTIC SPACE


SUPPORT BEAMS IN ATTIC SPACE


ATTIC SPACE


SUPPORT BEAM IN ATTIC SPACE


REINFORCED SUPPORT BEAM AND EXPOSED WIRING IN ATTIC


ATTIC SPACE


BLOWN IN INSULATION IN ATTIC SPACE


ATTIC SPACE

CEILING OF MAIN GATHERING HALL

LIGHT FIXTURE AND MAIN GATHERING HALL

CRAWL SPACE IN ATTIC SPACE

MAIN GATHERING HALL


PENETRATION THROUGH BALCONY IN GATHERING HALL


GATHERING HALL SPACE


PENETRATION THROUGH CEILING IN GATHERING HALL


BALCONY IN GATHERING HALL


WINDOW IN SECOND FLOOR MEETING ROOM


West meeting room windows


POOR SEAL AROUND SUPPORT COLUMN ALLOWS THERMAL TRANSFER


View into west wall

North second floor windows

Second floor panel

Stage

Suspended seating area


PLASTIC WRAP ON WINDOWS FOR WINTER INSULATION

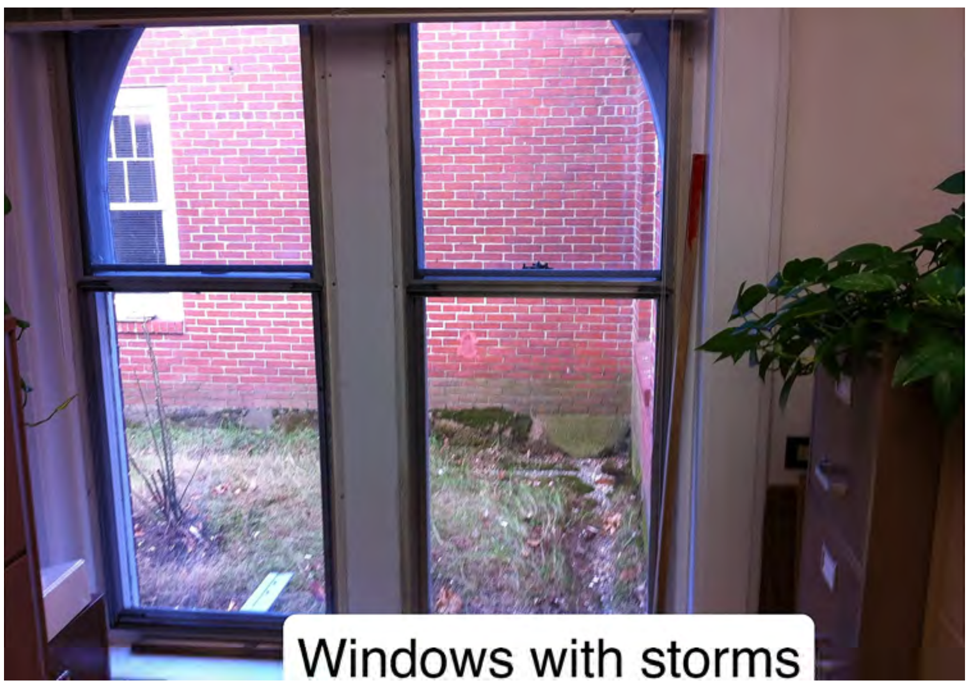

Steam radiator by stairs


Draft prevention


West exterior wall

Draft Prevention

Steam radiator in rear lobby



Windows with storms

Water cooler

Safe

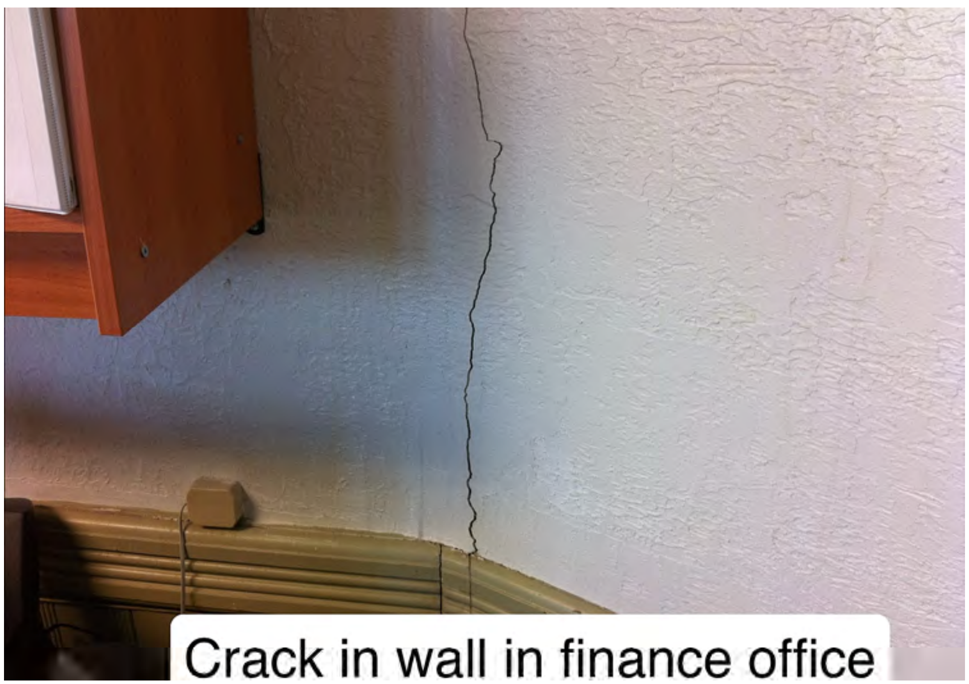

FINANCIAL OFFICE SPACE


Plastic wrap over window


Blocked off chimney in finance office

GATHERING HALL SPACE

STAIRCASE TO GATHERING HALL WITH BLANKET FOR DRAFT PREVENTION



Crack in wall in finance office

WINDOW IN GATHERING HALL


RADIATOR IN THE HALLWAY


ENTRY DOORS WITH POOR SEAL


HOLE IN THE WALL IN STAIRCASE


HALLWAY RADIATOR


FIRST FLOOR MAIN HALLWAY

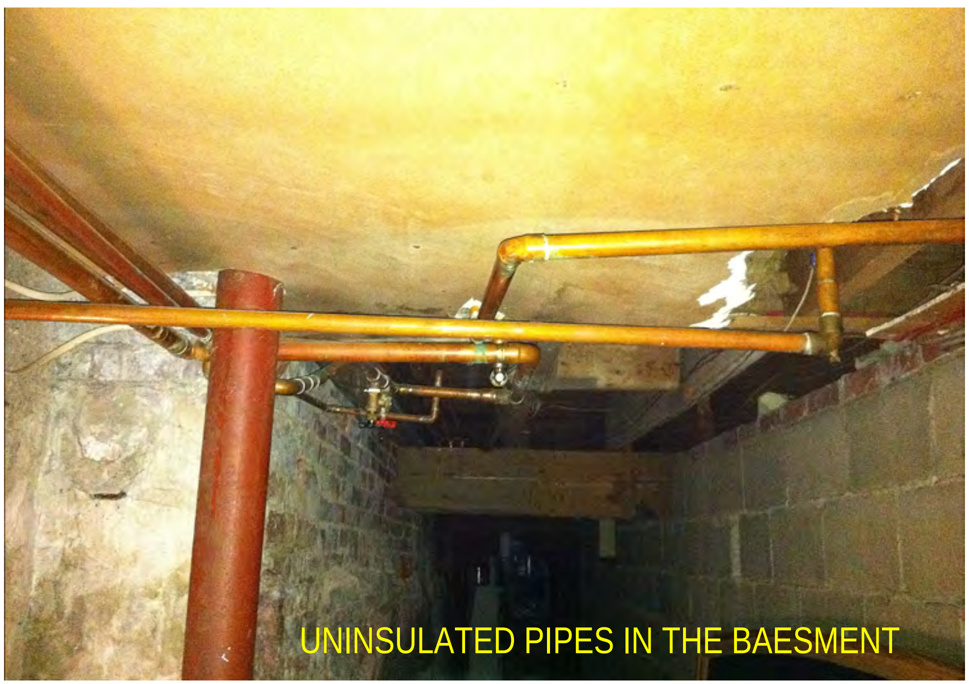

OFFICE DESK WITH RUNNING COMPUTERS


ASSESSING'S OFFICE SPACE


OFFICE COPIER IN BUILDING INSPECTION OFFICE

HOLE IN BASEMENT WALL ALLOWS THERMAL TRANSFER. RECOMMEND SEALING ALL WALLS IN BASEMENT TO RETAIN THERMAL ENERGY

VARIOUS WIRING RUNNING THROUGH THE BASEMENT



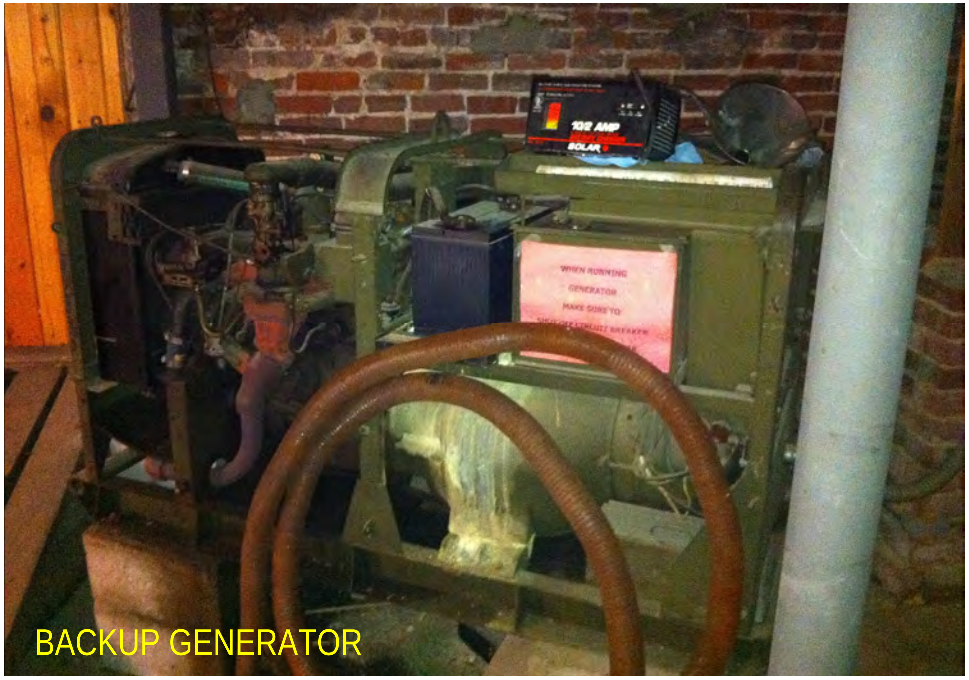
UNINSULATED PIPES IN THE BAESMENT

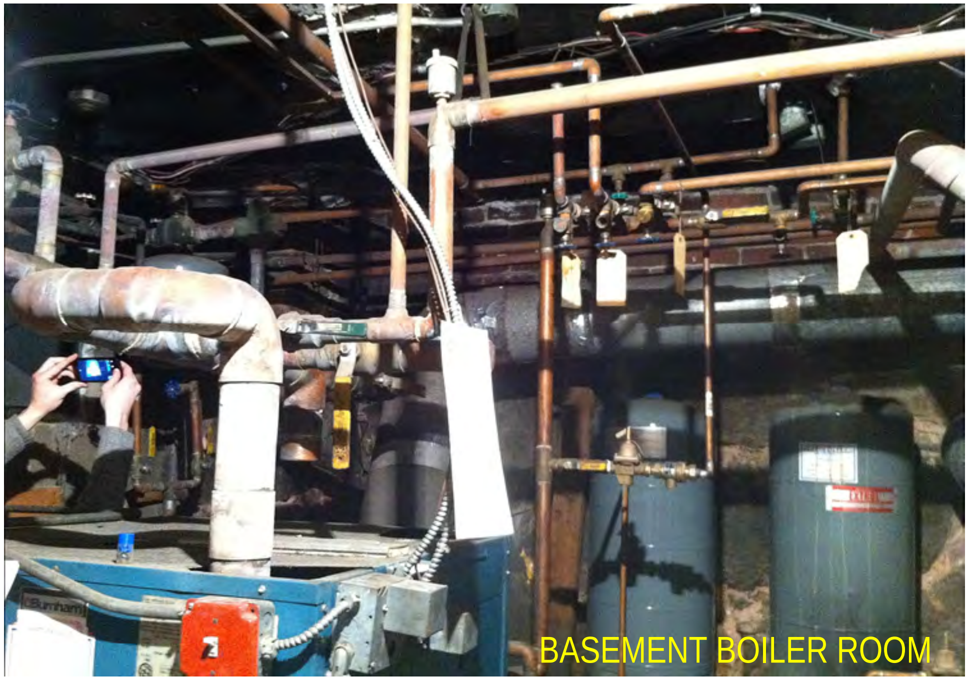
BASEMENT SPACE

OIL TANKS FOR BOILERS

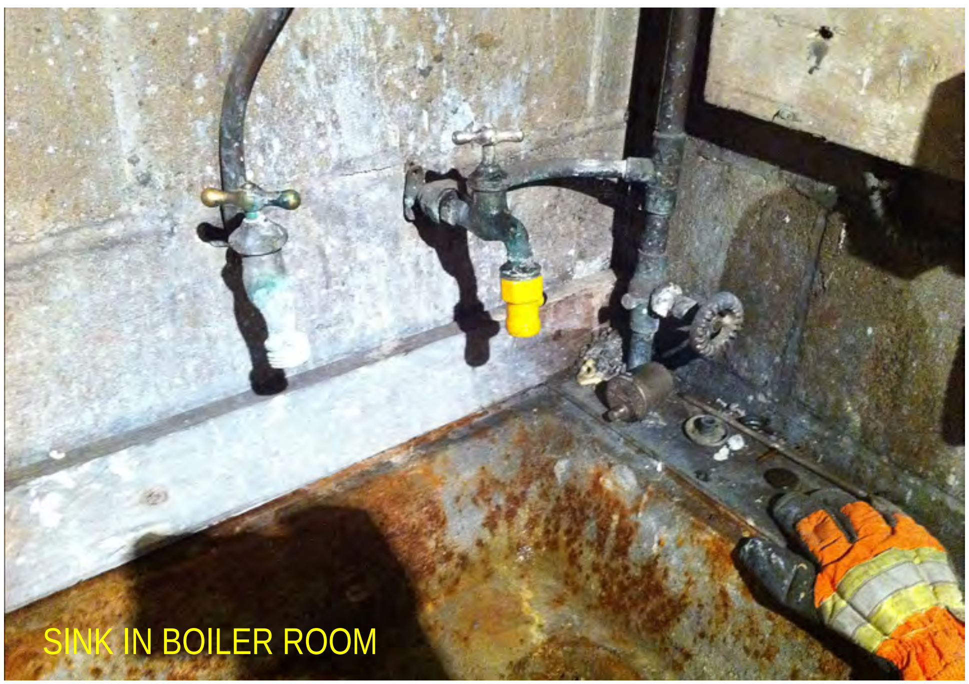

BASEMENT EXIT TO REAR PARKING LOT


HOT WATER HEATER PUMP


BACKUP GENERATOR


BASEMENT BOILER ROOM

UNINSULATED HOT WATER PIPES IN BASEMENT


SINK IN BOILER ROOM


BUNGEE STRAP HOLDING UP PIPE IN BASEMENT

OLD SAFE IN BASEMENT


PIPES RUNNING THROUGH BASEMENT


EXPOSED WIRING IN BASEMENT


ORIGINAL FOUNDATION DETERIORATING

MEETING ROOM IN NEW ADDITION

MEETING ROOM IN NEW ADDITION

PIPES AND WIRES THROUGH THE BASEMENT

MEETING ROOM IN NEW ADDITION


NEW ADDITION MEETING ROOM EXIT TO PARKING LOT


NORTH SIDE OF THE BUILDING


HEATER IN THE WALL NEXT TO BATHROOM


NORTH SIDE OF THE BUILDING

REAR ENTRANCE TO BUILDING


LOOSE BRICK IN BUILDING EXTERIOR ALLOWS THERMAL TRANSFER


NORTHWEST CORNER OF THE BUILDING


NORTH SIDE OF THE BUILDING

WEST (ROAD) SIDE OF THE BUILDING

WEST (ROAD) SIDE OF THE BUILDING

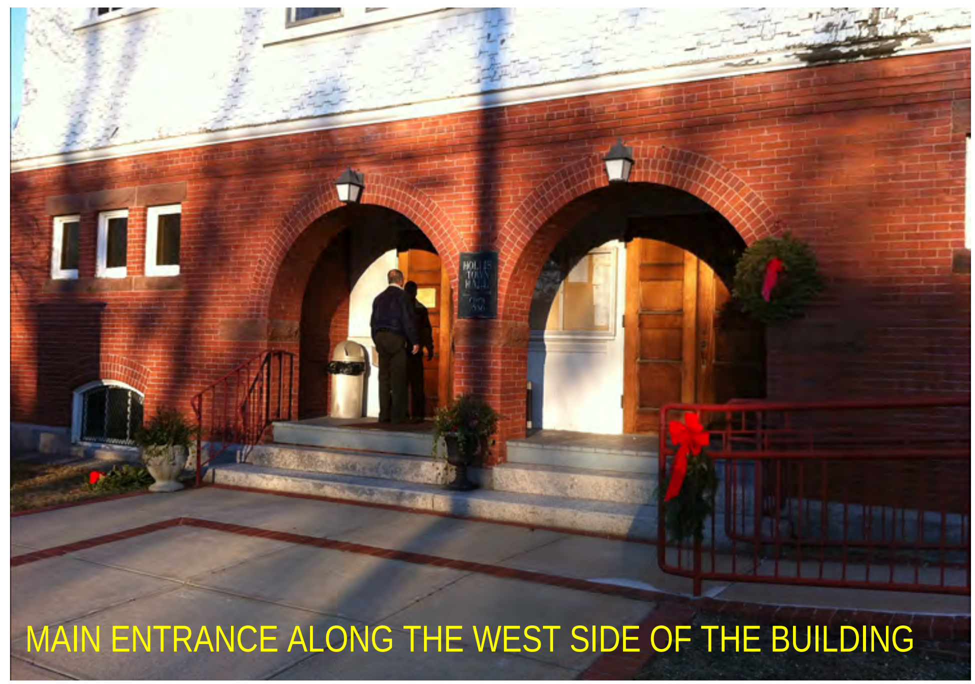
EXTERIOR WINDOW FRAME

WEST (ROAD) SIDE OF THE BUILDING


CLOCK TOWER


WEST SIDE OF THE BUILDING LOOKING SOUTH


MAIN ENTRANCE ALONG THE WEST SIDE OF THE BUILDING


MAIN ENTRANCE ALONG THE WEST SIDE OF THE BUILDING


CRACK IN THE CONCRETE FOUNDATION


PORTION OF PARKING LOT ABUTTING EAST SIDE OF BUILDING


SOUTH SIDE OF THE BUILDING


SOUTHEAST CORNER OF THE BUILDING


REAR ENTRANCE TO THE BUILDING


NORTH SIDE OF THE BUILDING


ENTRANCE TO THE NEW ADDITION OF THE BUILDING

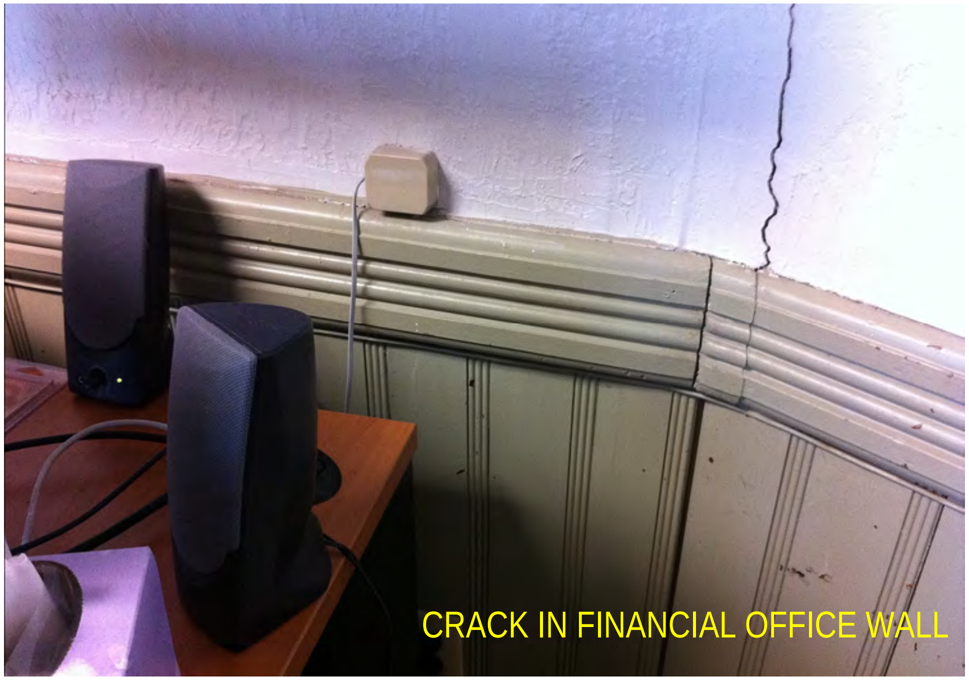

NORTHEAST CORNER OF THE BUILDING


BASEBOARD RADIATOR IN THE KITCHEN


SMALL HEATER IN THE STAFF BATHROOM

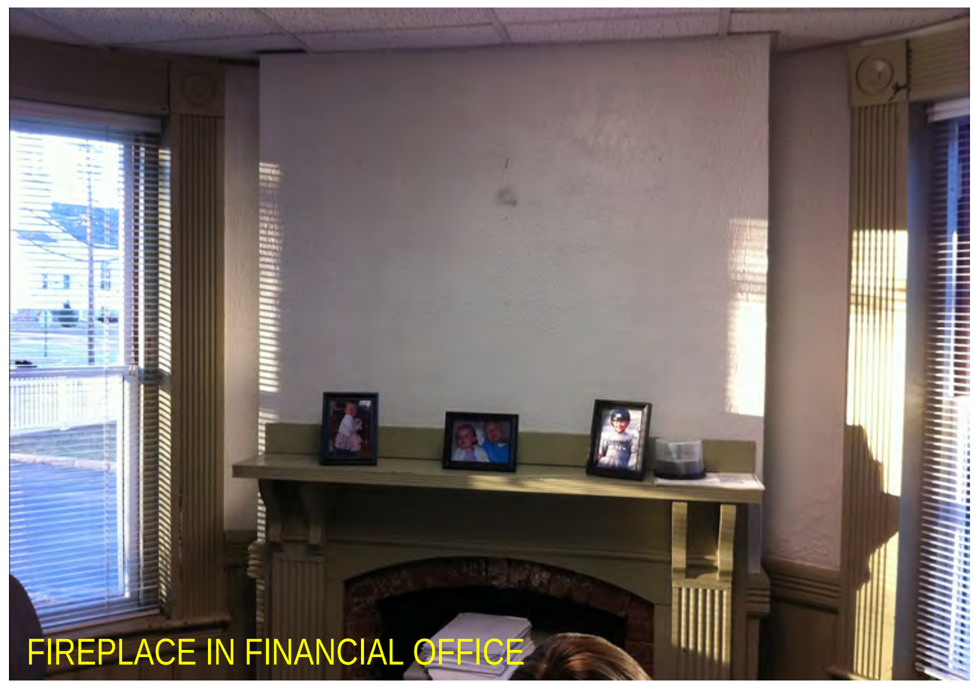

NORTH SIDE OF THE BUILDING

TEL/DATA EQUIPMENT IN THE KITCHEN


CRACK IN FINANCIAL OFFICE WALL

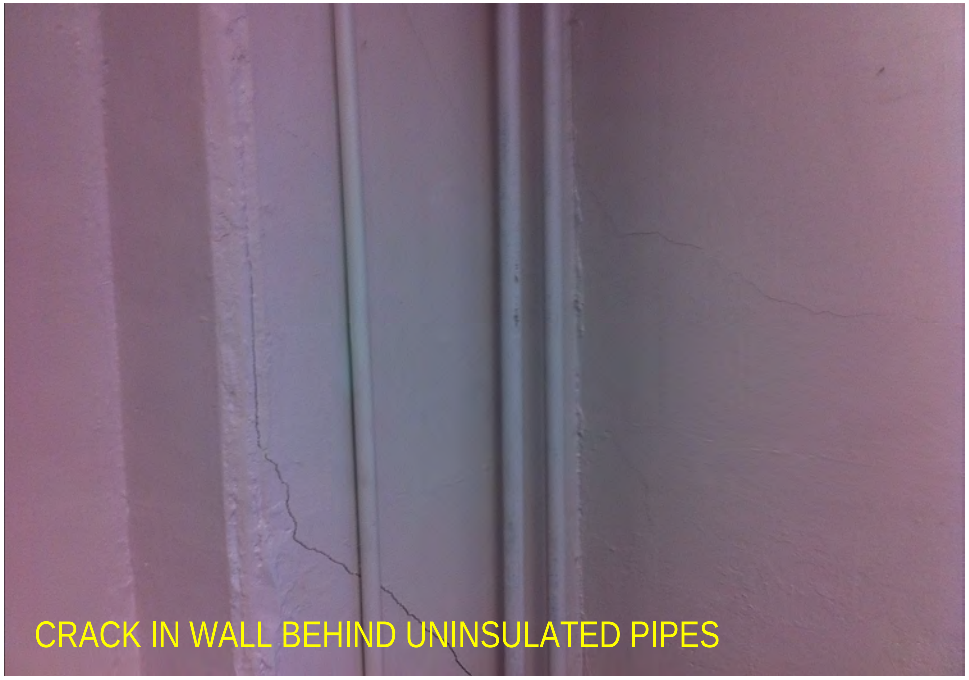

OLD CRT MONITOR CONSUMES MORE POWER THAN LCD


SMALL BASBOARD HEATER IN FINANCIAL OFFICE


FIREPLACE IN FINANCIAL OFFICE

CORNER OF OFFICE

ELECTRICAL WIRES HANGING OUT OF CEILING



CRACK IN WALL BEHIND UNINSULATED PIPES

LIGHT FIXTURE IN THE GATHERING HALL

INCANDESCENT LIGHT IN THE STAIRWELL

ELECTRICAL WIRING FOR CLOCK

ELECTRICAL WIRE HANGING OUT OF THE WALL

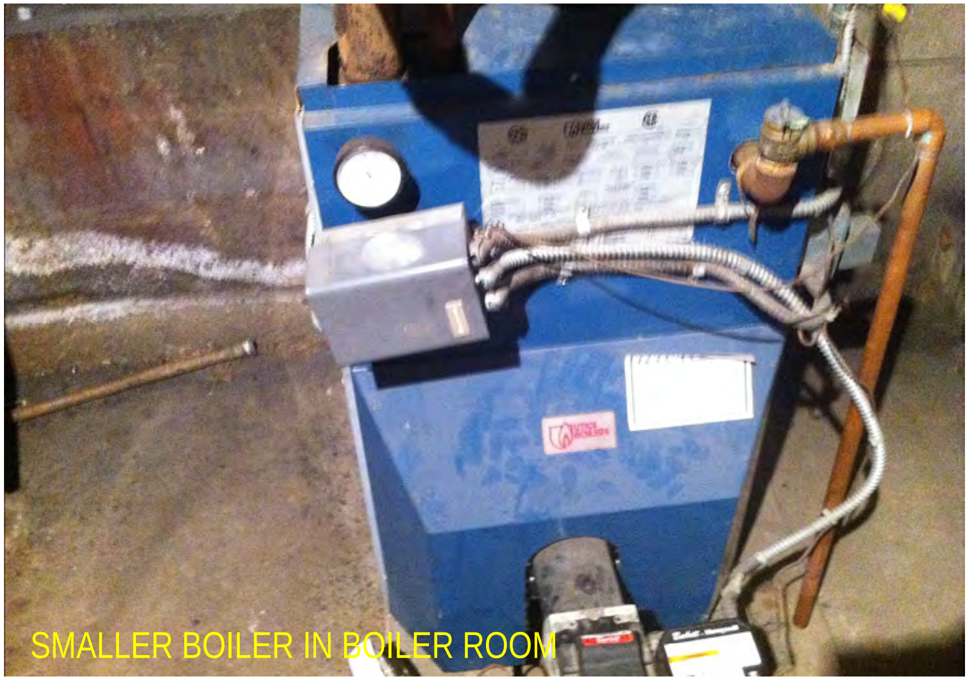
INCANDESCENT LIGHT IN THE CLOCK TOWER

EXHAUST PIPE RUNNING OUT FROM BASEMENT

BACKUP GENERATOR INFORMATION

BOX WITHOUT A COVER

HOLE IN WALL NOT FULLY FILLED ALLOWING THERMAL TRANSFER


SMALLER BOILER IN BOILER ROOM


HOT WATER TANK WITH UNINSULATED PIPES

BOILER INSPECTION CERTIFICATES FOR BOTH BOILERS


SPLICED WIRING

WATER STORAGE TANK

OLD INSULATED PIPES

HOT WATER TANK

BUNGEE STRAP USED TO HOLD UP PIPE IN BASEMENT


WIRING RUNNING THROUGH CEILING SPACE


DIGITAL THERMOSTAT


EXPOSED WIRING AND FALLING INSULATION


CEILING SPACE


CRAWL SPACE UNDERNEATH ADDITION FLOOR


WELCOME
TO
HOLLIS
TOWN 1746 CHARTER
HOLLIS TOWN SIGN AT TOWN HALL


HOT WATER HEATER IN CRAWL SPACE UNDERNEATH ADDITION FLOOR


CRAWL SPACE UNDERNEATH ADDITION FLOOR WITH HANGING WIRE AND OLD PAVEMENT.

HOLLIS TOWN HALL PLAQUE

APPENDIX B

Thermal Imaging Survey Reports

Inspection Report

Report Date	5/23/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Town Hall
Address	90 Main Street, Newmarket, NH 03857	Site Address	7 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

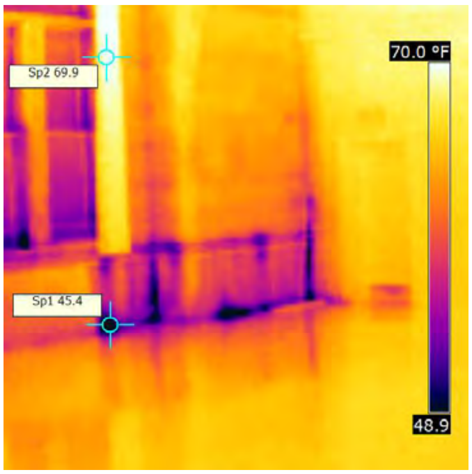


