Comprehensive Energy Audit
For
Nulato Tribal Office

Prepared For

Nulato Tribal Council

October 28, 2011

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PREFACE

The Energy Projects Group at the Alaska Native Tribal Health Consortium (ANTHC) prepared this document for the Nulato Tribal Council. The authors of this report are Carl H. Remley, Certified Energy Auditor (CEA) and Certified Energy Manager (CEM) and Gavin Dixon.

The purpose of this report is to provide a comprehensive document that summarizes the findings and analysis that resulted from an energy audit conducted over the past couple months by the Energy Projects Group of ANTHC. This report analyzes historical energy use and identifies costs and savings of recommended energy efficiency measures. Discussions of site specific concerns and an Energy Efficiency Action Plan are also included in this report.

ACKNOWLEDGMENTS

The Energy Projects Group gratefully acknowledges the assistance of the staff at the Nulato Tribal Council.

1. EXECUTIVE SUMMARY

This report was prepared for the Nulato Tribal Council. The scope of the audit focused on Nulato Tribal Office. The scope of this report is a comprehensive energy study, which included an analysis of building shell, interior and exterior lighting systems, HVAC systems, and plug loads.

Based on electricity and fuel oil prices in effect at the time of the audit, the annual predicted energy costs for the buildings analyzed are $2,180 for Electricity, $4,962 for #1 Oil and total energy costs of $7,142 per year.

It should be noted that this facility received the power cost equalization (PCE) subsidy from the state of Alaska last year. If this facility had not received PCE, electricity costs would have been $5,622, fuel costs would have been $4,962, and total energy costs would have been $10,584.

Table 1.1 below summarizes the energy efficiency measures analyzed for the Nulato Tribal Office. Listed are the estimates of the annual savings, installed costs, and two different financial measures of investment return.

Table 1.1
PRIORITY LIST – ENERGY EFFICIENCY MEASURES

Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR[1]	Simple Payback (Years)[2]
1	Setback Thermostat: Upstairs Offices	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Upstairs Offices space.	$804	$25	481.59	0.0
2	Setback Thermostat: Front Offices	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Front Offices space.	$168	$25	100.60	0.1
3	Other Electrical: Computers and Monitors	Improve Manual Switching	$21	$25	4.33	1.2
4	Other Electrical: Printers	Improve Manual Switching	$21	$25	4.15	1.2
5	Air Tightening	Perform air sealing to reduce air leakage by 27 cfm at 50 Pascals.	$26	$150	1.80	5.7
6	Other Electrical: Coffee Pot	Replace with Mr. Coffee Pot with Thermos and Improve Other Controls	$18	$55	1.78	3.1
7	Lighting: Exterior Lighting	Replace with 2 LED 20W Module Electronic	$110	$500	1.40	4.6
	TOTAL, all measures		**$1,167**	**$805**	**19.67**	**0.7**

Table Notes:

[1] Savings to Investment Ratio (SIR) is a life-cycle cost measure calculated by dividing the total savings over the life of a project (expressed in today's dollars) by its investment costs. The SIR is

an indication of the profitability of a measure; the higher the SIR, the more profitable the project. An SIR greater than 1.0 indicates a cost-effective project (i.e. more savings than cost). Remember that this profitability is based on the position of that Energy Efficiency Measure (EEM) in the overall list and assumes that the measures above it are implemented first.

[2] Simple Payback (SP) is a measure of the length of time required for the savings from an EEM to payback the investment cost, not counting interest on the investment and any future changes in energy prices. It is calculated by dividing the investment cost by the expected first-year savings of the EEM.

With all of these energy efficiency measures in place, the annual utility cost can be reduced by $1,167 per year, or 16.3% of the buildings' total energy costs. These measures are estimated to cost $805, for an overall simple payback period of 0.7 years.

Table 1.2 below is a breakdown of the annual energy cost across various energy end use types, such as Space Heating and Water Heating. The first row in the table shows the breakdown for the building as it is now. The second row shows the expected breakdown of energy cost for the building assuming all of the retrofits in this report are implemented. Finally, the last row shows the annual energy savings that will be achieved from the retrofits.

