



Comprehensive Energy Audit For Eek Health Clinic



Prepared For
Native Village of Eek

August 17, 2011

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PREFACE

The Energy Projects Group at the Alaska Native Tribal Health Consortium (ANTHC) prepared this document for the Native Village of Eek and the Yukon Kuskokwim Health Corporation (YKHC). The authors of this report are Carl Remley, Certified Energy Auditor (CEA) and Certified Energy Manager (CEM), Chris Mercer (CEA), and Gavin Dixon.

The purpose of this report is to provide a comprehensive document of the findings and analysis that resulted from an energy audit conducted over the past several 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 ANTHC Energy Projects Group gratefully acknowledges the assistance of Mr. Nick Carter of the Native Village of Eek, Ms. Carol Brown of the Yukon Kuskokwim Health Corporation, and Ms. Marcie Sherer of AVCP.

1. EXECUTIVE SUMMARY

This report was prepared for the Native village of Eek. The scope of the audit focused on the Eek Health Clinic. 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 energy costs for the building analyzed were \$4,315 for electricity, and \$7,997 for #1 fuel oil, resulting in a total energy cost of \$12,312 per year.

It should be noted that this facility received the power cost equalization subsidy last year. If it did not receive the PCE subsidy the annual electricity cost would have been \$14,350 and the total energy cost would be \$22,347 per year.

Table 1.1 below summarizes the energy efficiency measures analyzed for the Eek Health Clinic. 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: Eek Health Clinic | Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Eek Health Clinic space. | \$719 | \$200 | 53.69 | 0.3 |
| 2 | Appliances | Turn off appliances when not in use. | \$53 | \$10 | 23.58 | 0.2 |
| 3 | Arctic Box Heater | Eliminate the Laser 73, reduce the size of the enclosure, insulate it with at least 8 inches of insulation and add thermostatically controlled electric heat tape to keep it from freezing. | \$1,992 | \$1,500 | 21.22 | 0.8 |
| 4 | Lighting: Exterior Lighting | Replace with 2 LED 17W Module Electronic Wall Packs | \$293 | \$500 | 5.12 | 1.7 |
| 5 | Water Line Heat Tapes | Turn off heat tapes and use circulation pump to keep water from freezing. Use heat tape only for recovery. | \$208 | \$300 | 4.44 | 1.4 |

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 |
|----------------------------|--|--|-----------------------|----------------|---|-------------------------------------|
| 6 | Heating, Ventilation, and Domestic Hot Water | Remove the non-functioning direct digital control system and convert the heating and ventilation controls to conventional controls that can be maintained by the Tribal Council. Utilize the timed thermostat to also shut off the hot water circulator during unoccupied hours. | \$1,007 | \$6,000 | 3.20 | 6.0 |
| 7 | Air Tightening: Doors | Perform air sealing to reduce air leakage by 120 cfm at 50 Pascals. | \$107 | \$500 | 2.20 | 4.7 |
| TOTAL, all measures | | | \$4,380 | \$9,010 | 7.44 | 2.1 |

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 \$4,380 per year, or 35.6% of the buildings' total energy costs. These measures are estimated to cost \$9,010, for an overall simple payback period of 2.1 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 | Arctic Box Heating | Ventilation Fans | Service Fees | Total Cost |
|-----------------------------|---------------|---------------|---------------|----------|------------------|---------|--------------------|------------------|--------------|-----------------|
| Existing Building | \$4,480 | \$0 | \$994 | \$954 | \$2,732 | \$0 | \$3,060 | \$0 | \$0 | \$12,312 |
| With All Proposed Retrofits | \$2,818 | \$0 | \$947 | \$661 | \$2,346 | \$0 | \$1,068 | \$0 | \$0 | \$7,932 |
| SAVINGS | \$1,662 | \$0 | \$47 | \$293 | \$386 | \$0 | \$1,992 | \$0 | \$0 | \$4,380 |

2. AUDIT AND ANALYSIS BACKGROUND

2.1 Program Description

This audit included services to identify, develop, and evaluate energy efficiency measures at the Eek Health Clinic. 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 Eek Health Clinic 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.

Eek Health Clinic is classified a 2,350 square foot facility.

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. Eek Health Clinic

3.1. Building Description

The 2,350 square foot Eek Health Clinic was constructed in 1990, with a normal occupancy of three people. The building is in operation Monday through Friday, eight hours per day.