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/29/2011 3:14:20 PM
Image Name	IR_1984.jpg
Emissivity	0.96
Reflected apparent temperature	44.0 °F
Object Distance	15.0 ft

Text Comments

Description

North wall of assembly room. Note thermal bridging and areas with no insulation and difference in temeratures. Recommend insulating walls. Refer to EEM T3-2 for associated cost and savings.

Inspection Report

Report Date	5/23/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Town Hall
Address	90 Main Street, Newmarket, NH 03857	Site Address	7 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

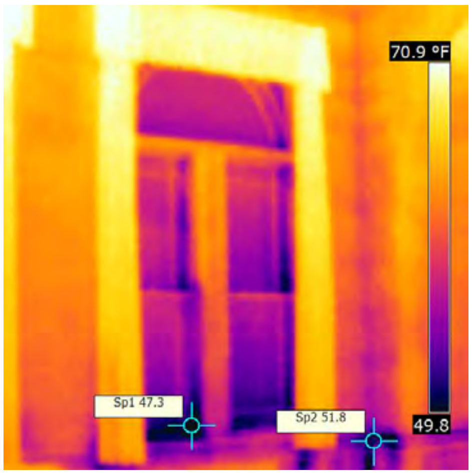


Image and Object Parameters

Text Comments

Camera Model	B-CAM Western S
Image Date	12/29/2011 3:14:55 PM
Image Name	IR_1985.jpg
Emissivity	0.96
Reflected apparent temperature	47.0 °F
Object Distance	15.0 ft

Description

North window of assembly room. Note thermal bridging through walls in areas with no insulation, as well as thermal bridging between the window and frame. Recommend air-sealing windows and insulating wall. Refer to EEMs T1-5 and T3-2 for cost and savings.

Inspection Report

Report Date	5/23/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Town Hall
Address	90 Main Street, Newmarket, NH 03857	Site Address	7 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

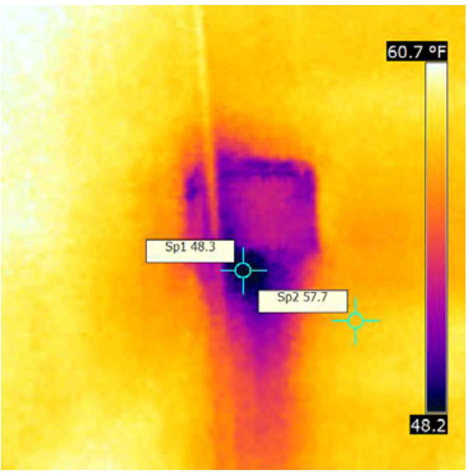


Image and Object Parameters

Text Comments

Camera Model	B-CAM Western S
Image Date	12/29/2011 3:29:04 PM
Image Name	IR_1987.jpg
Emissivity	0.96
Reflected apparent temperature	48.0 °F
Object Distance	10.0 ft

Description

Hole in tin wall covering. Note lack of insulation in walls provide air leakage resulting in loss of thermal energy. Recommend insulating walls. Refer to EEM T3-2 for associated cost and savings.

Inspection Report

Report Date	5/23/2012		
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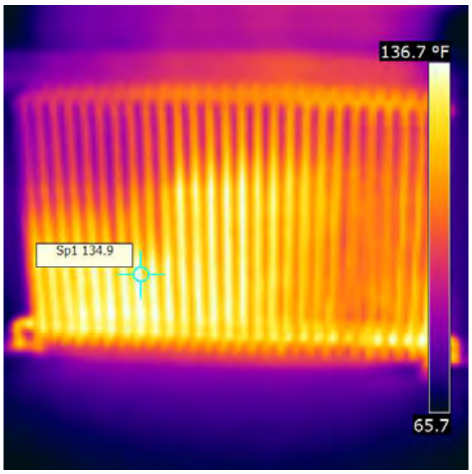
Address	90 Main Street, Newmarket, NH 03857	Site Address	7 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	



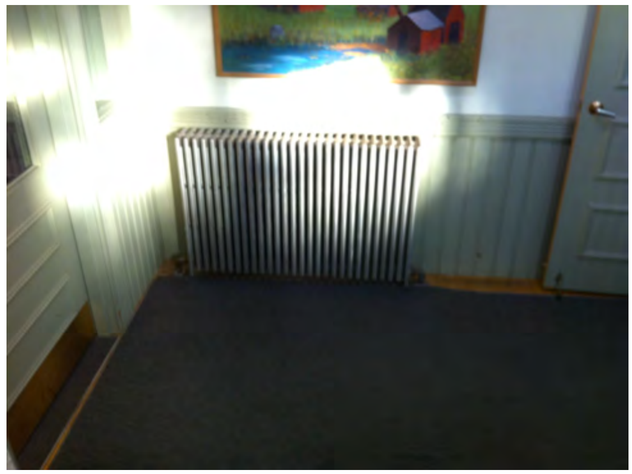


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/29/2011 3:29:37 PM
Image Name	IR_1988.jpg
Emissivity	0.96
Reflected apparent temperature	137.0 °F
Object Distance	5.0 ft

Text Comments

Description

Cast iron steam radiator in lobby reveals how heat is dispersed through unit. Unit would be removed if air-sourced heat pump were to be installed. Refer to EEM T3-10 for associated cost and savings.

Inspection Report

Report Date	5/23/2012		
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Address	90 Main Street, Newmarket, NH 03857	Site Address	7 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

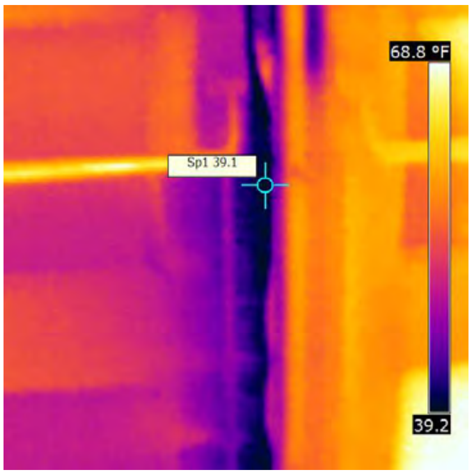

Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/29/2011 3:30:40 PM
Image Name	IR_1990.jpg
Emissivity	0.96
Reflected apparent temperature	38.0 °F
Object Distance	4.0 ft

Text Comments

Description

Poor weather stripping on main south entrance doors allow for considerable air infiltration resulting in drafts and loss of energy. Recommend air-sealing all doors and windows. Refer to EEM T1-5 for associated cost and savings.

Inspection Report

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Address	90 Main Street, Newmarket, NH 03857	Site Address	7 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

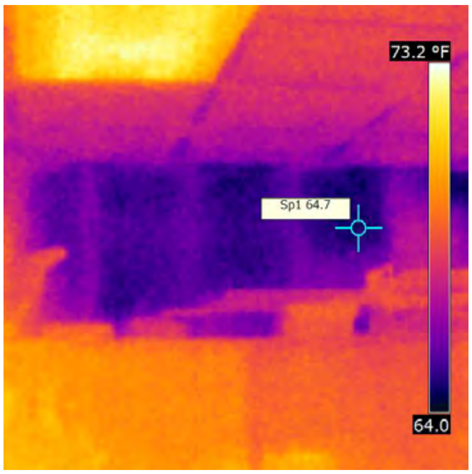


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/29/2011 3:31:33 PM
Image Name	IR_1991.jpg
Emissivity	0.96
Reflected apparent temperature	65.0 °F
Object Distance	10.0 ft

Text Comments

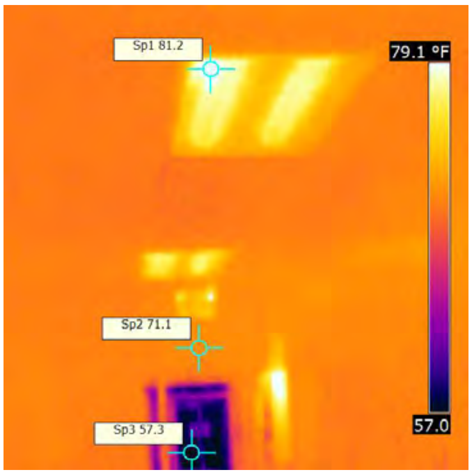
Description

IR of the inside of an assessing office exterior wall reveals lack of insulation in walls between stud bays resulting in lost themal energy. Recommend insulating walls. Refer to EEM T3-4 for cost and savings.

Inspection Report

Report Date	5/23/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Town Hall
Address	90 Main Street, Newmarket, NH 03857	Site Address	7 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	



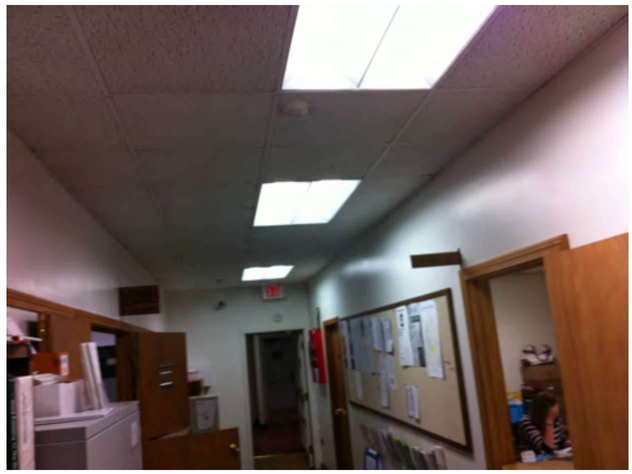


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/29/2011 3:33:22 PM
Image Name	IR_1992.jpg
Emissivity	0.96
Reflected apparent temperature	57.0 °F
Object Distance	25.0 ft

Text Comments

Description

Lighting fixtures in main corridor produce thermal energy. Rear door has lower thermal properties than walls and ceiling of hallway which is expected.

Inspection Report

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Thermographer	Hans Kuebler	Contact Person	

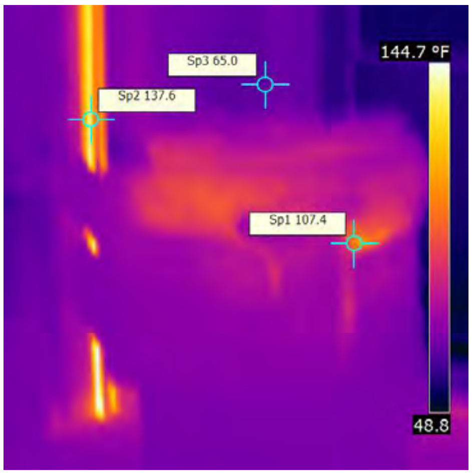


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/29/2011 3:35:03 PM
Image Name	IR_1993.jpg
Emissivity	0.96
Reflected apparent temperature	140.0 °F
Object Distance	10.0 ft

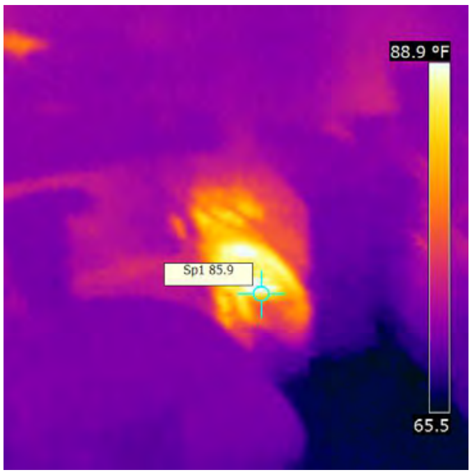
Text Comments

Description

IR of powered copy machine (Sp1) reveals thermal energy produced. Hot water pipes (rear vertical lines, Sp2) are uninsulated resulting in thermal transfer. Recommend time clock on copier (EEM T1-3) and insulating pipes (T2-3).

