



# Comprehensive Energy Audit For Upper Kalskag Tribal Office



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Prepared For  
**Kalskag Traditional Council**

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## PREFACE

The Energy Projects Group at the Alaska Native Tribal Health Consortium (ANTHC) prepared this document for the Kalskag Traditional Council. The authors of this report are Chris Mercer, Certified Energy Auditor (CEA) 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 Bonnie Persson, Tribal Administrator for the Kalskag Traditional Council.

# 1. EXECUTIVE SUMMARY

This report was prepared for the Kalskag Traditional Council. The scope of the audit focused on Upper Kalskag 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 \$5,406 for Electricity and \$25,345 for #1 Oil. The total energy costs are \$30,751 per year.

It should be noted that this facility received the power cost equalization (PCE) subsidy from the state of Alaska last year. If it had not received PCE, total electrical costs would have been

Table 1.1 below summarizes the energy efficiency measures analyzed for the Upper Kalskag 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 <sup>1</sup>	Simple Payback (Years) <sup>2</sup>
1	Setback Thermostat: Upper Kalskag Tribal Office	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Upper Kalskag Tribal Office space.	\$3,316	\$1,500	29.99	0.5
2	Other Electrical - Combined Retrofit: Bunn Coffee Machine	Replace with Bunn Coffee Maker with a single pot brewing coffee maker and store coffee in an insulated thermos.	\$170	\$50	19.71	0.3
3	Below- (part or all) Grade Wall: Tribal Council	Install R-40 rigid foam board to interior or exterior side of wall. Does not include cost of coverings.	\$1,549	\$7,620	4.82	4.9
4	Other Electrical - Controls Retrofit: Desktop Computers w/flat screen monitors	Have computers set to sleep mode to save energy when computers are not being used.	\$47	\$50	5.43	1.1
5	Air Tightening	Perform air sealing to reduce air leakage by 300 cfm at 50 Pascals.	\$393	\$1,200	3.04	3.1

**Table 1.1**  
**PRIORITY LIST – ENERGY EFFICIENCY MEASURES**

Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR <sup>1</sup>	Simple Payback (Years) <sup>2</sup>
6	HVAC And DHW	Install a new hydronic oil fired boiler, install a new Tekmar controller with outdoor air reset, eliminate the thermostatic valves and install zone valves controlled by thermostats, install three new circulation pumps that vary the flow with VFDs and only run on demand for heat, improve the control of the unit heaters in the basement so they only have heat and only run on demand for basement heat, and properly install the exhaust stack.	\$9,030 + \$500 Maint. Savings	\$60,000	2.68	6.6
7	On- or Below-Grade Floor, Perimeter: Tribal Council	Install 2' of R-30 rigid board insulation on Perimeter of Crawl Space Floor.	\$338	\$3,004	2.67	8.9
	<b>TOTAL, all measures</b>		<b>\$14,842 + \$500 Maint. Savings</b>	<b>\$73,424</b>	<b>3.48</b>	<b>4.9</b>

**Table Notes:**

<sup>1</sup> 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.

<sup>2</sup> 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 \$14,842 per year, or 48.3% of the buildings' total energy costs. These measures are estimated to cost \$73,424, for an overall simple payback period of 4.9 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	Refrigeration	Other Electrical	Cooking	Clothes Drying	Ventilation Fans	Total Cost
Existing Building	\$26,615	\$0	\$1,445	\$1,906	\$0	\$784	\$0	\$0	\$0	\$30,751
With All Proposed Retrofits	\$12,204	\$0	\$1,445	\$1,906	\$0	\$354	\$0	\$0	\$0	\$15,909
SAVINGS	\$14,411	\$0	\$0	\$0	\$0	\$431	\$0	\$0	\$0	\$14,842

## **2. AUDIT AND ANALYSIS BACKGROUND**

### ***2.1 Program Description***

This audit included services to identify, develop, and evaluate energy efficiency measures at the Upper Kalskag 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 Upper Kalskag 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.