The exterior walls are 2x6 construction with 6 inches of polyurethane insulation. The ceiling of the building is a warm roof with an attic and a top insulation layer of 10 inches of polyurethane

insulation. The floor of the building is an above grade floor on pilings with one foot of polyurethane insulation. Typical windows throughout the building are wood vinyl framed windows with double paned glass. Doors are metal with no thermal break.

Description of Heating Plants

The Heating Plants used in the building are:

Forced Air Furnace

Nameplate Information: Williamson Thermaflo, Model CHB-140-DD, 140,000 BTU @ 1 gpm 115 v, single phase, 3/4 hp motor, Beckett AFG Burner, Rotomatika Model 707502

| | |
|--------------------------|----------------|
| Fuel Type: | #1 Oil |
| Input Rating: | 140,000 BTU/hr |
| Steady State Efficiency: | 74 % |
| Idle Loss: | 2.5 % |
| Heat Distribution Type: | Air |

Monitor

| | |
|--------------------------|---------------|
| Fuel Type: | #1 Oil |
| Input Rating: | 40,000 BTU/hr |
| Steady State Efficiency: | 87 % |
| Idle Loss: | 1.5 % |
| Heat Distribution Type: | Air |

Toytomi Hot Water Heater

| | |
|--------------------------|----------------|
| Fuel Type: | #1 Oil |
| Input Rating: | 148,000 BTU/hr |
| Steady State Efficiency: | 87 % |
| Idle Loss: | 1.5 % |
| Heat Distribution Type: | Water |
| Boiler Operation: | All Year |

Space Heating Distribution Systems

Space heating is made up of a forced air furnace carrying the majority of the building load, and an additional Monitor space heating system in the front office when the forced air furnace fails to meet the load.

Domestic Hot Water System

Domestic Hot Water is supplied by a 40 gallon, oil fired hot water heater. The system is used to heat water for clinic activities, which primarily include hand washing and showers, with about 20 gallons of water on average used per day used. Hot water temperature is controlled via thermal well aquastat and varies between 110 and 120 degrees Fahrenheit.

Waste Heat Recovery Information

There is currently no waste heat recovery system for this building.

Description of Building Ventilation System

Ventilation for the Eek Clinic is provided through a fresh air intake integrated into the facility's air handling unit. As air is circulated through the building and a variable portion is exchanged with outside air.

Lighting

The building is lit primarily by 24 fluorescent, 32 watt lamp T8 electronic ballast fixtures. Exterior lighting is made up of two metal halide wall packs.

Plug Loads

Primary plug loads in the building come from a multitude of desktop computers, monitors, and printers, and the African telemedicine machine. Additional medical equipment makes up a significant portion of the load, and the server bank accounts for a similar percentage of electrical use.

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-Eek - 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 | \$ 0.16/kWh |
| #1 Oil | \$ 5.36/gallons |

3.2.1.1 Total Energy Use and Cost Breakdown

At current rates, the Native Village of Eek pays approximately \$12,312 annually for electricity and fuel oil costs for the Eek Health Clinic.

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

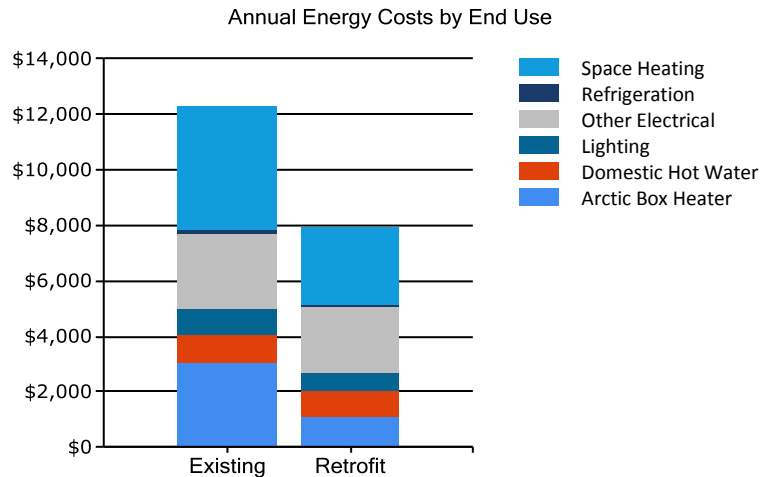


Figure 3.2 below shows how the annual energy cost of the building splits between the different fuels used by the building. The “Existing” bar shows the breakdown for the building as it is now; the “Retrofit” bar shows the predicted costs if all of the energy efficiency measures in this report are implemented.