Table 1.2
Annual Energy Cost Estimate

Description	Space Heating	Space Cooling	Water Heating	Lighting	Other Electrical	Cooking	Clothes Drying	Ventilation Fans	Service Fees	Total Cost
Existing Building	$5,030	$0	$74	$1,385	$594	$0	$0	$0	$0	**$7,142**
With All Proposed Retrofits	$4,119	$0	$74	$1,275	$447	$0	$0	$0	$0	**$5,975**
SAVINGS	$911	$0	$0	$110	$147	$0	$0	$0	$0	**$1,167**

2. AUDIT AND ANALYSIS BACKGROUND

2.1 Program Description

This audit included services to identify, develop, and evaluate energy efficiency measures at the Nulato Tribal Office. The scope of this project included evaluating building shell, lighting and other electrical systems, and HVAC equipment, motors and pumps. Measures were analyzed based on life-cycle-cost techniques, which include the initial cost of the equipment, life of the equipment, annual energy cost, annual maintenance cost, and a discount rate of 3.0%/year in excess of general inflation.

2.2 Audit Description

Preliminary audit information was gathered in preparation for the site survey. The site survey provides critical information in deciphering where energy is used and what opportunities exist within a building. The entire site was surveyed to inventory the following to gain an understanding of how each building operates:

- Building envelope (roof, windows, etc.)
- Heating, ventilation, and air conditioning equipment (HVAC)
- Lighting systems and controls
- Building-specific equipment

The building site visit was performed to survey all major building components and systems. The site visit included detailed inspection of energy consuming components. Summary of building occupancy schedules, operating and maintenance practices, and energy management programs provided by the building manager were collected along with the system and components to determine a more accurate impact on energy consumption.

Details collected from Nulato Tribal Office enable a model of the building's energy usage to be developed, highlighting the building's total energy consumption, energy consumption by specific building component, and equivalent energy cost. The analysis involves distinguishing the different fuels used on site, and analyzing their consumption in different activity areas of the building.

Nulato Tribal Office is classified as being made up of the following activity areas:

1) Front Offices: 522 square feet
2) Upstairs Offices: 1,798 square feet

In addition, the methodology involves taking into account a wide range of factors specific to the building. These factors are used in the construction of the model of energy used. The factors include:

- Occupancy hours
- Local climate conditions
- Prices paid for energy

2.3. Method of Analysis

Data collected was processed using AkWarm© Energy Use Software to estimate energy savings for each of the proposed energy efficiency measures (EEMs). The recommendations focus on the building envelope; HVAC; lighting, plug load, and other electrical improvements; and motor and pump systems that will reduce annual energy consumption.

EEMs are evaluated based on building use and processes, local climate conditions, building construction type, function, operational schedule, existing conditions, and foreseen future plans. Energy savings are calculated based on industry standard methods and engineering estimations.

Our analysis provides a number of tools for assessing the cost effectiveness of various improvement options. These tools utilize **Life-Cycle Costing**, which is defined in this context as a method of cost analysis that estimates the total cost of a project over the period of time that includes both the construction cost and ongoing maintenance and operating costs.

Savings to Investment Ratio (SIR) = **Savings** divided by **Investment**

Savings includes the total discounted dollar savings considered over the life of the improvement. When these savings are added up, changes in future fuel prices as projected by the Department of Energy are included. Future savings are discounted to the present to account for the time-value of money (i.e. money's ability to earn interest over time). The **Investment** in the SIR calculation includes the labor and materials required to install the measure. An SIR value of at least 1.0 indicates that the project is cost-effective—total savings exceed the investment costs.

Simple payback is a cost analysis method whereby the investment cost of a project is divided by the first year's savings of the project to give the number of years required to recover the cost of the investment. This may be compared to the expected time before replacement of the system or component will be required. For example, if a boiler costs $12,000 and results in a savings of $1,000 in the first year, the payback time is 12 years. If the boiler has an expected life to replacement of 10 years, it would not be financially viable to make the investment since the payback period of 12 years is greater than the project life.

The Simple Payback calculation does not consider likely increases in future annual savings due to energy price increases. As an offsetting simplification, simple payback does not consider the need to earn interest on the investment (i.e. it does not consider the time-value of money). Because of these simplifications, the SIR figure is considered to be a better financial investment indicator than the Simple Payback measure.

