Comprehensive Energy Audit For IGAP Building

Prepared For

Native Village of Eek

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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. The authors of this report are Carl H. Remley, Certified Energy Auditor (CEA) and Certified Energy Manager (CEM), Chris Mercer, PE and CEA, Gavin Dixon and Kyle Monti.

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 Mr. Nick Carter, Tribal Administrator and Marcie Sherer, Vice President of Business Enterprises, AVCP.

1. EXECUTIVE SUMMARY

This report was prepared for the Native Village of Eek. The scope of the audit focused on IGAP Building. 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 buildings analyzed was $1,144 for electricity and $4,827 for #1 fuel oil. This results in an annual energy cost of $5,970. Please note that this was for the calendar year 2010. Energy costs in rural Alaska fluctuate significantly with the price of oil.

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 $3,173 and the total energy cost would have been $7,999.

Table 1.1 below summarizes the energy efficiency measures analyzed for the IGAP Building. 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	Other Electrical: IGAP	Turn off Computer and Monitor when not in use.	$36	$0	>100	0.0
2	Other Electrical: Entry	Turn off Stereo when not in use.	$4	$0	>100	0.0
3	Other Electrical: ICWA	Turn off Printer when not in use.	$2	$0	>100	0.0
4	Setback Thermostat: IGAP Office, AVCP Office, and Child Care Office	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the IGAP Office, AVCP Office, and Child Care Office space.	$923	$200	69.09	0.2
5	Air Tightening: Doors	Perform air sealing to reduce air leakage by 1000 cfm at 50 Pascals.	$983	$800	12.63	0.8
6	Lighting: Storage	Add new Occupancy Sensor	$17	$30	3.19	1.7
7	Lighting: IGAP	Add new Occupancy Sensor	$16	$30	2.94	1.8
8	Lighting: Closet	Replace with LED 12W Module Electronic	$5	$15	2.29	3.0
9	Lighting: Childcare	Add new Occupancy Sensor	$12	$30	2.15	2.5
10	Lighting: ICWA	Add new Occupancy Sensor	$8	$30	1.50	3.6
11	Attic	Add R-21 blown cellulose insulation to attic with Standard Truss.	$266	$4,949	1.44	18.6

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]**
12	Lighting: Mech. Room	Add new Occupancy Sensor	$7	$30	1.32	4.1
	TOTAL, all measures		**$2,280**	**$6,114**	**5.17**	**2.7**

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 $2,280 per year, or 38.2% of the buildings' total energy costs. These measures are estimated to cost $6,114, for an overall simple payback period of 2.7 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	$4,894	$0	$0	$604	$472	$0	$0	$0	$0	**$5,970**
With All Proposed Retrofits	$2,870	$0	$0	$460	$361	$0	$0	$0	$0	**$3,691**
SAVINGS	$2,024	$0	$0	$144	$111	$0	$0	$0	$0	**$2,280**

2. AUDIT AND ANALYSIS BACKGROUND

2.1 Program Description

This audit included services to identify, develop, and evaluate energy efficiency measures at the IGAP Building. 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 IGAP Building 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 IGAP building has a total of 961 square feet of office space.

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. IGAP Building

3.1. Building Description

The 961 square foot IGAP Building was constructed in 1980, with a normal occupancy of 4 people. The building averages eight hours per day, five days per week in operation.

The building has a post and pad foundation with open air beneath the building. The exterior walls are 2x6 construction and have approximately R-19 batt insulation. The roof of the building is a cold roof with 8 inches of batt insulation. The floor is an above grade floor on the post and pad foundation with 6 inches of batt insulation. Typical windows throughout the building are double paned wood/vinyl frame windows with moderate external shading. Doors are metal and poorly insulated.

Description of Heating Plant

The Heating Plants used in the building are:

Toyotomi Laser 73

Nameplate Information:	Toyotomi Laser 73
Fuel Type:	#1 Oil
Input Rating:	40,000 BTU/hr
Steady State Efficiency:	87 %

Idle Loss:	2 %
Heat Distribution Type:	Air
Notes:	Fair Condition

The entire building is currently heated with a Toyotomi Laser 73. At present the temperature is not set back during the unoccupied hours. Eventually a waste oil burner will be installed in the old mechanical room.

Domestic Hot Water System

There is no domestic hot water system in the building.

Waste Heat Recovery Information

There is no heat recovery in the building.

Description of Building Ventilation System

The existing building ventilation system consists of several ceiling vents which seem to be working properly.

Lighting

The majority of the lighting in the building is made up of old T12 Magnetic ballast fluorescent lighting. There are a few incandescent bulbs in the building with limited usage.

