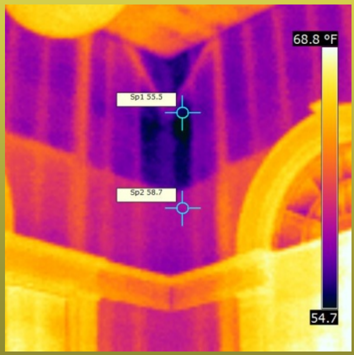

Facility Audit Report
Hollis Social Library

FINAL

May 2012

Prepared for:
Town of Hollis
7 Monument Square
Hollis, NH 03049

Prepared by:
Acadia Engineers & Constructors
90 Main Street
Newmarket, NH 03857

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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 Social Library

Phase one of the evaluation process involves site assessment planning including evaluating utility bills, benchmarking, reviewing building and mechanical plans where available, and coordinating site and visits. Phase two involves conducting 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 Social Library (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 January 3rd and 23rd, 2012 AEC personnel completed building site reviews at the Social Library 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 Social Library 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 Social Library 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 Social Library building:

1. The facility uses less energy than expected.
2. The facility does not have a mechanical exchange air ventilation system.
3. The envelope of the building is poorly insulated.

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.

- Energy use intensities (EUI) for the building are below the expected range for a library facility. The ENERGY STAR® Portfolio Manager indicates that the Hollis Social Library uses 62% less source energy than the library facilities currently entered in Portfolio Manager.
- Water infiltration and mold are evident in the basement. Two sump pumps and a portable dehumidification unit are used to control water infiltration and humidity levels.
- Mold is evident on the basement walls and ceiling.
- Water staining on framing timbers is evident in the original building attic. This appears to be an artifact of previous roof leaks.
- The thermal imaging survey revealed notable gaps in envelope insulation.
- The original copper roof of the dome was being replaced during the audit to repair persistent leaks.
- Dated knob and tube electrical wiring exists in the attic section. The wiring appears to be disconnected.

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. 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 III and more costly Tier II measures are presented in Appendix J.

Table 1: Energy Efficiency Measure Summary

EEM No.	EEM Description	Capital Cost	Annual Cost Savings	Payback (yrs.)	SIR
T1-1	Disconnect condensers on the two (2) water fountains.	$0	$262	-	-
T1-2	Disconnect cooling and heating element in water cooler in staff area.	$0	$236	-	-
T1-3	Close shades on the original building at night in the winter and during the day in the summer to limit thermal losses and gains.	$0	$75	-	-
T1-4	Install time controller on photocopier.	$45	$120	0.4	26.7
T1-5	Seal and insulate dome access hatch.	$25	$10	2.5	8.0
T1-6	Install a thermostatically controlled solar powered attic roof fan to reduce heating loads in summer months.	$850	$450	1.9	6.3
T1-7	Replace dehumidifier in basement with ENERGY STAR® model.	$115	$60	1.9	5.2
T1-8	Install draft damper in the book return box.	$150	$37	8.1	4.9
T1-9	Complete air-sealing on all on all entry door jambs, window jambs, partings, and moldings (interior and exterior).	$1,300	$650	2.0	4.0
T2-1	Replace existing domestic hot water heater with tankless propane hot water heater.	$1,200	$350	3.4	4.4
T2-2	Install task lighting (wall fixtures and lamps) in reading areas and offices and reduce overhead lighting.	$2,030	$410	5.0	3.0
T3-1	Install 2" rigid polyisocyanurate insulation (R-14) on interior basement walls and tape-seal joints. Apply spray-foam polyurethane insulation around sill interior.	$5,271	$310	17.0	2.1
T3-2	Remove existing fiberglass insulation in attic of dome and insulated with six (6) inches of closed-cell spray foam. Replace insulation in addition and add and addition six (6) inches of blow cellulous insulation to addition attic.	$29,770	$1,472	20.2	1.7
T3-3	Replace existing air condition condensers (5) with fewer (2 or 3) high-efficiency units (min. SEER 19). *(In lieu of EEM T3-7)*	$6,560	$545	12.0	1.7
T3-4	Identify gaps in insulation in wall sections and inject dense-pack cellulose or open-cell polyurethane spray foam into walls. Refer to IR appendix for sections and verify with IR camera.	$9,293	$370	25.1	1.4
T3-5	Replace the existing suspended trough fixtures with efficient T8 units and reduce wattage to provide recommended lighting densities.	$23,747	$915	26.0	1.0
T3-6	Replace exterior metal halide light fixtures with LED units (4).	$2,457	$90	27.3	0.9
T3-7	Replace the existing furnaces and split A/C units with an electric air-source heat pump system. Add interlocked energy recovery ventilation (ERV) system. *(In lieu of EEM T3-3)*	$136,505	$3,910	34.9	0.7

The following table summarizes the renewable energy technologies that were considered for the Hollis Social Library. 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	Score
Geothermal Heating and Cooling	84%
Solar Domestic Hot Water	78%
Biomass Heating	74%
Roof-Mounted Photovoltaic	73%
Ground-Mounted Photovoltaic	70%
Wind Turbine Generator	64%
Solar Thermal Heating	61%
Combined Heat and 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	1.1
Original Wall (c. 1910)	13.0 +3.8 ci	13.0 +3.8 ci	10.7
Addition Wall (c. 1993)	13.0 +3.8 ci	13.0 +3.8 ci	12.5
Original Attic (c. 1910)	38	38	10.6
Addition Attic (c. 1993)	38	38	16.6

Master Planning Considerations

The Hollis Social Library is a landmark building located in the historic Hollis Town Common. Constructed in 1910 as a library and social gathering place, it remains a functioning public library. In 1993 a major addition was constructed on the north side of the original structure. The original historic facility has been well preserved and maintained. Recent repairs include replacement of the copper dome roof. As part of the addition construction nineteen years ago, building systems were modernized including new furnaces and air conditioning units. No other major improvements have been made since that time.

Figure 2: Hollis Social Library (c. 2010)

Existing facility issues include groundwater infiltration into the basement mechanical room 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 and increased heating and cooling loads.

Insulation was recently added to the attic floor of the 1910 and 1993 building sections however much of the insulation has been disturbed and thermal transfer is evident. Little insulation exists in the walls of the original structure.

The existing heating system includes five (5) gas-fired residential Lennox® furnaces which supply forced-hot-air to the building. Cooling is provided by five (5) Rheem® condensing units which have a low efficiency rating compared to modern units. There are no mechanical exchange air ventilation systems in the building and air is currently exchanged by passive leakage through the building envelope and through door and windows.

The condition of the Social Library building systems are acceptable however planning and budgeting for the recommended improvements in the near future is prudent. Groundwater infiltration and high humidity levels promote fungal activity including mold development, reduced service life of mechanical equipment and building materials, and reduced indoor air quality and occupant comfort. The residential heating and cooling systems are nearing the end of their useful lives and the thermal integrity of the envelope can be substantially improved. Implementation of the recommended major improvements would reduce energy consumption and costs, improve indoor air quality, improve occupant comfort, and reduce the carbon footprint of the facility.

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 Hollis Social Library. 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, 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, the more favorable the return on investment is.

C. FACILITY BACKGROUND & ENERGY CONSUMPTION

Setting

The Hollis Social Library is located in Hollis, NH within a light commercial setting (Figure 3). The building and facilities are located on a land parcel owned by the Town of Hollis. The Library is located on the north side of Monument Square (2 Monument Square) within the Hollis Village Historic District. Abutting the library to the west is a Town owned baseball field and playground. The Congregational Church and cemetery abut the library to the east.

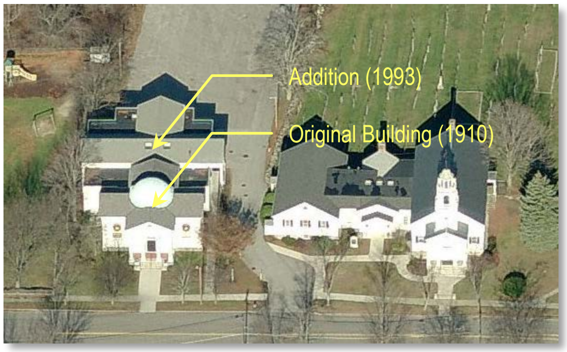


Figure 3: Aerial Photograph of Library (c. 2010)

A driveway separates the library and church leading to a parking lot to the north of the building. Given its location it is presumed that this parking lot is shared by library staff and patrons, church staff and patrons, the cemetery, and the recreation area. Wetlands lie beyond the parking lot to the north. The reported gross area of the Social Library is 7,795 square feet.

History

The Hollis Social Library was built in 1910 and is believed to be one of the oldest libraries established in New Hampshire. The library originated in 1851 and was kept in the church vestry. In 1886 when the Town Hall was constructed the library was relocated there until the current structure was built. In 1993 a major addition to the rear of the original building was erected thereby increasing the area of the original structure by nearly three times. This addition provides functional space for the children's library, a meeting room, an office space, and expanded library space.


Figure 4: Hollis Social Library (c. 1930)

In the winter of 2011/2012 the architecturally significant copper roof of the original building dome was replaced with a new period correct copper roof to mitigate persistent leaks. A history of groundwater infiltration into the basement is evident. The original library structure has been well preserved and maintained.

Use, Function & Occupancy Schedule

The Hollis Social Library and the land it occupies are owned by the Town of Hollis. The building is a single-story structure and functional space consists of a meeting room, children's library, staff desk and office space, and the main library area housing the collection and providing reading areas. Spatial configuration and function appear to adequately serve the needs of the library staff and patrons.

The library is open Monday to Thursday from 1030 to 2030, Friday from 1030 to 1730, Saturday from 1030 to 1700 (closes at 1430 in July and August), and Sunday from 1300 to 1700 (except July and August). This provides 57.5 operational hours per week with the exception of July and August (51 hours per week). The library is closed for seventeen (17) days in observance of holidays.

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 Social Library evaluation includes the following:

- The basement has a persistent problem of flooding, therefore three (3) sump pumps were installed, with two of them running continuously and one as a backup (Figure 5).
- Heating control is zoned and has a nighttime setback.
- With the exception of Sunday's, daily events are scheduled to attract various patrons in addition the regular library activities.

Figure 5: Basement Sump Pumps

Utility Data

Utility data for the Hollis Social Library was provided by the Town. Table 5 summarizes the total energy consumption for two years including electric and liquefied propane (LP) usage. Energy consumption and cost for electricity per pay period is shown in Table 6 and Figure 6. The regional electric utility supplier is Public Service Company of New Hampshire (PSNH) and LP provided by a local supplied.

Table 5: Annual Energy Consumption (2010-2011)

Energy	Period	Consumption	Units	Cost
Electric	December 2009 – November 2010	57,220	Kilowatt hours	$9,225
LP	December 2009 – November 2010	3,023	Gallons	$6,210
Total Annual Energy Cost (2009 – 2010):				$15,435
Electric	December 2010 – November 2011	40,440	Kilowatt hours	$6,669
LP	December 2010 – November 2011	2,875	Gallons	$4,838
Total Annual Energy Cost (2010 – 2011):				$11,507

The monthly electrical usage (Figure 5) reveals that the use is not consistent throughout the year. Over the twelve (12) month period (2009 – 2010), August was the peak demand month at 8,050 kWh. For the other twelve month period (2010-2011), July and August were the peak demand months, consuming 4,220 kWh and 4,240 kWh of electricity. Due to this summer peak for both years, it is estimated that cooling equipment consumes a large amount of energy.

Table 6: Monthly Electric Consumption (2010-2011)

Month	Year	Electric Use (kWh)	Cost
Dec	2009	3,460	$521
Jan	2010	3,740	$554
Feb	2010	3,880	$567
Mar	2010	3,630	$540
Apr	2010	4,960	$714
May	2010	3,450	$538
June	2010	3,520	$679
July	2010	6,570	$1,120
Aug	2010	8,050	$1,253
Sep	2010	7,250	$1,195
Oct	2010	4,590	$908
Nov	2010	4,120	$638
Totals:	*09 - '10*	*57,220*	*$9,225*
Dec	2010	3,490	$540
Jan	2011	3,690	$573
Feb	2011	3,550	$540
Mar	2011	3,200	$493
Apr	2011	3,450	$518
May	2011	2,600	$412
June	2011	3,090	$613
July	2011	4,220	$748
Aug	2011	4,240	$741
Sep	2011	3,380	$562
Oct	2011	3,000	$533
Nov	2011	2,530	$395
Totals:	*10 - '11*	*40,440*	*$6,669*
Totals:	*09 - '11*	*97,660*	*$15,894*

Annual electric usage for the Hollis Library based on the most recent data provided by Town of Hollis (December 2009 through November 2011) is averaged at 48,830 kWh at an average cost of $7,947. Based on the building size and function, this usage is relatively less than similar use library facilities.

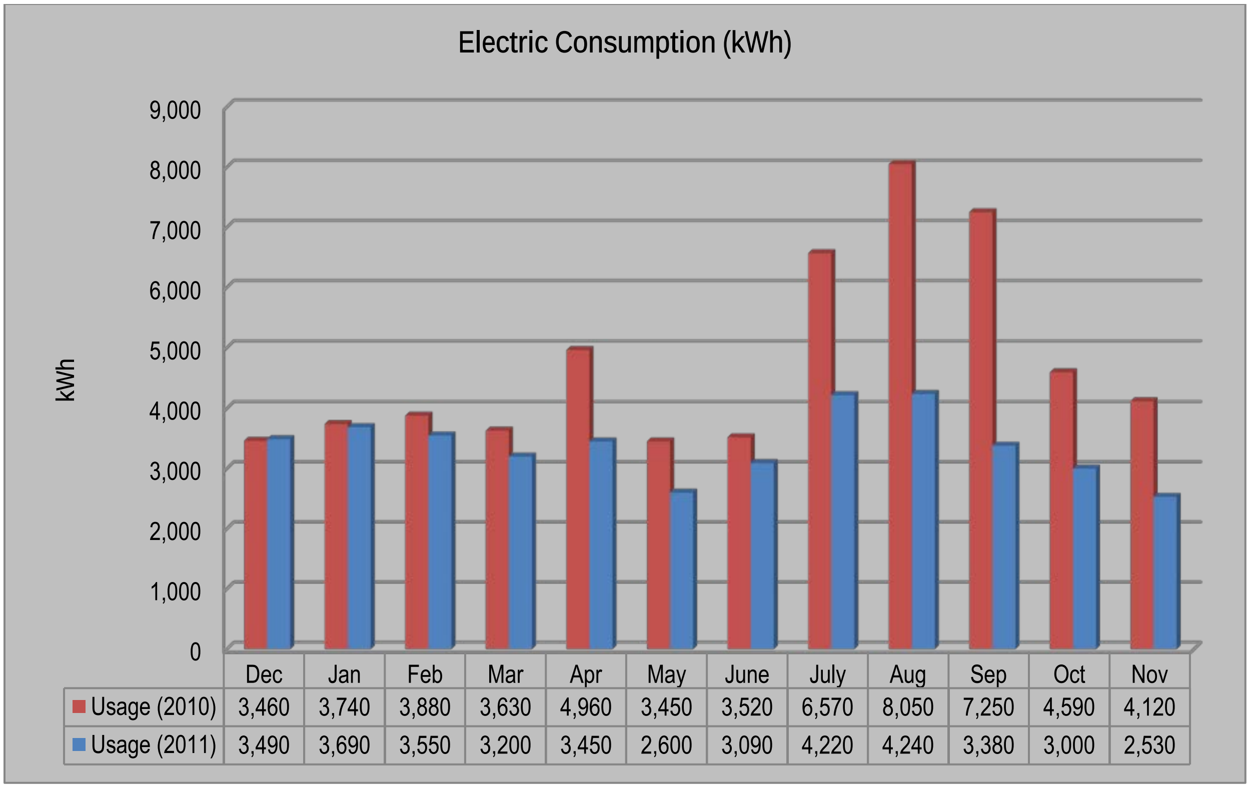


Figure 6: Electric Consumption (2010-2011)

To determine the most accurate predictions of energy reduction, the energy consumption according to end use was determined. Table 7 presents the estimated electrical usage by category including lighting, plug loads, and mechanical. Mechanical equipment includes all hard-wired, permanently installed equipment including ventilation, exhaust, heating, cooling, pumps, etc. These values were determined based on an equipment inventory and electric consumption. A more detailed accounting of all electrical equipment by end-use is presented in Part C of this Report.

Table 7: Categorized Electrical Consumption (est.) (2010 - 2011)

Equipment Type	Annual Consumption (kWh/yr)	% of Total Consumption	Annual Cost
Lighting Fixtures	14,399	36%	$2,016
Mechanical Equipment	14,226	35%	$1,992
Plug Loads	11,560	29%	$1,618
Totals:	40,185	100%	$5,626

According to estimates the consumption is evenly distributed between lighting fixtures, mechanical equipment and plug loads. Light fixtures account for the highest consumption at 14,399 kilowatt-hours per year (kWh/yr), or 36% of total electrical consumption. Mechanical equipment accounts for slightly less usage at 14,226 kWh/yr. Plug loads account for the least of the three categories at 11,560 kWh/yr, or 29% of electrical consumption.

The proportion of electrical consumption for mechanical equipment is somewhat less than expected for a library facility. This is mostly attributable to the absence of ventilation equipment.

Lighting is commonly the highest consumer of the three categories for most building types however this consumption can be reduced with simple measures. Mechanical equipment includes five (5) furnaces, five (5) air conditioners, a few pumps, and lavatory exhaust fans. There are no mechanical exchange air ventilation systems in the Social

Library. The majority of plug load consumption is due to computers, water fountains, a water cooler and a copier as well as miscellaneous equipment plugged in. Plug loads can also be reduced with simple measures outlined in the report. A cost breakdown of each category is supplied in Figure 7.

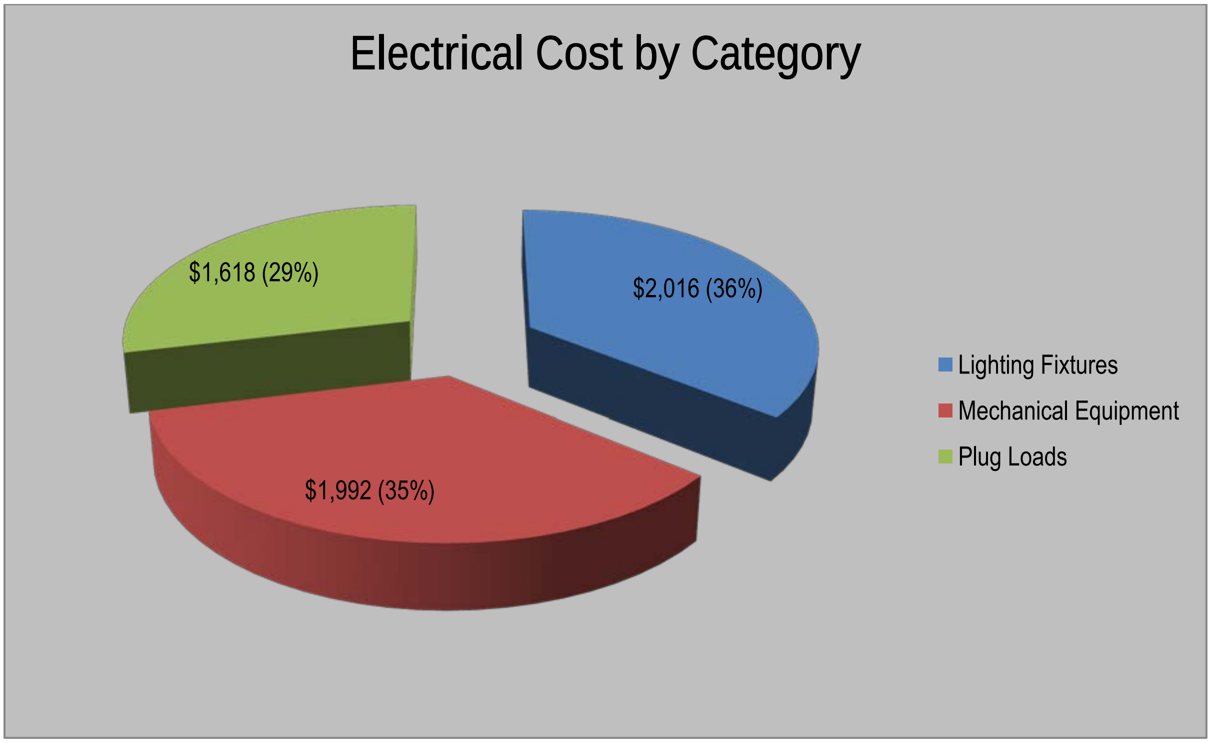


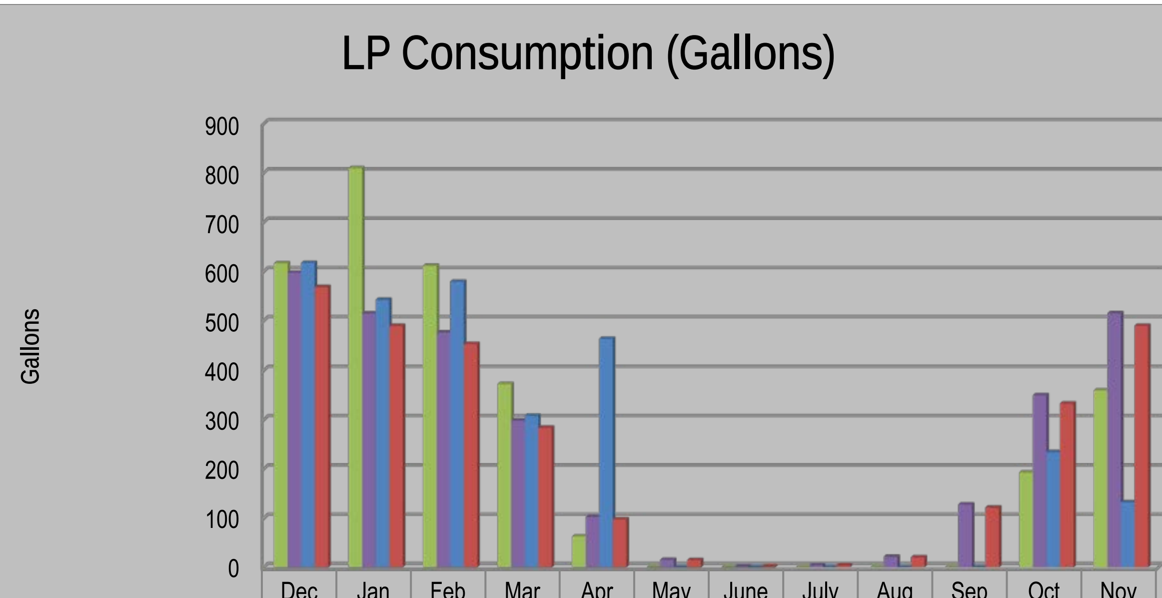
Figure 7: Hollis Social Library Electrical Cost by Category (2011-2012)

The annual electrical cost for lighting fixtures is estimated at $2,016 (2010-2011). It is noted that a lighting retrofit project was recently completed (2011) for the building which is predicted to have reduced the lighting fixture loads. Mechanical equipment accounts for an estimated $1,992 annually. Plug loads are moderate and are estimated at $1,618 per year. Simple measures further explained in this report can reduce the cost of each category.

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

Month	Year	Propane Bought (Gallons)	Cost of Purchase	Propane Usage (Gallons)	Cost of Usage
Dec	2009	616	$1,258	597	$1,227
Jan	2010	810	$1,789	514	$1,057
Feb	2010	611	$1,327	476	$977
Mar	2010	372	$799	298	$613
Apr	2010	62	$137	103	$211
May	2010	0	$0	15	$31
June	2010	0	$0	2	$4
July	2010	0	$0	4	$9
Aug	2010	0	$0	21	$44
Sep	2010	0	$0	128	$262
Oct	2010	193	$315	350	$718
Nov	2010	359	$583	515	$1,057
Totals:	*'09 - '10*	*3,023*	*$6,210*	*3,023*	*$6,210*
Dec	2010	617	$1,011	568	$956
Jan	2011	542	$890	489	$823
Feb	2011	579	$941	452	$761
Mar	2011	308	$497	284	$477
Apr	2011	463	$745	98	$164
May	2011	0	$0	15	$24
June	2011	0	$0	2	$3
July	2011	0	$0	4	$7
Aug	2011	0	$0	20	$34
Sep	2011	0	$0	121	$204
Oct	2011	234	$482	333	$560
Nov	2011	132	$271	489	$824
Totals:	*'10 - '11*	*2,875*	*$4,838*	*2,875*	*$4,838*
Totals:	*'09 - '11*	*5,898*	*$11,048*	*5,898*	*$11,048*

Heating fuel for space heating at the Hollis Social Library is provided by a local supplier (Table 8, Figure 8). The building consumed an annual total 3,023 gallons of liquefied propane (LP) at a cost of $6,210 (December 2009 to November 2010). Between December 2010 and November 2011, the facility consumed 2,875 gallons of LP at a cost of $4,838. The average annual heating fuel cost for the Social Library is $5,524 (2019-2011).



	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov
LP Purchased (2010)	616	810	611	372	62	0	0	0	0	0	193	359
Est. LP Usage (2010)	597	514	476	298	103	15	2	4	21	128	350	515
LP Purchased (2011)	617	542	579	308	463	0	0	0	0	0	234	132
Est. LP Usage (2011)	568	489	452	284	98	15	2	4	20	121	333	489

Figure 8: Heating Fuel Usage (2010-2011)

Heating fuel usage for the Social Library is lower than expected for a library facility of this size (7,795 sf). This is most attributable to the efficiency of the five (5) modern residential condensing hot-air furnaces located in the basement. The furnaces have a rated output capacity of 80,000 Btu/hr and an Annual Fuel Utilization Efficiency (AFUE) of 93.2% when new (1993). Based on the condition and age of the units, the de-rated thermal efficiency (AFUE) is 90%.

Other explanations for the low usage include heating setpoints that are lower than recommended. Four temperature readings were taken and varied between 63.6°F and 68.1°F with an average of 66.3. The recommended heating setpoints are between 66°F and 69°F depending on the space function.

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. Building additions or new constructions are required to comply with current energy codes. A set of building design plans were not available at the time of the audit, therefore construction methods are assumed to be those of best practice at the time of original construction (1910) and renovations (1993).

Floor Systems

The basement floor is a concrete slab-on-grade floor presumed to be four (4) inches in thickness. The floor system has an installed assembly insulation resistance (R) value of 1.0 (Table 9). Although the IECC does not specify an insulation requirement for an unheated slab-on-grade floor in Climate Zone 5, a minimum value of R-10 to 24 inches below grade is generally recommended.

Table 9: Floor Insulation Values

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	1.1
			2009 IECC Requirement:	NR
			Best Practice Recommendation:	10.0

Wall Systems

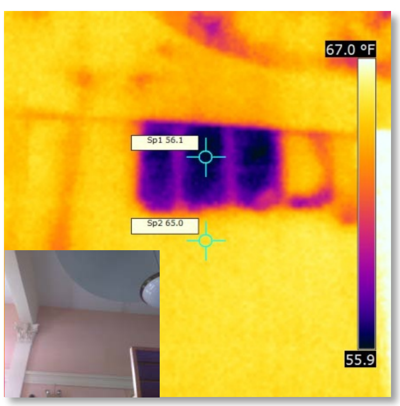


Figure 9: IR Image of 1st Floor Walls with Spot of Missing Insulation

The entire building is a timber framed single-story structure with a below grade basement with original stone foundation walls. The original building has granite stone blocks as an above grade foundation and horizontal clapboard on the exterior above grade. The addition walls contain a partially exposed cast-in-place concrete foundation above-grade wall with clapboard siding above.

Timber studs were visible using infra-red (IR) imaging indicating thermal bridging. The IR survey also revealed several insulation gaps including a large insulation gap above the original entryway along the south of the building. Upon inspection of this attic it was evident that there was no insulation in the wall cavities (Figure 9).

With respective thermal resistance values (R-value) of 11 and 13, neither the original wall assembly or the modern wall assembly comply with current energy code standards (R-13+3.8 ci). The lower values represent a low integrity rating based on the observed installation quality and the IR imaging survey.

Table 10: Wall Assembly Insulation Values

Original Wall System (c. 1910)				
Material	Thickness (in.)	R-value	Integrity Factor	Installed R-value
Exterior Air Film	NA	0.2	NA	0.2
Cedar Clapboard	0.5	0.34	0.9	0.3
Plywood Sheathing	0.25	0.3	0.9	0.3
FG Batt Insulation	4.0	12.6	0.7	8.8
Plaster	0.5	0.45	0.9	0.4
Interior air film	NA	0.7	NA	0.7
			Installed Assembly:	10.7
			2009 IECC Requirement:	13.0 + 3.8 ci
			Code Compliant?	NO
New Wall System (c. 1993)				
Material	Thickness (in.)	R-value	Integrity Factor	Installed R-value
Exterior Air Film	NA	0.2	NA	0.2
Clapboard	NA	0.8	0.9	0.7
Plywood Sheathing	0.5	0.6	0.9	0.5
FG Batt Insulation	4.0	12.6	0.8	10.0
Gypsum Board	0.5	0.45	0.9	0.4
Interior air film	NA	0.7	NA	0.7
			Installed Assembly:	12.5
			2009 IECC Requirement:	13.0 + 3.8 ci
			Code Compliant?	NO

Ceiling Systems

Ceilings consist of plaster in the original building and gypsum board in the modern addition. The above ceiling space is used for routing of ducting, piping, conduit, and electrical cable. There are two separate above-ceiling spaces above the 1910 building and above the 1993 addition.