Measures are implemented in order of cost-effectiveness. The program first calculates individual SIRs, and ranks all measures by SIR, higher SIRs at the top of the list. An individual measure must have an individual SIR>=1 to make the cut. Next the building is modified and re-simulated with the highest ranked measure included. Now all remaining measures are re-evaluated and ranked, and the next most cost-effective measure is implemented. AkWarm goes through this iterative process until all appropriate measures have been evaluated and installed.

It is important to note that the savings for each recommendation is calculated based on implementing the most cost effective measure first, and then cycling through the list to find the next most cost effective measure. Implementation of more than one EEM often affects the savings of other EEMs. The savings may in some cases be relatively higher if an individual EEM is implemented in lieu of multiple recommended EEMs. For example implementing a reduced operating schedule for inefficient lighting will result in relatively high savings. Implementing a reduced operating schedule for newly installed efficient lighting will result in lower relative savings, because the efficient lighting system uses less energy during each hour of operation. If multiple EEM's are recommended to be implemented, AkWarm calculates the combined savings appropriately.

Cost savings are calculated based on estimated initial costs for each measure. Installation costs include labor and equipment to estimate the full up-front investment required to implement a change. Costs are derived from Means Cost Data, industry publications, and local contractors and equipment suppliers.

2.4 Limitations of Study

All results are dependent on the quality of input data provided, and can only act as an approximation. In some instances, several methods may achieve the identified savings. This report is not intended as a final design document. The design professional or other persons following the recommendations shall accept responsibility and liability for the results.

3. Nulato Tribal Office

3.1. Building Description

The 2,320 square foot Nulato Tribal Office was constructed in 1976, with a normal occupancy of eight people. The number of hours of operation for this building average eight and a half hours per day, five days a week.

Description of Building Shell

The exterior walls are 2x6 construction with fewer than six inches of batt insulation.

The roof over the downstairs portion of the facility is a warm roof with three and a half inches of batt insulation. The roof over the upstairs portion of the facility is a cold roof with over three inches of batt insulation. Insulation could be higher, but we were unable to access the ceiling and attic to evaluate it. There may potentially be rough leaks that damage the insulation over the course of the year reducing much thicker insulations R-value.

The floor of the building is construction on pilings with over three inches off batt insulation.

Typical windows throughout the building are new operable double paned vinyl windows with tight seals.

Doors metal urethane with no thermal breaks.

Description of Heating and Cooling Plants

The Heating Plants used in the building are:

Monitor MPI 2400

Fuel Type:	#1 Oil
Input Rating:	43,000 BTU/hr
Steady State Efficiency:	93 %
Idle Loss:	1.5 %

Heat Distribution Type:	Air

Monitor MPI 2400

Fuel Type:	#1 Oil
Input Rating:	43,000 BTU/hr
Steady State Efficiency:	93 %
Idle Loss:	1.5 %
Heat Distribution Type:	Air

Water Heater

Fuel Type:	Electricity
Input Rating:	0 BTU/hr
Steady State Efficiency:	100 %
Idle Loss:	1.5 %
Heat Distribution Type:	Water
Boiler Operation:	All Year

The Cooling Plants used in the building are:

In Window Ari Conditioner

Cooling Capacity:	0.8 Tons
Cooling Distribution Type:	Air
Seasonal Efficiency, SEER:	60.00

Space Heating and Cooling Distribution Systems

Heat is supplied in the building solely by two Monitor MPI 2400 heating stoves set to 72 degrees. Cooling is provided for about one month per year in the summer time by a window air conditioner.

Domestic Hot Water System

Domestic Hot water is supplied by an electric how water heater in the bathroom. Hot water is used solely for washing hands and a little for supplying the coffee pot with warm water in the morning.

Lighting

The building is lit primarily by 21 magnetic T8 fluorescent ballasts with four 32 watt bulbs each. Exterior lighting is made up of two 70 watt metal halide fixtures.

Plug Loads

Plug loads are the second largest electrical load in the building and include 14 computers and monitors, eight printers and fax machines, and one coffee pot.

Major Equipment

The water circulation Pump for the facility is used only in the winter and is a Grundfos UP15-42 SF Circulation Pump.

