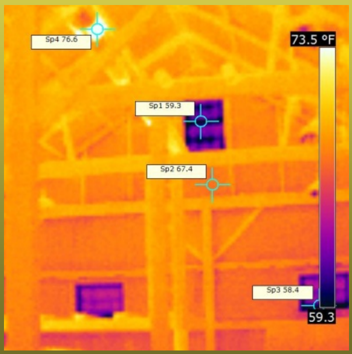


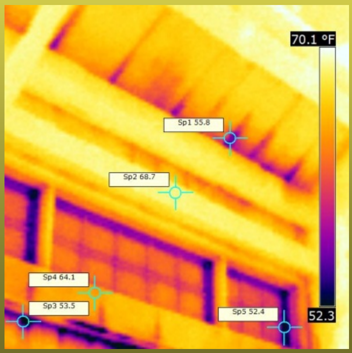

Facility Audit Report

Town of Hollis Lawrence Barn

FINAL

May 2012

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A. EXECUTIVE SUMMARY

Program Introduction

Figure 1: Lawrence Barn

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.

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

The objective of the building evaluation completed at the Lawrence Barn (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.

Between December 28th, 2011 and January 20th, 2012, AEC personnel completed site surveys at the Lawrence Barn 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 Lawrence Barn 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 Lawrence Barn 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 Lawrence Barn building:

1. The building is frequently utilized for Town and private events.
2. The 2004 rehabilitation project incorporated several high-performance building design elements.
3. Optimizing the function of the heating and cooling systems requires frequent manual attendance to accommodate user events occurring on an inconsistent schedule.

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 lower than expected for a social/meeting facility. ENERGY STAR® does not rate social/meeting facilities however compared to buildings in the program, the EUI is 13% below the national average.
- Structural insulated panels (SIPs) provide excellent thermal and air integrity.
- Fiberglass batt insulation is falling away from the attic rafter bays resulting in thermal losses.
- Heating is supplied by two (2) propane gas fired forced hot air units in the attic which have an efficiency of 92%. These units are standard for current technology.
- Domestic hot water (DHW) capacity exceeds the expected demand and hot water pipes are uninsulated allowing thermal losses.

- Gaps around entry doors and windows provide air leakage and thermal losses.
- Lighting/illumination densities in the lavatories exceed recommended industry standards.
- Measured indoor temperatures exceed recommended setpoints for unoccupied periods (68°F).
- Because the building is used on a inconsistent schedule by various users, control of the heating and cooling systems is inefficient.

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 Modeling Summary

EEM No.	EEM Description	Capital Cost	Annual Cost Savings	Payback (yrs.)	SIR
TI-1	Reduce heating setpoints during unoccupied hours to 58°F	$0	$350	0	-
TI-2	Replace/repair loose FG batt insulation in attic.	$50	$80	0.6	-
TI-3	Complete air-sealing on all window jambs, partings, and moldings (interior and exterior).	$500	$230	2.2	3.2
TI-4	Inject non-expanding polyurethane foam insulation in hollow aluminum frames on storefront assemblies.	$650	$60	10.8	2.8
T1-5	Replace twelve (12) interior metal halide lights with compact fluorescent bulbs.	$180	$14	12.9	1.6
T1-6	Replace kitchen refrigerator with an ENERGY STAR® rated unit.	$500	$50	10	1.2
T2-1	Replace DHW tank units with demand-tankless gas condensing unit.	$1,127	$350	3.2	4.7
T2-2	Replace exterior halogen fixtures with LED units (6).	$1,012	$257	3.9	4.6
T2-3	Install a remote web-based building control system to control temperate set points, lighting, and door locks.	$1,748	$753	3.3	6.0
T2-4	Add two (2) inches of foil faced polyisocyanurate to the ceiling and walls of the furnace loft. Tape all seams to reduce air leakage.	$2,789	$340	8.2	2.4
T3-1	Install a high-efficiency electric air-source heat pump with web-based controls and an interlocked energy recovery ventilation system.	$33,258	$2,586	12.9	2.1

The energy cost savings, resulting payback and SIR 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. Capital 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.

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

Table 2: Renewable Energy Technology Feasibility Scoring Results

Renewable Energy Technology	Grade
Roof Photovoltaic	82%
Wind Turbine Generator	80%
Ground Photovoltaic	79%
Solar DHW	77%
Geothermal Heating/Cooling	77%
Solar Thermal	72%
Biomass Heating	72%
Combined Heat & Power	66%

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
Floor Area 1	NA	10	2.8
Floor Area 2	NA	10	2.6
Floor Area 3	NA	10	1.2
Floor Area 4	NA	10	3.1
Floor Area 5	NA	10	1.1
Wall Type 1	13.0 +3.8 ci	13.0 +3.8 ci	2.5+14.0ci
Wall Type 2	13.0 +3.8 ci	13.0 +3.8 ci	2.1+14.0ci
Roof	38	38	28.5

Master Planning Considerations

The Lawrence Barn is a community center for the Town of Hollis. Various organizations and groups use the facility on a consistent basis and the facility is also used for special events throughout the year. The original building was constructed in the 1780's and has endured three major additions. A housing development was planned on the original site of the barn and in 1999 the barn was dismantled and relocated to its current location. Following various fundraising events and volunteer efforts, the barn was open to the public in 2007. With the exception of a lighting retrofit project in 2011, no major renovations have been completed since the 2007 construction.

Figure 2: Lawrence Barn

The windows on the building provide some air leakage and thermal transfer through frames and glazing resulting in nuisance drafts and increased heating and cooling loads. The siding of the building exterior appears to be in good condition and under infrared imaging revealed little thermal transfer. The roof was also observed to be in good condition.

Infra-red imaging indicates high integrity of the thermal envelope. The heating system contains a heat exchanger in the attic space located above the kitchen and it is controlled by programmable thermostats. The thermostats are user accessible and are adjusted frequently based on occupancy schedules. Cooling is provided by a condensing unit located on the south side of the building. Due to the varying occupancy schedule, it is difficult to optimize energy use for HVAC systems. As example, in the month of December there were 101 planned hours of occupancy while in January the planned occupancy was 78.5 hours.

Considering the condition of the Lawrence Barn, a major renovation is not necessary. Water is supplied by one branch of the Rocky Pond Pump House. This supply travels a long distance and services other Town buildings before terminating at the Lawrence Barn. A localized well servicing the Lawrence Barn would be beneficial.

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 Lawrence Barn. 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 EEMs 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 EEM 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 INFORMATION / EXISTING CONDITIONS

Setting

The Lawrence Barn is located in Hollis, NH (Figure 3). The building and facilities are located at Nicolas Field which is on a land parcel owned by the Town of Hollis. It is located at 28 Depot Road, about ¼ mile south of Monument Square at the center of Town. The facility is located at the northern end of the Nicolas field with two (2) baseball fields, two (2) tennis courts, a basketball court and a running track to the south.

Figure 3: Aerial Photo of Lawrence Barn (2011)

A row of mature trees defines the eastern boundary of the property with residences further to the east. An equestrian area lies immediately the north of the facility. A gravel parking area is located to the north of the facility and a second parking lot for the recreation fields is located to the south. The gross area of the Lawrence Barn is 3,909 square feet.

History

The Lawrence Barn was originally constructed in the 1780s and located at 163 Depot Road in Hollis. The first major addition was built in the early 19th century, estimated to be 1810. The second addition was completed in the late 19th or early 20th century. The building had several owners over this time before being bought by the Lawrence family in 1907. The operation of the Lawrence farm ceased in 1970 and the barn was left dormant. The property was purchased in 1999 with the intent of demolishing the barn and constructing a new housing development. The Hollis Heritage Commission acquired the facility and dismantled it with the intent to move and restore the building as a part of Hollis' past. Through various volunteers the building was moved to its current site at 28 Depot Road. Over a ten year period, the building was modernized while preserving its historical value. In 2007 the facility was opened to the public and has served as a public community center.


Figure 4: Original Lawrence Barn c. 1980

Use, Function & Occupancy Schedule

The Lawrence Barn and the land it occupies are owned by the Town of Hollis. The building functions as a community center and serves various groups, clubs and committees around Town. Special events and Town functions are often held in the Barn and surrounding recreation fields. With the varying uses there is no typical occupancy schedule resulting in the building used anywhere from one to seven days in a given week. December 2011 had 101 scheduled hours of use and January 2012 had 78.5 hours. With the variance in occupancy in terms of number of occupants, time of day of occupancy and total hours of occupancy, it makes it more difficult to efficiently run the facility.

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 Lawrence Barn evaluation includes the following:

- The heating temperate is setback at night to 60°F.
- The building is used often throughout the year with no defined schedule.
- The heating and cooling systems take some time to adjust the temperature from the setback value to the occupied value. Therefore the thermostat has to be manually increased prior to events.

Utility Data

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

Table 5: Annual Energy Consumption (2010 – 2011)

Energy	Period	Consumption	Units	Cost
Electric	January 2010 – December 2010	11,910	Kilowatt hours	$2,891
Propane Gas	January 2010 – December 2010	1,571	Gallons	$3,129
			Total Annual Energy Cost (2010):	$6,020
Electric	January 2011 – December 2011	10,940	Kilowatt hours	$2,844
Propane Gas	January 2011 – December 2011	1,272	Gallons	$2,266
			Total Annual Energy Cost (2011):	$5,110

Over the twelve (12) month period (2010), May was the peak demand month, consuming 1,340 kWh of electricity. For the second twelve month period analyzed (2011), February was the peak demand month, consuming 1,200 kWh of electricity. According to the event schedule there were no extraordinary events that would have increased energy consumption therefore it is most likely attributable to heating equipment for the peak demand in February. The annual trend for electrical consumption is somewhat typical however the peak usage for February, June, and August (2011) are higher than expected. This is most likely attributable to heating and cooling systems that are operating in intensive schedules. For example, 1,040 kWh were consumed in August 2011 (nearly double the July 2011 usage) however there were no atypical events scheduled during that month of August. Presumably this extraordinarily high usage was a result of excessive operation of the air conditioning systems.

Table 6: Monthly Electric Consumption (2010 – 2011)

Month	Year	Electric Consumption (kWh)	Electric Cost
Jan	2010	630	$135
Feb	2010	1,260	$263
Mar	2010	1,280	$279
Apr	2010	980	$212
May	2010	1,340	$293
June	2010	980	$240
July	2010	800	$239
Aug	2010	820	$244
Sep	2010	520	$205
Oct	2010	1,080	$266
Nov	2010	1,040	$243
Dec	2010	1,180	$271
Totals:	*2010*	*11,910*	*$2,891*
Jan	2011	1,020	$281
Feb	2011	1,200	$251
Mar	2011	1,000	$265
Apr	2011	1,000	$201
May	2011	800	$202
June	2011	940	$271
July	2011	660	$192
Aug	2011	1,040	$268
Sep	2011	580	$197
Oct	2011	760	$248
Nov	2011	920	$201
Dec	2011	1,020	$268
Totals:	*2011*	*10,940*	*$2,845*
Totals:	*10 - '11*	*22,850*	*$5,736*

Annual electric usage for the Lawrence Barn based on the most recent data provided by Town (January through December 2011) is 10,940 kWh at a cost of $2,845. Based on the building size and function, this usage is within the expected range however the noted spikes are higher than expected.

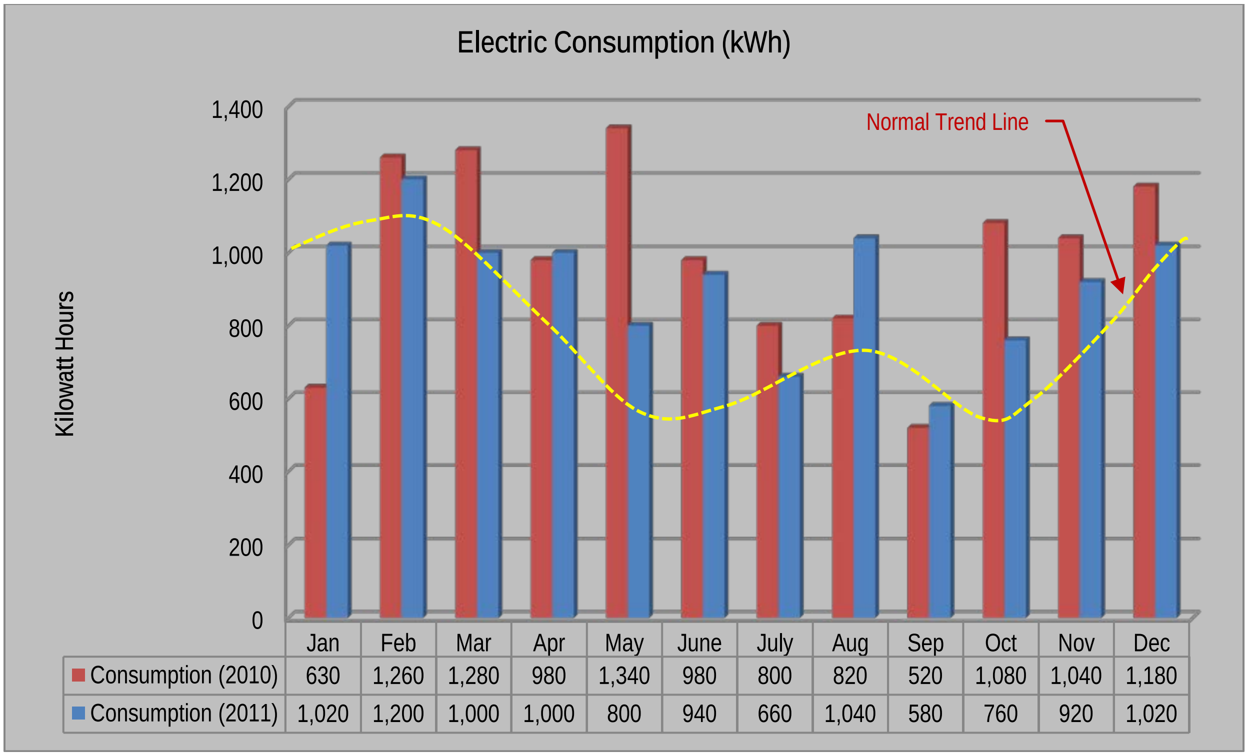


Figure 5: Electric Consumption (2010 – 2011)

To provide the most accurate recommendations for energy conservation, the energy consumption based on end use was determined. Table 7 presents the estimated electrical usage for categories including lighting, plug loads, and mechanical equipment. Mechanical equipment includes all hard-wired, permanently installed equipment including ventilation, exhaust, heating, cooling, pumps, etc. These values were determined using observations from the field audit and typical energy consumption data for appliances observed throughout the building. A more detailed accounting of all electrical equipment by end-use is presented in Part C of this Report.

Table 7: Categorized Electrical Consumption (2011)

Equipment Type	Annual Consumption (kWh/yr)	Percent of Total Consumption	Annual Cost
Mechanical Equipment	4,670	45%	$654
Lighting Fixtures	4,588	43%	$642
Plug Loads	1,232	12%	$172
Totals:	10,490	100%	$1,469

Between the three categories, lighting fixtures and mechanical equipment are estimated to use the same amount of energy with mechanical equipment at 45% and lighting fixtures at 44% of total consumption. Mechanical equipment includes the electric hot water heater, exhaust fans, pumps and the unit heater and is estimated to consume 4,670 kWh/yr of electricity. Lighting fixtures are estimated to consume 4,588 kWh/yr and can be reduced with simple measures. A Town-wide lighting upgrade project conducted in 2011 included the Lawrence Barn and it is assumed lighting energy consumption has reduced. Plug loads are predicted to consume the least amount of electricity at an estimated 1,232 kWh/yr.

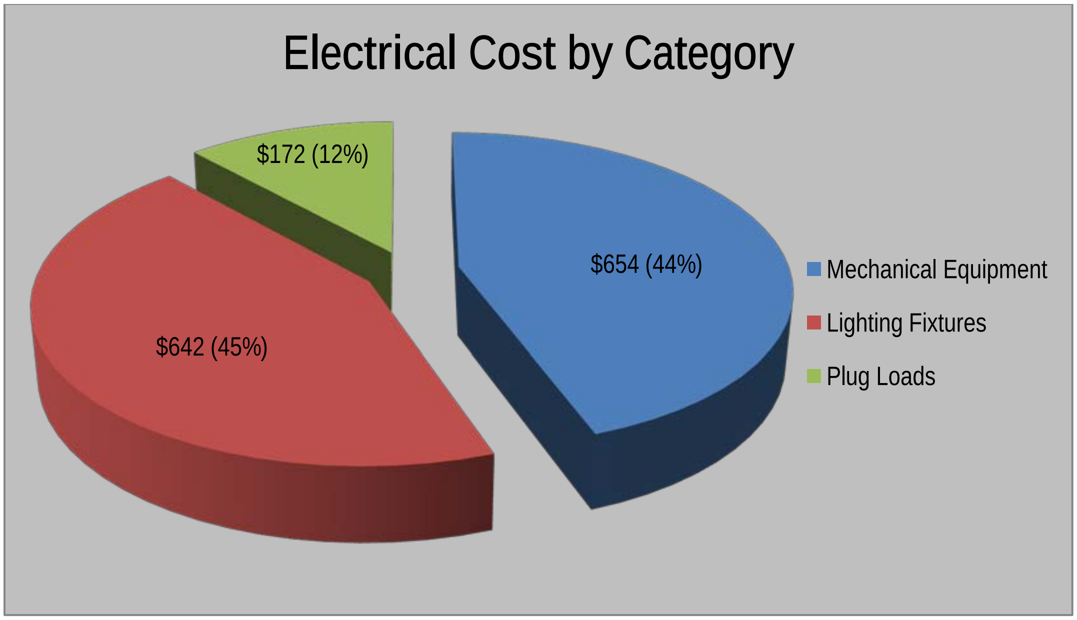


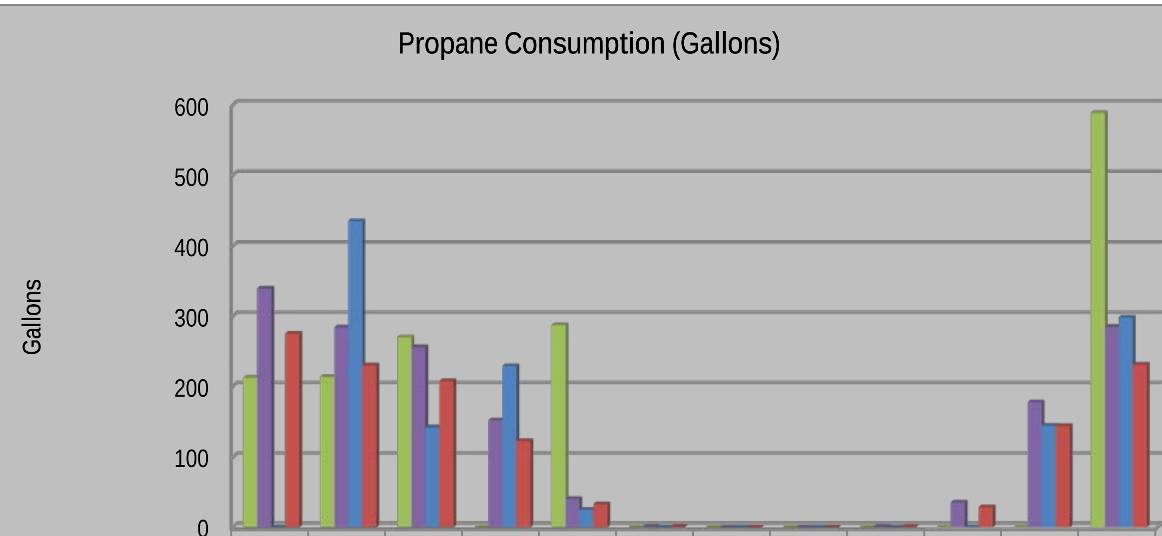
Figure 6: Lawrence Barn Electrical Cost by Category (2011)

Consumption for mechanical systems is within the expected range (40%-50%) at a cost of $654. Lighting fixtures consume a moderate amount of electricity but are still within a reasonable electrical consumption at 45% and a cost of $642. Plug loads account for the lowest annual cost of $172 (2011).