Plug Loads

Plug loads in the building are made up of desktop computers, printers, a microwave, and a stereo. For the most part, electronic equipment is being turned off at the end of the day, but not during low use periods while the office(s) are open.

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. One KW of electric demand is equivalent to 1,000 watts running at a particular moment. The basic usage charges are shown as generation service and delivery charges along with several non-utility generation charges.

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	$ 0.22/kWh
#1 Oil	$ 5.36/gallons

3.2.1.1 Total Energy Use and Cost Breakdown

At current rates, Native Village of Eek pays approximately $5,970 annually for electricity and other fuel costs for the IGAP Building.

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

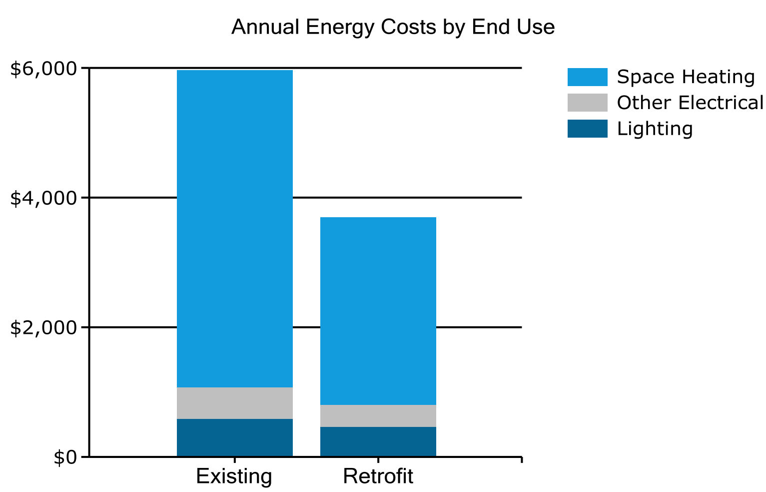


Figure 3.2 below shows how the annual energy cost of the building splits between the different fuels used by the building. The "Existing" bar shows the breakdown for the building as it is now; the

"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

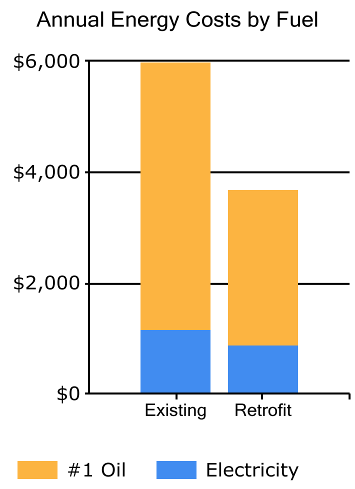
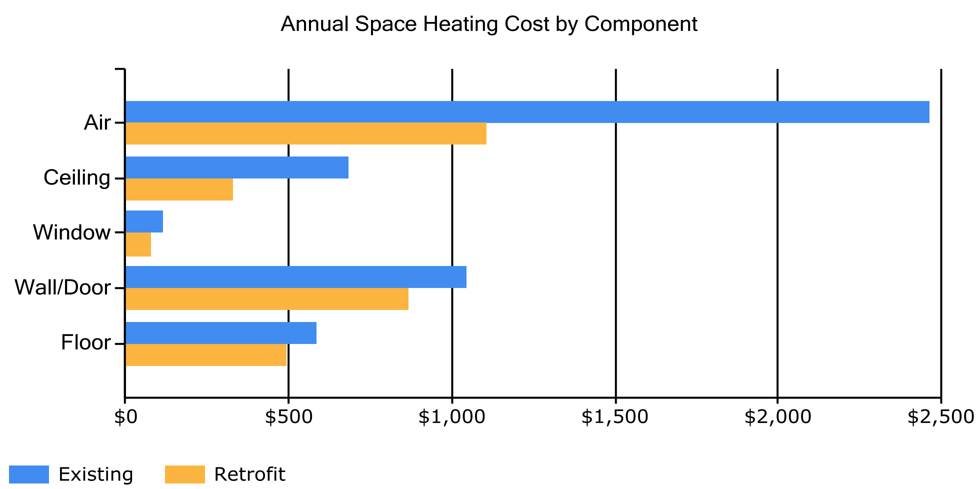


Figure 3.3 below addresses only Space Heating costs. The figure shows how each heat loss component contributes to those costs; for example, the figure shows how much annual space heating cost is caused by the heat loss through the Walls/Doors. For each component, the space heating cost for the Existing 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	233	212	233	226	233	226	233	233	226	233	226	233
Other_Electrical	182	166	182	176	182	176	182	182	176	182	176	182
Ventilation_Fans	0	0	0	0	0	0	0	0	0	0	0	0
DHW	0	0	0	0	0	0	0	0	0	0	0	0
Space_Heating	48	43	41	28	15	5	3	4	12	25	35	48
Space_Cooling	0	0	0	0	0	0	0	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	144	129	121	81	40	15	9	13	31	71	103	144