3.2 Predicted Energy Use

3.2.1 Energy Usage / Tariffs

The electric usage profile charts (below) represents the predicted electrical usage for the building. If actual electricity usage records were available, the model used to predict usage was calibrated to approximately match actual usage. The electric utility measures consumption in kilowatt-hours (kWh) and maximum demand in kilowatts (kW). One kWh usage is equivalent to 1,000 watts running for one hour.

The fuel oil usage profile shows the fuel oil usage for the building. Fuel oil consumption is measured in gallons. One gallon of #1 Fuel Oil provides approximately 132,000 BTUs of energy.

The following is a list of the utility companies providing energy to the building and the class of service provided:

Electricity: AVEC-Nulato - Commercial - Sm

The average cost for each type of fuel used in this building is shown below in Table 3.1. This figure includes all surcharges, subsidies, and utility customer charges:

Table 3.1 – Average Energy Cost

Description	Average Energy Cost
Electricity	$ 0.19/kWh
#1 Oil	$ 4.97/gallons

3.2.1.1 Total Energy Use and Cost Breakdown

At current rates, Nulato Tribal Council pays approximately $7,142 annually for electricity and other fuel costs for the Nulato Tribal Office.

Figure 3.1 below reflects the estimated distribution of costs across the primary end uses of energy based on the AkWarm© computer simulation. Comparing the “Retrofit” bar in the figure to the “Existing” bar shows the potential savings from implementing all of the energy efficiency measures shown in this report.

Figure 3.1
Annual Energy Costs by End Use

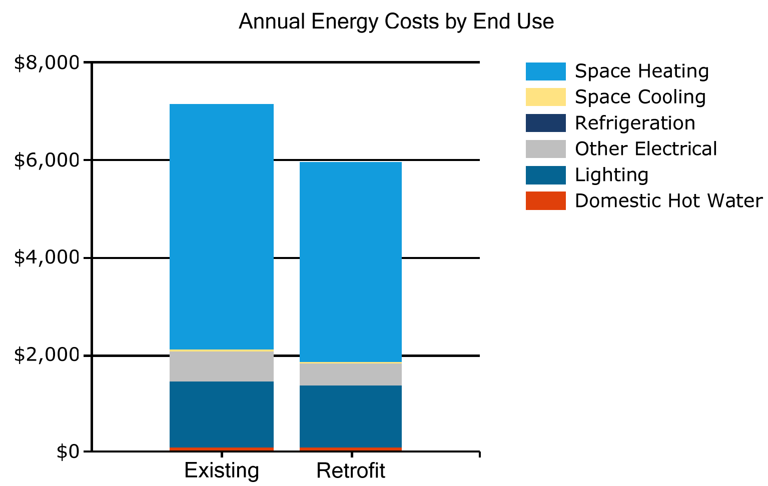


Figure 3.2 below shows how the annual energy cost of the building splits between the different fuels used by the building. The "Existing" bar shows the breakdown for the building as it is now; the "Retrofit" bar shows the predicted costs if all of the energy efficiency measures in this report are implemented.