Table 8: Monthly Heating Fuel Consumption (2011)

Month	Year	LP Purchased (Gallons)	Cost	LP Consumption (Gallons)	Cost
Jan	2010	212	$456	340	$676
Feb	2010	213	$491	284	$565
Mar	2010	270	$567	256	$510
Apr	2010	0	$0	152	$302
May	2010	287	$641	40	$81
June	2010	0	$0	1	$2
July	2010	0	$0	0	$0
Aug	2010	0	$0	0	$0
Sep	2010	0	$0	1	$2
Oct	2010	0	$0	35	$70
Nov	2010	0	$0	177	$353
Dec	2010	589	$973	285	$568
Totals:	*2010*	*1,571*	*$3,129*	*1,571*	*$3,129*
Jan	2011	0	$0	275	$462
Feb	2011	436	$701	230	$370
Mar	2011	142	$228	207	$334
Apr	2011	229	$369	123	$198
May	2011	25	$40	33	$53
June	2011	0	$0	1	$1
July	2011	0	$0	0	$0
Aug	2011	0	$0	0	$0
Sep	2011	0	$0	1	$1
Oct	2011	0	$0	29	$60
Nov	2011	144	$302	144	$302
Dec	2011	298	$627	231	$485
Totals:	*2011*	*1,273*	*$2,267*	*1,273*	*$2,267*
Totals:	*10 - '11*	*2,844*	*$5,395*	*2,844*	*$5,395*

Heating fuel for space heating at the Lawrence Barn is provided by a local supplier (Table 8, Figure 7). The building consumed a total of 1,571 gallons of propane in 2010 and 1,273 gallons of propane in 2011, for an annual average of 1,422 gallons of propane. The average annual heating fuel cost for the Lawrence Barn is $2,698 (2010 – 2011).



	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Purchased (2010)	212	213	270	0	287	0	0	0	0	0	0	589
Consumed (2010)	340	284	256	152	40	1	0	0	1	35	177	285
Purchased (2011)	0	436	142	229	25	0	0	0	0	0	144	298
Consumed (2011)	275	230	207	123	33	1	0	0	1	29	144	231

Figure 7: Liquefied Propane Consumption (2011)

Considering the building systems including the envelope integrity (insulation and air leakage), mechanical equipment, and use of the facility, the heating usage is within the expected range. Heat is provided to the building by two (2) propane fired York® high efficiency tubular furnaces with annual fuel utilization efficiencies (AFUEs) of 92.0% when new. Efficiencies decrease with age and based on estimated age (6 years) the AFUE is estimated to be less than 91.0%.

D. FACILITY SYSTEMS

Building Envelope

The following sections present the building envelope systems and insulation values for each assembly. Assembly values are compared to the *International Energy Conservation Code (IECC), 2009* for commercial buildings located in Climate Zone 5. The IECC code is used as a standard of comparison only and existing buildings are not required to comply with the code unless it undergoes a substantial renovation. New construction and major renovations are required to comply with current energy codes. Building plans were not available for review.

Floor Systems

A 4-inch thick concrete slab-on-grade extends the entire footprint of the building. Floor covering in the main hall flooring consists of end-cut southern yellow pine wood from Kaswell Flooring Systems® which are coated in polyurethane. Additional wooden planks are installed at the eastern side of the main hall leading into the meeting room. The smaller meeting room is finished in carpet and the kitchen is finished with vinyl tiles. Ceramic tile covers the lavatory floors.

Figure 8: Main Hall Floor

Table 9: Floor Insulation Values

Floor Area 1 (Main Hall)				
Material	Thickness (in.)	R-value	Integrity Factor	Installed R-value
Concrete slab	4.0	0.3	1.0	0.3
Pine Blocks	1.5	1.8	1.0	1.8
Interior air film	NA	0.7	NA	0.7
			Installed Assembly	2.8
			2009 IECC Requirement:	NR
			Best Practice Recommendation	10.0
Floor Area 2 (Main Hall)				
Material	Thickness (in.)	R-value	Integrity Factor	Installed R-value
Concrete slab	4.0	0.3	1.0	0.3
Wood Planks	1.5	1.8	0.9	1.6
Interior air film	NA	0.7	NA	0.7
			Installed Assembly	2.6
			2009 IECC Requirement:	NR
			Best Practice Recommendation	10.0
Floor Area 3 (Kitchen)				
Material	Thickness (in.)	R-value	Integrity Factor	Installed R-value
Concrete slab	4.0	0.3	1.0	0.3
Vinyl Tile	¼	0.2	1.0	0.2
Interior air film	NA	0.7	NA	0.7
			Installed Assembly	1.2
			2009 IECC Requirement:	NR
			Best Practice Recommendation	10.0
Floor Area 4 (Small Meeting)				
Material	Thickness (in.)	R-value	Integrity Factor	Installed R-value
Concrete slab	4.0	0.3	1.0	0.3
Fibrous Carpet	NA	2.1	1.0	2.1

Interior air film	NA	0.7	NA	0.7
Installed Assembly				3.1
2009 IECC Requirement:				NR
Best Practice Recommendation				10.0
Floor Area 5 (Small Meeting)				
Material	Thickness (in.)	R-value	Integrity Factor	Installed R-value
Concrete slab	4.0	0.3	1.0	0.3
Ceramic Tiling	NA	0.1	1.0	0.1
Interior air film	NA	0.7	NA	0.7
Installed Assembly				1.1
2009 IECC Requirement:				NR
Best Practice Recommendation				10.0

Wall Systems

The building is a single story structure with a vaulted ceiling in the main hall and an attic loft over the smaller meeting room and kitchen. The walls consist of a structural insulated panel (SIP) system, which is a modern insulated building system. Consistent with the historical character of the barn, pine shiplap boards are used to clad the interior and exterior building walls. Interior walls of the small meeting room, lavatories, and portions of the kitchen walls are finished in gypsum wallboard. Wall insulation exceeds the current IECC code requirements with higher continuous insulation (ci) values provided by the SIP system.

Table 10: Wall Assembly Insulation Values

Wall Type 1 (Wood Clad)				
Material	Thickness (in.)	R-value	Integrity Factor	Installed R-value
Exterior Air Film	NA	0.2	NA	0.2
Exterior Pine Board	¾	0.9	0.9	0.8
SIP	4.0	14.0	1.0	14.0
Interior Pine Shiplap	¾	0.9	0.9	0.8
Interior Air Film	NA	0.7	NA	0.7
Installed Assembly:				2.5+14.0ci
2009 IECC Requirement:				13+3.8ci
Code Compliant?				NO
Wall Type 2 (GWB)				
Material	Thickness (in.)	R-value	Integrity Factor	Installed R-value
Exterior Air Film	NA	0.2	NA	0.2
Exterior Pine Board	¾	0.9	0.9	0.8
SIP	4.0	14.0	1.0	14.0
Gypsum Board	5/8	0.5	0.9	0.4
Interior Air Film	NA	0.7	NA	0.7
Installed Assembly:				2.1+14.0ci
2009 IECC Requirement:				13+3.8ci
Code Compliant?				NO

Ceiling Systems

The ceiling in the main hall is a vaulted ceiling to the roof and is insulated between the ceiling and roof. Above the smaller meeting room is a drywall ceiling with batt insulation above. Ceilings in the bathroom are suspended acoustical tile (SAT) systems. The above ceiling space is used for routing of ducting, piping, conduit and electrical cable.

Roofing Systems

The roof of the building is a timber framed pitched metal roof. Fiberglass batt (FGB) insulation is in the ceiling space throughout and the roof above the main hall has an interior wood panel finish. Roof insulation does not meet current code standards. Some FG batts are falling away from the rafter bays and require improvement.

Table 11: Roof Insulation Values

Roof Insulation 1				
Material	Thickness (in.)	R-value	Integrity Factor	Installed R-value
Exterior Air Film	NA	0.2	NA	0.2
Metal Roofing	NA	0.0	1.0	0.0
Plywood Sheathing	5/8	0.2	1.0	0.2
FG Batt Insulation	12.0	38.0	0.7	26.6
Wood Panel	4.0	0.9	0.9	0.8
Interior Air Film	NA	0.7	NA	0.7
			Installed Assembly:	28.5
			2009 IECC Requirement:	38.0
			Code Compliant?	NO

Fenestration Systems

Fenestration systems on the Lawrence Barn include operable fixed window units, partially-glazed entry doors and fully-glazed entry doors. 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 therefore compliance with IECC standards for commercial buildings located in Climate Zone 5 cannot be established.

Figure 9: Storefront Assembly

Thermal transfer and air leakage commonly occurs at the seals of operable windows and the interface between the window and the wall opening which was observed using infrared imaging. As evidenced by the infra-red imaging (Figure 10), the aluminum frames for the storefront assemblies (doors and windows) are not insulated resulting in high thermal transfer. Recommendations include exterior and interior inspection and re-caulking of window jambs, headers, and sills as needed. Additional measures include insulating the storefront assembly frames with non-expanding spray-foam. If the operable window units have adjustable jambs they should be inspected and adjusted as necessary to maintain a complete air seal.

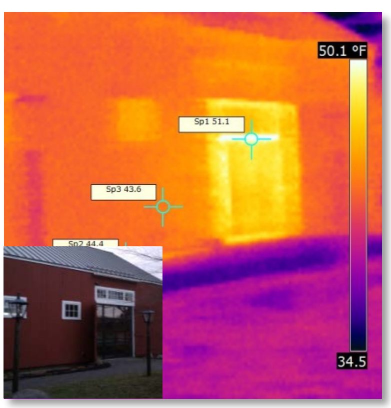


Figure 10: Thermal Transfer of Storefront Assembly

Doors

The door units in Lawrence Barn building include aluminum framed doors with full glazing at main entrances to the main hall. Partially glazed hollow metal doors are located at the side entrances. Wooden doors are installed on the east side of the building and larger wooden doors with fixed window units are installed on the north and south sides of the main hall. Based on visual observations and thermal imaging, the thermal integrity of the wooden door units is satisfactory however the seals on door jambs, partings, and thresholds are incomplete allowing air leakage. The hollow aluminum frames on the storefront assembly provides high thermal transfer. Recommendations include exterior and interior inspection, weather stripping, re-caulking windows, and insulating the hollow aluminum frames with non-expanding spray-foam.

Air Sealing

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

Air sealing of all door units can be improved with commercial weather-stripping. All door and window units should be regularly inspected (every 2 to 3 years) to ensure proper operation, identify faulty seals, and to identify any deteriorated caulking requiring replacement. Other air sealing recommendations include inspecting all exhaust and ventilation ducts to determine if they have a positive pressure actuated damper. Dampers are recommended on all exterior ducting to prevent passive air leakage.

Thermal Imaging Survey

The thermal imaging survey was conducted on the morning of December 28th, 2011. Outdoor ambient temperature was approximately 22°F at the time of the survey. The survey was conducted using a FLIR© B-CAM infra-red (IR) camera. The building exterior and interior envelope and major mechanical and electrical equipment were surveyed with the IR camera. IR camera surveys not only identify heat transfer through building envelopes, they also identify trapped moisture, electrical system overloading, heat loss through ducting and piping, high energy lighting fixtures, and energy intensive plug load equipment. Appendix B presents the survey report.

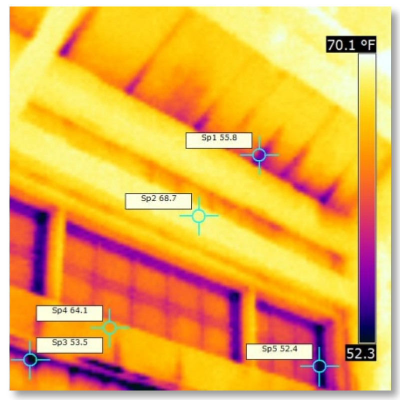


Figure 11: Interior IR

The IR surveys revealed the following notable observations:

- The integrity of wall insulation is sufficient with limited insulation gaps.
- Poorly sealed windows and doors allow thermal transfer and air leakage.
- The aluminum storefront assembly framing allows substantial thermal transfer.
- Uninsulated hot water pipes result in thermal loss.

Electrical Systems

Supply & Distribution

Grid electricity is supplied to Lawrence Barn to the main electrical panel provided by underground service. Overhead transmission lines supply the parcel with three-phase power.

Lighting Systems

As presented in Table 12, there are a variety of lighting fixtures and lamp types at the Lawrence Barn. Lighting fixtures in the main meeting consist of metal halide (MH) and compact fluorescent (CFL) fixtures. The main source of lighting in the remainder of the building consists of high performance T8 fixtures and CFL fixtures. The exterior of the building includes a combination of CFL, halogen, and incandescent bulbs in poles.

Table 12: Lighting Fixture Schedule

Fixture Lamp Type	Location(s)	Control	No. Lamps	Watts	Qty.	Total Watts
T8	Throughout	Switch	1,2	17, 28	29	1,333
CFL	Main Meeting, Men's Room, Cleaning Closet, Exterior	Switch, Photocell	1-3	17, 42	43	1,447
MH	Main Meeting	Switch, Photocell	1	50, 60	18	960
LED	Exit Signs	Always On	1	5	5	25
				Totals:	95	3,765

Table 13 presents the energy consumption by lighting fixture type. Lighting fixtures account for an estimated 4,588 kWh of electricity per year which is 44% of total energy consumption. Halogen lamps fixtures are located on the exterior and consume an estimated 1,672 kWh/yr of electricity which is 25% of the total lighting consumption. Compact fluorescent fixtures (CFL) are also prevalent in the main meeting hall in addition to in a few other locations and consume an estimated 1,570 kWh/yr of electricity. High performance T8 fixtures are located in the smaller meeting room and in closets and consume a small amount of the lighting consumption at an estimated 557 kWh/yr. Exterior fixtures are inefficient fixtures but are few in quantity accounting for 12% of the lighting consumption. Exit signs are lit constantly with LED fixtures and consume the least of the lighting fixtures at an estimated 218 kWh/yr.

Table 13: Lighting Fixture Energy Consumption

Fixture Lamp Type	Location(s)	Est. Usage (KWH/yr)	% of Total
CFL	Main Meeting, Men's Room, Cleaning Closet, Exterior	2,141	46%
Halogen	Exterior	1,142	25%
T8	Throughout	557	12%
MH	Main Hall	530	12%
LED	Exit Signs	218	5%
	Totals:	4,588	100%

Lighting density measurements in Lawrence Barn building 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 1108 and 1118. Table 14 presents the lighting density measurements obtained in units of foot-candles (FCs).

IESNA Standards

Lighting densities were recorded at five (5) representative locations. The lighting density in the men's bathroom was found high while the other three densities were slightly higher than the recommended limits. The main meeting room received some natural sunlight which attributed to its density reading. The lighting density data is included in Appendix C.

Table 14: Illumination Densities

Location	Lighting Density (FC)	Recommended Density (FC) (1)
Main Hall	35	30
East Meeting Room	35	30
Men's Lavatory	29	10
Kitchen	32	30
Supply Room	36	30

(1) Based upon IESNA standards and AEC recommendations.

Plug Loads

Plug loads for the Lawrence Barn facility 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 either appliances or electronics and office equipment. Appendix F presents an inventory of all plug load equipment.

Based on this analysis, the total annual plug load is 1,232 kWh/yr. This accounts for just 12% of annual consumption for the facility. Appliances account for the highest consumption at an estimated 1,063 kWh/yr. Appliances include the refrigerator, electric stove, microwave and vacuum. Electronics consume a limited amount of energy at an estimated 169 kWh/yr. Since the building is a shared facility for the community the plug load usage may be higher if users bring in separate equipment however is still reasonably low.

Table 15: Plug Load Energy Consumption

Category	Location(s)	Est. Usage (kWh/year)	% of Total
Appliances	Throughout	1,063	86%
Electronics, Video Equipment/Projector	Throughout	169	14%
	Subtotals	1,232	100%

Motors

There are no large motors at the Lawrence Barn.

Emergency Power Systems

There is no emergency power system at the Lawrence Barn.

Plumbing Systems

Domestic Water Supply

Domestic water supply for the Lawrence Barn is provided by the Rocky Pond Pump House. Water demand includes lavatory and kitchen uses. Demand is expected to be limited. Installing a new water well on site would eliminate the need to pump water from the Rocky Pond Pump House.

