Comprehensive Energy Audit
For
Nunapitchuk IRA Bingo Hall

Prepared For
Native Village of Nunapitchuk

February 13, 2012

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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 Nunapitchuk. The authors of this report are Carl H. Remley, Certified Energy Auditor (CEA) and Certified Energy Manager (CEM) and Gavin Dixon.

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

ACKNOWLEDGMENTS

The Energy Projects Group gratefully acknowledges the assistance of Eli Wassillie and Sophie Chaliak.

1. EXECUTIVE SUMMARY

This report was prepared for the Native Village of Nunapitchuk. The scope of the audit focused on the Nunapitchuk IRA Bingo Hall. 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 $539 for Electricity, $4,907 for #1 Oil and total energy costs of $5,446 per year.

It should be noted that this facility received the power cost equalization (PCE) subsidy from the state of Alaska last year. If the IRA Bingo Hall did not receive PCE, total electric costs would be $1,200, total fuel costs would be $4,907 and total electricity costs would be $6,107 per year.

Table 1.1 below summarizes the energy efficiency measures analyzed for the Nunapitchuk IRA Bingo Hall. 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: IGAP Office and Bingo Hall	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the IGAP Office and Bingo Hall space.	$722	$200	54.11	0.3
2	Air Tightening: Door and attic hatches	Perform air sealing to reduce air leakage by 600 cfm at 50 Pascals.	$681	$500	14.01	0.7
3	Lighting: Bingo Hall Incan	Replace with 5 FLUOR CFL, A Lamp 20W	$24	$50	3.03	2.1
4	Broken Windows	Remove existing glass and replace with triple pane, 2 low-E, and argon glass.	$45	$332	2.60	7.4
5	Window/Skylight: South Broken	Remove existing glass and replace with triple pane, 2 low-E, and argon glass.	$40	$322	2.36	8.1
6	Ceiling	Add R-30 fiberglass batts to attic with Standard Truss.	$262	$3,393	2.08	12.9
7	End walls, front and back	Install R-30 rigid foam board to exterior and cover with T1-11 siding or equivalent.	$316	$5,188	1.64	16.4
8	Lighting: Bingo Hall Fluorescent	Replace with FLUOR (2) T8 4' F32T8 28W Energy-Saver Instant Electronic	$3	$50	1.49	15.4
	TOTAL, all measures		**$2,094**	**$10,035**	**3.51**	**4.8**

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 $2,094 per year, or 38.4% of the buildings' total energy costs. These measures are estimated to cost $10,035, for an overall simple payback period of 4.8 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	Refrigera tion	Other Electrical	Cooking	Clothes Drying	Ventilation Fans	Service Fees	Total Cost
Existing Building	$4,978	$0	$127	$210	$0	$131	$0	$0	$0	$0	**$5,446**
With All Proposed Retrofits	$2,999	$0	$127	$95	$0	$131	$0	$0	$0	$0	**$3,353**
SAVINGS	$1,979	$0	$0	$115	$0	$0	$0	$0	$0	$0	**$2,094**

2. AUDIT AND ANALYSIS BACKGROUND

2.1 Program Description

This audit included services to identify, develop, and evaluate energy efficiency measures at the Nunapitchuk IRA Bingo Hall. 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 Nunapitchuk IRA Bingo Hall 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.

Nunapitchuk IRA Bingo Hall is classified as being made up of the following activity areas:

1) IGAP Office and Bingo Hall: 1,200 square feet

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

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

2.3. Method of Analysis

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

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

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

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

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

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

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

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

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

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

2.4 Limitations of Study

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

3. Nunapitchuk IRA Bingo Hall

3.1. Building Description

The 1,200 square foot Nunapitchuk IRA Bingo Hall was constructed in 1972, with a normal occupancy of 2 people. The number of hours of operation for this building average 8 hours per day, considering all seven days of the week.

Description of Building Shell

The exterior walls are 2x4 construction on the west and east sides, with 3.5 inches of batt insulation, with an additional 2 inches of rigid board insulation on the exterior.

The south and north walls of the building are 2x4 construction with 3.5 inches of damaged batt insulation.

The Roof of the building is constructed with a cold roof, and a bottom insulation layer of 6 inches of batt insulation, and a covering insulation layer of 3.5 inches of damaged insulation.

The Floor/Foundation of the building is constructed on pilings with a bottom insulation layer of 9.5 inches of batt insulation.

Typical windows throughout the building are wood vinyl windows with double paned glass, though there are two broken windows as well.

There is a single standard metal door with no thermal break.