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

1) Upper Kalskag Tribal Office: 6,376 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  $SIR \geq 1$  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. Upper Kalskag Tribal Office**

## ***3.1. Building Description***

The 6,376 square foot Upper Kalskag Tribal Office was constructed in 1984, with a normal occupancy of 10 people. The building is in operation from 9 a.m. to 5:00 p.m.

### **Description of Building Shell**

The below ground crawlspace walls are 2x6 construction with no insulation, the above ground crawlspace has 5.5 inches of fiberglass batt insulation. . The above grade walls are 2x10 construction with R-30 fiberglass batt insulation.

The roof of the building has a cold roof with 9.5 inches of fiberglass batt insulation.

The floor of the building is a below grade insulated crawlspace, an average distance below grade of four feet.

Typical windows throughout the building are double paned glass windows with wood frames.

Doors are metal with a polyurethane core and a metal edge.

### **Description of Heating Plants**

The Heating Plants used in the building are:

#### **Burnham**

Fuel Type:	#1 Oil
Input Rating:	620,000 BTU/hr
Steady State Efficiency:	70 %
Idle Loss:	4 %
Heat Distribution Type:	Glycol
Boiler Operation:	Aug - Jul
Notes:	Boiler is 30 years old, very dirty, controls need to be rewired and barometric damper is gone. No combustion air in mechanical room

#### **Monitor 441**

Fuel Type:	#1 Oil
Input Rating:	49,425 BTU/hr
Steady State Efficiency:	87 %
Idle Loss:	1.5 %
Heat Distribution Type:	Air

#### **Aero Oil fired Hot Water Heater 1**

Fuel Type:	#1 Oil
Input Rating:	100,000 BTU/hr
Steady State Efficiency:	80 %
Idle Loss:	1 %
Heat Distribution Type:	Water
Boiler Operation:	All Year

#### **Aero Oil fired Hot Water Heater 2**

Fuel Type:	#1 Oil
Input Rating:	100,000 BTU/hr
Steady State Efficiency:	80 %
Idle Loss:	0.5 %
Heat Distribution Type:	Water



### **Space Heating Distribution Systems**

The crawlspace is heated with unit heaters that are always hot. The main floor and apartment are heated with residential baseboard. Zoning is imitated to non-electric thermostatic valves on the baseboard. A ½ horsepower Grundfos pump circulates heat to the crawlspace, and a ½ horsepower and ¼ horsepower pump circulate heat to the baseboard in the rest of the facility. A monitor heater supplies some additional heat to the facility and should serve as a backup.

### **Domestic Hot Water System**

Domestic Hot water is supplied by a single Aero Oil Fired hot water heater, though a second heater is installed, but not used. The water is preheated by the boiler. The facility uses about 10 gallons of 120 degree hot water per day.

### **Lighting**

Lighting in the facility is made up of 44 T8 electronic ballast fluorescent lighting fixtures with two to four 32 watt fixtures each.

### **Plug Loads**

Plug loads in the facility are made up of 6 desktop computers with monitors, a fax machine, a microwave, a copy machine, a rarely used washer and dryer, and a BUNN Coffee Maker

## ***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-Lwr/Upr Kalskag - 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	\$ 0.27/kWh
#1 Oil	\$ 5.67/gallons

### 3.2.1.1 Total Energy Use and Cost Breakdown

At current rates, Kalskag Traditional Council pays approximately \$30,751 annually for electricity and other fuel costs for the Upper Kalskag 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**