Domestic Water Pump Systems

A water pressure booster pump located in the men's lavatory room closet.

Domestic Water Treatment Systems

There are no domestic water treatment systems installed at the Lawrence Barn. Water is treated at the source for hardness.

Domestic Hot Water Systems

Domestic hot water is heated by an electric State Select 50 gallon hot water heater (Figure 12). Capacity is expected to exceed demand. It is recommended that this unit be replaced with a tankless gas unit. It is also recommended that all hot water piping be insulated to reduce thermal losses.

Figure 12: Hot Water Heater

Hydronic Systems

There are no hydronic systems installed at the Lawrence Barn.

Mechanical Systems

Figure 13: York® Furnace

Heating Systems

Heat is provided by two (2) York® propane gas fired furnaces (Figure 13). The rated efficiency of these units when new is 92.0% and the de-rated efficiency is estimated at less than 91%. These are relatively efficient units and it is not necessary to replace them at this time. High-efficiency condensing gas units with a minimum AFUE of 96% should be installed when the existing units are ready for replacement. The York® units have an expected service-life of 20 years.

Table 16: Heating Supply Systems

Heating Unit	Unit Description	Area(s) Served	Output (MBH)	Age (yrs.)	AFUE (new)	Control Type
Gas Furnace 1-2	York®	Throughout	100	6	92.0	Thermostat

Cooling Systems

Cooling is provided to the east meeting room section by one (1) York® split unit. The condenser is charged with R-22 refrigerant. It is noted that the use of refrigerant R-22 is no longer permitted (per USEPA) based on its high ozone depletion potential. The Seasonal Energy Efficiency Ratio (SEER) of this unit when new was 10.1 with an EER of 9.5 and the de-rated SEER is estimated to be less than 10. The existing unit is relatively inefficient compared to modern standards.

Operating efficiency tends to decrease with system age. As cooling condensing units fail, they should be replaced with the highest rated equipment available. All exterior condensers piping insulation should be rated for outdoor exposure. 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. Modern cooling systems can achieve SEERs up to 24. 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.

Pumps

There is one (1) booster pump located in the building used to increase water pressure for domestic use. There is another pump in the building for the sprinkler system.

Controls Systems

The heating and cooling systems are tied into a programmable thermostat (Figure 14). The scheduling capability of the unit was observed to be used however it was not optimized. The building was unoccupied during the field visit however the setpoint was 68°F. It is recommended that the unoccupied setpoint be reduced to 58°F.

Figure 14: Programmable Thermostat

Figure 15: Web-Based Control System (Home Control®)

Because the building is occupied on an irregular schedule it is recommended that a remote building controls system be installed. New technology allows all types of building systems to be controls remotely in an economical way. Lights, heating and cooling systems, building temperature and building occupancy can be monitored remotely. This would give operators at the Town Hall the ability to remotely shut lights off, change the temperate in the building or even unlock the door to the facility.

Refrigeration

There are no commercial refrigeration units at the Lawrence Barn.

Mechanical Equipment Energy Consumption

The electrical energy consumption for mechanical equipment was determined according to 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. Total mechanical consumption per year is estimated to be 4,670 kWh per year compared to 4,588 kWh for light fixture loads and 1,232 kWh for lighting.

Table 17: Mechanical Equipment Energy Consumption

Equipment Type	Qty.	Consumption (kWh/yr)	% of Total
Booster Pump	1	1,620	35%
Hot Water Heater	1	1,140	24%
Exhaust Fan	3	950	20%
Air Conditioner Condensing Unit	1	830	18%
Unit Heater	1	130	3%
Gas Furnace	2	NA	NA
Totals:	9	4,670	100%

Ventilation Systems

Exhaust Ventilation Systems

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

Exhaust ventilation systems in the Lawrence Barn are limited to the lavatories and kitchen stove-hood.

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. Ventilation rates and system capacity should be designed consistent with the minimum prescribed code standards (ASHRAE 62.1). Systems should be demand (CO_2) controlled with energy recovery capacity (ASHRAE 90.1).

There are no exchange air ventilation systems installed at the Lawrence Barn. Current building code requires exchange air ventilation in assembly spaces.

Energy Recovery Ventilation Systems

There are no energy recovery ventilation systems installed at the Lawrence Barn. Installation of new exchange air ventilation systems should include energy recovery capacity.

Indoor Air Quality

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

Recommended temperatures vary based on the season, occupant activity, and relative humidity levels. Generally, recommended setpoint heating temperatures in northern New England range between 67°F and 70°F and recommended cooling setpoint temperatures range between 73°F and 76°F. Relative humidity (RH) levels fluctuate consistent with seasonal atmospheric conditions. A range between 30% and 65% is recommended (ASHRAE). While there are no known adverse health effects related to elevated CO_2 concentrations, it can cause acute illness including headaches, drowsiness, lethargy, and nausea. For this reason, the U.S. Environmental Protection Agency (EPA) has established a recommended threshold concentration of 1,000 ppm.

The IAQ in the Lawrence Barn was measured on January 3rd, 2012 between the hours of 1108 and 1118. The building was unoccupied when the measurements were obtained. Five (5) IAQ measurements were obtained at representative locations throughout the building. Appendix C presents all of the measurements. Results of the IAQ measurements are summarized as follows:

- Temperatures in the building ranged from 66.0°F in the unoccupied meeting room to 67.8°F in the supply room. The average recorded temperature was 67.1°F.
- Relative humidity measurements ranged from 19.9% in the east meeting room to 24.4% in unoccupied west meeting hall. The average relative humidity was 21.2%.
- CO_2 concentrations ranged from 367 ppm in the east meeting room to 403 ppm in the supply room 321 with an average of 380 ppm.

Table 18: Summary of IAQ Data

IAQ Metric	Low	High	Avg.	Range of Variance	Recommended
Temperature (°F)	66.0	67.8	67.1	1.8	67 – 70
Relative Humidity (%)	19.9	24.4	21.2	4.5	30 – 65
Carbon Dioxide (ppm)	367	403	380	36	<1,000

Temperatures had a small range of variance of 1.8°F. Temperatures were high for the unoccupied space indicating the mechanical equipment runs more frequently to condition the unoccupied space resulting in increased energy consumption. Relative humidity also had a small variance at 4.5%. CO_2 was consistently low with a small variance.

The low CO_2 in correlation with no major exhaust equipment indicates the building may have sufficient ventilation through the existing equipment and building envelope. Presumably the CO_2 levels would be much higher when the building is partially or fully occupied. Figure 15 below graphically depicts the relationships between temperature, relative humidity and CO_2 concentrations.

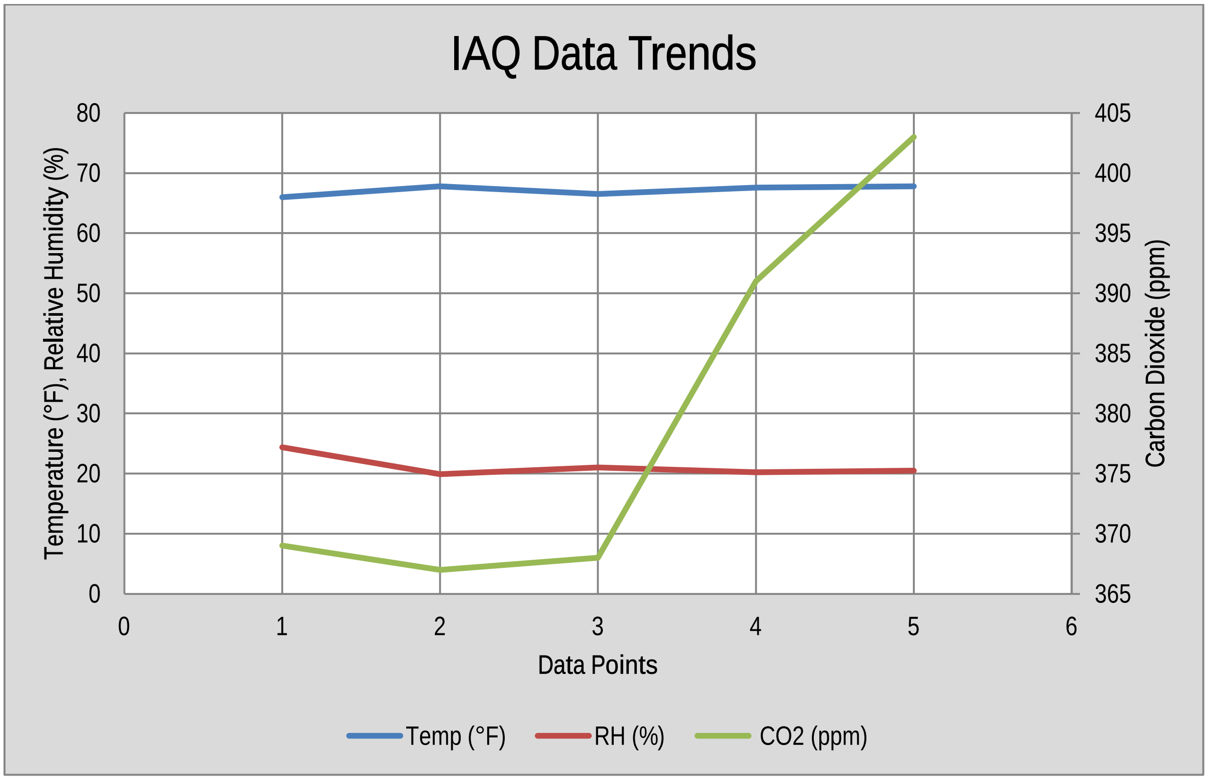


Figure 16: Indoor Air Quality Data Trends

Secondary Observations

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

Structural Systems

There were no structural systems issues noted within the Lawrence Barn.

Roofing Systems

There were no roofing system issues observed at the Lawrence Barn.

Building Code

Current building code requires mechanical exchange air ventilation of assembly use spaces. Air exchange in the Lawrence Barn is limited to passive envelope leakage (minimal) and operating doors and windows. During high occupancy events when the building is in heating mode the ventilation will not be adequate pursuant to code requirements. Installation of an energy recovery ventilation (ERV) system for the main hall is recommended. The system should be designed and sized consistent with the occupancy loads. Demand CO_2 controllers should be used to optimize the ERV system and prevent over-ventilation of the building.

Life Safety Code

No life safety codes were observed during the field audit. The building contains a wet sprinkler system.

ADA Accessibility

The Lawrence Barn facility substantially complies with current ADA standards.

Hazardous Building Materials

No hazardous building materials were found at the facility.

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 fuel.

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 Lawrence Barn 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, major Energy Efficiency Measures (EEMs) were simulated within the model including:

- Installing an air source heat pump for heating and cooling.

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 10,940 kWh/yr is slightly higher than the model prediction of 10,310 kWh/yr.

Table 19: Model Predicted Baseline Electrical Usage

Electric Category	Annual Usage (kWh x 1,000)
Space Cooling	0.83
Hot Water	1.14
Vent. Fans	0.92
Pumps & Aux.	1.62
Exterior Lighting	0.97
Plug Loads	1.27
Area Lights	3.57
Total Predicted:	**10.31**
Total Actual:	**10.94**

Actual heating fuel consumption (116.6 MBtu) is slightly higher than the model predicted value (115.4 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	115.4
Total Predicted:	115.4
Total Actual:	116.6

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

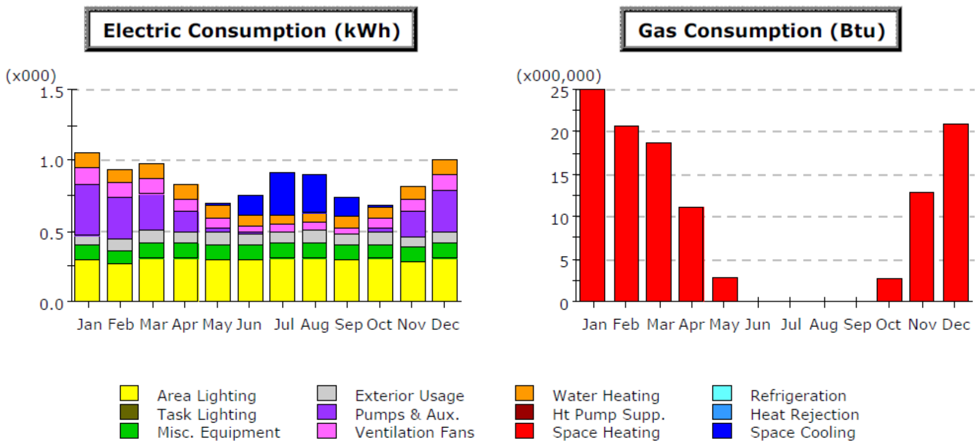


Figure 17: Monthly Energy Use by Category (Baseline)

Annual energy consumption by category is also graphed using eQUEST® (Figure 17). This information is depicted in a pie graph and helps determine the largest overall use categories. For the Lawrence Barn the "Misc. Equipment" category is determined to use the most electrical energy (38%) while "Space Heating" consumes the most amount of gas (95%). "Misc. Equipment" includes all plug loads such as office equipment and appliances. A final comparison between the baseline and modeled energy efficiency measures is also provided in the appendices in bar graph format to illustrate changes in energy use with each measure. This provides an indication of where the EEM savings occur and any possible increased energy use from the new measure. That information is then used to formulate whether the EEM is economically sound for the particular application.

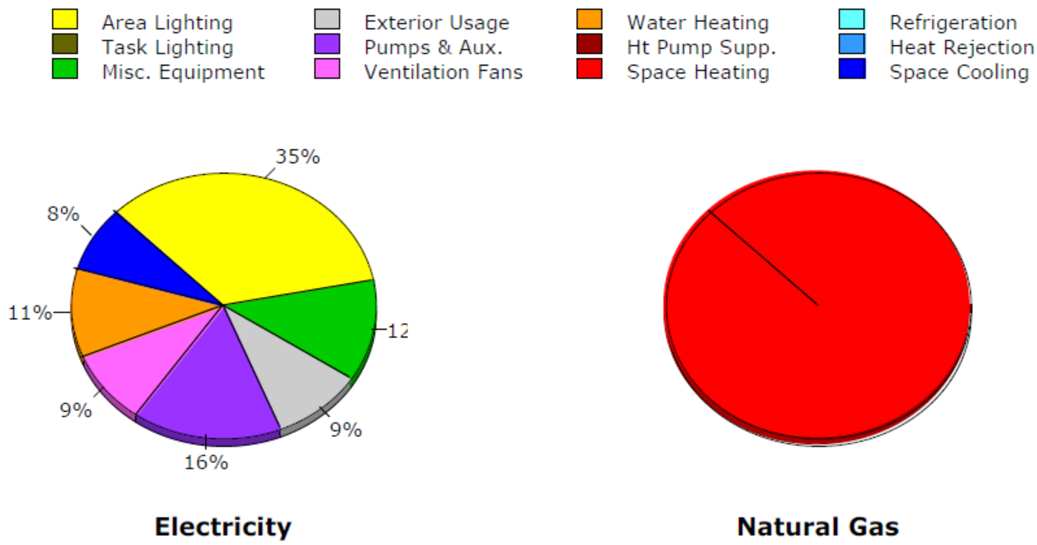


Figure 18: Annual Energy Use by Category (Baseline)

F. FACILITY BENCHMARKING

ENERGY STAR for Commercial Buildings

The LAWRENCE BARN 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 Lawrence Barn is defined as a "Social/Meeting" 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 January 2012) 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	37,327
Propane Gas	116,649
Total Energy:	153,976

Table 22: SEP Benchmarking Summary

Location	Site EUI (kBtu/ft²/yr)	Source EUI (kBtu/ft²/yr)
Lawrence Barn	39	62
National Median (Social/Meeting)	43	71
	% Difference:	-13%
	Portfolio Manager Score:	NA

Compared to the office buildings that have entered data into Portfolio Manager to date, the Lawrence Barn facility energy use is less than the national average. The source EUI for the facility is 62 kBtu/ft²/yr while the national average is 71 kBtu/ft²/yr, meaning it uses 13% less energy than the average social/meeting facility.

G. RECOMMENDATIONS

Energy Conservation Measures

Based on the observations and measurements of the Lawrence Barn, 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 capital cost for implementation versus the net estimated energy cost savings.

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

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

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

Energy cost savings are based current cost of electricity at $0.14 per kWh (PSNH) and the current price of propane of $3.53 per gallon. (NHOEP March 26, 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. Six (6) Tier I EEMs are recommended.

Table 23: Tier I Energy Efficiency Measures

EEM No.	EEM Description	Capital Cost	Annual Cost Savings	Payback (yrs.)	SIR
TI-1	Reduce heating setpoints during unoccupied hours to 58°F	$0	$350	0	-
TI-2	Replace/repair loose FG batt insulation in attic.	$50	$80	0.6	-
TI-3	Complete air-sealing on all window jambs, partings, and moldings (interior and exterior).	$500	$230	2.2	3.2
TI-4	Inject non-expanding polyurethane foam insulation in hollow aluminum frames on storefront assemblies.	$650	$60	10.8	2.8
T1-5	Replace twelve (12) interior metal halide lights with compact fluorescent bulbs.	$180	$14	12.9	1.6
T1-6	Replace kitchen refrigerator with an ENERGY STAR® rated unit.	$500	$50	10	1.2

Recommended Tier I EEMs include reducing the heating consumption by several measures such as: reducing setpoints during unoccupied periods; replacing batt insulation that has fall in the rafters; and completing air-sealing on all windows and doors to limit thermal transfer. Lighting consumption can be reduced by replacing the twelve (12) MH fixtures with CFL fixtures. The plug load can be reduced by replacing the refrigerator with an ENERGY STAR® rated unit.

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) recommended Tier II EEMs are presented in Table 24.