Figure 10: Children's Library Ceiling

Insulation in the original building includes blown-in fiberglass, blown-in cellulose, and fiber glass (FG) batts. The insulation is inconsistent and incomplete due to installation methods and displacement by workers. Overall integrity of the attic insulation is poor. Fiberglass batt insulation is installed in the roof joists above the suspended ceiling in the 1993 addition. Installation quality is low due to gaps and missing sections of insulation.

Roofing Systems

The roofing system on the 1910 structure consists of a pitched shingled roof with a copper dome in the middle. The interior of the dome and roof is timber framed with no insulation (on attic floor). The 1993 roof is constructed similarly; a wooden framed pitched shingled roof with insulation only in the attic floor. Since the roofs of both structures are “cold roofs” and allow substantial thermal transfer, roofing insulation is based on treating the ceiling system as the roof and attic space as outdoor space. Insulation values are presented in Table 11. The insulation does not comply with current code standards.

Table 11: Attic Floor Insulation

Original Attic Floor (c. 1910)				
Material	Thickness (in.)	R-value	Integrity Factor	Installed R-value
Exterior Air Film	NA	0.2	NA	0.2
FG Batts/Blown FG & Cellulose	6	13.2	0.7	9.2
Plaster	5/8	0.5	0.9	0.5
Interior Air Film	NA	0.7	NA	0.7
			Installed Assembly:	10.6
			2009 IECC Requirement (roof):	38.0
			Code Compliant?	NO
Addition Attic Floor (c. 1993)				
Exterior Air Film	NA	0.2	NA	0.2
Fiberglass Batt Insulation	6	19.0	0.8	15.2
Gypsum Board	½	0.5	0.9	0.5
Interior Air Film	NA	0.7	NA	0.7
			Installed Assembly:	16.6
			2009 IECC Requirement (roof):	38.0
			Code Compliant?	NO

Fenestration Systems

Fenestration systems on the Social Library building include operable windows, fixed window units, glazed entry doors, and fixed storefront entry units. Window units in the building are wooden, metal and vinyl framed units with double-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. No manufacturer information was available for the windows or doors in the Library and therefore compliance with IECC standards for commercial buildings located in Climate Zone 5 cannot be established.

Based on visual inspection and survey with the infra-red thermal camera the glazed units performed marginally allowing thermal transfer through the frames and glazing. Typical of operable units, most thermal transfer and air leakage occurs at the seals and the interface between the window and the wall opening. Recommendations include exterior and interior inspection and re-caulking of window jambs, headers, moldings, and sills. If the operable window units have adjustable jambs, they should be inspected and adjusted as necessary to maintain a complete air seal. Weather-stripping should be inspected and replaced as needed. Other recommendations include closing the window shades during the winter evenings and summer daytime to limit thermal transfer.

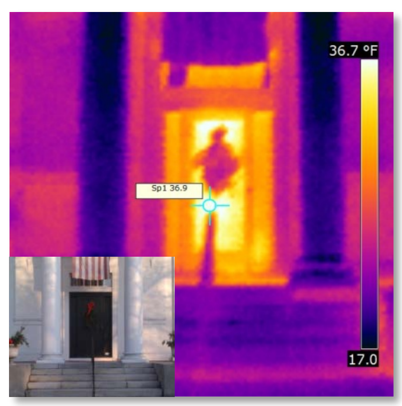


Figure 11: Exterior of 1910 Entrance

Doors

Door units at the Social Library include hollow metal units with partial glazing (east main entrance), top glazing (rear emergency exit), full glazing (east private entrance) and the original solid wooden door (south/road entrance). Glazed door units appear to allow some thermal transfer through the frame. As expected, the solid wooden door allows a significant amount of thermal transfer (Figure 11). 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 the door thresholds.

Air Sealing

Based on the thermal imaging survey and visual observations, air leakage occurs at windows, entry doors and wall to roof interfaces. Although this is typical even for modern buildings, 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 new weather-stripping and sweeps. 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.

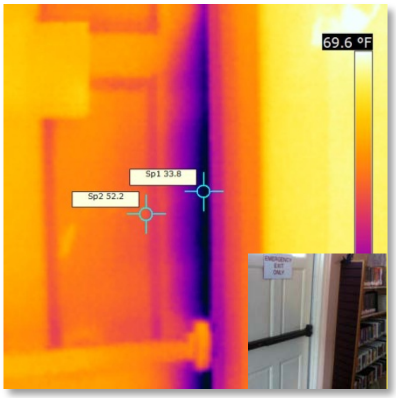


Figure 12: Air Leakage Through Entry Door

Other air sealing measures for the Hollis Social Library include sealing all wall and ceiling penetrations (thermal barrier). Cracks in plaster and gypsum board and gaps in decorative moldings (windows, baseboard, ceiling) can provide significant air leakage from the unconditioned attic space. Simple measures such as filling gaps with caulking will reduce energy consumption and nuisance drafts and cold-spots.

Thermal Imaging Survey

A thermal imaging survey was completed on the mornings of January 3rd, 2012. Outdoor ambient temperature was approximately 25°F. 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 energy 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 at the Social Library:

- The thermal integrity of the envelope (walls and roof) is generally poor. Gaps in insulation should be identified and filled with injected open-cell spray foam or dense-pack cellulose insulation.
- The concrete foundation wall extending above grade provides substantial thermal transfer.
- The original wooden entrance door allows significant thermal transfer.
- A moderate amount of thermal transfer occurs at the bottom of the dome.
- A section of missing insulation was identified along the south wall resulting in significant thermal transfer.
- Windows and doors provide a significant amount of thermal transfer and air leakage. IR of ceiling space above the new addition, specifically in the meeting and children's rooms, revealed missing insulation.
- Thermal transfer occurs through the batts in the ceiling of the new addition.
- The basement dehumidifier (frequently operating) produces a significant amount of heat.
- The domestic hot water heater in the basement is well insulated.
- Electronic equipment including photocopiers and computers/monitors operate at high temperatures and increase heat loading of the building interior.

Figure 13: Knob and Tube Wiring in 1910 Attic

Electrical Systems

Supply & Distribution

Grid electricity is supplied to Social Library to the main electrical panel in the basement. Single-phase grid power is supplied to the building by PSNH via overhead transmission lines. The electric meter is located on the southern side of the building to the east of the 1910 original door. Knob and tube wiring was found in the attic of the 1910 building and appears to be disconnected.

Lighting Systems

Figure 14: Induction Light Ballasts

As presented in Table 12, there are six (6) different lamp types including: 1) suspended high performance T8 fluorescent fixtures which account for the majority of lighting capacity and provide the main source of lighting; 2) suspended single-bulb induction light fixtures; 3) recessed mounted CFL's in the meeting room, children's library and back office; 4) LED's in the exit sign fixtures; 5) metal halide bulbs in the exterior fixtures; and, 6) one T12 fixture in the 1910 entrance vestibule. The high performance T8 fixtures account for the highest quantity of fixtures (43) and highest total wattage (3,500 watts). CFL bulbs are the second most common fixture with 11 total fixtures and 969 watts. There are a total of 8 induction lighting fixtures which total 320 watts. Exterior metal halide fixtures have a total of 280 watts. The one T12 fixture and 7 LED exit signs make up the remaining light fixtures at the Social Library. The library was part of a lighting retrofit project on selected public buildings throughout Town in 2011.

Table 12: Lighting Fixture Schedule

Fixture Lamp Type	Location(s)	Control	No. Lamps	Watts/ lamp	Qty. of Fixtures	Total Watts
T8	Throughout	Switch	1-4	28	43	3,500
T12	Old Entrance Vestibule	Switch	3	40	1	120
CFL	Back Office, Meeting Room, Children's Library, Exterior	Switch	1, 4	17, 28	16	1,074
Metal Halide	Exterior	Timer	2	75	4	280
Induction	Main Library Area	Switch	1	40	8	320
LED	Exit Signs	Always On	1	5	7	35
T8	Throughout	Switch	1-4	28	43	3,500
				Totals:	79	5,329

Table 13 presents the energy consumption by lighting fixture type. The suspended trough high performance T8 fluorescent fixtures are the main source of lighting and account for an estimated 65% of all lighting energy consumption annually at 9,541 kWh. Trough fixtures (Figure 15) are inefficient by design. They disperse light upward toward the ceiling to provide an accent "wash" effect. With an effective light efficiency less than 20% (at the reading surface) trough fixtures are not recommended as the main lighting fixture in any application. A more efficient and appropriate T8 fixture could reduce lighting wattage by an estimated 60% (Figure 16).

Figure 15: Trough Accent Lighting Fixture

Compact fluorescent fixtures are located in the back office, meeting room and children's library and account for 20% of the total lighting at an estimated 2,976 kWh/yr. LED lighting is in the exit signs and run continuously, accounting for an estimated 813 kWh/yr and 6% of lighting consumption. There are hanging fixtures in the main library area which have induction lamps accounting for and estimated 6% of lighting consumption. Exterior lighting is provided by four (4) metal halide lights consuming an estimated 508 kWh/yr. There is a single T12 fixture in the old entrance vestibule which is seldom used and accounts for less than 1% of the lighting load.

Table 13: Lighting Fixture Energy Consumption

Fixture Lamp Type	Location(s)	Est. Usage (kWh/yr)	% of Total
Trough T8	Throughout	9,541	65%
T12	Old Entrance Vestibule	6	<1%
CFL	Back Office, Meeting Room, Children's Library, Exterior	2,976	20%
Metal Halide	Exterior	888	6%
Induction	Main Library Area	1,015	7%
LED	Exit Signs	306	2%
	Total:	14,732	100%

Figure 16: Lithonia® Avante Fixture

Lighting density measurements in Social Library 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 January 3rd, 2012 between the hours of 1105 and 1111. Table 14 presents the lighting density measurements obtained in units of foot-candles (FCs). Most interior lamp fixtures (T8, compact fluorescent, induction, LED) are high efficiency units controlled by manual switches. The T12 fixture contains higher wattage lamps but is seldom used and therefore was not replaced during the lighting upgrade project. Exterior fixtures are metal halide fixture and controlled by a timer. It is recommended bathroom lights be put on a motion controlled switch to control usage. Replacing the exterior metal halide fixtures with high efficiency LED fixtures will provide a reasonable payback. Lighting quality is enhanced and maintenance costs for LED fixtures are significantly reduced with lamps lasting 10 times or longer than metal halide lamps.

IESNA Standards

In general, lighting/illumination densities in the Hollis Social Library are consistent with recommended standards (IESNA Lighting Handbook). Methods to reduce illumination densities include reducing the quantity of fixtures and installing lower wattage bulbs in the existing fixtures. Other methods to reduce illumination densities include replacing overhead lighting with task lighting, adding multiple control zones, and adding controllers (motion, daylight, dimming, time scheduled). Complete lighting density data for the Social Library is included in Appendix C.

Four (4) lighting density measurements were obtained. The children's library was slightly higher than the recommended density but natural lighting may have contributed to the higher density. Most of the fixtures are modern efficient fixtures installed as part of a recent lighting retrofit (2011). Recommendations to increase illumination densities in the general areas include replacing the suspended trough fixtures with more efficient units.

Table 14: Illumination Densities

Location	Measured Density (FC)	Recommended Density (FC) (1)
Children's library	38	30
Main library - West	31	30
Main library - East	20	30
Back office	24	30

(1) Based upon IESNA standards.

Plug Loads

Plug loads for the Social Library 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. Table 15 presents a summary of plug loads by category and Appendix F presents an inventory of all plug load equipment.

Based on this analysis, the total annual plug load is 11,560 kWh. Office equipment and computers account for the majority of plug load energy consumption (56%). Appliances account for a moderate percentage of the plug load, estimated at 38% of total energy consumption. Miscellaneous electronics account for 6% of consumption.

Table 15: Plug Load Energy Consumption

Category	Location(s)	Est. Usage (kWh/year)	% of Total
Office Equipment, Computers	Throughout	6,462	56%
Appliances	Throughout	4,385	38%
Electronics, Others	Throughout	713	6%
	Subtotals	11,560	100%

Figure 17: Water Cooler in Office

The number of plug loads is fairly limited due to the size and function of the building however there are still a number of ways to reduce the plug loads. There are a total of eighteen (18) desktop computers which estimated to consume the most kilowatt-hours of the plug loads at kWh. There are six (6) office computers which may be able to be consolidated and ten (10) desktop computers for library patrons which should be monitored to be shut down when not in use and put on a timer to shut down after building operation hours to be sure they do not run overnight. The photocopier uses a considerable amount of energy as well, even when in standby mode. Controlling it with a time scheduled controller is recommended.

Appliances include two (2) water fountains which consume a considerable amount of energy from their condensers keeping the water cold. The water dispenser in the back office also uses a considerable amount of energy to supply either hot or cold water (Figure 17). It is recommended both water fountain condensers and the cooling and heating element in the water cooler be disconnected or controlled with a time schedule controller to conserve energy.

Motors

Electrical motors are used for the two sump pumps in the basement and one pump for the well. Each motor is three quarter horse power.

Emergency Power Systems

There is no emergency power system located at Social Library.

Plumbing Systems

Figure 18: Well Tank in Basement

Domestic Water Supply

The Hollis Social Library obtains domestic water from the Congregational Church next door. Water usage includes lavatories, water fountains, and the meeting room sink which are expected to have limited use.

Domestic Water Pump Systems

It is presumed there is a pump in the Congregational Church to provide pressure for the Library.

Domestic Water Treatment Systems

No domestic water treatment systems are present in the Social Library.

Domestic Hot Water Systems

Domestic hot water (DHW) is provided by a single 10-gallon electric heated tank. Recommendations include replacing the unit with an electric or gas fired-tankless demand unit.

Hydronic Systems

There are no hydronic systems installed in the Social Library. Heat is supplied by a forced hot air system.

Fire Suppression System

There are no fire suppression systems in the Library.

Mechanical Systems

Figure 19: 1 of 5 Lennox Furnaces

Heating Systems

Heating is provided to the building by five (5) residential Lennox® Pulse 21 condensing furnaces located in the basement. The furnaces have an 80,000 Btu/hr capacity with an Annual Fuel Utilization Efficiency (AFUE) of 93.2% when installed in 1993 (est.). Based on the unit condition and age the de-rated thermal efficiencies (AFUE) are 90%. These furnaces were one of the first condensing units available and they tend to be high maintenance due to condensation / moisture accumulation. They are costly to maintain and repair.

Replacing the units at this time is not recommended however they should be replaced in the next 5-7 years. New gas-fired furnaces can achieve AFUE's over 98%. Recommendations for replacement include installing two (2) commercial gas-fired condensing furnaces with modulating capability.

Table 16: Heating Supply Systems

Heating Unit	Unit Description	Area(s) Served	Output (MBH)	Age (yrs.)	AFUE	Control Type
Furnaces	Lennox®	Throughout	80	19	90%	Thermostat

Cooling Systems

Figure 20: Rheem® Condensers

There are a total of five (5) Rheem® exterior air conditioning split systems on individual concrete pads along the west side of the building (Figure 20). Four (4) of the five (5) units are five-ton units while the other unit is a three-ton unit. All units are charged with R-22. It is noted that the use of R-22 is not permitted for use as a refrigerant in new equipment based on its high ozone depletion potential (per USEPA).

All units had a Seasonal Energy Efficiency Ratio (SEER) of 10 when installed which is considerably low by today's standards. Operating efficiency tends to decrease with system age and the de-rated SEER is less than 9. As cooling condensing units fail, they should be replaced with the highest rated equipment available. Modern cooling systems can achieve SEERs up to 24. Replacement of the units should consider consolidating the 5 units to 2 or 3 units with equivalent total capacity.

As prescribed by the 2009 IECC, the current minimum SEER for smaller cooling systems is 13 and larger units are rated at a minimum EER of 11.2. As example, replacing a unit with a SEER rating of 8 with a new unit rated at 16 would reduce energy consumption by 50% and provide an equivalent cooling capacity.

Refrigeration

Refrigeration is limited to a compact refrigerator in the back office area. There are no commercial refrigeration units at the Social Library.

Pumps

There are two (2) sump pumps located in the basement of the building. These units frequently operate during wet months to removed water that infiltrates the basement.

Controls Systems

Heating and cooling for the building is controlled by five (5) digital programmable (7-day) thermostats. All thermostats appear to be scheduled consistent with the occupancy schedules for the library.

Mechanical Equipment Energy Consumption

The electrical energy consumption for mechanical equipment was determined according to equipment nameplate information and building function and occupancy schedules. Table 17 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.

Based on the equipment inventory and expected operation frequencies, the predicted consumption of mechanical equipment was calculated. At 14,226 kWh per year mechanical equipment represents 35% of total electrical consumption of the three categories including lighting (14,399 kWh, 36%) and plug loads (11,560 kWh, 29%). Nearly half of the mechanical load is due to the air conditioning condensers and 34% is attributable to the Lennox® furnace fan motors.

Table 17: Mechanical Equipment Energy Consumption

Equipment Type	Qty.	Manufacturer(s)	Consumption (kWh/yr)	% of Total
AC Split Systems	5	Rheem®	6,976	49%
Furnace Forced Hot Air	5	Lennox®	4,794	34%
DHW Circulation Pump	1	Rheem®	1,456	10%
Sump Pump	2	NA	750	5%
Well Pump	1	NA	250	2%
		Totals:	14,226	100%

Ventilation Systems

Exhaust Air 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 (interlocked with light switch) or they may operate constantly 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 passive air flow and heat loss when the units are not operating.

There is an exhaust fan in each of the bathrooms which are interconnected with the lights. Based on carbon dioxide (CO_2) measurements the building receives adequate ventilation through passive air transfers.

Exchange Air Ventilation Systems

Exchange air ventilation systems exhaust interior air with high CO_2 concentrations and humidity and replace it with fresh outdoor air. There are currently no exchange air ventilation systems at the Social Library. Installing modern ventilation systems in all spaces of the Library is recommended. Ventilation rates and system capacity should be designed consistent with minimum prescribed code standards (ASHRAE 62.1). Systems should be demand (CO_2) controlled with energy recovery capacity.

Energy Recovery Ventilation Systems

The Hollis Social Library does not have any energy recovery ventilation systems.

Indoor Air Quality

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

Recommended temperatures vary based upon the season, occupant activity, and relative humidity levels. Generally, recommended setpoint heating temperatures in northern New England range between 66°F and 69°F and recommended cooling setpoint temperatures range between 74°F and 78°F. Relative humidity (RH) levels fluctuate consistent with seasonal atmospheric conditions. A range between 30% and 65% is recommended (ASHRAE 62.1). While there are no known adverse health effects related to elevated CO_2 concentrations, it can cause acute adverse affects including headaches, drowsiness, lethargy, and nausea. The U.S. Environmental Protection Agency (EPA) has established a recommended threshold concentration of 1,000 ppm.

The IAQ in the Social Library was measured on January 3rd, 2012 between the hours of 1105 and 1111. The building was lightly occupied when the measurements were obtained. Four (4) 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 varied from 63.6°F in the Children's Library, to 68.1°F in the back office. The average recorded temperature was 66.3°F. This is slightly lower than expected for a library.
- Relative humidity levels were relatively consistent, ranging from 23.4% in the back office to 29.7% in the Children's Library. The average measured relative humidity was 26.6%.
- CO_2 concentrations varied slightly from 561 ppm in the rear office to 637 ppm in the Children's Library with an average of 589 ppm. All measurements were below the EPA recommended threshold of 1,000 ppm.

Table 18: Summary of IAQ Data

IAQ Metric	Low	High	Avg.	Range of Variance	Recommendation
Temperature (°F)	63.6	68.1	66.3	4.5	66 – 69
Relative Humidity (%)	23.4	29.7	26.6	6.3	30 – 65
Carbon Dioxide (ppm)	561	637	589	76	<1,000

Measured IAQ throughout the spaces measured was satisfactory. All temperatures were within or slightly below the recommended setpoints. Relative humidity only ranged slightly and was close to ambient RH. Carbon dioxide measurements were all measured below the EPA recommended threshold of 1,000 ppm, even with no major ventilation systems.

Figure 21 presents the data trending for the three IAQ parameters. This trending graphically depicts the steady measured IAQ throughout the building.

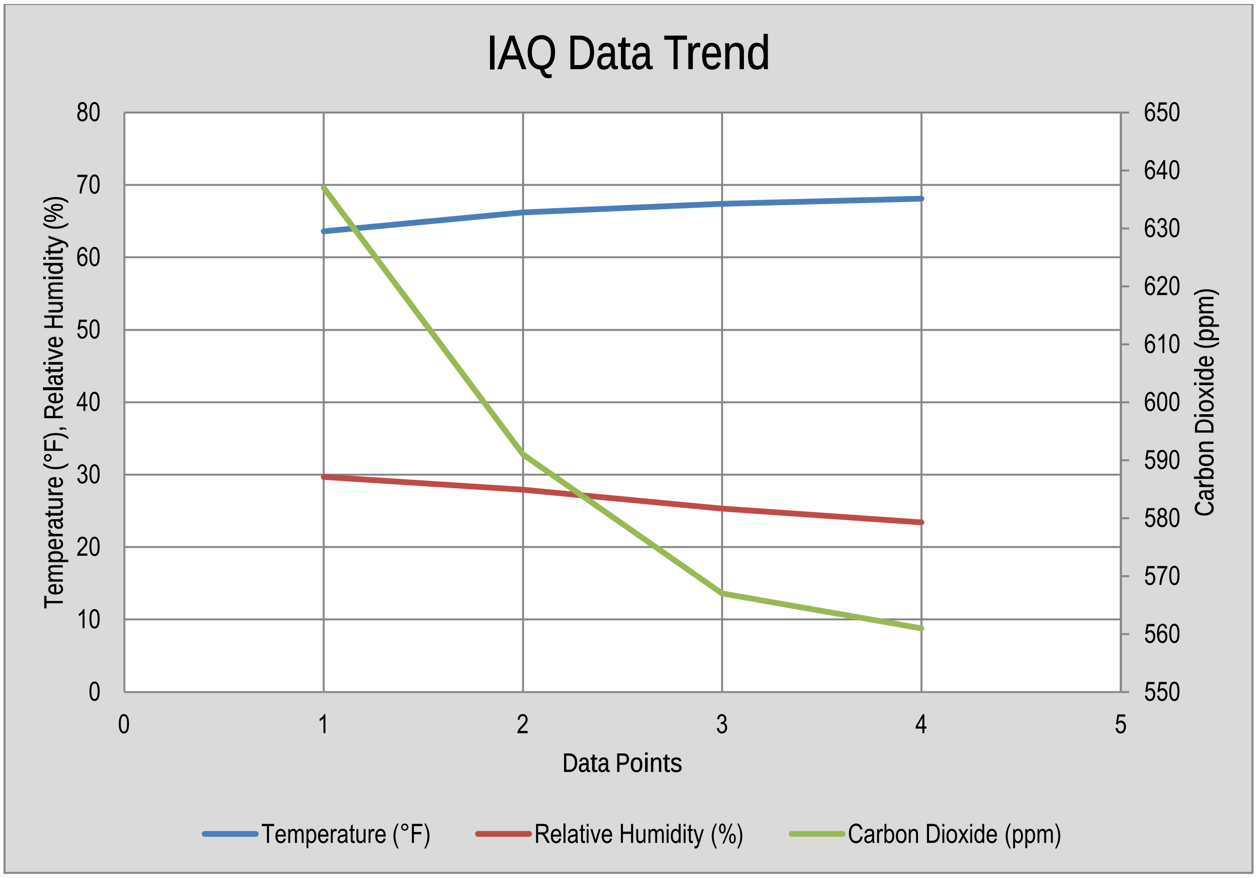


Figure 21: IAQ Data Trends

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 District's consideration and may warrant further investigation.

Structural Systems

No structural issues were noted.

Roofing Systems

The copper roofing on the dome section was recently replaced to mitigate leaks (2012). There was evidence of roof leaks in the library and vaulted ceiling section of the 1993 addition (skylights). Investigation of the leaks is recommended to determine if it an active leak and mitigate further damage and to reduce the potential for mold formation.

Building Code

As noted in the preceding sections, current code requires mechanical exchange air ventilation (ASHRAE 62.1). Installation of an energy recovery ventilating (ERV) system is recommended.

Knob and tube wiring exists in the attic space. It is unknown if it is in service and should be removed to mitigate the potential fire hazard.

Life Safety Code

No significant life safety code issues were noted during the evaluation.

ADA Accessibility

No apparent ADA accessibility issues were identified during the building assessment.

Hazardous Building Materials

The 1910 building is presumed to contain lead on all painted surfaces. Based on the building age, building materials maybe asbestos containing materials (ACMs) including plaster, window glazing, roofing substrate. Presumably the newer section (1993 construction) does not contain any hazardous building materials.

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 Social Library facility 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:

- Install insulation to limit thermal transfer.
- Replacing the exterior lighting with LED fixtures.
- Replace the air condensers with SEER 19 rated units.
- Convert to an air source heat pump.
- Convert to a gas source heat pump.
- Install thermal insulated window shades.

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 19 and 20 present a summary of the model predicted annual energy usage by category for electrical and heating fuel. The actual electrical consumption of 40,440 kWh/yr is slightly higher than the model prediction of 39,220 kWh/yr.

Table 19: Model Predicted Baseline Electrical Usage

Electric Category	Annual Usage (kWh x 1,000)
Space Cooling	6.57
Hot Water	1.43
Ventilation	4.79
Pumps & Aux.	1.08
Exterior Lighting	0.89
Misc. Equipment	0.88
Area Lights	14.55
Total Predicted:	39.20
Total Actual:	40.44

Actual heating fuel consumption (263.5 MBtu) is slightly lower than the model predicted value (269.3 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	269.3
Total Predicted:	269.3
Total Actual:	263.5

The energy modeling results are depicted graphically by a monthly bar graph (Figure 22) which summarizes the energy consumption for electricity and gas consumption separately by category. For example, "Area Lighting" is relatively consistent throughout the year while "Space Cooling" has a seasonal variation and spikes in the summer.

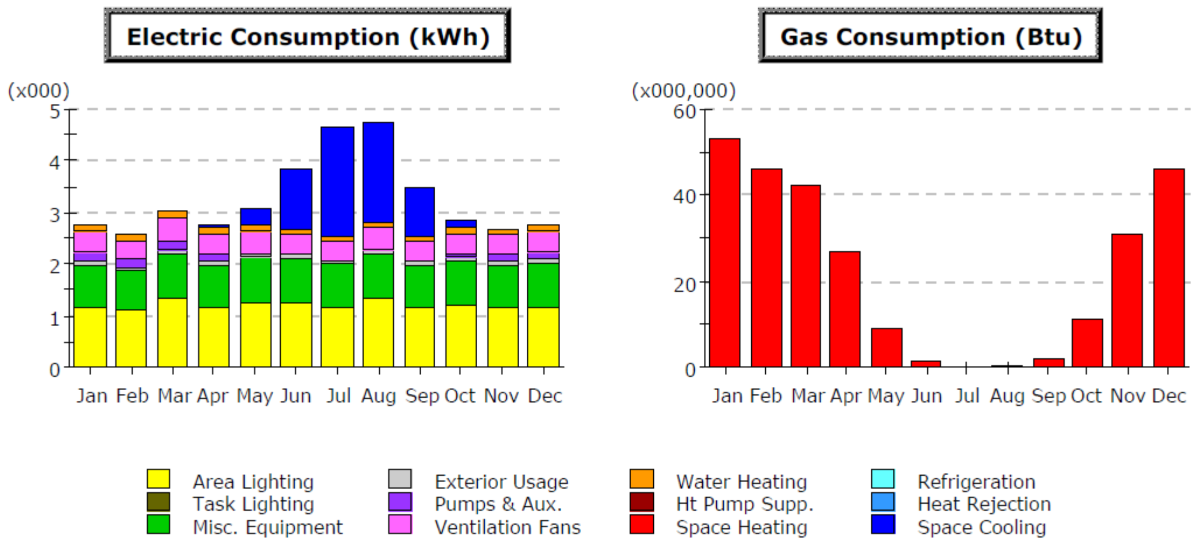


Figure 22: Monthly Energy Use Graph by Category (Baseline)

Annual energy consumption by category is also graphed using eQUEST® (Figure 23). This information is depicted in a pie graph and helps determine the largest overall use categories. For the Library the "Area Lighting" category is determined to use the most electrical energy (37%) while "Space Heating" consumes all of the gas as hot water is produced electrically. "Area Lighting" includes all lights inside the building and does not include exterior lights which are categorized as "Exterior Usage". 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.