Description of Heating Plants

The Heating Plants used in the building are:

Monitor 2400

Fuel Type:	#1 Oil
Input Rating:	34,200 BTU/hr

Steady State Efficiency:	87 %
Idle Loss:	0 %
Heat Distribution Type:	Air
Notes:	Age is approximate

Monitor 2400

Fuel Type:	#1 Oil
Input Rating:	34,200 BTU/hr
Steady State Efficiency:	87 %
Idle Loss:	0 %
Heat Distribution Type:	Air
Notes:	Age is approximate

Hot Water Heater

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

Space Heating Distribution Systems

The building is heated by a pair of monitor heating stoves which supply warm air directly to the building.

Domestic Hot Water System

The domestic hot water heater is an electric on demand hot water heater with very low usage.

Lighting

Lighting in the building is made up of a variety of incandescent light bulbs, compact fluorescent light bulbs, and fluorescent lighting.

Major Equipment

The individual electrical load in the facility is a sewer line electric heat tape that keeps the sewer tank and line from freezing in the winter.

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-Nunapitchuk/Kasig - 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	$ 5.73/gallons

3.2.1.1 Total Energy Use and Cost Breakdown

At current rates, Native Village of Nunapitchuk pays approximately $5,446 annually for electricity and other fuel costs for the Nunapitchuk IRA Bingo Hall.

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

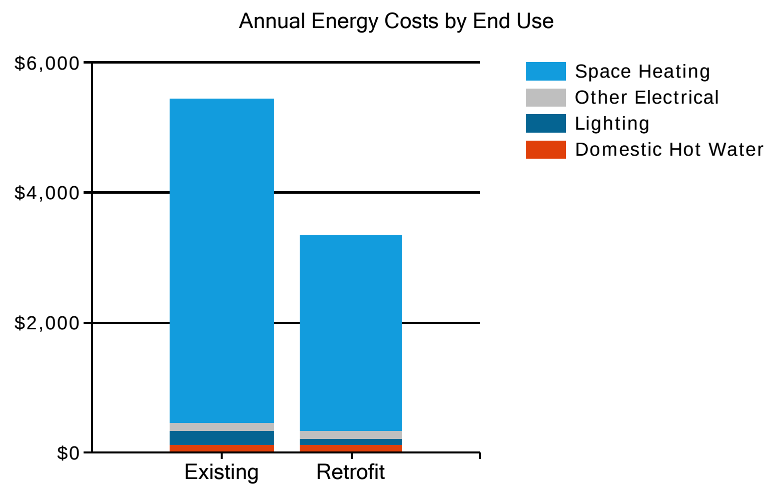


Figure 3.2 below shows how the annual energy cost of the building splits between the different fuels used by the building. The "Existing" bar shows the breakdown for the building as it is now; the "Retrofit" bar shows the predicted costs if all of the energy efficiency measures in this report are implemented.

Figure 3.2
Annual Energy Costs by Fuel Type

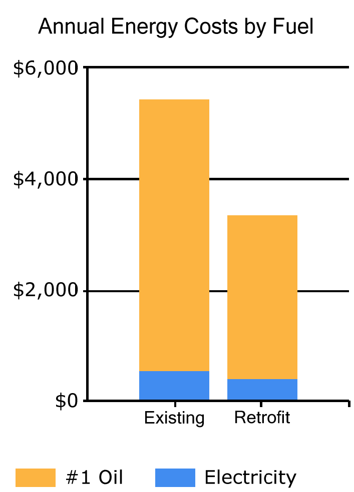
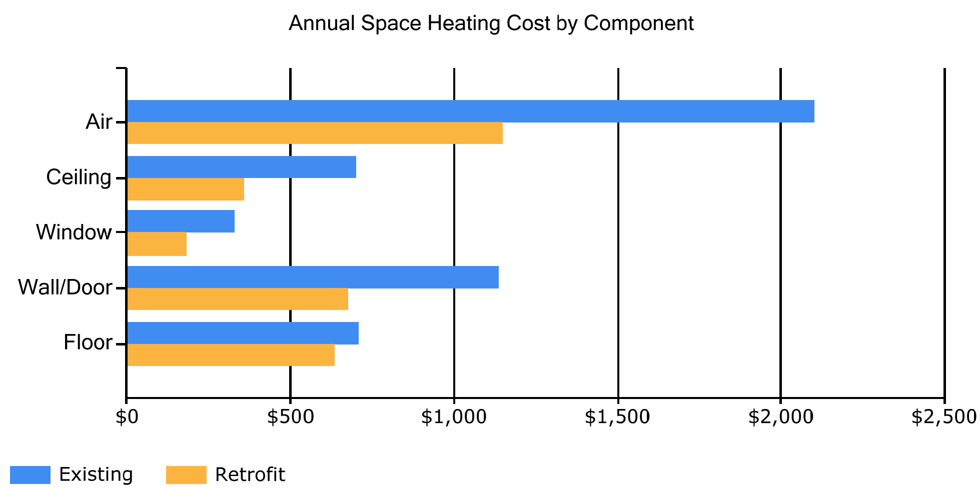