Inspection Report

Report Date	5/23/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Town Hall
Address	90 Main Street, Newmarket, NH 03857	Site Address	7 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	



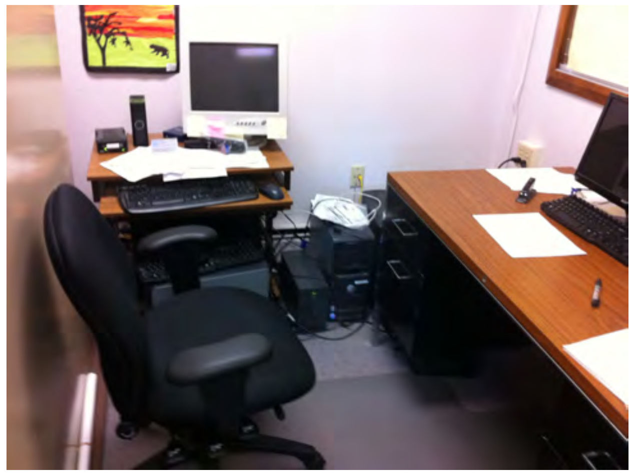


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/29/2011 3:35:21 PM
Image Name	IR_1994.jpg
Emissivity	0.96
Reflected apparent temperature	87.0 °F
Object Distance	5.0 ft

Text Comments

Description

IR of running office equipment reveals thermal energy produced resulting in increased energy consumption and added heat load to building. Recommend powering down all office equipment when unoccupied.

Inspection Report

Report Date	5/23/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Town Hall
Address	90 Main Street, Newmarket, NH 03857	Site Address	7 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

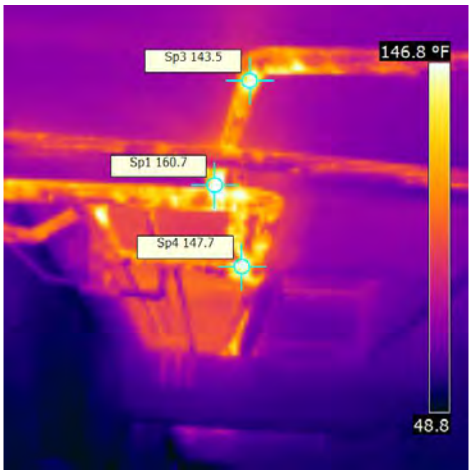


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/29/2011 3:39:25 PM
Image Name	IR_1995.jpg
Emissivity	0.96
Reflected apparent temperature	164.0 °F
Object Distance	6.0 ft

Text Comments

Description

Uninsulated piping in the basement contributes to thermal losses. Recommend insulating all hot water piping to limit thermal losses and providing proper heating source to efficiently heat basement. Refer to EEM T2-3 for cost and savings of pipe insulation

Inspection Report

Report Date	5/23/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Town Hall
Address	90 Main Street, Newmarket, NH 03857	Site Address	7 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/29/2011 3:44:52 PM
Image Name	IR_1996.jpg
Emissivity	0.96
Reflected apparent temperature	92.0 °F
Object Distance	10.0 ft

Text Comments

Description

Uninsulated piping in the basement contributes to thermal losses. Recommend insulating all hot water piping to limit thermal losses and providing proper heating source to efficiently heat basement. Refer to EEM T2-3 for cost and savings of pipe insulation

Inspection Report

Report Date	5/23/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Town Hall
Address	90 Main Street, Newmarket, NH 03857	Site Address	7 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

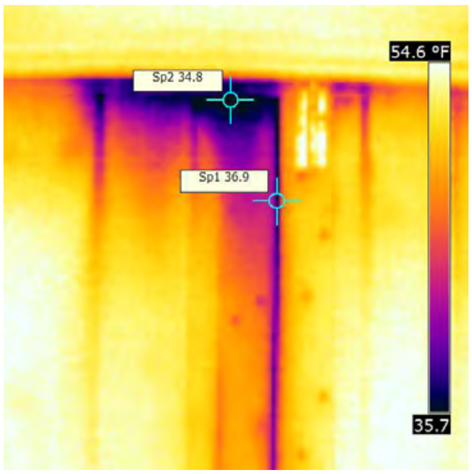


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/29/2011 3:46:18 PM
Image Name	IR_1997.jpg
Emissivity	0.96
Reflected apparent temperature	33.0 °F
Object Distance	5.0 ft

Text Comments

Description

Door in the basement allows for significant air infiltration allowing energy to be lost. Recommend air-sealing door (EEM T1-5) or replacing door with insulated unit.

Inspection Report

Report Date	5/23/2012		
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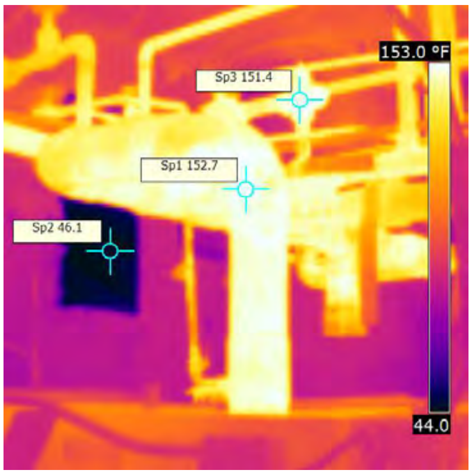
Address	90 Main Street, Newmarket, NH 03857	Site Address	7 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	



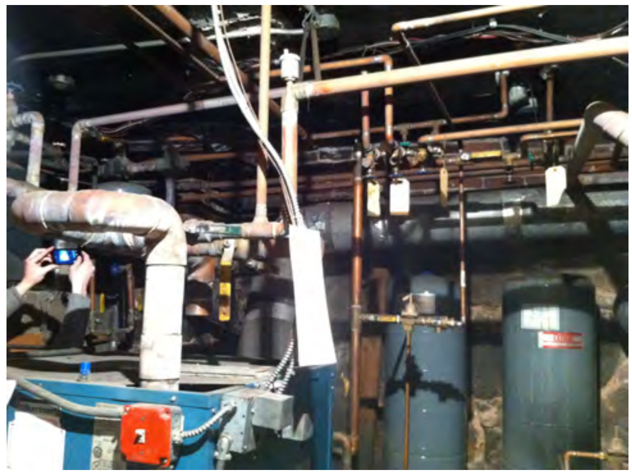


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/29/2011 3:47:24 PM
Image Name	IR_1998.jpg
Emissivity	0.96
Reflected apparent temperature	156.0 °F
Object Distance	3.0 ft

Text Comments

Description

Uninsulated and poorly insulated boiler pipes allow for thermal transfer. Open wall (background dark square) allows for inefficient thermal transfer. Recommend insulating all hot water pipes (EEM T3-2).

Inspection Report

Report Date	5/23/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Town Hall
Address	90 Main Street, Newmarket, NH 03857	Site Address	7 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

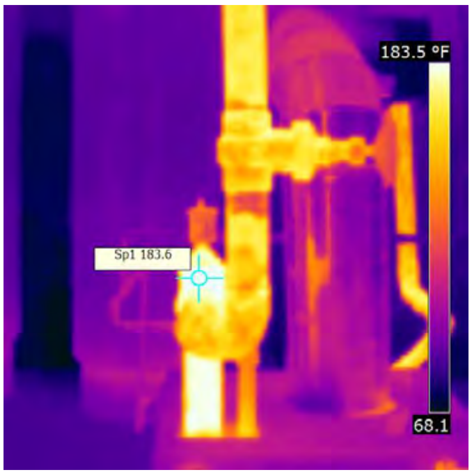


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/29/2011 3:47:28 PM
Image Name	IR_1999.jpg
Emissivity	0.96
Reflected apparent temperature	188.0 °F
Object Distance	2.0 ft

Text Comments

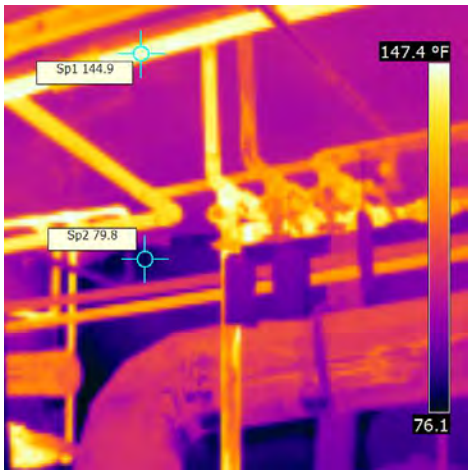
Description

Uninsulated piping in the basement contributes to thermal losses. Recommend insulating all hot water piping to limit thermal losses and replacing heat emitted to basement with proper heat source. Refer to EEM T2-3 for insulating piping.

Inspection Report

Report Date	5/23/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Town Hall
Address	90 Main Street, Newmarket, NH 03857	Site Address	7 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	



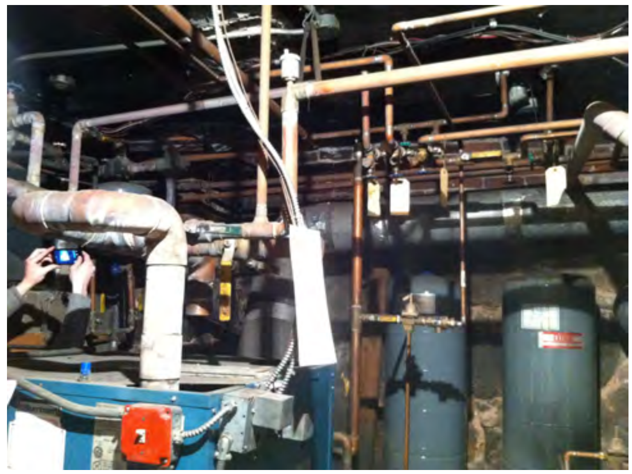


Image and Object Parameters

Text Comments

Camera Model	B-CAM Western S
Image Date	12/29/2011 3:47:37 PM
Image Name	IR_2000.jpg
Emissivity	0.96
Reflected apparent temperature	148.0 °F
Object Distance	4.0 ft

Description

Uninsulated piping in the basement contributes to thermal losses. Recommend insulating all hot water piping to limit thermal losses and replacing heat emitted to basement with proper heat source. Refer to EEM T2-3 for insulating piping.

Inspection Report

Report Date	5/23/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Town Hall
Address	90 Main Street, Newmarket, NH 03857	Site Address	7 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

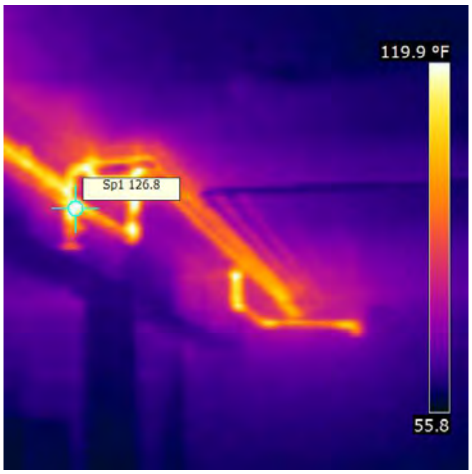


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/29/2011 3:54:48 PM
Image Name	IR_2001.jpg
Emissivity	0.96
Reflected apparent temperature	129.0 °F
Object Distance	7.0 ft

Text Comments

Description

Uninsulated piping in the basement contributes to thermal losses. Recommend insulating all hot water piping to limit thermal losses and replacing heat emitted to basement with proper heat source. Refer to EEM T2-3 for insulating piping.

Inspection Report

Report Date	5/23/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Town Hall
Address	90 Main Street, Newmarket, NH 03857	Site Address	7 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/29/2011 4:03:02 PM
Image Name	IR_2002.jpg
Emissivity	0.96
Reflected apparent temperature	145.0 °F
Object Distance	4.0 ft

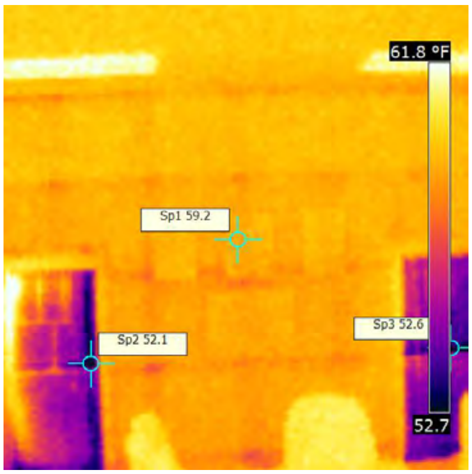
Text Comments

Description

Uninsulated piping in the basement contributes to thermal losses. Recommend insulating all hot water piping to limit thermal losses and replacing heat emitted to basement with proper heat source. Refer to EEM T2-3 for insulating piping.

Inspection Report

Report Date	5/23/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Town Hall
Address	90 Main Street, Newmarket, NH 03857	Site Address	7 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	



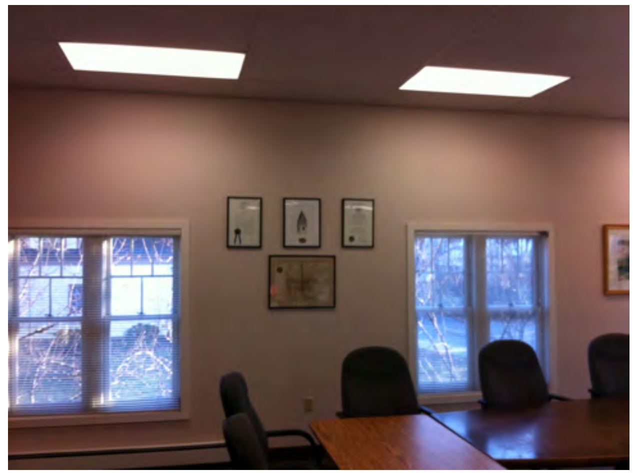


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/29/2011 4:15:17 PM
Image Name	IR_2003.jpg
Emissivity	0.96
Reflected apparent temperature	52.0 °F
Object Distance	10.0 ft

Text Comments

Description

North window and walls in the newer addition part of the Town Hall reveal some thermal transfer at the windows and no gaps in insulation in the walls. Recommend air-sealing all windows and doors. Refer to EEM T1-5 for associated cost and savings.

Inspection Report

Report Date	5/23/2012		
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Address	90 Main Street, Newmarket, NH 03857	Site Address	7 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

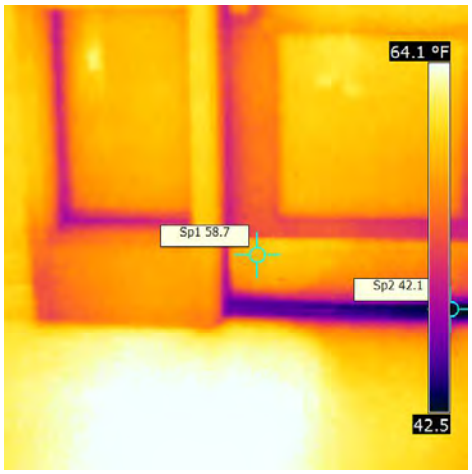

Image and Object Parameters

Text Comments

Camera Model	B-CAM Western S
Image Date	12/29/2011 4:15:51 PM
Image Name	IR_2005.jpg
Emissivity	0.96
Reflected apparent temperature	41.0 °F
Object Distance	4.0 ft

Description

Rear entrance to building in new addition. Recommend adding weather stripping to limit air infiltration. Refer to EEM T1-5 for associated cost and savings.

Inspection Report

Report Date	5/23/2012		
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Address	90 Main Street, Newmarket, NH 03857	Site Address	7 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

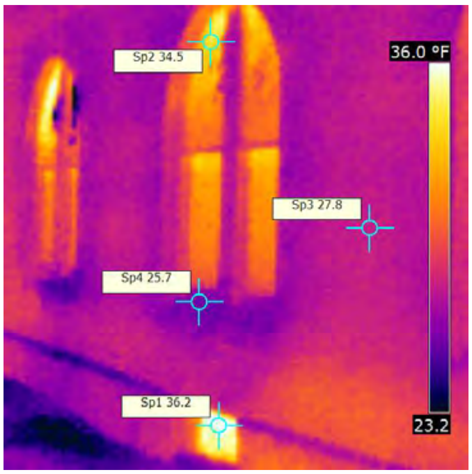

Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/29/2011 4:17:40 PM
Image Name	IR_2006.jpg
Emissivity	0.96
Reflected apparent temperature	23.0 °F
Object Distance	7.0 ft

Text Comments

Description

North exterior wall reveals thermal transfer through vent to basement below and transfer through window frames. Recommend air-sealing vent and replacing windows may or may not be viable. Refer to EEMs T1-2, T3-8 and T3-9 for associated cost and savings.

Inspection Report

Report Date	5/23/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Town Hall
Address	90 Main Street, Newmarket, NH 03857	Site Address	7 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

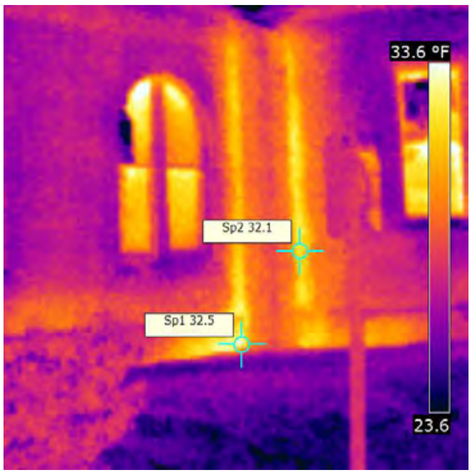

Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/29/2011 4:18:56 PM
Image Name	IR_2007.jpg
Emissivity	0.96
Reflected apparent temperature	30.0 °F
Object Distance	12.0 ft

Text Comments

Description

North exterior wall reveals thermal breaching at the column in the corner. Recommend sealing this seam and adding insulation to the walls. Refer to EEM T3-4 for cost and savings.

Inspection Report

Report Date	5/23/2012		
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Thermographer	Hans Kuebler	Contact Person	

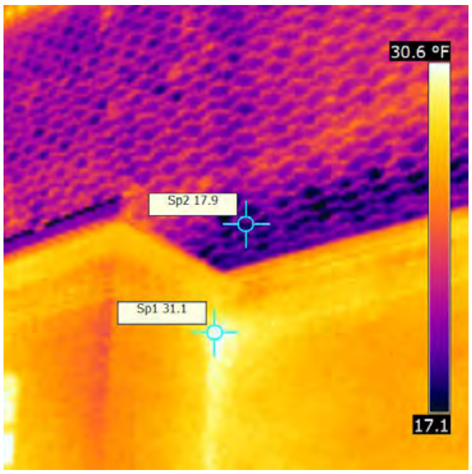

Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/29/2011 4:19:48 PM
Image Name	IR_2008.jpg
Emissivity	0.96
Reflected apparent temperature	29.0 °F
Object Distance	12.0 ft

Text Comments

Description

Rear of building exterior. Cedar siding preforms better under IR because it does not transfer heat from the interior as inefficiently. Recommend adding insulation to both floors of original building. Refer to EEms T3-2 and T3-4 for cost and savings.

Inspection Report

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Address	90 Main Street, Newmarket, NH 03857	Site Address	7 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

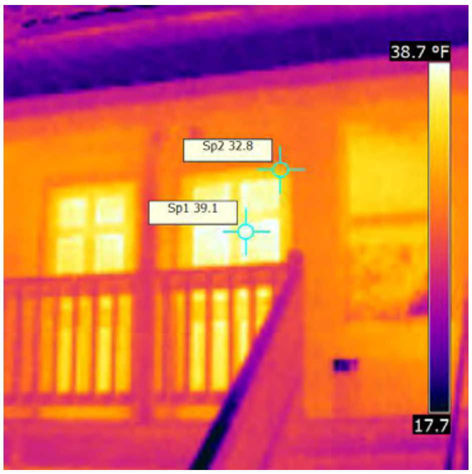


Image and Object Parameters

Text Comments

Camera Model	B-CAM Western S
Image Date	12/29/2011 4:20:32 PM
Image Name	IR_2010.jpg
Emissivity	0.96
Reflected apparent temperature	37.0 °F
Object Distance	15.0 ft

Description

Rear of building. Doors provide significant thermal bridging.

Inspection Report

Report Date	5/23/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Town Hall
Address	90 Main Street, Newmarket, NH 03857	Site Address	7 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

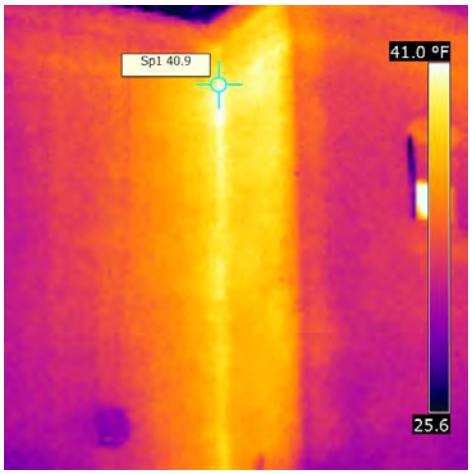


Image and Object Parameters

Text Comments

Camera Model	B-CAM Western S
Image Date	12/29/2011 4:22:21 PM
Image Name	IR_2011.jpg
Emissivity	0.96
Reflected apparent temperature	39.0 °F
Object Distance	10.0 ft

Description

Corner of the building reveals thermal transfer at the seam. Recommend adding insulation to the walls. Refer to EEM T3-4 for associated cost and savings.