Figure 3.2
Annual Energy Costs by Fuel Type

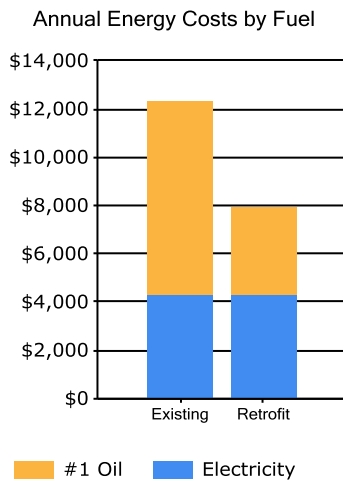
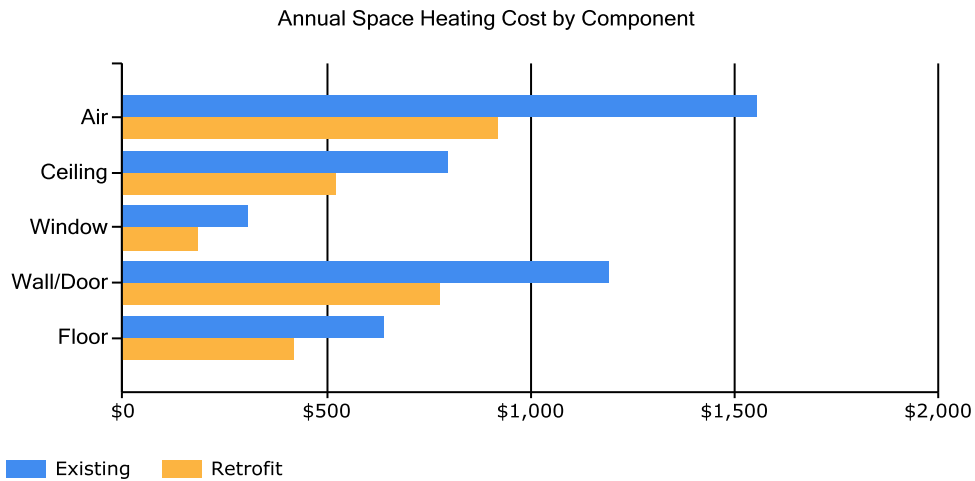


Figure 3.3 below addresses only Space Heating costs. The figure shows how each heat loss component contributes to those costs; for example, the figure shows how much annual space heating cost is caused by the heat loss through the Walls/Doors. For each component, the space heating cost for the Existing 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 | 506 | 461 | 506 | 490 | 506 | 490 | 506 | 506 | 490 | 506 | 490 | 506 |
| Refrigeration | 49 | 44 | 49 | 47 | 49 | 47 | 49 | 49 | 47 | 49 | 47 | 49 |
| Other_Electrical | 1634 | 1489 | 1634 | 1581 | 1098 | 1046 | 1081 | 1081 | 1581 | 1634 | 1581 | 1634 |
| Arctic Box Heater | 190 | 173 | 190 | 184 | 190 | 184 | 190 | 190 | 184 | 190 | 184 | 190 |
| Ventilation_Fans | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| DHW | 41 | 37 | 41 | 40 | 41 | 40 | 41 | 41 | 40 | 41 | 40 | 41 |
| Space_Heating | 115 | 101 | 90 | 50 | 15 | 5 | 4 | 5 | 16 | 45 | 76 | 115 |

| Fuel Oil #1 Consumption (Gallons) | | | | | | | | | | | | |
|-----------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|-----|-----|-----|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sept | Oct | Nov | Dec |
| Arctic Box Heater | 43 | 39 | 43 | 41 | 43 | 41 | 43 | 43 | 41 | 43 | 41 | 43 |
| DHW | 15 | 13 | 15 | 14 | 15 | 14 | 15 | 15 | 14 | 15 | 14 | 15 |
| Space_Heating | 129 | 115 | 105 | 65 | 31 | 20 | 20 | 21 | 31 | 60 | 90 | 130 |