Figure 3.2
Annual Energy Costs by Fuel Type

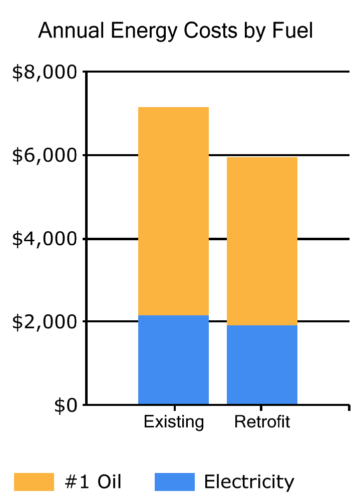
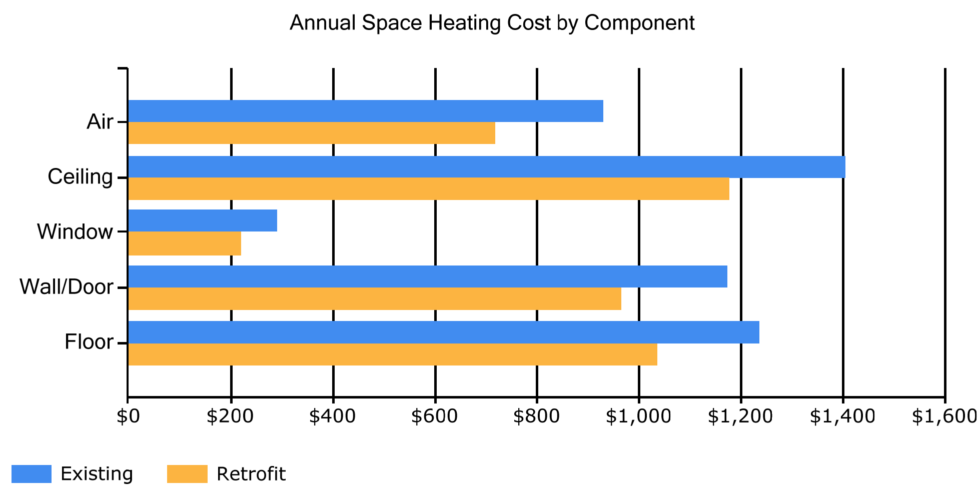


Figure 3.3 below addresses only Space Heating costs. The figure shows how each heat loss component contributes to those costs; for example, the figure shows how much annual space heating cost is caused by the heat loss through the Walls/Doors. For each component, the space heating cost for the Existing building is shown (blue bar) and the space heating cost assuming all retrofits are implemented (yellow bar) are shown.

Figure 3.3
Annual Space Heating Cost by Component



The tables below show AkWarm's estimate of the monthly fuel use for each of the fuels used in the building. For each fuel, the fuel use is broken down across the energy end uses. Note, in the tables below "DHW" refers to Domestic Hot Water heating.

Electrical Consumption (kWh)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Lighting	642	585	642	621	588	567	586	586	567	642	621	642
Refrigeration	26	24	26	26	26	26	26	26	26	26	26	26
Other_Electrical	292	266	292	282	230	221	228	228	221	292	282	292
Ventilation_Fans	0	0	0	0	0	0	0	0	0	0	0	0
DHW	33	30	33	32	33	32	33	33	32	33	32	33
Space_Heating	45	42	43	32	22	16	14	15	19	29	37	46
Space_Cooling	0	0	0	0	0	0	2	0	0	0	0	0

Fuel Oil #1 Consumption (Gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
DHW	0	0	0	0	0	0	0	0	0	0	0	0
Space_Heating	134	125	126	92	55	35	29	32	47	79	106	137

3.2.2 Energy Use Index (EUI)

Energy Use Index (EUI) is a measure of a building's annual energy utilization per square foot of building. This calculation is completed by converting all utility usage consumed by a building for one year, to British Thermal Units (Btu) or kBtu, and dividing this number by the building square footage. EUI is a good measure of a building's energy use and is utilized regularly for comparison of energy performance for similar building types. The Oak Ridge National Laboratory (ORNL) Buildings Technology Center under a contract with the U.S. Department of Energy maintains a Benchmarking Building Energy Performance Program. The ORNL website determines how a building's energy use compares with similar facilities throughout the U.S. and in a specific region or state.

Source use differs from site usage when comparing a building's energy consumption with the national average. Site energy use is the energy consumed by the building at the building site only. Source energy use includes the site energy use as well as all of the losses to create and distribute the energy to the building. Source energy represents the total amount of raw fuel that is required to operate the building. It incorporates all transmission, delivery, and production losses, which allows for a complete assessment of energy efficiency in a building. The type of utility purchased has a substantial impact on the source energy use of a building. The EPA has determined that source energy is the most comparable unit for evaluation purposes and overall global impact. Both the site and source EUI ratings for the building are provided to understand and compare the differences in energy use.
The site and source EUIs for this building are calculated as follows. (See Table 3.4 for details):

Building Site EUI = *(Electric Usage in kBtu + Fuel Oil Usage in kBtu + similar for other fuels)* / *Building Square Footage*

Building Source EUI = *(Electric Usage in kBtu X SS Ratio + Fuel Oil Usage in kBtu X SS Ratio + similar for other fuels)* / *Building Square Footage*

where "SS Ratio" is the Source Energy to Site Energy ratio for the particular fuel.