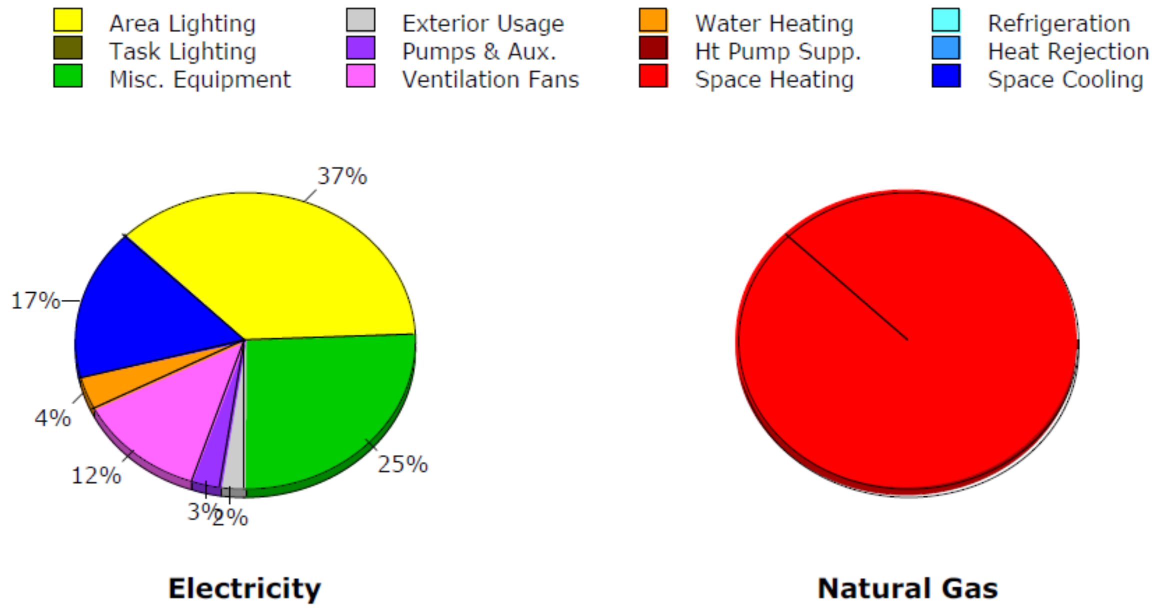


Figure 23: Annual Energy Use Graph by Category (Baseline)

F. FACILITY BENCHMARKING

ENERGY STAR for Commercial Buildings

The Social Library 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 75th 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 Social is defined as a "Library" 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 21 presents the annual energy use (through November 2011) and Table 22 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	137,981
Fuel Oil (No. 2)	263,441
Total Energy:	401,422

Table 22: SEP Benchmarking Summary

Location	Site EUI (kBtu/ft²/yr)	Source EUI (kBtu/ft²/yr)
Hollis Social Library	52	93
National Median (K-12 facility)	92	246
	% Difference:	-62%
	Portfolio Manager Score:	NA

Compared to other libraries that have entered data into Portfolio Manager to date, the Hollis Social Library energy use is well below the national average. The source EUI for the building is 93 kBtu/ft²/yr while the national average is 246 kBtu/ft²/yr, meaning the Library uses 62% less energy than the average library. ENERGY STAR® does not currently certify libraries therefore the Hollis Social Library cannot be assigned a Portfolio Manager score.

G. RECOMMENDATIONS

Energy Conservation Measures

Based on the observations and measurements of the Social Library, several energy conservation measures (EEMs) are proposed for consideration (Tables 23 to 25). 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 cost investment 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.

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, the more favorable the return on investment is.

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.
- Future plans for facility modifications (improvements or renovations) or changes in facility use.

Energy cost savings are based on a utility charge of $0.14 per kWh (PSNH) and a propane cost of $3.55 per gallon (NHOEP March 7th, 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 23). They include routine maintenance items that can often be completed by facility maintenance personnel, and changes to occupant behavior or building operation. Seven (7) Tier I EEMs are recommended.

Table 23: Tier I Energy Efficiency Measures

EEM No.	EEM Description	Capital Cost	Annual Cost Savings	Payback (yrs.)	SIR
T1-1	Disconnect condensers on the two (2) water fountains.	$0	$262	-	-
T1-2	Disconnect cooling and heating element in water cooler in staff area.	$0	$236	-	-
T1-3	Close shades on the original building at night in the winter and during the day in the summer to limit thermal losses and gains.	$0	$75	-	-
T1-4	Install time controller on photocopier.	$45	$120	0.4	26.7
T1-5	Seal and insulate dome access hatch.	$25	$10	2.5	8.0
T1-6	Install a thermostatically controlled solar powered attic roof fan to reduce heating loads in summer months.	$850	$450	1.9	6.3
T1-7	Replace dehumidifier in basement with ENERGY STAR® model.	$115	$60	1.9	5.2
T1-8	Install draft damper in the book return box.	$150	$37	8.1	4.9
T1-9	Complete air-sealing on all on all entry door jambs, window jambs, partings, and moldings (interior and exterior).	$1,300	$650	2.0	4.0

Water coolers and fountains consume a moderate amount of electricity to condition the water and there are two fountains and one cooler located in the library. Disconnecting the condenser on the fountain will still provide water at ground temperature. As evidenced by IR photos, shades can help retain heat from escaping in the wintertime and block solar heat from entering in the summertime which reduces the thermal transfers. The copier uses a considerable amount of energy even in standby mode. Installing a time clock would ensure it completely shuts down after occupational hours.

The access hatch to the dome in the quiet nook room is not properly sealed or insulated which allows thermal energy to transfer through. Sealing this would limit conditioned air from escaping and unconditioned air from entering. The dehumidifier in the basement runs constantly to limit humidity which inhibits mold. Using an ENERGY STAR® model would ensure the most efficient dehumidifier is being used to limit energy consumption. Common on most buildings, a considerable amount of energy is lost around deteriorating and poorly sealed windows and doors. Completing air-sealing on all entry door jambs, window jambs, partings and moldings would greatly reduce this loss.

The attic is expected to get exceptionally warm in the summer months and a portion of this heat transfers into the library resulting in a higher cooling load to counteract the heat. Installing a thermostatically controlled solar powered fan would exhaust hot air the solar panel at no operating cost.

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. Two (2) Tier II EEMs are provided in Table 24 for the Social Library.

Table 24: Tier II Energy Efficiency Measures

EEM No.	EEM Description	Capital Cost	Annual Cost Savings	Payback (yrs.)	SIR
T2-1	Replace existing domestic hot water heater with tankless propane hot water heater.	$1,200	$350	3.4	4.4
T2-2	Install task lighting (wall fixtures and lamps) in reading areas and offices and reduce overhead lighting.	$2,030	$410	5.0	3.0

Hot water demand is expected to be limited therefore it is recommended the hot water heater be replaced with a demand tankless unit which would not keep conditioned hot water and only produce hot water when it is called for. Adding task lighting to reading and office spaces would reduce overhead lighting requirements and increase lighting quality.

Tier III Energy Efficiency Measures

EEMs that require large capital expenditure and budgetary planning (one year or greater) are categorized as Tier III measures. Six (6) Tier III EEMs are provided in Table 25 for the Hollis Social Library. 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.

Table 25: Tier III Energy Efficiency Measures

EEM No.	EEM Description	Capital Cost	Annual Cost Savings	Payback (yrs.)	SIR
T3-1	Install 2" rigid polyisocyanurate insulation (R-14) on interior basement walls and tape-seal joints. Apply spray-foam polyurethane insulation around sill interior.	$5,271	$310	17.0	2.1
T3-2	Remove existing fiberglass insulation in attic of dome and insulated with six (6) inches of closed-cell spray foam. Replace insulation in addition and add and addition six (6) inches of blow cellulous insulation to addition attic.	$29,770	$1,472	20.2	1.7
T3-3	Replace existing air condition condensers (5) with fewer (2 or 3) high-efficiency units (min. SEER 19). *(In lieu of EEM T3-7)*	$6,560	$545	12.0	1.7
T3-4	Identify gaps in insulation in wall sections and inject dense-pack cellulose or open-cell polyurethane spray foam into walls. Refer to IR appendix for sections and verify with IR camera.	$9,293	$370	25.1	1.4
T3-5	Replace the existing suspended trough fixtures with efficient T8 units and reduce wattage to provide recommended lighting densities.	$23,747	$915	26.0	1.0
T3-6	Replace exterior metal halide light fixtures with LED units (4).	$2,457	$90	27.3	0.9
T3-7	Replace the existing furnaces and split A/C units with an electric air-source heat pump system. Add interlocked energy recovery ventilation (ERV) system. *(In lieu of EEM T3-3)*	$136,505	$3,910	34.9	0.7

The basement walls are uninsulated and offer a poor thermal barrier which allows thermal transfer to occur and eventually affect the main library space. Insulating these walls with rigid and foam insulation will save a considerable amount of energy.

Figure 24: LED Wall Pack (MaxLite®)

Improving attic floor insulation in the entire building will provide a reasonable payback. Removing the fiberglass insulation and installing close-cell spray foam in the attic of the original building will improve thermal integrity, improve air-sealing, provide sound attenuation, deter rodent infestation (observed), and will provide the most durable solution to insulating a difficult space.

The air conditioning condensers have a low SEER efficiency rating and combined with their age make for an inefficient cooling system. Replacing the condensers with a SEER of 19 or greater would considerably reduce the cooling energy consumption. This EEM is only recommended if T3-7 is not implemented.

Numerous gaps in insulation in the walls were noticed while conducting the IR survey and the insulation in the 1910 attic is in poor condition. Identifying these gaps and replacing insulation in these areas would limit thermal transfer through the envelope of the building and reduce nuisance drafts and cold-spots.

The design of trough lighting fixtures provides inefficient lighting and low illumination at the reading surface. Replacing these with lower wattage fixtures with more efficient lighting dispersion will reduce energy and increase lighting quality and aesthetics.

The exterior metal halide lights are high wattage bulbs which have poor light quality. Replacing these fixtures with LED fixtures would limit energy consumption while providing a better light quality and would reduce maintenance as they have a longer lifespan. Discounted fixtures are available through the nhsaves® program (www.nhsaves.com).

Installing an electric air-source heat pump system with an interlocked ERV would replace the five (5) furnaces and the five (5) A/C condensing units. Most of the ductwork currently installed would be able to be used with the heat pump which reduces the installation cost. Although the SIR for the system is less than 1.0, it provides exhaust ventilation systems for the building which are a code requirement and will substantially improve indoor air quality and occupant comfort. The new heat pump system will also be significantly quieter that the existing furnaces and A/C units.

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 considered as part of the building evaluation but are not recommended as best-value EEMs. Considerations include the cost practicality and payback term and occupant comfort concerns.

1. Identify gaps in insulation in addition section (1993) and inject dense-pack cellulose or open-cell polyurethane spray foam into walls. Verify with IR camera. SIR = 0.3.
2. Install thermal insulated shades on all windows (25). SIR = 0.7

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. Replacing older mechanical equipment with modern equipment generally reduces maintenance and repair requirements and costs. Most significantly, it reduces repair costs for outside vendors.
2. Replacing the existing furnaces will significantly reduce maintenance and repair costs. Servicing the new furnace units will be much easier with readily available parts.

Indoor Air Quality Considerations

IAQ considerations identify any potential changes to existing conditions as EEMs are implemented. Periodic monitoring of IAQ conditions including temperature, relative humidity, and CO_2 concentrations is recommended to ensure that minimum IAQ standards are maintained as EEMs are implemented and the building systems are optimized. IAQ data also directly correlates to the performance efficiency of building conditioning and ventilation systems.

- Mold is evident in the basement area. This is an indication of and under-ventilated building with high humidity levels. Installing a mechanical exchange air ventilation system and controlling moisture intrusion in the basement will eliminate the conditions that support mold development.

- Improving the building envelope by air sealing will reduce the volume of air exchanged through passive leakage. Mechanical ventilation becomes more critical as air leakage is reduced.
- Demand CO_2 controllers should be installed on new exhaust air ventilation systems to optimize system operation. Location of the sensors is critical to ensure that minimum indoor air quality standards are met.

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 technical and economic 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).

Qualitative considerations for renewable energies include owner initiatives and public awareness and education.

Table 26 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 Social Library facility. 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 is considering implementing any renewable energy system.

Table 26: Renewable Energy Considerations

Renewable Energy System	System Description & Site Feasibility
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: 84%	***Site Feasibility:*** *A geothermal heating and cooling system is a practical consideration for the building. Adequate space would have to be provided by the abutting town-owned field for a well and piping network. Considering the existing forced-hot-air heating and cooling equipment is compatible with a ground-source water heat pump system, it is a practical technology for the building. Considering the high heating and cooling costs for the building, payback for the system would be relatively quick and the carbon footprint would be greatly reduced.*
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. The system would have to be approved by the Historic Commission.*
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: 74%	***Site Feasibility:*** *A conventional pellet furnace 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 Social Library facility.*
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: 73%	***Site Feasibility:*** *Based on the area of the southern facing roof, the inclination, and the condition of the roof, a small to medium roof-mounted system (5kW-30kW) could be installed on the building. 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 system would have to be approved by the Historic Commission.*

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: 70%	*Site Feasibility:* *Based on the limited southern facing land area at the Hollis Social Library, a small to medium sized PV system (5-30 kW) could be sited at the north end of the parking lot where obstructing shadows are limited. 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 parcel that the building is sited on, a large pole-mounted WTG unit may not be practical. A single or multiple smaller units (<5kW) are practical considerations for the site. These can be pole mounted (15-30 ft) or roof-mounted. As described above, there are many constraints that determine if WTG is prudent for a particular site including:* • *Local zoning restrictions.* • *Detraction of the local landscape and abutter opinion.* • *Permitting requirements (local, state, FAA).* • *Local wind characteristics.* *Determining the local wind characteristics would require a wind study of the site.*
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: 61%	*Site Feasibility:* *Considering the lack of heating and ventilation equipment, the capital costs to install the system would not provide a reasonable payback unless substantial grant or incentive monies were obtained by the Town. Solar thermal should be re-evaluated if new air exchange equipment is installed as recommended. As outlined previously, some southern facing roof space is available however a structural study to determine if it could support the additional load would need to be done. The system would have to be approved by the Historic Commission.*
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 there is no natural gas on-site or within the Town, a CHP unit may not be practical. Additionally, costs associated with the infrastructure development may not be practical. CHP systems also require substantial 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, HV AC 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 New Hampshire , 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


EXTERIOR WINDOW

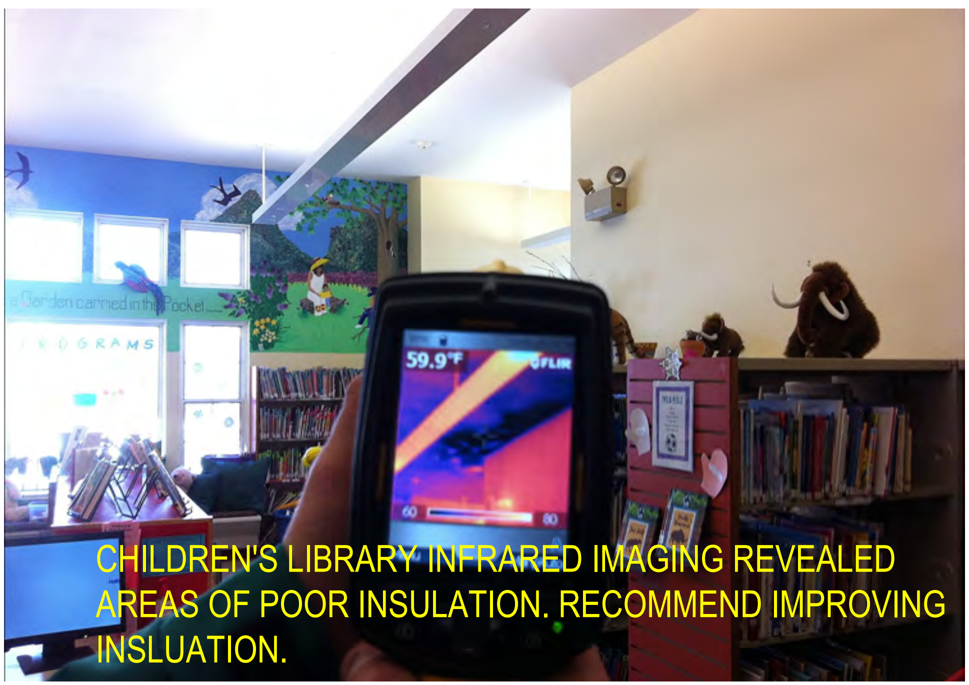

ENTRANCE VESTIBULE TO LIBRARY

WEST (ROAD) SIDE OF LIBRARY


EXTERIOR WINDOW AND DOOR ALONG EAST SIDE

CHILDREN'S LIBRARY INFRARED IMAGING REVEALED AREAS OF POOR INSULATION.


WINDOW SILL



CHILDREN'S LIBRARY INFRARED IMAGING REVEALED AREAS OF POOR INSULATION. RECOMMEND IMPROVING INSLUATION.


OVERHEAD SKYLIGHT


LIBRARY LIGHTING FIXTURES


LAMP INFORMATION


INTERIOR WINDOW

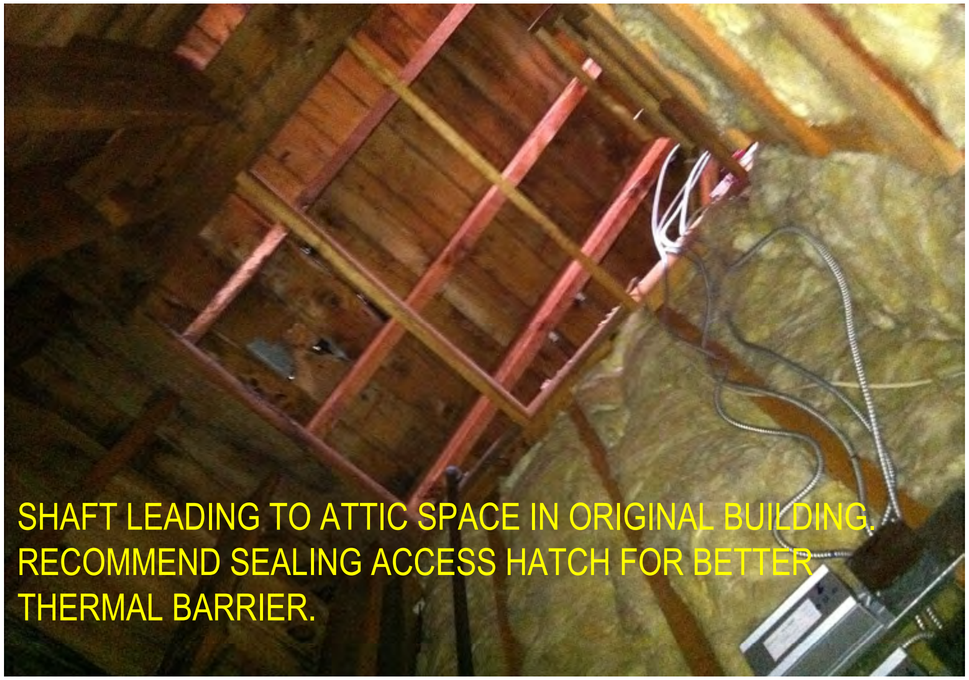

BALLASTS OF LIGHT FIXTURE

IFRARED IMAGING OF WEST WALL OF ORIGINAL BUILDING REVEALAS AREA OF MISSING INSULATION. RECOMMEND

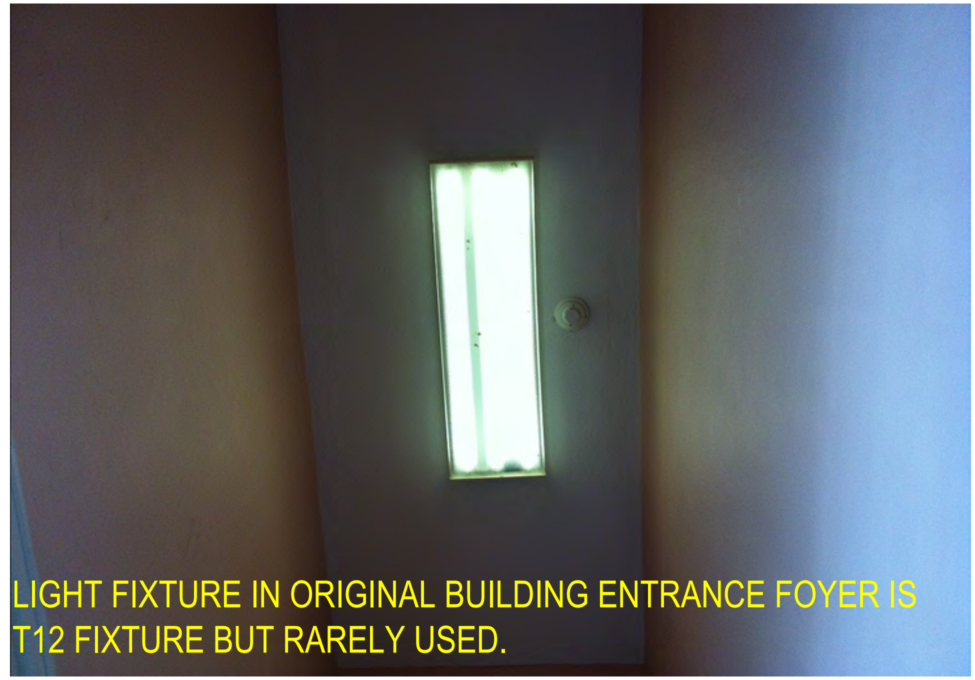

WINDOW ALONG SOUTH WALL OF ORIGINAL BUILDING


LIGHTING FIXTURE IN CHILDREN'S LIBRARY


WINDOW ALONG SOUTH WALL OF ORIGINAL BUILDING

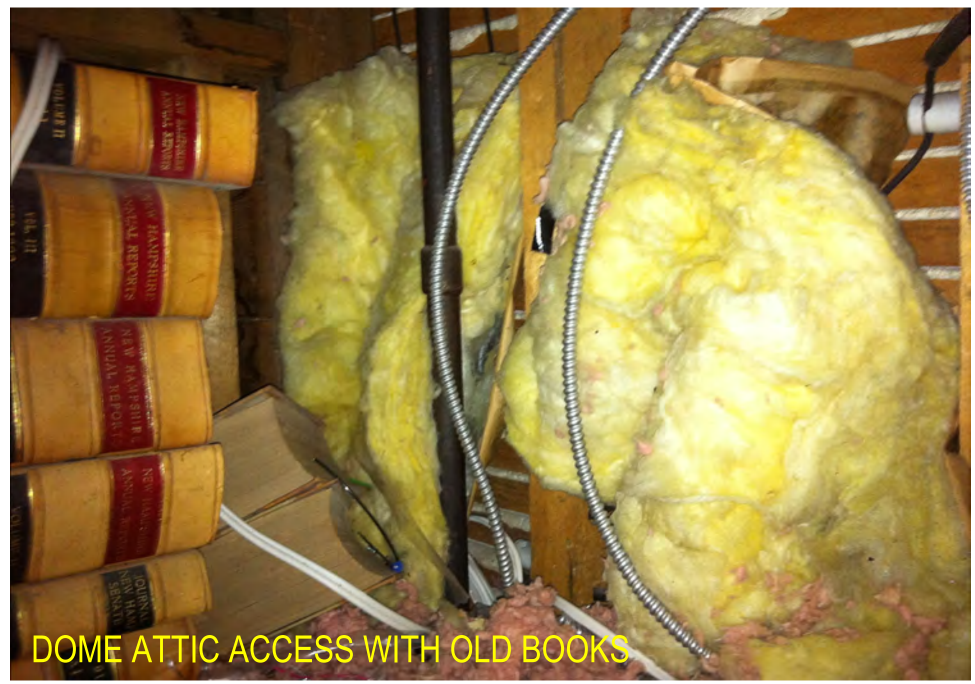


SHAFT LEADING TO ATTIC SPACE IN ORIGINAL BUILDING. RECOMMEND SEALING ACCESS HATCH FOR BETTER THERMAL BARRIER.



LIGHT FIXTURE IN ORIGINAL BUILDING ENTRANCE FOYER IS T12 FIXTURE BUT RARELY USED.

LIGHTING EFFICIENCY CONTROLS ALONG SHAFT IN ATTIC



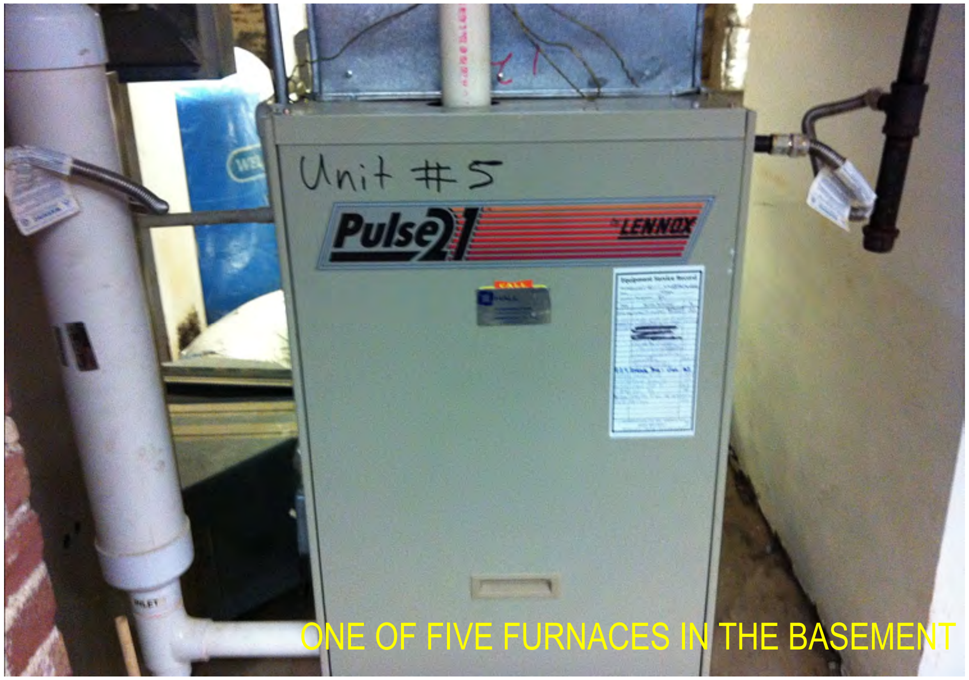
DOME ATTIC ACCESS WITH OLD BOOKS


DISPLAY CASE IN ORIGINAL VESTIBULE


ORIGINAL BUILDING COLUMN AND DOME


DISPLAY CASE IN ORIGINAL VESTIBULE


HVAC VENT IN LIBRARY



ONE OF FIVE FURNACES IN THE BASEMENT


REAR ENTRANCE ALONG EAST SIDE OF BUILDING


BASEMENT SPACE


EAST SIDE OF BUILDING AND PARKING LOT

REAR ENTRANCE ALONG EAST SIDE OF BUILDING


NORTH SIDE OF THE BUILDING ABUTTING TOWN FIELD


NORTHEAST CORNER OF THE BUILDING


NORTHEAST CORNER OF THE BUILDING

NORTH SIDE OF BUILDING ABUTTING FIELD

NORTHWEST CORNER OF THE BUILDING WITH SCAFFOLDING FOR ROOF/DOME REPAIRS

NORTH SIDE OF BUILDING

NORTH SIDE OF BUILDING

WEST (ROAD) ORIGINAL ENTRANCE TO THE LIBRARY

SOUTH SIDE OF BUILDING WITH SIDEWALK LEADING TO ENTRANCE

NORTHWEST CORNER OF THE BUILDING WITH SCAFFOLDING FOR ROOF REPAIRS

SOUTHWEST CORNER OF THE BUILDING


MAIN ENTRANCE ALONG THE SOUTH SIDE OF THE BUILDING

LIBRARY HOLIDAY HOURS POSTED NEXT TO MAIN DOOR


WALKWAY LEADING TO ENTRANCE ALONG SOUTH SIDE

TYPICAL LIBRARY HOURS POSTED NEXT TO MAIN DOOR

FILTER ACCESS LABELED ON MECHANICAL EQUIPMENT

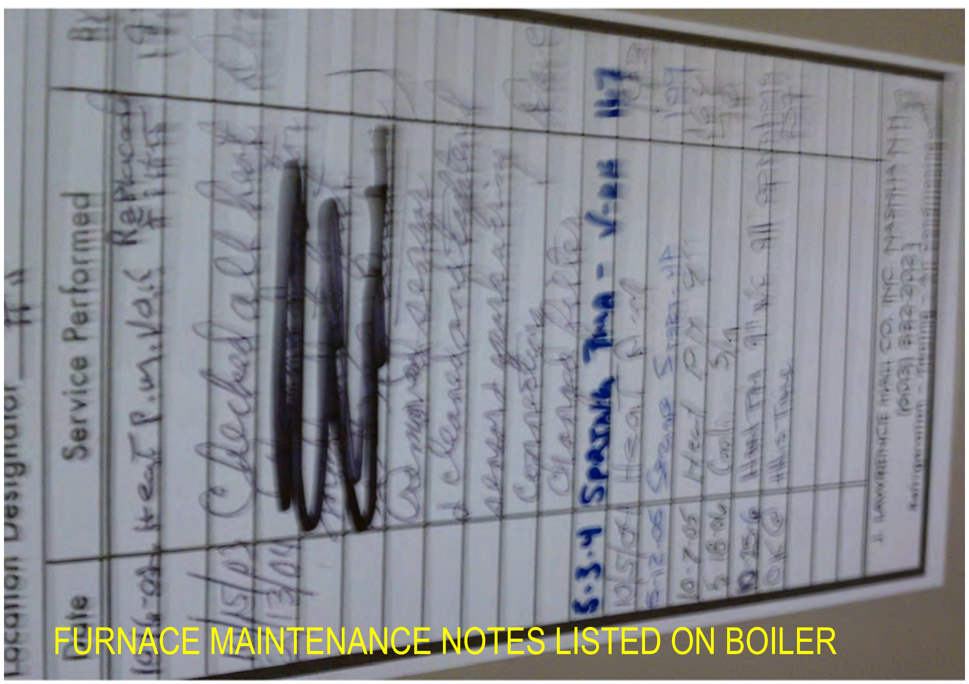
BASEMENT DEHUMIDIFIER RUNS CONSTANTLY. RECOMMEND REPLACING WITH ENERGY STAR RATED MODEL.