Inspection Report

Report Date	5/23/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Town Hall
Address	90 Main Street, Newmarket, NH 03857	Site Address	7 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

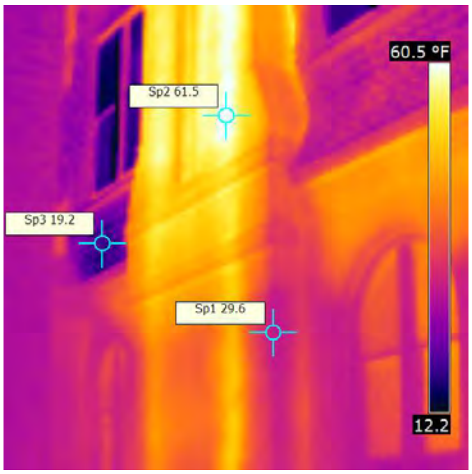


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/29/2011 4:22:45 PM
Image Name	IR_2012.jpg
Emissivity	0.96
Reflected apparent temperature	28.0 °F
Object Distance	15.0 ft

Text Comments

Description

South exterior wall and chimney reveals thermal energy lost out the chimney. Recommend insulating and sealing all abandoned chimneys and vents. Refer to EEM T1-2 for associated cost and savings.

Inspection Report

Report Date	5/23/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Town Hall
Address	90 Main Street, Newmarket, NH 03857	Site Address	7 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

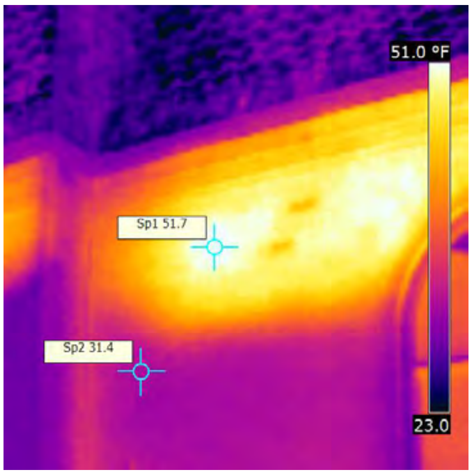


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/29/2011 4:23:03 PM
Image Name	IR_2013.jpg
Emissivity	0.96
Reflected apparent temperature	30.0 °F
Object Distance	15.0 ft

Text Comments

Description

South exterior wall (Troy's Office) with warm spot reveals area of high thermal transfer, most likely due to lack of insulation. Recomend installing insulation in all walls. Refer to EEM T3-4 for associated cost and savings.

Inspection Report

Report Date	5/23/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Town Hall
Address	90 Main Street, Newmarket, NH 03857	Site Address	7 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

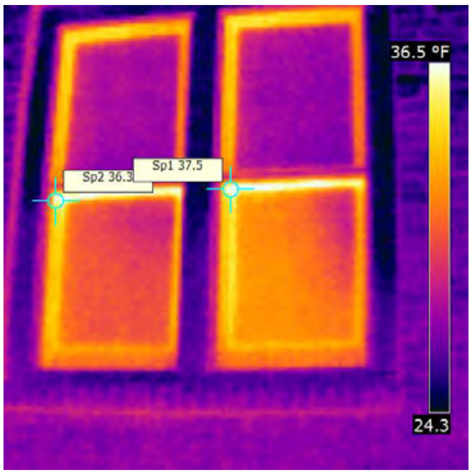


Image and Object Parameters	
Camera Model	B-CAM Western S
Image Date	12/29/2011 4:23:29 PM
Image Name	IR_2014.jpg
Emissivity	0.96
Reflected apparent temperature	35.0 °F
Object Distance	8.0 ft

Text Comments

Description

Windows with poor air sealing allow for thermal energy to be lost to exterior and nuisance draft. Recommend weather sealing all exterior doors and windows. Refer to EEM T1-5 for associated cost and savings.

Inspection Report

Report Date	5/23/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Town Hall
Address	90 Main Street, Newmarket, NH 03857	Site Address	7 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

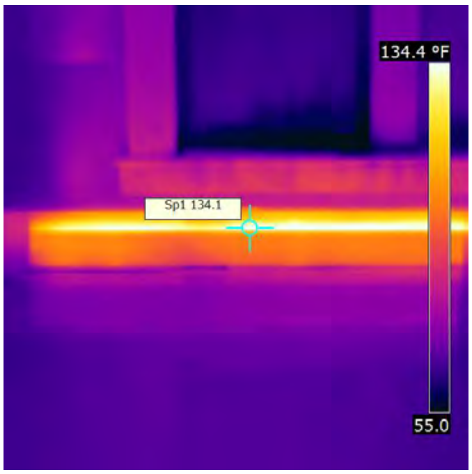


Image and Object Parameters

Text Comments

Camera Model	B-CAM Western S
Image Date	12/29/2011 4:32:42 PM
Image Name	IR_2015.jpg
Emissivity	0.96
Reflected apparent temperature	137.0 °F
Object Distance	8.0 ft

Description

Baseboard radiator in the kitchen reveals thermal energy produced and emitted.

Inspection Report

Report Date	5/23/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Town Hall
Address	90 Main Street, Newmarket, NH 03857	Site Address	7 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

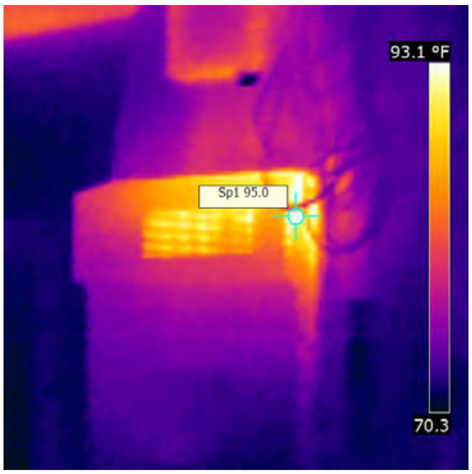


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/29/2011 4:32:58 PM
Image Name	IR_2016.jpg
Emissivity	0.96
Reflected apparent temperature	96.0 °F
Object Distance	4.0 ft

Text Comments

Description

Communication equipment in the kitchen produces thermal energy adding heat load to the space.

Inspection Report

Report Date	5/23/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Town Hall
Address	90 Main Street, Newmarket, NH 03857	Site Address	7 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/29/2011 4:33:12 PM
Image Name	IR_2017.jpg
Emissivity	0.96
Reflected apparent temperature	42.0 °F
Object Distance	8.0 ft

Text Comments

Description

Rear door in building reveals thermal transfer between the door and frame as well as through the uninsulated door. Recommend air-sealing all exterior doors and windows. Refer to EEM T1-5 for associated cost and savings.

Inspection Report

Report Date	5/23/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Town Hall
Address	90 Main Street, Newmarket, NH 03857	Site Address	7 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/29/2011 4:35:35 PM
Image Name	IR_2020.jpg
Emissivity	0.96
Reflected apparent temperature	56.0 °F
Object Distance	3.0 ft

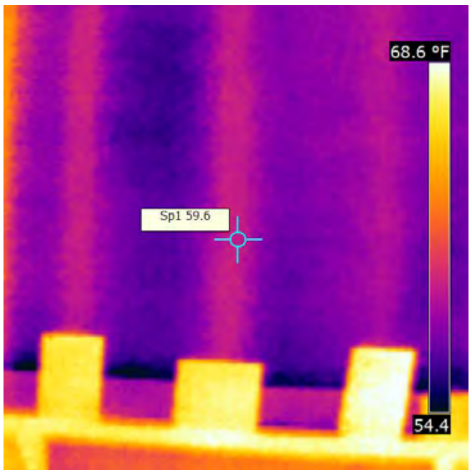
Text Comments

Description

Uninsulated wall in the finance officer’s office reveals areas of thermal breaching. Recommend insulating all walls in the original building. Refer toEEM T3-4 for associated cost and savings.

Inspection Report

Report Date	5/23/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Town Hall
Address	90 Main Street, Newmarket, NH 03857	Site Address	7 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	



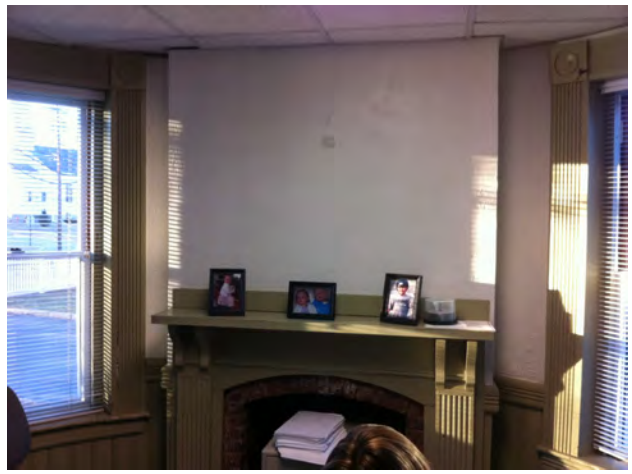


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/29/2011 4:36:01 PM
Image Name	IR_2021.jpg
Emissivity	0.96
Reflected apparent temperature	59.0 °F
Object Distance	5.0 ft

Text Comments

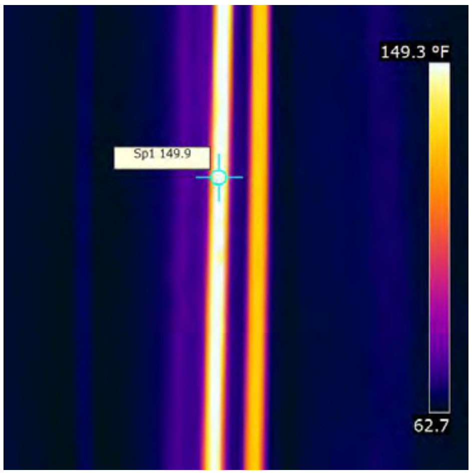
Description

Uninsulated wall in the finance officer’s office reveal thermal breaching and insulation that is not constant. Recommend insulaing all original walls. Refer to EEM T3-4 for cost and savings.

Inspection Report

Report Date	5/23/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Town Hall
Address	90 Main Street, Newmarket, NH 03857	Site Address	7 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	



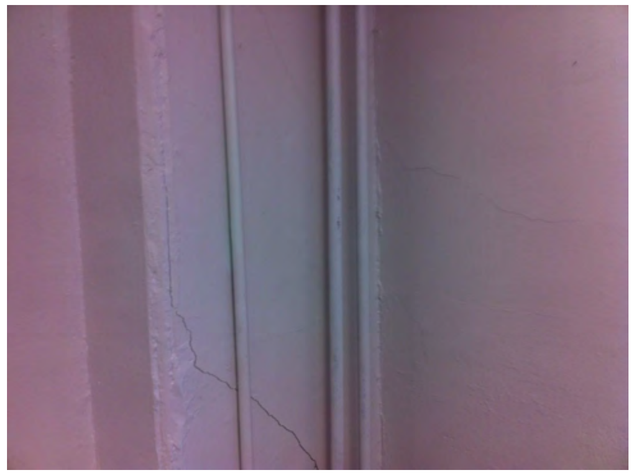


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/29/2011 4:36:58 PM
Image Name	IR_2022.jpg
Emissivity	0.96
Reflected apparent temperature	153.0 °F
Object Distance	5.0 ft

Text Comments

Description

Uninsulated pipes by copy machine reveal thermal energy lost to the space through pipes. Recommed insulating all hot water pipes and efficiently heating space through proper means. Refer to EEM T2-3 for pipe insulation cost and savings.

Inspection Report

Report Date	5/23/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Town Hall
Address	90 Main Street, Newmarket, NH 03857	Site Address	7 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

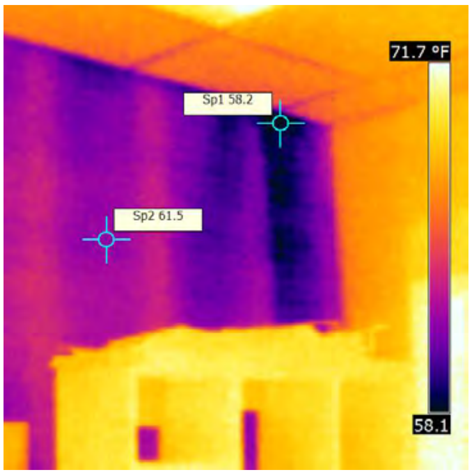


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/29/2011 4:37:29 PM
Image Name	IR_2023.jpg
Emissivity	0.96
Reflected apparent temperature	58.0 °F
Object Distance	6.0 ft

Text Comments

Description

IR of inside of exterior wall reveals some areas of poor insulation allowing thermal loss through the walls. Recommend insulating all original building walls. Refer to EEM T3-4 for associated cost and savings.

Inspection Report

Report Date	5/23/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Town Hall
Address	90 Main Street, Newmarket, NH 03857	Site Address	7 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

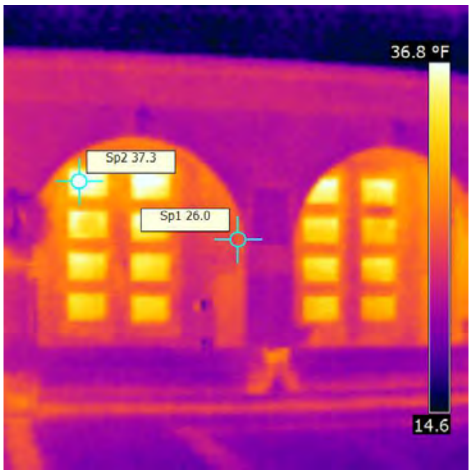


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/3/2012 7:56:55 AM
Image Name	IR_2041.jpg
Emissivity	0.96
Reflected apparent temperature	36.0 °F
Object Distance	15.0 ft

Text Comments

Description

Main entrance of building. Doors are uninsulated and allow thermal loss to the exterior.

Inspection Report

Report Date	5/23/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Town Hall
Address	90 Main Street, Newmarket, NH 03857	Site Address	7 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

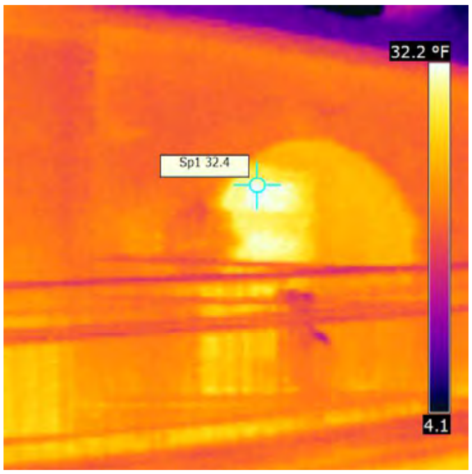


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/3/2012 7:57:22 AM
Image Name	IR_2043.jpg
Emissivity	0.96
Reflected apparent temperature	30.0 °F
Object Distance	15.0 ft

Text Comments

Description

Front side entrance of building between original building and addition. Doors allow thermal transfer between interior and exterior.

Inspection Report

Report Date	5/23/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Town Hall
Address	90 Main Street, Newmarket, NH 03857	Site Address	7 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

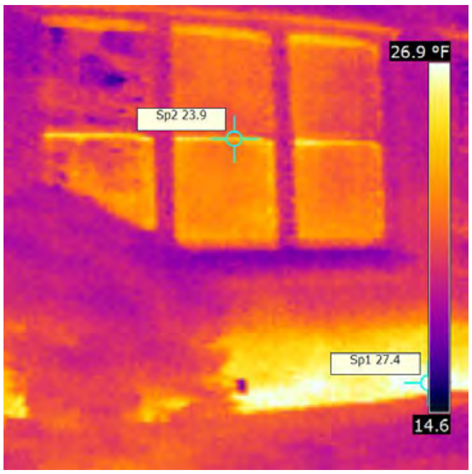


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/3/2012 7:57:34 AM
Image Name	IR_2044.jpg
Emissivity	0.96
Reflected apparent temperature	25.0 °F
Object Distance	8.0 ft

Text Comments

Description

Front of addition. This portion of the building is insulated better than the original and windows performed better under IR. EEMs on these wall sections are not recommended at this time.

Inspection Report

Report Date	5/23/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Town Hall
Address	90 Main Street, Newmarket, NH 03857	Site Address	7 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

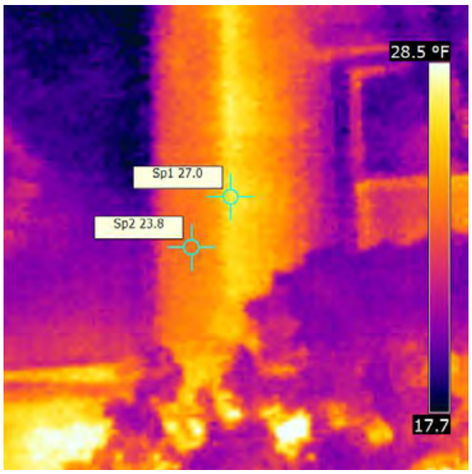


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/3/2012 7:57:40 AM
Image Name	IR_2045.jpg
Emissivity	0.96
Reflected apparent temperature	21.0 °F
Object Distance	7.0 ft

Text Comments

Description

IR of a corner along the front of the building reveals some thermal transfer occurring. Recommend insulating all original building walls. Refer to EEM T3-4 for associated cost and savings.

Inspection Report

Report Date	5/23/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Town Hall
Address	90 Main Street, Newmarket, NH 03857	Site Address	7 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

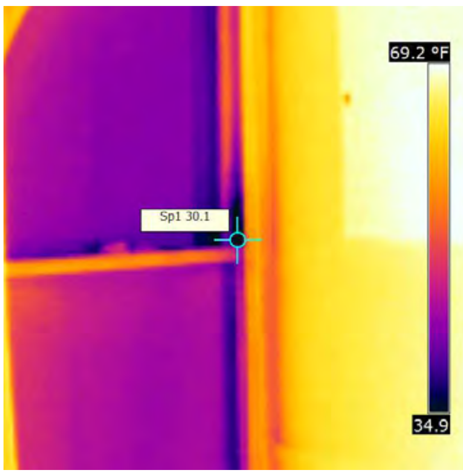


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/3/2012 8:04:40 AM
Image Name	IR_2047.jpg
Emissivity	0.96
Reflected apparent temperature	28.0 °F
Object Distance	5.0 ft

Text Comments

Description

Window in Troy's Office reveals thermal transfer around window frame. Recommend weather sealing all exterior doors and windows. Refer to EEM T1-5 for associated cost and savings.