Table 24: Tier II Energy Efficiency Measures

EEM No.	EEM Description	Capital Cost	Annual Cost Savings	Payback (yrs.)	SIR
T2-1	Replace DHW tank units with demand-tankless gas condensing unit.	$1,127	$350	3.2	4.7
T2-2	Replace exterior halogen fixtures with LED units (6).	$1,012	$257	3.9	4.6
T2-3	Install a remote web-based building control system to control temperate set points, lighting, and door locks.	$1,748	$753	3.3	6.0
T2-4	Add two (2) inches of foil faced polyisocyanurate to the ceiling and walls of the furnace loft. Tape all seams to reduce air leakage.	$2,789	$340	8.2	2.4

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

The DHW tank capacity is expected to exceed the demand of the building resulting in an excess consumption of energy. Replacing this with a demand-tankless gas condensing unit would limit the consumption. The exterior halogen light fixtures are an energy intensive light source and replacing them with LED fixtures would decrease electrical consumption while providing a higher quality light output. Adding additional insulation to the mechanical loft is a simple and economical measure that will reduce heating loads for the building.

Tier III Energy Efficiency Measures

EEMs that require large capital expenditure and budgetary planning (one year or greater) are categorized as Tier III measures. One (1) Tier III EEMs are provided in Table 25 for the Lawrence Barn.

Table 25: Tier III Energy Efficiency Measures

EEM No.	EEM Description	Capital Cost	Annual Cost Savings	Payback (yrs.)	SIR
T3-1	Install a high-efficiency electric air-source heat pump with web-based controls and an interlocked energy recovery ventilation system.	$33,258	$2,586	12.9	2.1

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

Heating and cooling consume a high percentage of the facilities energy consumption. Installing a high-efficiency inverter driven electric air-source VRF heat pump system would replace the existing heating and cooling systems and decrease energy consumption. The addition of web-based controls would provide remote operation and scheduling and the interlocked energy recovery ventilation system would provide the required ventilation pursuant to building code requirements for an assembly use space.

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

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

EEMs Considered but not Recommended

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

1. A lighting retrofit project was recently completed (2011) and replacing the modern fixtures with higher efficiency units is not cost practical at this time.
2. Several insulation gaps were noted during the IR survey of walls. Spot injection insulation would improve the thermal integrity of the walls however the cost payback is rather long.
3. The integrity of the FB batt roof insulation in the main hall is low. However based on the construction of the ceiling and roof (vaulted ceiling) improving the insulation would be costly and would not provide a reasonable payback. Future replacement of the roof should consider installing a SIP system over the entire roof.

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 light fixtures will provide a longer bulb lifetime which decreases the maintenance to replace bulbs, especially in hard to reach fixtures such as the main hall and exterior.
2. The residential heating and cooling systems are rather new but their expected service life is limited (10 to 15 years). Replacing these with a commercial electric heat-pump system with an expected service life of 25 to 30 years would offset future maintenance and replacement costs.
3. Installing web-based controls will eliminate the need for manual adjustment of thermostats in the building.

Indoor Air Quality Measures

Based upon the measured indoor air quality in the Lawrence Barn, all areas were below the EPA CO_2 recommended threshold of 1,000 ppm. CO_2 concentrations ranged between 367 and 403, with a building average of 380 ppm. The building was unoccupied during the audit therefore concentrations at full capacity are unknown.

Because there are no mechanical exchange air ventilation systems in the building, IAQ is expected to be low during peak occupancy events. Current code requires mechanical ventilation of assembly use spaces. Recommended systems include an energy recovery ventilation system with demand CO^2 controls. This system should be interlocked with the building controls system.

Renewable Energy Considerations

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

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

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

Table 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 Lawrence Barn 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
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: 82%	***Site Feasibility:*** ***There is an ample amount of roof space which could accommodate a small to mid-sized (5kW-30kW) system. 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. Based on the current construction the facility may be able to integrate the PV system without any upgrades.***
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: 80%	***Site Feasibility:*** ***There is adequate site space to install a small (<5kW) to medium-sized pole-mounted wind turbine. However, considering the relatively low mean wind speeds in the region, a WTG unit may not be a cost practical consideration. Based on the location and visibility of the building this would also increase public awareness.***
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: 79%	***Site Feasibility:*** ***There is an ample amount of grounds open at the Lawrence where a small- (5kW-10kW) to mid- (10kW-30kW) sized system could be installed. 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.***

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: 77%	*Site Feasibility:* *Based on the moderate demand for domestic hot water, a solar hot-water system may be a practical consideration for the building. The capital cost could be offset with substantial utility rebates and incentives. The system could provide primary DHW during summer months when demand is low. In colder months, it would provide secondary heating.*
Geothermal Heating & Cooling	System Description: Geothermal heating systems utilize solar energy residing in the upper crust of the earth. Cooling is provided by transferring heat from the building to the ground. There are a variety of heating/cooling transfer systems but the most common consists of a deep well and piping loop network. All systems include a compressor and pumps which require electrical energy. Geothermal systems are a proven and accepted technology in the New England region. Site constraints and building HVAC characteristics determine the practicality.
Score: 77%	*Site Feasibility:* *A geothermal ground-source heat pump system is a practical application for heating and cooling of the building. However, because the building is occupied on an irregular and part-time schedule, it may not be the most efficient system for the building.*
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: 72%	*Site Feasibility:* *The building currently has an ample amount of space for a PV system to be installed and the solar-thermal could utilize the existing heat exchanger. A more focused evaluation is required to determine if this is a cost practical solution.*
Biomass Heating Systems	System Description: Biomass heating systems include wood chip fueled furnaces and wood pellet fueled furnaces. For several reasons, wood chip systems are generally practical only in large scale applications. Wood pellet systems can be practical in any size. Wood chip systems are maintenance intensive based on the market availability and procurement of woodchip feedstock and variability of woodchip characteristics (specie, size, moisture content, bark content, Btu value) which affect the operating efficiency of the furnace and heating output. They require a constant feed via a hopper and conveyor system and feed rates must vary according to feedstock Btu value and heating demand. For these reasons they typically require full-time maintenance and are practical only in large scale applications. Wood pellet systems are much less maintenance intensive and feedstock availability and consistency is less of an issue. Both systems reduce the dependency on fossil-fuels and feedstock can be harvested locally.
Score: 72%	*Site Feasibility:* *A conventional pellet boiler unit may be a practical heating system for the building based on the low demand; 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 may be a practical application at the Lawrence Barn.*
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: 66%	*Site Feasibility:* *Considering the relatively small electric and heating demand for the Lawrence Barn, a CHP may not be cost practical. There is no natural gas within the Town and costs associated with the infrastructure development for a large propane tank would be high. CHP systems also require intensive maintenance and have a low expected service life.*

H. ENERGY EFFICIENCY INCENTIVE AND FUNDING OPPORTUNITIES

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

New Hampshire Public Utilities Commission

New Hampshire 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)