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):

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

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

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

Table 3.4
Eek Health Clinic 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 | 26,970 kWh | 92,050 | 3.340 | 307,447 |
| #1 Oil | 1,492 gallons | 196,945 | 1.010 | 198,914 |
| Total | | 288,995 | | 506,361 |
| BUILDING AREA | | | | |
| | | 2,350 | Square Feet | |
| BUILDING SITE EUI | | | | |
| | | 123 | kBTU/Ft ² /Yr | |
| BUILDING SOURCE EUI | | | | |
| | | 215 | 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 Eek Health Clinic was modeled using AkWarm© energy use software to establish a baseline space heating and cooling energy usage. Climate data from Eek 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 Eek. 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.

| Table 4.1 Eek Health Clinic, Eek, 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: Eek Health Clinic | Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Eek Health Clinic space. | \$719 | \$200 | 53.69 | 0.3 |
| 2 | Appliances | Turn off appliances when not in use. | \$53 | \$10 | 23.58 | 0.2 |
| 3 | Arctic Box Heater | Eliminate the Laser 73, reduce the size of the enclosure, insulate it with at least 8 inches of insulation and add thermostatically controlled electric heat tape to keep it from freezing. Reduce temperature setting of electric heater in the lift station electrical panel. | \$1,992 | \$1,500 | 21.22 | 0.8 |
| 4 | Lighting: Exterior Lighting | Replace with 2 LED 17W Module Electronic Wall Packs | \$293 | \$500 | 5.12 | 1.7 |
| 5 | Water Line Heat Tapes | Turn off heat tapes and use circulation pump to keep water from freezing. Use heat tape only for recovery. | \$208 | \$300 | 4.44 | 1.4 |

Table 4.1
Eek Health Clinic, Eek, Alaska
PRIORITY LIST – ENERGY EFFICIENCY MEASURES

| Rank | Feature | Improvement Description | Annual Energy Savings | Installed Cost | Savings to Investment Ratio, SIR | Simple Payback (Years) |
|----------------------------|--|--|-----------------------|----------------|----------------------------------|------------------------|
| 6 | Heating, Ventilation, and Domestic Hot Water | Remove the non-functioning direct digital control system and convert the heating and ventilation controls to conventional controls that can be maintained by the Tribal Council. Utilize the timed thermostat to also shut off the hot water circulator during unoccupied hours. | \$1,007 | \$6,000 | 3.20 | 6.0 |
| 7 | Air Tightening: Doors | Perform air sealing to reduce air leakage by 120 cfm at 50 Pascals. | \$107 | \$500 | 2.20 | 4.7 |
| TOTAL, all measures | | | \$4,380 | \$9,010 | 7.44 | 2.1 |

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

Building shell improvements are those that reduce heating costs by reducing the heat lost through the floor, walls, ceiling, windows and doors. AKWarm can automatically calculate the appropriate places to add insulation, how much to add, and the installed cost. The costs have a built in location factor that includes shipping and the installation cost is factored for local costs for labor, including travel where necessary.

4.3.1 Energy Efficiency Measure: Seal Air Leaks

| Rank | Estimated Air Leakage | Recommended Air Leakage Target | Energy Auditor Comments | Cost | Savings |
|------|---|---|---|-------|---------|
| 7 | Air Tightness from Blower Door Test: 1520 cfm at 50 Pascals | Perform air sealing to reduce air leakage by 120 cfm at 50 Pascals. | Add weather stripping and seal better around doors. | \$500 | \$107 |

Many buildings, especially older ones, have air leaks allowing heated and cooled air to escape when the air pressure differs between the inside and outside of the building. Because these leaks allow unconditioned air to enter as conditioned air is lost, air leaks can be a significant waste of energy and money. They also make the building drafty. Many buildings have hidden air leaks requiring a weatherization technician to find and seal. As part of this audit, we performed a blower door test. It is recommended that you add weather stripping to the doors and seal better around the doors. Buildings with indoor air pollution caused by combustion heating, tobacco smoking, or moisture problems, may require more ventilation than average buildings. This building is new enough, and in good enough condition that no direct building shell measures were recommended. The exhaust air from the furnace is poorly sealed and is the largest leak in the building. Adding weather stripping to the doors would provide additional energy savings.