APPENDIX C

Indoor Metering Data

INDOOR METERING DATA

Facility:	Location:	Date	Ambient Outdoor:
Hollis Town Hall	Hollis, NH	12/29/2011	Temp= 28 RH= 25 CO2= 315

Location /Use Description	Time	Occupied	Air Quality				Notes
			Temp (°F)	RH (%)	CO2 (ppm)	Vert (FC)	
Stage and balcony	1404	N	67.8	14.9	415	17	Natural light
2nd fl meeting room	1400	N	77.1	3.9	407	145	All natural light
West entrance vestibule	1412	N	70.5	5.5	333	11.2	
1st fl EW hall	1414	N	69.8	15.1	541	47.4	
Bldg insp, zoning, info main	1419	Y	70.7	15.7	567	36.7	
Planning board	1420	Y	70.7	17.6	549	23.5	
Finance officer	1423	Y	70.1	14.6	536	29.3	
Assessing	1425	Y	69.8	15.7	566	50.9	
Selectmen	1426	Y	71	16.3	631	42.9	
Troy brown	1428	N	71	15.5	610	37.3	
Kitchen	1432	N	71.6	15.4	533	25.2	
Community room	1509	N	61.8	16.6	337	18.2	
Men's room	1511	N	66	26.4	618	28.7	
Averages			69.8	14.9	511	39.5	

APPENDIX D

Lighting Fixture Inventory

LIGHTING FIXTURE INVENTORY

Facility:		Location:				Date:	
Hollis Town Hall		Hollis, NH				12/29/2011	
Location /Use Description	**Fixture**	**Watts/fixture**	**Qty**	**Controls**	**Total watts**	**Est. Hr/Wk**	**Est. KWH Consumption/Yr**
Back Basement	CFL	17	6	Switch	102	0	0
Basement and Stairs	CFL	17	1	Switch	17	0	0
Basement Under Stairs	CFL	17	1	Switch	17	0	0
Bell Tower	CFL	17	3	Switch	51	0	0
Boiler Room and Access	CFL	17	1	Switch	17	0	0
Boiler Room and Access	CFL	17	1	Switch	17	0	0
Employee Bathroom	CFL	17	1	Switch	17	20	18
Employee Closet	CFL	17	1	Switch	17	0	0
Exterior	CFL	40	6	Photo	240	68	849
Stage Room and Balcony	CFL	5	8	Switch	40	20	42
Basement and Stairs	Circle T9	32	1	Switch	32	10	17
2nd Floor Meeting Room	Inc.	60	1	Switch	60	10	31
Basement Baths	Inc.	60	4	Switch	240	0	0
Bell Tower	Inc.	60	1	Switch	60	0	0
Boiler Room and Access	Inc.	100	1	Switch	100	0	0
North Stairs	Inc.	60	2	Switch	120	40	250
South Stairs	Inc.	60	2	Switch	120	40	250
Stage Room and Balcony	Inc.	100	6	Switch	600	20	624
Exit	LED	5	16	Always On	80	168	699
Stage Room and Balcony	Stage	32	6	Switch	192	40	399
1st Floor EW	T8	64	4	Switch	256	40	532
Assessing	T8	64	5	Switch	320	35	582
Basement and Stairs	T8	56	3	Switch	168	5	44
Bldg Insp, Zoning, Info Main	T8	64	12	Switch	768	30	1,198
Community Meeting	T8	56	23	Switch	1,288	12	804
Community Men's Room	T8	56	2	Switch	112	30	175
Community Room	T8	28	12	Switch	336	20	349
Community Women's Room	T8	56	2	Switch	112	30	175
East Vestibule	T8	64	1	Switch	64	40	133
Finance Officer	T8	64	1	Switch	64	35	116
Kitchen	T8	64	2	Switch	128	20	133
North Stairs	T8	32	1	Switch	32	40	67
Planning Board	T8	32	3	Switch	96	20	100
Selectmen	T8	64	4	Switch	256	35	466
South Stairs	T8	32	1	Switch	32	40	67
Stage Room and Balcony	T8	32	8	Switch	256	40	532
Troy Brown	T8	64	4	Switch	256	35	466
West Entrance Vestibule	T8	32	1	Switch	32	40	67
		Totals:	**158**		**6,715**		**9,183**

APPENDIX E

Mechanical Equipment Inventory

MECHANICAL EQUIPMENT INVENTORY

Facility:		Location:			
Hollis Town Hall		Hollis, NH			
Location /Use Description	**Qty**	**Affiliated System**	**Age**	**Wattage**	**Consumption (kWh/yr)**
Basement/DHW	1	DHW	10 (est)	4500	2925
Crawlspace/DHW	1	DHW	10 (est)	2500	1625
		PUMPS			
Domestic Water Booster	1	Domestic Water	10	600	312
Hydonic Pump Old	1	Heating		500	800
Hydonic Pump New	1	Heating		500	800

BOILER DATA SHEET

Facility:	Location:	Date:
Hollis Town Hall	Hollis, NH	12/29/2011

Location /Use Description	Manufacturer	Model Number	Qty	Year	Capacity (mbh)	Efficiency (%)	Circ Pump	Blower wattage	Consumption (kWh/yr)
Basement/ Hydronic Heating/ New building	Utica Boilers	SFH-5200W	1	2000 (est)	280/231	78	Yes	700	1680
Basement/ Hydronic Heating/ Old Building	Burnham	V-905A	1	1995 (est)	646/562	80	Yes	600	1440

APPENDIX F

Plug Load Inventory

PLUG LOAD INVENTORY

Facility:	Location:	Date:
Hollis Town Hall	Hollis, NH	12/29/2011

Location /Use Description	Category	Description	Watts/ fixture	Qty	Total watts	Est. Hr/Wk	Est. kWh/Yr
Kitchen	AL - Large Appliance	Electric Oven	2,800	1	2,800	1	146
Community Room Main	AS - Small Appliance	Microwave	1,000	1	1,000	1	52
Kitchen	AS - Small Appliance	Coffee Maker Keurig	1,500	1	1,500	2	156
Kitchen	AS - Small Appliance	Microwave	1,000	1	1,000	1	52
Kitchen	AS - Small Appliance	Toaster Oven	1,300	1	1,300	1	68
Mail/Planning Board	CD - Desktop Computer	Computer Desktop	90	1	90	40	187
Bldg Insp, Zoning, Info Main	CD - Desktop Computer	Computer Desktop	90	4	360	40	749
Assessing	CD - Desktop Computer	Computer Desktop	90	3	270	40	562
Financial Officer	CD - Desktop Computer	Computer Desktop	90	1	90	40	187
Troy Brown	CD - Desktop Computer	Computer Desktop	90	1	90	40	187
Selectmen's Office	CD - Desktop Computer	Computer Desktop	90	1	90	40	187
Mail/Planning Board	CM - Computer Monitor	Computer Monitor LCD	15	1	15	40	31
Bldg Insp, Zoning, Info Main	CM - Computer Monitor	Computer Monitor LCD	15	3	45	40	94
Bldg Insp, Zoning, Info Main	CM - Computer Monitor	Computer Monitor Old	35	1	35	40	73
Assessing	CM - Computer Monitor	Computer Monitor LCD	15	3	45	40	94
Financial Officer	CM - Computer Monitor	Computer Monitor LCD	15	1	15	40	31
Troy Brown	CM - Computer Monitor	Computer Monitor LCD	15	1	15	40	31
Selectmen's Office	CM - Computer Monitor	Computer Monitor LCD	15	1	15	40	31
Mail/Planning Board	CN - Notebook Computer	Computer Laptop	30	1	30	40	62
Financial Officer	CN - Notebook Computer	Computer Laptop	30	1	30	40	62
Mail/Planning Board	DL - Desk Lamp	Desk Lamp	60	3	180	40	374
Selectmen's Office	EL - Electronics	Clock Radio	15	1	15	5	4
Bldg Insp, Zoning, Info Main	FN - Fan	Fan	20	1	20	3	3
Assessing	FN - Fan	Fan	20	2	40	3	6
Financial Officer	FN - Fan	Fan	20	1	20	3	3
Troy Brown	FN - Fan	Small fan	20	1	20	3	3
Community Room Main	OE - Office Equipment	Router	50	1	50	168	437
Bldg Insp, Zoning, Info Main	OE - Office Equipment	Laminator	365	1	365	2	38
Bldg Insp, Zoning, Info Main	OE - Office Equipment	Router	50	1	50	168	437
Bldg Insp, Zoning, Info Main	OE - Office Equipment	Scanner	35	1	35	2	4
Bldg Insp, Zoning, Info Main	OE - Office Equipment	Label Maker	15	1	15	2	2
Bldg Insp, Zoning, Info Main	OE - Office Equipment	Surge Protector	10	2	20	168	175
Bldg Insp, Zoning, Info Main	OE - Office Equipment	Postage Printer	120	1	120	2	12
Bldg Insp, Zoning, Info Main	OE - Office Equipment	Shredder	200	1	200	2	21
Troy Brown	OE - Office Equipment	Label Maker	10	1	10	2	1
Selectmen's Office	OE - Office Equipment	Label Maker	10	1	10	2	1
Bldg Insp, Zoning, Info Main	PC - Photocopier	Photocopier	1,440	1	1,440	10	749
Mail/Planning Board	PR - Computer Printer	Plotter	1,200	1	1,200	2	125
Bldg Insp, Zoning, Info Main	PR - Computer Printer	Printer Desk Jet	15	2	30	2	3
Assessing	PR - Computer Printer	Printer Laser Jet	500	2	1,000	2	104

Assessing	PR - Computer Printer	Printer All-in-one	500	1	500	2	52
Financial Officer	PR - Computer Printer	Printer Laser Jet	500	1	500	2	52
Troy Brown	PR - Computer Printer	Printer Laser Jet	500	1	500	2	52
Selectmen's Office	PR - Computer Printer	Printer Desk Jet	125	1	125	2	13
Selectmen's Office	PR - Computer Printer	Printer Laser Jet	500	1	500	2	52
Kitchen	RS - Standard Refrigerator	Refrigerator Full	403	1	403	60	1,256
Community Room Main	WF - Water Fountain	Water Fountain	200	1	200	40	416
Throughout Building	AL - Large Appliance	Window Air Conditioner	2,500	9	22,500	8	1,800
Kitchen	WF - Water Fountain	Water Cooler	200	1	200	40	416
		Totals:		**72**	**39,103**		**9,652**

APPENDIX G

ENERGY STAR® Statement of Energy Performance

STATEMENT OF ENERGY PERFORMANCE
Hollis Town Hall

Building ID: 1706064
For 12-month Period Ending: December 31, 2011[1]
Date SEP becomes ineligible: N/A

Date SEP Generated: February 16, 2012

Facility
Hollis Town Hall
7 Monument Square
Hollis, NH 03049

Facility Owner
Town of Hollis
7 Monument Square
Hollis, NH 03049

Primary Contact for this Facility
Troy Brown
7 Monument Square
Hollis, NH 03049

Year Built: 1886
Gross Floor Area (ft^2): 15,606

Energy Performance Rating[2] (1-100) N/A

Site Energy Use Summary[3]	
Electricity - Grid Purchase(kBtu)	97,825
Fuel Oil (No. 2) (kBtu)	665,465
Natural Gas - (kBtu)[4]	0
Total Energy (kBtu)	763,290

Energy Intensity[4]	
Site ($kBtu/ft^2/yr$)	49
Source ($kBtu/ft^2/yr$)	64

Emissions (based on site energy use)	
Greenhouse Gas Emissions ($MtCO_2e$/year)	60

Electric Distribution Utility
Public Service Co of New Hampshire [Northeast Utilities]

National Median Comparison	
National Median Site EUI	68
National Median Source EUI	164
% Difference from National Median Source EUI	-61%
Building Type	Office

Stamp of Certifying Professional

Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.

Meets Industry Standards[5] **for Indoor Environmental Conditions:**

Ventilation for Acceptable Indoor Air Quality	**N/A**
Acceptable Thermal Environmental Conditions	**N/A**
Adequate Illumination	**N/A**

Certifying Professional
Timothy Nichols
20 Madbury Road STE 3
Durham, NH 03824

Notes:
1. Application for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR is not final until approval is received from EPA.
2. The EPA Energy Performance Rating is based on total source energy. A rating of 75 is the minimum to be eligible for the ENERGY STAR.
3. Values represent energy consumption, annualized to a 12-month period.
4. Values represent energy intensity, annualized to a 12-month period.
5. Based on Meeting ASHRAE Standard 62 for ventilation for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

ENERGY STAR® Data Checklist for Commercial Buildings

In order for a building to qualify for the ENERGY STAR, a Professional Engineer (PE) or a Registered Architect (RA) must validate the accuracy of the data underlying the building's energy performance rating. This checklist is designed to provide an at-a-glance summary of a property's physical and operating characteristics, as well as its total energy consumption, to assist the PE or RA in double-checking the information that the building owner or operator has entered into Portfolio Manager.

Please complete and sign this checklist and include it with the stamped, signed Statement of Energy Performance.
NOTE: You must check each box to indicate that each value is correct, OR include a note.

CRITERION	VALUE AS ENTERED IN PORTFOLIO MANAGER	VERIFICATION QUESTIONS	NOTES	☑
Building Name	Hollis Town Hall	Is this the official building name to be displayed in the ENERGY STAR Registry of Labeled Buildings?		☐
Type	Office	Is this an accurate description of the space in question?		☐
Location	7 Monument Square, Hollis, NH 03049	Is this address accurate and complete? Correct weather normalization requires an accurate zip code.		☐
Single Structure	Single Facility	Does this SEP represent a single structure? SEPs cannot be submitted for multiple-building campuses (with the exception of a hospital, k-12 school, hotel and senior care facility) nor can they be submitted as representing only a portion of a building.		☐

Town Hall (Office)

CRITERION	VALUE AS ENTERED IN PORTFOLIO MANAGER	VERIFICATION QUESTIONS	NOTES	☑
Gross Floor Area	11,881 Sq. Ft.	Does this square footage include all supporting functions such as kitchens and break rooms used by staff, storage areas, administrative areas, elevators, stairwells, atria, vent shafts, etc. Also note that existing atriums should only include the base floor area that it occupies. Interstitial (plenum) space between floors should not be included in the total. Finally gross floor area is not the same as leasable space. Leasable space is a subset of gross floor area.		☐
Weekly operating hours	40 Hours	Is this the total number of hours per week that the Office space is 75% occupied? This number should exclude hours when the facility is occupied only by maintenance, security, or other support personnel. For facilities with a schedule that varies during the year, "operating hours/week" refers to the total weekly hours for the schedule most often followed.		☐
Workers on Main Shift	10	Is this the number of employees present during the main shift? Note this is not the total number of employees or visitors who are in a building during an entire 24 hour period. For example, if there are two daily 8 hour shifts of 100 workers each, the Workers on Main Shift value is 100. The normal worker density ranges between 0.3 and 5.3 workers per 1000 square feet (92.8 square meters)		☐
Number of PCs	10	Is this the number of personal computers in the Office?		☐
Percent Cooled	Less than 50%	Is this the percentage of the total floor space within the facility that is served by mechanical cooling equipment?		☐
Percent Heated	Less than 50%	Is this the percentage of the total floor space within the facility that is served by mechanical heating equipment?		☐

Town Hall Basement (Other)

CRITERION	VALUE AS ENTERED IN PORTFOLIO MANAGER	VERIFICATION QUESTIONS	NOTES	☑

Gross Floor Area	3,725 Sq. Ft.	Does this square footage include all supporting functions such as kitchens and break rooms used by staff, storage areas, administrative areas, elevators, stairwells, atria, vent shafts, etc. Also note that existing atriums should only include the base floor area that it occupies. Interstitial (plenum) space between floors should not be included in the total. Finally gross floor area is not the same as leasable space. Leasable space is a subset of gross floor area.		☐
Number of PCs	0(Optional)	Is this the number of personal computers in the space?		☐
Weekly operating hours	40Hours(Optional)	Is this the total number of hours per week that the space is 75% occupied? This number should exclude hours when the facility is occupied only by maintenance, security, or other support personnel. For facilities with a schedule that varies during the year, "operating hours/week" refers to the total weekly hours for the schedule most often followed.		☐
Workers on Main Shift	0(Optional)	Is this the number of employees present during the main shift? Note this is not the total number of employees or visitors who are in a building during an entire 24 hour period. For example, if there are two daily 8 hour shifts of 100 workers each, the Workers on Main Shift value is 100.		☐

Energy Consumption

Power Generation Plant or Distribution Utility: Public Service Co of New Hampshire [Northeast Utilities]

Fuel Type: Electricity

Meter: 8004806-01-0-9_electric (kWh (thousand Watt-hours))
Space(s): Entire Facility
Generation Method: Grid Purchase

Start Date	End Date	Energy Use (kWh (thousand Watt-hours))
12/01/2011	12/31/2011	2,060.00
11/01/2011	11/30/2011	1,780.00
10/01/2011	10/31/2011	2,043.00
09/01/2011	09/30/2011	2,205.00
08/01/2011	08/31/2011	2,817.00
07/01/2011	07/31/2011	2,808.00
06/01/2011	06/30/2011	1,926.00
05/01/2011	05/31/2011	1,764.00
04/01/2011	04/30/2011	2,412.00
03/01/2011	03/31/2011	2,556.00
02/01/2011	02/28/2011	3,078.00
01/01/2011	01/31/2011	3,222.00
8004806-01-0-9_electric Consumption (kWh (thousand Watt-hours))		**28,671.00**
8004806-01-0-9_electric Consumption (kBtu (thousand Btu))		**97,825.45**
Total Electricity (Grid Purchase) Consumption (kBtu (thousand Btu))		**97,825.45**
Is this the total Electricity (Grid Purchase) consumption at this building including all Electricity meters?		☐

Fuel Type: Fuel Oil (No. 2)

Meter: oil (Gallons)
Space(s): Entire Facility

Start Date	End Date	Energy Use (Gallons)
12/01/2011	12/31/2011	735.10
11/01/2011	11/30/2011	819.70
10/01/2011	10/31/2011	0.00
09/01/2011	09/30/2011	0.00
08/01/2011	08/31/2011	0.00
07/01/2011	07/31/2011	0.00
06/01/2011	06/30/2011	0.00
05/01/2011	05/31/2011	370.00
04/01/2011	04/30/2011	550.00
03/01/2011	03/31/2011	448.70

02/01/2011	02/28/2011	1,026.90
01/01/2011	01/31/2011	847.80
oil Consumption (Gallons)		**4,798.20**
oil Consumption (kBtu (thousand Btu))		**665,464.76**
Total Fuel Oil (No. 2) Consumption (kBtu (thousand Btu))		**665,464.76**
Is this the total Fuel Oil (No. 2) consumption at this building including all Fuel Oil (No. 2) meters?		☐

Additional Fuels	
Do the fuel consumption totals shown above represent the total energy use of this building? Please confirm there are no additional fuels (district energy, generator fuel oil) used in this facility.	☐

On-Site Solar and Wind Energy	
Do the fuel consumption totals shown above include all on-site solar and/or wind power located at your facility? Please confirm that no on-site solar or wind installations have been omitted from this list. All on-site systems must be reported.	☐

Certifying Professional

(When applying for the ENERGY STAR, the Certifying Professional must be the same PE or RA that signed and stamped the SEP.)

Name: ____ Date: ____________

Signature: ____________________________________

Signature is required when applying for the ENERGY STAR.

FOR YOUR RECORDS ONLY. DO NOT SUBMIT TO EPA.

Please keep this Facility Summary for your own records; do not submit it to EPA. Only the Statement of Energy Performance (SEP), Data Checklist and Letter of Agreement need to be submitted to EPA when applying for the ENERGY STAR.

Facility
Hollis Town Hall
7 Monument Square
Hollis, NH 03049

Facility Owner
Town of Hollis
7 Monument Square
Hollis, NH 03049

Primary Contact for this Facility
Troy Brown
7 Monument Square
Hollis, NH 03049

General Information

Hollis Town Hall	
Gross Floor Area Excluding Parking: (ft^2)	15,606
Year Built	1886
For 12-month Evaluation Period Ending Date:	December 31, 2011

Facility Space Use Summary

Town Hall	
Space Type	Office
Gross Floor Area(ft^2)	11,881
Weekly operating hours	40
Workers on Main Shift	10
Number of PCs	10
Percent Cooled	Less than 50%
Percent Heated	Less than 50%

Town Hall Basement	
Space Type	Other - Other
Gross Floor Area(ft^2)	3,725
Number of PCs[o]	0
Weekly operating hours[o]	40
Workers on Main Shift[o]	0

Energy Performance Comparison

	Evaluation Periods		Comparisons		
Performance Metrics	**Current** (Ending Date 12/31/2011)	**Baseline** (Ending Date 12/31/2007)	**Rating of 75**	**Target**	**National Median**
Energy Performance Rating	N/A	N/A	75	N/A	N/A
Energy Intensity					
Site (kBtu/ft2)	49	7	54	N/A	68
Source (kBtu/ft2)	64	24	71	N/A	164
Energy Cost					
$/year	$ 17,676.04	$ 5,158.85	$ 19,566.16	N/A	$ 24,575.15
$/ft2/year	$ 1.13	$ 0.33	$ 1.25	N/A	$ 1.57
Greenhouse Gas Emissions					
$MtCO_2e$/year	60	13	66	N/A	83
$kgCO_2e/ft^2$/year	4	1	4	N/A	6

More than 50% of your building is defined as Office. This building is currently ineligible for a rating. Please note the National Median column represents the CBECS national median data for Office. This building uses 61% less energy per square foot than the CBECS national median for Office.

Notes:
o - This attribute is optional.
d - A default value has been supplied by Portfolio Manager.

APPENDIX H

Renewable Energies Screening Worksheets

RENEWABLE ENERGY SCREENING SUMMARY

Building/Facility:	Hollis Town Hall	Location:	Hollis, NH
Gross Area (sf):	15,606	Date:	3/2/2012
Use Category:	Office	EUI (kBtu/sf/yr):	64
Heating Fuel(s):	Oil (No. 2)	PM Grade:	NA
Heating System(s):	Hydronic	Cooling System(s):	Window AC

RE Technology	Score (out of 70 pts.)	Grade	Notes/Comments
Solar DHW	54.5	78%	DHW demand should be confirmed.
Geothermal Heating/Cooling	52.0	74%	Closed-loop GSHP system.
Biomass Heating	50.5	72%	Pellet feed system recommended.
Roof Photovoltaic	48.5	69%	Small system 5kw-10kw.
Ground Photovoltaic	47.5	68%	Small system 5kw-10kw.
Wind Turbine Generator	44.5	64%	Permit requirements are height dependent.
Solar Thermal	41.5	59%	Medium-temperature collector.
Combined Heat & Power	40.5	58%	75kW system.