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


NORTHEAST CORNER OF BUILDING


ONE NORTH ENTRANCE TO BUILDING


NORTHEAST CORNER OF BUILDING


NORTH SIDE OF BUILDING

NORTH ENTRANCE TO BUILDING

NORTHWEST CORNER OF BUILDING

NORTH SIDE OF BUILDING

NORTH SIDE OF BUILDING

WEST (ROAD) SIDE OF BUILDING


SOUTH ENTRANCE TO BUILDING

WEST (ROAD) SIDE OF BUILDING

SOUTHWEST CORNER OF BUILDING


SOUTH SIDE OF BUILDING


EAST SIDE OF BULIDING


SOUTH SIDE OF BUILDING


SOUTHEAST CORNER OF BUILDING

FLOORING TILE INFORMATION

NORTHWEST CORNER OF BULIDING


NORTHEAST SIDE OF BUILDING


MAIN BARN FLOORING


SOUTHWEST CORNER OF BUILDING


MAIN BARN SPACE


WEST SIDE CEILING


MAIN BARN AREA

DOOR FRAME ALONG NORTH SIDE OF BUILDING

MAIN SPACE LOOKING EAST INTO SMALLER MEETING AREA AND OPEN SPACE ABOVE CEILING SHOWN

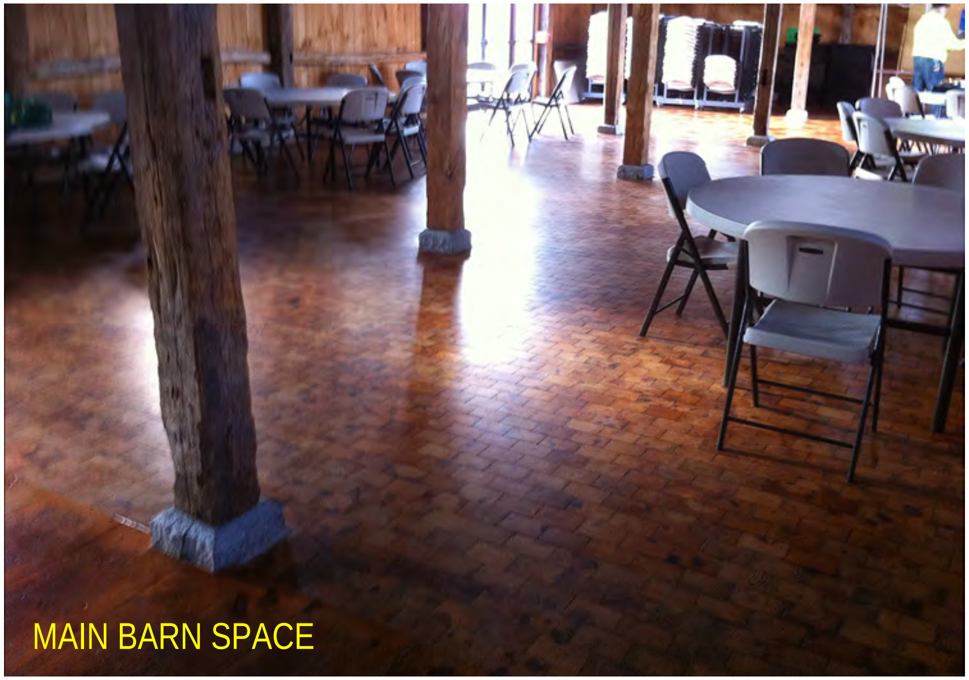
WINDOW SEAL ALONG NORTH SIDE

WEST END OF MAIN SPACE WITH TYPICAL LIGHT FIXTURE


OPEN SPACE IN MAIN BARN ABOVE SMALLER MEETING AREA


INTERIOR CORNER OF DOOR


CEILING OF MAIN BARN AREA


MAIN BARN SPACE

KITCHEN COUNTER

WINDOWS ABOVE NORTH SIDE ENTRANCE

KITCHEN SPACE

ELECTRICAL PANELS IN CLOSET

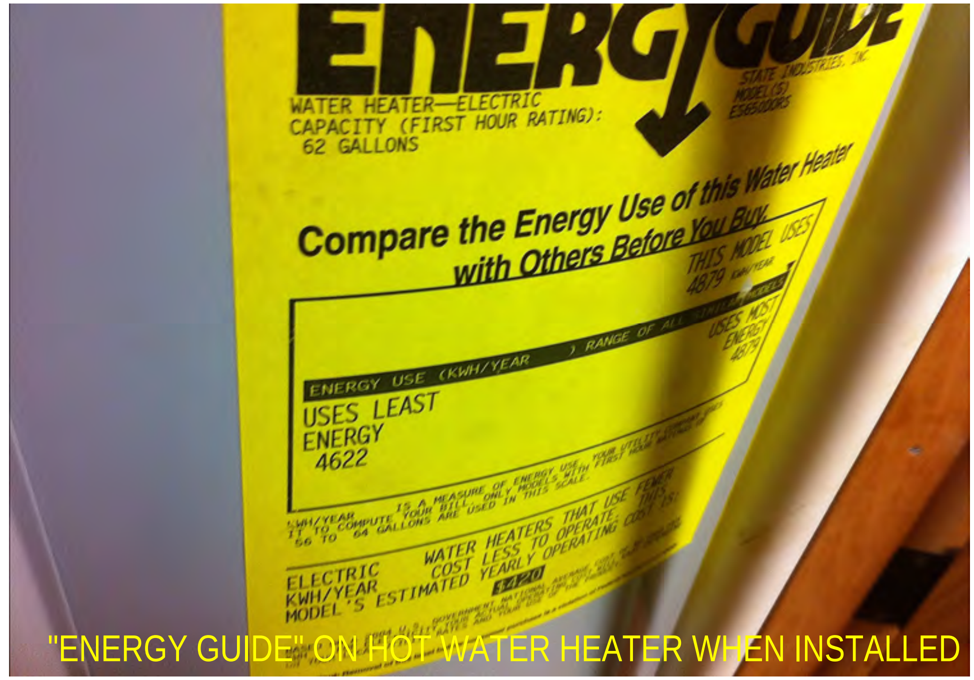
THERMOSTAT

WALL OF SMALL MEETING SPACE AREA

INSIDE OF EXTERIOR DOOR (RIGHT) AND WALL ALONG NORTH SIDE

LOOKING WEST IN MAIN BARN AREA

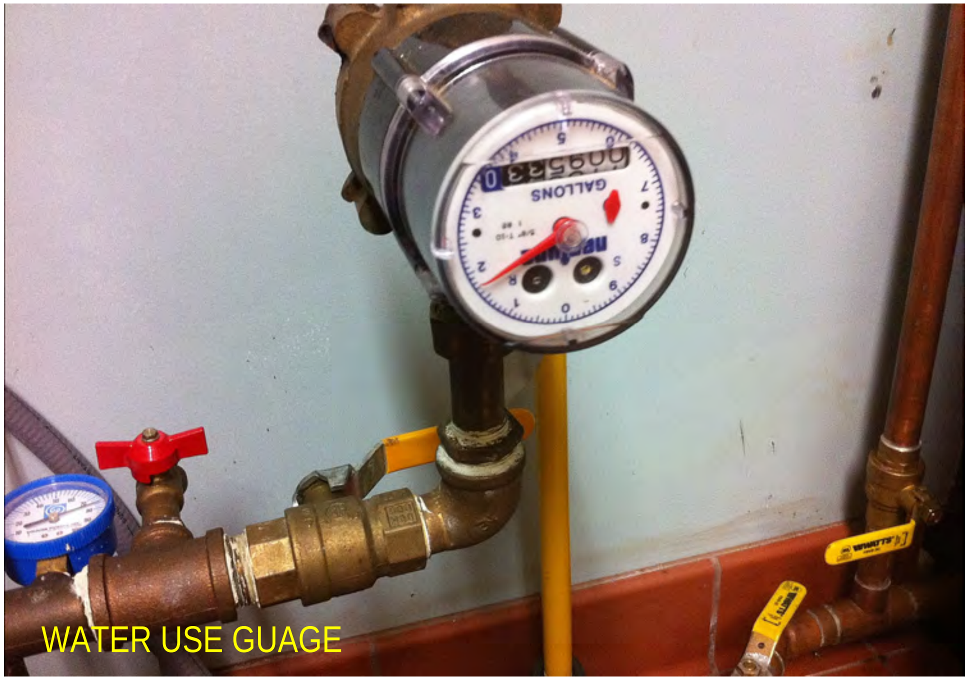

HOT WATER HEATER



"ENERGY GUIDE" ON HOT WATER HEATER WHEN INSTALLED

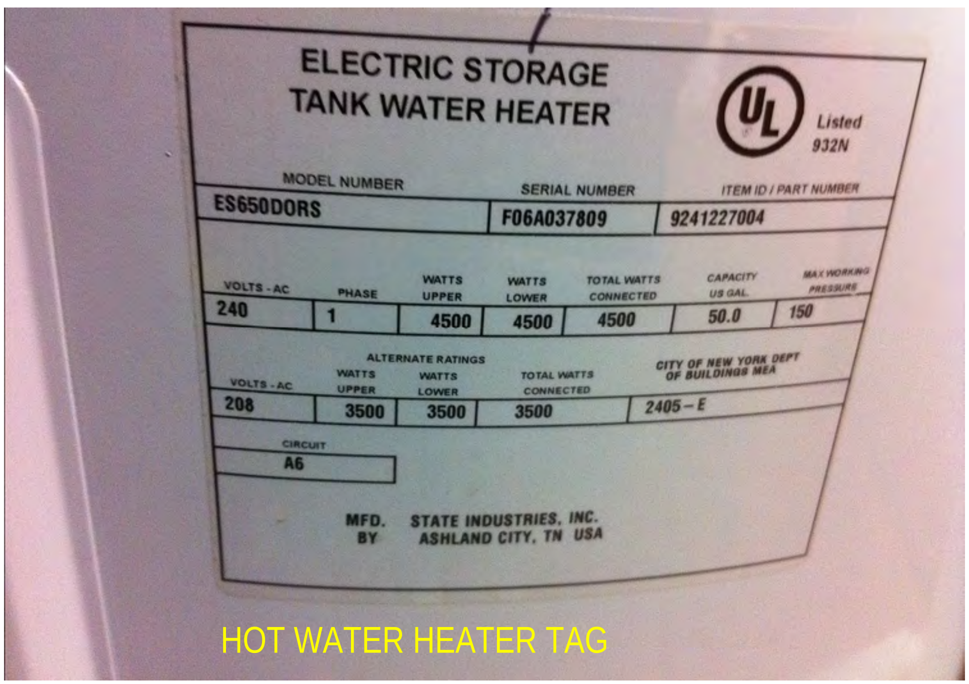

KITCHEN SINK DRAIN


HOT WATER HEATER



WATER USE GUAGE


REFRIGERATOR IN KITCHEN

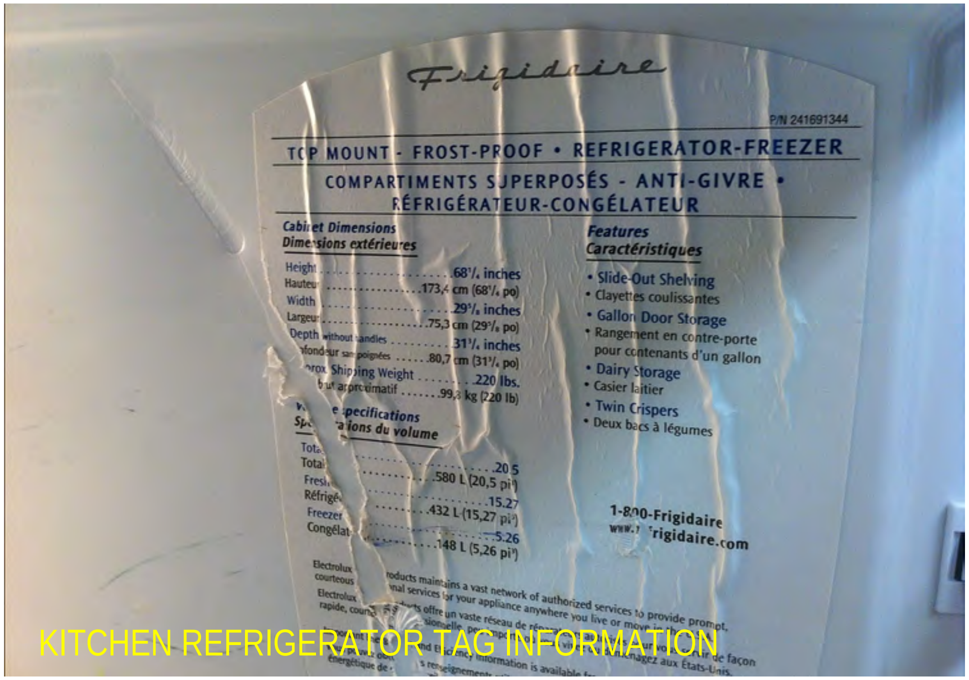


HOT WATER HEATER TAG


HOT WATER BOOSTER

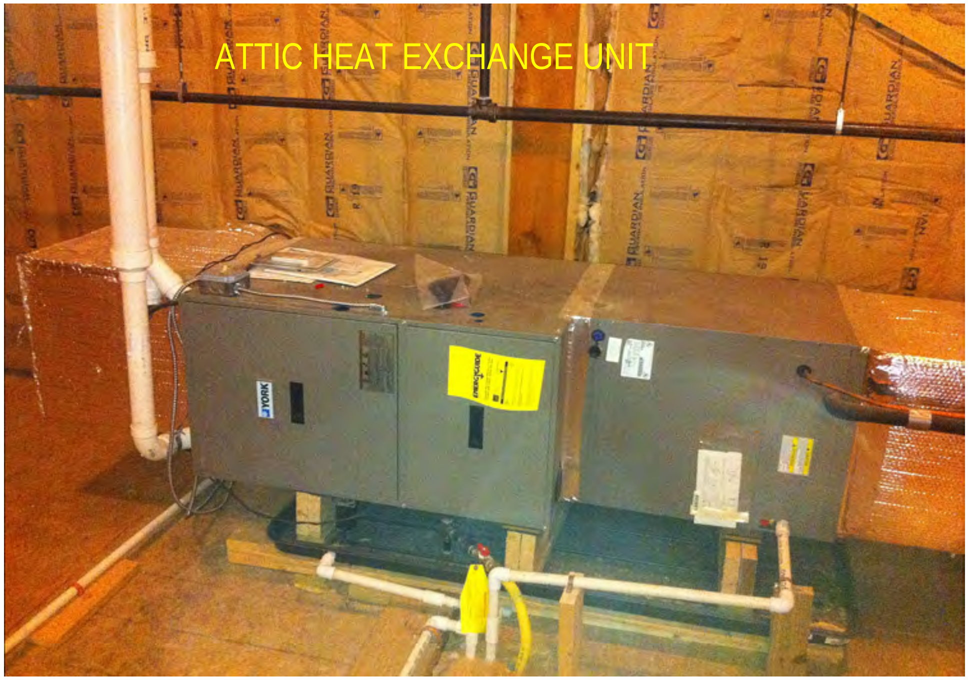
MAIN BARN AREA LOOKING WEST

FALLEN INSULATION ON ATTIC FLOOR. RECOMMEND REINSTALLING



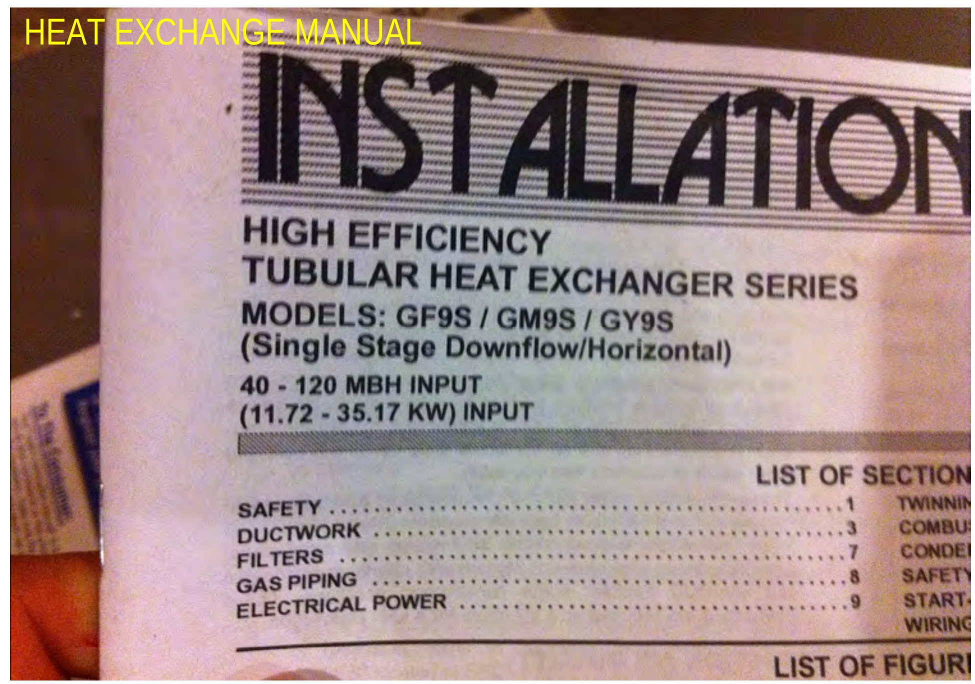
KITCHEN REFRIGERATOR TAG INFORMATION

FALLING INSULATION IN ATTIC SPACE


ATTIC HEAT EXCHANGE UNIT


INSULATED FLOOR SPACE OF ATTIC

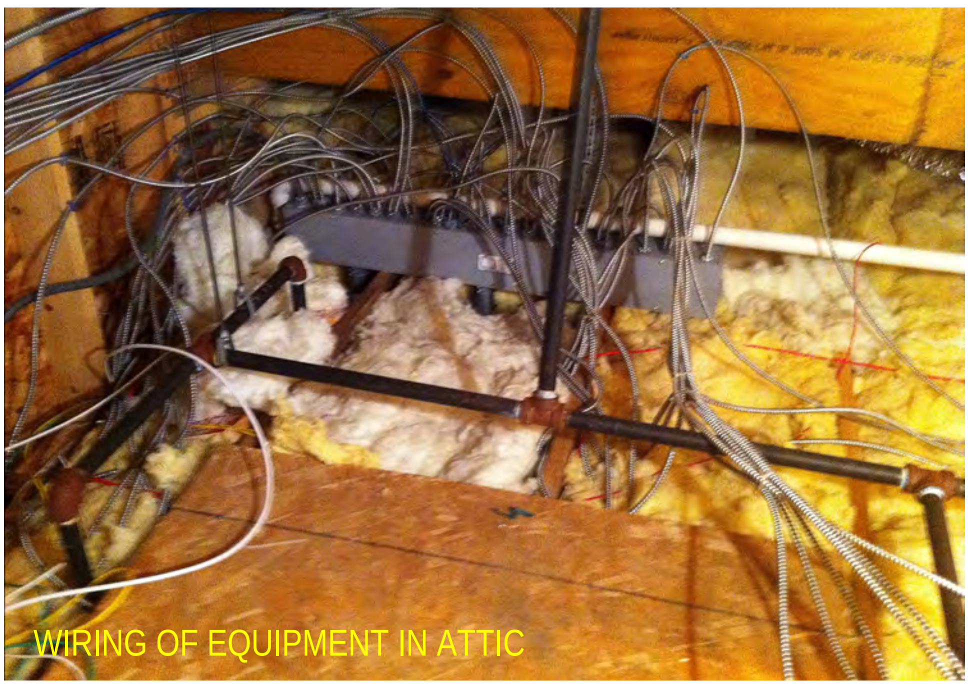

AREA OF MISSING INSULATION



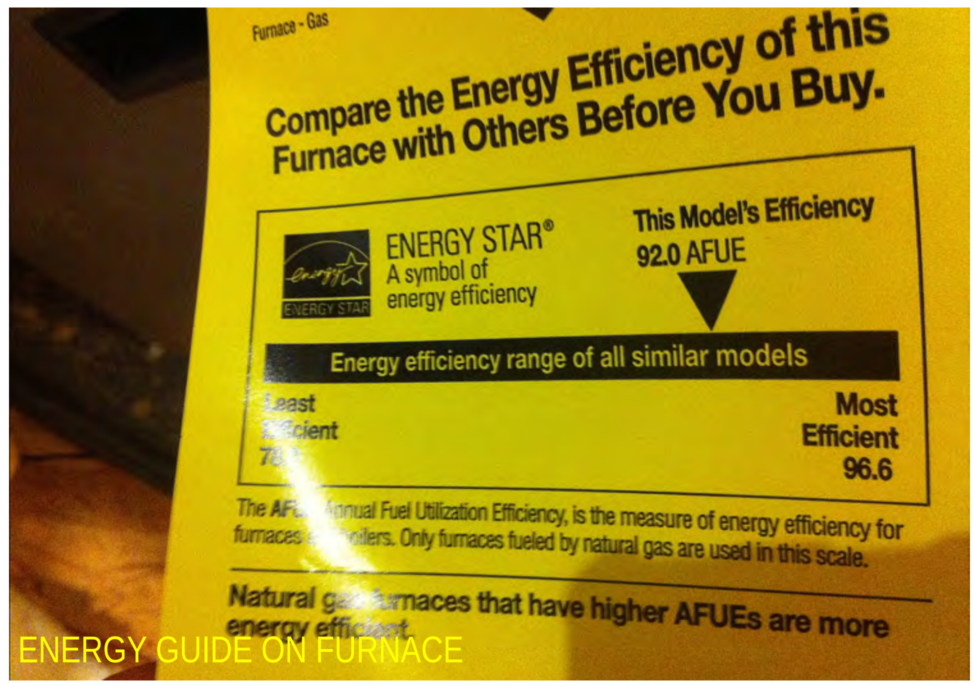
HEAT EXCHANGE MANUAL

ATTIC HEAT EXCHANGE UNIT

MAIN BARN TYPICAL LIGHTING FIXTURE



WIRING OF EQUIPMENT IN ATTIC



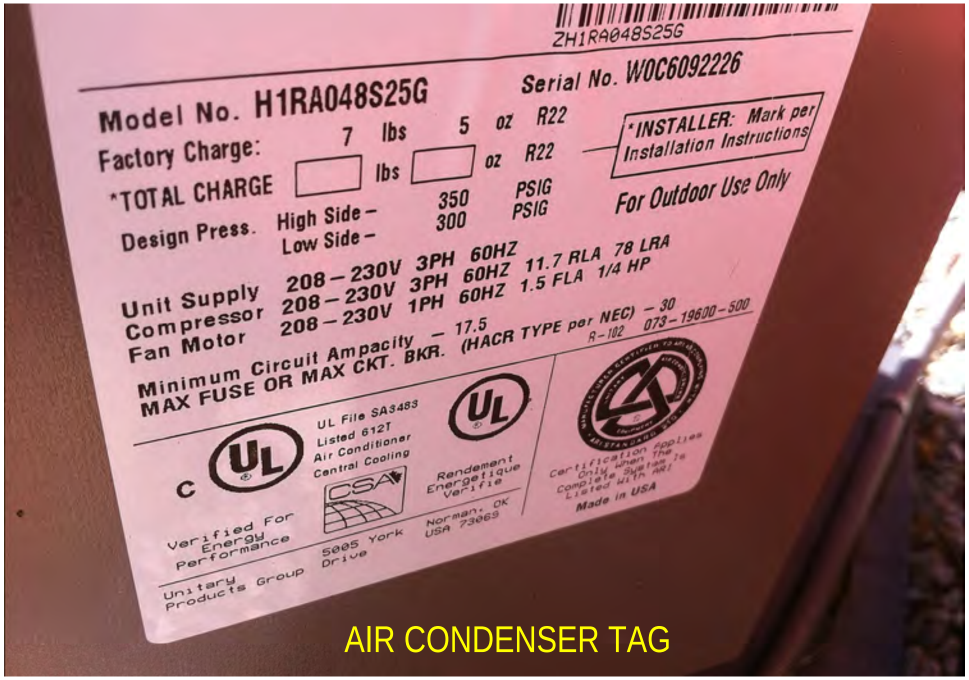
ENERGY GUIDE ON FURNACE


ELECTRICAL METER ON NORTH SIDE OF BUILDING


PROPANE TANK BELOW


DUCTWORK RUNNING FROM ATTIC TO WEST END

ELECTRICAL METER ON NORTH SIDE OF BUILDING

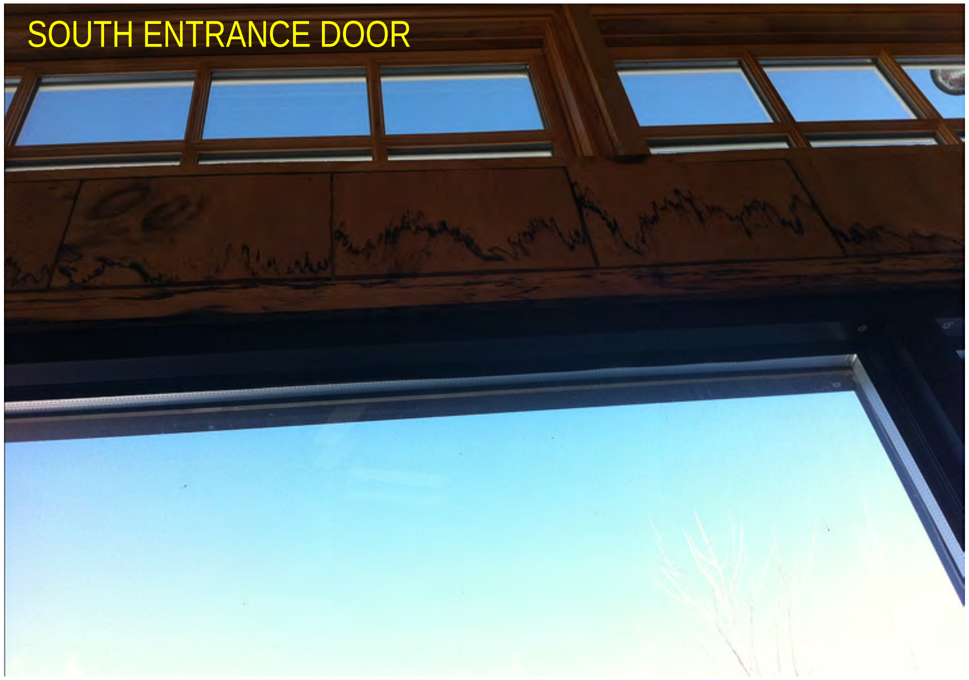


AIR CONDENSER TAG


ENTRANCE ALONG SOUTHEAST SIDE OF BUILDING


AIR CONDENSER ON SOUTHEAST SIDE OF BUILDING


SEAL FALLING OFF ALONG SOUTHEAST SIDE OF BUILDING



SOUTH ENTRANCE DOOR

SEALING NOT TIGHT AROUND SOUTH ENTRANCE DOOR

PROPANE REGULATOR ON EAST SIDE OF FIRE PUMP ROOM

SEALING FALLING OFF AROUND SOUTH ENTRANCE DOOR

APPENDIX B

Thermal Imaging Survey Reports

Inspection Report

Report Date	5/30/2012

Company	AEC	Customer	Lawrence Barn
Address	90 Main Street	Site Address	28 Depot Road, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

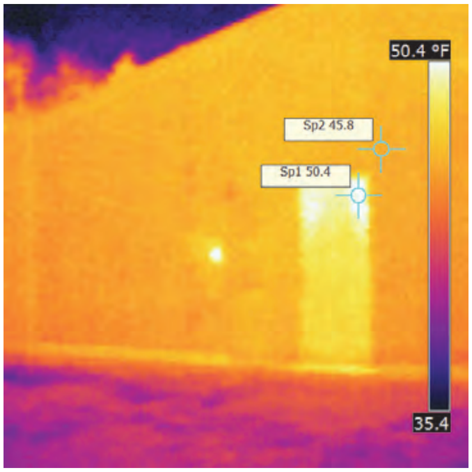


Image and Object Parameters

Text Comments

Camera Model	B-CAM Western S
Image Date	12/28/2011 8:42:07 AM
Image Name	IR_1887.jpg
Emissivity	0.96
Reflected apparent temperature	49.0 °F
Object Distance	20.0 ft

Description

IR of rear entrance reveals thermal transfer slightly higher around door frame than through exterior wall. Recommend weather sealing all openings (EEM T1-3)

Inspection Report

Report Date	5/30/2012

Company	AEC	Customer	Lawrence Barn
Address	90 Main Street	Site Address	28 Depot Road, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

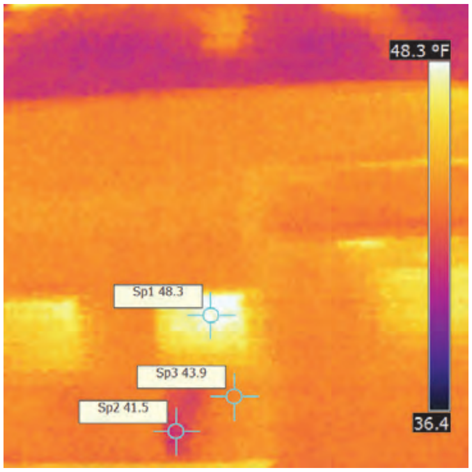


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/28/2011 8:42:20 AM
Image Name	IR_1888.jpg
Emissivity	0.96
Reflected apparent temperature	42.0 °F
Object Distance	20.0 ft

Text Comments

Description

IR of exterior window reveals some thermal transfer. Wet spot noticeable on picture shows colder on IR.