ONE OF FIVE FURNACES IN THE BASEMENT

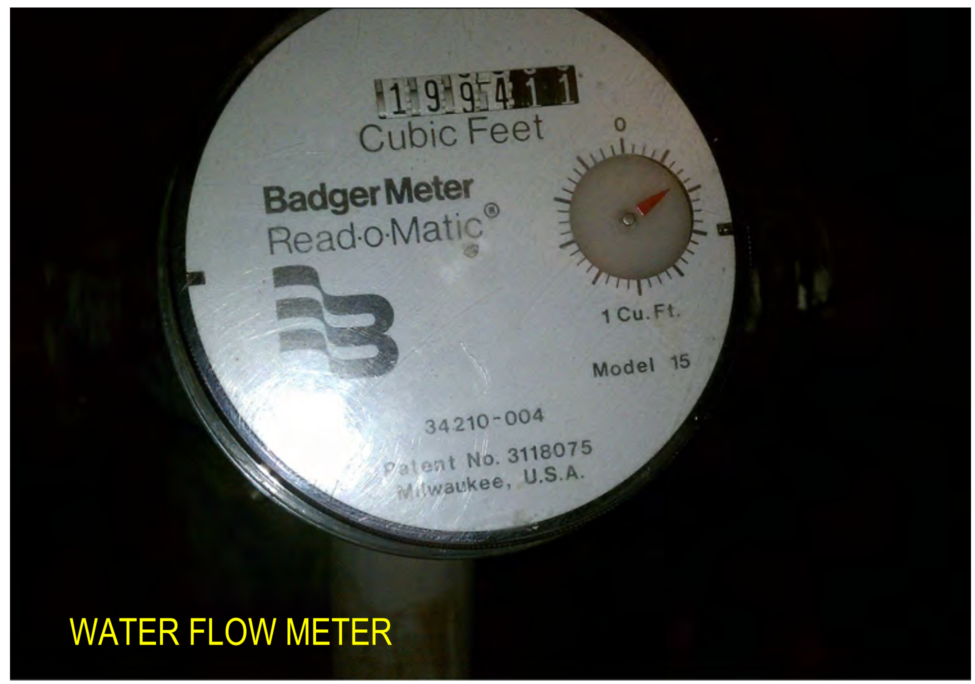
FURNACE ELECTRICAL BOX AND CONDENSATE DRIP LINE

WELL WATER TANK


INSULATED DUCTWORK IN BASEMENT



FURNACE MAINTENANCE NOTES LISTED ON BOILER

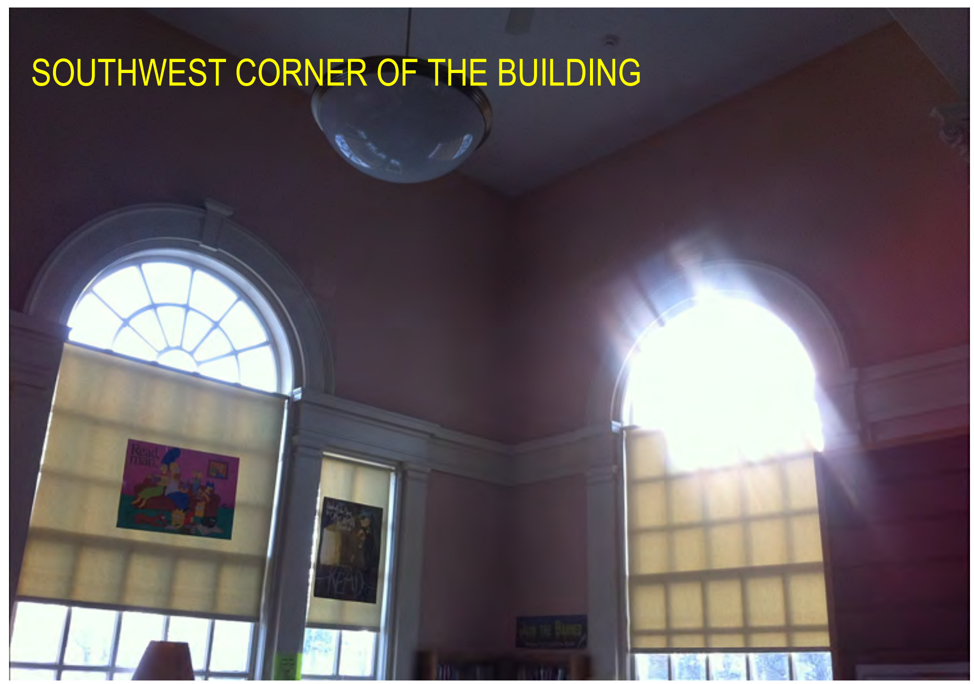


WATER FLOW METER


SOUTH SIDE OF ORIGINAL BUILDING


INSIDE OF DOME IN ORIGINAL BUILDING

LIBRARY COMMEMORATIVE PLAQUE


SOUTHWEST CORNER OF THE BUILDING


CORNER OF THE ORIGINAL BUILDING


SOUTH WALL OF NEW LIBRARY ADDITION


INSIDE OF THE DOME ON THE ORIGINAL BUILDING


SOUTH WALL OF ORIGINAL LIBRARY

STAFF OFFICE WITH SECURITY MONITORING

COMPUTERS IN BACK CORNER OF STAFF OFFICE

LIBRARY WALL

WATER COOLER IN STAFF OFFICE

HEATING VENT IN MAIN LIBRARY

SOUTH ENTRANCE VESTIBULE

TIME CLOCK FOR EXTERIOR LIGHTS

OVERHEAD SKYLIGHT IN MAIN LIBRARY

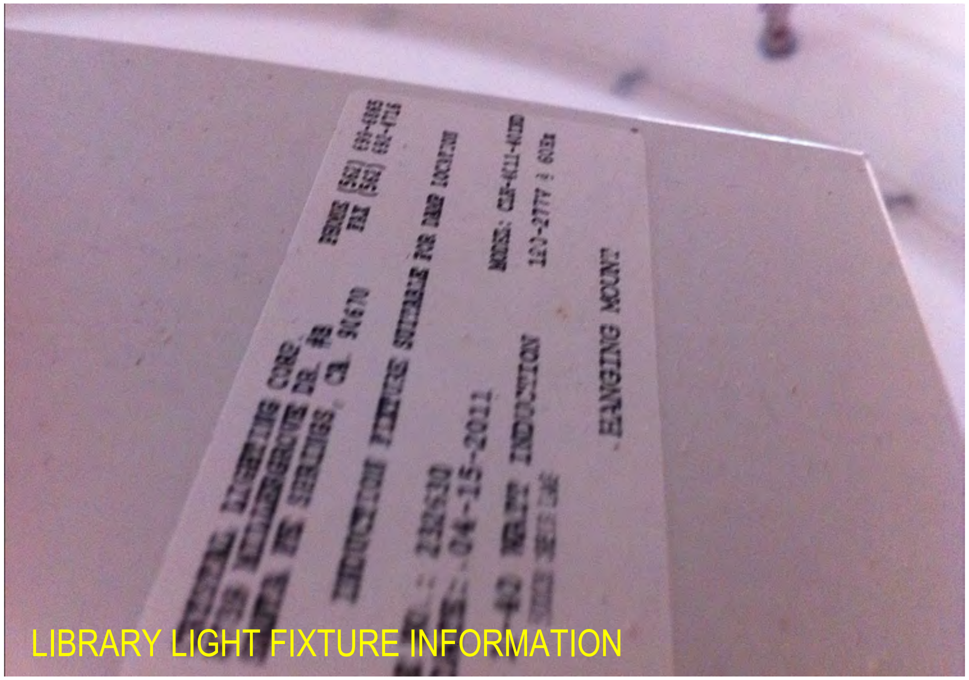
CEILING IN MEETING ROOM

EMERGENCY EXIT ALONG EAST SIDE OF THE BUILDING

MEETING ROOM SPACE

LIGHTING FIXTURES WITHIN THE MAIN LIBRARY AREA

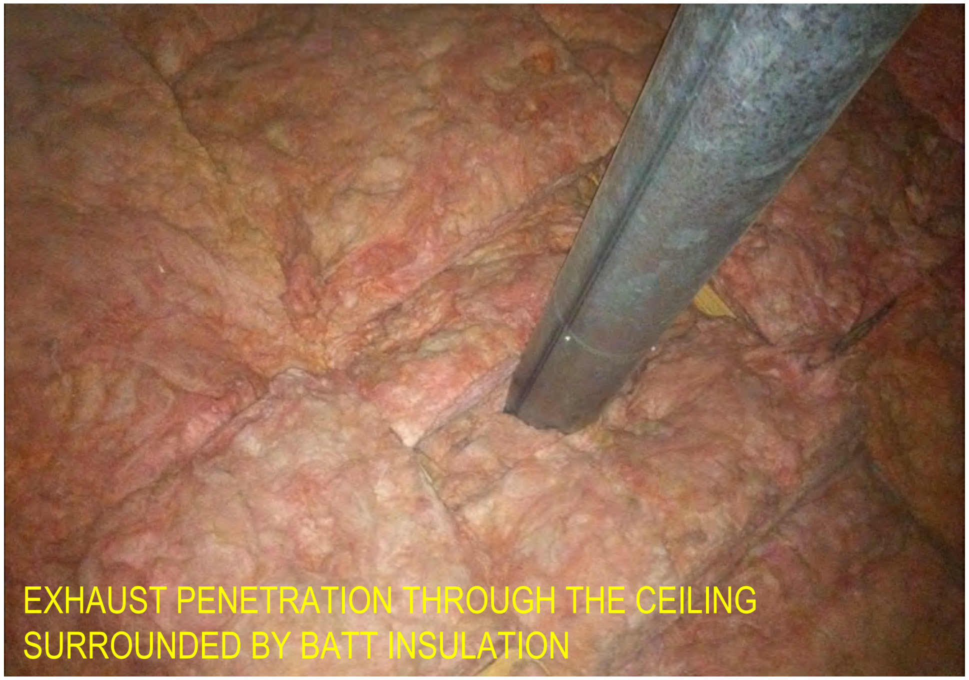
MAIN LIBRARY SPACE



LIBRARY LIGHT FIXTURE INFORMATION

WINDOW ALONG THE NORTH SIDE OF THE BUILDING

LIBRARY LIGHT FIXTURE INFORMATION


EXHAUST PENETRATION THROUGH THE CEILING
SURROUNDED BY BATT INSULATION


INSULATION NOT CONSISTENT THROUGHOUT CEILING
ALLOWING THERMAL TRANSFER


INSULATION NOT CONSISTENT THROUGHOUT CEILING


ATTIC SPACE INSULATION. IR REVEALS THERMAL BREACHING


KNOB AND TUBE WIRING IN ATTIC


KNOB AND TUBE
WIRING IN ATTIC


BOOKS STORED IN ATTIC ACCESS SPACE


KNOB AND TUBE WIRING IN ATTIC


KNOB AND TUBE WIRING IN ATTIC


POORLY INSULATED ATTIC WALLS


POORLY INSULATED ATTIC WALLS


KNOB AND TUBE WIRING IN ATTIC


KNOB AND TUBE WIRING IN ATTIC


ATTIC SPACE


POOR INSULATION IN ATTIC


KNOB AND TUBE WIRING IN ATTIC

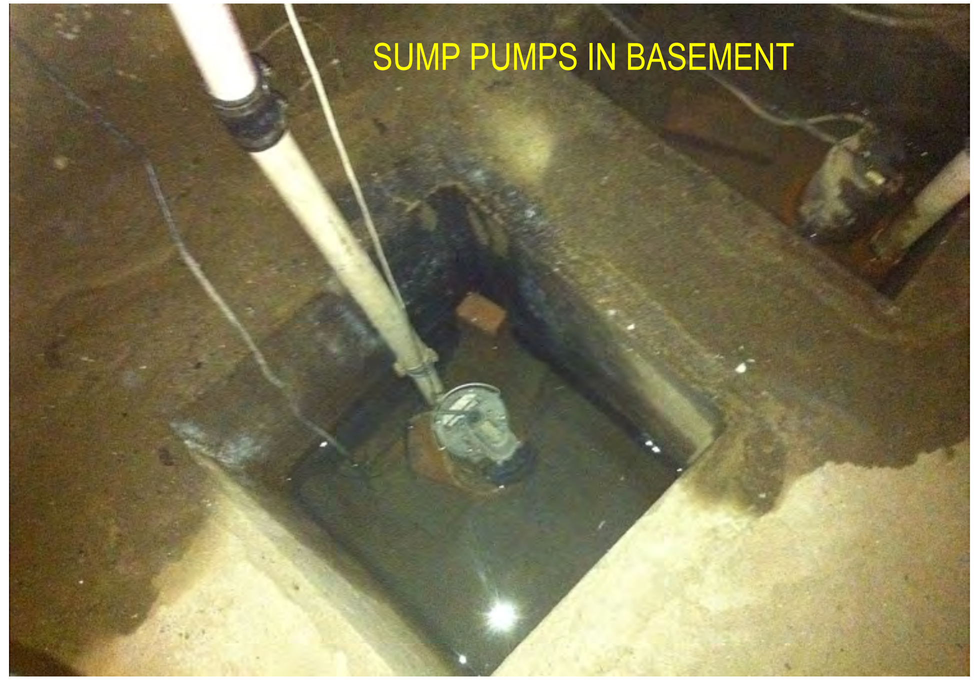
INSIDE OF LIBRARY DOME

LIGHT EFFICIENCY CONTROLS FOR SINGLE LAMP FIXTURES

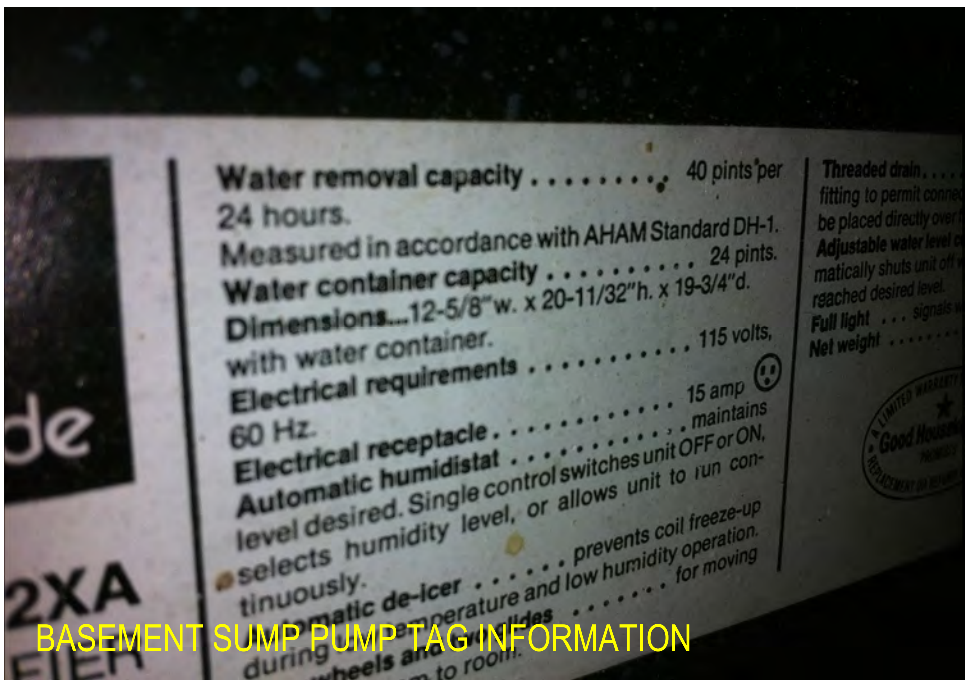
KNOB AND TUBE WIRING IN ATTIC

LIGHT EFFICIENCY CONTROLS FOR SINGLE LAMP FIXTURES

MECHANICAL EQUIPMENT IN BASEMENT



SUMP PUMPS IN BASEMENT



BASEMENT SUMP PUMP TAG INFORMATION

SUMP PUMPS IN BASEMENT

RHEEM HOT WATER HEATER IN BASEMENT

BOILER TAG INFORMATION


RHEEM HOT WATER HEATER IN BASEMENT


DUCTWORK IN BASEMENT UNINSULATED


BLACK ON COLUMN INDICATES MOLD


OUTDOOR AIR CONDENSING UNITS


EXIT FROM BASEMENT TO STAIRS LEADING TO FIRST FLOOR

CLEAN FILTER SEEN IN ALL FURNACE UNITS

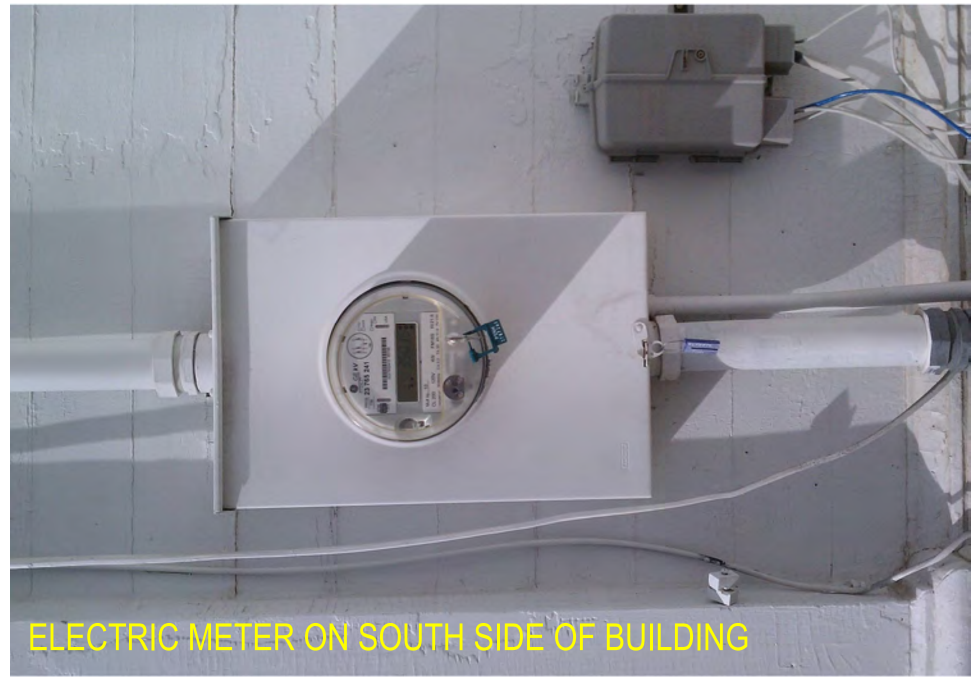
AIR CONDITION TAG INFORMATION

AIR CONDITION TAG INFORMATION


TOP OF OUTDOOR AIR CONDITIONER

AIR CONDITIONER RATED AT SEER 10

PROGRAMMABLE THERMOSTAT


ELECTRIC METER ON SOUTH SIDE OF BUILDING


EXTERIOR LIGHTING OVER ENTRANCE


WELL IN DRIVEWAY SHARED BY CHURCH AND LIBRARY

PROPANE REFUELING ON WEST SIDE OF BUILDING

PIPING ON WEST SIDE OF BUILDING

LIGHT OVER 1910 ENTRANCE

PROPANE REFUELING ON WEST SIDE OF BUILDING


EXTERIOR LIGHT OVER NORTH EMERGENCY EXIT DOOR


PARKING LOT WITH POLE MOUNTED LIGHTS


PIPING ON WEST SIDE OF BUILDING


EXTERIOR LIGHTING

APPENDIX B

Thermal Imaging Survey Reports

Inspection Report

Report Date	5/21/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

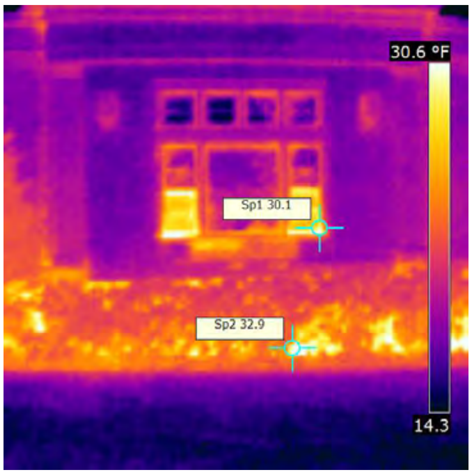


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/3/2012 7:49:28 AM
Image Name	IR_2024.jpg
Emissivity	0.96
Reflected apparent temperature	28.0 °F
Object Distance	15.0 ft

Text Comments

Description

IR of the parking lot side of the Library indicates thermal transfer through concrete foundation behind the bushes as well as some transfer through and underneath window and frame. Refer to EEM T1-9 for air-sealing window.

Inspection Report

Report Date	5/21/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

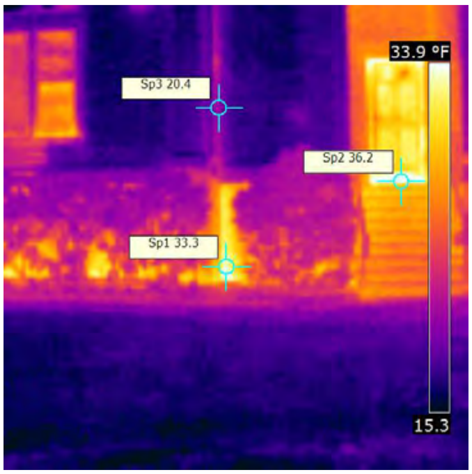


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/3/2012 7:49:43 AM
Image Name	IR_2025.jpg
Emissivity	0.96
Reflected apparent temperature	31.0 °F
Object Distance	15.0 ft

Text Comments

Description

IR of the rear of the building reveals thermal transfer through concrete foundation as well as around exterior door and through concrete below door. Refer to EEM T1-9 for air-sealing door cost and savings.

Inspection Report

Report Date	5/21/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

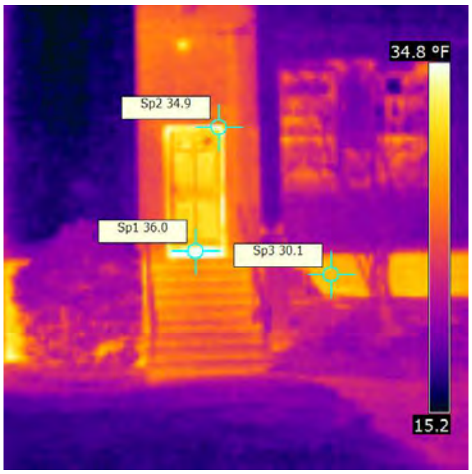


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/3/2012 7:49:53 AM
Image Name	IR_2026.jpg
Emissivity	0.96
Reflected apparent temperature	33.0 °F
Object Distance	20.0 ft

Text Comments

Description

IR of rear entrance reveals thermal transfer around door as well as through concrete foundation and stairs. Refer to EEM T1-9 for air-sealing door cost and savings.

Inspection Report

Report Date	5/21/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 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 7:50:07 AM
Image Name	IR_2027.jpg
Emissivity	0.96
Reflected apparent temperature	37.0 °F
Object Distance	15.0 ft

Text Comments

Description

IR of rear entrance reveals thermal transfer through concrete below door as well as around seal between door and frame. Brighter spot below door due to concrete. Refer to EEM T1-9 for air-sealing door cost and savings.

Inspection Report

Report Date	5/21/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

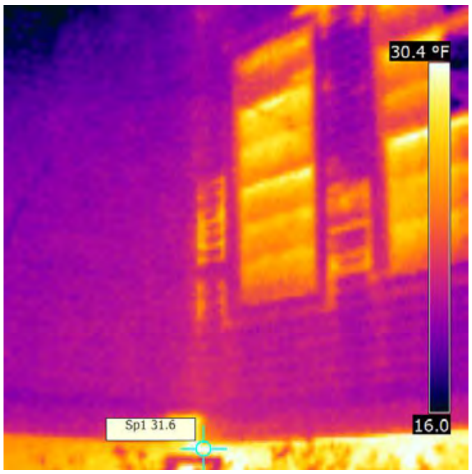


Image and Object Parameters

Text Comments

Camera Model	B-CAM Western S
Image Date	1/3/2012 7:50:23 AM
Image Name	IR_2028.jpg
Emissivity	0.96
Reflected apparent temperature	29.0 °F
Object Distance	15.0 ft

Description

Corner of building reveals thermal transfer through concrete foundation and some transfer through window.

Inspection Report

Report Date	5/21/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

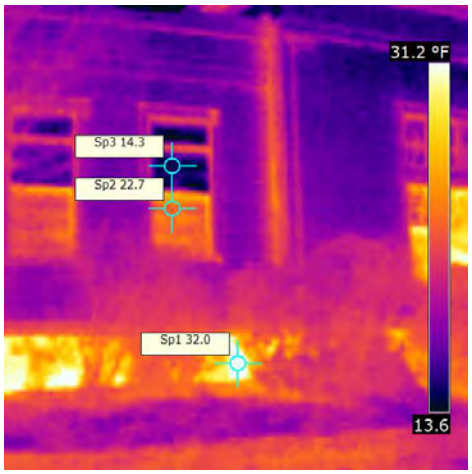


Image and Object Parameters

Text Comments

Camera Model	B-CAM Western S
Image Date	1/3/2012 7:50:45 AM
Image Name	IR_2029.jpg
Emissivity	0.96
Reflected apparent temperature	30.0 °F
Object Distance	15.0 ft

Description

West side of the Library reveals thermal transfer through concrete foundation as well as through window. Note difference in transfer between exposed portion of window (Sp2) and portion of window with shade down (Sp3). Refer to EEM T1-3 for savings.

Inspection Report

Report Date	5/21/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

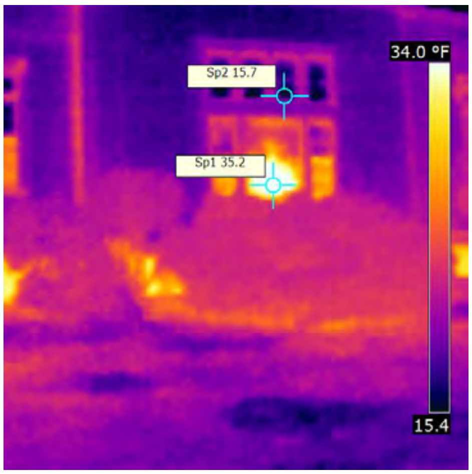


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/3/2012 7:51:04 AM
Image Name	IR_2030.jpg
Emissivity	0.96
Reflected apparent temperature	13.0 °F
Object Distance	25.0 ft

Text Comments

Description

IR of recreation field side of the Library reveals thermal transfer through concrete foundation as well as through window. Note difference in thermal transfer between shaded (Sp2) and unshaded (Sp1) portions of the window. Refer to EEM T1-3 for savings.