RENEWABLE ENERGY SCREENING WORKSHEET

Building/Facility:	Hollis Town Hall	Location:	Hollis, NH
Gross Area (sf):	15,606	Date:	3/2/2012
Use Category:	Office	EUI (kBtu/sf/yr):	64
Heating Fuel(s):	Oil (No. 2)	PM Grade:	NA
Heating System(s):	Hydronic	Cooling System(s):	Window AC

Technology: **Solar Domestic Hot Water**

No.	Criteria	Score (1-5 pts.)	Notes/Comments
1	Demonstrated technology	4	Well demonstrated technology although system design and function can vary.
2	Expected service life/durability	3	Expected service life of heating panels is 15 years.
3	Geographical considerations	3.5	Limited solar availability in New England.
4	Energy demand	4.5	Expected DHW demand is low.
5	Facility/systems conditions	4	System could utilize the existing 47-gal storage tank.
6	Facility/systems compatibility	4	System could utilize the existing 47-gal storage tank.
7	Permitting constraints	5	No special permitting required.
8	Abutter concerns	5	Low visibility/impact.
9	Capital investment	2.5	High capital cost.
10	O&M requirements	4	Panel replacement and normal DHW system maintenance.
11	Financial incentives	2.5	Limited incentives in NH.
12	Owner initiatives	4	Owner is open to renewable options.
13	CO2e emissions	3.5	Low reduction of oil use based on DHW demand.
14	Public awareness/education	5	High public visibility and use.
	Total Score:	**54.5**	
	Total Possible Score:	**70**	
	Grade:	**78%**	

RENEWABLE ENERGY SCREENING WORKSHEET

Building/Facility: Hollis Town Hall
Location: Hollis, NH
Gross Area (sf): 15,606
Date: 3/2/2012
Use Category: Office
EUI (kBtu/sf/yr): 64
Heating Fuel(s): Oil (No. 2)
PM Grade: NA
Heating System(s): Hydronic
Cooling System(s): Window AC

Technology: **Geothermal Heating & Cooling**

No.	Criteria	Score (1-5 pts.)	Notes/Comments
1	Demonstrated technology	5	Well demonstrated technology but does require engineering design.
2	Expected service life/durability	5	Well field and loop system has +50 year service life. Equipment has +20 yr service life.
3	Geographical considerations	4.5	Abundant geothermal energy reserves.
4	Energy demand	4	Heating and cooling energy consumption is relatively high.
5	Facility/systems conditions	2	Existing system is functioning but outdated.
6	Facility/systems compatibility	2	Building system is old and out dated. Space is limited on site therefore it would have to be drilled in Town common across the street which increases costs.
7	Permitting constraints	5	No special permitting required for a closed-loop system (open-loop would require state permit and is not recommended).
8	Abutter concerns	4	Abutters with water supply wells can be sensitive to geothermal wells but a closed-loop system will have no impact. Some impact made to Town common.
9	Capital investment	2	High capital cost.
10	O&M requirements	4.5	Very low O&M except routine equipment maintenance.
11	Financial incentives	2.5	Limited incentives in NH.
12	Owner initiatives	4	Owner is open to renewable options.
13	CO2e emissions	4.5	The building currently uses a large amount of oil.
14	Public awareness/education	3	Moderate public use. Information could be displayed in the building so users are aware of geothermal system.
	Total Score:	**52**	
	Total Possible Score:	**70**	
	Grade:	**74%**	

RENEWABLE ENERGY SCREENING WORKSHEET

Building/Facility:	Hollis Town Hall	Location:	Hollis, NH
Gross Area (sf):	15,606	Date:	3/2/2012
Use Category:	Office	EUI (kBtu/sf/yr):	64
Heating Fuel(s):	Oil (No. 2)	PM Grade:	NA
Heating System(s):	Hydronic	Cooling System(s):	Window AC

Technology: **Biomass Heating Systems (wood, chips, pellets)**

No.	Criteria	Score (1-5 pts.)	Notes/Comments
1	Demonstrated technology	4	Well demonstrated technology. Some woodchip and pellet feed units are newer technology.
2	Expected service life/durability	4	Expected service life is 20 yrs.
3	Geographical considerations	3	Limited fuel in Southern NH
4	Energy demand	4	Heating energy is relatively high in the building.
5	Facility/systems conditions	3	Limited storage area for woodchips/pellets.
6	Facility/systems compatibility	3	Limited storage area for woodchips/pellets.
7	Permitting constraints	5	No special permits required.
8	Abutter concerns	4	Systems are located inside building. Wood or chip feedstock located outside could be a concern.
9	Capital investment	4	Low capital cost.
10	O&M requirements	3	Wood and woodchip units require constant attending and feedstock must be sourced. Pellet systems with hoppers are less intensive and feedstock is commercially available.
11	Financial incentives	2.5	Limited incentives.
12	Owner initiatives	4	Owner is open to renewable options.
13	CO2e emissions	3.5	Biomass does emit CO2 but the net reduction from the oil system will be significant.
14	Public awareness/education	3.5	Limited public use. Information could be displayed in the building so users are aware of biomass heating system.
	Total Score:	**50.5**	
	Total Possible Score:	**70**	
	Grade:	**72%**	

RENEWABLE ENERGY SCREENING WORKSHEET

Building/Facility:	Hollis Town Hall	Location:	Hollis, NH
Gross Area (sf):	15,606	Date:	3/2/2012
Use Category:	Office	EUI (kBtu/sf/yr):	64
Heating Fuel(s):	Oil (No. 2)	PM Grade:	NA
Heating System(s):	Hydronic	Cooling System(s):	Window AC

Technology: **Roof-Mounted Solar PV**

No.	Criteria	Score (1-5 pts.)	Notes/Comments
1	Demonstrated technology	5	Well demonstrated technology with more efficient panel systems in development.
2	Expected service life/durability	3	Expected service life of collector panels is 15 years.
3	Geographical considerations	3.5	Limited solar availability in New England.
4	Energy demand	3	Relatively low grid electrical demand.
5	Facility/systems conditions	3	Limited roof space faces south on the main building. South facing roof space is available on the smaller roof of the addition.
6	Facility/systems compatibility	3	Roof is new on main building but older on addition. Electrical system is old.
7	Permitting constraints	2.5	Utility grid connection permit is long-lead and may require a designed/engineered system.
8	Abutter concerns	4	Commercial/residential setting.
9	Capital investment	2.5	High capital cost.
10	O&M requirements	3	Increased roof maintenance and panel replacement.
11	Financial incentives	2.5	Limited incentives in NH.
12	Owner initiatives	4	Owner is open to renewable options.
13	CO2e emissions	4.5	Electrical source energy is NH has lower than average CO2 emissions.
14	Public awareness/education	5	High visibility in town square.
	Total Score:	**48.5**	
	Total Possible Score:	**70**	
	Grade:	**69%**	

RENEWABLE ENERGY SCREENING WORKSHEET

Building/Facility:	Hollis Town Hall	Location:	Hollis, NH
Gross Area (sf):	15,606	Date:	3/2/2012
Use Category:	Office	EUI (kBtu/sf/yr):	64
Heating Fuel(s):	Oil (No. 2)	PM Grade:	NA
Heating System(s):	Hydronic	Cooling System(s):	Window AC

Technology: **Ground-Mounted Solar PV**

No.	Criteria	Score (1-5 pts.)	Notes/Comments
1	Demonstrated technology	5	Well demonstrated technology with more efficient panel systems in development.
2	Expected service life/durability	3	Expected service life of collector panels is 15 years.
3	Geographical considerations	3.5	Limited solar availability in New England.
4	Energy demand	3	Relatively low grid electrical demand.
5	Facility/systems conditions	2.5	Older facility and systems.
6	Facility/systems compatibility	2.5	Limited land.
7	Permitting constraints	2.5	Utility grid connection permit is long-lead and may require a designed/engineered system.
8	Abutter concerns	3	Residential / commercial setting.
9	Capital investment	3	High capital cost.
10	O&M requirements	3.5	Vegetative cutting and panel replacement.
11	Financial incentives	2.5	Limited incentives in NH.
12	Owner initiatives	4	Owner is open to renewable options.
13	CO2e emissions	4.5	Electrical source energy is NH has lower than average CO2 emissions.
14	Public awareness/education	5	High visibility.
	Total Score:	**47.5**	
	Total Possible Score:	**70**	
	Grade:	**68%**	

RENEWABLE ENERGY SCREENING WORKSHEET

Building/Facility:	Hollis Town Hall	Location:	Hollis, NH
Gross Area (sf):	15,606	Date:	3/2/2012
Use Category:	Office	EUI (kBtu/sf/yr):	64
Heating Fuel(s):	Oil (No. 2)	PM Grade:	NA
Heating System(s):	Hydronic	Cooling System(s):	Window AC

Technology: **Wind Turbine Generator**

No.	Criteria	Score (1-5 pts.)	Notes/Comments
1	Demonstrated technology	4	A well demonstrated technology but proper site selection is critical.
2	Expected service life/durability	3	Some turbine units have proven unreliable (design flaws). Selection of a reputable manufacturer is critical.
3	Geographical considerations	2.5	Limited wind energy but a feasibility study is required.
4	Energy demand	3	Electric energy consumption is relatively low.
5	Facility/systems conditions	3	Older systems.
6	Facility/systems compatibility	3	Older systems.
7	Permitting constraints	2	Special permits are required depending on the height of the pole-mounted turbine. Roof-mounted turbines may be practical however they provide less energy.
8	Abutter concerns	2	Pole-mounted turbines have a large visual impact. Located in residential / commercial setting.
9	Capital investment	3.5	Moderate capital cost.
10	O&M requirements	3	Routine maintenance required. Units are subject to damage from elements.
11	Financial incentives	2.5	Limited incentives in NH.
12	Owner initiatives	4	Owner open to renewable options.
13	CO2e emissions	4	Electrical source energy is NH has lower than average CO2 emissions.
14	Public awareness/education	5	High visibility.
	Total Score:	**44.5**	
	Total Possible Score:	**70**	
	Grade:	**64%**	

RENEWABLE ENERGY SCREENING WORKSHEET

Building/Facility:	Hollis Town Hall	Location:	Hollis, NH
Gross Area (sf):	15,606	Date:	3/2/2012
Use Category:	Office	EUI (kBtu/sf/yr):	64
Heating Fuel(s):	Oil (No. 2)	PM Grade:	NA
Heating System(s):	Hydronic	Cooling System(s):	Window AC

Technology: **Solar Thermal HVAC**

No.	Criteria	Score (1-5 pts.)	Notes/Comments
1	Demonstrated technology	3.5	Well demonstrated technology but supply limited. More efficient than regular PV.
2	Expected service life/durability	4	Expected service life of system is 20-25 years.
3	Geographical considerations	3	Limited solar availability in New England.
4	Energy demand	3	Heating and cooling is moderate.
5	Facility/systems conditions	1	No air handling equipment currently installed.
6	Facility/systems compatibility	1	Considerable space required. Plumbing complex to protect against freezing. No mechanical equipment currently installed.
7	Permitting constraints	2.5	Utility grid connection permit is long-lead and may require a designed/engineered system.
8	Abutter concerns	3	Residential / commercial setting.
9	Capital investment	2	High capital cost.
10	O&M requirements	3	Vegetative cutting for ground mount, roof maintenance for roof mount, panel replacement.
11	Financial incentives	2.5	Limited incentives in NH.
12	Owner initiatives	4	Owner is open to renewable options.
13	CO2e emissions	4	Electrical source energy in NH has lower than average CO2 emissions.
14	Public awareness/education	5	High visibility.
	Total Score:	**41.5**	
	Total Possible Score:	**70**	
	Grade:	**59%**	

RENEWABLE ENERGY SCREENING WORKSHEET

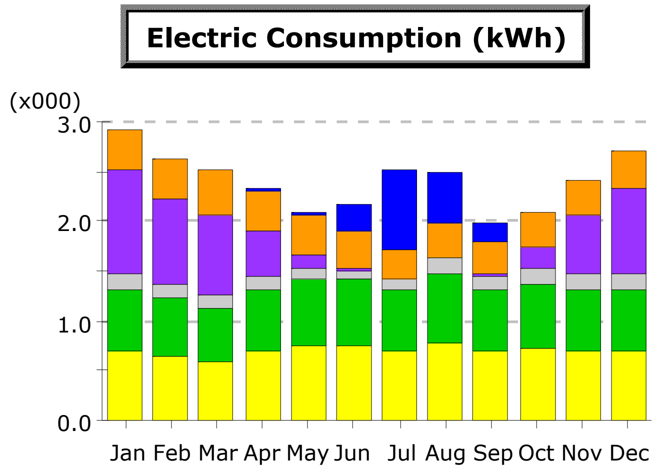
Building/Facility:	Hollis Town Hall	Location:	Hollis, NH
Gross Area (sf):	15,606	Date:	3/2/2012
Use Category:	Office	EUI (kBtu/sf/yr):	64
Heating Fuel(s):	Oil (No. 2)	PM Grade:	NA
Heating System(s):	Hydronic	Cooling System(s):	Window AC

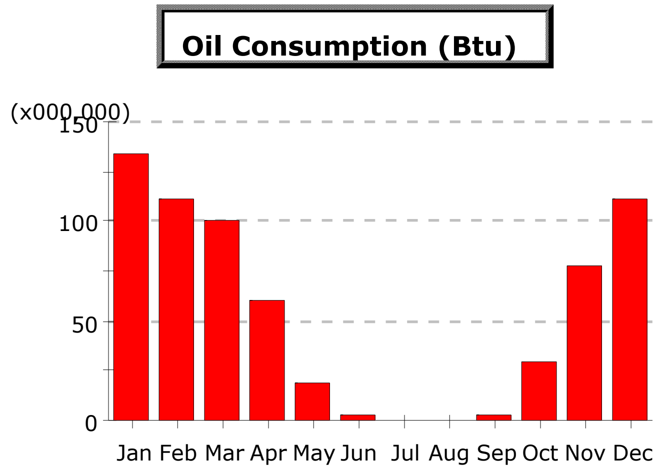
Technology: **Combined Heat & Power System**

No.	Criteria	Score (1-5 pts.)	Notes/Comments
1	Demonstrated technology	5	Smaller CHP units are relatively new technology. Larger units (+75kW) are more reliable.
2	Expected service life/durability	2.5	Expected service life for a small CHP unit is 10 yrs. Large CHPs have a 20 yr. service life.
3	Geographical considerations	3	NH has a low electrical energy cost.
4	Energy demand	3	Electric energy consumption is moderate.
5	Facility/systems conditions	2.5	Older building.
6	Facility/systems compatibility	1	No renewables currently on site.
7	Permitting constraints	5	No special permits required.
8	Abutter concerns	5	Modern CHPs are relatively quiet and would be inside of the building.
9	Capital investment	2	High capital cost.
10	O&M requirements	2	Frequent maintenance required. Large system manufacturers require that they complete maintenance for warranty validation.
11	Financial incentives	2	Limited incentives.
12	Owner initiatives	4	Owner is open to renewable options.
13	CO2e emissions	1	CHPs consume a large amount of fuel and emissions relative to the re-used energy.
14	Public awareness/education	2.5	Limited public use. Information could be displayed in the building so users are aware of CHP system. However CHP is not entirely renewable.
	Total Score:	**40.5**	
	Total Possible Score:	**70**	
	Grade:	**58%**	

APPENDIX I

eQUEST® Energy Efficiency Measure Modeling





Electric Consumption (kWh x000)

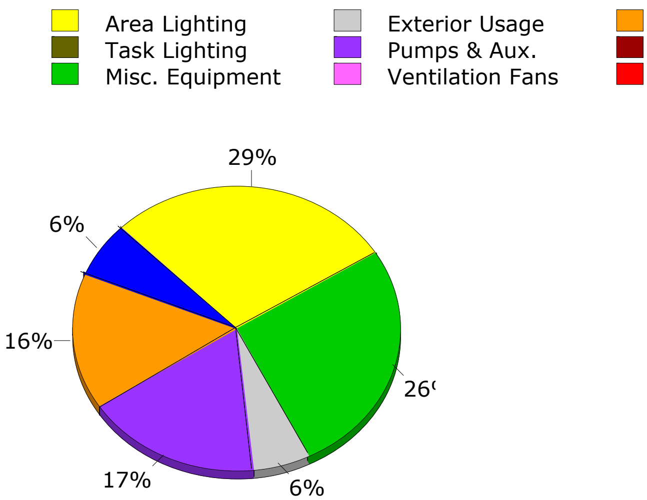
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	0.02	0.04	0.26	0.80	0.52	0.20	-	-	-	1.84
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	0.41	0.39	0.47	0.41	0.41	0.37	0.32	0.34	0.31	0.34	0.36	0.38	4.51
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	1.04	0.87	0.79	0.46	0.14	0.02	-	-	0.02	0.21	0.59	0.86	4.99
Ext. Usage	0.16	0.12	0.14	0.13	0.09	0.09	0.09	0.15	0.15	0.15	0.15	0.16	1.59
Misc. Equip.	0.63	0.59	0.54	0.62	0.68	0.68	0.63	0.70	0.62	0.65	0.62	0.63	7.59
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	0.69	0.65	0.60	0.68	0.75	0.74	0.69	0.78	0.68	0.72	0.68	0.69	8.33
Total	2.92	2.62	2.52	2.32	2.10	2.16	2.53	2.49	1.99	2.08	2.41	2.71	28.86

Oil Consumption (Btu x000,000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	134.09	111.44	100.60	59.64	18.81	2.39	-	-	3.01	29.53	78.21	110.98	648.70
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	134.09	111.44	100.60	59.64	18.81	2.39	-	-	3.01	29.53	78.21	110.98	648.70

Annual Energy Consumption by Enduse

	Electricity kWh	Oil MBtu	Steam Btu	Chilled Water Btu
Space Cool	1,840	-	-	-
Heat Reject.	-	-	-	-
Refrigeration	-	-	-	-
Space Heat	-	648.70	-	-
HP Supp.	-	-	-	-
Hot Water	4,513	-	-	-
Vent. Fans	-	-	-	-
Pumps & Aux.	4,986	-	-	-
Ext. Usage	1,595	-	-	-
Misc. Equip.	7,593	-	-	-
Task Lights	-	-	-	-
Area Lights	8,332	-	-	-
Total	28,858	648.70	-	-



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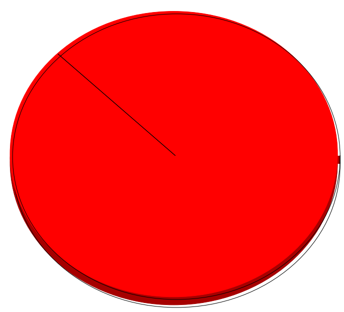

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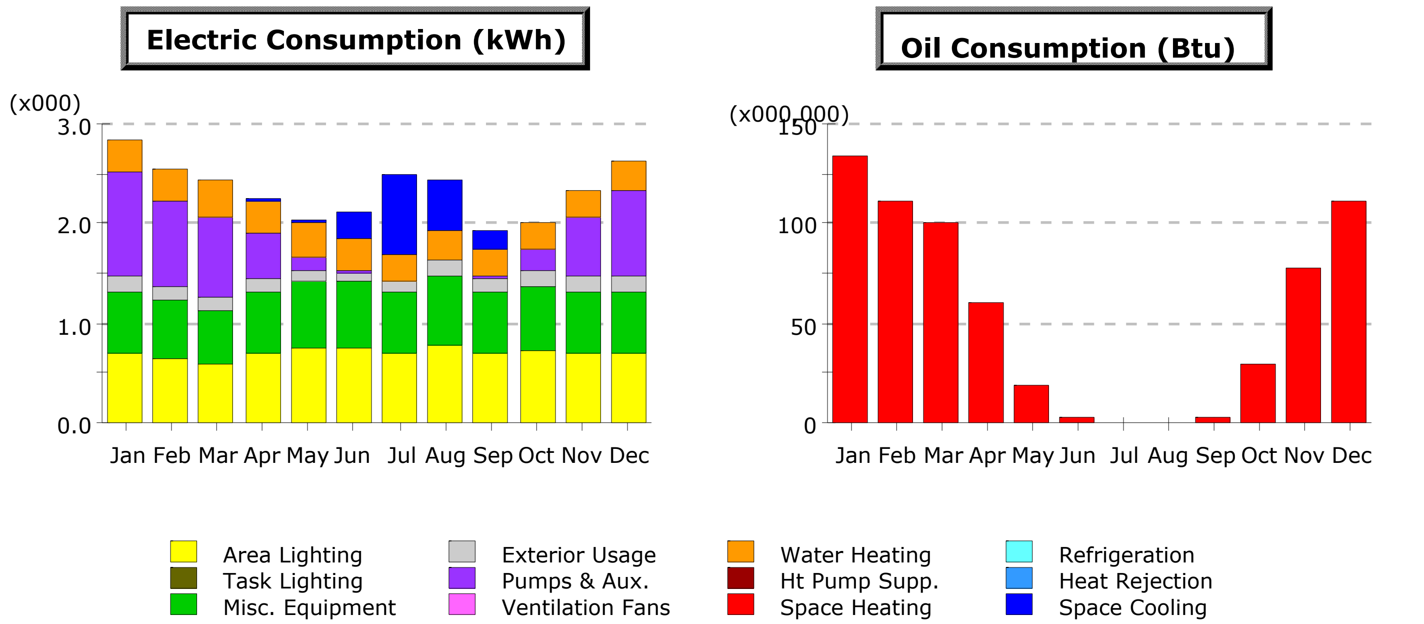


Electric Consumption (kWh x000)