Table 3.4
Nulato Tribal Office EUI Calculations

Energy Type	Building Fuel Use per Year	Site Energy Use per Year, kBTU	Source/Site Ratio	Source Energy Use per Year, kBTU
Electricity	11,474 kWh	39,159	3.340	130,792
#1 Oil	998 gallons	131,796	1.010	133,113
Total		**170,955**		**263,906**
BUILDING AREA		2,320	Square Feet	
BUILDING SITE EUI		74	$kBTU/Ft^2/Yr$	
BUILDING SOURCE EUI		114	**$kBTU/Ft^2/Yr$**	
* Site - Source Ratio data is provided by the Energy Star Performance Rating Methodology for Incorporating Source Energy Use document issued March 2011.				

3.3 AkWarm© Building Simulation

An accurate model of the building performance can be created by simulating the thermal performance of the walls, roof, windows and floors of the building. The HVAC system and central plant are modeled as well, accounting for the outside air ventilation required by the building and the heat recovery equipment in place.

The model uses local weather data and is trued up to historical energy use to ensure its accuracy. The model can be used now and in the future to measure the utility bill impact of all types of energy projects, including improving building insulation, modifying glazing, changing air handler schedules, increasing heat recovery, installing high efficiency boilers, using variable air volume air handlers, adjusting outside air ventilation and adding cogeneration systems.

For the purposes of this study, the Nulato Tribal Office was modeled using AkWarm© energy use software to establish a baseline space heating and cooling energy usage. Climate data from Nulato was used for analysis. From this, the model was be calibrated to predict the impact of theoretical energy savings measures. Once annual energy savings from a particular measure were predicted and the initial capital cost was estimated, payback scenarios were approximated. Equipment cost estimate calculations are provided in Appendix D.

Limitations of AkWarm© Models

• The model is based on typical mean year weather data for Nulato. This data represents the average ambient weather profile as observed over approximately 30 years. As such, the gas and electric profiles generated will not likely compare perfectly with actual energy billing information from any single year. This is especially true for years with extreme warm or cold periods, or even years with unexpectedly moderate weather.
• The heating and cooling load model is a simple two-zone model consisting of the building's core interior spaces and the building's perimeter spaces. This simplified approach loses accuracy for buildings that have large variations in cooling/heating loads across different parts of the building.
• The model does not model HVAC systems that simultaneously provide both heating and cooling to the same building space (typically done as a means of providing temperature control in the space).

The energy balances shown in Section 3.1 were derived from the output generated by the AkWarm© simulations.

4. ENERGY COST SAVING MEASURES

4.1 Summary of Results

The energy saving measures are summarized in Table 4.1. Please refer to the individual measure descriptions later in this report for more detail. Calculations and cost estimates for analyzed measures are provided in Appendix C.

Table 4.1
Nulato Tribal Office, Nulato, Alaska
PRIORITY LIST – ENERGY EFFICIENCY MEASURES

Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR	Simple Payback (Years)
1	Setback Thermostat: Upstairs Offices	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Upstairs Offices space.	$804	$25	481.59	0.0
2	Setback Thermostat: Front Offices	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Front Offices space.	$168	$25	100.60	0.1
3	Other Electrical: Computers and Monitors	Improve Manual Switching	$21	$25	4.33	1.2

Table 4.1 Nulato Tribal Office, Nulato, Alaska PRIORITY LIST – ENERGY EFFICIENCY MEASURES						
Rank	**Feature**	**Improvement Description**	**Annual Energy Savings**	**Installed Cost**	**Savings to Investment Ratio, SIR**	**Simple Payback (Years)**
4	Other Electrical: Printers	Improve Manual Switching	$21	$25	4.15	1.2
5	Air Tightening	Perform air sealing to reduce air leakage by 27 cfm at 50 Pascals.	$26	$150	1.80	5.7
6	Other Electrical: Coffee Pot	Replace with Mr. Coffee Pot with Thermos and Improve Other Controls	$18	$55	1.78	3.1
7	Lighting: Exterior Lighting	Replace with 2 LED 20W Module Electronic	$110	$500	1.40	4.6
	TOTAL, all measures		**$1,167**	**$805**	**19.67**	**0.7**

4.2 Interactive Effects of Projects

The savings for a particular measure are calculated assuming all recommended EEMs coming before that measure in the list are implemented. If some EEMs are not implemented, savings for the remaining EEMs will be affected. For example, if ceiling insulation is not added, then savings from a project to replace the heating system will be increased, because the heating system for the building supplies a larger load.