Inspection Report

Report Date	5/21/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

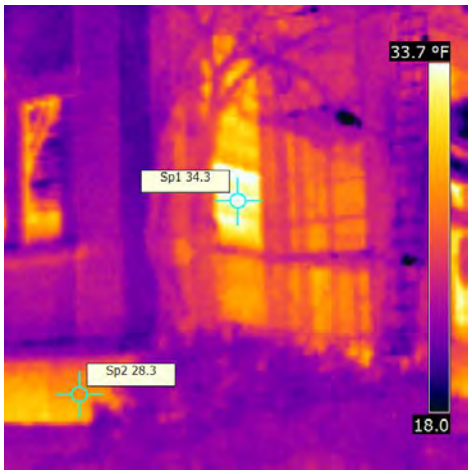


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/3/2012 7:51:55 AM
Image Name	IR_2033.jpg
Emissivity	0.96
Reflected apparent temperature	32.0 °F
Object Distance	15.0 ft

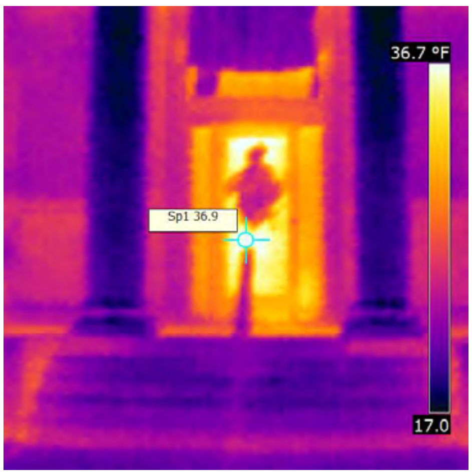
Text Comments

Description

IR of the front of the building reveals thermal transfer through concrete foundation as well as through window.

Inspection Report

Report Date	5/21/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	



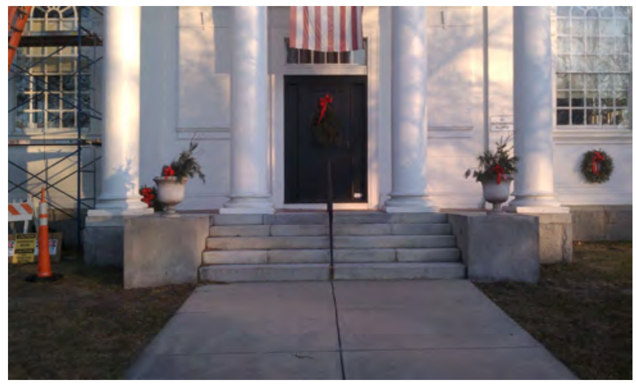


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/3/2012 7:52:23 AM
Image Name	IR_2035.jpg
Emissivity	0.96
Reflected apparent temperature	35.0 °F
Object Distance	20.0 ft

Text Comments

Description

IR of front side of the building reveals some thermal transfer through front wood door.

Inspection Report

Report Date	5/21/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

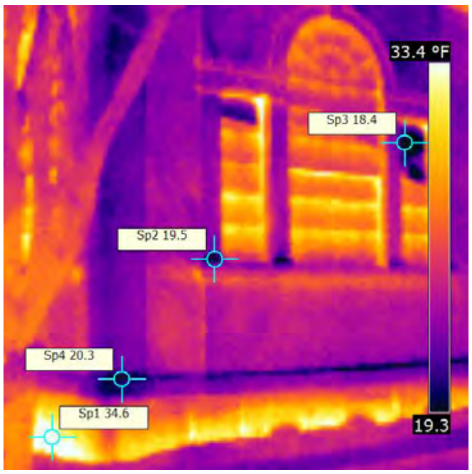


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/3/2012 7:52:46 AM
Image Name	IR_2037.jpg
Emissivity	0.96
Reflected apparent temperature	15.0 °F
Object Distance	12.0 ft

Text Comments

Description

IR of side of building reveals thermal transfer through concrete foundation as well as between foundation and walls, around window frame and through window. Refer to EEMs T1-3 for closing shades and T1-9 for air-sealing cost and savings.

Inspection Report

Report Date	5/21/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

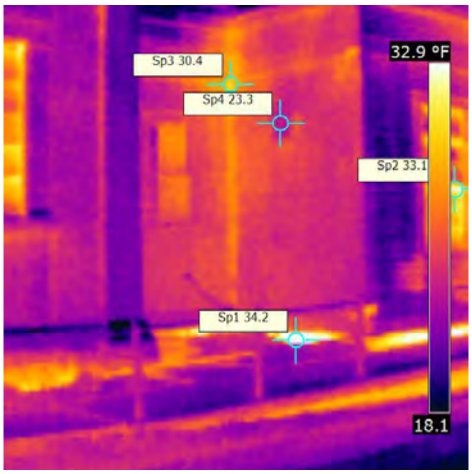


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/3/2012 7:52:57 AM
Image Name	IR_2038.jpg
Emissivity	0.96
Reflected apparent temperature	21.0 °F
Object Distance	15.0 ft

Text Comments

Description

IR of side main entrance reveals thermal transfer through concrete stairs, window frame and at the seam at the entrance walls.

Inspection Report

Report Date	5/21/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

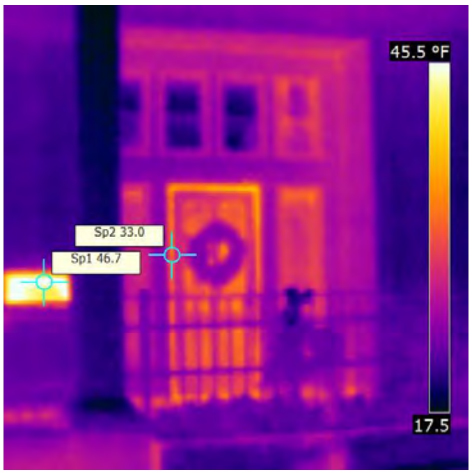


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/3/2012 7:53:12 AM
Image Name	IR_2039.jpg
Emissivity	0.96
Reflected apparent temperature	31.0 °F
Object Distance	20.0 ft

Text Comments

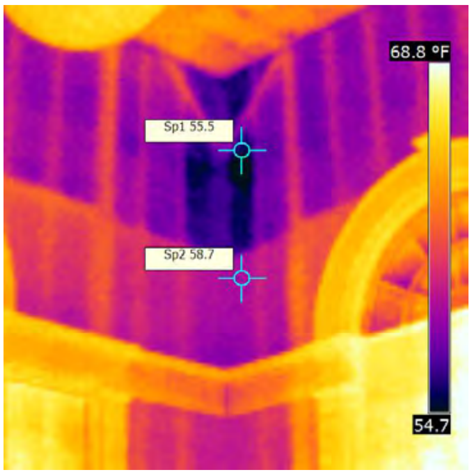
Description

IR of side main entrance reveals thermal transfer though the return drop-box as well as between the door and frame. Refer to EEMs T1-8 to install draft damper on book return and T1-9 for air-sealing cost and savings.

AEC

Inspection Report

Report Date	5/21/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	



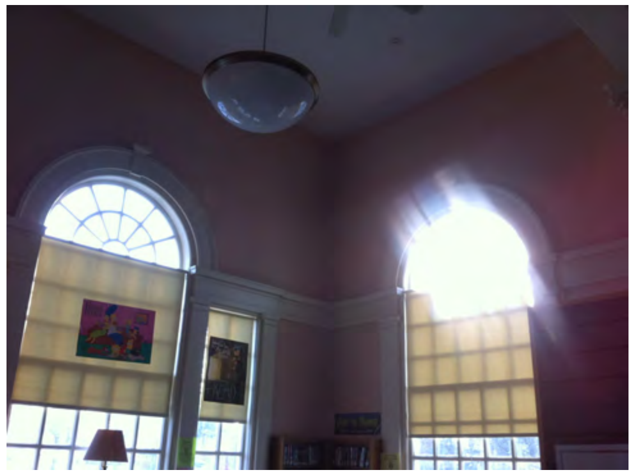


Image and Object Parameters

Text Comments

Camera Model	B-CAM Western S
Image Date	1/3/2012 8:47:20 AM
Image Name	IR_2050.jpg
Emissivity	0.96
Reflected apparent temperature	55.0 °F
Object Distance	25.0 ft

Description

Corner of original building reveals thermal transfer through walls. Studs are visible indicating insulation is not constant and thermal briding is occurring. Insulation possibly missing at Sp1. Refer to EEM T3-4 for wall insulation cost and savings.

Inspection Report

Report Date	5/21/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

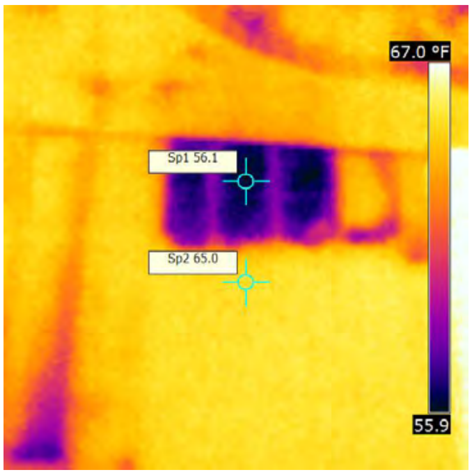


Image and Object Parameters

Text Comments

Camera Model	B-CAM Western S
Image Date	1/3/2012 8:47:37 AM
Image Name	IR_2051.jpg
Emissivity	0.96
Reflected apparent temperature	56.0 °F
Object Distance	20.0 ft

Description

Front wall of library from interior looks fine but under IR reveals bridging due to poor and missing insulation. Refer to EEM T3-4 for wall insulation cost and savings.

Inspection Report

Report Date	5/21/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

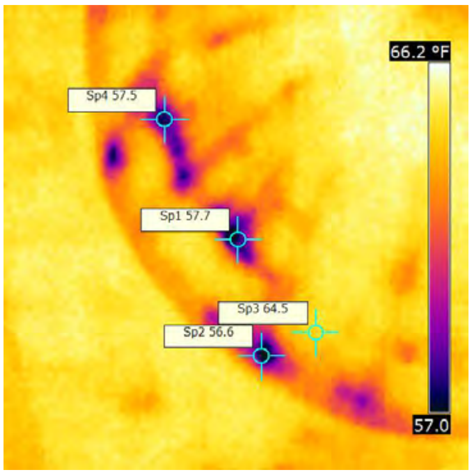


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/3/2012 8:47:53 AM
Image Name	IR_2052.jpg
Emissivity	0.96
Reflected apparent temperature	56.0 °F
Object Distance	20.0 ft

Text Comments

Description

IR of interior of dome reveals areas thermal transfer occurs. Refer to EEM T3-2 for spray foam insulation of entire attic with cost and savings.

Inspection Report

Report Date	5/21/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

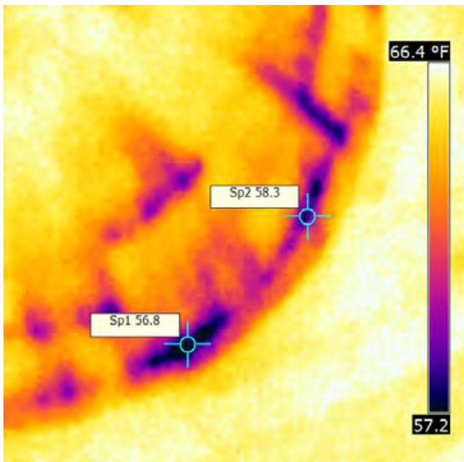


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/3/2012 8:48:23 AM
Image Name	IR_2053.jpg
Emissivity	0.96
Reflected apparent temperature	57.0 °F
Object Distance	20.0 ft

Text Comments

Description

IR of interior of dome reveals areas where thermal transfer occurs. Refer to EEM T3-2 for spray foam insulation of entire attic with cost and savings.

Inspection Report

Report Date	5/21/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

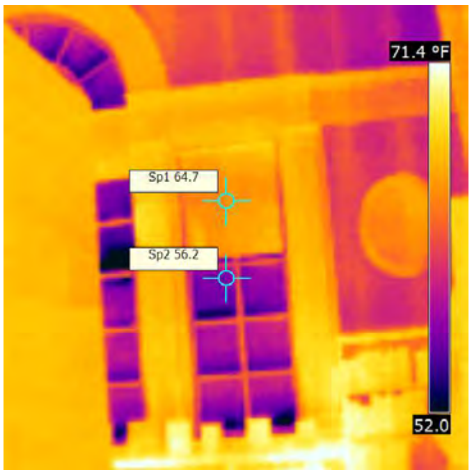


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/3/2012 8:49:28 AM
Image Name	IR_2056.jpg
Emissivity	0.96
Reflected apparent temperature	56.0 °F
Object Distance	15.0 ft

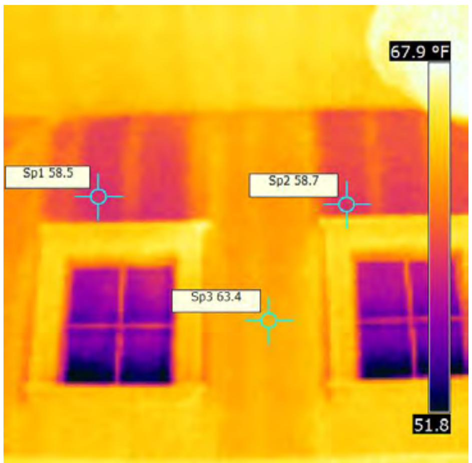
Text Comments

Description

Window IR reveals thermal transfer through window and frame. Note difference in thermal transfer where shade is pulled down and where it is not. Refer to EEM T1-3 for savings of closing shades.

Inspection Report

Report Date	5/21/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	



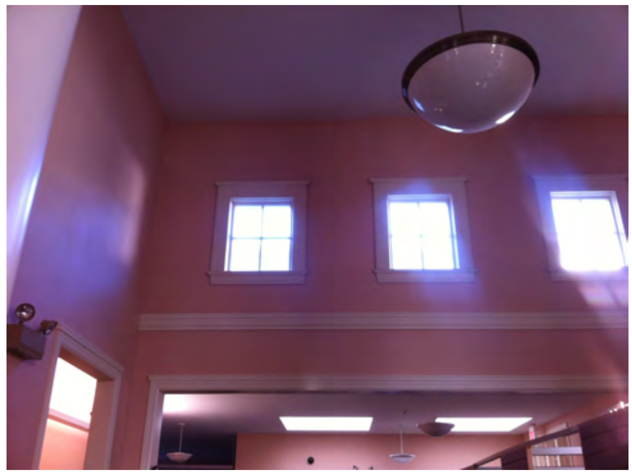


Image and Object Parameters

Text Comments

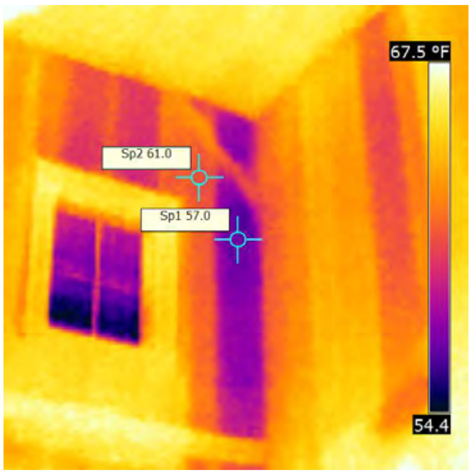
Camera Model	B-CAM Western S
Image Date	1/3/2012 8:50:59 AM
Image Name	IR_2057.jpg
Emissivity	0.96
Reflected apparent temperature	58.0 °F
Object Distance	20.0 ft

Description

IR of upper windows inside Library reveals different thermal properties indicating lack of quality insulation. Refer to EEM T3-4 for cost and savings of insulating wall.

Inspection Report

Report Date	5/21/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	



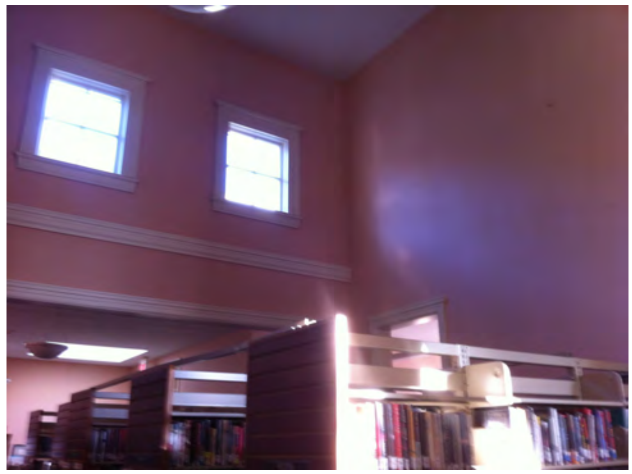


Image and Object Parameters

Text Comments

Camera Model	B-CAM Western S
Image Date	1/3/2012 8:51:49 AM
Image Name	IR_2058.jpg
Emissivity	0.96
Reflected apparent temperature	56.0 °F
Object Distance	20.0 ft

Description

IR in a corner of the Library reveals thermal transfer due to poor insulation. Refer to EEM T3-4 for cost and savings of insulating wall.

Inspection Report

Report Date	5/21/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

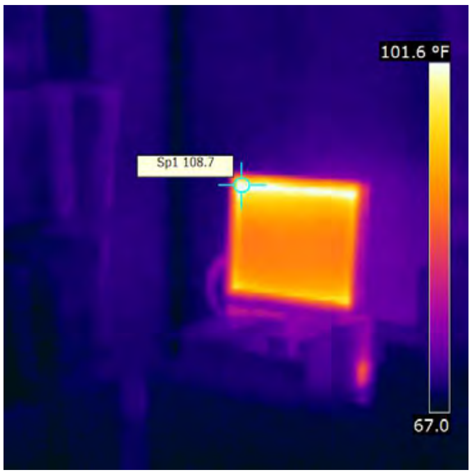


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/3/2012 8:52:41 AM
Image Name	IR_2059.jpg
Emissivity	0.96
Reflected apparent temperature	110.0 °F
Object Distance	12.0 ft

Text Comments

Description

IR of video surveillance system reveals thermal energy produced from running monitor. Recommend shutting down electronics during unoccupied periods.

Inspection Report

Report Date	5/21/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

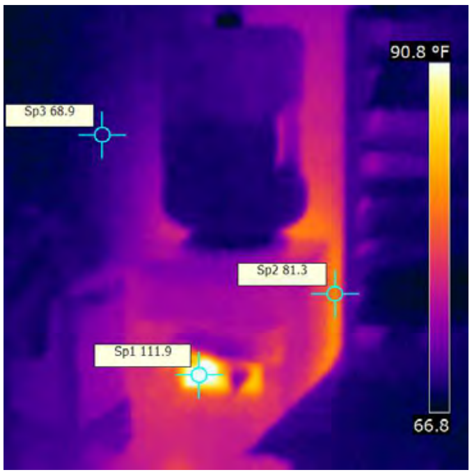


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/3/2012 8:54:22 AM
Image Name	IR_2060.jpg
Emissivity	0.96
Reflected apparent temperature	113.0 °F
Object Distance	8.0 ft

Text Comments

Description

Water dispenser IR reveals thermal energy produced from hot water dispenser (front) and motor to create hot water (rear glow). Note difference in wall temperature behind cooler and further along wall. Refer to EEM T1-2 for savings of disconnecting cooler.

Inspection Report

Report Date	5/21/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

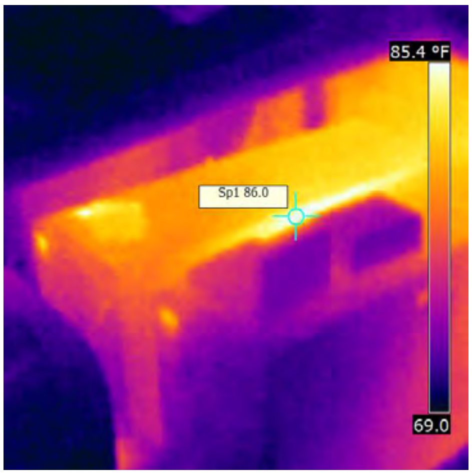


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/3/2012 8:54:49 AM
Image Name	IR_2061.jpg
Emissivity	0.96
Reflected apparent temperature	87.0 °F
Object Distance	5.0 ft

Text Comments

Description

Running computer in the back of the office produces thermal energy. Recommed shutting down all electronics when unoccupied.

Inspection Report

Report Date	5/21/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

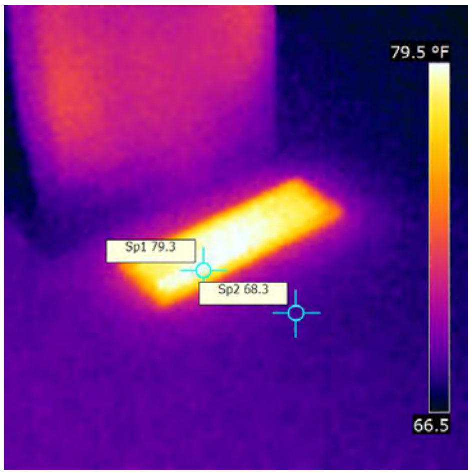


Image and Object Parameters

Text Comments

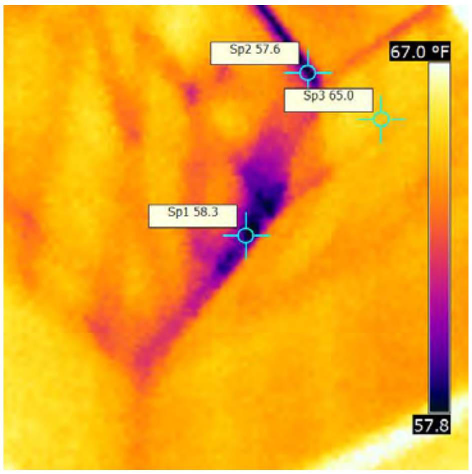
Camera Model	B-CAM Western S
Image Date	1/3/2012 8:57:06 AM
Image Name	IR_2062.jpg
Emissivity	0.96
Reflected apparent temperature	80.0 °F
Object Distance	6.0 ft

Description

IR of floor vent in Library reveals thermal heat emitted.

Inspection Report

Report Date	5/21/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	



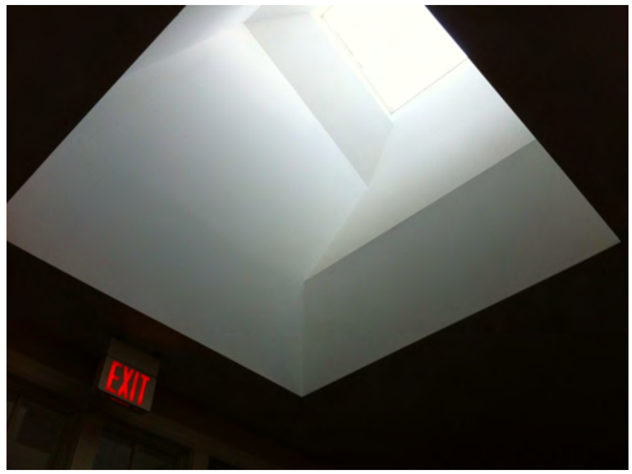


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/3/2012 8:57:21 AM
Image Name	IR_2063.jpg
Emissivity	0.96
Reflected apparent temperature	58.0 °F
Object Distance	15.0 ft

Text Comments

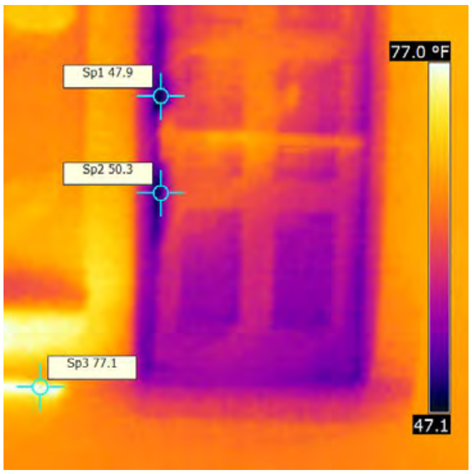
Description

IR of walls below skylight reveal area of thermal transfer (dark spot), most likely due to wall geometry allowing water buildup which could lead to mold. Bridging also occurs at seal of skylight. Refer to EEM T3-4 for cost and savings of insulating wall.

Inspection Report

Report Date	5/21/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	



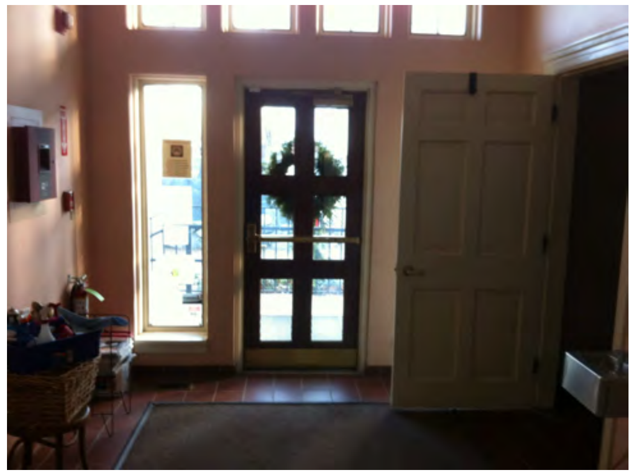


Image and Object Parameters

Text Comments

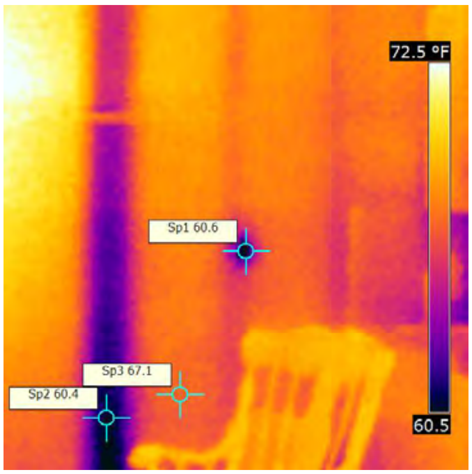
Camera Model	B-CAM Western S
Image Date	1/3/2012 8:57:33 AM
Image Name	IR_2064.jpg
Emissivity	0.96
Reflected apparent temperature	50.0 °F
Object Distance	10.0 ft

Description

IR of interior of side main door reveals thermal bridging occurring between door and frame as well as heat rising through floor vent to left. Refer to EEM T1-9 for air-sealing cost and savings.

Inspection Report

Report Date	5/21/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	



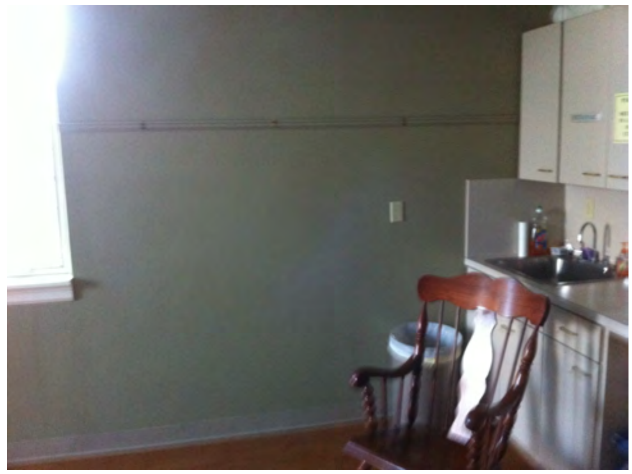


Image and Object Parameters

Text Comments

Camera Model	B-CAM Western S
Image Date	1/3/2012 8:58:08 AM
Image Name	IR_2065.jpg
Emissivity	0.96
Reflected apparent temperature	60.0 °F
Object Distance	8.0 ft

Description

Wall of meeting room reveals thermal transfer through electrical cover as well as a large vertical strip where presumably insulation is missing. Refer to EEM T3-5 for cost and savings of insulating wall.

Inspection Report

Report Date	5/21/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

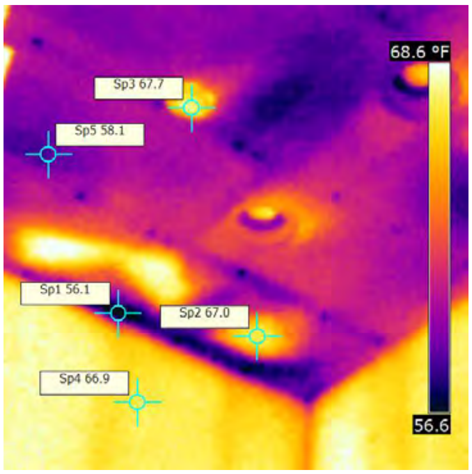


Image and Object Parameters

Text Comments

Camera Model	B-CAM Western S
Image Date	1/3/2012 8:59:36 AM
Image Name	IR_2066.jpg
Emissivity	0.96
Reflected apparent temperature	56.0 °F
Object Distance	12.0 ft

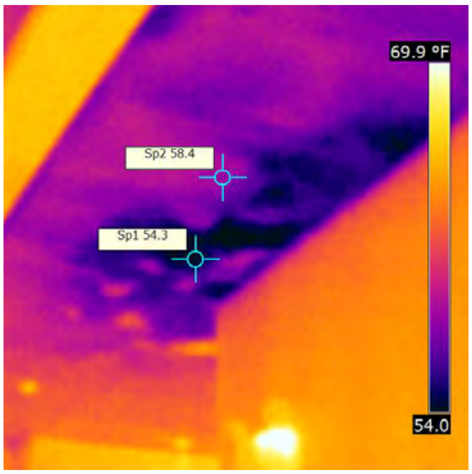
Description

IR of meeting room ceiling reveals various thermal properties indicating poor or missing insulation above. Refer to EEM T3-2 for cost and savings of insulating attic.