Inspection Report

Report Date	5/30/2012

Company	AEC	Customer	Lawrence Barn
Address	90 Main Street	Site Address	28 Depot Road, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

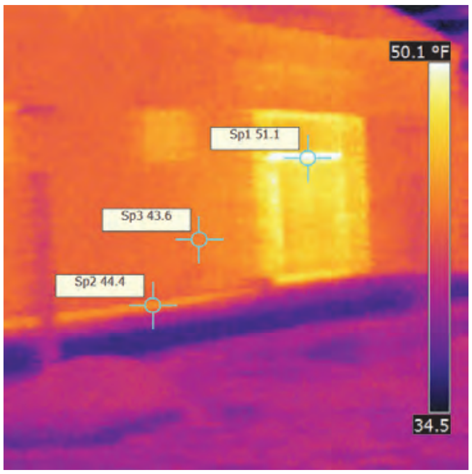


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/28/2011 8:42:34 AM
Image Name	IR_1890.jpg
Emissivity	0.96
Reflected apparent temperature	50.0 °F
Object Distance	20.0 ft

Text Comments

Description

Side entrance IR reveals some thermal transfer between the top of the door and and glass above and slight thermal transfer through the concrete foundation.

Inspection Report

Report Date	5/30/2012		
Company	AEC	Customer	Lawrence Barn
Address	90 Main Street	Site Address	28 Depot Road, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

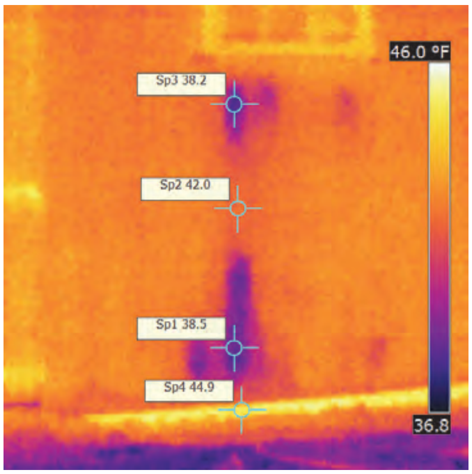


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/28/2011 8:42:49 AM
Image Name	IR_1891.jpg
Emissivity	0.96
Reflected apparent temperature	36.0 °F
Object Distance	15.0 ft

Text Comments

Description

IR of building exterior reveals leaking areas (dark blotches) as well as thermal transfer through the concrete foundation.

Inspection Report

Report Date	5/30/2012

Company	AEC	Customer	Lawrence Barn
Address	90 Main Street	Site Address	28 Depot Road, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

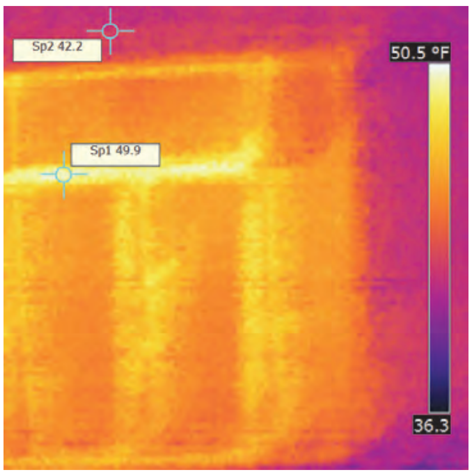


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/28/2011 8:43:14 AM
Image Name	IR_1893.jpg
Emissivity	0.96
Reflected apparent temperature	48.0 °F
Object Distance	15.0 ft

Text Comments

Description

IR of side entrance door reveals thermal transfer between top of door and glass above.

AEC

Inspection Report

Report Date	5/30/2012		
Company	AEC	Customer	Lawrence Barn
Address	90 Main Street	Site Address	28 Depot Road, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

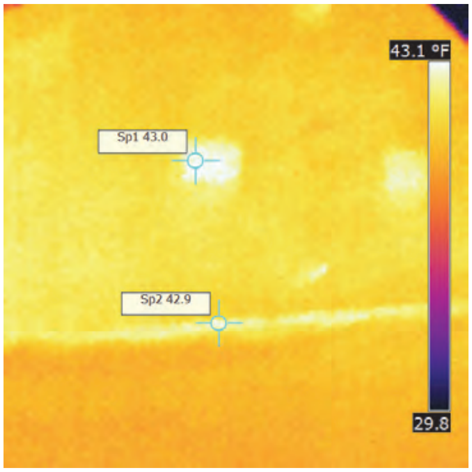


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/28/2011 8:43:29 AM
Image Name	IR_1894.jpg
Emissivity	0.96
Reflected apparent temperature	41.0 °F
Object Distance	25.0 ft

Text Comments

Description

IR of side of barn reveals some thermal transfer through the window and concrete foundation.

Inspection Report

Report Date	5/30/2012		
Company	AEC	Customer	Lawrence Barn
Address	90 Main Street	Site Address	28 Depot Road, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

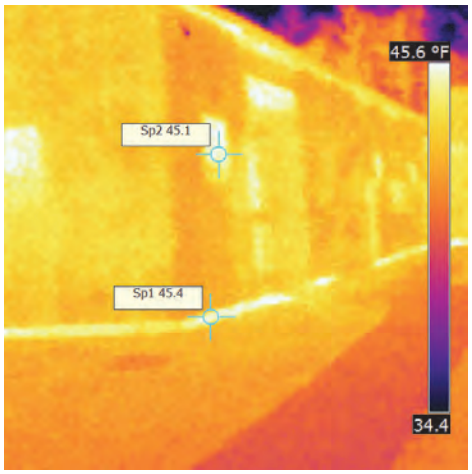


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/28/2011 8:43:49 AM
Image Name	IR_1895.jpg
Emissivity	0.96
Reflected apparent temperature	44.0 °F
Object Distance	20.0 ft

Text Comments

Description

IR of side of barn reveals some thermal transfer through windows and concrete foundation.

AEC

Inspection Report

Report Date	5/30/2012

Company	AEC	Customer	Lawrence Barn
Address	90 Main Street	Site Address	28 Depot Road, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

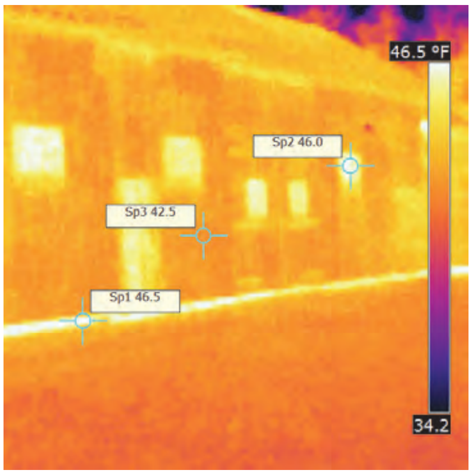


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/28/2011 8:44:06 AM
Image Name	IR_1896.jpg
Emissivity	0.96
Reflected apparent temperature	45.0 °F
Object Distance	25.0 ft

Text Comments

Description

IR of exterior of the barn reveals some thermal transfer through windows, doors and cocncrete foundation.

AEC

Inspection Report

Report Date	5/30/2012

Company	AEC	Customer	Lawrence Barn
Address	90 Main Street	Site Address	28 Depot Road, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

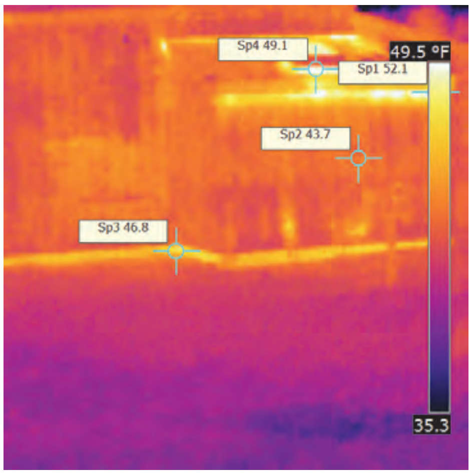


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/28/2011 8:44:50 AM
Image Name	IR_1898.jpg
Emissivity	0.96
Reflected apparent temperature	51.0 °F
Object Distance	20.0 ft

Text Comments

Description

IR of exterior firepump room reveals thermal transfer through seal between wall and roof as well as around skylight and concrete foundation. (EEM TI-3)

Report Date	5/30/2012

Company	AEC	Customer	Lawrence Barn
Address	90 Main Street	Site Address	28 Depot Road, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

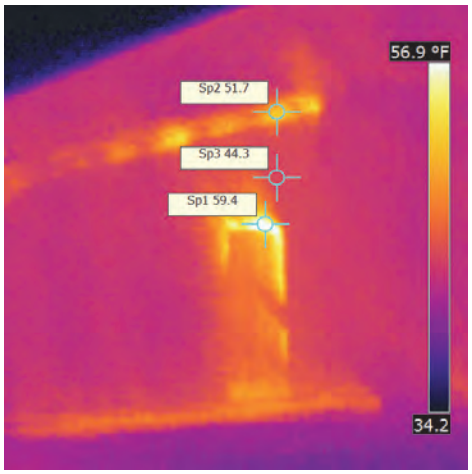


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	12/28/2011 8:45:09 AM
Image Name	IR_1899.jpg
Emissivity	0.96
Reflected apparent temperature	59.0 °F
Object Distance	20.0 ft

Text Comments

Description

Entrance to fire pump room reveals thermal transfer above door. Recommend installing weather stripping (EEM TI-3).

Inspection Report

Report Date	5/30/2012

Company	AEC	Customer	Lawrence Barn
Address	90 Main Street	Site Address	28 Depot Road, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

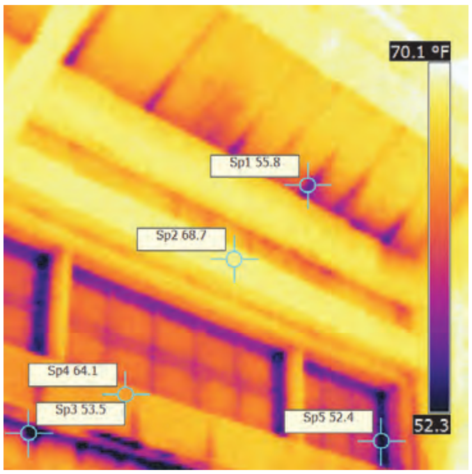


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/3/2012 10:43:57 AM
Image Name	IR_2098.jpg
Emissivity	0.96
Reflected apparent temperature	52.0 °F
Object Distance	20.0 ft

Text Comments

Description

IR of interior space reveals thermal transfer through roof boards, window frames and above the entrance door.

Inspection Report

Report Date	5/30/2012		
Company	AEC	Customer	Lawrence Barn
Address	90 Main Street	Site Address	28 Depot Road, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

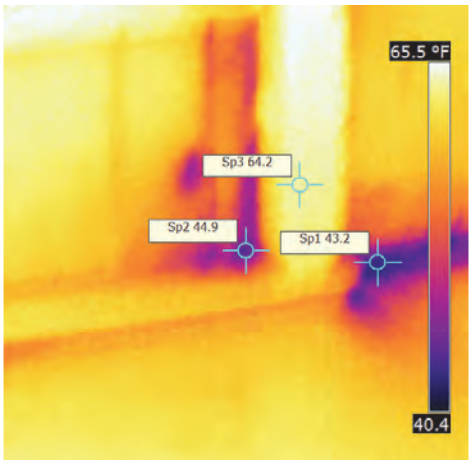


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/3/2012 10:44:13 AM
Image Name	IR_2099.jpg
Emissivity	0.96
Reflected apparent temperature	42.0 °F
Object Distance	6.0 ft

Text Comments

Description

Exterior door reveals thermal transfer around framing. Recommend sealing all jams with weather stripping (EEM T1-4)

Inspection Report

Report Date	5/30/2012

Company	AEC	Customer	Lawrence Barn
Address	90 Main Street	Site Address	28 Depot Road, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

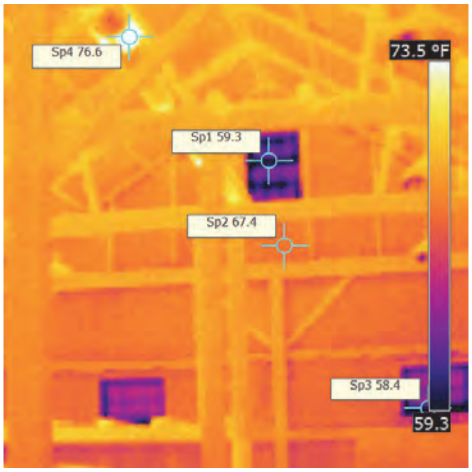


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/3/2012 10:45:05 AM
Image Name	IR_2100.jpg
Emissivity	0.96
Reflected apparent temperature	58.0 °F
Object Distance	25.0 ft

Text Comments

Description

Interior IR depecits thermal transfer through windows and overhead air duct.

AEC

Inspection Report

Report Date	5/30/2012		
Company	AEC	Customer	Lawrence Barn
Address	90 Main Street	Site Address	28 Depot Road, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

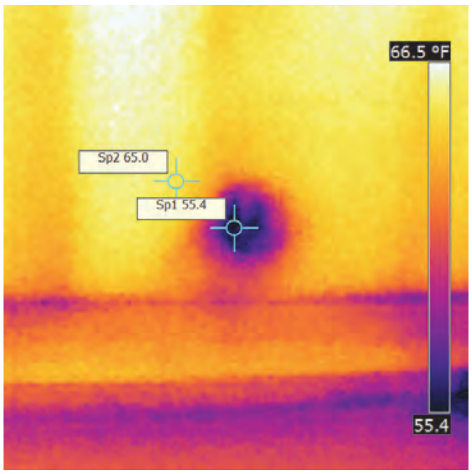


Image and Object Parameters

Text Comments

Camera Model	B-CAM Western S
Image Date	1/3/2012 10:45:43 AM
Image Name	IR_2101.jpg
Emissivity	0.96
Reflected apparent temperature	55.0 °F
Object Distance	5.0 ft

Description

Wall IR reveals spot of thermal transfer which could be the result of missing insulation or mold buildup.

Inspection Report

Report Date	5/30/2012

Company	AEC	Customer	Lawrence Barn
Address	90 Main Street	Site Address	28 Depot Road, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

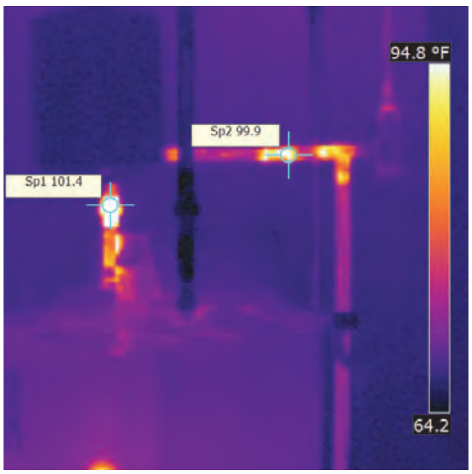


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/3/2012 10:49:26 AM
Image Name	IR_2102.jpg
Emissivity	0.96
Reflected apparent temperature	101.0 °F
Object Distance	5.0 ft

Text Comments

Description

Uninsulated hot water pipes for supply and return to the hot water heater results in a thermal loss. (EEM T2-1)

Inspection Report

Report Date	5/30/2012		
Company	AEC	Customer	Lawrence Barn
Address	90 Main Street	Site Address	28 Depot Road, Hollis, NH 03049
Thermographer	Hans Kuebler	Contact Person	

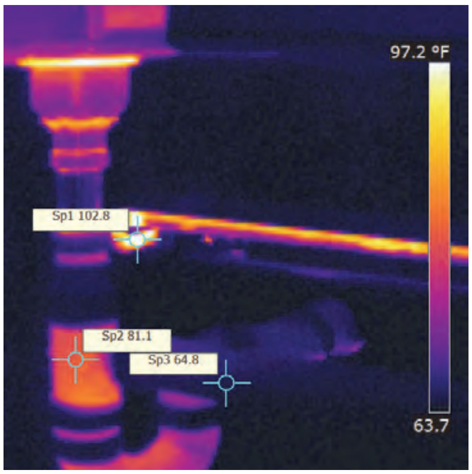


Image and Object Parameters

Camera Model	B-CAM Western S
Image Date	1/3/2012 10:49:46 AM
Image Name	IR_2103.jpg
Emissivity	0.96
Reflected apparent temperature	104.0 °F
Object Distance	3.0 ft

Text Comments

Description

Water pipes underneath the sink reveal different thermal properties through different pipes and couplings (foreground) as well as the hot water pipie (background).