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 = *(<u>Electric Usage in kBtu + Oil Usage in kBtu + similar for other fuels</u>)*
Building Square Footage

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

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

Table 3.4
IGAP Building 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	5,199 kWh	17,745	3.340	59,270
#1 Oil	900 gallons	118,863	1.010	120,051
Total		**136,608**		**179,321**
BUILDING AREA		961	Square Feet	
BUILDING SITE EUI		142	kBTU/Ft²/Yr	
BUILDING SOURCE EUI		187	**kBTU/Ft²/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 IGAP Building 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 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 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. Calculations and cost estimates for analyzed measures are provided in Appendix C.

Table 4.1
IGAP Building, 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	Other Electrical: IGAP	Turn off Computer and Monitor when not in use.	$36	$0	>100	0.0
2	Other Electrical: Entry	Turn off Stereo when not in use.	$4	$0	>100	0.0
3	Other Electrical: ICWA	Turn off Printer when not in use.	$2	$0	>100	0.0
4	Setback Thermostat: IGAP Office, AVCP Office, and Child Care Office	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the IGAP Office, AVCP Office, and Child Care Office space.	$923	$200	69.09	0.2
5	Air Tightening: Doors	Perform air sealing to reduce air leakage by 1000 cfm at 50 Pascals.	$983	$800	12.63	0.8
6	Lighting: Storage	Add new Occupancy Sensor	$17	$30	3.19	1.7
7	Lighting: IGAP	Add new Occupancy Sensor	$16	$30	2.94	1.8
8	Lighting: Closet	Replace with LED 12W Module Electronic	$5	$15	2.29	3.0
9	Lighting: Childcare	Add new Occupancy Sensor	$12	$30	2.15	2.5
10	Lighting: ICWA	Add new Occupancy Sensor	$8	$30	1.50	3.6
11	Attic	Add R-21 blown cellulose insulation to attic with Standard Truss.	$266	$4,949	1.44	18.6
12	Lighting: Mech. Room	Add new Occupancy Sensor	$7	$30	1.32	4.1
	TOTAL, all measures		**$2,280**	**$6,114**	**5.17**	**2.7**

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

Building shell improvements are those that reduce heating 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.

1. Building Envelope					
Insulation					
Rank	**Location**	**Existing Type/R-Value**	**Recommendation Type/R-Value**	**Installed Cost**	**Annual Energy Savings**
11	Attic	Framing Type: Standard Framing Spacing: 24 inches Insulated Sheathing: None Bottom Insulation Layer: Fiberglass/Loose fill, 8 inches Top Insulation Layer: None Insulation Quality: Damaged Modeled R-Value: 20.7	Add R-21 blown cellulose insulation to attic with Standard Truss.	$4,949	$266

4.3.1. Energy Efficiency Measure: Add or Replace Insulation

4.3.1.1 Improvement: Rank 11
Location: Attic
Area (Feet^2): 961
Existing Situation: Framing Type: Standard
Framing Spacing: 24 inches
Insulated Sheathing: None
Bottom Insulation Layer: Fiberglass/Loose fill, 8 inches

Top Insulation Layer: None
Insulation Quality: Damaged
Modeled R-Value: 20.7

Recommended Measures: Add R-21 blown cellulose insulation to attic with Standard Truss.
Annual Energy Savings: $266
Installed Costs:
Material Costs: Not Available
Labor Costs: Not Available
Total Estimated Costs: $4,949
Simple Payback (Years): 19
Auditor Comments: Add blown cellulose insulation to attic and seal off ceiling tiles so heated air cannot bypass insulation above tiles

4.3.2. Energy Efficiency Measure: Seal Air Leaks

Rank	Estimated Air Leakage	Recommended Air Leakage Target	Energy Auditor Comments	Cost	Savings
5	Air Tightness from Blower Door Test: 2200 cfm at 50 Pascals	Perform air sealing to reduce air leakage by 1000 cfm at 50 Pascals.	The blower door testing indicated that the areas around the doors have significant air leakage. Weather stripping should be added and the doors better sealed. Also, the old boiler stack should be sealed off and insulated.	$800	$983

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. It is recommended you find a seal-up technician who uses a blower door to help identify where the air is leaking and, after sealing the leaks, verifies the reduction in leakage. Buildings with indoor air pollution caused by combustion heating, tobacco smoking, or moisture problems, may require more ventilation than average buildings. The door in particular needs to be weather stripped, windows need to be caulked, and most importantly, the old boiler stack vent needs to be sealed or blocked until the new used oil burning heating system is put into use.