Inspection Report

Report Date	5/21/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	



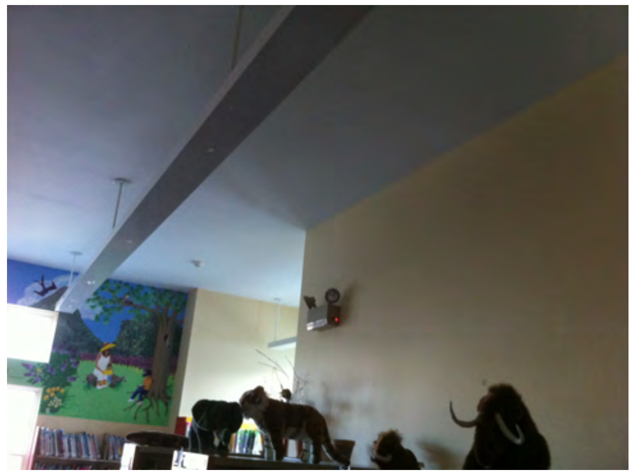


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/3/2012 9:00:25 AM
Image Name	IR_2067.jpg
Emissivity	0.96
Reflected apparent temperature	54.0 °F
Object Distance	12.0 ft

Text Comments

Description

IR of ceiling in the Childrens Library reveals spotty areas of thermal transfer indicating poor insulation above. Refer to EEM T3-2 for cost and savings of insulating attic.

Inspection Report

Report Date	5/21/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

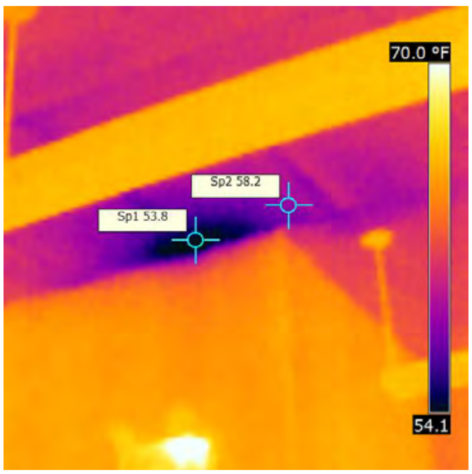


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/3/2012 9:01:10 AM
Image Name	IR_2068.jpg
Emissivity	0.96
Reflected apparent temperature	53.0 °F
Object Distance	10.0 ft

Text Comments

Description

Thermal transfer is occurring in a spot in the ceiling above the Children's Library. Refer to EEM T3-2 for cost and savings of insulating attic.

Inspection Report

Report Date	5/21/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

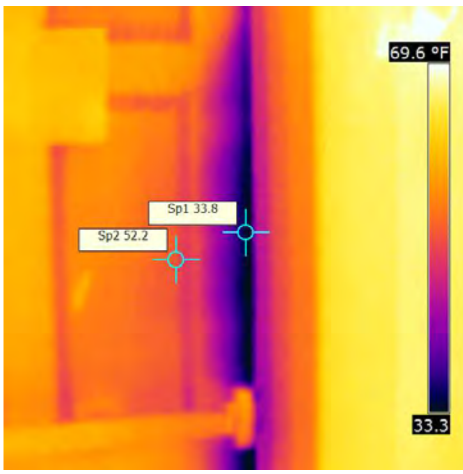


Image and Object Parameters

Text Comments

Camera Model	B-CAM Western S
Image Date	1/3/2012 9:02:19 AM
Image Name	IR_2069.jpg
Emissivity	0.96
Reflected apparent temperature	32.0 °F
Object Distance	5.0 ft

Description

IR of emergency exit at the back of the Library reveals significant thermal transfer between door and frame. Recommend weather sealing all exterior doors and windows. Refer to EEM T1-9 for cost and savings of air-sealing door.

Inspection Report

Report Date	5/21/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

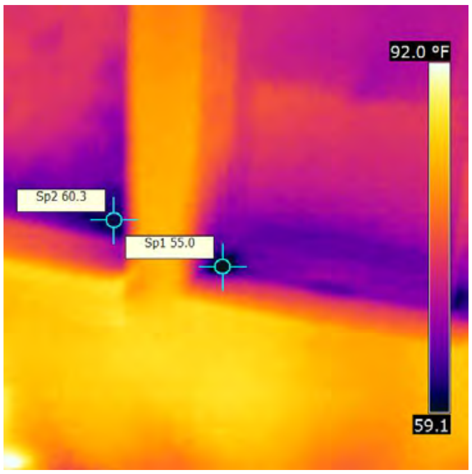


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/3/2012 9:03:13 AM
Image Name	IR_2070.jpg
Emissivity	0.96
Reflected apparent temperature	55.0 °F
Object Distance	7.0 ft

Text Comments

Description

IR of side window reveals thermal transfer between window and frame. Refer to EEM T1-9 for cost and svaings of air-sealing windows.

Inspection Report

Report Date 5/21/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

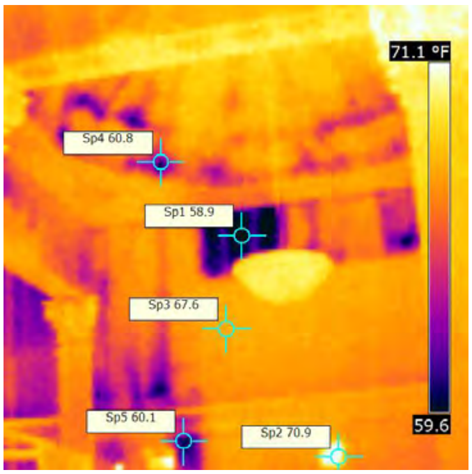


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/3/2012 9:05:56 AM
Image Name	IR_2071.jpg
Emissivity	0.96
Reflected apparent temperature	59.0 °F
Object Distance	20.0 ft

Text Comments

Description

Wall of the old library reveals varrying degrees of thermal transfers occurring indicating areas of good, poor and missing insulation. Refer to EEM T3-4 and T3-2 for cost and savings of insulating walls and ceiling.

Inspection Report

Report Date	5/21/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

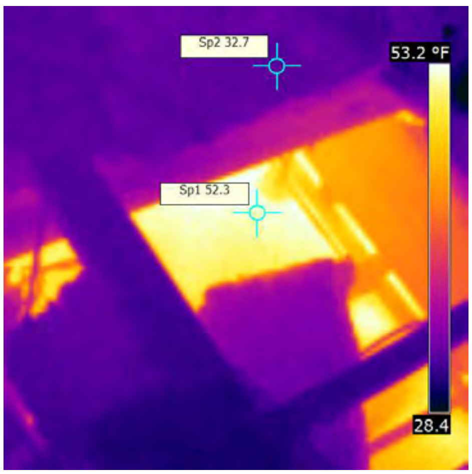


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/3/2012 9:13:24 AM
Image Name	IR_2072.jpg
Emissivity	0.96
Reflected apparent temperature	52.0 °F
Object Distance	4.0 ft

Text Comments

Description

IR of attic floor with missing insulation. Note difference in temperatures where insulation is present and where it is not. Refer to EEM T3-2 for insulating attic cost and savings.

Inspection Report

Report Date	5/21/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

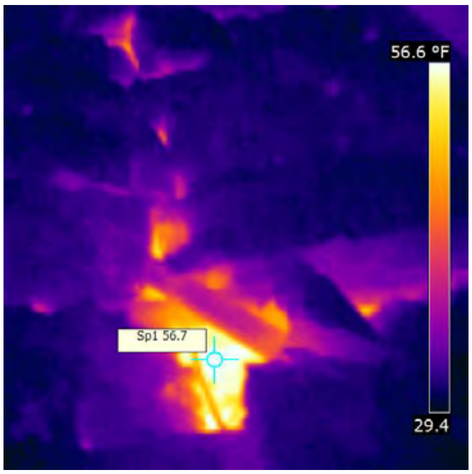


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/3/2012 9:13:29 AM
Image Name	IR_2073.jpg
Emissivity	0.96
Reflected apparent temperature	56.0 °F
Object Distance	4.0 ft

Text Comments

Description

IR reveals insulation is not constant and thermal breaching is occurring. Refer to EEM T3-2 for insulating attic cost and savings.

Inspection Report

Report Date	5/21/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

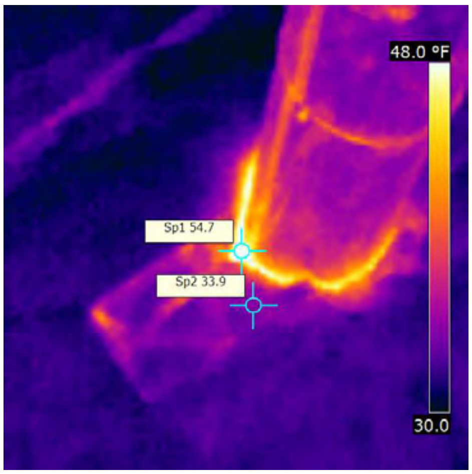


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/3/2012 9:14:25 AM
Image Name	IR_2074.jpg
Emissivity	0.96
Reflected apparent temperature	54.0 °F
Object Distance	3.0 ft

Text Comments

Description

Insulation around exhaust pipe through attic is not adequate at the penetration allowing thermal breaching. Refer to EEM T3-2 for insulating attic cost and savings.

Inspection Report

Report Date	5/21/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

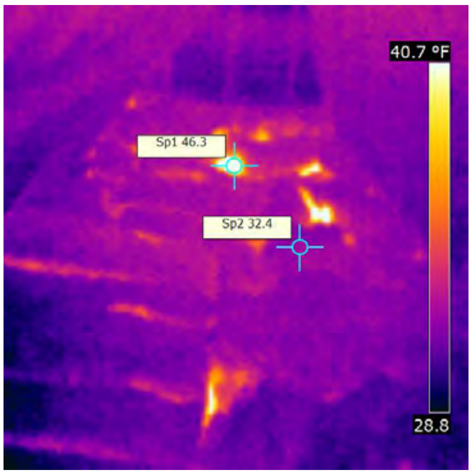


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/3/2012 9:16:13 AM
Image Name	IR_2075.jpg
Emissivity	0.96
Reflected apparent temperature	31.0 °F
Object Distance	10.0 ft

Text Comments

Description

IR of attic space reveals thermal breaching between the batt insulation in the floors. Refer to EEM T3-2 for insulating attic cost and savings.

Inspection Report

Report Date	5/21/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

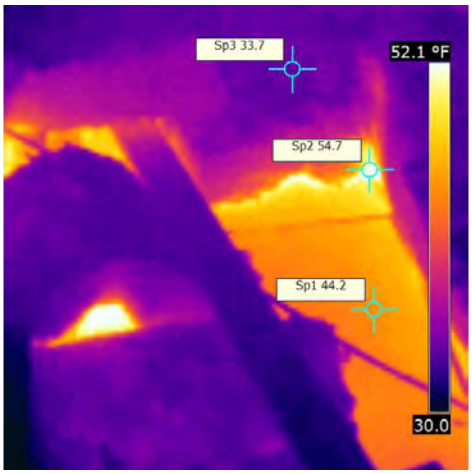


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/3/2012 9:19:13 AM
Image Name	IR_2076.jpg
Emissivity	0.96
Reflected apparent temperature	54.0 °F
Object Distance	3.0 ft

Text Comments

Description

Missing insulation in the attic floor allows for thermal breaching. Note difference in temperatures at no insulation (Sp1), between insulation and floor (Sp2) and on top of insulation (Sp3). Refer to EEM T3-2 for insulating attic cost and savings.

Inspection Report

Report Date	5/21/2012		
Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

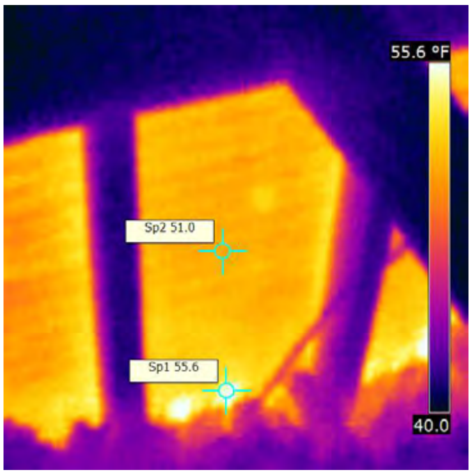


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/3/2012 9:30:48 AM
Image Name	IR_2077.jpg
Emissivity	0.96
Reflected apparent temperature	50.0 °F
Object Distance	4.0 ft

Text Comments

Description

IR of inside of exterior wall reveals thermal transfer through wall. Refer to EEM T3-2 for insulating attic cost and savings.

AEC

Inspection Report

Report Date	5/21/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

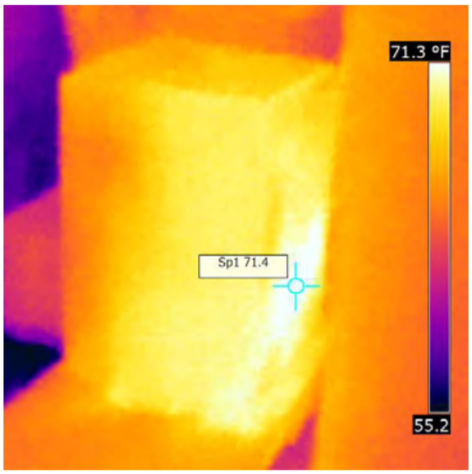


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/3/2012 9:50:28 AM
Image Name	IR_2078.jpg
Emissivity	0.96
Reflected apparent temperature	72.0 °F
Object Distance	5.0 ft

Text Comments

Description

IR of dehumidifier in the basement reveals thermal energy produced. Since this unit runs continuously it is recommended it be replaced with an Energy Star rated model. Refer to EEM T1-7 for associated cost and savings.

Inspection Report

Report Date	5/21/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

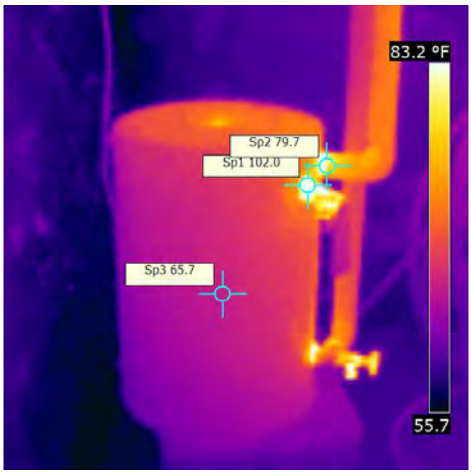


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/3/2012 9:51:57 AM
Image Name	IR_2079.jpg
Emissivity	0.96
Reflected apparent temperature	103.0 °F
Object Distance	5.0 ft

Text Comments

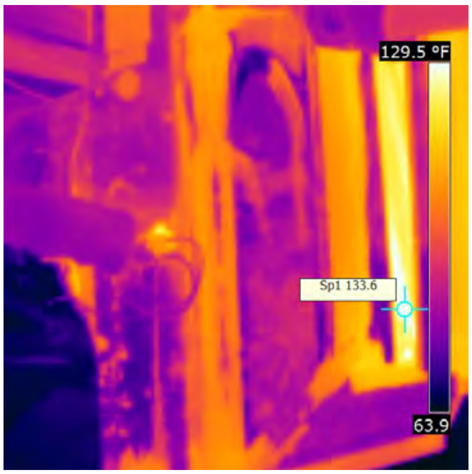
Description

IR of Rheem hot water heater reveals thermal transfer through uninsulated portions of pipe. Heater core is insulated as the IR depicts it. Recommend replacing with tankless hot water heater. Refer to EEM T2-1 for associated cost and savings.

Inspection Report

Report Date	5/21/2012

Company	Acadia Engineers and Constructors	Customer	Hollis Social Library
Address	90 Main Street, Newmarket, NH 03857	Site Address	2 Monument Square, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	



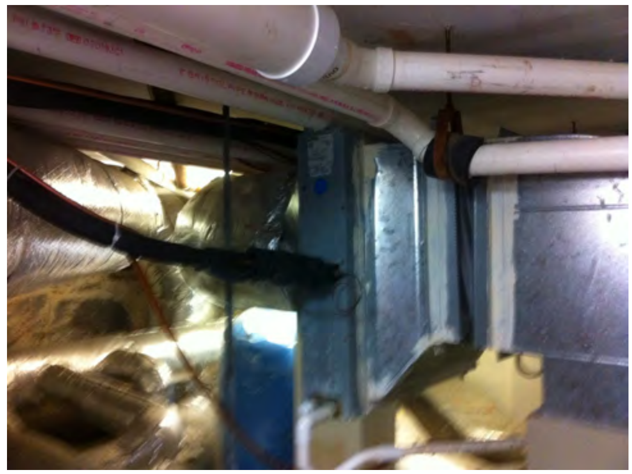


Image and Object Parameters

Text Comments

Camera Model	B-CAM Western S
Image Date	1/3/2012 9:52:51 AM
Image Name	IR_2080.jpg
Emissivity	0.96
Reflected apparent temperature	136.0 °F
Object Distance	4.0 ft

Description

IR of exhaust duct in the basement reveals thermal breaching around the seals.

APPENDIX C

Indoor Metering Data

INDOOR METERING DATA

Facility:	Location:	Date:	Ambient Outdoor:
Hollis Social Library	Hollis, NH	01/03/12	Temp= 23 RH= 25 CO2= 315

Location /Use Description	Time	Occupied	Air Quality			Lighting Density	Notes
			Temp (°F)	RH (%)	CO2 (ppm)	Vert (FC)	
Children's library	1105	Y	63.6	29.7	637	37.8	
Main library - 1993	1109	Y	66.2	27.9	591	30.7	
Main library - 1910	1110	N	67.4	25.3	567	20.1	Lights off, nat light
Back office	1111	N	68.1	23.4	561	23.5	
Averages			66.3	26.6	589	28.0	

APPENDIX D

Lighting Fixture Inventory

LIGHTING FIXTURE INVENTORY

Facility:		Location:				Date:	
Hollis Social Library		Hollis, NH				01/03/2012	

Location /Use Description	Fixture	Watts/ fixture	Qty	Controls	Total watts	Est. Hr/Wk	Est. KWH Consumption/Yr
Children's	CFL	17	1	Switch	17	61	54
Back Office Area	CFL	28	1	Switch	28	61	89
Employee Bathroom	CFL	28	1	Switch	28	5	7
Meeting Room	CFL	112	4	Switch	448	61	1,421
Meeting Room Storage	CFL	112	1	Switch	112	1	6
Back Office Area	CFL	112	3	Switch	336	61	1,066
Exterior	CFL	21	5	Timer	105	61	333
Main Library Area 1910	Induction	40	4	Switch	160	61	508
Main Library Area 1993	Induction	40	4	Switch	160	61	508
Exit	LED	5	7	Always On	35	168	306
Exterior	Metal Halide	70	4	Timer	280	61	888
Emergency Exit	T12	120	1	Switch	120	1	6
Main Storage	T8	28	2	Switch	56	1	3
Quiet Nook 1	T8	28	1	Switch	28	61	89
Quiet Nook 2	T8	28	1	Switch	28	61	89
Bottom Basement Entrance	T8	28	1	Switch	28	5	7
Basement	T8	28	8	Switch	224	5	58
Bathroom 1	T8	56	1	Switch	56	5	15
Bathroom 2	T8	56	1	Switch	56	5	15
Basement Entrance	T8	56	1	Switch	56	5	15
Basement	T8	56	1	Switch	56	5	15
Main Library Area	T8	112	13	Switch	1,456	61	4,618
Entrance Vestibule	T8	112	1	Switch	112	61	355
Meeting Room	T8	112	4	Switch	448	61	1,421
Children's	T8	112	8	Switch	896	61	2,842
			79		**5,329**		**14,732**

APPENDIX E

Mechanical Equipment Inventory

FURNACE DATA SHEET

Facility:	Location:	Date:
Hollis Social Library	Hollis, NH	01/03/2012

Location /Use Description	Manufacturer	Model Number	Qty	Year	Capacity Output/Input (btuh)	AFUE Efficiency (%)	Circ Pump	Blower wattage	Consumption (kWh/yr)
Basement / Forced Hot Air	Lennox	Pulse 21: G21Q5-80-1	5	1993	74,000/80,000	93.2	Yes	559	4794

OUTDOOR AC SYSTEM INVENTORY

Facility: Hollis Social Library | Location: Hollis, NH | Date: 01/03/2012

Location /Use Description	Qty.	Serves	Affiliated System	Volt	Phase	Compressor			Fan		SEER	Refrig. Type	Manufacturer	Model	Age (yrs)	Est. kWh/yr
						RLA	LRA	Cooling (TON)	FLA	HP						
Outdoor West Side / AC	4	Throughout	AC	208	1	28.9	169	5	2.0	1/3	10	R22	Rheem	RAKA-060JAZ	17	6,009
Outdoor West Side / AC	1	Throughout	AC	208	1	16.5	95	3	1.3	1/5	10	R22	Rheem	RAKA-037JAZ	16	967

HOT WATER EQUIPMENT INVENTORY

Facility:			Location:		
Hollis Social Library			Hollis, NH		
Location /Use Description	**Qty**	**Capacity (gal.)**	**Affiliated System**	**Wattage**	**Consumption (kWh/yr)**
Basement/DHW	1	10	DHW	2000	1456

PUMPS

Facility:		Location:
Hollis Social Library		Hollis, NH
Location /Use Description	**Qty**	**Consumption (kWh/yr)**
Basement / Sump pump	2	750
Well / Water supply pump	1	250

APPENDIX F

Plug Load Inventory

PLUG LOAD INVENTORY

Facility:			Location:			Date:		
Hollis Social Library			Hollis, NH			01/03/2012		

Location /Use Description	Category	Description	Watts/ fixture	Qty	Total watts	Est. Hr/Wk	Est. kWh/Yr	Notes
Meeting Room	AS - Small Appliance	Coffee Maker Keurig	1,500	1	1,500	1	78	
Meeting Room	AS - Small Appliance	Hot Water	1,000	1	1,000	0	13	Not plugged
Top Basement Entrance	AS - Small Appliance	Vacuum	1,440	1	1,440	2	150	
Back Office	AS - Small Appliance	Microwave	1,000	1	1,000	1	52	
Back Office	AS - Small Appliance	Toaster Oven	1,300	1	1,300	1	68	
Back Office	AS - Small Appliance	Water cooler	540	1	540	60	1,685	
Children's Library	CD - Desktop Computer	Computer Desktop	80	2	160	55	458	
Main Library	CD - Desktop Computer	Computer Desktop	80	10	800	55	2,288	
Back Office	CD - Desktop Computer	Computer Desktop	80	6	480	55	1,373	
Children's Library	CM - Computer Monitor	Computer Monitor LCD	15	2	30	55	86	
Main Library	CM - Computer Monitor	Computer Monitor LCD	15	10	150	55	429	
Back Office	CM - Computer Monitor	Computer Monitor LCD	15	7	105	55	300	
Main Library	DL - Desk Lamp	Lamp	13	1	13	55	37	
Children's Library	EL - Electronics	CD Player	15	1	15	3	2	
Main Library	FN - Fan	Ceiling Fan	20	2	40	3	6	
Top Basement Entrance	FN - Fan	Fan	20	1	20	3	3	
Children's Library	OE - Office Equipment	Barcode Scanner	1	1	1	2	0	
Main Library	OE - Office Equipment	Barcode Scanner	1	2	1	2	0	
Main Library	OE - Office Equipment	Receipt Printer	240	2	480	1	25	
Main Library	OE - Office Equipment	Modem	15	1	15	60	47	
Back Office	OE - Office Equipment	Disc Cleaner	1,200	1	1,200	2	125	
Back Office	OE - Office Equipment	Barcode Scanner	1	1	1	2	0	
Main Library	PC - Photocopier	Photocopier	1,440	1	1,440	15	1,123	
Main Library	PR - Computer Printer	Printer Laser Jet	500	1	500	2	52	
Main Library	PR - Computer Printer	Printer Laser Jet	500	1	500	2	52	
Back Office	PR - Computer Printer	Printer Laser Jet	500	1	500	2	52	
Back Office	PR - Computer Printer	Printer Desk Jet	500	1	500	2	52	
Back Office	RM - Mini Refrigerator	Refrigerator Compact	150	1	150	60	468	
Entrance	VE - Video Equipt/Projector	Video Surveillance	8	1	8	168	70	
Main Library	VE - Video Equipt/Projector	Video Surveillance	8	4	32	168	280	
Back Office	VE - Video Equipt/Projector	Digimerge Video Surveillance	36	1	36	168	314	
Entrance	WF - Water Fountain	Water Fountain	300	2	600	60	1,872	
		Totals:		**70**	**14,557**		**11,560**	

APPENDIX G

ENERGY STAR® Statement of Energy Performance

OMB No. 2060-0347

STATEMENT OF ENERGY PERFORMANCE
Hollis Social Library

Building ID: 1714463
For 12-month Period Ending: November 30, 2011[1]
Date SEP becomes ineligible: N/A

Date SEP Generated: February 17, 2012

Facility
Hollis Social Library
2 Monument Square
Hollis, NH 03049

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

Primary Contact for this Facility
N/A

Year Built: 1910
Gross Floor Area (ft²): 7,795

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

Site Energy Use Summary[3]	
Electricity - Grid Purchase(kBtu)	137,981
Propane (kBtu)	263,441
Natural Gas - (kBtu)[4]	0
Total Energy (kBtu)	401,422

Energy Intensity[4]	
Site (kBtu/ft²/yr)	52
Source (kBtu/ft²/yr)	93

Emissions (based on site energy use)	
Greenhouse Gas Emissions ($MtCO_2e$/year)	32

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

National Median Comparison	
National Median Site EUI	92
National Median Source EUI	246
% Difference from National Median Source EUI	-62%
Building Type	Library

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
N/A

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 Social Library	Is this the official building name to be displayed in the ENERGY STAR Registry of Labeled Buildings?		☐
Type	Library	Is this an accurate description of the space in question?		☐
Location	2 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.		☐

Library Basement (Other)

CRITERION	VALUE AS ENTERED IN PORTFOLIO MANAGER	VERIFICATION QUESTIONS	NOTES	☑
Gross Floor Area	2,295 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	168Hours(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.		☐

Social Library - New Addition (Other)

CRITERION	VALUE AS ENTERED IN PORTFOLIO MANAGER	VERIFICATION QUESTIONS	NOTES	☑
Gross Floor Area	4,000 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	15(Optional)	Is this the number of personal computers in the space?		☐

Weekly operating hours	68Hours(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	5(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.		☐

Social Library - Original (Other)

CRITERION	VALUE AS ENTERED IN PORTFOLIO MANAGER	VERIFICATION QUESTIONS	NOTES	☑
Gross Floor Area	1,500 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	68Hours(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 STAR® Data Checklist
for Commercial Buildings

Energy Consumption

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

Fuel Type: Electricity		
Meter: 8004808-01-6-4 (kWh (thousand Watt-hours)) **Space(s):** Entire Facility **Generation Method:** Grid Purchase		
Start Date	**End Date**	**Energy Use (kWh (thousand Watt-hours))**
11/01/2011	11/30/2011	2,530.00
10/01/2011	10/31/2011	3,000.00
09/01/2011	09/30/2011	3,380.00
08/01/2011	08/31/2011	4,240.00
07/01/2011	07/31/2011	4,220.00
06/01/2011	06/30/2011	3,090.00
05/01/2011	05/31/2011	2,600.00
04/01/2011	04/30/2011	3,450.00
03/01/2011	03/31/2011	3,200.00
02/01/2011	02/28/2011	3,550.00
01/01/2011	01/31/2011	3,690.00
12/01/2010	12/31/2010	3,490.00
8004808-01-6-4 Consumption (kWh (thousand Watt-hours))		**40,440.00**
8004808-01-6-4 Consumption (kBtu (thousand Btu))		**137,981.28**
Total Electricity (Grid Purchase) Consumption (kBtu (thousand Btu))		**137,981.28**
Is this the total Electricity (Grid Purchase) consumption at this building including all Electricity meters?		☐

Fuel Type: Propane		
Meter: 12344 Propane (Gallons) **Space(s):** Entire Facility		
Start Date	**End Date**	**Energy Use (Gallons)**
11/01/2011	11/30/2011	131.60
10/01/2011	10/31/2011	234.00
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	0.00
04/01/2011	04/30/2011	462.80
03/01/2011	03/31/2011	308.40
02/01/2011	02/28/2011	578.50

01/01/2011	01/31/2011	541.70
12/01/2010	12/31/2010	617.50
12344 Propane Consumption (Gallons)		**2,874.50**
12344 Propane Consumption (kBtu (thousand Btu))		**263,441.03**
Total Propane Consumption (kBtu (thousand Btu))		**263,441.03**
Is this the total Propane consumption at this building including all Propane 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 Social Library
2 Monument Square
Hollis, NH 03049

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

Primary Contact for this Facility
N/A

General Information

Hollis Social Library	
Gross Floor Area Excluding Parking: (ft^2)	7,795
Year Built	1910
For 12-month Evaluation Period Ending Date:	November 30, 2011

Facility Space Use Summary

Library Basement	
Space Type	Other - Other
Gross Floor Area(ft^2)	2,295
Number of PCs°	0
Weekly operating hours°	168
Workers on Main Shift°	0

Social Library - Original	
Space Type	Other - Library
Gross Floor Area(ft^2)	1,500
Number of PCs°	0
Weekly operating hours°	68
Workers on Main Shift°	0

Social Library - New Addition	
Space Type	Other - Library
Gross Floor Area(ft^2)	4,000
Number of PCs°	15
Weekly operating hours°	68
Workers on Main Shift°	5

Energy Performance Comparison

	Evaluation Periods		Comparisons		
Performance Metrics	**Current** (Ending Date 11/30/2011)	**Baseline** (Ending Date 12/31/2008)	**Rating of 75**	**Target**	**National Median**
Energy Performance Rating	N/A	N/A	75	N/A	N/A
Energy Intensity					
Site (kBtu/ft²)	52	54	0	N/A	92
Source (kBtu/ft²)	93	99	0	N/A	246
Energy Cost					
$/year	$ 11,506.66	$ 13,360.96	N/A	N/A	$ 20,555.59
$/ft²/year	$ 1.48	$ 1.71	N/A	N/A	$ 2.64
Greenhouse Gas Emissions					
$MtCO_2e$/year	32	34	0	N/A	57
$kgCO_2e/ft^2$/year	4	4	0	N/A	7

More than 50% of your building is defined as Library. This building is currently ineligible for a rating. Please note the National Median column represents the CBECS national median data for Library. This building uses 62% less energy per square foot than the CBECS national median for Library.