APPENDIX C

Indoor Metering Data

INDOOR METERING DATA

Facility:	Location:	Date:	Ambient Outdoor:
Lawrence Barn	Hollis, NH	01/03/2012	Temp= 28 RH= 30 CO2= 310

Location /Use Description	Time	Occupied	Air Quality			Lighting Density	Notes
			Temp (°F)	RH (%)	CO2 (ppm)	Vert (FC)	
Main meeting	1108	N	66	24.4	369	35	
Small meeting	1115	N	67.8	19.9	367	34.5	
Men's room	1116	N	66.5	21	368	28.7	
Kitchen	1117	N	67.6	20.2	391	31.6	
Supply room	1118	N	67.8	20.5	403	36.3	
Averages			**67.1**	**21.2**	**380**		

APPENDIX D

Lighting Fixture Inventory

LIGHTING FIXTURE INVENTORY

Facility:	Location:	Date:
Lawrence Barn	Hollis, NH	01/03/2012

Location /Use Description	Fixture	Watts/fixture	Qty	Controls	Total watts	Est. Hr/Wk	Est. KWH Consumption/Yr
Men's Room	CFL	17	1	Motion	17	3	3
Exterior	CFL	17	12	Switch / Photocell	204	61	647
Small Meeting	CFL	34	9	Motion	306	17	271
Main Meeting	CFL	42	12	Motion	504	17	446
Main Meeting	CFL	42	4	Motion	168	17	149
Cleaning Closet	CFL	51	1	Motion	51	0.5	1
Exit	LED	5	5	Always On	25	168	218
Main Meeting	Metal Halide	50	12	Switch	600	17	530
Exterior	Halogen	60	6	Switch / Photocell	360	61	1,142
Exterior	Pole	60	3	Switch / Photocell	180	61	571
Exterior	Pole CFL	17	1	Switch / Photocell	17	61	54
Electrical Closet	T8	17	1	Switch Dual	17	0.5	0
Small Meeting	T8	28	9	Switch Dual	252	17	223
Storage Closet	T8	56	2	Switch Dual	112	0.5	3
Men's Room	T8	56	4	Switch Dual	224	3	35
Women's Room	T8	56	5	Switch Dual	280	3	44
Women's Room Closet	T8	56	1	Switch Dual	56	0.5	1
Supply Room	T8	56	2	Switch Dual	112	0.5	3
Kitchen	T8	56	5	Switch Dual	280	17	248
		Totals:	**95**		**3,765**		**4,588**

APPENDIX E

Mechanical Equipment Inventory

MECHANICAL EQUIPMENT INVENTORY

Facility:		Location:				Date:				
Lawrence Barn		Hollis, NH				01/03/2012				

Location /Use Description	Qty	Affiliated System	MBH	CFM	HP	V	phase	EER	Model	Est. kWh/yr
Attic / Heat Exchanger	2	Heat	100	2000						NA
Exterior / Air Conditoining	1	AC	46	1600	1/4	208	3	9.5	H1RA048S25G	830
Storage Closet / Hot Water Heater	1	DHW	-	-	-	240	1		ES650DORS - 50 gal	1,140
Sprinkler room / Unit heater	1	Heat								130
Bathroom / Exhaust fan	2	Exhaust								700
Kitchen / Exhaust fan	1	Exhaust								250
Total										3,050

PUMPS DATA SHEET

Facility:	Location:	Date:
Lawrence Barn	Hollis, NH	01/03/2012

Location /Use Description	Qty	GPM	HP	Est. kWh/yr
Water Tank Closet / Booster Pump	1		3/4	1620

APPENDIX F

Plug Load Inventory

PLUG LOAD INVENTORY

Facility:			Location:			Date:	
Lawrence Barn			Hollis, NH			01/03/2012	

Location /Use Description	Category	Description	Watts/fixture	Qty	Total watts	Est. Hr/Wk	Est. kWh/Yr
Kitchen	AL - Large Appliance	Electric stove	1,800	1	1,800	4	374
Kitchen	AS - Small Appliance	Microwave	1,000	1	1,000	1	52
Supply Closet	AS - Small Appliance	Vacuum	1,440	1	1,440	1	75
Electrical Closet	EL - Electronics	DVD player	35	1	35	2	4
Main Meeting	FN - Fan	Ceiling Fan	20	6	120	5	31
Kitchen	FN - Fan	Exhaust Fan	20	1	20	2	2
Main Meeting	MI - Musical/Audio Eqpt	Speakers	10	6	60	4	12
Electrical Closet	MI - Musical/Audio Eqpt	Amplifier	300	1	300	4	62
Kitchen	RS - Standard Refrigerator	Refrigerator Full	360	1	360	30	562
Supply Closet	TV - Television	TV	145	1	145	1	8
Main Meeting	VE - Video Equipt/Projector	Projector	240	1	240	4	50
			Totals:	**21**	**5,520**		**1,232**

APPENDIX G

ENERGY STAR® Statement of Energy Performance

OMB No. 2060-0347

STATEMENT OF ENERGY PERFORMANCE
Lawrence Barn

Building ID: 1714784
For 12-month Period Ending: December 31, 2011[1]
Date SEP becomes ineligible: N/A

Date SEP Generated: February 16, 2012

Facility
Lawrence Barn
28 Depot Road
Hollis, NH 03049

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

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

Year Built: 2006
Gross Floor Area (ft²): 3,909

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

Site Energy Use Summary[3]

Electricity - Grid Purchase(kBtu)	37,327
Propane (kBtu)	116,649
Natural Gas - (kBtu)[4]	0
Total Energy (kBtu)	153,976

Energy Intensity[4]

Site (kBtu/ft²/yr)	39
Source (kBtu/ft²/yr)	62

Emissions (based on site energy use)

Greenhouse Gas Emissions ($MtCO_2e$/year)	12

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

National Median Comparison

National Median Site EUI	43
National Median Source EUI	71
% Difference from National Median Source EUI	-13%
Building Type	Social/Meeting

Stamp of Certifying Professional

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

Meets Industry Standards[5] for Indoor Environmental Conditions:

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

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

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

ENERGY STAR® Data Checklist for Commercial Buildings

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

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

CRITERION	VALUE AS ENTERED IN PORTFOLIO MANAGER	VERIFICATION QUESTIONS	NOTES	☑
Building Name	Lawrence Barn	Is this the official building name to be displayed in the ENERGY STAR Registry of Labeled Buildings?		☐
Type	Social/Meeting	Is this an accurate description of the space in question?		☐
Location	28 Depot Road, 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.		☐

Lawrence Barn (Other)

CRITERION	VALUE AS ENTERED IN PORTFOLIO MANAGER	VERIFICATION QUESTIONS	NOTES	☑
Gross Floor Area	3,909 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	1(Optional)	Is this the number of personal computers in the space?		☐
Weekly operating hours	40Hours(Optional)	Is this the total number of hours per week that the space is 75% occupied? This number should exclude hours when the facility is occupied only by maintenance, security, or other support personnel. For facilities with a schedule that varies during the year, "operating hours/week" refers to the total weekly hours for the schedule most often followed.		☐
Workers on Main Shift	1(Optional)	Is this the number of employees present during the main shift? Note this is not the total number of employees or visitors who are in a building during an entire 24 hour period. For example, if there are two daily 8 hour shifts of 100 workers each, the Workers on Main Shift value is 100.		☐

Energy Consumption

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

Fuel Type: Electricity		
Meter: 56249551003 PSNH (kWh (thousand Watt-hours)) **Space(s):** Entire Facility **Generation Method:** Grid Purchase		
Start Date	**End Date**	**Energy Use (kWh (thousand Watt-hours))**
12/01/2011	12/31/2011	1,020.00
11/01/2011	11/30/2011	920.00
10/01/2011	10/31/2011	760.00
09/01/2011	09/30/2011	580.00
08/01/2011	08/31/2011	1,040.00
07/01/2011	07/31/2011	660.00
06/01/2011	06/30/2011	940.00
05/01/2011	05/31/2011	800.00
04/01/2011	04/30/2011	1,000.00
03/01/2011	03/31/2011	1,000.00
02/01/2011	02/28/2011	1,200.00
01/01/2011	01/31/2011	1,020.00
56249551003 PSNH Consumption (kWh (thousand Watt-hours))		**10,940.00**
56249551003 PSNH Consumption (kBtu (thousand Btu))		**37,327.28**
Total Electricity (Grid Purchase) Consumption (kBtu (thousand Btu))		**37,327.28**
Is this the total Electricity (Grid Purchase) consumption at this building including all Electricity meters?		☐

Fuel Type: Propane		
Meter: 81274 Propane (Gallons) **Space(s):** Entire Facility		
Start Date	**End Date**	**Energy Use (Gallons)**
12/01/2011	12/31/2011	298.10
11/01/2011	11/30/2011	143.80
10/01/2011	10/31/2011	0.00
09/01/2011	09/30/2011	0.00
08/01/2011	08/31/2011	0.00
07/01/2011	07/31/2011	0.00
06/01/2011	06/30/2011	0.00
05/01/2011	05/31/2011	24.70
04/01/2011	04/30/2011	228.90
03/01/2011	03/31/2011	141.80

02/01/2011	02/28/2011	435.50
01/01/2011	01/31/2011	0.00
81274 Propane Consumption (Gallons)		**1,272.80**
81274 Propane Consumption (kBtu (thousand Btu))		**116,649.07**
Total Propane Consumption (kBtu (thousand Btu))		**116,649.07**
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
Lawrence Barn
28 Depot Road
Hollis, NH 03049

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

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

General Information

Lawrence Barn	
Gross Floor Area Excluding Parking: (ft²)	3,909
Year Built	2006
For 12-month Evaluation Period Ending Date:	December 31, 2011

Facility Space Use Summary

Lawrence Barn	
Space Type	Other - Social/Meeting
Gross Floor Area(ft²)	3,909
Number of PCs°	1
Weekly operating hours°	40
Workers on Main Shift°	1

Energy Performance Comparison

	Evaluation Periods		Comparisons		
Performance Metrics	**Current** (Ending Date 12/31/2011)	**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)	39	54	0	N/A	43
Source (kBtu/ft²)	62	82	0	N/A	71
Energy Cost					
$/year	$ 5,111.17	$ 6,818.18	N/A	N/A	$ 5,579.60
$/ft²/year	$ 1.31	$ 1.74	N/A	N/A	$ 1.43
Greenhouse Gas Emissions					
$MtCO_2e$/year	12	16	0	N/A	13
$kgCO_2e/ft^2$/year	3	4	0	N/A	3

More than 50% of your building is defined as Social/Meeting. This building is currently ineligible for a rating. Please note the National Median column represents the CBECS national median data for Social/Meeting. This building uses 13% less energy per square foot than the CBECS national median for Social/Meeting.

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:	Lawrence Barn	Location:	Hollis, NH
Gross Area (sf):	3,909	Date:	3/26/2012
Use Category:	Social/Meeting	EUI (kBtu/sf/yr):	62
Heating Fuel(s):	Propane	PM Grade:	NA
Heating System(s):	Forced Hot Air	Cooling System(s):	Limited (DX Coils)

RE Technology	Score (out of 70 pts.)	Grade	Notes/Comments
Roof Photovoltaic	57.5	82%	Small system 5kw - 15kw.
Wind Turbine Generator	56.0	80%	Permit requirements are height dependent.
Ground Photovoltaic	55.5	79%	Small system 5kw - 15kw.
Solar DHW	54.0	77%	DHW demand should be confirmed.
Geothermal Heating/Cooling	54.0	77%	Closed-loop GSHP system.
Solar Thermal	50.5	72%	Medium-temperature system.
Biomass Heating	50.5	72%	Pellet feed system recommended.
Combined Heat & Power	46.0	66%	75kW system.

RENEWABLE ENERGY SCREENING WORKSHEET

Building/Facility: Lawrence Barn
Location: Hollis, NH
Gross Area (sf): 3,909
Date: 3/26/2012
Use Category: Social/Meeting
EUI (kBtu/sf/yr): 62
Heating Fuel(s): Propane
PM Grade: NA
Heating System(s): Forced Hot Air
Cooling System(s): Limited (DX Coils)

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	3.5	Expected service life of collector panels is 15 years.
3	Geographical considerations	3.5	Limited solar availability in New England.
4	Energy demand	4	Moderate grid electrical demand.
5	Facility/systems conditions	5	Ample amount of south facing roof space.
6	Facility/systems compatibility	5	Ample amount of south facing roof space; newer electrical system
7	Permitting constraints	3	Utility grid connection permit is long-lead and may require a designed/engineered system.
8	Abutter concerns	5	Along main road but not near residences.
9	Capital investment	3	High capital cost.
10	O&M requirements	3.5	Increased roof maintenance and panel replacement.
11	Financial incentives	3	Limited incentives in NH.
12	Owner initiatives	4.5	Owner is open to renewable options.
13	CO2e emissions	4.5	Electrical source energy in NH has lower than average CO2 emissions.
14	Public awareness/education	5	Moderately high public use facility, visible from high traffic volume road.
	Total Score:	**57.5**	
	Total Possible Score:	**70**	
	Grade:	**82%**	

RENEWABLE ENERGY SCREENING WORKSHEET

Building/Facility:	Lawrence Barn	Location:	Hollis, NH
Gross Area (sf):	3,909	Date:	3/26/2012
Use Category:	Social/Meeting	EUI (kBtu/sf/yr):	62
Heating Fuel(s):	Propane	PM Grade:	NA
Heating System(s):	Forced Hot Air	Cooling System(s):	Limited (DX Coils)

Technology: **Wind Turbine Generator**

No.	Criteria	Score (1-5 pts.)	Notes/Comments
1	Demonstrated technology	4.5	A well demonstrated technology but proper site selection is critical.
2	Expected service life/durability	4	Some turbine units have proven unreliable (design flaws). Selection of a reputable manufacturer is critical.
3	Geographical considerations	3.5	Limited wind energy but a feasibility study is required.
4	Energy demand	5	Electric energy consumption is high.
5	Facility/systems conditions	5	Newer building and electrical systems.
6	Facility/systems compatibility	5	Newer building and electrical systems.
7	Permitting constraints	3.5	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	2.5	Pole-mounted turbines have a large visual impact.
9	Capital investment	3.5	Moderate capital cost.
10	O&M requirements	3.5	Routine maintenance required. Units are subject to damage from elements.
11	Financial incentives	3	Limited incentives in NH.
12	Owner initiatives	4	Owner is 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:	**56**	
	Total Possible Score:	**70**	
	Grade:	**80%**	

RENEWABLE ENERGY SCREENING WORKSHEET

Building/Facility:	Lawrence Barn	Location:	Hollis, NH
Gross Area (sf):	3,909	Date:	3/26/2012
Use Category:	Social/Meeting	EUI (kBtu/sf/yr):	62
Heating Fuel(s):	Propane	PM Grade:	NA
Heating System(s):	Forced Hot Air	Cooling System(s):	Limited (DX Coils)

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	4	Moderate grid electrical demand.
5	Facility/systems conditions	5	Newer facility and systems.
6	Facility/systems compatibility	5	Multiple areas where system could be installed.
7	Permitting constraints	2.5	Utility grid connection permit is long-lead and may require a designed/engineered system.
8	Abutter concerns	4.5	Limited abutting properties.
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	4.5	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	Moderately high public use, visible from high traffic volume road..
	Total Score:	**55.5**	
	Total Possible Score:	**70**	
	Grade:	**79%**	

RENEWABLE ENERGY SCREENING WORKSHEET

Building/Facility:	Lawrence Barn	Location:	Hollis, NH
Gross Area (sf):	3,909	Date:	3/26/2012
Use Category:	Social/Meeting	EUI (kBtu/sf/yr):	62
Heating Fuel(s):	Propane	PM Grade:	NA
Heating System(s):	Forced Hot Air	Cooling System(s):	Limited (DX Coils)

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	50-gal. hot water tank currently installed.
6	Facility/systems compatibility	4	50-gal. hot water tank currently installed.
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	Moderate reduction of oil use based on DHW demand.
14	Public awareness/education	4.5	Moderately high public use, visible from high traffic volume road..
	Total Score:	**54**	
	Total Possible Score:	**70**	
	Grade:	**77%**	

RENEWABLE ENERGY SCREENING WORKSHEET

Building/Facility:	Lawrence Barn	Location:	Hollis, NH
Gross Area (sf):	3,909	Date:	3/26/2012
Use Category:	Social/Meeting	EUI (kBtu/sf/yr):	62
Heating Fuel(s):	Propane	PM Grade:	NA
Heating System(s):	Forced Hot Air	Cooling System(s):	Limited (DX Coils)

Technology: **Geothermal Heating & Cooling**

No.	Criteria	Score (1-5 pts.)	Notes/Comments
1	Demonstrated technology	4.5	Well demonstrated technology but does require engineering design.
2	Expected service life/durability	4.5	Well field and loop system has +50 year service life. Equipment has +20 yr service life.
3	Geographical considerations	4.5	Abundant geothermal energy reserves.
4	Energy demand	3	Heating and cooling energy consumption is low.
5	Facility/systems conditions	3.5	Existing system and spacial considerations are met. Low occupancy and small size make system more costly.
6	Facility/systems compatibility	3	Existing system and spacial considerations are met. Low occupancy and small size make system more costly.
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	2.5	High capital cost.
10	O&M requirements	4.5	Very low O&M except routine equipment maintenance.
11	Financial incentives	2.5	Limited incentives in NH.
12	Owner initiatives	4	Owner is open to renewable options.
13	CO2e emissions	3	The building currently uses a low amount of propane.
14	Public awareness/education	4.5	Moderately high public use. Information could be displayed in the building so users are aware of geothermal system.
	Total Score:	**54**	
	Total Possible Score:	**70**	
	Grade:	**77%**	

RENEWABLE ENERGY SCREENING WORKSHEET

Building/Facility:	Lawrence Barn	Location:	Hollis, NH
Gross Area (sf):	3,909	Date:	3/26/2012
Use Category:	Social/Meeting	EUI (kBtu/sf/yr):	62
Heating Fuel(s):	Propane	PM Grade:	NA
Heating System(s):	Forced Hot Air	Cooling System(s):	Limited (DX Coils)

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 years.
3	Geographical considerations	3	Limited solar availability in New England.
4	Energy demand	3.5	Heating and cooling moderate.
5	Facility/systems conditions	5	Existing mechanical system could be incorporated into system.
6	Facility/systems compatibility	4	Considerable space required but could be made available. Plumbing complex to protect against freezing.
7	Permitting constraints	2.5	Utility grid connection permit is long-lead and may require a designed/engineered system.
8	Abutter concerns	4.5	Limited abutting properties.
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 is NH has lower than average CO2 emissions.
14	Public awareness/education	5	Moderately high public use, visible from high traffic volume road..
	Total Score:	**50.5**	
	Total Possible Score:	**70**	
	Grade:	**72%**	

RENEWABLE ENERGY SCREENING WORKSHEET

Building/Facility:	Lawrence Barn	Location:	Hollis, NH
Gross Area (sf):	3,909	Date:	3/26/2012
Use Category:	Social/Meeting	EUI (kBtu/sf/yr):	62
Heating Fuel(s):	Propane	PM Grade:	NA
Heating System(s):	Forced Hot Air	Cooling System(s):	Limited (DX Coils)

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	3.5	Heating energy is low in the building.
5	Facility/systems conditions	3	Limited storage space for woodchips/pellets.
6	Facility/systems compatibility	3	Limited storage space 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	2.5	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 resources.
13	CO_2e emissions	3.5	Biomass does emit CO_2 but the net reduction from the oil system will be significant.
14	Public awareness/education	4	Moderately high public use. Information could be displayed in the building so users are aware of biomass heating system.
	Total Score:	**50.5**	
	Total Possible Score:	**70**	
	Grade:	**72%**	