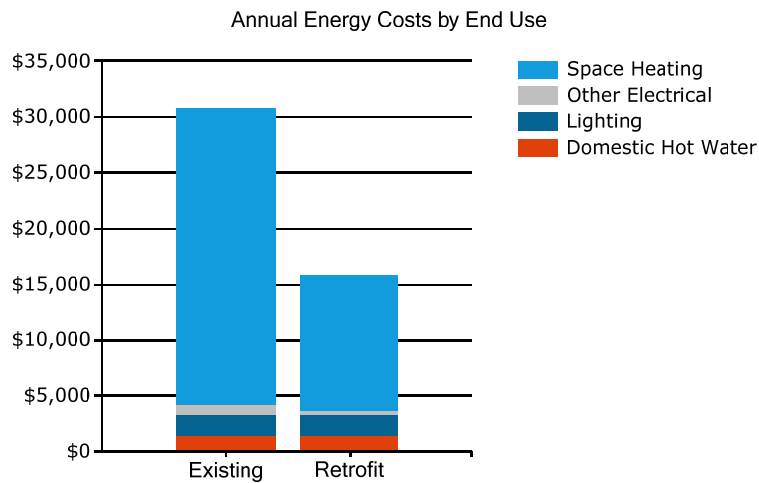


Figure 3.2 below shows how the annual energy cost of the building splits between the different fuels used by the building. The “Existing” bar shows the breakdown for the building as it is now; the “Retrofit” bar shows the predicted costs if all of the energy efficiency measures in this report are implemented.

**Figure 3.2**  
**Annual Energy Costs by Fuel Type**

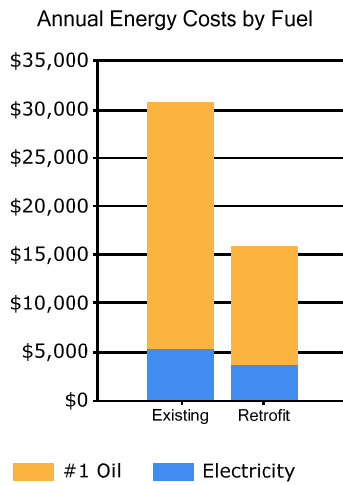
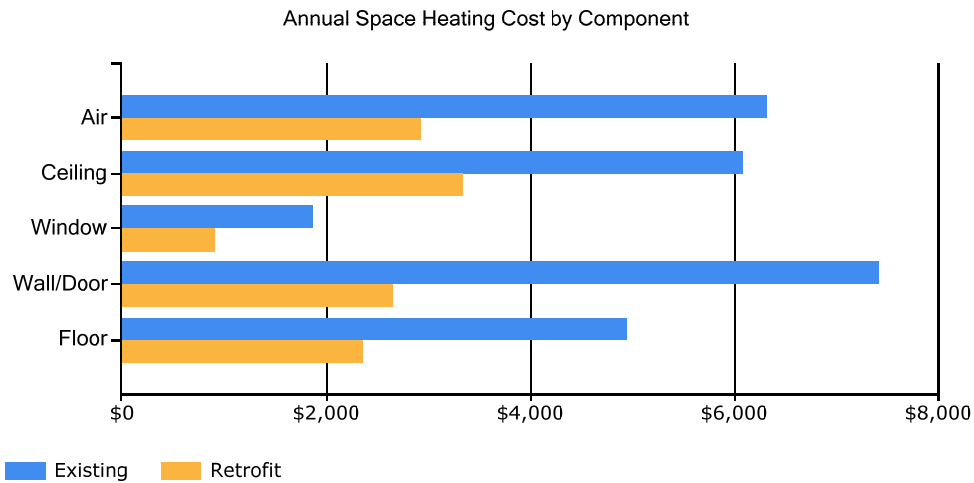


Figure 3.3 below addresses only Space Heating costs. The figure shows how each heat loss component contributes to those costs; for example, the figure shows how much annual space heating cost is caused by the heat loss through the Walls/Doors. For each component, the space heating cost for the Existing 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	599	546	599	580	599	580	599	599	580	599	580	599
Other_Electrical	247	225	247	239	247	239	247	247	239	247	239	247
DHW	5	5	5	5	5	5	5	5	5	5	5	5
Space_Heating	857	780	854	821	844	815	836	842	816	848	825	858

Fuel Oil #1 Consumption (Gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
DHW	21	19	21	21	21	21	21	21	21	21	21	21
Space_Heating	633	548	514	351	202	141	54	146	171	342	475	641

### 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):

$$\text{Building Site EUI} = \frac{(\text{Electric Usage in kBtu} + \text{Fuel Oil Usage in kBtu})}{\text{Building Square Footage}}$$

$$\text{Building Source EUI} = \frac{(\text{Electric Usage in kBtu} \times \text{SS Ratio} + \text{Fuel Oil Usage in kBtu} \times \text{SS Ratio})}{\text{Building Square Footage}}$$