Figure 3.3 below addresses only Space Heating costs. The figure shows how each heat loss component contributes to those costs; for example, the figure shows how much annual space heating cost is caused by the heat loss through the Walls/Doors. For each component, the space heating cost for the Existing 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	81	74	81	78	81	78	81	81	78	81	78	81
Other_Electrical	51	46	51	49	51	49	51	51	49	51	49	51
DHW	49	45	49	48	49	48	49	49	48	49	48	49
Space_Heating	43	38	37	28	19	13	12	13	17	26	33	43

Fuel Oil #1 Consumption (Gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Space_Heating	128	115	108	75	42	22	16	21	35	69	95	129

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):

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

$$\text{Building Source EUI} = \frac{\text{(Electric Usage in kBtu X SS Ratio + Fuel Oil Usage in kBtu X SS Ratio + similar for other fuels)}}{\text{Building Square Footage}}$$

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

Table 3.4
Nunapitchuk IRA Bingo Hall 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	2,451 kWh	8,366	3.340	27,943
#1 Oil	856 gallons	113,039	1.010	114,170
Total		**121,406**		**142,113**
BUILDING AREA		1,200	Square Feet	
BUILDING SITE EUI		101	kBTU/Ft²/Yr	
BUILDING SOURCE EUI		118	**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 Nunapitchuk IRA Bingo Hall was modeled using AkWarm© energy use software to establish a baseline space heating and cooling energy usage. Climate data from Nunapitchuk 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 Nunapitchuk. 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
Nunapitchuk IRA Bingo Hall, Nunapitchuk, 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: IGAP Office and Bingo Hall	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the IGAP Office and Bingo Hall space.	$722	$200	54.11	0.3
2	Air Tightening: Door and attic hatches	Perform air sealing to reduce air leakage by 600 cfm at 50 Pascals.	$681	$500	14.01	0.7
3	Lighting: Bingo Hall Incan	Replace with 5 FLUOR CFL, A Lamp 20W	$24	$50	3.03	2.1
4	Broken Windows	Remove existing glass and replace with triple pane, 2 low-E, argon glass.	$45	$332	2.60	7.4
5	Window/Skylight: South Broken	Remove existing glass and replace with triple pane, 2 low-E, argon glass.	$40	$322	2.36	8.1

Table 4.1 Nunapitchuk IRA Bingo Hall, Nunapitchuk, Alaska PRIORITY LIST – ENERGY EFFICIENCY MEASURES						
Rank	**Feature**	**Improvement Description**	**Annual Energy Savings**	**Installed Cost**	**Savings to Investment Ratio, SIR**	**Simple Payback (Years)**
6	Ceiling	Add R-30 fiberglass batts to attic with Standard Truss.	$262	$3,393	2.08	12.9
7	End walls, front and back	Install R-30 rigid foam board to exterior and cover with T1-11 siding or equivalent.	$316	$5,188	1.64	16.4
8	Lighting: Bingo Hall Fluorescent	Replace with FLUOR (2) T8 4' F32T8 28W Energy-Saver Instant Electronic	$3	$50	1.49	15.4
	TOTAL, all measures		**$2,094**	**$10,035**	**3.51**	**4.8**

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**
7	End walls, front and back	Wall Type: Single Stud Siding Configuration: Just Siding Insul. Sheathing: None Structural Wall: 2 x 4, 16 inches on center R-11 Batt:FG or RW, 3.5 inches Window and door headers: Not Insulated Modeled R-Value: 10.6	Install R-30 rigid foam board to exterior and cover with T1-11 siding or equivalent.

Installation Cost	$5,188	**Estimated Life of Measure (yrs)**	30	**Energy Savings (/yr)**	$316
Breakeven Cost	$8,496	**Savings-to-Investment Ratio**	1.6	**Simple Payback yrs**	16

Auditors Notes: The original construction of the building was 2 X 4. The side walls have had 2 inch rigid added to the outside but the end walls have not. Adding rigid board insulation to the end walls will drastically reduce heating loads in the building.

Rank	Location	Existing Type/R-Value	Recommendation Type/R-Value
6	Ceiling	Framing Type: Standard Framing Spacing: 24 inches Insulated Sheathing: None Bottom Insulation Layer: R-19 Batt:FG or RW, 6 inches Top Insulation Layer: R-11 Batt:FG or RW, 3.5 inches Insulation Quality: Damaged Modeled R-Value: 29.3	Add R-30 fiberglass batts to attic with Standard Truss.