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 Social Library	Location:	Hollis, NH
Gross Area (sf):	7,795	Date:	3/8/2012
Use Category:	Library	EUI (kBtu/sf/yr):	93
Heating Fuel(s):	Propane	PM Grade:	NA
Heating System(s):	Forced Hot Air	Cooling System(s):	Outdoor Air Condensers

RE Technology	Score (out of 70 pts.)	Grade	Notes/Comments
Geothermal Heating/Cooling	59.0	84%	Closed-loop GSHP system.
Solar DHW	54.5	78%	DHW demand should be confirmed.
Biomass Heating	51.5	74%	Pellet feed system recommended.
Roof Photovoltaic	51.0	73%	Small (5kw-10kw) or medium (10kw-30kw) system.
Ground Photovoltaic	49.0	70%	Small (5kw-10kw) or medium (10kw-30kw) system.
Wind Turbine Generator	45.0	64%	Permit requirements are height dependent.
Solar Thermal	43.0	61%	Medium-temperature collector.
Combined Heat & Power	40.5	58%	75kW system.

RENEWABLE ENERGY SCREENING WORKSHEET

Building/Facility:	Hollis Social Library	Location:	Hollis, NH
Gross Area (sf):	7,795	Date:	3/8/2012
Use Category:	Library	EUI (kBtu/sf/yr):	93
Heating Fuel(s):	Propane	PM Grade:	NA
Heating System(s):	Forced Hot Air	Cooling System(s):	Outdoor Air Condensers

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	5	Abundant geothermal energy reserves.
4	Energy demand	4.5	Heating and cooling energy consumption is relatively high.
5	Facility/systems conditions	3	Existing system is functioning
6	Facility/systems compatibility	4	Building system is old and out dated but a heat pump can be installed. Could be installed in abutting town-owned field.
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	5	Abutters with water supply wells can be sensitive to geothermal wells but a closed-loop system will have no impact.
9	Capital investment	3	High capital cost.
10	O&M requirements	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	The building currently uses a moderately high amount of fuel.
14	Public awareness/education	4	HIgh public use. Information could be displayed in the building so users are aware of geothermal system.
	Total Score:	**59**	
	Total Possible Score:	**70**	
	Grade:	**84%**	

RENEWABLE ENERGY SCREENING WORKSHEET

Building/Facility:	Hollis Social Library	Location:	Hollis, NH
Gross Area (sf):	7,795	Date:	3/8/2012
Use Category:	Library	EUI (kBtu/sf/yr):	93
Heating Fuel(s):	Propane	PM Grade:	NA
Heating System(s):	Forced Hot Air	Cooling System(s):	Outdoor Air Condensers

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 10-gal storage tank.
6	Facility/systems compatibility	4	System could utilize the existing 10-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 Social Library — Location: Hollis, NH
Gross Area (sf): 7,795 — Date: 3/8/2012
Use Category: Library — EUI (kBtu/sf/yr): 93
Heating Fuel(s): Propane — PM Grade: NA
Heating System(s): Forced Hot Air — Cooling System(s): Outdoor Air Condensers

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	4.5	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	4	Moderate public use. Information could be displayed in the building so users are aware of biomass heating system.
	Total Score:	**51.5**	
	Total Possible Score:	**70**	
	Grade:	**74%**	

RENEWABLE ENERGY SCREENING WORKSHEET

Building/Facility:	Hollis Social Library	Location:	Hollis, NH
Gross Area (sf):	7,795	Date:	3/8/2012
Use Category:	Library	EUI (kBtu/sf/yr):	93
Heating Fuel(s):	Propane	PM Grade:	NA
Heating System(s):	Forced Hot Air	Cooling System(s):	Outdoor Air Condensers

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	3.5	Moderate grid electrical demand.
5	Facility/systems conditions	4.5	South facing roofs at the Library include small portions on either side of the dome which is enough space for a few panels while more south space is available on the 1993 roof.
6	Facility/systems compatibility	3.5	Roof is in decent shape and most electrical systems are modern.
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:	**51**	
	Total Possible Score:	**70**	
	Grade:	**73%**	

RENEWABLE ENERGY SCREENING WORKSHEET

Building/Facility:	Hollis Social Library	Location:	Hollis, NH
Gross Area (sf):	7,795	Date:	3/8/2012
Use Category:	Library	EUI (kBtu/sf/yr):	93
Heating Fuel(s):	Propane	PM Grade:	NA
Heating System(s):	Forced Hot Air	Cooling System(s):	Outdoor Air Condensers

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	3.5	Moderate grid electrical demand.
5	Facility/systems conditions	3	Older facility and systems.
6	Facility/systems compatibility	3.5	Most practical panel placement for south facing panels would be at the back of the parking lot where there are limited shadow obstructions to the south.
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	4.5	High visibility.
	Total Score:	**49**	
	Total Possible Score:	**70**	
	Grade:	**70%**	

RENEWABLE ENERGY SCREENING WORKSHEET

Building/Facility: Hollis Social Library
Location: Hollis, NH
Gross Area (sf): 7,795
Date: 3/8/2012
Use Category: Library
EUI (kBtu/sf/yr): 93
Heating Fuel(s): Propane
PM Grade: NA
Heating System(s): Forced Hot Air
Cooling System(s): Outdoor Air Condensers

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	3.5	Electric energy consumption is moderate.
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:	**45**	
	Total Possible Score:	**70**	
	Grade:	**64%**	

RENEWABLE ENERGY SCREENING WORKSHEET

Building/Facility:	Hollis Social Library	Location:	Hollis, NH
Gross Area (sf):	7,795	Date:	3/8/2012
Use Category:	Library	EUI (kBtu/sf/yr):	93
Heating Fuel(s):	Propane	PM Grade:	NA
Heating System(s):	Forced Hot Air	Cooling System(s):	Outdoor Air Condensers

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	4.5	Heating and cooling is high percentage of building energy consumption.
5	Facility/systems conditions	1	No air handling equipment currently installed.
6	Facility/systems compatibility	1.5	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	4.5	High visibility.
	Total Score:	**43**	
	Total Possible Score:	**70**	
	Grade:	**61%**	

RENEWABLE ENERGY SCREENING WORKSHEET

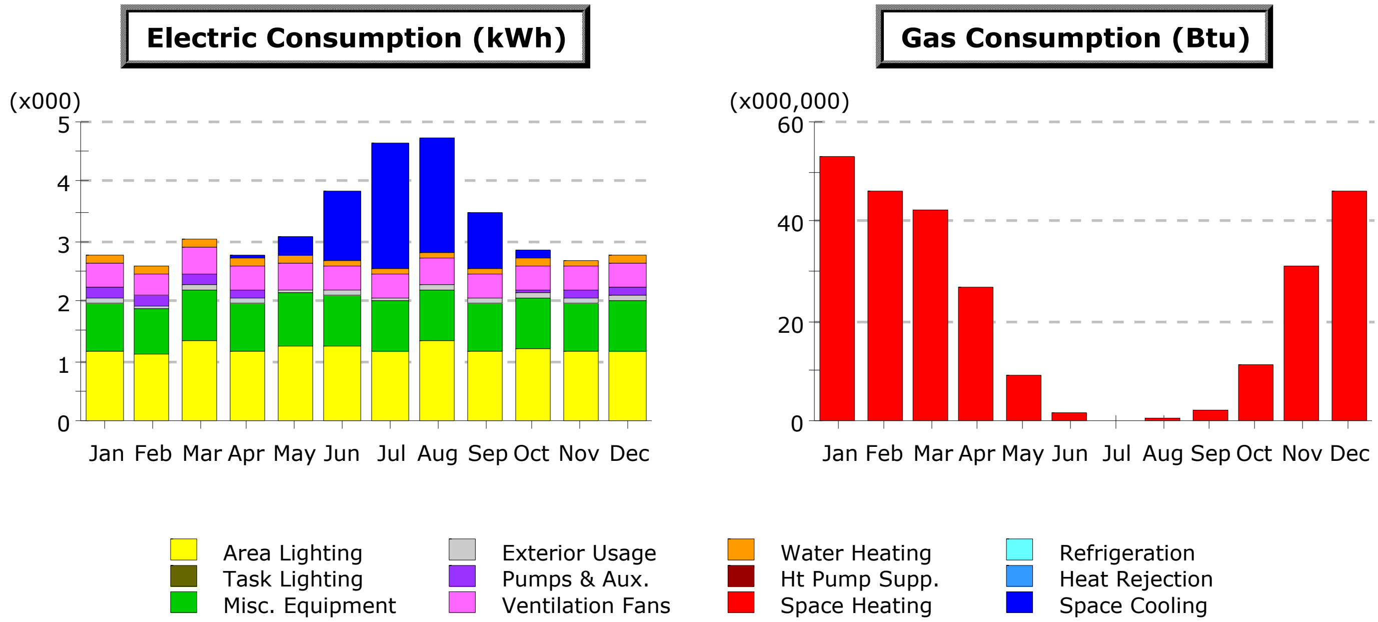
Building/Facility:	Hollis Social Library	Location:	Hollis, NH
Gross Area (sf):	7,795	Date:	3/8/2012
Use Category:	Library	EUI (kBtu/sf/yr):	93
Heating Fuel(s):	Propane	PM Grade:	NA
Heating System(s):	Forced Hot Air	Cooling System(s):	Outdoor Air Condensers

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)

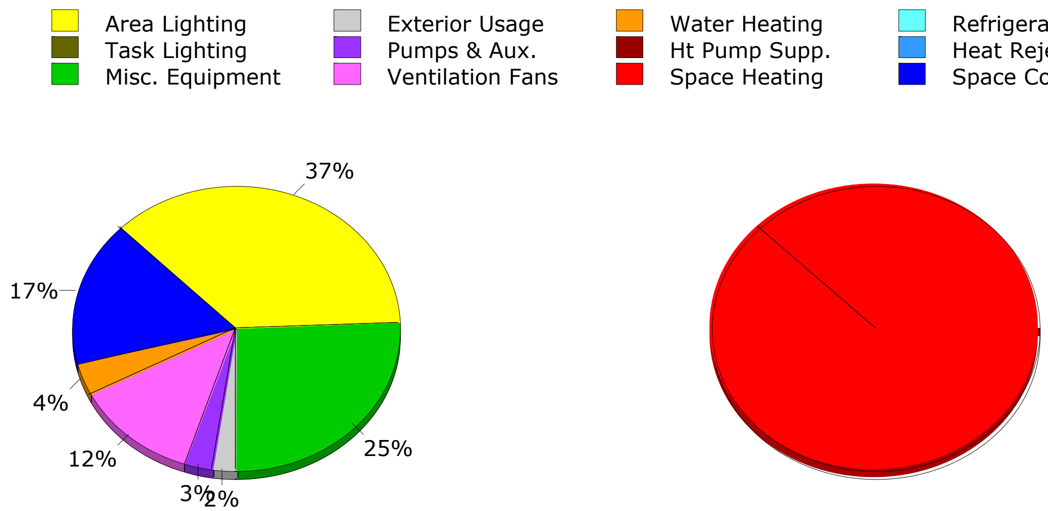
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	0.04	0.32	1.13	2.11	1.90	0.95	0.13	0.00	-	6.57
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	0.13	0.12	0.15	0.13	0.13	0.12	0.11	0.11	0.10	0.11	0.11	0.12	1.43
Vent. Fans	0.39	0.36	0.42	0.40	0.41	0.41	0.40	0.42	0.39	0.40	0.38	0.40	4.79
Pumps & Aux.	0.18	0.17	0.17	0.14	0.03	-	-	-	0.00	0.06	0.15	0.17	1.08
Ext. Usage	0.09	0.07	0.08	0.07	0.05	0.05	0.05	0.09	0.08	0.09	0.09	0.09	0.89
Misc. Equip.	0.80	0.75	0.89	0.81	0.86	0.85	0.81	0.89	0.80	0.83	0.79	0.81	9.88
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	1.17	1.11	1.32	1.17	1.27	1.27	1.18	1.32	1.17	1.22	1.16	1.18	14.55
Total	2.76	2.58	3.03	2.77	3.06	3.83	4.66	4.73	3.49	2.84	2.68	2.77	39.20

Gas Consumption (Btu x000,000)

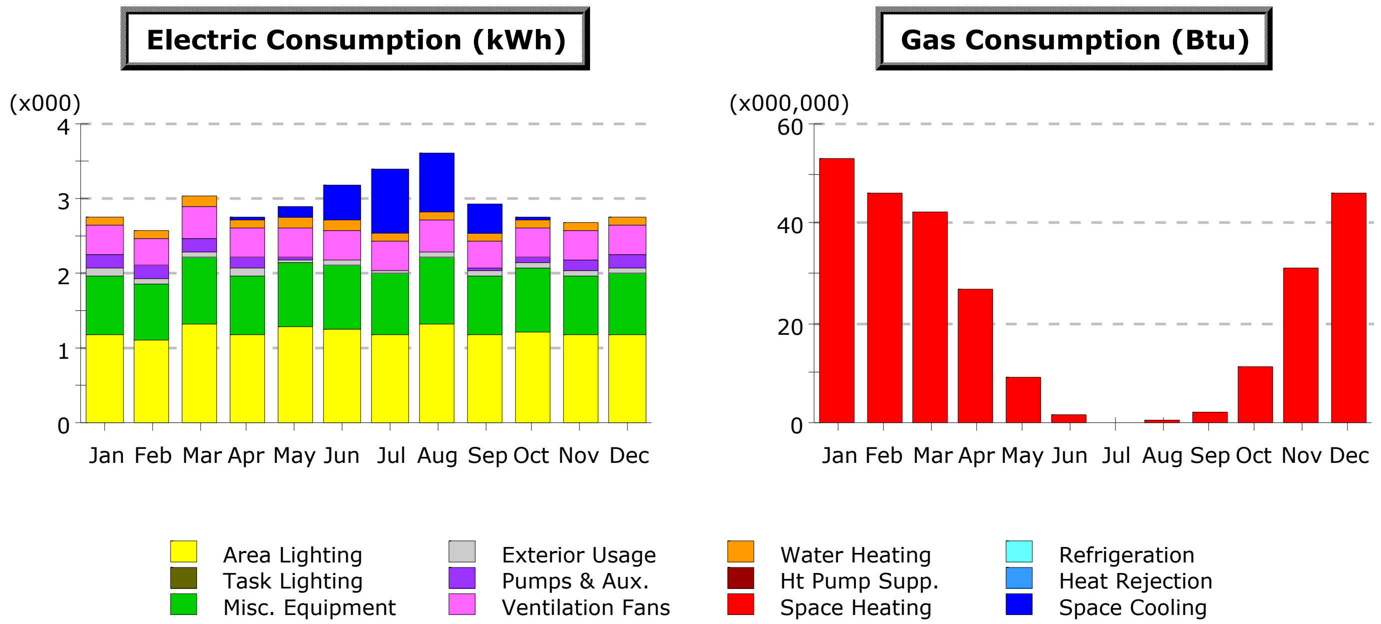
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	53.21	45.83	42.38	26.57	9.14	1.36	0.16	0.40	1.90	11.36	31.16	45.85	269.32
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	53.21	45.83	42.38	26.57	9.14	1.36	0.16	0.40	1.90	11.36	31.16	45.85	269.32

Annual Energy Consumption by Enduse

	Electricity kWh	Natural Gas MBtu	Steam Btu	Chilled Water Btu
Space Cool	6,574	-	-	-
Heat Reject.	-	-	-	-
Refrigeration	-	-	-	-
Space Heat	-	269.32	-	-
HP Supp.	-	-	-	-
Hot Water	1,426	-	-	-
Vent. Fans	4,792	-	-	-
Pumps & Aux.	1,084	-	-	-
Ext. Usage	893	-	-	-
Misc. Equip.	9,882	-	-	-
Task Lights	-	-	-	-
Area Lights	14,547	-	-	-
Total	39,197	269.32	-	-



Electricity **Natural Gas**



Electric Consumption (kWh x000)

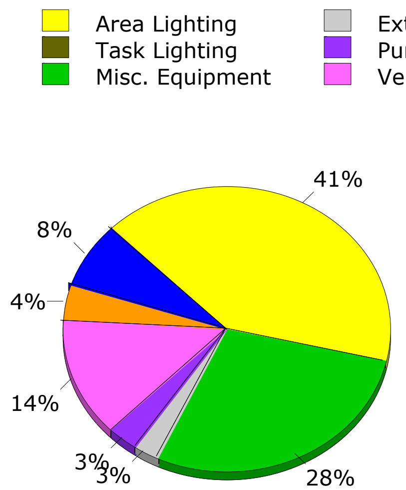
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	0.02	0.13	0.46	0.86	0.78	0.39	0.05	0.00	-	2.69
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	0.13	0.12	0.15	0.13	0.13	0.12	0.11	0.11	0.10	0.11	0.11	0.12	1.43
Vent. Fans	0.39	0.36	0.42	0.40	0.41	0.41	0.40	0.42	0.39	0.40	0.38	0.40	4.79
Pumps & Aux.	0.18	0.17	0.17	0.14	0.03	-	-	-	0.00	0.06	0.15	0.17	1.08
Ext. Usage	0.09	0.07	0.08	0.07	0.05	0.05	0.05	0.09	0.08	0.09	0.09	0.09	0.89
Misc. Equip.	0.80	0.75	0.89	0.81	0.86	0.85	0.81	0.89	0.80	0.83	0.79	0.81	9.88
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	1.17	1.11	1.32	1.17	1.27	1.27	1.18	1.32	1.17	1.22	1.16	1.18	14.55
Total	2.76	2.58	3.03	2.74	2.88	3.16	3.41	3.61	2.93	2.76	2.68	2.77	35.31

Gas Consumption (Btu x000,000)

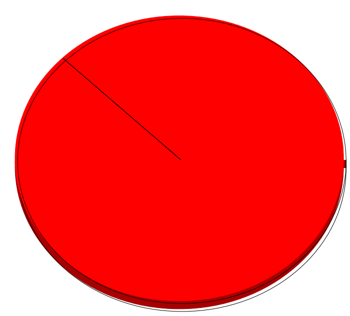
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	53.21	45.83	42.38	26.57	9.14	1.36	0.16	0.40	1.90	11.36	31.16	45.85	269.32
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	53.21	45.83	42.38	26.57	9.14	1.36	0.16	0.40	1.90	11.36	31.16	45.85	269.32

Annual Energy Consumption by Enduse

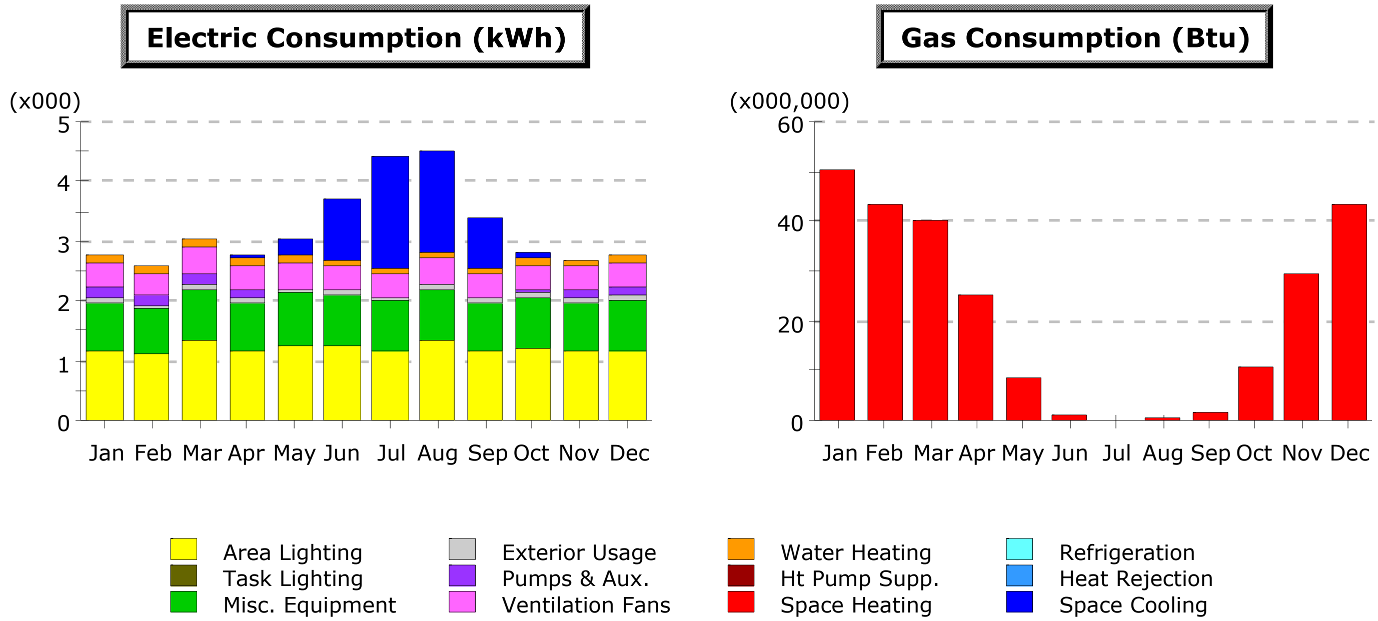
	Electricity kWh	Natural Gas MBtu	Steam Btu	Chilled Water Btu
Space Cool	2,691	-	-	-
Heat Reject.	-	-	-	-
Refrigeration	-	-	-	-
Space Heat	-	269.32	-	-
HP Supp.	-	-	-	-
Hot Water	1,426	-	-	-
Vent. Fans	4,792	-	-	-
Pumps & Aux.	1,084	-	-	-
Ext. Usage	893	-	-	-
Misc. Equip.	9,882	-	-	-
Task Lights	-	-	-	-
Area Lights	14,547	-	-	-
Total	35,314	269.32	-	-



Electricity



Natural Gas



Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	0.04	0.28	1.01	1.89	1.70	0.85	0.12	0.00	-	5.89
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	0.13	0.12	0.15	0.13	0.13	0.12	0.11	0.11	0.10	0.11	0.11	0.12	1.43
Vent. Fans	0.39	0.36	0.42	0.40	0.41	0.41	0.40	0.42	0.39	0.40	0.38	0.40	4.79
Pumps & Aux.	0.18	0.17	0.17	0.14	0.03	-	-	-	0.00	0.06	0.15	0.17	1.08
Ext. Usage	0.09	0.07	0.08	0.07	0.05	0.05	0.05	0.09	0.08	0.09	0.09	0.09	0.89
Misc. Equip.	0.80	0.75	0.89	0.81	0.86	0.85	0.81	0.89	0.80	0.83	0.79	0.81	9.88
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	1.17	1.11	1.32	1.17	1.27	1.27	1.18	1.32	1.17	1.22	1.16	1.18	14.55
Total	2.76	2.58	3.03	2.76	3.03	3.71	4.43	4.53	3.39	2.83	2.68	2.77	38.51

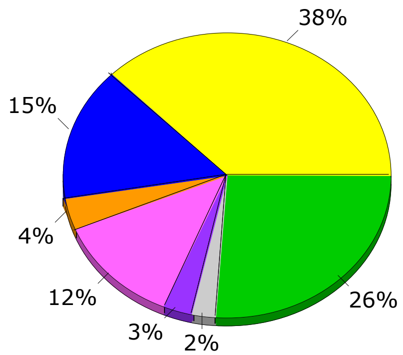
Gas Consumption (Btu x000,000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	50.61	43.59	40.31	25.27	8.70	1.29	0.15	0.38	1.80	10.81	29.64	43.61	256.14
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	50.61	43.59	40.31	25.27	8.70	1.29	0.15	0.38	1.80	10.81	29.64	43.61	256.14

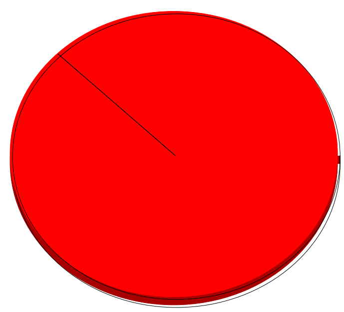
Annual Energy Consumption by Enduse

	Electricity kWh	Natural Gas MBtu	Steam Btu	Chilled Water Btu
Space Cool	5,887	-	-	-
Heat Reject.	-	-	-	-
Refrigeration	-	-	-	-
Space Heat	-	256.14	-	-
HP Supp.	-	-	-	-
Hot Water	1,426	-	-	-
Vent. Fans	4,792	-	-	-
Pumps & Aux.	1,084	-	-	-
Ext. Usage	893	-	-	-
Misc. Equip.	9,882	-	-	-
Task Lights	-	-	-	-
Area Lights	14,547	-	-	-
Total	38,510	256.14	-	-

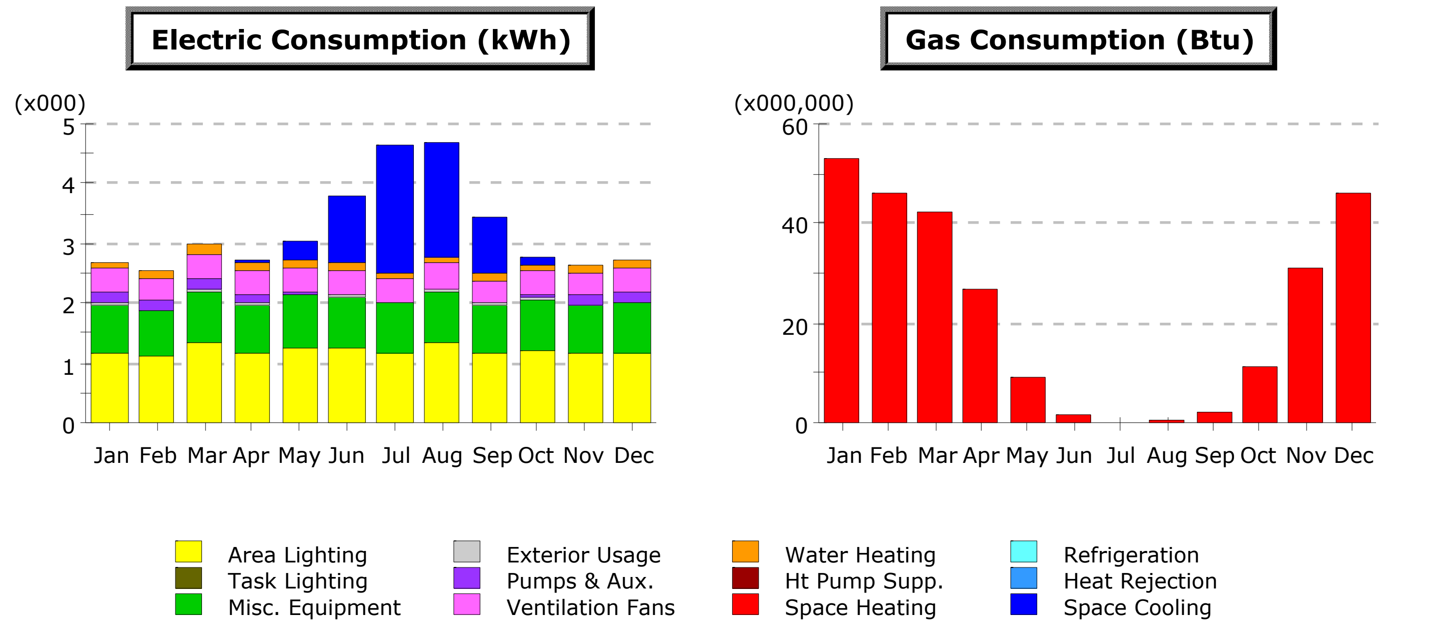
Area Lighting
Task Lighting
Misc. Equipment
Exterior Usage
Pumps & Aux.
Ventilation Fans
Water Heating
Ht Pump Supp.
Space Heating
Refrigeration
Heat Rejection
Space Cooling