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

**Table 3.4  
Upper Kalskag Tribal Office EUI Calculations**

<b>Energy Type</b>	<b>Building Fuel Use per Year</b>	<b>Site Energy Use per Year, kBTU</b>	<b>Source/Site Ratio</b>	<b>Source Energy Use per Year, kBTU</b>
Electricity	20,021 kWh	68,333	3.340	228,233
#1 Oil	4,470 gallons	590,046	1.010	595,947
<b>Total</b>		<b>658,379</b>		<b>824,180</b>
<b>BUILDING AREA</b> 6,376 Square Feet				
<b>BUILDING SITE EUI</b> 103 kBTU/Ft <sup>2</sup> /Yr				
<b>BUILDING SOURCE EUI</b> 129 kBTU/Ft <sup>2</sup> /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 Upper Kalskag Tribal Office was modeled using AkWarm© energy use software to establish a baseline space heating and cooling energy usage. Climate data from Upper Kalskag was used for analysis. From this, the model was 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 Upper Kalskag. 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.

<b>Table 4.1</b> <b>Upper Kalskag Tribal Office, Upper Kalskag, Alaska</b> <b>PRIORITY LIST – ENERGY EFFICIENCY MEASURES</b>						
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1	Setback Thermostat: Upper Kalskag Tribal Office	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Upper Kalskag Tribal Office space.	\$3,316	\$1,500	29.99	0.5
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**Upper Kalskag Tribal Office, Upper Kalskag, Alaska**  
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7	On- or Below-Grade Floor, Perimeter: Tribal Council	Install 2' of R-30 rigid board insulation on Perimeter of Crawl Space Floor.	\$338	\$3,004	2.67	8.9
	<b>TOTAL, all measures</b>		<b>\$14,842 + \$500 Maint. Savings</b>	<b>\$73,424</b>	<b>3.48</b>	<b>4.9</b>

### ***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 Insulation Measures

Rank	Location	Existing Type/R-Value	Recommendation Type/R-Value	
3	Below- (part or all) Grade Wall: Tribal Council	Wall Type: All Weather Wood Insul. Sheathing: None Framed Wall: 2 x 6, 24" on center None Modeled R-Value: 8.1	Install R-40 rigid foam board to interior or exterior side of wall. Does not include cost of coverings.	
<b>Installation Cost</b>		\$7,620	<b>Estimated Life of Measure (yrs)</b> 30	<b>Energy Savings (/yr)</b> \$1,549
<b>Breakeven Cost</b>		\$36,711	<b>Savings-to-Investment Ratio</b> 4.8	<b>Simple Payback yrs</b> 5
Auditors Notes: Adding board stock insulation to the walls in the crawl space would drastically reduce the heat losses in the facility.				

Rank	Location	Existing Type/R-Value	Recommendation Type/R-Value	
7	On- or Below-Grade Floor, Perimeter: Tribal Council	Insulation for 0' to 2' Perimeter: None Insulation for 2' to 4' Perimeter: None Modeled R-Value: 16.7	Install 2' of R-30 rigid board insulation on Perimeter of Crawl Space Floor.	
<b>Installation Cost</b>		\$3,004	<b>Estimated Life of Measure (yrs)</b> 30	<b>Energy Savings (/yr)</b> \$338
<b>Breakeven Cost</b>		\$8,017	<b>Savings-to-Investment Ratio</b> 2.7	<b>Simple Payback yrs</b> 9
Auditors Notes: Installing two feet of board stock insulation on the perimeter of the crawlspace would reduce heating losses in the facility significantly.				

#### 4.3.2 Air Sealing Measures

Rank	Location	Existing Air Leakage Level (cfm@50/75 Pa)	Recommended Air Leakage Reduction (cfm@50/75 Pa)	
5		Air Tightness estimated as: 3000 cfm at 50 Pascals	Perform air sealing to reduce air leakage by 300 cfm at 50 Pascals.	
<b>Installation Cost</b>		\$1,200	<b>Estimated Life of Measure (yrs)</b> 10	<b>Energy Savings (/yr)</b> \$393
<b>Breakeven Cost</b>		\$3,652	<b>Savings-to-Investment Ratio</b> 3.0	<b>Simple Payback yrs</b> 3
Auditors Notes: Weather stripping for doors, caulking air gaps around window frames, and insuring attic hatches are well sealed and insulated would reduce heat losses in the facility.				