Installation Cost	$3,393	**Estimated Life of Measure (yrs)**	30	**Energy Savings (/yr)**	$262
Breakeven Cost	$7,046	**Savings-to-Investment Ratio**	2.1	**Simple Payback yrs**	13

Auditors Notes: The original roof was a hot roof. A new lower (8 foot) ceiling has been added with R11 insulation. Can add more insulation above the R11 easily.

4.3.2 Window Measures

Rank	Location		Size/Type, Condition		Recommendation	
5	Window/Skylight: South Broken		Glass: Single, Glass Frame: Wood\Vinyl Spacing Between Layers: Half Inch Gas Fill Type: Air Modeled U-Value: 0.94 Solar Heat Gain Coefficient including Window Coverings: 0.52		Remove existing glass and replace with triple pane, 2 low-E, argon glass.	
Installation Cost		$322	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$40
Breakeven Cost		$762	**Savings-to-Investment Ratio**	2.4	**Simple Payback yrs**	8
Auditors Notes: Windows with broken panes should be replaced so to reduce heat transfer and increase the buildings energy performance.						

Rank	Location		Size/Type, Condition		Recommendation	
4	Broken Windows		Glass: Single, Glass Frame: Wood\Vinyl Spacing Between Layers: Half Inch Gas Fill Type: Air Modeled U-Value: 0.94 Solar Heat Gain Coefficient including Window Coverings: 0.52		Remove existing glass and replace with triple pane, 2 low-E, and argon glass.	
Installation Cost		$332	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$45
Breakeven Cost		$864	**Savings-to-Investment Ratio**	2.6	**Simple Payback yrs**	7
Auditors Notes: The outside pane is broken on one north facing and one south facing window. Should be able to just replace the glass.						

4.3.3 Air Sealing Measures

Rank	Location		Existing Air Leakage Level (cfm@50/75 Pa)		Recommended Air Leakage Reduction (cfm@50/75 Pa)	
2	Door and attic hatches		Air Tightness from Blower Door Test: 1600 cfm at 50 Pascals		Perform air sealing to reduce air leakage by 600 cfm at 50 Pascals.	
Installation Cost		$500	**Estimated Life of Measure (yrs)**	10	**Energy Savings (/yr)**	$681
Breakeven Cost		$7,004	**Savings-to-Investment Ratio**	14.0	**Simple Payback yrs**	1
Auditors Notes: The large gap at the bottom of the main entrance door is a major leak source. The door needs to be reworked or replaced to eliminate the gap. Also, both attic hatches need weather stripping.						

4.4 Mechanical Equipment Measures

4.4.1 Night Setback Thermostat Measures

Rank	Building Space			Recommendation	
1	IGAP Office and Bingo Hall			Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the IGAP Office and Bingo Hall space.	
Installation Cost	$200	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$722
Breakeven Cost	$10,821	**Savings-to-Investment Ratio**	54.1	**Simple Payback yrs**	0
Auditors Notes: Using the temperature setback capability of the monitors to reduce the heating temperature in the building to 60 degrees when the building is not occupied would reduce the heating demand of the building. Programming information for the monitors can be found online, and should take 15 minutes to take care of manually.					

4.5 Electrical & Appliance Measures

4.5.1 Lighting Measures

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

4.5.1a Lighting Measures – Replace Existing Fixtures/Bulbs

Rank	Location	Existing Condition		Recommendation	
8	Bingo Hall Fluorescent	FLUOR (2) T12 4' F40T12 34W Energy-Saver Magnetic with Manual Switching		Replace with FLUOR (2) T8 4' F32T8 28W Energy-Saver Instant Electronic	
Installation Cost	$50	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$3
Breakeven Cost	$74	**Savings-to-Investment Ratio**	1.5	**Simple Payback yrs**	15
Auditors Notes: This is the only two lamp 4 foot fluorescent in the office. Lamps are available at the Tribal Office.					

Rank	Location	Existing Condition		Recommendation	
3	Bingo Hall Incan	5 INCAN A Lamp, Std 75W with Manual Switching		Replace with 5 FLUOR CFL, A Lamp 20W	
Installation Cost	$50	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$24
Breakeven Cost	$152	**Savings-to-Investment Ratio**	3.0	**Simple Payback yrs**	2
Auditors Notes: There are actually four fixtures, one of the fixtures has two lamps. Replacing the incandescent bulbs with more efficient compact fluorescent bulbs will reduce energy usage.					

5. ENERGY EFFICIENCY ACTION PLAN

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

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

Appendix A – Listing of Energy Conservation and Renewable Energy Websites

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

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

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

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

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

Hot Water Heaters

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

Solar Water Heating

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

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

Plug Loads

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

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

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

Wind

AWEA Web Site – http://www.awea.org

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

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

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

Homepower Web Site: http://homepower.com

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

Solar

NREL – http://www.nrel.gov/rredc/

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

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

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