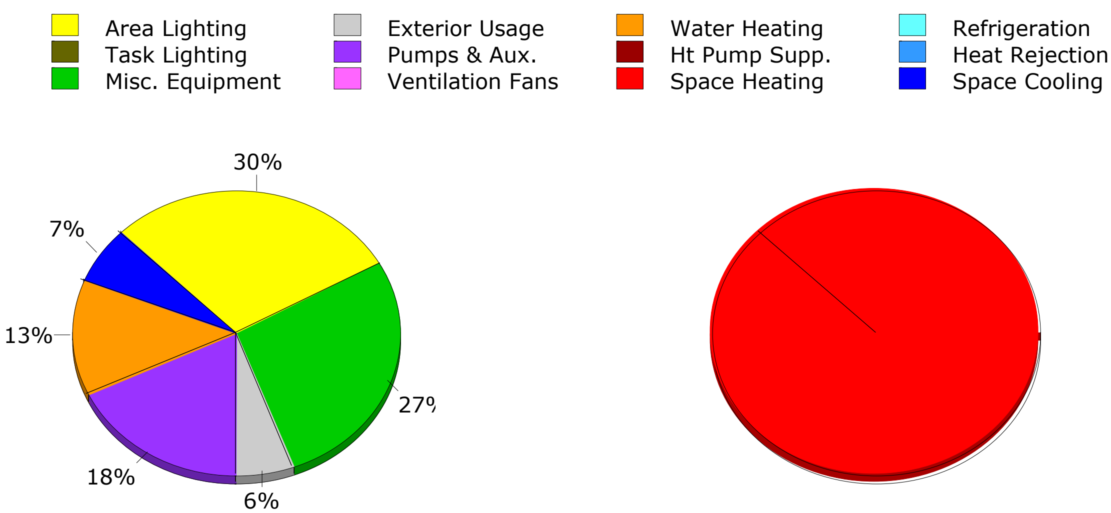
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	0.02	0.04	0.26	0.80	0.52	0.20	-	-	-	1.84
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	0.33	0.32	0.39	0.34	0.34	0.32	0.27	0.29	0.25	0.28	0.29	0.31	3.73
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	1.04	0.87	0.79	0.46	0.14	0.02	-	-	0.02	0.21	0.59	0.86	4.99
Ext. Usage	0.16	0.12	0.14	0.13	0.09	0.09	0.09	0.15	0.15	0.15	0.15	0.16	1.59
Misc. Equip.	0.63	0.59	0.54	0.62	0.68	0.68	0.63	0.70	0.62	0.65	0.62	0.63	7.59
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	0.69	0.65	0.60	0.68	0.75	0.74	0.69	0.78	0.68	0.72	0.68	0.69	8.33
Total	2.84	2.56	2.45	2.25	2.03	2.11	2.48	2.44	1.93	2.01	2.34	2.64	28.08

Oil Consumption (Btu x000,000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	134.09	111.44	100.60	59.64	18.81	2.39	-	-	3.01	29.53	78.21	110.98	648.70
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	134.09	111.44	100.60	59.64	18.81	2.39	-	-	3.01	29.53	78.21	110.98	648.70

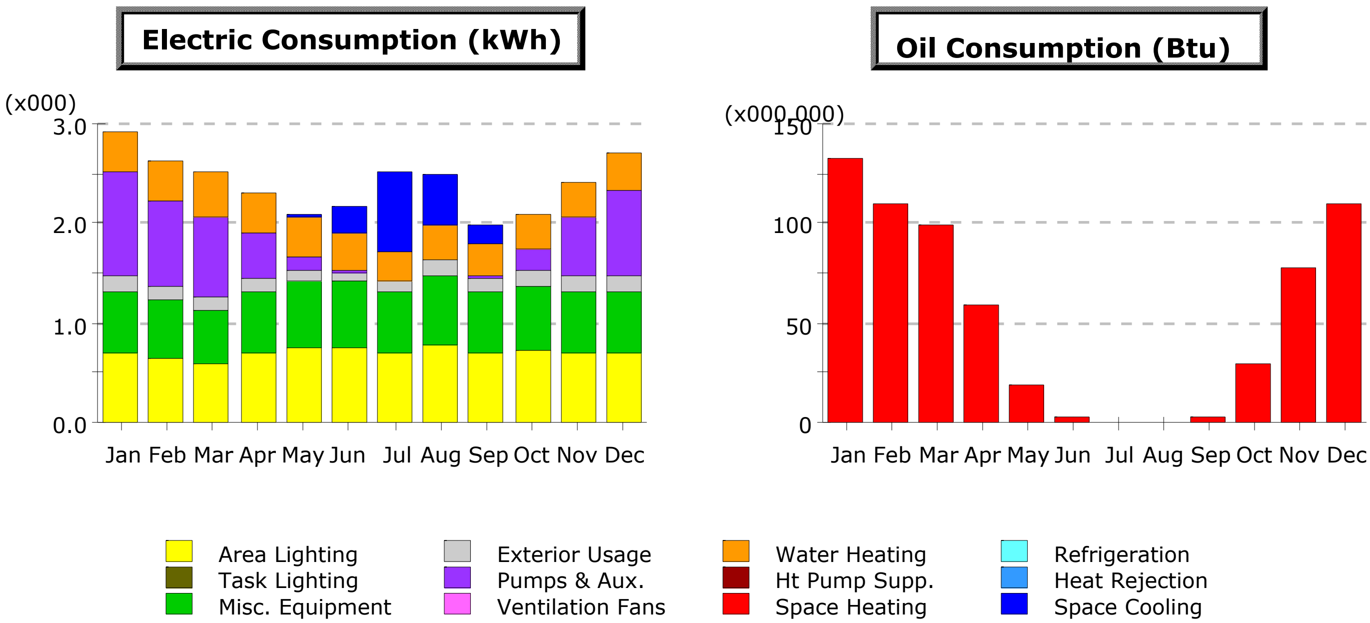
Annual Energy Consumption by Enduse

	Electricity kWh	Oil MBtu	Steam Btu	Chilled Water Btu
Space Cool	1,840	-	-	-
Heat Reject.	-	-	-	-
Refrigeration	-	-	-	-
Space Heat	-	648.70	-	-
HP Supp.	-	-	-	-
Hot Water	3,735	-	-	-
Vent. Fans	-	-	-	-
Pumps & Aux.	4,986	-	-	-
Ext. Usage	1,595	-	-	-
Misc. Equip.	7,593	-	-	-
Task Lights	-	-	-	-
Area Lights	8,332	-	-	-
Total	28,080	648.70	-	-



Electricity

Oil



Electric Consumption (kWh x000)

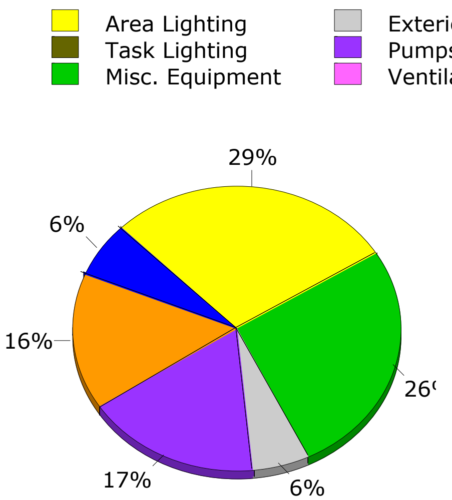
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	0.02	0.04	0.26	0.80	0.52	0.20	-	-	-	1.84
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	0.41	0.39	0.47	0.41	0.41	0.37	0.32	0.34	0.31	0.34	0.36	0.38	4.51
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	1.04	0.86	0.78	0.45	0.13	0.02	-	-	0.02	0.21	0.59	0.85	4.95
Ext. Usage	0.16	0.12	0.14	0.13	0.09	0.09	0.09	0.15	0.15	0.15	0.15	0.16	1.59
Misc. Equip.	0.63	0.59	0.54	0.62	0.68	0.68	0.63	0.70	0.62	0.65	0.62	0.63	7.59
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	0.69	0.65	0.60	0.68	0.75	0.74	0.69	0.78	0.68	0.72	0.68	0.69	8.33
Total	2.92	2.62	2.52	2.32	2.10	2.16	2.53	2.49	1.98	2.08	2.41	2.71	28.82

Oil Consumption (Btu x000,000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	133.09	110.34	99.44	58.59	18.31	2.29	-	-	2.83	28.90	77.33	109.91	641.04
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	133.09	110.34	99.44	58.59	18.31	2.29	-	-	2.83	28.90	77.33	109.91	641.04

Annual Energy Consumption by Enduse

	Electricity kWh	Oil MBtu	Steam Btu	Chilled Water Btu
Space Cool	1,840	-	-	-
Heat Reject.	-	-	-	-
Refrigeration	-	-	-	-
Space Heat	-	641.04	-	-
HP Supp.	-	-	-	-
Hot Water	4,513	-	-	-
Vent. Fans	-	-	-	-
Pumps & Aux.	4,952	-	-	-
Ext. Usage	1,595	-	-	-
Misc. Equip.	7,593	-	-	-
Task Lights	-	-	-	-
Area Lights	8,332	-	-	-
Total	28,825	641.04	-	-



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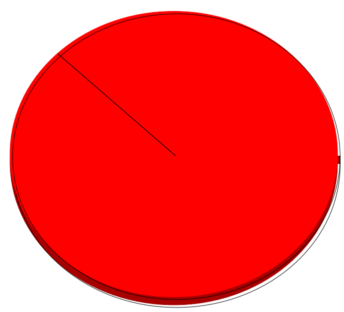

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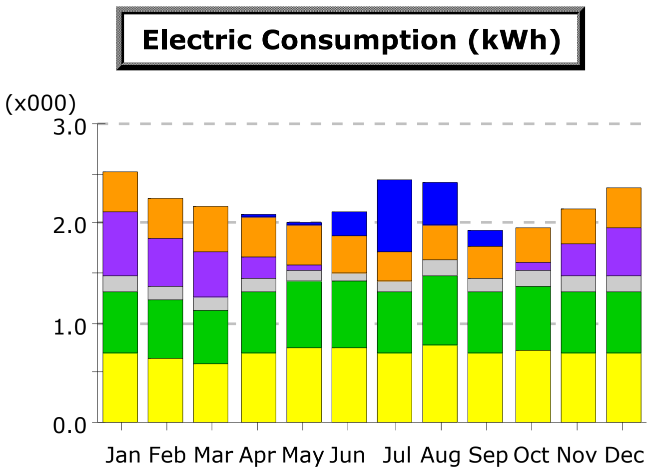
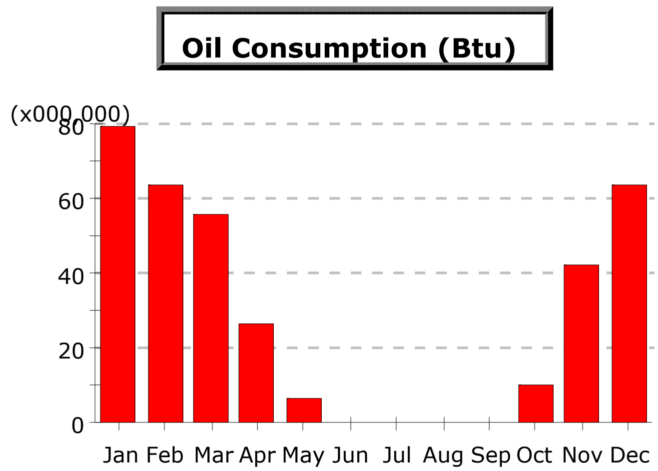




Electric Consumption (kWh x000)

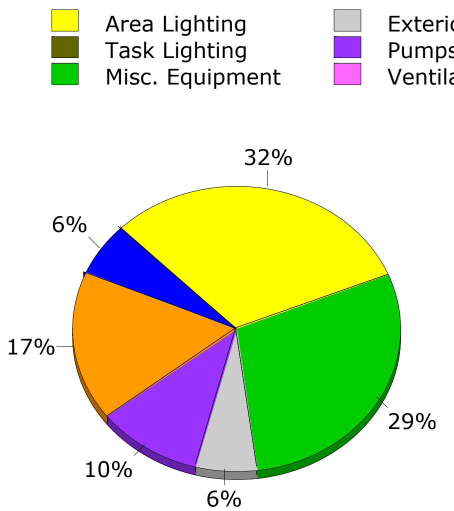
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	0.02	0.03	0.25	0.72	0.44	0.17	-	-	-	1.63
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	0.41	0.40	0.47	0.41	0.41	0.37	0.32	0.34	0.31	0.34	0.36	0.39	4.53
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	0.63	0.50	0.44	0.21	0.05	-	-	-	0.00	0.08	0.33	0.49	2.74
Ext. Usage	0.16	0.12	0.14	0.13	0.09	0.09	0.09	0.15	0.15	0.15	0.15	0.16	1.59
Misc. Equip.	0.63	0.59	0.54	0.62	0.68	0.68	0.63	0.70	0.62	0.65	0.62	0.63	7.59
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	0.69	0.65	0.60	0.68	0.75	0.74	0.69	0.78	0.68	0.72	0.68	0.69	8.33
Total	2.52	2.25	2.18	2.08	2.01	2.13	2.44	2.42	1.93	1.95	2.14	2.36	26.41

Oil Consumption (Btu x000,000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	79.10	63.22	55.46	26.69	6.65	-	-	-	-	9.82	41.89	63.23	346.05
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	79.10	63.22	55.46	26.69	6.65	-	-	-	-	9.82	41.89	63.23	346.05

Annual Energy Consumption by Enduse

	Electricity kWh	Oil MBtu	Steam Btu	Chilled Water Btu
Space Cool	1,626	-	-	-
Heat Reject.	-	-	-	-
Refrigeration	-	-	-	-
Space Heat	-	346.05	-	-
HP Supp.	-	-	-	-
Hot Water	4,527	-	-	-
Vent. Fans	-	-	-	-
Pumps & Aux.	2,735	-	-	-
Ext. Usage	1,595	-	-	-
Misc. Equip.	7,593	-	-	-
Task Lights	-	-	-	-
Area Lights	8,332	-	-	-
Total	26,408	346.05	-	-



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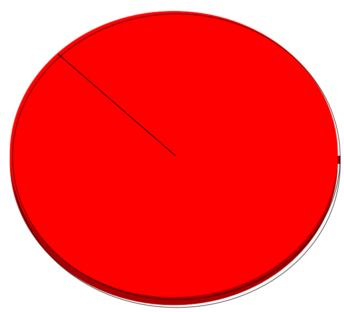

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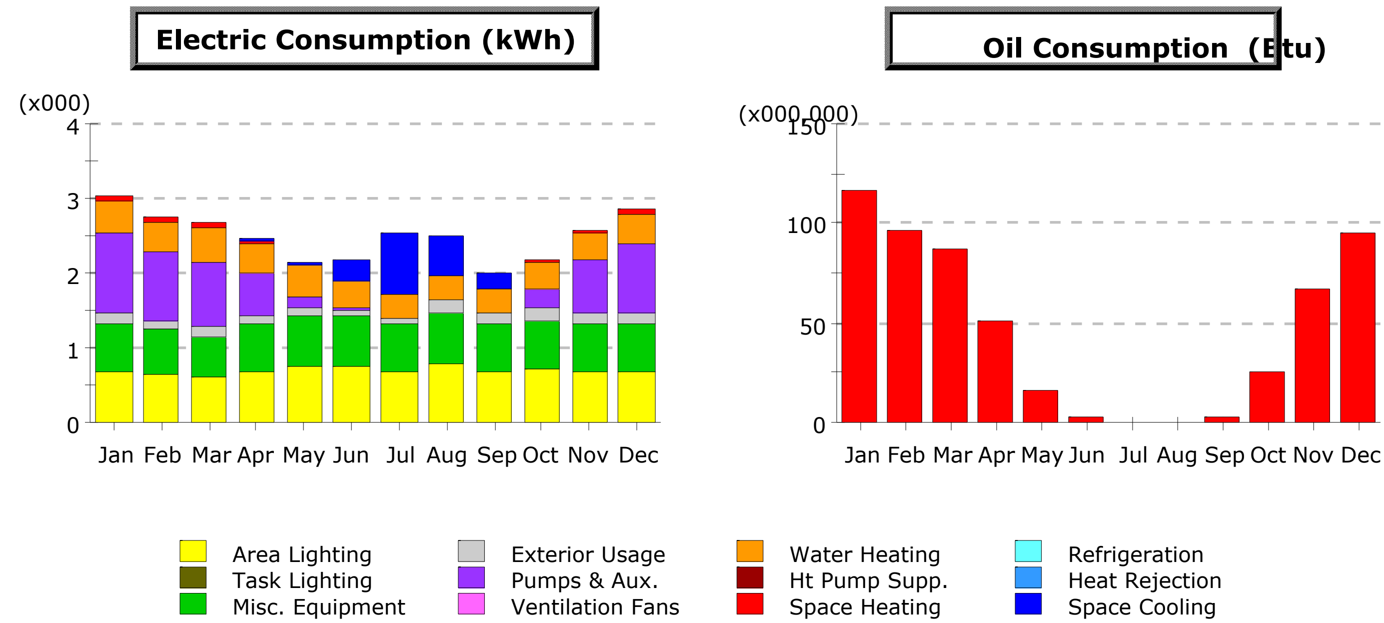


Electric Consumption (kWh x000)

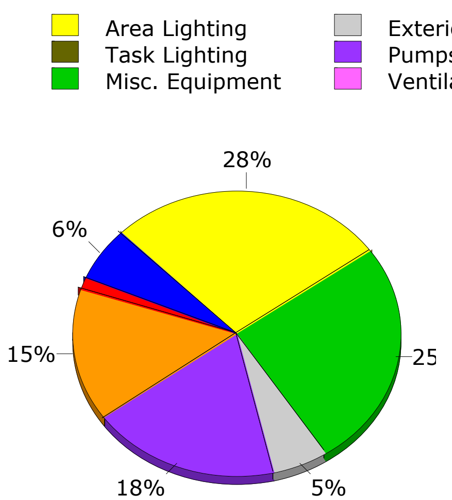
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	0.02	0.04	0.26	0.80	0.52	0.20	-	-	-	1.84
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	0.09	0.07	0.07	0.04	0.01	0.00	-	-	0.00	0.02	0.05	0.07	0.44
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	0.41	0.39	0.47	0.41	0.41	0.37	0.32	0.34	0.31	0.34	0.36	0.38	4.51
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	1.08	0.92	0.86	0.55	0.17	0.02	-	-	0.03	0.28	0.70	0.92	5.52
Ext. Usage	0.16	0.12	0.14	0.13	0.09	0.09	0.09	0.15	0.15	0.15	0.15	0.16	1.59
Misc. Equip.	0.63	0.59	0.54	0.62	0.68	0.68	0.63	0.70	0.62	0.65	0.62	0.63	7.59
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	0.69	0.65	0.60	0.68	0.75	0.74	0.69	0.78	0.68	0.72	0.68	0.69	8.33
Total	3.05	2.75	2.66	2.45	2.15	2.16	2.53	2.49	1.99	2.16	2.57	2.85	29.83

Oil Consumption (Btu x000,000)

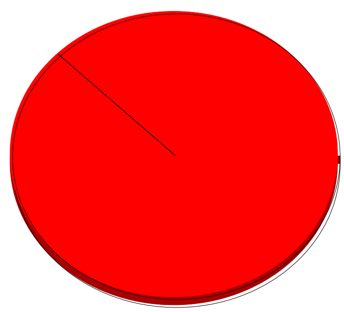
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	116.00	96.00	86.60	51.02	16.22	2.05	-	-	2.55	25.48	67.37	95.74	559.02
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	116.00	96.00	86.60	51.02	16.22	2.05	-	-	2.55	25.48	67.37	95.74	559.02

Annual Energy Consumption by Enduse

	Electricity kWh	Oil MBtu	Steam Btu	Chilled Water Btu
Space Cool	1,840	-	-	-
Heat Reject.	-	-	-	-
Refrigeration	-	-	-	-
Space Heat	437	559.02	-	-
HP Supp.	-	-	-	-
Hot Water	4,513	-	-	-
Vent. Fans	-	-	-	-
Pumps & Aux.	5,517	-	-	-
Ext. Usage	1,595	-	-	-
Misc. Equip.	7,593	-	-	-
Task Lights	-	-	-	-
Area Lights	8,332	-	-	-
Total	29,826	559.02	-	-



Electricity



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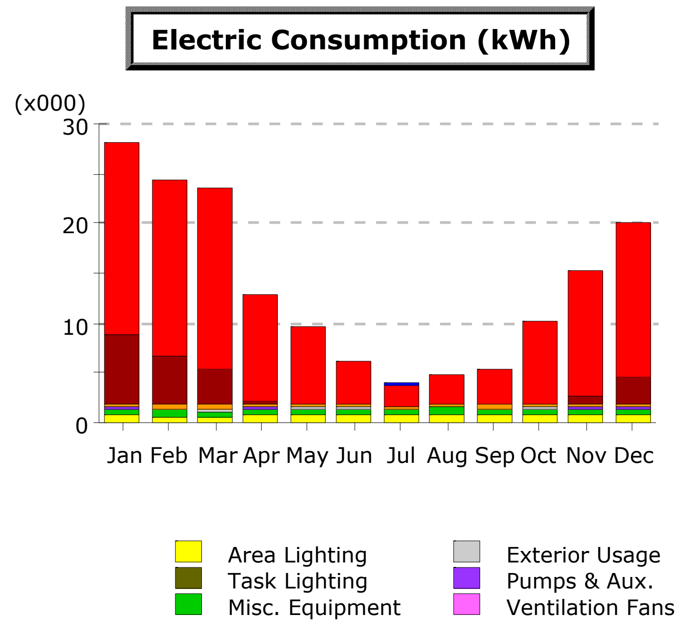