### 4.4 Mechanical Equipment Measures

#### 4.4.1 Heating/ Domestic Hot Water Measure



Rank	Recommendation				
6	Install a new hydronic oil fired boiler, install a new Tekmar controller with outdoor air reset, eliminate the thermostatic valves and install zone valves controlled by thermostats, install three new circulation pumps that vary the flow with VFDs and only run on demand for heat, improve the control of the unit heaters in the basement so they only have heat and only run on demand for basement heat, and properly install the exhaust stack.				
<b>Installation Cost</b>	\$60,000	<b>Estimated Life of Measure (yrs)</b>	20	<b>Energy Savings (/yr)</b>	\$9,030
				<b>Maintenance Savings (/yr)</b>	\$500
<b>Breakeven Cost</b>	\$161,032	<b>Savings-to-Investment Ratio</b>	2.7	<b>Simple Payback yrs</b>	7
Auditors Notes:					

#### 4.4.2 Night Setback Thermostat Measures

Rank	Building Space	Recommendation			
1	Upper Kalskag Tribal Office	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Upper Kalskag Tribal Office space.			
<b>Installation Cost</b>	\$1,500	<b>Estimated Life of Measure (yrs)</b>	15	<b>Energy Savings (/yr)</b>	\$3,316
<b>Breakeven Cost</b>	\$44,979	<b>Savings-to-Investment Ratio</b>	30.0	<b>Simple Payback yrs</b>	0
Auditors Notes: This retrofit should be installed at the same time as the new heating system. The building does not need to be heated above 60 degrees when the facility is unoccupied. Using a programmable thermostat to set back the temperature heating demand in the facility when it is unoccupied, such as at night and on weekends would reduce fuel costs.					

#### 4.5 Electrical & Appliance Measures

##### 4.5.1 Other Electrical Measures

Rank	Location	Description of Existing	Efficiency Recommendation		
2	Bunn Coffee Machine	Bunn Coffee Maker with Manual Switching	Replace with Bunn Coffee Maker and Improve Manual Switching		
<b>Installation Cost</b>	\$50	<b>Estimated Life of Measure (yrs)</b>	7	<b>Energy Savings (/yr)</b>	\$170
<b>Breakeven Cost</b>	\$985	<b>Savings-to-Investment Ratio</b>	19.7	<b>Simple Payback yrs</b>	0
Auditors Notes: Replacing the current BUNN coffee machine with a single pot brewing system and purchasing an insulated thermos to store brewed coffee would reduce electrical usage and maintain warm coffee.					

Rank	Location	Description of Existing	Efficiency Recommendation		
4	Desktop Computers w/flat screen monitors	6 Desktop Computers w/flat screen monitors with Manual Switching	Improve Manual Switching		
<b>Installation Cost</b>	\$50	<b>Estimated Life of Measure (yrs)</b>	7	<b>Energy Savings (/yr)</b>	\$47
<b>Breakeven Cost</b>	\$272	<b>Savings-to-Investment Ratio</b>	5.4	<b>Simple Payback yrs</b>	1
Auditors Notes: Computers can be set to shut off, or go into sleep mode when they have been unused for a period of time, 30 minutes for example. Using the software that comes with your computers operating system you can quickly change the settings so that computers will turn off or sleep and save energy.					

## 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](http://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/](http://apps1.eere.energy.gov/consumer/your_workplace/)

Energy Star – [http://www.energystar.gov/index.cfm?c=lighting.pr\\_lighting](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](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](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/](http://apps1.eere.energy.gov/consumer/your_workplace/)

Energy Star – [http://www.energystar.gov/index.cfm?fuseaction=find\\_a\\_product](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/](http://rredc.nrel.gov/solar/old_data/nsrdb/1991-2005/tmy3/)

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