Electricity



Natural Gas



Electric Consumption (kWh x000)

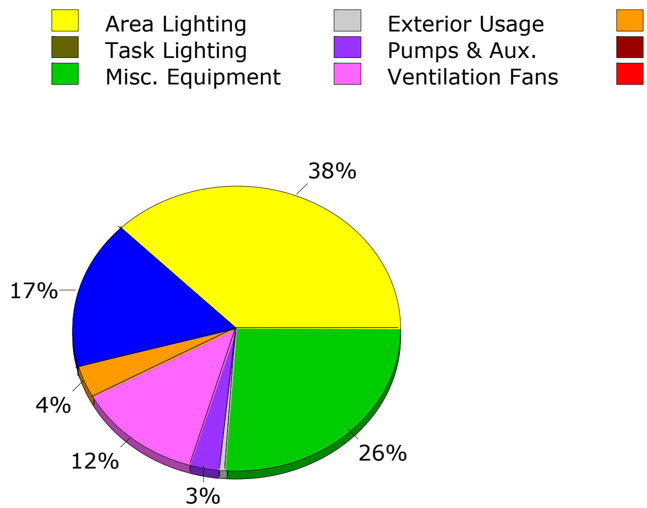
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	0.04	0.32	1.13	2.11	1.90	0.95	0.13	0.00	-	6.57
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	0.13	0.12	0.15	0.13	0.13	0.12	0.11	0.11	0.10	0.11	0.11	0.12	1.43
Vent. Fans	0.39	0.36	0.42	0.40	0.41	0.41	0.40	0.42	0.39	0.40	0.38	0.40	4.79
Pumps & Aux.	0.18	0.17	0.17	0.14	0.03	-	-	-	0.00	0.06	0.15	0.17	1.08
Ext. Usage	0.03	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.03	0.26
Misc. Equip.	0.80	0.75	0.89	0.81	0.86	0.85	0.81	0.89	0.80	0.83	0.79	0.81	9.88
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	1.17	1.11	1.32	1.17	1.27	1.27	1.18	1.32	1.17	1.22	1.16	1.18	14.55
Total	2.69	2.53	2.98	2.71	3.03	3.79	4.62	4.67	3.43	2.78	2.62	2.70	38.56

Gas Consumption (Btu x000,000)

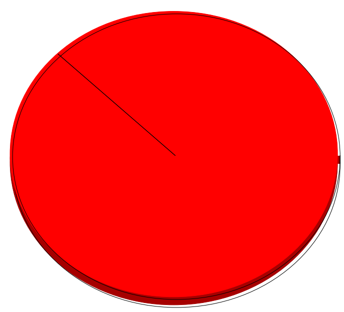
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	53.21	45.83	42.38	26.57	9.14	1.36	0.16	0.40	1.90	11.36	31.16	45.85	269.32
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	53.21	45.83	42.38	26.57	9.14	1.36	0.16	0.40	1.90	11.36	31.16	45.85	269.32

Annual Energy Consumption by Enduse

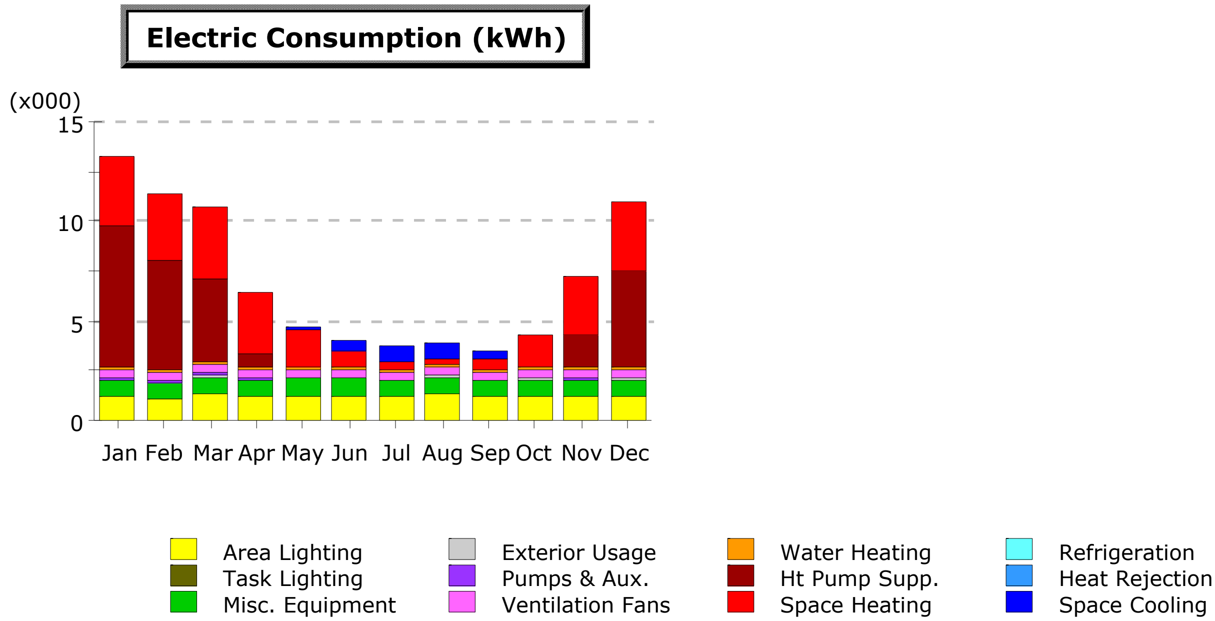
	Electricity kWh	Natural Gas MBtu	Steam Btu	Chilled Water Btu
Space Cool	6,574	-	-	-
Heat Reject.	-	-	-	-
Refrigeration	-	-	-	-
Space Heat	-	269.32	-	-
HP Supp.	-	-	-	-
Hot Water	1,426	-	-	-
Vent. Fans	4,792	-	-	-
Pumps & Aux.	1,084	-	-	-
Ext. Usage	255	-	-	-
Misc. Equip.	9,882	-	-	-
Task Lights	-	-	-	-
Area Lights	14,547	-	-	-
Total	38,559	269.32	-	-



Electricity



Natural Gas



Electric Consumption (kWh x000)

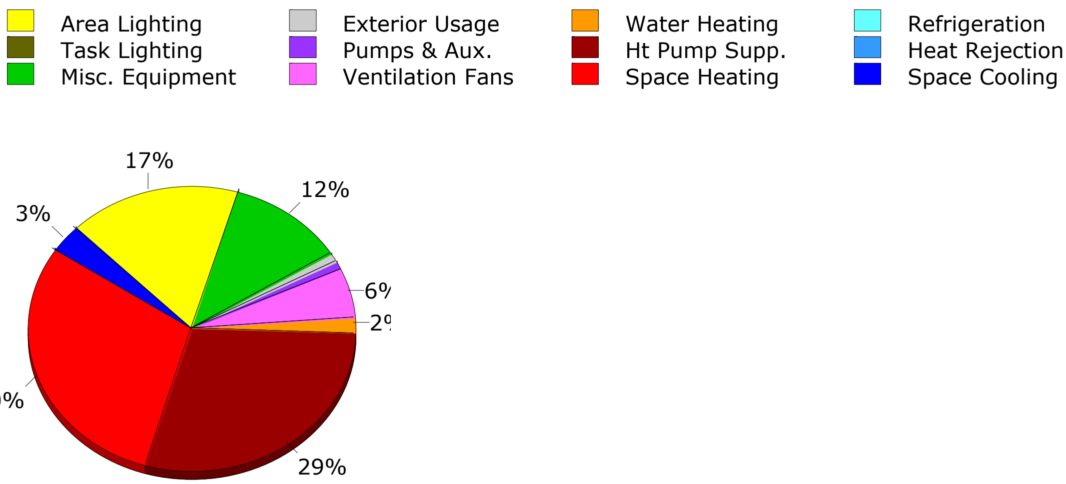
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	0.02	0.13	0.47	0.87	0.79	0.39	0.05	0.00	-	2.72
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	3.56	3.32	3.64	3.10	1.79	0.80	0.39	0.29	0.48	1.53	2.83	3.45	25.19
HP Supp.	7.05	5.58	4.16	0.67	-	-	-	-	-	0.02	1.72	4.83	24.03
Hot Water	0.13	0.12	0.15	0.13	0.13	0.12	0.11	0.11	0.10	0.11	0.11	0.12	1.43
Vent. Fans	0.39	0.36	0.42	0.40	0.41	0.41	0.40	0.42	0.39	0.40	0.38	0.40	4.79
Pumps & Aux.	0.11	0.10	0.11	0.10	0.02	-	-	-	0.00	0.05	0.10	0.11	0.69
Ext. Usage	0.09	0.07	0.08	0.07	0.05	0.05	0.05	0.09	0.08	0.09	0.09	0.09	0.89
Misc. Equip.	0.80	0.75	0.89	0.81	0.86	0.85	0.81	0.89	0.80	0.83	0.79	0.81	9.88
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	1.17	1.11	1.32	1.17	1.27	1.27	1.18	1.32	1.17	1.22	1.16	1.18	14.55
Total	13.29	11.42	10.77	6.46	4.66	3.96	3.81	3.91	3.42	4.31	7.19	10.98	84.17

Gas Consumption (Btu)

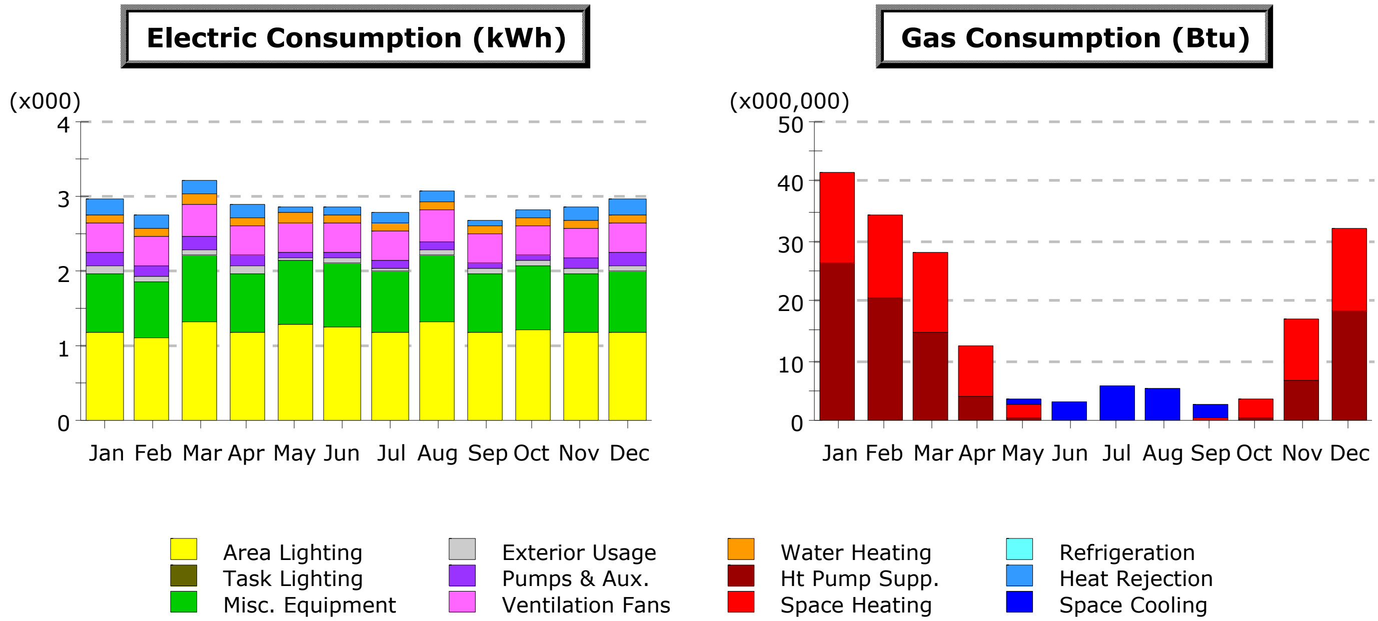
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool													
Heat Reject.													
Refrigeration													
Space Heat													
HP Supp.													
Hot Water													
Vent. Fans													
Pumps & Aux.													
Ext. Usage													
Misc. Equip.													
Task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

Annual Energy Consumption by Enduse

	Electricity kWh	Natural Gas Btu	Steam Btu	Chilled Water Btu
Space Cool	2,718	-	-	-
Heat Reject.	-	-	-	-
Refrigeration	-	-	-	-
Space Heat	25,188	-	-	-
HP Supp.	24,030	-	-	-
Hot Water	1,426	-	-	-
Vent. Fans	4,792	-	-	-
Pumps & Aux.	695	-	-	-
Ext. Usage	893	-	-	-
Misc. Equip.	9,882	-	-	-
Task Lights	-	-	-	-
Area Lights	14,547	-	-	-
Total	84,170	-	-	-



Electricity



Electric Consumption (kWh x000)

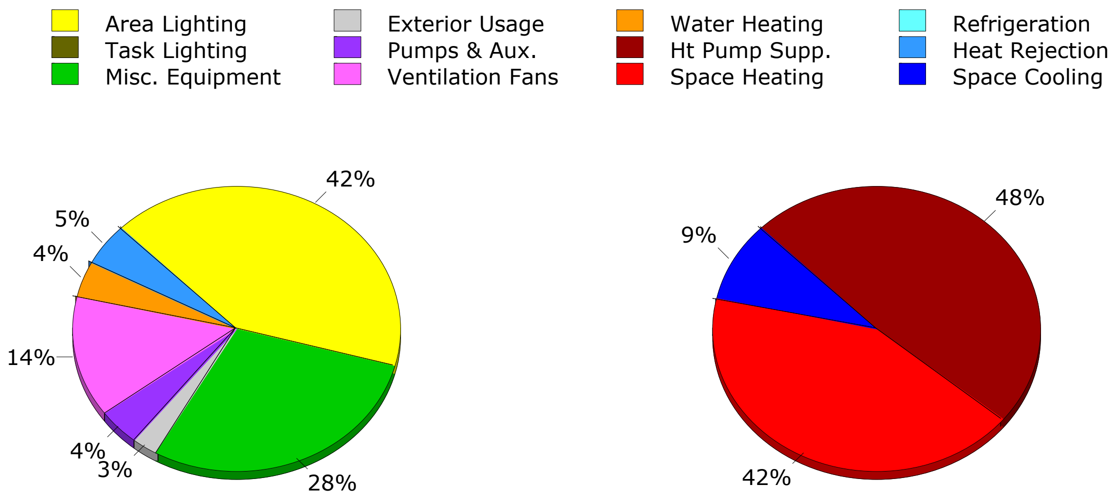
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	0.20	0.19	0.20	0.16	0.08	0.09	0.15	0.14	0.08	0.07	0.17	0.20	1.72
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	0.13	0.12	0.15	0.13	0.13	0.12	0.11	0.11	0.10	0.11	0.11	0.12	1.43
Vent. Fans	0.39	0.36	0.42	0.40	0.41	0.41	0.40	0.42	0.39	0.40	0.38	0.40	4.79
Pumps & Aux.	0.17	0.16	0.17	0.15	0.07	0.06	0.10	0.09	0.06	0.08	0.15	0.17	1.43
Ext. Usage	0.09	0.07	0.08	0.07	0.05	0.05	0.05	0.09	0.08	0.09	0.09	0.09	0.89
Misc. Equip.	0.80	0.75	0.89	0.81	0.86	0.85	0.81	0.89	0.80	0.83	0.79	0.81	9.88
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	1.17	1.11	1.32	1.17	1.27	1.27	1.18	1.32	1.17	1.22	1.16	1.18	14.55
Total	2.95	2.76	3.22	2.88	2.87	2.85	2.79	3.07	2.68	2.81	2.85	2.96	34.69

Gas Consumption (Btu x000,000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	0.09	0.78	2.95	5.82	5.13	2.44	0.30	0.01	-	17.52
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	14.99	13.55	13.25	8.61	2.44	0.16	0.00	0.01	0.27	2.89	10.23	13.87	80.29
HP Supp.	26.55	20.67	14.89	3.94	0.33	0.00	-	-	0.01	0.48	6.85	18.41	92.12
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	41.54	34.22	28.14	12.63	3.55	3.12	5.82	5.14	2.72	3.67	17.10	32.28	189.93

Annual Energy Consumption by Enduse

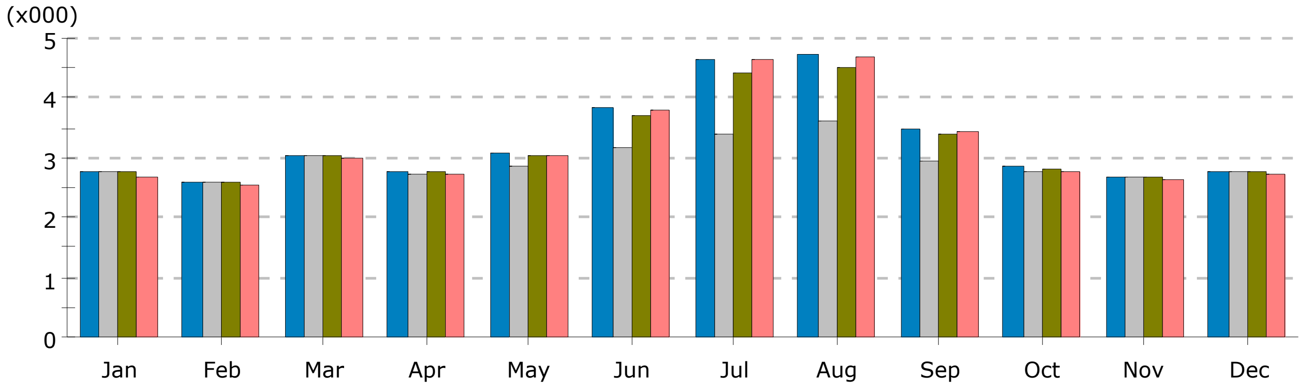
	Electricity kWh	Natural Gas MBtu	Steam Btu	Chilled Water Btu
Space Cool	-	17.52	-	-
Heat Reject.	1,720	-	-	-
Refrigeration	-	-	-	-
Space Heat	-	80.29	-	-
HP Supp.	-	92.12	-	-
Hot Water	1,426	-	-	-
Vent. Fans	4,792	-	-	-
Pumps & Aux.	1,435	-	-	-
Ext. Usage	893	-	-	-
Misc. Equip.	9,882	-	-	-
Task Lights	-	-	-	-
Area Lights	14,547	-	-	-
Total	34,695	189.93	-	-



Electricity

Natural Gas

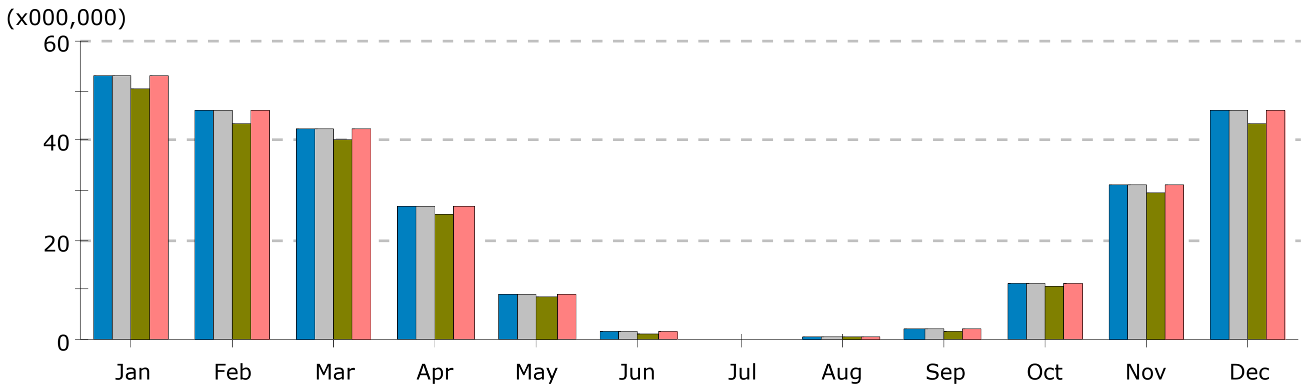
Electric Consumption (kWh)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Run 1.	2.76	2.58	3.03	2.77	3.06	3.83	4.66	4.73	3.49	2.84	2.68	2.77	39.20
Run 2.	2.76	2.58	3.03	2.74	2.88	3.16	3.41	3.61	2.93	2.76	2.68	2.77	35.31
Run 3.	2.76	2.58	3.03	2.76	3.03	3.71	4.43	4.53	3.39	2.83	2.68	2.77	38.51
Run 4.	2.69	2.53	2.98	2.71	3.03	3.79	4.62	4.67	3.43	2.78	2.62	2.70	38.56
Run 5.													

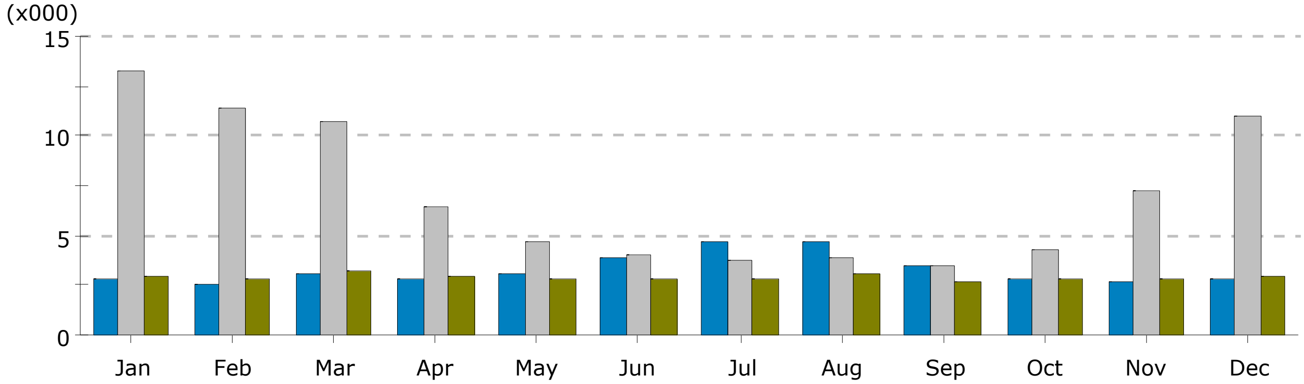
1. Social Library - Baseline Design (03/07/12 @ 13:11)
2. Social Library - AC SEER 19 (03/07/12 @ 13:12)
3. Social Library - Shades (03/07/12 @ 13:12)
4. Social Library - Exterior Lighting (03/07/12 @ 13:12)

Gas Consumption (Btu)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Run 1.	53.21	45.83	42.38	26.57	9.14	1.36	0.16	0.40	1.90	11.36	31.16	45.85	269.32
Run 2.	53.21	45.83	42.38	26.57	9.14	1.36	0.16	0.40	1.90	11.36	31.16	45.85	269.32
Run 3.	50.61	43.59	40.31	25.27	8.70	1.29	0.15	0.38	1.80	10.81	29.64	43.61	256.14
Run 4.	53.21	45.83	42.38	26.57	9.14	1.36	0.16	0.40	1.90	11.36	31.16	45.85	269.32
Run 5.													

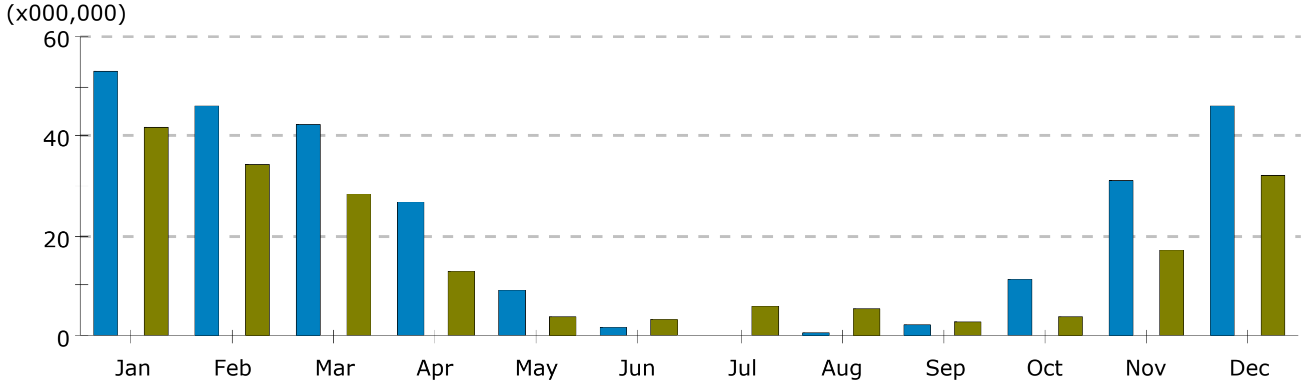
Electric Consumption (kWh)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Run 1.	2.76	2.58	3.03	2.77	3.06	3.83	4.66	4.73	3.49	2.84	2.68	2.77	39.20
Run 2.	13.29	11.42	10.77	6.46	4.66	3.96	3.81	3.91	3.42	4.31	7.19	10.98	84.17
Run 3.	2.95	2.76	3.22	2.88	2.87	2.85	2.79	3.07	2.68	2.81	2.85	2.96	34.69
Run 4.													
Run 5.													

1. Social Library - Baseline Design (03/07/12 @ 13:11)
2. Social Library - Air Source Heat (03/07/12 @ 13:12)
3. Social Library - Gas Source Heat (03/07/12 @ 13:12)

Gas Consumption (Btu)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Run 1.	53.21	45.83	42.38	26.57	9.14	1.36	0.16	0.40	1.90	11.36	31.16	45.85	269.32
Run 2.	-	-	-	-	-	-	-	-	-	-	-	-	-
Run 3.	41.54	34.22	28.14	12.63	3.55	3.12	5.82	5.14	2.72	3.67	17.10	32.28	189.93
Run 4.													
Run 5.													

APPENDIX J

Cost Estimates

BUDGETARY COST ESTIMATE

Facility: **Hollis Social Library**

Date: **3/8/2012**

EEM	Design + Engineering	Installed Cost				Construction Management	Contingency (15%)	Total Investment
		Pricing Unit	Price	Qty	Subtotal			
Replace exterior metal halide light fixtures with LED units (4).	$ 500	EA	$ 372	4	**$ 1,488**	$ 149	$ 321	**$ 2,457**
Install 2" rigid polyisocyanurate insulation (R-14) on interior basement walls and tape-seal joints. Apply spray-foam polyurethane insulation around sill interior.	$ 500	SF	$ 2.32	1,600	**$ 3,712**	$ 371	$ 687	**$ 5,271**
Replace existing air condition condensers (5) with fewer (2 or 3) high-efficiency units (min. SEER 19).	$ 500	EA	$ 4,731	1	**$ 4,731**	$ 473	$ 856	**$ 6,560**
Identify gaps in insulation in addition section (1993) and inject dense-pack cellulose or open-cell polyurethane spray foam into walls.	$ 1,800	EA	$ 4,230	1	**$ 4,230**	$ 423	$ 968	**$ 7,421**
Identify gaps in insulation in original section (1910) and inject dense-pack cellulose or open-cell polyurethane spray foam into walls.	$ 1,800	EA	$ 5,710	1	**$ 5,710**	$ 571	$ 1,212	**$ 9,293**
Install thermal insulated shades on all windows.	$ -	EA	$ 320	25	**$ 8,000**	$ 800	$ 1,320	**$ 10,120**
Remove existing fiberglass insulation in attic of dome and insulated with six (6) inches of closed-cell spray foam. Replace insulation in addition and add and addition six (6) inches of blow cellulous insulation to addition attic.	$ 750	BF	$ 1.13	9,000	**$ 10,170**	$ 1,017	$ 1,791	**$ 13,728**
	$ 750	BF	$ 0.40	30,000	**$ 12,000**	$ 1,200	$ 2,093	**$ 16,043**
Replace the existing suspended trough fixtures with efficient T8 units and reduce wattage to provide recommended lighting densities.	$ 500	EA	$ 426	43	**$ 18,318**	$ 1,832	$ 3,097	**$ 23,747**
Replace the existing furnaces and split A/C units with an electric air-source heat pump system. Add interlocked energy recovery ventilation (ERV) system.	$ 6,500	EA	$ 102,000	1	**$ 102,000**	$ 10,200	$ 17,805	**$ 136,505**