4.4 Heating Measures

4.4.1. EEM Heating Plants, Cooling 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. This way, you will have time to compare bids, check references and ensure the contractors are bonded and insured. However, your Toyotomi Laser 73 appears to be in fairly good condition, and is fairly efficient, so we do not recommend replacing it at this time. We do however recommend that you take advantage of the built in temperature set back capability of the Laser 73 and set back the temperature to 60 degrees during the unoccupied hours.

4.4.1.1. EXISTING SYSTEMS

4.4.1.1.1 Toyotomi Laser 73
Description: Toyotomi Laser 73 heating plant fueled by #1 Fuel Oil, with a Natural draft.
Size : 40,000 BTU/h
Efficiency (Steady State & Idle): 87%
Portion of heat supplied by this unit: 100%
Notes: Fair Condition

4.4.1.1.2 Toyotomi Laser 73 Space Heating

Notes: Distribution is with the Toyotomi Laser 73

4.4.2 Programmable Thermostat

Location	Existing Situation	Recommended Improvement	Install Cost	Annual Savings	Notes
IGAP Office, AVCP Office, and ICWA	Existing Unoccupied Heating Setpoint: 70.0 deg F	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the IGAP Office, AVCP Office, and Child Care Office space.	$200	$923	

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 – Add Occupancy Sensors and Replace Closet Lamp

Location	Existing Lighting	Recommended Improvement	Install Cost	Annual Savings	Notes
Storage	FLUOR (4) T12 4' F40T12 40W Standard Magnetic with Manual Switching	Add new Occupancy Sensor	$30	$17	
IGAP	2 FLUOR (4) T12 4' F40T12 40W Standard Electronic with Manual Switching	Add new Occupancy Sensor	$30	$16	
Closet	INCAN A Lamp, Halogen 60W with Manual Switching	Replace with LED 12W Module Electronic	$15	$5	

Childcare	3 FLUOR (2) T12 4' F40T12 40W Standard Electronic with Manual Switching	Add new Occupancy Sensor	$30	$12	
ICWA	3 FLUOR (2) T12 4' F40T12 40W Standard Electronic with Manual Switching	Add new Occupancy Sensor	$30	$8	
Mech. Room	FLUOR (2) T12 4' F40T12 40W Standard Electronic with Manual Switching	Add new Occupancy Sensor	$30	$7	

Description:

This EEM includes adding occupancy sensors to most rooms in the building, which would reduce energy consumption by as much as 25%.

This EEM also includes replacement of all incandescent fixtures to LED fixtures, results in a significant energy savings and longer bulb life expectancy.

4.6 Appliances

Location	Life in Years	Description	Recommendation	Cost	Savings	Notes
IGAP	7	6 Desktop & Monitor with Manual Switching	Turn off when not in use	$0	$36	
Entry	7	Stereo with Manual Switching	Turn off when not in use - unplug	$0	$4	
ICWA	7	Printer/Scanner/Fax with Manual Switching	Turn off when not in use	$0	$2	

Description: : Many appliances in the IGAP building 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 stereo in the front entry should be turned off when not in use. One way to reduce computer electrical usage is to use power management settings on the computer.

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 City of Eek and 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/

Caliper Program – http://www1.eeere.energy.gov/buildings/ssl/caliper.html

Solid State Lighting Gateway Demonstrations – http://www1/eere/energy.gov/buildings/ssl/gatewaydemos.html

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

Tank less DHW Heaters -
http://apps1.eere.energy.gov/consumer/your_home/water_heating/index.cfm/mytopic=12820

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

AHRI –Residential Water Heaters - http://ari.org/Content/ResidentialWaterHeaters_594.aspx

American Council for Energy-Efficient Economy -
http://www.aceee.org/consumerguide/waterheating.htm#heatpump

Solar Water Heating

DOE Energy and Efficiency and Renewable Energy Solar Energy Technologies Program –
http://www1.eere.energy.gov/solar/solar_heating.html

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

FEMP Case Studies – www.eere.energy.gov/femp/technologies/renewable_casestudies.html

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

Top 10 energy efficient desktop PCs –
http://crave.cnet.co.uk/cnetuk/crave/greentech/0,250000598,10001753,00.htm

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

- AWEA Small wind toolbox: www.awea.org/smallwind/

NWTC Web Site – http:www.nreal.gov/wind

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

Best Links: www.freash-energy.org

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