4.4 Heating Measures

4.4.1. EEM Heating Plants and Distribution Systems

A heating system is expected to last approximately 20-25 years, depending on the system. If the system is nearing the end of its life, it is better to replace it sooner rather than later to avoid being without heat for several days when it fails. Your heating system is not near its end of life but does need some improvements.

Recommendation: Remove the non-functioning direct digital control system and convert the heating and ventilation controls to conventional controls that can be maintained by the Tribal Council. Utilize the timed thermostat to also shut off the hot water circulator during unoccupied hours.

Estimated Cost: \$6,000

Estimate Savings per Year: \$1,007

4.4.2 Programmable Thermostat

| Location | Existing Situation | Recommended Improvement | Install Cost | Annual Savings | Notes |
|-------------------|--|---|--------------|----------------|-------|
| Eek Health Clinic | Existing Unoccupied Heating Setpoint: 70.0 deg F | Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Eek Health Clinic space. | \$200 | \$719 | |

Recommendation: We recommend that you install a new set back thermostat for the forced hot air furnace as well as utilize the built in setback capability of the Toyotomi in the front office and set unoccupied temperature setbacks to 60 degrees.

4.5 LIGHTING UPGRADES

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.

4.5.1 Lighting Upgrade – Replace Existing Fixtures and Bulbs

| Location | Existing Lighting | Recommended Improvement | Install Cost | Annual Savings | Notes |
|-------------------|--|---|--------------|----------------|--|
| Exterior Lighting | 2 MH 100 Watt Magnetic with On/Off Photoswitch | Replace existing fixtures with 2 LED 17W fixtures | \$500 | \$293 | Convert exterior light fixtures from metal halide to LED. This requires replacing the entire fixture with a new wall pack. |

Description:

This exterior lighting EEM replaces the existing 100 watt metal halide exterior lighting fixtures with new 17 watt LED fixtures.

4.6 Other Electrical

| Location | Life in Years | Description | Recommendation | Cost | Savings | Notes |
|-----------------------|---------------|--|--|-------|---------|-------|
| Appliances | 7 | 19 Computers, radios, phones, paper shredders, kitchen items with Manual Switching | Turn off Appliances when not in use. | \$10 | \$53 | |
| Water Line Heat Tapes | 7 | Heat Tape with Manual Switching | Convert from simple on/off switch to outside thermostat control. Install at the same time as improved heating controls and upgrade of arctic box controls. | \$300 | \$208 | |

Description: Heat tape is often installed as a method of freeze recovery. Use of heat tape under other conditions will be very costly, in situations where a circulation pump is available; the circ pump should

be used as the primary method of freeze prevention. If the circulation pump is failing, savings can still be realized by turning off heat tape when outdoor temperatures are high enough to prevent freezing.

Many appliances in clinic are left on needlessly. Computers and monitors in particular need to be shut off when not in use, as well as printers and copy machines that aren't required to be on for fax receipt twenty four hours a day. The CB radio should be turned off at the end of the day, and kitchen appliances should be unplugged when not in use. One way to reduce computer electrical usage is to use power management settings on the computer.

4.7 Arctic Box Heater

| Location | Life in Years | Energy Source | Description | Recommendation | Cost | Savings | Notes |
|----------|---------------|-------------------|-------------|---|---------|---------|-------|
| Outside | 15 | Fuel and Electric | | Eliminate the Laser 73, reduce the size of the enclosure, insulate it with at least 8 inches of insulation and add thematically controlled electric heat tape to keep it from freezing. Turn down thermostat on the electric heater in the lift station electrical panel. | \$1,500 | \$1,992 | |

Description: Eliminate the Toyotomi Laser 73, as this is an oversized heating device for the lift station. Reduce the size of the enclosure and insulate it with at least 8 inches of insulation and add thermostatically controlled electric heat tape to keep it from freezing.

Additionally, the electric heater in the lift station electrical panel is set to 75 degrees. This is far too high for an outdoors electrical panel. Reducing the temperature setting to 50 degrees should maintain proper function of the electrical panel and reduce electrical costs. Additionally, turning the heater all the way off when the weather is above freezing for extended periods will provide for further savings.

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.

Attached to this report is Appendix A. The objective of this appendix is to provide the Eek Traditional Council with a wide range of websites to further your knowledge of both energy conservation and renewable energy.

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>