In general, all projects are evaluated sequentially so energy savings associated with one EEM would not also be attributed to another EEM. By modeling the recommended project sequentially, the analysis accounts for interactive affects among the EEMs and does not “double count” savings.

Interior lighting, plug loads, facility equipment, and occupants generate heat within the building. When the building is in cooling mode, these items contribute to the overall cooling demands of the building; therefore, lighting efficiency improvements will reduce cooling requirements in air-conditioned buildings. Conversely, lighting-efficiency improvements are anticipated to slightly increase heating requirements. Heating penalties and cooling benefits were included in the lighting project analysis.

4.3 Building Shell Measures

4.3.1 Air Sealing Measures

Rank	**Location**	**Existing Air Leakage Level (cfm@50/75 Pa)**		**Recommended Air Leakage Reduction (cfm@50/75 Pa)**	
5		Air Tightness from Blower Door Test: 827 cfm at 50 Pascals		Perform air sealing to reduce air leakage by 27 cfm at 50 Pascals.	
Installation Cost	$150	**Estimated Life of Measure (yrs)**	10	**Energy Savings (/yr)**	$26
Breakeven Cost	$270	**Savings-to-Investment Ratio**	1.8	**Simple Payback yrs**	6
Auditors Notes: New weather stripping for doors and caulking around leaky windows downstairs will reduce air leakage.					

4.4 Mechanical Equipment Measures

4.4.1Night Setback Thermostat Measures

Rank	Building Space			Recommendation	
2	Front Offices			Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Front Offices space.	
Installation Cost	$25	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$168
Breakeven Cost	$2,515	**Savings-to-Investment Ratio**	100.6	**Simple Payback yrs**	0
Auditors Notes: Using the temperature setback capabilities of the monitor to reduce the heating level of the building to 60 degrees when the facility is unoccupied would be a significant fuel savings. There is no reason to keep the facility heated to comfortable levels when there is no one in the facility, such as on weekends, and at night. These settings would ensure that the building is heated to a comfortable level by the time people arrive in the morning. Please see the monitor information manual or check online for instructions.					

Rank	Building Space			Recommendation	
1	Upstairs Offices			Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Upstairs Offices space.	
Installation Cost	$25	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$804
Breakeven Cost	$12,040	**Savings-to-Investment Ratio**	481.6	**Simple Payback yrs**	0
Auditors Notes: Using the temperature setback capabilities of the monitor to reduce the heating level of the building to 60 degrees when the facility is unoccupied would be a significant fuel savings. There is no reason to keep the facility heated to comfortable levels when there is no one in the facility, such as on weekends, and at night. These settings would ensure that the building is heated to a comfortable level by the time people arrive in the morning. Please see the monitor information manual or check online for instructions.					

4.5 Electrical & Appliance Measures

4.5.1 Lighting Measures

The goal of this section is to present any lighting energy conservation measures that may also be cost beneficial. It should be noted that replacing current bulbs with more energy-efficient equivalents will have a small effect on the building heating and cooling loads. The building cooling load will see a small decrease from an upgrade to more efficient bulbs and the heating load will see a small increase, as the more energy efficient bulbs give off less heat.

4.5.1a Lighting Measures – Replace Existing Fixtures/Bulbs

Rank	Location	Existing Condition		Recommendation	
7	Exterior Lighting	2 MH 70 Watt Magnetic with Manual Switching		Replace with 2 LED 20W Module Electronic	
Installation Cost	$500	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$110
Breakeven Cost	$700	**Savings-to-Investment Ratio**	1.4	**Simple Payback yrs**	5
Auditors Notes: Replacing current 70 watt metal halide fixtures with LED wall packs would use significantly less energy, reduce maintenance of replacing bulbs and improve performance of exterior lighting in the cold.					