RENEWABLE ENERGY SCREENING WORKSHEET

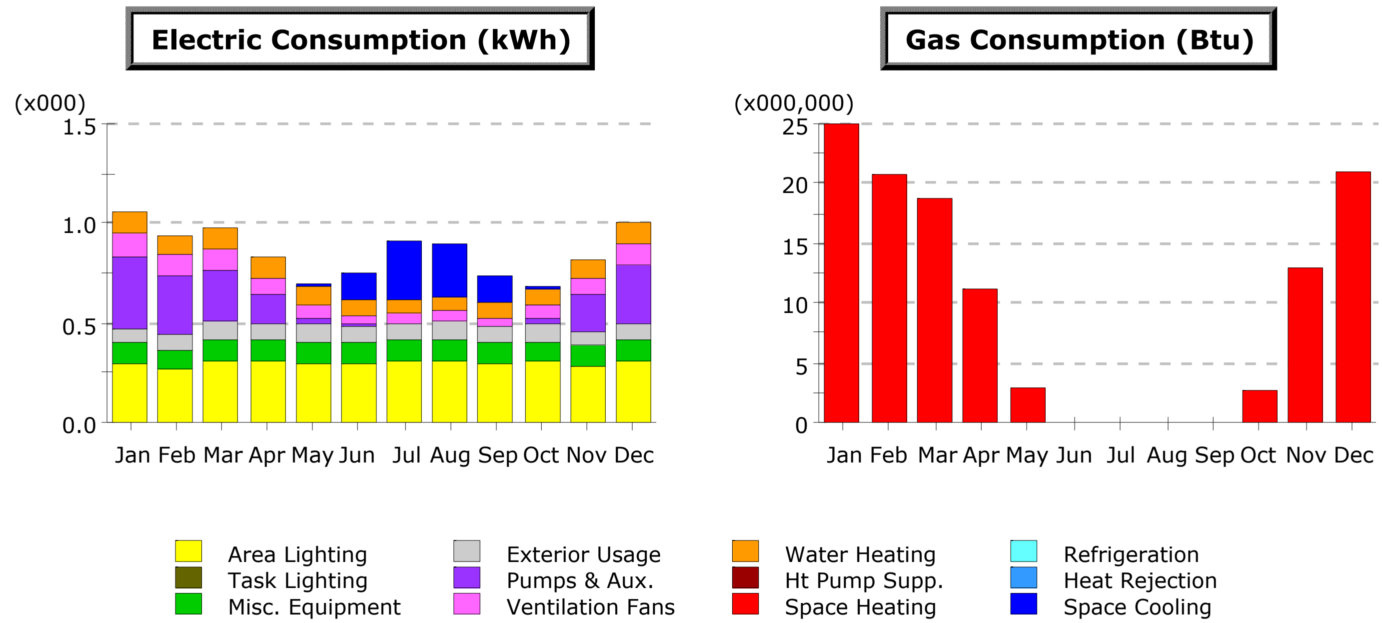
Building/Facility:	Lawrence Barn	Location:	Hollis, NH
Gross Area (sf):	3,909	Date:	3/26/2012
Use Category:	Social/Meeting	EUI (kBtu/sf/yr):	62
Heating Fuel(s):	Propane	PM Grade:	NA
Heating System(s):	Forced Hot Air	Cooling System(s):	Limited (DX Coils)

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	3.5	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 low.
5	Facility/systems conditions	5	Newer building and electrical system.
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	CO_2e emissions	1	CHPs consume a large amount of fuel and emissions relative to the re-used energy.
14	Public awareness/education	4.5	Moderately high public use. Information could be displayed in the building so users are aware of CHP system. However CHP is not entirely renewable.
	Total Score:	**46**	
	Total Possible Score:	**70**	
	Grade:	**66%**	

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	-	-	-	-	0.01	0.13	0.29	0.26	0.13	0.01	-	-	0.83
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	0.11	0.10	0.11	0.11	0.10	0.09	0.08	0.08	0.08	0.09	0.09	0.10	1.14
Vent. Fans	0.11	0.10	0.10	0.08	0.06	0.05	0.05	0.05	0.05	0.06	0.09	0.11	0.92
Pumps & Aux.	0.36	0.30	0.26	0.15	0.04	0.00	-	-	0.00	0.03	0.18	0.30	1.62
Ext. Usage	0.08	0.07	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.97
Misc. Equip.	0.10	0.10	0.11	0.11	0.11	0.11	0.11	0.11	0.10	0.11	0.10	0.11	1.27
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	0.29	0.27	0.31	0.30	0.30	0.30	0.30	0.31	0.29	0.30	0.28	0.30	3.57
Total	1.06	0.94	0.98	0.83	0.70	0.75	0.92	0.90	0.73	0.68	0.82	1.00	10.31

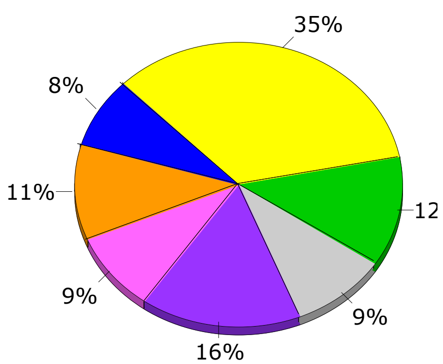
Gas Consumption (Btu x000,000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	24.94	20.85	18.80	11.13	2.97	0.07	-	-	0.06	2.59	13.02	20.93	115.36
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	24.94	20.85	18.80	11.13	2.97	0.07	-	-	0.06	2.59	13.02	20.93	115.36

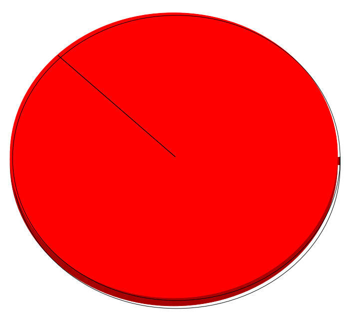
Annual Energy Consumption by Enduse

	Electricity kWh	Natural Gas MBtu	Steam Btu	Chilled Water Btu
Space Cool	834	-	-	-
Heat Reject.	-	-	-	-
Refrigeration	-	-	-	-
Space Heat	-	115.36	-	-
HP Supp.	-	-	-	-
Hot Water	1,136	-	-	-
Vent. Fans	918	-	-	-
Pumps & Aux.	1,616	-	-	-
Ext. Usage	968	-	-	-
Misc. Equip.	1,266	-	-	-
Task Lights	-	-	-	-
Area Lights	3,570	-	-	-
Total	10,309	115.36	-	-

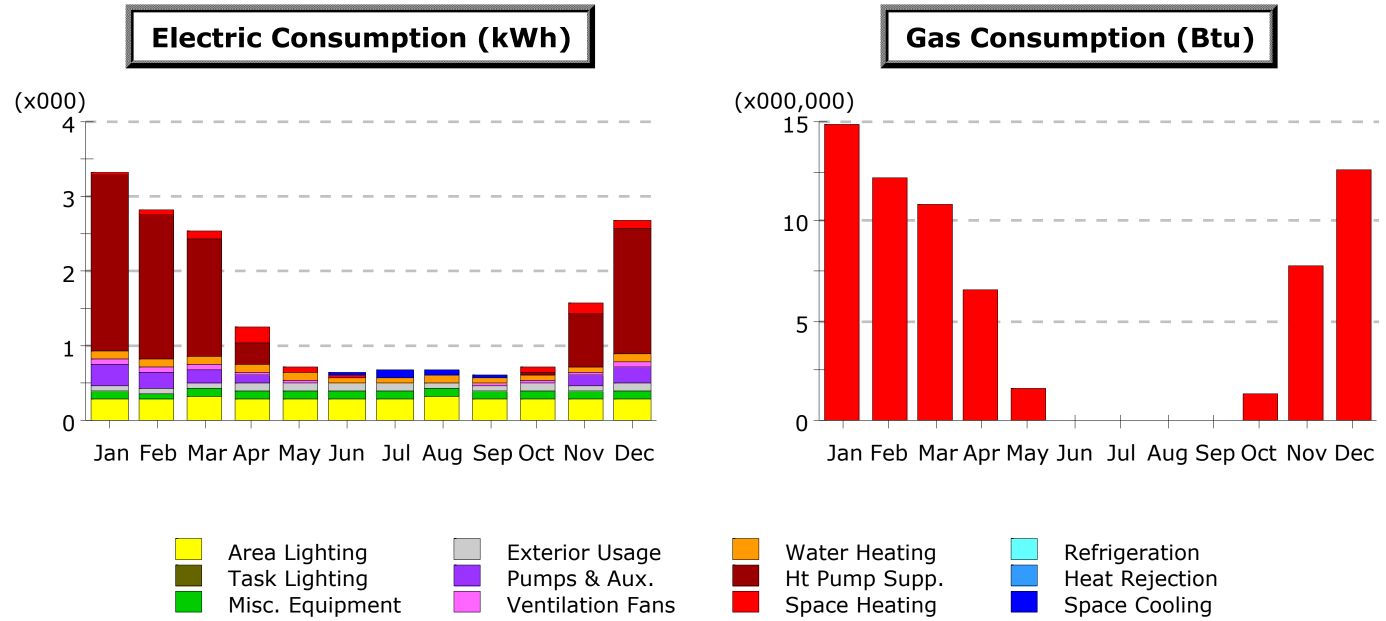
Area Lighting
Task Lighting
Misc. Equipment
Exterior Usage
Pumps & Aux.
Ventilation Fans
Water Heating
Ht Pump Supp.
Space Heating
Refrigeration
Heat Rejection
Space Cooling



Electricity



Natural Gas



Electric Consumption (kWh x000)

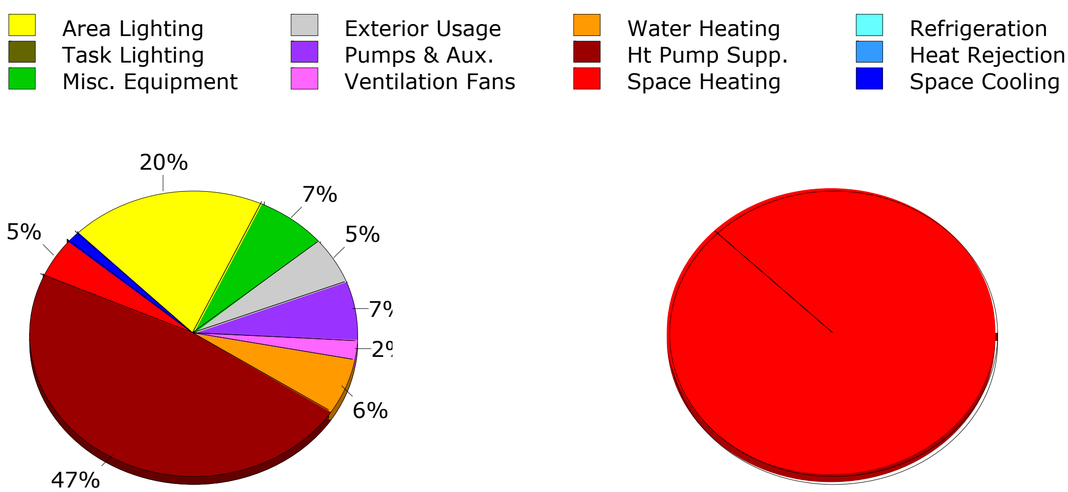
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	0.00	0.04	0.08	0.08	0.04	0.00	-	-	0.24
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	0.03	0.05	0.11	0.22	0.09	0.00	-	-	0.00	0.08	0.16	0.09	0.83
HP Supp.	2.36	1.95	1.58	0.30	0.00	-	-	-	-	0.01	0.69	1.71	8.60
Hot Water	0.11	0.10	0.11	0.11	0.10	0.09	0.08	0.08	0.08	0.09	0.09	0.10	1.14
Vent. Fans	0.06	0.05	0.05	0.04	0.02	0.01	0.01	0.01	0.01	0.02	0.04	0.06	0.39
Pumps & Aux.	0.26	0.22	0.19	0.11	0.03	0.00	-	-	0.00	0.02	0.13	0.22	1.18
Ext. Usage	0.08	0.07	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.97
Misc. Equip.	0.10	0.10	0.11	0.11	0.11	0.11	0.11	0.11	0.10	0.11	0.10	0.11	1.27
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	0.29	0.27	0.31	0.30	0.30	0.30	0.30	0.31	0.29	0.30	0.28	0.30	3.57
Total	3.31	2.81	2.55	1.26	0.73	0.63	0.67	0.67	0.61	0.70	1.58	2.67	18.18

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	14.83	12.19	10.84	6.50	1.62	0.02	-	-	0.02	1.40	7.82	12.58	67.81
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	14.83	12.19	10.84	6.50	1.62	0.02	-	-	0.02	1.40	7.82	12.58	67.81

Annual Energy Consumption by Enduse

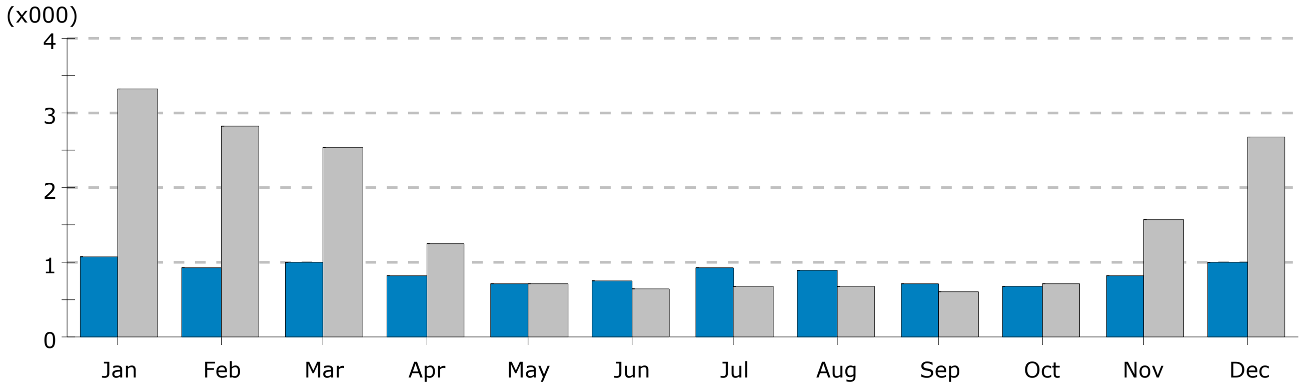
	Electricity kWh	Natural Gas Btu (x000)	Steam Btu	Chilled Water Btu
Space Cool	239	-	-	-
Heat Reject.	-	-	-	-
Refrigeration	-	-	-	-
Space Heat	825	67,812	-	-
HP Supp.	8,602	-	-	-
Hot Water	1,137	-	-	-
Vent. Fans	392	-	-	-
Pumps & Aux.	1,184	-	-	-
Ext. Usage	968	-	-	-
Misc. Equip.	1,266	-	-	-
Task Lights	-	-	-	-
Area Lights	3,570	-	-	-
Total	18,183	67,812	-	-



Electricity

Natural Gas

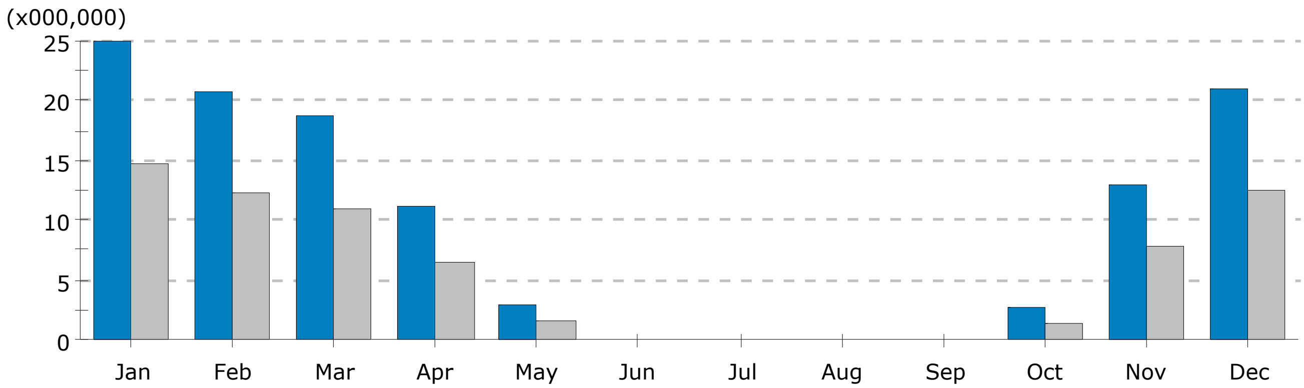
Electric Consumption (kWh)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Run 1.	1.06	0.94	0.98	0.83	0.70	0.75	0.92	0.90	0.73	0.68	0.82	1.00	10.31
Run 2.	3.31	2.81	2.55	1.26	0.73	0.63	0.67	0.67	0.61	0.70	1.58	2.67	18.18
Run 3.													
Run 4.													
Run 5.													

1. Lawrence Barn - Baseline Design (03/26/12 @ 10:34)
2. Lawrence Barn Heat Pumps - Baseline Design (03/26/12 @ 10:41)

Gas Consumption (Btu)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Run 1.	24.94	20.85	18.80	11.13	2.97	0.07	-	-	0.06	2.59	13.02	20.93	115.36
Run 2.	14.83	12.19	10.84	6.50	1.62	0.02	-	-	0.02	1.40	7.82	12.58	67.81
Run 3.													
Run 4.													
Run 5.													

APPENDIX J

Cost Estimates

BUDGETARY COST ESTIMATE

Facility: **Lawrence Barn**

Date: **3/27/2012**

EEM	Design + Engineering	Installed Cost				Construction Management	Contingency (15%)	Total Investment
		Pricing Unit	Price	Qty	Subtotal			
Replace the existing DHW boiler with tankless gas unit	$ 100	EA	$ 800	1	**$ 800**	$ 80	$ 147	**$1,127**
Install a remote web-based building controls system to control lights, temperature and door entry.	$ 200	EA	$ 1,800	1	**$ 1,800**	$ 180	$ 327	**$2,507**
Replace exterior halogen lights with LED lights.	-	EA	$ 200	4	**$ 800**	$ 80	$ 132	**$1,012**
Add two (2) inches of foil faced polyisocyanurate to the ceiling and walls of the furnace loft. Tape all seams	-	SQFT	$ 3.50	630	**$ 2,205**	$ 221	$ 364	**$2,789**
Install a high-efficiency electric air-source heat pump with web-based controls and an interlocked energy recovery ventilation system.	$ 1,750	EA	$ 24,700	1	**$ 24,700**	$ 2,470	$ 4,338	**$33,258**