Electric Consumption (kWh x000)

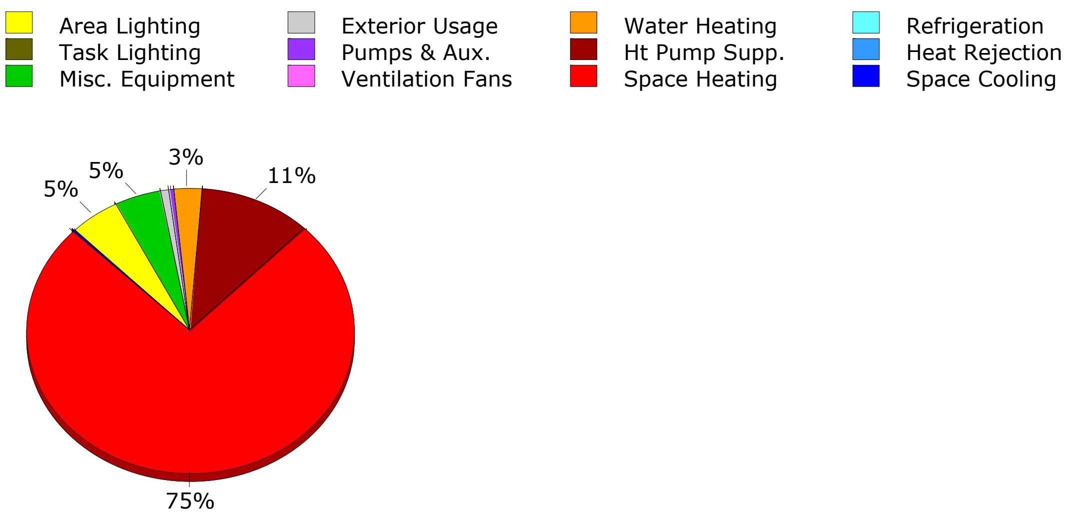
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	0.00	0.01	0.05	0.16	0.10	0.04	-	-	-	0.37
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	19.27	17.85	18.15	10.68	7.79	4.17	2.01	2.77	3.66	8.28	12.63	15.60	122.86
HP Supp.	6.89	4.75	3.48	0.22	-	-	-	-	-	0.01	0.72	2.61	18.68
Hot Water	0.41	0.40	0.47	0.41	0.41	0.37	0.32	0.34	0.31	0.34	0.36	0.39	4.53
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	0.11	0.10	0.11	0.10	0.02	-	-	-	0.00	0.04	0.10	0.11	0.70
Ext. Usage	0.16	0.12	0.14	0.13	0.09	0.09	0.09	0.15	0.15	0.15	0.15	0.16	1.59
Misc. Equip.	0.63	0.59	0.54	0.62	0.68	0.68	0.63	0.70	0.62	0.65	0.62	0.63	7.59
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	0.69	0.65	0.60	0.68	0.75	0.74	0.69	0.78	0.68	0.72	0.68	0.69	8.33
Total	28.16	24.46	23.48	12.85	9.74	6.10	3.90	4.85	5.46	10.20	15.27	20.18	164.65

Gas Consumption (Btu)

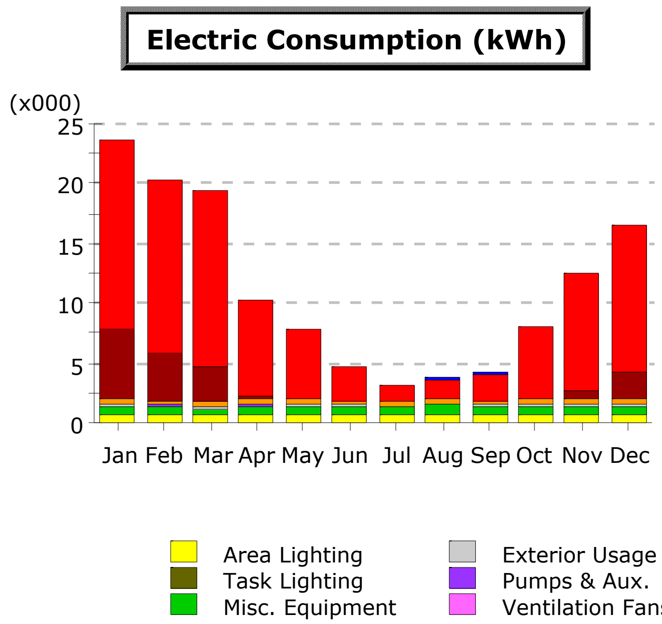
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool													
Heat Reject.													
Refrigeration													
Space Heat													
HP Supp.													
Hot Water													
Vent. Fans													
Pumps & Aux.													
Ext. Usage													
Misc. Equip.													
Task Lights													
Area Lights													
Total													

Annual Energy Consumption by Enduse

	Electricity kWh (x000)	Natural Gas Btu	Steam Btu	Chilled Water Btu
Space Cool	0.37	-	-	-
Heat Reject.	-	-	-	-
Refrigeration	-	-	-	-
Space Heat	122.86	-	-	-
HP Supp.	18.68	-	-	-
Hot Water	4.53	-	-	-
Vent. Fans	-	-	-	-
Pumps & Aux.	0.70	-	-	-
Ext. Usage	1.59	-	-	-
Misc. Equip.	7.59	-	-	-
Task Lights	-	-	-	-
Area Lights	8.33	-	-	-
Total	164.65	-	-	-



Electricity



Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	0.01	0.01	0.06	0.18	0.12	0.05	-	-	-	0.42
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	15.98	14.61	14.65	8.13	5.97	2.74	1.30	1.69	2.34	6.17	9.95	12.40	95.93
HP Supp.	5.74	3.89	2.95	0.22	-	-	-	-	-	0.01	0.72	2.16	15.68
Hot Water	0.41	0.40	0.47	0.41	0.41	0.37	0.32	0.34	0.31	0.34	0.36	0.39	4.53
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	0.11	0.10	0.11	0.10	0.02	-	-	-	0.00	0.04	0.10	0.11	0.70
Ext. Usage	0.16	0.12	0.14	0.13	0.09	0.09	0.09	0.15	0.15	0.15	0.15	0.16	1.59
Misc. Equip.	0.63	0.59	0.54	0.62	0.68	0.68	0.63	0.70	0.62	0.65	0.62	0.63	7.59
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	0.69	0.65	0.60	0.68	0.75	0.74	0.69	0.78	0.68	0.72	0.68	0.69	8.33
Total	23.72	20.36	19.45	10.30	7.92	4.68	3.21	3.79	4.15	8.08	12.59	16.53	134.79

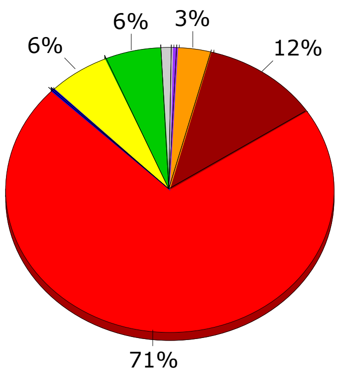
Gas Consumption (Btu)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool													
Heat Reject.													
Refrigeration													
Space Heat													
HP Supp.													
Hot Water													
Vent. Fans													
Pumps & Aux.													
Ext. Usage													
Misc. Equip.													
Task Lights													
Area Lights													
Total													

Annual Energy Consumption by Enduse

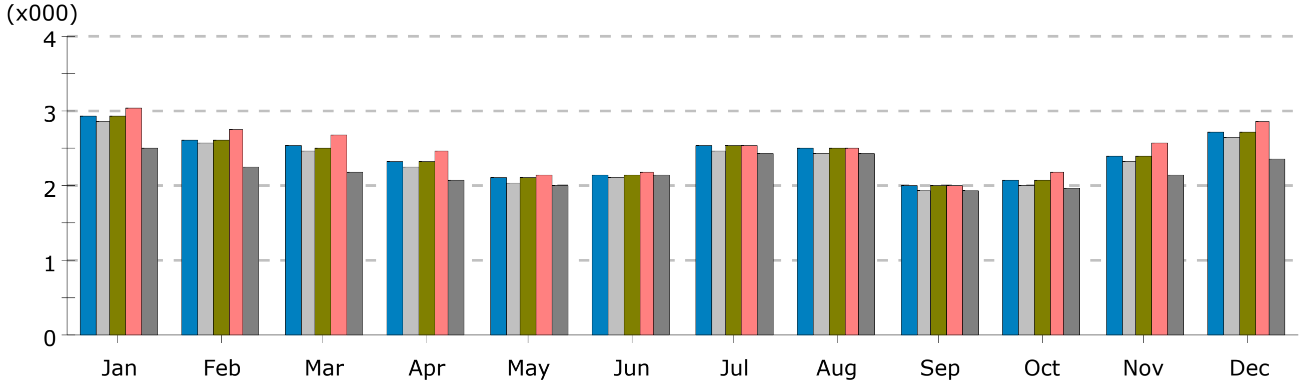
	Electricity kWh (x000)	Natural Gas Btu	Steam Btu	Chilled Water Btu
Space Cool	0.42	-	-	-
Heat Reject.	-	-	-	-
Refrigeration	-	-	-	-
Space Heat	95.93	-	-	-
HP Supp.	15.68	-	-	-
Hot Water	4.53	-	-	-
Vent. Fans	-	-	-	-
Pumps & Aux.	0.70	-	-	-
Ext. Usage	1.59	-	-	-
Misc. Equip.	7.59	-	-	-
Task Lights	-	-	-	-
Area Lights	8.33	-	-	-
Total	134.79	-	-	-

Area Lighting
Task Lighting
Misc. Equipment
Exterior Usage
Pumps & Aux.
Ventilation Fans
Water Heating
Ht Pump Supp.
Space Heating
Refrigeration
Heat Rejection
Space Cooling



Electricity

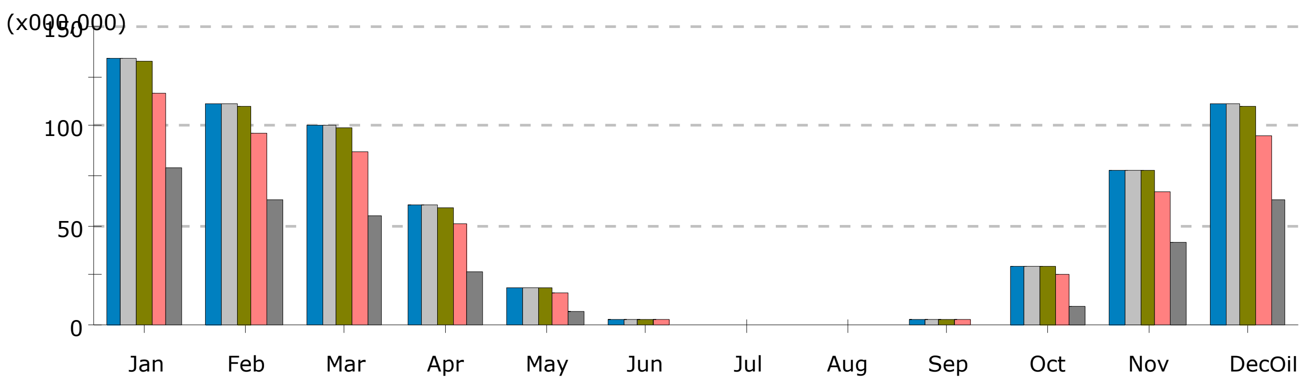
Electric Consumption (kWh)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Run 1.	2.92	2.62	2.52	2.32	2.10	2.16	2.53	2.49	1.99	2.08	2.41	2.71	28.86
Run 2.	2.84	2.56	2.45	2.25	2.03	2.11	2.48	2.44	1.93	2.01	2.34	2.64	28.08
Run 3.	2.92	2.62	2.52	2.32	2.10	2.16	2.53	2.49	1.98	2.08	2.41	2.71	28.82
Run 4.	3.05	2.75	2.66	2.45	2.15	2.16	2.53	2.49	1.99	2.16	2.57	2.85	29.83
Run 5.	2.52	2.25	2.18	2.08	2.01	2.13	2.44	2.42	1.93	1.95	2.14	2.36	26.41

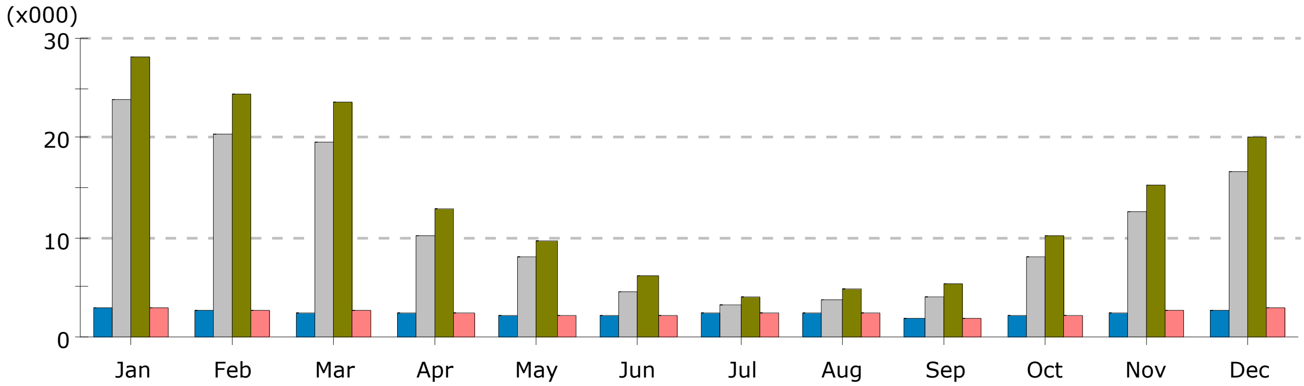
1. Hollis Town Hall Baseline
2. Hollis Town Hall Tankless Hot Water Heater
3. Hollis Town Hall Insulate Hydronic Piping
4. Hollis Town Hall Boiler Replacement
5. Hollis Town Hall Insulate Building

Oil Consumption (Btu)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Run 1.	134.09	111.44	100.60	59.64	18.81	2.39	-	-	3.01	29.53	78.21	110.98	648.70
Run 2.	134.09	111.44	100.60	59.64	18.81	2.39	-	-	3.01	29.53	78.21	110.98	648.70
Run 3.	133.09	110.34	99.44	58.59	18.31	2.29	-	-	2.83	28.90	77.33	109.91	641.04
Run 4.	116.00	96.00	86.60	51.02	16.22	2.05	-	-	2.55	25.48	67.37	95.74	559.02
Run 5.	79.10	63.22	55.46	26.69	6.65	-	-	-	-	9.82	41.89	63.23	346.05

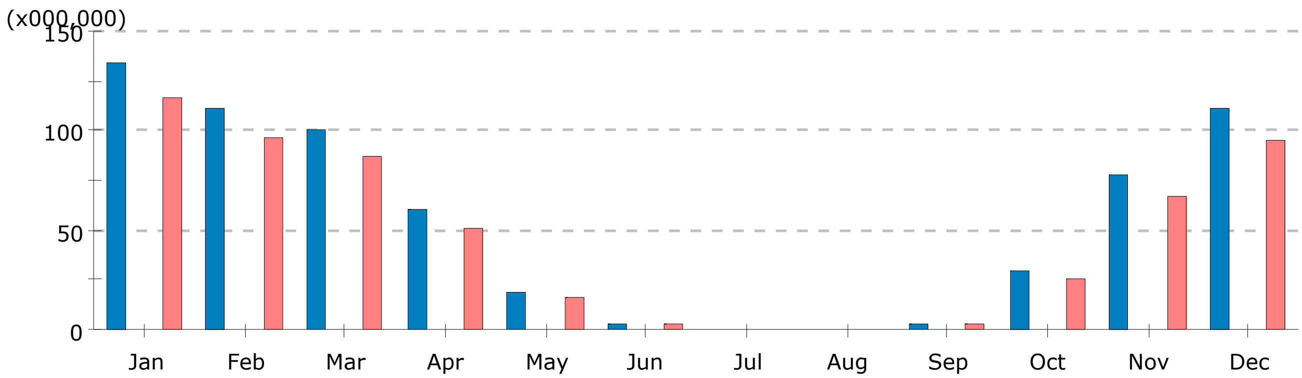
Electric Consumption (kWh)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Run 1.	2.92	2.62	2.52	2.32	2.10	2.16	2.53	2.49	1.99	2.08	2.41	2.71	28.86
Run 2.	23.72	20.36	19.45	10.30	7.92	4.68	3.21	3.79	4.15	8.08	12.59	16.53	134.79
Run 3.	28.16	24.46	23.48	12.85	9.74	6.10	3.90	4.85	5.46	10.20	15.27	20.18	164.65
Run 4.	3.05	2.75	2.66	2.45	2.15	2.16	2.53	2.49	1.99	2.16	2.57	2.85	29.83
Run 5.													

1. Hollis Town Hall Basline
2. Hollis Town Hall Heat Pumps and Insulation
3. Hollis Town Hall hHeat Pumps
4. Hollis Town Hall Boiler Replacement

Oil Consumption (Btu)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Run 1.	134.09	111.44	100.60	59.64	18.81	2.39	-	-	3.01	29.53	78.21	110.98	648.70
Run 2.	-	-	-	-	-	-	-	-	-	-	-	-	-
Run 3.	-	-	-	-	-	-	-	-	-	-	-	-	-
Run 4.	116.00	96.00	86.60	51.02	16.22	2.05	-	-	2.55	25.48	67.37	95.74	559.02
Run 5.													

APPENDIX J

Cost Estimates

BUDGETARY COST ESTIMATE

Facility: **Hollis Town Hall**

Date: **3/7/2012**

EEM	Design + Engineering	Installed Cost				Construction Management	Contingency (15%)	Total Investment
		Pricing Unit	Price	Qty	Subtotal			
Add 4" of blown-in cellulose insulation to the addition ceiling (plaster ceiling) and seal and insulate the hatch.	$ 500	EA	$ 4,500	1	**$ 4,500**	$ 450	$ 818	**$ 6,268**
Install 2 staggered layers of 1" FF rigid polyisocyanurate insulation (R-14) on interior of basement walls and tape-seal seams.	$ 500	BF	$ 2.32	2,000	**$ 4,640**	$ 464	$ 841	**$ 6,445**
Install a vapor/moisture barrier (4-mil polyethylene sheeting) and place 6" of blown-in cellulose insulation in the addition crawlspace.	$ 750	EA	$ 7,750	1	**$ 7,750**	$ 775	$ 1,391	**$ 10,666**
Air-seal all floor penetrations and install additional six (6) inches of blown cellulose insulation in attic.	$ 500	EA	$ 9,700	1	**$ 9,700**	$ 970	$ 1,676	**$ 12,846**
Restore the original historic windows (21) with coil spring pulleys, insulate weight boxes with spray foam, seal top portion of double-hung units, and install interior storm window units.	$ 3,250	EA	$ 1,650	21	**$ 34,650**	$ 3,465	$ 6,205	**$ 47,570**
Replace two (2) boiler units with high-efficiency oil fired units. Replace existing heating registers with modern control valves and fin tube heating units. Improve zone control and install new programmable thermostats.	$ 2,700	EA	$ 47,540	1	**$ 47,540**	$ 4,754	$ 8,249	**$ 63,243**
Replace existing original windows with new fiberglass frame triple-pane high effiicency historically correct custom windows (21).	$ 2,700	EA	$ 2,780	21	**$ 58,380**	$ 5,838	$ 10,038	**$ 76,956**
Insulate second floor walls of original building: limited demolition of original plaster wall sections and injection holes, fill/inject larger cavities with blown-in dense-packed cellulose insulation, inject small cavities (including wall corners, plates, and window and door frames) with open-cell polyurethane foam, patch and finish walls. Assume 8" deep wall cavity. Apply polyurethane caulking to air-seal all wall penetrations and gaps. Provide real-time verification of cavity insulation using IR camera and camera scope.	$ 5,500	SF	$ 6.70	3,500	**$ 23,450**	$ 2,345	$ 4,694	**$ 35,989**
Insulate first floor walls of original building: demolition of newer framed walls and limited demolition of original plaster wall sections, fill/inject larger cavities with blown-in dense-packed cellulose insulation, inject small cavities (including wall corners, plates, and window and door frames) with open-cell polyurethane foam, patch walls/install gypsum board and finish walls. Assume 8" deep wall cavity. Apply polyurethane caulking to air-seal all wall penetrations and gaps. Provide real-time verification of cavity insulation using IR camera and camera scope.	$ 5,500	SF	$ 6.88	2,500	**$ 17,200**	$ 1,720	$ 3,663	**$ 28,083**
Replace the existing hydronic heating system and window air-conditioning units with a high-efficiency inverter driven electric air-source heat pump system (VRF). Add interlocked ERV ventilation system.	$ 12,400	EA	$ 234,000	1	**$ 234,000**	$ 23,400	$ 40,470	**$ 310,270**