4.5.2 Other Electrical Measures

Rank	Location		Description of Existing		Efficiency Recommendation	
6	Coffee Pot		"" Coffee Pot with Manual Switching, Other Controls		Replace with Mr. Coffee Pot with Thermos and Improve Other Controls	
Installation Cost		$55	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$18
Breakeven Cost		$98	**Savings-to-Investment Ratio**	1.8	**Simple Payback yrs**	3
Auditors Notes: The current coffee pot is a heavy user of electricity. By replacing the current coffee pot with a smaller single pot brewing system, and then storing the brewed coffee in an insulated thermos for consumption throughout the day, electricity could be saved.						

Rank	Location		Description of Existing		Efficiency Recommendation	
4	Printers		8 Printers and Fax Machines with Manual Switching		Improve Manual Switching	
Installation Cost		$25	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$21
Breakeven Cost		$104	**Savings-to-Investment Ratio**	4.2	**Simple Payback yrs**	1
Auditors Notes: Shutting down or unplugging all printers at night would reduce electrical loads when the machines are not being used. This could be done with a power strip, or by simple device shut down.						

Rank	Location		Description of Existing		Efficiency Recommendation	
3	Computers and Monitors		14 Computers and Monitors with Manual Switching		Improve Manual Switching	
Installation Cost		$25	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$21
Breakeven Cost		$108	**Savings-to-Investment Ratio**	4.3	**Simple Payback yrs**	1
Auditors Notes: Computers and Monitors should be shut down at night to minimize electrical use. There is no damage done to the machine to shut it down completely or set it to hibernate. Energy management software on the computer can be used to set the computer to shut down automatically after it has been unused for a certain period of time, such as half an hour.						

5. ENERGY EFFICIENCY ACTION PLAN

Through inspection of the energy-using equipment on-site and discussions with site facilities personnel, this energy audit has identified several energy-saving measures. The measures will reduce the amount of fuel burned and electricity used at the site. The projects will not degrade the performance of the building and, in some cases, will improve it.

Several types of EEMs can be implemented immediately by building staff, and others will require various amounts of lead time for engineering and equipment acquisition. In some cases, there are logical advantages to implementing EEMs concurrently. For example, if the same electrical contractor is used to install both lighting equipment and motors, implementation of these measures should be scheduled to occur simultaneously.

Appendix A – Listing of Energy Conservation and Renewable Energy Websites

Lighting
Illumination Engineering Society - http://www.iesna.org/

Energy Star Compact Fluorescent Lighting Program - www.energystar.gov/index.cfm?c=cfls.pr_cfls

DOE Solid State Lighting Program - http://www1.eere.energy.gov/buildings/ssl/

DOE office of Energy Efficiency and Renewable Energy - http://apps1.eere.energy.gov/consumer/your_workplace/

Energy Star – http://www.energystar.gov/index.cfm?c=lighting.pr_lighting

Hot Water Heaters

Heat Pump Water Heaters - http://apps1.eere.energy.gov/consumer/your_home/water_heating/index.cfm/mytopic=12840

Solar Water Heating

FEMP Federal Technology Alerts – http://www.eere.energy.gov/femp/pdfs/FTA_solwat_heat.pdf

Solar Radiation Data Manual – http://rredc.nrel.gov/solar/pubs/redbook

Plug Loads

DOE office of Energy Efficiency and Renewable Energy – http:apps1.eere.energy.gov/consumer/your_workplace/

Energy Star – http://www.energystar.gov/index.cfm?fuseaction=find_a_product

The Greenest Desktop Computers of 2008 - http://www.metaefficient.com/computers/the-greenest-pcs-of-2008.html

Wind

AWEA Web Site – http://www.awea.org

National Wind Coordinating Collaborative – http:www.nationalwind.org

Utility Wind Interest Group site: http://www.uwig.org

WPA Web Site – http://www.windpoweringamerica.gov

Homepower Web Site: http://homepower.com

Windustry Project: http://www.windustry.com

Solar

NREL – http://www.nrel.gov/rredc/

Firstlook – http://firstlook.3tiergroup.com

TMY or Weather Data – http://rredc.nrel.gov/solar/old_data/nsrdb/1991-2005/tmy3/

State and Utility Incentives and Utility Policies - http://www.dsireusa.org